

Yearly Operational Plan 2013

Holyoke Gas & Electric Department Holyoke, Massachusetts



gas | electric | steam | telecom

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FUSS & O'NEILL

78 Interstate Drive
West Springfield, MA 01089

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1 Introduction

This Yearly Operational Plan (YOP) has been prepared in accordance with 333 CMR 11.00, Rights of Way Management. The YOP is based on the Vegetation Management Plan (VMP) prepared for the period 2013 - 2017, which is attached to this document as *Appendix A*. This 1-year plan provides a detailed program for vegetation management for the calendar year 2013 for the Rights-of-Way (ROWs) associated with the hydroelectric, gas, and electric utility operations of the City of Holyoke Gas and Electric Department (hereafter referred to as "HG&E") and ROWs associated with pathways in Lower Riverside Park and Gatehouse Park, which are recreational parks owned and maintained by HG&E.

A YOP must be submitted to the Massachusetts Department of Agricultural Resources (MDAR) every year that herbicides are intended for use to maintain ROWs. The MDAR publishes a notice of receipt of the YOP in the *Environmental Monitor* (<http://www.env.state.ma.us/mepa/emonitor.aspx>). The applicant, HG&E, must provide the notice that appeared in the *Environmental Monitor* to the Boards of Health, the Conservation Commissions, and the chief elected officials for the City of Holyoke, the City of Chicopee, and the Town of South Hadley. This YOP will also be posted on the Holyoke Gas & Electric Website as allowed in 333 CMR 11.06(3). There is a 45-day comment period on the YOP that begins when the YOP and *Environmental Monitor* notice is received by the municipalities.

Public notice of actual herbicide application in the ROWs is made at least 21 days in advance of the planned application. Notice is sent to the MDAR, the Boards of Health, the Conservation Commissions, and the chief elected officials for the City of Holyoke, the City of Chicopee, and the Town of South Hadley. In addition, notice of the herbicide application will be published in at least one newspaper of general circulation in Holyoke, Chicopee, and South Hadley at least 48 hours prior to the herbicide application. The notice will appear in the "local section" of the newspaper and will measure at least 4 inches by 5 inches in size. This published notice will include information regarding:

- The method and location of herbicide application.
- The approximate dates on which herbicide application will begin and conclude, but the application will commence not more than 10 days before nor conclude more than 10 days after the approximate dates published.
- A list of the potential herbicides to be used.
- A description of the purpose of the application.
- The name, title, business address and telephone number of a designated contact person that can be contacted for information about the herbicide application.

2 Location of Rights of Way

The majority of ROWs included in this YOP are located within the City of Holyoke, with some electric transmission/distribution lines located in the adjacent City of Chicopee and the ROWs associated with Lower Riverside Park and Gatehouse Park are located across the Connecticut River in South Hadley. The ROWs can be divided into five categories:

1. ROWs associated with the HG&E electrical system.
 - These consist of electrical transmission and distribution lines located within the City of Holyoke, with a limited amount of lines extending into the adjacent City of Chicopee. Vegetation management activities, including removal of invasive species, will also occur adjacent to the North Canal substation. The locations of the lines included in this YOP are shown in the mapping in *Appendix B* and are listed in *Table 1*.
2. ROWs associated with above-ground portions of gas distribution vaults.
 - Areas to be maintained consist of locations within a 10-foot radius of the above-ground structures. They are shown as point locations in the mapping in *Appendix B* and are listed in *Table 1* by street location. All are located within the City of Holyoke.
3. ROWs adjacent to the canal system owned and operated by HG&E (*Appendix C*).
 - Areas to be maintained consist of ROWs located on either side of the canals that are fenced in most locations. The three-level canal system extends through the southeastern areas of the City of Holyoke and provides water for industrial and hydropower generation. The canal ROWs total approximately 8 miles in length.
4. ROWs associated with public access pathways in Lower Riverside Park.
 - Areas subject to 333 CMR 11.00 include the pathways that provide public and emergency vehicle access to the park (*Appendix M*). The ROW area is approximately 1,300 linear feet. Other vegetation management activities outside of the ROWs, but within the park may occur. These include removal of invasive species, removal of woody species threatening the structural integrity of stone masonry walls, and vista pruning to create viewsheds of the Connecticut River and Holyoke Dam.
5. ROWs associated with public access pathways in Gatehouse Park.
 - Areas subject to 333 CMR 11.00 include the pathways that provide public and emergency vehicle access to the park (*Appendix N*). The ROW area is approximately 250 linear feet. Only trimming and mowing of vegetation will occur to manage vegetation in this park.

Table 1 – Gas Electric Transmission/Distribution ROW Locations Potentially Scheduled for Herbicide Treatment in 2013

ROW Type	Location
Gas Distribution Vaults (Appendix B)	<ul style="list-style-type: none"> • Apremont Highway at Dupuis Road • Hampden Street at Lincoln Street • Lincoln Street • Nick Cosmos Way at Essex Street • Appleton Street at First Level Canal • Gatehouse Road near Flood Control Locks • Arbor Way in Polaski Park • South Canal Street at South Bridge Street • Beaulieu Street at Main Street • Garfield Street • Peltiah Street at Main Street • Whiting Farms Road at Northampton Street • Bobala Road at Whitney Avenue • Homestead Road at Westfield Road • Old Jarvis Avenue near Bassett Road • Hampden Street at Northampton Street • Apremont Highway at Rock Valley Road • Mueller Road • County Road at Weiser Drive • Northampton Street at Vadnais Street
Electric Transmission / Distribution Lines (Appendix B)	<ul style="list-style-type: none"> • Pioneer Valley Railroad line from Papineau St. to Lower Westfield Road near Ashley Reservoir. • From Front Street/railroad line to Race Street, across from end of Hampshire Street, except over canals. Includes connection to substation between First and Second Level Canals. • Along Race Street from approximately Hamilton Street to just beyond Appleton Street. • Along Appleton Street from Race Street to North Canal Street. • Along North Canal Street from Appleton Street approximately 1200 feet northeast. • Near North Canal substation • Near Prospect Street Substation approximately 800 feet northwest of Buckley Boulevard (Chicopee). • Approximately 100 feet southeast of Water Street, parallel to Water Street, from Appleton Street and northeast approximately 1100 feet. • Rock Valley Road to Apremont Highway • An interval of approximately 600 feet where a distribution line deviates from Mountain Road approximately 600 feet south of Cherry Street. • Along Apremont Highway to Westfield Road near the High Service Reservoir, east along Westfield Road for approximately 400 feet, then



ROW Type	Location
	<p>south, cross country, to access road (Dailey's Road) west of Ashley Reservoir (these areas are MOW ONLY).</p> <ul style="list-style-type: none">• From the end of Mount Tom Ski Road, up Mount Tom, to telecommunications infrastructure located at the Mount Tom summit (approximately 5,200 feet).

The previous YOP from 2012 included a steam/condensate ROW in Holyoke. These lines were located along two miles of easements and have since been decommissioned and removed, and are therefore not part of HG&E's vegetation management activities.

3 Identification of Sensitive Areas and Flagging Methods to Designate Sensitive Areas on the ROW

Sensitive areas defined in 333 CMR 11.04 are identified as public groundwater supplies, public surface water supplies, private drinking water supplies, surface waters, wetlands, stated-listed species habitat, inhabited areas and agricultural areas. For the purpose of identification, sensitive areas can be separated into two categories:

- areas not readily identifiable in the field; and
- areas that are readily identifiable in the field.

Each sensitive area has a defined limit for special protection to further minimize environmental and public health risks. Within most sensitive areas, there is an area in which herbicide use is prohibited (no spray zones). Within those portions of the sensitive area where herbicide application is allowed, the use of herbicides and application methods recommended jointly by the MDAR and DEP is required. The general characteristics of the sensitive area herbicides are: low toxicity to humans and other animal species; short term soil persistence; biodegradation of active ingredients; and low soil mobility. Details on these characteristics are discussed in the MDAR Herbicide Fact Sheets included in *Appendix D*.

It is the intent of HG&E to use only herbicides and application methods recommended for use in sensitive areas, as per 333 CMR 11.04 (d), on the full length and width of all ROW areas it shall treat. The operational effect of this policy is that outer limits of sensitive areas need not be identified in the field by treatment crews.

The following is a description of how the sensitive areas will be identified for required protection:

- Consult the appropriate reference materials and sources to determine the precise location of these areas.
- Place the boundaries of these sensitive areas on US Geological Survey (USGS) topographical maps or other HG&E mapping.
- Prior to commencement of herbicide application operations, the treatment crew will be provided the marked-up mapping with which to mark boundaries of these sensitive areas.
- The treatment crew will deploy a cutting crew or point person in advance of the main herbicide application operation to locate and mark these.

Sensitive areas readily identifiable in the field include surface waters, inhabited areas, wetlands, agricultural areas and major road crossings. The method utilized to identify these sensitive areas will be as follows:

- Consult USGS topographic maps to locate any of these sensitive areas that may already be identified on these maps.

- Consult MassGIS spatial data to locate any of these sensitive areas that may already be identified on these maps.
- Prior to commencement of herbicide application operations, the treatment crew will be provided the marked mapping.
- The treatment crew will visually survey the area to be treated for any sensitive areas.
- Appropriate distances will be measured from sensitive areas to identify no herbicide treatment zones and limited herbicide treatment zones.

Table 2 – Sensitive Area Restriction Guide (333 CMR 11.04)

Sensitive Area	No Spray Zone	Limited Use Zone	Where Identified
Wetlands and Water Over Wetlands	Within 10 feet (unless provisions of 333 CMR 11.04(4)(c) are followed)	10 – 100 feet; 12 months must elapse between applications; Selective low pressure, using foliar techniques or basal or cut-stump applications	YOP Maps ¹ and identify on site ²
Certified Vernal Pool	Within 10 feet	10 feet to the outer boundary of any Certified Vernal Pool Habitat; 12 months must elapse between applications; Selective low pressure, using foliar techniques or basal or cut-stump applications	YOP Maps ¹ and identify on site ²
Public Ground Water Supply	Within 400 feet (Zone I)	Zone II or IWPA (Primary Recharge Area); 24 months must elapse between applications; Selective low pressure, using foliar techniques or basal or cut-stump applications	YOP Maps ¹
Public Surface Water Supply	Within 100 feet of any Class A public surface water source	100 feet to the outer boundary of the Zone A; 24 months must elapse between applications; Selective low pressure, using foliar techniques or basal or cut-stump applications	YOP Maps ¹
	Within 10 feet of any tributary or associated surface water body located outside of the Zone A	10 feet to the outer boundary of the Zone A; 24 months must elapse between applications; Selective low pressure, using foliar techniques or basal or cut-stump applications	

¹Maps are located in *Appendices B and C*

² Methods are shown in *Appendix E*.

Sensitive Area	No Spray Zone	Limited Use Zone	Where Identified
	Within 100 feet of any tributary or associated surface water body located within the Zone A of a Class A public surface water source		
	Within a lateral distance of 100 feet for 400 feet upstream of any Class B Drinking Water Intake	Within a lateral distance of between 100 -200 feet for 400 feet upstream of intake; 24 months must elapse between applications; Selective low pressure, using foliar techniques or basal or cut-stump applications	
Private Water Supply	Within 50 feet	50 – 100 feet; 24 months must elapse between applications; Selective low pressure, using foliar techniques or basal or cut-stump applications	In YOP well list ³ and identify on site ²
Surface Waters	Within 10 feet from mean annual high-water line	10 feet from the mean annual high water line and the outer boundary of the Riverfront Area; 12 months must elapse between applications; Selective low pressure, using foliar techniques or basal or cut-stump applications	YOP Maps ¹ and identify on site ²
Agricultural and Inhabited Areas	N/A	0 – 100 feet 12 months must elapse between application; Selective low pressure, using foliar techniques or basal or cut-stump applications.	Identify on site ²
State-listed Species Habitat	No application within habitat area except in accordance with a Yearly Operational Plan approved in writing by the Division of Fisheries and Wildlife		YOP Maps ¹

Flagging Methods to Mark Sensitive Areas

As shown in the diagrams in *Appendix E*, RED flagging will identify the outer boundary of the NO HERBICIDE TREATMENT ZONE surrounding surface waters, private water supplies, and public surface and groundwater supplies. If the herbicide treatment to be used is different within the LIMITED USE ZONE than in the adjacent non-sensitive area, then YELLOW flagging will be used to mark the outer boundary of the LIMITED USE ZONE. If herbicides

³ Well list is contained in *Appendix K*.

approved for use in sensitive areas are to be used in adjacent non-sensitive areas, no flagging of the outer boundary of the LIMITED USE ZONE is necessary.

If herbicide treatment on or within 10 feet of a wetland will be used in the adjacent LIMITED USE ZONE, the 10' boundary from the wetland will be flagged RED and YELLOW. If the adjacent LIMITED USE ZONE and non-sensitive area will be treated as a wetland, then no flagging is necessary.

4 Vegetation Management Activities in Priority Habitat Areas

The Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) and regulations found at 321 CMR 10.00 protect rare species and their habitats by prohibiting the “take” of any plant or animal listed as Endangered, Threatened or of Special Concern by the Massachusetts Department of Fisheries and Wildlife (DFW). The regulations require that work in the areas mapped as Priority Habitats (PHs) be subject to review and approval by DFW. Portions of the HG&E rights-of-way are located within areas identified as Priority Habitat areas by the Natural Heritage Endangered Species Program (NHESP) of the DFW.

The following notification requirements to NHESP must be observed:

- Prior to work within ROWs containing PH areas, NHESP shall be provided with written notification of the following:
 - anticipated start and end date for the vegetation management,
 - anticipated start location
 - name, phone number and email address for project manager that will be performing on-site supervision of work crews.
- Should vegetation management be necessary in areas that are not shown in the YOP mapping, NHESP must be provided with a minimum 72 hours notice.
- Emergency maintenance and repair activities within PHs may be conducted without prior notification, but NHESP must be notified within 24 hours of the onset of such activities through the submission of an “Emergency ROW Work within Priority Habitat” in *Appendix J*. If possible, NHESP should be notified in advance of emergency activities. Note that mitigation may be required for damage done to state-listed species habitat due to emergency activities.

The following procedures must be incorporated for vegetation management within PHs and within portions of the ROWs indicated in the mapping in *Figures 1, 2, 3, 4, 5, 6, 6a, 6b, and 6c* and *Appendices B and C*:

1. Avoid cutting or applying herbicide to shrubs species (e.g. scrub oak) less than 8 feet tall where possible. Shrubs may be managed:
 - a. within a 30-foot diameter area surrounding electrical towers and pole structures
 - b. within an existing vehicle access road
 - c. to manage taller species growing within a shrub area

- d. to improve access to a work site after review and approval by NHESP
 - e. if the shrub species is considered to be an invasive species (see http://www.mass.gov/dfwele/dfw/nhesp/conservation/invasives/invasive_plant_info.htm for more information on invasive species in Massachusetts)
2. Avoid cutting or applying herbicide to areas dominated by low-growing native shrub species (e.g., lowbush blueberry, huckleberry, sheep laurel, New Jersey tea, sweet-fern).
 3. A subset of ROW areas proposed for vegetation management activities are mapped, in part, for the presence of state-listed snake species. These areas are shown in *Figure 2* as areas with “State Listed Snake Species Habitat”, but also include any work around as vaults. Work crews should familiarize themselves with the management requirements in *Appendix I* and *Figure 2*, including:
 - a. Mowing shall be avoided in these areas between 1 April and 1 November. If mowing *must* occur between 1 April and 1 November, raising the height of mower blades to greater than 8 inches above the ground will reduce the likelihood of snake mortality, if the mower does not have a weighted stability bar mounted behind the blades.
 - b. Maintenance conducted between 2 November and 31 March poses minimal risk to state-listed snakes and can proceed as described elsewhere in this document.
 - c. Crew members should be aware that any snakes observed during vegetation management activities may be state-listed and protected species. Direct harm to or capture of these species without a permit from the Division of Fisheries and Wildlife is considered an unauthorized “taking” of a state-listed species and may be punishable by fines or imprisonment (321 CMR 10.06).
 - d. Any snakes encountered should be avoided by vehicles or heavy equipment.

A subset of ROW areas proposed for vegetation management activities in 2013 are mapped, in part, for the presence of “Data Sensitive Species”. These species are highly susceptible to collection and are therefore of high concern to Natural Heritage.

Information about these species (including presence/absence) cannot be released to anyone else (especially including release to third parties or published) unless such release is agreed to in writing by the Natural Heritage Program (See Massachusetts Public Records law: M.G.L. chapter 66 section 17D). These species include the vascular plants Lily-leaf Twayblade and Wall-rue Spleenwort and the snake species Copperhead, Timber Rattlesnake, and Eastern Rat Snake. If you know the species list we are providing will be published (based on application) do not release the species name instead use “sensitive plant, sensitive invertebrate, or sensitive vertebrate”.

4. A subset of ROW areas proposed for vegetation management activities are mapped, in part, for the presence of state-listed reptile and amphibian species. These include turtle species (Wood Turtle and Eastern Box Turtle) and salamander species (Marbled Salamander and Jefferson Salamander). Within these ROW areas, extra care should be taken to avoid direct impacts to turtles by following the recommendations provided in *Appendix I*, “ROW Vegetation Management in State-listed Turtle Habitat” and “ROW Vegetation Management in Vernal Pool Habitat for State-listed Species” and listed on *Figures 3* and *4*. These recommendations for turtles include:

- a. Avoiding such areas between 1 April and 31 October. In general, activities associated with vegetation management that are conducted between 1 November and 31 March will pose minimal or no risk to state-listed turtles.
- b. No special conditions are required for hand-cutting target vegetation or for herbicide applications.
- c. Mandatory training for staff conducting vegetation management work within Turtle Habitat from April 1 – October 31.
- d. For work between April 1 – October 31, each work crew conducting vegetation management activities with mapped turtle habitat areas must have a designated and NHESP-approved turtle “Team Leader” as described in *Appendix I*.
- e. If at all possible, avoid work between 25 May and 5 July, the prime nesting season for most state-listed turtle species.
- f. If mowing is to occur between 1 April and 31 October, raising the height of mower blades 10 to 12 inches above the ground will reduce the likelihood of turtle mortality. Preferably, if possible, mow from the center of the utility ROW out toward the forested edges.
- g. Immediately prior to mowing, the use of large mechanical operational equipment or driving large equipment off existing roads, visual “turtle sweeps” must be conducted in the work area by trained personnel under the supervision of the turtle “Team Leader” as described in *Appendix I*. Any turtles encountered must be moved a safe distance from the path of the vehicles or heavy equipment in the direction the turtle was oriented when observed and outside of the limit of work (e.g. 250 - 500 feet).

Specific recommendations for amphibians include:

- a. Work within vernal pools should be avoided if at all possible.
- b. Year-round practices include:
 - i. Diving of equipment (e.g. trucks and ATVs) is allowed along existing access roads.
 - ii. Do not conduct fueling activities within VP Habitat Areas. Chainsaws (and other handheld equipment) may be fueled within the VP Habitat Areas, provided they are fueled down-gradient and at least ten (10) feet away from wetlands areas.
 - iii. When possible, avoid running machinery through wetland areas, even during dry periods, to avoid changing the hydrology.
 - iv. Avoid adding slash material resulting from vegetation management activities to the wetland areas. Where significant amounts of slash fall into the wetland areas, remove it by hand or some other low-impact method.
 - v. Herbicide applications must follow the restrictions in 333 CMR 11.00, Rights of Way Regulations.
- c. Vegetation Management conducted between 1 December and 28 February:
 - i. In general, maintenance activities associated with VMPs that are conducted between 1 December and 28 February will pose minimal or no risk to state-listed amphibians.
- d. Vegetation Management conducted between 1 March and 30 November:
 - i. No mowing or operation of heavy equipment shall occur within the delineated boundaries of wetland areas (hand-cutting and trimming is permitted).

- ii. Do not alter or otherwise disturb (e.g. drive over with heavy equipment) existing piles of slash

Any state-listed reptiles and amphibians that are encountered shall be photographed and reported to the NHESP on Rare Animal Observation Forms (available at www.nhesp.org) and included in *Appendix J*. A Scientific Collection Permit is required to handle state-listed species, and appropriate training of crews will be required if mowing in state-listed turtle habitat will occur without raising the mower blades. Previous experience searching for turtles or appropriate hands-on training with such an experienced person will be required.

5. A subset of ROW areas proposed for vegetation management activities are mapped, in part, for the presence of state-listed lepidoptera (moth and butterfly) species. Many state-listed lepidoptera are host specific, feeding on very specific host plants as caterpillars. Within these ROW areas, extra care should be taken to avoid direct impacts to state-listed plants and lepidoptera by following the recommendations provided in the attached document in *Appendix I*, “Vegetation Management of Existing Right-of-Ways (ROW) in State-listed Plant, Lepidoptera, Bird and Snake Priority Habitats”. Vegetation management activities, excluding the broadcast application of herbicides, occurring within these areas between 2 November and 14 April will pose minimal or no risk to the state-listed plants, moths and butterflies identified in *Figure 5*. For all operation and maintenance activities occurring between 15 April and 1 November within these ROW areas, extra care should be taken to avoid direct impacts to rare plants or moth and butterfly host plants by following the recommendations presented in the attached document (*Appendix I*) and mapping, including:
 - a. No herbicides shall be applied to the host plants in Priority Habitat areas identified in the YOP mapping, nor shall herbicides be allowed to reach the host plants when targeting other species.
 - b. On a case by case basis, the NHESP may request that Holyoke Gas & Electric employ a trained botanist to survey work areas identified as rare plant or rare moth/butterfly habitat. Botanical surveys shall focus on the state-listed plant species or host plants for state-listed moths/butterflies identified within portions of ROW, but any and all rare plant species found shall be identified, reported, and flagged by the botanist and avoided by the work crews.
6. A subset of ROW areas proposed for vegetation management activities are mapped, in part, for the presence of state-listed plant species. In general, vegetation management activities, excluding broadcast application of herbicides, occurring between 2 November and 14 April pose minimal or no risk to state-listed plant species and can proceed as described elsewhere in this YOP. For activities between 15 April and 1 November, care must be taken to avoid harm to state-listed plant species. Work crews must carefully review the information in *Appendix I* and *Figures 6, 6a, 6b, and 6c*. Management requirements for these areas include:
 - a. Delineate population and avoid – Requires delineation by NHESP-approved botanist and NHESP approval prior to any vegetation management activities
 - b. Avoid herbicide on grasses/sedges, ferns or forbs
 - c. Avoid herbicide on grasses/sedges, ferns, forbs or vines

A subset of ROW areas proposed for vegetation management activities in 2013 are mapped, in part, for the presence of “Data Sensitive Species”. These species are highly susceptible to collection and are therefore of high concern to Natural Heritage.

Information about these species (including presence/absence) cannot be released to anyone else (especially including release to third parties or published) unless such release is agreed to in writing by the Natural Heritage Program (See Massachusetts Public Records law: M.G.L. chapter 66 section 17D). These species include the vascular plants Lily-leaf Twayblade and Wall-rue Spleenwort. If you know the species list we are providing will be published (based on application) do not release the species name instead use “sensitive plant, sensitive invertebrate, or sensitive vertebrate”.

7. A subset of ROW areas are mapped, in part, for the presence of known Bald Eagle nesting sites (*Figure 1*). Within these ROW areas, extra care should be taken to avoid disturbing breeding birds by following the following recommendations:
 - a. Avoid work during breeding season 1 January through 15 August - The breeding season for Bald Eagles in Massachusetts begins with courtship during late fall or early winter. The entire breeding cycle, from nest construction to fledging of young, lasts 6–8 months.
8. Reporting requirements – NHESP requires the following reporting requirements:
 - a. **Within 15 months from the date of the NHESP approval letter, a written summary (and/or shapefile) of activities which occurred within PH, including locations, dates, a description of vegetation management techniques, and the BMPs which were implemented, shall be submitted to the NHESP.**
 - i. The summary shall include a written summary of the vegetation management activities which occurred within turtle habitat and vernal pool habitat, including dates, approximate work area boundaries, description of vegetation management techniques at each work site, and information on any vernal pools identified, and the BMPs which were implemented by the end of the treatment year.
 - b. Observations of state-listed turtles shall be reported within 30 days of each observation.
 - c. All observed state-listed plants must be identified, reported, and mapped following the guidelines in *Appendix I*.

The following activities that may be related to vegetation management for utility ROWs are exempt from the review requirements outlined in 321 CMR 10.18 through 10.23:

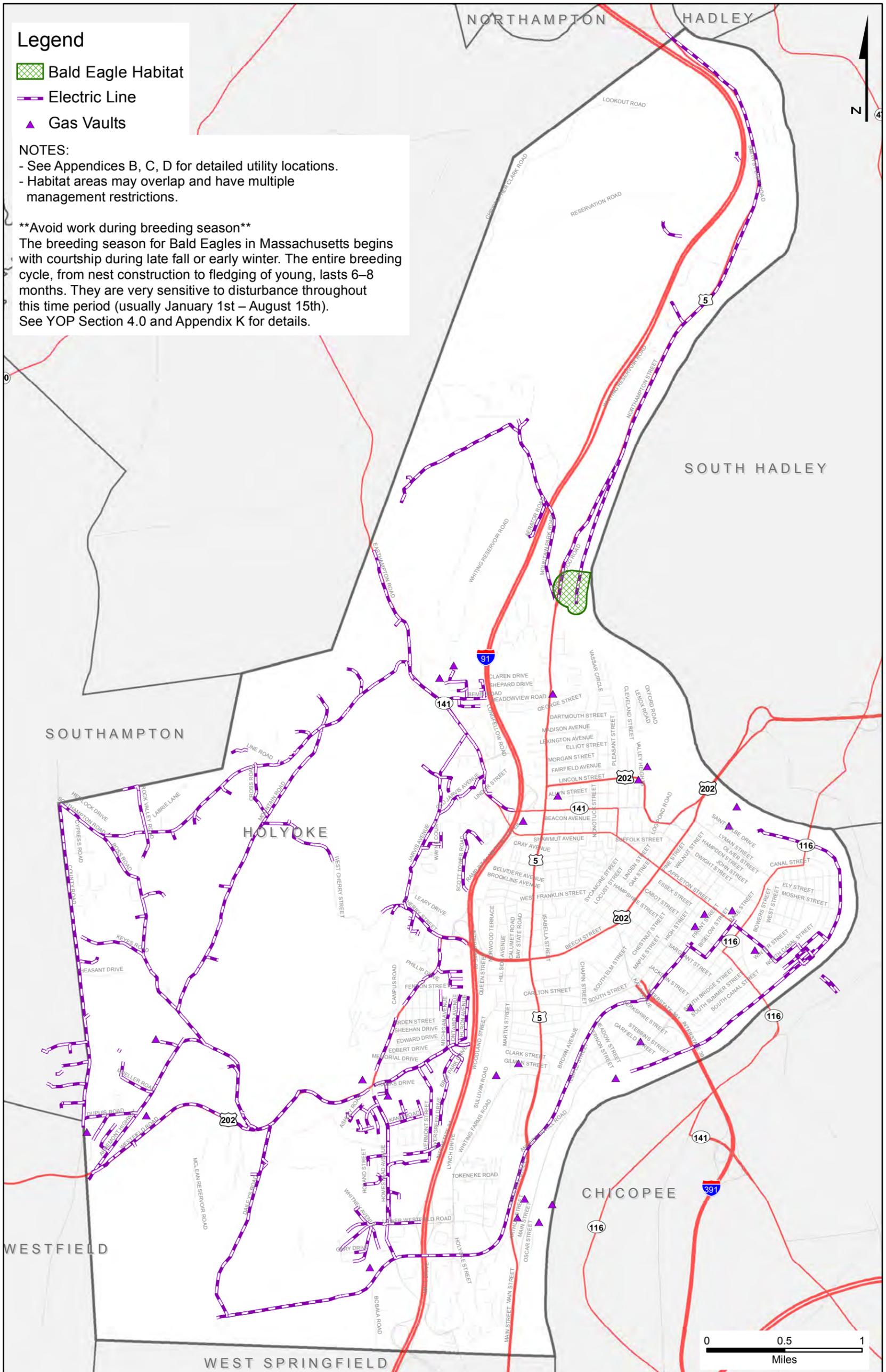
- Observations of state-listed turtles shall be reported within 30 days of each observation.
- Installation, repair, replacement, and maintenance of utility lines (gas, water, sewer, phone, electrical) for which all associated work is within ten feet from the edge of existing paved roads.
- The maintenance or replacement but not the expansion of existing lawns and landscaped areas.

The following activities that may be related to vegetation management for pathway ROWs are exempt from the review requirements outlined in 321 CMR 10.18 through 10.23:

- The maintenance or replacement but not the expansion of existing lawns and landscaped areas.
- Performance of customary land surveying activities, wetland resource area delineations, environmental assessments and investigations performed in accordance with M.G.L. c. 21E, and other customary preliminary site investigations.
- The active management of State-listed Species habitat, including but not limited to mowing, cutting, burning, or pruning of vegetation, or removing exotic or invasive species, for the purpose of maintaining or enhancing the habitat for the benefit of rare species, provided that the management is carried out in accordance with a habitat management plan approved in writing by the Division of Fisheries and Wildlife.

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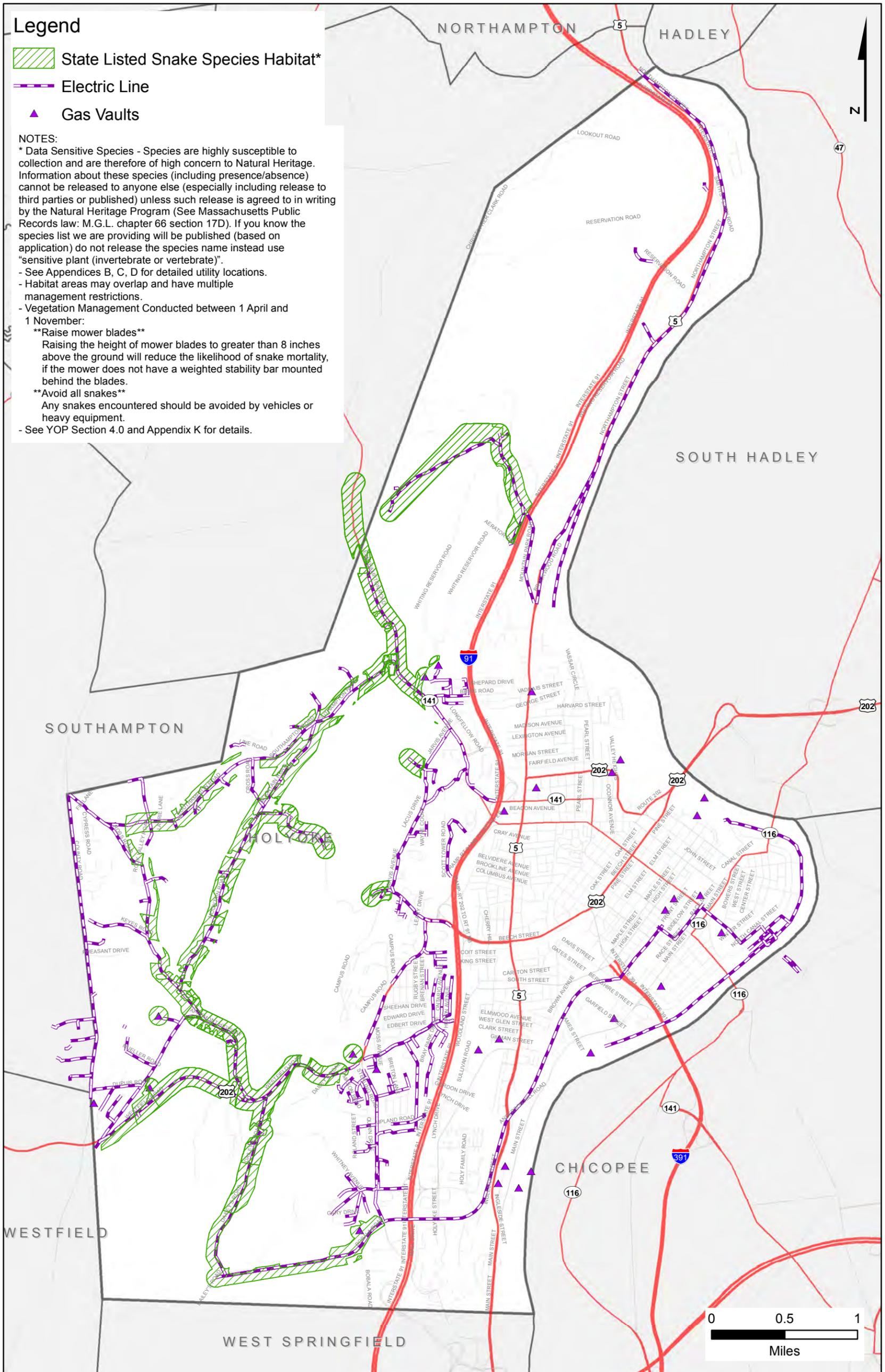
FIGURE 1: MANAGEMENT REQUIREMENTS FOR STATE-LISTED BIRD HABITAT



Sources: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs; Natural Heritage and Endangered Species Program (NHESP), 2012; Holyoke Gas & Electric Department.

HOLYOKE GAS & ELECTRIC DEPARTMENT

FIGURE 2: MANAGEMENT REQUIREMENTS FOR STATE-LISTED SNAKE HABITAT



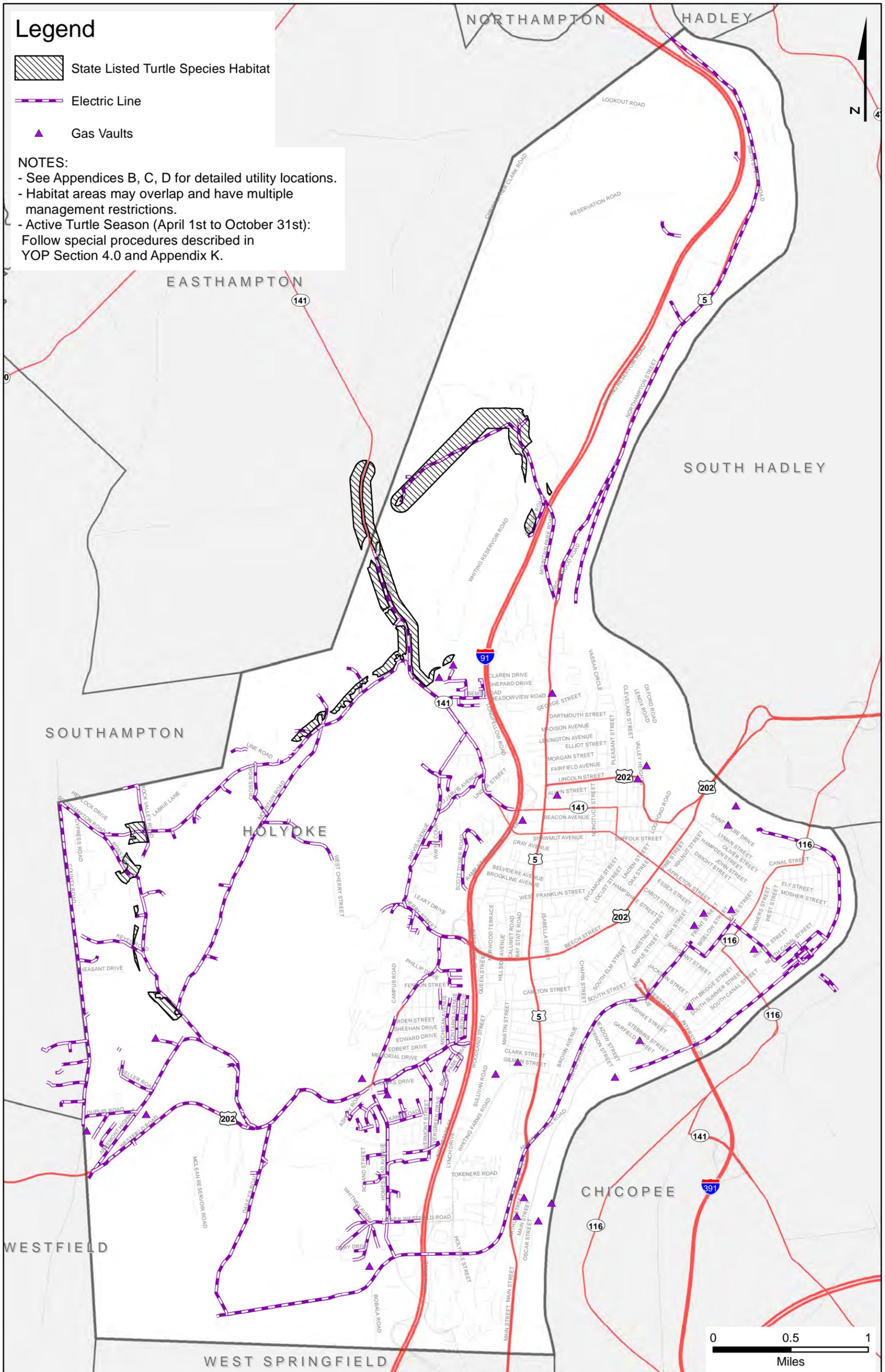
Sources: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs; Natural Heritage and Endangered Species Program (NHESP), 2012; Holyoke Gas & Electric Department.

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HOLYOKE GAS & ELECTRIC DEPARTMENT

FIGURE 3: MANAGEMENT REQUIREMENTS FOR STATE-LISTED TURTLE HABITAT



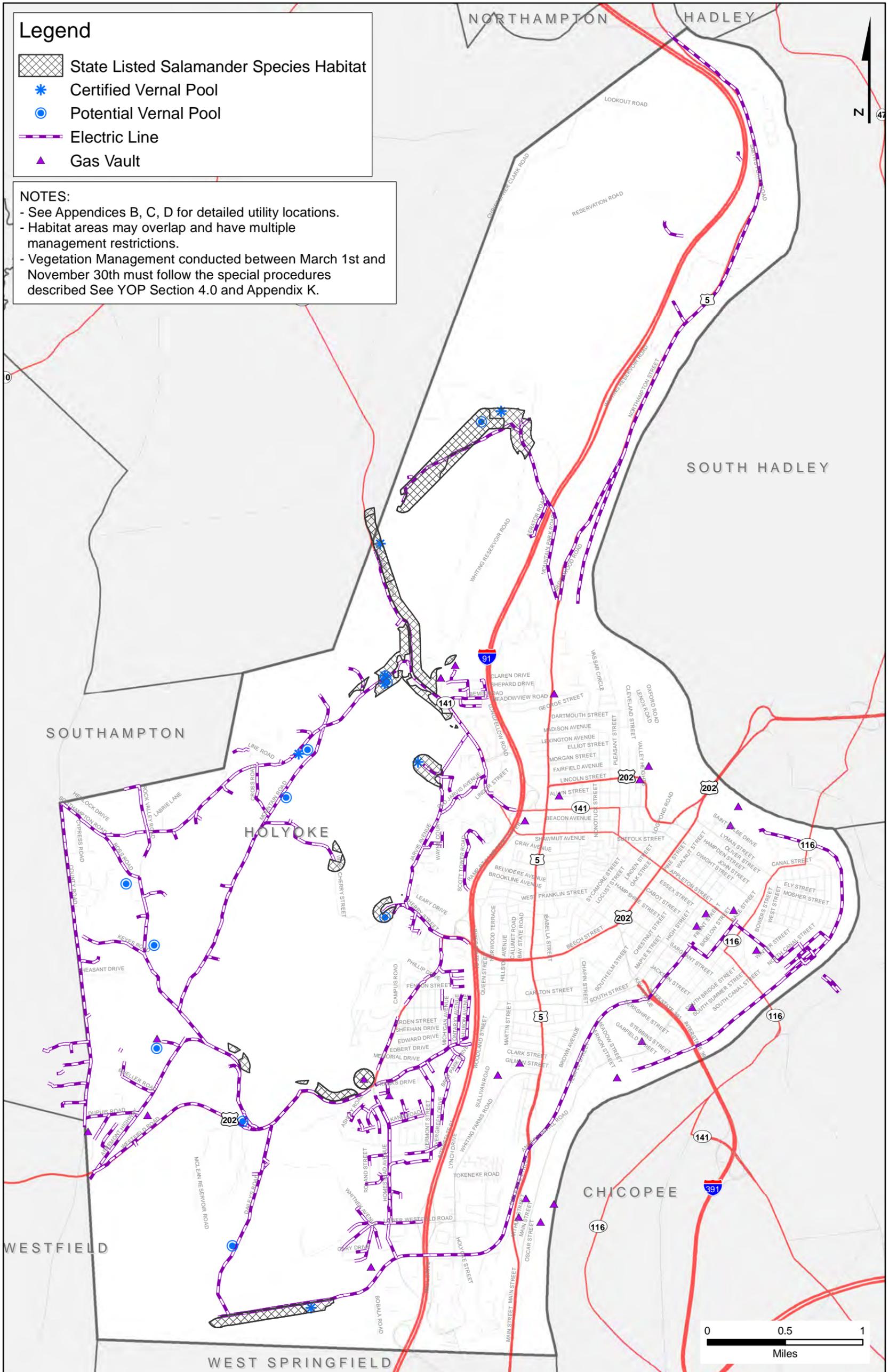
Sources: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs; Natural Heritage and Endangered Species Program (NHESP), 2012; Holyoke Gas & Electric Department.

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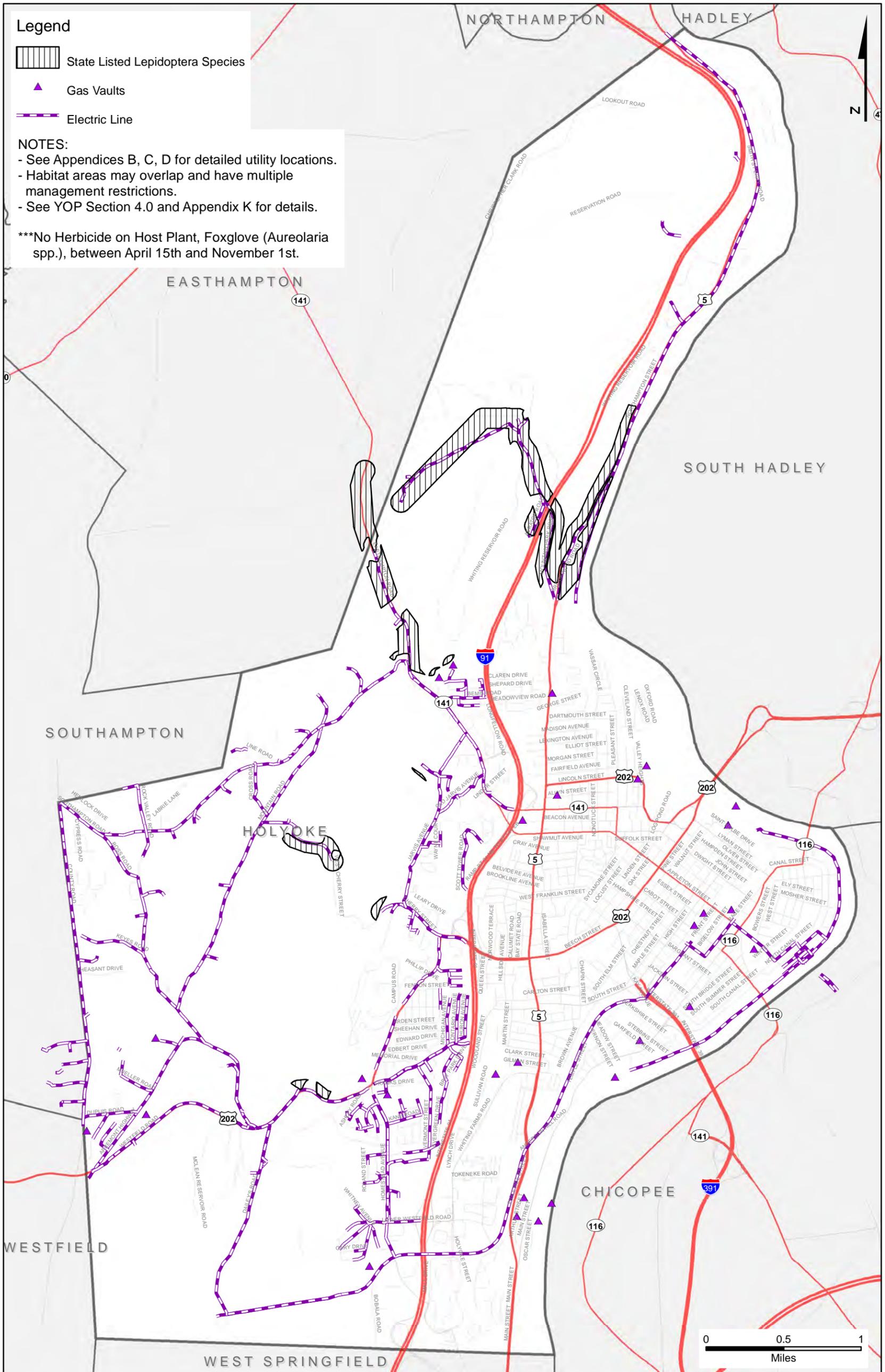
FIGURE 4: MANAGEMENT REQUIREMENTS FOR STATE-LISTED SALAMANDER HABITAT



Sources: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs; Natural Heritage and Endangered Species Program (NHESP), 2012; Holyoke Gas & Electric Department.

HOLYOKE GAS & ELECTRIC DEPARTMENT

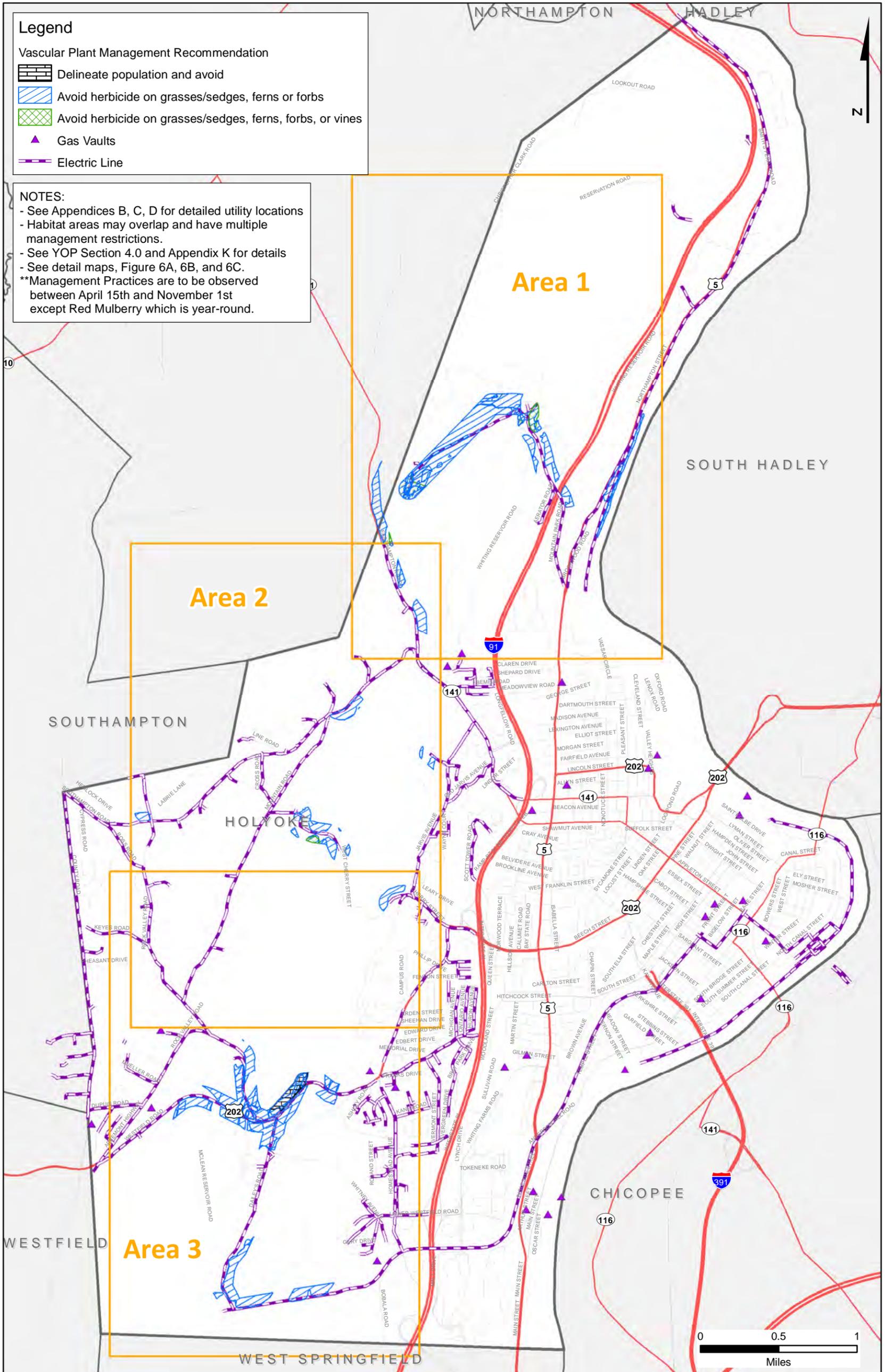
FIGURE 5: MANAGEMENT REQUIREMENTS FOR STATE-LISTED MOTH HABITAT



Sources: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs; Natural Heritage and Endangered Species Program (NHESP), 2012; Holyoke Gas & Electric Department.

HOLYOKE GAS & ELECTRIC DEPARTMENT

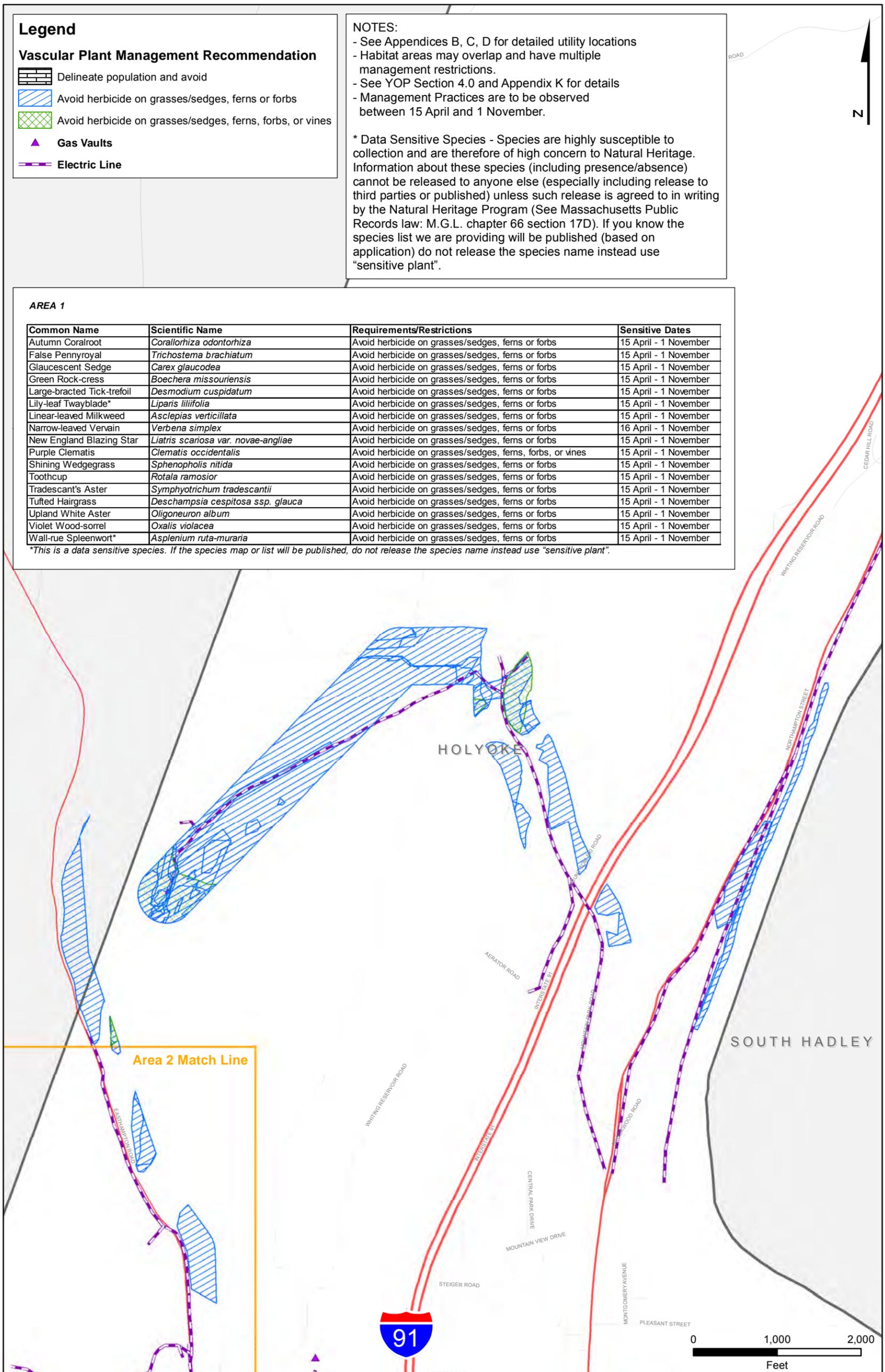
FIGURE 6: MANAGEMENT REQUIREMENTS FOR STATE-LISTED VASCULAR PLANT HABITAT



Sources: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs; Natural Heritage and Endangered Species Program (NHESP), 2012; Holyoke Gas & Electric Department.
 Path: J:\GIS\2000\727\A89\Draft\YOP\Fig6_YOP_plant_2012.mxd

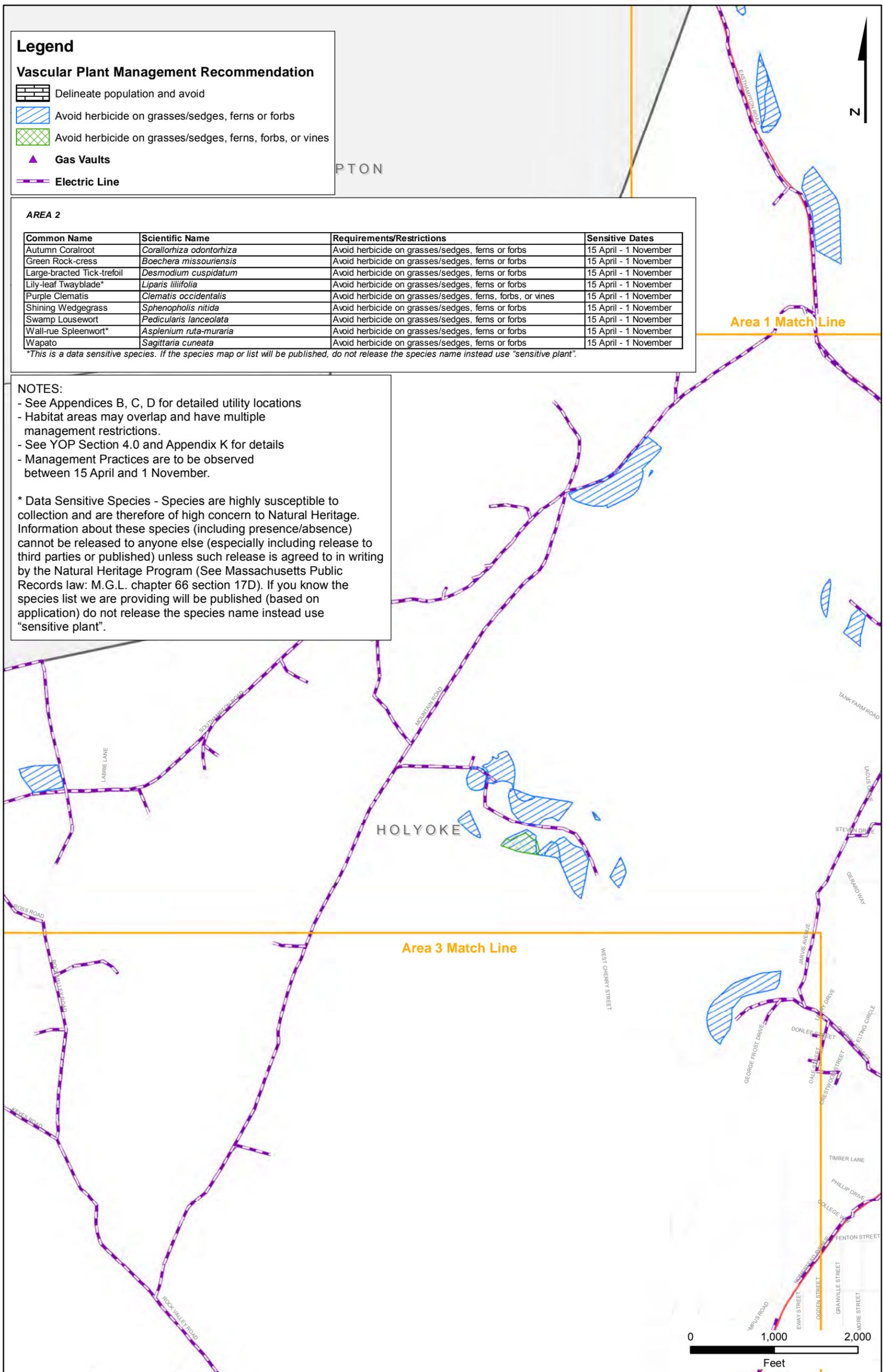
HOLYOKE GAS & ELECTRIC DEPARTMENT

FIGURE 6A: MANAGEMENT REQUIREMENTS FOR STATE-LISTED VASCULAR PLANT HABITAT (AREA 1)



HOLYOKE GAS & ELECTRIC DEPARTMENT

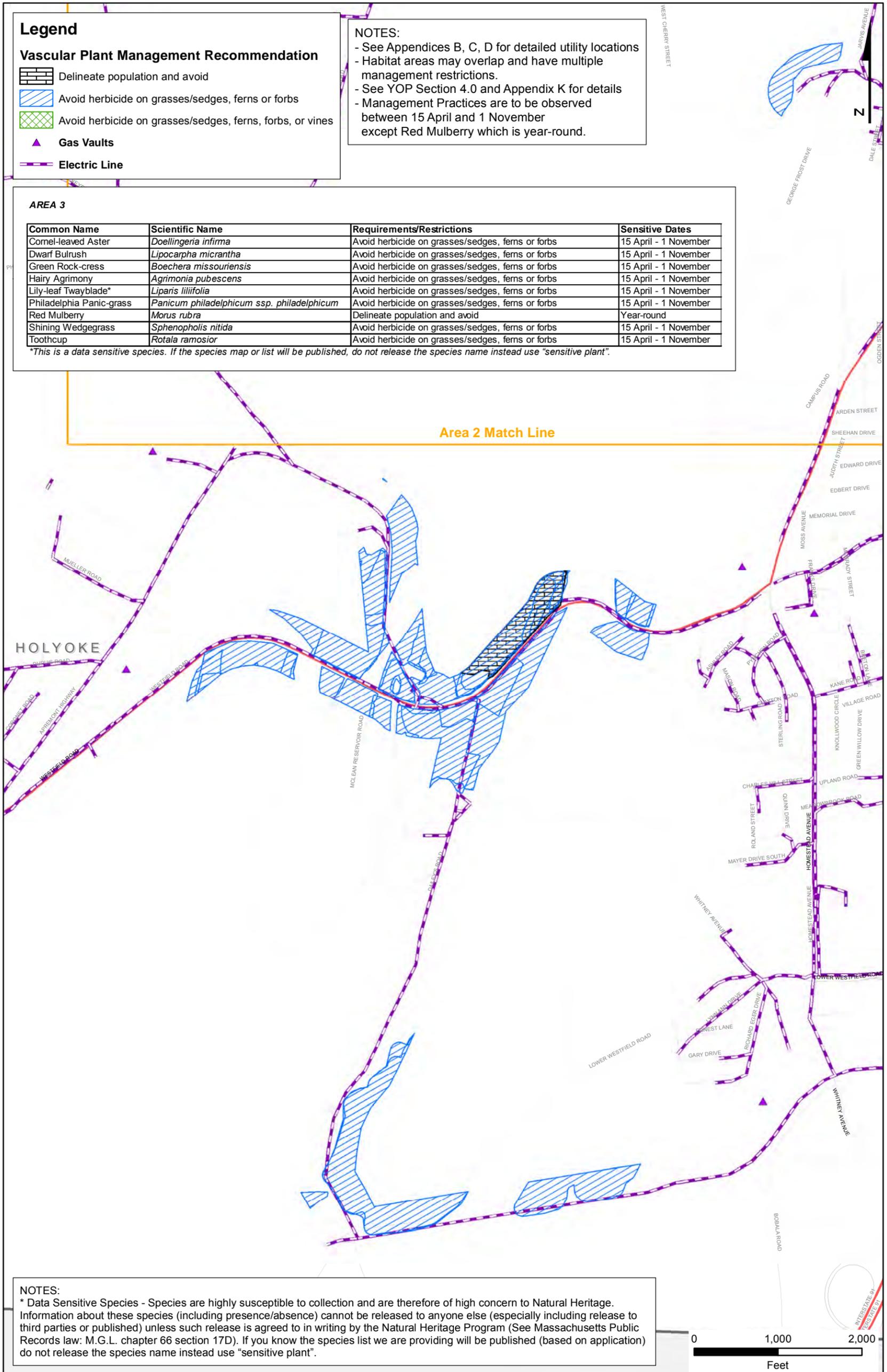
FIGURE 6B: MANAGEMENT REQUIREMENTS FOR STATE-LISTED VASCULAR PLANT HABITAT (AREA 2)



Sources: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs; Natural Heritage and Endangered Species Program (NHESP), 2012; Holyoke Gas & Electric Department.
 Path: J:\GIS\2000\727\A89\Draft\YOP\Fig6b_YOP_plant_2012_Area2.mxd

HOLYOKE GAS & ELECTRIC DEPARTMENT

FIGURE 6C: MANAGEMENT REQUIREMENTS FOR STATE LISTED VASCULAR PLANT HABITAT (AREA 3)



5 Herbicides Proposed Including Application Rates, Carriers, and Adjuvants

Herbicides that may be used on the ROWs during the calendar year 2013 are limited to the following:

Table 3 – Herbicides Proposed for Use

Trade Name	EPA Reg.	Active Ingredient(s)	Application Method	Carrier/ Adjuvant*	Percent Solution	Application Rates
Polaris Herbicide	228-534	Imazapyr	Foliar	Nonionic surfactant	0.05–5%	Manufacturer label recommendations, not to exceed 3 pints/acre every 3 rd year OR 2 pints/acre every other year
Rodeo	62719-324	Glyphosate	Foliar	Nonionic surfactant	0.75-10%	Manufacturer's label recommendations; lowest labeled rates
Rodeo	62719-324	Glyphosate	Cut Stump	None (mix with water only)	50-100%	Manufacturer's label recommendations; lowest labeled rates
Escort	352-439	Metsulfuron-methyl	Foliar	Surfactant	0.25%-2%	Manufacturer's label recommendations; lowest labeled rates
Garlon 4	62719-40	Triclopyr, butoxy ethyl ester	Foliar & Cut Stump	Surfactant	0.25–50%	Manufacturer's label recommendations, Lowest of the following rates: lowest labeled rate or 0.5 pints/acre between 10 – 50 feet of resource; Lowest labeled rate or 3.0 pints/acre between 50 feet and boundary of spray zone

*Adjuvants and drift control agents may be included in application mixtures according to label requirements.

6 Herbicide Application Techniques and Alternative Control Procedures Proposed

Vegetation along the ROWs will involve IPM, including mechanical control methods (e.g., hand cutting, mowing, selective trimming) and chemical control (e.g., foliar herbicide treatments and cut stump treatments). The method chosen for a given vegetation problem will attempt to achieve a long-term, low maintenance vegetation management program through the encouragement of a stable herbaceous community.

Hand Cutting

Hand cutting consists of the mechanical cutting of target species using chain saws or brush cutters. Target species are cut as close to the ground as practical with stump heights usually not exceeding three inches. Hand cutting is used in order to protect environmentally sensitive sites

or on target vegetation greater than twelve feet tall where herbicide use is prohibited by regulation. Hand cutting is used on those restricted sites where terrain, site size, or sensitivity renders mowing impossible or impractical. Hand cutting may be used at any time of the year.

Mowing

Mowing consists of the mechanical cutting of target vegetation using machines. Depending upon the resources available, mechanical cutting may be made using a consumer-type push mower, a large self-propelled or rider mower, brush hog, edgers, and “Weed Whackers”. Selection of specific equipment is based on terrain, target vegetation size and equipment availability. Mowing is used on sites where herbicide use is prohibited by regulation, where a large number of target species stems have exceeded maximum control heights, or where access is inhibited by high woody vegetation density and that access is required in the short term. The use of mowing as a treatment method is restricted by steep slopes, rocky terrain, and wet sites with deep soft soils. Mowing shall be used in most areas where terrain, site size and sensitivity permit efficient use of the equipment. Mowing may be used at any time of the year except when snow precludes operations.

Selective Trimming

Selective trimming consists of the mechanical pruning of the tops or encroaching limbs of trees. This trimming will be accomplished using aerial lifts mounted on trucks or tractors or, if terrain or obstructions prevent equipment access, climbing crews.

Foliar Treatments

Foliar treatments involve the selective application of an herbicide diluted in water to the foliage of target vegetation. The two types of equipment used for foliar treatments are the hand-held pump sprayers and motorized truck-mounted sprayer. Both treatments use low pressure (i.e., below 60 psi at the nozzle) for application. Foliar treatments with hand-held pump sprayers are used on low-density target vegetation. Motorized application equipment is used on higher density target vegetation. Truck-mounted hydraulic sprayers are used to apply the herbicide solution to lightly wet the target plant.

Foliar treatments are used on woody plants, grasses, weeds and conifer species. Only hardwood species less than 12 feet in height will be foliar herbicide treated. Treatments will take place when plants are in full leaf and actively growing, or in accordance with the manufacturer’s recommendations. Foliar treatments are incorporated into the VMP because, when used according to the HG&E application program, they are an effective and efficient method to control the whole target plant. Controlling the whole target plant reduces competition from sprout growth.

Cut Stump Treatment

Cut stump treatments consist of mechanical cutting of target species using chain saws immediately followed by a herbicide treatment applied with a squirt bottle or painted on the freshly cut surface of the stump within 2 hours after cutting. The herbicide is limited to the freshly cut surface of the remaining stump. The cutting procedure is identical to the outlined in Hand Cutting. Hardwoods greater than 12 feet tall will be cut stump treated. Cut stump application is preferred during the dormant period.

Vista Pruning

Vista pruning, as defined in 310 CMR 10.04, is the selective thinning of tree branches of understory shrubs to establish a specific “window” to improve visibility. Vista pruning does not include the cutting of trees which would reduce the leaf canopy to less than 90% of the existing crown cover and does not include the mowing or removal of understory brush. Vista pruning activities in the Lower Riverside Park will be conducted from the bottom of the slope. Cutting will be minimized by evaluating the visual effects of cutting practices as work is conducted.

7 Companies which will Perform Herbicide Treatment

One or more of the following companies will apply herbicides, under contract to HG&E. The specific company or companies will be identified in the notification given at least 21 days prior to herbicide treatment, in accordance with 333 CMR 11.07, Public Notification.

Asplundh Tree Expert Co.
P.O. Box 207 (1044 Main Street)
Watertown, CT 06795
(860) 274-0615
Local Contact: Barry P. Croke
65 Maple Street
Belchertown, MA 01007
Telephone (Day) 860-307-4998

Northern Tree Service
290 Park
Palmer, MA 01069
(413) 596-6132

Mountain View Landscape
67 Old James Avenue
Chicopee, MA 01020
(413) 536-7555

Lewis Tree Service, Inc.
Walt Dodge
89 Brookfield Rd.
Brookfield, MA 01010
(413) 245-6166

CMS Landscaping
175 Suffolk Street,
Holyoke, MA 01040
(413) 533-3300
Contact: Bob Cameron

Country View Lawn Care
14 Ernest Lane,
Holyoke, MA 01040
(413) 532-8355
Contact: Bob McKenzie

8 Identification of Target Vegetation

For the purposes of this plan, plant species are divided into two groups, undesirable species that have the potential to impede access to public pathways or fault overhead conductors on the ROW or are capable of damaging or interfering with physical and visual access to above-ground lines and equipment for inspection, maintenance and repair, and desirable species which cannot. It is the responsibility of the vegetation control contractor to be knowledgeable about and to instruct crews in the identification of desirable and undesirable species and the various herbicide control techniques necessary for integrated vegetation management. In general, undesirable species include trees, tall maturing shrubs and vines. This includes, but is not limited to the following species:

<u>Common Name</u>	<u>Scientific Name</u>
Grape Vines	<i>Vitis</i> spp.
Virginia creeper	<i>Parthenocissus quinquefolia</i>
Bittersweet	<i>Solanum dulcamara</i>
Poison ivy	<i>Rhus radicans</i>
Mulberry	<i>Morus</i> spp.
Staghorn sumac	<i>Rhus typhina</i>
Catalpa	<i>Chilopsis linearis</i>
Ailanthus	<i>Ailanthus altissima</i>
White ash	<i>Fraxinus Americana</i>
Cottonwood	<i>Populus deltoids</i>
Poplar	<i>Populus</i> spp.
Silver maple	<i>Acer saccharinum</i>
Red oak	<i>Quercus falcate</i>
American elm	<i>Ulmus Americana</i>
Russian olive	<i>Elaeagnus angustifolia</i>
Box elder	<i>Acer negundo</i>
Black cherry	<i>Prunus serotina</i>
Black birch	<i>Betula nigra</i>
Japanese bamboo	<i>Polygonum cuspidatum</i>
Dogwood	<i>Cornus</i> spp.
Black Locust	<i>Robinia pseudoacacia</i>
Norway maple	<i>Acer platanoides</i>
Northern catalpa	<i>Catalpa speciosa</i>
Tree of Heaven	<i>Ailanthus altissima</i>
Autumn olive	<i>Elaeagnus umbellate</i>
Japanese barberry	<i>Berberis thunbergii</i>
Exotic bush honeysuckle	<i>Lonicera</i> sp
Oriental bittersweet	<i>Celastrus orbiculata</i>

Control of woody species is critical because they have the potential to short circuit overhead electrical conductors on the ROWs. Removal of other invasive species is necessary to facilitate physical and visual access to the ROW for inspection, maintenance and repair.

Desirable species in the ROWs typically include low maturing shrubs (less than 12 feet), ferns, grasses, herbs, and wildflowers. In the 10-foot radius surrounding the gas distribution vaults, only low-growing grasses are desirable.

9 Individuals Representing Applicant Supervising YOP

The applicant is represented by Fuss & O'Neill, Inc. Consulting Engineers. The contact person at Fuss & O'Neill is:

Diane M.L. Mas, PhD
Senior Environmental Engineer
Fuss & O'Neill Inc. Consulting Engineers
78 Interstate Drive
West Springfield, MA 01089
Telephone: 413-452-0445
dmas@FandO.com

The individual responsible for supervision of the YOP implementation is:

Charles L. Martel
Environmental Health and Safety Coordinator
City of Holyoke Gas & Electric Department
99 Suffolk Street
Holyoke, MA 01040-5082
Telephone: 413-536-9369
Fax: 413-532-4305
Email: cmartel@hged.com

10 Procedures and Locations for Handling, Mixing, and Loading Herbicide Concentrates

No herbicide concentrates shall be handled, mixed or loaded on a ROW within 100 feet of a sensitive area. The following guidance is provided for the handling, mixing and loading of herbicide concentrates.

1. Follow all manufacturers' label directions.
2. Wear protective clothing as specified on the manufacturer's label, i.e., rubber gloves, hat, respirator, goggles, face shield.
3. Immediately change clothes if herbicide concentrate is spilled or splashed on clothing.

4. Have soap and water available for cleanup.
5. While pouring herbicides, keep head above the container opening and positioned so that winds do not carry concentrate onto face or body.
6. Do not overfill sprayer.
7. Triple rinse empty containers and use the rinsings when possible.

In order to minimize the potential for spills of herbicide concentrate and mitigate the impact of any accidental spills, the following procedures will be followed.

Only the amount of herbicide necessary to carry out the vegetation control, based on the monitoring results, will ensure that there will be no waste and minimize potential problems. Any vehicle carrying out a spray operation will be equipped with a bag of adsorbent, activated charcoal, leak-proof containers, a broom and a shovel in case of minor spills. A clipboard log of the herbicides on the vehicle will be kept on the vehicle. Herbicide labels and fact sheets should be carried on-site by the applicator.

As soon as any spill is observed, immediate action will be taken to contain the spill and protect the spill area. The cause of the spill must be identified and secured. Spill containment will be accomplished by covering the spill with adsorptive clay or other adsorptive material or, for large spills, building clay or soil dikes to impede spill progress. Until completely clean, protection of the spill area will be accomplished by placing barriers, flagging or a crewmember at strategic locations. If a fire is involved, care will be taken to avoid breathing fumes from any burning chemicals.

EMERGENCY CONTACTS

In the event of a spill or emergency, information on safety precautions and cleanup procedures may be gathered from the following sources:

<u>Source</u>	<u>Telephone Number</u>
Herbicide Label	See <i>Appendix F</i>
Herbicide Fact Sheet	See <i>Appendix D</i>
Herbicide Material Safety Data Sheet	See <i>Appendix F</i>
Herbicide Manufacturer	
Dow AgroSciences (Rodeo and Garlon 4)	(800) 992-5994
DuPont (Escort)	(800) 441-3637
NuFarm Americas Inc. (Polaris Herbicide)	(877) 325-1840
Holyoke, Chicopee, and South Hadley Fire and/or Police Departments	911
Holyoke Gas & Electric Department (EH&S Coordinator)	(413) 536-9392
Holyoke Board of Health	(413) 322-5595
Holyoke Conservation Commission	(413) 322-5615
Chicopee Health Department	(413) 594-1660
Chicopee Conservation Commission (Planning Dept.)	(413) 594-1516
South Hadley Board of Health	(413) 538-5017 ext. 204
South Hadley Conservation Commission	(413) 538-5017 ext. 208
Holyoke Medical Center	(413) 534-2500
Massachusetts Pesticide Program	(617) 626-1776
Massachusetts Dept. of Environmental Protection (DEP)	(413) 784-1100
Massachusetts Dept. of Public Health, Environmental Toxicology Program	(617) 624-5757
Massachusetts Poison Control Center	(800) 222-1222
CHEMTREC	(800) 262-8200
US Environmental Protection Agency (EPA) National Pesticide Information Center	(800) 858-7378

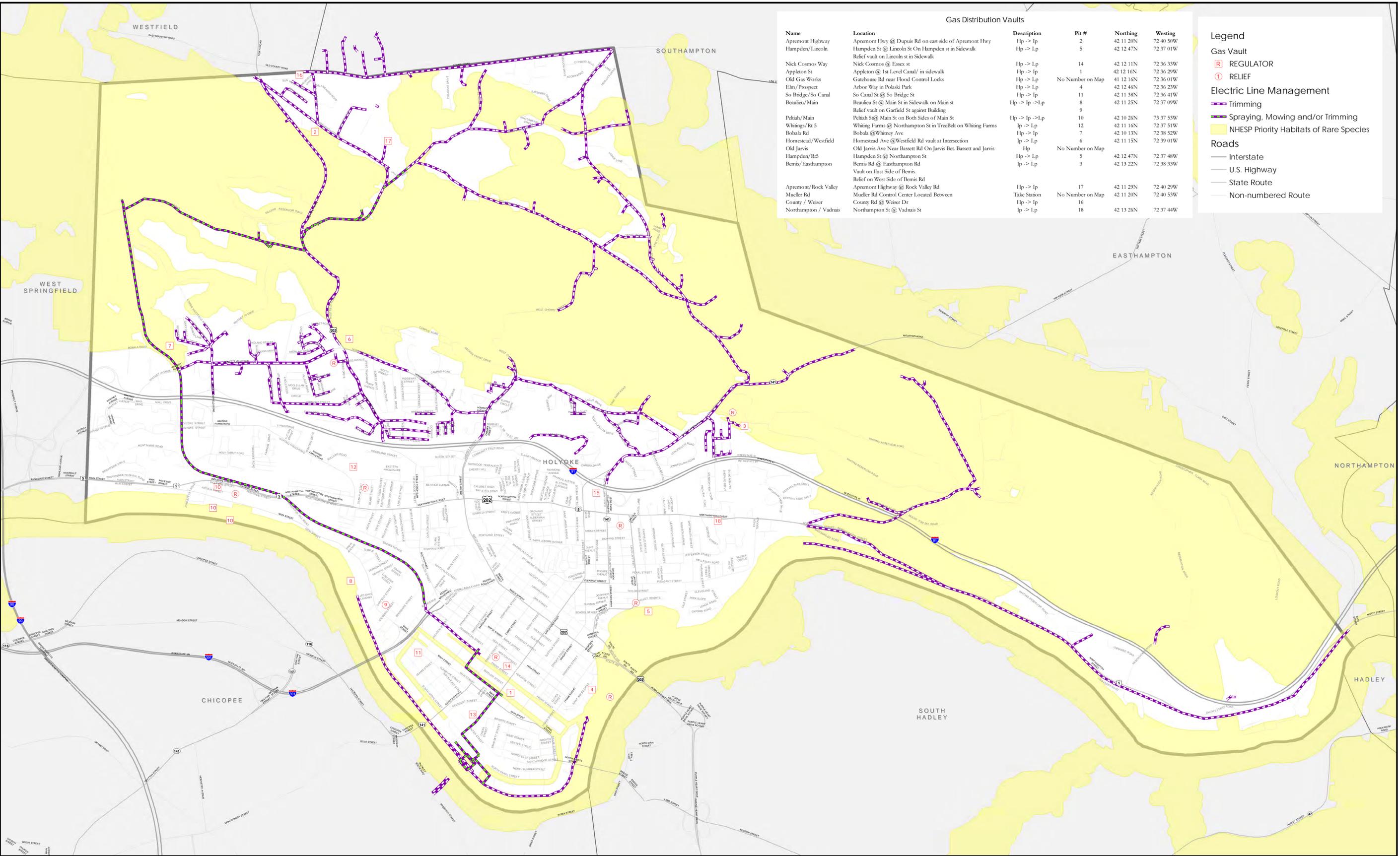
Appendix A

Vegetation Management
Plan 2013-2017

(Enclosed Separately)

Appendix B

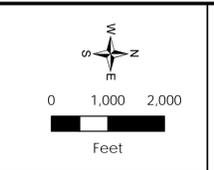
Gas & Electrical Transmission/Distribution ROW Maps



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REVISIONS			

PROJ. MANAGER:	SEAL	SEAL
CHEIF DESIGNER:		
REVIEWED BY:	DATE	



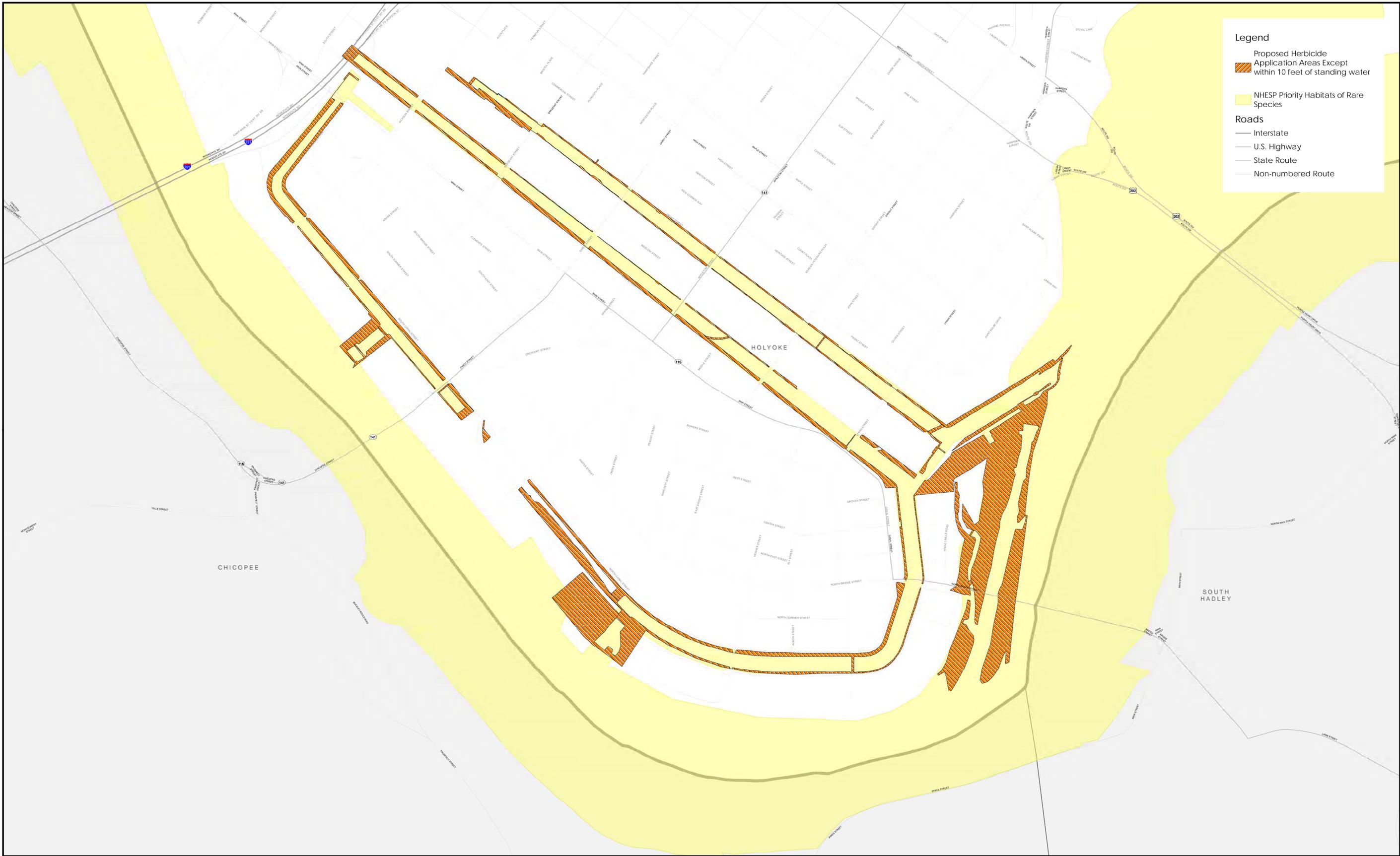
FUSS & O'NEILL
 78 INTERSTATE DRIVE
 WEST SPRINGFIELD, MA 01089
 413.452.0445
 www.fando.com

Holyoke Gas & Electric Department
 Electric Transmission/Distribution System &
 Gas Distribution System
 Yearly Operational Plan (YOP)
 HOLYOKE MASSACHUSETTS

PROJ. No. 2000727.A89
 DATE: JAN. 2013
APP. B

Appendix C

Canal Right of Way Map



Legend

- Proposed Herbicide Application Areas Except within 10 feet of standing water
- NHESP Priority Habitats of Rare Species

Roads

- Interstate
- U.S. Highway
- State Route
- Non-numbered Route

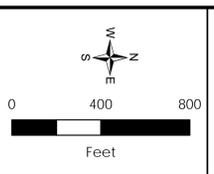
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REVISIONS			

PROJ. MANAGER:	
CHEIF DESIGNER:	
REVIEWED BY:	DATE

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 413.452.0445
 www.fandco.com

Holyoke Gas & Electric Department
 Canal System Pesticide Application Areas
 Yearly Operational Plan (YOP)
 HOLYOKE MASSACHUSETTS

PROJ. No. 2000727.A89
 DATE: JAN. 2013

APP. C

Appendix D

Herbicide Fact Sheets



Rights of Way Sensitive Area Materials List

Active Ingredient Use Restrictions	Product Names (EPA #) Registrant	
Glyphosate Lowest Labeled Rate for all Glyphosate products	Round Up Pro (524-475) Monsanto	Glyphro-Plus (62719-322) Accord Concentrate or Rodeo (62719-324) Dow AgroSciences
	Razor (228-366) Razor-Pro (228-366) Riverdale AquaNeat Aquatic Herbicide (228-365) Nu Farm Americas	
	While Accord Concentrate, Rodeo, Glyphosate VMF and Aquaneat all have aquatic uses, approval for their use as sensitive materials does NOT mean that they can be used for aquatic weed control, or directly applied to water, as part of a rights of way management program. Products are subject to the no-spray and limited spray provisions of 333 CMR 11.04.	
Metsulfuron Methyl Lowest Labeled Rate for all Metsulfuron Methyl Products*	Escort XP (352-439) EI Dupont	Patriot Selective Herbicide, (228-391) Nu Farm Americas
Sulfometuron Methyl Lowest Labeled Rate for all Sulfometuron-Methyl Products*	Oust XP (352-601) EI Dupont	Riverdale Spyder Herbicide, (228-408) Nu Farm Americas
Metsulfuron Methyl Sulfometuron Methyl Lowest Labeled Rate*	Oust Extra (352-622) EI Dupont	
Ammonium Salt of Fosamine Lowest Labeled Rate*	Krenite S (352-395) EI Dupont	
Imazapyr 3 pints/acre every 3rd year OR	Arsenal (241-346) Arsenal Powerline (241-431) Arsenal Railroad	Polaris Herbicide (228-534) Nu Farm Americas

Contact

Hotze Wijnja
Hotze.Wijnja@state.ma.us
 617-626-1771

Additional
Resources

[Massachusetts Department
 of Agricultural Resources](#)

[Division of Crop and Pest
 Services](#)

[Pesticide Program](#)

[Rights of Way Vegetation
 Management](#)

[Herbicide Review Process for
 Sensitive Areas](#)

[Rights of Way Sensitive Area
 Materials List](#)

[Vegetation Management &
 Yearly Operation Plans](#)

[See All](#)

2 pints/acre every other year for all Imazapyr Products	Herbicide (241-273) BASF	
Triclopyr, Butoxy Ethyl Ester  The lowest of the following rates: 1. Between 10 feet and 50 feet of the resource: Lowest labeled rate* or 0.5 pints per acre 2. Between 50 feet and the boundary of the limited spray zone: Lowest labeled rate* or 3 pints per acre	Garlon 4 (62719-40) Dow AgroSciences Garlon 4 Ultra (62719-527) Dow AgroSciences	
Paclobutrazol  Lowest Labeled Rate*	Cambistat (74779-3) Rainbow Treecare	

* **Lowest labelled rate** the minimum labelled rate of the pesticide product for the appropriate site, pest and application method

Disclaimer

The Massachusetts Department of Agricultural Resources (MDAR) makes no endorsement of any companies, organizations, persons, products, trade or brand names referenced in this Rights of Way Sensitive Area Materials List ("the list"). Active Ingredients on the list are reviewed pursuant to a Cooperative Agreement between MDAR and the Massachusetts Department of Environmental Protection. Only environmental fate and toxicological data, including eco-toxicological data, are reviewed when evaluating an active ingredients suitability for inclusion on the list. Inclusion on the list does not represent any endorsement by MDAR as to the efficacy of the active ingredient for rights-of-way vegetation management.

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THE COMMONWEALTH OF MASSACHUSETTS

EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS



Department of Agricultural Resources

251 Causeway Street, Suite 500, Boston, MA 02114
617-626-1700 fax: 617-626-1850 www.mass.gov/agr



TRICLOPYR

In addition to the review that is presented below, a comprehensive review available from USDA Forest Service provides information that incorporates more recent studies and data. The US Forest Service risk assessment report is available at: <http://www.fs.fed.us/foresthealth/pesticide/risk.shtml>

Review conducted by MDAR and MassDEP for use in Sensitive Areas of Rights-of-Way in Massachusetts

Common Trade Name(s): Garlon 3A, Garlon 4

Chemical Name: Triclopyr [(3 ,5,6-Trichloro-2-pyridinyl) oxy] acetic acid

CAS No: 55335—06—3

GENERAL INFORMATION

Triclopyr is a picolinic acid derivative and is marketed as Garlon 3A the triethylamine (TEA) salt (CAS #057213-69-1) and Garlon 4 the butoxyethyl ester (**CAS#** 008008-20-6).

Triclopyr is effective against a wide variety of woody plants as a foliar spray, basal spray and when applied to cut surfaces. Triclopyr is absorbed by both plant leaves and roots and is readily translocated throughout the plant. It produces an auxin-type response in growing plants in that it appears to interfere with normal growth processes. Thus, maximal plant response occurs when applications are made soon after full leaf development and when there is sufficient soil moisture for plant growth.

ENVIRONMENTAL FATE

Mobility

Most laboratory and field studies indicate that Triclopyr is a relatively mobile herbicide under most conditions. Soil organic carbon partition coefficients K(oc) were determined for the TEA salt in 12 soils which ranged from 0.081% to 21.7% organic carbon. The K(oc) values range from 12 to 78 (14), indicating that Triclopyr should be mobile in most soils. In the same study the K(oc) values of trichloropyridinol, the major metabolite, were reported to range from 114 to 156 in three soils which were not identified. This indicates that trichloropyridinol is less mobile than Triclopyr and should have moderate mobility in soil(14).

In a laboratory study using sandy loam soil with a low organic matter content (0.62%), 75-80% of the applied Triclopyr leached through a 12 inch soil column between days 11 and 15. Water was applied at the rate of 0.5 inches/day for 45 days. The major degradation product, trichloropyridinol required 13 inches of applied water to elute, nearly twice as much (7.5 inches) as Triclopyr(14).

In a field study, Garlon 3A was applied at the rate of 3 gallons/ acre (9 lbs/acre) to six soils ranging from clays to loamy sands in six states. Rainfall was reported to be normal, but not given. Small amounts of Triclopyr and its metabolites were found in the 6—12 inch and 12-18 inch layers of soil 28 to 56 days after application (14,15). Although an application rate of 9 lbs per acre is rather high, the presence of Triclopyr at those depths should be noted especially since there is a correlation with the previous laboratory studies.

In other studies, Triclopyr exhibited significantly lower mobility than had been previously reported. In a field study conducted in Massachusetts, Triclopyr was applied to sandy loam soil at a rate of 0.6 lb/acre. Rainfall was reported as normal, but not given. Triclopyr was never detected below the top ten inch layer of soil at any time during the three month study (100). As part of the same study, Triclopyr was applied to soil columns containing the same soil as in the field study at the rate of 0.6 and 6.0 lbs/acre. Simulated rainfall was applied to the soil columns at a rate of 1 inch per week for a total of 5 inches. Triclopyr was not detected below the top 4 inch layer of soil (100). These results indicate lower mobility than previously reported, but they may reflect the short persistence of Triclopyr in soil rather than its mobility through the soil profile.

Persistence

Soil

Microbial degradation is the primary mechanism by which Triclopyr is degraded in soils to two metabolites (15). Degradation under anaerobic conditions (i.e. saturated soils) is reported to be 5 to 8 times slower than under aerobic conditions (14). Triclopyr in soils is not thought to be degraded to any appreciable extent by chemical hydrolysis and, due to its low volatility, is not thought to volatilize from soil to any great extent (15).

A review by TRW states that Triclopyr “is not considered to be a persistent compound in soils” (95). Studies indicate that under certain conditions the half-life of Triclopyr can be relatively short. The Dow Chemical Company has reported a half-life of 10 days in silty clay loam (96). In a small West Virginia watershed the half-life was estimated as between 14 and 16 days (15). Triclopyr was applied aerially at the rate of 10 lbs/acre, but much of the Triclopyr was intercepted by foliage. Average Triclopyr residues in soil from the treated area of this study, measured on the day of the treatment, were non—detectable in densely wooded areas, 4.4 ppm in lightly wooded areas, and 18 ppm in open areas (15). In a Massachusetts field study, the half—life of Triclopyr was reported as 10 days after the applications of 0.6 and 6.0 lbs/acre Triclopyr to non-target vegetation (100).

Most other studies suggest a much longer persistence for Triclopyr in soil. In a laboratory study, Dow reported a half-life of 46 days for Triclopyr in loam. The loam was maintained in the laboratory at **95 deg F** with moisture at field capacity for the duration of the study (96). A **95 deg** soil temperature and moisture at field capacity are both quite high and indicate that the persistence at less than ideal conditions would be longer. Dow also reports the average half-life of Triclopyr in soil to be 30 days (101). An average half-life of 46 days is reported in the Herbicide Handbook (10) and by Ghassemi et al. (95). In addition, other investigators have reported a half—life in soil of “less than 50 days” at temperatures between 25-35 deg C, and between 79 and 156 days at 15deg C (14). In a field study conducted in Sweden, Garlon 3A was applied at the rate of 2 lbs (a.i.)/acre to eight different forest soils. Residues of Triclopyr persisted for 1 to 2 years, and in some cases in excess of 2 years, at levels approximately 10 percent or less of initial soil residue levels (15). It must be noted that soil temperature levels never exceeded 14deg C (57 deg F) and these temperatures are not favorable to microbial degradation (15). These low maximum temperatures are not typical of year round Massachusetts temperatures, but indicate the increased persistence that may occur when applications are made in the fall and are followed by cold weather.

The variable half-lives reported for Triclopyr indicate that soil half-life may be dependent on the soil and climatic conditions. As in most situations of microbial degradation; cold and, dry or saturated soils decrease the decomposition rate, while warm moist soils increase it.

Aquatic

The fate of the butoxyethyl ester of Triclopyr (TBEE) in water is summarized in Figure 1. This diagram shows the major degradation pathways for the ester in water, but does not include processes such as sediment and particulate adsorption. The fate of the ester in water has also been simulated with a modelling technique by McCall et al., 1988 (115). A recent study by Woodburn (116) with the triethylamine salt of Triclopyr experimentally applied to a lake in Florida also provides useful comparative data on the persistence of Triclopyr degradation products. The degradation path is believed to be TBEE to Triclopyr acid to 3,5,6—trichloro-2-pyridinol (TCP) to non-halogenated organic acids.

