

Yearly Operational Plan 2022

Holyoke Gas & Electric Department Holyoke, Massachusetts



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Note: Species-specific maps are not included in the redacted version of the YOP. For further information contact Lauren Glorioso at the Natural Heritage and Endangered Species Program at (508) 389-6362 or lauren.glorioso@state.ma.us.

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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 2018–2022, which is attached to this document as *Appendix A*. This 1-year plan provides a detailed program for vegetation management for the calendar year 2022 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 is also posted on the Holyoke Gas & Electric Website as allowed in 333 CMR 11.06(3).

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 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 2022

ROW Type	Location
Gas Distribution Vaults <i>(Appendix B)</i>	<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 <i>(Appendix B)</i>	<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 south, cross country, to access road (Dailey's Road) west of Ashley Reservoir (these areas are MOW ONLY).

ROW Type	Location
	<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).

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.

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.

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 area). Within those portions of the sensitive area where herbicide application is allowed (i.e., limited spray areas), the use of herbicides and application methods recommended jointly by the MDAR and Massachusetts Department of Environmental Protection (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*.

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 areas and limited herbicide treatment areas.

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

Sensitive Area	No Spray Area	Limited Spray Area	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

¹Maps are located in *Appendices B and C*

²Methods are shown in *Appendix E*



Public Surface Water Supply	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	
	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

³ Well list is contained in *Appendix K*.

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
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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 AREA surrounding surface waters, private water supplies, and public surface and groundwater supplies. If the herbicide treatment to be used is different within the LIMITED SPRAY AREA than in the adjacent non-sensitive area, then YELLOW flagging will be used to mark the outer boundary of the LIMITED SPRAY AREA. If herbicides approved for use in sensitive areas are to be used in adjacent non-sensitive areas, no flagging of the outer boundary of the LIMITED SPRAY AREA is necessary.

If herbicide treatment on or within 10 feet of a wetland will be used in the adjacent LIMITED SPRAY AREA, the 10 feet boundary from the wetland will be flagged RED and YELLOW. If the adjacent LIMITED SPRAY AREA 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 in writing the names and phone numbers of key contacts who will know where work is happening at any given time.
- Within one (1) year 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.
- Should vegetation management be necessary in areas that are not shown in the YOP mapping, NHESP must be provided with a minimum 72 hour 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/eea/agencies/dfg/dfw/natural-heritage/land-protection-and-management/invasive-species/invasive-plants.html> 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**. *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).* 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:
 - f. Mowing shall be avoided in these areas between April 1st and November 1st. If mowing *must* occur between April 1st and November 1st, 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.
 - g. Maintenance conducted between November 2nd and March 31st poses minimal risk to state-listed snakes and can proceed as described elsewhere in this document.
 - h. Any snakes encountered should be avoided by vehicles or heavy equipment.
 - i. 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).

A subset of ROW areas proposed for vegetation management activities in 2022 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 include the snake species [REDACTED].

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** (*Figures 3 and 4*). These include turtle species ([REDACTED]) and salamander species ([REDACTED]). 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 (*Appendix I*). These recommendations for turtles include:
 - j. Avoiding such areas between April 1st and October 31st. In general, activities associated with vegetation management that are conducted between November 1st and March 31st will pose minimal or no risk to state-listed turtles.
 - k. No special conditions are required for hand-cutting target vegetation or for herbicide applications.
 - l. Mandatory training for staff conducting vegetation management work within Turtle Habitat from April 1st and October 31st.
 - m. For work between April 1st and October 31st, 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*.
 - n. If at all possible, avoid work between May 25th and July 5th, the prime nesting season for most state-listed turtle species.
 - o. If mowing is to occur between April 1st and October 31st, 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.
 - p. 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).

Work within areas labeled as “VP Habitat” shall implement the BMPs described in the document “ROW Vegetation Management in Vernal Pool Habitat” included in *Appendix I*. Specific recommendations 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 December 1st and February 28th:
 - i. In general, maintenance activities associated with VMPs that are conducted between December 1st and February 28th will pose minimal or no risk to state-listed amphibians.
- d. Vegetation Management conducted between March 1st and November 30th:
 - 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 “NHESP Animal Observation Form,” 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, and Bird Priority Habitats”. Vegetation management activities, excluding the broadcast application of herbicides, occurring within these areas between November 2nd and April 14th 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 April 15th and November 1st 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:
 - q. 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. Herbicide application shall avoid grasses/sedges, ferns, or forbs.
 - r. Mowing of host plants shall be avoided from April 1st to November 15th.
 - s. Treat as necessary in ROW – where plants important to Lepidoptera do not interfere with the regular maintenance of the ROW, they should not be cut or treated.
 - t. 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 November 2nd and April 14th pose minimal or no risk to state-listed plant species and can proceed as described elsewhere in this YOP. For activities between April 15th and November 1st, 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:

- u. Delineate population and avoid – Requires delineation by NHESP-approved botanist and NHESP approval prior to any vegetation management activities
- v. Avoid herbicide on grasses/sedges, ferns or forbs
- w. Avoid herbicide on grasses/sedges, ferns, forbs or vines
- x. Leave unmowed during sensitive dates – April 1 to November 15

A subset of ROW areas proposed for vegetation management activities in 2022 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 [REDACTED].