TBEE degrades quite rapidly in water to Triclopyr acid. Laboratory studies indicate that photolysis is the principal degradation pathway with hydrolysis also contributing (117, 118). Several studies indicate that the half-life of the ester in water can range from 1.5—2 days as a result of photolysis (117, 119). Hydrolysis half—lives are dependent upon water pH and temperature and range from 0.06 d to 208 d in natural waters. They decrease with increasing temperature and increasing pH. Acidic conditions increase the persistence of the ester substantially. The 208 d half—life was observed in natural unbuffered water at pH 5 and 15 °C. Waters with this pH level occur in Massachusetts. One laboratory study has produced contradictory results where the ester was stable to hydrolysis, and little photodegradation of the ester occurred over 9 months (120). This study however was performed with buffered, sterile water. Modelling results for the dissipation of the ester indicate that decay should be fairly rapid with a half-life of 12-18 hours (115).

The acid is short-lived in the aquatic environment with reported half—lives of from 2.1 hours at the water's surface in summer at 40deg N latitude to 14 hr at 1m water depth in winter (117). The principal decay product of the acid is 3,5,6-trichloro-2-pyridinol (TCP), a transient metabolite in water with half—lives ranging from minutes to one day (121). TCP rapidly degrades into nonhalogenated, low molecular weight organic acids (116,121), with phototransformation playing a larger role than hydrolysis in this process.

Salomon et al. (118) demonstrated a half—life of 3.8-4.3 days at 16-17 deg C for the ester to TCP step in an Ontario Lake. Woodburn (116) added Triclopyr salt to a Florida lake and determined a half—life of 0.5—3.6 d at 300 C for the salt to organic acid step. The time scales of both of these studies are in general agreement with the other data on the time course of breakdown for the ester (or salt) to organic acids. With the exceptions of the Hamaker (120) study and a slow breakdown at pH 5, most studies indicate that TBEE in water is degraded relatively rapidly.

TOXICITY REVIEW

Acute (Mammalian)

The Triclopyr toxicity database has been reviewed in several places including the GEIR on the Control of Vegetation on Utility and Railroad Rights-of-Way in Massachusetts (14), Herbicide Handbook Weed Science Society of America (10), and by the U.S. Forest Service (15). Several Dow Publications review the Triclopyr information (101) and Garlon products (102 and 103).

The oral LD50 for Triclopyr in rats is 729 mg/kg in males and 630 mg/kg in females (15, 101). The rat oral LD50 for combined sexes has been reported as 713 mg/kg (10, 14). Rabbits and guinea pigs are more susceptible to oral administration of Triclopyr with LDSOs of 550 and 310 mg/kg respectively (14, 15, 10). The Garlon products have oral LD5Os of greater than 2000 mg/kg (10, 14, 15, 101, 103, 103).

The dermal LD5Os are greater than 2000 mg/kg in rabbits (Triclopyr), and greater than 3980 mg/kg in rabbits for Garlon 4 and Garlon 3A (101, 102, 103)

The effects of Triclopyr on the eye are dependent on the chemical derivative involved: the butoxyethyl ester found in Garlon 4 is essentially non-irritating (102, 15, 14, and 101), while the triethylamine salt is not only an irritant but can cause serious injury (101, 14, 15). These eye injuries include conjunctival irritation, moderate internal redness and moderate to severe corneal damage which may be permanent (14). An inhalation study showed that 100% of the test rats survived a 1 hour exposure to 3 to 20 dilutions of Garlon 3A in air. Transitory nasal irritation to rats was noted after a 4 hour exposure to Garlon 4 aerosol (14).

Metabolism

Two studies, one dermal and one oral have been done in humans to determine pharmacokinetic and metabolic profiles. Five mg/kg acid equivalent (ae) was applied to the forearm of 5 volunteers in the dermal study. One point five eight percent to 1.11% of the applied dose was absorbed and the percutaneous absorption half-life was 16.8 hours (108). In the oral study, 6 volunteers received 0.1 or 0.5 mg/kg Triclopyr (acid equivalent) in apple juice. The excretion half-life is 5 hours and 80% of the dose is recovered as unchanged Triclopyr in the urine (109). The 20% which was unaccounted for could be attributed to one of several explanations including incomplete collections of urine, incomplete absorption of material or metabolism to an unknown metabolite.

Subchronic/Chronic Studies (Mammalian)

Long-term bioassays have been done using Triclopyr in rats (107) and mice (106). Summaries of these studies, provided by Dow Chemical Company have been reviewed for this discussion.

Fischer 344 rats received 5, 20, 50 or 250 mg/kg/d in a preliminary 13 week study. There was a decrease in body weight gain at 50 and 250 mg/kg/d and kidney effects were observed in both sexes at doses of 20 mg/kg or greater (107). In the full two year study, the doses were 0, 3, 12 and 36 mg/kg/d. The dose related effects in the males were increased body weight at 12 and 36 mg/kg/d, and in females there was an increase in pigmentation in the proximal tubules at 3, 12 and 36 mg/kg/d. Neither the weight increase in the males nor the increased pigmentation in the females were accompanied by morphological, histological or functional changes. The NOAEL for males and females was reported to be 3 mg/kg/d (107).

In the mouse bioassay, ICR mice received Triclopyr in their diets for twenty-two months. The doses were 0, 50, 250, 1250 ppm (0, 5, 55, 28.6 and 143 mg/kg/d in males and 0, 5.09, 26.5 and 135 mg/kg/d in females). The range finding study included doses of 0, 200, 400, 800, 1600 or 3200 ppm. At the high dose there were decreases in body weight, anemia, changes in urine, increase in cholesterol levels and multiple changes in liver functions. Some of the liver changes were also observed in the 1600 and 800 ppm groups. There were decreases in body weights, changes in kidney and urine (at various doses and points in time) and liver effects at the 1250 ppm dose. At 250 ppm there were mild kidney effects and the NOEL was reported as 50 ppm (5.55 and 5.09 mg/kg/d for males and females respectively) (106).

In subchronic studies, the 90 day dietary NOELs were 30 mg/kg/d and 20 mg/kg/d for rats and mice, respectively. Dogs were more sensitive to dietary administration of Triclopyr, with kidney effects (decrease in excretion) at 2.5 mg/kg/d (14, 101). Dogs refused to eat food that would result in doses of 30 and 100 mg/kg (104). In a one year study, dogs received doses of 0, 0.5, 2.5 or 5.0 mg/kg/d. Minimal kidney effects were observed at 2.5 and 5.0 mg/kg/d. These findings were considered non-adverse by Dow making the NOAEL 5.0 mg/kg/d and the NOEL 0.5 mg/kg/d (105).

Two monkey studies were done to investigate kidney effects in primates. In one study, the monkeys received 0, 10, 20 or 30 mg/kg/d in diet for 28 days. There was no effect on urinary excretion or other responses observed (101, 104). In a second study, 4 monkeys received Triclopyr at 5 mg/kg/d for 28 days, the dose was then increased to 20 mg/kg/d for 102 days. The effects observed in this study were stool softening and diarrhea (104).

Oncocrenicity Studies

There have been two chronic bioassays done for Triclopyr. Rats received 0, 3, 12 or 36 mg/kg/d and mice received 0, 50, 250 or 1250 ppm (0, 5.55, 28.6, 143 mg/kg/d for males and 0, 5.09, 26.5 and 135 mg/kg/d for females). The only positive result was an increase in combined incidence of mammary adenomas and adenocarcinomas in the female rats at the high dose. There was no evidence of multiple tumors and the effect was not dose related (107, 106).

Mutagenicity Testing

Triclopyr has been tested for mutagenicity in a variety of test systems and found to be weakly positive in one, the dominant lethal study in rats. Triclopyr was non-mutagenic in bacterial assay systems, cytogenic assays, and mouse dominant lethal studies (15).

Developmental Studies

The teratology of Triclopyr was investigated using the rabbit model. Doses in the range finding study were 0, 25, 50, 100 and 200 mg/kg. There was 50% and 71% mortality in the 100 and 200 mg/kg groups respectively. The doses used in the full study were 0, 10, 25 and 75 mg/kg/d for days 6 to 18 of gestation. There were 16 rabbits per dose group. One dam in the 25 mg/kg/d group aborted and one dam in the 75 mg/kg/d group died. In the 25 mg/kg group one fetus had hyperplasia of the aortic arch with pulmonary arterial semilunar valve stenosis. Another fetus had a missing gall bladder. There was a statistically significant but non-dose related increase in resorptions at 10 mg/kg/d. This increase was within historical control variability. The developmental NOEL was reported as 75 mg/kg/d with a slight increase in maternal mortality (110)

Tolerances and Other Guidelines

Tolerances are set for Triclopyr on 5 raw agricultural commodities: grasses, forage (500 ppm); grasses, forage, hay (500 ppm); milk (0.01 ppm); meat, fat and meat by products (except liver and kidney) of cattle, goats, hogs, horses, and sheep (0.05 ppm); and liver and kidney of cattle, goats, hogs, horses, and sheep (0.5) ppm (8).

The Dow internal guideline for inhalation exposure to Triclopyr is 10 milligrams/cubic meter (102, 103).

Avian

The toxic effects of Triclopyr on birds have been investigated in a small number of studies conducted by the Dow Chemical Company. For mallard ducks, acute oral LCSOs are reported at 1,698 mg/kg for unformulated Triclopyr, 3,176 mg/kg for Garlon 3A, and 4,640 mg/kg for Garlon 4. Eight day subchronic oral LC5Os are reported as follows for the various triclopyr formulations:

Triclopyr

mallard duck LC50 = 5,000 ppm
bobwhite quail LC50 = 2,935 ppm
Japanese quail LC50 = 3,278 ppm

Garlon 3A

mallard duck LC50=10,000 ppm
bobwhite quail LC50=11,622 ppm

Garlon 4

mallar d duck LC50=10,000 ppm
bobwhite quail LC50=9,026 ppm

Source: (15)

The data summarized above indicate low acute and subchronic toxicity to the bird species tested. No field studies on the toxic effects of Triclopyr or its formulations in birds have been reported (15).

Invertebrates

Very little data were available on the invertebrate and microorganism toxicity of Triclopyr. The data reported are primarily for the triethylamine salt (Garlon 3A) and were generated by the Dow Chemical Company.

The data indicate low acute lethal toxicity* to organisms tested, with a 96 hr LC50 of 895 ppm in shrimp, 96 hr LC50 greater than 1000 ppm in crabs, and 48 hr LC50s ranging between 56 and 87 ppm in oysters (15). The 48 hr LC50 for Daphnia is reported as 1,170 ppm (15). After 72 hours of incubation with 500 ppm of Triclopyr, no apparent effects on growth were observed in six soil microorganisms when compared to a control (15).

No information was obtained on the invertebrate toxicity of Garlon 4, the butoxyethyl ester of Triclopyr.

Aquatic

The available information on Triclopyr toxicity to fish indicate a wide response of fish to the two formulations of Triclopyr and to unformulated Triclopyr. The butoxyethyl ester of Triclopyr (Garlon 4) is "highly toxic to fish", based upon the Clarke et al. criteria. The 96 hour LC50 values for rainbow trout and bluegill sunfish are 0.74 and 0.87 ppm respectively (15). The corresponding value for juvenile Coho salmon is 1.3 ppm (122).

The triethylamine salt formulation (Garlon 3A) is "slightly toxic" to fish with 96 hour LC50s of 552 and 891 ppm for rainbow trout and bluegills respectively. The corresponding values for unformulated Triclopyr are 117 ppm for rainbow trout and 148 ppm for bluegill. Both fish species were less sensitive to Garlon 3A than to the active ingredient (15).

No fish toxicity data are available for 3,5,6—trichloro—2—pyridinol (TCP), the intermediate breakdown product from the Triclopyr acid to the non—halogenated organic acid end product.

Dow Chemical Company reports that in natural soil and aquatic environments, both amine and ester formulations rapidly convert (photodegrade) to Triclopyr acid, which in turn is neutralized to a salt at normal environment pH (5.5-6.5)(15). No information is provided with any of the fish toxicity data on the actual form of Triclopyr present in the test water. The persistence data summarized in a previous section and the simulation results of McCall et al. (115), however provide a description of the probable fate of Triclopyr in the toxicity test tanks. The majority of the fish mortalities during the toxicity tests with bluegill sunfish and rainbow trout exposed to the ester occurred during the first 24 hours of the test: a pattern consistent with the change of the toxic ester form to less toxic breakdown products during this period (124).

EXPOSURE ASSESSMENT

For the exposure assessment, we have chosen to analyze the fate of the butoxyethyl ester form of Triclopyr (Garlon 4) in water because of its reported high aquatic toxicity in laboratory studies. Garlon 4 would be applied basally at an average application rate of 0.5 pints per acre for the proposed utility program.

In aquatic organisms, LC50s greater than 10 ppm are considered to be indicative of only slight toxicity and LC50s less than 1 ppm are considered to reflect high acute toxicity (Clarke et al., 1970 as referenced in [15]).

Since Garlon 4 contains 61.6% of the active ingredient, this application could distribute 37 mg Triclopyr BEE/m². The requested maximum application rate is 2 pints per acre.

Two aquatic exposure scenarios have been constructed to evaluate the potential contamination of non-target surface waters with Garlon 4 from a typical land application. The first, most extreme, and very unlikely scenario is for the case of a static stream traversing a treated acre with a percentage of all of the herbicide applied to the acre running into the water. The second represents a more shallow, static stream or standing water body of much less volume with runoff from a portion of the bordering land.

SCENARIO (1)

ASSUMPTIONS:

- Application rate = 0.5 pint/acre
- 0.47 L/pint
- 61.6% active ingredient
- 20% of herbicide applied to acre runs off
- density of applied herbicide = 1.0 g/ml

RUNOFF:

$$0.20 \times 0.5 \text{ pt/acre} \times 0.47 \text{ L/pt} \times 0.616 = 0.03 \text{ L/acre}$$

RECEIVING WATER:

- Static stream crossing a treated acre
- Dimension: 0.3 x 1.22 x 64 m = 23.4 m³ (volume)

DILUTION:

$$0.03 \text{ L into } 23.4 \text{ m}^3 = 1.3 \text{ mL/m}^3$$

$$1.3 \text{ mL/m}^3 \times 1 \text{ m}^3 / 10^3 \text{ L} = 1.3 \times 10^{-3} \text{ mL/L}$$

$$1.3 \times 10^{-3} \text{ mL/L} \times 1 \text{ g/ml} \times 10^3 \text{ mg/g} = 1.3 \text{ mg TBEE/L}$$

SCENARIO (2)

ASSUMPTIONS:

- Application Rate = 0.5 pt/acre
- 0.47 L/pt
- 61.6% active ingredient **2**
- 20% of herbicide applied to 3m² runs off
- density of applied herbicide = 1.0 g/ml

RUNOFF:

$$0.2 \times 0.5 \text{ pt/acre} \times 0.47 \text{ L/pt} \times 0.616 \times 2.47$$

$$\times 10^{-4} \text{ acre/m}^2 \times 10 \text{ mL/L} \times 3 \text{ m}^2 = 0.02 \text{ mL}$$

RECEIVING WATER:

- Static stream,
- Dimensions: 0.15 x 1 x 5 m = 0.75 m³ (volume)

DILUTION:

$$0.02 \text{ mL into } 0.75 \text{ m}^3 = 0.03 \text{ mL/m}^3$$

$$0.03 \text{ mL/m}^3 \times 10^3 \text{ m}^3 / 10^3 \text{ L} \times 1 \text{ g/ml} = \underline{0.03 \text{ mg/L}}$$

The calculations presented above illustrate that the probable immediate post—runoff concentrations of TBEE in static water bodies will be in the sub-parts per million range. At maximum application rates (2 pts/acre), these concentrations would range from about 0.1 to 5.2 mg/L. The concentrations for the worst exposure scenario (#1) are greater than (7x) the 96 hour LC50 concentrations for freshwater fish; those

for the other scenario are almost an order of magnitude less. The no effect level for TBEE with juvenile Coho salmon is ≤ 1.0 mg/L (122). Therefore, under the worst exposure scenario with the maximum application rate of herbicide, the 96 hour LC50 could be exceeded. Under other, less extreme conditions at average application rates, predicted concentrations of the active ingredient would be substantially less than the reported no effect level in Coho salmon. The persistence characteristics of TBEE are such that the ester form of Triclopyr would not likely persist in surface waters for longer than a couple of days, except in those waters in Massachusetts which are acidic where the ester may persist for up to several months. It is also very unlikely that rainbow trout would be impacted at application rates of 0.5 pts/acre based on the reasonable scenario (#2) which predicts water concentrations of Garlon 4 less than toxic concentrations.

The following factors would also tend to reduce the exposure concentrations that fish would experience: flowing waters would provide greater dilution than assumed for static conditions; the Massachusetts Right-of-Way Management Act mandates an application setback of 10 feet from standing or flowing waters or from wetlands (33 CMR 11.04:(1) and (4) (a)); and actual runoff of the applied herbicide would probably be less than used for these sample calculations. Scenario 1 represents an extremely unlikely event where 20% of all the herbicide applied to an acre runs off into a small water course. The conditions which would foster this type of runoff across setbacks (i.e. heavy rains) would tend to turn static stream systems into flowing water courses and hence increase dilution.

The application rate used in the previous non—target species assessment (June 23, 1990) was 0.5 pints per acre applied basally. The utilities involved in managing rights-of-way and the manufacturer of Garlon 4 have since indicated that the required application rate may range as high as 2-3 quarts of Garlon 4 per acre for effective control of vegetation. The following addition to the exposure assessment examines the resultant changes in the predicted exposure concentrations that might occur in freshwater fish habitats when Garlon 4 is applied at the 2-3 quarts /acre rate.

The change in the application rate will result in the following differences in predicted exposure concentrations from those originally predicted for 0.5 pts/acre:

$$\underline{2 \text{ qt/acre}} \times 2 \text{ pt/ qt} = \times 8 \text{ 0.5 pt/acre}$$

$$\underline{3 \text{ qt/acre}} \times 2 \text{ pt/qt} = \times 12 \text{ 0.5 pt/acre}$$

Application rates will therefore be 8-12 times greater than for the 0.5 pts/acre case. The probable concentrations in water after runoff as previously predicted were 1.3 (Scenario 1) and 0.03 mg/L (Scenario 2) ing butoxyethyl ester of Triclopyr / L. These concentrations would therefore range from 0.24 — 15.6 ing/L for application rates between two and six quarts.

These predicted concentrations encompass and substantially exceed the reported LC50 concentrations for fish (in range of 0.7 - 1.3 mg/L and the NOEL of 1 mg/L for juvenile Coho salmon. The more realistic exposure scenario (#2) predicts exposure concentrations of the same order of magnitude as the LC50 values.

Given that the higher application rates required for vegetation control in some areas have the potential to produce potentially lethal concentrations of the butoxyethyl ester of Triclopyr to fish in water as a result of runoff, a setback greater than the mandated 10 feet from standing or flowing waters (333 CMR 11.04: (1) and (4) (a)) will provide an additional level of protection when application rates exceed 0.5 pts/acre.

SUMMARY

Triclopyr exhibits moderate mobility in most of the soils tested. Soils with higher organic carbon content would be expected to retard the mobility of Triclopyr. Trichloropyridinol, the major breakdown product, is less mobile than Triclopyr.

Microbial degradation is the primary mechanism by which Triclopyr is degraded in soils. Degradation rates are variable and appear to be dependent on the soil and climatic conditions. In Massachusetts conditions, Triclopyr can be expected to have moderate persistence when applied in warm weather (late spring—early fall), and slightly longer persistence in colder weather. 713 mg/kg. Rabbits and guinea pigs have oral LDSOs of 550 and 310 mg/kg respectively. The target organ for Triclopyr is in the liver. The only positive result in the oncogenicity studies was an increase in the combined incidence of mammary adenomas and adenocarcinomas in the female rats at the high dose. Mutagenicity tests were negative. The developmental NOEL was reported as 75 mg/kg/d with a slight increase in maternal mortality. Using EPA's carcinogen classification scheme, Triclopyr may be considered a group C carcinogen (possible human carcinogen: limited animal evidence).

RECOMMENDATION

The herbicide Garlon 4, containing the butoxyethyl ester of Triclopyr (EPA Reg. No. 464-554), is recommended for use in sensitive areas only at application rates of 0.5 pt/acre pursuant to 333 CMR 11.00. Applications at rates up to three quarts per acre are permitted with a setback of 50 feet from standing or flowing waters suitable for fish habitat. The set back restriction may be waived upon demonstration to both the Departments of Food and Agriculture and Environmental Protection that runoff concentrations from applications of Garlon 4 with setbacks less than 50 feet do not pose a threat to fish.

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THE COMMONWEALTH OF MASSACHUSETTS

EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS



Department of Agricultural Resources

251 Causeway Street, Suite 500, Boston, MA 02114
617-626-1700 fax: 617-626-1850 www.mass.gov/agr



METSULFURON METHYL

In addition to the review that is presented below, a comprehensive review available from USDA Forest Service provides information that incorporates more recent studies and data. The US Forest Service risk assessment report is available at: <http://www.fs.fed.us/foresthealth/pesticide/risk.shtml>

Review conducted by MDAR and MassDEP for use in Sensitive Areas of Rights-of-Way in Massachusetts

Common Trade Names: Escort, Escort XP (2)

Chemical Name: Methyl 2 E[C[(4-Methoxy—6-methyl-1,3,5-Triazifl—2-yl) aminolcarbonyl] amino] sulfonyl.]benzoate] (9)

CAS NO.: 74223-64-6

GENERAL INFORMATION

Metsulfuron methyl is a sulfonyl urea herbicide initially registered by E.I. DuPont in 1986. It is a foliar herbicide registered for use on wheat and barley and non-cropland sites such as Right of Way (9).

ENVIRONMENTAL FATE

Mobility

Metsulfuron methyl is a relatively new herbicide. The studies reviewed here have been provided by the registrant, EI DuPont.

The soil water partition coefficients (Kd) of Metsulfuron Methyl have been determined in four different soils: Cecil sand, Flanagan silt loam, Fallsington silt loam, and keyport silt loam. The Kd values range from 0.36 for Cecil sand to 1.40 for Flanagan silt loam, and Kom values ranged from 29 for Fallsington silt loam to 120 for Cecil sand (100). The values for Kd and Kom indicate that metsulfuron methyl is not adsorbed well to soil and that the organic content of the soil is not the only adsorption component. The silt and clay contents appear to influence adsorption, but there are probably other factors also involved.

The previous study also determined the Rf values for soil. Thin layer chromatography was performed on four soils for metsulfuron methyl. The Rf values ranged from 0.64 to 1.00; only one value was less than 0.90 (100). This result confirms the validity of the Kd values, indicating that metsulfuron methyl is mobile and that the organic matter content of the Soil is a significant component of adsorption.

Metsulfuron methyl was applied to tops of 12 inch columns [containing four different soils], and eluted with 20 inches of water in 20 hours. Following the percolation of the total volume of water, 106% of the metsulfuron

methyl was eluted from the Fallsington sandy loam, 96% from the Flanagan silt loam, 81% for Keyport silt loam and 93% for Myakka sand (100). The breakthrough volumes for the Fallsington, Flangan, Keyport and Myakka soils were 6.5, 4.5, 6.9 and 5.8 inches of water respectively (101).

Metsulfuron methyl is relatively mobile in most soils, but will be retained longer in soils with higher percentages of organic matter.

Persistence

There are two studies which have reviewed the persistence of metsulfuron methyl in the soil. One study was conducted in the southern United States and the second was in the northern United States and Canada. The results of the studies indicate a somewhat contradictory picture of the persistence of metsulfuron methyl.

The soil half-lives in Delaware, North Carolina, Mississippi and Florida were 1 week, 4 weeks, 3 weeks and 1 week respectively following an application in mid to late summer (102). The results are varied and indicate that either climatic or soil factors determine the persistence. The climate is sufficiently similar to be able to discount that as a factor. However, both of the locations where the shortest half-lives were observed had the highest organic matter content in the soils. Furthermore, the half—lives correspond with the organic matter content.

The half—lives following spring applications were 4 and 56 weeks for two sites in Colorado, 6 weeks in North Dakota and 28 weeks in Idaho (103). In contrast to the southern United States study there does not appear to be any correlation with climatic or soil characteristics. There appears to be a slightly shorter half—life in acidic soils in the same location.

Metsulfuron methyl was also applied in the fall and the half-lives determined in two sites in Colorado, North Dakota and Idaho. These half—lives were 8 weeks, 12 weeks, 42 weeks and 28 weeks respectively. As was expected there were longer half—lives following fall applications in North Dakota (6 weeks vs. 42 weeks) however, in Idaho there was no change at all, which is unexpected.

In Canada following spring applications the reported half-lives were 10 weeks, 4 weeks, 4 weeks and 6 weeks for Alberta, 2 locations in Saskatchewan and Manitoba (103). One would expect longer half lives in Northern locations due to the effects of temperature on degradation rates. The results from Canada are generally shorter than those in the U.S. locations, which is unexpected.

Therefore, the half-life of Metsulfuron methyl in the soil is variable and dependent on the location. It is shorter when applied in the spring but appears independent of other environmental factors in most locations.

TOXICITY REVIEW

Acute (Mammalian)

The toxicology database for Metsulfuron methyl has been reviewed and accepted by the EPA (9). DuPont supplied excerpts from their monograph on Ally herbicide (112). Summaries of studies were supplied by DuPont for subchronic, chronic and reproductive studies.

Technical metsulfuron methyl has been tested in two acute oral LD50 studies in CrI:CD Rats. In the first study the LD50 was greater than 5,000 mg/kg and in the second it was greater than 25,000 mg/kg (the maximum feasible dose) (112). Clinical signs included salivation, chromodacryorrhea, stained face, stained perineal area and weight loss (112).

In a 10—dose subacute study using male rats, a single repeated dose of 3,400 mg/kg/day for 10 days over a 2 week period was administered. This was followed by a two week recovery period. No deaths occurred and slight weight loss was the only clinical sign observed. In addition, no gross or microscopic changes were observed (112). The dermal LD50 is greater than 2,000 mg/kg in male and female rabbits (112). Technical metsulfuron methyl caused mild erythema as a 40% solution in guinea pigs. There was no reaction observed at the 4% concentration. No response occurred when treated animals were challenged (112).

In rabbits, moderate areas of slight corneal clouding and severe to moderate conjunctivitis were observed in both washed and unwashed eyes following treatment with technical metsulfuron methyl. The unwashed eyes were

normal in 3 days and the washed eyes in 14 days (112).

Metabolism

Elimination of metsulfuron methyl in the rat is rapid, with 91% of a radioactive dose excreted over 96 hours (9). The routes of elimination were not specified within the report.

Subchronic/Chronic (Mammalian)

Ninety day feeding studies have been done with metsulfuron methyl in rats and mice. The rat study was done in conjunction with a one generation reproduction study (see Developmental Study Section). In this study rats received 0, 100, 1000, or 7500 ppm (0, 5.7, 57, 428 mg/kg/d) (a) in their diets. Effects observed at the high dose were: a decrease in body weight and an increase in total serum protein in the females, and a decrease in liver weight and a decrease in cytoplasmic clearing of hepatocytes in the males the NOEL in this study was 1000 ppm (104).

The 90 day mouse study was done in conjunction with the 18 month mouse study. Groups of 90 mice per sex per dose received 0, 5, 25, 500, 2500 or 5000 ppm (0, 0.66, 3.3, 66.6, 333.3, 666.6 mg/kg/d) in their diets. Clinical evaluations were made at 1, 2, 3, 6, 12 and 18 months. Ten animals per group were sacrificed at the 90 day time point for pathological evaluation. The 2500 ppm group was sacrificed at 12 months. Sporadic effects were observed on the body weight, food consumption, and organ weights. These were not dose related, resulting in a NOEL of 5000 ppm in diet for mice (111).

In the twenty-one day dermal rabbit study, the intact skin of male and female New Zealand White Rabbits received doses of 0, 125, 500 and 2,000 mg/kg for 6 hrs/day for 21 days. Clinical signs observed were sporadic weight loss and diarrhea in a few rabbits. These effects were not dose related. Non dose related histological effects were observed in male rabbits. This effect was characterized as mild testicular atrophy occurring sporadically at all doses (112, 108).

Feeding studies in dogs have been done with purebred beagles. The animals received metsulfuron methyl in diets at dose levels of 0, 50, 500 and 5000 ppm (0, 0.2, 2, 20 mg/kg/d) for one year. There was a decrease in food consumption in the high dose males. There was a decrease in serum lactate dehydrogenase in all groups of both sexes at two or more doses these values were within the historical controls. The NOEL was 500 ppm in the males and 5000 ppm in females (112).

In a chronic feeding study in rats, the animals received metsulfuron methyl at doses of 0, 5, 25, 500, 2500 or 5000 ppm (0, 0.28, 1.4, 28.6, 143 or 286 mg/kg/d. Interim sacrifices were done at 13 and 52 weeks (105).

At the 13 week sacrifice there was a decrease in body weight in the 2500 and 5000 ppm groups; there was a decrease in absolute liver weight at 2500 and 5000 ppm males. There was a decrease in the relative liver weights in the 2500 and 5000 ppm females.

(a) In these discussions the assumptions made for estimated conversion of ppm (diet) to mg/kg/D were:

Species Body weight (kg) Intake (kg)

Rat 0.35 0.020 Mouse 0.03 0.004 Dog 10 0.4

When data were presented as ppm, the dose was estimated in mg/kg and is presented in parenthesis.

Findings at the 52 week sacrifice included increase in kidney weight (2500 ppm males) and increased absolute brain weights (at doses of 25, 500, 2500 and 5000 ppm) in males and at doses of 2,500 and 5000 ppm in females. There was an increase in absolute heart weight at 2500 ppm in males and at 2500 and 5000 ppm in females. The absolute organ weights were back to normal at termination. Relative brain weights of the 2500 and 5000 ppm groups were increased (105)

Oncogenicity Studies

There were no gross or histopathological changes observed in mice receiving up to 5000 ppm metsulfuron methyl in their diets (112, 111). Similar results were obtained in the 104 week rat study; there were no histopathological changes observed which were attributable to metsulfuron methyl (105, 112). EPA concludes that there were no

oncogenic effects in rats or mice at the highest dose tested; 5000 ppm in both cases (9).

Mutagenicity Testing

Metsulfuron methyl was negative in the unscheduled DNA synthesis assay; in *in vivo* bone marrow cytogenic assay in rats (doses were 500, 1,000, and 5,000 mg/kg bw); CHO/HGPRT Assay; *Salmonella typhimurium* reverse mutation assay four strains with and without S9 metabolic activation; and also in the *in vivo* mouse micronucleus assay at doses of 166, 500, 1666, 3000 and 5000 mg/kg (112). The only positive mutagenicity assay was in the *in vitro* assay for chromosome aberrations in Chinese Hamster Ovary at high doses (greater than 2.63 mM, 1.0 mg/mL). In this assay no increases in structural aberrations were observed at 0.13 or 1.32 mM (0.05 or 0.5 mg/mL) (112).

Developmental Studies

Several studies have been done to investigate the effects of Metsulfuron methyl on reproduction and development in rats and rabbits.

Pregnant Cr1: COBS CD(SD) BR rats received metsulfuron methyl at doses of 0, 40, 250 or 1000 mg/kg by the oral route on days 5 to 14 of gestation. There were 25 rats per group. Maternal toxicity was observed at doses of 250 and 1000 mg/kg/d. The maternal toxicity NOEL was 40 mg/kg/d. There was no evidence of "teratogenic" response or embryo fetal toxicity (112).

In the rabbit study, New Zealand white rabbits received 0, 25, 100, 300 or 700 mg/kg/d on days 6 to 18 gestation. There was a dose related increase in maternal deaths; 1, 2 and 12 deaths at doses of 100, 300 and 700 mg/kg respectively. The maternal toxicity NOEL was 25 mg/kg/d and there was no evidence of teratogenic or embryolethal effects observed in this study (112).

Several multigenerational studies have been done with Metsulfuron methyl. A four litter reproduction study was done concurrently with the chronic bioassay. Rats from each treatment were separated from the main study and bred. The doses were 0, 5, 25, 500, 2500, and 5000 ppm (0, 0.28, 1.4, 28.6, 143 and 286 mg/kg/d). There was a dose dependent decrease in body weight in the parental (P1) generation at doses of 25 ppm and greater in males and females. This effect was not present in dams during gestation or lactation (106).

Overall fertility in the P1 and filial (F1) matings was low in both control and treated groups with no apparent cause. There was a decrease in pup size in the F1a but not the F1b, F2a, or F2b litters. The gestation index was 100% for all groups in both filial generations with the exception of F2a when it was 90%. On the basis of the lower body weights and lower growth rates, the NOEL was 25 ppm for this study (106).

In a 90 day, 2 generation 4 litter protocol, rats received 0, 25, 500 or 5000 ppm (0, 1.4, 28.6, 286 mg/kg/d) Metsulfuron methyl in their diets for 90 days prior to mating. In this protocol the parental generation was bred twice first to produce the F1a and then the F1b. The F1b rats were then fed the appropriate diet for 90 days (after weaning). There was a decrease in litter size in the 5000 ppm group in the F2a generation, but not in any other generation. The NOEL for this study was 500 ppm (107).

In a 90 day feeding, one generation rat study, 16 male and 16 female rats received 0, 100, 1000 or 7500 ppm in their diet prior to mating. There were no differences observed in reproduction and lactation performance or litter survival among groups. There was an overall low fertility in the control and treated groups. This result made the effects of metsulfuron methyl on fertility difficult to assess from this study (104).

Tolerances and Guidelines

Tolerances have been set for metsulfuron methyl in barley wheat (from 0.05 to 20 ppm, depending on the commodity) and in meat and meat byproducts (0.1 ppm). The tolerance in milk is 0.05 ppm (8, 9). The acceptable daily intake is 0.0125 mg/kg/d based on a one year dog NOEL of 1.25 mg/kg/d using a safety factor of 100 (9).

Avian

Metsulfuron methyl has been tested in two species of birds, the mallard duck and the bobwhite quail. The acute oral LD50 is greater than 2150 mg/kg in the duck. Two, 8 day dietary studies have been done. The 8 day LC50 is greater than 5620 ppm in both the duck and the quail (9).

Invertebrates

The 48 hour LC50 for Daphnia is greater than 150 ppm and the acute toxicity in the honeybee is greater than 25 mg/bee (9).

Aquatic

Metsulfuron methyl has acute LC50 of greater than 150 ppm in both the rainbow trout and the bluegill sunfish (9).

Summary

Metsulfuron methyl has a moderate to high mobility in the soil profile and is relatively persistent in the environment, especially when applied in the fall. These factors would be of concern under most circumstances. However, metsulfuron methyl is applied at very low rates (3-4 ozs./A) and therefore the amounts which reach the soil are quite low. Consequently, Metsulfuron methyl should not impact groundwater as a result of leaching or migrate from the target area. Metsulfuron methyl has low toxicity (EPA Toxicity Category III) for acute dermal exposure and primary eye irritation and is category IV for all other acute exposures. The chronic studies indicate no oncogenicity response and the systemic NOEL's are 500 ppm in rats and 5000 ppm in mice. There was no evidence of teratological effects in the rat or the rabbit at the highest dose tested in both species. While there was evidence of maternal toxicity at 40 mg/kg/d in the rat and 100 mg/kg/d in the rabbits.

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EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS



Department of Agricultural Resources

251 Causeway Street, Suite 500, Boston, MA 02114
617-626-1700 fax: 617-626-1850 www.mass.gov/agr



IMAZAPYR

In addition to the review that is presented below, a comprehensive review available from USDA Forest Service provides information that incorporates more recent studies and data. The US Forest Service risk assessment report is available at: <http://www.fs.fed.us/foresthealth/pesticide/risk.shtml>

Review conducted by MDAR and MassDEP for use in Sensitive Areas of Rights-of-Way in Massachusetts

Common Trade Name(s): Arsenal

Chemical Name: Imazapyr!

2-(4-isopropyl-4-methyl-5-oxy-2-imidazolin-2-yl)
nicotinic acid with isopropyl amine (2)

CAS No.: 81510-83-0

GENERAL INFORMATION

Imazapyr is effective against and provides residual control of a wide variety of annual and perennial weeds, deciduous trees, vines and brambles in non-cropland situations. It also provides residual control and may be applied either pre or postemergence. Postemergence is the preferred method especially for the control of perennial species. Imazapyr is readily absorbed by the foliage and from soil by the root systems. Imazapyr kills plants by inhibiting the production of an enzyme, required in the biosynthesis of certain amino acids, which is unique to plants (10, 100).

ENVIRONMENTAL FATE

Mobility

There are few studies which have investigated the mobility of Imazapyr in soil, but available reports indicate that Imazapyr does not leach and is strongly absorbed to soil (100). Imazapyr has a high water solubility (1 — 1.5%) which could generally indicate a high leaching potential, but as with other organic acids Imazapyr is much less mobile than would normally be expected (100). No soil partition coefficients have been reported, but they may be expected to be quite high (100).

One field study investigated Imazapyr mobility in a sandy loam soil (0.9% organic matter, 8.0% clay; 38.8% silt). Imazapyr did not leach below the 18—21 inch layer after 634 days and 49.6 inches of rain. The levels found below the 12 inch layer were just above the 5 ppb detection limit. In addition, this study investigated the off-target mobility of Imazapyr and found no residues further than 3 inches from the sprayed area after 1 year (102).

Although low levels of Imazapyr did move to the 18 to 21 inch layer this was only after nearly 2 years and fifty inches of rain. This indicates that imazapyr is relatively non-mobile and does not leach through the soil profile. Imazapyr remains near the soil surface and heavy precipitation may cause some off target movement from surface erosion of treated soils.

Persistence

The main route of Imazapyr degradation is photolysis. In a study of photodegradation in water, the half—life of Imazapyr was calculated as 3.7, 5.3 and 2.5 days in distilled water, pH 5 and pH 9 buffers respectively (101). A soil photolysis study for Arsenal on sandy loam calculated a half—life of 149 days (101).

Studies have investigated the persistence of Imazapyr in soil under aerobic and anaerobic conditions. The half-life of Imazapyr in soil has been reported as varying from 3 months to 2 years (100). A laboratory study found the half-life to be 17 months (101). Detectable residues were found in a field study in all soil layers to 21 inches at 634 days (102). Vegetation was sprayed with radio-labelled Imazapyr at a rate of 1 lb. a.i./acre. The soil was a sandy loam (0.9% organic matter) which received 49.6 inches of rain during 634 days. The highest level of radioactivity (0.234 ppm Imazapyr) was found in the top 3 inches of soil at 231 days after application and there were detectable levels in the 9-12 inch layer. The concentrations in the top layer increased steadily from day 4 to 231 when they reached their maximum (0.234 ppm) and then declined. At day 634 the level in the top layer (0-3 inch) was 0.104 ppm (102). These data indicate that Imazapyr is persistent in soil and, most importantly, that Imazapyr is translocated within plants from the plant shoots back to the roots and released back into soil. Very little of the Imazapyr actually reached the soil during application. The soil residues may be due to the decay of plant material containing Imazapyr in the soil (102).

TOXICITY REVIEW

Acute (Mammalian)

The acute oral LD50 in both male and female rats was greater than 5000 mg/kg using technical Imazapyr. The acute dermal LD50 in male and female rabbits was greater than 2000 mg/kg. The compound was irritating to the rabbit eye but recovery was noted 7 days after application of 100 mg of the test substance. It was classified as mildly irritating to the rabbit skin following application of 0.5 grams of the material on abraded or intact skin (103).

Arsenal product formulation was tested in a similar battery of tests. The rat oral LD50 value was greater than 5000 mg/kg and the rabbit dermal LD50 was greater than 2148 mg/kg. The irritation was observed following installation of 0.5 ml of the test substance in the skin study and 0.1 ml in the eye study (104).

Technical Imazapyr was administered to rats as an aerosol for four hours at a concentration of 5.1 mg/L. There were ten rats per sex and the animals were observed for 14 days after treatment before they were sacrificed. Slight nasal discharge was seen in all rats on day one but disappeared on day two (105).

The inhalation LC50 is greater than 5.0 mg/L for both the formulation and the technical product (105,106). Technical Imazapyr was applied dermally at the following dosages: 0, 100, 200 and 400 mg/kg/day (109). Arsenal was used at 0, 25, 50 and 100% of the formulated solution in sterile saline. Each dose group consisted of 10 male and 10 female rabbits and the test substance was applied to either intact or abraded skin and occluded for 6 hours each day.

The result of the dermal studies with Imazapyr as well as Arsenal were non remarkable with regard to body weights, food consumption, hematology, serum chemistry, clinical observations, necropsy observations and histopathology. It was noted that Arsenal, undiluted, was locally irritating (109).

Subchronic and Chronic Studies (Mammalian)

In the subchronic tests a NOEL for systemic toxicity with dermal administration in rabbits was 400 mg/kg/d (2,109). After dietary administration for 13 weeks in the rat, there was no effect at 10,000 ppm (571. mg/kg/d) which was the highest dose tested (141).

A bioassay is currently underway to evaluate the potential oncogenicity of technical Imazapyr. Groups of 65 rats per sex per dose group have received 0, 1000, 5000 or 10,000 ppm in the diet. Hematology, clinical chemistry and urinalysis tests were conducted at 3, 6 and 12 months and will also be done at 18 months and at study termination. At the 12 month sacrifice the only effect noted was a slight increase in mean food consumption in all treated female groups. Most of the increases were statistically significant, but they did not always exhibit a dose response. The oncogenicity test is due to be submitted to the EPA in the spring of 1989 (115).

Oncogenicity Studies

Chronic bioassays as discussed in the subchronic/chronic section are underway.

Mutagenicity Testing

Five different bacterial strains of Salmonella typhimurium (TA1535, TA98, TA100, TA1537, and TA1538) and one of Escherichia coli (WP-2 uvrA-) were used to evaluate the mutagenicity of Imazapyr. It is unclear whether the compound used was technical or formulated Imazapyr. Dose levels up to 5000 micrograms/plate were used and each strain was evaluated both in the presence or absence of PCB—induced rat liver 5—9 microsomes. Negative results were noted in all assays. The six tester strains were designed to detect either base-pair substitutions or frameshift mutations (113).

Developmental Studies (Mammalian)

Two teratology studies have been done and both of these studies evaluated technical Imazapyr. One study used rats as the test species and the other utilized rabbits (111,112).

Pregnant rats received dosages of 0, 100, 300 or 1000 mg/kg/d of Imazapyr during days 6—15 of gestation. There were 22 rats in the control group and 24, 23 and 22 in the low, mid and high dose groups. All doses were administered orally by gavage. Salivation was noted only during the dosing period in 6 of the 22 females in the highest dose group (1000 mg/kg). No other adverse observations were noted in the treated dams (111). Fetal body weight and crown-rump length data for the treated groups were comparable to controls. Fetal development (external, skeletal and visceral) “revealed no aberrant structural changes which appeared to be the result of the exposure to Imazapyr” (111). The NOEL for maternal toxicity was 300 mg/kg and the NOEL for teratogenicity and fetotoxicity was 1000 mg/kg (116).

Four groups of 18 pregnant rabbits were exposed on days 6-18 of gestation to doses of 0, 25, 100, 400 mg/kg/d Imazapyr. There was no statistically significant difference between control and treated groups at any dose (112).

Avian

Acute oral LD50s of Imazapyr in bobwhite quail and mallard duck were 2150 mg/kg. The 8 day dietary LC50 in the bobwhite quail and mallard duck were greater than 5000 ppm (101).

Invertebrates

The dermal honey bee LD50 for Imazapyr is greater than 100 mg/bee (101). The LD50 (48 hr) was greater than 100 mg/L for the water flea (100).

Aquatic

The LC50s of Imazapyr in the rainbow trout, bluegill sunfish and channel catfish were greater than 100 mg/L (101).

SUMMARY

Imazapyr is a relatively immobile herbicide in the soil profile even when used in sandy and low organic content soils. It is also persistent in soils. The low mobility and persistence may result in off-target movement of Imazapyr from surface erosion of treated soils.

The atypical soil—plant flux characteristics of Imazapyr and delayed maximum soil concentrations indicate that repeated annual applications may result in build—up of Imazapyr in soil. Consequently, an interval is required to allow for the degradation of soil residues before a repeated application is made.

The oral LD50 of Imazapyr in rats is greater than 5000 mg/kg and the dermal LD50 is greater than 2000 mg/kg in rabbits. The oncogenicity bioassay is currently underway and the only effect reported in the interim study was an increase in food consumption in the treated females. No mutagenic effects were observed.

The acute oral LD50s of Imazapyr and the Arsenal formulation are greater than 5000 mg/kg. In the subchronic 13 week rat study there was no effect observed at the highest dose tested 10,000 ppm. The oncogenicity study is currently underway.

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Department of Agricultural Resources

251 Causeway Street, Suite 500, Boston, MA 02114
617-626-1700 fax: 617-626-1850 www.mass.gov/agr



GLYPHOSATE

In addition to the review that is presented below, a comprehensive review available from USDA Forest Service provides information that incorporates more recent studies and data. The US Forest Service risk assessment report is available at: <http://www.fs.fed.us/foresthealth/pesticide/risk.shtml>

Review conducted by MDAR and MassDEP for use in Sensitive Areas of Rights-of-Way in Massachusetts

Common Trade Name(s): Roundup, Glyphosate VMF Round Up Pro, Rodeo, Accord, Accord Concentrate,

Chemical Name: N—(phosphonomethyl)glycine—isopropylamine salt
CAS No.: 1071-83-6

GENERAL INFORMATION

Glyphosate, n-phosphonomethyl glycine, is a systemic, broad spectrum herbicide effective against most plant species, including deep rooted perennial species, annual and biennial species of grasses, sedges, and broadleafed weeds. The major pathway for uptake in plants is through the foliage, however, some root uptake may occur. The presence of surfactants and humidity increases the rate of absorption of glyphosate by plants (15).

Foliarly applied glyphosate is readily absorbed and translocated from treated areas to untreated shoot regions. The mechanism of herbicidal action for glyphosate is believed to be inhibition of amino acid biosynthesis resulting in a reduction of protein synthesis and inhibition of growth (10, 15, 101).

Glyphosate is generally formulated as the isopropylamine salt in aqueous solution (122). Of the three products containing glyphosate considered here, Roundup is sold with a surfactant and Rodeo and Accord are mixed with surfactants prior to use (15). Glyphosate has been reviewed by US Forest Service (15), FAO (122), and EPA 00W (51).

ENVIRONMENTAL FATE

Mobility

Glyphosate is relatively immobile in most soil environments as a result of its strong adsorption to soil particles. Adsorption to soil particles and organic matter begins almost immediately after application. Binding occurs with particular rapidity to clays and organic matter (15). Clays and organic matter saturated with iron and aluminum (such as in the Northeast) tend to absorb more glyphosate than those saturated with sodium or calcium. The soil phosphate level is the main determinant of the amount of glyphosate adsorbed to soil particles. Soils which are low in phosphates will adsorb higher levels of glyphosate (14, 15).

Glyphosate is classified as immobile by the Helling and Turner classification system. In soil column leaching studies using aged (1 month) Glyphosate, leaching of glyphosate was said to be insignificant after 0.5 inches of water per day for 45 days (14).

Persistence

It has been reported that glyphosate dissipates relatively rapidly when applied to most soils (14). However, studies indicate that the soil half-life is variable and dependent upon soil factors. The half-life of glyphosate in greenhouse studies when applied to silty clay loam, silt loam, and sandy loam at rates of 4 and 8 ppm was 3, 27 and 130 days respectively, independent of application rate (14). An average half-life of 2 months has been reported in field studies for 11 soils (15).

Glyphosate is mainly degraded biologically by soil micro-organisms and has a minimal effect on soil microflora (15). In the soil environment, glyphosate is resistant to chemical degradation such as hydrolysis and is stable to sunlight (15). The primary metabolite of glyphosate is aminomethyl phosphonic acid (AMPA) which has a slower degradation rate than glyphosate (15). The persistence of AMPA is reported to be longer than glyphosate, possibly due to tighter binding to soil (14). No data are available on the toxicity of this compound.

Glyphosate degradation by microorganisms has been widely tested in a variety of field and laboratory studies. Soil characteristics used in these studies have included organic contents, soil types and pHs similar to those that occur in Massachusetts (117).

Glyphosate degradation rates vary considerably across a wide variety of soil types. The rate of degradation is correlated with microbial activity of the soils and does not appear to be largely dependent on soil pH or organic content (117). While degradation rates are likely temperature dependent, most reviews of studies do not report or discuss the dependence of degradation rate on temperature. Mueller et al. (1981 cited in 117) noted that glyphosate degraded in Finnish agricultural soils (loam and fine silt soils) over the winter months; a fact which indicates that degradation would likely take place in similar soils in the cool Massachusetts climate. Glyphosate half-lives for laboratory experiments on sandy loam and loamy sand, which are common in Massachusetts, range up to 175 days (117). The generalizations noted for the body of available results are sufficiently robust to incorporate conditions and results applicable to glyphosate use in Massachusetts.

TOXICITY REVIEW

Acute (Mammalian)

Glyphosate has reported oral LD50s of 4,320 and 5,600 mg/kg in male and female rats (15,4). The oral LD50s of the two major glyphosate products Rodeo and Roundup are 5,000 and 5,400 mg/kg in the rat (15).

A dermal LD50 of 7,940 mg/kg has been determined in rabbits (15,4). There are reports of mild dermal irritation in rabbits (6), moderate eye irritation in rabbits (7), and possible phototoxicity in humans (9). The product involved in the phototoxicity study was Tumbleweed marketed by Murphys Limited UK (9). Maibach (1986) investigated the irritant and the photo irritant responses in individuals exposed to Roundup (41% glyphosate, water, and surfactant); Pinesol liquid, Johnson Baby Shampoo, and Ivory Liquid dishwashing detergent. The conclusion drawn was that glyphosate has less irritant potential than the Pinesol or the Ivory dishwashing liquid (120).

Metabolism

Elimination of glyphosate is rapid and very little of the material is metabolized (6,106).

Subchronic/Chronic Studies (Mammalian)

In subchronic tests, glyphosate was administered in the diet to dogs and rats at 200, 600, and 2,000 ppm for 90 days. A variety of toxicological endpoints were evaluated with no significant abnormalities reported (15,10).

In other subchronic tests, rats received 0, 1,000, 5,000, or 20,000 ppm (57, 286, 1143 mg/kg) in the diet for 3 months. The no observable adverse effect level (NOAEL) was 20,000 ppm (1,143 mg/kg) (115). In the one year oral dog study, dogs received 20, 100, and 500 mg/kg/day. The no observable effect level (NOEL) was 500 mg/kg (116).

Oncogenicity Studies

Several chronic carcinogenicity studies have been reported for glyphosate including an 18 month, mouse study; and a two year rat study. In the rat study, the animals received 0, 30, 100 or 300 ppm in their diet for 2 years. EPA has determined that the doses in the rat study do not reach the maximum tolerated dose (112) and replacement studies are underway with a high dose of 20,000 ppm (123). The mice received 1000, 5000 or 30,000 ppm for 18 months in their diets. These studies were non-positive (112,109). There was a non-statistically significant increase in a rare renal tumor (renal tubular adenoma (benign) in male mice (109). The rat chronic study needs to be redone with a high dose to fill a partial data gap (112). The EPA weight of evidence classification would be D: not classified (51).

Mutagenicity Testing

Glyphosate has been tested in many short term mutagenicity tests. These include 7 bacterial (including *Salmonella typhimurim* and *B. subtilis*) and 1 yeast strain *Sacchomyces cerevisiae* as well as a mouse dominant lethal test and sister chromatid exchange. The microbial tests were negative up to 2,000 mg/plate (15), as were the mouse dominant lethal and the Chinese hamster ovary cell tests. EPA considers the mutagenicity requirements for glyphosate to be complete in the Guidance for the Registration of Pesticide Products containing glyphosate (112).

The developmental studies that have been done using glyphosate include teratogenicity studies in the rat and rabbit, three generation reproduction studies in the rat, and a reproduction study in the deer mouse. (15)

Rats were exposed to levels of up to 3,500 mg/kg/d in one rat teratology study. There were no teratogenic effects at 3,500 mg/kg/d and the fetotoxicity NOEL was 1,000 mg/kg/d. In the rabbit study a fetotoxicity NOEL was determined at 175 mg/kg/d and no teratogenic effects were observed at 10 or 30 mg/kg/d in one study and 350 mg/kg/d in the other study (15). No effects were observed in the deer mouse collected from conifer forest sprayed at 2 lbs active ingredient per acre (15).

Tolerances & Guidelines

EPA has established tolerances for glyphosate residues in at least 75 agricultural products ranging from 0.1 ppm (most vegetables) to 200 ppm for animal feed commodities such as alfalfa (8).

U.S. EPA Office of Drinking Water has released draft Health Advisories for Glyphosate of 17.50 mg/L (ten day) and 0.70 mg/L (Lifetime)(51).

Avian

Two types of avian toxicity studies have been done with glyphosate: ingestion in adults and exposure of the eggs. The species used in the ingestion studies were the mallard duck, bobwhite quail, and the adult hen (chickens). The 8 day feeding LC50s in the mallard and bobwhite are both greater than 4,640 ppm. In the hen study, 1,250 mg/kg was administered twice daily for 3 days resulting in a total dose of 15,000 mg/kg. No behavioral or microscopic changes were observed (15).

Invertebrates

A variety of invertebrates (mostly arthropods) and microorganisms from freshwater, marine, and terrestrial ecosystems have been studied for acute toxic effects of technical glyphosate as well as formulated Roundup. The increased toxicity of Roundup compared with technical glyphosate in some studies indicates that it is the surfactant (MONO 818) in Roundup that is the primary toxic agent (117). Acute toxicity information may be summarized as follows:

Glyphosate (technical): Acute toxicity ranges from a 48 hr EC50 for midge larvae of 55 mg/L to a 96 hr TL50 for the fiddler crab of 934 mg/L (15).

Roundup: Acute toxicity ranges from a 48 hr EC50 for *Daphnia* of 3 mg/L to a 95 hr LC50 for catfish of 1000 mg/L (15).

Among the insects tested, the LD50 for honeybees was 100 mg/bee 48 hours after either ingestion, or topical application of technical glyphosate and Roundup. This level of experimental exposure is considerably in excess of exposure levels that would occur during normal field applications (15).

Aquatic Species (Fish) Technical glyphosate and the formulation Roundup have been tested on various fish species. Roundup is more toxic than glyphosate, and it is the surfactant that is considered to be the primary toxic agent in Roundup:

Glyphosate (technical):

Acute 96 hr LC50s range from 24 mg/L for bluegill (Dynamic test) to 168 mg/L for the harlequin fish (15).

Roundup: Acute lethal toxicity values range from a 96 hr LC50 for the fathead minnow of 2.3 mg/L to a 96 hr TL50 for rainbow trout of 48 mg/L (15).

Tests with Roundup show that the egg stage is the least sensitive fish life stage. The toxicity increases as the fish enter the sac fry and early swim up stages.

Higher test temperatures increased the toxicity of Roundup to fish, as did higher pH (up to pH 7.5). Above pH 7.5, no change in toxicity is observed.

Glyphosate alone is considered to be only slightly acutely toxic to fish species (LC50s greater than 10 mg/L), whereas Roundup is considered to be toxic to some species of fish, having LC50s generally lower than 10 mg/L (15,118).

SUMMARY

Glyphosate when used as recommended by the manufacturer, is unlikely to enter watercourses through run-off or leaching following terrestrial application (117). Toxic levels are therefore unlikely to occur in water bodies with normal application rates and practices (118).

Glyphosate has oral LD50s of 4,320 and 5,600 in male and female rats respectively. The elimination is rapid and very little of it is metabolized. The NOAEL in rats was 20,000 ppm and 500 mg/kg/d in dogs. No teratogenic effect was observed at doses up to 3,500 mg/kg/d and the fetotoxicity NOELS were 1,000 mg/kg/d in the rat and 175 mg/kg/d in the rabbit.

The evidence of oncogenicity in animals is judged as insufficient at this time to permit classification of the carcinogenic potential of glyphosate. The compound is not mutagenic.

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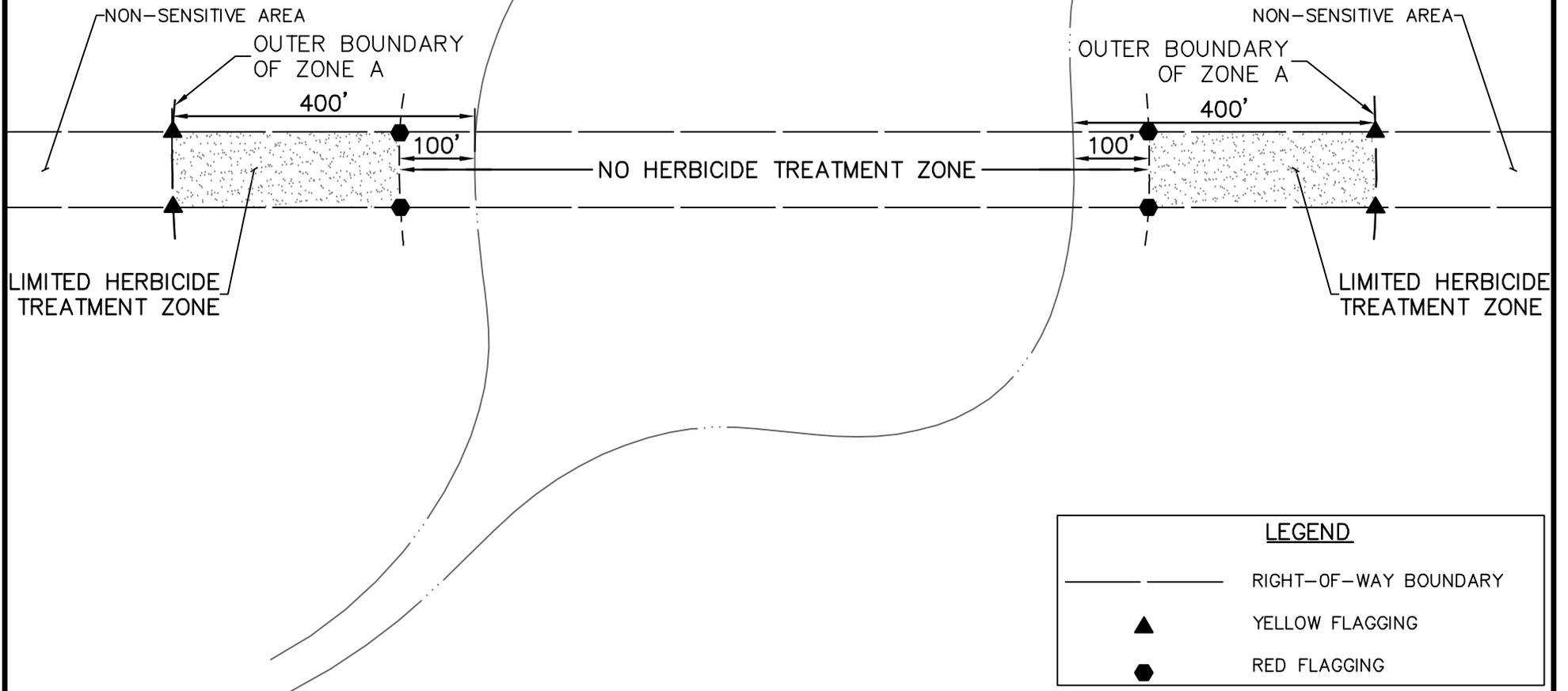
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Appendix E

Methods for Flagging In Sensitive Areas

SURFACE WATER SOURCE
UPPER BOUNDARY OF BANK



MS VIEW: FIG. 2
 L:\MAN: PLOT
 00727A24SIP001.dwg
 UCS: WORLD
 CTB: F&O Standard

SCALE:	
HORZ.:	N.T.S.
VERT.:	N/A
DATUM:	
HORZ.:	N/A
VERT.:	N/A
GRAPHIC SCALE	

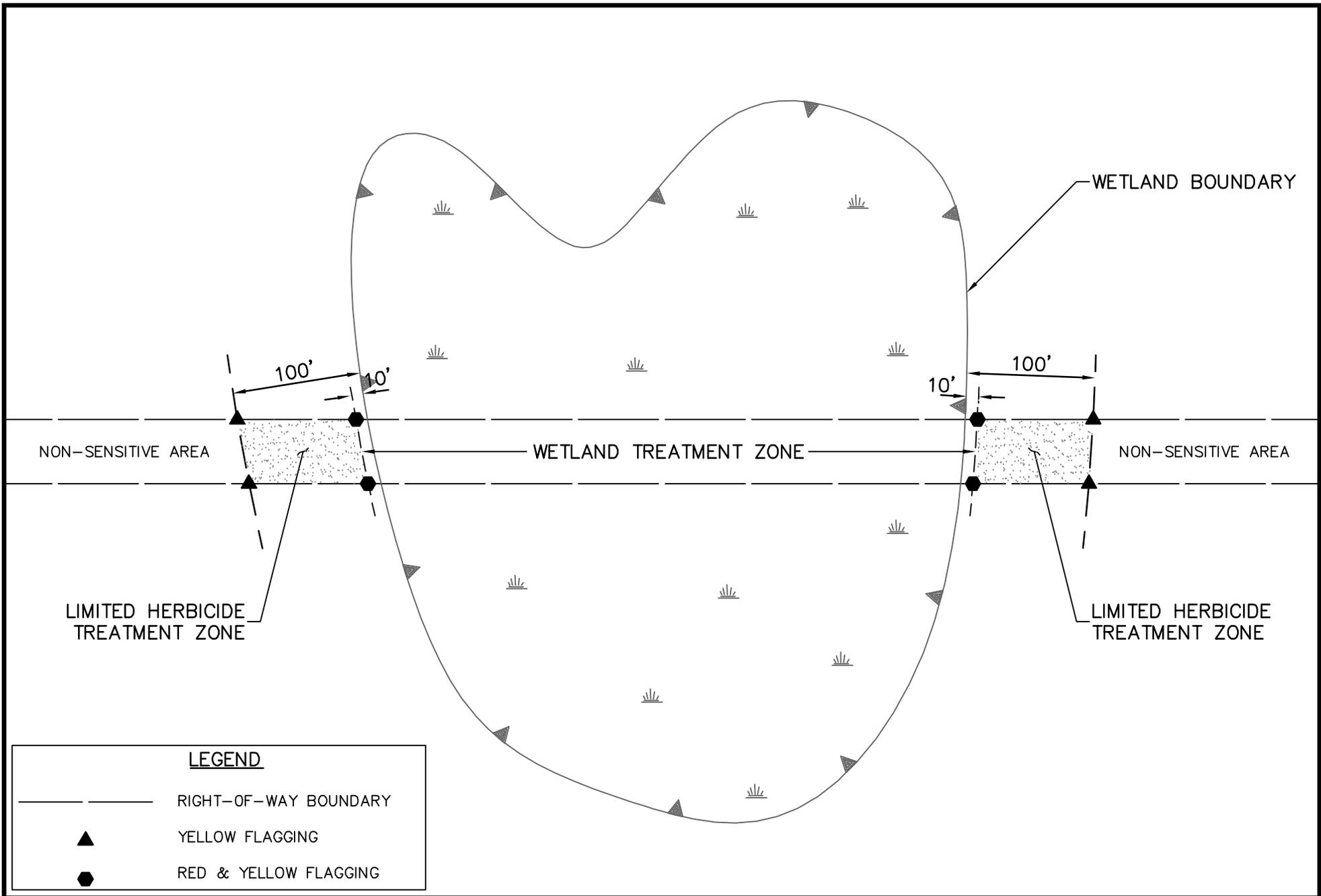

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HOLYOKE GAS & ELECTRIC DEPARTMENT
 METHOD TO FLAG PUBLIC SURFACE WATER SOURCE
 VEGETATION MANAGEMENT PLAN
 HOLYOKE MASSACHUSETTS

PROJ. No.: 2000727.A89 DATE: JANUARY 2013
FIG. 2

MS VIEW: FIG. 1
LIVAN: PLOT
00727A24STP001.dwg
UCS: WORLD



SCALE:	
HORZ:	N.T.S.
VERT:	N/A
DATUM:	
HORZ:	N/A
VERT:	N/A
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HOLYOKE GAS & ELECTRIC DEPARTMENT

METHOD TO FLAG WETLANDS

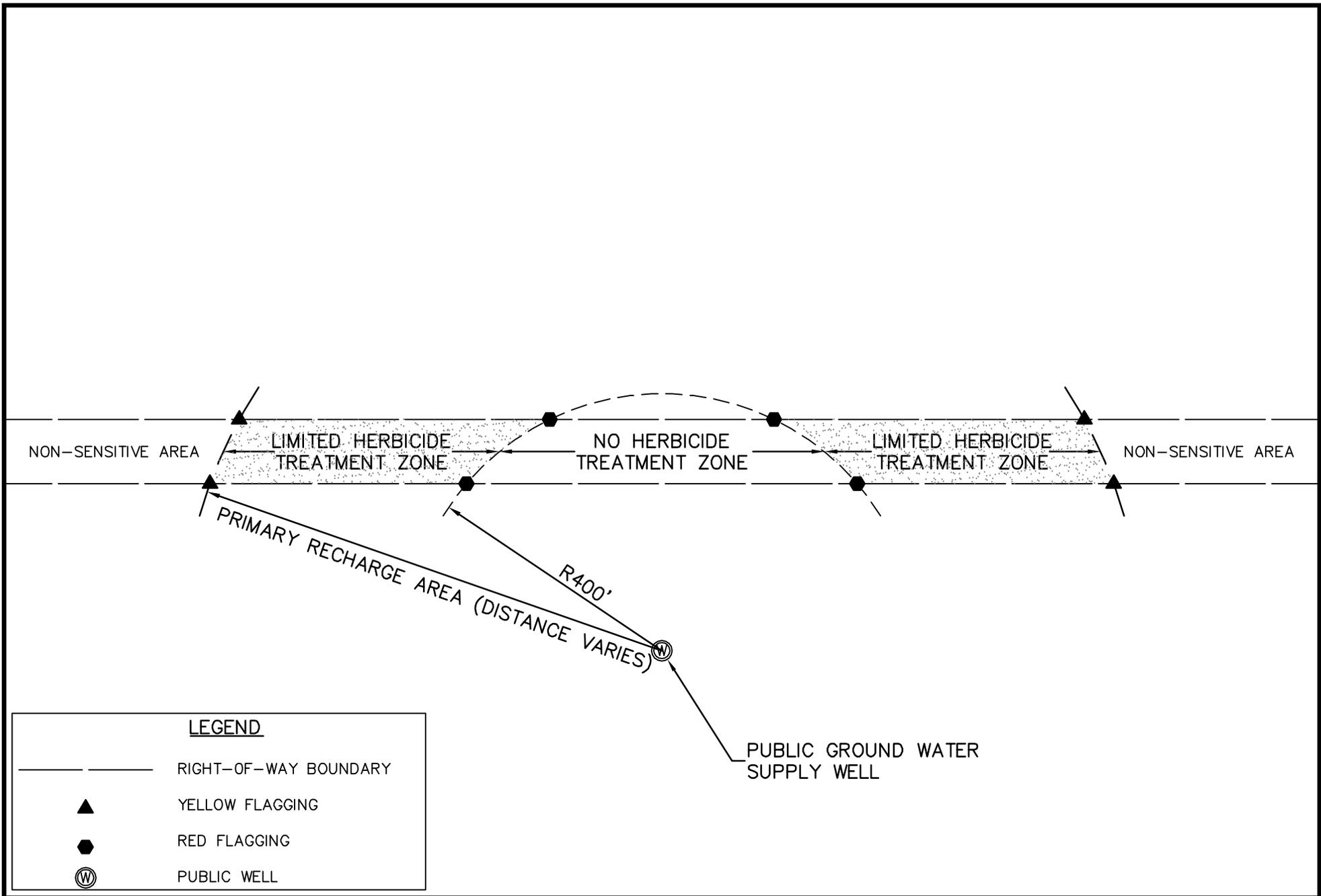
VEGETATION MANAGEMENT PLAN

HOLYOKE MASSACHUSETTS

PROJ. No.: 2000727.A89
DATE: JANUARY 2013

FIG. 1

UCS: WRID
 MS VIEW: FIG. 3
 00727A24STP001.dwg
 LMAN: PLOT
 CTB: F&O Standard



LEGEND

- RIGHT-OF-WAY BOUNDARY
- ▲ YELLOW FLAGGING
- RED FLAGGING
- Ⓜ PUBLIC WELL

SCALE:	
HORZ:	N.T.S.
VERT:	N/A
DATUM:	
HORZ:	N/A
VERT:	N/A
GRAPHIC SCALE	



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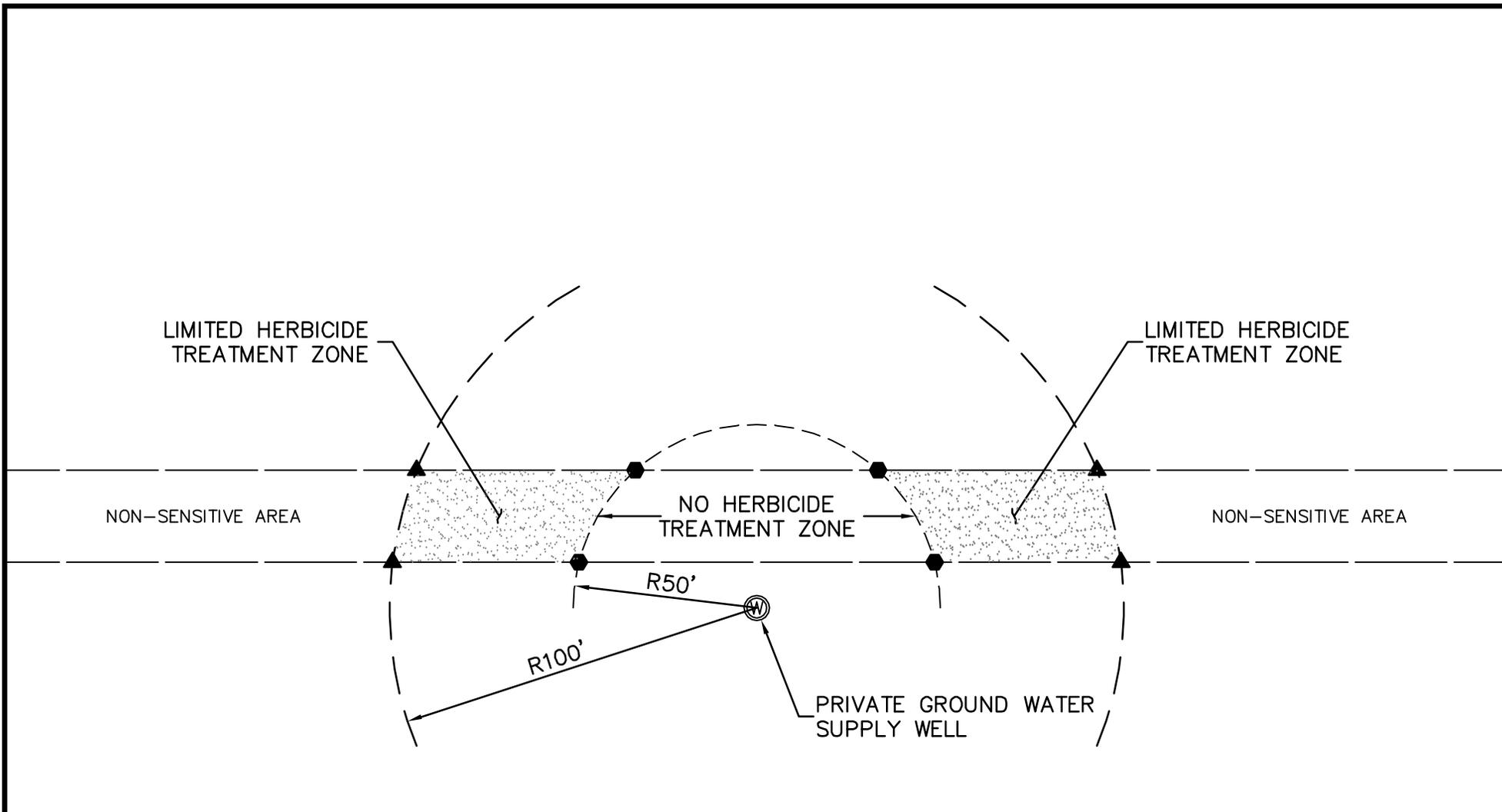
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HOLYOKE GAS & ELECTRIC DEPARTMENT
 METHOD TO FLAG PUBLIC GROUND WATER SUPPLY WELL
 VEGETATION MANAGEMENT PLAN
 HOLYOKE MASSACHUSETTS

PROJ. No.: 2000727.A89
 DATE: JANUARY 2013

FIG. 3

MS VIEW: FIG. 4
 00727A24STP001.dwg
 L:\MAN: PLOT
 CTB: F&O Standard



LEGEND

- RIGHT-OF-WAY BOUNDARY
- YELLOW FLAGGING
- RED FLAGGING
- PRIVATE WELL

SCALE:

HORIZ.: N.T.S.
VERT.: N/A

DATUM:

HORIZ.: N/A
VERT.: N/A

0

 GRAPHIC SCALE

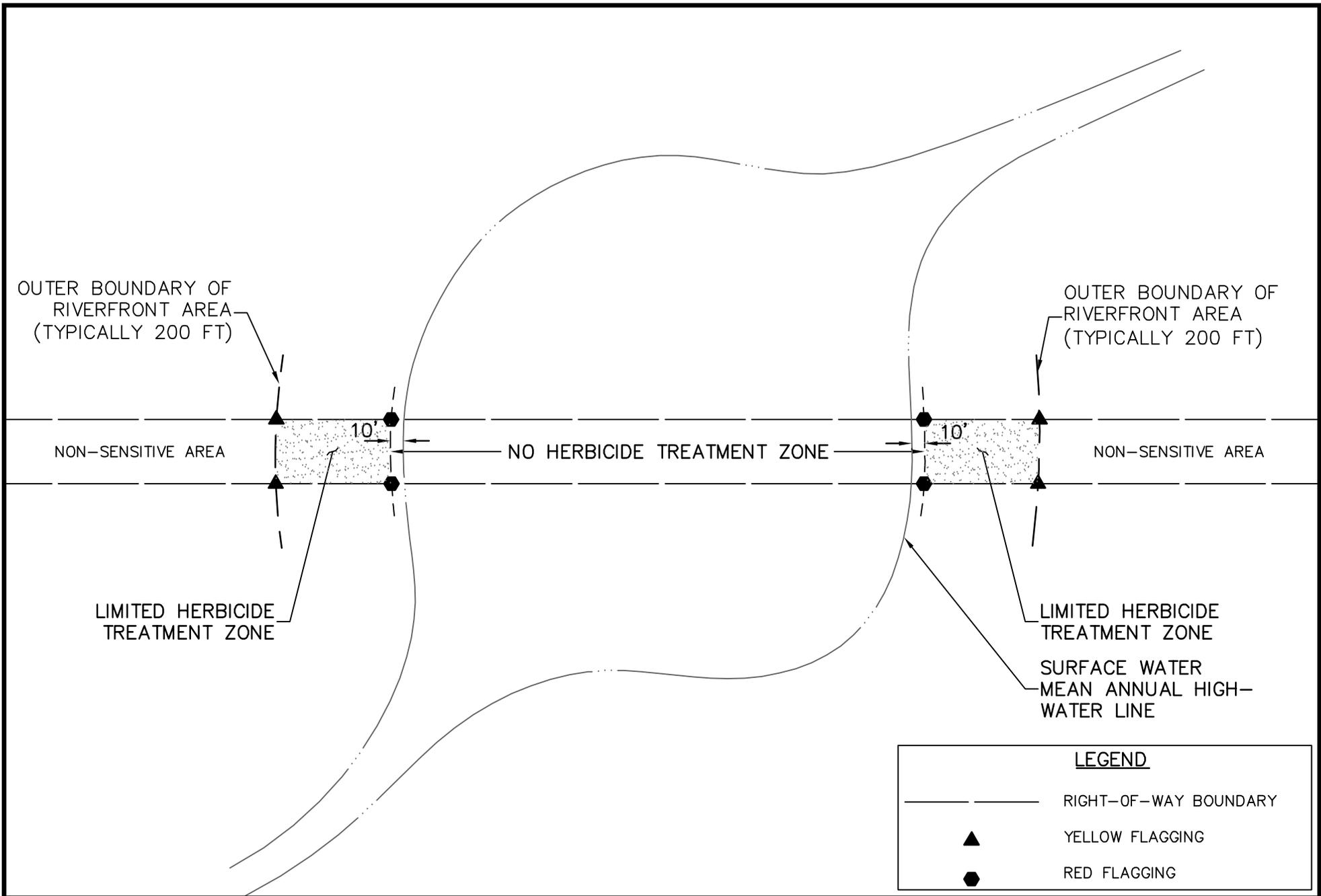
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HOLYOKE GAS & ELECTRIC DEPARTMENT
 METHOD TO FLAG PRIVATE GROUND WATER SUPPLY WELL
 VEGETATION MANAGEMENT PLAN
 HOLYOKE MASSACHUSETTS

PROJ. No.: 2000727.A89
 DATE: JANUARY 2013

FIG. 4

UCS: WRLD
MIS VIEW: FIG. 5
LIVAN: PLOT
00727A24STP001.dwg
CTB: F&O Standard



LEGEND

- RIGHT-OF-WAY BOUNDARY
- ▲ YELLOW FLAGGING
- RED FLAGGING

SCALE:

HORIZ.: N.T.S.
VERT.: N/A

DATUM:

HORIZ.: N/A
VERT.: N/A

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GRAPHIC SCALE

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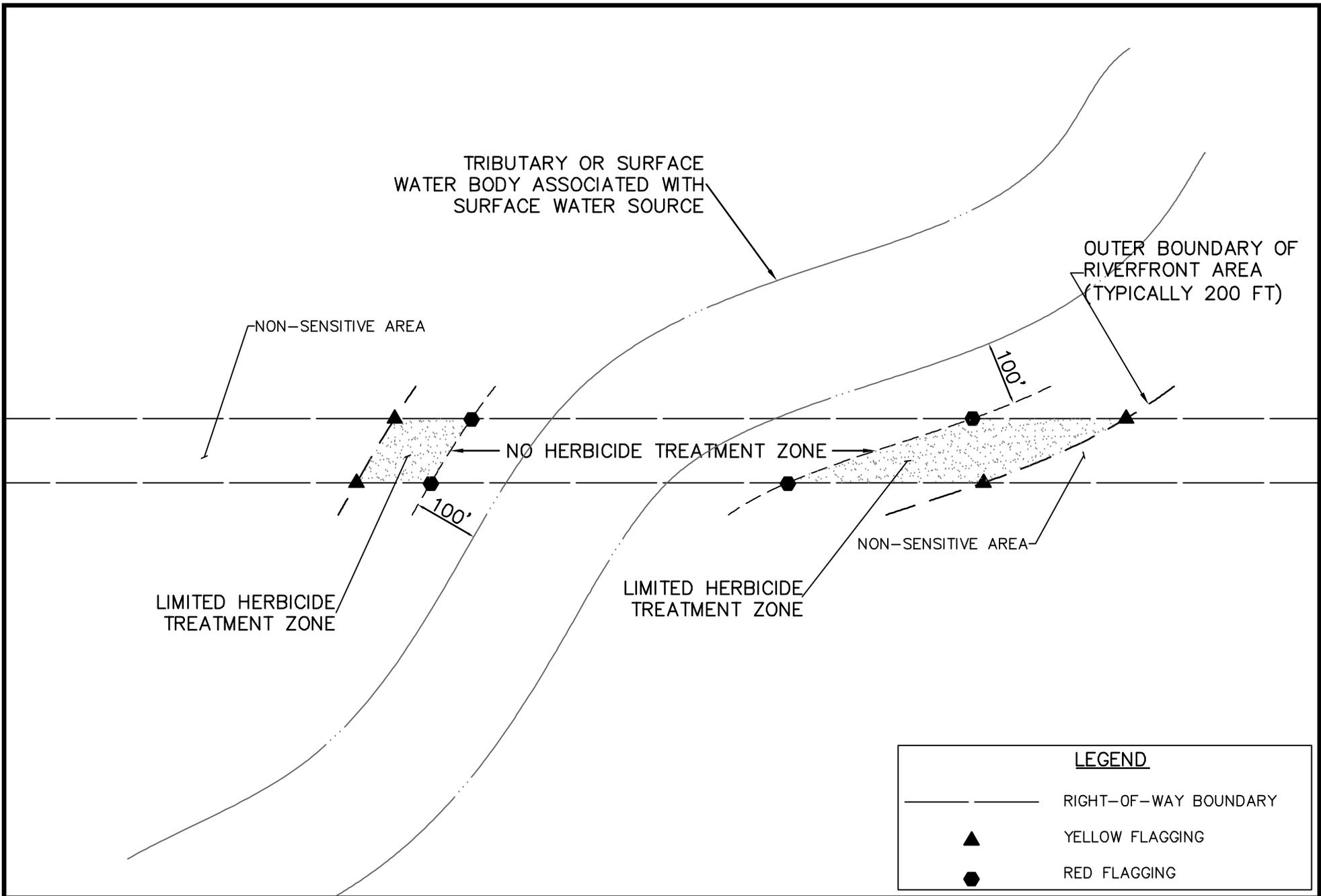
HOLYOKE GAS & ELECTRIC DEPARTMENT
METHOD TO FLAG STANDING SURFACE WATER
VEGETATION MANAGEMENT PLAN

HOLYOKE MASSACHUSETTS

PROJ. No.: 2000727.A89
DATE: JANUARY 2013

FIG. 5

MS VIEW: FIG. 6
00727A24STP001.dwg
LWAN: PLOT
CTB: F&O Standard
UCS: WORLD



LEGEND

- RIGHT-OF-WAY BOUNDARY
- ▲ YELLOW FLAGGING
- RED FLAGGING

SCALE:
HORZ.: N.T.S.
VERT.: N/A
DATUM:
HORZ.: N/A
VERT.: N/A

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GRAPHIC SCALE

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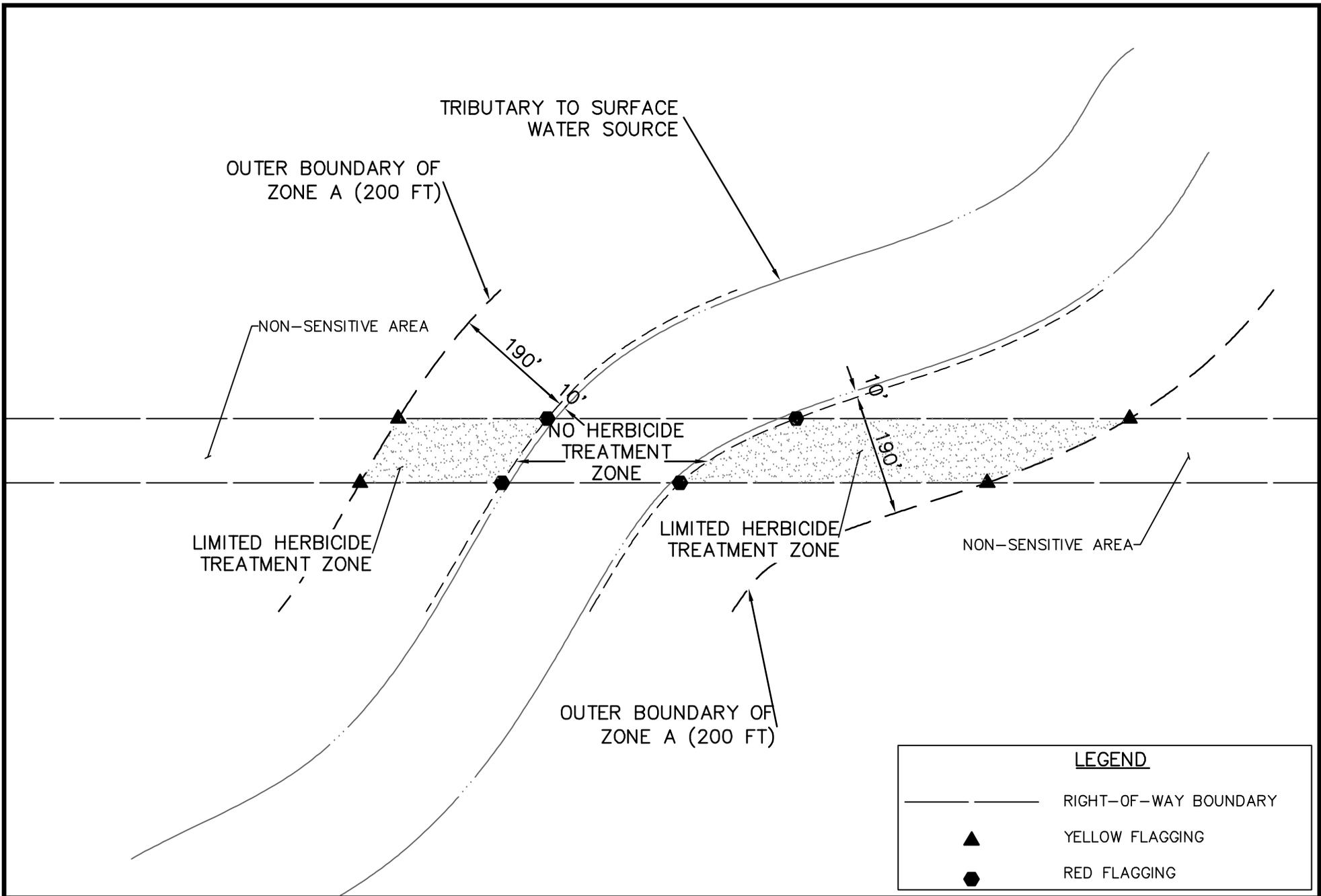
HOLYOKE GAS & ELECTRIC DEPARTMENT
METHOD TO FLAG TRIBUTARY TO PUBLIC SURFACE WATER SUPPLY
VEGETATION MANAGEMENT PLAN

HOLYOKE MASSACHUSETTS

PROJ. No.: 2000727.A89
DATE: JANUARY 2013

FIG. 6

MS VIEW: FIG. 7
00727A24STP001.dwg
LWAN: PLOT
CTB: F&O Standard
UCS: WORLD



LEGEND

- RIGHT-OF-WAY BOUNDARY
- ▲ YELLOW FLAGGING
- RED FLAGGING

SCALE:
HORZ.: N.T.S.
VERT.: N/A
DATUM:
HORZ.: N/A
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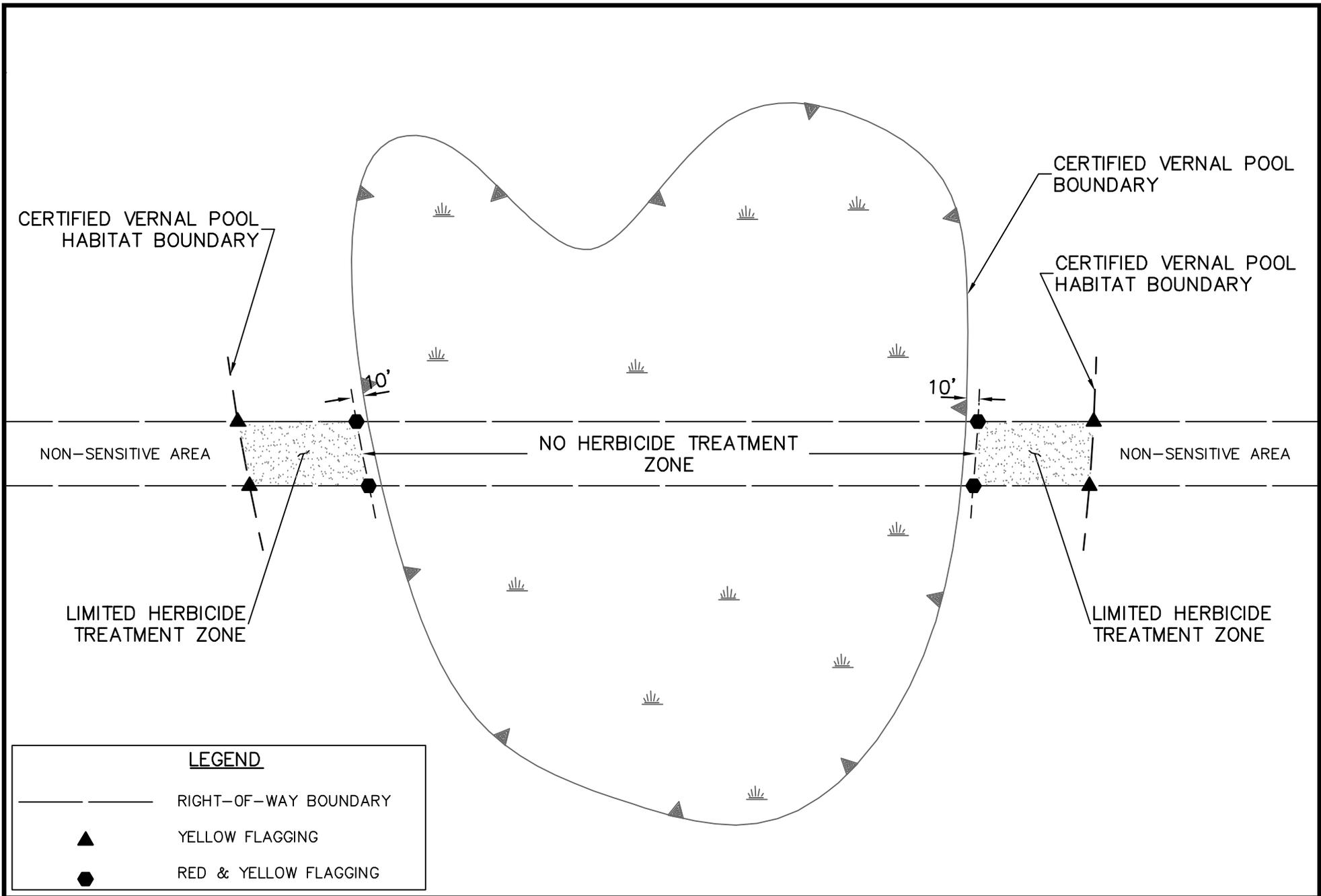
HOLYOKE GAS & ELECTRIC DEPARTMENT
METHOD TO FLAG TRIBUTARY TO PUBLIC SURFACE WATER SUPPLY
OUTSIDE OF A ZONE A
VEGETATION MANAGEMENT PLAN

HOLYOKE MASSACHUSETTS

PROJ. No.: 2000727.A89
DATE: JANUARY 2013

FIG. 7

MS VIEW: FIG. 8
LIVAN: PLOT
00727A24STP001.dwg
UCS: WRLD



SCALE:	
HORZ:	N.T.S.
VERT:	N/A
DATUM:	
HORZ:	N/A
VERT:	N/A
0 GRAPHIC SCALE	

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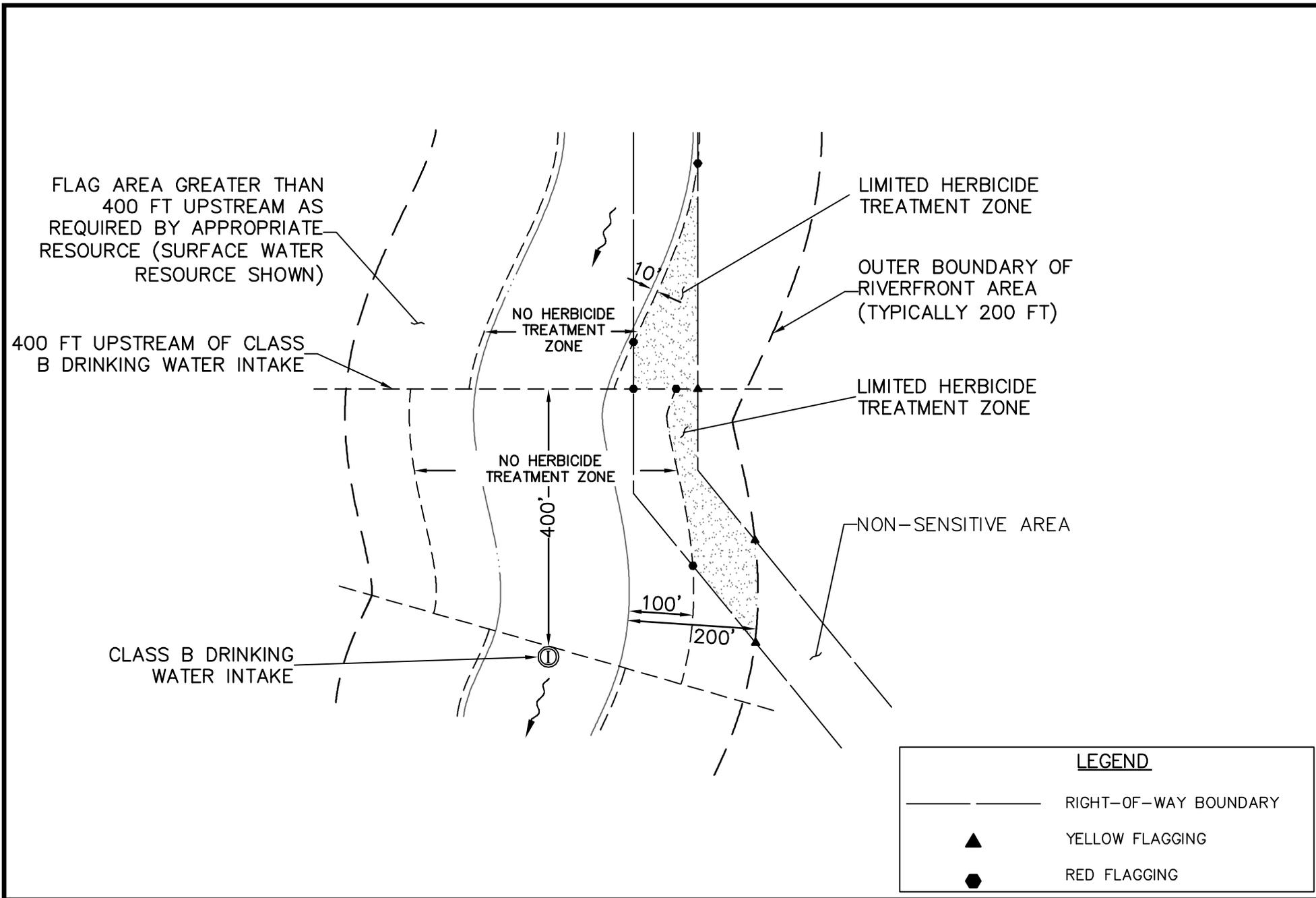
HOLYOKE GAS & ELECTRIC DEPARTMENT
METHOD TO FLAG CERTIFIED VERNAL POOLS
VEGETATION MANAGEMENT PLAN

HOLYOKE MASSACHUSETTS

PROJ. No.: 2000727.A89
DATE: JANUARY 2013

FIG. 8

UCS: WRID
 MS VIEW: FIG. 9
 00727A24STP001.dwg
 LMAN: PLOT
 CTB: F&O Standard



LEGEND	
	RIGHT-OF-WAY BOUNDARY
	YELLOW FLAGGING
	RED FLAGGING

SCALE:	
HORIZ:	N.T.S.
VERT:	N/A
DATUM:	
HORIZ:	N/A
VERT:	N/A
 GRAPHIC SCALE	



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HOLYOKE GAS & ELECTRIC DEPARTMENT
 METHOD TO FLAG CLASS B DRINKING WATER INTAKE
 VEGETATION MANAGEMENT PLAN
 HOLYOKE MASSACHUSETTS

PROJ. No.: 2000727.A89
 DATE: JANUARY 2013

FIG. 9

Appendix F

Herbicide Labels and MSDS

**DuPont™ Escort® XP Herbicide**

Version 2.1

Revision Date 04/26/2012

Ref. 130000036195

This SDS adheres to the standards and regulatory requirements of the United States and may not meet the regulatory requirements in other countries.

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name : DuPont™ Escort® XP Herbicide
Tradename/Synonym : DPX-T6376 60 XP
Metsulfuron Methyl 60 XP
Escort 60 XP
B11495142
METSULFURON METHYL (Methyl 2-[[[(4-methoxy-6-methyl-1,3,4-triazin-2-yl)amino]carbonyl]amino]sulfonyl]benzoate)

MSDS Number : 130000036195

Product Use : Herbicide

Manufacturer : DuPont
1007 Market Street
Wilmington, DE 19898

Product Information : 1-800-441-7515 (outside the U.S. 1-302-774-1000)
Medical Emergency : 1-800-441-3637 (outside the U.S. 1-302-774-1139)
Transport Emergency : CHEMTREC: 1-800-424-9300 (outside the U.S. 1-703-527-3887)

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

CAUTION!

Causes eye irritation. Avoid contact with skin, eyes and clothing. Avoid breathing dust or spray mist.

Potential Health Effects

This section includes potential acute adverse effects which could occur if this material is not used according to the label.

Eyes : May cause: Irritation with discomfort, pain, redness, or visual impairment.

Carcinogenicity

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, or OSHA, as a carcinogen.

**DuPont™ Escort® XP Herbicide**

Version 2.1

Revision Date 04/26/2012

Ref. 130000036195

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Concentration
Metsulfuron methyl	74223-64-6	60 %
Other Ingredients		40 %

SECTION 4. FIRST AID MEASURES

- Skin contact : Take off all contaminated clothing immediately. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.
- Eye contact : Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.
- Inhalation : No specific intervention is indicated as the compound is not likely to be hazardous. Consult a physician if necessary.
- Ingestion : No specific intervention is indicated as the compound is not likely to be hazardous. Consult a physician if necessary.
- General advice : Have the product container or label with you when calling a poison control center or doctor, or going for treatment.
For medical emergencies involving this product, call toll free 1-800-441-3637.
See Label for Additional Precautions and Directions for Use.
- Notes to physician : Treat symptomatically.



DuPont™ Escort® XP Herbicide

Version 2.1

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SECTION 5. FIREFIGHTING MEASURES

Flammable Properties

Flash point : not applicable

Suitable extinguishing media : Water spray, Dry chemical, Foam, Carbon dioxide (CO₂)

Unsuitable extinguishing media : High volume water jet, (contamination risk)

Firefighting Instructions : In the event of fire, wear self-contained breathing apparatus. Wear full protective equipment. (on small fires) If area is heavily exposed to fire and if conditions permit, let fire burn itself out since water may increase the area contaminated. Cool containers / tanks with water spray.

SECTION 6. ACCIDENTAL RELEASE MEASURES

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Safeguards (Personnel) : Evacuate personnel, thoroughly ventilate area, use self-contained breathing apparatus.

Spill Cleanup : Sweep up and shovel into suitable containers for disposal. If spill area is on ground near valuable plants or trees, remove 5 cm of top soil after initial clean-up.

Accidental Release Measures : Prevent material from entering sewers, waterways, or low areas. Never return spills in original containers for re-use. Dispose of in accordance with local regulations.

SECTION 7. HANDLING AND STORAGE

Handling (Personnel) : Wash hands thoroughly with soap and water after handling and before eating,



DuPont™ Escort® XP Herbicide

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drinking, chewing gum, using tobacco, or using the toilet.

Storage : Do not contaminate water, other pesticides, fertilizer, food or feed in storage. Store in original container. Store in a cool, dry place. Keep out of the reach of children.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Personal protective equipment

Skin and body protection : Applicators and other handlers must wear:
 Long sleeved shirt and long pants
 Shoes plus socks
 Personal protective equipment required for early entry:
 Coveralls
 Shoes plus socks

Protective measures : Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

Exposure Guidelines

Exposure Limit Values

Metsulfuron methyl

AEL * (DUPONT) 10 mg/m3 8 & 12 hr. TWA

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Form : solid, granular
 Color : light brown
 Odor : odourless
 pH : 5.0
 Specific gravity : 1.47 at 25 °C (77 °F)
 Bulk density : 0.64 - 0.74 g/ml



DuPont™ Escort® XP Herbicide

Version 2.1

Revision Date 04/26/2012

Ref. 130000036195

Water solubility : Tapped dispersible

SECTION 10. STABILITY AND REACTIVITY

Stability : Stable at normal temperatures and storage conditions.
Conditions to avoid : None reasonably foreseeable.
Incompatibility : No materials to be especially mentioned.

SECTION 11. TOXICOLOGICAL INFORMATION

DuPont™ Escort® XP Herbicide

Dermal LD50 : > 5,000 mg/kg , rat
Oral LD50 : > 5,000 mg/kg , rat
Skin irritation : No skin irritation, rabbit
Eye irritation : slight irritation, rabbit
Sensitisation : Animal test did not cause sensitization by skin contact., guinea pig

Metsulfuron methyl

Inhalation 4 h LC50 : > 5.0 mg/l , rat
Repeated dose toxicity : The following effects occurred at levels of exposure that significantly exceed those expected under labeled usage conditions.
Oral
rat
Reduced body weight gain, Organ weight changes, Liver
Dermal
rabbit



DuPont™ Escort® XP Herbicide

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Revision Date 04/26/2012

Ref. 130000036195

		Skin irritation
Carcinogenicity	:	Did not show carcinogenic effects in animal experiments.
Mutagenicity	:	Did not show mutagenic effects in animal experiments. Did not cause genetic damage in cultured bacterial cells. Genetic damage in cultured mammalian cells was observed in some laboratory tests but not in others.
Reproductive toxicity	:	Animal testing did not show any effects on fertility.
Teratogenicity	:	Animal testing showed no developmental toxicity.

SECTION 12. ECOLOGICAL INFORMATION

Aquatic Toxicity
Metsulfuron methyl

96 h LC50	:	Oncorhynchus mykiss (rainbow trout) > 150 mg/l
96 h LC50	:	Lepomis macrochirus (Bluegill sunfish) > 150 mg/l
72 h EC50	:	Anabaena flos-aquae (cyanobacteria) 0.066 mg/l
14 d EC50	:	Lemna minor 0.00036 mg/l
48 h EC50	:	Daphnia magna (Water flea) > 120 mg/l
Additional ecological information	:	Environmental Hazards: Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment washwaters or rinsate.

SECTION 13. DISPOSAL CONSIDERATIONS

Waste Disposal : Do not contaminate water, food or feed by disposal. Wastes resulting from the



DuPont™ Escort® XP Herbicide

Version 2.1

Revision Date 04/26/2012

Ref. 130000036195

use of this product must be disposed of on site or at an approved waste disposal facility.

Container Disposal

: Refer to the product label for instructions.
Do not transport if this container is damaged or leaking.

In the event of a major spill, fire or other emergency, call 1-800-441-3637 day or night.

SECTION 14. TRANSPORT INFORMATION

IATA_C	UN number	: 3077
	Proper shipping name	: Environmentally hazardous substance, solid, n.o.s. (Metsulfuron methyl)
	Class	: 9
	Packing group	: III
	Labelling No.	: 9MI
IMDG	UN number	: 3077
	Proper shipping name	: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Metsulfuron methyl)
	Class	: 9
	Packing group	: III
	Labelling No.	: 9
	Marine pollutant	: yes (Metsulfuron methyl)

Not regulated as a hazardous material by DOT.

SECTION 15. REGULATORY INFORMATION

SARA 313 Regulated Chemical(s)	: SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.
Title III hazard	: Acute Health Hazard: Yes



DuPont™ Escort® XP Herbicide

Version 2.1

Revision Date 04/26/2012

Ref. 130000036195

classification Chronic Health Hazard: No
 Fire: No
 Reactivity/Physical hazard: No
 Pressure: No

EPA Reg. No. : 352-439
 In the United States this product is regulated by the US Environmental Protection Agency (EPA) under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). It is a violation of Federal law to use this product in a manner inconsistent with its labeling. Read and follow all label directions. This product is excluded from listing requirements under EPA/TSCA.

PA Right to Know : Substances on the Pennsylvania Hazardous Substances List present at Regulated Chemical(s) a concentration of 1% or more (0.01% for Special Hazardous Substances): Sucrose , Trisodium orthophosphate

SECTION 16. OTHER INFORMATION

	NFPA	HMIS
Health :	1	1
Flammability :	1	1
Reactivity/Physical hazard :	0	0

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Contact person : DuPont Crop Protection, Wilmington, DE, 19898, Phone: 1-888-638-7668

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Significant change from previous version is denoted with a double bar.



DuPont™ Escort® XP Herbicide

Version 2.1

Revision Date 04/26/2012

Ref. 130000036195



DuPont™ Escort® XP
herbicide



DuPontTM

Escort[®] XP

herbicide

Dry Flowable

Active Ingredient	By Weight
Metsulfuron methyl	
Methyl 2-[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]-carbonyl]amino]sulfonyl]benzoate	60%
Other Ingredients	40%
TOTAL	100%

EPA Reg. No. 352-439 EPA Est. No. _____

Nonrefillable Container

Net: _____

OR

Refillable Container

Net: _____

KEEP OUT OF REACH OF CHILDREN CAUTION

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand this label, find someone to explain it to you in detail.)

FIRST AID

IF ON SKIN OR CLOTHING: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for further treatment advice.

IF IN EYES: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for further treatment advice.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-441-3637 for emergency medical treatment information.

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION! Causes eye irritation. Avoid contact with skin, eyes or clothing. Avoid breathing dust or spray mist.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators and other handlers must wear:

Long-sleeved shirt and long pants.

Shoes plus socks.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

USER SAFETY RECOMMENDATIONS

USERS SHOULD: Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.

ENVIRONMENTAL HAZARDS

Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment washwaters or rinsate.

This herbicide is injurious to plants at extremely low concentrations. Nontarget plants may be adversely effected from drift and run-off.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

DuPont™ ESCORT® XP must be used only in accordance with instructions on this label or in separately published DuPont instructions.

DuPont will not be responsible for losses or damages resulting from the use of this product in any manner not specified on this label. User assumes all risks associated with such non-specified use.

Do not apply more than 4 ounces of ESCORT® XP per acre per year.

Do not use on food or feed crops except as specified by this label or supplemental labeling.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

For any requirements specific to your State or Tribe, consult the agency in your State responsible for pesticide regulation.

PRODUCT INFORMATION

ESCORT® XP herbicide is a dispersible granule that is mixed in water and applied as a spray by ground or aerial application.

ESCORT® XP is registered for the control of annual and perennial weeds and unwanted woody plants on private, public and military lands, on rights-of-way, industrial sites, non-crop areas, ditchbanks of dry drainage ditches, certain types of unimproved turf grass, and conifer and hardwood plantations, including grazed areas on these sites. Do not use on irrigation ditches.

ESCORT® XP controls weeds and woody plants primarily by postemergent activity. Although ESCORT® XP has preemergence activity, best results are generally obtained when ESCORT® XP is applied to foliage after emergence or dormancy break. Generally, for the control of annual weeds, ESCORT® XP provides the best results when applied to young, actively growing weeds. For the control of perennial weeds, applications made at the bud/bloom stage or while the target weeds are in the fall rosette stage may provide the best results. The use rate depends upon the weed species and size at the time of application.

The degree and duration of control may depend on the following:

- weed spectrum and infestation intensity
- weed size at application
- environmental conditions at and following treatment
- soil pH, soil moisture, and soil organic matter.

ESCORT® XP may be applied on conifer and hardwood plantations, and non-crop sites that contain areas of temporary surface water caused by the collection of water between planting beds, in equipment ruts, or in other depressions created by management activities. It is permissible to treat intermittently flooded low lying sites, seasonally dry flood plains and transitional areas between upland and lowland sites when no water is present. It is also permissible to treat marshes, swamps and bogs after water has receded as well as seasonally dry flood deltas. DO NOT make applications to natural or man-made bodies of water such as lakes, reservoirs, ponds, streams and canals.

BIOLOGICAL ACTIVITY

ESCORT® XP is absorbed primarily through the foliage of plants, and by the roots to a lesser degree. Plant cell division is generally inhibited in sensitive plants within a few hours following uptake. Two to 4 weeks after application, leaf growth slows followed by discoloration and tissue death. The final effects on annual weeds are evident about 4 to 6 weeks after application. The ultimate affect on perennial weeds and woody plants occurs in the growing season following application.

Warm, moist conditions following treatment promote the activity of ESCORT® XP, while cold, dry conditions may reduce or delay activity. Weeds and brush hardened off by cold weather or drought stress may not be controlled. Weed and brush control may be reduced if rainfall occurs soon after application.

ADJUVANTS

The use of a surfactant is recommended to enhance the control of susceptible plants, except where noted. Apply at a minimum rate (concentration) of 1/4% volume/volume (1 quart per 100 gallons of spray solution), or at the manufacturer's recommended rate. Use only EPA approved surfactants containing at least 80% active ingredient. Certain types of surfactants, such as those incorporating acetic acid (i.e. LI- 700), may not be compatible with ESCORT® XP and may result in decreased performance. Certain surfactants may not be suitable for use on desirable plants, such as turf and conifers, listed on this label. Consult the surfactant manufacturer's label for appropriate uses.

INVASIVE SPECIES MANAGEMENT

This product may be considered for use on public, private, and tribal lands to treat certain weed species infestations that have been determined to be invasive, consistent with the Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW) National Early Detection and Rapid Response (EDRR) System for invasive plants.

Effective EDRR systems address invasions by eradicating the invader where possible, and controlling them when the invasive species is too established to be feasibly eradicated. Once an EDRR assessment has been completed and action is recommended, a Rapid Response needs to be taken to quickly contain, deny reproduction, and if possible eliminate the invader. Consult your appropriate state extension service, forest service, or regional multidisciplinary invasive species management coordination team to determine the appropriate Rapid Response.

RESISTANCE

DuPont™ ESCORT® XP which contains the active ingredient metsulfuron methyl is a Group 2 herbicide based on the mode of action classification system of the Weed Science Society of America.

When herbicides that affect the same biological site of action are used repeatedly over several years to control the same weed species in the same field, naturally-occurring resistant biotypes may survive a correctly applied herbicide treatment, propagate, and become dominant in that field. Adequate control of these resistant weed biotypes cannot be expected. If weed control is unsatisfactory, it may be necessary to retreat the problem area using a product affecting a different site of action.

To better manage herbicide resistance through delaying the proliferation and possible dominance of herbicide resistant weed biotypes, it may be necessary to change cultural practices within and between crop seasons such as using a combination of tillage, retreatment, tank-mix partners and/or sequential herbicide applications that have a different site of action. Weed escapes that are allowed to go to seed will promote the spread of resistant biotypes.

It is advisable to keep accurate records of pesticides applied to individual fields to help obtain information on the spread and dispersal of resistant biotypes. Consult your agricultural dealer, consultant, applicator, and/or appropriate state agricultural extension service representative for specific alternative cultural practices or herbicide recommendations available in your area.

INTEGRATED PEST MANAGEMENT

This product may be used as part of an Integrated Pest Management (IPM) program that can include biological, cultural, and genetic practices aimed at preventing economic pest damage. IPM principles and practices include field scouting or other detection methods, correct target pest identification, population monitoring, and treating when target pest populations reach locally determined action thresholds. Consult your state cooperative extension service, professional consultants or other qualified authorities to determine appropriate action treatment threshold levels for treating specific pest/crop systems in your area.

PREPARING FOR USE - Site Specific Considerations

Understanding the risks associated with the application of ESCORT® XP is essential to aid in preventing off-site injury to desirable vegetation and agricultural crops. The risk of off-site movement both during and after application may be affected by a number of site specific factors such as the nature, texture and stability of the soil, the intensity and direction of prevailing winds, vegetative cover, site slope, rainfall, drainage patterns, and other local physical and environmental conditions. A careful evaluation of the potential for off-site movement from the intended application site, including movement of treated soil by wind or water erosion, must be made prior to using ESCORT® XP. This evaluation is particularly critical where desirable vegetation or crops are grown on neighboring land for which the use of ESCORT® XP is not labeled. If prevailing local conditions may be expected to result in off-site movement and cause damage to neighboring desirable vegetation or agricultural crops, do not apply ESCORT® XP.

Before applying ESCORT® XP the user must read and understand all label directions, precautions and restrictions completely, including these requirements for a site specific evaluation. If you do not understand any of the instructions or precautions on the label, or are unable to make a site specific evaluation yourself, consult your local agricultural dealer, cooperative extension service, land managers, professional consultants, or other qualified authorities familiar with the area to be treated. If you still have questions regarding the need for site specific considerations, please call 1-888-6-DUPONT.

TANK MIXES

ESCORT® XP may be tank mixed with other herbicides registered for the use sites described in this label. Use only those tank mix partners which are labeled for the appropriate use site. When tank mixing, use the most restrictive label limitations for each of the products being used in the tank mix.

AGRICULTURAL USES

AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE) and restricted-entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted-entry interval (REI) of 4 hours. PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water is:

- Coveralls
- Shoes plus socks

CONIFER PLANTATIONS

Application Information

DuPont™ ESCORT® XP is registered for the control of many species of weeds and deciduous trees on sites where conifers are growing or are to be planted. Apply by ground equipment or by air (helicopter only). Refer to the "Weeds Controlled" and "Brush Species Controlled" for a listing of susceptible species.

Application Timing

Apply ESCORT® XP after weeds have emerged or after undesirable hardwoods have broken winter dormancy and have reached the point of full leaf expansion.

Conifer Site Preparation

--Application Before Transplanting

After consulting the "Weeds Controlled" and "Brush Species Controlled" tables, apply the rates of ESCORT® XP specified for the most difficult to control species on the site.

Southeast—Apply up to 4 ounces per acre for loblolly and slash pines. Transplant the following planting season.

Northeast and Lake States—Apply up to 2 ounces per acre for red pine. Transplant the following planting season. Apply up to 2 ounces per acre for black, white and Norway spruce. Transplant the following spring.

West—Apply up to 2 ounces per acre prior to planting Douglas Fir, Sitka Spruce, Western Red Cedar, Western Hemlock, Ponderosa Pine, and Grand Fir in the Coast Rangeland and western slope of the Cascades in Oregon and Washington. These conifer species listed can be planted anytime after application. Other conifer species can be planted providing the user has prior experience indicating acceptable tolerance to ESCORT® XP soil residues.

Without prior experience, it is recommended that other species be planted on a small scale to determine selectivity before large-scale plantings are made as unacceptable injury may occur. DuPont will not assume responsibility for injury to any conifer species not listed on this label.

Tank Mix Combinations—

For broader spectrum control, the following products may be used in combination with ESCORT® XP.

Glyphosate (4 pound active per gallon)

Tank mix 1 to 2 ounces of ESCORT® XP with 2 to 10 quarts of glyphosate per acre. Refer to the product container for a list of species controlled.

Imazapyr (4 pound active per gallon)

Tank mix 1 to 2 ounces of ESCORT® XP with 10 to 24 fluid ounces of imazapyr per acre. Loblolly and slash pines may be transplanted the planting season following application. This combination controls ash, black gum, cherry, hawthorn, honeysuckle, hophornbeam, persimmon, oaks (red, white and water), sassafras, sweetgum, Vaccinium species, and suppresses blackberry, dogwood, elms, myrtle dahoon, hickories, and red maple.

Glyphosate (4 pound active per gallon) + Imazapyr (4 pound active per gallon)

Tank mix 1/2 to 1 ounce of ESCORT® XP with 16 to 64 fluid ounces of glyphosate and 10 to 12 fluid ounces of imazapyr per acre. Slash and loblolly pines may be transplanted the planting season following application. This combination controls cherry, dogwood, elms, oaks (red and water), persimmon, sassafras, sweetgum and suppresses hickory.

DuPont™ VELPAR® L or VELPAR® DF

Tank mix 1 to 2 ounces of DuPont™ ESCORT® XP per acre with VELPAR® L or VELPAR® DF at the rates specified on the container for various soil textures. Loblolly and slash pines may be transplanted the planting season following application. Refer to the product container for a list of species controlled.

DuPont™ OUST® EXTRA

Tank mix 1/2 to 1 1/2 ounces of ESCORT® XP with 2 to 3 ounces of OUST® EXTRA per acre for herbaceous weed control. Refer to the product container and the "Weeds Controlled" section of this label for a listing of the weeds controlled. Loblolly and slash pines may be transplanted the planting season following application. Tank mix 2 ounces of ESCORT® XP with 3 ounces of OUST® EXTRA per acre for herbaceous weed control and early spring suppression of bull thistle and Canada thistle in the Coast Rangeland and western slope of the Cascade Mountains. Douglas fir may be transplanted at least 90 days following application.

Release--Hardwood Control and Suppression

ESCORT® XP may be used for application over the top of established slash and loblolly pine to control the species listed in "Weeds Controlled" and "Brush Species Controlled" section of this label. Apply 1 to 4 ounces per acre to control the species indicated, including kudzu.

Tank Mix Combinations—

For broader spectrum control the following products may be used in combination with ESCORT® XP.

Imazapyr (4 pound active per gallon)

Tank mix 1 to 2 ounces of ESCORT® XP with 8 to 16 fluid ounces of imazapyr per acre for application to loblolly pine. Refer to the imazapyr label regarding the use of surfactants and the appropriate application timing with respect to the age and development stage of the pines. This combination controls ash, black gum, cherry, hawthorn, honeysuckle, hophornbeam, oaks (red, white and water), sassafras, sweetgum, Vaccinium species, and suppresses blackberry, dogwood, elms, myrtle dahoon, hickories, persimmon, and red maple.

VELPAR® L or VELPAR® DF

Tank mix 1 to 2 ounces of ESCORT® XP with VELPAR® L or VELPAR® DF at the rates specified on the container for various soil textures. This combination may be applied to loblolly and slash pines.

Release--Herbaceous Weed Control

ESCORT® XP may be applied to transplanted loblolly and slash pine for the control of herbaceous competition. Consult the "Weeds Controlled" for a listing of the susceptible species and application rates. Best results are obtained when ESCORT® XP is applied just before weed emergence until shortly after weed emergence.

Tank Mix Combinations—

For broader spectrum control the following products may be used in combination with ESCORT® XP.

Imazapyr (4 pound active per gallon)

Tank mix 1/2 to 1 ounce of ESCORT® XP with 4 fluid ounces of imazapyr per acre. The tank mix may be used on loblolly pine.

VELPAR® L or VELPAR® DF

Tank mix 1/2 to 1 ounce of ESCORT® XP with VELPAR® L or VELPAR® DF at the rates specified on the container for various soil textures. This combination may be applied to loblolly and slash pines.

Release - Directed Spray in Conifers

Western US

To release conifers from competing brush species, such as, blackberry, salmonberry, snowberry, thimbleberry and wild roses, mix 2 to 4 ounces of ESCORT® XP per 100 gallons of spray solution. Direct spray onto the foliage of competing brush species using a knapsack or backpack sprayer. For best results, apply any time after the brush species have reached full leaf stage but before autumn coloration. For best results at application, the majority of the brush must be less than six feet in height to help ensure adequate spray coverage. Thorough coverage of the target foliage is necessary to optimize results. Care must be taken to direct the ESCORT® XP spray solution away from the conifer foliage.

NOTE:

ESCORT® XP may cause temporary yellowing and or growth suppression when the spray solution contacts conifer foliage. The use of a surfactant with ESCORT® XP may improve brush control results. When using a surfactant with ESCORT® XP, extra precaution must be taken to avoid contact with conifer foliage. Excessive drift onto conifers may result in severe injury.

IMPORTANT PRECAUTIONS—CONIFER PLANTATIONS ONLY

- Applications of DuPont™ ESCORT® XP made to conifers that are suffering from loss of vigor caused by insects, diseases, drought, winter damage, animal damage, excessive soil moisture, planting shock, or other stresses may injure or kill the trees.
- Applications of ESCORT® XP made for herbaceous release must only be made after adequate rainfall has closed the planting slit and settled the soil around the roots following transplanting.
- Do not apply ESCORT® XP to conifers grown as ornamentals.
- ESCORT® XP applications may result in damage and mortality to other species of conifers when they are present on sites with those listed in the preceding specifications for conifer plantations.

HARDWOOD PLANTATIONS

Application Information

ESCORT® XP may be used at rates of up to 2 ounces per acre for the control of many weed species on sites where yellow poplar is growing or is to be planted, and on sites where red alder is to be planted. Apply by ground equipment or by air (helicopter only). Refer to the "Weeds Controlled" sections of this label for a listing of susceptible species.

Application Timing

ESCORT® XP may be applied as a site preparation treatment prior to planting red alder or yellow poplar. As a prior to planting site preparation treatment for red alder, ESCORT® XP may be tank mixed with other herbicides labeled for this use.

ESCORT® XP may also be applied over-the-top of planted yellow poplar seedlings after the soil has settled around the root system, but before the seedlings have broken dormancy (prior to bud break).

Release--Herbaceous Weed Control

ESCORT® XP may be applied to yellow poplar for the control of herbaceous competition. Consult the "Weeds Controlled" for a listing of the susceptible species and specified application rates. Best results are obtained when ESCORT® XP is applied just before weed emergence until shortly after weed emergence.

Tank Mix Combinations—

Tank mix 1/2 ounce of ESCORT® XP with 4 to 6 pints of DuPont™ VELPAR® L as directed on the package label for "RELEASE--HERBACEOUS WEED CONTROL" in pine plantations in the eastern U.S. Follow the VELPAR® L label directions regarding altering the application rate by soil texture.

IMPORTANT PRECAUTIONS—HARDWOOD PLANTATIONS ONLY

- Application of VELPAR® L and ESCORT® XP made to yellow poplar that are suffering from loss of vigor caused by insects, disease, drought, winter damage, animal damage, excessive soil moisture, planting shock or other stresses may injure or kill the seedlings.
- Applications of ESCORT® XP made for release must only be made after adequate rainfall has closed the planting slit and settled the soil around the roots following transplanting.
- The use of surfactant is not recommended for applications made over the tops of trees.
- Careful consideration must be given by an experienced and knowledgeable forester to match the requirements of yellow poplar and/or red alder to the conditions of the site. Treatment of yellow poplar and/or red alder planted on a site inadequate to meet its requirements may injure or kill the seedlings.

NON-AGRICULTURAL USES

NON-AGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

Do not enter or allow others to enter the treated area until sprays have dried.

Non-crop industrial weed control and selective weed control in turf (industrial, unimproved only) are not within the scope of the Worker Protection Standard.

NON-CROP SITES

Application Information

ESCORT® XP is registered for weed control on private, public and military lands as follows: Uncultivated nonagricultural areas (including airports, highway, railroad and utility rights-of-way, sewage disposal areas); uncultivated agricultural areas - non-crop producing (including farmyards, fuel storage areas, fence rows, soil bank land and barrier strips); industrial sites - outdoor (including lumberyards, pipeline and tank farms) including grazed areas on these sites. It may also be used for the control of certain noxious and troublesome weeds.

Consult the "Weeds Controlled" and "Brush Species Controlled" tables to determine the appropriate application rate.

DuPont™ ESCORT® XP may be applied in tank mixture with other herbicides labeled for use on non-crop sites. Fully read the labels and follow all directions and restrictions on each label.

Applications may be made by ground or air. Use a sufficient volume of water to ensure thorough coverage of the target vegetation with the application equipment being used.

NATIVE GRASSES

ESCORT® XP is registered for weed control and suppression in the establishment and maintenance of native grasses. It may be used where blue grama, bluestems (big, little, plains, sand, ww spar) bromegrasses (meadow), buffalograss, green sprangletop, indiagrass, kleingrass, lovegrasses (atherstone, sand, weeping, wilman), orchardgrass, sideoats grama, switchgrass (blackwell), wheatgrass (bluebunch, intermediate, pubescent, Siberian, slender, streamband, tall, thickspike, western), and Russian wildrye are established. It may also be applied over these species in the seedling stage, except for orchardgrass and Russian wildrye.

When used as directed, there are no grazing or haying restrictions for use rates of 1 2/3 ounce per acre or less. At use rates greater than 1 2/3 ounce per acre and up to 3 1/3 ounce per acre, forage grasses may be cut for hay, fodder or green forage and fed to livestock, including lactating animals, 3 days after treatment.

Rotation Intervals for Overseeding and Renovation

Location	Crop or Grass Species	Maximum ESCORT® XP Rate (oz per A)	Minimum Rotation Interval (months)
AL, AR, FL, GA, KY, LA, MS, NC, OK, SC, TN, TX, VA, WV	Alfalfa, red clover, white clover, sweet clover, bermudagrass, bluegrass, ryegrass, tall fescue	1/10 to 3/10	4
	Wheat (except durum)	1/10 to 3/10	1
	Durum, barley, oat	1/10 to 3/10	10
ALL STATES NOT INCLUDED ABOVE	Red clover, white clover, and sweet clover	1/10 to 2/10	12
	Bermudagrass, bluegrass, ryegrass	1/10 to 2/10	6
	Tall Fescue	1/10 to 2/10	18
	Wheat (except durum)	1/10 to 2/10	1
	Durum, barley, oat	1/10 to 2/10	10
ALL AREAS WITH SOIL PH OF 7.5 OR LESS	Russian wildrye	1/10 to 1/2	1
	Green needlegrass, switchgrass, sheep fescue	1/10 to 1	1
	Meadow brome, smooth brome, alta fescue, red fescue, meadow foxtail, orchardgrass, Russian wildrye, timothy	1/10 to 1	2
ALL AREAS WITH SOIL PH OF 7.9 OR LESS	Alkali sacaton, mountain brome, blue grama thickspike wheatgrass	1/10 to 1	1
	Sideoats grama, switchgrass	1/10 to 1/2	2
	Western wheatgrass	1/10 to 1	2
	Sideoats grama, switchgrass, big bluestem	1/10 to 1	3

Application Information

Apply DuPont™ ESCORT® XP at the rate of 1/10 ounce per acre for the control and suppression* of bur buttercup (testiculate), common purslane, common sunflower*, cutleaf eveningprimrose*, flaxweed*, lambsquarters* (common and slimleaf), marehail*, pigweed (redroot and tumble), snow speedwell, tansymustard* and tumble mustard (Jim Hill mustard).

* Suppression is a visual reduction in weed competition (reduced population or vigor) as compared to untreated areas. Degree of suppression will vary with the size of weed and environmental conditions following treatment.

Application Timing

For established grasses, apply when weeds are in the seedling stage.

For grasses in the seedling stage, apply preplant or preemergence where the soil (seed bed) has been cultivated.

IMPORTANT PRECAUTIONS—NATIVE GRASSES

- Grass species or varieties may differ in their response to various herbicides. If no information is available, limit the initial use of ESCORT® XP to a small area. Components in a grass seed mixture will vary in tolerance to ESCORT® XP, so the final stand may not reflect the seed ratio.
- Under certain conditions such as heavy rainfall, high pH, prolonged cold weather, or wide fluctuations in day/night temperatures prior to or soon after ESCORT® XP application, temporary discoloration and/or grass injury may occur. Injury may result when ESCORT® XP is applied to grass that is stressed by severe weather conditions, drought, low fertility, water-saturated soils, disease, or insect damage. Severe winter stress, drought, disease, or insect damage before or following application also may result in grass injury.

GRASS REPLANT INTERVALS

Following an application of ESCORT® XP to non-crop areas, the treated sites may be replanted with various species of grasses at the intervals listed below.

For soils with a pH of 7.5 or less, observe the following replant intervals:

Species	Rate (ounces per acre)	Replant Interval (months)
Brome, Meadow	1/2—1	2
	1—2	3
Brome, Smooth	1/2—1	2
	1—2	4
Fescue, Alta	1/2—1	2
	1—2	4
Fescue, Red	1/2—1	2
	1—2	4
Fescue, Sheep	1/2—1	1
	1—2	4
Foxtail, Meadow	1/2—1	2
	1—2	4
Green Needlegrass	1/2—2	1
Orchardgrass	1/2—1	2
	1—2	4
Russian wildrye	1/2—1	1
	1	2
	2	3
Switchgrass	1/2—1	1
	1—2	3
Timothy	1/2—1	2
	1—2	4
Wheatgrass, Western	1/2—1	2
	1—2	3

For soils with a pH of 7.5 or greater observe the following replant intervals:

Species	Rate (ounces per acre)	Replant Interval (months)
Alkali Sacaton	1/2—1	1
	1—2	3
Bluestem, Big	1/2—2	3
Brome, Mountain	1/2—1	1
	1—2	2
Grama, Blue	1/2—2	1
Grama, Sideoats	1/2	2
	>1/2	>3
Switchgrass	1/2	2
	>1/2	>3
Wheatgrass, Thickspike	1/2—2	1
Wheatgrass, Western	1—2	2
	1/2—1	3

The specified intervals are for applications made in the Spring to early Summer. Because DuPont™ ESCORT® XP degradation is slowed by cold or frozen soils, applications made in the late Summer or Fall should consider the intervals as beginning in the Spring following treatment.

Testing has indicated that there is considerable variation in response among the species of grasses when seeded into areas treated with ESCORT® XP. If species other than those listed above are to be planted into areas treated with ESCORT® XP, a field bioassay must be performed, or previous experience may be used, to determine the feasibility of replanting treated sites.

ADDITIONAL GRASS INFORMATION

APPLICATION INFORMATION FOR GRASS ESTABLISHMENT

ESCORT® XP may be used for the control or suppression of broadleaf weeds to aid in the establishment of the following perennial native or improved grasses:

Blue Grama	Sideoats grama
Bluestems –	Switchgrass –
big	blackwell
little	Wheatgrasses –
plains	bluebunch
sand	crested
WW spar	intermediate
Buffalograss	pubescent
Green sprangletop	Siberian
Kleingrass	slender
Lovegrasses –	steambank
atherstone	tall
sand	thickspike
weeping	Western
wilman	Wildrye grass –
Orchardgrass	Russian

Maximize potential for grass establishment by consulting with the Natural Resource and Conservation Service or other government agencies or local experts concerning planting techniques and other cultural practices.

Performance from ESCORT® XP may not always be satisfactory due to the inability of newly planted grass stands to sufficiently compete with weeds, and the severity of weed pressure in new grass stands.

An additional herbicide application or mowing may be needed.

Use Rates and Application Timing for Grass Establishment Preplant (prior to planting) or Preemergence (after planting but before grass emergence)

Do not use more than 1/10 ounce per acre of ESCORT® XP for grass establishment.

Apply ESCORT® XP at 1/10 ounce per acre on all labeled grasses except orchardgrass and Russian wildrye grass. Do not apply ESCORT® XP preplant or preemergence to orchardgrass and Russian wildrye grass as severe crop injury may result.

Early postemergence to new plantings

Apply ESCORT® XP at 1/10 ounce per acre, plus a non-ionic surfactant at the rate of 2 to 4 pints per 100 gallons of spray solution on all labeled grasses anytime after grass emergence.

Do not use a spray adjuvant other than non-ionic surfactant.

Because grass species differ in time of emergence, apply only after the majority of grasses are in the 3 to 4 leaf stage.

Postemergence to stands with 1 – 5 leaf grasses planted the previous season

Apply DuPont™ ESCORT® XP at 1/10 ounce per acre plus a non-ionic surfactant at the rate of 2 to 4 pints per 100 gallons of spray solution, on all labeled grasses when the majority of the grasses have one or more leaves.

Do not use a spray adjuvant other than non-ionic surfactant.

APPLICATION INFORMATION FOR ESTABLISHED GRASSES

Use Rates for Established Grasses

Apply up to 1 ounce ESCORT® XP per acre as a broadcast application to established grasses. For spot applications, use 1 ounce per 100 gallons of water. Do not apply more than 1 2/3 ounces of ESCORT® XP per acre per year.

Refer to the Weeds Controlled section of this label for a listing of the weeds controlled by ESCORT® XP and the appropriate use rate to obtain control.

Application Timing – Established Grasses

ESCORT® XP may be applied to established native grasses such as bluestems and grama, and on other established grasses such as bermudagrass, bluegrass, orchardgrass, bromegrass, fescue and timothy that were planted the previous growing season (or earlier) and are fully tillered, unless otherwise directed on this label. Specific application timing information on several of these grass species follows:

<u>Grass</u>	<u>Minimum time from Grass establishment ESCORT® XP application</u>
Bermudagrass	2 months
Bluegrass, bromegrass, Orchardgrass	6 months
Timothy	12 months
Fescue	24 months

Fescue and Timothy Precautions

When used on fescue and timothy grasses, ESCORT® XP may cause reduced first cutting yields due to temporary stunting, leaf yellowing, or seed head suppression. To help minimize these symptoms, follow the information below:

- Use the lowest labeled rate for the target weeds
- Tank mix 2,4-D with ESCORT® XP applications
- Apply ESCORT® XP at no more than 4/10 ounce per acre
- Make applications when the grasses are 5 to 6 inches tall in late summer or fall
- Use only a non-ionic surfactant at 1/2 pint per 100 gallons of spray solution
- When liquid nitrogen is the spray carrier, do not include the surfactant

Other Grasses:

Application of ESCORT® XP to Pensacola bahiagrass, ryegrass (Italian or perennial) and Garrison's creeping foxtail may cause severe injury to and/or loss of forage.

Varieties and species of forage grasses differ in their tolerance to herbicides. When using ESCORT® XP on a particular grass for the first time, limit use to a small area. In no injury occurs throughout the season, larger acreage may be treated the following season.

Broadleaf forage species, such as alfalfa and clover, are highly sensitive to ESCORT® XP and will be severely stunted or injured by ESCORT® XP.

CROP ROTATION

Before using ESCORT® XP, carefully consider your crop rotation plans and options.

Minimum Rotational Intervals

Minimum rotation intervals* are determined by the rate of breakdown of ESCORT® XP applied. ESCORT® XP breakdown in the soil is affected by soil pH, presence of soil microorganisms, soil temperature, and soil moisture. Low soil pH, high soil temperature, and high soil moisture increase ESCORT® XP breakdown in soil, while high soil pH, low soil temperature, and low soil moisture slow ESCORT® XP breakdown.

Of these 3 factors, only soil pH remains relatively constant. Soil temperature, and to a greater extent, soil moisture, can vary significantly from year to year and from area to area. For this reason, monitor soil temperature and soil moisture on a regular basis when considering any crop rotations.

* The minimum rotation interval represents the period of time from the last application to the anticipated date of the next planting.

Soil pH Limitations

ESCORT® XP must not be used on soils having a pH above 7.9, as extended soil residual activity could extend crop rotation intervals beyond normal. Under certain conditions, ESCORT® XP could remain in the soil for 34 months or more, injuring wheat and barley. In addition, other crops planted in high-pH soils can be extremely sensitive to low concentrations of ESCORT® XP.

Checking Soil pH

Before using DuPont™ ESCORT® XP, determine the soil pH of the areas of intended use. To obtain a representative pH value for the test area, take several 0" to 4" samples from different areas of the field and analyze them separately. Consult local extension publications for additional information on recommended soil sampling procedures.

BIOASSAY

A field bioassay must be completed before rotating to any crop or grass species/variety not listed in the Rotation Intervals Table, or if the soil pH is not in the specified range, or if the use rate applied is not specified in the table.

To conduct a field bioassay, grow test strips of the crop(s) or grass(es) you plan to grow the following year in fields previously treated with ESCORT® XP. Crop or grass response to the bioassay will indicate whether or not to rotate to the crop(s) or grass(es) grown in the test strips.

If a field bioassay is planned, check with your local Agricultural dealer or DuPont representative for information detailing the field bioassay procedure.

IMPORTANT PRECAUTIONS

- Grass species or varieties may differ in their response to various herbicides. If no information is available, limit the initial use of ESCORT® XP to a small area.
- Components in a grass seed mixture will vary in tolerance to ESCORT® XP so the final stand may not reflect the seed ratio.
- Under certain conditions such as heavy rainfall, high pH, prolonged cold weather, or wide fluctuations in day/night temperatures prior to or soon after ESCORT® XP application, temporary discoloration and/or grass injury may occur. ESCORT® XP applied to grass that is stressed by severe weather conditions, drought, low fertility, water-saturated soils, disease, or insect damage can result in grass injury. Severe winter stress, drought, disease, or insect damage before or following application also may result in grass injury.
- Applications of ESCORT® XP to lands undersown with legumes may cause injury to the legumes. Legumes in a seeding mixture may be severely injured or killed following an application of ESCORT® XP.
- The control of weeds in wheel track areas may be reduced if ground applications are made when dry, dusty field conditions exist. The addition of 2,4-D or MCPA may improve weed control under these conditions.

WEEDS CONTROLLED

1/3 to 1/2 ounce per acre

Annual sowthistle	Goldenrod
Aster	Lambsquarters
Bahiagrass	Marestail/horseweed****
Beebalm	Maximillion sunflower
Bittercress	Miners lettuce
Bitter sneezeweed	Pennsylvania smartweed
Blackeyed-susan	Plains coreopsis
Blue mustard	Plantain
Bur buttercup	Redroot pigweed
Chicory	Redstem filaree
Clover	Rough fleabane
Cocklebur	Shepherd's purse
Common chickweed	Silky crazyweed (locoweed)
Common groundsel	Smallseed falseflax
Common purslane	Smooth pigweed
Common yarrow	Sweet clover
Conical catchfly	Tansymustard
Corn cockle	Treacle mustard
Cow cockle	Tumble mustard
Crown vetch	Wild carrot
Dandelion	Wild garlic
Dogfennel	Wild lettuce
False chamomile	Wild mustard
Fiddleneck tarweed	Wooly croton
Field pennycress	Wood sorrel
Flixweed	Yankeweed

1/2 to 1 ounce per acre

Blackberry
Black henbane
Broom snakeweed*
Buckhorn plantain
Bull thistle
Common crupina
Common sunflower
Curly dock
Dewberry
Dyer's woad
Garlic mustard
Gorse
Halogeton
Henbit

Honeysuckle
Multiflora rose and other
wild roses
Musk thistle***
Oxeye daisy
Plumeless thistle
Prostrate knotweed
Rosering gaillardia
Seaside arrowgrass
Sericea lespedeza
Tansy ragwort
Teasel
Wild caraway

1 to 2 ounces per acre

Common mullein
Common tansy
Field bindweed**
Greasewood
Gumweed
Houndstongue
Lupine
Old world climbing fern
(Lygodium)
Perennial pepperweed
Poison hemlock

Purple loosestrife
Purple scabious
Scotch thistle
Scouringrush
Salsify
Snowberry
St. Johnswort
Sulphur cinquefoil
Western salsify
Whitetop (hoary cress)
Wild Iris

1 1/2 to 2 ounces per acre

Canada thistle**
Dalmation toadflax**
Duncecap larkspur
Russian knapweed**

Tall larkspur
Wild parsnip
Yellow toadflax**

2 ounces per acre

Onionweed

3 to 4 ounces per acre

Kudzu

* Apply fall through spring.

** Suppression, which is a visual reduction in weed competition (reduced population or vigor) as compared to untreated areas. Apply as a full coverage spray for best performance.

*** Certain biotypes of musk thistle are more sensitive to DuPont™ ESCORT® XP and may be controlled with rates of 1/4 to 1/2 ounce per acre. Treatments of ESCORT® XP may be applied from rosette through bloom stages of development.

**** Certain biotypes of marestail/horsetail are less sensitive to ESCORT® XP and may be controlled by tank mixes with herbicides with a different mode of action.

Problem Weed Control

For broader spectrum control and for use on certain biotypes of broadleaf weeds which may be resistant to ESCORT® XP and herbicides with the same mode of action, the following tank mixes may be used.

Dicamba + 2,4-D

Weed	Rate of ESCORT® XP	Rate of dicamba (fluid ounces/acre)	Rate of 2,4-D (fluid ounces/acre)
Kochia control	1/2	8	16
Spotted knapweed control	1/2	8	16
Rush skeletonweed suppression	1	8	16

INDUSTRIAL TURFGRASS UNIMPROVED ONLY

Application Information

ESCORT® XP is registered for selective weed control in unimproved industrial turfgrass where certain grasses are well established and desired as ground cover. ESCORT® XP may also be used for the control of certain noxious and troublesome weeds in turfgrass.

In addition to conventional spray equipment, ESCORT® XP may also be applied with invert emulsion equipment. When using an invert emulsion, mix the prescribed rate of ESCORT® XP in the water phase.

Consult the "Weeds Controlled" table to determine which weeds will be controlled by the following application rates:

Turfgrass Type	Rate of DuPont™ ESCORT® XP (ounces/acre)
Fescue and Bluegrass	1/4 to 1/2
Crested Wheatgrass and Smooth Brome	1/4 to 1
Bermudagrass	1/4 to 2

Application Timing

Applications may be made at anytime of the year, except when the soil is frozen.

When a spring application is made on fescue or bluegrass, a second application may be made during the summer after full seedhead maturation.

Growth Suppression and Seedhead Inhibition

(Chemical Mowing)

Application Information

ESCORT® XP may be used for growth suppression and seedhead inhibition in well established fescue and bluegrass turfgrass at the use rate of 1/4 to 1/2 ounce per acre.

Tank Mix Combination

ESCORT® XP may be tank mixed with "Embark" for improved performance in the regulation of growth and seedhead suppression. Tank mix 1/4 to 1/2 ounce of ESCORT® XP with 1/8 to 1/4 pint of "Embark".

Application Timing

Application may be made after at least 2 to 3 inches of new growth has emerged until the appearance of the seed stalk.

IMPORTANT PRECAUTIONS

—INDUSTRIAL TURFGRASS ONLY

- An application of ESCORT® XP may cause temporary discoloration (chlorosis) or stunting of the turfgrasses. Use the lower specified rates for minimum discoloration or stunting.
- With fescue and bluegrass, sequential applications made during the same or consecutive growth periods (i.e. spring and fall) may result in excessive injury to turfgrass.
- Excessive injury may result when ESCORT® XP is applied to turfgrass that is under stress from drought, insects, disease, cold temperatures (winter injury) or poor fertility.
- ESCORT® XP is not recommended for use on bahiagrass.

BRUSH CONTROL

Application Information

ESCORT® XP is registered for the control of undesirable brush growing in non-crop areas including grazed areas on these sites. Applications may be made by air, high volume ground application, low volume ground application and ultra-low volume ground application. Except as noted for multiflora rose, ESCORT® XP must be applied as a spray to the foliage.

The application volume required will vary with the height and density of the brush and the application equipment used. Generally, aerial applications will require 15 to 25 gallons of water per acre; high volume ground application will require 100 to 400 gallons of water per acre; low volume ground application will require 20 to 50 gallons of water per acre; and ultra-low volume ground application will require 10 to 20 gallons of water per acre.

Regardless of the application volume and equipment used, thorough coverage of the foliage, particularly the terminal growing points, is necessary to optimize results.

BRUSH SPECIES CONTROLLED

Species	High Volume Rate (ounces/100 gallon)	Broadcast Rate (ounces/acre)
Ash	1—2	1—3
Aspen	1—2	1—3
Black locust	1—2	1—3
Blackberry	1—2	1—3
Camelthorn	1—2	1—3
Cherry	1—2	1—3
Cottonwood	1—2	2—3
Eastern red cedar	1—2	2—3
Elder	1—2	2—3
Elm	1—2	1—3
Firs	3	1—2
Hawthorn	1—2	1—3
Honeysuckle	1—2	1/2—1
Mulberry	1—2	2—3
Multiflora rose	1—2	1—3
Muscadine (wild grape)	1—2	2—3
Oaks	1—2	1—3
Ocean spray (<i>Holodiscus</i>)	1—2	2—3
Osage orange	1—2	2—3
Red maple	1—2	2—3
Salmonberry	1/2—1	1—3
Snowberry	1/2—1	1—3
Spruce (black and white)	3	2—3
Thimbleberry	1/2—1	1—3
Tree of heaven (<i>Ailanthus</i>)	1—2	1—2
Wild roses	1/2—1	1—3
Willow	1/2—1	1—3
Yellow poplar	1/2—1	1—3

For low volume and ultra-low volume ground applications, mix 4 to 8 ounces of DuPont™ ESCORT® XP per 100 gallons of spray solution.

Application Timing

Make a foliar application of the specified rate of ESCORT® XP during the period from full leaf expansion in the spring until the development of full fall coloration on deciduous species to be controlled. Coniferous species may be treated at anytime during the growing season.

Spot Treatment

ESCORT® XP may be used for the control of many species of weeds including noxious/invasive weeds in certain established grasses growing on non-crop areas.

Refer to the "Weeds Controlled" section for a listing of susceptible weed species and the application rate per acre per the target weed.

Or, mix one gram of ESCORT® XP per one gallon of water along with a surfactant. Spray to the point of wetting the entire surface of the target weeds, approximately 40 gallons of solution per acre.

Tank Mix Combinations—

ESCORT® XP may be tank mixed with any product labeled for non-crop brush control at the application rates specified on the companion product's label for the pests specified on the product's companion label. Read and follow the label instructions of both products when tank mixing. Follow the most restrictive limitations of any of the product labels being tank mixed.

Low Rate Applications

Imazapyr (2 pound active per gallon)

Combine 1 to 2 ounces of ESCORT® XP with 1 to 4 pints of imazapyr herbicide per acre and apply as a broadcast spray. For aerial applications use a minimum of 15 gallons per acre spray volume. In addition to species listed above controlled by ESCORT® XP, this combination controls black gum, hophornbeam, sassafras, sweetgum, *Vaccinium* species, dogwood, myrtle dahoon, hickories, and persimmon.

Picloram (2 pound active per gallon) + Imazapyr (2 pound active per gallon)

Combine 1 to 1 1/2 ounce of ESCORT® XP with 2 to 8 fluid ounces of imazapyr and 1 to 2 pints of picloram per 100 gallons of water. Apply as a high volume spray. This tank mix controls cherry, elms, box elder, maples, hackberry, redbud, ash, oaks (including shingle oak), black locust and sassafras.

*Picloram is a restricted use pesticide.

Spotgun Basal Soil Treatment

For control of multiflora rose, prepare a spray suspension of DuPont™ ESCORT® XP by mixing 1 ounce per gallon of water. Mix vigorously until the ESCORT® XP is dispersed and agitate periodically while applying the spray suspension.

Apply the spray preparation with an exact delivery handgun applicator. Apply at the rate of 4 milliliters for each 2 feet of rose canopy diameter. Direct the treatment to the soil within 2 feet of the stem union. When treating large plants and more than one delivery is required, make applications on opposite sides of the plant.

For best results, make applications from early spring to summer.

IMPORTANT PRECAUTIONS

—NON-CROP BRUSH ONLY

- When using tank mixtures of ESCORT® XP with companion herbicides, read and follow all use instructions, application rates, warnings and precautions appearing on the labels. Follow the most restrictive label instructions for each of the herbicides used.

SPRAY EQUIPMENT

Low rates of ESCORT® XP can kill or severely injure most crops. Following an ESCORT® XP application, the use of spray equipment to apply other pesticides to crops on which ESCORT® XP is not registered may result in their damage. The most effective way to reduce this crop damage potential is to use dedicated mixing and application equipment.

MIXING INSTRUCTIONS

1. Fill the tank 1/4 to 1/3 full of water.
2. While agitating, add the required amount of ESCORT® XP.
3. Continue agitation until the ESCORT® XP is fully dispersed, at least 5 minutes.
4. Once the ESCORT® XP is fully dispersed, maintain agitation and continue filling tank with water. ESCORT® XP must be thoroughly mixed with water before adding any other material.
5. As the tank is filling, add tank mix partners (if desired) then add the necessary volume of nonionic surfactant. Always add surfactant last.
6. If the mixture is not continuously agitated, settling will occur. If settling occurs, thoroughly re-agitate before using.
7. ESCORT® XP spray preparations are stable if they are pH neutral or alkaline and stored at or below 100° F.
8. If ESCORT® XP and a tank mix partner are to be applied in multiple loads, pre-slurry the ESCORT® XP in clean water prior to adding to the tank. This will prevent the tank mix partner from interfering with the dissolution of the ESCORT® XP.

PRODUCT PRECAUTIONS

- When used as directed, there is no grazing or haying restriction for use rates of 1 2/3 ounce per acre or less. At use rates greater than 1 2/3 ounce per acre and up to 3 1/3 ounce per acre, forage grasses may be cut for hay, fodder or green forage and fed to livestock, including lactating animals, 3 days after treatment.
- Injury to or loss of desirable trees or other plants may result if spray equipment is drained or flushed on or near these trees or plants, or on areas where their roots may extend, or in locations where the product may be washed or moved into contact with their roots.
- Treatment of powdery, dry soil or light, sandy soil when there is little likelihood of rainfall soon after treatment may result in off target movement and possible damage to susceptible crops when soil particles are moved by wind or water. Injury to crops may result if treated soil is washed, blown, or moved onto land used to produce crops. Exposure to ESCORT® XP may injure or kill most crops. Injury may be more severe when the crops are irrigated. Do not apply ESCORT® XP when these conditions are identified and powdery, dry soil or light or sandy soils are known to be prevalent in the area being treated.
- Applications made where runoff water flows onto agricultural land may injure crops. Applications made during periods of intense rainfall, to soils saturated with water, to surfaces paved with materials such as asphalt or concrete, or to soils through which rainfall will not readily penetrate may result in runoff and movement of ESCORT® XP.
- Do not treat frozen or snow covered soil.
- Leave treated soil undisturbed to reduce the potential for ESCORT® XP movement by soil erosion due to wind or water.

PRODUCT RESTRICTIONS

- Do not use on lawns, walks, driveways, tennis courts or similar areas.
- Do not apply through any type of irrigation system.
- Do not use this product in the following counties of Colorado: Saguache, Rio Grande, Alamosa, Costilla and Conejos.
- Do not use this product in California.

SPRAYER CLEANUP

Spray equipment must be cleaned before DuPont™ ESCORT® XP is sprayed. Follow the cleanup procedures specified on the labels of previously applied products. If no directions are provided, follow the six steps outlined below.

When multiple loads of ESCORT® XP herbicide are applied, it is recommended that at the end of each day of spraying, the interior of the tank be rinsed with fresh water and then partially filled, and the boom and hoses flushed. This will prevent the buildup of dried pesticide deposits that can accumulate in the application equipment.

1. Drain tank; thoroughly rinse spray tanks, boom, and hoses with clean water. Loosen and physically remove any visible deposits.
2. Fill the tank with clean water and 1 gallon of ammonia (contains 3% active minimum) for every 100 gallons of water. Flush the hoses, boom, and nozzles with the cleaning solution. Then add more water to completely fill the tank. Circulate the cleaning solution through the tank and hoses for at least 15 minutes. Flush the hoses, boom, and nozzles again with the cleaning solution, and then drain the tank.
3. Remove the nozzles and screens and clean separately in a bucket containing cleaning agent and water.
4. Repeat step 2.
5. Rinse the tank, boom, and hoses with clean water.
6. Dispose of the rinsate on a labeled site or at an approved waste disposal facility. If a commercial cleaner is used follow the commercial cleaner directions for rinsate disposal.

Notes:

1. Mixing chlorine bleach with ammonia can cause dangerous gases to form. Clean spray equipment outdoors.
2. Use steam cleaning or other commercial cleaners to facilitate the removal of any caked pesticide deposits.
3. When ESCORT® XP is tank mixed with other pesticides, all cleanout procedures for each product must be examined and the most rigorous procedure must be followed.
4. In addition to this cleanout procedure, all pre-cleanout guidelines on subsequently applied products must be followed as per the individual product labels.

SPRAY DRIFT MANAGEMENT

The interaction of many equipment and weather-related factors determines the potential for spray drift. The applicator is responsible for considering all these factors when making application decisions. Avoiding spray drift is the responsibility of the applicator.

IMPORTANCE OF DROPLET SIZE

The most effective drift management strategy is to apply the largest droplets which are consistent with pest control objectives. The presence of sensitive species nearby, the environmental conditions, and pest pressure may affect how an applicator balances drift control and coverage. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly or under unfavorable environmental conditions.

A droplet size classification system describes the range of droplet sizes produced by spray nozzles. The American Society of Agricultural and Biological Engineers (ASABE) provide a Standard that describes droplet size spectrum categories defined by a number of reference nozzles (fine, coarse, etc.). Droplet spectra resulting from the use of a specific nozzle may also be described in terms of volume mean diameter (VMD). Coarser droplet size spectra have larger VMD's and lower drift potential.

Controlling Droplet Size - General Techniques

- **Nozzle Type** - Select a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. The use of low-drift nozzles will reduce drift potential.
- **Pressure** - The lowest spray pressures recommended for the nozzle produce the largest droplets. Higher pressure reduces droplet size and does not improve canopy penetration. When higher flow rates are needed, using a higher-capacity nozzle instead of increasing pressure results in the coarsest droplet spectrum.
- **Flow Rate/Orifice Size** - Using the highest flow rate nozzles (largest orifice) that are consistent with pest control objectives reduces the potential for spray drift. Nozzles with higher rated flows produce coarser droplet spectra.

Controlling Droplet Size - Aircraft

- Nozzle Type - Solid stream, or other low drift nozzles produce the coarsest droplet spectra.
- Number of Nozzles - Using the minimum number of nozzles with the highest flow rate that provide uniform coverage will produce a coarser droplet spectrum
- Nozzle Orientation - Orienting nozzles in a manner that minimizes the effects of air shear will produce the coarsest droplet spectra. For some nozzles such as solid stream, pointing the nozzles straight back parallel to the airstream will produce a coarser droplet spectrum than other orientations.
- Pressure - Selecting the pressure that produces the coarsest droplet spectrum for a particular nozzle and airspeed reduces spray drift potential. For some nozzle types such as solid streams, lower pressures can produce finer droplet spectra and increase drift potential

BOOM LENGTH (AIRCRAFT), AND APPLICATION HEIGHT

- Boom Length (aircraft) - Using shorter booms decreases drift potential. Boom lengths are expressed as a percentage of an aircraft's wingspan or a helicopter's rotor blade diameter. Shorter boom length and proper positioning can minimize drift caused by wingtip or rotor vortices.
- Application Height (aircraft) - Applications made at the lowest height that are consistent with pest control objectives and the safe operation of the aircraft will reduce the potential for spray drift.
- Application Height (ground) - Applications made at the lowest height consistent with pest control objectives, and that allow the applicator to keep the boom level with the application site and minimize bounce, will reduce the exposure of spray droplets to evaporation and wind, and reduce spray drift potential.

WIND

Drift potential is lowest when applications are made in light to gentle sustained winds (2-10 mph), which are blowing in a constant direction. Many factors, including droplet size and equipment type also determine drift potential at any given wind speed. **AVOID GUSTY OR WINDLESS CONDITIONS.**

Local terrain can also influence wind patterns. Every applicator is expected to be familiar with local wind patterns and how they affect spray drift.

TEMPERATURE AND HUMIDITY

Setting up equipment to produce larger droplets to compensate for droplet evaporation can reduce spray drift potential. Droplet evaporation is most severe when conditions are both hot and dry.

SURFACE TEMPERATURE INVERSIONS

Drift potential is high during a surface temperature inversion. Surface inversions restrict vertical air mixing, which may cause small suspended droplets to remain close to the ground and move laterally in a concentrated cloud. Surface inversions are characterized by increasing temperature with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Mist or fog may indicate the presence of an inversion in humid areas. Inversions may also be identified by producing smoke and observing its behavior. Smoke that remains close to the ground, or moves laterally in a concentrated cloud under low wind conditions indicates a surface inversion. Smoke that moves upward and rapidly dissipates indicates good vertical air mixing.

SHIELDED SPRAYERS

Shielding the boom or individual nozzles can reduce the effects of wind. However, it is the responsibility of the applicator to verify that the shields are minimizing drift potential, and not interfering with uniform deposition of the product.

AIR ASSISTED (AIR BLAST) FIELD CROP SPRAYERS

Air assisted field crop sprayers carry droplets to the target via a downward directed air stream. Some may reduce the potential for drift, but if a sprayer is unsuitable for the application and/or set up improperly, high drift potential can result. It is the responsibility of the applicator to determine that a sprayer is suitable for the intended application, that it is configured properly, and that drift potential has been minimized.

Note: Air assisted field sprayers can affect product performance by affecting spray coverage and canopy penetration. Read the specific crop use and application equipment instructions to determine if an air assisted field crop sprayer can be used.

SENSITIVE AREAS

Making applications when there is a sustained wind moving away from adjacent sensitive areas (e.g., residential areas, bodies of water, known habitat for threatened or endangered species, non-target crops) is an effective way to minimize the effect of spray drift.

DRIFT CONTROL ADDITIVES

Using product compatible drift control additives can reduce drift potential. When a drift control additive is used, read and carefully observe cautionary statements and all other information on the additive's label. If using an additive that increases viscosity, ensure that the nozzles and other application equipment will function properly with a viscous spray solution. Preferred drift control additives have been certified by the Chemical Producers and Distributors Association (CPDA).

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal.

Pesticide Storage: Store product in original container only. Store in a cool, dry place.

Pesticide Disposal: Waste resulting from the use of this product must be disposed of on site or at an approved waste disposal facility.

Container Handling:

Refer to the Net Contents section of this product's labeling for the applicable "Nonrefillable Container" or "Refillable Container" designation.

Nonrefillable Plastic and Metal Containers (Capacity Equal to or Less Than 50 Pounds): Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Then, for Plastic Containers, offer for recycling if available or puncture and dispose of in a sanitary landfill, or by incineration. Do not burn, unless allowed by state and local ordinances. For Metal Containers, offer for recycling if available or reconditioning if appropriate, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

Nonrefillable Plastic and Metal Containers (Capacity Greater Than 50 Pounds): Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times. Then, for Plastic Containers, offer for recycling if available or puncture and dispose of in a sanitary landfill, or by incineration. Do not burn, unless allowed by state and local ordinances. For Metal Containers, offer for recycling if available or reconditioning if appropriate, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

Nonrefillable Plastic and Metal Containers, e.g., Intermediate Bulk Containers [IBC] (Size or Shape Too Large to be Tipped, Rolled or Turned Upside Down): Nonrefillable container. Do not reuse or refill this container. Clean container promptly after emptying the contents from this container into application equipment or mix tank and before final disposal using the following pressure rinsing procedure. Insert a lance fitted with a suitable tank cleaning nozzle into the container and ensure that the water spray thoroughly covers the top, bottom and all sides inside the container. The nozzle manufacturer generally provides instructions for the appropriate spray pressure, spray duration and/or spray volume. If the manufacturer's instructions are not available, pressure rinse the container for at least 60 seconds using a minimum pressure of 30 PSI with a minimum rinse volume of 10% of the container volume. Drain, pour or pump rinsate into application equipment or rinsate collection system. Repeat this pressure rinsing procedure two more times. Then, for Plastic Containers, offer for recycling if available or puncture and dispose of in a sanitary landfill, or by incineration. For Metal Containers, offer for recycling if available or reconditioning if appropriate, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

Nonrefillable Paper or Plastic Bags, Fiber Sacks including Flexible Intermediate Bulk Containers (FIBC) or Fiber Drums With Liners: Nonrefillable container. Do not reuse or refill this container. Completely empty paper or plastic bag, fiber sack or drum liner by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application or manufacturing equipment. Then offer for recycling if available or dispose of empty paper or plastic bag, fiber sack or fiber drum and liner in a sanitary landfill, or by incineration. Do not burn, unless allowed by state and local ordinances.

Refillable Fiber Drums With Liners: Refillable container (fiber drum only). Refilling Fiber Drum: Refill this fiber drum with DuPont™ ESCORT® XP containing metsulfuron methyl only. Do not reuse this fiber drum for any other purpose. Cleaning before refilling is the responsibility of the refiller. Completely empty liner by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application or manufacturing equipment. Disposing of Fiber Drum and/or Liner: Do not reuse this fiber drum for any other purpose other than refilling (see preceding). Cleaning the container (liner and/or fiber drum) before final disposal is the responsibility of the person disposing of the container. Offer the liner for recycling if available or dispose of liner in a sanitary landfill, or by incineration. Do not burn, unless allowed by state and local ordinances. If drum is contaminated and cannot be reused, dispose of it in the manner required for its liner. To clean the fiber drum before final disposal, completely empty the fiber drum by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application or manufacturing equipment. Then offer the fiber drum for recycling if available or dispose of in a sanitary landfill, or by incineration. Do not burn, unless allowed by state and local ordinances.

All Other Refillable Containers: Refillable container. Refilling Container: Refill this container with DuPont™ ESCORT® XP containing metsulfuron methyl only. Do not reuse this container for any other purpose. Cleaning before refilling is the responsibility of the refiller. Prior to refilling, inspect carefully for damage such as cracks, punctures, abrasions, worn out threads and closure devices. If damage is found, do not use the container, contact DuPont at the number below for instructions. Check for leaks after refilling and before transporting. If leaks are found, do not reuse or transport container, contact DuPont at the number below for instructions. Disposing of Container: Do not reuse this container for any other purpose other than refilling (see preceding). Cleaning the container before final disposal is the responsibility of the person disposing of the container. To clean the container before final disposal, use the following pressure rinsing procedure. Insert a lance fitted with a suitable tank cleaning nozzle into the container and ensure that the water spray thoroughly covers the top, bottom and all sides inside the container. The nozzle manufacturer generally provides instructions for the appropriate spray pressure, spray duration and/or spray volume. If the manufacturer's instructions are not available, pressure rinse the container for at least 60 seconds using a minimum pressure of 30 PSI with a minimum rinse volume of 10% of the container volume. Drain, pour or pump rinsate into application equipment or rinsate collection system. Repeat this pressure rinsing procedure two more times. Then, for Plastic Containers, offer for recycling if available or puncture and dispose of in a sanitary landfill, or by incineration. Do not burn, unless allowed by state and local ordinances. For Metal Containers, offer for recycling if available or reconditioning if appropriate, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

Outer Foil Pouches of Water Soluble Packets (WSP): Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available or, dispose of the empty outer foil pouch in the trash as long as WSP is unbroken. If the outer pouch contacts the formulated product in any way, the pouch must be triple rinsed with clean water. Add the rinsate to the spray tank and dispose of the outer pouch as described previously.

Do not transport if this container is damaged or leaking. If the container is damaged, leaking or obsolete, or in the event of a major spill, fire or other emergency, contact DuPont at 1-800-441-3637, day or night.

NOTICE TO BUYER: Purchase of this material does not confer any rights under patents of countries outside of the United States.

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**LIMITATION OF
WARRANTY AND LIABILITY**

NOTICE: Read this Limitation of Warranty and Liability Before Buying or Using This Product. If the Terms Are Not Acceptable, Return the Product at Once, Unopened, and the Purchase Price Will Be Refunded.

It is impossible to eliminate all risks associated with the use of this product. Such risks arise from weather conditions, soil factors, off target movement, unconventional farming techniques, presence of other materials, the manner of use or application, or other unknown factors, all of which are beyond the control of DuPont. These risks can cause: ineffectiveness of the product, crop injury, or injury to non-target crops or plants. **WHEN YOU BUY OR USE THIS PRODUCT, YOU AGREE TO ACCEPT THESE RISKS.**

DuPont warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for the purpose stated in the Directions for Use, subject to the inherent risks described above, when used in accordance with the Directions for Use under normal conditions.

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To the extent consistent with applicable law that allows such requirement, DuPont or its Ag Retailer must have prompt notice of any claim so that an immediate inspection of buyer's or user's growing crops can be made. Buyer and all users shall promptly notify DuPont or a DuPont Ag Retailer of any claims, whether based on contract, negligence, strict liability, other tort or otherwise, or be barred from any remedy.

This Limitation of Warranty and Liability may not be amended by any oral or written agreement.

For product information call: 1-888-6-DUPONT [1-888-638-7668]

Internet address: <http://cropprotection.dupont.com/>

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Product Name: GARLON* 4 Herbicide

Issue Date: 04/26/2012

Print Date: 26 Apr 2012

Dow AgroSciences LLC encourages and expects you to read and understand the entire (M)SDS, as there is important information throughout the document. We expect you to follow the precautions identified in this document unless your use conditions would necessitate other appropriate methods or actions.

1. Product and Company Identification**Product Name**

GARLON* 4 Herbicide

COMPANY IDENTIFICATION

Dow AgroSciences LLC
A Subsidiary of The Dow Chemical Company
9330 Zionsville Road
Indianapolis, IN 46268-1189
United States

Customer Information Number:

800-992-5994

SDSQuestion@dow.com**EMERGENCY TELEPHONE NUMBER****24-Hour Emergency Contact:**

800-992-5994

Local Emergency Contact:

352-323-3500

2. Hazards Identification**Emergency Overview****Color:** Yellow**Physical State:** Liquid.**Odor:** Gasoline-like**Hazards of product:**

DANGER! Combustible liquid and vapor. May cause allergic skin reaction. May cause eye irritation. May cause skin irritation. Harmful or fatal if swallowed; can enter lungs and cause damage. Isolate area. Toxic fumes may be released in fire situations. Highly toxic to fish and/or other aquatic organisms.

OSHA Hazard Communication Standard

This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Potential Health Effects

Eye Contact: May cause pain disproportionate to the level of irritation to eye tissues. May cause slight eye irritation. Corneal injury is unlikely.

Skin Contact: Brief contact may cause slight skin irritation with local redness. May cause drying and flaking of the skin. Repeated contact may cause severe skin irritation with local redness and discomfort.

Skin Absorption: Prolonged skin contact is unlikely to result in absorption of harmful amounts.

Skin Sensitization: Has caused allergic skin reactions when tested in guinea pigs. With the dilute mix, no allergic skin reaction is expected.

Inhalation: No adverse effects are anticipated from single exposure to mist. Mist may cause irritation of upper respiratory tract (nose and throat).

Ingestion: Low toxicity if swallowed. Small amounts swallowed incidentally as a result of normal handling operations are not likely to cause injury; however, swallowing larger amounts may cause injury.

Aspiration hazard: Aspiration into the lungs may occur during ingestion or vomiting, causing lung damage or even death due to chemical pneumonia.

Cancer Information: In a lifetime animal dermal carcinogenicity study, an increased incidence of skin tumors was observed when kerosene was applied at doses that also produced skin irritation. This response was similar to that produced in skin by other types of chronic chemical/physical irritation. No increase in tumors was observed when non-irritating dilutions of kerosene were applied at equivalent doses, indicating that kerosene is unlikely to cause skin cancer in the absence of long-term continued skin irritation.

Birth Defects/Developmental Effects: For the active ingredient(s): Has been toxic to the fetus in laboratory animals at doses toxic to the mother.

Reproductive Effects: For similar active ingredient(s). Triclopyr. In laboratory animal studies, effects on reproduction have been seen only at doses that produced significant toxicity to the parent animals.

3. Composition Information

Component	CAS #	Amount
Triclopyr-2-butoxyethyl ester	64700-56-7	61.6 %
Kerosene (petroleum)	8008-20-6	>= 18.6 - <= 31.0 %
Balance	Not available	>= 7.4 - <= 19.8 %

4. First-aid measures

Description of first aid measures

General advice: First Aid responders should pay attention to self-protection and use the recommended protective clothing (chemical resistant gloves, splash protection). If potential for exposure exists refer to Section 8 for specific personal protective equipment.

Inhalation: Move person to fresh air. If person is not breathing, call an emergency responder or ambulance, then give artificial respiration; if by mouth to mouth use rescuer protection (pocket mask etc). Call a poison control center or doctor for treatment advice.

Skin Contact: Take off contaminated clothing. Wash skin with soap and plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice. Wash clothing before reuse. Shoes and other leather items which cannot be decontaminated should be disposed of properly. Suitable emergency safety shower facility should be available in work area.

Eye Contact: Hold eyes open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eyes. Call a poison control center or doctor for treatment advice.

Ingestion: Immediately call a poison control center or doctor. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give any liquid to the person. Do not give anything by mouth to an unconscious person.

Most important symptoms and effects, both acute and delayed

Aside from the information found under Description of first aid measures (above) and Indication of immediate medical attention and special treatment needed (below), no additional symptoms and effects are anticipated.

Indication of immediate medical attention and special treatment needed

The decision of whether to induce vomiting or not should be made by a physician. If lavage is performed, suggest endotracheal and/or esophageal control. Danger from lung aspiration must be weighed against toxicity when considering emptying the stomach. No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient. Have the Safety Data Sheet, and if available, the product container or label with you when calling a poison control center or doctor, or going for treatment.
Skin contact may aggravate preexisting dermatitis.

5. Fire Fighting Measures

Suitable extinguishing media

Water fog or fine spray. Dry chemical fire extinguishers. Carbon dioxide fire extinguishers. Foam. Alcohol resistant foams (ATC type) are preferred. General purpose synthetic foams (including AFFF) or protein foams may function, but will be less effective.

Special hazards arising from the substance or mixture

Hazardous Combustion Products: During a fire, smoke may contain the original material in addition to combustion products of varying composition which may be toxic and/or irritating. Combustion products may include and are not limited to: Phosgene. Nitrogen oxides. Hydrogen chloride. Carbon monoxide. Carbon dioxide.

Unusual Fire and Explosion Hazards: Container may rupture from gas generation in a fire situation. Violent steam generation or eruption may occur upon application of direct water stream to hot liquids. Dense smoke is produced when product burns.

Advice for firefighters

Fire Fighting Procedures: Keep people away. Isolate fire and deny unnecessary entry. Consider feasibility of a controlled burn to minimize environment damage. Foam fire extinguishing system is preferred because uncontrolled water can spread possible contamination. Use water spray to cool fire exposed containers and fire affected zone until fire is out and danger of reignition has passed. Fight fire from protected location or safe distance. Consider the use of unmanned hose holders or monitor nozzles. Immediately withdraw all personnel from the area in case of rising sound from venting safety device or discoloration of the container. Burning liquids may be extinguished by dilution with water. Do not use direct water stream. May spread fire. Move container from fire area if this is possible without hazard. Burning liquids may be moved by flushing with water to protect personnel and minimize property damage. Contain fire water run-off if possible. Fire water run-off, if not contained, may cause environmental damage. Review the "Accidental Release Measures" and the "Ecological Information" sections of this (M)SDS.

Special Protective Equipment for Firefighters: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, trousers, boots, and gloves). Avoid contact with this material during fire fighting operations. If contact is likely, change to full chemical resistant fire fighting clothing with self-contained breathing apparatus. If this is not available, wear full chemical resistant clothing with self-contained breathing apparatus and fight fire from a remote location. For protective equipment in post-fire or non-fire clean-up situations, refer to the relevant sections.

6. Accidental Release Measures

Personal precautions, protective equipment and emergency procedures: Isolate area. Keep unnecessary and unprotected personnel from entering the area. Refer to Section 7, Handling, for additional precautionary measures. No smoking in area. Use appropriate safety equipment. For additional information, refer to Section 8, Exposure Controls and Personal Protection.

Environmental precautions: Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. See Section 12, Ecological Information.

Methods and materials for containment and cleaning up: Contain spilled material if possible. Small spills: Absorb with materials such as: Clay. Dirt. Sand. Sweep up. Collect in suitable and properly labeled containers. Large spills: Contact Dow AgroSciences for clean-up assistance. See Section 13, Disposal Considerations, for additional information.

7. Handling and Storage

Handling

General Handling: Keep away from heat, sparks and flame. Keep out of reach of children. Avoid contact with eyes, skin, and clothing. Avoid breathing vapor or mist. Do not swallow. Use with adequate ventilation. Wash thoroughly after handling. See Section 8, EXPOSURE CONTROLS AND PERSONAL PROTECTION.

Other Precautions: Containers, even those that have been emptied, can contain vapors. Do not cut, drill, grind, weld, or perform similar operations on or near empty containers. Spills of these organic materials on hot fibrous insulations may lead to lowering of the autoignition temperatures possibly resulting in spontaneous combustion.

Storage

Store in a dry place. Store in original container. Keep container tightly closed. Do not store near food, foodstuffs, drugs or potable water supplies.

Avoid temperatures below -10 °C

8. Exposure Controls / Personal Protection

Exposure Limits

Component	List	Type	Value
Kerosene (petroleum)	Dow IHG	TWA as total hydrocarbon vapor	10 mg/m3 SKIN
	ACGIH	TWA Non-aerosol. as total hydrocarbon vapor	200 mg/m3 P: Application restricted to conditions in which there are negligible aerosol exposures.
Triclopyr-2-butoxyethyl ester	Dow IHG	TWA	2 mg/m3 D-SEN

RECOMMENDATIONS IN THIS SECTION ARE FOR MANUFACTURING, COMMERCIAL BLENDING AND PACKAGING WORKERS. APPLICATORS AND HANDLERS SHOULD SEE THE PRODUCT LABEL FOR PROPER PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING.

A "skin" notation following the inhalation exposure guideline refers to the potential for dermal absorption of the material including mucous membranes and the eyes either by contact with vapors or by direct skin contact.

It is intended to alert the reader that inhalation may not be the only route of exposure and that measures to minimize dermal exposures should be considered.

A D-SEN notation following the exposure guideline refers to the potential to produce dermal sensitization, as confirmed by human or animal data.

Personal Protection

Eye/Face Protection: Use safety glasses (with side shields).

Skin Protection: Use protective clothing chemically resistant to this material. Selection of specific items such as face shield, boots, apron, or full body suit will depend on the task.

Hand protection: Use gloves chemically resistant to this material. Examples of preferred glove barrier materials include: Chlorinated polyethylene. Neoprene. Nitrile/butadiene rubber ("nitrile" or "NBR"). Polyethylene. Ethyl vinyl alcohol laminate ("EVAL"). Examples of acceptable glove barrier materials include: Butyl rubber. Natural rubber ("latex"). Polyvinyl chloride ("PVC" or "vinyl"). Viton. NOTICE: The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical

requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials, as well as the instructions/specifications provided by the glove supplier.

Respiratory Protection: Respiratory protection should be worn when there is a potential to exceed the exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, wear respiratory protection when adverse effects, such as respiratory irritation or discomfort have been experienced, or where indicated by your risk assessment process. In misty atmospheres, use an approved particulate respirator. The following should be effective types of air-purifying respirators: Organic vapor cartridge with a particulate pre-filter.

Ingestion: Avoid ingestion of even very small amounts; do not consume or store food or tobacco in the work area; wash hands and face before smoking or eating.

Engineering Controls

Ventilation: Use local exhaust ventilation, or other engineering controls to maintain airborne levels below exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, general ventilation should be sufficient for most operations. Local exhaust ventilation may be necessary for some operations.

9. Physical and Chemical Properties

Appearance	
Physical State	Liquid.
Color	Yellow
Odor	Gasoline-like
Odor Threshold	No test data available
pH	6.4 (@ 1 %) <i>pH Electrode</i>
Melting Point	Not applicable
Freezing Point	No test data available
Boiling Point (760 mmHg)	No test data available.
Flash Point - Closed Cup	65.5 °C (149.9 °F) <i>EC Method A9 (CC)</i>
Evaporation Rate (Butyl Acetate = 1)	No test data available
Flammability (solid, gas)	No
Flammable Limits In Air	Lower: No test data available Upper: No test data available
Vapor Pressure	No test data available
Vapor Density (air = 1)	No test data available
Specific Gravity (H₂O = 1)	1.08 23 °C/4 °C <i>EC Method A3</i>
Solubility in water (by weight)	emulsifiable
Partition coefficient, n-octanol/water (log Pow)	4.09 <i>Measured</i>
Autoignition Temperature	No test data available
Decomposition Temperature	No test data available
Dynamic Viscosity	16.4 mPa.s @ 20 °C
Kinematic Viscosity	11.2 cSt @ 20 °C
Explosive properties	No <i>EEC A14</i>
Oxidizing properties	No significant increase (>5C) in temperature.
Surface tension	27.0 mN/m @ 25 °C <i>EC Method A5</i>

10. Stability and Reactivity

Reactivity

No dangerous reaction known under conditions of normal use.

Chemical stability

Thermally stable at typical use temperatures.

Possibility of hazardous reactions

Polymerization will not occur.

Conditions to Avoid: Active ingredient decomposes at elevated temperatures. Generation of gas during decomposition can cause pressure in closed systems.

Incompatible Materials: Avoid contact with: Acids. Bases. Oxidizers.

Hazardous decomposition products

Decomposition products depend upon temperature, air supply and the presence of other materials.

Decomposition products can include and are not limited to: Carbon monoxide. Carbon dioxide.

Hydrogen chloride. Nitrogen oxides. Phosgene. Toxic gases are released during decomposition.

11. Toxicological Information

Acute Toxicity**Ingestion**

As product: LD50, rat, female 1,338 mg/kg

Dermal

As product: LD50, rabbit > 2,000 mg/kg

Inhalation

As product: LC50, 4 h, Aerosol, rat > 5.2 mg/l

No deaths occurred at this concentration.

Eye damage/eye irritation

May cause pain disproportionate to the level of irritation to eye tissues. May cause slight eye irritation.

Corneal injury is unlikely.

Skin corrosion/irritation

Brief contact may cause slight skin irritation with local redness. May cause drying and flaking of the skin.

Repeated contact may cause severe skin irritation with local redness and discomfort.

Sensitization**Skin**

Has caused allergic skin reactions when tested in guinea pigs. With the dilute mix, no allergic skin reaction is expected.

Respiratory

No relevant data found.

Repeated Dose Toxicity

Based on available data, repeated exposures are not anticipated to cause additional significant adverse effects.

Chronic Toxicity and Carcinogenicity

Active ingredient did not cause cancer in laboratory animals. In a lifetime animal dermal carcinogenicity study, an increased incidence of skin tumors was observed when kerosene was applied at doses that also produced skin irritation. This response was similar to that produced in skin by other types of chronic chemical/physical irritation. No increase in tumors was observed when non-irritating dilutions of kerosene were applied at equivalent doses, indicating that kerosene is unlikely to cause skin cancer in the absence of long-term continued skin irritation.

Carcinogenicity Classifications:

Component	List	Classification
Kerosene (petroleum)	ACGIH	Confirmed animal carcinogen with unknown relevance to humans.; Group A3

Developmental Toxicity

For the active ingredient(s): Has been toxic to the fetus in laboratory animals at doses toxic to the mother. Did not cause birth defects in laboratory animals.

Reproductive Toxicity

For similar active ingredient(s). Triclopyr. In laboratory animal studies, effects on reproduction have been seen only at doses that produced significant toxicity to the parent animals. For kerosene: Limited data in laboratory animals suggest that the material does not affect reproduction.

Genetic Toxicology

Contains a component(s) which were negative in in vitro genetic toxicity studies. Contains component(s) which were negative in animal genetic toxicity studies.

12. Ecological Information

Toxicity

Material is highly toxic to aquatic organisms on an acute basis (LC50/EC50 between 0.1 and 1 mg/L in the most sensitive species tested). Material is slightly toxic to birds on an acute basis (LD50 between 501 and 2000 mg/kg).

Fish Acute & Prolonged Toxicity

LC50, *Oncorhynchus mykiss* (rainbow trout), flow-through test, 96 h: 0.984 mg/l

Aquatic Invertebrate Acute Toxicity

EC50, *Daphnia magna* (Water flea), flow-through test, 48 h, immobilization: 0.35 mg/l

Aquatic Plant Toxicity

EbC50, *Pseudokirchneriella subcapitata* (green algae), biomass growth inhibition, 72 h: 10.6 mg/l

Toxicity to Above Ground Organisms

oral LD50, *Colinus virginianus* (Bobwhite quail): 1350 mg/kg bodyweight.

oral LD50, *Apis mellifera* (bees): > 100 ug/bee

contact LD50, *Apis mellifera* (bees): > 100 ug/bee

Toxicity to Soil Dwelling Organisms

LC50, *Eisenia fetida* (earthworms), 14 d: 2,552 mg/kg

Persistence and Degradability

Biodegradation under aerobic static laboratory conditions is high (BOD20 or BOD28/ThOD > 40%).

Bioaccumulative potential

Bioaccumulation: Bioconcentration potential is moderate (BCF between 100 and 3000 or Log Pow between 3 and 5).

Partition coefficient, n-octanol/water (log Pow): 4.09 Measured

Bioconcentration Factor (BCF): 505

Mobility in soil

Mobility in soil: No relevant data found.

13. Disposal Considerations

If wastes and/or containers cannot be disposed of according to the product label directions, disposal of this material must be in accordance with your local or area regulatory authorities. This information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations. If the material as supplied becomes a waste, follow all applicable regional, national and local laws.

14. Transport Information

DOT Non-Bulk

NOT REGULATED

DOT Bulk

Proper Shipping Name: COMBUSTIBLE LIQUID, N.O.S.

Technical Name: Contains Triclopyr-2-butoxyethyl Ester, KEROSENE

Hazard Class: COMBUSTIBLE LIQUID **ID Number:** NA1993 **Packing Group:** PG III

IMDG**Proper Shipping Name:** ENVIRONMENTALLY HAZARDOUS SUBSTANCES, LIQUID, N.O.S**Technical Name:** Contains Triclopyr-2-butoxyethyl Ester, KEROSENE**Hazard Class:** 9 **ID Number:** UN3082 **Packing Group:** PG III**EMS Number:** F-A,S-F**Marine pollutant.:** Yes**ICAO/IATA****Proper Shipping Name:** ENVIRONMENTALLY HAZARDOUS SUBSTANCES, LIQUID, N.O.S**Technical Name:** Contains Triclopyr-2-butoxyethyl Ester, KEROSENE**Hazard Class:** 9 **ID Number:** UN3082 **Packing Group:** PG III**Cargo Packing Instruction:** 964**Passenger Packing Instruction:** 964**Additional Information****MARINE POLLUTANT**

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

15. Regulatory Information

OSHA Hazard Communication Standard

This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Sections 311 and 312

Immediate (Acute) Health Hazard	Yes
Delayed (Chronic) Health Hazard	Yes
Fire Hazard	Yes
Reactive Hazard	No
Sudden Release of Pressure Hazard	No

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Section 313

To the best of our knowledge, this product does not contain chemicals at levels which require reporting under this statute.

Component	CAS #	Amount
Triclopyr-2-butoxyethyl ester	64700-56-7	61.6%

Pennsylvania (Worker and Community Right-To-Know Act): Pennsylvania Hazardous Substances List and/or Pennsylvania Environmental Hazardous Substance List:

The following product components are cited in the Pennsylvania Hazardous Substance List and/or the Pennsylvania Environmental Substance List, and are present at levels which require reporting.

Component	CAS #	Amount
Kerosene (petroleum)	8008-20-6	>= 18.6 - <= 31.0 %
Triclopyr-2-butoxyethyl ester	64700-56-7	61.6%

Pennsylvania (Worker and Community Right-To-Know Act): Pennsylvania Special Hazardous Substances List:

To the best of our knowledge, this product does not contain chemicals at levels which require reporting under this statute.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Section 103

To the best of our knowledge, this product does not contain chemicals at levels which require reporting under this statute.

California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986)

This product contains no listed substances known to the State of California to cause cancer, birth defects or other reproductive harm, at levels which would require a warning under the statute.

Toxic Substances Control Act (TSCA)

All components of this product are on the TSCA Inventory or are exempt from TSCA Inventory requirements under 40 CFR 720.30

16. Other Information

Hazard Rating System

NFPA	Health	Fire	Reactivity
	2	2	1

Revision

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Most recent revision(s) are noted by the bold, double bars in left-hand margin throughout this document.

Legend

N/A	Not available
W/W	Weight/Weight
OEL	Occupational Exposure Limit
STEL	Short Term Exposure Limit
TWA	Time Weighted Average
ACGIH	American Conference of Governmental Industrial Hygienists, Inc.
DOW IHG	Dow Industrial Hygiene Guideline
WEEL	Workplace Environmental Exposure Level
HAZ DES	Hazard Designation
Action Level	A value set by OSHA that is lower than the PEL which will trigger the need for activities such as exposure monitoring and medical surveillance if exceeded.

Dow AgroSciences LLC urges each customer or recipient of this (M)SDS to study it carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this (M)SDS and any hazards associated with the product. The information herein is provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his activities comply with all federal, state, provincial or local laws. The information presented here pertains only to the product as shipped. Since conditions for use of the product are not under the control of the manufacturer, it is the buyer's/user's duty to determine the conditions necessary for the safe use of this product. Due to the proliferation of sources for information such as manufacturer-specific (M)SDSs, we are not and cannot be responsible for (M)SDSs obtained from any source other than ourselves. If you have obtained an (M)SDS from another source or if you are not sure that the (M)SDS you have is current, please contact us for the most current version.

Specimen Label



Garlon[®] 4

Specialty Herbicide

[®]Trademark of Dow AgroSciences LLC

For the control of woody plants and annual and perennial broadleaf weeds in non-crop industrial manufacturing and storage sites, rights-of-way such as electrical power lines, communication lines, pipelines, roadsides, railroads, forests and in the establishment and maintenance of wildlife openings. Use on these sites may include application to grazed areas.

Active Ingredient:

triclopyr: 3,5,6-trichloro-2- pyridinyloxyacetic acid, butoxyethyl ester.....	61.6%
Other Ingredients	38.4%
Total.....	100.0%

Contains petroleum distillates

Acid equivalent: triclopyr - 44.3% - 4 lb/gal

EPA Reg. No. 62719-20

Keep Out of Reach of Children

CAUTION PRECAUCION

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Precautionary Statements

Hazards to Humans and Domestic Animals

Causes Moderate Eye Irritation • Harmful If Swallowed • Prolonged Or Frequently Repeated Skin Contact May Cause Allergic Reactions In Some Individuals

Avoid contact with eyes or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, or using tobacco.

Personal Protective Equipment (PPE)

Applicators and other handlers who handle this pesticide must wear:

- Long-sleeved shirt and long pants
- Shoes plus socks

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables are given, use detergent and hot water. Keep and wash PPE separately from other laundry.

Engineering Controls

When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the WPS (40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the WPS.

User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

First Aid

If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

If swallowed: Immediately call a poison control center or doctor. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give **any** liquid to the person. Do not give anything by mouth to an unconscious person.

Note to Physician: This product may pose an aspiration pneumonia hazard. Contains petroleum distillates.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-992-5994 for emergency medical treatment information.

Environmental Hazards

This pesticide is toxic to fish. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate.

This chemical has properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

Physical or Chemical Hazards

Combustible. Do not use or store the product near heat or open flame.

Notice: Read the entire label. Use only according to label directions. **Before using this product, read Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies elsewhere on this label. If terms are unacceptable, return at once unopened.**

In case of emergency endangering health or the environment involving this product, call 1-800-992-5994. If you wish to obtain additional product information, visit our web site at www.dowagro.com.

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Read all Directions for Use carefully before applying.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation.

Agricultural Use Requirements

The requirements in this box apply to forestry uses.

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. This standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE) and restricted-entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 12 hours.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:

- Coveralls
- Chemical-resistant gloves
- Shoes plus socks
- Protective eyewear

Non-Agricultural Use Requirements

The requirements in this box apply to all use sites on this label except for forestry uses.

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for Agricultural Pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

Entry Restrictions for Non-WPS Uses: For applications to non-cropland areas, do not allow entry into areas until sprays have dried.

Storage and Disposal

Do not contaminate water, food, or feed by storage and disposal. Open dumping is prohibited.

Pesticide Storage: Store above 28°F or agitate before use.

Pesticide Disposal: Wastes resulting from the use of this product must be disposed of on site or at an approved waste disposal facility.

Storage and Disposal (Cont.)

Nonrefillable containers 5 gallons or less:

Container Reuse: Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available.

Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. **Pressure rinse** as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.

Refillable containers 5 gallons or larger:

Container Reuse: Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment or a mix tank. Fill the container about 10% full with water and, if possible, spray all sides while adding water. If practical, agitate vigorously or recirculate water with the pump for two minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times.

Nonrefillable containers 5 gallons or larger:

Container Reuse: Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available.

Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times.

Pressure rinse as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.

General Information

Use Garlon® 4 specially herbicide for the control of woody plants and annual and perennial broadleaf weeds in non-crop industrial manufacturing and storage sites, rights-of-way such as electrical power lines, communication lines, pipelines, roadsides, railroads, forests and in the establishment and maintenance of wildlife openings. Use on these sites may include application to grazed areas.

Garlon 4 is an oil soluble, emulsifiable liquid product containing the herbicide triclopyr. Garlon 4 may be applied to woody or herbaceous broadleaf plants as a foliar spray or as a basal bark or cut stump application to woody plants. As a foliar spray, Garlon 4 controls only herbaceous plants that have emerged from the soil or woody plants that are in full leaf at the time of application. Small amounts of Garlon 4 can kill or injure many broadleaf plants. To prevent damage to crops and other desirable plants, follow all directions and precautions.

General Use Precautions and Restrictions

In Arizona: The state of Arizona has not approved Garlon 4 for use on plants grown for commercial production; specifically forests grown for commercial timber production, or on designated grazing areas.