7. A subset of ROW areas are mapped, in part, for the presence of known [REDACTED] nesting sites (*Figure 1*). Within these ROW areas, extra care should be taken to avoid disturbing breeding birds by following the following recommendations:
 - y. Avoid work during breeding season, January 1st through August 15th. The breeding season for [REDACTED] 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 one (1) year 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.

5 Herbicides Proposed Including Application Rates, Carriers, and Adjuvants

Herbicides that may be used on the ROWs during the calendar year 2022 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	228-570	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, butoxyethyl 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 area

Trade Name	EPA Reg.	Active Ingredient(s)	Application Method	Carrier/ Adjuvant*	Percent Solution	Application Rates
Garlon 4 Ultra	62719-527	Triclopyr, butoxyethyl 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 area
Cambistat	74779-3	Paclobutrazol	Soil Injection & Basal Drench	None (mix with water only) Non-ionic, organosilicone surfactant for high clay content or compacted soils	8.33%	Manufacturer's label recommendations; lowest labeled rates

*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, and 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.

Soil Injection

Soil injection is the injection of herbicide into sites at the base of the tree. The number of injection sites is based on manufacturer’s instructions. The required dose is divided evenly among injection sites and spaced uniformly around the base of the tree close to the point of contact between the soil and the tree. The number of injection sites, depth of injection, volume of herbicide and pressure used for application should follow manufacturer’s directions.

Basal Drench

Basal drench is the application of herbicide into a small trench at the base of the target tree. The tree and soil should be inspected and treatment should not occur if severe trunk injury or significant girdling of roots are present. If the soil is saturated with water, treatment should be delayed until soil dries out. Tree species need to be accurately identified in order to determine dosage based on manufacturer's directions. For application, a small trench is excavated around base of the tree that is a minimum of 4 inches deep and 3 inches wide; deeper if there is a potential of herbicide moving to other plants, or if the soil is a heavy clay or is compacted. Excavated soil should be kept on the outside of the trench. The proper herbicide dose should be applied slowly and evenly around the whole tree. After the herbicide is completely absorbed into the soil, excavated soil should be firmly packed down in the trench to prevent runoff.

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. All applicators will be appropriately licensed and will be supervised on site by personnel possessing a ROW category license (Cat.40). 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)
East Windsor, CT 06088
(860) 292-8700

Northern Tree Service
1290 Park
Palmer, MA 01069
(413) 596-6132

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

All Reliable Services, Inc.
159 Hampton Point Drive
St. Augustine, FL 32092
(267) 648-3653

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

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

B&J's Lawn Care
14 Ernest Lane,
Holyoke, MA 01040
(413) 532-8355
Contact: Bob McKenzie

8 Identification of Target Vegetation

For the purpose 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:

Common Name

Grape Vines
Virginia creeper
Poison ivy
Mulberry

Scientific Name

Vitis spp.
Parthenocissus quinquefolia
Toxicodendron radicans
Morus spp.

<u>Common Name</u>	<u>Scientific Name</u>
Staghorn sumac	<i>Rhus birta</i>
White ash	<i>Fraxinus americana</i>
Cottonwood	<i>Populus deltoides</i>
Poplar	<i>Populus spp.</i>
Silver maple	<i>Acer saccharinum</i>
Red oak	<i>Quercus rubra</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 lenta</i>
Japanese bamboo	<i>Polygonum cuspidatum</i>
Dogwood	<i>Swida spp.</i>
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 umbellata</i>
Japanese barberry	<i>Berberis thunbergii</i>
Exotic bush honeysuckle	<i>Lonicera spp.</i>
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. The contact person at Fuss & O'Neill is:

Diane M. L. Mas, PhD, RS/REHS
Associate
Fuss & O'Neill, Inc.
1550 Main Street, Suite 400
Springfield, MA 01103
Telephone: 860-646-2469 ext. 4433
dmas@FandO.com

The individual responsible for supervision of the YOP implementation is:

Christopher Perry
Environmental Health and Safety Coordinator
Holyoke Gas & Electric Department
99 Suffolk Street
Holyoke, MA 01040-5082
Cell: 413-563-9818
Cell: 860-944-4942
Fax: 413-536-9315
Email: CPerry@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 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)	(800) 345-3330
Rainbow Treecare Scientific Advancements (Cambistat)	(877) 272-6747
Holyoke, Chicopee, and South Hadley Fire and/or Police Departments	911
Holyoke Gas & Electric Department (EH&S Coordinator)	(413) 563-9818
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) 594-1515
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) 626-1784
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 2018-2022

Vegetation Management Plan 2018 - 2022

Holyoke Gas & Electric
Holyoke, MA

January 2019



gas | electric | steam | telecom



FUSS & O'NEILL

1550 Main Street, Suite 400
Springfield, MA 01103

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1 Introduction

The purpose of this Vegetation Management Plan (VMP) is to outline the City of Holyoke Gas and Electric Department (hereafter referred to as “HG&E”) plan for managing vegetation during the five-year period 2018 through 2022 in compliance with the Rights-of-Way (ROWs) Management regulations 333 CMR 11.00 (see *Appendix B*). This VMP addresses the HG&E plan for managing vegetation along rights-of-way associated with their gas and electrical transmission and distribution operations as well as the approximately 8 miles of ROWs along the three canals in Holyoke, Massachusetts managed by HG&E. In addition, included in *Appendix A* of this VMP is additional guidance intended to meet the requirements of the NERC Standard Compliance Template FAC-003-1 Requirement 1 for vegetation management specifically for transmission lines. This information is included to satisfy the ISO New England self-certification for the compliance with the NERC requirement cited above. The North American Electric Reliability Corporation (NERC) Transmission Vegetation Management Plan (TVMP) is included as *Appendix A* to consolidate HG&E vegetation management-related documentation.

In addition to the utility ROWs listed above, the VMP addresses vegetation management activities in ROWs associated with public pathways owned and maintained by HG&E and located in Lower Riverside Park, and Gatehouse Park in South Hadley, Massachusetts.

2 Goals and Objectives

2.1 Goals of the Vegetation Management Plan

The primary goals of this utility right-of-way VMP are the control of vegetation and the establishment of standard operating procedures relative to vegetation management to maintain the safe and uninterrupted electric, gas and the hydropower systems of HG&E. The provision of physical and visual access to HG&E equipment and lines is also necessary to permit routine and emergency maintenance and operation in order to provide continuous and reliable utility service. Additional goals for ROWs in Lower Riverside Park and Gatehouse Park include removal and control of nuisance and invasive species to provide safe access and passage for the public utilizing the parks.

An additional goal of this VMP is that the vegetation management practices along all HG&E ROWs are conducted in the most environmentally sound manner through an integrated vegetation management (IVM) program that will continue to minimize the reliance upon herbicides and encourage the growth of herbaceous species within the ROWs. In certain locations, the frequency of application has been reduced since the HG&E program was started over a decade ago. For example, at Lower Riverside Park application was not necessary in 2016. At Gate House Park, no application was required after 2014. Application at Race Street (near the canals) has not occurred since 2013. Achieving less frequent or reduced volume applications continues to be a goal of the VMP.

This VMP is a guidance document that forms the basis for the Yearly Operational Plans (YOPs). A YOP will be prepared for each year of the VMP to provide a detailed description of the vegetation management activities to be conducted in that calendar year.

2.2 Objectives of the Vegetation Management Plan

The primary objectives of the VMP are:

- the selective elimination of woody vegetation that has the potential to fault overhead conductors on the ROW, causing circuits to open and leading to interruptions in electrical service;
- the maintenance of a required low-growth area around gas distribution vaults in accordance with requirements of the Massachusetts Department of Public Utilities;
- the control of vegetation to provide physical and visual access to above-ground lines and equipment and the canal banks for inspection, maintenance and repair;
- the selective elimination of woody vegetation to protect the structural integrity of the canal walls by preventing root systems from penetrating and damaging the masonry walls of the canals, which could impact power generation; and
- control of nuisance vegetation (e.g., poison ivy), invasive species, and maintenance of low-growth areas along pathway ROWs in Lower Riverside Park and Gatehouse Park to provide safe access and passage for the public and emergency vehicles.

The program -outlined in this VMP is also designed to maintain an acceptable appearance of the rights-of-way, as well as minimize erosion and inhibit the re-establishment of target tree species by encouraging the development of ground cover and low shrubs.

The management program will accomplish these objectives in a cost effective manner with appropriate regard for worker safety, protection of public health and the environment from unreasonable adverse effects, and in compliance with all applicable Local, State, and Federal laws and regulations.

In order of preference by HG&E, this VMP will involve the use of mechanical, chemical, and cultural control techniques to control undesirable vegetation in an ecologically sound manner. The choice of the target vegetation and appropriate control technique will be the core of the program. 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.