When applying this product in tank mix combination, follow all applicable use directions, precautions, and limitations on each manufacturer's label.

Chemigation: Do not apply this product through any type of irrigation system.

Apply no more than 1/2 gallon of Garlon 4 (2 lb ae of triclopyr) per acre per growing season on rights-of-way or any area where grazing or harvesting is allowed.

On forestry sites, Garlon 4 may be used at rates up to 6 quarts (6 lb ae of triclopyr) per acre per year.

Garlon 4 may be used at rates up to 8 quarts (8 lb ae of triclopyr) per acre per year on non-crop industrial manufacturing and storage sites, rights-of-way such as electrical power lines, communication lines, pipelines, roadsides and railroads, fence rows, non-irrigation ditch banks. Portions of grazed areas that intersect treated non-cropland, rights-of-way and forestry sites may be treated at up to 8 lb ae per acre if the area to be treated on the day of application comprises no more than 10% of the total grazable area.

Do not apply Garlon 4 directly to, or otherwise permit it to come into direct contact with, cotton, grapes, peanuts, soybeans, tobacco, vegetable crops, flowers, citrus, or other desirable broadleaf plants. Do not permit spray mists containing Garlon 4 to drift onto such plants.

It is permissible to treat non-irrigation ditch banks, seasonally dry wetlands (such as flood plains, deltas, marshes, swamps, or bogs) and transitional areas between upland and lowland sites where surface water is not present except in isolated pockets due to uneven or unlevel conditions. Do not apply to open water (such as lakes, reservoirs, rivers, streams, creeks, salt water bays, or estuaries).

Do not apply on ditches currently being used to transport irrigation water. Do not apply where runoff or irrigation water may flow onto agricultural land as injury to crops may result.

Do not apply this product using mist blowers unless a drift control additive, high viscosity inverting system, or equivalent is used to control spray drift.

Sprays applied directly to Christmas trees may result in conifer injury. When treating unwanted vegetation in Christmas tree plantations, care should be taken to direct sprays away from conifers.

Garlon 4 is formulated as a low volatile ester. However, the combination of spray contact with impervious surfaces, such as roads and rocks, and increasing ambient air temperatures, may result in an increase in the volatility potential for this herbicide, increasing a risk for off-target injury to sensitive crops such as grapes and tomatoes.

Grazing and Haying Restrictions

Except for lactating dairy animals, there are no grazing restrictions following application of this product.

- **Grazing Lactating Dairy Animals:** Do not allow lactating dairy animals to graze treated areas until the next growing season following application of this product.
- Do not harvest hay for 14 days after application.
- Portions of grazed areas that intersect treated non-cropland, rights-of-way and forestry sites may be treated at up to 8 lb ae per acre if the area to be treated on the day of application comprises no more than 10% of the total grazable area.

Slaughter Restrictions: During the season of application, withdraw livestock from grazing treated grass at least 3 days before slaughter.

Avoiding Injurious Spray Drift

Make applications only when there is little or no hazard from spray drift. Small quantities of spray, which may not be visible, may seriously injure susceptible plants. Do not spray when wind is blowing toward susceptible crops or ornamental plants that are near enough to be injured. It is suggested that a continuous smoke column at or near the spray site or a smoke generator on the spray equipment be used to detect air movement, lapse conditions, or temperature inversions (stable air). If the smoke layers or indicates a potential of hazardous spray drift, do not spray.

Aerial Application: Garlon 4 may be aerially applied by fixed wing aircraft or helicopter. For aerial application on rights-of-way or other areas near susceptible crops, apply through a Microfoil[†] or Thru-Valve boom[†], or use an agriculturally labeled drift control additive. Other drift reducing systems or thickened sprays prepared by using high viscosity inverting systems may be used if they are made as drift-free as mixtures containing agriculturally labeled thickening agents or applications made with the Microfoil or Thru Valve boom. Do not use a thickening agent with the Microfoil or Thru Valve booms, or other systems that cannot accommodate thick sprays. Spray only when the wind velocity is low (follow state regulations). Avoid application during air inversions. If a spray thickening agent is used, follow all use recommendations and precautions on the product label.

[†]Reference within this label to a particular piece of equipment produced by or available from other parties is provided without consideration for use by the reader at its discretion and subject to the reader's independent circumstances, evaluation, and expertise. Such reference by Dow AgroSciences is not intended as an endorsement of such equipment, shall not constitute a warranty (express or implied) of such equipment, and is not intended to imply that other equipment is not available and equally suitable. Any discussion of methods of use of such equipment does not imply that the reader should use the equipment other than is advised in directions available from the equipment's manufacturer. The reader is responsible for exercising its own judgment and expertise, or consulting with sources other than Dow AgroSciences, in selecting and determining how to use its equipment.

Spray Drift Management

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment and weather related factors determine the potential for spray drift. The applicator and the grower are responsible for considering all these factors when making decisions.

The following drift management requirements must be followed to avoid off-target drift movement from aerial applications:

1. The distance of the outer most operating nozzles on the boom must not exceed 3/4 the length of the rotor.
2. Nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees.

Where states have more stringent regulations, they should be observed.

The applicator should be familiar with and take into account the information covered in the following Aerial Drift Reduction Advisory. [This information is advisory in nature and does not supersede mandatory label requirements.]

Aerial Drift Reduction Advisory

Information on Droplet Size: The most effective way to reduce drift potential is to apply large droplets. The best drift management strategy is to apply the largest droplets that provide sufficient coverage and control. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly, or under unfavorable environmental conditions (see Wind, Temperature and Humidity, and Temperature Inversions).

Controlling Droplet Size:

- **Volume** - Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with higher rated flows produce larger droplets.
- **Pressure** - Do not exceed the nozzle manufacturer's recommended pressures. For many nozzle types lower pressure produces larger droplets. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.
- **Number of Nozzles** - Use the minimum number of nozzles that provide uniform coverage.
- **Nozzle Orientation** - Orienting nozzles so that the spray is released parallel to the airstream produced larger droplets than other orientations and is the recommended practice. Significant deflection from horizontal will reduce droplet size and increase drift potential.
- **Nozzle Type** - Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low-drift nozzles. Solid stream nozzles oriented straight back produce the largest droplets and the lowest drift.

Boom Length: For some use patterns, reducing the effective boom length to less than 3/4 of the wingspan or rotor length may further reduce drift without reducing swath width.

Application Height: Applications should not be made at a height greater than 10 feet above the top of the largest plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces exposure of droplets to evaporation and wind.

Swath Adjustment: When applications are made with a crosswind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the field, the applicator must compensate for this displacement by adjusting the path of the aircraft upwind. Swath adjustment distance should increase, with increasing drift potential (higher wind, smaller drops, etc.).

Wind: Drift potential is lowest between wind speeds of 2 to 10 mph. However, many factors, including droplet size and equipment type determine drift potential at any given speed. Application should be avoided below 2 mph due to variable wind direction and high inversion potential. **Note:** Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect spray drift.

Temperature and Humidity: When making applications in low relative humidity, set up equipment to produce larger droplets to compensate for evaporation. Droplet evaporation is most severe when conditions are both hot and dry.

Temperature Inversions: Applications should not occur during a local, low level temperature inversion because drift potential is high. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud. This cloud can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of the smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical air mixing.

Sensitive Areas: The pesticide should only be applied when the potential for drift to adjacent sensitive areas (e.g., residential areas, bodies of water, known habitat for threatened or endangered species, non-target crops) is minimal (e.g., when wind is blowing away from the sensitive areas).

Ground Equipment: To aid in reducing spray drift, Garlon 4 should be used in thickened (high viscosity) spray mixtures using an agriculturally labeled drift control additive, high viscosity invert system, or equivalent as directed by the manufacturer. When using a spray thickening or inverting additive, follow all use directions and precautions on the product label. With ground equipment, spray drift can be reduced by keeping the spray boom as low as possible; by applying 20 gallons or more of spray per acre; by keeping the operating spray pressures at the lower end of the manufacturer's recommended pressures for the specific nozzle type used (low pressure nozzles are available from spray equipment manufacturers); and by spraying when wind velocity is low. In hand-gun applications, select the minimum spray pressure that will provide adequate plant coverage (without forming a mist). Do not apply with nozzles that produce a fine droplet spray. Select nozzles and pressures which provide adequate plant coverage, but minimize the production of fine spray particles.

High Volume Leaf-Stem Treatment: To minimize spray drift, keep sprays no higher than brush tops and keep spray pressures low enough to provide coarse spray droplets. An agriculturally labeled thickening agent may be used to reduce drift.

Mixing Directions

Garlon 4 may be foliarly applied by diluting with water or by preparing an oil-water emulsion. For woody plant control, an oil-water emulsion performs more dependably under a broader range of conditions than a straight water dilution and is recommended for aerial applications.

Oil-Water Mixture Sprays

Prepare a premix of oil, surfactant and Garlon 4 in a separate container using diesel fuel, fuel oil, or kerosene plus an emulsifier such as Sponto 712 or Triton X-100. Use a jar test to check spray mix compatibility before preparing oil-water emulsion sprays in the mixing tank. Do not allow any water or mixtures containing water to get into the premix or Garlon 4 since a thick "invert" (water in oil) emulsion may form that will be difficult to break. Such an emulsion may also be formed if the premix or Garlon 4 is put into the mixing tank before the addition of water. Fill the spray tank about one-half full with water, then slowly add the premix with continuous agitation and complete filling the tank with water. Continue moderate agitation.

Ground Application: Add oil to the spray mix at a rate of 5 to 10% of the total mix, up to a maximum of 1 gallon of oil per acre, using agricultural spray emulsifiers according to mixing instructions below.

Aerial Application: Use oil and water in the spray mixture in a 1:5 ratio (1 part oil to 5 parts water), up to a maximum of 1 gallon of oil per acre according to mixing instructions below.

Oil Mixture Sprays for Basal Treatment

Prepare oil-based spray mixtures using either diesel fuel, No. 1 or No. 2 fuel oil, kerosene or a commercially available basal oil. Substitute other oils or diluents only as recommended by the oil or diluent's manufacturer. When preparing an oil mixture, read and follow the use directions and precautions on the manufacturer's product label. Add Garlon 4 to the required amount of oil in the spray tank or mixing tank and mix thoroughly. If the mixture stands over 4 hours, reagitation is required.

Oil Mixtures of Garlon 4 and Tordon K: Tordon K and Garlon 4 may be used in tank mix combination for basal bark treatment of woody plants. These herbicides are incompatible and will not form a stable mixture when mixed together directly in oil. Make a stable tank mixture for basal bark application by first combining each product with a compatibility agent prior to final mixing in the desired ratio. (See product bulletin for mixing instructions.) Tordon K is not registered for use in the states of California and Florida.

Water Dilutions

For water dilutions, an agricultural surfactant at the manufacturer's recommended rate may be added to the spray mixture to provide improved wetting of foliage. To help minimize spray drift, a drift control and deposition aid cleared for application to growing crops is recommended.

Tank Mixing

Garlon 4 may be applied in tank mix combination with labeled rates of other herbicides provided (1) the tank mix product is labeled for the timing and method of application for the use site to be treated; and (2) tank mixing is not prohibited by the label of the tank mix product. When tank mixing Garlon 4 with other materials, a compatibility test (jar test) using relative proportions of the tank mix ingredients should be conducted prior to mixing ingredients in the spray tank. Use a clear glass quart jar with lid and mix the tank mix ingredients in the required order and their relative proportions. Invert the jar containing the mixture several times and observe the mixture for approximately 1/2 hour. If the mixture balls-up, forms flakes, sludges, jels, oily films or layers, or other precipitates, it is not compatible and the tank mix combination should not be used.

Mixing Order for Tank Mixes: Add one-half of the needed water to the mixing tank and start agitation. Add different materials in the order indicated below, allowing time for complete dispersion and mixing after addition of each product.

1. Water soluble herbicide (if used)
2. Premix of oil, emulsifier, Garlon 4 and other oil-soluble herbicide (if used); see below

Add the remaining water. During the final filling of the tank, add a drift control and deposition aid cleared for application to growing crops (if used), plus an agricultural surfactant (if a water dilution rather than an oil-water emulsion spray is used). Maintain continuous agitation of the spray mixture during mixing, final filling and throughout application to ensure spray uniformity.

Premixing: Prepare a premix of oil, emulsifier (if oil-water emulsion), and Garlon 4 plus other oil-soluble herbicide (if used), e.g., 2,4-D ester. **Note:** Do not allow water or mixtures containing water to get into the premix or Garlon 4 since a thick "invert" (water in oil) emulsion may form that will be difficult to break. Such an emulsion may also be formed if the premix or Garlon 4 is put into the mixing tank before the addition of water.

Tank Mixing Precautions:

- Read carefully and follow all applicable use directions, precautions, and limitations on the respective product labels.
- Do not exceed recommended application rates. If products containing the same active ingredient are tank mixed, do not exceed the maximum allowable active ingredient use rates.
- For direct injection or other spray equipment where the product formulations will be mixed in undiluted form, special care should be taken to ensure tank mix compatibility.
- Always perform a (jar) test to ensure the compatibility of products to be used in tank mixture.

Mixing with Liquid Fertilizer for Broadleaf Weed Control

Garlon 4 may be tank mixed with liquid nitrogen fertilizer and foliarly applied for weed control and fertilization of grass pastures. Use Garlon 4 in accordance with recommendations for grass pastures as given on this label. Apply at rates recommended by supplier or Extension Service Specialist. **Note:** Garlon 4 is not recommended for use with liquid fertilizer on woody plants (brush). Foliage burn caused by liquid fertilizer may reduce herbicide effectiveness on woody plants. Test for mixing compatibility using desired procedure and spray mix proportions in clear glass jar before mixing in spray tank. A compatibility aid such as Unite or Complex may be needed in some situations. **Compatibility is best with straight liquid nitrogen fertilizer solutions. Mixing with N-P-K solutions or suspensions may not be satisfactory even with the addition of compatibility aid.** Premixing Garlon 4 with 1 to 4 parts water may help in difficult situations.

Fill in the spray tank about half full with the liquid fertilizer, then add the herbicide with agitation and complete filling the tank with fertilizer. Apply immediately and continue agitation in the spray tank during application. **Do not store liquid fertilizer spray mixtures.** Application during very cold weather (near freezing) is not advisable. The likelihood of mixing or compatibility problems with liquid fertilizer increases under cold conditions.

Note: Do not use spray equipment for other applications to land planted, or to be planted, to susceptible crops or desirable plants **unless** it has been determined that all phytotoxic herbicide residue has been removed by thoroughly cleaning the equipment.

Plants Controlled by Garlon 4

Woody Plant Species

alder	cottonwood	maple (except bigleaf, vine ¹)	sweetbay magnolia
arrowwood	crataegus (hawthorn)	milkweed vine ²	sweetgum
ash	dogwood	mulberry	sycamore
aspen	Douglas-fir	oaks	tanoak
bear clover (bearmat)	elderberry	osage orange	thimbleberry
beechnut	elm (except winged elm)	pepper vine ³	tree-of-heaven (<i>Ailanthus</i>) ¹
birch	gallberry	persimmon, eastern	trumpet creeper ²
blackberry	gorse	pine	tulip poplar
blackbrush	granjeno	poison ivy	twisted acacia
blackgum	guajillo	poison oak	Virginia creeper ²
boxelder ¹	guava ³	poplar	wax myrtle (top growth)
Brazilian pepper	hazel	salmonberry	wild rose
buckthorn	hickory	saltbush	willow
casahuate	hornbeam	(<i>Braccharis</i> spp.) ³	willow primrose
ceanothus	huisache (suppression)	salt cedar ¹	winged elm
cherry ³	kudzu ²	sassafras	
chinquapin	locust	scotch broom	
choke cherry	madrone	sumac	

¹For best control, use either a basal bark or cut stump treatment.

²For complete control, re-treatment may be necessary.

³Basal or dormant stem applications only.

Annual, Biennial and Perennial Broadleaf Weeds

Note: Numbers in parentheses refer to footnotes below table.

black medic	dandelion (top growth)	Oxalis	vetch
bull thistle	dogfennel	plantain	wild carrot
burdock	field bindweed	purple loosestrife	(Queen Anne's lace)
Canada thistle	goldenrod	ragweed	wild lettuce
chicory	ground ivy	sericea lespedeza (1)	wild violet
cinquefoil	lambquarters	smartweed	yarrow
clover	lespedeza	sulfur cinquefoil (2)	
creeping beggarweed	matchweed	sweet clover	
curly dock	mustard	tropical soda apple (3)	

1. **Sericea lespedeza:** Apply 1 to 2 pints of Garlon 4 per acre. For best results, apply after maximum foliage development in the late spring to early summer, but prior to bloom.
2. **Sulfur cinquefoil:** Apply 1 to 2 pints of Garlon 4 per acre. For best results, apply to plants in the rosette stage.
3. **Tropical soda apple:** Apply 2 pints of Garlon 4 per acre when tropical soda apple plants reach the first flower stage. For best results, apply in a total spray volume of 40 gallons per acre using ground equipment. An agricultural surfactant may be added at the manufacturer's recommended rate to provide more complete wetting and coverage of the foliage. Spot treatments may be used to control sparse plant stands. For spot treatment use a 1 to 1.5% solution of Garlon 4 in water (1 to 1 1/2 gallons of Garlon 4 in 100 gallons total spray mixture) and spray the entire plant to completely wet the foliage. **In Florida,** control of tropical soda apple may be improved by using the following management practices:

- Mow plants to a height of 3 inches every 50 to 60 days or whenever they reach flowering. Continue the mowing operation through April.
- In late May to June (50 to 60 days after the April mowing), apply Garlon 4 as a broadcast treatment.
- Use spot treatment to control any remaining plants or thin stands of plants that germinate following a broadcast treatment.

Application Methods

Use Garlon 4 at rates of 1 to 8 quarts per acre to control broadleaf weeds and woody plants. It is suggested that rates higher in this rate range be used to control woody plants. In all cases, use the amount specified in enough water to give uniform and complete coverage of the plants to be controlled. The order of addition to the spray tank is water, spray thickening agent (if used), surfactant (if used), additional herbicide (if used), and Garlon 4. If a standard agricultural surfactant is used, use at a rate of 1 to 2 quarts per acre. Use continuous adequate agitation.

Before using any recommended tank mixtures, read the directions and all precautions on both labels.

For best results apply when woody plants and weeds are actively growing. When hard to control species such as ash, blackgum, choke cherry, elm, maples (other than vine or big leaf), oaks, pines, or winged elm are prevalent, during applications made during late summer when the plants are mature, or during drought conditions, use the higher rates of Garlon 4 alone or in combination with Tordon® 101 Mixture specialty herbicide or Tordon K herbicide. Tordon 101 Mixture and Tordon K are restricted use pesticides. Tordon 101 Mixture and Tordon K are not registered for use in the states of California and Florida.

When using Garlon 4 in combination with 2,4-D low volatile ester herbicide, generally the higher rates of Garlon 4 should be used for satisfactory brush control.

Use the higher dosage rates when brush approaches an average of 15 feet in height or when the brush covers more than 60% of the area to be treated. If lower rates are used on hard to control species, resprouting may occur the year following treatment.

On sites where easy to control brush species dominate, rates less than those listed may be effective. Consult state or local extension personnel for such information.

Foliage Treatment With Ground Equipment

Use sufficient spray volume to completely and uniformly cover foliage. For ground application, apply 10 gallons or more of total spray volume per acre. Use higher spray volumes for ground applications to ensure adequate coverage with increased depth and density of foliage, particularly for treatment of woody plants.

High Volume Foliage Treatment

For control of woody plants, use Garlon 4 at the rate of 2 to 6 quarts per 100 gallons of spray mixture, or Garlon 4 at 2 to 4 quarts may be tank mixed with labeled rates of 2,4-D low volatile ester herbicide, Tordon 101 Mixture, or Tordon K and diluted to make 100 gallons of spray. Do not apply more than 2 gallons of Garlon 4 per acre. On rangeland and permanent pasture sites, make 1 application per year and apply no more than 2 quarts of Garlon 4 (2 lb ae of triclopyr) per acre. Apply at a volume of 100 to 400 gallons of total spray per acre depending upon size and density of woody plants. Tordon 101 Mixture and Tordon K are not registered for use in the states of California and Florida. When tank mixing, follow applicable use directions and precautions on each manufacturer's label.

Depending upon the size and density of the woody plants, apply sufficient spray volume to thoroughly wet all leaves, stems, and root collars. To minimize spray drift, select the minimum spray pressure that provides adequate plant coverage without forming a mist and direct sprays no higher than the top of the target plants. Use a drift control additive cleared for application to growing crops to reduce spray drift. Before using any tank mixture, read the directions and use precautions on both labels. For best results, apply when woody plants and weeds are actively growing.

Table 1: The following table is provided as a guide to the user to achieve the proper rate of Garlon 4.

Total Spray Volume (gallons/acre)	Rate of Garlon 4	
	Forestry Sites (qt/100 gallons of spray) ¹	Non-Cropland Sites (qt/100 gallons of spray) ²
400	1.5	2
300	2	2.7
200	3	4
100	6	8
50	12	16
40	15	20
30	20	26.7
20	30	40
10	60	80

¹Do not exceed the maximum use rate of 6 qt of Garlon 4 (6 lb ae of triclopyr) per acre per year.

²Do not exceed the maximum use rate of 8 qt of Garlon 4 (8 lb ae of triclopyr) per acre per year for non-grazable areas, or 2 qt (2 lb ae of triclopyr) per acre per year for grazed areas, except on portions of grazed areas that meet the following requirement. Portions of grazed areas that intersect treated non-cropland, rights-of-way and forestry sites may be treated at up to 8 lb ae per acre if the area to be treated on the day of application comprises no more than 10% of the total grazable area.

Table 2

Application Rates per 100 Gallons of Spray		
Garlon 4	Plus Tank Mix Product	Rate (qt)
1 - 4 qt	--	--
1 - 2 qt	Grazon® P+D specialty herbicide	4
1 - 2 pt	2,4-D low volatile ester herbicide	1 - 2
1 - 2 qt	Tordon 22K	1 - 2
2 qt	Reclaim® specialty herbicide ^{1,2}	2

¹Reclaim is registered for use only in Arizona, Texas, Oklahoma and New Mexico.

²See directions for Mesquite Control Using High Volume Foliage Treatment below.

Mesquite Control Using High Volume Foliage Treatment: For control of mesquite infestations of low to moderate density, apply Garlon 4 and Reclaim in a tank mixture to individual plants with backpack or hand-held sprayers or a vehicle-mounted sprayer with hand-held spray wand or spray gun. For individual plant treatment, use 2 quarts of Garlon 4 in combination with 2 quarts of Reclaim per 100 gallons of total spray solution (1/2% v/v of each product). Apply in water or as an oil-water emulsion as described in Mixing Directions. If using an oil-water emulsion, add the oil at a rate of 5% of the total spray volume. Apply as a complete spray-to-wet foliar application, including all leaves. Thorough coverage is necessary for good results, but do not spray to the point of runoff. Do not apply when mesquite foliage is wet. The total amount of Garlon 4 applied should not exceed 1 1/3 pints per acre. For best results, follow information given elsewhere in this label concerning effect of environmental conditions and application timing on control. This application method works best for brush less than 8 feet tall since efficient treatment and thorough coverage of taller brush is difficult to achieve with this method. To minimize drift, select a spray nozzle and pressure that provides good coverage while forming a coarse spray. Additionally, drift may be reduced by using the minimum pressure necessary to obtain plant coverage without forming a mist and by directing sprays no higher than the top of target plants. If desired, a spray dye may be added to the spray mixture to mark the treated plants.

Low Volume Foliage Treatment

To control susceptible woody plants, mix up to 20 quarts of Garlon 4 in 10 to 100 gallons of finished spray. The spray concentration of Garlon 4 and total spray volume per acre should be adjusted according to the size and density of target woody plants and kind of spray equipment used. With low volume sprays, use sufficient spray volume to obtain uniform coverage of target plants including the surfaces of all foliage, stems, and root collars (see General Use Precautions and Restrictions). For best results, a surfactant should be added to all spray mixtures. Match equipment and delivery rate of spray nozzles to height and density of woody plants. When treating tall, dense brush, a truck mounted spray gun with spray tips that deliver up to 2 gallons per minute at 40 to 60 psi may be required. Backpack or other types of specialized spray equipment with spray tips that deliver less than 1 gallon of spray per minute may be appropriate for short, low to moderate density brush.

Tank Mixing: As a low volume foliage spray, up to 12 quarts of Garlon 4 may be applied in tank mix combination with labeled rates of Tordon K or Tordon 101 Mixture in 10 to 100 gallons of finished spray. Tordon 101 Mixture and Tordon K are not registered for use in the states of California and Florida.

Broadcast Applications With Aerial or Ground Equipment

Environmental conditions and application timing influence brush and weed control results. For best results, apply when woody plants and weeds are actively growing. For woody species, apply after the rapid growth period of early spring when leaf tissue is fully expanded and terminal growth has slowed. Brush regrowth should be at least 4 ft high prior to treatment to insure adequate foliage for herbicide absorption. Adequate soil moisture before and after treatment as well as the presence of healthy foliage at the time of application are important factors contributing to optimal herbicidal activity.

Use sufficient spray volume to completely and uniformly cover foliage. For ground application, apply 10 gallons or more of total spray volume per acre. For aerial application, apply at least 2 gallons of total spray volume per acre. Use higher spray volumes for ground or aerial applications to ensure adequate coverage with increased depth and density of foliage, particularly for treatment of woody plants.

Mesquite: The herbicidal response of mesquite is strongly influenced by foliage condition, growth stage and environmental conditions. For best results, apply when new growth foliage has turned from light to dark green, when the soil temperature is above 75°F at a depth of 12 to 18 inches, and soil moisture is adequate for plant growth. Apply within 60 days after the 75°F minimum soil temperature at the 12- to 18-inch depth has been reached. Product performance may be adversely affected if application is made before mesquite foliage has turned from light to dark green or if foliage has been injured or removed by late frost, insects, hail or plant diseases. Do not treat if mesquite exhibits new (light green) terminal growth in response to recent heavy rainfall during the growing season. Rate of soil warm-up at the 12- to 18-inch depth may vary with soil texture and drainage. Coarse-textured (sandy) soils warm up sooner than fine-textured (clay) soils and dry soils warm up more quickly than wet soils. Mesquite regrowth should be at least 4 ft high prior to treatment to insure adequate foliage for herbicide absorption.

Mesquite Only

Apply 1/2 to 1 pint of Garlon 4 per acre in combination with 2/3 to 1 1/3 pint per acre of Reclaim. See label for Reclaim for additional treatment recommendations and information on mesquite control. Apply aerially as an oil:water emulsion in 4 gallons or more total volume per acre or with ground equipment in 10 gallons or more total volume per acre. Use a maximum of 1 gallon of oil per acre for aerial or ground application.

Mesquite and Pricklypear Cactus

If pricklypear cactus is a target species in association with mesquite, apply a tank mix of 1/2 to 1 pint of Garlon 4 with 1 to 2 pints of Tordon 22K per acre. (The 2 pint per acre rate of Tordon 22K provides a higher and more uniform plant kill of pricklypear.) Tordon 22K may also be applied in combination with Reclaim to control pricklypear while providing improved control of mesquite. See labels for Tordon 22K and Reclaim for additional information and treatment recommendations. Apply aerially as an oil:water emulsion in 4 gallons or more total volume per acre or with ground equipment in 10 or gallons or more total volume per acre. If mesquite canopy is dense, use higher spray volumes. Use a maximum of 1 gallon of oil per acre for aerial or ground application.

South Texas Mixed Brush (Mesquite, Pricklypear Cactus, Blackbrush, Twisted Acacia and Granjeno)

Use 1 to 2 pints of Garlon 4 in a tank mix with 2 pints of Tordon 22K per acre if pricklypear is a problem, or with 2/3 to 1 1/3 pints of Reclaim per acre if mesquite is the prevalent species. Garlon 4 contributes to the control of non-legume species such as granjeno and oaks. However, if woody legume species are predominate, apply 2 pints of Tordon 22K per acre in combination with 2/3 to 1 1/3 pints of Reclaim per acre for improved control. See labels for Tordon 22K and Reclaim for additional information and treatment recommendations. Apply aerially in an oil:water emulsion in 4 gallons or more total volume per acre or with ground equipment in 15 gallons or more total volume per acre. Use a maximum of 1 gallon of oil per acre for aerial or ground application. The use of an oil:water emulsion is critical and good spray coverage is essential for acceptable brush control.

Sand Shinnery Oak Suppression

In Texas, New Mexico and Oklahoma, apply Garlon 4 alone at a rate of 1/2 to 2 pints per acre for suppression of shinnery oak growing on sandy soils. Grass response following suppression may be impressive where rainfall is adequate. Grazing deferment following application together with proper grazing management is recommended to allow for the reestablishment of grass stands.

Post Oak and Blackjack Oak - Regrowth Stands

Apply in the late spring (May) to early summer (June-July) when oak leaves are fully developed (expanded). Use 2 quarts of Garlon 4 alone or in tank mix combination with 0.5 to 1 pints of 2,4-D low-volatile ester herbicide per acre. Apply in an oil:water emulsion or water surfactant dilution in sufficient total volume per acre to assure thorough coverage, usually 5 gallons or more per acre by fixed-wing aircraft or helicopter or 15 to 25 gallons per acre by ground equipment. Use a maximum of 1 gallon of oil per acre for aerial or ground application. Lower rates may be used for suppression only. Control will require at least 3 consecutive treatments. **Note:** Regrowth plants have a large root mass relative to top growth when compared to undisturbed plants. In order for top growth to intercept and translocate enough herbicide to control the roots, delay broadcast treatment until top growth is at least 4 ft tall.

High Volume Foliage Treatment: For regrowth less than 4 ft tall, apply 2 quarts of Garlon 4 per 100 gallons of water and 2 quarts of ag surfactant alone or in tank mix combination with 1 gallon of Grazon P+D or 1 quart of Tordon 22K. Apply as a high volume leaf-stem treatment to individual plants using ground equipment.

Post Oak and Blackjack Oak - Mature Stands

For control of mature stands (greater than 5 ft tall), apply 2 quarts of Garlon 4 per acre in late spring (May) to early summer (June-July) when oak leaves are fully developed (expanded). Understory species such as winged elm, buckbrush, tree huckleberry and ash occurring in some areas will not be controlled (only suppressed or defoliated) by using Garlon 4 alone. Where these understory species occur, control may be improved by tank mixing 2 quarts of Garlon 4 with 1 quart of Tordon 22K or 4 quarts of Grazon P+D per acre. For best results, apply as an oil:water emulsion in a total volume of 5 gallons per acre or more by fixed-wing aircraft or helicopter.

Other Susceptible Woody Plants

Apply 2 to 4 pints of Garlon 4 alone or in combination with 2 to 3 quarts of 3.8 lb/gal 2,4-D low volatile ester or amine formulation per acre. If difficult to control species such as ash, choke cherry, elm, maple or oaks are prevalent, and during applications made when plants are mature late in the summer or during drought conditions, use the higher rates of Garlon 4, alone or with 2,4-D. Garlon 4 may also be applied in a tank mixture with Grazon P+D or Tordon 22K for increased control of certain species. See labels for Grazon P+D and Tordon 22K for additional information and treatment recommendations. Apply aerially in 4 gallons or more total volume per acre or with ground equipment in 10 gallons or more total volume per acre. For best results on blackberry, apply during or after bloom. For management of kudzu, apply 1 quart of Garlon 4 per acre. Repeat application may be necessary to achieve desired level of control.

Susceptible Broadleaf Weeds

Use 2 pints of Garlon 4 per acre in a water spray. Apply as a broadcast spray in a total volume of 10 gallons or more per acre by ground equipment or aerially in a total volume of 2 gallons or more per acre. Apply anytime the weeds are actively growing. Garlon 4 at 1/2 to 3 pints may be tank mixed with 1 to 2 quarts of 3.8 lb/gal 2,4-D amine or low volatile ester.

Woody Plant Control

Foliage Treatment: Use 4 to 8 quarts of Garlon 4 in enough water to make 5 gallons or more per acre of total spray, or 1 1/2 to 3 quarts of Garlon 4 may be combined with labeled rates of 2,4-D low volatile ester, Tordon 101 Mixture, or Tordon K in sufficient water to make 5 gallons or more per acre of total spray. Tordon 101 Mixture and Tordon K are not registered for use in the states of California and Florida.

Broadleaf Weed Control

Use Garlon 4 at rates of 1 to 4 quarts in a total volume of 5 gallons or more per acre as a water spray mixture. Apply anytime weeds are actively growing. Garlon 4 at 0.25 to 3 quarts may be tank mixed with labeled rates of 2,4-D amine or low volatile ester, Tordon K, or Tordon 101 Mixture to improve the spectrum of activity. For thickened (high viscosity) spray mixtures, Garlon 4 can be mixed with diesel oil or other inverting agent. When using an inverting agent, read and follow the use directions and precautions on the product label. Tordon 101 Mixture and Tordon K are not registered for use in the states of California and Florida.

Foliage Treatment (Utility and Pipeline Rights-of-Way)

Use 4 to 8 quarts of Garlon 4 alone, or 3 to 4 quarts of Garlon 4 in a tank mix combination with labeled rates of 2,4-D low volatile ester, Tordon 101 Mixture or Tordon K and apply in a total spray volume of 10 to 30 gallons per acre. Use the higher rates and volumes when plants are dense or under drought conditions. Tordon 101 Mixture and Tordon K are not registered for use in the states of California and Florida.

Portions of grazed areas that intersect treated non-cropland, rights-of-way and forestry sites may be treated at up to 8 lb ae per acre if the area to be treated on the day of application comprises no more than 10% of the total grazable area.

Basal Bark, Dormant Stem and Cut Surface Treatments

Individual plant treatments such as basal bark and cut surface applications may be used on any use site listed on this label at a maximum use rate of 8 lb ae of triclopyr per acre. These types of applications are made directly to ungrazed parts of plants and, therefore, are not restricted by the grazing maximum rate of 2 lb ae of triclopyr per acre.

Basal Bark Treatment

To control susceptible woody plants with stems less than 6 inches in basal diameter, mix 1 to 5 gallons of Garlon 4 in enough oil to make 100 gallons of spray mixture. Apply with knapsack sprayer or power spraying equipment using low pressure (20 to 40 psi). Spray the basal parts of brush and tree trunks to a height of 12 to 15 inches from the ground, thoroughly wetting the indicated area. Spray until runoff at the ground line is noticeable. Old or rough bark requires more spray than smooth young bark. Apply anytime, including the winter months, except when snow or water prevent spraying to the ground line. **Mixing with oil requires vigorous agitation to form an oil solution.** Once a solution is formed it will stay stable.

Low Volume Basal Bark Treatment

To control susceptible woody plants with stems less than 6 inches in basal diameter, mix 20 to 30 gallons of Garlon 4 in enough oil to make 100 gallons of spray mixture. Apply with a backpack or knapsack sprayer using low pressure and a solid cone or flat fan nozzle. Spray the basal parts of brush and tree trunks to a height of 12 to 15 inches from the ground in a manner that thoroughly wets the lower stems, including the root collar area, but not to the point of runoff. Herbicide concentration should vary with size and susceptibility of species treated. Apply anytime, including the winter months, except when snow or water prevent spraying to the ground line or when stem surfaces are saturated with water. See Table 1 for relationship between mixing rate, spray volume and maximum application rate. **Note:** The addition of a soil active herbicide to a basal bark mixture with Garlon 4 may result in damage to surrounding non-target vegetation. Care should be taken to assess the areas in which these soil active herbicides are used in combination with Garlon 4 in basal bark applications. **Mixing with oil requires vigorous agitation to form an oil solution.** Once a solution is formed it will stay stable.

Garlon 4 Plus Tordon K in Oil Tank Mix: Garlon 4 and Tordon K may be used in tank mix combination as a low volume basal bark treatment to improve control of certain woody species such as ash, elm, maple, poplar, aspen, hackberry, oak, oceanspray, birch, hickory, pine, tanoak, cherry, locust, sassafras, and multiflora rose. (See product bulletin for mixing instructions.) Tordon K is not registered for use in the states of California and Florida.

Streamline Basal Bark Treatment (Southern States)

To control or suppress susceptible woody plants for conifer release, mix 20 to 30 gallons of Garlon 4 in enough oil to make 100 gallons of spray mixture. Streamline basal bark treatments are most effective on stems less than 4 inches in basal diameter. Apply with a backpack or knapsack sprayer using equipment that provides a directed straight stream spray. Apply the spray in a 2- to 3-inch wide band to one side of stems less than 3 inches in basal diameter. When the optimum amount of spray mixture is applied, the treated zone should widen to encircle the stem within approximately 30 minutes. Treat both sides of stems which are 3 to 4 inches in basal diameter. Direct the spray at bark that is approximately 12 to 24 inches above ground. Pines (loblolly, slash, shortleaf, and Virginia) up to 2 inches in diameter breast height (dbh) can be controlled by directing the spray at a point approximately 4 feet above ground. Vary spray mixture concentration with size and susceptibility of the species being treated. Better control is achieved when spray is applied to thin juvenile bark and above rough thickened mature bark. This technique is not recommended for scrub and live oak species, including blackjack, turkey, post, live, bluejack and laurel oaks, or bigleaf maple. Apply anytime, including winter months, except when snow or water prevents spraying at the desired height above ground level. **Note:** Best results with some hardwood species occur when applications are made from approximately 6 weeks prior to leaf expansion in the spring until approximately 2 months after leaf expansion is completed. **Mixing with oil requires vigorous agitation to form an oil solution.** Once a solution is formed it will stay stable.

Low Volume Stem Bark Band Treatment (North Central and Lake States)

To control susceptible woody plants with stems less than 6 inches in basal diameter, mix 20 to 30 gallons of Garlon 4 in enough oil to make 100 gallons of spray mixture. Apply with a backpack or knapsack sprayer using low pressure and a solid cone or flat fan nozzle. Apply the spray in a 6- to 10-inch wide band that completely encircles the stem. Spray in a manner that completely wets the bark, but not to the point of runoff. The treatment band may be positioned at any height up to the first major branch. For best results, apply the band as low as possible. Spray mixture concentration should vary with size and susceptibility of species to be treated. Applications may be made anytime, including winter months. **Mixing with oil requires vigorous agitation to form an oil solution.** Once a solution is formed it will stay stable.

Thinline Basal Bark Treatment

To control susceptible woody plants with stems less than 6 inches in diameter, apply Garlon 4, either undiluted or mixed at 50 to 75% v/v with oil, in a thin stream to all sides of the lower stems. The stream should be directed horizontally to apply a narrow band of Garlon 4 around each stem or clump. Use a minimum of 2 to 15 milliliters of Garlon 4 or oil mixture with Garlon 4 to treat single stems and from 25 to 100 milliliters to treat clumps of stems. Use an applicator metered or calibrated to deliver the small amounts required. **Mixing with oil requires vigorous agitation to form an oil solution.** Once a solution is formed it will stay stable.

Dormant Stem Treatment

Dormant stem treatments control susceptible woody plants and vines with stems less than 2 inches in diameter. Plants with stems greater than 2 inches in diameter may not be controlled and resprouting may occur. This treatment method is best suited for sites with dense, small diameter brush. Dormant stem treatments of Garlon 4 can also be used as a chemical side-trim for controlling lateral branches of larger trees that encroach onto roadside, utility, or other rights-of-way.

Mix 4 to 8 quarts of Garlon 4 in 2 to 3 gallons of crop oil concentrate or other recommended oil and add this mixture in enough water to make 100 gallons of spray solution. Use continuous adequate agitation. Apply with knapsack or power spraying equipment, using low pressure (20 to 40 psi). In western states, apply anytime after woody plants are dormant and most of the foliage has dropped. In other areas apply anytime within 10 weeks of budbreak, generally February through April. Thoroughly wet the upper parts of the stems and use the remainder to wet the lower 12 to 15 inches above the ground to the point of runoff. For root suckering species such as sumac, sassafras and locust, also spray the ground under the plant to cover small root suckers which may not be visible above the solid surface. For oil-water mixture application, mix 6 quarts of Garlon 4, 25 gallons of oil and 1.5 gallons of an approved agricultural spray emulsifier such as Sponto 712 or Triton X-100 as indicated in the mixing directions. Treat as above. Garlon 4 may be mixed with 4 quarts of Weedone 170 herbicide to improve the control of black cherry and broaden the spectrum of herbicidal activity. Do not apply to wet or saturated bark as poor control may result.

Cut Stump Treatment

To control resprouting, mix 20 to 30 gallons of Garlon 4 in enough oil to make 100 gallons of spray mixture. Apply with a backpack or knapsack sprayer using low pressures and a solid cone or flat fan nozzle. Spray the root collar area, sides of the stump, and the outer portion of the cut surface, including the cambium, until thoroughly wet, but not to the point of runoff. Spray mixture concentration should vary with the size and susceptibility of species treated. Apply anytime, including in winter months, except when snow or water prevent spraying to the ground line. **Mixing with oil requires vigorous agitation to form an oil solution.** Once a solution is formed it will stay stable.

Cut Stump Treatment in Western States

To control resprouting of salt cedar and other *Tamarix* species, bigleaf maple, tanoak, Oregon myrtle, and other susceptible species, apply undiluted Garlon 4 to wet the cambium and adjacent wood around the entire circumference of the cut stump. Treatments may be applied throughout the year; however, control may be reduced with treatment during periods of moisture stress as in late summer. Cut stumps so that they are approximately level to facilitate uniform coverage of Garlon 4. Use an applicator which can be calibrated to deliver the small amounts of material required.

Growing Point and Leaf Base (Crown) Treatment of Yucca

Prepare a 2% v/v solution of Garlon 4 in diesel or fuel oil (13 fl oz of Garlon 4 in 5 gallons of spray mixture). Thoroughly wet the center of the plant including growing point and leaf bases to the soil surface. Complete coverage of leaves is not necessary.

Forest Management Applications

For broadcast applications, apply 1 to 6 quarts of Garlon 4 per acre in a total spray volume of 5 to 25 gallons per acre by air or 10 to 100 gallons per acre by ground. Use spray volumes sufficient to provide thorough coverage of treated foliage. Nozzles or additives that produce larger droplets of spray may require higher spray volumes to provide adequate coverage.

Plant Back Interval for Conifers: Conifers planted sooner than 1 month after treatment with Garlon 4 at less than 4 quarts per acre or sooner than 2 months after treatment at 4 to 6 quarts per acre may be injured. When tank mixtures of herbicides are used for forest site preparation, labels for all products in the mixture should be consulted and the longest recommended waiting period before planting observed.

Forest Site Preparation (Not for Conifer Release)

Southern States including Alabama, Arkansas, Delaware, Florida, Georgia, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia: To control susceptible woody plants and broadleaf weeds, apply Garlon 4 at a rate of 4 to 6 quarts per acre. To broaden the spectrum of woody plants and broadleaf weeds controlled, apply 2 to 4 quarts of Garlon 4 per acre in tank mix combination with labeled rates of Tordon 101 Mixture or Tordon K. Tordon 101 Mixture and Tordon K are not registered for use in the state of Florida. Where grass control is also desired, Garlon 4, alone or in tank mix combination with Tordon K or Tordon 101 Mixture, may be applied with labeled rates of other herbicides registered for grass control in forests. Use of tank mix products must be in accordance with the most restrictive of label limitations and precautions. Do not exceed labeled application rates. Garlon 4 cannot be tank mixed with any product containing a label prohibition against such mixing.

Western, Northeastern, North Central, and Lake States (States not Listed Above as Southern States): To control susceptible woody plants and broadleaf weeds, apply Garlon 4 at a rate of 3 to 6 quarts per acre. To broaden the spectrum of woody plants and broadleaf weeds controlled, apply 1.5 to 3 quarts of Garlon 4 per acre in tank mix combination with labeled rates of Tordon 101 Mixture, Tordon K, or 2,4-D low volatile ester. Tordon 101 Mixture and Tordon K are not registered for use in the state of California. Where grass control is also desired, Garlon 4, alone or in tank mix combination with Tordon 101 Mixture or Tordon K, may be applied with labeled rates of other herbicides registered for grass control in forests. When applying tank mixes, follow applicable use directions and precautions on each product label.

Southern Coastal Flatwoods: To control susceptible broadleaf weeds and woody species such as gallberry and wax-myrtle, and for partial control of saw-palmetto, apply 2 to 4 quarts of Garlon 4 per acre. To broaden the spectrum of species controlled to include fetterbush, staggerbush, titi, and grasses, apply 2 to 3 quarts of Garlon 4 per acre in tank mix combination with labeled rates of Arsenal Applicator's Concentrate herbicide. Where control of gallberry, wax-myrtle, broadleaf weeds, and grasses is desired, apply 2 to 3 quarts of Garlon 4 per acre in tank mix combination with labeled rates of Accord Concentrate or Accord SP herbicide.

These treatments may be broadcast during site preparation of flat planted or bedded sites or, on bedded sites, applied in bands over the top of beds. For best results, apply in late summer or fall. Efficacy may not be satisfactory when applications are made in early season prior to August. **Note:** Do not apply after planting pines.

Directed Spray Applications for Conifer Release

To release conifers from competing hardwoods and brush such as red maple, sugar maple, striped maple, sweetgum, red and white oaks, ash, hickory, alder, birch, aspen, pin cherry, *Ceanothus* spp., blackberry, chinquapin, and poison oak, mix 4 to 20 quarts of Garlon 4 in enough water to make 100 gallons of spray mixture. This spray mixture should be directed onto foliage of competitive hardwoods using knapsack or backpack sprayers with flat fan nozzles or equivalent anytime after the hardwoods and brush have reached full leaf size, but before autumn coloration. The majority of treated hardwoods and brush should be less than 6 feet in height to ensure adequate spray coverage. Care should be taken to direct spray away from contact with conifer foliage, particularly foliage of desirable pines. See Table 1 for relationship between mixing rate, spray volume and maximum application rate.

Note: Spray may cause temporary damage and growth suppression where contact with conifers occurs; however, injured conifers should recover and grow normally. Over-the-top spray applications can kill pines.

Broadcast Applications for Mid-Rotation Understory Brush Control in Southern Coastal Flatwoods Pine Stands (Ground Equipment Only)

For control of susceptible species such as gallberry and wax-myrtle and broadleaf weeds, apply 2 to 4 quarts of Garlon 4 per acre. To broaden the spectrum of woody plants controlled to include fetterbush, staggerbush, and tili, apply 2 to 3 quarts of Garlon 4 per acre in tank mix combination with labeled rates of Arsenal Applicator's Concentrate. Saw-palmetto will be partially controlled by use of Garlon 4 at 4 quarts per acre or by mixtures of Garlon 4 at 2 to 3 quarts per acre in tank mix combination with either Arsenal Applicator's Concentrate or Escort herbicide. These mixtures should be broadcast applied over target understory brush species, **but to prevent injury to pines, make applications underneath the foliage of pines.** Apply sprays in 30 gallons or more per acre of total volume. For best results, apply in late summer or fall. Efficacy may not be satisfactory when applications are made in early season prior to August.

Broadcast Applications for Conifer Release in the Pacific Northwest and California

Dormant Conifers Before Bud Swell (Excluding Pines): To control or suppress deciduous hardwoods such as vine maple, bigleaf maple, alder, scotch broom, or willow **before leaf-out**, or evergreen hardwoods such as madrone, chinquapin, and *Ceanothus* spp., use Garlon 4 at 1 to 2 quarts per acre. Use diesel or fuel oil as a diluent, or use water plus 1 to 2 gallons per acre of diesel oil or a suitable surfactant or oil substitute at manufacturer's recommended rates. **Mixing with oil as the only diluent requires vigorous agitation to form an oil solution.** Once a solution is formed it will stay stable.

Conifer Plantations (Excluding Pines) After Hardwoods Begin Growth and Before Conifer Bud Break ("Early Foliar" Hardwood Stage): Use Garlon 4 at 1 to 1.5 quarts alone or with 2,4-D low volatile ester herbicide in water carrier to provide no more than 3 lb ae per acre from both products. After conifer bud break, these sprays may cause more serious injury to the crop trees. Use of a surfactant may cause unacceptable injury to conifers especially after bud break.

Conifer Plantations (Excluding Pines) After Conifers Harden Off in Late Summer and While Hardwoods are Still Actively Growing: Use Garlon 4 at rates of 1 to 1.5 quarts per acre alone or with 2,4-D low volatile ester to provide no more than 3 lb ae per acre from both products. Treat as soon after conifer bud hardening as possible so that hardwoods and brush are actively growing. Use of oil, oil substitute, or surfactant may cause unacceptable injury to the conifers.

Broadcast Applications for Conifer Release in the Eastern United States

To release spruce, fir, red pine, and white pine from competing hardwoods such as red maple, sugar maple, striped maple, alder, birch (white, yellow, and grey), aspen, ash, pin cherry, and *Rubus* spp. and perennial and annual broadleaf weeds, use Garlon 4 at rates of 1.5 to 3 quarts per acre alone or with 2,4-D amine or low volatile ester to provide no more than 4 lb ae per acre from both products. Apply in late summer or early fall after conifers have formed their overwintering buds and hardwoods are in full leaf and prior to autumn coloration.

Broadcast Applications for Conifer Release in the Lake States Region

To release spruce, fir, and red pine from competing hardwoods such as aspen, birch, maple, cherry, willow, oak, hazel, and *Rubus* spp. and perennial and annual broadleaf weeds, use Garlon 4 at rates of 1.5 to 3 quarts per acre. Apply in late summer or early fall after conifers have formed their overwintering buds and hardwoods are in full leaf and prior to autumn coloration.

Terms and Conditions of Use

If terms of the following Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies are not acceptable, return unopened package at once to the seller for a full refund of purchase price paid. Otherwise, use by the buyer or any other user constitutes acceptance of the terms under Warranty Disclaimer, Inherent Risks of Use and Limitation of Remedies.

Warranty Disclaimer

Dow AgroSciences warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. Dow AgroSciences MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label, such as unfavorable temperature, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of Dow AgroSciences or the seller. All such risks shall be assumed by buyer.

Limitation of Remedies

To the extent permitted by law, the exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories), shall be limited to, at Dow AgroSciences' election, one of the following:

1. Refund of purchase price paid by buyer or user for product bought, or
2. Replacement of amount of product used.

To the extent permitted by law, Dow AgroSciences shall not be liable for losses or damages resulting from handling or use of this product unless Dow AgroSciences is promptly notified of such loss or damage in writing. To the extent permitted by law, in no case shall Dow AgroSciences be liable for consequential or incidental damages or losses.

The terms of the Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies cannot be varied by any written or verbal statements or agreements. No employee or sales agent of Dow AgroSciences or the seller is authorized to vary or exceed the terms of the Warranty Disclaimer or this Limitation of Remedies in any manner.

*Trademark of Dow AgroSciences LLC

Produced for Dow AgroSciences LLC • Indianapolis, IN 46268 USA

Label Code: D02-102-026

Replaces Label: D02-102-025

LOES Number: 010-00085

EPA accepted 04/18/07

Revisions:

1. Product may be applied by fixed wing aircraft or helicopter.
2. Added mixing directions section.
3. Added blackbrush, granjeno, guajillo, guava, milkweed vine, osage orange, pepper vine, trumpet creeper, twisted acacia, Virginia creeper and willow primrose to list of woody plants controlled.
4. Added biennial broadleaf weeds to list of weeds controlled.
5. Added dormant stem and cut surface treatments.

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Nufarm Polaris® Herbicide
EPA Reg. No.: 228-534
Synonyms: Imazapyr, Isopropylamine Salt; IPA Salt of Imazapyr; 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridine-carboxylic acid, salt with 2-propanamine (1:1)
Product Type: Herbicide
Company Name: Nufarm Americas Inc.
150 Harvester Drive, Suite 200
Burr Ridge, IL 60527
Telephone Numbers: For Chemical Emergency, Spill, Leak, Fire, Exposure, or Accident,
Call CHEMTREC Day or Night: 1-800-424-9300
For Medical Emergencies Only, Call 1-877-325-1840
Date of Issue: June 20, 2012 **Supersedes:** January 14, 2008
Sections Revised: 2, 7, 13

2. HAZARDS IDENTIFICATION**Emergency Overview:**

Appearance and Odor: Blue colored liquid with a faint ammonia-like odor.

Warning Statements: Keep out of reach of children. CAUTION. Minimally toxic. Acute toxicity tests show very low potential for immediate risk in handling this product. Follow instructions for personal protective equipment and user safety recommendations.

Potential Health Effects:

Likely Routes of Exposure: Inhalation, eye and skin contact.

Eye Contact: Minimally irritating based on toxicity studies.

Skin Contact: Slightly toxic and slightly irritating based on toxicity studies.

Ingestion: Slightly toxic based on toxicity studies.

Inhalation: Low inhalation toxicity.

Medical Conditions Aggravated by Exposure: None known.

See Section 11: TOXICOLOGICAL INFORMATION for more information.

Potential Environmental Effects:

This pesticide is toxic to plants. Drift and runoff may be hazardous to plants in water adjacent to treated areas. Treatment of aquatic weeds can result in oxygen depletion due to decomposition of dead plants. Oxygen loss, if severe, can cause fish suffocation. This product is phytotoxic at extremely low concentrations. Non-target plants may be adversely affected from drift.

See Section 12: ECOLOGICAL INFORMATION for more information.

3. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENT	CAS NO.	% BY WEIGHT
Isopropylamine Salt of Imazapyr	81510-83-0	27.7
Other Ingredients		72.3

4. FIRST AID MEASURES

If in Eyes: Hold eye open and rinse slowly and gently with water for 15 to 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

If on Skin or Clothing: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15 to 20 minutes. Call a poison control center or doctor for treatment advice.

If Inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.

If Swallowed: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. Do not give anything by mouth to an unconscious person.

5. FIRE FIGHTING MEASURES

Flash Point: >212° F (>100° C) Pensky-Martens

Autoignition Temperature: Not determined **Flammability Limits:** Not determined

Extinguishing Media: Recommended for large fires: foam or water spray. Recommended for small fires: dry chemical or carbon dioxide.

Special Fire Fighting Procedures: Firefighters should wear NIOSH/MSHA approved self-contained breathing apparatus and full fire-fighting turn out gear. Dike area to prevent runoff and contamination of water sources. Dispose of fire control water later.

Unusual Fire and Explosion Hazards: If water is used to fight fire, contain runoff, using dikes to prevent contamination of water supplies. Dispose of fire control water later.

Hazardous Decomposition Materials (Under Fire Conditions): May produce gases such as oxides of carbon, hydrogen and nitrogen.

National Fire Protection Association (NFPA) Hazard Rating:

Rating for this product: Health: 1 Flammability: 1 Reactivity: 0

Hazards Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Wear appropriate protective gear for the situation. See Personal Protection information in Section 8.

Environmental Precautions: Prevent material from entering public sewer systems or any waterways. Do not flush to drain. Large spills to soil or similar surfaces may necessitate removal of topsoil. The affected area should be removed and placed in an appropriate container for disposal.

Methods for Containment: Dike spill using absorbent or impervious materials such as earth, sand or clay. Collect and contain contaminated absorbent and dike material for disposal.

Methods for Cleanup and Disposal: Pump any free liquid into an appropriate closed container. Collect washings for disposal. Decontaminate tools and equipment following cleanup. See Section 13: DISPOSAL CONSIDERATIONS for more information.

Other Information: Large spills may be reportable to the National Response Center (800-424-8802) and to state and/or local agencies.

7. HANDLING AND STORAGE**Handling:**

Users should wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. Remove clothing/Personal Protective Equipment (PPE) immediately if pesticide gets inside. Then wash

thoroughly and put on clean clothing. If pesticide gets on skin, wash immediately with soap and water. Remove PPE immediately after handling this product. Wash outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

Spray solutions of this product should be mixed, stored and applied only in stainless steel, fiberglass, plastic and plastic-lined steel containers. Do not mix, store or apply this product or spray solutions of this product in unlined steel (except stainless steel) containers or spray tanks.

Storage:

Do not store below 10° F. Do not contaminate water, food or feed by storage or disposal.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls:

Where engineering controls are indicated by specific use conditions or a potential for excessive exposure, use local exhaust ventilation at the point of generation.

Personal Protective Equipment:

Eye/Face Protection: Not normally required. To avoid contact with eyes, wear chemical goggles or shielded safety glasses. An emergency eyewash or water supply should be readily accessible to the work area.

Skin Protection: To avoid contact with skin, wear long pants, long-sleeved shirt, socks, shoes and chemical-resistant gloves made of any waterproof material. An emergency shower or water supply should be readily accessible to the work area.

Respiratory Protection: Not normally required. If vapors or mists exceed acceptable levels, wear NIOSH approved air-purifying respirator with cartridges/canisters approved for use against pesticides.

General Hygiene Considerations: Personal hygiene is an important work practice exposure control measure and the following general measures should be taken when working with or handling this material: 1) do not store, use and/or consume foods, beverages, tobacco products, or cosmetics in areas where this material is stored; 2) wash hands and face carefully before eating, drinking, using tobacco, applying cosmetics or using the toilet.

Exposure Guidelines:

Component	OSHA		ACGIH		Unit
	TWA	STEL	TWA	STEL	
Isopropylamine Salt of Imazapyr	NE	NE	NE	NE	

NE = Not Established

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance and Odor: Blue colored liquid with a faint ammonia-like odor.

Boiling Point:	Not determined	Solubility in Water:	Soluble
Density:	8.80 pounds/gallon	Specific Gravity:	1.057 @ 20°C
Evaporation Rate:	Not determined	Vapor Density:	Not determined
Freezing Point:	Not determined	Vapor Pressure:	Not determined
pH:	6.26 (1% solution)	Viscosity:	3.766 cst @ 20°C

Note: Physical data are typical values, but may vary from sample to sample. A typical value should not be construed as a guaranteed analysis or as a specification.

10. STABILITY AND REACTIVITY

Chemical Stability: This material is stable under normal handling and storage conditions.

Conditions to Avoid: Excessive heat. Do not store near heat or flame.

Incompatible Materials: Oxidizing agents and reducing agents.

Hazardous Decomposition Products: Under fire conditions may produce gases such as oxides of carbon, hydrogen and nitrogen.

Hazardous Reactions: Hazardous polymerization will not occur.

11. TOXICOLOGICAL INFORMATION

Toxicological Data:

Data from laboratory studies on this product are summarized below:

Oral: Rat LD₅₀: >5,000 mg/kg (female)

Dermal: Rat LD₅₀: >5,000 mg/kg

Inhalation: Rat 4-hr LC₅₀: >2.07 mg/L

Eye Irritation: Rabbit: Minimally irritating

Skin Irritation: Rabbit: Slightly irritating

Skin Sensitization: Not a contact sensitizer in guinea pigs following repeated skin exposure.

Subchronic (Target Organ) Effects: No adverse effects at approximately 1,700 mg/kg/day (highest dose tested).

Carcinogenicity / Chronic Health Effects: Imazapyr did not cause cancer in laboratory animals. EPA has classified imazapyr as a Group E (evidence of non-carcinogenicity for humans) carcinogen.

Reproductive Toxicity: The results of animal studies gave no indication of a fertility impairing effect.

Developmental Toxicity: No indications of a developmental toxic / teratogenic effect were seen in animal studies.

Genotoxicity: No mutagenic effect was found in various tests with microorganisms and mammals.

Assessment Carcinogenicity: None listed with ACGIH, IARC, NTP or OSHA.

See Section 2: HAZARDS IDENTIFICATION for more information.

12. ECOLOGICAL INFORMATION

Ecotoxicity:

Data on Imazapyr:

96-hour LC ₅₀ Bluegill:	>100 mg/l	Bobwhite Quail 8-day Dietary LC ₅₀ :	>5,000 ppm
96-hour LC ₅₀ Rainbow Trout:	>100 mg/l	Bobwhite Quail Oral LD ₅₀ :	>2,150 mg/kg
48-hour EC ₅₀ Daphnia:	>100 mg/l	Mallard Duck 8-day Dietary LC ₅₀ :	>5,000 ppm
Honey Bee LD ₅₀ :	>100 mg/bee	Mallard Duck Oral LD ₅₀ :	>2,150 mg/kg

Environmental Fate:

Imazapyr is degraded by microbial metabolism and can be relatively persistent in soils. It has an average half-life in soils that ranges from 2 weeks to 5 months. Half-lives tend to be shorter in forest litter and soils. Imazapyr is water-soluble and variably binds to organic materials in the soils. Although the potential to leach is high, leaching is limited under typical field conditions. In water, imazapyr can be rapidly degraded by photolysis with a half-life averaging 2 days. Due to its rapid photodegradation by sunlight, water contamination by imazapyr is generally not of concern.

13. DISPOSAL CONSIDERATIONS**Waste Disposal Method:**

Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Handling and Disposal:

Nonrefillable Containers 5 Gallons or Less: Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying. **Triple rinse as follows:** Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by State and local authorities. Plastic containers are also disposable by incineration, or, if allowed by State and local authorities, by burning. If burned stay out of smoke.

Nonrefillable containers larger than 5 gallons: Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available. Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse as follows:** Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times. **Pressure rinse as follows:** Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.

Refillable containers larger than 5 gallons: Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment or a mix tank. Fill the container about 10% full with water and, if possible, spray all sides while adding water. Agitate vigorously or recirculate water with the pump for two minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times. Then offer for recycling if available or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures allowed by state and local authorities. If burned, stay out of smoke.

14. TRANSPORTATION INFORMATION

Follow the precautions indicated in Section 7: HANDLING AND STORAGE of this MSDS.

DOT

Non Regulated – See 173.132(b)(3)

IMDG

Non Regulated - See IMDG 2.6.2.1.3

IATA

Non Regulated - See IATA 3.6.1.5.3

15. REGULATORY INFORMATION**U.S. Federal Regulations:**

TSCA Inventory: This product is exempted from TSCA because it is solely for FIFRA regulated use.

SARA Hazard Notification/Reporting:

Hazard Categories Under Criteria of SARA Title III Rules (40 CFR Part 370):

Immediate

Section 313 Toxic Chemical(s):

None

Reportable Quantity (RQ) under U.S. CERCLA:

None

RCRA Waste Code:

None

State Information:

Other state regulations may apply. Check individual state requirements.

California Proposition 65: Not listed

16. OTHER INFORMATION

This Material Safety Data Sheet (MSDS) serves different purposes than and DOES NOT REPLACE OR MODIFY THE EPA-ACCEPTED PRODUCT LABELING (attached to and accompanying the product container). This MSDS provides important health, safety and environmental information for employers, employees, emergency responders and others handling large quantities of the product in activities generally other than product use, while the labeling provides that information specifically for product use in the ordinary course.

Use, storage and disposal of pesticide products are regulated by the EPA under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) through the product labeling, and all necessary and appropriate precautionary, use, storage, and disposal information is set forth on that labeling. It is a violation of Federal law to use a pesticide product in any manner not prescribed on the EPA-accepted label.

Although the information and recommendations set forth herein (hereinafter "Information") are presented in good faith and believed to be correct as of the date hereof, Nufarm Americas Inc. makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability for their purposes prior to use. In no event will Nufarm Americas Inc. be responsible for damages of any nature whatsoever resulting from the use of or reliance upon Information. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR THE PRODUCT TO WHICH INFORMATION REFERS.

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Nufarm

POLARIS®

Herbicide

Applications may be made for the control of undesirable emergent and floating aquatic vegetation in estuarine marine surface water. For the control of undesirable vegetation in fencerows, non-irrigation ditch banks, for establishment and maintenance of wildlife openings, grass pastures and rangeland, unimproved industrial noncropland Bermudagrass and Bahiagrass, under certain paved areas, and industrial noncropland areas including railroad, utility, pipeline and highway rights-of-way, utility plant sites, petroleum tank farms, pumping installations, storage areas, non-irrigation ditchbanks, roads, transmission lines, and industrial bareground areas.

ACTIVE INGREDIENT:

Isopropylamine salt of Imazapyr: (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid)* 27.7%

OTHER INGREDIENTS: 72.3%

TOTAL: 100.0%

* Equivalent to 22.62% 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid or 2 pounds acid per gallon.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

**KEEP OUT OF REACH OF CHILDREN
CAUTION / PRECAUCION**

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

SEE INSIDE BOOKLET FOR ADDITIONAL
PRECAUTIONARY STATEMENTS

For Chemical Spill, Leak, Fire, or Exposure, Call CHEMTREC (800) 424-9300

For Medical Emergencies Only, Call (877) 325-1840

EPA Reg. No. 228-534

Manufactured for
Nufarm Americas Inc.
150 Harvester Drive
Burr Ridge, IL 60527



**PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION / PRECAUCION**

No human or domestic animal hazard statements are required. Follow instructions for Personal Protective Equipment and User Safety Recommendations.

PERSONAL PROTECTIVE EQUIPMENT (PPE):

Some materials are chemical resistant to this product are natural rubber ≥ 14 mils. If you want more options, follow the instructions for category A on the EPA chemical resistance category selection chart.

Mixers, loaders, applicators and other handlers must wear:

- Long-sleeved shirt and long pants,
- Shoes plus socks
- Chemical-resistant gloves for mixers and loaders, plus applicators using handheld equipment.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them.

Pilots must use an enclosed cockpit that meet the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d) (6)].

USER SAFETY RECOMMENDATIONS

Users Should:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. If pesticide gets on skin, wash immediately with soap and water.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

PHYSICAL AND CHEMICAL HAZARDS

Spray solutions of this product should be mixed, stored and applied only in stainless steel, fiberglass, plastic and plastic-lined steel containers.

Do not mix, store or apply this product or spray solutions of this product in unlined steel (except stainless steel) containers or spray tanks.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to plants. Drift and run off may be hazardous to plants in water adjacent to treated areas. Do not apply directly to water except as specified on the label. Treatment of aquatic weeds may result in oxygen depletion or loss due to decomposition of dead plants. Do not treat more than one half the surface area of the water in a single operation and wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outward in bands to allow aquatic organisms to move into untreated areas. Do not contaminate water when disposing of equipment washwater or rinsate. See Directions for Use for additional precautions and requirements.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

Do not use on food crops or Christmas trees. Keep from contact with fertilizers, insecticides, fungicides and seeds. Do not drain or flush equipment on or near desirable trees or other plants, or on areas where their roots may extend, or in locations where the treated soil may be washed or moved into contact with their roots. Do not side trim desirable vegetation with this product unless severe injury and plant death can be tolerated. Prevent drift of spray to desirable plants.

Clean application equipment after using this product by thoroughly flushing with water.

AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE) and restricted entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

DO NOT enter or allow worker entry into treated areas during the restricted entry interval (REI) of 48 hours.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:

- Coveralls
- Shoes plus socks
- Chemical-resistant gloves made of any waterproof material
- Protective eyewear

NON-AGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard (WPS) for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

Noncrop weed control is not within the scope of the Worker Protection Standard. See the PRODUCT INFORMATION section of this label for a description of noncrop sites.

DO NOT enter or allow others to enter treated areas until sprays have dried.

USE PRECAUTIONS AND RESTRICTIONS

Applications may be made for the control of undesirable emergent and floating aquatic vegetation in and around standing and flowing water, including estuarine and marine sites. Applications may be made to control undesirable wetland, riparian and terrestrial vegetation growing in or around surface water when applications may result in inadvertent applications to surface water.

Aerial application is restricted to fixed wing aircraft and to helicopter only. Only helicopters can be used for aquatic applications.

Aquatic application of this product can only be made by federal or state agencies, such as Water Management District personnel, municipal officials and the U.S. Army Corps of Engineers, or those applicators who are licensed or certified as aquatic pest control applicators and are authorized by the state or local government.

Treatment to other than non-native invasive species is limited to only those plants that have been determined to be a nuisance by a federal or state government entity.

Applications to private waters: Applications may be made to private waters that are still, such as ponds, lakes and drainage ditches where there is minimal or no outflow to public waters.

Application to public waters: Applications may be made to public waters such as ponds, lakes, reservoirs, marshes, bayous, drainage ditches, canals, streams, rivers, and other slow-moving or quiescent bodies of water for control of aquatic weeds or for control of riparian and wetland weed species.

Consult local state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.

Recreational Use of Water in Treatment Area: There are no restrictions on the use of water in the treatment area for recreational purposes, including swimming and fishing.

Livestock Use of Water in/from Treatment Area: There are no restrictions on livestock consumption of water from the treatment area.

Precautions for Potable Water Intakes: Do not apply this product directly to water within one-half mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within one-half mile of an active potable water intake in a standing body of water such as lake, pond or reservoir. To make aquatic applications around and within one-half mile of active potable water intakes, the water intake must be turned off during application and for a minimum of 48 hours after the application. These aquatic applications may be made only in the cases where there are alternative water sources or holding ponds, which would permit the turning off of an active potable water intake for a minimum period of 48 hours after the applications. Note: Existing potable water intakes which are no longer in use, such as those replaced by connections to wells or a municipal water system, are not considered to be active potable water intakes. This restriction does not apply to intermittent, inadvertent overspray of water in terrestrial use sites.

APPLICATION TO WATERS USED FOR IRRIGATION

Water treated with this product may not be used for irrigation purposes for 120 days after application or until product residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less.

Seasonal Irrigation Waters: This product may be applied during the off-season to surface waters that are used for irrigation on a seasonable basis, provided that there is a minimum of 120 days between product application and the first use of treated water for

irrigation purposes or until product residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less.

Irrigation Canals/Ditches: Do not apply this product to irrigation canals/ditches unless the 120-day restriction on irrigation water usage can be observed or product residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less. Do not apply this product to dry irrigation canals/ditches.

Quiescent or Slow Moving Waters: In lakes and reservoirs Do not apply this product within one (1) mile of an active irrigation water intake during the irrigation season. Applications less than one (1) mile from an inactive irrigation water intake may be made during the off-season, provided that the irrigation intake will remain inactive for a minimum 120 days after application or until product residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less.

Moving water: Do not apply within one-half mile downstream of an active irrigation water intake. When making applications upstream from an active irrigation water intake, the intake must be turned off for a period of time sufficient to allow the upstream portion of treated water to completely flow past the irrigation intake before use can resume. Shut off time will be determined by the speed of water flow and the distance and length of water treated upstream from the intake. Consult local, state and/or federal authorities before making any applications upstream from an active irrigation water intake.

PRODUCT INFORMATION

Aquatic Use Sites: This product is an aqueous solution to be mixed with water and a surfactant and applied as a spray solution to control floating and emergent undesirable vegetation (see AQUATIC WEEDS CONTROLLED section and the ADDITIONAL WEEDS CONTROLLED section) in or near bodies of water which may be flowing, non-flowing, or transient. This product may be applied to specified aquatic sites that include lakes, rivers, streams, ponds, seeps, drainage ditches, canals, reservoirs, swamps, bogs, marshes, estuaries, bays, brackish water, transitional areas between terrestrial and aquatic sites and seasonal wet areas. See AQUATIC USE section of this label for precautions, restrictions, and instructions on aquatic uses.

Read and observe the following directions if aquatic sites are present in terrestrial noncrop areas and are part of the intended treatment area:

Herbicidal Activity: This product will control most annual and perennial grasses and broadleaf weeds in addition to many brush and vine species with some residual control of undesirable species that germinate above the waterline. This product is readily absorbed through emergent leaves and stems and is translocated rapidly throughout the plant, with accumulation in the meristematic regions. Treated plants stop growing soon after spray application. Chlorosis appears first in the newest leaves, and necrosis spreads from this point. In perennials, the herbicide is translocated into, and kills, underground or submerged storage organs, which prevents regrowth. Chlorosis and tissue necrosis may not be apparent in some plant species until two or more weeks after application. Complete kill of plants may not occur for several weeks. Applications of this product are rainfast one hour after treatment.

This product does not control plants which are completely submerged or have a majority of their foliage under water.

Application Methods: This product must be applied to the emergent foliage of the target vegetation and has little to no activity on submerged aquatic vegetation. Product concentrations resulting from direct application to water are not expected to be of sufficient concentration or duration to provide control of target vegetation. Application should be made in such a way as to maximize spray interception by the target vegetation while minimizing the amount of overspray that enters the water. For maximum activity, weeds should be growing vigorously at the time of application and the spray solution should include a surfactant (See ADJUVANTS section for specific recommendations). This product may be selectively applied by using low-volume directed application techniques or may be broadcast-applied by using ground equipment, watercraft or by helicopter. In addition, this product may also be used for cut stump, cut stem and frill and girdle treatments within aquatic sites (see AERIAL APPLICATIONS and GROUND APPLICATIONS sections for additional details).

This product should be applied with surface or helicopter application equipment in a minimum of 5 gallons of water per acre. When applying by helicopter, follow directions under the AERIAL APPLICATIONS section of this label, otherwise refer to section on GROUND APPLICATIONS when using surface equipment.

Applications made to moving bodies of water should be made while traveling upstream to prevent concentration of this herbicide in water. Do not apply to bodies of water or portions of bodies of water where emergent and/or floating weeds do not exist.

When application is to be made to target vegetation that covers a large percentage of the surface area of impounded water, treating the area in strips may avoid oxygen depletion due to decaying vegetation. Oxygen depletion may result in the suffocation of some sensitive aquatic organisms. Do not treat more than one half of the surface area of the water in a single operation and wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outward in bands to allow aquatic organisms to move into untreated areas.

Avoid wash-off of sprayed foliage by spray boat or recreational boat backwash for one hour after application.

Apply this product at 2 to 6 pints per acre depending on species present and weed density. Do not exceed the maximum label rate of 6 pints per acre (1.5 lb ai/A) per year. Use the higher labeled rates for heavy weed pressure. Consult the AQUATIC WEEDS CONTROLLED section and the ADDITIONAL WEEDS CONTROLLED section of this label for specific rates.

This product may be applied as a draw down treatment in areas described above. Apply this product to weeds after water has been drained and allow 14 days before reintroduction of water.

Terrestrial Use Sites: This product is an aqueous solution to be mixed with water and a surfactant and applied as a spray solution to grass pasture and rangeland and noncropland areas such as railroad, utility, pipeline and highway rights-of-way, utility plant sites,

petroleum tank farms, pumping installations, fence rows, storage areas, non-irrigation ditchbanks, including grazed or hayed areas within these sites. This product is used for the establishment and maintenance of wildlife openings. This product may also be used for the release of unimproved Bermudagrass (see specific directions) and for use under certain paved surfaces (see specific directions).

Application Methods: This product will control most annual and perennial grasses and broadleaf weeds in addition to many brush and vine species and this product will provide residual control of labeled weeds which germinate in the treated areas. This product may be applied either preemergence or post-emergence to the weeds; however, post-emergence application is the method of choice in most situations, particularly for perennial species. For maximum activity, weeds should be growing vigorously at the time of post-emergence application and the spray solution should include a surfactant (See Adjuvant Section for specific recommendations). These solutions may be applied selectively by using low-volume techniques or may be applied broadcast by using ground equipment or aerial equipment. In addition, this product may also be used for stump and cut stem treatments (see specific directions).

Herbicidal Activity: This product is readily absorbed through leaves, stems, and roots and is translocated rapidly throughout the plant, with accumulation in the meristematic regions. Treated plants stop growing soon after spray application. Chlorosis appears first in the newest leaves, and necrosis spreads from this point. In perennials, the herbicide is translocated into, and kills, underground storage organs which prevents regrowth. Chlorosis and tissue necrosis may not be apparent in some plant species until two weeks after application. Complete kill of plants may not occur for several weeks. Applications of this product are rainfast one hour after treatment.

PRECAUTIONS FOR AVOIDING INJURY TO NON-TARGET PLANTS

Untreated desirable plants can be affected by root uptake of this product from treated soil. Injury or loss of desirable plants may result if this product is applied on or near desirable plants, on areas where their roots extend, or in locations where the treated soil may be washed or moved into contact with their roots. When making applications along shorelines where desirable plants may be present, caution should be exercised to avoid spray contact with their foliage or spray application to the soil in which they are rooted. Shoreline plants that have roots that extend into the water in an area where this product has been applied generally will not be adversely affected by uptake of the herbicide from the water.

If treated vegetation is to be removed from the application site, Do not use the vegetative matter as mulch or compost on or around desirable species.

Untreated trees can occasionally be affected by root uptake of this product through movement into the top soil. Injury or loss of desirable trees or other plants may result if this product is applied on or near desirable trees or other plants, on areas where their roots extend, or in locations where the treated soil may be washed or moved into contact with their roots.

MANAGING OFF-TARGET MOVEMENT

The following information is provided as general guidance for managing off-target movement. Specific use for this product may differ depending on the application technique used and the vegetation management objective.

Spray Drift: Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment-and-weather-related factors determines the potential for spray drift. The applicator and the entity authorizing spraying are responsible for considering all these factors when making decisions. The following drift management requirements must be followed to avoid off-target drift movement from aerial applications: 1) The distance of the outer most operating nozzles must not exceed 3/4 the length of the rotor. 2) Nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees. Where states have more stringent regulations, they must be observed.

Spray drift from applying this product may result in damage to sensitive plants adjacent to the treatment area. Only apply this product when the potential for drift to these and other adjacent sensitive areas (e.g. residential areas, bodies of water, known habitat for threatened or endangered species, or non-target crops) is minimal. Do not apply when the following conditions exist that increase the likelihood of spray drift from intended targets: high or gusty winds, high temperatures, low humidity, temperature inversions.

To minimize spray drift, the applicator should be familiar with and take into account the following drift reduction advisory information. Additional information may be available from state enforcement agencies or the Cooperative Extension on the application of this product.

The best drift management strategy and most effective way to reduce drift potential are to apply large droplets that provide sufficient coverage and control. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly, or under unfavorable environmental conditions (see WIND, TEMPERATURE AND HUMIDITY, and TEMPERATURE INVERSIONS).

CONTROLLING DROPLET SIZE

- Volume - Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with higher rated flows produce larger droplets.
- Pressure - Do not exceed the nozzle manufacturer's recommended pressures. For many nozzle types, lower pressure produces larger droplets. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.
- Number of Nozzles - Use the minimum number of nozzles that provide uniform coverage.
- Nozzle Orientation - Orienting nozzles so that the spray is released parallel to the airstream produces larger droplets than other orientations and is recommended practice. Significant deflection from the horizontal will reduce droplet size and increase drift potential.
- Nozzle Type - Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low-drift nozzles. Solid stream nozzles oriented straight back produce the largest droplets and the lowest drift. Do not use nozzles producing a mist droplet spray.

APPLICATION HEIGHT

Making applications at the lowest possible height (helicopter, ground driven spray boom) that is safe and practical reduces exposure of droplets to evaporation and wind.

SWATH ADJUSTMENT

When applications are made with a crosswind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the treatment area, the applicator must compensate for this displacement by adjusting the path of the application equipment (e.g. aircraft, ground) upwind. Swath adjustment distance should increase with increasing drift potential (higher wind, smaller droplets, etc.).

WIND

Drift potential is lowest between wind speeds of 3-10 mph. However, many factors, including droplet size and equipment type, determine drift potential at any given speed. Application should be avoided below 3 mph due to variable wind direction and high inversion potential. NOTE: Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect spray drift.

TEMPERATURE AND HUMIDITY

When making applications in low relative humidity, set up equipment to produce larger droplets to compensate for evaporation. Droplet evaporation is most severe when conditions are both hot and dry.

TEMPERATURE INVERSIONS

Drift potential is high during a temperature inversion. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud, which can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical air mixing.

WIND EROSION

Avoid treating powdery dry or light sandy soils when conditions are favorable for wind erosion. Under these conditions, the soil surface should first be settled by rainfall or irrigation.

ADJUVANTS

Post-emergence applications of this product require the addition of a spray adjuvant for optimum herbicide performance. Only spray adjuvants that are approved or appropriate for aquatic use should be utilized. The addition of a Chemical Producers and Distributors Association (CPDA) certified adjuvant can increase control. A CPDA certified drift control agent may also be used.

Nonionic Surfactants: Use a nonionic surfactant at the rate 0.25% v/v or higher (see manufacturer's label) of the spray solution (0.25% v/v is equivalent to 1 quart in 100 gallons). For best results, select a nonionic surfactant with a HLB (hydrophilic to lipophilic balance) ratio between 12 and 17 with at least 70% surfactant in the formulated product (alcohols, fatty acids, oils, ethylene glycol or diethylene glycol should not be considered as surfactants to meet the above requirements).

Methylated Seed Oils or Vegetable Oil Concentrates; Instead of a surfactant, a methylated seed oil or vegetable-based seed oil concentrate may be used at the rate of 1.5 to 2 pints per acre. When using spray volumes greater than 30 gallons per acre, methylated seed oil or vegetable based seed oil concentrates should be mixed at a rate of 1 % of the total spray volume, or alternatively use a nonionic surfactant as described above. Research indicates that these oils may aid in product deposition and uptake by plants under moisture or temperature stress.

Silicone Based Surfactants: See manufacturer's label for specific rate recommendations. Silicone-based surfactants may reduce the surface tension of the spray droplet, allowing greater spreading on the leaf surface as compared to conventional nonionic surfactants. However, some silicone-based surfactants may dry too quickly, limiting herbicide uptake.

Invert emulsions; This product can be applied as an invert emulsion. The spray solution results in an invert (water-in-oil) spray emulsion designed to minimize spray drift and spray run-off, resulting in more herbicide on the target foliage. The spray emulsion may be formed in a single tank (batch mixing) or injected (in-line mixing). Consult the invert chemical label for proper mixing directions.

Fertilizer/Surfactant Blends: Nitrogen based liquid fertilizers such as 28%N, 32%N, 10-34-0 or ammonium sulfate, may be added at the rate of 2 to 3 pints per acre in combination with the recommended rate of nonionic surfactant, methylated seed oil or vegetable/seed oil concentrate. The use of fertilizers in a tank mix without a nonionic surfactant, methylated seed oil or vegetable/seed oil concentrate is not recommended.

Other: An antifoaming agent, spray pattern indicator or drift reducing agent may be applied at the product labeled rate if necessary or desired.

TANK MIXES

This product may be tank-mixed with other herbicides provided that the label for the tank mix product does not prohibit such mixing. Consult manufacturer's labels for specific rates and weeds controlled. Always follow the more restrictive label when making an application involving tank-mixes.

AERIAL APPLICATIONS

All restrictions must be taken to minimize or eliminate spray drift. Both helicopter and fixed wing aircraft can be used to apply this product, but applications to aquatic sites are restricted to helicopter only. Do not make applications by helicopter or fixed wing aircraft unless appropriate buffer zones can be maintained to prevent spray drift out of the target area, or when spray drift as a result of helicopter application can be tolerated.

Uniformly apply the specified amount of this product in 2 to 30 gallons of water per acre. A foam reducing agent may be added at the specified label rate.

Immediately after each use of this product thoroughly clean application equipment, including landing gear. Uncoated steel surfaces (except stainless steel surfaces) may result in corrosion and failure after prolonged exposure to the product. The maintenance of a paint (organic coating) may prevent corrosion.

Aerial Applications Restrictions:

1. Applicators are required to use a Coarse or Coarser droplet size (ASABE S572) or, if specifically using a spinning atomizer nozzle, applicators are required to use a volume mean diameter (VMD) of 385 microns or greater for release heights below 10 feet; Applicators are required to use a Very Coarse or coarser droplet size or, if specifically using a spinning atomizer nozzle, applicators are required to use a VMD of 475 microns or greater for release heights above 10 feet; Applicators must consider the effects of nozzle orientation and flight speed when determining droplet size.
2. Applicators are required to use upwind swath displacement.
3. The boom length must not exceed 60% of the wingspan or 90% of the rotor blade diameter to reduce spray drift.
4. Applications with wind speeds less than 3 mph and with wind speeds greater than 10 mph are prohibited.
5. Applications into temperature inversions are prohibited.
6. Aerial equipment designed to minimize spray drift, such as a helicopter equipped with a Microfoil boom, Thru-Valve boom or raindrop nozzles, must be used and calibrated. Except when applying with a Microfoil boom, a drift control agent may be added at the recommended label rate.

GROUND APPLICATION (BROADCAST)

FOLIAR APPLICATIONS

Low Volume Foliar:

Use equipment calibrated to deliver 5 to 20 gallons of spray solution per acre. To prepare the spray solution, thoroughly mix in water 0.5 to 5% of this product plus surfactant (see the ADJUVANTS section of this label for specific recommendations). A foam reducing agent may be applied at the recommended label rate, if needed. For control of difficult species (see AQUATIC WEEDS CONTROLLED section and the TERRESTRIAL WEEDS CONTROLLED section for relative susceptibility of weed species), use the higher concentrations of herbicide and/or spray volumes but do not apply more than 6 pints of this product per acre. Excessive wetting of foliage is not recommended. See the MIXING GUIDE below for some suggested volumes of this product and water.

For low volume, select proper nozzles to avoid over-application. Proper application is critical to ensure desirable results. Best results are achieved when the spray covers the crown and approximately 70% of the plant. The use of an even flat fan tip with a spray angle of 40 degrees or less will aid in proper deposition.

Recommended tip sizes include 4004E, or 1504E. For a straight stream and cone pattern, adjustable cone nozzles such as 5500 X3 or 5500 X4 may be used. Attaching a rollover valve onto a Spraying Systems Model 30 gunjet or other similar spray guns allows for the use of both a flat fan and cone tips on the same gun.

Moisten, but do not drench target vegetation causing spray solution to run off.

Low Volume Foliar with Backpacks:

For low-growing species, spray down on the crown, covering crown and penetrating approximately 70% of the plant.

For target species 4 to 8 feet tall, swipe the sides of target vegetation by directing spray to at least two sides of the plant in smooth vertical motions from the crown to the bottom. Make sure to cover the crown whenever possible.

For target species over 8 feet tall, lace sides of the target vegetation by directing spray to at least two sides of the target in smooth zigzag motions from crown to bottom.

Low Volume Foliar with Hydraulic Handgun Application Equipment:

Use same technique as described above for Low Volume Foliar with Backpacks.

For broadcast applications, simulate a gentle rain near the top of target vegetation, allowing spray to contact the crown and penetrate the target foliage without falling to the understory. Herbicide spray solution which contacts the understory may result in severe injury or death of plants in the understory.

SPRAY SOLUTION MIXING GUIDE FOR LOW-VOLUME FOLIAR APPLICATIONS

AMOUNT OF SPRAY SOLUTION BEING PREPARED	DESIRED CONCENTRATION (fluid volume)				
	0.5%	0.75%	1%	1.5%	5%
	(amount of product to use)				
1 gallon	0.6 fl. oz.	0.9 fl. oz.	1.3 fl. oz.	1.9 fl. oz.	6.5 fl. oz.
3 gallons	1.9 fl. oz.	2.8 fl. oz.	3.8 fl. oz.	5.8 fl. oz.	1.2 pint
4 gallons	2.5 fl. oz.	3.8 fl. oz.	5.1 fl. oz.	7.7 fl. oz.	1.6 pint
5 gallons	3.2 fl. oz.	4.8 fl. oz.	6.5 fl. oz.	9.6 fl. oz.	2 pints
50 gallons	2 pints	3 pints	4 pints	6 pints	10 quarts
100 gallons	4 pints	6 pints	8 pints	6 quarts	5 gallons
2 Tablespoons = 1 fluid ounce					

High Volume Foliar:

For optimum performance when spraying medium to high-density vegetation and brush, use equipment calibrated to deliver up to 100 gallons of spray solution per acre (GPA). Spray solutions exceeding 100 GPA may result in excessive spray run-off, causing increased ground cover injury, and injury to desirable species. To prepare the spray solution, thoroughly mix this product in water and add a surfactant (see ADJUVANT section for specific recommendations and rates of surfactants). A foam-reducing agent may be added at the recommended label rate, if needed. For control of difficult species (see AQUATIC WEEDS CONTROLLED section and the ADDITIONAL WEEDS CONTROLLED section for relative susceptibility of weed species), use the higher concentrations of herbicide and/or spray volumes, but do not apply more than 6 pints of this product per acre in aquatic and non-cropland sites and 3 pints per acre in pasture and rangeland sites. Uniformly cover the foliage of the vegetation to be controlled but do not apply to run-off. Excessive wetting of foliage is not recommended.

Side Trimming:

Do not side trim with this product unless severe injury or death of the treated tree can be tolerated. This product is readily translocated and can result in death of the entire tree.

Ground Boom Applications Restrictions:

1. Applicators are required to use a nozzle height below 4 feet above the plant canopy or the ground and coarse or Coarser droplet size (ASABE S572) or, if specifically using a spinning atomizer nozzle, applicators are required to use a volume mean diameter (VMD) of 385 microns or greater.
2. Applications with wind speeds greater than 10 mph are prohibited.
3. Applications into temperature inversions are prohibited.

CUT SURFACE TREATMENTS

This product may be used to control undesirable woody vegetation by applying the product solution to the cambium area of freshly cut stump surfaces or to fresh cuts on the stem of the target woody vegetation. Applications can be made at any time of the year except during periods of heavy sap flow in the spring. Do not over apply solution causing run-off from the cut surface.

Injury may occur to desirable woody plants if the shoots extend from the same root system or their root systems are grafted to those of the treated tree.

Mixing: This product may be mixed as either a concentrated or dilute solution for stump and cut stem treatments. The dilute solution may be used for applications to the surface of the stump or to cuts on the stem of the target woody vegetation. Concentrated solutions may be used for applications to cuts on the stem. Use of the concentrated solution permits application to fewer cuts on the stem, especially for large diameter trees. Follow the application instructions to determine proper application techniques for each type of solution.

- To prepare a dilute solution, mix 8 to 12 fluid ounces of this product with one gallon of water. If temperatures are such that freezing of the spray mixture may occur, antifreeze (ethylene glycol) may be used according to manufacturer's label to prevent freezing. The use of a surfactant or penetrating agent may improve uptake through partially callused cambiums.
- To prepare a concentrated solution, mix 2 quarts of this product with no more than 1 quart of water.

Cut stump treatments:

- Dilute Solution - Spray or brush the solution onto the cambium area of the freshly cut stump surface. Insure that the solution thoroughly wets the entire cambium area (the wood next to the bark of the stump).

Cut stem (injection, hack & squirt) treatments:

- Dilute Solutions- Using standard injection equipment, apply 1 milliliter of solution at each injection site around the tree with no more than one-inch intervals between cut edges. Insure that the injector completely penetrates the bark at each injection site.
- Concentrate Solutions- Using standard injection equipment, apply 1 milliliter of solution at each injection site. Make at least one injection cut for every 3 inches of Diameter at Breast Height (DBH) on the target tree. For example, a 3-inch DBH tree will receive 1 injection cut and a 6-inch DBH tree will receive 2 injection cuts. On trees requiring more than one injection site place the injection cuts at approximately equal intervals around the tree.

Frill or girdle treatments:

- Using a hatchet, machete, or chain saw, make cuts through the bark and completely around the tree to expose the cambium. The cut should angle downward extending into the cambium enough to expose at least two growth rings. Using a spray applicator or brush, apply a 25% to 100% solution of this product into each cut until thoroughly wet. Avoid applying so much herbicide that runoff to the ground or water occurs.

NONCROPLAND USES

When applied as directed and under the conditions described applications may be made for the control of undesirable vegetation growing in the following areas: airfields; airports; alleys, lanes, trails & access roads; around commercial or industrial structures or outbuildings; around farm and ranch structures and outbuildings; around ornamental gardens; around ornamental trees & shrubs; bare ground; beaches; campgrounds; construction sites; ditch banks; drive-in theaters; driveways & ramps; dry ditches & canals; fences & fencerows; firebreaks; gravel yards; habitat restoration & management areas; highways & roadsides (including aprons, medians, guardrails & right of ways); industrial plant sites; industrial areas; lumber yards; mulched areas; natural areas; paths and trails; parking areas; parks; paved areas; petroleum & other tank farms; pumping installations; pipeline, power, telephone & utility rights-of-way; power stations; preplant to turf & ornamental plants; railroad rights-of way; recreation areas; refineries; resorts; schools; sidewalks; sports areas; storage areas; substations; tennis courts; uncropped farmstead areas; uncultivated non-agricultural areas; vacant lots; walkways; wastelands; & wildlife habitat areas.

This product may also be used for the establishment and maintenance of wildlife openings, for the release of unimproved Bermudagrass and Bahiagrass, for bareground weed control, and for under certain paved surfaces. Applications to noncropland areas are not applicable to treatment of commercial timber or other plants grown for slae or other commercial use, or for commercial seed production, or for research purposes.

TANK-MIXES AND APPLICATION RATES FOR LOW VOLUME FOLIAR CONTROL *

Target Vegetation	Rate of this product	Tank Mix
Mixed hardwoods without elm, locust, or pine	1.0 - 1.5% by volume	Surfactant
Mixed hardwoods containing elm, locust, and pine	0.5 - 1.0% by volume	Accord® at 2 - 3% by volume plus surfactant
Mixed hardwoods with locust and pine but no elm	0.5 - 1.0% by volume	krenite at 2 - 5% by volume plus surfactant
Mixed hardwoods with locust and elm but no pine	0.5 - 1.0% by volume	Escort® at 2 oz./Acre or 2.3 grams/gal. plus surfactant

* Tank-Mixes with 2,4-D or products containing 2,4-D have resulted in reduced efficacy of this product.

MIXING CHART

% Solution	Amount of this product per Gallon of Mix	Amount of this product per 4 Gallon Backpack
0.5%	0.6 fl. oz.	2.6 fl. oz.
1.0%	1.3 fl. oz.	5.1 fl. oz.
2.0%	2.6 fl. oz.	10.2 fl. oz.
3.0%	3.8 fl. oz.	15.4 fl. oz.
5.0%	6.4 fl. oz.	25.6 fl. oz.

MEASURING CHART		
128 fluid ounces	=	1 gallon
16 fluid ounces	=	1 pint
8 pints	=	1 gallon
4 quarts	=	1 gallon
2 pints	=	1 quart

**FOR CONTROL OF UNDESIRABLE WEEDS IN UNIMPROVED BERMUDAGRASS AND BAHIAGRASS
AND OTHER NON-CROPLAND INDUSTRIAL SITES**

This product may be used on unimproved industrial noncropland Bermudagrass and bahiagrass turf, roadsides and utility rights-of-way. The application of this product on established common and coastal Bermudagrass and bahiagrass provides control of labeled broadleaf and grass weeds. Competition from these weeds is eliminated, releasing the Bermudagrass and bahiagrass. Treatment of Bermudagrass with this product results in a compacted growth habit and seedhead inhibition.

Uniformly apply with properly calibrated ground equipment using at least 10 gallons of water per acre with a spray pressure 20 to 50 psi. **IMPORTANT:** Temporary yellowing of grass may occur when treatment is made after growth commences. **DO NOT** add surfactant in excess of the recommended rate (1 fl. oz. per 25 gallons of spray solution). **DO NOT APPLY** to grass during its first growing season. **DO NOT APPLY** to grass that is under stress from drought, disease, insects, or other causes.

DOSAGE RATES AND TIMING:

Bermudagrass - Apply this product at 6 to 12 fl. oz. per acre when the Bermudagrass is dormant. Apply this product at 6 to 8 fl. oz. per acre after the bermudagrass has reached full green-up. Applications made during green-up will delay green-up. Include a surfactant in the spray solution (See **IMPORTANT** statement above).

For additional pre-emergence control of annual grasses and small seeded broadleaf weeds, add Pendulum® Aquacap™ herbicide at the rate of 3.1 to 6.3 pints per acre. Consult the Pendulum® label for weeds controlled and for other use directions and precautions.

For control of Johnsongrass in bermudagrass turf, apply this product at 8 fl. oz. per acre plus Roundup® at 12 fl. oz. per acre plus surfactant. For additional control of broadleaves and vines, Tahoe®3A or Garlon®3A may be added to the above mix at the rate of 1-2 pints per acre. Observe all precautions and restrictions on the Tahoe®3A, Garlon®3A and Roundup® labels.

Bahiagrass - Apply this product at 4 to 8 fl. oz. per acre when the bahiagrass is dormant or after the grass has initiated green-up but has not exceeded 25% green-up. Include in the spray solution a surfactant (See Adjuvant section for specific recommendations on surfactants).

WEEDS CONTROLLED

- | | | |
|--|---|---|
| Bedstraw (<i>Galium spp.</i>) | Foxtail (<i>Setaria spp.</i>) | White clover (<i>Trifolium repens</i>) |
| Bishopweed (<i>Ptilimnium capillaceum</i>) | Little barley (<i>Hordeum pusillum</i>) | Yellow woodsorrel (<i>Oxalis stricta</i>) |
| Buttercup (<i>Ranunculus parviflorus</i>) | Seedling Johnsongrass (<i>Sorghum</i> | |
| Carolina geranium (<i>Geranium carolinianum</i>) | <i>halepense</i>) | |
| Fescue (<i>Festuca spp.</i>) | Wild carrot (<i>Daucus carota</i>) | |

GRASS GROWTH AND SEEDHEAD SUPPRESSION

This product may be used to suppress growth and seedhead development of certain turfgrass in unimproved areas. When applied to desirable turf, this product may result in temporary turf damage and/or discoloration. Effects to the desirable turf may vary with environmental conditions. For optimum performance, application should be made prior to culm elongation. Applications may be made before or after mowing. If applied prior to mowing, allow at least three days of active growth before mowing. If following a mowing, allow sufficient time for the grasses to recover before applying this product or injury may be amplified.

DO NOT APPLY to turf under stress (drought, cold, insect damaged, etc.) or severe injury or death may occur.

Bermudagrass - Apply this product at 6 to 8 fl. oz. per acre from early green-up to prior to seed head initiation. **DO NOT** add a surfactant for this application.

Cool Season Unimproved Turf - Apply this product at 2 fl. oz. per acre plus 0.25% nonionic surfactant. For increased suppression, this product may be tank-mixed with such products as Campaign® (24 fl. oz. per acre) or Embark® (8 fl. oz. per acre).

Tank-mixes may increase injury to desired turf. Consult each product label for recommended turf species and other use directions and precautions. Tank mixes with 2,4-D or products containing 2,4-D may decrease the effectiveness of this product.

TOTAL VEGETATION CONTROL WHERE BAREGROUND IS DESIRED

This product is an effective herbicide for preemergence or post-emergence control of many annual and perennial broadleaf and grass weeds where bareground is desired. This product is particularly effective on hard-to-control perennial grasses. This product at 1.5 to 6 pints per acre can be used alone or in tank-mix with herbicides approved for use in bare ground. The degree and duration of control are dependent on the rate of this product used, tank-mix partner, the volume of carrier, soil texture, rainfall and other conditions.

Consult manufacturer's labels for specific rates and weeds controlled. Always follow the more restrictive label when making an application involving tank-mixes.

TANK MIX RECOMMENDATIONS FOR BAREGROUND

Herbicide Rates per Acre*		
This product in Pints	Pendulum® 3.3 EC in Quarts	Diuron in Pounds a.i.
1.5 - 3	4.8	4 - 6
2 - 4	4.8	6 - 10
3 - 6	4.8	8 - 12

* Use higher rates for fall applications and in areas that have not been previously treated or that feature heavy infestations.

Applications of this product may be made anytime of the year. Use equipment calibrated to deliver desired gallons per acre spray volume and uniformly distribute the spray pattern over the treated area.

Post-emergence Applications: Always use a spray adjuvant (See Adjuvant section of this label) when making a post-emergence application. For optimum performance on tough to control annual grasses, applications should be made at a total volume of 100 gallons per acre or less. For quicker burndown or brown-out of target weeds, this product may be tank-mixed with products such as Razor®, or Roundup®. Tank mixes with 2,4-D or products containing 2,4-D may reduce the performance of this product. Always follow the more restrictive label when tank-mixing.

Spot Treatments: This product may be used as a follow-up treatment to control escapes or weed encroachment in a bareground situation. To prepare the spray solution, thoroughly mix in each gallon of water 0.5 to 5% of this product plus an adjuvant. For increased burndown, include Razor®, Roundup® or similar products. For added residual weed control or to increase the weed spectrum, add Pendulum® Aquacap™ herbicide, Overdrive® herbicide or diuron. Always follow the more restrictive label when tank-mixing.

FOR CONTROL OF UNDESIRABLE WEEDS UNDER PAVED SURFACES

This product can be used under asphalt, pond liners and other paved areas, ONLY in industrial sites or where the pavement has a suitable barrier along the perimeter that prevents encroachment of roots of desirable plants.

This product should be used only where the area to be treated has been prepared according to good construction practices. If rhizomes, stolons, tubers or other vegetative plant parts are present in the site, they should be removed by scalping with a grader blade to a depth sufficient to insure their complete removal.

IMPORTANT: Paving should follow applications of this product as soon as possible. DO NOT apply where the chemical may contact the roots of desirable trees or other plants.

Injury or death of desirable plants may result if this product is applied where roots are present or where they may extend into the treated area. Roots of trees and shrubs may extend a considerable distance beyond the branch extremities or so-called drip line.

APPLICATION DIRECTIONS FOR PAVED SURFACES:

Applications should be made to the soil surface only when final grade is established. Do not move soil following application of this product. Apply this product in sufficient water (at least 100 gal. per acre) to ensure thorough and uniform wetting of the soil surface, including the shoulder areas. Add this product at a rate of 6 pints per acre (2.2 fluid ounce per 1000 square feet) to clean water in the spray tank during the filling operation. Agitate before spraying.

If the soil is not moist prior to treatment, incorporation of this product is needed for herbicide activation. This product can be incorporated into the soil to a depth of 4 to 6 inches using a rototiller or disc. Rainfall or irrigation of 1 inch will also provide uniform incorporation. Do not allow treated soil to wash or move into untreated areas.

SPOT TREATMENTS AND CRACK -AND-CREVICE TREATMENTS:

Use this product as a follow up or initial treatment to control weed escapes or weed encroachment in bareground situations, including cracks and crevices in paved surfaces such as parking lots, paths, sidewalks, runways and roadways.

FOR SPOT TREATMENT WEED CONTROL IN GRASS PASTURE AND RANGELAND

For the control of undesirable vegetation in grass pasture and rangeland, this product may be applied as a spot treatment at a rate of 2 to 48 fluid ounces of product per acre using any of the ground application methods as described in this label. Spot applications may not exceed more than one tenth of the area to be grazed or cut for hay in grass pasture and rangeland. See appropriate sections of this label for specific use directions for the application method and vegetation control desired.

Do not apply more than 48 fluid ounces per acre per year.

Grazing and Haying Restrictions:

- Do not cut forage grass for hay for 7 days after application of this product.
- There are no grazing restrictions following application of this product.

Rangeland Use Instructions:

This product may be applied to rangeland for the control of undesirable vegetation to achieve one or more of the following vegetation management objectives:

- Control of undesirable (noxious, invasive and non-native) plant species.
- Control of undesirable vegetation for wildlife habitat improvement.
- Control of undesirable vegetation to aid in the establishment of desirable rangeland plant species.
- Release of existing desirable rangeland plant communities from the competitive pressure of undesirable plant species.
- Control of undesirable vegetation to aid in the establishment of undesirable vegetation following a fire.
- Control of undesirable vegetation to reduce wildfire fuel.

To ensure the protection of threatened and endangered plants, when applying this product to rangeland:

- Federal agencies must follow NEPA regulations to ensure protection of threatened and endangered plants.
- Other organizations or individuals must operate under a habitat conservation plan if threatened or endangered plants are known to be present on the land to be treated.
- State agencies must work with the Fish and Wildlife Service or the Service's designated state conservation agency to ensure protection of threatened and endangered plants.

See appropriate sections of this label for specific use directions for the desired rangeland vegetation management control desired.

This product must only be applied to a given rangeland acre as specific weed problems arise. Long-term control of undesirable weeds ultimately depends on the successful use of the land management practices that promote the sustainability and growth of desirable rangeland plant species.

ROTATIONAL CROP GUIDELINE

Rotational crops may be planted 12 months after applying this product at the specified pasture and rangeland rate. Twelve months after an application of this product, and before planting any crop, a successful field bioassay must be completed. The field bioassay consists of a test strip of the intended rotational crop planted in the previously treated area in the grass pasture and rangeland once grown to maturity. The test strip should include low areas and knolls, and include variations in soil type and pH within the treated area. If no crop injury is evident in the test strip, the intended rotational crop may be planted the following year.

Use of this product in accordance with label directions is expected to result in normal growth of rotational crops in most situations; however, various agronomic factors and environmental factors make it impossible to eliminate all risks associated with the use of this product and, therefore, rotational crop injury is always possible.

TERRESTRIAL WEEDS CONTROLLED

In terrestrial sites, this product will provide pre-emergence or post-emergence control with residual control of the following target vegetation species at the rates listed. Residual control refers to control of newly germinating seedlings in both annuals and perennials. In general, annual weeds may be controlled by pre-emergence or post-emergence applications of this product. For established biennials and perennials post-emergence applications of this product are recommended.

The rates shown below pertain to broadcast applications and indicate the relative sensitivity of these weeds. The relative sensitivity should be referenced when preparing low volume spray solutions (see "Low Volume" section of "Ground Applications"); low volume applications may provide control of the target species with less product per acre than is shown for the broadcast treatments. This product should be used only in accordance with the Directions for Use on this label.

The relative sensitivity of the species listed below can also be used to determine the relative risk of causing non-target plant injury if any of the below listed species are considered to be desirable within the area to be treated.

Resistant Biotypes: Naturally occurring biotypes (a plant within a given species that has a slightly different, but distinct genetic makeup from other plants of the same species) of some weeds listed on this label may not be effectively controlled. If naturally occurring resistant biotypes are present in an area, this product should be tank-mixed or applied sequentially with an appropriate registered herbicide having a different mode of action to ensure control.

GRASSES

COMMON NAME	SPECIES	GROWTH HABIT ²
Apply 2-3 pints per acre¹		
Annual bluegrass	(<i>Poa annua</i>)	A
Broadleaf signalgrass	(<i>Brachiaria platyphylla</i>)	A
Canada bluegrass	(<i>Poa compressa</i>)	P
Downy brome	(<i>Bromus tectorum</i>)	A
Fescue	(<i>Festuca</i> spp.)	A/P
Foxtail	(<i>Setaria</i> spp.)	A
Italian ryegrass	(<i>Lolium multiflorum</i>)	A
Johnsongrass	(<i>Sorghum halepense</i>)	P
Kentucky bluegrass	(<i>Poa pratensis</i>)	P
Lovegrass	(<i>Eragrostis</i> spp.)	A/P
*Napier grass	(<i>Pennisetum purpureum</i>)	P
Orchardgrass	(<i>Dactylis glomerata</i>)	P
Paragrass	(<i>Brachiaria mutica</i>)	P
Quackgrass	(<i>Agropyron repens</i>)	P
Sandbur	(<i>Cenchrus</i> spp.)	A
Sand dropseed	(<i>Sporobolus cryptandrus</i>)	P
Smooth brome	(<i>Bromus inermis</i>)	P
Vaseygrass	(<i>Paspalum urvillei</i>)	P
Wild oats	(<i>Avena fatua</i>)	A
Witchgrass	(<i>Panicum capillare</i>)	A
Apply 3-4 pints per acre¹		
Barnyardgrass	(<i>Echinochloa crus-gali</i>)	A
Beardgrass	(<i>Andropogon</i> spp.)	P
Bluegrass, Annual	(<i>Poa annua</i>)	A
*Bulrush	(<i>Scirpus validus</i>)	P
Cheat	(<i>Bromus secalinus</i>)	A
Crabgrass	(<i>Digitaria</i> spp.)	A
Crowfootgrass	(<i>Dactyloctenium aegyptium</i>)	A
Fall panicum	(<i>Panicum dichotomiflorum</i>)	A
Giant Reed	(<i>Arundo donax</i>)	A
Goosegrass	(<i>Eleusine indica</i>)	A
Itchgrass	(<i>Rottboellia exaltata</i>)	A
Junglerice	(<i>Echinochloa colonum</i>)	A
Lovegrass	(<i>Eragrostis</i> spp.)	A
*Maidencane	(<i>Panicum hemitomon</i>)	A
Panicum, Browntop	(<i>Panicum fasciculatum</i>)	A
Panicum, Texas	(<i>Panicum texanum</i>)	A
Prairie threeawn	(<i>Aristida oligantha</i>)	P
Reed canarygrass	(<i>Phalaris arundinacea</i>)	P
Sandbur, Field	(<i>Cenchrus incertus</i>)	A
Signalgrass	(<i>Brachiaria platyphylla</i>)	A
Torpedograss	(<i>Panicum repens</i>)	P
Wild barley	(<i>Hordeum</i> spp.)	A
Wooly Cupgrass	(<i>Eriochloa villosa</i>)	A

GRASSES (continued)

COMMON NAME	SPECIES	GROWTH HABIT ²
Apply 4-6 pints per acre¹		
Bahiagrass	(<i>Paspalum notatum</i>)	P
Bermudagrass ³	(<i>Cynodon dactylon</i>)	P
Big bluestem	(<i>Andropogon gerardii</i>)	P
Cattail	(<i>Typha</i> spp.)	P
Cogongrass	(<i>Imperata cylindrica</i>)	P
Dallisgrass	(<i>Paspalum dilatatum</i>)	P
Feathertop	(<i>Pennisetum villosum</i>)	P
Guineagrass	(<i>Panicum maximum</i>)	P
Phragmites	(<i>Phragmites australis</i>)	P
Prarie cordgrass	(<i>Spartina pectinata</i>)	P
Saltgrass ³	(<i>Distichlis stricta</i>)	P
Sand dropseed	(<i>Sporobolus cryptandrus</i>)	P
Sprangletop	(<i>Leptochloa</i> spp.)	A
Timothy	(<i>Phleum pratense</i>)	P
Wirestem muhly	(<i>Muhlenbergia frondosa</i>)	P

BROADLEAF WEEDS

COMMON NAME	SPECIES	GROWTH HABIT ²
Apply 2-3 pints per acre¹		
Alligatorweed*	(<i>Alternanthera philoxeroides</i>)	A/P
Burdock	(<i>Arctium</i> spp.)	B
Goosegrass	(<i>Eleusine indica</i>)	A
Camphorweed	(<i>Heterotheca subaxillaris</i>)	P
Carolina geranium	(<i>Geranium carolinianum</i>)	A
Clover	(<i>Trifolium</i> spp.)	A/P
Common chickweed	(<i>Stellaria media</i>)	A
Common ragweed	(<i>Ambrosia artemisiifolia</i>)	A
Dandelion	(<i>Taraxacum officinale</i>)	P
Dog fennel	(<i>Eupatorium capillifolium</i>)	A
Filaree	(<i>Erodium</i> spp.)	A
Fleabane	(<i>Erigeron</i> spp.)	A
Hoary vervain	(<i>Verbena stricta</i>)	P
Horseweed	(<i>Conyza canadensis</i>)	A
Indian mustard	(<i>Brassica juncea</i>)	A
Kochia	(<i>Kochia scoparia</i>)	A
Lambsquarters	(<i>Chenopodium album</i>)	A
*Lespedeza	(<i>Lespedeza</i> spp.)	P
Miners lettuce	(<i>Montia perfoliata</i>)	A
Mullein	(<i>Verbascum</i> spp.)	B
Nettleleaf goosefoot	(<i>Chenopodium murale</i>)	A
Oxeye daisy	(<i>Chrysanthemum leucanthemum</i>)	P
Pepperweed	(<i>Lepidium</i> spp.)	A
Pigweed	(<i>Amaranthus</i> spp.)	A

(continued)

BROADLEAF WEEDS (continued)

COMMON NAME	SPECIES	GROWTH HABIT ²
Apply 2-3 pints per acre¹		
Plantain	(<i>Plantago</i> spp.)	P
Puncturevine	(<i>Tribulus terrestris</i>)	A
Russian thistle	(<i>Salsola kali</i>)	A
Smartweed	(<i>Polygonum</i> spp.)	A/P
Sorrell	(<i>Rumex</i> spp.)	P
Sunflower	(<i>Helianthus</i> spp.)	A
Sweet clover	(<i>Melilotus</i> spp.)	A/B
Tansymustard	(<i>Descurainia pinnata</i>)	A
Western ragweed	(<i>Ambrosia psilostachya</i>)	P
Wild carrot	(<i>Daucus carota</i>)	B
Wild lettuce	(<i>Lactuca</i> spp.)	A/B
Wild parsnip	(<i>Pastinaca sativa</i>)	B
Wild turnip	(<i>Brassica campestris</i>)	B
Woollyleaf bursage	(<i>Franseria tomentosa</i>)	P
Yellow woodsorrel	(<i>Oxalis stricta</i>)	P
Apply 3-4 pints per acre¹		
Broom snakeweed ⁴	(<i>Gutierrezia sarothrae</i>)	P
Bull thistle	(<i>Cirsium vulgare</i>)	B
Burclover	(<i>Medicago</i> spp.)	A
Chickweed, Mouseear	(<i>Cerastium vulgatum</i>)	A
Clover, Hop	(<i>Trifolium procumbens</i>)	A
Cocklebur	(<i>Xanthium strumarium</i>)	A
Cudweed	(<i>Gnaphalium</i> spp.)	A
Desert Camelthorn	(<i>Alhagi pseudalhagi</i>)	P
Diffuse knapweed	(<i>Centaurea diffusa</i>)	A
Dock	(<i>Rumex</i> spp.)	P
Fiddleneck	(<i>Amsinckia intermedia</i>)	A
Goldenrod	(<i>Solidago</i> spp.)	P
Henbit	(<i>Lamium aplexicaule</i>)	A
Knotweed, prostrate	(<i>Polygonum aviculare</i>)	A/P
Pokeweed	(<i>Phytolacca americana</i>)	P
Purple loosestrife	(<i>Lythrum salicaria</i>)	P
Purslane	(<i>Portulaca</i> spp.)	A
Pusley, Florida	(<i>Richardia scabra</i>)	A
Rocket, London	(<i>Sisymbrium irio</i>)	A
Rush skeletonweed ⁴	(<i>Chondrilla juncea</i>)	B
Saltbush	(<i>Atriplex</i> spp.)	A
Shepherd's-purse	(<i>Capsella bursa-pastoris</i>)	A
Spurge, Annual	(<i>Euphorbia</i> spp.)	A
Stinging nettle ⁴	(<i>Urtica dioica</i>)	P
Velvetleaf	(<i>Abutilon theophrasti</i>)	A
Yellow starthistle	(<i>Centaurea solstitialis</i>)	A
Apply 4-6 pints per acre¹		
Arrowweed	(<i>Pluchea sericea</i>)	A
Canada thistle	(<i>Cirsium arvense</i>)	P

BROADLEAF WEEDS (continued)

COMMON NAME	SPECIES	GROWTH HABIT ²
Apply 4-6 pints per acre¹		
Giant ragweed	(<i>Ambrosia trifida</i>)	A
Grey rabbitbrush	(<i>Chrysothamnus nauseosus</i>)	P
Little mallow	(<i>Malva parviflora</i>)	B
Milkweed	(<i>Asclepias</i> spp.)	P
Primrose	(<i>Oenothera kunthiana</i>)	P
Russian knapweed	(<i>Centaurea repens</i>)	P
Silverleaf nightshade	(<i>Solanum eleagnifolium</i>)	P
Sowthistle	(<i>Sonchus</i> spp.)	A
Texas thistle	(<i>Cirsium texanum</i>)	P

VINES AND BRAMBLES

COMMON NAME	SPECIES	GROWTH HABIT ²
Apply 1 pint per acre		
Field bindweed	(<i>Convolvulus arvensis</i>)	P
Hedge bindweed	(<i>Calystegia sepium</i>)	A
Apply 2-3 pints per acre¹		
Wild buckwheat	(<i>Polygonum convolvulus</i>)	P
Apply 3-4 pints per acre¹		
Greenbriar	(<i>Smilax</i> spp.)	P
Honeysuckle	(<i>Lonicera</i> spp.)	P
Morningglory	(<i>Ipomoea</i> spp.)	A/P
Poison ivy	(<i>Rhus radicans</i>)	P
Redvine	(<i>Brunnichia cirrhosa</i>)	P
Wild rose	(<i>Rosa</i> spp.)	P
Including: Multiflora rose	(<i>Rosa multiflora</i>)	P
McCartney rose	(<i>Rosa bracteata</i>)	P
Apply 4-6 pints per acre¹		
Blackberry	(<i>Rubus</i> spp.)	P
Dewberry	(<i>Rubus</i> spp.)	P
*Kudzu ³	(<i>Pueraria lobata</i>)	P
Trumpetcreeper	(<i>Campsis radicans</i>)	P
Virginia creeper	(<i>Parthenocissus quinquefolia</i>)	P
Wild grape	(<i>Vitis</i> spp.)	P

BRUSH SPECIES

COMMON NAME	SPECIES	GROWTH HABIT ²
Apply 4-6 pints per acre¹		
American beech	(<i>Fagus grandifolia</i>)	P
Ash	(<i>Fraxinus</i> spp.)	P
Bald cypress	(<i>Taxodium distichum</i>)	P
Bigleaf maple	(<i>Acer macrophyllum</i>)	P
Black locust ⁵	(<i>Robinia pseudoacacia</i>)	P

(continued)

BRUSH SPECIES (continued)

COMMON NAME	SPECIES	GROWTH HABIT ²
	Apply 4-6 pints per acre ¹	
Blackgum	(<i>Nyssa sylvatica</i>)	P
Boxelder	(<i>Acer negundo</i>)	P
Brazilian peppertree	(<i>Schinus terebinthifolius</i>)	P
Cherry	(<i>Prunus</i> spp.)	P
Chinaberry	(<i>Melia azadarach</i>)	P
Chinese tallowtree	(<i>Sapium sebiferum</i>)	P
Dogwood	(<i>Cornus</i> spp.)	P
Elm ⁶	(<i>Ulmus</i> spp.)	P
Hawthorn	(<i>Crataegus</i> spp.)	P
Hickory	(<i>Carya</i> spp.)	P
Honeylocust ⁵	(<i>Gleditsia triacanthos</i>)	P
Maple	(<i>Acer</i> spp.)	P
Melaleuca	(<i>Melaleuca quinquenervia</i>)	P
Mulberry	(<i>Morus</i> spp.)	P
Oak	(<i>Quercus</i> spp.)	P
Persimmon	(<i>Diospyros virginiana</i>)	P
*Pine ⁵	(<i>Pinus</i> spp.)	P
Poplar	(<i>Populus</i> spp.)	P
Privet	(<i>Ligustrum vulgare</i>)	P
Red Alder	(<i>Alnus rubra</i>)	P

BRUSH SPECIES (continued)

COMMON NAME	SPECIES	GROWTH HABIT ²
	Apply 4-6 pints per acre ¹	
Red Maple	(<i>Acer rubrum</i>)	P
Rubber rabbitbrush	(<i>Chrysothamnus nauseosus</i>)	P
Russian Olive	(<i>Eleagnus angustifolia</i>)	P
Sassafras	(<i>Sassafras albidum</i>)	P
Saltcedar	(<i>Tamarix ramosissima</i>)	P
Sourwood	(<i>Oxydendrum arboreum</i>)	P
Sumac	(<i>Rhus</i> spp.)	P
Sweetgum	(<i>Liquidambar styraciflua</i>)	P
*Water willow	(<i>Justica americana</i>)	P
Willow	(<i>Salix</i> spp.)	P
Yellow poplar	(<i>Liriodendron tulipifera</i>)	P
	*Not approved for use in California	
	¹ The higher rates should be used where heavy or well-established infestations occur.	
	² Growth Habit - A = Annual, B = Biennial, P = Perennial	
	³ Use a minimum of 75 GPA - Control of established stands may require repeat applications.	
	⁴ For best results early postemergence applications are required.	
	⁵ Tank mix with glyphosate or triclopyr.	
	⁶ Tank-mix with with glyphosate.	

AQUATIC WEEDS CONTROLLED

This product may be applied for control of floating and emergent weeds (see Aquatic Weeds Controlled and Terrestrial Weeds Controlled) in or near bodies of water that may be nonflowing, flowing, or transient. This product may be applied to aquatic sites that include rivers, lakes, streams, seeps, drainage ditches, ponds, reservoirs, canals, bogs, marshes, swamps, estuaries, bays, brackish water, transitional areas between terrestrial and aquatic sites, riparian sites and seasonal wet areas. See Use Precautions and Restrictions section of this label for instructions, directions, precautions and restrictions on aquatic uses.

Read and observe the following directions if aquatic sites are present in noncrop areas and are part of the intended treatment area.

This product must be applied to the emergent foliage of the target vegetation and little to no activity on submerged aquatic weeds. Concentration of this product, resulting from direct application to water, are not expected to be of sufficient concentration nor duration to control target vegetation. Application should be made in such a way as to maximize spray interception by the target vegetation while minimizing the amount of overspray that enters the water.

This product does not control plants that have a majority of their foliage underwater or plants that are completely submerged.

Product Application: This product should be applied with helicopter or surface application equipment in a minimum of 2 gallons of water per acre. When applying by helicopter, follow directions under Aerial Application section of this label; when using surface equipment refer to the Ground Application section.

When applying this product to moving bodies of water applications should be made while traveling upstream to prevent concentration of this herbicide in water. Do not apply to bodies of water or portions of bodies of water where emergent and/or floating weeds do not exist.

Large Application Areas / O² Depletion: When application is to be made to target vegetation that covers a large percentage of surface area of impounded water, treating area in strips may avoid oxygen depletion from vegetation decay. Oxygen depletion may result in the suffocation of some sensitive aquatic organisms. If oxygen depletion is a concern, treat no more than 1/2 of the surface area of the water at a time. Wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outward in bands to allow aquatic organisms ability to move into untreated areas.

Avoid washoff of sprayed foliage by recreational boat backwash or spray boat for 1 hour after application.

Apply this product at 2 to 6 pints per acre depending on weed density and species present. Do not exceed the maximum label rate of 6 pints per acre (1.5 lbs ae per acre) per year. Use the higher labeled rate for heavy weed pressure. See Aquatic Weeds Controlled and Terrestrial Weeds Controlled sections for specific rates.

This product may be applied as a draw-down treatment in areas described in this label. Apply this product to weeds after water has been drained and allow 14 days before reintroduction of water.

AQUATIC WEEDS CONTROLLED

This product will control the following target species as specified in the Use Rates and Application Directions section of the table. Rate instructions are expressed in terms of product volume for broadcast applications and as a percent solution for directed applications including spot treatments. For percent solution applications, do not apply more than the equivalent of 6 pints of this product per acre. Not for aquatic use sites in the states of Massachusetts and New York.

COMMON NAME	SCIENTIFIC NAME	USE RATES AND APPLICATION DIRECTIONS
Floating Species		
*Duckweed	<i>Lemna minor</i>	2-3 pints/acre (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Duckweed, Giant	<i>Spirodela polyrriza</i>	2-3 pints/acre (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Frogbit	<i>Limnobium spongia</i>	1-2 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Spatterdock	<i>Nuphar luteum</i>	Apply a tank-mix of 2-4 pints/acre of this product + 4-6 pints/acre glyphosate (0.5% this product + 1.5% glyphosate) in 100 GPA water for best control. Ensure 100% coverage of actively growing, emergent foliage.
*Water Hyacinth	<i>Eichhornia crassipes</i>	1-2 pints/acre (0.5% solution) applied in 100 GPA water to actively growing foliage.
*Water Lettuce	<i>Pistia stratiotes</i>	1-2 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
Emerged Species		
*Alligatorweed	<i>Alternanthera philoxeroides</i>	1-4 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage. Tank-mix with glyphosate is NOT recommended, and may reduce alligatorweed control, requiring higher product rates.
*Arrowhead, Duck-potato	<i>Sagittaria</i> spp.	1-2 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Bacopa, lemon	<i>Bacopa</i> spp.	1-2 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Parrot feather	<i>Myriophyllum aquaticum</i>	Must be foliage above water for sufficient product uptake. Apply 2-4 pints to actively growing emergent foliage.
*Pennywort	<i>Hydrocotyle</i> spp.	1-2 pints/acre (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Pickerelweed	<i>Pontederia cordata</i>	2-3 pints/acre (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Taro, wild; Dasheen; Elephant's Ear; Coco Yam	<i>Colocasia esculentum</i>	4-6 pints/acre (1.5% solution) applied in 100 GPA with a high quality 'sticker' adjuvant. Ensure good coverage of actively growing, emergent foliage.
*Water lily	<i>Nymphaea odorata</i>	2-3 pints/acre (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing, emergent foliage.
*Water primrose	<i>Ludwigia uruguayensis</i>	4-6 pints/acre (1.5% solution), ensure 100% coverage of actively growing, emergent foliage. Tank-mix with glyphosate is NOT recommended and may reduce water primrose control.
Terrestrial/Marginal		
*Soda Apple, aquatic; Nightshade	<i>Solanum tampicense</i>	2 pints/acre applied to foliage
*Bamboo, Japanese	<i>Phyllostachys</i> spp.	3-4 pints/acre applied to the foliage when plant is actively growing. Before setting seed head. More foliage will result in greater herbicide uptake, resulting in greater root kill.
Brazilian Pepper; Christmasberry	<i>Schinus terebinthifolius</i>	2-4 pints/acre applied to foliage

*Use not permitted in California unless otherwise directed by supplemental labeling.

(continued)

AQUATIC SPECIES CONTROLLED (continued)

COMMON NAME	SCIENTIFIC NAME	USE RATES AND APPLICATION DIRECTIONS
Terrestrial/Marginal (continued)		
Cattail	<i>Typha</i> spp.	2-4 pints (1% solution) applied to actively growing, green foliage after full leaf elongation. Lower rates will control cattail in the north; higher rates are needed in the south.
Chinese Tallow Tree	<i>Sapium sebiferum</i>	16-24 fluid ounces applied to foliage
Cogon Grass	<i>Imperata cylindrica</i>	Burn foliage, till area, that fall spray 2 quarts/acre this product + MSO applied to new growth.
Cordgrass, prairie	<i>Spartina</i> spp.	4-6 pints applied to actively growing foliage
*Cutgrass	<i>Zizaniopsis miliacea</i>	4-6 pints applied to actively growing foliage
*Elephant Grass; Napier Grass	<i>Pennisetum purpureum</i>	3 pints/acre applied to actively growing foliage
*Flowering rush	<i>Butumu typla</i>	2-3 pints applied to actively growing foliage
Giant Reed, Wild Cane	<i>Arundo donax</i>	4-6 pints/acre applied in spring to actively growing foliage
*Golden Bamboo	<i>Phyllostachys aurea</i>	3-4 pints/acre applied to the foliage when plant is actively growing. Before setting seed head. More foliage will result in greater herbicide uptake, resulting in greater root kill.
Junglerice	<i>Echinochloa colonum</i>	3-4 pints applied to actively growing foliage
Knapweeds	<i>Centaurea species</i>	Russian Knapweed - 2 to 3 pints + 1 quart/acre MSO fall applied after senescence begins
Knotweed, Japanese (see Fallopia japonica)	<i>Polygonum cuspidatum</i>	3-4 pints/acre applied postemergence to actively growing foliage
Melaleuca; Paperbark Tree	<i>Melaleuca quinquenervia</i>	For established stands, apply 6 pints/acre this product+ 6 pints/acre glyphosate + spray adjuvant. For best results use 4 quarts/A methylated seed oil as an adjuvant. For ground foliar application, uniformly apply to ensure 100% coverage. For broadcast foliar control, apply aerially in a minimum of two passes at 10 gallons/acre applied cross treatment. For spot treatment use a 25% this product + 25% solution of + glyphosate + 1.25% MSO in water applied as a frill or stump treatment.
*Nutgrass; Kill'p'opu	<i>Cyperus rotundus</i>	2 pints this product + 1 quart/acre MSO applied early postemergence
*Nutsedge	<i>Cyperus</i> spp.	2-3 pints postemergence to foliage or pre-emergence incorporated, non-incorporated preemergence applications will not control.
Phragmites; Common Reed	<i>Phragmites australis</i>	4-6 pints/acre applied to actively growing, green foliage after full leaf elongation, ensure 100% coverage. If stand has a substantial amount of old stem tissue, mow or burn, allow to regrow to approximately 5' tall before treatment. Lower rates will control phragmites in the north; higher rates are needed in the south.
*Poison Hemlock	<i>Conium maculatum</i>	2 pints this product + 1 quart/acre MSO applied preemergence to early postemergence to rosette, prior to flowering
Purple Loosestrife	<i>Lythrum salicaria</i>	1 pint/acre applied to actively growing foliage
Reed canarygrass	<i>Phalaris arundinacea</i>	3-4 pints/acre applied to actively growing foliage
Rose, swamp	<i>Rosa palustris</i>	2-3 pints/acre applied to actively growing foliage
Russian-Olive	<i>Elaeagnus angustifolia</i>	2-4 pints/acre or a 1% solution, applied to foliage
Saltcedar; Tamarisk	<i>Tamarix species</i>	Aerial apply 2 quarts this product + 0.25%v/v NIS applied to actively growing foliage during flowering. For spot spraying use 1% solution of this product + 0.25%v/v NIS and spray to wet foliage. After application wait at least two years before disturbing treated saltcedar. Earlier disturbance can reduce overall control.
Smartweed	<i>Polygonum</i> spp.	2 pints/acre applied early postemergence

*Use not permitted in California unless otherwise directed by supplemental labeling.

(continued)

AQUATIC SPECIES CONTROLLED *(continued)*

COMMON NAME	SCIENTIFIC NAME	USE RATES AND APPLICATION DIRECTIONS
Terrestrial/Marginal <i>(continued)</i>		
Sumac	<i>Rhus</i> spp.	2-3 pints/acre applied to foliage
Swamp Morning Glory; Water Spinach; Kangkong	<i>Ipomoea aquatica</i>	1-2 pints/acre this product + 1 quart/acre MSO applied early postemergence
Torpedo Grass	<i>Panicum repens</i>	4 pints/acre (1 - 1.5% solution), ensure good coverage to actively growing foliage.
*White Top; Hoary Cress	<i>Cardaria draba</i>	1-2 pints/acre applied in spring, to foliage, during flowering.
Willow	<i>Salix</i> spp.	2-3 pints/acre of this product applied to actively growing foliage, ensure good coverage.

*Use not permitted in California unless otherwise directed by supplemental labeling.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

PESTICIDE STORAGE: DO NOT store below 10° F.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product must be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL:

[Nonrefillable Containers 5 Gallons or Less:] Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available. Triple rinse container (or equivalent) promptly after emptying. **Triple rinse as follows:** Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by State and local authorities. Plastic containers are also disposable by incineration, or, if allowed by State and local authorities, by burning. If burned stay out of smoke.

[Nonrefillable containers larger than 5 gallons:] Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available. If recycling or reconditioning not available, puncture and dispose of in a sanitary landfill, or by other procedures approved by State and local authorities. Plastic containers are also disposable by incineration, or, if allowed by State and local authorities, by burning. If burned stay out of smoke. Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse as follows:** Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times. **Pressure rinse as follows:** Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.

[Refillable containers larger than 5 gallons:] Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment or a mix tank. Fill the container about 10% full with water. Agitate vigorously or recirculate water with the pump for two minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times. Then offer for recycling if available or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures allowed by state and local authorities If burned stay out of smoke.

WARRANTY DISCLAIMER

The directions for use of this product must be followed carefully. TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, (1) THE GOODS DELIVERED TO YOU ARE FURNISHED "AS IS" BY MANUFACTURER OR SELLER AND (2) MANUFACTURER AND SELLER MAKE NO WARRANTIES, GUARANTEES, OR REPRESENTATIONS OF ANY KIND TO BUYER OR USER, EITHER EXPRESS OR IMPLIED, OR BY USAGE OF TRADE, STATUTORY OR OTHERWISE, WITH REGARD TO THE PRODUCT SOLD, INCLUDING, BUT NOT LIMITED TO MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, USE, OR ELIGIBILITY OF THE PRODUCT FOR ANY PARTICULAR TRADE USAGE. UNINTENDED CONSEQUENCES, INCLUDING BUT NOT LIMITED TO INEFFECTIVENESS, MAY RESULT BECAUSE OF SUCH FACTORS AS THE PRESENCE OR ABSENCE OF OTHER MATERIALS USED IN COMBINATION WITH THE GOODS, OR THE MANNER OF USE OR APPLICATION, INCLUDING WEATHER, ALL OF WHICH ARE BEYOND THE CONTROL OF MANUFACTURER OR SELLER AND ASSUMED BY BUYER OR USER. THIS WRITING CONTAINS ALL OF THE REPRESENTATIONS AND AGREEMENTS BETWEEN BUYER, MANUFACTURER AND SELLER, AND NO PERSON OR AGENT OF MANUFACTURER OR SELLER HAS ANY AUTHORITY TO MAKE ANY REPRESENTATION OR WARRANTY OR AGREEMENT RELATING IN ANY WAY TO THESE GOODS.

LIMITATION OF LIABILITY

TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, IN NO EVENT SHALL MANUFACTURER OR SELLER BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, OR FOR DAMAGES IN THEIR NATURE OF PENALTIES RELATING TO THE GOODS SOLD, INCLUDING USE, APPLICATION, HANDLING, AND DISPOSAL. TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, MANUFACTURER OR SELLER SHALL NOT BE LIABLE TO BUYER OR USER BY WAY OF INDEMNIFICATION TO BUYER OR TO CUSTOMERS OF BUYER, IF ANY, OR FOR ANY DAMAGES OR SUMS OF MONEY, CLAIMS OR DEMANDS WHATSOEVER, RESULTING FROM OR BY REASON OF, OR ARISING OUT OF THE MISUSE, OR FAILURE TO FOLLOW LABEL WARNINGS OR INSTRUCTIONS FOR USE, OF THE GOODS SOLD BY MANUFACTURER OR SELLER TO BUYER. ALL SUCH RISKS SHALL BE ASSUMED BY THE BUYER, USER, OR ITS CUSTOMERS. TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, BUYER'S OR USER'S EXCLUSIVE REMEDY, AND MANUFACTURER'S OR SELLER'S TOTAL LIABILITY SHALL BE FOR DAMAGES NOT EXCEEDING THE COST OF THE PRODUCT.

If you do not agree with or do not accept any of directions for use, the warranty disclaimers, or limitations on liability, do not use the product, and return it unopened to the Seller, and the purchase price will be refunded.

(RV010412)

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All other trademarks are the property of their respective owners.

MATERIAL SAFETY DATA SHEET



Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

RODEO* HERBICIDE

Effective Date: 3/23/04
Product Code: 84825
MSDS: 006694

1. PRODUCT AND COMPANY IDENTIFICATION:

PRODUCT: Rodeo* Herbicide

COMPANY IDENTIFICATION:

Dow AgroSciences LLC
9330 Zionsville Road
Indianapolis, IN 46268-1189

2. COMPOSITION/INFORMATION ON INGREDIENTS:

Glyphosate IPA: N-(phosphono-methyl) glycine, Isopropylamine Salt	CAS # 038641-94-0	53.8%
Balance, Total		46.2%

3. HAZARDOUS IDENTIFICATIONS:

EMERGENCY OVERVIEW

Clear, pale yellow liquid. May cause eye irritation. Slightly toxic to aquatic organisms.

EMERGENCY PHONE NUMBER: 800-992-5994

4. FIRST AID:

EYE: Flush eyes thoroughly with water for several minutes. Remove contact lenses after initial 1-2 minutes and continue flushing for several additional minutes. If effects occur, consult a physician, preferably an ophthalmologist.

SKIN: Wash skin with plenty of water.

INGESTION: No emergency medical treatment necessary.

INHALATION: Remove person to fresh air; if effects occur, consult a physician.

NOTE TO PHYSICIAN: No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.

5. FIRE FIGHTING MEASURES:

FLASH POINT: >214°F (>101°C)

METHOD USED: Setaflash

FLAMMABLE LIMITS:

LFL: Not applicable

UFL: Not applicable

EXTINGUISHING MEDIA: Foam, CO₂, Dry Chemical

FIRE AND EXPLOSION HAZARDS: Foam fire extinguishing system is preferred because uncontrolled water can spread possible contamination. Toxic irritating gases may be formed under fire conditions.

FIRE-FIGHTING EQUIPMENT: Use positive-pressure, self-contained breathing apparatus and full protective equipment.

6. ACCIDENTAL RELEASE MEASURES:

ACTION TO TAKE FOR SPILLS: Absorb small spills with an inert absorbent material such as Hazorb, Zorbball, sand, or dirt. Report large spills to Dow AgroSciences on 800-992-5994.

7. HANDLING AND STORAGE:

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Keep out of reach of children. Do not swallow. Avoid contact with eyes, skin, and clothing. Avoid breathing vapors and spray mist. Handle concentrate in ventilated area. Wash thoroughly with soap and water after handling and before eating, chewing gum, using tobacco, using the toilet or smoking. Keep away from food, feedstuffs, and water supplies. Store in original container with the lid tightly closed. Store above 10°F (-12°C) to keep from crystallizing.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION:

These precautions are suggested for conditions where the potential for exposure exists. Emergency conditions may require additional precautions.

EXPOSURE GUIDELINES: None established

ENGINEERING CONTROLS: Good general ventilation should be sufficient for most conditions. Local exhaust ventilation may be necessary for some operations.

RECOMMENDATIONS FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS:

EYE/FACE PROTECTION: Use safety glasses.

SKIN PROTECTION: No precautions other than clean body-covering clothing should be needed.

MATERIAL SAFETY DATA SHEET



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Dow AgroSciences LLC
Indianapolis, IN 46268

Effective Date: 3/23/04
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RODEO* HERBICIDE

RESPIRATORY PROTECTION: For most conditions, no respiratory protection should be needed; however, if discomfort is experienced, use a NIOSH approved air-purifying respirator.

APPLICATIONS AND ALL OTHER HANDLERS: Please refer to the product label for personal protective clothing and equipment.

9. PHYSICAL AND CHEMICAL PROPERTIES:

APPEARANCE: Clear, pale yellow liquid
DENSITY: 10.0 - 10.5 lbs/gal
pH: 4.8 - 5.0
ODOR: None
SOLUBILITY IN WATER: Miscible
SPECIFIC GRAVITY: 1.21 gm/L
FREEZING POINT: -7°F - -10°F (-21°C - -25°C)

10. STABILITY AND REACTIVITY:

STABILITY: (CONDITIONS TO AVOID) Stable under normal storage conditions.

INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID) Galvanized or unlined steel (except stainless steel) containers or spray tanks may produce hydrogen gas which may form a highly combustible gas mixture.

HAZARDOUS DECOMPOSITION PRODUCTS: None known.

HAZARDOUS POLYMERIZATION: Not known to occur.

11. TOXICOLOGICAL INFORMATION:

EYE: May cause slight temporary eye irritation. Corneal injury is unlikely.

SKIN: Essentially non-irritating to skin. Prolonged skin contact is unlikely to result in absorption of harmful amounts. The LD₅₀ for skin absorption in rabbits is >5000 mg/kg. Did not cause allergic skin reactions when tested in guinea pigs.

INGESTION: Very low toxicity if swallowed. Harmful effects not anticipated from swallowing small amounts. The oral LD₅₀ for rats is >5000 mg/kg.

INHALATION: Brief exposure (minutes) is not likely to cause adverse effects. The aerosol LC₅₀ for rats is >6.37 mg/L for 4 hours.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: For a similar material, glyphosate, in animals, effects have been reported on the following organ: liver.

CANCER INFORMATION: A similar material, glyphosate, did not cause cancer in laboratory animals.

TERATOLOGY (BIRTH DEFECTS): For glyphosate IPA, available data are inadequate for evaluation of potential to cause birth defects.

REPRODUCTIVE EFFECTS: For glyphosate IPA, available data are inadequate to determine effects on reproduction.

MUTAGENICITY: For a similar material, glyphosate, in-vitro and animal genetic toxicity studies were negative.

12. ECOLOGICAL INFORMATION:

ENVIRONMENTAL DATA:

ECOTOXICOLOGY:

Material is practically non-toxic to aquatic organisms on an acute basis (LC₅₀ or EC₅₀ is >100 mg/L in most sensitive species tested).

Acute LC₅₀ for rainbow trout (*Oncorhynchus mykiss*) is >2500 mg/L.

Acute immobilization EC₅₀ in water flea (*Daphnia magna*) is 918 mg/L.

Material is practically non-toxic to birds on an acute basis (LD₅₀ is >2000 mg/kg).

Acute oral LD₅₀ in bobwhite (*Colinus virginianus*) is >2000 mg/kg.

The LC₅₀ in earthworm *Eisenia foetida* is >1000 mg/kg.

Acute contact LD₅₀ in honey bee (*Apis mellifera*) is >100 µg/bee.

Acute oral LD₅₀ in honey bee (*Apis mellifera*) is >100 µg/bee.

Growth inhibition EC₅₀ in green alga (*Selenastrum capricornutum*) is 127 mg/L.

Growth inhibition EC₅₀ in duckweed (*Lemna sp.*) is 24.4 mg/L.

13. DISPOSAL CONSIDERATIONS:

DISPOSAL METHOD: If wastes and/or containers cannot be disposed of according to the product label directions, disposal of this material must be in accordance with your local or area regulatory authorities.

MATERIAL SAFETY DATA SHEET



Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

Effective Date: 3/23/04
Product Code: 84825
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RODEO* HERBICIDE

This information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations.

If the material as supplied becomes a waste, follow all applicable regional, national and local laws and regulations.

14. TRANSPORT INFORMATION:

U.S. DEPARTMENT OF TRANSPORTATION (DOT) INFORMATION:

For all package sizes and modes of transportation:
This material is not regulated for transport.

15. REGULATORY INFORMATION:

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations.

U.S. REGULATIONS

SARA 313 INFORMATION: To the best of our knowledge, this product contains no chemical subject to SARA Title III Section 313 supplier notification requirements.

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

Not to have met any hazard category

TOXIC SUBSTANCES CONTROL ACT (TSCA): All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

STATE RIGHT-TO-KNOW: This product is not known to contain any substances subject to the disclosure requirements of

New Jersey
Pennsylvania

OSHA HAZARD COMMUNICATION STANDARD: This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT (CERCLA, or SUPERFUND): To the best of our knowledge, this product contains no chemical subject to reporting under CERCLA.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:

<u>CATEGORY</u>	<u>RATING</u>
Health	1
Flammability	1
Reactivity	0

16. OTHER INFORMATION:

MSDS STATUS: Revised Sections: 3,4,11,12,13,14 & 15
Reference: DR-0361-8028
Replaces MSDS Dated: 1/12/00
Document Code: D03-148-002
Replaces Document Code: D03-148-001

The Information Herein Is Given In Good Faith, But No Warranty, Express Or Implied, Is Made. Consult Dow AgroSciences For Further Information.

Specimen Label



Rodeo®

Herbicide

For control of annual and perennial weeds and woody plants in forests, non-crop sites, and in and around aquatic sites; also for use in wildlife habitat areas, for perennial grass release, and grass growth suppression and grazed areas on these sites.

Avoid contact of herbicide with foliage, green stems, exposed non-woody roots or fruit of crops, desirable plants and trees, because severe injury or destruction may result.

Active Ingredient(s):	
glyphosate ¹ N-(phosphonomethyl)glycine, isopropylamine salt	53.8%
Other Ingredients	46.2%
Total Ingredients	100.0%

¹ Contains 5.4 pounds per gallon glyphosate, isopropylamine salt (4 pounds per gallon glyphosate acid).

EPA Reg. No. 62719-324

Keep Out of Reach of Children

CAUTION PRECAUCION

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Precautionary Statements

Hazards to Humans and Domestic Animals

Harmful If Inhaled

Avoid breathing spray mist. Remove contaminated clothing and wash before reuse. Wash thoroughly with soap and water after handling.

Personal Protective Equipment (PPE)

Applicators and other handlers must wear:

- Long-sleeved shirt and long pants
- Shoes plus socks.

Follow manufacturer's instructions for cleaning/maintaining PPE (Personal Protective Equipment). If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

Engineering Controls

When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240 (d) (4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

First Aid

If inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. Call a poison control center or doctor for further treatment advice.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-992-5994 for emergency medical treatment information.

Environmental Hazards

Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Treatment of aquatic weeds can result in oxygen depletion or loss due to decomposition of dead plants. This oxygen loss can cause fish suffocation.

In case of leak or spill, soak up and remove to a landfill.

Physical or Chemical Hazards

Spray solutions of this product should be mixed, stored and applied using only stainless steel, aluminum, fiberglass, plastic or plastic-lined steel containers.

Do not mix, store or apply this product or spray solutions of this product in galvanized steel or unlined steel (except stainless steel) containers or spray tanks. This product or spray solutions of this product react with such containers and tanks to produce hydrogen gas, which may form a highly combustible gas mixture. This gas mixture could flash or explode, causing serious personal injury, if ignited by open flame, spark, welder's torch, lighted cigarette or other ignition source.

Notice: Read the entire label. Use only according to label directions. Before using this product, read Terms and Conditions of Use, Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies elsewhere on this label. If terms are unacceptable, return at once unopened.

In case of emergency endangering health or the environment involving this product, call 1-800-992-5994. If you wish to obtain additional product information, visit our web site at www.dowagro.com.

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Read all Directions for Use carefully before applying.

This is an end-use product. Dow AgroSciences does not intend and has not registered it for reformulation. See individual container label for repackaging limitations.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation.

Agricultural Use Requirements

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE), and restricted entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 4 hours.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:

- Coveralls
- Chemical-resistant gloves made of any waterproof material
- Shoes plus socks

Non-Agricultural Use Requirements

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries or greenhouses.

Keep people and pets off treated areas until spray solution has dried.

Storage and Disposal

Do not contaminate water, food, feed or seed by storage or disposal.

Pesticide Storage: Store above 10°F (-12°C) to keep product from crystallizing. Crystals will settle to the bottom. If allowed to crystallize, place in a warm room 68°F (20°C) for several days to redissolve and roll or shake container or recirculate in mini-bulk containers to mix well before using.

Pesticide Disposal: Wastes resulting from use of this product that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticide disposal or in accordance with applicable Federal, state or local procedures.

Nonrefillable containers 5 gallons or less:

Container Reuse: Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available.

Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. **Pressure rinse** as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.

Refillable containers larger than 5 gallons:

Container Reuse: Refillable container. Refill this container with pesticide only. Do not reuse this container for any other purpose. Cleaning the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller. To clean the container before final disposal, empty the remaining contents from this container into application equipment or a mix tank. Fill the container about 10% full with water and, if possible, spray all sides while adding water. If practical, agitate vigorously or recirculate water with the pump for two minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times.

Nonrefillable containers larger than 5 gallons:

Container Reuse: Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available.

Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times. **Pressure rinse** as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.

General Information **(How this product works)**

This product is a water-soluble liquid, which mixes readily with water and nonionic surfactant to be applied as a foliar spray for the control or destruction of many herbaceous and woody plants. This product is intended for control of annual and perennial weeds and woody plants in forests, pine straw plantations, non-crop sites such as utility rights-of-way, and in and around aquatic sites; also for use in wildlife habitat areas, for perennial grass release, and grass growth suppression and grazed areas on these sites.

The active ingredient in this product moves through the plant from the point of foliage contact to and into the root system. Visible effects on most annual weeds occur within 2 to 4 days, 7 days or more on most perennial weeds, and 30 days or more on most woody plants. Extremely cool or cloudy weather following treatment may slow the activity of this product and delay visual effects of control. Visible effects include gradual wilting and yellowing of the plant which advances to complete browning of above-ground growth and deterioration of underground plant parts.

Unless otherwise directed on this label, delay application until vegetation has emerged and reached the stages described for control of such vegetation under the "Weeds Controlled" section of this label.

Unemerged plants arising from unattached underground rhizomes or root stocks of perennials or brush will not be affected by the spray and will continue to grow. For this reason best control of most perennial weeds or brush is obtained when treatment is made at late growth stages approaching maturity.

Always use the higher rate of this product and surfactant within the recommended range when vegetation is heavy or dense, when treating dense multi-canopied sites or woody vegetation or difficult-to-control herbaceous or woody plants.

Do not treat weeds, brush or trees under poor growing conditions such as drought stress, disease or insect damage, as reduced control may result. Reduced control of target vegetation may also occur if foliage is heavily covered with dust at the time of treatment.

Reduced control may result when applications are made to woody plants or weeds following site disturbance or plant top growth removal from grazing, mowing, logging or mechanical brush control. For best results, delay treatment of such areas until resprouting and foliar growth has restored the target vegetation to the recommended stage of growth for optimum herbicide exposure and control.

Rainfall or irrigation occurring within 6 hours after application may reduce effectiveness. Heavy rainfall or irrigation within 2 hours after application may wash the product off the foliage and a repeat treatment may be required.

This product does not provide residual weed control. For subsequent residual weed control, follow a label-approved herbicide program. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used.

Note: The maximum rates stated throughout this product's labeling apply to this product combined with the use of all other herbicides containing glyphosate or sulfosate as the active ingredient, whether applied as mixtures or separately. Calculate the application rates and ensure that the total use of this and other glyphosate or sulfosate containing products does not exceed the maximum use rates.

Grazing Restrictions: This product may be used to treat undesirable vegetation in utility rights-of-way that pass through pastures, rangeland, and forestry sites that are being grazed. For tank mix applications, comply with all restrictions appearing on the tank mix product label.

Except for lactating dairy animals there are no grazing restrictions following the labeled applications of this product.

- For lactating dairy animals there are no grazing restrictions for the following labeled applications of this product:
 - ▶ Where the spray can be directed onto undesirable woody brush and trees, such as in handgun spray-to-wet or low volume directed spray treatments.
 - ▶ For tree injection of frill applications and for cut stump treatments
- For broadcast applications, observe the following restrictions for lactating dairy animals:
 - ▶ For application rates of greater than 4.5 but not to exceed 7.5 quarts per acre, no more than 15 percent of the available grazing area may be treated.
 - ▶ For application rates that do not exceed 4.5 quarts per acre, no more than 25 percent of the available grazing area may be treated.
- These restrictions do not apply to pastures, rangeland or forestry sites outside of utility rights-of-way.

NOTE: Use of this product in any manner not consistent with this label may result in injury to persons, animals or crops, or other unintended consequences. When not in use, keep container closed to prevent spills and contamination.

Buyer and all users are responsible for all loss or damage in connection with the use or handling of mixtures of this product or other materials that are not expressly recommended in this label. Mixing this product with herbicides or other materials not recommended in this label may result in reduced performance.

ATTENTION: Avoid drift. Extreme care must be used when applying this product to prevent injury to desirable plants and crops.

Do not allow the herbicide solution to mist, drip, drift or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants or other areas on which treatment was not intended. The likelihood of plant or crop injury occurring from the use of this product is greatest when winds are gusty or in excess of 5 miles per hour or when other conditions, including lesser wind velocities, will allow spray drift to occur. When spraying, avoid combinations of pressure and nozzle type that will result in splatter or fine particles (mist) which are likely to drift. **Avoid applying at excessive speed or pressure.**

Spray Drift Management

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment-and-weather-related factors determine the potential for spray drift. The applicator and the grower are responsible for considering all these factors when making decisions. The following drift management requirements must be followed to avoid off-target drift movement from aerial applications to agricultural field crops. These requirements do not apply to forestry applications, public health uses or to applications using dry formulations.

1. The distance of the outer most nozzles on the boom must not exceed 3/4 the length of the wingspan or rotor.
2. Nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees. Where states have more stringent regulations, they should be observed.

The applicator should be familiar with and take into account the information covered in the following **Aerial Drift Reduction Advisory Information:**

Importance of Droplet Size: The most effective way to reduce drift potential is to apply large droplets. The best drift management strategy is to apply the largest droplets that provide sufficient coverage and control. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly, or under unfavorable environmental conditions (see Wind, Temperature and Humidity, and Temperature Inversion section of this label).

Controlling Droplet Size: Volume-Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with higher rated flows produce larger droplets.

Pressure-Use the lower spray pressures recommended for the nozzle. Higher pressure reduces droplet size and does not improve canopy penetration. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.

Number of nozzles-Use the minimum number of nozzles that provide uniform coverage.

Nozzle Orientation-Orienting nozzles so that the spray is released backwards, parallel to the airstream will produce larger droplets than other orientations. Significant deflection from the horizontal will reduce droplet size and increase drift potential.

Nozzle Type-Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low-drift nozzles. Solid stream nozzles oriented straight back produce larger droplets than other nozzle types.

Boom Length-For some use patterns, reducing the effective boom length to less than 3/4 of the wingspan or rotor length may further reduce drift without reducing swath width.

Application-Applications should not be made at a height greater than 10 feet above the top of the largest plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces exposure of droplets to evaporation and wind.

Swath Adjustment: When applications are made with a crosswind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the field, the applicator must compensate for this displacement by adjusting the path of the aircraft upwind. Swath adjustment distance should increase, with increasing drift potential (higher wind, smaller drops, etc.).

Wind: Drift potential is lowest between wind speeds of 2-10 mph. However, many factors, including droplet size and equipment type determine drift potential at any given speed. Application should be avoided below 2 mph due to variable wind direction and high inversion potential. Note: Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect drift.

Temperature and Humidity: When making applications in low relative humidity, set up equipment to produce larger droplets to compensate for evaporation. Droplet evaporation is most severe when conditions are both hot and dry.

Temperature Inversions: Applications should not occur during a temperature inversion, because drift potential is high. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud. This cloud can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a connected cloud (under low wind conditions) indicates an inversion, while smoke that moves upwards and rapidly dissipates indicates good vertical air mixing.

Sensitive Areas: The pesticide should only be applied when the potential for drift to adjacent sensitive areas (e.g., residential areas, bodies of water, known habitat for threatened or endangered species, non-target crops) is minimal (e.g., when wind is blowing away from the sensitive areas).

Mixing And Application Instructions

Apply these spray solutions in properly maintained and calibrated equipment capable of delivering desired volumes. Hand-gun applications should be properly directed to avoid spraying desirable plants. Note: reduced results may occur if water containing soil is used, such as water from ponds and unlined ditches.

Mixing

This product mixes readily with water. Mix spray solutions of this product as follows:

1. Fill the mixing or spray tank with the required amount of water while adding the required amount of this product (see "Directions for Use" and "Weeds Controlled" sections of this label).
2. Near the end of the filling process, add the required surfactant and mix well. Remove hose from tank immediately after filling to avoid siphoning back into the water source.

Note: If tank mixing with Garlon® 3A herbicide, ensure that Garlon 3A is well mixed with at least 75 percent of the total spray volume before adding this product to the spray tank to avoid incompatibility.

During mixing and application, foaming of the spray solution may occur. To prevent or minimize foam, avoid the use of mechanical agitators, place the filling hose below the surface of the spray solution (only during filling), terminate by-pass and return lines at the bottom of the tank, and, if needed, use an approved anti-foam or defoaming agent.

Keep by-pass line on or near bottom of tank to minimize foaming. Screen size in nozzle or line strainers should be no finer than 50 mesh. Carefully select correct nozzle to avoid spraying a fine mist. For best results with conventional ground application equipment, use flat fan nozzles. Check for even distribution of spray droplets.

IMPORTANT: When using this product, unless otherwise specified, mix with a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient. For conifer release (pine release) use only surfactants that are approved for conifer release, and specified on the surfactant label as safe for use in conifer release (pine release). Always read and follow the manufacturer's surfactant label recommendations for best results.

Colorants or marking dyes approved for use with herbicides may be added to spray mixtures of this product. Colorants or dyes used in spray solutions of this product may reduce performance, especially at lower rates or dilutions. Use colorants or dyes according to the manufacturer's label recommendations.

Clean sprayer and parts immediately after using this product by thoroughly flushing with water and dispose of rinsate according to labeled use or disposal instructions.

Carefully observe all cautionary statements and other information appearing in the surfactant label.

Application Equipment And Techniques

ATTENTION: AVOID DRIFT. EXTREME CARE MUST BE EXERCISED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift, or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to crops, plants, or other areas on which the treatment was not intended. The likelihood of plant or crop injury occurring from the use of this product is greatest when winds are gusty or in excess of 5 miles per hour or when other conditions, including lesser wind velocities, will allow spray drift to occur. When spraying, avoid combinations of pressure and nozzle type that will result in splatter or fine particles (mist) which are likely to drift. **AVOID APPLYING AT EXCESSIVE SPEED OR PRESSURE.**

Note: Use of this product in a manner not consistent with this label may result in injury to persons, animals, or crops, or other unintended consequences. When not in use, keep container closed to prevent spills and contamination.

Aerial Equipment

For aerial application of this product in California, refer to Federal supplemental label for this product entitled "For Aerial Application in California Only". In California, aerial application may be made in aquatic sites and noncrop areas, including aquatic sites present in noncrop areas that are part of the intended treatment.

For control of weed or brush species listed in this label using aerial application equipment: For aerial broadcast application, unless otherwise specified, apply the rates of this product and surfactant recommended for broadcast application in a spray volume of 3 to 20 gallons of water per acre. See the "Weeds Controlled" section of this label for labeled annual and herbaceous weeds and woody plants and broadcast rate recommendations. Aerial applications of this product may only be made as specifically recommended in this label.

AVOID DRIFT. Do not apply during inversion conditions, when winds are gusty or under any other condition which will allow drift. Drift may cause damage to any vegetation contacted to which treatment is not intended. To prevent injury to adjacent desirable vegetation, appropriate buffer zones must be maintained.

Coarse sprays are less likely to drift; therefore, do not use nozzles or nozzle configurations which dispense spray as fine spray droplets. Do not angle nozzles forward into the airstream and do not increase spray volume by increasing nozzle pressure.

Drift control additives may be used. When a drift control additive is used, read and carefully observe the cautionary statements and all other information appearing in the additive label. The use of a drift control agent for conifer and herbaceous release applications may result in conifer injury and is not recommended.

Ensure uniform application. To avoid streaked, uneven or overlapped application, use appropriate marking devices.

Thoroughly wash aircraft, especially landing gear, after each day of spraying to remove residues of this product accumulated during spraying or from spills. **Prolonged exposure of this product to uncoated steel surfaces may result in corrosion and possible failure of the part. Landing gear are most susceptible.** The maintenance of an organic coating (paint) which meets aerospace specification MIL-C-38413 may prevent corrosion.

Ground Broadcast Equipment

For control of weed or brush species listed in this label using conventional boom equipment: For ground broadcast application, unless otherwise specified, apply the rates of this product and surfactant recommended for broadcast application in a spray volume of 3 to 30 gallons of water per acre. See the "Weeds Controlled" section of this label for labeled annual and herbaceous weeds and woody plants and broadcast rate recommendations. As density of vegetation increases, spray volume should be increased within the recommended range to ensure complete coverage. Carefully select correct nozzle to avoid spraying a fine mist. For best results with ground application equipment, use flat fan nozzles. Check for even distribution of spray droplets.

Forestry and Utility Rights-of-Way Sites: This product is recommended for broadcast applications using suitable ground equipment in forestry sites, utility sites, and utility rights-of way. Apply the recommended rates of this product and surfactant in a spray volume of 10 to 60 gallons per acre. Check for even distribution of spray droplets.

**Hand-Held and High-Volume Equipment
(Use Coarse Sprays Only)**

For control of weeds listed in this label using knapsack sprayers or high-volume spraying equipment utilizing handguns or other suitable nozzle arrangements:

High volume sprays: Prepare a **3/4 to 2 percent solution** of this product in water, add a nonionic surfactant and apply to foliage of vegetation to be controlled. For specific rates of application and instructions for control of various annual and perennial weeds, see the "Weeds Controlled" section in this label.

Applications should be made on a spray-to-wet basis. Spray coverage should be uniform and complete. Do not spray to point of runoff.

Low volume directed sprays: This product may be used as a **5 to 10 percent solution** in low-volume directed sprays for spot treatment of trees and brush. This treatment method is most effective in areas where there is a low density of undesirable trees or brush. If a straight stream nozzle is used, start the application at the top of the targeted vegetation and spray from top to bottom in a lateral zig-zag motion. Ensure that at least 50 percent of the leaves are contacted by the spray solution. For flat fan and cone nozzles and with hand-directed mist blowers, mist the application over the foliage of the targeted vegetation. Small, open-branched trees need only be treated from one side. If the foliage is thick or there are multiple root sprouts, applications must be made from several sides to ensure adequate spray coverage.

Prepare the desired volume of spray solution by mixing the amount of this product in water, shown in the following table:

Spray Solution

Desired Volume	Amount of this product							
	3/4%	1%	1 1/4%	1 1/2%	2%	5%	8%	10%
1 gal	1 fl oz	1 1/3 fl oz	1 2/3 fl oz	2 fl oz	2 2/3 fl oz	6 1/2 fl oz	10 1/4 fl oz	12 3/4 fl oz
25 gal	1 1/2 pt	1 qt	1 1/4 qt	1 1/2 qt	2 qt	5 qt	2 gal	2.5 gal
100 gal	3 qt	1 gal	1 1/4 gal	1 1/2 gal	2 gal	5 gal	8 gal	10 gal

2 tablespoons = 1 fluid ounce

For use in knapsack sprayers, it is suggested that the recommended amount of this product be mixed with water in a larger container. Fill the knapsack sprayer with the mixed solution and add the correct amount of surfactant.

Selective Equipment

This product may be applied through shielded sprayers or wiper application equipment. This equipment may be used to selectively control undesirable vegetation without harming desirable vegetation.

Shielded sprayers direct the herbicide solution onto weeds while shielding desirable vegetation from the spray solution. Any recommended rate or tank mixture of this product may be used employing this equipment.

Wiper applicators physically wipe product directly onto undesirable vegetation. Care should be taken to avoid wiping desirable vegetation. Use a 33 to 100 percent solution of this product, diluted in water for wiper applications. Use a 33 percent solution for wick or gravity feed systems. Higher concentrations may be used in pressurized systems that are capable of handling thicker solutions. Addition of a nonionic surfactant at a rate of 10 percent by volume of total herbicide solution is recommended.

Weeds Controlled

Annual Weeds

Apply to actively growing annual grasses and broadleaf weeds.

Allow at least 3 days after application before disturbing treated vegetation. After this period the weeds may be mowed, tilled or burned. See "Directions for Use," "General Information" and "Mixing and Application Instructions" for labeled uses and specific application instructions.

Broadcast Application Rates: For weeds less than 6 inches tall, use 1 1/2 pints of this product per acre plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient. If weeds are greater than 6 inches tall, use 2 1/2 pints of this product per acre plus a non-ionic surfactant containing 80% or greater active ingredient.

Hand-Held, High-Volume Application Rates: Use a 3/4 percent solution of this product in water plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient. Apply to foliage of vegetation to be controlled.

When applied as directed, this product plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient will control the following annual weeds:

Common Name	Scientific Name
Balsamapple [†]	<i>Momordica charantia</i>
Barley	<i>Hordeum vulgare</i>
Barnyardgrass	<i>Echinochloa crus-galli</i>
Bassia, fivehook	<i>Bassia hyssopifolia</i>
Bluegrass, annual	<i>Poa annua</i>
Bluegrass, bulbous	<i>Poa bulbosa</i>
Brome	<i>Bromus spp.</i>
Buttercup	<i>Ranunculus spp.</i>
Cheat	<i>Bromus secalinus</i>
Chickweed, mouseear	<i>Cerastium vulgatum</i>
Cocklebur	<i>Xanthium strumarium</i>
Corn, volunteer	<i>Zea mays</i>
Crabgrass	<i>Digitaria spp.</i>
Dwarf dandelion	<i>Krigia cespitosa</i>
Falseflax, smallseed	<i>Camelina microcarpa</i>
Fiddleneck	<i>Amsinckia spp.</i>
Flaxleaf fleabane	<i>Conyza bonariensis</i>
Fleabane	<i>Erigeron spp.</i>
Foxtail	<i>Setaria spp.</i>
Foxtail, Carolina	<i>Alopecurus carolinianus</i>
Groundsel, common	<i>Senecio vulgaris</i>
Horseweed/Marestail	<i>Conyza canadensis</i>
Kochia	<i>Kochia scoparia</i>
Lambsquarters, common	<i>Chenopodium album</i>
Lettuce, prickly	<i>Lactuca scariola</i>
Morningglory	<i>Ipomoea spp.</i>
Mustard, blue	<i>Chorispora tenella</i>
Mustard, tansy	<i>Descurainia pinnata</i>
Mustard, tumble	<i>Sisymbrium altissimum</i>
Mustard, wild	<i>Sinapis arvensis</i>
Oats, wild	<i>Avena fatua</i>
Panicum	<i>Panicum spp.</i>
Pennycress, field	<i>Thlaspi arvense</i>
Pigweed, redroot	<i>Amaranthus retroflexus</i>
Pigweed, smooth	<i>Amaranthus hybridus</i>
Ragweed, common	<i>Ambrosia artemisiifolia</i>
Ragweed, giant	<i>Ambrosia trifida</i>
Rocket, London	<i>Sisymbrium irio</i>
Rye	<i>Secale cereale</i>
Ryegrass, Italian ^{††}	<i>Lolium multiflorum</i>
Sandbur, field	<i>Cenchrus spp.</i>
Shattercane	<i>Sorghum bicolor</i>
Shepherd's-purse	<i>Capsella bursa-pastoris</i>
Signalgrass, broadleaf	<i>Brachiaria platyphylla</i>
Smartweed, Pennsylvania	<i>Polygonum pennsylvanicum</i>
Sowthistle, annual	<i>Sonchus oleraceus</i>
Spanishneedles ^{††}	<i>Bidens bipinnata</i>
Stinkgrass	<i>Eragrostis cilianensis</i>
Sunflower	<i>Helianthus annuus</i>
Thistle, Russian	<i>Salsola kali</i>
Spurry, umbrella	<i>Holosteum umbellatum</i>
Velvetleaf	<i>Abutilon theophrasti</i>
Wheat	<i>Triticum aestivum</i>
Witchgrass	<i>Panicum capillare</i>

[†] Apply with hand-held equipment only.

^{††} Apply 3 pints of this product per acre.

Annual weeds will generally continue to germinate from seed throughout the growing season. Repeat treatments will be necessary to control later germinating weeds.

Perennial Weeds

Apply this product to control most vigorously growing perennial weeds. Unless otherwise directed, apply when target plants are actively growing and most have reached early head or early bud stage of growth. Unless otherwise directed, allow at least 7 days after application before disturbing vegetation.

NOTE: If weeds have been mowed or tilled, do not treat until regrowth has reached the recommended stages. Fall treatments must be applied before a killing frost.

Repeat treatments may be necessary to control weeds regenerating from underground parts or seed.

Specific Weed Control Recommendations: For perennial weeds, apply the recommended rate plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient. Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information.

When applied as directed, this product plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient will control the following perennial weeds: (Numbers in parentheses "(-)" following common name of a listed weed species refer to "Specific Perennial Weed Control Recommendations" for that weed which follow the species listing.)

Common Name	Scientific Name
Alfalfa (31)	<i>Medicago sativa</i>
Alligatorweed [†] (1)	<i>Alternanthera philoxeroides</i>
Anise/Fennel (31)	<i>Foeniculum vulgare</i>
Artichoke, Jerusalem (31)	<i>Helianthus tuberosus</i>
Bahiagrass (31)	<i>Paspalum notatum</i>
Bermudagrass (2)	<i>Cynodon dactylon</i>
Bindweed, field (3)	<i>Convolvulus arvensis</i>
Bluegrass, Kentucky (12)	<i>Poa pratensis</i>
Blueweed, Texas (3)	<i>Helianthus ciliaris</i>
Brackenfern (4)	<i>Pteridium spp.</i>
Bromegrass, smooth (12)	<i>Bromus inermis</i>
Canarygrass, reed (12)	<i>Palaris arundinacea</i>
Cattail (5)	<i>Typha spp.</i>
Clover, red (31)	<i>Trifolium pratense</i>
Clover, white (31)	<i>Trifolium repens</i>
Cogongrass (6)	<i>Imperata cylindrica</i>
Cordgrass (7)	<i>Spartina spp.</i>
Cutgrass, giant [†] (8)	<i>Zizaniopsis miliacea</i>
Dallisgrass (31)	<i>Paspalum dilatatum</i>
Dandelion (31)	<i>Taraxacum officinale</i>
Dock, curly (31)	<i>Rumex crispus</i>
Dogbane, hemp (9)	<i>Apocynum cannabinum</i>
Fescue (31)	<i>Festuca spp.</i>
Fescue, tall (10)	<i>Festuca arundinacea</i>
Guineagrass (11)	<i>Panicum maximum</i>
Hemlock, poison (31)	<i>Conium maculatum</i>
Horsenettle (31)	<i>Solanum carolinense</i>
Horseradish (9)	<i>Armoracia rusticana</i>
Ice Plant (22)	<i>Mesembryanthemum crystallinum</i>
Johnsongrass (12)	<i>Sorghum halepense</i>
Kikuyugrass (21)	<i>Pennisetum clandestinum</i>

Common Name	Scientific Name
Knapweed (9)	<i>Centaurea repens</i>
Lantana (13)	<i>Lantana camara</i>
Lespedeza, common (31)	<i>Lespedeza striata</i>
Lespedeza, sericea (31)	<i>Lespedeza cuneata</i>
Loosestrife, purple (14)	<i>Lythrum salicaria</i>
Lotus, American (15)	<i>Nelumbo lutea</i>
Maidencane (16)	<i>Panicum hematomon</i>
Milkweed (17)	<i>Asclepias spp.</i>
Muhly, wirestem (21)	<i>Muhlenbergia frondosa</i>
Mullein, common (31)	<i>Verbascum thapsus</i>
Napiergrass (31)	<i>Pennisetum purpureum</i>
Nightshade, silverleaf (3)	<i>Solanum elaeagnifolium</i>
Nutsedge, purple (18)	<i>Cyperus rotundus</i>
Nutsedge, yellow (18)	<i>Cyperus esculentus</i>
Orchardgrass (12)	<i>Dactylis glomerata</i>
Pampasgrass (19)	<i>Cortaderia jubata</i>
Paragrass (16)	<i>Brachiaria mutica</i>
Phragmites ¹ (20)	<i>Phragmites spp.</i>
Quackgrass (21)	<i>Agropyron repens</i>
Reed, giant (22)	<i>Arundo donax</i>
Ryegrass, perennial (12)	<i>Lolium perenne</i>
Smartweed, swamp (31)	<i>Polygonum coccineum</i>
Spatterdock (23)	<i>Nuphar luteum</i>
Starthistle, yellow (31)	<i>Centaurea solstitialis</i>
Sweet potato, wild ¹ (24)	<i>Ipomoea pandurata</i>
Thistle, artichoke (25)	<i>Cynara cardunculus</i>
Thistle, Canada (25)	<i>Cirsium arvense</i>
Timothy (12)	<i>Phleum pratense</i>
Torpedograss ¹ (26)	<i>Panicum repens</i>
Tules, common (27)	<i>Scirpus acutus</i>
Vaseygrass (31)	<i>Paspalum urvillei</i>
Velvetgrass (31)	<i>Holcus spp.</i>
Waterhyacinth (28)	<i>Eichornia crassipes</i>
Waterlettuce (29)	<i>Pistia stratiotes</i>
Waterprimrose (30)	<i>Ludwigia spp.</i>
Wheatgrass, western (12)	<i>Agropyron smithii</i>

¹ Partial control.

¹ Partial control in southeastern states. See "Specific Weed Control Recommendations" below.

Specific Perennial Weed Control Recommendations:

- Alligatorweed:** Apply 6 pints of this product per acre as a broadcast spray or as a 1 1/4 percent solution with hand-held equipment to provide partial control of alligatorweed. Apply when most of the target plants are in bloom. Repeat applications will be required to maintain such control.
- Bermudagrass:** Apply 7 1/2 pints of this product per acre as a broadcast spray or as a 1 1/2 percent solution with hand-held equipment. Apply when target plants are actively growing and when seedheads appear.
- Bindweed, field / Silverleaf Nightshade / Texas Blueweed:** Apply 6 to 7 1/2 pints of this product per acre as a broadcast spray west of the Mississippi River and 4 1/2 to 6 pints of this product per acre east of the Mississippi River. With hand-held equipment, use a 1 1/2 percent solution. Apply when target plants are actively growing and are at or beyond full bloom. For silverleaf nightshade, best results can be obtained when application is made after berries are formed. Do not treat when weeds are under drought stress. New leaf development indicates active growth. For best results apply in late summer or fall.
- Brackenfern:** Apply 4 1/2 to 6 pints of this product per acre as a broadcast spray or as a 3/4 to 1 percent solution with hand-held equipment. Apply to fully expanded fronds which are at least 18 inches long.
- Cattail:** Apply 4 1/2 to 6 pints of this product per acre as a broadcast spray or as a 3/4 percent solution with hand-held equipment. Apply when target plants are actively growing and are at or beyond the early-to-full bloom stage of growth. Best results are achieved when application is made during the summer or fall months.
- Cogongrass:** Apply 4 1/2 to 7 1/2 pints of this product per acre as a broadcast spray. Apply when cogongrass is at least 18 inches tall and actively growing in late summer or fall. Allow 7 or more days after application before tillage or mowing. Due to uneven stages of growth and the dense nature of vegetation preventing good spray coverage, repeat treatments may be necessary to maintain control.
- Cordgrass:** Apply 4 1/2 to 7 1/2 pints of this product per acre as a broadcast spray or as a 1 to 2 percent solution with hand-held equipment. Schedule applications in order to allow 6 hours before treated plants are covered by tidewater. The presence of debris and silt on the cordgrass plants will reduce performance. It may be necessary to wash targeted plants prior to application to improve uptake of this product into the plant.
- Cutgrass, giant:** Apply 6 pints of this product per acre as a broadcast spray or as a 1 percent solution with hand-held equipment to provide partial control of giant cutgrass. Repeat applications will be required to maintain such control, especially where vegetation is partially submerged in water. Allow for substantial regrowth to the 7 to 10-leaf stage prior to retreatment.
- Dogbane, hemp / Knapweed / Horseradish:** Apply 6 pints of this product per acre as a broadcast spray or as a 1 1/2 percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth. For best results, apply in late summer or fall.
- Fescue, tall:** Apply 4 1/2 pints of this product per acre as a broadcast spray or as a 1 percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained.
- Guineagrass:** Apply 4 1/2 pints of this product per acre as a broadcast spray or as a 3/4 percent solution with hand-held equipment. Apply when target plants are actively growing and when most have reached at least the 7-leaf stage of growth.
- Johnsongrass / Bluegrass, Kentucky / Bromegrass, smooth / Canarygrass, reed / Orchardgrass / Ryegrass, perennial / Timothy / Wheatgrass, western:** Apply 3 to 4 1/2 pints of this product per acre as a broadcast spray or as a 3/4 percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained. In the fall, apply before plants have turned brown.
- Lantana:** Apply this product as a 3/4 to 1 percent solution with hand-held equipment. Apply to actively growing lantana at or beyond the bloom stage of growth. Use the higher application rate for plants that have reached the woody stage of growth.
- Loosestrife, purple:** Apply 4 pints of this product per acre as a broadcast spray or as a 1 to 1 1/2 percent solution using hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost.

15. **Lotus, American:** Apply 4 pints of this product per acre as a broadcast spray or as a 3/4 percent solution with hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost. Repeat treatment may be necessary to control regrowth from underground parts and seeds.
16. **Maidencane / Paragrass:** Apply 6 pints of this product per acre as a broadcast spray or as a 3/4 percent solution with hand-held equipment. Repeat treatments will be required, especially to vegetation partially submerged in water. Under these conditions, allow for regrowth to the 7 to 10-leaf stage prior to retreatment.
17. **Milkweed, common:** Apply 4 1/2 pints of this product per acre as a broadcast spray or as a 1 1/2 percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth.
18. **Nutsedge: purple, yellow:** Apply 4 1/2 pints of this product per acre as a broadcast spray, or as a 3/4 percent solution with hand-held equipment to control existing nutsedge plants and immature nutlets attached to treated plants. Apply when target plants are in flower or when new nutlets can be found at rhizome tips. Nutlets which have not germinated will not be controlled and may germinate following treatment. Repeat treatments will be required for long-term control.
19. **Pampasgrass:** Apply a 1 1/2 percent solution of this product with hand-held equipment when plants are actively growing.
20. **Phragmites:** For partial control of phragmites in Florida and the counties of other states bordering the Gulf of Mexico, apply 7 1/2 pints per acre as a broadcast spray or apply a 1 1/2 percent solution with hand-held equipment. In other areas of the U.S., apply 4 to 6 pints per acre as a broadcast spray or apply a 3/4 percent solution with hand-held equipment for partial control. For best results, treat during late summer or fall months when plants are actively growing and in full bloom. Due to the dense nature of the vegetation, which may prevent good spray coverage and uneven stages of growth, repeat treatments may be necessary to maintain control. Visual control symptoms will be slow to develop.
21. **Quackgrass / Kikuyugrass / Muhly, wirestem:** Apply 3 to 4 1/2 pints of this product per acre as a broadcast spray or as a 3/4 percent solution with hand-held equipment when most quackgrass or wirestem muhly is at least 8 inches in height (3 to 4-leaf stage of growth) and actively growing. Allow 3 or more days after application before tillage.
22. **Reed, giant / ice plant:** For control of giant reed and ice plant, apply a 1 1/2 percent solution of this product with hand-held equipment when plants are actively growing. For giant reed, best results are obtained when applications are made in late summer to fall.
23. **Spatterdock:** Apply 6 pints of this product per acre as a broadcast spray or as a 3/4 percent solution with hand-held equipment. Apply when most plants are in full bloom. For best results, apply during the summer or fall months.
24. **Sweet potato, wild:** Apply this product as a 1 1/2 percent solution using hand-held equipment. Apply to actively growing weeds that are at or beyond the bloom stage of growth. Repeat applications will be required. Allow the plant to reach the recommended stage of growth before retreatment.
25. **Thistle, Canada / artichoke:** Apply 3 to 4 1/2 pints of this product per acre as a broadcast spray or as a 1 1/2 percent solution with hand-held equipment for Canada thistle. To control artichoke thistle, apply a 2 percent solution as a spray-to-wet application. Apply when target plants are actively growing and are at or beyond the bud stage of growth.
26. **Torpedograss:** Apply 6 to 7 1/2 pints of this product per acre as a broadcast spray or as a 3/4 to 1 1/2 percent solution with hand-held equipment to provide partial control of torpedograss. Use the lower rates under terrestrial conditions, and the higher rates under partially submerged or a floating mat condition. Repeat treatments will be required to maintain such control.
27. **Tules, common:** Apply this product as a 1 1/2 percent solution with hand-held equipment. Apply to actively growing plants at or beyond the seedhead stage of growth. After application, visual symptoms will be slow to appear and may not occur for 3 or more weeks.
28. **Waterhyacinth:** Apply 5 to 6 pints of this product per acre as a broadcast spray or apply a 3/4 to 1 percent solution with hand-held equipment. Apply when target plants are actively growing and at or beyond the early bloom stage of growth. After application, visual symptoms may require 3 or more weeks to appear with complete necrosis and decomposition usually occurring within 60 to 90 days. Use the higher rates when more rapid visual effects are desired.
29. **Waterlettuce:** For control, apply a 3/4 to 1 percent solution of this product with hand-held equipment to actively growing plants. Use higher rates where infestations are heavy. Best results are obtained from mid-summer through winter applications. Spring applications may require retreatment.
30. **Waterprimrose:** Apply this product as a 3/4 percent solution using hand-held equipment. Apply to plants that are actively growing at or beyond the bloom stage of growth, but before fall color changes occur. Thorough coverage is necessary for best control.
31. **Other perennial weeds listed above:** Apply 4 1/2 to 7 1/2 pints of this product per acre as a broadcast spray or apply as a 3/4 to 1 1/2 percent solution with hand-held equipment.

Woody Brush and Trees

NOTE: If brush has been mowed or tilled or trees have been cut, do not treat until regrowth has reached the recommended stage of growth.

Application Rates and Timing

When applied as a 5 to 8 percent solution as a directed application as described in the "Hand-Held and High-Volume Equipment" section, this product will control or partially control all wood brush and tree species listed in this section of this label. Use the higher rate of application for dense stands and larger woody brush and trees.

Specific Brush or Tree Control Recommendations: Numbers in parentheses "(-)" following the common name of a listed brush or tree species refer to "Specific Brush or Tree Control Recommendations" which follow the species listing. See this section for specific application rates and timing for listed species.

For woody brush and trees, apply the recommended rate plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient. Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information. Make applications when plants are actively growing and, unless otherwise directed, after full-leaf expansion. Use the higher rate for larger plants and/or dense areas of growth. On vines, use the higher rate for plants that have reached the woody stage of growth. Best results are obtained when application is made in late summer or fall after fruit formation.

In arid areas, best results are obtained when application is made in the spring or early summer when brush species are at high moisture content and are flowering. Ensure thorough coverage when using hand-held equipment. Symptoms may not appear prior to frost or senescence with fall treatments.

Allow 7 or more days after application before tillage, mowing or removal. Repeat treatments may be necessary to control plants regenerating from underground parts or seed. Some autumn colors on undesirable deciduous species are acceptable provided no major leaf drop has occurred. Reduced performance may result if fall treatments are made following a frost.

See the "Directions for Use" and "Mixing and Application Instructions" sections in this label for labeled use and specific application instructions. **When applied as directed, this product plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient will control the following woody brush plants and trees:** (Numbers in parentheses "-" following common name of a listed brush or tree species refer to "Specific Brush or Tree Control Recommendations" for that species which follow the species listing.)

Common Name	Scientific Name
Alder (1)	<i>Alnus spp.</i>
Ash (20)	<i>Fraxinus spp.</i>
Aspen, quaking (2)	<i>Populus tremuloides</i>
Bearclover, Bearmat (20)	<i>Chamaebatia foliolosa</i>
Birch (3)	<i>Betula spp.</i>
Blackberry (1)	<i>Rubus spp.</i>
Broom, French (4)	<i>Cytisus monspessulanus</i>
Broom, Scotch (4)	<i>Cytisus scoparius</i>
Buckwheat, California (5)	<i>Eriogonum fasciculatum</i>
Cascara (20)	<i>Rhamnus purshiana</i>
Catsclaw (6)	<i>Acacia greggi</i>
Ceanothus (20)	<i>Ceanothus spp.</i>
Chamise (17)	<i>Adenostoma fasciculatum</i>
Cherry, bitter (7)	<i>Prunus emarginata</i>
Cherry, black (7)	<i>Prunus serotina</i>
Cherry, pin (7)	<i>Prunus pensylvanica</i>
Coyote brush (8)	<i>Baccharis consanguinea</i>
Creeper, Virginia (20)	<i>Parthenocissus quinquefolia</i>
Dewberry (1)	<i>Rubus trivialis</i>
Dogwood (9)	<i>Cornus spp.</i>
Elderberry (3)	<i>Sambucus spp.</i>
Elm (20)	<i>Ulmus spp.</i>
Eucalyptus, bluegum (10)	<i>Eucalyptus globulus</i>
Hasardia (5)	<i>Haplopappus squamosus</i>
Hawthorn (2)	<i>Crataegus spp.</i>
Hazel (3)	<i>Corylus spp.</i>
Hickory (9)	<i>Carya spp.</i>
Holly, Florida (11) (Brazilian peppertree)	<i>Schinus terebinthifolius</i>
Honeysuckle (1)	<i>Lonicera spp.</i>
Hornbeam, American (20)	<i>Carpinus caroliniana</i>
Kudzu (12)	<i>Pueraria lobata</i>
Locust, black (20)	<i>Robinia pseudoacacia</i>
Manzanita (20)	<i>Arctostaphylos spp.</i>
Maple, red (13)	<i>Acer rubrum</i>
Maple, sugar (14)	<i>Acer saccharum</i>
Maple, vine (20)	<i>Acer circinatum</i>
Monkey flower (5)	<i>Mimulus guttatus</i>
Oak, black (20)	<i>Quercus velutina</i>
Oak, northern pin (14)	<i>Quercus palustris</i>
Oak, post (1)	<i>Quercus stellata</i>

Common Name	Scientific Name
Oak, red (14)	<i>Quercus rubra</i>
Oak, southern red (7)	<i>Quercus falcata</i>
Oak, white (20)	<i>Quercus alba</i>
Persimmon (20)	<i>Diospyros spp.</i>
Poison-ivy (15)	<i>Rhus radicans</i>
Poison-oak (15)	<i>Rhus toxicodendron</i>
Poplar, yellow (20)	<i>Liriodendron tulipifera</i>
Prunus (7)	<i>Prunus spp.</i>
Raspberry (1)	<i>Rubus spp.</i>
Redbud, eastern (20)	<i>Cercis canadensis</i>
Rose, multiflora (16)	<i>Rosa multiflora</i>
Russian-olive (20)	<i>Elaeagnus angustifolia</i>
Sage: black (17), white	<i>Salvia spp.</i>
Sagebrush, California (17)	<i>Artemisia californica</i>
Salmonberry (3)	<i>Rubus spectabilis</i>
Salt cedar (9)	<i>Tamarix spp.</i>
Saltbush, sea myrtle (18)	<i>Baccharis halimifolia</i>
Sassafras (20)	<i>Sassafras albidum</i>
Sourwood (20)	<i>Oxydendrum arboreum</i>
Sumac, poison (20)	<i>Rhus vernix</i>
Sumac, smooth (20)	<i>Rhus glabra</i>
Sumac, winged (20)	<i>Rhus copallina</i>
Sweetgum (7)	<i>Liquidambar styraciflua</i>
Swordfern (20)	<i>Polystichum munitum</i>
Tallowtree, Chinese (17)	<i>Sapium sebiferum</i>
Thimbleberry (3)	<i>Rubus parviflorus</i>
Tobacco, tree (5)	<i>Nicotiana glauca</i>
Trumpet creeper (2)	<i>Campsis radicans</i>
Waxmyrtle, southern (11)	<i>Myrica cerifera</i>
Willow (19)	<i>Salix spp.</i>

(Partial control (See below for control or partial control instructions.)

Specific Brush or Tree Control Recommendations:

- Alder / Blackberry / Dewberry / Honeysuckle / Oak, Post / Raspberry:** For control, apply 4 1/2 to 6 pints per acre as a broadcast spray or as a 3/4 to 1 1/4 percent solution with hand-held equipment.
- Aspen, Quaking / Hawthorn / Trumpet creeper:** For control, apply 3 to 4 1/4 pints of this product per acre as a broadcast spray or as a 3/4 to 1 1/4 percent solution with hand-held equipment.
- Birch / Elderberry / Hazel / Salmonberry / Thimbleberry:** For control, apply 3 pints per acre of this product as a broadcast spray or as a 3/4 percent solution with hand-held equipment.
- Broom, French / Broom, Scotch:** For control, apply a 1 1/4 to 1 1/2 percent solution with hand-held equipment.
- Buckwheat, California / Hasardia / Monkey flower / Tobacco, tree:** For partial control of these species, apply a 3/4 to 1 1/2 percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.
- Catsclaw:** For partial control, apply a 1 1/4 to 1 1/2 percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.
- Cherry, bitter / Cherry, black / Cherry, pin / Oak, southern red / Sweetgum / Prunus:** For control, apply 3 to 7 1/2 pints of this product per acre as a broadcast spray or as a 1 to 1 1/2 percent solution with hand-held equipment.
- Coyote brush:** For control, apply a 1 1/4 to 1 1/2 percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

9. **Dogwood / Hickory / Salt cedar:** For partial control, apply a 1 to 2 percent solution of this product with hand-held equipment or 6 to 7 1/2 pints per acre as a broadcast spray.
10. **Eucalyptus, bluegum:** For control of eucalyptus resprouts, apply a 1 1/2 percent solution of this product with hand-held equipment when resprouts are 6 to 12-foot tall. Ensure complete coverage. Apply when plants are actively growing. Avoid application to drought-stressed plants.
11. **Holly, Florida / Waxmyrtle, southern:** For partial control, apply this product as a 1 1/2 percent solution with hand-held equipment.
12. **Kudzu:** For control, apply 6 pints of this product per acre as a broadcast spray or as a 1 1/2 percent solution with hand-held equipment. Repeat applications will be required to maintain control.
13. **Maple, red:** For control, apply as a 3/4 to 1 1/4 percent solution with hand-held equipment when leaves are fully developed. For partial control, apply 2 to 7 1/2 pints of this product per acre as a broadcast spray.
14. **Maple, sugar / Oak: northern pin / Oak, red:** For control, apply as a 3/4 to 1 1/4 percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.
15. **Poison-ivy / Poison-oak:** For control, apply 6 to 7 1/2 pints of this product per acre as a broadcast spray or as a 1 1/2 percent solution with hand-held equipment. Repeat applications may be required to maintain control. Fall treatments must be applied before leaves lose green color.
16. **Rose, multiflora:** For control, apply 3 pints of this product per acre as a broadcast spray or as a 3/4 percent solution with hand-held equipment. Treatments should be made prior to leaf deterioration by leaf-feeding insects.
17. **Sage, black / Sagebrush, California / Chamise / Tallowtree, Chinese:** For control of these species, apply a 3/4 percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.
18. **Saltbush, sea myrtle:** For control, apply this product as a 1 percent solution with hand-held equipment.
19. **Willow:** For control, apply 4 1/2 pints of this product per acre as a broadcast spray or as a 3/4 percent solution with hand-held equipment.
20. **Other woody brush and trees listed above:** For partial control, apply 3 to 7 1/2 pints of this product per acre as a broadcast spray or as a 3/4 to 1 1/2 percent solution with hand-held equipment.

Aquatic and other Noncrop Sites

Apply this product as directed and under conditions described to control or partially control weeds and woody plants listed in the "Weeds Controlled" section in industrial, recreational and public areas or other similar aquatic or terrestrial sites on this label.

Noncrop Sites

This product may be used to control the listed weeds in and around aquatic sites and on noncrop sites such as :

Airports
 Golf Courses
 Habitat Restoration & Management Areas
 Highways & Roadsides
 Industrial Plant Sites
 Lumberyards
 Parking Areas
 Parks
 Petroleum Tank Farms

Pipeline, Power, Telephone & Utility Rights-of-Way
 Pumping Installations
 Railroads
 Schools
 Storage Areas
 Similar Sites

Aquatic Sites

This product may be applied to emerged weeds in all bodies of fresh and brackish water which may be flowing, nonflowing or transient. This includes lakes, rivers, streams, ponds, estuaries, rice levees, seeps, irrigation and drainage ditches, canals, reservoirs, wastewater treatment facilities, wildlife habitat restoration and management areas and similar sites.

If aquatic sites are present in the noncrop area and are part of the intended treatment, read and observe the following directions:

- **This product does not control plants which are completely submerged or have a majority of their foliage under water.**
- There is no restriction on the use of treated water for irrigation, recreation or domestic purposes.
- Consult local state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.
- **NOTE:** Do not apply this product directly to water within 1/2 mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within 1/2 mile of an active potable water intake in a standing body of water such as lake, pond or reservoir. To make aquatic applications around and within 1/2 mile of active potable water intakes, the water intake must be turned off for a minimum period of 48 hours after the application. The water intake may be turned on prior to 48 hours if the glyphosate level in the intake water is below 0.7 parts per million as determined by laboratory analysis. These aquatic applications may be made **only** in those cases where there are alternative water sources or holding ponds which would permit the turning off of an active potable water intake for a minimum period of 48 hours after the applications. This restriction does not apply to intermittent inadvertent overspray of water in terrestrial use sites.
- For treatments after drawdown of water or in dry ditches, allow 7 or more days after treatment before reintroduction of water to achieve maximum weed control. Apply this product within 1 day after drawdown to ensure application to actively growing weeds.
- Floating mats of vegetation may require retreatment. Avoid wash-off of sprayed foliage by spray boat or recreational boat backwash or by rainfall within 6 hours of application. Do not re-treat within 24 hours following the initial treatment.
- Applications made to moving bodies of water must be made while traveling upstream to prevent concentration of this herbicide in water. When making any bankside applications, do not overlap more than 1 foot into open water. Do not spray in bodies of water where weeds do not exist. The maximum application rate of 7 1/2 pints per acre must not be exceeded in any single broadcast application that is being made over water.

- When emerged infestations require treatment of the total surface area of impounded water, treating the area in strips may avoid oxygen depletion due to decaying vegetation. Oxygen depletion may result in fish kill.

Forestry Sites and Utility Rights-of-Way

In forest and utility sites, this product is recommended for the control or partial control of woody brush, trees, and annual and perennial herbaceous weeds. This product is also recommended for use in preparing or establishing wildlife openings within these sites, in pine straw plantations for maintaining logging roads, and for side trimming along utility rights-of-way.

In forestry sites, this product is recommended for use in site preparation prior to planting any tree species, including Christmas trees and silvicultural nursery sites.

In utility sites, this product is recommended for use along electrical power, pipeline, and telephone rights-of-way, and in other utility sites associated with these rights-of-way, such as substations.

Application Rates ¹:

Method of Application	Application Rate	Spray Volume (gal/acre)
Broadcast		
Aerial	1.5 to 7.5 qt/acre	5 to 30
Ground	1.5 to 7.5 qt/acre	10 to 60
Spray-to-Wet		
Handgun, Backpack Mistblower	0.75 to 2% by volume	spray-to-wet
Low Volume Directed Spray ²		
Handgun, Backpack Mistblower	5% to 10% by volume	partial coverage

¹ Where repeat applications are necessary, do not exceed 8.0 quarts per acre per year.

² For low volume directed spray applications, coverage should be uniform with at least 50 percent of the foliage contacted. For best results, coverage of the top one-half of the plant is important.

In forestry site preparation and utility rights-of-way applications, this product requires use with a surfactant such as a non-ionic surfactant containing greater than 80 percent active ingredient. Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information.

Use higher rates of this product within the recommended rate ranges for control or partial control of woody brush, trees and hard-to-control perennial herbaceous weeds. For best results, apply to actively growing woody brush and trees after full leaf expansion and before fall color and leaf drop. Use increased rates within the recommended rate range to control of perennial herbaceous weeds from emergence up to the appearance of seedheads, flowers or berries appear. Use lower rates within the recommended rate range to control annual herbaceous weeds and actively growing perennial herbaceous weeds after seedheads, flowers or berries appear. Apply to foliage of actively growing annual herbaceous weeds anytime after emergence.

Tank Mixtures

This product may be used in tank mix combination with other herbicide products to broaden the spectrum of vegetation controlled. When tank mixing, read and observe applicable use directions, precautions and limitations on the respective product labels. Use according to the most restrictive precautionary statements for each product on the mixture. Any recommended rate of this product may be used in a tank mix.

Note: For forestry site preparation, make sure the tank mix product is approved for use prior to planting the desired species. Observe planting interval restrictions. For side trimming treatments in utility rights-of-way, tank mixtures with Arsenal 2WSL herbicide are not recommended. For side trimming treatments, it is recommended that this product be used alone as recommended, or as a tank mix with Garlon.

Product	Broadcast Rate	Use Sites
Arsenal Applicators Concentrate	2 to 16 fl oz/acre	Forestry site preparation
Oust	1 to 4 oz/acre	Forestry site preparation, utility sites
Garlon 3A ¹	1 to 4 qt/acre	Forestry site preparation, utility sites
Garlon 4	1 to 4 qt/acre	Forestry site preparation, utility sites
Arsenal 2WSL	2 to 32 fl oz/acre	Utility sites
	Spray-to-Wet Rates	
Arsenal Applicators Concentrate	1/32% to 1/2% by volume	Forestry site preparation
Arsenal 2WSL	1/32% to 1/2% by volume	Utility sites
	Low Volume Directed Spray Rates	
Arsenal Applicators Concentrate	1/8% to 1/2% by volume	Forestry site preparation
Arsenal 2WSL	1/8% to 1/2% by volume	Utility sites

¹ Ensure that Garlon 3A is thoroughly mixed with water before adding this product. Agitation is required while mixing this product with Garlon 3A to avoid compatibility problems.

For control of herbaceous weeds, use the lower recommended tank mixture rates. For control of dense stands or difficult-to-control woody brush and trees, use the higher recommended rates.

Forestry Conifer and Hardwood Release

Directed Sprays and Selective Equipment

This product may be applied as a directed spray or by using selective equipment in forestry conifer and hardwood sites, including Christmas tree plantations and silvicultural nurseries. This product requires use with a surfactant. Use only surfactants that are approved for conifer release and specified on the surfactant label as safe for use in conifer release (pine release). Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information.

Tank Mixing: In hardwood plantations, tank mixtures with Oust may be used. In pine plantations, tank mixtures with Garlon 4 or Arsenal AC may be used. Comply with all site restrictions, forestry species limitations, and precautions on the tank mix product labels.

Avoid contact of spray drift, mist or drips with foliage, green bark or non-woody surface roots of desirable plant species. See "Application Equipment and Techniques" section of this label for specific recommendations and precautions.

Spray-to-Wet Applications: Use a 2 percent spray solution to control undesirable woody brush and trees. To control herbaceous weeds, use a 1 to 2 percent spray solution.

Low Volume Directed Spray Applications: Use a 5 to 10 percent spray solution. Coverage should be uniform with at least 50 percent of the foliage contacted. Coverage of the top one-half of the unwanted vegetation is important.

Broadcast Applications: For equipment calibrated for broadcast applications, use 1 1/2 to 7 1/2 quarts of this product per acre. Apply in 10 to 60 gallons of clean water per acre. Shielded application equipment may be used to avoid contact of the spray solution with desirable plants. Shields should be adjusted to prevent spray contact with the foliage of green bark of desirable vegetation.

Wiper Application Equipment: See the "Selective Equipment" section of this label for equipment and application rate recommendations.

Broadcast Application

Note: Except where specifically recommended below, make broadcast applications of this product only where conifers have been established for more than one year.

Broadcast application must be made after formation of final conifer resting buds in the fall or prior to initial bud swelling in the spring.

Injury may occur to conifers treated for release, especially where spray patterns overlap or the higher rates are applied. Damage can be accentuated if applications are made when conifers are actively growing, or are under stress from drought, flood water, improper planting, insects, animal damage or diseases.

This product requires use with a surfactant. Use a surfactant that is labeled/recommended for use in over-the-top release applications. Use of this product without a surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information.

For release of the following conifer species outside the Southeastern United States:

Douglas fir (*Pseudotsuga menziesii*)

Fir (*Abies* species)

Hemlock [†] (*Tsuga* species)

Pines [†] (*Pinus* species)

Redwood, California ^{††} (*Sequoia* species)

[†] Includes all species except loblolly pine, longleaf pine, shortleaf pine or slash pine.

^{††} Use of a surfactant is not recommended for release of hemlock species or California redwood. In mixed conifer stands, injury to these species may result if a surfactant is used.

Application Rate for Conifer Release: Apply 3/4 to 1 1/2 quarts per acre as a broadcast spray. In Maine and New Hampshire, up to 2 1/4 quarts per acre of this product may be used for the control and suppression of difficult-to-control hardwood species.

To release Douglas fir, and pine and spruce species at the end of the first growing season (except in California), apply 3/4 to 1 1/8 quarts per acre of this product. Make sure that all conifers are well hardened off.

Note: For release of Douglas fir with this product or recommended tank mixtures, a nonionic surfactant recommended for over-the-top foliar spray may be used. To avoid possible conifer injury, nonionic surfactants may be used at 2 fluid ounces per acre at elevations above 1500 feet, or 1 fluid ounce per acre in the coastal range or at elevations below 1500 feet. Use of surfactant rates exceeding those listed above may result in unacceptable conifer injury and are not recommended. Make sure that the nonionic surfactant has been adequately tested for safety to Douglas fir before use.

Tank Mixtures with Oust: To release jack pine, white pine and white spruce, apply 3/4 to 1 1/2 quarts of this product with 1 to 3 ounces (1 to 1 1/2 ounces for white pine) of Oust per acre. Make applications to actively growing weeds as a broadcast spray over the top of established conifers. Applications at these rates should be made after formation of conifer resting buds in the late summer or fall.

Tank Mixtures with Arsenal Applicators Concentrate: This product may be tank mixed with Arsenal Applicators Concentrate for release of Douglas fir. Tank mix 3/4 to 1 1/8 quarts of this product with 2 to 6 fluid ounces of Arsenal Applicators Concentrate per acre. For release of balsam fir and red spruce, apply a mixture of 1 1/2 quarts of this product with 1 to 2 1/2 fluid ounces of Arsenal Applicators Concentrate per acre.

In Maine and New Hampshire for the release of red pine, balsam fir, red spruce, white spruce, Norway spruce, and black spruce with dense tough-to-control brush and where maples make up a large component of the undesirable trees, up to 2 1/4 quarts per acre of this product may be tank mixed with 1 to 2 1/2 fluid ounces per acre of Arsenal Applicators Concentrate herbicide and applied as a broadcast spray.

Tank mixtures with Arsenal Applicators Concentrate and Oust or Oust XP Herbicides: In Maine and New Hampshire for release of red pine, balsam fir, red spruce, white spruce, Norway spruce and black spruce with heavy grass and herbaceous weed densities, tough-to-control brush and where maples make up a large component of the undesirable trees up to 2 1/4 quarts per acre of this product may be tank mixed with 1 to 2.5 fluid ounces per acre of Arsenal Applicators Concentrate and 1 to 3 oz of Oust or Oust XP herbicides and applied as a broadcast spray.

For release of the following conifer species in the Southeastern United States:

Loblolly pine (*Pinus taeda*)

Eastern white pine (*Pinus strobus*)

Shortleaf pine (*Pinus echinata*)

Slash pine (*Pinus elliottii*)

Virginia pine (*Pinus virginiana*)

Longleaf pine (*Pinus palustris*)

Apply 1 1/8 to 1 7/8 quarts of this product per acre as a broadcast spray during late summer or early fall after the conifers have hardened off. For applications at the end of the first growing season, use 3/4 quart of this product alone or in a recommended tank mixture.

Tank Mixtures with Arsenal Applicators Concentrate: For conifer release, apply 3/4 to 1 1/2 quarts of this product with 2 to 16 fluid ounces of Arsenal Applicators Concentrate per acre as a broadcast spray. Use only on conifer species that are labeled for over-the-top spray for both products. Use the higher recommended rates for dense tough-to-control wood brush and trees.

Read and observe label claims, cautionary statements and all information on the labels of each product used in these tank mixtures. Use according to the most restrictive precautionary statements for each product in the mixture.

Herbaceous Release

When applied as directed, this product plus listed residual herbicides provides postemergence control of the annual weeds and control or suppression of the perennial weeds listed in this label, and residual control of the weeds listed in the residual herbicide label. Make applications to actively growing weeds as a broadcast spray over the top of labeled conifers.

Tank Mixtures with Oust: To release loblolly pines, tank mix 12 to 18 fluid ounces of this product with 2 to 4 ounces of Oust per acre.

To release slash pines, tank mix 9 to 12 fluid ounces of this product with 2 to 4 ounces of Oust per acre.

In Maine and New Hampshire for release of red pine, balsam fir, red spruce, white spruce, Norway spruce, and black spruce with heavy grass and herbaceous weeds infesting the site, up to 2 1/4 quarts per acre of this product may be tank mixed with 1 to 3 oz of Oust herbicide or Oust XP herbicide to control grass, herbaceous weeds and woody brush, and applied as a broadcast spray.

For tank mixtures with Oust use a surfactant that is labeled/ recommended for use in over-the-top herbaceous release applications. Use of this product without a surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information.

Weed control may be reduced if water volumes exceed 25 gallons per acre for these treatments.

Tank Mixture with Atrazine: To release Douglas fir, apply 3/4 quart of this product with 4 pounds a.i. of atrazine per acre. Apply only over Douglas fir that has been established for at least one full growing season. Apply in the early spring, usually mid-March through early April. Injury will occur if applications are made after bud swell in the spring. For this use, do not add surfactant to the tank mixture.

Always read and follow the manufacturer's label for all herbicides and surfactants used.

Wetland Sites

This product may be used in and around water (aquatic areas) and wetlands found in forestry and in power, telephone and pipeline rights-of-way sites, including where these sites are adjacent to or surrounding domestic water supply reservoirs, supply streams, lakes and ponds. Read and observe the following before making applications in and around water.

Consult local public water control authorities before applying this product in and around public water. Permits may be required to treat in such areas.

There is no restriction on the use of treated water for irrigation, recreation or domestic purposes.

Note: Do not apply this product directly to water within 1/2 mile up-stream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within 1/2 mile of an active potable water intake in a standing body of water such as a lake, pond or reservoir. To make aquatic applications around and within 1/2 mile of active potable water intakes, the water intake must be turned off for a minimum period of 48 hours after application. These aquatic applications may be made ONLY in those cases where there are alternative water sources or holding ponds which would permit the turning off of an active potable water intake for a minimum period of 48 hours after the application. This restriction does not apply to intermittent inadvertent overspray of water in terrestrial use sites.

Do not spray open bodies of water where woody brush, trees and herbaceous weeds do not exist. The maximum application rate of 3 3/4 quarts per acre must not be exceeded in a single over-water broadcast application except as follows, where any recommended rate may be applied:

- Stream crossings in utility right-of-way.
- Where applications will result in less than 20 percent of the total water area being treated.

Wildlife Habitat Restoration and Management Areas

This product is recommended for the restoration and/or maintenance of native habitat and in wildlife management areas.

Habitat Restoration and Maintenance: When applied as directed, exotic and other undesirable vegetation may be controlled in habitat management areas. Applications may be made to allow recovery of native plant species, to open up water to attract waterfowl, and for similar broad-spectrum vegetation control requirements in habitat management areas. Spot treatments may be made to selectively remove unwanted plants for habitat enhancement. For spot treatments, care should be exercised to keep spray off of desirable plants.

Wildlife Food Plots: This product may be used as a site preparation treatment prior to planting wildlife food plots. Apply as directed to control vegetation in the plot area. Any wildlife food species may be planted after applying this product, or native species may be allowed to reinfest the area. If tillage is needed to prepare a seedbed, wait 7 days after applying this product before tilling to allow for maximum effectiveness.

Wiper Applications

For wick or wiper applications, mix 1 gallon of this product with 2 gallons of clean water to make a 33 percent solution. Addition of a nonionic surfactant at a rate of 10 percent by volume of total herbicide solution is recommended.

Wiper applications can be used to control or suppress annual and perennial weeds listed on this label. In heavy weed stands, a double application in opposite directions may improve results. See the "Weed Controlled" section in this label for recommended timing, growth stage and other instructions for achieving optimum results

Cut Stump Application

Woody vegetation may be controlled by treating freshly cut stumps of trees and resprouts with this product. Apply this product using suitable equipment to ensure coverage of the entire cambium. Cut vegetation close to the soil surface. **Apply a 50 to 100 percent solution of this product to freshly cut surface immediately after cutting.** Delay in applying this product may result in reduced performance. For best results, trees should be cut during periods of active growth and full leaf expansion.

When used according to directions for cut stump application, this product will **control, partially control or suppress** most woody brush and tree species, some of which are listed below:

Common Name	Scientific Name
Alder	<i>Alnus spp.</i>
Coyote brush [†]	<i>Baccharis consanguinea</i>
Dogwood [†]	<i>Cornus spp.</i>
Eucalyptus	<i>Eucalyptus spp.</i>
Hickory [†]	<i>Carya spp.</i>
Madrone	<i>Arbutus menziesii</i>
Maple [†]	<i>Acer spp.</i>
Oak	<i>Quercus spp.</i>
Poplar [†]	<i>Populus spp.</i>
Reed, giant	<i>Arundo donax</i>
Salt cedar	<i>Tamarix spp.</i>
Sweet gum [†]	<i>Liquidambar styraciflua</i>
Sycamore [†]	<i>Platanus occidentalis</i>
Tan oak	<i>Lithocarpus densiflorus</i>
Willow	<i>Salix spp.</i>

[†] This product is not approved for this use on these species in the state of California.

Injection and Frill Applications

Woody vegetation may be controlled by injection or frill application of this product. Apply this product using suitable equipment which must penetrate into living tissue. Apply the equivalent of 1 ml of this product per 2 to 3 inches of trunk diameter. This is best achieved by applying 25 to 100 percent concentration of this product either to a continuous frill around the tree or as cuts evenly spaced around the tree below all branches. As tree diameter increases in size, better results are achieved by applying dilute material to a continuous frill or more closely spaced cuttings. Avoid application techniques that allow runoff to occur from frill or cut areas in species that exude sap freely after frills or cutting. In species such as these, make frill or cut at an oblique angle so as to produce a cupping effect and use undiluted material. For best results, applications should be made during periods of active growth and full leaf expansion.

This treatment will control the following woody species:

Common Name	Scientific Name
Oak	<i>Quercus spp.</i>
Poplar	<i>Populus spp.</i>
Sweet gum	<i>Liquidambar styraciflua</i>
Sycamore	<i>Platanus occidentalis</i>

This treatment will suppress the following woody species:

Common Name	Scientific Name
Black gum [†]	<i>Nyssa sylvatica</i>
Dogwood	<i>Cornus spp.</i>
Hickory	<i>Carya spp.</i>
Maple, red	<i>Acer rubrum</i>

[†] This product is not approved for this use on this species in the state of California.

Release of Bermudagrass or Bahiagrass on Noncrop Sites

Release Of Dormant Bermudagrass And Bahiagrass

When applied as directed, this product will provide control or suppression of many winter annual weeds and tall fescue for effective release of dormant bermudagrass or bahiagrass. Make applications to dormant bermudagrass or bahiagrass.

For best results on winter annuals, treat when weeds are in an early growth stage (below 6 inches in height) after most have germinated. For best results on tall fescue, treat when fescue is in or beyond the 4 to 6-leaf stage.

Weeds Controlled

Rate recommendations for control or suppression of winter annuals and tall fescue are listed below.

Apply the recommended rates of this product in 10 to 25 gallons of water per acre plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient.. Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information.

Weeds Controlled or Suppressed [†]

Note: C = Controlled; S = Suppressed

Weed Species	Rate (Fluid Ounces Per Acre)					
	6	9	12	18	24	48
Barley, little <i>Hordeum pusillum</i>	S	C	C	C	C	C
Bedstraw, catchweed <i>Galium aparine</i>	S	C	C	C	C	C
Bluegrass, annual <i>Poa annua</i>	S	C	C	C	C	C
Chervil <i>Chaerophyllum tainturieri</i>	S	C	C	C	C	C
Chickweed, common <i>Stellaria media</i>	S	C	C	C	C	
Clover, crimson <i>Trifolium incarnatum</i>	•	S	S	C	C	C
Clover, large hop <i>Trifolium campestre</i>	•	S	S	C	C	C
Speedwell, corn <i>Veronica arvensis</i>	S	C	C	C	C	C
Fescue, tall <i>Festuca arundinacea</i>	•	•	•	•	S	S
Geranium, Carolina <i>Geranium carolinianum</i>	•	•	S	S	C	C
Henbit <i>Lamium amplexicaule</i>	•	S	C	C	C	C
Ryegrass, Italian <i>Lolium multiflorum</i>	•	•	S	C	C	C
Vetch, common <i>Vicia sativa</i>	•	•	S	C	C	C

[†]These rates apply only to sites where an established competitive turf is present.

Release Of Actively Growing Bermudagrass

NOTE: Use only on sites where bahiagrass or bermudagrass are desired for ground cover and some temporary injury or yellowing of the grasses can be tolerated.

When applied as directed, this product will aid in the release of bermudagrass by providing control of annual species listed in the "Weeds Controlled" section in this label, and suppression or partial control of certain perennial weeds.

For control or suppression of those annual species listed in this label, use 3/4 to 2 1/4 pints of this product as a broadcast spray in 10 to 25 gallons of spray solution per acre, plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient.. Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information. Use the lower rate when treating annual weeds below 6 inches in height (or length of runner in annual vines). Use the higher rate as size of plants increases or as they approach flower or seedhead formation.

Use the higher rate for partial control or longer-term suppression of the following perennial species. Use lower rates for shorter-term suppression of growth.

Bahiagrass	Johnsongrass [†]
Dallisgrass	Trumpet creeper ^{††}
Fescue (tall)	Vaseygrass

[†] Johnsongrass is controlled at the higher rate.

^{††} Suppression at the higher rate only.

Use only on well-established bermudagrass. Bermudagrass injury may result from the treatment but regrowth will occur under moist conditions. Repeat applications in the same season are not recommended, since severe injury may result.

Bahiagrass Seedhead and Vegetative Suppression

When applied as directed in the "Noncrop Sites" section in this label, this product will provide significant inhibition of seedhead emergence and will suppress vegetative growth for a period of approximately 45 days with single applications and approximately 120 days with sequential applications.

Apply this product 1 to 2 weeks after full green-up of bahiagrass or after the bahiagrass has been mowed to a uniform height of 3 to 4 inches. Applications must be made prior to seedhead emergence. Apply 5 fluid ounces per acre of this product in 10 to 25 gallons of water per acre, plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient. Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information.

Sequential applications of this product plus nonionic surfactant may be made at approximately 45-day intervals to extend the period of seedhead and vegetative growth suppression. For continued vegetative growth suppression, sequential applications must be made prior to seedhead emergence.

Apply no more than 2 sequential applications per year. As a first sequential application, apply 3 fluid ounces of this product per acre plus nonionic surfactant. A second sequential application of 2 to 3 fluid ounces per acre plus nonionic surfactant may be made approximately 45 days after the last application.

Annual Grass Growth Suppression

For growth suppression of some annual grasses, such as annual ryegrass, wild barley and wild oats growing in coarse turf on roadsides or other industrial areas, apply 3 to 4 ounces of this product in 10 to 40 gallons of water per acre plus a surfactant such as a non-ionic surfactant containing 80% or greater active ingredient. Use of this product without surfactant will result in reduced herbicide performance. Refer to the "Mixing and Application Instructions" section of this label and the surfactant manufacturer label for more information. Applications should be made when annual grasses are actively growing and before the seedheads are in the boot stage of development. Treatments made after seedhead emergence may cause injury to the desired grasses.

Terms and Conditions of Use

If terms of the following Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies are not acceptable, return unopened package at once to the seller for a full refund of purchase price paid. Otherwise, use by the buyer or any other user constitutes acceptance of the terms under Warranty Disclaimer, Inherent Risks of Use and Limitations of Remedies.

Warranty Disclaimer

Dow AgroSciences warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. Dow AgroSciences MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. Crop injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label, such as unfavorable temperatures, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of Dow AgroSciences or the seller. To the fullest extent permitted by law, all such risks shall be assumed by buyer.

Limitation of Remedies

The exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories), shall be limited to, at Dow AgroSciences' election, one of the following:

- (1) Refund of purchase price paid by buyer or user for product bought, or
- (2) Replacement of amount of product used.

Dow AgroSciences shall not be liable for losses or damages resulting from handling or use of this product unless Dow AgroSciences is promptly notified of such loss or damage in writing. To the fullest extent permitted by law, in no case shall Dow AgroSciences be liable for consequential or incidental damages or losses.

The terms of the Warranty Disclaimer above and this Limitation of Remedies cannot be varied by any written or verbal statements or agreements. No employee or sales agent of Dow AgroSciences or the seller is authorized to vary or exceed the terms of the Warranty Disclaimer or this Limitation of Remedies in any manner.

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Revisions:

1. Updated Storage and Disposal

Appendix G

HG&E Summary of Canal Wall Maintenance Responsibilities

3. Canal Walls

Most of the mill sites which were sold to the water line of the canal had a reservation in the original indenture reserving the canal walls to remain for the protection of the canal. Subsequent indentures or agreements sometimes spelled out that the mill site owner was responsible for maintaining a certain wall. In the compilation of the Canal Wall Maintenance Responsibility list, all canal walls which were reserved in the original or subsequent indentures, and all walls adjacent to HWP berme land or other HWP property were assumed to be the responsibility of HWP Co. for maintenance unless there was an agreement for others to maintain them. If such an agreement exists, it is so noted in the reference column.

Responsibility for the maintenance of canal walls on mill sites which were sold to the water line with walls not reserved and without any other mention of maintenance responsibility has not been determined as of this date. (Walls No. 6, 7 and 32 are the only walls which fall into this category.)

1/31/67
LMC

CANAL WALL MAINTENANCE NOTES

1. Letter dated 7/23/24, Lyman M.B., indicates that DS&B Corp. is responsible for maintaining the wall at the abutments of the bridge crossing the First Level canal, and also that portion of the wall above El. 103.00 on either side of the bridge.
2. Feeder canal maintenance is the responsibility of DS&B Realty Corp. (Whiting No. 2 Mill Book Page 26, 38, 60.)
3. Wm. A. Millane to maintain bridge abutments and the canal wall on both sides of the bridge for a distance of 15' (Wm. Prentiss Consolidated Site, Page 83.)
4. Owners of mill site adjacent to this wall to protect wall from damage caused by use of the mill site. (Wm. Prentiss Consolidated Site, Page 83.)
5. Ownership and maintenance responsibilities of bridge belongs to owner of site adjacent to Wall.11. (Wm. Prentiss Consolidated Site, Page 112.)
6. Walls to be maintained within 3 ft. radius of steam line by owners of mill site. (Wm. Skinner & Sons M.B. Page 103.)
7. Tailrace wall: maintenance is the responsibility of owners of mill site.
 - American Thread Co. No. I MB
 - Highland Mfg. Co. MB
 - Holyoke Machine Co. MB
 - Holyoke Paper Co. MB Page 17
8. East wall of wasteway reserved by HWP Co.
 - South wall of raceway deeded to Hadley Co. (Now G&E Dept.) Hadley Co. MB Page 16)
 - See A.W.L. letter of Feb. 10, 1928, and memo of Feb. 2, 1928, concerning south wall of raceway. (A.W.L. correspondence file - "HG&E Municipal Plant" folder.)
9. Owners of land adjacent to this wall to maintain portion of retaining wall which is located on HWP Co. easement strip and which runs at a 45° angle with Lyman Street. (Deed Book D, Page 540)
10. B&M R.R. to maintain walls under R.R. bridge crossing 2nd Level canal between Cabot and Sargeant Streets for a distance of approximately 65 ft. on either end. See Drawer G1, packet 5, main vault.

CANAL WALLS - MAINTENANCE

3/30/67

NO. ON PLAN	LOCATION ON CANALS	APPROX. LENGTH	MAINTAINED BY	MILL BOOK* OR OTHER REFERENCE	AS TO PROPERTY LINES AND RESERVATIONS
1	First - South Side to R.R. Bridge	950'	HWP Co.	-	HWP CO. Owns Property
2	First - West Side 220' N of Lyman	283	HWP Co.	Deed Book E Pg. 183	Sold to Water Line Walls Reserved by HWP Co.
3	First - West Side N of Lyman	220	HWP Co. See Note 9	Deed Book D Pg. 540	Sold to Water Line Walls Reserved by HWP Co.
4	First - East Side N. of Lyman	440	HWP Co.	D. Mackintosh & Sons	HWP Owns 5' Strip Adjacent to Canal.
5	First - East Side S. Side of Feeder Canal to Boatlock Sta.	420	HWP Co.	Whiting Pa. Co. No. 1 Pg. 10	HWP Owns 10 Ft. Strip Adjacent to Canal
6	First - West Side S. of Lyman	470		Lyman Mills 12 & 118	Sold to Water Line Walls Not Reserved by HWP
7	First - East Side South of Lyman	680	See Note 1	Lyman Mills Pg. 12 & 63	Sold to Water Line Walls not Reserved from Lyman 470 Ft. South. Remainder Reserve
8	Second - West Side South of Lyman	700	DSB Realty Corp.	Lyman Mills Pg. 12, 63, 94	Sold to Water Line Walls not Reserved from Lyman 470 Ft. South. Remainder Reserve
9	Second - West Side North of Dwight	240	HWP Co.	Whiting Pa. Co. No. 2	Sold to Water Line Walls Reserved by HWP
10	First - East Side 205' N of Dwight	55	HWP Co. See Note 2	Whiting Pa. Co. No. 2	Sold to Water Line Walls Reserved by HWP
11	First - West Side North of Dwight	440	HWP Co. See Note 4 & 5	Wm. Prentiss Consolidated Sites Pg. 143	Sold to Water Line Wall Reserved by HWP
12	First - East Side North of Dwight	205	HWP Co. See Notes 3, 4 & 5	Wm. A. Prentiss Consolidated Sites Pg. 143	Sold to Water Line Wall Reserved by HWP
13	First - South of Dwight St.	470	HWP Co.	Wm. Skinner & Sons Dwight St. Mill Pg. 117	HWP Owns 7½ ft. wide strip adjacent to canal.

CANAL WALLS - MAINTENANCE

3/30/67

NO. ON PLAN	LOCATION ON CANALS	APPROX. LENGTH	MAINTAINED BY	MILL BOOK OR OTHER REFERENCE	AS TO PROPERTY LINES AND RESERVATIONS
14	First - East Side South of Dwight	371.89	HWP Co.		HWP Co. Owns Mill Site
15	Second - West Side South of Dwight	429.35	HWP Co.		HWP Co. Owns Mill Site
* 16	Second - West Side North of Appleton	510.65	Tecnifax Corp.	Am. Thread Co. Merrick Mills #2 Pg. 64 Deed Book E Pg. 305	Sold to Water Line Wall Reserved by HWP
* 17	First - East Side North of Appleton	568.11	Tecnifax Corp.	"	Sold to Water Line Wall Reserved by HWP
18	First - West Side North of Appleton	470	HWP Co. See Note 6	Wm. Skinner & Sons Pg. 40	Sold to Water Line Wall Reserved by HWP
19	First - East Side South of Appleton	200	HWP Co. See Note 6	Wm. Skinner & Sons Pg. 40	Sold to Water Line Wall Reserved by HWP
* 20	Second - West Side South of Appleton	940	Holyoke Ind. Properties, Inc.	Box 1-6 Packet 12 Land Grant Farr Alpaca Bigelow Mill Bk. 2, Pg. 46	Sold to Water Line Wall not Reserved by HWP
21	First - East Side North of Cabot	232	HWP Co.	Farr Alpaca Co. Cabot St. Mills Pg. 11	Sold to Water Line Walls Reserved by HWP
22	First - West Side North of Cabot	470	HWP Co.	Farr Alpaca Co. Cabot St. Mills Pg. 11	Sold to Water Line Wall Reserved by HWP
* 23	First - East Side 200' S of Appleton	508	Holyoke Ind. Properties, Inc.	Farr Alpaca Co. Bigelow St. Mill Pg. 38	Sold to Water Line Wall Reserved by HWP
J* 24	First - West Side South of Appleton	470	Hart Top Mfg. Company	Farr Alpaca Company Bigelow St. Mill Pg. 38	Sold to Water Line Wall Reserved by HWP
25	First - East Side South of Cabot	390	HWP Co.	Crocker-McElwain Co. Pg. 13	Sold to Water Line Wall Reserved by HWP

3/30/67

NO. ON PLAN	LOCATION ON CANALS	APPROX. LENGTH	MAINTAINED BY	MILL BOOK OR OTHER REFERENCE	AS TO PROPERTY LINES AND RESERVATIONS
26	Second - West Side South of Cabot	450	HWP Co.	Crocker-McElwain Company Pg. 13	Sold to Water Line Wall Reserved by HWP
27	First - East Side 390' S of Cabot	250	HWP Co.	Electric Plant - City of Holyoke Pg. 9	Sold to Water Line Wall Reserved by HWP
28	Second - West Side North of Sargeant	470	HWP Co. See Note 10	Geo. R. Dickinson Pa.Co.Div. Land Vault P2-13	Sold to Water Line Wall Reserved by HWP
29	First - East Side North of Sargeant	300	HWP Co.	Geo. R. Dickinson Paper Company Div.	Sold to Water Line Wall Reserved by HWP
30	First - East Side South of Sargeant	600	HWP Co.	Parsons Pa. Co. Pg. 5	HWP Owns 35 ft. wide Strip adjacent to Canal
31	Second - West Side South of Sargeant	600	HWP Co.	Parsons Paper Co. Pg. 5	HWP Owns 25 ft. wide Strip Adjacent to Canal
32	First - West Side South of Sargeant	690		Farr Alpaca Co. #2 Mill M.B. Pg. 101 - Deed Bk. D Pg. 374	Sold to Water Line Walls not Reserved
33	First - West Side North of Sargeant	600	HWP Co.	Wm. Skinner MB - Pg. 93-C Crocker-McElwain MB Pg 48 Deed Book D Pg. 400	HWP Owns 20 ft. wide Strip adjacent to Canal
34	First - West Side South of Cabot	340	HWP Co.	Farr Alpaca Co. Cabot St. Mill - Pg. 71	" " " "
35	Second - East Side Lyman St. to Sargeant	3940	HWP Co. See Note 10		HWP Co. Owns Berme
36	First - East Side 200' N of Jackson	80	HWP Co.	Linden Paper Co.Div. Pg. 5 & 6	HWP Owns 35 ft. Wide Strip Adjacent to Canal
37	Second - West Side North of Jackson	340	HWP Co.	"	HWP Owns 25 Ft. Wide Strip Adjacent to Canal

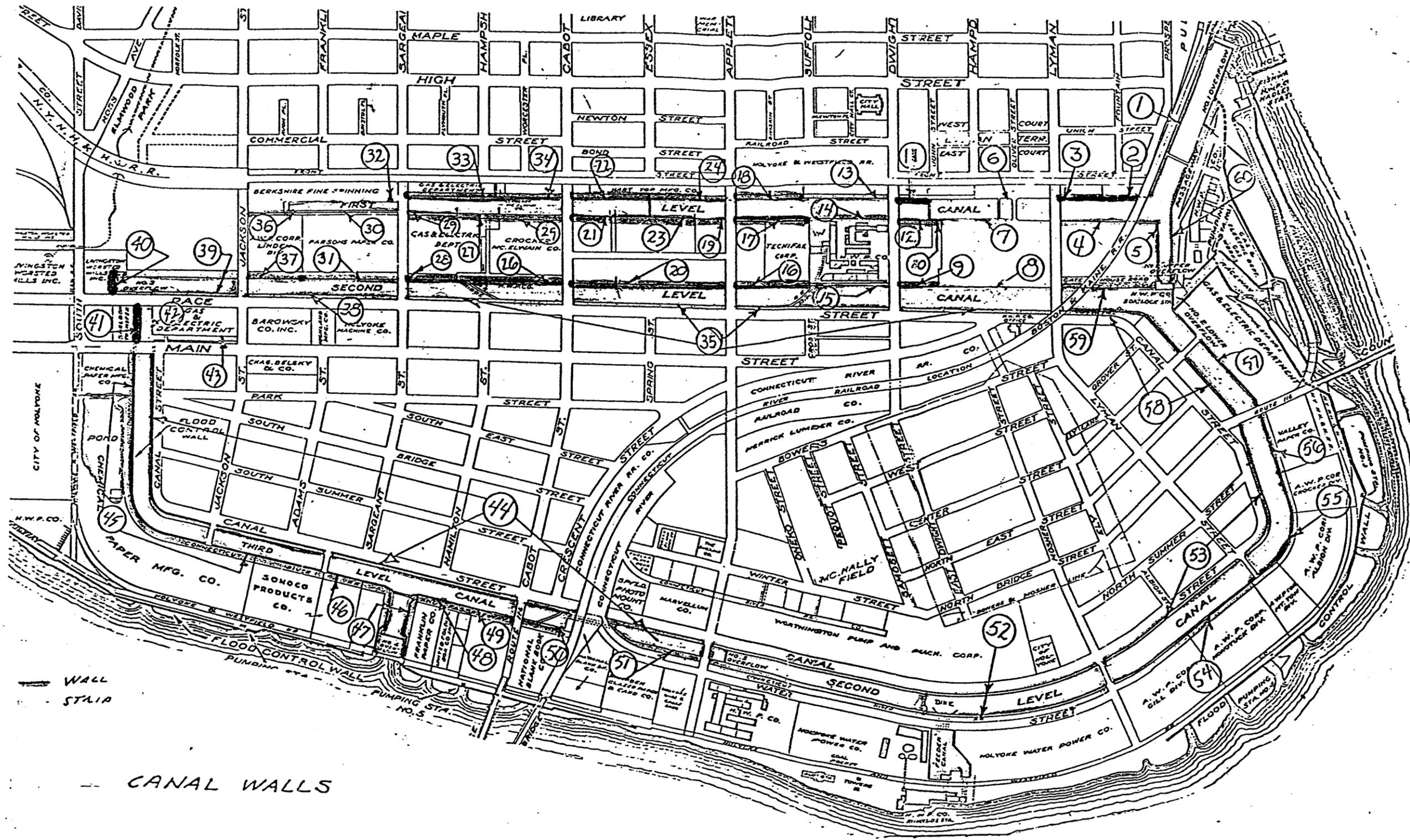
3/30/67

NO. ON PLAN	LOCATION ON CANALS	APPROX. LENGTH	MAINTAINED BY	MILL BOOK OR OTHER REFERENCE	AS TO PROPERTY LINES AND RESERVATIONS
38	Second - East Side between Sargeant & Jackson St.	900'	HWP Co.		HWP Co. Owns Berme
39	Second - Both Sides South of Jackson	1200'	HWP Co.		HWP Co. Owns Berme
40	Second - South End Near No. 3 Overflow	200'	HWP Co.	Germania Mills Pg. 14	Sold to Water Line Walls Reserved by HWP
41	Third - South Side bet'wn Race & Main	200'	HWP Co.	Sheldon Transfer Co.	Sold to Water Line Walls Reserved by HWP
42	Third - North Side between Race & Main St.	146		Holyoke Paper Co. Div. (Am. Writing Pa. Co.) Pg. 9	Sold to Water Line
43	Raceway	515	Holyoke G&E See Note 7	Holyoke Paper Co. (Amer. Writing Pa. Co.)	See Page 16)
44	Third - West Side #5 Overflow to Main St.	4200'	HWP Co.		HWP Co. owns Berme
45	Third - East Side Main St. to a point 300' N of Jackson St.	1500'	HWP Co.	Chemical Pa. Co.	HWP Co. owns Berme
46	Third - East Side Opposite Adams St.	800'	HWP Co.	Newton Pa. Co. Taylor-Logan Co. Spfld. Blanket Co.	HWP Co. owns 10 ft. wide strip adjacent to Canal
47	No. 4 Overflow	700'	HWP Co.		HWP Co. owns Property
48	Third - East Side North of No. 4 Overflow	175	HWP Co.	Franklin Paper Co.	HWP Co. owns 10 ft. Wide Strip Adjacent to Canal
49	Third - East Side South of Cabot	415	HWP Co.	Riverside Pa. Co. Div. 1 & 3 Amer. Writing Pa. Co.	" " " "

CANAL WALLS - MAINTENANCE

3/30/67

NO. ON PLAN	LOCATION ON CANALS	APPROX. LENGTH	MAINTAINED BY	MILL BOOK* OR OTHER REFERENCE	AS TO PROPERTY LINES AND RESERVATIONS
50	Third - East Side N of Cabot	250	HWP CO.	Riverside Pa.Co. Div. 2 of the AWP Co.	HWP Owns 10 Ft. Wide Strip Adjacent to Canal
51	Third - East Side #5 Overflow to R.R. Arches	600	HWP CO.		HWP Owns Berme
52	Second - Both Sides #5 Overflow to Mosher	4600'	HWP CO.		" " "
53	Second - West Side Mosher St. to Rt. 116	1900'	HWP CO.		" " "
54	Second - East Side Mosher to Lyman	1000'	HWP CO.	Gill & Nonotuck Div. American Writing Pa.	HWP OWNS 10 Ft. Wide Strip ADJACENT TO CANALS
55	Second - East Side Lyman St. North	770	HWP CO.	Mt. Tom Albion & Crocker Div. of AWP Co.	" " "
56	Second - East Side Vicinity of Valley Pa.	364'	HWP CO.	Valley Paper Co.	HWP CO. OWNS 10 FT. WIDE STRIP ADJACENT TO CANALS
57	Second - North Side Rte. 116 to #2 Overflow	750	HWP CO. See Note 8	American Thread Co. Hadley Mills	" " " " "
58	Second - South Side Rte. 116 to Lyman	1360	HWP CO.	American Thread Co. Hadley Mills	" " " " "
59	Second - West Side Lyman St. to Boatlock	530	HWP CO.		HWP Owns Berme
60	First - North Side No. 1 Overflow to Boatlock Sta.	1000'	HWP CO.		" " "



— WALL
 — STAIR

CANAL WALLS

Appendix H

Endangered and Threatened Species Protection Plan



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HOLYOKE PROJECT
(FERC NO. 2004) — 11/6

Threatened and Endangered Species Protection Plan



gas electric steam | power

**HOLYOKE PROJECT
(FERC NO. 2004)**

THREATENED AND ENDANGERED SPECIES PROTECTION PLAN

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gas • electric • steam | telecom

**HOLYOKE PROJECT
(FERC NO. 2004)**

THREATENED AND ENDANGERED SPECIES PROTECTION PLAN

1.0 INTRODUCTION

The 43.8 megawatt (MW) Holyoke Hydroelectric Project (FERC No. 2004) is located on the Connecticut River at mile 80 in Hampden, Hampshire, and Franklin counties, Massachusetts. The Connecticut River is the longest river in New England, originating 2,625 feet above sea level in the Fourth Connecticut Lake and accumulating water from several major tributaries as it flows south at a slope of about 6 feet per mile. The waterway serves as the boundary between New Hampshire and Vermont, then runs through Massachusetts and Connecticut before emptying into Long Island Sound, over 400 miles from its source. An area of about 8,309 square miles is drained by the river at the Holyoke dam. The main facilities of the project are located in the City of Holyoke and the Town of South Hadley, Massachusetts.

Originally licensed in 1949, the project consists of a 30-foot-high, 985-foot-long dam topped by five 3-1/2 foot high inflatable rubber dam sections. The project impounds a 2,290 acre reservoir with a normal maximum surface elevation of 100.6 feet National Geodetic Vertical Datum (NGVD). A three-level canal system extends through the lower areas of the City of Holyoke and provides water for industrial and hydropower generation. The Holyoke project includes twenty-two generating units and several upstream and downstream fish passage facilities. The canal system also provides water to 16 other hydroelectric generating stations. The City of Holyoke Gas and Electric Department (HG&E) owns four of these stations and the other twelve are privately owned. HG&E is required to provide water to these private non-project facilities according to industrial water rights agreements.

The previous owner, Holyoke Water Power Company (HWP), was granted a new license by FERC for the Holyoke Hydroelectric Project on August 20, 1999. By Order dated September

20, 2001, the Federal Energy Regulatory Commission (FERC) approved the transfer of the Holyoke Project from HWP to HG&E, and the sale closed on December 14, 2001. This transfer of license ordered HG&E to comply with all license conditions and compliance plans associated with the new license.

Relative to compliance plans, on October 26, 2001, HWP and HG&E filed with FERC a joint request for extension of time to file compliance plans for license articles 405-414 and 416. FERC issued an order on December 31, 2001, revising the dates for filing the aforementioned compliance plans.

During the license transfer process and prior to the closing, HG&E began informal consultation with federal, state and local stakeholders and non-governmental organizations to begin addressing the development of compliance plans related to the Holyoke Project. Upon financial close, HG&E initiated a cooperative consultation process with stakeholders to discuss compliance issues, and the terms and conditions of the license as well as other mandatory conditioning documents (401 WQC, Biological Opinion, Section 18 prescriptions). HG&E held stakeholder meetings on December 19, 2001, February 7, April 3, and June 14, 2002. Participants included the United States Fish and Wildlife Service (USFWS) and the Silvio O. Conte National Fish and Wildlife Refuge (Conte Refuge), National Marine Fisheries Service (NMFS), Massachusetts Division of Fish and Wildlife (MDFW), Massachusetts Department of Environmental Protection (MADEP), Massachusetts Executive Office of Environmental Affairs (MEOEA), Trout Unlimited (TU), and Connecticut River Watershed Council (CRWC).

License Article 416 (Appendix A) requires the Licensee to prepare a Threatened and Endangered Species Protection Plan that includes the federally listed endangered shortnose sturgeon (*Acipenser brevirostrum*) and dwarf wedgemussel (*Alismidonta heterodon*), the federally threatened bald eagle (*Haliaeetus leucocephalus*) and Puritan tiger beetle (*Cicindela puritana*) and the state listed endangered yellow lampmussel (*Lampsilis cariosa*). The plan will specifically include the following:

- Measures to enhance bald eagle nesting sites (i.e., by erecting eagle nest platforms) and to protect and enhance eagle perching and feeding activities;

- A commitment to cooperate with USFWS, MDFW, and Massachusetts Department of Environmental Management (MDEM) to continue educating the public and managing recreational activities at Puritan tiger beetle habitat sites (particularly at Rainbow Beach), and develop other protective measures, such as no-wake zones;
- Measures to protect and enhance shortnose sturgeon habitat consistent with the measures developed as the result of the on-going shortnose sturgeon studies and the provisions of Articles 405, 406, 411, and 412;
- Measures to protect and enhance the yellow lampmussel and dwarf wedgemussel, as identified in the Comprehensive Canal Operations Plan (Article 409);
- A schedule for implementing the measures;
- A description of the method for monitoring the results of the implemented measures;
- A monitoring schedule; and
- A schedule for providing the monitoring results to USFWS, the Silvio O. Conte National Fish and Wildlife Refuge, NMFS, MDFW, and FERC.

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2.0 OTHER COMPLIANCE PLANS AND THE T&E PLAN

Several other compliance plans for the Holyoke Project will either affect or be affected by the Threatened and Endangered Species plan (T&E). The following provides a brief description/analysis of these plans as they apply to the T&E plan. Where necessary, relevant sections from these plans may be reiterated or incorporated by reference into the plan.

2.1 Comprehensive Operation and Flow Plan (COFP) – (LA 405, 406, 407 and 408, WQC 9, 11, and 12)

This plan directly affects the T&E Plan, as the results of the COFP will determine the suitability of the bypass reach and canal flows for protecting and enhancing fish and mussel populations and habitat.

The COFP addresses the release of minimum flows into the bypass reach downstream of the dam. The outcome of this plan will affect flow distribution, which in turn may affect ZOP and fish habitat in the bypass reach.

2.2 Comprehensive Canal Operations Plan (CCOP) - (LA 409, WQC 13)

The Comprehensive Canal Operations Plan sets forth the order of dispatch of the canal units for different river flows, describes how minimum flows will be maintained in the canal, and presents the procedure for canal drawdowns. The CCOP show minimum flows will be maintained in the canal and presents the procedure for canal drawdowns. The CCOP also affects the T&E Plan, as it addresses monitoring of mussel populations in the canal system, and outlines measures to protect and enhance this mussel habitat.

2.3 Fish and Aquatic Habitat Monitoring Plan (FAHMP) (LA 410)

The FAHMP requires the licensee to monitor the effectiveness of the bypass reach and canal flows in protecting and enhancing fish and mussel habitat and populations, and to assess the need for additional enhancement measures. This plan will overlap/parallel the mussel monitoring program presented in the T&E plan.

2.4 Annual Fishway Monitoring Plan, Shortnose Sturgeon Monitoring Plan and Post-Construction Effectiveness Monitoring of New and Modified Fish Passage Facilities Plan (LA 414, WQC 14 and 15)

This plan specifically includes monitoring activities with the MADEP at the fishway. This monitoring will help provide population numbers of anadromous fish in the bypass reach. This plan also addresses monitoring of sturgeon to determine the effectiveness of measures taken, which may eventually result in changes to ZOP flows and timing, and changes to minimum flows in the bypass reach. Any changes to the ZOP flows or minimum flows may result in habitat alterations, changes to the fish assemblage, and ZOP flows for other anadromous species.

2.5 Invasive Species Monitoring Plan (LA 417)

The invasive species plan requires the licensee to monitor for purple loosestrife, water chestnut, and zebra mussels. Monitoring requires an annual boat trip in the impoundment and removal of invasives found. This plan will overlap with the T&E plan when the boat trip is used concurrently to examine Puritan tiger beetle habitat in the impoundment. Potential areas for transplanting beetles will also be evaluated.

2.6 Comprehensive Recreation and Land Management Plan (CRLMP) (LA 418)

The CRLMP requires the licensee to include conservation easements and strategies for maintaining open space on certain lands within the impoundment. Recreation aspects are considered as well, such as Rainbow Beach where the population of Puritan tiger beetles exists. The CRLMP will encompass measures outlined in the T&E plan to ensure that the endangered species, such as tiger beetles and bald eagles, are protected and management decisions will not adversely affect habitat.

3.0 AMERICAN BALD EAGLE

Measures to protect and enhance the bald eagle (*Haliaeetus leucocephalus*) habitat are required per LA 416. As required, this plan shall include measures to enhance bald eagle nesting sites and to protect and enhance eagle perching and feeding activities. WQC 19, the Riparian Management Plan, also serves to "protect riparian habitat areas and buffers for species which use the riparian area in conjunction with Project waters, including...bald eagle perch trees used for feeding."

There is no single cause for the decline in the bald eagle population. When Europeans first arrived on this continent, bald eagles were fairly common. As the human population grew, the eagle population declined. The food supplies for eagles decreased, because the people hunted and fished over a broad area. Essentially, eagles and humans competed for the same food, and humans, with weapons at their disposal, had the advantage. As the human population expanded westward, the natural habitat of the eagles was destroyed, leaving them fewer places to nest and hunt, which caused the population of bald eagles to decline sharply by the late 1800s.

By the 1930s, people became aware of the diminishing bald eagle population, and in 1940 the Bald Eagle Act was passed. This reduced the harassment by humans, and eagle populations began to recover. However, at the same time DDT and other pesticides began to be widely used. Pesticides sprayed on plants were eaten by small animals, which were later consumed by birds of prey. The DDT poison harmed both the adult birds and the eggs that they laid. The eggshells became too thin to with stand the incubation period, and were often crushed. Eggs that were not crushed during incubation often did not hatch, due to high levels of DDT and its derivatives. Large quantities of DDT were discovered in the fatty tissues and gonads of dead bald eagles, which may have caused them to become infertile.

The bald eagle is making a comeback and was recently down-listed from federally endangered to federally threatened. The enforcement of federal endangered species laws and regulations and improved controls of herbicides and pesticides on agricultural lands has aided the recovery of this species. Wintering eagles and nesting pairs have been identified within the project area. The eagles perch in riverbank trees and circle over the river searching for food.

The bald eagle is found over most of North America, from Alaska and Canada to northern Mexico. About half of the world's 70,000 bald eagles live in Alaska. Combined with British Columbia's population of about 20,000, the northwest coast of North America is by far their greatest stronghold. They flourish here in part because the salmon. Dead or dying fish are an important food source for all bald eagles.

Relative to the Holyoke Project, HG&E will provide three bald eagle nesting platforms in order to enhance the return of this species to the project area. HG&E will work with the USFWS and MDFW to identify suitable areas for the platforms and begin construction. HG&E will look for sites that have three or more super-canopy trees within one-quarter mile of each nest as roosting and perching sites. Once the sites have been selected, HG&E will begin construction.

The platforms will be built in either hardwood or conifers trees that are taller than surrounding trees or at the edge of the forest stand in order to ensure a clear flight path. Nest platforms will be five to six feet in length and width. These platforms will also be protected from prevailing winds, have a southeast exposure to maximize sunlight in the early nesting season, and be built below the crown of the tree to provide shade in the summer. Consultation with the appropriate stakeholders will occur at various stages during the process to ensure compliance.

Based on HG&E's consultation with stakeholders, the MDFW believes that the above proposal is a proactive approach to eagle protection and will provide attractive areas for new nesting pairs. In addition, providing these nesting platforms in safeguarded areas, such as currently protected areas or an area with open space easements, is a proactive approach to eagle management. The method of keeping the eagle from establishing nests in potentially hazardous areas by attracting them to areas that they can be easily secured from danger has been used successfully in the past in other areas of Massachusetts and is encouraged by MDFW.

To protect perching and feeding trees as required by LA 416, HG&E will not remove trees within the impoundment that are actively used by bald eagles. This protective measure will ensure that HG&E does not take part in any tree removal activity. Enforcing this measure on lands not owned by HG&E is not possible, however, as HG&E does not have legal enforcement authority.

3.1 Protection and Enhancement Measures

- Investigate nesting sites with MDFW and USFWS by July 31, 2003
- Procure materials by August 31, 2003
- Complete construction by October 31, 2003
- Begin monitoring after construction is completed to verify that eagles are utilizing platforms

3.2 Monitoring

For the first five years following nest construction:

- HG&E will visit the nest sites each spring to observe the nest and determine if nests are being used
- HG&E will return during the late spring-early summer and observe nests to determine the number of eaglets fledged
- HG&E will provide by December 31 a written report to USFWS, The Conte Refuge, MDFW and FERC on nest use and number of eaglets successfully fledged
- As part of the invasive species annual monitoring, HG&E will observe trees along the impoundment, record any problems, and act accordingly with "No Trespassing" signs to protect perching and feeding trees

4.0 PURITAN TIGER BEETLE

The Puritan tiger beetle (*Cicindela puritana*) is found in shoreline habitat along the Connecticut River in New England and the Chesapeake Bay in Maryland (Hill and Knisley 1993). This species has disappeared from a large part of its range in New England. Due to its declining range and vulnerability to natural and human-related threats, this species was listed as federally threatened in August of 1990 (USFWS, 1990). The Puritan tiger beetle is also listed as endangered by the Commonwealth of Massachusetts. LA 416 requires HG&E to cooperate with USFWS, MDFW, and MDEM to continue educating the public and policing recreational activities at habitat sites. Other protective measures are also being developed.

Historically, the Puritan tiger beetle occupied riverine beaches along the Connecticut River from Claremont, New Hampshire to Cromwell, Connecticut. Currently, only two populations of Puritan tiger beetles remain: one near Cromwell, Connecticut and the other in Northampton, Massachusetts at Rainbow Beach. The Rainbow Beach population is the primary concern of this plan because it is located within the project boundary.

The Puritan tiger beetle is a medium-sized terrestrial beetle. Their coloration is dark bronze-brown to bronze-green with cream-colored markings on the elytral surfaces. Puritan tiger beetle larvae on the Connecticut River generally are found among scattered herbaceous vegetation at the upper portions of sandy beaches and occasionally near the water's edge.

Puritan tiger beetles usually undergo a two-year larval period before emergence. Larvae hatch in late July or August. Larvae tend to be most active in the fall with lesser numbers appearing in the spring and summer. Adults emerge from late June to early July in the Connecticut River. Puritan tiger beetles are prey to robber flies, jumping spiders and tiphiid wasps. It is suspected that many larvae die when winter storms shear off large sections of the beach. Larval mortality associated with winter storms may contribute to the dramatic local fluctuations observed in these populations.

The USFWS lists (1) hydraulic changes caused by dams, (2) reduced beach habitat,

(3) reduced bank erosion bank stabilization, and (4) pollution as factors that may have contributed to this species' decline. It is believed that recreational uses along the river imperil the remaining Puritan tiger beetle populations as well as reintroduction sites. For example, camping, beach recreation, and collecting threaten the Rainbow Beach site. Woody plants are invading the Puritan tiger beetle habitat as secondary succession occurs. Returning the land to early conditions could mitigate the lack of potential habitat.

Personnel from the MDEM, MDFW and USFWS have conducted both biological and interpretive work at Rainbow Beach. During 1997, signs were posted and fencing was placed around the Puritan tiger beetle larval habitat and interpreters were sent to the site to discuss with beach users the importance of staying out of the beetle larval habitat. A detailed discussion of the work conducted during the 1997 season can be found in "Rainbow Beach, Final Report" (Davis, 1997) (Appendix B).

MDFW has conducted research focusing on understanding the beetle's habitat requirements. Research consisted of monitoring the population (larvae and adults), and examining alterations to habitats due to alterations in the river's hydrology. The previous licensee provided historic water level elevation data and impoundment maps in support of the research. Explanatory signage is currently used to educate Rainbow Beach users about the tiger beetles.

Through the consultation process, the USFWS submitted several recommendations as part of the T&E plan. These measures include providing alternative camping and day-use areas to relieve recreational pressure at Rainbow Beach. Other recommendations included providing funding for any or all of the following: (1) research on recreational impacts on tiger beetle feeding and reproductive behavior; (2) population augmentation on Rainbow Beach; (3) research on vegetation management in order to maintain existing habitat and/or create additional habitat; (4) staff to enforce no-wake zones, (5) development, production, and distribution of education material targeted at recreational users (boaters) of Rainbow Beach; and (6) monitoring the Rainbow Beach population. The USFWS also recommended acquisition of tiger beetle habitat in the area around Rainbow Beach and/or potential habitat identified by qualified biologists, and providing assistance in removing invasive plant species in areas identified as potential habitat (either staff, equipment, and/or funding).

HG&E concurs with the USFWS concerning the recreational pressure at Rainbow Beach. HG&E also notes that there are other existing resources on the Holyoke impoundment that offer similar recreational opportunities. Two in particular are under-utilized, Elwood Island and Mitch's Island. To help reduce use at Rainbow Beach HG&E will erect displays informing the boating public of the recreational opportunities available at Elwood Island and Mitch's Island. The displays will be located at marinas on the impoundment and include a location map and a description of the recreational opportunities available at these two areas.

On or before December 31, 2002 HG&E will file the Comprehensive Recreation and Land Management Plan (CRLMP). The CRLMP will include a more extensive inventory of recreational usage on the impoundment and an evaluation of the need for additional facilities.

HG&E will support research on recreational impacts on tiger beetle feeding and reproduction behavior. Much of the prior research was performed by volunteers and/or students. To support similar efforts going forward, HG&E will provide in-kind services. These services will include providing data, staff support and paying a share of the research expenses.

HG&E will also work with stakeholders to identify suitable and preferable habitat on HG&E property within the project boundary for use in protecting the tiger beetles. HG&E will designate employee(s) as volunteers to aid the USFWS with research on, and transplanting and monitoring of, tiger beetles. This volunteer(s) will be available to do any and all of the above as requested. If HG&E property is used for tiger beetle relocation, HG&E will establish a protected use area and mark with signs, if appropriate and/or recommended by USFWS. If the USFWS or MDEM determines that Rainbow Beach is the only suitable habitat, HG&E will work in the same manner outlined above to transplant, monitor, and conduct research on the tiger beetles in that area.

HG&E does not have the legal authority to establish and/or enforce no-wake zones on the Connecticut River. State agencies have the authority and responsibility for enforcement. HG&E can and will, however, support the state's efforts to establish additional no-wake zones. HG&E will consult with and request from MDEM a no-wake zone near Rainbow Beach and other beetle habitat sites (as determined by USFWS) and will be incorporated these no-wake zones into the CRLMP (LA 418). Additionally, HG&E will continue to work with USFWS and MDFW to

provide in kind services, such as historic water level elevation data, impoundment maps and hydrology information, as requested to better understand the beetle's habitat requirements. A water level monitor has been installed at Rainbow Beach in order to obtain an understanding of the fluctuations that occur there

HG&E will cooperate with USFWS, MDFW, and MDEM as a partner to continue educating the public about the Puritan tiger beetle. HG&E will provide brochures highlighting the importance of the endangered tiger beetle. The brochures will be available to the public at the Holyoke Dam fish viewing facility and also be distributed to marinas on the Holyoke impoundment. An interpretive display outlining the importance of protecting tiger beetle habitat will also be available for viewing at the fish viewing facility. An additional interpretive display will be constructed at the Norwottuck Rail Trail, which is visited by both cyclists and pedestrians. The displays will list the cooperative partners in the effort to protect the tiger beetles, including HG&E, USFWS, and any other agencies that are willing to partake. This should greatly enhance the public education effort as thousands of people visit these facilities annually.

At Rainbow Beach, MDEM has already provided signs outlining a protected area. As needed, HG&E will supply additional signs that inform the public of the protected area, without mentioning that an endangered species exists there. To further ensure that the public will be informed about protected areas, HG&E will construct displays aimed at recreational boaters at the marinas (with permission) and at public launches.

As an additional education measure, HG&E will describe the beetles on their website, and also provide other information about what is being done to protect threatened and endangered species. Information about what the public can do to help will also be included on the website, as well as possible links to other sites, such as the USFWS.

As part of the Invasive Species Monitoring Plan (filed by HWP on August 21, 2001), HG&E schedules a boat trip each August to monitor invasive species in the impoundment. In 2002, the invasive species monitoring will include a determination of potential tiger beetle habitat. The Invasive Species Monitoring Group will also monitor the succession of woody plants in the prime beetle habitat and work towards a plan to remove unwanted vegetation. The

CRLMP will include a section on tiger beetles and management efforts that will be in place to protect them.

4.1 Protection and Enhancement Measures

- Display signs at marinas and public boat launches to educate the public about protected areas and encourage the use of alternative sites such as Mitch's Island and Elwood Island
- Construct interpretive displays at both the fish viewing facility and the Norwottuck Rail Trail by April 2003
- If brochures are determined to be a good education tool, HG&E will design and provide brochures to the public at the fish viewing facility at the Holyoke Dam as well as marinas on the impoundment.
- HG&E will continue to work with USFWS and MDFW's research efforts to provide in kind services, such as historic water level elevation data, impoundment maps and hydrology information, as requested, to better understand the beetle's habitat requirements
- HG&E will also provide staff support and share in the research expenses.
- HG&E will request a no wake zone at Rainbow Beach from MDEM
- If a no wake zone is approved and established by MDEM, within 45 days of approval HG&E will provide no wake signage at Rainbow Beach and help set up buoys, channel markers, and posted speed limits
- A no-wake zone near Rainbow Beach and other beetle habitat sites (as determined by USFWS) will be incorporated into the CRLMP (LA 418) by December 31, 2002

- HG&E will consult with stakeholders to identify HG&E land within the project boundary that may be suitable habitat and provide in kind services (volunteers) on a consistent basis to facilitate in relocating beetles
- If suitable HG&E lands are used for relocation of tiger beetles, HG&E will work with USFWS to designate the lands as a restricted use area and mark with signs as appropriate
- As part of the invasive species monitoring, HG&E will examine potential habitat on the impoundment
- HG&E will include the tiger beetles in the CRLMP submitted by December 31, 2002
- HG&E will describe the tiger beetles and other endangered species on their website as an additional measure to educate the public, including links to the USFWS home page

4.2 Monitoring

- As appropriate, HG&E will work with the USFWS, Conte Refuge, MDFW and MDEM to maintain existing signs
- HG&E will provide researchers with hydrology information of the Connecticut River within the project area, as needed
- HG&E will provide employees to volunteer to aid in research, transplanting, and monitoring tiger beetles
- For five years, HG&E will provide an annual written report to USFWS, the Conte Refuge, MDFW, MDEM and FERC on Puritan tiger beetle activities within the project area

5.0 YELLOW LAMPMUSSEL & DWARF WEDGEMUSSEL

Lampsilis cariosa, commonly known as the yellow lampmussel, is a freshwater species, a mollusk characterized by a bivalve shell. The key characteristics of this Massachusetts endangered species are the bright yellow color without rays and the oval shape of its shell. Federally, the yellow lampmussel was proposed for a Category 2 listing in 1991 (Federal Register Vol. 56, No. 225, pg.58817), but with the disbanding of these prelisting categories it has no federal listing status. Historically, records of the yellow lampmussel from the Connecticut River have been few and always from observations made below the Turner's Falls rapids. The only other southern New England population occurred in the Merrimack River, but that population became extinct by the early 20th century.

Alismidonta heterodon is commonly known as the dwarf wedgemussel. The mussel was listed as endangered by the USFWS in 1990. The largest of the dwarf wedgemussel populations, which numbers in the tens of thousands, can be found in two stretches of the Connecticut River flowing between New Hampshire and Vermont. The dwarf wedgemussel is an oval-shaped, clam-like creature with a smooth, thin shell. It lives in rivers and creeks of varying sizes, settling on sand and gravel bottoms. It can be found in water a few inches to over 20 feet in depth, generally in a firm substrate. Both the yellow lampmussel and dwarf wedgemussel are included in the T&E Plan as required by FERC I.A 416.

Since the early 1990s, several studies have identified specimens or populations of individuals that have changed the current understanding of the distribution and diversity of freshwater mussel populations in the Holyoke Project area of the Connecticut River. In 1992, Charles A. Menzie reported collecting one juvenile yellow lampmussel within 50 feet of the shore from the west side of the Connecticut River, downstream of the Holyoke tailrace. This was the first finding since the early 1970s and as a result new surveys were undertaken to identify the source population. In 1996, D.G. Smith and D. McClain conducted a survey of the Holyoke canal system and located four live juvenile or young adult yellow lampmussels (*Lampsilis cariosa*). This verified that yellow lampmussels still existed within the canal system.

During a 1997 mussel survey of the Connecticut River, a single live specimen of dwarf wedgemussel (*Alismidonta heterodon*) was found just below the Hadley Falls Station tailrace

(NUEL 1997), representing the first reported occurrence of this species in the Massachusetts section of the Connecticut River. Most recently (October 1998 - June 1999), survey findings documented yellow lampmussels (six females) in the main stem of the Connecticut River north of the Holyoke Dam and just down river of the Calvin Coolidge Bridge, Route 9, Northampton, MA (Werle 1999). Subsequent to this survey (August 1999), Werle located another five yellow lampmussels: three juvenile or young adult females, one large adult female, and one adult male (personal communication, D.G. Smith). The significance of these most recent reports is that they represent the first findings since the 1970s of yellow lampmussels in the main stem of the Connecticut River not attributable to the remnant canal system population.

License Article 409 requires a description of the operational and maintenance measures that will be used to protect and enhance mussel populations in the canal system. This includes specific procedures for installing a sandbag weir, or other appropriate measures, to maintain watered conditions in areas of the canal necessary to maintain mussel habitat. LA 416 calls for measures to protect and enhance the yellow lampmussel and dwarf wedgemussel. WQC 13 requires a 5 year plan for protection and monitoring of aquatic resources, including mussel populations, in the canal system. The required 5 year plan shall include an evaluation of the frequency and necessity of canal drawdowns.

With input from USFWS and MDFW, as well as other stakeholders, HG&E has decided upon a number of measures described in this plan. These include: (1) installing a sandbag weir at the beginning of the First Level Canal to enhance mussel habitat in the canal system, (2) monitoring habitat, (3) providing minimum canal flows, and (4) implementing the new drawdown procedure to maintain watered conditions in mussel habitat areas.

In addition, two mitigation efforts have already been implemented in the canal system that will enhance mussel survival and habitat conditions under this license. Providing a minimum canal flow (see below) and moving the annual maintenance drawdown to October will improve water quality within the canal system and minimize drawdown effects on mussel populations. Minimum flows will be provided through a combination of leakage, releases through overflows, and generation, and will increase the opportunities for host fish to enter the canal. This measure serves two purposes: (1) it enhances opportunities for the fish to become infected with mussel larvae (*glochidia*), and (2) enhances survival of host fish and glochidia,

which will result in an increase in the number of juvenile mussels that may ultimately be released into suitable habitat in the canal system. In addition, any urban or industrial pollution to the canal system will be diluted by the continual flushing of the canal system mussel habitats with river water.

In the past, maintenance drawdowns were typically performed during July and August (low flow months) to minimize lost generation. Moving the canal maintenance drawdowns from July and August, the hottest periods of the year, to October, when water and air temperatures are typically cool and similar, should not only favor adult mussel survival, but the survival of recently recruited juveniles. The juveniles live in the top few millimeters of sediment and are greatly affected by conditions in the sediment/air interface.

Even though some of the disturbances in the canal system are unavoidable, such as the semi-annual maintenance drawdowns described above, HG&E has developed methods to draw down the canals in spring and fall to maintain watered areas between Boatlock Station and Riverside Station (Section 5.4). This area has been identified as prime mussel habitat. Mussel populations, especially common freshwater mussels (*Elliption complanata*) and the Alewife floater (*Anodonta implicata*), in the canal system appear to be thriving in areas where riverine type habitat and suitable substrate is available. During drawdowns, prime mussel habitat in pools within the canal system will be documented and maintained at established transects (see Figure 5.1). Transects will be established with agency input, and evaluated and re-established as necessary. If zebra mussels, *Dreissena polymorpha*, or quagga mussels, *D. bugensis*, become established in the canal system, canal maintenance activities will increase dramatically, impacting canal mussel populations to a much greater extent than those in the mainstem of the river.

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HG&E proposes the following specific protection, mitigation, and enhancement measures.

5.1 Habitat Enhancement

The following discussion of habitat enhancement measures focuses primarily on watering critical areas in the First Level Canal, and parallels the drawdown procedures described in the CCOP section 3.4.1

Following recommendations from USFWS and TU at the June 14 and 27, 2002 meetings (Appendix D), HG&E will mitigate any effects that may be caused by the dewatering of the First Level Canal by building an experimental sandbag weir at the beginning of that canal just upstream of the railroad bridge. The top of the weir will be approximately four feet high at its tallest point, maintaining watered conditions at least 750 ft into the First Level Canal. The top of the weir will be approximately at El 85.5 (NGVD) and will result in a wetted area of approximately 1.8 acres. Other methods of maintaining watered conditions were explored, such as stop logs, but are not feasible because of the silty substrate. The final height, width, and location will be determined by engineering analysis, with the final design submitted to the stakeholders for review. Installation of the experimental sandbag weir is scheduled for the Fall 2002 drawdown.

Because the insertion of a weir at the beginning of the First Level Canal may alter the ecology of the area, sediment build-up and erosion, as well as velocity and flow, field studies will be performed on the upstream and downstream sides of the weir during the next two drawdowns. Evaluation will occur both in Fall 2002 and Fall 2003, to track changes in both mussel habitat populations and siltation. A topographic survey will be conducted both upstream and downstream of the weir to identify any changes to siltation patterns. Habitat/populations studies will be performed as described in Section 5.2, below. A draft report of the findings will be submitted to the stakeholders, encompassing a determination of the effectiveness of the weir, any necessary modifications, and potential additional evaluation studies.

Other enhancement measures are outlined below, including the new drawdown procedure and recent upgrades to methods used in river monitoring.

5.2 Habitat Monitoring

License Article 410 requires a plan to monitor mussel habitat and populations within the Holyoke canal system. Previous studies have identified sections of the Holyoke canal system as suitable habitat with moderate populations of Alewife floater (*Anodonta implicata*), and a sparse population of yellow lampmussel. HG&E plans to survey these areas and document the densest populations and the location of drawdown pools supporting mussel populations. The target areas for survey work are the more northeastern sections of the canal system where the yellow lampmussels have been reported.

The WQC calls for a 5-year plan to perform annual monitoring. At the request of USFWS, HG&E will perform the same number of surveys, but will perform the surveys every other year for twelve years. Interim reports will be filed every four years, and a final report will be submitted at the end of this period (see Table 5-1 below).

During the October canal drawdown, qualitative and quantitative mussel surveys will be conducted every other year within the canal system to estimate the health and abundance of mussels. The qualitative surveys will focus on documenting the relative abundance of rare (<1% of the total population) species of mussels and identification of invasive mussel species (zebra and quagga mussels). Based on qualitative surveys, permanent transects in representative habitats will be permanently marked and established for quantitative sampling efforts in both the First and Second Level Canals. Transect locations will be determined in conjunction with MDFW. All species of mussels collected at each transect will be counted during each October drawdown and species composing less than 5% of the total population will be measured. Along each transect, eight 0.125 m² samples of sediment will be screened to 2 mm and the juvenile mussels counted, preserved and identified to the lowest practical taxonomic grouping. Surveying for mussels may be expanded with more transects if yellow lampmussels are found.

In addition to the biennial Holyoke canal system mussel surveys in October, a qualitative and quantitative survey for resident mussels, including the yellow lampmussel, will be conducted over an eighteen-mile section of the Connecticut River in the area of the Holyoke impoundment every four years. Qualitative assessments of mussel abundance will be made from the North Hadley and Hatfield areas to Bachelor Brook in the South Hadley and Holyoke areas. Seven areas over this section of the Connecticut River will be surveyed. Both shallow (<2 m) and deep water (2-10 meters) areas will be sampled using SCUBA, snorkeling and wading with the aid of underwater viewers. Divers will be trained to identify the glochidia of the different species. When located, deposits of mollusk shells left by river otters (otter middens) or other predators will be inspected to obtain voucher specimens and further document the relative abundance of mollusk species in the river.

Every four years a quantitative assessment of adult mussels will be conducted in the area below the Holyoke Dam bypass to assess the effects of bypass minimum flow on mussel populations as required in License Article 410. In this area, general surveys will be conducted to locate concentrations of adult mussels. Five distinctly different areas (varying depth, sediment type, current, etc.) in an approximately one-mile stretch of river will be sampled using a 100 meter transect line. Each linear transect will be selected to maximize the number of mussels sampled for an area. Biologists using SCUBA will identify all adult mussels within one meter of each side of the 100-meter line.

Table 5-1 Schedule of Monitoring and Reporting

Date	Canal Survey	River/Bypass Survey	Report
October, 2003	First Canal Survey		
October, 2005	Second Canal Survey	First River/Bypass Survey	
March 31, 2006			<i>First Interim report</i>
October, 2007	Third Canal Survey		
October, 2009	Fourth Canal Survey	Second River/Bypass Survey	
March 31, 2008			<i>Second Interim Report</i>
October, 2011	Fifth Canal Survey		
October, 2013	Sixth Canal Survey	Third River/Bypass Survey	
March 31, 2014			<i>Third Interim Report</i>
October 1, 2014			<i>Final Monitoring Report</i>

5.3 Minimum Canal Flows

Minimum project flows for the Holyoke Project, including flows into the canal system, are detailed in LA 406 and WQC Condition 12. Minimum flows are required per LA 409 in part to maintain mussel habitat. LA 406 requires the following seasonal minimum flows in the canal: (1) from April 1 through November 15, "at least 810 cfs, or impoundment inflow minus fish passage and bypassed reach minimum flows, whichever is less," and (2) from November 16 through March 31, "at least 400 cfs, or impoundment inflow minus fish passage and bypassed reach minimum flows, whichever is less." The WQC, on the other hand, calls for a year-round continuous minimum flow of 400 cfs downstream of the louver bypass. The WQC assigns this canal flow the highest priority of any minimum flow, including flows into the bypass reach. HG&E's plan to provide minimum flows for the entire Holyoke Project is detailed in the Comprehensive Operation and Flow Plan (COFP), which was developed in conjunction with the Comprehensive Canal Operations Plan (CCOP).

5.4 Canal Drawdown

The procedure in place for canal drawdowns ensures that existing mussel habitat in the Second Level Canal remains watered. The spring outage usually lasts one or two days and the longer fall outage typically lasts five to seven days. The spring drawdown has two purposes: (1) to prepare for the spring freshet via cleaning various structures and performing any emergency repairs, and (2) to inspect the canal system infrastructure and develop a scope of work for the fall drawdown. Based on the spring drawdown, HG&E will develop a scope of work, plan, and schedule the fall outage. To the extent possible, HG&E will include maintenance work planned by other owners on the canal system. The plan will be submitted to the stakeholders 30 days prior to the fall outage.

An area of particular concern during drawdowns involves a stretch of canal on the Second Level Canal, downstream of Boatlock station. HG&E will attempt to reasonably expedite work performed during future drawdowns, and will attempt to undertake such work in a manner that least impacts aquatic resources. The FERC license calls for maintaining minimum flows during drawdown. This is not possible, however HG&E

will follow the procedures outlined below to maintain whatever flow is possible during the drawdowns. Below are HG&E's drawdown procedures for the First and Second Level Canals.

5.4.1 First Level Canal

A concern of the stakeholders is the practice of hauling sediment from in front of Boatlock station and depositing it into the head of the First Level Canal branch. The previous owner began this practice approximately five years ago, prior to this the sediment and debris were removed from the canal. In the future, HG&E will use a clamshell to clean the area in front of Boatlock station and remove the sediment and debris from the canal.

With the installation of full depth louvers and a trash rake before the Spring 2003 drawdown, the need for heavy machinery in the canal and the time it takes to remove debris at Boatlock should be significantly diminished. If heavy machinery is necessary, HG&E will provide cones and mark boundaries to reduce vehicular traffic in the First Level Canal during maintenance drawdowns. Should additional measures become necessary (such as clearing areas of mussels), HG&E will consult with stakeholders regarding appropriate procedures.

5.4.2 Second Level Canal

The following discussion of drawdown procedures for the First Level Canal reiterates the description contained in the CCOP's section 3.4.2.

During the Spring 2002 drawdown, modified procedures were utilized in an effort to provide the maximum amount of wetted canal floor in the Second Level Canal downstream of Boatlock Station. Stakeholders were on-site to observe the effects of these procedures, and all present were generally satisfied with the conditions. Therefore, the drawdown procedures will be replicated for future outages as feasible. HG&E will attempt to coordinate drawdown efforts

with other station owners to maintain maximum wetted areas. Below are the general procedures HG&E will follow under normal (non-emergency) conditions:

- 1) Before the canal drain begins all HG&E and customer units except Boatlock and Riverside Stations must be shut down.
- 2) The canal headgates will be closed, beginning the canal drainage.
- 3) Boatlock station units will be operated until the water level in the First Level Canal reaches El. 92.5 ft (NGVD). After the water elevation reaches El. 92.5 ft Boatlock feed gates will be opened to continue draining the First Level Canal.
- 4) One or more waste gates at the No. 1 Overflow will be opened to assist the draining process. These waste gates will have to be carefully regulated as to not overflow the fishway attraction system and/or allow the attraction water system and 4-ft diameter drain pipe to the Hadley tailrace to fill with debris.
- 5) The No. 2 Overflow will remain closed during the drawdown, until the end, as maintenance activities require. Should HG&E find that the No. 2 Overflow does not maintain sufficient water levels due to leakage, HG&E will consult with stakeholders about the feasibility of installing a weir in front of the No. 2 Overflow.
- 6) When the Second Level Canal reaches El. 74.5 ft (NGVD), all but one of the Riverside station generating units will be secured. A unit on the Second Level will be operated at speed/no load to drain the Second Level Canal. This eliminates the previously employed step of securing all units at Riverside station, opening penstock drain valves on Units 4 and 5. The waste gates at the No. 2 Overflow will be opened during the last 24 hours of the outage for inspection of both the civil works and safety on each unit. Drainage will occur slowly to allow for

maximum wetting of the canal floor. Slow drainage typically takes 6-8 hours; emergency drainage lasts 2 hours.

- 7) At the start of the drawdown, the waste gates at the No. 3 Overflow will be opened to facilitate draining the other end of Second Level Canal. When the Second Level Canal reaches El. 70.5 ft (NGVD), the No. 3 Overflow will be closed, as maintenance activities require, maintaining pooled areas between Boatlock and Riverside.
- 8) The No. 4 Overflow gates will be opened to drain the Third Level Canal.

HG&E may need to occasionally deviate from the above drawdown procedure to perform essential maintenance work. This may include drawing the Second Level Canal down deeper to gain access to certain structures and equipment. These types of drawdowns are infrequent and HG&E will make all reasonable efforts to minimize the duration of the drawdowns.

Typically during drawdowns there is some leakage past the headgates, which serves to provide a minimal amount of flow through a portion of the canal system. To the extent it does not interfere with maintenance activities, HG&E will not completely seal off leakage past the headgates. This will provide a minimum flow during the outage.

5.5 Protection and Enhancement Measures

- A four-foot high experimental sandbag weir will be constructed at the beginning of the First Level Canal, just upstream of the railroad bridge. The exact dimensions and locations of the experimental weir will be determined by engineering analysis

- The area surrounding the weir will be evaluated and a topographic survey conducted to estimate the amount of siltation and the abundance of mussel populations
- Based upon the results of the surveys, HG&E will consult with the stakeholders concerning the need to make any modifications or additional evaluations
- HG&E will conduct river and canal mussel surveys as described above
- The canal maintenance drawdown practices as described in Section 5.4 will be continued
- During the October canal drawdown, qualitative and quantitative mussel surveys will be conducted within the canal system to assess the health and abundance of mussels
- HG&E will provide cones and mark boundaries to reduce vehicular traffic in the First Level Canal during maintenance drawdowns until the trash rake is installed
- HG&E will not completely shut off leakage during drawdowns in order to maintain flow throughout the canal system
- A qualitative and quantitative survey for resident mussels will be conducted over an eighteen-mile section of the Connecticut River on a biennial basis
- Beginning in 2002, minimum canal flows will be provided to improve water quality within the canal system and minimize drawdown effects on mussel populations

5.6 Monitoring

Beginning in 2002, every 2-3 years for 12 years:

- HG&E will continually follow research that monitors the canal population of dwarf wedgemussels and yellow lampmussels
- HG&E will conduct river and canal mussel surveys as described above
- HG&E will provide a written report to USFWS, the Refuge, MDFW, and FERC on results of the two surveys by March 31 of the following year
- Based on mussel survey information collected over 12 years, HG&E will determine what if any future work and/or surveys should be undertaken

6.0 *SHORTNOSE STURGEON*

The shortnose sturgeon (*Acipenser brevirostrum*) is currently listed as an endangered species pursuant to the Endangered Species Act (ESA), as amended, 16 U.S.C. Section 1531 et seq. NMFS has authority over this species under Section 4(a)(2) of the ESA, 16 U.S.C. Section 1533 (a)(2). The shortnose sturgeon was placed on the endangered species list in 1967 (32 Fed. Reg. 4001 (1967)) by the USFWS. The USFWS restated the endangered status of the species in the 1973 edition of *Threatened Wildlife of the United States*. NMFS published final regulations on November 27, 1974 (39 Fed. Reg. 41367-77) confirming NMFS jurisdiction over shortnose sturgeon and maintaining the species as endangered under the ESA. At present all populations of shortnose sturgeon throughout its present range remain listed as endangered species pursuant to the ESA.

Compared to the other resources in the project area, little is known about shortnose sturgeon. Therefore, a Connecticut River Shortnose Sturgeon Working Group (Work Group) was formed early in the Holyoke Dam relicensing process (1996) because shortnose sturgeon had been passed upstream of the dam (Table 6-1). The Work Group, composed of representatives from NMFS, FERC, USFWS, MDFW, Connecticut DEP, Conte Lab, HWP and HG&E, was formed to assess the impacts of the Holyoke Dam on shortnose sturgeon. The Work Group focused on determining the need for sturgeon passage and designs of upstream and downstream passage facilities.

Three issues exist regarding the downstream passage of shortnose sturgeon: canal passage, passage at Hadley Falls Station and the No. 1 Overflow. The first, passage through the canal system, is being addressed by the installation of full depth louvers (Figure 6-1). On June 3, 1999, NMFS submitted a Federal Power Act Section 18 Fishway Prescription to FERC. The full depth louvers are mentioned in the NMFS prescription, which requires studies at the downstream bypass in the canal system. Instead of studying the need for the full depth louvers, HG&E will install full depth louvers in the Holyoke canal system in Fall 2002 to enhance shortnose sturgeon guidance.

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The design of the full depth louvers is based upon a louver flume test conducted at Alden Lab using the Connecticut River shortnose sturgeon and a louver array similar to the existing partial depth louvers in the First Level Canal. The results from the laboratory studies indicate that louver arrays angled at 15-degrees to the approach flow appear to have considerable potential to guide downstream migrants. However, the tests, which were conducted under ideal laboratory conditions (clear water, laminar flow) using a full-depth bypass and relatively short lengths and shallow depths of bar racks and louvers, may have produced guidance efficiency estimates that are different than would be expected for a field application. Therefore, field tests will be conducted to verify the laboratory results.

As agreed upon at the December 19, 2001 agency meeting, planning for a Spring 2003 field test is underway and a release-recapture study could be conducted by marking fish, releasing them upstream of the louvers, and recapturing them in the bypass collection facilities or in sampling gear located downstream of the louver array (see Appendix D: Meeting notes relevant to T&E). Radio telemetry or PIT tags could also be used (alone or in combination with conventional mark release-recapture techniques) to monitor fish movement along the louver array and through the bypass system. There may be constraints associated with the evaluation of shortnose sturgeon because of their endangered species status. Plans to field-test the Holyoke canal system full depth louvers will be developed in consultation with stakeholders.

The second issue regards downstream passage at Hadley Falls Station. As part of their prescriptions, NMFS and USFWS required an angled bar rack for downstream passage guidance at the Hadley Falls intakes. The Work Group, realizing that there was no evidence to prove if sturgeon would actually be guided, initiated a research program to study the angled bar racks. Phase 1 of the research involved the development of a computer model to evaluate the effectiveness of the bar rack. Alden Laboratory has developed a computational fluid dynamic model of the Hadley Falls intake area and presented their findings to HG&E and stakeholders. The model has been revised based on agency comments to simulate additional scenarios, referred to as Phase 2 Research. The Phase 2 Research program is currently ongoing.

To facilitate the shortnose sturgeon research efforts, HG&E proposes to reconvene the Work Group. The group's primary goal will be to develop a practical method for downstream sturgeon passage. Because this issue impacts both downstream and upstream passage of other

species, the Work Group will strive attain a consensus based solution for sturgeon passage at the Holyoke Project.

NMFS will have the technical oversight and provide overall direction for the Work Group. HG&E will fund the Work Group's efforts and serve as the group's overall coordinator. The Work Group will meet in September 2002 to review the findings of the Phase 2 Research and establish a plan and schedule for successful work. This may include additional research, identifying potential technologies for downstream passage, and evaluating the technologies through computer models, physical models, or field work. To accomplish its goal, the Work Group may have to obtain more information on habitat and movement of sturgeon. Status reports will be submitted to FERC every 6 months.

Once the Work Group finds a solution for downstream passage for shortnose sturgeon, HG&E will consult with stakeholders to ensure that a consensus based solution is developed. HG&E will then submit a conceptual plan to FERC for review and approval. Upon approval from FERC, HG&E will implement the downstream passage facilities.

The third issue regarding sturgeon involves the Number 1 Overflow. The No. 1 Overflow is located on the First Level canal upstream of the louvers and discharges into the river downstream of the dam. Sturgeon have been observed entering the intake of the No. 1 Overflow and returning to the river. To prevent the passage of sturgeon through this structure, an exclusion rack for the No. 1 Overflow will be installed during the Fall 2002 drawdown (Figure 6-2). The exclusion rack was developed in consultation with the stakeholders and meets established criteria for bar spacing and velocity.

HG&E is proposing the following specific measures:

6.1 Protection and Enhancement

- By September 1, 2002, HG&E will work with stakeholders to reconvene the Work Group to assist in developing and directing research efforts

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- HG&E will, upon consensus of the group, implement the recommendation of the Work Group
- HG&E will modify the louvers in the Holyoke canal system in the Fall of 2002 and have the full depth louvers functional by the end of the year
- HG&E will fund Alden labs' modeling of the angled bar rack (Phase 2 Research)
- When Alden research results are available and louver effectiveness studies completed, the Work Group will convene to decide how to proceed
- HG&E will continue to participate in the Work Group to develop guidance or exclusion options for the Hadley Falls intake and to continue assessing impacts of the Holyoke Dam on shortnose sturgeon
- An exclusion rack for the Number 1 overflow will be installed during the Fall 2002 drawdown
- HG&E will submit annual reports to FERC on the progress of the above items

6.2 Monitoring

- HG&E will conduct additional research to determine the success of the full depth louvers
- HG&E will conduct additional research to determine the success of any Hadley Falls guidance system

Table 6-1. Number of Shortnose Sturgeon Lifted at Holyoke Dam Annually (1975-2001).

<u>Year</u>	<u>Number Lifted</u>
1975	5
1976	3
1977	0
1978	1
1979	3
1980	0
1981	4
1982	4
1983	4
1984	10
1985	6
1986	13
1987	3
1988	4
1989	4
1990	5
1991	0
1992	4
1993	6
1994	1
1995	1
1996	16
1997	0
1998	14
1999	1
2000	0
2001	0*
Total	112

* Two sturgeon entered lift but returned downstream per NMFS

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APPENDIX A
RELEVANT PASSAGES FROM CONDITIONING DOCUMENTS

APPENDIX A

License Order:

Article 416

Within one year after the date of issuance of this license, the licensee shall, after consultation with the U.S. Fish and Wildlife Service (FWS), Silvio O. Conte National Fish and Wildlife Refuge (Refuge), National Marine Fisheries Service (NMFS), Massachusetts Division of Fisheries and Wildlife (MDFW), and Massachusetts Department of Environmental Protection (MDEP), as appropriate, file for Commission approval a Threatened and Endangered Species Protection Plan (T&E Plan) for the Holyoke Project. The T&E Plan shall include the federally listed endangered shortnose sturgeon (*Acipenser brevirostrum*), and threatened bald eagle (*Haliaeetus leucocephalus*) and Puritan tiger beetle (*Cicindela puritana*), and shall include, but not necessarily limited to, the state listed endangered yellow lampmussel (*Lampsilis cariosa*) and dwarf wedge mussel (*Alismidonta heterodon*).

The T&E Plan shall include, but not be limited to, the following:

- (1) Measures to enhance bald eagle nesting sites (i.e., by erecting eagle nest platforms) and to protect and enhance eagle perching and feeding activities; a commitment to cooperate with the FWS, MDFW, and MDEM to continue educating the public and policing recreational activities at Puritan tiger beetle habitat sites (particularly at Rainbow Beach), and develop other protective measures, such as no-wake zones; measures to protect and enhance shortnose sturgeon habitat consistent with the measures developed as the result of the on-going shortnose sturgeon studies and the provisions of Articles 405, 406, 411, and 412; and measures to protect and enhance the yellow lampmussel and dwarf wedgemussel, as identified in the canal operations plan (Article 409);
- (2) a schedule for implementing the measures;
- (3) a description of the method for monitoring the results of the implemented measures;
- (4) a monitoring schedule; and
- (5) a schedule for providing the monitoring results to FWS, the Refuge, NMFS, MDFW, and the Commission.

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The licensee shall include in the T&E Plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to FWS, the Refuge, NMFS, MDFW, and MDEP, and descriptions of how the agencies' comments and recommendations are accommodated by the plan. The licensee shall allow a minimum of 30 days for the agencies to comment before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing shall include the Licensee's reasons, based on project-specific information.

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The Commission reserves the right to require changes to the plan. Upon Commission approval, the licensee shall implement the T&E Plan, including any changes required by the Commission.
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Regarding Fish Passage and Shortnose Sturgeon:

Article 405

The licensee shall operate the project in a run-of-river mode and maintain a minimum impoundment elevation of 100.6 feet National Geodetic Vertical Datum with an allowable fluctuation of ± 0.2 foot for the protection of water quality, aquatic and fisheries, and recreational resources of the Holyoke Project and Connecticut River.

The licensee shall at all times act to minimize the fluctuation of the impoundment surface elevation by maintaining a discharge from the project so that, at any point in time, flows, as measured immediately downstream of the project tailrace, approximate the sum of the inflows to the project impoundment.

The run-of-river mode operation and minimum impoundment surface elevation may be temporarily modified if required by operating emergencies beyond the control of the licensee (e.g., extreme runoff events, droughts, ice conditions, equipment failure, or flood storage requirements), and for short periods upon mutual agreement between the licensee, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the Massachusetts Department of Environmental Protection, and the Massachusetts Division of Fisheries and Wildlife. If project operations are so modified, the licensee shall notify the Commission as soon as possible, but no later than 10 days after each incident.

Article 406

The licensee shall release seasonally-adjusted minimum flows into the bypassed reach and canal system for the protection and enhancement of water quality and aquatic and fisheries resources.

The licensee shall release continuous instantaneous minimum flows to the bypassed reach as follows:

<u>Period</u>	<u>Flow</u>
July 16 through March 31	at least 420 cfs, or impoundment inflow, whichever is less
April 1 through July 15	at least 800 cfs, or impoundment inflow, whichever is less

The licensee shall release continuous instantaneous minimum flows to the canal system as follows:

<u>Period</u>	<u>Flow</u>
April 1 through November 15	at least 810 cfs, or impoundment inflow minus fish passage and bypassed reach minimum flows, whichever is less
November 16 through March 31	at least 400 cfs, or impoundment inflow minus fish passage and bypassed reach minimum flows, whichever is less

The licensee shall operate the Holyoke Project according to the following flow prioritization scheme: (1) fish passage flows (Articles 411, 412, and 413); (2) bypassed reach flows; (3) minimum canal flows; and (4) hydroelectric generation, to the extent that such priorities do not conflict with Condition 16 of the Section 401 water quality certification attached as part of this license.

The licensee shall specify the methods for operating and releasing bypassed reach and canal system minimum flows as required by Article 407 of this license, and shall monitor compliance with the minimum flows as required by Article 408.

Releases from the Holyoke Project may be temporarily modified if required by operating emergencies beyond the control of the licensee (e.g., extreme runoff events, droughts, ice conditions, equipment failure, or flood storage requirements), or for short periods upon mutual agreement between the licensee, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the Massachusetts Department of Environmental Protection, and the Massachusetts Division of Fisheries and Wildlife. If the flows are so modified, the licensee shall notify the Commission in advance if known or as soon as

possible otherwise, but no later than 10 days after each such incident, and shall provide the reason for the modified flow.

Article 411

The licensee shall install, operate, and maintain downstream fish passage facilities at the Holyoke Project to provide efficient downstream fish passage for a variety of anadromous fish species past the project.

Within 180 days after the date of issuance of this license, the licensee shall file, for Commission approval, a plan to install, operate, maintain, and, as appropriate, evaluate downstream fish passage facilities at the Holyoke Project that includes, but is not limited to:

- (1) provisions for the continued operation of the canal louver bypass facility and the Boatlock station downstream fish passage facility (as necessary), as well as the operation of the proposed Bascule gate downstream fish passage facility once installed;
- (2) a provision to operate the downstream fish passage facilities, as identified below, during the designated migration period whenever the Hadley Falls station is operating or generation flows are provided in the First Level canal --

<u>Species</u>	<u>Downstream</u>
Atlantic salmon	4/1 - 6/15 (juv.) Fall/Winter (adult)
American shad & Blueback herring	6/1 - 7/31 (adult) 9/1 - 11/15 (juv.)
Shortnose sturgeon	4/1 - 11/15 (adult)
American eel	8/15 - 11/15 Undetermined spring run

- (3) a schedule for implementing the provisions of this plan, including the installation of all facilities and structures, except as specifically noted, within two years of license issuance;
- (4) provisions to notify the U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Massachusetts Division of Fisheries and Wildlife (MDFW), and Connecticut River Atlantic Salmon Commission (CRASC) of any extensions of time to comply with the provisions of this plan;
- (5) provisions for: (a) maintaining the fish passage facilities in proper order and keeping such facilities clear of trash, logs, and material that would hinder passage; (b) performing maintenance such that the fish passage facilities would operate effectively prior to and during the migratory periods; and (c) developing a fish passage maintenance plan describing the anticipated maintenance, a maintenance schedule, and contingencies;

- (6) a provision to allow agency personnel access to the project site and to pertinent project records, for the purpose of inspecting the fish passage facilities;
- (7) a provision to construct the downstream fish passage facility at the spillway Bascule gate (i.e., fly-over), with a surface intake, conforming to the design depicted in hydraulic model studies undertaken by Holyoke Power, including measures to manage flows that are shed through the structure to eliminate interference with the spillway fishlift attraction flows;
- (8) specification of the operational flows for the Bascule gate [i.e., 600 cubic feet per second (cfs)], louver bypass, and Boatlock station downstream fish passage facilities;
- (9) a provision to design, model, and install an angled ($\gg 45^\circ$) bar rack in the Hadley Falls station forebay, with 1-inch clear bar spacing, leading to a downstream fish bypass entrance/conveyance structure located at the existing Bascule gate, or at the rubber dam;
- (10) an evaluation of the existing surface bypass and partial-depth louver structure in the First Level canal, as well as other reasonable measures, for providing downstream passage of shortnose sturgeon and American eel;
- (11) a provision to continue operating the existing Boatlock station downstream migrant facility, and an evaluation of the facility to determine whether the facility should cease operation;
- (12) the estimated capital cost of installing the facilities, the estimated annual costs of operating and maintaining the facilities, and the cost, in lost generation, of operating the facilities; and
- (13) provisions for providing any proposals to modify existing facilities and/or install new facilities, relative to the evaluations of Items 9, 10, and 11 above, as well as the monitoring required by Article 414, to the aforementioned agencies and the Commission.

Article 412

The licensee shall install, operate, and maintain upstream fish passage facilities at the Holyoke Project to provide efficient upstream fish passage for a variety of anadromous fish species past the project.

Within 180 days after the date of issuance of this license, the licensee shall file with the Commission, for approval, a plan to install, operate, maintain, and, as appropriate, evaluate upstream fish passage facilities at the Holyoke Project that includes, but is not limited to:

- (1) provisions for the continued operation of the tailrace and spillway fishlifts;

- (2) specification of the design population for each target species (i.e., 1,000,000 each for American shad and blueback herring; 6,000 for Atlantic salmon; unquantified for American eels, and an estimated 500 shortnose sturgeon);
- (3) a provision to operate the upstream fishlifts during the designated migration seasons, as identified below, at flows up to 40,000 cubic feet per second (cfs), as measured at USGS Gage No. 01172003 --

<u>Species</u>	<u>Upstream</u>
Atlantic salmon	4/1 - 7/15
American shad & Blueback herring	9/15 - 11/15
Shortnose sturgeon	4/1 - 7/15
American eel	6/1 - 11/15
	4/1 - 11/15

- (4) a schedule for implementing the provisions of this plan, including the installation of all facilities and structures, except as specifically noted, within two years of license issuance;
- (5) provisions to notify the U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Massachusetts Division of Fisheries and Wildlife (MDFW), and Connecticut River Atlantic Salmon Commission (CRASC) of any extensions of time to comply with the provisions of this plan;
- (6) provisions for: (a) maintaining the fish passage facilities in proper order and keeping such facilities clear of trash, logs, and material that would hinder passage; (b) performing maintenance such that the fish passage facilities would operate effectively prior to and during the migratory periods; and (c) developing a fish passage maintenance plan describing the anticipated maintenance, a maintenance schedule, and contingencies;
- (7) a provision to allow agency personnel access to the project site and to pertinent project records, for the purpose of inspecting the fish passage facilities;
- (8) a provision to make necessary physical modifications to the upstream fishlift system to ensure operation up to 40,000 cfs, and to provide at least 12 inches of freeboard from operating water levels in the fishlifts to the top of the fishlift walls and fish crowders;
- (9) a provision to expand the spillway and tailrace fishlifts by (a) increasing width of the spillway entrance and the spillway entrance channel to 8 feet, (b) providing attraction flows of 200 cfs at the spillway fishlift entrance and 120 cfs at each of the tailrace fishlift's entrance, (c) increasing the tailrace fishlift hopper capacity to 330 cubic feet, (d) increasing the spillway fishlift hopper capacity to 460 cubic feet, (e) increasing the width of the fishlift exit channel to 14 feet from the fishlift hoppers to the counting station and 10 feet beyond, and (f) providing an adjustable back lighted panel at all fish counting station windows;

- (10) a provision to install a second fish trapping and counting station in the fishlift exit channel;
- (11) a provision to (a) install a new fish trapping and hauling system, as proposed by HG&E (see response to additional information request, Item 6.C.3, filed December 23, 1998), or, (b) if such a facility is determined not to be feasible, evaluate other mechanisms and/or procedures to enhance trapping and hauling operations at the Holyoke Project, and provide any relevant proposals in this regard;
- (12) provisions to remove the rock-outcropping at the entrance of the tailrace fishlift below Unit #2 to allow efficient operation of this entrance, and provide bottom-level access to the tailrace and spillway fishlifts, as necessary;
- (13) a provision to construct a barrier at the confluence of the Hadley Falls tailrace and the Overflow No. 2 channel; and
- (14) the estimated capital cost of installing the facilities, the estimated annual costs of operating and maintaining the facilities, and the cost, in lost generation, of operating the facilities.
- (15) provisions for providing any proposals to modify existing facilities and/or install new facilities, relative to the monitoring required by Article 414, to the aforementioned agencies and the Commission.

Regarding Canal Operations:

Article 409

Within 180 days from the date of issuance of this license, the licensee shall file, for Commission approval, a comprehensive canal operations plan. The plan shall describe the operational and maintenance measures that will be used to protect and enhance water quality and mussel populations in the canal system.

The plan shall include, but not be limited to: (1) a description of how the minimum flows required by the license will be circulated through the three-level canal system to improve and maintain water quality and aesthetic conditions; (2) specific procedures for installing a sandbag weir, or other appropriate measures, to maintain watered conditions in areas of the canal necessary to maintain mussel habitat; (3) description of any modification of structures necessary to achieve minimum canal flow requirements and conditions protective of mussels during maintenance drawdowns; (4) a description of how the minimum canal flows required by this license will be maintained during canal maintenance drawdowns; and (5) a method and schedule for monitoring the effectiveness of minimum canal flow requirements in protecting and enhancing mussel populations per Article 410.

The plan also shall include a schedule for: (1) implementation of the monitoring plan; (2) consultation with the appropriate federal and state agencies concerning the results of the monitoring; and (3) filing the results, agency comments, and licensee's response to agency comments with the Commission.

Canal Operations and Monitoring Mussels

Article 410

Within 180 days after the date of issuance of this license, the licensee shall file, for Commission approval, a plan to monitor fish and aquatic habitat and fish populations within the bypassed reach and the Holyoke canals. The plan shall provide for monitoring the effectiveness of the bypassed reach and canal flows and other measures in protecting and enhancing fish and mussel habitat conditions and populations, and to determine the need for additional enhancement measures.

The plan shall include methods to monitor and assess: (1) the adequacy of bypassed reach flows to provide a safe zone of passage for anadromous fish through the bypassed reach; (2) the occurrence of fish stranding in the bypassed reach; (3) fish populations in the bypassed reach; and (4) changes in canal mussel populations and the adequacy of the sandbag weir, minimum flows, and drawdown procedures for protecting mussel populations in the canal system.

As part of the monitoring plan, the licensee shall determine the need for additional measures to ensure or enhance the safe passage of shortnose sturgeon through the bypassed reach as required by Articles 412 and 416. Such measures may include, but not be limited to: (1) changes in zone-of-passage flows and/or timing (pulsed flows); (2) changes in bypass aquatic habitat flows; and/or (3) bypass reach channel modifications. The plan shall include working in conjunction with the Connecticut River Shortnose Sturgeon Working Group and/or its findings to determine the most beneficial project modifications that would meet plan requirements and protection measures for the shortnose sturgeon.

The plan shall include a schedule for: (1) implementing the plan; (2) consulting with the appropriate federal and state agencies concerning the results of the study and any additional measures needed to protect aquatic and fisheries resources and mussel populations; (3) reporting on a biannual, or other appropriate interval, on anadromous fish and mussel populations, with a final report and recommendations at the end of the agreed-to monitoring period; and (4) filing the results, agency comments, and the licensee's response to agency comments with the Commission. The final report shall: (1) identify the changes in populations over time; (2) outline the proposals for changes in operations or structures, if any, to protect and enhance fish or mussel populations; and (3) discuss the basis and need for continued monitoring.

From the 401 Water Quality Certificate:

19. Riparian Management Plan

... (b) The riparian zone shall be sufficient to:

- (i) Serve as a vegetative filter to substantially reduce non-point source discharges of oil and grease, sediment, nutrients and fertilizers, pesticides, and other contaminants that may be transported to Project waters in overland runoff from existing or potential adjacent residential, commercial or agricultural uses or roads;
- (ii) Protect near shore fish, aquatic life and wildlife habitat from degradation resulting from adjacent uses and disturbances and from alterations to the shoreline including docks, riprap, and other structural modifications;
- (iii) Include significant wildlife habitats and buffers adequate to avoid disturbance from adjacent uses, for species utilizing Project waters and associated wetlands, including but not limited to rare, threatened, or endangered wildlife species, or other state or federally listed species of concern; and
- (iv) Protect riparian habitat areas and buffers for species which use the riparian area in conjunction with Project waters, including turtle nesting areas, and bald eagle perch trees used for feeding;...

APPENDIX B
"RAINBOW BEACH: FINAL REPORT"

Rainbow Beach
Final Report
MA DFW NHESP
December 20, 1997
Chris Davis

The 1997 field season for the biological and interpretive work at Rainbow Beach began on May 21, 1997 with a work day to install symbolic fencing of *Cicindela puritana* larval habitat, post signs and assess vegetative density in larval areas. Participants included personnel from: Massachusetts Department of Environmental Management, Massachusetts Division of Fisheries and Wildlife, Natural Heritage Endangered Species Program, River Rover volunteers and Dr. Phil Nothnagle.

Due to rather aggressive vegetative management at the beginning of the 1996 field season, Dr. Nothnagle recommended some very light removal of vegetation and fallen tree limbs. Symbolic fencing to prevent foot traffic and subsequent trampling of larval burrows was installed in areas Dr. Nothnagle has identified as the best available larval habitat.

Interpretative Training

A meeting was held on May 29, 1997 at the USFWS Connecticut River Resource Management Complex, Sunderland, MA to briefly review the River Rover Program for 1996 and plan training of River Rovers for the 1997 field season. Additionally, we outlined the areas interpreters were needed and established procedures for scheduling and reporting. Jennifer Palaia, DEM summer staff, volunteered to coordinate scheduling for all volunteer activities.

Participants: Massachusetts Department of Environmental Protection, USFWS Conte Refuge, CT River Coordinator, DFW NHESP.

River Rover training took place on June 19, 1997 at the USFWS Connecticut River Resource Management Complex, Sunderland, MA. Training included an overview of the USFWS and the roles and responsibilities of several divisions, i.e., refuges,

Sunderland Office of Fisheries Assistance, CT River Coordinator, etc. and federal activities within the Connecticut River watershed such as anadromous fish restoration, land acquisition, endangered species management, fishing pole loan programs and habitat enhancement.

Volunteers were provided with a River Rover manual containing background on other volunteer opportunities, maps of dams and fish passage facilities in the Connecticut River watershed and life histories of anadromous fishes and freshwater mussels.

A trip to the Sunderland boat launch included an electrofishing boat demonstration, geologic history of the area, and discussion of endangered species and nuisance exotic wildlife. A tour of the Cronin Salmon Station concluded the day.

Participants: Massachusetts Department of Environmental Protection, USFWS Conte Refuge, CT River Coordinator, Sunderland Office of Fisheries Assistance, Massachusetts Division of Fisheries and Wildlife NHESP.

Tiger Beetle Training

Tiger beetle training was held on June 30, 1997 for River Rovers specifically interested in Rainbow Beach. Training included a trip Cromwell, CT to the most northern and largest population of *Cicindela puritana* in Connecticut. Numbers of *C. puritana* were good and we had difficulty finding *C. repanda*, a common species occurring there.

Dr. Nothnagle explained his discovery of *C. puritana* at this site and some of the issues associated with rare species occurring on private property. Adult *C. puritana* were captured, sexed and identifying characteristics explained. Several *C. repanda* larvae were dug up from larval tubes and the life histories of *C. puritana* and *C. repanda* were compared and contrasted.

During an afternoon trip to Rainbow Beach *C. repanda* were captured and examined. Four *C. puritana* were netted, marked and released.

Dr. Nothnagle suggested that Beach Clotbur, *Xanthium echinatum* and Japanese Knotweed, *Polygonella cuspidatum* be removed from some of the larval habitat

later in the summer. Both species grow quickly and can shade large areas thereby eliminating areas for *C. puritana* ovipositing.

Media

Terry Blunt, DEM issued a press release prior to the River Rover volunteer training on June 19, 1997. Media present at the training included: Springfield Union, Greenfield Recorder, WFCR, WGGB channel 40 and WWLP channel 22.

The Daily Hampshire Gazette ran an article on Rainbow Beach and unfortunately chose to focus on the controversy surrounding the use of the beach and the negative response to WMA regulations and tiger beetle research.

Volunteers

8 River Rovers volunteered time at Rainbow Beach during the 1997 field season. The dates and number of volunteers that participated in *C. puritana* research:

6/28/97	1	7/12/97	2	8/17/97	1
6/29/97	2	7/13/97	2		
6/30/97	2	7/15/97	2		
7/4/97	1	7/20/97	2		
7/5/97	2	7/27/97	3		
7/6/97	3	8/3/97	1		

Scheduling of volunteers was coordinated by Jennifer Palaia. We spoke 1-2 times per week to discuss coverage for the upcoming weekend. As with any volunteer effort, consistency of participation was the greatest challenge. Most volunteers became quite good at spotting *C. puritana*'s among the *C. repanda* even without binoculars.

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Interpretive Contacts and Beach User Impact
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Beach users at Rainbow Beach Wildlife Management Area can be placed in one of four Categories:

1. First time users
2. Occasional users
3. Regular users
4. Party users

The quality of the interpretive contact varied with each type of user.

First time users are often unaware of the presence of tiger beetles and are usually interested in the project. Some expressed support and were glad that "someone" is watching the beach and helping take care of it.

Occasional users may or may not know about the tiger beetles. Many seem to be accepting of the need to protect the habitat and seem to not be greatly inconvenienced by the WMA regulations.

Regular users are there nearly every weekend and many have a long personal history with the beach, some having been brought there as children. Most are family groups. These people are highly invested in "their" beach and their perceived rights to its use. Interpretive contacts can be challenging and we often encountered hostility towards the beetle and regulation of the beach, in particular, the no camping regulation. They seem to respect the beach in terms of litter and can be observed picking up trash at the end of the day.

Many in this group tend to beach their boats in the same location. This group has staked out the wide sandy center of the beach. This forces other users to the north and south ends of the beach where most of the arrivals and departures can be observed during the course of a day.

Party users have a very low investment in the beach as their main activity seems to be the consumption of alcohol. They can be belligerent and are not receptive to WMA regulations or tiger beetle research.

During the course of the field season, the need for interpretive contacts declined. Many of the regular users knew us by name and re-contact, other than in a casual manner and unless initiated by a beach user, was unnecessary. In fact, once the regular users accepted the fact that their use of the beach had to change, an interpretive presence seemed counterproductive to good public relations. The false perception that we were in an enforcement role seriously jeopardized our efforts to educate and build trust with beach users. Interpreters are in a difficult situation as we are a visible and easy target for any reaction a beach user may have.

Foot traffic and beaching of boats at the shoreline, occurring mainly at the center of the beach, appears to have no significant negative impact on adult *C. puritana*. While not fully understood, foot traffic near the vegetation at the edge of the flood plain forest *may* contribute some beneficial disturbance in the maintenance of larval habitat.

Environmental Police Officers

Coordination with EPO's generally went well with the acceptance of not being able to reach them by radio on occasion. Most weekend days patrols passed by the beach 3-4 times. We received reports from beach users of enforcement of the no camping regulation. The EPO's continued to express their frustration over the lack of resources to adequately meet boating and safety responsibilities but still responded well to requests to include Rainbow Beach in their patrols. Regular procedure included a Saturday and Sunday morning check-in with EPO's to review the previous night's activity at the beach.

Tiger Beetle Research- Adults

Capture procedures consisted of 1-4 people slowly walking perpendicular to the shoreline approximately 5 feet apart covering an area of between 5-20 feet depending on the number of observers. Tiger beetles were observed with the naked eye or through binoculars and *C. puritana* were located among *C. repanda*. General body shape, presence of a white line on abdomen side and overall lighter and wider markings on elytra distinguish *C. puritana* from *C. repanda*.

Unmarked *C. puritana* are netted, sexed and marked with a unique color combination to enable visual "recapture" and eliminate subsequent netting of previously marked beetles.

29 *C. puritana* were netted, sexed, marked and released. This represents 18 males and 11 females. Marking methodology followed recommendations from Dr. Nothnagle based on mark-recapture studies with *C. puritana* at Connecticut sites.

C. puritana were marked with 1 or 2 colored dots. Males were marked on the left elytra and females on the right. For example, a male marked BT1BL1 has one blue dot on the thorax and one blue dot on the left elytra in the #1 position at the humera luna. A female marked TOBR2 has no mark on the thorax and one blue dot on the right elytra middle position.

No predation of marked *C. puritana* was observed. Copulation was also not observed. However, two marked males attempted copulation during a fifteen minute observation period. On 8/8/97 at the north banks, TORL3 mounted YT1BL1. Five minutes later, YT1BL1 mounted TORL3. Both males were observed walking up and down a 70 yards section of beach feeding at the shoreline and presumably looking for females.

C. puritana were observed, captured and marked in three areas: the north end of the beach directly opposite the northern fenced larval habitat, the south end roughly between 50 yards north and 100 yards south of the double snag and at the "north banks" 3/4 of a mile north of Rainbow Beach, west side of the Connecticut River.

C. puritana Marking Data:

N in location for the north end represents the northern most sign of the fenced area. For reference purposes signs are numbered starting at the north proceeding south N1, N2, N3 and so on. The numbering begins again at one for the southern fenced area, S1, S2, etc.

Length of resighting and dispersal

The table below represents the # of days from initial capture and marking and the last resight.

<u>Males</u>	<u>Females</u>
1	7
3	12
13	28
14	
27	

C.puritana larvae survey

Two fenced enclosures were erected at the north end of Rainbow Beach based on Dr. Nothnagle's observations of larval sites in previous years. The symbolic fenced worked well to exclude visitors from those areas.

During the course of the field season, Dr. Nothnagle, Tim Simmons and myself developed a set of assumptions for the habitat requirements for C. puritana larvae. Factors that influence selection of egg laying locations and survival of larvae likely include but are not limited to: aspect, soil composition, vegetation composition, vegetation density, root structure, flooding, ice scouring, mean level above water table and other natural and man made disturbances. Rather than implement habitat management based on an incomplete understanding of these requirements and risk negatively impacting reproduction, we decided to survey for C. puritana larvae during September when activity was most likely to occur. A total of 30 C. puritana larvae were found at Rainbow Beach and the North Banks.

North Banks

13 C. puritana larvae were distributed on first and second terrace-shelves in sandy, silty substrate in small clusters along an approximately 180 ft. section of riverbank. Cover estimates of vegetation were 5-10% and included: *Equisetum*

arvensis, Salix nigra, Panicum sp., Populus seedlings, Xanthium, Calamagrostis canadense and 25 other species. Some larvae were observed directly beneath the leaves of Equisetum.

Estimates of elevation of larvae above mean high water: 34 inches and 42 inches.

Instars observed:

1st instar - 2 2nd instar - 6 3rd instar - 5

Rainbow Beach

17 C. puritana larvae were observed. Larvae were distributed in clusters near vegetation (sparse cover <25%). One larva was located within the southern enclosure near fence post 5s. 7 larvae were observed in a frequently used trail immediately south of the southern enclosure. 3 larvae were located among the stems of the clump of sandbar willow (Salix exigua, state threatened) and one 3rd instar was observed 30 feet south of the southern edge of the sandbar willow.

Estimates of elevation of larvae above mean high water: 42 inches.

Instars observed:

1st instar - 3 2nd instar - 12 3rd instar - 2

Results of the larval survey seem to indicate that C. puritana select at least two different types of habitat for egg laying. Both the terraced banks north of Rainbow Beach and the sandbar willows and trail area were favored over more densely vegetated areas. With the exception of the north banks, it is interesting to note that the areas of highest adult activity at Rainbow Beach were some distance both north and south of the areas selected for egg laying. It is quite possible that egg laying occurred on terraced shelves on the east bank of the Connecticut river across from Rainbow Beach. Additional study is needed to gain a fuller understanding of the optimal conditions for larval habitat.

Recommendations for 1998

C. puritana Research

The presence of adult and larvae at sites north of Rainbow Beach indicate that even with a relatively low population, emigration and reproduction are occurring away from what has historically been considered the core of the population. This strongly indicates the need for expansion of the research area to include all historic and/or likely suitable habitat both upriver and down river of Rainbow Beach. The southern end of the recommend research area would include the Oxbow and mouth of the Mill River, proceeding northward to include Elwell Island and the sandy point approximately 1/2 mile upriver. All suitable habitat should be searched for adult C. puritana during July and early August and for larvae during September.

Capture and marking of adult C. puritana should again be conducted in 1998 in order to continue to collect valuable data on habitat requirements for adults, population estimates and dispersal. It is recommended that unique color combinations be used again to allow for ease in resighting marked individuals and to maximize the data collected from each marked animal.

Vegetation

Since C. puritana appear to be opportunistic with regard to selection of egg laying locations and the influence of natural and man made disturbance is poorly understood, it is recommended that no vegetation clearing/management, with the possible exception of exotics, be implemented in 1998. An additional season of research will greatly increase our understanding of the locations and habitat requirement for larvae.

Interpretation

Interpretive goals for 1997 included: education of the beach users to the presence of C. puritana and the need for research, informing about WMA regulations and attempting to de-link the regulations with C. puritana, to provide an opportunity for dialogue regarding use of the beach and to request their

assistance in avoiding the fenced enclosures. In large measure these goals were met. Very few people were seen going into the enclosures and few tracks indicating activity within the enclosures were observed. However, as noted above, some misperceptions and problems resulted from our efforts. Even with the very low key, non confrontational approach we employed our role was interpreted as one of enforcement. A continued interpretive presence seems to antagonize rather than educate or enlist support. The message has been received and while few are happy about it, they realize that their use of Rainbow Beach has changed and that those changes are here to stay. My recommendation for 1998 is to eliminate interpretive contacts while maintaining signage explaining WMA regulations, need for enclosures, etc.

Enforcement

Continue to liaison with MA ELE to support them in their enforcement of WMA regulations at Rainbow Beach. If possible, advocate for additional resources for Connecticut River patrols which could provide a greater enforcement presence for Rainbow Beach.

Publicity

Media coverage of the River Rover training was positive and aided in informing the public of the volunteer opportunity at Rainbow Beach. However, future publicity around the research being conducted on *C. puritana* at Rainbow Beach and elsewhere is likely to be counterproductive, particularly in light of the occurrence of *C. puritana* on private property. While *C. puritana* have been recorded at other locations the controversy surrounding their presence is recent and rancorous. Future negative publicity could seriously impact landowner cooperation.

#37

RECEIVED
11/6/97

I Submitted by: Tim Simmons
Restoration Ecologist
Division Of Fisheries and Wildlife
1 Rabbit Hill Road
Westborough, MA 01581
(508) 792-7270 ext 126
Tim Simmons@state.ma.us

II Title: Determination of puritan tiger beetle (*Cicindela puritana*) distribution, habitat dynamics and habitat requirements along the Connecticut River in Massachusetts

Abstract. The puritan tiger beetle remains in danger of extirpation in Massachusetts in part because its habitat is extremely rare and in part because its habitat requirements are poorly understood. The lack of critical information impedes protection and conservation decision making. Monitoring the population (larvae and adults), examining alterations to habitats due to alterations in fluvial hydrology of the river, and systematically measuring and evaluating the physical and biological features of occupied habitat are three research approaches which will be applied to increasing the understanding of both beetle population dynamics and the dynamics of the habitats and natural communities associated with this section of the Connecticut River.

III. Project Description.

Location: The proposed project is located in the towns of Northampton, Hadley and south Hadley, in Massachusetts (see attachment 1).

Scope of work: The puritan tiger beetle, a federally endangered and state endangered species occurs in Massachusetts only along a short stretch of the Connecticut River. The small population which appears, in recent years, to be making a slight recovery from alarmingly low numbers, is associated with Rainbow Beach which is owned by the Division of Fisheries and Wildlife (DFW) and the town of Northampton and managed by DFW.

Research sponsored by the Challenge Cost Share program and conducted in 1997 resulted in several important findings concerning the preservation and management of the animal and raised questions. The answers are crucial to the preservation not only of the population but also for the management of adjacent natural communities.

Specifically, larvae were found not only at Rainbow Beach but also within the sandy cliffs upstream of the beach. Adults, marked at Rainbow beach, were also observed upstream of the beach. Plant cover, especially exotic species, has increased dramatically at Rainbow Beach in areas formerly occupied by larvae. The sand cliffs are also partially vegetated mostly by exotic or weedy plant species. Larvae appeared to be found most consistently in an elevation band approximately 3 feet above average river altitude in early autumn when larval activity is high.

Restoring the Massachusetts population of puritan tiger beetles to more stable conditions requires a more thorough understanding of life history, habitat requirements of larvae and adults and processes and factors that influence the dynamics and habitability of the riparian communities upon which they depend.

Four fundamental questions have been identified.

- Have alterations in hydrological processes such as flooding, erosion and deposition resulted in habitat degradation by encouraging exotics or otherwise decreasing available habitat for puritan tiger beetles and other significant riparian communities?
- What are the characteristics of optimal habitat for larvae and where are these areas likely to be found currently and in the future?
- What specific measures, in terms of vegetation and user management are required to guarantee a future for the population and associated natural communities?

Puritan Tiger Beetle Proposal to Conte Wildlife Refuge Cost Share Program 5 November 1997

- What impact are invasive exotic plant species having upon important riparian communities and puritan tiger beetle habitats?

Objectives.

Objective 1. Design and implement a research plan to address the four questions while continuing to educate beach users and the public.

Objective 2. Conduct a modified and expanded Indicators of Hydrological Alterations assessment including evaluations and field verification of ecologically relevant water levels.

Objective 3. Conduct surveys for adults and larval puritan tiger beetles on all potential habitat from Elwell Island to the mouth of Mill river.

Objective 4 Conduct multivariate analyses of occupied larval habitat and adjacent unoccupied habitat

Methodologies.

Indicators of Hydrological Alteration Assessment. The methodologies for the hydrological alterations assessment are found in Richter et. al. 1997 (attached). This methodology will be applied to the stretch of the river between Elwell Island and the mouth of Mill River in Northampton. The exercise will be performed by Philip Nothnagle Ph.D. in cooperation with Tim Simmons. The only stream gage available for evaluation is the USGS gage in Montague. This data will be supplemented by accessing, if available, stage data from the Holyoke dam. In addition, staff gages for the establishment of relationships between stream gage and hydrological stage at 5 important sites along the river will be installed. This will allow for the evaluation of the timing, frequency, duration and magnitude of flooding for floodplain forest and other riparian communities.

Puritan tiger beetle population monitoring and public outreach. Surveys will be performed in spring summer and fall by an intern hired to continue work performed last year. The intern will be trained by Dr. Nothnagle and Tim Simmons who will also assist in the surveys. In addition, this person will serve as volunteer coordinator and liaison with the various agencies and the general public.

Multivariate study design, data collection and analyses. These tasks will be designed and performed by Dr. Nothnagle in consultation with Tim Simmons. The intern will also be responsible for collecting data. In order to increase our understanding of habitat parameters important to the beetle population a systematic evaluation of locations where larvae and adults are found is necessary. Among the information fields considered significant are vegetation composition and structure, soil characteristics (particle size and stratification), distance to water vertically and horizontally and elevation relative to water surface and established datum points.

Results and products.

A report on the assessment of indicators of hydrological alteration will be completed by 30 October 1998. The report will focus on hydrological effects on biotic resources in the study area, especially puritan tiger beetle habitats and floodplain forest communities.

A report on the multivariate habitat analyses will be completed by 1 December 1998.

A report on puritan tiger beetle population monitoring and beach user education will be completed by 15 November 1998.

A report on management recommendations summarizing the practical applications of all the research and monitoring will be completed by 1 December 1998.

Puritan Tiger Beetle Proposal to Conte Wildlife Refuge Cost Share Program 5 November 1997

Timeframe: Starting Date - 5 January 1998 Completion Date - 1 December 1998

Applicant: The applicant serves as restoration ecologist at the Division of Fisheries and Wildlife's Natural Heritage and Endangered Species Program and administers the ecological restoration component of the Biodiversity Initiative. I also have considerable experience working with tiger beetle populations and have collaborated with Dr. Nothnagle on another federally listed beetle population in Massachusetts.

Partnerships: This project will continue to be a partnership involving the Conte National Fish and Wildlife Refuge, MA DFW, MA DEM via the river rovers program and the Connecticut River Program, the MA DFWELE Environmental Police and *The Nature Conservancy*.

Ownership: The ownership of the lands on which the project occurs are DFW and the town of Northampton for Elwell Island and Rainbow Beach. Several private landowners, who will be asked for permission prior to any activity, own portions of riverbank.

Additional: Multiple factors have contributed to the decline of puritan tiger beetle including river management, recreational use of habitat, collecting, riverbank stabilization, invasive exotic plant species, combinations of these forces and unknown factors

IV. Project Budget

Item	Challenge Cost Share Request	Biodiversity Initiative Contribution
Salary for beach/beetle intern	\$6,700.00	
Dr. Nothnagle Stipend IHA		\$3,500
Dr. Nothnagle Stipend MVA-habitat		\$2,200.00
Restoration Ecologist		\$1,100
Equipment-soil sample tubes, miscellaneous		\$ 300.00
Administrative Support		\$ 225.00
Travel Costs		<u>\$2,000.00</u>
Total	\$6700.00	\$9,325.00
Project total		\$16,325.00

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APPENDIX C
MUSSEL MONITORING STUDY ON CT RIVER

CONNECTICUT RIVER SURVEY IN THE VICINITY OF THE HOLYOKE DAM FOR THE YELLOW LAMPMUSSEL

Introduction

The yellow lampmussel, *Lampsilis cariosa*, once common to Connecticut River, is only rarely reported in mussel collections today and for seven to eight years was thought to no longer populate the river. Dr. Douglas G. Smith, University of Massachusetts, documented the occurrence of this mussel in the Holyoke canal system on July 5, 1984 and the next specimen was not collected until NU divers, working with Menzie-Cura (an environmental consultant), collected a juvenile yellow lampmussel below the Holyoke Dam in October 1992. Currently, this species is listed as "Endangered" by the State of Massachusetts and is listed as "Special Concern" in Connecticut. Federally, *L. cariosa* was proposed for a "Category 2" listing in 1991 (Federal Register, Vol. 56, No. 225, pg. 58817), a listing which is an awareness notification only and does not require any mandated management. Very little is known about the biology and ecology of this mussel. The reasons for the declining numbers of *L. cariosa* are not clear, but loss of suitable habitat and urban pollution are considered contributing factors (D.G. Smith, personal communication).

In light of the 1992 discovery of a live yellow lampmussel during a coal tar deposit survey in the Connecticut River, the U.S. Fish and Wildlife Services requested that data be gathered on the population size of this mussel below the Holyoke Dam. This survey was conducted on August 14 and 15, 1995 by personnel working for the Aquatic Services Branch of the Environmental Department of Northeast Utilities. Dr. D.G. Smith, an authority in the field of invertebrate taxonomy for this area of the Connecticut River, was contracted to verify the identifications of mussels collected in the field. Patricia Huckery, representing the Massachusetts Fish and Wildlife (non-game species) Department, participated in field work conducted on August 14, 1995.

Material and Methods

A qualitative and quantitative survey for resident mussels, including the yellow lampmussel, was conducted over an eighteen mile section of the Connecticut River. On August 14, 1995, qualitative assessments of mussel abundance were made from the North Hadley and Hatfield area to Bachelor Brook in the South Hadley and Holyoke area (Fig. 1). Seven areas over this section of the Connecticut river were surveyed during a nine hour period. Both shallow (<2 m) and deep water (2-10 meters) areas were sampled using SCUBA, snorkeling and wading with the aid of underwater viewers. All mussels were identified live and returned to the river bottom. When located, deposits of mollusk shells left by river otters (otter middens) or other predators were inspected to obtain voucher specimens and further document the relative abundance of mollusk species in the river.

A quantitative assessment of adult mussels was conducted on August 15, 1995 in the area from which the most recent specimen of yellow lampmussel was collected, i.e., below the Holyoke Dam. In this area, general surveys were conducted to locate concentrations of adult mussels. Five distinctly different areas (varying depth, sediment type, current, etc.) in about a one-mile stretch of river were sampled using a 100 meter transect line. Each linear transect was selected to maximize the number of mussels sampled for an area. Along the first two transects, two biologists using

SCUBA collected all adult mussels within one meter of each side of the 100 meter line. Mussels were counted, identified to species, and returned to the river bottom alive. The low numbers of mussels and the ability of the divers to identify them on the bottom allowed transects three, four and five to be sampled by bringing only unusual looking mussels to the surface for verification. Otter middens or similar shell deposits were censused for relative species abundance. This sampling effort required approximately 6 hours to complete.

Results

Qualitative survey. Yellow lampmussels were not found in any of the areas sampled. The only living mussels collected were the eastern elliptio, *Elliptio complanata* (Table 1). Of all the seven sites surveyed, Site 1, the shoal in the North Hadley/Hatfield area, was considered to have the best potential habitat for the yellow lampmussel based on its coarse gravel substrata and varied types of niches (e.g., water depths ranging from 0 to 2 meters, substrata ranging from coarse gravel/cobble to mud/clay, vegetation ranging from none to dense mats along the eastern shore). The densities of eastern elliptios were greatest at Site 1 and, for this reason, we allocated 1.5 hours using two biologists diving and three biologists wading with viewers for a total of 7.5 search hours, the most effort expended at any site. Sites 6 and 7 were considered the next best areas based on the numbers of mussels found. Survey times ranged from 0.5 to 1.5 hours using from 4 to 5 biologists (2 to 7.5 hours of total search effort) per site and were dependent on the extent of mussel aggregations in each area.

Quantitative survey. Yellow lampmussels were not found in any of the transect areas. Although the eastern elliptio was the most common species, a few alewife floaters, *Anodonta implicata*, were collected (Table 2). The highest densities of the eastern elliptio were located along Transect 1, averaging nearly 4 mussels/m² (779 mussels/200 m²). However, a 100 meter transect covered many different density aggregations of mussels which ranged from <1/m² to >50/m². The first 25 meters of the Transect 1 yielded 46% of the mussels collected over the entire 100 m. Of the five transects sampled, Transects 1 and 2 had the greatest numbers of eastern elliptios, but the most alewife floaters were collected from Transect 5. General surveys conducted along the shore, wading using viewers and SCUBA divers drifting along the bottom of the Holyoke Dam tailrace canal, yielded only eastern elliptio.

Discussion

The qualitative study was designed to assess the presence or absence of yellow lampmussels north of the Holyoke Dam. This effort was conducted because the identification of other aggregations of yellow lampmussels would better place into context the existence of aggregations below the Holyoke Dam. The quantitative survey in the area below the Holyoke Dam was designed to determine the size of any aggregations of yellow lampmussels that might remain in this river area where a juvenile has been collected in 1992.

The absence of the yellow lampmussel indicates this freshwater mussel, if present in this area of the river, is extremely rare. Of the two species collected, eastern elliptio and alewife floater, the most common mussel over the eighteen mile study area was the eastern elliptio. Alewife floaters, although documented, were rare in occurrence with only three live specimens being collected

during the two days of effort. These data suggest that the yellow lampmussel juvenile collected in 1992 was an anomaly. Adults may still exist in this section of the river, but they are probably quite solitary and sparsely distributed.

Conclusion

The yellow lampmussel, *Lampsilis cariosa*, is extremely rare or absent from the eighteen mile stretch of the Connecticut River extending from North Hadley, Massachusetts down river to just below the tailrace canal for the Holyoke Dam. The most common freshwater mussel in this stretch of river is the eastern elliptio, *Elliptio complanata*.

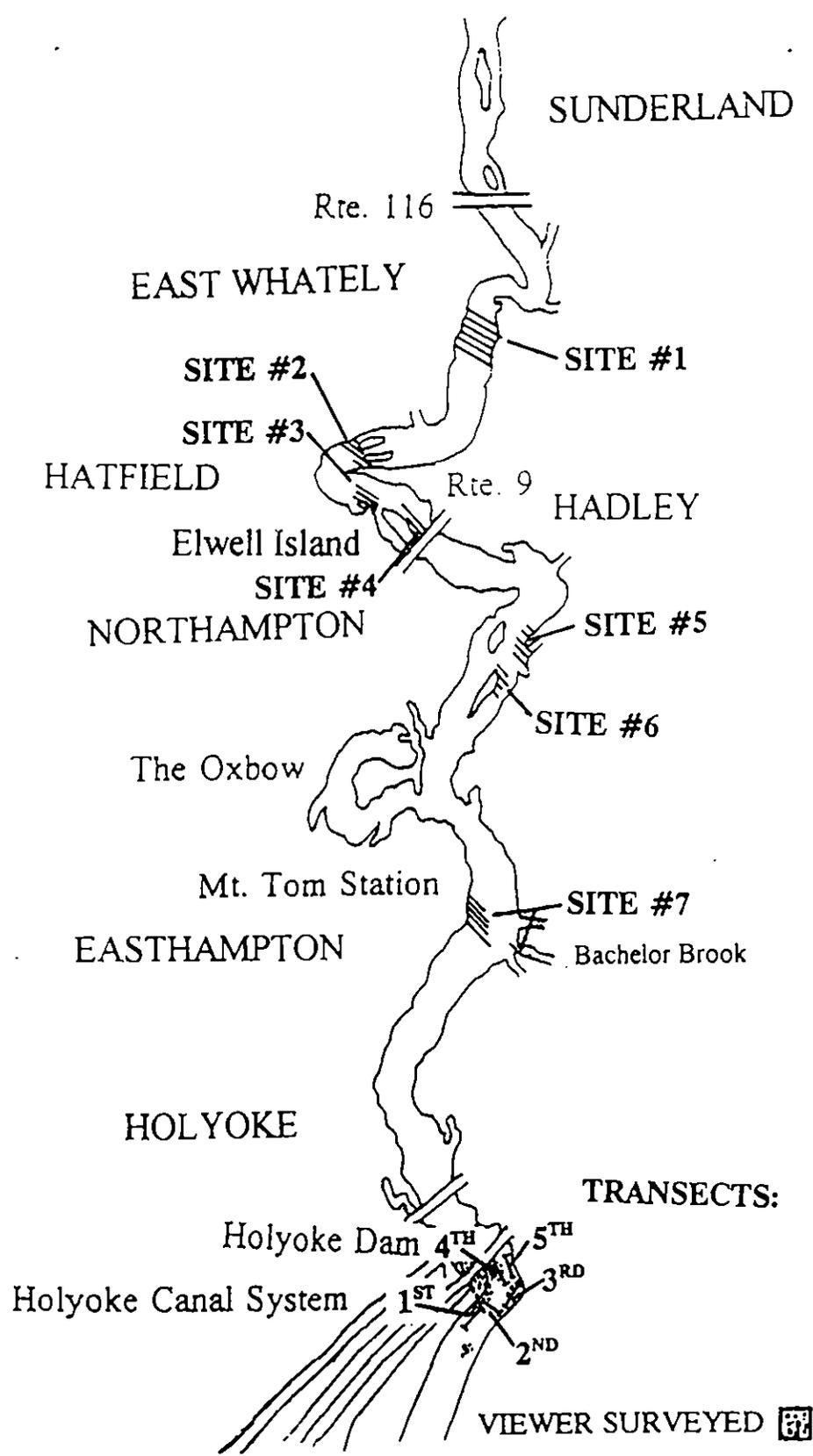


FIGURE 1. The sites and transects on the Connecticut River that were surveyed on August 14 and 15, 1995, respectively, for presence of the yellow lampmussel, *Lampetlis cariosa*.

TABLE 1 General site descriptions and relative abundances of the eastern elliptio, *Elliptio complanata*, during the August 1995 yellow lampmussel survey of the Connecticut River over an eighteen mile area above the Holyoke Dam

SITE	LOCATION	DESCRIPTION	ABUNDANCE*	COMMENTS
1	North Hadley/Hatfield	Shoal area in middle of river; exposed substrata approx. 100 m long and 30 m wide	Moderate	Surveyed by wading with viewer; substratum was coarse gravel
		Western shore of river in deepest water, depth approx. 3 m	Moderate	Surveyed by divers; substratum was coarse gravel
		Eastern shore, north of shoal, heavily vegetated; water depth approx. 1-2 m	Heavy	Surveyed by wading with viewer; substrata were fine sand and mud
		Otter midden, eastern shore	Heavy	Hundreds of shells above water-line (clay/mud); all but two shells were <i>E. complanata</i> , two shells were <i>Anodonta imbecilis</i>
2	Canary/Scott Island	Very shallow area, approx. water depth 0-1 m, most of effort spent around Scott Island	Sparse	Surveyed by wading/viewers and snorkeling; bottom sandy, probably a lot of boat disturbance in area
3	0.5 miles west of Elwell Island	Natural rocky substrata on southern shore, water depth over 10 m fairly close to shore	Moderate	Surveyed by wading/viewers, shore walks and SCUBA; considerable amounts of fluffy sediments on rocks; all mussels <i>E. complanata</i> ; generally the mussels were larger than those observed up-river
4	Elwell Island	Sampling primarily from east side of island, where water depths ranged from 0-2 m; backside of island stagnant with soft bottom and no mussels	Moderate	Surveyed by wading/viewers, shoreline walks and snorkeling; mussels very small, less than 2 cm in shell length, approx. 2-4 year olds; high energy waves (boat traffic) washing many of the mussels onto the beach
5	Shepherd Island	Western side of island stagnant with a soft bottom covered by floating, suspended and attached algae; eastern side much deeper, but many submerged trees; mussels surveyed on eastern side of river	Sparse	Surveyed by wading/viewers and snorkeling; shallow sandy substrata; high energy waves (boat traffic)
6	Mitch's Island	Entire perimeter of island surveyed, but mussel concentrations were highest at northeastern end of island	Moderate - Heavy	Surveyed by wading/viewers and snorkeling; shallow (0-2 m) sandy substrata; 100% <i>E. complanata</i> ; all sizes of mussels present; growth appeared good
7	Bachelor Brook	West side of river opposite brook mouth, water depth over 3	Moderate - Heavy	Surveyed by SCUBA; 100% <i>E. complanata</i> , coarse sandy substrata.

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on east side of river, mussels were not collected in the mouth of Bachelor Brook, which had a silty soft bottom and was heavily vegetated

*Relative abundance: sparse (< 1 mussels m²), moderate (1-50 mussels m²), and heavy (> 50 mussels m²)

TABLE 2. Transect descriptions and abundances of the eastern elliptio, *Elliptio complanata*, during the August 1995 yellow lampmussel survey of the Connecticut River over approximately one mile of river below the Holyoke Dam

TRANSECT	LOCATION DESCRIPTION	ABUNDANCE #/200 m ²	SHELL LENGTH Min-Max	COMMENTS
1	Starting south of tailrace for the Holyoke Dam on the western side of river, approximately 35 m from shore, running 100 m up river and ending in front of the #3 overflow of the third level canal	779	40-98 mm	Surveyed using SCUBA with general surveys of shore line and shallow areas by wading using viewers. 100% <i>E. complanata</i> , nearly half of the mussels collected along the transect were taken in the first 25 meters heading from south to north (from down river end), substrata fine sandy silt down river progressing to coarse gravel up river, some vegetation present
2	Starting approximately 40 m from western shore, east of the #3 overflow of the third level canal, running 100 m across the river, ending 50 m from the eastern shore	200	28-97 mm	Surveyed using SCUBA, only, 200 <i>E. complanata</i> and 1 <i>Anodontia implecata</i> (38 mm), substrata cobble and sand across entire river, current very strong at times, giving the divers problems with staying on the transect line
3	Starting at the Holyoke Dam Boat Ramp on the east side of river, running 100 m down river approximately 20 m from shore	73	N/A*	Surveyed using SCUBA, only, 100% <i>E. complanata</i> , identified by divers on bottom, substrata heavily vegetated (<i>Vallisneria</i> and <i>Potamogeton</i>)
4	Starting below Rt 116 Bridge and above the tail race, approximately 20 m off a sandy peninsula in the center of river, running 100 m down river	4	N/A	Surveyed using SCUBA, only, 100% <i>E. complanata</i> , identified by divers on bottom, a large section of coal tar observed
5	Starting on the eastern shore of river just below Rt 116 Bridge and approximately 300 m above the Holyoke Dam Ramp, running 100 m down river approximately 20 m off shore	4	70-71 mm	Surveyed using SCUBA, only, 4 <i>E. complanata</i> and 2 <i>A. implecata</i> (105 & 113 mm), identified by divers on bottom and brought to surface for measurement

*N/A—not applicable, because diver-identified *E. complanata* were not brought to surface for measurement

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APPENDIX D
MEETING NOTES RELEVANT TO T&E PLAN

MEETING NOTES SUMMARY

ATTENDEES: Paul Duchency-HG&E
Joe Clark-HG&E
John Warner-USFWS
Ben Rizzo-USFWS
Bob Stira-NGS
John O'Leary-MA EOE
Caleb Slater-MA Division of Fisheries & Wildlife
Don Pugh-Trout Unlimited
Charlie Olchowski-Trout Unlimited
Tom Miner-CT River Watershed Council
Fred Szufnarowski-Kleinschmidt Associates
Kelly Schaeffer-Kleinschmidt Associates
Dave Robinson-Kleinschmidt Associates
Randy Dorman-Kleinschmidt Associates
Chris Frese-Kleinschmidt Associates

DATE: December 19, 2001

LOCATION: Holyoke Gas and Electric, Holyoke, MA

PURPOSE

Review the results of the December 5, 2001 flow demonstration and discuss the following: 1) full-depth louvers; 2) proposed solution to sturgeon entering the upstream attraction water supply system; 3) T&E plan for tiger beetles and mussels; 4) need for the Alden weir and floating apparatus; 5) Alden phase 2 research; and 6) the January 2002 agency meeting.

SUMMARY

Introductory Comments

Paul Duchency opened the meeting and welcomed the participants. He announced that Holyoke closed the deal with Northeast Utilities on Thursday, December 13, 2001 at midnight.

Paul also mentioned that the rubber dam is in service and is working extremely well.

Paul concluded by reminding everyone that the City of Holyoke and Holyoke Gas and Electric Department are separate, distinct entities. Statements made by the City and political officials may not represent HG&E's position.

Discussions

1. John Warner asked about the transition of the project from HWP in terms of personnel who will operate the project.
 - Paul explained that he has a core staff that are experienced in the operations of the Holyoke project. Paul personally selected these individuals based on their qualifications and commitment to HG&E's operational philosophy.

2. Paul discussed the distribution of water through the canal system. With the integration of the HG&E and HWP units into the canal operations plan, water is now circulating through the entire 3-level canal system.
3. John O'Leary mentioned that Slim Shad Point is not accessible to persons with disabilities and would like to know when this facility will comply with the ADA. Paul said that this could be addressed as part of the CLRMP.
4. There will be an official consultation meeting on January 18, 2002. Specific dates and times were discussed. See Attachment A for a preliminary agenda and meeting details.

FLOW DEMONSTRATION

Fred summarized the December 5, 2001 flow demonstration and distributed draft-meeting notes for the agencies' review and comment. Final notes will be distributed prior to the January 18, 2002 consultation meeting. Overall, the flow demonstration accomplished its purpose. Some problems were incurred maintaining the position of the bascule gate. HG&E will correct these problems by upgrading the bascule gate operating system in the first quarter of 2002.

Remaining work includes: 1) installing a permanent staff gage as well as an electronic gage at the Texon building; 2) repeating the zone of passage (ZOP) flow demonstration after the upgrades to the bascule gate operating system are complete; 3) performing the ZOP flow demonstration using the West rubber dam section; 4) performing the habitat flow demonstration using the East rubber dam section and the attraction water gate/bascule gate; and 5) repeat the ZOP flow demonstration during the spring migration season.

John O'Leary asked how the rubber dam would operate during high water conditions. Dave presented an overview of the rubber dam operations (Attachment B). The agencies prefer that the bascule gate **not be operated first** during fish passage season.

With the rubber dam and new license conditions, the impoundment will be operated much differently than in the past. Paul asked for the agencies support in contacting property owners and upstream users concerning the new reservoir elevations and operations of the rubber dam. Tom Miner of the CT Watershed Council suggested that this issue be included in the next Channel Marking Committee meeting (January/February 2002). Tom offered to coordinate this effort.

FERC may require some sort of safety warning when the bladders of the rubber dam are about to deflate. Paul mentioned that HG&E would likely install surveillance cameras in the bypass reach.

FULL DEPTH LOUVERS

The existing half-depth louvers (10-ft panels in the 20-ft deep canal) are very effective guiding surface migrants downstream. The new license requires evaluating alternatives like full-depth louvers to guide sturgeon and eels migrating downstream in the canal. HG&E would like to explore accelerating the installation of the full-depth louvers to take advantage of the fact that contractors are not as busy during winter months and fabrication costs tend to be lower. Installing the full-depth louvers would also enable HG&E to simplify canal/project operations and also help expedite development of various compliance plans required by FERC.

Dave Robinson led a discussion concerning the following design parameters:

a. Bar Racks or Louvers

Bar racks are perpendicular to the axis of the structure and louvers are angled 15 degrees. Research by Alden suggests that bar racks are slightly more effective at guiding bottom migrants when using a bottom overlay. John Warner pointed out that the louvers are much more effective at guiding surface migrants. Given the benefits for surface migrants, the consensus was to use louvers and to expedite their installation.

b. Bottom Overlay/Skirt

Research by Alden suggests that the full-depth louvers are more effective at guiding bottom migrants when the bottom 30-cm (approximately 12 inches) is solid. Reducing the louver panel area may be counter-productive due to higher velocities across the louvers.

Another concern is scour under the lower panels. Dave inspected the canal during the fall outage and found areas upstream of the louvers filled in with sticks, debris and silt; while other areas have not filled in.

The following plan was developed to address the above concerns. For the downstream most 40-ft section of louvers, the entrance ramp should provide adequate protection for this area. All of the eleven 40-ft. bays have a 12" high steel tube below the bottom of the lower louver panel. For the second 40-ft section, install a closure panel on the upstream face of the louvers. Cover the bottom one to two feet between the steel tube and the canal bottom to protect against scour. The need for any further modifications will be addressed after effectiveness testing.

c. Evaluation

Studies will be required to evaluate the effectiveness of the louvers for both surface and bottom migrants under all flow conditions. The effectiveness of the partial-depth louvers has been evaluated under certain flow conditions. The agencies suggested that it might be possible to use this data for evaluating effectiveness if the flow patterns and velocities do not change with the full-depth louvers. As appropriate effectiveness may also be evaluated using mark and recapture techniques,

observations, and existing data and with new technologies (biotelemetry and x-vision). Further discussion on an appropriate evaluation measure is needed.

d. Trash Rake

Full-depth raking is essential for the full-depth louvers to be effective. A full-depth rake will be installed concurrent with the full-depth louvers.

e. Schedule

The window for installing the full-depth louvers and rake is before or after the upstream migration season. The canal must be kept in service during the migration season to provide attraction water. Dave checked with the preferred rake manufacturers and delivery before May (when the upstream season typically starts) will be difficult. Another factor affecting an expedited installation is the NMFS consultation. Due to the sale and transfer, communications with NMFS has been minimal and it is uncertain where the NMFS stands with the use of the louvers. Orders will have to be placed with fabricators in January 2002.

STURGEON AND UPSTREAM ATTRACTION WATER

The intake for the upstream attraction water supply is located at the bottom of the canal. At the Number 1 overflow, there are reports of sturgeon getting caught in the attraction water and being passed back into the river. Dave presented the proposed "Gooseneck" solution (Attachment C). The "Gooseneck" would effectively raise the attraction water intake to mid-canal depth. Ben Rizzo said the proposal would exceed the USFWS maximum velocity of 2 fps and require bar racks with 1-inch clear spacing. This effectively made the "Gooseneck" solution unworkable.

The agencies suggested exploring other alternatives including a surface intake (and evaluating whether or not surface species can survive the experience of going through the attraction water system) and exploring how to address the problem on the downstream end of the system. Dave agreed to look for other design alternatives and provide a status report at the January 2002 meeting.

ALDEN PHASE 2 RESEARCH

Dave presented the results of NU and HG&E's November 16, 2001 meeting with Alden Labs and will review and provide comments at the January 18, 2002 meeting. Another meeting with Alden will likely be required.

Don Pugh asked why the angled bar rack was not being considered for Phase 2. From Don's perspective, the objective is fish exclusion and not guidance. Other team members noted that there are several technical issues associated with bar racks, including impingement.

John O'Leary asked if we know how and where the sturgeon are moving. The agencies acknowledged that there is a huge information gap. John Warner said that we do not want to be in a rush to build something and then find out that it does not work.

Caleb Slater acknowledged that the schedule in the 401 Certificate does not provide adequate time for the additional studies. He said that at this point, it would be sufficient to demonstrate progress and maintain a consistent effort in addressing the downstream passage issue.

ALDEN WEIR APPARATUS

With the rubber dam in service, HG&E would like to remove the Alden weir and associated apparatus on a trial basis. Ben Rizzo said that the effectiveness of the Alden weir is known where as the rubber dam is unknown. Ben explained that the West rubber dam section is located further away from the Hadley Falls intake and he is concerned that the downstream migrants may not be able to find it. Alden has done a lot of research on this and Ben suggested that we contact them to get their thoughts on the proposal.

THREATENED AND ENDANGERED SPECIES (T&E) COMPLIANCE PLAN

HG&E is drafting a compliance plan for the T&E species with the exception of sturgeon and Atlantic salmon. To complete the draft, Chris Frese reviewed a list of talking points to get stakeholders input (Attachment D). The primary topics of the T&E plan will be mussels (in the canal), bald eagles, and the Puritan tiger beetle.

Bald Eagles

- Nesting platforms
- Preserving large white pines to accommodate natural nesting and perches
- Revisit buffer zone management – ensure appropriate set backs from river
- Protect known sites from disturbance, especially recreation
 - Couple of nests exist upstream (North) of the Oxbow
- Eagle count will take place over next couple of weeks – this might provide additional information on nesting and existing eagle population

Puritan Tiger Beetle-Rainbow Beach

- Enhancement-ROR-minimize fluctuations
- USFWS, MDFW and MDEP have developed an education program at Rainbow Beach
- Additional signage
- Fence off habitat
- Buoys and signs
- Mooring area or boat dock to limit people going ashore
- Puritan tiger beetles have also been found North of Rainbow Beach
 - Erosion, including sloughing banks may be a problem – need to identify and examine these other areas as well as alternatives to protect them
- Additional beetle surveys are scheduled this year
 - National Heritage might be taking the lead on those surveys. John O’Leary will find a contact (or an organizer)
- Susan Vonoeppi is the USFWS contact for Puritan tiger beetles

Mussels

The presence of one federally listed endangered species (dwarf wedge mussel) has been confirmed in the Connecticut River. The yellowlamp mussel is listed as a federal category 2, but currently has no formal listing status. The yellow lampmussel, which is a state-endangered species, has been known to exist in the 2nd level canal.

John Warner would like to expand mussel habitat in the canal to the extent practical and try to minimize drawdowns and associated operational impacts. This includes decreasing human contact on the mussels and no equipment on mussel beds.

The agencies said there was not enough water in the habitat areas of the canal during the 2001 drawdown. They noted that the water levels maintained during the fall 2000 drawdown were much better. In general, the leakage flows are doing a good job preventing stagnation. Weirs or some other means are needed to form pools in the habitat areas and facilitate more water in the 2nd level canal. The pools may have to be staggered to accommodate the slope of the canal invert. As far as pool depth, Don Pugh offered two criteria: 1) protect the mussels from predation, and 2) avoid overstressing.

The (permanent) compliance plan for canal drawdown was due in October 2001. Due to the sale and license transfer, the schedule for completing the compliance plan is July 15, 2002. HG&E will perform a qualitative assessment of the above issues and review this with all parties before the spring outage so that during the spring 2002 outage, the mussels are protected. This should enable completion of a final canal drawdown plan prior the to the 2002 fall drawdown.

John Warner suggested that we involve Tom French of National Heritage. John will also discuss the T&E plan with Susan Vonocppi (USFWS). Caleb recommended that we contact Marlene Curran to get MA DEM input.

Before proceeding any further with T&E plan development, the agencies will provide their comments regarding bald eagles, puritan tiger beetles, and mussels.

CONSULTATION MEETING

The next stakeholder consultation meeting will be held on Friday, January 18, 2002 at 9:30 a.m. at 1 Canal Street in Holyoke, MA. The following draft agenda has been developed.

1. Stakeholder input on additional compliance plans. HG&E will develop a list of talking points/outline for the plans.
2. Discuss the scope of the Alden Phase 2 research effort. Agencies will provide their comments to the November 16, 2001 ARL meeting notes.
3. Discuss ADA angler access to Slim Shad Point.
4. Coordination of pond levels/rubber dam operations with marina owners. Tom Miner will take the lead on scheduling a meeting.

Holyoke Meeting Notes

December 19, 2001 _____ 7.

5. HG&E will review the water quality certificate and develop a draft schedule for the remaining compliance plans.
6. Discuss the functional design drawing.

A follow-up consultation meeting has been tentatively scheduled for April 3, 2002.

MEETING NOTES SUMMARY

- ATTENDEES:**
- Paul Ducheny-HG&E
 - Ben Rizzo-USFWS
 - John Warner-USFWS
 - Caleb Slater-MDFW
 - Bob Stira-Northeast Generation Services
 - Joe Clark-HG&E
 - Tom Miner-CRWC
 - Bob Kubit-MADEP
 - John O'Leary-MAEOEA
 - Jen Anderson-NMFS
 - Carrie McDaniel-NMFS
 - Don Pugh-Trout Unlimited
 - Fred Szufnarowski-Kleinschmidt
 - Dave Robinson-Kleinschmidt
 - Kelly Schaeffer-Kleinschmidt
 - Randy Dorman-Kleinschmidt
 - Chris Frese-Kleinschmidt
 - Susan Board-Kleinschmidt

DATE: February 7, 2002

LOCATION: Holiday Inn, Holyoke, MA

PURPOSE

Team meeting to discuss progress and receive agency input on compliance plans.

SUMMARY

- I. Spring Flow Demonstration. Overall, the agencies expressed satisfaction with the results of the December flow demonstration, and reiterated their desire to see the bypassed reach during the spring fish run. Caleb Slater noted that he also wanted to see flows discharged from points other than the bascule gate, including ZOP flows using rubber dam section 5 (Holyoke Side), the modified bascule gate and possibly rubber dam section 1 (South Hadley Side) and the bascule gate or rubber dam section 5. Caleb also wanted to see habitat flows using rubber dam section 1. Kleinschmidt will provide a summary table showing how the bascule gate and rubber dam sections will be operated to achieve these target flows.

John Warner questioned the 0.13' shortfall on zone of passage (ZOP) flows, and asked how HG&E would operate the project during the spring run, without having first verified the specific gate settings that will produce the target ZOP water surface elevations. The team discussed the possibility of scheduling another flow demonstration before the spring run begins, and Kleinschmidt will investigate this possibility. One limiting factor is that the demonstration would have to occur after the bascule gate upgrade, which is scheduled for the middle two weeks of March.

As part of a discussion on reconciling the FERC license order with other mandatory conditioning documents, the group felt that focusing the discussion on water surface elevations, rather than cfs values, would be the best way to verify compliance to the satisfaction of all parties.

2. Alden Weir. David Robinson summarized the discussions held at the December meeting on the weir, and described the results of his investigation into the possibility of not replacing the weir this spring. HG&E believes that the weir is currently in disrepair, provides uncertain benefits, and is ultimately an interim measure. HG&E is also concerned that the weir interferes with upstream attraction water.

However, neither USFWS nor MADFW were receptive to removing the weir, particularly given the uncertain timeline for implementing permanent solutions. Despite any possible shortcomings, the effectiveness of the weir is a known quantity and, in the absence of modeling data, should be considered the default option. After further discussion, three possibilities were considered: (1) repair and install the weir, (2) perform effectiveness testing without the weir, and (3) keep the weir but remove the pier extension.

3. Full Depth Louvers. Louvers will be installed in fall 2002, to be followed by an inspection during the spring 2003 outage to ensure that erosion is not creating a gap beneath the bottom of the louvers. The louvers would have the same clear spacing as the partial-depth (2 in.) Flow patterns will be evaluated to see if existing tests from partial depth louvers can be reused. USFWS suggested participating in a field inspection of the substrate and topography under the louver array during the spring canal drawdown, to assess if a gap exists below the lowermost structural member and bottom of canal.

4. Fishway Attraction Water Intake (Goosneck 2). David Robinson provided a description of the revised designs, which have been reviewed by Ben Rizzo. The new design for the intake structure limits surface velocities at 2 fps or less. The agencies approved the design and asked that it be submitted in writing for formal approval.

5. FERC Process. Kelly Schaeffer provided an overview of the upcoming relicensing of the Number 4 Hydro Project (FERC No. 7758). Number 4 is a canal project owned by HG&E; a notice of intent (NOI) will be filed by the end of February. HG&E also owns three other canal units, each of which has a separate FERC license. HG&E is proposing to relicense all four stations as a single FERC project. The agencies appeared generally receptive to this idea.

6. Mandatory Conditioning and Fishway Prescriptions. Kleinschmidt provided an updated matrix of fishway prescriptions, which details parallel conditions between the license order, 401 certificate, NMFS Section 18 prescription, and USFWS Section 18.

The group worked through the matrix, identifying any issues that contain inconsistent or contradictory prescriptions. In general, most conditions were in agreement, and the few exceptions could usually be reconciled due to qualifying language in the prescriptions. Only a few items appeared to be fundamentally in conflict.

The group then discussed how to most effectively reconcile the conditioning documents. The goal as described by Kelly Schaeffer would be for the group to provide FERC with a unified group of prescriptions that (a) everyone agrees to, and (b) could be incorporated into the license. Possible options ranged from reopening the original prescription documents, to issuing addendums, to submitting to FERC a document outlining unified prescriptions. MADEP, USFWS, and NMFS all expressed reluctance over reopening their prescription documents. Both John Warner and Carrie McDaniels agreed to consult with legal counsel for their respective agencies, in order to determine how best to proceed and have an answer by February 21, 2002.

7. Canal Drawdown. Caleb Slater will provide pictures of the 2000 drawdown, when the No. 1 overflow was closed and water levels in the canals were higher. Don Pugh is interested in examining mussel habitats in the entire canal system, including whatever can be found of the yellow lampmussel in the substrate. All agree that mussel experts should be involved, and the 2000 drawdown plan should be repeated. An interim plan will be filed before the spring drawdown.
8. Operating Plans. Dave Robinson reviewed a graph showing trip points set by the manufacturer with the rubber dam. The elevations will likely be revised based on actual operating experience. A table summarizing the dispatch of canal units was also circulated and discussed.
9. Threatened and Endangered Species. Chris Frese is going to contact the T&E specialists from USFWS and MADFW. Sturgeon are being addressed in the passage plans and after further evaluation, they will be included in the T&E plan as well. A draft plan will be submitted in April.
10. CRLMP. Kelly Schaeffer detailed HG&E's ongoing efforts to revise the CRLMP. Several outstanding issues remain unresolved, including about 160 acres of Bachelor Brook and Stony Brook that are still HWP land, with conservation restrictions on about 30 acres. NU did not include these parcels in the sale of the project, and has valued the property at approximately one million dollars. Plans will be put together regarding Slim Shad Point and circulated among the agencies. The final issue discussed concerned the large number of rental properties on the project impoundment. HG&E is pursuing options to address these properties.

HG&E has formally requested FERC to hold in abeyance the plan submitted by HWP, an action mirroring a request made by CRWC and several other stakeholders. A final CRLMP will be filed by Dec. 31, 2002.

HG&E Meeting Notes
February 7, 2002

11. ARI Phase 2 Research. The group decided to proceed with ARI's recommendations for the Phase 2 research program, and to schedule a team meeting after initial results were in.
12. Upstream Fish Passage. David Robinson presented a proposed schedule for completion of upstream fish passage, using two construction seasons. 2002 work is concentrated on functional design drawings, and construction will occur in the 2003 and 2004 fall seasons. An updated schedule showing how fish will be lifted in spring 2004 will be provided. Attempts will be made to minimize interruption during the fall seasons, and the feasibility of trapping during the fall season will be investigated. The conceptual design and preliminary drawings will be reviewed with resource agencies. John Warner emphasized the need to plan construction activities to ensure passage during the spring 2004 season.
13. Accepted FERC Plans. Kelly Schaeffer reviewed the five plans that have already been accepted by FERC including invasive species, water quality monitoring, shoreline erosion, and low flow contingency. All of the team members were content with the plans as submitted.
14. HG&E. Action Items will be summarized and prioritized, and smaller working groups will be formed. The next meeting is scheduled for April 3, 2002.

MEETING NOTES SUMMARY

ATTENDEES: Paul Ducheny-HG&E
 Ben Rizzo-USFWS
 John Warner-USFWS
 Caleb Slater-MDFW
 Bob Stira-NGS
 Chris Tomichuk-HG&E
 Joe Clark-HG&E
 Tom Miner-CRWC
 John O'Leary-MAEOEA
 Jen Anderson-NMFS
 Don Pugh-Trout Unlimited
 Fred Szufnarowski-Kleinschmidt
 Dave Robinson-Kleinschmidt
 Randy Dorman-Kleinschmidt
 Chris Frese-Kleinschmidt
 Susan Board-Kleinschmidt

DATE: April 3, 2002

LOCATION: HG&E, One Canal St., Holyoke, MA

PURPOSE

Aquatics and Fisheries Team meeting to discuss progress and receive agency input on compliance plans.

SUMMARY

1. The revised February 7, 2002 meeting notes were reviewed and accepted.
2. Spring Canal Drawdown: Chris Frese reviewed the procedures that were followed to maintain watered conditions in the canal during the March 26-27, 2002 drawdown. The agencies agreed that conditions in the second level canal between Boatlock and Riverside Stations were much improved over the fall of 2001 and to their liking. John Warner suggested closing the No. 1 overflow as soon as work at Boatlock Station and full-depth louvers is complete. A suggestion was also made that the No. 2 overflow be inspected at the end of the spring outage, and that HG&E investigate keeping No. 3 overflow closed as much as possible. Comments were made regarding the full depth louvers, suggesting that they may reduce debris loading into the canal, which may reduce cleaning requirements and the amount of vehicular traffic in the canal.

Paul Ducheny noted that HG&E had received several complaints about the drawdown from owners of other canal projects, who could not get into their units during the drawdown to perform maintenance as expected. HG&E will notify affected customers of the modified procedures so appropriate steps can be undertaken.

Concerning future drawdowns the following suggestions were offered:

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- To meet FERC inspection requirements the No. 2 overflow needs to be inspected once each year. The inspection should be the last maintenance activity undertaken during the spring drawdown.
 - Following the March 26 mussel survey several individuals visited additional sections of the canal, and noted that the upper portion of the second level canal is sloped toward the No. 3 overflow. HG&E will investigate keeping the No. 3 overflow closed during canal drainage procedures, which should allow water to pond in the upper portion of the second level canal.
 - Although unknown at this time comments were made regarding the full depth louvers, suggesting that they may reduce both debris loading and equipment traffic between Boatlock station, the lover structure and the railroad bridge.
3. Canal Minimum Flow Plan: A draft plan was distributed for review and comment. The new license and water quality certificate require a continuous minimum release of 400 cfs into the canal. To verify compliance the water must be passed through turbines. The plan proposed by HG&E takes into account headgate openings and existing leakage to achieve the required 400 cfs minimum flow.

HG&E estimates leakage to be on the order of 400 cfs, +/- 100cfs. This is significant because the priority of dispatch requires that the first 400 cfs of river flow be released into the canal. This means that during low flow conditions up to 900 cfs (400 cfs through generation + up to 500 cfs leakage) is dispatched into the canal before any water is released into the bypass reach.

Overall, the agencies expressed approval, however the suggestion was made to measure flows and velocities at various locations to confirm that water is moving through the three levels of the canals. HG&E will draft a plan that identifies the proposed locations of the velocity measurements and the method to be used. Based on measurements, operation tables may be modified to account for leakage.

4. Canal Operations Plan: Items 2 and 3 listed above will be compiled into a comprehensive canal operations plan that will be submitted to the agencies for review and comment. The plan is due at FERC on July 15, 2002.
5. ARL Phase 2 Research: The agencies agreed that modeling and analyzing the existing situation (*i.e.* Alden weir in place) does not need to occur. The meeting at Alden Labs for presentation of the initial research results will take place in late June or early July.
6. Sturgeon Exclusion: USFWS has reviewed and approved the conceptual design plan of the proposed exclusion structure at the No. 1 overflow and attraction water. NMFS also reviewed and approved the design and will send an official letter indicating their concurrence with the conceptual plan. Installation of the device is scheduled to occur during the 2002 fall canal drawdown.

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7. Full Depth Louvers and Rake: The louvers were inspected during the spring drawdown, and some gaps were found between the bottommost member and the substrate at the upstream and downstream ends. The gaps will be filled during installation of the full depth louvers. USFWS and NMFS reviewed and approved the conceptual design plans, and NMFS will send an official letter. The installation is currently scheduled for the fall dewatering (October 19 through 26 2002). Critical path is delivery of the full depth rake is expected to take 6 months.
8. Bascule Gate Upgrade: A 2-day outage is necessary for installation, and will be scheduled for the end of the spring fish passage season.
9. Water Quality Report: The water quality report that was submitted to FERC and MDEP on April 1, 2002 was distributed. The temperature spike at noon on Day 4 of the constant monitor results monitored at the Project's intake, tailrace, and bypass (Table 2, Figure 1) was noted.
10. Invasive Species Report: A draft of the 2001 invasive species monitoring report was distributed, and HG&E reconfirmed that they will continue monitoring as has been done in the past. Monitoring will be discussed further at the annual meeting between HG&E, the Massachusetts Executive Office of Environmental Affairs (John O'Leary), and Conte Refuge staff.
11. April Flow Demonstration: The flow demonstration is scheduled for April 12, 2002 at 9:30 a.m. at Hadley Falls, river flows permitting. If the river flows are less than 28,000 cfs, we will observe Bascule gate and rubber dam #5 releases for interference with attraction water flows. If the river flows are less than 16,000 cfs, we will also observe ZOP flows in the bypass for the following three scenarios: 1) Bascule gate and attraction water flows; 2) Bascule gate, attraction water flows and rubber dam section #5; and 3) rubber dam sections no.1 and 5. Until the spring flow demo is completed, the -0.15 ft reading on the Texon building staff gauge will be used for ZOP flows. Approach patterns at the Alden weir will be observed without the pier wall extension in place.
12. Comprehensive Operations and Flow Plan: A draft of the plan was distributed. Potential issues discussed included false attraction and apron surfing of fish under certain rubber dam operating scenarios. The agencies agreed to HG&E acquiring rubber dam operating experience and observing upstream fish passage under a variety of conditions. Site visits were scheduled for May 14, 21, 29, and June 4, 2002 to check for these conditions. In addition, the agencies suggested having Gene Lavoie and the fishway counting staff check the bypass reach and spillway apron for these conditions and note them on a standardized form. Based on this information, the plan for rubber dam releases may be changed to improve fish passage. Comments on the plan are due on April 17, 2002.
13. Fishlift Operations (Readiness): The louvers, the tailrace lift, and the ARI weir are ready for the fish passage season. The spillway lift is ready except for the hoist cable,

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which is being replaced, as soon as possible, by HG&E. Paul Ducheny will investigate the feasibility of using the spillway lift until the cable is replaced.

14. Access, Security, and Safety: The protocol for site access was distributed and the agencies agreed that safety is a priority. Agencies will contribute names to form a standard list for access.
15. Fishway Operating Guidelines: The agencies received draft plans for review and comment. Two phone numbers were listed incorrectly, and are being changed. Caleb Slater requested that HG&E provide him with a list of potential fishway employees, which would afford MADFW the opportunity to screen potential applicants. HG&E also indicated that since the counting activities occur under the direction of MADFW that Caleb Slater or his designee should review operating and safety procedures with the seasonal fishway employees at the beginning of the spring passage season.
16. Evaluation of Tailrace modifications: A draft plan was distributed for comment. From a historical perspective Caleb Slater indicated that the entrance in the collection gallery located at Unit 2 was not working when Unit 2 was operating and Unit 1 was shut down. He suggested specifically testing the entrance with Unit 2 running and Unit 1 shut down. He also indicated random observations should focus on daily periods of peak shad activity (11 AM to 4 PM) during the peak of the passage season (10 May to 31 May) John O'Leary suggested using Gene Lavoie to observe the modifications' effectiveness. Videotapes of fish using various entrances will be viewed by seasonal fishway employees as time permits.
17. T&E: The eagles and mussels can be drafted into the compliance plan at this time. The sturgeon issue cannot be addressed until unified fish prescriptions are developed and FERC accepts the BO. In addition, the tiger beetles need to be addressed first in the CRLMP, followed by the T&E plan. An extension of time request is going to be submitted to FERC for the T&E plan. However, during the extension period, HG&E will continue to work on mussel and tiger beetle issues with the appropriate agency staff.

T&E Follow-up Subsequent to the meeting HG&E learned that the FERC will accept a compliance plan that includes further research and development on shortnose sturgeon. HG&E will prepare a 4-section plan covering the tiger beetles, eagles, mussels and sturgeon. The first three sections will be complete. For the fourth section we will develop the sturgeon part as much as possible and then file the plan. We'll amend section four as necessary as more information is developed on the sturgeon.

DRAFT
MEETING NOTES SUMMARY

ATTENDEES: Paul Duchenev-HG&E
John Warner-USFWS
Caleb Slater-MDFW
Chris Tomichck
Joe Clark-HG&E
Tom Miner-CRWC
John O'Leary-MAEEOEA
Jen Anderson-NMFS
Don Pugh-Trout Unlimited
Fred Szufnarowski-Kleinschmidt
Dave Robinson-Kleinschmidt
Kelly Schaeffer-Kleinschmidt
Susan Board-Kleinschmidt

DATE: June 14, 2002

LOCATION: HG&E, One Canal St., Holyoke, MA

PURPOSE

Team meeting to receive agency input on Project Operations, Canal Operations, and T&E compliance plans.

SUMMARY

1. The April 3, 2002 meeting notes were reviewed. The discussion regarding removal of debris in front of Boatlock Station needs to be added (page 2, item 4).
2. Status Updates
 - a) Full Depth Louvers: The structural steel contract is going out to bid in the next couple of weeks to install the louvers during the October drawdown. The same RFP is also being distributed for the sturgeon exclusion structure at the attraction water intake. The full depth rake will also be installed after the drawdown as soon as it is received. Until then, the top panels of the racks will be cleaned by hand.
 - b) Eel Passage: Dave Robinson is working on the conceptals with Alex Haro of The Conte Lab and will report back to agencies within the next couple of weeks. Installation is scheduled for 2003. The possibility of conducting sampling and determining lift efficiency was discussed.
 - c) Bascule Gate Upgrades: There will be a 1-2 day outage in July or August to conduct the work.
 - d) Alden Phase 2 Research: Initial modeling is well underway and is about 75% completed. A meeting will be held during the week of August 12 to discuss findings.

- e) Functional Design Drawing: The drawing currently consists of 6 sheets that are about 50% completed. There will be a dewatering this summer to survey and photograph the area to finalize the drawing. A construction plan and schedule will be submitted to FERC in December 2002.
 - f) Hadley Falls Unit 2 Entrance: HG&E will clean, restore, and relocate the V gate closer to Unit 1 during the dewatering. The gate will be modified for full travel. The above work will be completed in time for the 2003 season. Preliminary indications are that the modifications to the west side entrance have improved effectiveness. The geometry of the structure will be evaluated to determine what modifications can be made to make it operate more like the east side entrance.
 - g) ZOP Flows in Bypass: The Flow Demo notes were distributed. The wording of Item 3 will be revised to read "close Bascule Gate for 45-60 minutes several times a day." The obstruction to upstream fish passage on the Holyoke channel will be investigated when the Habitat Flow Demo is performed during the week of August 12. Kleinschmidt will distribute a draft report of the May flow demonstration for review and comment. As noted in the flow demonstration notes, HG&E believes that Scenario 1 is more conducive to fish passage. For the immediate future however, they will operate the project for ZOP flows according to Scenario 2 (a reading of $-0.05' \pm 0.1'$ on the Texon gage).
3. Comments to the Comprehensive Operation and Flow Plan
- a) incorporate results of 5/29/02 flow demo
 - b) Figure 1-1 should number the rubber dam sections
 - c) Separate Parsons and Aubin
 - d) Table 2-1-Priority 5 should read "to Unit 1 capacity"
 - e) Table 2-1-Priority 7 should read "Hadley Falls 2 to capacity"
 - f) Incorporate canal leakage into meeting the canal minimum flow
 - g) Page 15: update target WSELs and staff gage
 - h) Page 16-18: develop standard consistent language for notifications—use 401 language
 - i) John Warner shared his experience with automatic data collection and emphasized that the data needs to be QC'd.
4. Comments to the Threatened and Endangered Species Protection Plan
- a) Detailed comments from the USFWS will be provided by Mike Amaral on the bald eagles, and Susi von Oettingen on the mussels and tiger beetles. They will review the plan and send comments via mail.
 - b) Experts within the MDFW would like to submit comments as well. A meeting with state and federal experts will be arranged.
 - c) Bald Eagles: Don Pugh would like the plan to address protection and enhancement of perching and feeding trees per the FERC license.
 - d) Tiger Beetles: HG&E to meet with state and federal scientists
 - i. HG&E to come up with a position on signage—either it used to educate or avoided because of potential vandalism
 - ii. A pond level recorder will be added at Rainbow Beach
 - iii. FERC never initiated consultation. If an agreement cannot be reached, USFWS will request formal consultation

- e) Shortnose Sturgeon: The working group is being reactivated
 - i. a meeting will be held in the beginning of August
 - ii. language will be added to the plan that the licensee will implement findings of the working group
 - iii. language will also be added to the plan that NMFS will have technical oversight and provide overall direction. HG&E will facilitate the group.
 - iv. John O'Leary suggested adding more detail on the working group, such as a schedule and periodic updates
 - v. Jen Anderson would also like to see more detail on the working group in the plan

- 5. Comments to the Comprehensive Canal Operations Plan
 - a) HG&E will make the Canal Operations Plan consistent with the Project Operations Plan
 - b) Elevation in introduction is local datum, it needs to be changed to NGVD
 - c) Page 9: include fall passage
 - d) Pages 9 and 10: maximum canal capacity is listed as both 6590 and 6000 cfs. Change all to 6000 cfs
 - e) Page 14: using leakage to meet minimum flows will not be approved until a study is conducted demonstrating adequate flow distribution and water quality
 - f) Plan will state that HG&E will develop a field study plan to verify flow distribution with the agencies
 - g) John Warner expressed his concern about leakage of habitat water over the duration of larger outages. Suggestions include:
 - i. feeding more water through the headgates
 - ii. raising the sill at the Riverside intake
 - iii. expediting work on the first level canal and refill as soon as possible
 - h) Agencies were happy with the drawdown procedure that took place in March, but the plan needs to reflect that. The plan will be modified to reflect that the No. 3 overflow will be closed until the last day of the outage. As noted above (item 5.g), the leakage issue was questioned for the longer fall outage
 - i) Page 15: The plan needs to explain why it is not practical to build a weir to backwater the habitat in the first level canal. Survey data should be included in this. Don Pugh would like to see the first 1200-1400 ft of the first level canal watered
 - j) Page 16: The plan needs to specify which species will be relocated (just state listed). If mussels are moved, it should not be done during the spring, suitable habitat should be chosen, and the population should be monitored to evaluate survival
 - k) Page 17: Add "No. 2 Overflow stays closed." This will water the first level canal as soon as possible
 - l) Page 18: Item 8 should describe how mussels will be identified
 - m) Page 18: There are no Atlantic Spike mussels in the CT River
 - n) Page 18, Section 4, 2nd paragraph: According to the FERC license, the objective is to enhance/expand the habitat
 - o) Page 19: The license calls for annual monitoring for 6 years. USFWS believes it is better to monitor over a longer period time every 2 or 3 years

HG&F Meeting Notes
June 14, 2002

4.

- p) John Warner believes there should be a more specific study plan and/or more details should be provided
- q) Section 13d of the 401 WQC calls for an explanation of the need and frequency of drawdowns. This should be included in the plan
- r) Article 409 of the FERC license calls for minimum canal flows during leakage. All agreed that this is not possible and the license article will have to be revised.

6. Wrap-Up

- a) The tiger beetle meeting will be scheduled
- b) The mussel meeting is scheduled for June 27, 2002
- c) Some of the compliance plans cannot be completed at this time and will contain sub study plans to address information that will become available in the future. Sub study plans- -mention that we will commit to develop details
- d) Schedule a kick-off meeting for SNS working group
- e) ARL Phase 2 meeting is scheduled for August 13-15, 2002
- f) The bypass flow demonstration and investigation of channel modifications will be scheduled for August 13-15, 2002

MEETING NOTES SUMMARY

ATTENDEES: Pat Huckery-NHESP/DFW
Don Pugh-TU
John Warner-USFWS
John O'Leary-EOEA
Chris Tomichek-HG&E
Chris Frese-Kleinschmidt Associates
Susan Board-Kleinschmidt Associates

DATE: June 27, 2002

LOCATION: Holyoke, MA

PURPOSE

To discuss comments to the Threatened and Endangered Species Protection Plan and discuss measures to effectively protect and enhance species identified.

SUMMARY

1. Mussels

- a) An experimental weir will be built at the end of the first level canal. Its purpose is to pool water during future drawdowns.
 - The weir will be made of sandbags, since an engineering analysis of stop logs and other construction materials was determined not to be feasible due to silt deposition in the Canal
 - Agency members would like to see a weir constructed that ponds water in the first level canal up to the first intake (Aubin) which is located approximately 750 ft up the first level canal from the railroad bridge located at the head of this canal. To pond water in the first level back to the Aubin intake, a four foot weir needs to be constructed (see attached table). Although agency members indicated that they would like the weir to pond four feet of water it was understood that final weir design would be based on results of further engineering and operational analysis. It was also understood that the weir may not pond water as desired.
 - The experimental weir has the potential to change sediment deposition and/or the distribution of mussels in the first level canal and/or the second level canal in the immediate vicinity of the weir. As a result a plan will need to be developed to access the affects of the weir.
 - The plan will be include a monitoring program to access effects on the mussel population, and sediment build up or erosion including the effects of water velocity. It is anticipated that monitoring will be conducted on both sides of the weir.

- During the fall 2002 drawdown, the weir will be installed and monitoring sites and/or transects will be identified by members of the mussel team

b) Canal Drawdown Procedure

- Except for this fall, the headgates at No. 3 overflow will be closed
- New bullet should be added stating that the No. 2 overflow remains closed throughout the fall drawdown (Note: once gate has been tested during spring drawdown no need to open during fall drawdown unless required to facilitate maintenance activities)
- Since the water continued to drain from the canals during the March 2002 drawdown, the agencies agree that the No. 1 overflow needs to be opened first. Once maintenance activities have been conducted, such as examining the louvers, debris removal, and scheduled maintenance activities, the overflow should be closed, allowing water back into the second level canal as soon as possible
- Although the license order states that minimum flows must be maintained, all agreed this was impossible but would like language in the plan indicating that a feasible attempt will be made to keep some water flowing during drawdowns in the three canals around scheduled maintenance activities.
- Include that heavy machinery will only be added when necessary

c) Canal Monitoring

- Agencies reinforced that the plan should mention monitoring mussels every 2-3 years for 12 years
- agencies would like the plan to include a monitoring schedule
- the schedule can say "amended as operation continues"
- During the fall drawdown, transects will be sited in the first and second level canals. Transect selection will meet the requirements of "adaptive cluster sampling" which will allow the plan to meet multiple objectives including: 1) identification of rare mussels and 2) density determinations of resident mussels.
- transects will not be placed every 100 feet, placement needs to be based on where mussels are concentrated
- HG&E should hire someone (names of several grad students were mentioned) to assist with transect placement as well as conduct the survey
- Most transects should be located in the first level canal, however there are two areas in the second level canal where transects should be located (in pooled area near discharge of Boatlock station and near the entrance to Riverside Station)
- Include a map in the plan showing where the transects used to be and where the proposed transects will be located
- Agencies would like to see more in the plan discussing the necessity and frequency of drawdowns

d) River Monitoring

- Mussels sampling in the river should be conducted differently than in the past
 1. In the past, divers would bring up mussels from the river bottom to be identified
 2. Divers should instead be trained to look for glochodia when mussels are displaying. Rare mussels and common mussels display differently
 3. Transects should be set up to look for species, then when rare mussels are found, conduct cluster surveys

Last report on river survey should be added as an appendix
Note: Add details and specifics to Plan when possible. When plan is not specific, explain why.

2. Puritan Tiger Beetles

- a) Overall, the tiger beetle portion of the plan needs more specifics and more integration between plans is necessary. For instance, the invasives species plan, shoreline plan, and land management plan should be cross-referenced with the T&E
- b) Vegetation management is a good idea, but if too much is cleared, especially on Rainbow Beach, invasives will grow
- c) HG&E must send a proposal to the Dept. of Environmental Law Enforcement saying they want to set up a no-wake zone at Rainbow Beach
- d) Cove Island would be a great place to transplant tiger beetles. If the island becomes available for public recreation, the city should first set up protected areas where no trespassing is allowed. Therefore, the public will not have beach area "taken away" from them as on Rainbow Beach

3. Discussion of Puritan Tiger Beetles with Susi von Oettingen (June 28, 2002)

- a) Even though the CRIIMP is not completed, the plans should still mention protective measures that each is going to take
- b) When HG&E offers help with research, she would like to see something more consistent. The USFWS needs to know that if they need help, they will be able to call someone and get it
- c) HG&E needs to be a full-fledged partner in helping to save the beetles
- d) A cooperative agreement with the state should be established to help put up signs, buoys, channel markers, and post speed limits
- e) A number 1 priority is public outreach –flyers should be distributed at the marinas and public launches
 - Flyers will tell people to start using Mitch's Island as a rec site
 - Warn public to avoid protected areas
 - Material will put HG&E, USFWS, and possibly the state, CRWC, and TU as partners in trying to protect habitat
- f) An interpretive display would be helpful at the bike path

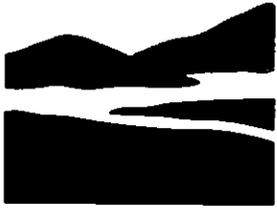
Holyoke Meeting Notes
June 27, 2002

- g) The boat trip for invasive species needs to be scheduled for early August, and it will become a tiger beetle habitat search as well

APPENDIX E

SCHEDULE

APPENDIX F
STAKEHOLDER COMMENTS



CONNECTICUT RIVER WATERSHED COUNCIL

Protecting the Connecticut River Since 1952

15 Bank Row, Greenfield, MA 01301

June 7, 2002

Fred Szufnarowski
Project Manager
Kleinschmidt
PO Box 1050
Deep River, CT 06417

Re: Holyoke Project (FERC No. 2004)
LA 416: Threatened and Endangered Species Plan

Dear Fred:

I have reviewed the May 2002 draft "Threatened and Endangered Species Protection Plan" (the Plan) and have a number of comments on Sections 2 and 3 dealing with, respectively, American bald eagle and Puritan tiger beetle protection. I am concerned that the Plan articulates little in the way of substantive effort by HG&E to protect these important species as required by Article 416.

Introduction

In the list of attendees at the December 19, 2001 stakeholder meeting, the Plan lists the Conte Refuge; however, the meeting notes (Appendix C) do not indicate that anyone from the Refuge attended, nor do I recall anyone present. (Also, the full name of the Refuge is the Silvio O. Conte National Fish & Wildlife Refuge - the Plan left out "Fish.") To my knowledge, all consultation with the Refuge has been conducted separately from the cooperative stakeholder process.

Section 2 - American Bald Eagle

The only measure proposed by the Plan to protect and enhance bald eagle habitat is for HG&E to provide an unspecified number of nesting platforms in safeguarded areas (safeguarded area described as currently protected areas or an area with open space easements). The Plan proposes a schedule for action a year from now. These actions are characterized as a "proactive approach."

CRWC finds the Plan to be seriously deficient, and hardly proactive. It provides no information about the bald eagle population in the project area, nor any assessment of existing and potential habitat. More important, the Plan includes no measures to protect bald eagle habitat as required by Article 416.

To remedy these deficiencies, CRWC believes the Plan should include a map of the project area that identifies existing and potential nesting, perching and feeding sites. Further, it should detail what actions HG&E will take immediately and over the life of the license to protect primary sites and the buffer they require. An effective plan will require a commitment of funds to acquire easements, or fee interest if appropriate, to protect bald eagle habitat.

CRWC sees no reason why HG&E cannot initiate the nesting platform measures described in Section 2.1 this year. Monitoring (Section 2.2) should be carried out in consultation and partnership with MDFW and USFWS and include nesting, perching and feeding sites. The Plan should indicate that monitoring will occur over the life of the license, not just for the first five years. The entire Plan should be reviewed in consultation with MDFW and USFWS and updated as needed at least every ten years.

Section 3 - Puritan Tiger Beetle

The Plan should include a map of existing and potential Puritan tiger beetle habitat in the project area and a detailed map of Rainbow Beach (which is located in Northampton, not Easthampton).

The Plan lists five principal threats to the globally significant Puritan tiger beetle in the project area -- hydraulic changes caused by dams, reduced beach habitat, reduced bank erosion stabilization, pollution, recreational use of the Connecticut River, and encroachment of woody plants into the beetle's primary habitat. While the change of project operation to run-of-river addresses the first threat, the Plan itself does little to address the other threats. Providing educational brochures and a display at the Barrett fish viewing facility, which is open only six weeks a year, and consulting with MDEM about a no-wake zone cannot be considered a commitment to cooperate with state and federal agencies to educate the public and police recreational activities as required by Article 416.

We believe the Plan should identify all existing and potential Puritan tiger beetle habitat in the project area and present a plan of action by HG&E for their protection. (While this is beyond educating and policing the public, it is fully within the scope of Article 418, the Comprehensive Recreation and Land Management Plan.) The Plan should assess the degree of threat from each of the threats cited in the above paragraph, and identify measures to be taken by HG&E to address each. This should include consideration of acquisition of fee interest or easements to insure protection of threatened areas of habitat.

Unquestionably, the greatest threat to Puritan tiger beetles is recreational use of the Connecticut River and Rainbow Beach. A no-wake zone is highly unlikely in this heavily used section of the River by large and small powerboats. Even if one were created, its enforcement would be virtually impossible without the constant presence of the MA Environmental Police. The most appropriate measure is public education aimed at recreational boaters, as well as the general public.

Public education has to be an ongoing effort from May to October over the life of the license, and provided directly to boaters, not at a usually closed facility below the Holyoke Dam. HG&E should prepare brochures and signage that can be displayed and distributed at all marinas and boat launches serving the Holyoke Pool. Public outreach must also include the many property owners with docks on the River in the project area. Again, this has to be an ongoing effort.

Data on this Puritan tiger beetle population are essential for an effective effort to protect and enhance this species. HG&E should do more than just "follow research" (Section 3.2). We believe the Plan should include a commitment to support this research. And based on the research, the Plan should include provisions for new and/or expanded efforts by HG&E to insure this globally significant species is protected over the life of the license.

CRWC Comments – Threatened & Endangered Species Plan

Page 3

Thank you for the opportunity to comment on the Plan. I hope these comments will lead to revisions that will provide the protection of threatened and endangered species required by Articles 416 and 418.

Sincerely,



Tom Miner
Executive Director

cc: Paul Ducheny, HG&E
Distribution List (via email)

Distribution List

Jennifer Anderson, NMFS
Beth Goettel, Conte Refuge
Bob Kubit, MDEP
Terry Blunt, MDEM
John O'Leary, MEOEA
Pat Huckery, MDFW
Ben Rizzo, USFWS
Susi von Oettigen, USFWS
John Warner, USFWS
Don Pugh, TU



DEERFIELD/MILLERS CHAPTER

June 21, 2002

10 Old Stage Road
Wendell, MA 01379

Fred Szufnarowski
Kleinschmidt
PO Box 1050
Deep River, CT 06417

Dear Fred,

Following are Trout Unlimited's (TU) comments on HG&E's Threatened and Endangered Species Protection Plan (Plan).

Bald Eagles

Federal Energy Regulatory Commission (FERC) requires protection and enhancement of eagle perching and feeding activities. HG&E only proposes building nesting platforms in the area of perching and feeding trees. This does not constitute protection or enhancement of perching or feeding activities. Protection or enhancement would seem to require ensuring that these trees are not cut down and that human activities in the vicinity of these trees does not disturb or interfere with perching or feeding.

As the effects of the project will be ongoing, monitoring and reporting should be for the term of license.

Puritan Tiger Beetles

As the effects of the project will be ongoing, monitoring and reporting of Puritan tiger beetles should be for the term of the license.

Freshwater Mussels

The structure of past and present drawdowns, essentially one in the same, is described. Drawdowns occur in the spring for a short time period and in the fall for a more extended period. The impact of the fall drawdown is of much greater consequence for mussels in the canal. The canal drains much more completely during this period and reaches of the canal that may not become dry in a day or two become dry in 5 to 7 days. Section 13 (d) of the Water Quality Certificate requires the evaluation of the need for and the frequency of canal drawdowns. HG&E should describe why two days in the spring and a week in the fall is required for drawdowns as well as measures that will be taken to shorten these periods.

Article 409 of the FERC license requires that the canal operations plan include a "(3) description of any modification of structures necessary to achieve minimum canal flow requirements and conditions protective of mussels *during* (emphasis added) maintenance drawdowns; ...". There

is no indication in the FERC license that the minimum flow in the canal during drawdowns is different or anything less than the FERC requirement of 810 cfs from April 1 to November 15 and 400 cfs from November 16 through March 31 (Article 406). The Plan should describe how minimum flow would be passed during canal drawdowns and any structures necessary to achieve this goal.

Elliptio complanata is the correct spelling. The common name is Eastern Elliptio. The common name of *Elliptio producta* is Atlantic spike.

The citations for "NUEL 1997" and "Wetle 1999" should be provided.

While discoveries of yellow lamp mussels in the mainstem of the Connecticut River are encouraging, the total number reported is only eleven. Of these animals, only one is a male and the sex of three is not identified. This is hardly a vigorous population or necessarily one that is expanding. Considering the broadcast method of reproduction, if the location of the male is downstream of the females this population is functionally extinct. Rather than being viewed as a resurgent population, these animals may be a remnant of a population on the decline, as is the entire population in the Connecticut River. The lack of prior surveys in the area precludes drawing conclusions as to the status of this mainstem population in regard to whether it is resurgent or declining.

Reassessment of mussel populations in the canal, and the protection thereof, is appropriate and required by both the Massachusetts WQC and the FERC license. Reassessment of mussel populations does not mean redefining the canal system as something other than aquatic habitat. The canal system is a part of the waters of the state of Massachusetts. Nor does reassessment mean, in light of the location on a very small number of yellow lamp mussels in the mainstem of the Connecticut River, that the canal is no longer a refuge for yellow lamp mussels. Clearly it is a refuge.

Protection and **enhancement** of the population in the canal, rather than elimination (by relocation to the Connecticut River), should be the goal of the Plan. Protection and enhancement of the mussel population is the goal of Article 409 of the FERC license. The Plan should be a framework to enhance mussel populations through protection of the existing sections of the canal that have remained wetted during past drawdowns and increasing the area of the canal that remains wetted during future drawdowns.

Anodonta implicata (Alewife floater) and *E. complanata* are described on page 12 as thriving and on page 14 as moderate. *A. implicata* is not thriving in the canal system. Even in the areas where numerous *E. complanata* were observed during the drawdown site visit in the spring of 2002, few live *A. implicata* were observed. The population of *E. complanata* is reasonably described as moderate in some areas of the first and second level canals.

TU agrees with the Plan regarding zebra and quagga mussels and does not support their presence in the canal system.

HG&E implicitly acknowledges that the canal is aquatic habitat by providing minimum flows, fish bypass protection, and developing a plan to protect mussels. It sees, as one of the benefits of minimum flows, increased opportunities for fish to enter the canal and postulates that these fish can be hosts to glochidia. HG&E describes the additional deposition of glochidia in the canal as mussel enhancement. Unfortunately neither the fish nor the glochidia are aware of the reaches that HG&E seeks to keep watered during drawdowns. Deposition of glochidia in the canal is independent of drawdown conditions. Survival of glochidia is dependent on many factors: velocity, substrate, food supply, predation, and respiration. Dewatering is not considered favorable for survival.

Section 4.2

It is unclear that any dwarf wedgemussels have been located in the canal system.

TU is opposed to relocation of mussels from or within the canal except in very special circumstances. Relocation does not ensure adequate protection. Survival of mussels after relocation, as reviewed in Cope and Waller (1995), is highly variable with a mean success of only about 50% across the thirty-three studies reviewed in their paper. In addition to this significant mortality, all mussels would not be located for transplanting due to burrowing, as a defense mechanism, upon dewatering (Samad and Stanley 1986) and the small size of juvenile mussels. Juvenile mussels are difficult to locate with visual searches (Hornbach and Deneka 1996, Obermeyer 1998) and would constitute the large majority of mussels colonizing the canal between drawdowns.

Mussels in the canal are most directly impacted by dewatering during drawdowns. Maintaining water in reaches such as Boatlock to Riverside in the second level canal can be achieved by not opening the #2 overflow gates until the last 24 hours of the drawdown. A similar operational modification at the Holyoke #3 end of the second level canal could be employed to maintain water in that end of the canal. Backwatering of the first level canal from Boatlock to the bypass louvers should be done as soon as possible after debris in front of the Boatlock racks is removed. With installation of the full depth louvers in the fall of 2002 the need for dewatering in front of Boatlock may be eliminated. The positive impact of this will be considerable as heavy machinery will no longer be put in the canal to move this debris from in front of Boatlock Station and the reach will remain watered throughout the drawdown.

In addition to these operational modifications proactive measures are also needed to protect the 1st level canal segment that runs north to south. Construction of a weir, or a series of weirs, south of the railroad bridge at the north end of this canal segment would keep significant mussel habitat wetted. The FERC anticipated the need for weirs in Article 409: "(2) specific procedures for installing a sandbag weir, or other appropriate measures, to maintain watered conditions in areas of the canal necessary to maintain mussel habitat; ..."

TU agrees that the greatest likelihood of observing female yellow lampmussels occurs when they are displaying. Counting, measuring, and marking may be appropriate depending on monitoring or research needs but moving to another canal level is not. Mussels that are likely to be dewatered during drawdowns should have their locations marked so that during the fall drawdown, after the reproductive period, they can be relocated and moved to the nearest suitable

area in the same canal level. As sexually mature females are unlikely to occur in dewatered areas this condition will likely be very infrequent. With the construction of the weir/weirs in the north/south segment of the first level canal, the necessity for relocation will be greatly reduced.

During the October drawdown surveys only dewatered mussels should be relocated to the nearest suitable habitat in the same canal level. In the October survey all mussels other than *E. complanata* in dewatered habitat should be relocated. All mussels other than *E. complanata* should be counted and measured. *A. implicata* is the only species that might exceed the 5% threshold proposed for measurement. Determination of the percentage of *A. implicata* of the "total population" will likely be difficult during the survey. If this or another species rebounds to exceed some burdensome level for measurement, consultation with the parties should be undertaken to modify the above-recommended protocol.

Eight 0.25 m² samples 10 cm deep should be screened at each transect. Juvenile mussels should be identified and counted and returned to the substrate. Preservation of rare mussels is contrary to maintaining and enhancing their populations.

The locations of the seven areas in the mainstem Connecticut River, reasons for their selection, and specifics regarding the survey protocols should be provided in the final plan.

4.3

TU recommends the construction of a weir south of the railroad bridge in the north/south segment of the first level canal. The first level canal in the 'Boatlock to railroad bridge' reach is historic yellow lampmussel habitat. Protection of the high quality habitat in the first level canal is justified. This is an area where thousands of live mussels were observed during the spring 2002 canal drawdown. It is also an area where many times more shells of dead animals were observed. Based upon the mobility of mussels and the relatively low velocities in the canal, shells in this area are likely a result of mussels that died in this area.

The procedure for clearing areas of mussels when required heavy machinery is necessary during drawdowns should be described. As greater than 50% of mussels may be under the substrate (particularly in the early spring and late fall) (Amyot and Downing, 1991) procedures for clearing these mussels should be described.

4.3.1

The area in front of Boatlock should be cleaned without putting heavy machinery in the canal. Sediments moved from in front of Boatlock in prior years should be removed from the north/south segment of the first level canal. This sediment has been placed in the general area that yellow lampmussels have been located in the past. It degrades habitat in an area of the canal that has good habitat where this debris and sand do not occur.

4.3.2

The modified procedures for drawdown of the second level canal in the spring of 2002 were satisfactory in so far as the size of the pool created from Boatlock and Riverside is concerned. The pool, though, dropped 1.8" per hour on March 27. While this cannot be expanded to accurately describe pool depth at the end of a 5-day period the daily drop, at this rate, would be

3.6 feet per day. Maintaining of the Boatlock to Riverside pool will require inflow through the drawdown.

Accomplishing this will require flow through the first level canal throughout the drawdown. Work in the first level canal will need to accommodate these flows. Exceptional construction projects (e.g. full depth louvers) may justify some flow minimization or require development of alternative means to maintain second level pool depths. Flows through the first level canal to the Boatlock station should be sufficient to backwater the first level canal to the louvers and to maintain the level of the pool from Boatlock to Riverside. Flows through the first level canal and backwatering of the first level canal will protect habitat from the Gatehouse to the Boatlock station and ensure that the pool from Boatlock to Riverside does not shrink through leakage and seepage.

Waste gates at the #3 overflow and any other means of draining that end of the second level canal should be closed until the final 24 hours of the drawdown to maintain water in that end of the second level canal. It is unclear how the #3 overflow gates can be used to maintain the pooled area between Boatlock and Riverside.

4.4

There is no description in the text of the Plan of the weir at the #2 overflow listed as a protection or enhancement measure on page 19. Conditions that would cause the weir to be necessary should be described as should the difference in protection from the present proposal of keeping the #2 overflow gate closed.

No machinery should be placed in the first level canal for routine clearing of debris in front of the Boatlock station.

4.5

Based on five years of mussel survey information HG&E should provide **recommendations** to MADEP, MADFW, and USFWS for future work required to protect mussel populations and for survey work to assess these measures or to ensure that canal operations do not negatively impact mussel populations during the remainder of the license term.

Shortnose Sturgeon

The Massachusetts WQC requires the installation of an angled bar rack or alternative structure at the Hadley Falls intake, ...". Ongoing consultation and evaluation of options will determine the nature of the protection structure that will be installed.

5.1

TU is unaware of previous field-testing of the partial depth louvers with sturgeon (bullet #3), the results of which are proposed for incorporation in the evaluation of full depth louvers. The results of these tests should be included as an Appendix.

Thank you very much for your consideration of these comments. If you have any questions, I can be reached at 413 863 3832 or at the above address.

Sincerely,



Donald Pugh

cc.

Paul Duchney, HG&E
John Warner, USFWS
Susi von Ottengen, USFWS
Caleb Slater, MADFW
Pat Huckery, NHESP
Bob Kubit, MADEP
John O'Leary, EOE
Tom Miner, CRWC

Literature cited:

Amyot, J_P and Downing, J.A. 1991. Endo- and epibenthic distribution of a unionid mollusc *Elliptio complanata*. *J. N. Am. Benthol. Soc.* 10: 280-285.

Cope, W.G and Waller, D.L. 1995. Evaluation of freshwater mussel relocation as a conservation and management strategy. *Reg. Riv.: Res. & Mgt.* 11: 147-155.

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Obermeyer, B.K. 1998. A comparison of quadrates versus timed snorkel searches for assessing freshwater mussels. *Am. Mid. Nat.* 139: 331-339.

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United States Department of the Interior



FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087

June 4, 2002

Susan M. Board
Kleinschmidt Associates
161 River Street
P.O. Box 1050
Deep River, CT 06417

Dear Ms. Board:

I reviewed the Draft HG&E Puritan Tiger Beetle Plan as requested in your April 18, 2002 letter and offer the following comments. My response also incorporates comments provided by the Silvio O. Conte National Fish and Wildlife Refuge and state biologists who reviewed the draft plan. Per our discussion via e-mail on May 14, 2002, I am providing some background information prior to my review of the draft plan.

Background Information

Historically, the Puritan tiger beetle (*Cicindela puritana*) was collected at numerous sites along the Connecticut River in the 1800s and early 1900s. Eleven historical records indicate that the tiger beetle occupied riverine beach habitat along the Connecticut River between Claremont, New Hampshire and Cromwell, Connecticut. Barry Knisley in a 1987 status report observed that "environmental disruption"—in particular, the building of dams—most likely was the major cause in the extirpation of these sites. The extirpation of nine of these populations occurred in the early 1900s. After 1936, no collection records were documented from the Connecticut River. At least two known sites (Claremont and Charlestown, NH) are now inundated. Two small populations are currently found on the Connecticut River, one on Rainbow Beach in Northampton, Massachusetts and one near Cromwell, Connecticut. There are probably no additional extant populations of the tiger beetle in the region.

The U.S. Fish and Wildlife Service (Service) determined that there were adverse effects to the Puritan tiger beetle from activities authorized in the license approved by FERC for the Holyoke Hydroelectric Project. Adverse effects included accelerated erosion of existing and potential habitat, recreational impacts on currently occupied habitat, and recreational impacts on tiger beetle feeding and reproduction (October 7, 1999 USFWS letter to FERC; May 26, 2000 USFWS letter

to Northeast Utilities Service Company). In both letters, the Service stated that erosion of occupied and potential tiger beetle habitat may reduce the area available for egg deposition and larval habitat. The Service noted that erosion areas along the Connecticut River (within the scope of the project) were identified in the Final Environmental Impact Statement and included larval habitat north and east (opposite bank) of the currently occupied habitat. The FEIS noted that the erosion would continue in part due to "inflow variations, high flows, and natural and boat-induced wave action."

The Service provided potential measures to eliminate or reduce adverse effects in the October 7, 1999 letter to FERC. These measures included:

- Implementation of a "no wake" zone at occupied tiger beetle sites as well as potential habitat.
- Identification of potential tiger beetle habitat for protection, restoration and management.
- Minimization of recreational impacts to tiger beetles and their habitat through education and policing of recreational activities (*i.e.*, enforcement of "no wake" zones and no camping restrictions).

Plan Review

Outreach and public awareness is an important component of Puritan tiger beetle recovery. The draft plan states that Holyoke Gas Electric (HG&E) will cooperate with the Service and Massachusetts state agencies in public education efforts, but does not clearly identify actions that HG&E might take. According to the draft plan, HG&E is willing to distribute informational brochures at the fish viewing facility, although these brochures currently do not exist. Moreover, we are uncertain as to how the brochures will minimize recreational impacts on Rainbow Beach, since we are unaware of a correlation between the visitors at the fish viewing facility and the recreational users at Rainbow Beach. The draft plan states that HG&E will provide explanatory and "no wake" signs at tiger beetle habitat. The creation of a "no wake" zone is vital, although signage without enforcement will be ineffective and will not result in increased protection. The draft plan did not provide measures to implement the "no wake" zone.

The in-kind services mentioned in the draft plan, *e.g.*, historic water level elevation data, impoundment maps and hydrology information provided to the Service and the state upon request will be useful, but will merely describe the effects of water level variations on adults, larvae and habitat. This information will not minimize or avoid adverse effects, or result in beneficial effects if flow regimes or water release schedules cannot be subsequently affected.

And finally, we wonder what the basis of an annual report on tiger beetle activities will be, since HG&E has not proposed any research, concrete conservation actions or funding of activities benefitting tiger beetle recovery.

Recommended Conservation Measures

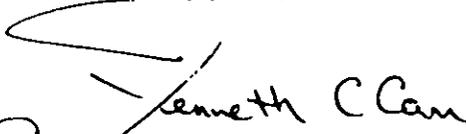
In order to comply with the conditions of the FERC license and develop an endangered species plan that addresses recovery actions as well as actions that would minimize adverse effects resulting from dam operations, we recommend that the following be incorporated into a revision of the draft plan:

1. provide alternative camping and day-use areas to relieve recreational pressure at Rainbow Beach;
2. provide funding for any or all of the following:
 - a. research on recreational impacts on tiger beetle feeding and reproductive behavior;
 - b. population augmentation (moving larvae) on Rainbow Beach;
 - c. research on vegetation management in order to maintain existing habitat and/or create additional habitat;
 - d. staff to enforce "no wake" zones;
 - e. development, production and distribution of education material targeted at recreational users (boaters) of Rainbow Beach;
 - f. monitoring the Rainbow Beach population;
3. acquire (through easements or fee-title) tiger beetle habitat in the area around Rainbow Beach and/or potential habitat identified by qualified biologists;
4. provide assistance in removal of invasive plant species in areas identified as potential habitat (either staff, equipment and/or funding).

The Service is also interested in protecting potential habitat downriver of the Holyoke Dam project and would be willing to discuss possible conservation actions with HG&E, although we realize that these areas are outside of the project's geographic scope.

Thank you for your cooperation. If you have any questions regarding our comments, please call me at 603-223-2541 ext. 22.

Sincerely yours,


for Susanna L. von Oettingen
Endangered Species Biologist
New England Field Office

CC: Reading File
John Warner, FWS-NEFO
Michelle Babione, SOCNWR
Chris Davis
201 West Pelham Road
Shutesbury, MA 01072
Tim Simmons, MADFW
ES: SvonOettingen:6-4-02:603-223-2541 ext. 22



United States Department of the Interior



FISH AND WILDLIFE SERVICE
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087

REF: FERC No. 2004 - Holyoke Project

July 2, 2002

Mr. Fred Szufnarowski
Kleinschmidt Associates
P.O. Box 1050
Deep River, CT 06417

Dear Mr. Szufnarowski :

We have completed our review of the draft *Comprehensive Canal Operations Plan (CCOP)*, transmitted by your letter dated May 31, 2002. Most of these comments were conveyed to KA and HGE at meetings on June 14, and June 27, 2002.

3.0 Canal Operation Plan

3.1.1 Spring Passage

Discharges from the Second Level Canal are passed through Riverside and Holyoke 3 at river flows below 5,390 cfs. At the June 14 meeting, it was explained that the flow would be spilt approximately evenly between the two. This should be stated in the plan.

3.1.2 Fall Passage

During the fall passage period, canal flows must remain at 400 cfs for water quality and canal flow circulation purposes, or be raised to 3,000 cfs, which is the minimum flow at which juvenile shad passage was evaluated.

3.2 Canal Minimum Flow Plan

The plan states that the agencies approved the HGE's plan to include leakage in calculating its minimum flow requirement to the canal. This is not accurate. The agencies accepted that leakage may be substantial and may provide adequate circulation throughout the canal. However, until canal flow distribution and flow velocities throughout the canal at leakage flow are established, we have not approved HGE's proposal.

The plan proposes the velocity measurements discussed above. The plan should state that a study plan will be developed and submitted for agency review and comment and that a report will be prepared for agency review and comment following the completion of the velocity measurements.

3.4 Canal Drawdown Procedure

3.4.1 First Level Canal

The concept of constructing a weir to retain wetted area in the first level canal branch is dismissed in this section as not practical. No explanation is given as to the size of wetted area that would be provided by one or more weirs, and the size of weirs that would be needed, while still permitting maintenance activities. At the June 27, 2002 meeting, data from the survey of elevations of the First Level Canal were distributed and discussed. Based on these results, HGE proposes installation of a small sandbag weir near the railroad bridge at the upstream end of the branch of the First Level Canal. The weir would be installed during the Fall 2002 outage. At that time, additional survey data of the 750 feet that would be pooled by the weir would be gathered, and mussel abundance established. During the Spring 2003 outage, the weir would be inspected to assess its structural integrity, water tightness and the amount of sedimentation deposited near the weir (possible re-survey). Similar inspections would occur in Fall 2003 and thereafter including reevaluation of mussels. We concur with this proposal as a reasonable approach to evaluate the feasibility of adding weirs in the canal. A brief plan for the installation and evaluation of the sandbag weir should be developed and circulated for review by agencies and other parties. If successful, additional weirs could be installed in the future.

In the Draft Plan, HGE proposed to mitigate impacts of canal drawdown by moving mussels to the second level canal. We had a number of concerns with this proposal. First, the proposal aimed only at moving the state-listed yellow lampmussel. The first level canal is populated by large numbers of other species, mostly common elliptio and these would not be protected. Moving rare species was also a concern, given that the habitat that the mussels would be placed would need to be established as being suitable. Also, moving mussels in June would likely mean that mussels would be moved during reproduction. This is not an ideal time to move mussels. If relocation of mussels was determined to be acceptable, monitoring the transplanted mussels would be needed to assure that relocated mussels survived. A plan for marking, moving and monitoring relocated mussels would need to be developed and provided to the agencies for review. Based on our concerns, HGE has abandoned this proposal and instead is proposing the sandbag weirs discussed above.

3.4.2 Second Level Canal

The drawdown procedures for the Second Level canal do not fully reflect what we had previously discussed. The agencies were generally satisfied that the drawdown procedure employed for this year's spring drawdown worked well to maintain a large wetted area from the Boatlock Station discharge to Riverside Station. However, when we were on site, we discussed the need for monitoring of the water surface elevation of the pool throughout the drawdown period.

Data from the drawdown indicated that the water level in the Second Level Canal continued to fall throughout the drawdown. Since fall drawdowns last longer, the wetted area of the canal will continue to shrink under the conditions evaluated this spring. There appear to be two options to correct this problem. HGE could use sandbags or other temporary structures atop the sill in front of the Riverside intake to establish a higher temporary pool level. The larger pool would allow more time before it became dry. Alternatively, HGE could assure that flow from the gatehouse through Boatlock Station be re-established as soon as possible to compensate for the leakage from the canal. A combination of these two measures is likely needed to maintain the desired wetted conditions between Boatlock Station and Riverside during future canal drawdowns.

The procedures for draining the Second Level Canal should not state that the Number 2 Overflow will not be opened during the drawdowns. The Second Level drainage procedure 6 states that the Number 3 Overflow gate will be regulated during drawdown. We had previously discussed that unless maintenance or replacement of the Number 3 overflow gate were needed, that the Number 3 overflow would also remain closed except for the very end of each drawdown in order to maintain wetted area in that end of the Second Level Canal.

Procedure number 8 states that cones will be placed in the canal in areas that heavy equipment will travel in order to minimize impacts to mussels and their habitat. This should be done if heavy equipment is, in fact, needed in the canal, but a careful survey for mussels prior to cone placement would be needed. However, we understood that routine maintenance activities requiring heavy equipment were limited to clearing sediment from in front of Boatlock Station. HGE agreed that from now on, sediment that needs to be removed from in front of Boatlock would be removed from the canal with a clamshell and crane and not moved by a backhoe as in the past. Therefore, the need for heavy equipment on the canal is likely diminished.

4.0 Plan for Protection and Monitoring

This section of the draft plan states that the objective of the plan is to ensure maintenance of the present mussel habitat rather than creating more habitat. It goes on to state that the intent is to stabilize existing habitat without encouraging expansion of habitat for rare mussel species. These statements are completely wrong and should be stricken from the final plan. Protection of existing habitat and expansion of wetted areas to encourage increased production are, in fact, the dual purposes for canal minimum flows and revised drawdown procedures. HGE acknowledges this fact based on its proposals for the drawdown discussed above.

In order to monitor mussel populations, the draft plan proposes qualitative and quantitative sampling of the canal. At the June 14, 2002 meeting, John Warner of my staff provided comments and scientific papers on surveying for mussels. The preferred methods would include stratified random sampling and cluster sampling in the vicinity where yellow lampmussels were discovered. We discussed the need for HGE to develop a short study proposal outlining the proposed sampling method and location of survey sites/transects. The study plan should be provided to agency and other parties for review and comment. Sufficient time should be allotted for review and comment on the plan prior to the Fall 2002 drawdown.

We appreciate this opportunity to review the proposed designs and look forward to continued progress in implementing fish passage improvements at the project. If you have any questions, please contact John Warner at (603) 223-2541.

Sincerely,



William J. Neidermyer
Assistant Supervisor, Federal Activities
New England Field Office

Appendix I

NHESP Management Recommendations



Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director*

April 27, 2012

Charles Martel
Environmental Health & Safety Coordinator
City of Holyoke Gas & Electric Department
99 Suffolk Street
Holyoke, MA 01040-5082

RE: Applicant: City of Holyoke Gas & Electric Department (HG&E)
Project Description: Guidelines for Vegetation Management Plan - 2012
File Number: 12-30538

Dear Mr. Martel:

The routine vegetation management of existing electrical/transmission lines (ROW) are exempt from review pursuant to the MA Endangered Species Act Regulations (MESA) (321 CMR 10.00) that are administered by the Natural Heritage and Endangered Species Program (NHESP) of the MA Division of Fisheries and Wildlife (Division). The exemption is conditional based on the NHESP's annual review and approval of a vegetation management plan (vmp) (321 CMR 10.14 (16)). We have been evaluating your 2012 Yearly Operational Plan (YOP) and the associated shapefiles submitted for approval under 333 CMR 11.04(3)(a-c) and 321 CMR 10.14(16). Below, we provide guidelines for vegetation management activities scheduled to occur within areas harboring specific types of state-listed species. These areas are identified and labeled in a shapefile that the NHESP has provided to you via email attachment. Management guidelines listed below shall be incorporated into the vmp, and must be followed by vegetation management crews in the field. All activities occurring anywhere within *Priority Habitat (PH)* shall follow the strictest Best Management Practices described for Sensitive Areas in standard YOP documents for Right-of-Way Vegetation Management.

The following procedures should be incorporated into the vmp and shall be implemented within PH and within portions of the Right-of-Ways (ROW) indicated in the enclosed shapefiles:

1. Avoid cutting or applying herbicide to shrubs species (e.g. scrub oak) less than 8 feet tall where possible. Shrubs may be managed:
 - a. within a 30-foot diameter area surrounding electrical towers and pole structures
 - b. within an existing vehicle access road
 - c. to manage taller species growing within a shrub area
 - d. to improve access to a work site after review and approval by NHESP
 - e. if the shrub species is considered to be an invasive species (see http://www.mass.gov/dfwele/dfw/nhesp/conservation/invasives/invasive_plant_info.htm for more information on invasive species in Massachusetts)
2. Avoid cutting or applying herbicide to areas dominated by low-growing native shrub species (e.g., lowbush blueberry, huckleberry, sheep laurel, New Jersey tea, sweet-fern).

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3. Within areas labeled as "Turtle Habitat" the Best Management Practices (BMPs) described in the document "ROW Vegetation Management in State-listed Turtle Habitat" shall be implemented (provided via email attachment). The NHESP will be providing a turtle training seminar to all Utility Companies in order to fulfill requirements outlined in the BMPs in the above-listed document. Please note that this document has been revised from previous years.
4. Within areas labeled as "VP Habitat" the BMPs described in the document "ROW Vegetation Management in Vernal Pool Habitat" shall be implemented (provided via email attachment). Please note that this document has been revised from previous years.
5. A subset of ROW areas proposed for vegetation management activities in 2012 are mapped, in part, for the presence of state-listed plant, lepidoptera (moth and butterfly), bird, and snake species. Within these ROW areas, extra care should be taken to avoid direct impacts to these state-listed species. Within areas labeled as "Other" the management guidelines described in the document "Vegetation Management of Existing Right-of-Ways (ROW) in State-listed Plant, Lepidoptera, Bird, and Snake Priority Habitats" and presented in the shapefile (provided via email attachment) must be implemented.
6. A subset of ROW areas proposed for vegetation management activities in 2012 are mapped, in part, for the presence of "Data Sensitive Species" (denoted in the shapefile). These species are highly susceptible to collection and are therefore of high concern to Natural Heritage. Information about these species (including presence/absence) cannot be released to anyone else (especially including release to third parties or published) unless such release is agreed to in writing by the Natural Heritage Program (See Massachusetts Public Records law: M.G.L. chapter 66 section 17D). If you know the species list we are providing will be published (based on application) do not release the species name instead use "sensitive plant (invertebrate or vertebrate)".

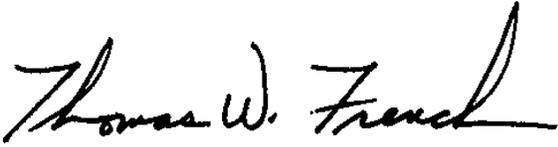
As part of this management plan, the NHESP shall be provided in writing with the names and phone numbers of key contacts who will know where work is happening at any given time. This will facilitate site visits by NHESP personnel. **Additionally, within fifteen (15) months from the date of this NHESP approval letter, a written summary (and/or shapefile) of activities which occurred within PH, including locations, dates, a description of vegetation management techniques, and the BMPs which were implemented, shall be submitted to the NHESP.**

A minimum of 72-hour notification shall be given to NHESP for any vegetation management activities not shown in the current VMP. The NHESP will respond with any procedures or conditions necessary to protect state-listed rare species and their habitats. Additionally, emergency maintenance and repair activities within *PH* may be conducted without prior NHESP notification. However, the NHESP should be notified of such emergency activities pursuant to 321 CMR 10.15, and mitigation may be required for any damage done to state-listed species habitats. If possible, we recommend that the NHESP be notified in advance of emergency management activities, so that we can provide immediate information about rare species associated with the work area. An emergency work form is also provided via email attachment which will assist you in providing us the necessary information for emergency work within *PH*.

Provided that the management recommendations contained in the 2012 shapefile provided by the NHESP and found in the accompanying documents are adhered to, the VMP for 2012 is approved and meets the requirement for exemption from review by the NHESP pursuant to 321 CMR 10.18 through 10.23. The NHESP approval of the 2012 HG&E vmp is valid for one year from the date of issuance of this letter. We appreciate the measures that HG&E is taking to manage and protect rare species habitats within ROW's, and we look forward to working with you to further streamline the rare species review process for ROW

management. If you have any questions or suggestions, please contact Eve Schlüter, Endangered Species Review Biologist, at (508) 389-6346 (eve.schluter@state.ma.us).

Sincerely,

A handwritten signature in black ink that reads "Thomas W. French". The signature is written in a cursive style with a large, sweeping flourish at the end of the name.

Thomas W. French, Ph.D.
Assistant Director

cc: Michael McClean, Pesticide Board



Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director*

April 2012

Vegetation Management of Existing Right-of-Ways (ROW) in State-listed Plant, Lepidoptera, Bird, and Snake Priority Habitats

The routine vegetation management of existing electrical/transmission lines in right-of-ways (ROW) are exempt from review pursuant to the MA Endangered Species Act Regulations (MESA) (321 CMR 10.00) that are administered by the Natural Heritage and Endangered Species Program (NHESP) of the MA Division of Fisheries and Wildlife (Division). The exemption is conditional based on the NHESP's annual review and approval of a vegetation management plan (vmp) (321 CMR 10.14 (16)). If ROW vegetation management activities occur in *Priority Habitat (PH)*, measures must be taken to minimize the mortality of state-listed species. This document is meant to accompany shapefiles, also provided by NHESP, of known state-listed plant, Lepidoptera (moth and butterfly), and bird and is meant to provide guidance to ROW managers preparing vmps for these areas. It includes an outline of procedures that shall be implemented to safeguard these species.

STATE-LISTED PLANTS

There are many native plants that are officially listed as "Endangered", "Threatened" or of "Special Concern" in Massachusetts and tracked by the NHESP. State-listed plants occur in a variety of habitats across the Commonwealth of Massachusetts, including along utility ROW. They can occur in wetlands, dry forests, on banks of streams or ponds, grasslands and shrublands, seasonally flooded depressions, and wet meadows. Many of the state-listed plants found along ROW thrive in the early successional habitats that are maintained through the removal of overstory trees and shrubs and the removal of competing plant species. However, state-listed plants in utility ROW can also be negatively impacted by herbicides, vehicles and heavy machinery, and the introduction of invasive plant species. Below and in the accompanying shapefile, the NHESP provides management guidelines for the areas identified to contain state-listed plant species found along the ROW scheduled for Vegetation Management activities.

Management Guidelines

Many state-listed plant species will thrive in low-shrub and herbaceous communities that are compatible with ROW vegetation management goals. Efforts to promote and maintain low-growing stable plant communities as a method of biological control of trees, which would otherwise interfere with electrical transmission, are strongly encouraged.

1. In general, management activities associated with vmps, *excluding the broadcast application of herbicides*, which are conducted between 2 November and 14 April, will pose minimal or no risk to state-listed plants and can proceed as described in the submitted Yearly Operational Plan (YOP) or vmp. However, vegetation management activities occurring between 15 April and 1 November may cause harm to state-listed plants. Included in the shapefile is a column labeled "Sens_Dates" which identifies the dates within which proposed activities may harm state-listed species. Please note that certain plants have year-round sensitive dates since management activities at any time of year may cause harm.

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2. If management activities occur during the sensitive dates for state-listed plants certain steps must be taken to avoid such harm. Below are the management guidelines for state-listed plants found in the "Guide_1" and "Guide_2" columns of the shapefile. Exact guidelines are clarified below, and must be followed where state-listed plant species are identified. If management guidelines for state-listed plant species can be followed as described below in the locations identified in the accompanying shapefile, no further restrictions are placed on vegetation management activities described in the associated YOP document (provided any other guidelines for other state-listed species in the same area are also followed). However, if these guidelines cannot be followed, or if the management guideline is to identify and avoid the extent of the population, botanical surveys will be required.

Detailed descriptions of "Guide 1" and "Guide 2":

"Delineate population and avoid": Certain state-listed plants are particularly sensitive to vegetation management practices and/or are at very high risk of extinction or extirpation from the state. In areas known to harbor these species (identified in the accompanying shapefile), surveys must be conducted by a qualified botanist. The NHESP-approved botanist will be required to identify the extent and condition of populations of state-listed plants, flag populations for work crews, and file a report with the NHESP *prior* to commencement of vegetation management in these areas. **Where possible, crews should avoid these delineated areas containing state-listed plant populations. If work must occur within these delineated areas, crews must be careful to not directly impact the state-listed plants.**

All observed state-listed plants shall be identified, reported, and mapped. Observations of state-listed species will require the submittal of an NHESP Rare Species Observation Form, including photographs, characters used for identification, observer contact information, locus map and signature. Rare Species Observation Forms must be received by the NHESP within *90 days* of completion of the survey. Additionally, results for surveys which failed to find state-listed species should be reported to the NHESP and should include a map and description of the area that was surveyed. A copy of the NHESP Botanical Survey Protocols and the Rare Plant Observation Form are included with this document.

"Avoid herbicide on grasses/sedges, ferns or forbs": Certain state-listed plants could be inadvertently harmed by even selective herbicide use. **In areas where herbicides must be used, extra caution should used to avoid over-spray onto grasses/sedges, ferns or forbs when targeting other species.** Activities which necessitate use of herbicide on grasses/sedges, ferns or forbs within state-listed plant areas of ROW may require botanical surveys as described under "Delineate population and avoid" above.

"Avoid herbicide on grasses/sedges, ferns, forbs or vines": Certain state-listed plants could be inadvertently harmed by even selective herbicide use. **In areas where herbicides must be used, extra caution should used to avoid over-spray onto grasses/sedges, ferns, forbs, or vines when targeting other species.** Activities which necessitate use of herbicide on grasses/sedges, ferns or forbs within state-listed plant areas of ROW may require botanical surveys as described under "Delineate population and avoid" above.

"Leave unmowed during sensitive dates": Certain state-listed plants actually require some disturbance to survive and propagate and/or are easily outcompeted by other species. However, mowing during the growing season can harm the plant itself, and therefore, if mowing is to occur, mowing during the dormant season will not harm these plants. Additionally, mowing during the non-growing season will maintain populations of these species by providing the disturbance they need and by removing competing plant species. **If mowing only in the dormant season is not possible within these areas of**

ROW, the NHESP should be contacted and alternative methods of maintaining these populations shall be developed.

STATE-LISTED LEPIDOPTERA (MOTHS AND BUTTERFLIES)

State-listed moths and butterflies occur in a variety of habitats across the Commonwealth of Massachusetts, including along utility ROW. These species spend a portion of their lives as larvae (caterpillars) feeding on very specific host plants which may benefit from the maintenance of early successional habitats within ROW. Additionally, some Lepidoptera species feed on the nectar of flowers as adults, and often utility ROW provide prime growing conditions for such nectar sources. State-listed moths and butterflies and their host plants can be negatively impacted by broadcast herbicides, pesticides, heavy machinery, mowing during the larval stage, loss of nectar sources, and the introduction of invasive plant species. In order to protect and maintain state-listed moth and butterfly species found within utility ROW, the NHESP will require specific management for the host plants found along ROW scheduled for vegetation management.

Management Guidelines

The host plants of many state-listed moth and butterfly species will thrive in low-shrub and herbaceous communities that are compatible with ROW vegetation management goals. Efforts to promote and maintain low-growing stable plant communities as a method of biological control of trees, which would otherwise interfere with electrical transmission, are strongly encouraged.

1. In general, management activities associated with vmps, *excluding the broadcast application of herbicides*, which are conducted between 2 November and 14 April, will pose minimal or no risk to state-listed Lepidoptera species and can proceed as described in the submitted Yearly Operational Plan (YOP) or vmp. However, vegetation management activities occurring between 15 April and 1 November may cause harm to state-listed Lepidoptera species. Included in the shapefile is a column labeled "Sens_Dates" which identifies the dates within which proposed activities may harm state-listed species.
2. If management activities occur during the sensitive dates for state-listed Lepidoptera species certain steps must be taken to avoid such harm. Below are the management guidelines for state-listed plants found in the "Guide_1" and "Guide_2" columns of the shapefile. Exact guidelines are clarified below, and must be followed where state-listed Lepidoptera species are identified. If management guidelines for state-listed Lepidoptera species can be followed as described below in the locations identified in the accompanying shapefile, no further restrictions are placed on vegetation management activities described in the associated YOP document (provided any other guidelines for other state-listed species in the same area are also followed). However, if these guidelines cannot be followed, the NHESP should be contacted and alternative methods of managing these areas shall be developed.

Detailed descriptions of "Guide 1" and "Guide 2":

"Avoid host plant to greatest extent possible": Certain host plants for state-listed species are fairly easily identified in the field with minimal training, and can be avoided by vegetation control crews. If crews cannot easily identify these host plants to avoid them, botanical surveys will be required as described above to delineate the host plant populations so crews can avoid them. **Extra caution should be used with herbicides in these areas.**

STATE-LISTED BIRDS

A subset of ROW areas proposed for operation and maintenance activities in 2012 are mapped, in part, for the presence of known Bald Eagle nesting sites. Within these ROW areas, extra care should be taken to avoid disturbing breeding birds by following the recommendation provided in the "Guide_1" column of the shapefile table. The recommendation is as follows:

Detailed descriptions of "Guide_1":

"Avoid work during breeding season": The breeding season for Bald Eagles in Massachusetts begins with courtship during late fall or early winter. The entire breeding cycle, from nest construction to fledging of young, lasts 6-8 months. They are very sensitive to disturbance throughout this time period (usually 1 January - 15 August).

STATE-LISTED SNAKES

A subset of ROW areas proposed for vegetation management activities are mapped, in part, for the presence of state-listed snake species. **Crew members should be aware that any snakes observed during vegetation management activities may be state-listed and protected species. Direct harm to or capture of these species without a permit from the Division of Fisheries and Wildlife is considered an unauthorized "taking" of a state-listed species and may be punishable by fines or imprisonment (321 CMR 10.06).**

Management Recommendations

1. Vegetation Management Conducted between 2 November and 31 March: In general, maintenance activities associated with VMPs that are conducted between 1 November and 31 March will pose minimal or no risk to state-listed snakes and can proceed as described in the submitted VMP.
2. Vegetation Management Conducted between 1 April and 1 November: Vegetation management activities occurring between 1 April and 1 November may cause harm to state-listed snakes and certain steps must be taken to avoid such harm. Included with this document is a shapefile of ROW areas documented to support state-listed snakes. Below are the management recommendations for state-listed snakes found in the "Mgmt_rec1" and "Mgmt_rec2" columns of the shapefile table. Exact recommendations are clarified below, and must be followed where state-listed snake species are identified.

Detailed descriptions of "Mgmt_rec1" and "Mgmt_rec2" guidelines

"Raise mower blades": Raising the height of mower blades to greater than 8 inches above the ground will reduce the likelihood of snake mortality, if the mower does not have a weighted stability bar mounted behind the blades.

"Avoid all snakes": Any snakes encountered should be avoided by vehicles or heavy equipment.

Based on these efforts and information currently found in the NHESP database, subsequent annual management guidelines may be revised.

BEST MANAGEMENT PRACTICES:

ROW Vegetation Management in State-listed Turtle Habitat



BEST MANAGEMENT PRACTICES: **ROW Vegetation Management in State-listed Turtle Habitat**

Freshwater turtles in Massachusetts are increasingly threatened by habitat loss, road mortality, increases in the density of certain predators associated with suburban sprawl (e.g. skunks & raccoons), and other factors. Because turtles naturally suffer high rates of nest failure and hatchling/juvenile mortality, adults must be very long-lived, on average, in order to successfully reproduce. As a result, even small increases in adult mortality resulting from human activity can have a significant impact on turtle populations. Given these increasing threats, 6 of the 10 freshwater turtle species native to Massachusetts are listed as “Endangered”, “Threatened” or of “Special Concern” and tracked by the Natural Heritage & Endangered Species Program (NHESP) of the Massachusetts Division of Fisheries & Wildlife (for more information on listed species, and turtle biology, in general, see Appendix A).

Utility rights-of-way (ROW) provide important open-canopy nesting, basking, and feeding habitat for turtles in Massachusetts (Figure 1). During certain times of year some turtle species such as the state-listed Eastern Box Turtle and Wood Turtle may occur at high densities within some ROWs. As a result, the potential exists for adult turtles to be inadvertently injured or killed by mowing equipment and other heavy machinery used for ROW vegetation management (Figure 2).

Figure 1. Blanding’s Turtle Nesting Area within ROW, Bristol County, MA. Photograph courtesy of ENSR/AECOM.



Figure 2. Wood Turtle (a) and Eastern Box Turtle (b) hit by mowing equipment within ROW’s, Essex & Barnstable Counties, MA.



Management Goal

Maintain important shrubland, grassland, and nesting habitat while minimizing risks of adult turtle mortality from mowing/heavy equipment.

Best Management Practices

The following practices must be implemented within sections of ROW indicated as “Turtle Habitat” on maps and shapefiles provided by the NHESP.

Turtle Inactive Season; 1 November–31 March: No special procedures required.

Turtle Active Season; 1 April–31 October: Follow the special procedures described below.

Training and Pre-treatment Requirements

1. *Staff Training:* All staff conducting vegetation management work within Turtle Habitat from April 1 – October 31 shall have completed a training seminar conducted by a qualified biologist on turtle life history, species identification, and protection procedures.
 - a. NHESP staff will conduct at least one training seminar on an annual basis.
 - b. In consultation with the NHESP, utility companies may elect to conduct their own NHESP approved turtle training programs for staff.
 - c. Upon request, utilities shall provide the NHESP with a list of staff and contract personnel who have completed the training. The list shall be updated as necessary during the turtle active season.

2. *Team Leader Training:*
 - a. Each work crew conducting mechanized vegetation management work with large equipment within Turtle Habitat from April 1 – October 31 shall have a designated and NHESP-approved turtle “Team Leader” who has completed an expanded version of the training described above.
 - b. The Team Leader shall be responsible for overseeing turtle “sweeps,” if necessary, reporting observed state-listed turtles to the NHESP, and taking other measures to protect state-listed turtles, as described below. Turtle “sweeps” require qualified individuals to visually search the work area for turtles prior to any heavy machinery entering the work zone.
 - c. Prior to April 15th each calendar year, utilities shall provide the NHESP with a list of staff and contract personnel who have completed the “Team Leader” training. The list shall be updated as necessary during the turtle active season.

3. *A Scientific Collection Permit* must be obtained by the Utility from the NHESP.

Treatment Practices

Using a variety of treatment practices, vegetation management activities on electric utility rights-of-way target specific vegetation. These targets obscure or impede access to the ROW corridors and structures, and grow tall enough to interfere with the safe, efficient and legal operation of an electrical power line. Targets, include but are not limited to, trees and limbs, tall growing shrubs, vegetation growing around substations, structures, access roads, gates, equipment, and where applicable, invasive and other noxious or poisonous vegetation species.

Some vegetation management activities occurring during the Turtle Active Season will not harm State-listed turtles while others have the potential to harm State-listed turtles, and must be conducted under the supervision of an NHESP-approved “Team Leader” following the practices listed below.

Herbicide Applications and Hand Cutting:

1. No special conditions are required for hand-cutting target vegetation or for herbicide applications.

Mowing and the Use of Heavy Equipment:

1. Avoid work between 25 May and 5 July if at all possible. This will avoid the primary nesting season for most state-listed turtle species.
2. Raise mower blades to 10 to 12 inches above the ground to reduce the likelihood of turtle mortality. Preferably, if possible, mow from the center of the utility ROW out toward the forested edges or streams.
3. Immediately prior to mowing, the use of large mechanical operational equipment or driving large equipment off existing roads, visual "turtle sweeps" must be conducted in the work area by trained personnel under the supervision of the turtle "Team Leader." Any turtles encountered must be moved a safe distance from the path of the vehicles or heavy equipment in the direction the turtle was oriented when observed and outside of the limit of work (e.g. 250 - 500 feet).
4. All observed state-listed turtles should be identified and reported to the NHESP.

Data Collection & Reporting

The NHESP shall be provided a written summary of the vegetation management activities which occurred within Turtle Habitat, including dates, approximate work area boundaries, description of vegetation management techniques at each work site, and the BMPs which were implemented by the end of the treatment year. Observations of state-listed turtles shall be reported within 30 days of each observation.

Optional Turtle Enhancement Activities

Utility companies may choose to work with NHESP turtle biologists in key areas to create and maintain exposed soil for turtle nesting areas. Additionally, high turtle activity areas could be identified and the vegetation management adjusted accordingly.

Appendix A

Turtle Habitat Descriptions and Identification

While many turtles occur primarily in wetlands, most species spend at least a part of their lives in uplands, and the Eastern Box Turtle makes extensive use of upland habitats. ROWs primarily provide nesting (e.g. open, well-drained, and sandy soils) and basking (sun-exposure for warmth) habitat for state-listed turtles. ROW's also provide important terrestrial foraging habitat for two state-listed species, the Wood Turtle and the Eastern Box Turtle (e.g. slugs, fruiting shrubs, mushrooms, etc.), ROW's also provide terrestrial migratory, estivation, and breeding habitat for turtles. Finally, wetlands within ROW's can provide important habitat for both listed and more common aquatic turtle species such as the Blanding's Turtle and Painted Turtle. Turtles generally nest in open-canopy upland habitats with sparse vegetation and exposed soil. Further details regarding habitat descriptions can be found in the rare species fact sheets for each species.

- *Semi-Aquatic Turtles*

Northern Red-bellied Cooter (*Pseudemys rubriventris*) - "Endangered"

These state and federally listed turtles typically use freshwater ponds that have abundant aquatic vegetation and reside within aquatic habitats, except during the nesting season. This species is only documented to occur within Plymouth County. The Northern Red-bellied Cooter overwinters in freshwater ponds including coastal plain ponds. This species is similar in appearance to the Eastern Painted Turtle, a very common species in MA. The Northern Red-bellied Cooter can be distinguished most readily by its large size relative to the Painted Turtle, and lack of a yellow spot that is prominent near the eye of Painted Turtle.

Blanding's Turtle (*Emydoidea blandingii*) - "Threatened"

These turtles use a variety of wetlands (e.g. marsh, vernal pool, river/stream, shrub swamp, forested wetlands, etc.), and migrate, estivate, and nest within uplands (e.g. forest, shrubland, field, orchards, grasslands, etc.) habitats, This species has been documented to move greater than two kilometers (> 6,700 feet) between wetlands (upland and aquatic movement) and overland to upland nesting habitat in Massachusetts. The Blanding's Turtle overwinters in deep marshes, shrub swamps, and areas of deep open water. This species is most easily recognized by the yellow coloration of the chin and neck and the highly-domed "helmet" shape of the shell.

Wood Turtle (*Glyptemys insculpta*) - "Special Concern"

The primary habitats of the Wood Turtle are rivers/streams followed closely by early successional/non-forested habitats. Usually, the migratory corridor between all utilized upland and wetland habitats is the primary river/stream. This species utilizes early successional shrub/field habitat between early May and October before returning to the primary river/stream to hibernate. The Wood Turtle overwinters in perennial streams and rivers, preferring less steeply inclined streams. This species is recognized by the coarse texture of the shell (resembling wood) and the orange/bronze coloration of the throat and legs.

- *Terrestrial Turtle Species*

Eastern Box Turtle (*Terrapene carolina*) - "Special Concern"

The primary habitats of the Eastern Box Turtle include forested uplands and wetlands and a variety of mostly upland early successional habitats (shrublands, grasslands, etc.). This species also occasionally visits shallow wetland (vernal pool, shrub swamp, marsh) habitats for brief periods of time between April and October to hydrate, feed, and estivate. The Eastern Box Turtle overwinters in forests, in burrows or otherwise underground. This species' shell is highly domed

and very colorful with a gradient of yellow, orange, light browns, and gold resembling oak leaves on the forest floor.

Turtle Biology

The general annual activity cycle of turtles is as follows:

- In the early spring, turtles emerge from hibernation and move to breeding, foraging, and basking habitat (overland and aquatic migration).
- Throughout June, most female turtles nest in upland habitats with open canopy, loose, and often sandy soil (overland migration).
- During mid to late summer (after nesting), turtles may have a period of reduced activity or dormancy called estivation that occurs in wetlands and forests, and other upland habitat that may surround wetland habitat utilized earlier that year.
- In early to mid fall, turtles move to hibernation habitat (overland and aquatic migration).
- Late November through late March turtles are in hibernation (inactive).

The state-listed turtle species referenced above vary in amount of time spent in upland, which for a single species may be up to two to three months for semi-aquatic turtles (Wood, Blanding's, and Northern Red-bellied Turtles) and upwards of seven months for upland turtles (Eastern Box Turtle) during the annual activity period. All state-listed turtle species can be observed on land from late March through November in upland non-forested (e.g. field, shrubland, ROW, etc.) and forested (e.g. oak and mixed forest) habitats. Eastern Box Turtles primarily utilize upland habitats throughout their active period, but occasionally hydrate and feed in shallow wetlands (<5 ft) for short periods of time during the year. In general, turtles are relatively easy to detect when moving, for example when traveling overland and nesting, however when estivating or at rest, they can be hard to detect (well-camouflaged with leaf litter and vegetation and enclosed in shell).

Turtle nesting occurs largely during the month of June, as females travel to open-canopy habitat with well-drained, loose, sandy-loam soils. Turtle nesting may occur in small open areas along trails, fields, grasslands, stream banks, and within the ROW. Usually, turtles will nest between dusk and dawn hours when light is low and they are most protected against mammalian predators. Once eggs are deposited in the ground, turtles vacate the nesting habitat and in most cases hydrate in nearby wetlands. The majority of hatchling turtles will emerge between mid August and late October, however some hatchlings may overwinter within the nest cavity.

BEST MANAGEMENT PRACTICES:

ROW Vegetation Management in Vernal Pool Habitat for State-listed Species



BEST MANAGEMENT PRACTICES:

ROW Vegetation Management in Vernal Pool Habitat for State-listed Species

Vernal pools provide unique wildlife habitats for species of amphibians and invertebrates that are officially listed as “Endangered”, “Threatened” or of “Special Concern” in Massachusetts and tracked by the Natural Heritage & Endangered Species Program (NHESP) of the Massachusetts Division of Fisheries & Wildlife. State-listed amphibians occur in a variety of habitats across the Commonwealth of Massachusetts, including along utility rights-of-way (ROW). As a result, the use of heavy machinery, vehicles, and the alteration of wetland hydrology which may occur during vegetation management activities can negatively impact state-listed amphibians found within utility ROW.

Management Goal

Maintain the integrity of vernal pool habitat and reduce mortality from mowing/heavy equipment.

Vernal Pool Identification

1. GIS data layers or maps containing NHESP designated Vernal Pool Habitat (“VP Habitat”) will be provided by the NHESP.
2. GIS data layers containing NHESP Certified, Potential Vernal Pools, and other significant wetland areas will be provided by the NHESP.
3. The boundaries of all wetland areas identified by the NHESP (see #2 above) within VP Habitat shall be flagged (or otherwise visibly delineated) by qualified personnel to facilitate avoidance by equipment operators. Additionally, if the qualified personnel find other potential vernal wetland habitats within the ROW not included in the NHESP GIS datalayer, utility staff shall make a good faith effort to delineate these areas as well.

Best Management Practices

Work within delineated wetland areas should be avoided if at all possible. The following Best Management Practices shall be implemented within VP Habitat areas:

Year-round practices

- Diving of equipment (e.g. trucks and ATVs) is allowed along existing access roads.
- Do not conduct fueling activities within VP Habitat Areas. Chainsaws (and other handheld equipment) may be fueled within the VP Habitat Areas, provided they are fueled down-gradient and at least ten (10) feet away from wetlands areas identified in #3 above.
- When possible, avoid running machinery through wetland areas identified in #3 above, even during dry periods, to avoid changing the hydrology.
- Avoid adding slash material resulting from vegetation management activities to the wetland areas identified in #3 above. Where significant amounts of slash fall into the wetland areas, remove it by hand or some other low-impact method. Amounts of slash materials are considered significant when, due to the volume of slash, leaving the slash would obscure the pool surface and reduce available light, or where slash would displace water in the pool. If the wetland areas contain water, attempt to leave the slash until the dry season or the winter. Removing it when wetland areas hold water can disrupt amphibian egg and larval development. Some slash material may remain in wetlands areas.

- Herbicide applications must follow the restrictions in 333 CMR 11.00, Rights of Way Regulations.

Vegetation Management conducted between 1 December and 28 February:

In general, maintenance activities that are conducted between 1 December and 28 February will pose minimal or no risk to state-listed species and can proceed. However, swamp mats should be used in conjunction with heavy equipment to avoid altering the hydrology. Mats shall be removed immediately upon completion of the project.

Vegetation Management conducted between 1 March and 30 November:

- No mowing or operation of heavy equipment shall occur within the delineated boundaries of wetland areas (hand-cutting and trimming is permitted)
- Do not alter or otherwise disturb (e.g. drive over with heavy equipment) existing piles of slash.

Reporting

A report summarizing the management activities implemented within VP Habitat shall be submitted to the NHESP by the end of the treatment year. Said report should include dates, the management techniques implemented, and information on any vernal pools identified.

State-listed Amphibian Descriptions and Biology

The three state-listed salamanders are in the same family of mole salamanders (*Ambystomatidae*): the Blue-spotted Salamander (*Ambystoma laterale*), Jefferson Salamander (*Ambystoma jeffersonianum*), and the Marbled Salamander (*Ambystoma opacum*). These species are often thought of in association with their aquatic breeding habitat, which is primarily in ephemeral vernal pools. Although these aquatic habitats are essential for reproduction, these salamanders are only in the breeding pools for a few days to a couple of weeks per year. It is the surrounding upland forest habitat where the juvenile and adult salamanders spend 90% of their lives. Breeding migration to and from aquatic habitat occurs in the early spring for Blue-spotted and Jefferson Salamanders, while for Marbled Salamanders it occurs in the late summer and fall. Outside of these breeding periods, the adult salamanders reside in underground burrows and tunnels and beneath moist coarse woody debris.

The final state-listed amphibian is the Eastern Spadefoot (*Scaphiopus holbrookii*) and is the most fossorial species of frog or toad in Massachusetts. These toads live in areas with dry sand or sandy loam. They spend most of their time up to eight feet underground—hibernating during the cold months and avoiding desiccation during the rest of the year. In warmer months, from April to September, the Eastern Spadefoot comes up at night to breed in temporary ponds after prolonged warm and heavy rains.



Appendix J

NHESP Species Observation Forms and Emergency Work Form



STATE-LISTED SPECIES HABITAT ASSESSMENT GUIDELINES: WILDLIFE

The Natural Heritage and Endangered Species Program (NHESP) may request a State-listed Species Habitat Assessment for imperiled wildlife species. The assessment can be used by the applicant and the NHESP to minimize project or activity-related impacts to state-listed species and their habitats.

CONDUCTING THE ASSESSMENT

- The NHESP must pre-approve the biologist who will conduct the assessment. The biologist must demonstrate experience working with the species that is the subject of the habitat assessment.
- The assessment should address the entire project site, not just the portion within the proposed project "footprint". The habitat assessment must consider the landscape context of the project site, and identify and map off-site habitat features that may be of importance to the focal state-listed species.

REPORTING REQUIREMENTS

- The final document must include the following:
 - Cover Type Maps: Upland and wetland portions of the project site should be divided into land-use/land-cover types based upon dominant vegetation and existing development. Certified and potential Vernal Pools (see MassGIS) should be mapped, including all potential vernal pools observed in the field that do not appear on the MassGIS Potential Vernal Pools coverage.
 - Habitat Map/Existing Conditions: Each portion of the project site and adjacent land should be classified based upon its ability to provide habitat functions for the relevant species (e.g. feeding, breeding, nesting, etc.). A description should include important site features such as existing developed or disturbed areas, as well as a discussion of the quality of the habitat including calculations of acreages. Hydrology of wetlands and ponds should be described, as should the hydroperiod of any vernal pools. The map should be overlaid on an ortho-photo (see MassGIS) of the project site with an indication of the scale.
 - Representative photographs must be provided for all habitat types and key habitat features. Please indicate on a map photograph locations and the cardinal direction of view.
 - Impact Analysis: This section should include quantification of the impacts of the proposed project to state-listed species habitat, including calculations of acreages and a description of impacts to each specific habitat function (e.g., potential nesting, breeding, feeding, migratory, overwintering, estivating). Additionally, recommendations should be provided for protective measures, potential design changes that avoid and/or minimize impacts, and possible mitigation if applicable.
 - A list of references, experts, and any other resources used must also be included.
- If any state-listed species are observed, a Rare Animal or Plant Observation Form must be submitted to the NHESP within one month of the observation.
- Please submit one (1) paper copy and one (1) copy on CD of the final report to the NHESP.
 - Please note: If the full report is less than 4MB, you may email an electronic copy to the appropriate review biologist or assistant in lieu of sending a CD. Please be sure to include the NHESP Tracking Number in the email. A paper copy should still be mailed to the office.

Mail Report To:

Regulatory Review
Natural Heritage & Endangered Species Program
100 Hartwell St, Suite 230
West Boylston, MA 01583

Emergency ROW Work within Priority Habitat

Please complete this form to update the Natural Heritage & Endangered Species Program on any ROW emergency work within Priority Habitat (Please submit only one emergency project per form).

Contact Information:

Name:

Company:

Address:

City:

State:

Zip Code:

Daytime Phone:

Ext.

Information on work performed:

Location:

Town:

Acreage of Disturbance:

Date & Duration of Work:

Description of Emergency Work Performed and Current Site Conditions: (If necessary attach additional sheet)

Has the work associated with this emergency been completed?

Yes

No

Do you anticipate the need for future work associated with this emergency?

Yes

No

If yes, explain: (If necessary attach additional sheet)

Please enclose a copy of a USGS topographic map in the scale 1:24,000 or 1:25,000 with the site location clearly marked and centered on the copy page.

Please **mail** this completed form and topographic map to:

Regulatory Review / Utilities
Natural Heritage and Endangered Species Program
MA Division of Fisheries and Wildlife
1 Rabbit Hill Road
Westborough, MA 01581

Questions regarding this form should be directed to (508) 389-6346



Natural Heritage & Endangered Species Program

Massachusetts Division of Fisheries & Wildlife

Name: _____

Telephone #: _____

Email: _____

Please note, for report to be accepted into NHESP database, all required fields including signature field on page 3 must be completed

IN MAKING THIS OBSERVATION FORM AVAILABLE FOR USE BY THE PUBLIC, THE NHESP DOES NOT AUTHORIZE OR CONDONE ENTRY ONTO PRIVATE PROPERTY WITHOUT THE OWNER'S KNOWLEDGE AND PERMISSION. THE UNLAWFUL TRESPASS ONTO PRIVATE PROPERTY MAY SUBJECT A TRESPASSER TO THE CRIMINAL OR CIVIL SANCTIONS AVAILABLE UNDER THE LAW. FOR THESE REASONS, THE NHESP STRONGLY RECOMMENDS THAT THE PERMISSION OF THE LANDOWNER BE OBTAINED PRIOR TO ENTERING PRIVATE PROPERTY TO COLLECT INFORMATION FOR THIS FORM. IT IS THE SOLE RESPONSIBILITY OF EACH PERSON COLLECTING INFORMATION FOR THIS FORM TO ENSURE THAT THEIR ACTIVITIES COMPLY WITH THE LAW.

NHESP ANIMAL OBSERVATION FORM

***Required Fields** (additional information may be requested during NHESP review of observation report)

Survey Information

***SPECIES NAME** (scientific name preferred): _____

***Date(s) and time(s) of observation(s):** _____

Amount of area surveyed/time spent surveying area: _____

Species Identification

***Description of the diagnostic characteristics upon which the ID was based** (including how distinguished from similar species): _____

***Photographs taken (Y / N)?** If yes, please submit a clear photo/slide/or electronic digital image of the animal showing diagnostic features. On image, please indicate your name, the date, location, and species.

***Was a specimen taken and curated for deposition in a biological research collection (Y / N)?** If yes, please indicate the institution or personal collection where the specimen will be deposited: _____

Location Information

***Town:** _____ **County:** _____ **Waterbody:** _____

***Describe how to get to the site of the observation using obvious permanent landmarks such as a road intersection (measuring to at least the nearest 1/10 mile):** _____

***Please attach a copy of the appropriate section of a USGS topo map, aerial photograph, or similar map** (i.e. Google Earth map, GIS map, etc.), **and carefully mark the specific site where you observed this rare species.**

Site Coordinates (if available): System used (circle one): UTM Lat-Long Mass. State Plane Datum: _____

Source of coordinates (circle one): GPS Google Earth other GIS system (please specify _____)

Coordinates at original observation location

If GPS, accuracy of GPS unit at the time the coordinates were taken:

Obs #1: _____

Obs #2: _____

Obs #3: _____

Please submit field forms, appropriate maps with specific location clearly marked, and all supporting documentation to:
Data Manager, Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife, Rt. 135, Westborough, MA 01581

Population Information

***Number of individuals observed.** If known, age/life stage, and sex (please describe how age and sex were determined):

Evidence (if any) of breeding activity at this site (e.g. eggs, nests, carrying food to young, copulation, juveniles present):

Behavioral notes (e.g. crossing road, basking):

Have you observed this species at this site in previous years (Y / N)? If yes, please give details:

Site Information

Description of habitat at site where the animal was observed (e.g. forest, open field). If possible, please list dominant vegetation, size of habitat patch, information on the physical environment (e.g. vegetation structure, substrate type, hydrology, slope), and information on local land use and alterations to ecological processes (e.g. damming, logging, rip-rapping of stream):

Associated species at this site:

Observed or potential threats to the species or its habitat at this site (e.g. land clearing, invasive species)? If yes, describe:

Landowner's name and address, if known:

Additional comments:

Observer Information and Certification

*Observed at original location by (please sign below): _____

*Observer's Permanent Address: _____

*Email Address (if available): _____ *Telephone: _____

Affiliations/Qualifications: _____

*List names of other observers (and qualifications): _____

I hereby certify under pains and penalties of perjury that the information contained in this report is true and complete to the best of my knowledge.

*Signature: _____ *Date: _____

(The person who observed the species must sign here)

Additional Data Submission Information

If the organism's species identification was made by someone other than the observer listed above, please provide contact information for person who identified the organism:

Name: _____

Permanent Address: _____

Email Address: _____

Telephone: _____

Affiliations/Qualifications: _____

If form filled out by someone other than the observer listed above, please provide contact information:

Name: _____

Permanent Address: _____

Email Address: _____

Telephone: _____

Affiliations/Qualifications: _____

IS THIS OBSERVATION ASSOCIATED WITH A NHESP REVIEW FILE? Yes ___ No ___ Don't Know ___

If "Yes" please list NHESP file/tracking #: _____

IS THIS OBSERVATION ASSOCIATED WITH A COLLECTION PERMIT? Yes ___ No ___ Don't Know ___

If "Yes" please list Collection Permit #: _____

Thank you for contributing to the Natural Heritage & Endangered Species Program database.
Your efforts are valuable and appreciated.



Natural Heritage & Endangered Species Program

Massachusetts Division of Fisheries & Wildlife

Name: _____

Tel. #/email: _____

Please note, for report to be accepted into NHESP database, all required fields including signature field on page 3 must be completed

IN MAKING THIS OBSERVATION FORM AVAILABLE FOR USE BY THE PUBLIC, THE NHESP DOES NOT AUTHORIZE OR CONDONE ENTRY ONTO PRIVATE PROPERTY WITHOUT THE OWNER'S KNOWLEDGE AND PERMISSION. THE UNLAWFUL TRESPASS ONTO PRIVATE PROPERTY MAY SUBJECT A TRESPASSER TO THE CRIMINAL OR CIVIL SANCTIONS AVAILABLE UNDER THE LAW. FOR THESE REASONS, THE NHESP STRONGLY RECOMMENDS THAT THE PERMISSION OF THE LANDOWNER BE OBTAINED PRIOR TO ENTERING PRIVATE PROPERTY TO COLLECT INFORMATION FOR THIS FORM. IT IS THE SOLE RESPONSIBILITY OF EACH PERSON COLLECTING INFORMATION FOR THIS FORM TO ENSURE THAT THEIR ACTIVITIES COMPLY WITH THE LAW.

NHESP PLANT OBSERVATION FORM

***Required Fields** (additional information may be requested during NHESP review of observation report)

Survey Information

***SPECIES NAME** (scientific preferred): _____ **EO#, if known:** _____

***Date(s) of observation(s):** _____ ***Population Found (Y / N)?**

Amount of area surveyed/time spent surveying area: _____

Species Identification

***Photographs or slides taken (Y / N)?** If yes, please submit a clear photo/slide/or electronic digital image of the plant showing diagnostic features. On image, please indicate your name, the date, location, and species.

***Was a specimen collected and curated for deposition in a biological research collection (Y / N)? If yes, please**

indicate the repository: _____ **Collection # (optional):** _____

***Are you confident of this species ID (Y / N)?** If No, please explain: _____

***Description of the diagnostic characteristics upon which the ID was based** (including how distinguished from congeners or look-alikes): _____

Reference used: _____

Location Information

***Town:** _____ **County:** _____ **Waterbody or site name:** _____

***Describe how to get to the area surveyed and the rare plant population** (if found) using permanent landmarks and cardinal directions. Please include potential accessibility obstacles or dangers (e.g., river crossing, tides). If you would like to provide a sketch, please do so on the last page: _____

***Please attach a copy of the appropriate section of a USGS topo map, aerial photograph, or similar map** (i.e. Google Earth map, GIS map, etc.), **and carefully mark the specific site(s) of the rare plant population (if found) and the total area surveyed.**

Please submit field forms, appropriate maps with specific location clearly marked, and all supporting documentation to:
Data Manager, Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife, Rt. 135, Westborough, MA 01581

Site Coordinates (if available): *System* used (circle one): UTM Lat-Long Mass. State Plane Datum: _____

Source of coordinates (circle one): GPS Google Earth other GIS system (please specify _____)

Coordinates at original observation location If GPS, accuracy of GPS unit at the time the coordinates were taken:

Obs #1: _____

Obs #2: _____

Obs #3: _____

Population Information

Did your survey encompass the entire population extent, if known (please circle one)? Yes No Uncertain

Approximate area occupied by the population (circle appropriate unit): _____ meters² hectares feet² acres

***Population Size:**

Total number of "genets" (i.e., genetically distinct, or clearly separate individuals): _____ (Precise count *or* estimate?)
and/or

Total number of "ramets" (i.e., stems or shoots arising from clones): _____ (Precise count *or* estimate?)

***Population Structure** (please indicate the # or % in each age class and condition if known, or just check all that apply):

Age Classes Present

____ Seedlings

____ Immature plants

____ Mature plants

____ Plants of unknown age

Reproductive Condition of the Population on this Date

____ Vegetative

____ In bud

____ In flower

____ Immature fruit

____ Mature fruit

____ Seed dispersing

____ Senescent

____ Dormant

How would you characterize the vigor of this population (please circle one)? Excellent Good Fair Poor

Have you observed this species at this site in previous years (Y / N)? If yes, please give details: _____

Site Information

Describe the habitat, including the natural community and associated species: _____

Circle Appropriate Habitat Descriptors:

Landform/Topography

summit/crest

upper slope

mid slope

lower slope

rolling terrain/plain

floodplain/terrace

wetland

shore/lake/stream

Aspect (_____ °)

N NE

E SE

S SW

W NW

flat/variable

Slope (_____ %)

flat

gentle

average

steep

very steep

abrupt

Light

open

filtered

shade

Soil Moisture Regime

xeric

dry

mesic

wet

inundated

Elevation: _____ (ft or m?) **Soil Type(s):** _____

Surficial Geology: _____ **Bedrock Geology:** _____

List invasive species present and describe their perceived threat level (low, medium, high): _____

Please describe other observed threats to the population at this site (e.g. disease, predation, disruptive land uses):

Landowner's name and address, if known: _____

Managed Area Name (if applicable): _____

Contact Person name & tel#/email (if known): _____

Owner Comments: _____

What are your recommendations for future inventory, monitoring, research, and/or management? _____

What are your protection recommendations? _____

Additional comments: _____

Observer Information and Certification

*Observed at original location by (please sign below): _____

*Observer's Permanent Address: _____

*Email Address (if available): _____ *Telephone: _____

Affiliations/Qualifications: _____

*List names of other observers (and qualifications): _____

I hereby certify under pains and penalties of perjury that the information contained in this report is true and complete to the best of my knowledge.

*Signature: _____ *Date: _____

(The person who observed the species must sign here)

Additional Data Submission Information

If the organism's species identification was made by someone other than the observer listed above, please provide contact information for person who identified the organism:

Name: _____

Permanent Address: _____

Email Address: _____

Telephone: _____

Affiliations/Qualifications: _____

If form filled out by someone other than the observer listed above, please provide contact information:

Name: _____

Permanent Address: _____

Email Address: _____

Telephone: _____

Affiliations/Qualifications: _____

IS THIS OBSERVATION ASSOCIATED WITH A NHESP REVIEW FILE? Yes ___ No ___ Don't Know ___

If "Yes" please list NHESP file/tracking #: _____

IS THIS OBSERVATION ASSOCIATED WITH A COLLECTION PERMIT? Yes ___ No ___ Don't Know ___

If "Yes" please list Collection Permit #: _____

Thank you for contributing to the Natural Heritage & Endangered Species Program database.
Your efforts are valuable and appreciated.

Please submit field forms, appropriate maps with specific location clearly marked, and all supporting documentation to:
Data Manager, Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife, Rt. 135, Westborough, MA 01581



STATE-LISTED SPECIES HABITAT ASSESSMENT AND SURVEY

GUIDELINES: PLANTS

The Natural Heritage and Endangered Species Program (NHESP) may request a State-listed Species Habitat Assessment & Survey for imperiled plants. The assessment can be used by the applicant and the NHESP to minimize project or activity-related impacts to state-listed species and their habitats.

PRIOR TO THE ASSESSMENT AND SURVEY

- The NHESP must pre-approve the botanist who will conduct the assessment or survey. The botanist must demonstrate the ability to locate and identify the state-listed plant species and their habitat(s).
- The assessment and survey protocol must be pre-approved in writing by the NHESP and should address the entire project site, not just the portion within the proposed project "footprint". The methods and timing of survey for each imperiled plant should also be described in the protocol. Please note that multiple visits may be necessary for larger properties, certain plant species, and throughout the time period where the target plant is most detectable.
- If a botanist and/or the NHESP believes that specimens of a state-listed species must be collected for confirmation or vouchering, a "Scientific Collection Permit" will be required. For additional details, please refer to the Guidelines for Rare Plant Collection in Massachusetts (revised 9 February 2007).

REPORTING REQUIREMENTS

- The final document must include the following:
 - Summary of survey methodology and a map of the survey area extent.
 - Cover Type Maps: As applicable to the species being surveyed, upland and wetland portions of the project site should be subdivided into land-use/land-cover types based upon dominant vegetation and existing development.
 - Existing Conditions: The description should include important site features such as existing developed or disturbed areas and detailed observation notes with a representative list of vascular plants. As applicable to the species being surveyed, vegetation and general habitat conditions should be described as outlined in the "Classification of the Natural Communities of Massachusetts" (Swain & Kearsley 2001). The map should be overlaid on an ortho-photo (see MassGIS) of the project site with an indication of the scale.
 - Representative Photographs of the site. Please indicate on a map photograph locations and the cardinal direction of view.
 - Summary of the survey results including representative photographs of each target plant and those easily confused with the target plant.
 - Impact Analysis: A quantification, including calculations of acreages, of the impacts of the proposed project to target plants and their habitats. Additionally, recommendations should be provided for protective measures, potential design changes that avoid and/or minimize impacts, and possible mitigation if applicable.
 - A list of botanical references, herbaria, experts, and any other resources used for identifications or during surveys must also be included.
- If any state-listed species are observed, a Rare Animal or Plant Observation Form must be submitted to the NHESP within one month of the observation.
- Please submit one (1) paper copy and one (1) copy on CD of the final report to the NHESP.
 - If the full report is less than 4MB, you may email an electronic copy to the appropriate review biologist or assistant in lieu of sending a CD. Please be sure to include the NHESP Tracking number in the email. A paper copy should still be mailed to the office.

Mail Report To:

Regulatory Review
Natural Heritage & Endangered Species Program
1 Rabbit Hill Road
Westborough, MA 01581

Appendix K

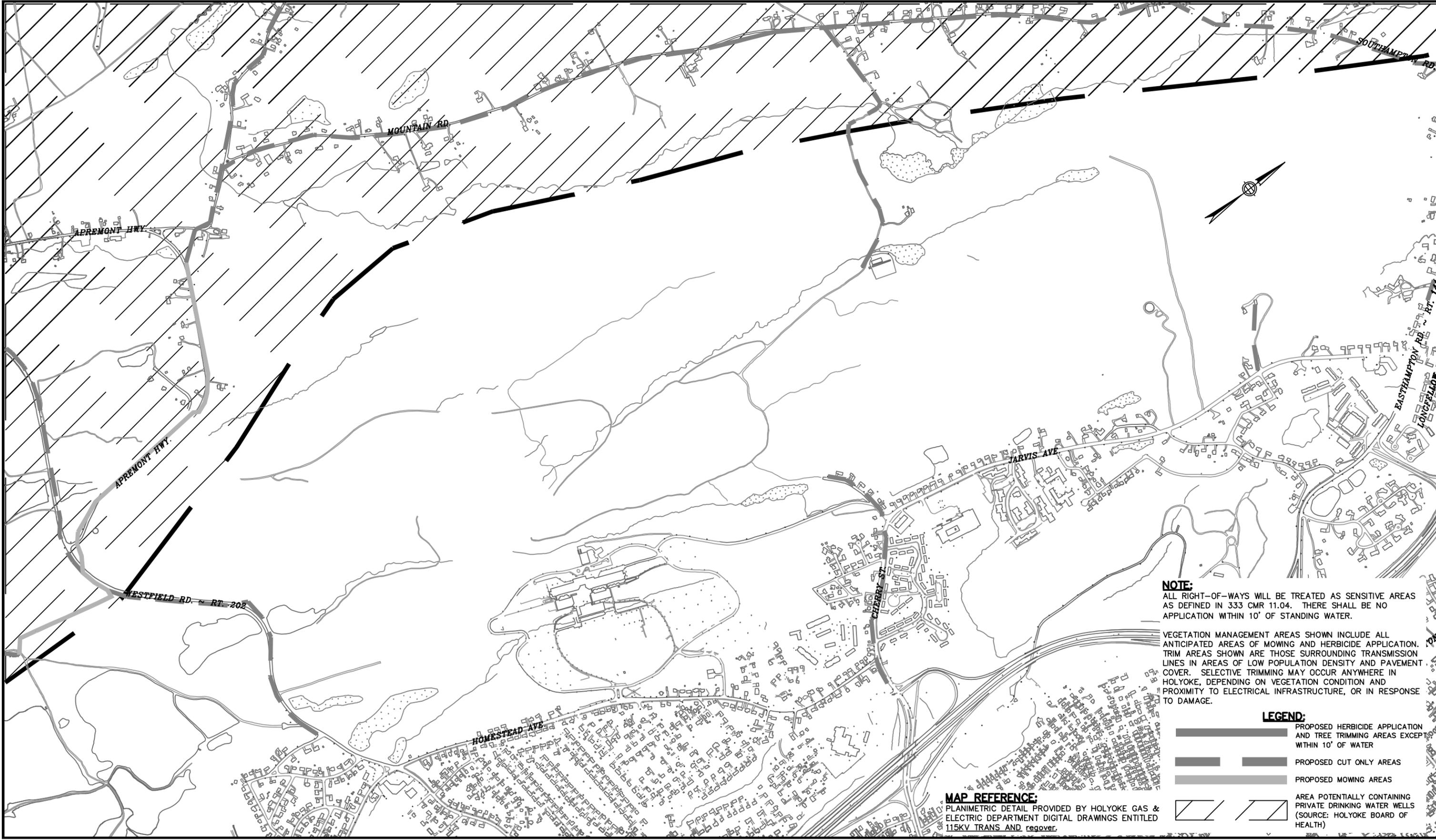
Well Area/List

Location of Known Private Drinking Water Supply Wells

Holyoke – In 2004, Holyoke Health Department supplied information on the portion of the city where private drinking water wells are likely to be located. This area is shown on the figure contained in *Appendix K*. The Department has been contacted during each subsequent year to update this information. Since 2004, several additional private drinking water wells were installed within the area shown on the figure in *Appendix K*, since this area of the city does not have public drinking water service. Herbicide application crews will attempt to field-identify other private drinking water wells in this area.

Chicopee – The Chicopee Health Department was contacted during 2004 to determine if any drinking water wells are present in the area where HG&E is proposing vegetation management. No known wells were reported. Subsequent annual discussions with the Department indicated that no private drinking water wells were installed or proposed for installation in this area since 2004.

South Hadley -- The area in South Hadley where vegetation management is proposed includes no residences, and extensive ground survey has not identified evidence of any private drinking water wells in the vicinity of the project.



NOTE:
 ALL RIGHT-OF-WAYS WILL BE TREATED AS SENSITIVE AREAS AS DEFINED IN 333 CMR 11.04. THERE SHALL BE NO APPLICATION WITHIN 10' OF STANDING WATER.

VEGETATION MANAGEMENT AREAS SHOWN INCLUDE ALL ANTICIPATED AREAS OF MOWING AND HERBICIDE APPLICATION. TRIM AREAS SHOWN ARE THOSE SURROUNDING TRANSMISSION LINES IN AREAS OF LOW POPULATION DENSITY AND PAVEMENT COVER. SELECTIVE TRIMMING MAY OCCUR ANYWHERE IN HOLYOKE, DEPENDING ON VEGETATION CONDITION AND PROXIMITY TO ELECTRICAL INFRASTRUCTURE, OR IN RESPONSE TO DAMAGE.

LEGEND:

-  PROPOSED HERBICIDE APPLICATION AND TREE TRIMMING AREAS EXCEPT WITHIN 10' OF WATER
-  PROPOSED CUT ONLY AREAS
-  PROPOSED MOWING AREAS
-  AREA POTENTIALLY CONTAINING PRIVATE DRINKING WATER WELLS (SOURCE: HOLYOKE BOARD OF HEALTH)

MAP REFERENCE:
 PLANIMETRIC DETAIL PROVIDED BY HOLYOKE GAS & ELECTRIC DEPARTMENT DIGITAL DRAWINGS ENTITLED 115KV TRANS AND recover.

No.	DATE	DESCRIPTION	BY

PROJ. MANAGER:	
CHIEF DESIGNER:	
REVIEWED BY:	
DATE:	

SCALE:

HORIZ.: 1" = 1000'
 VERT.: N/A

DATUM:

HORIZ.:
 VERT.:

0 500 1000

GRAPHIC SCALE



FUSS & O'NEILL

78 INTERSTATE DRIVE
 WEST SPRINGFIELD, MA 01089
 413.452.0445
 www.fando.com

CITY OF HOLYOKE GAS & ELECTRIC DEPT.
 PRIVATE DRINKING WATER WELL LOCATIONS
 YEARLY OPERATIONAL PLAN 2013

HOLYOKE MASSACHUSETTS

PROJ. No.: 2000727.A89
 DATE: JANUARY 2013

APP. K

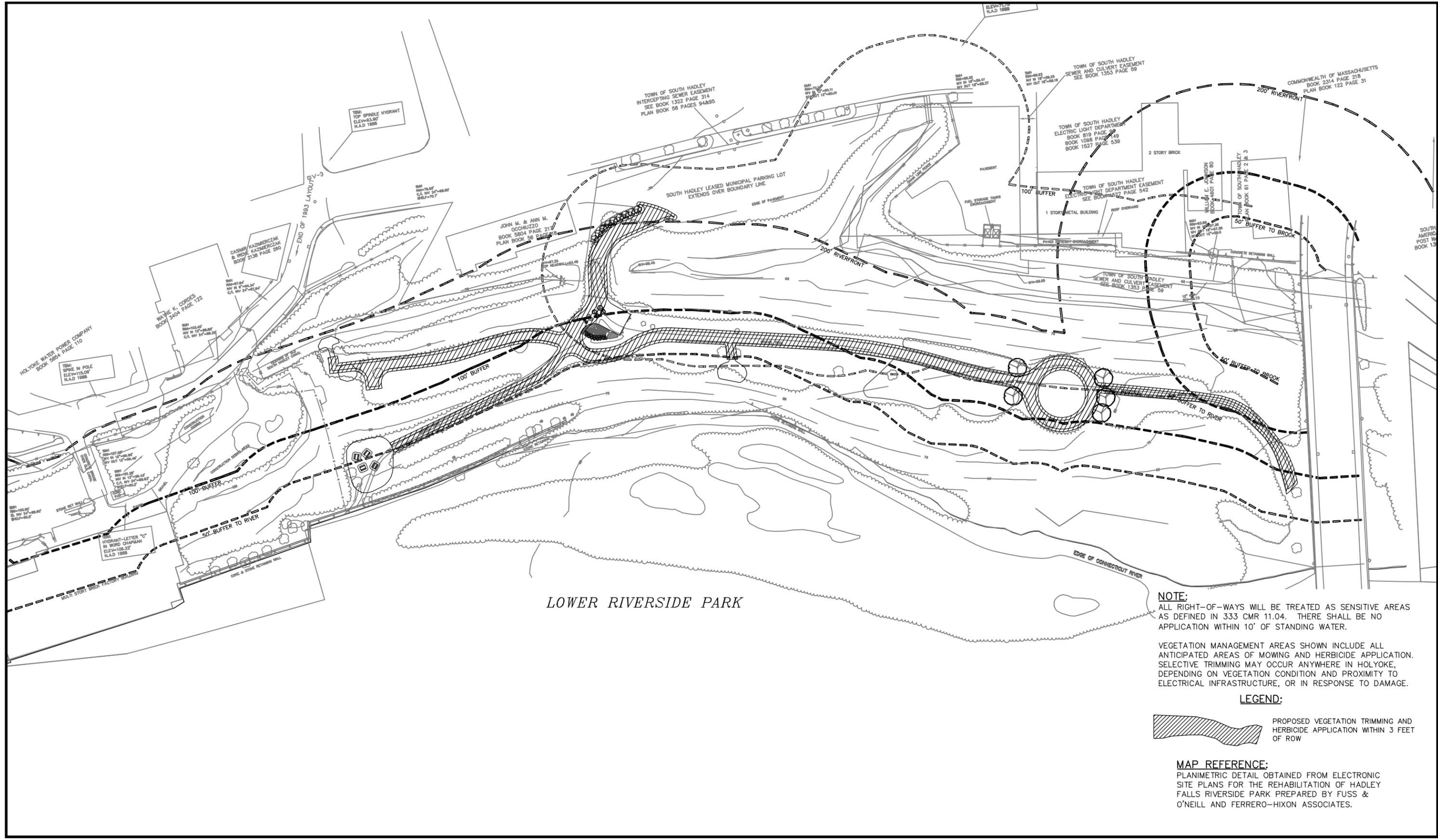
CTB: F&O Standard
 LMAN: ELEC-WELLS
 MS VIEW: 1000.E3
 LUCS: WRLD

Appendix L

Public Notice and MDAR YOP Approval Letter

Appendix M

Lower Riverside Park ROW Map



LOWER RIVERSIDE PARK

NOTE:
ALL RIGHT-OF-WAYS WILL BE TREATED AS SENSITIVE AREAS AS DEFINED IN 333 CMR 11.04. THERE SHALL BE NO APPLICATION WITHIN 10' OF STANDING WATER.

VEGETATION MANAGEMENT AREAS SHOWN INCLUDE ALL ANTICIPATED AREAS OF MOWING AND HERBICIDE APPLICATION. SELECTIVE TRIMMING MAY OCCUR ANYWHERE IN HOLYOKE, DEPENDING ON VEGETATION CONDITION AND PROXIMITY TO ELECTRICAL INFRASTRUCTURE, OR IN RESPONSE TO DAMAGE.

LEGEND:
 PROPOSED VEGETATION TRIMMING AND HERBICIDE APPLICATION WITHIN 3 FEET OF ROW

MAP REFERENCE:
PLANIMETRIC DETAIL OBTAINED FROM ELECTRONIC SITE PLANS FOR THE REHABILITATION OF HADLEY FALLS RIVERSIDE PARK PREPARED BY FUSS & O'NEILL AND FERRERO-HIXON ASSOCIATES.

UCS: RIVERSIDE PARK
IMS VIEW:
LIMAN: RIVERSIDE
CTB: F&O Standard

PROJ. MANAGER:		
CHIEF DESIGNER:		
REVIEWED BY:	DATE	
1.	DATE	DESCRIPTION
No.	DATE	DESCRIPTION
REVISIONS		BY

SCALE:	HORZ: 1" = 100'
	VERT: N/A
DATUM:	HORZ:
	VERT:
0 50 100	
GRAPHIC SCALE	



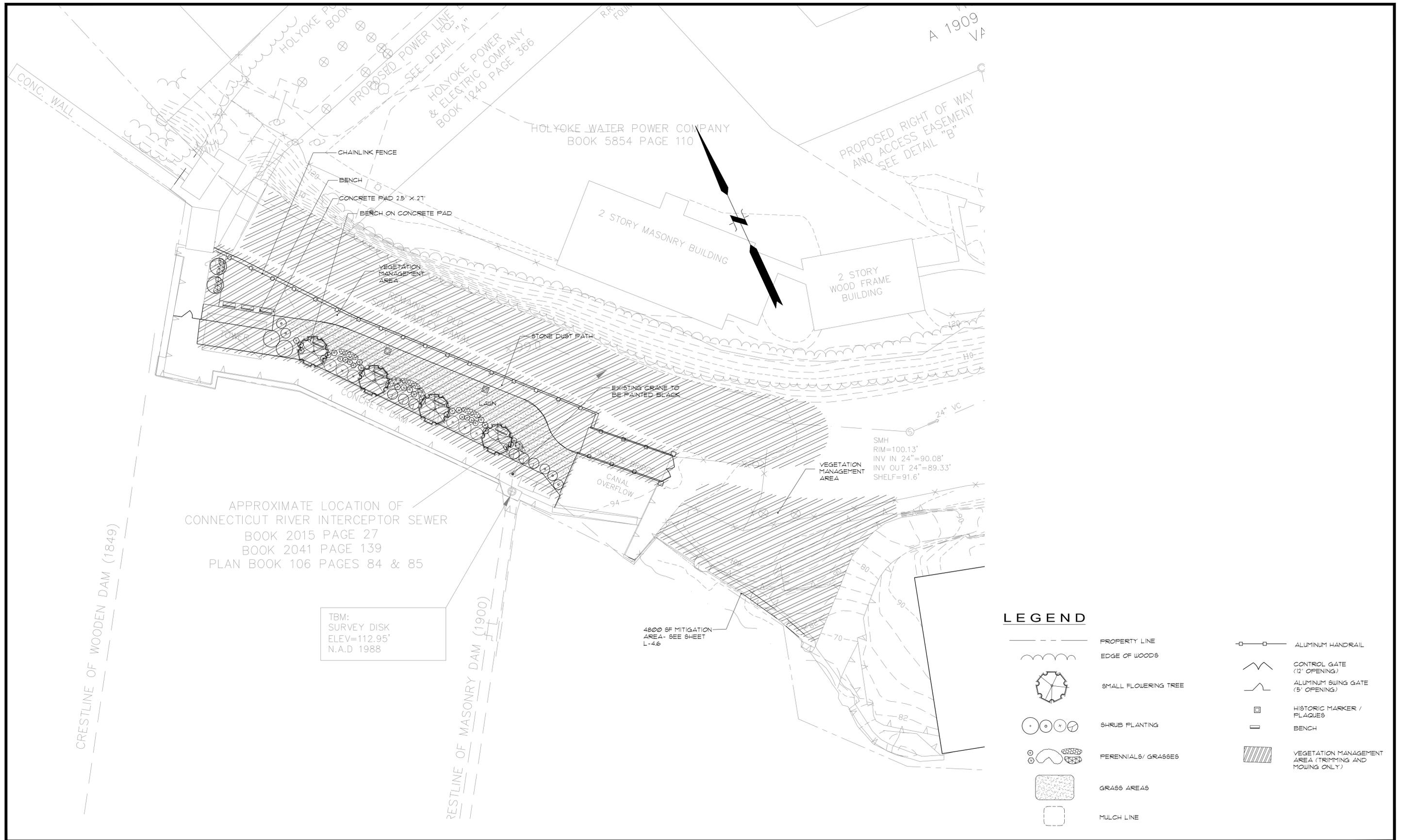
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YEARLY OPERATIONAL PLAN 2012
HOLYOKE MASSACHUSETTS

PROJ. No: 2000727.A88
DATE: JANUARY 2013
LRP

Appendix N

Gatehouse Park ROW Map



No.	DATE	DESCRIPTION	BY
2	1/27/11	PLANT LIST UPDATE	BS
1	1/13/11	ADDITIONAL MITIGATION AREA / PLANT LIST BOT. NAME UPDATE	BS
REVISIONS			

PROJ. MANAGER:	MRG
CHIEF DESIGNER:	ATB
REVIEWED BY:	DATE

SEAL	
------	--



FERRERO HIXON ASSOC
 Landscape Architects & Planners
 P.O. Box 425 Simsbury, Connecticut 06070
 Phone (860) 658-0456 Fax (860) 658-5580

SCALE:
 HORZ.: 1" = 20'
 VERT.:
 DATUM:
 HORZ.:
 VERT.:
 GRAPHIC SCALE

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APP. N