This VMP is intended to provide State and Local officials, and any other interested parties, a basic source of information on the HG&E VMP. This document is further designed to provide overall guidance for the licensed and certified applicators working on behalf of the HG&E to implement the VMP.

2.3 Location of Rights-of-Way

The ROWs for electrical transmission and distribution lines are primarily located within the City of Holyoke, with a limited amount of lines extending into the adjacent City of Chicopee. Approximately 906 pole miles of transmission and distribution lines provide service.

Transmission lines operate at a voltage of 115 KV and connect the HG&E generating facilities with substations and are also interconnected with the transmission facilities of other utilities. The distribution lines operate at 4,800 and 13,800 volts. Bulk supply lines link substations and local distribution lines. The latter provide electrical service to HG&E customers.

The majority of the local distribution lines are located along roads and driveways. The remainder of the lines are off-road and traverse a variety of land uses. Although included in prior VMPs, the above ground steam distribution and condensate lines located in downtown Holyoke have been decommissioned and removed. While the gas distribution lines are located below ground, gas distribution vaults contain pressure regulating/relief stations that may have equipment projecting above ground. These stations reduce and control the gas pressure in a pipeline downstream from a higher pressure source of natural gas.

The HG&E canal ROWs are located in the City of Holyoke (see *Figure 1*). The three-level canal system extends through the lower areas of the City of Holyoke and provides water for industrial and hydropower generation. The canal ROWs total approximately 8 miles in length.

Lower Riverside Park is located along the Connecticut River in South Hadley, Massachusetts. The recreational park is located downstream of the Holyoke Dam, east of Route 202, and west of Route 116. The nearly 8.4 acre park has approximately 1,300 linear feet of pathways providing public pedestrian, ADA and emergency vehicle access, limited parking, and a viewing platform (*Figure 1*).

Gatehouse Park is located along the Connecticut River in South Hadley, Massachusetts, upstream of Lower Riverside Park. This park is located adjacent to the Holyoke Dam, east of Route 202 and west of Route 116. The park provides public access and is approximately 350 feet long and 100 feet wide and provides a picnic area overlooking the dam (*Figure 1*).

2.4 Summary

In summary, the goals and objectives of this plan are as follows:

- To utilize an IVM program designed to maximize control of undesirable vegetation while minimizing the use of herbicides through their judicious use.
- To maintain the canal ROWs to their full width.
- To coordinate vegetation management activities with the existing Comprehensive Canal Operations Plan (CCOP) and Threatened and Endangered Species Protection Plan for the canals.

- To insure that all vegetation management operations are conducted in a safe, effective manner and in conformity with Local, State and Federal laws, regulations and permit conditions.
- At a minimum, to treat all public or private ground and surface drinking water supplies, surface waters, wetlands and water over wetlands, inhabited areas, agricultural areas, certified vernal pools, and priority habitat areas as sensitive sites that require special consideration during vegetation management operations.
- To hand cut or mow when possible, especially to protect environmentally sensitive sites and other areas where herbicide use is not permitted.
- To retain appropriately certified and licensed applicators to implement the HG&E VMP.
- To have an HG&E representative respond quickly to any questions or complaints from the public and/or governmental agencies that relate to the VMP.
- To perform an annual review of the VMP to assess treatment and cost effectiveness, environmental effects, public safety and compliance with regulations.

3 Identification of Target Vegetation

For the purposes of this plan, plant species are divided into two groups, (1) undesirable (i.e. target) species capable of interfering with conductors and access to electric lines and gas distribution vaults and/or capable of damaging the canal walls and access to canals, and (2) desirable species. 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 IVM.

In general, undesirable species include trees, tall maturing shrubs (i.e., greater than 12 feet in height) and vines. This includes, but is not limited to, conifers, pines, grape vines, Virginia creeper, bittersweet, poison ivy, mulberry, staghorn sumac, catalpa, white ash, cottonwood, poplar, silver maple, red oak, American elm, box elder, black cherry, black birch, black locust, dogwood, Japanese knotweed, Norway maple, tree of heaven, autumn olive, Japanese barberry, exotic bush honeysuckle, and black willow. Grasses also may be considered target species in the immediate vicinity of the gas distribution vaults. Removal of other undesirable species is necessary to facilitate physical and visual access to the ROWs for inspection, maintenance and repair.

Desirable species in the canal, electric line, and park ROWs include low maturing shrubs, ferns, grasses, herbs, and wildflowers. In the area immediately surrounding the above-ground portions of the gas distribution vaults (i.e., an approximately 10-foot radius), only low-growing grasses are desirable.

4 Methods of Vegetation Management and Rationale for Use

Vegetation along the ROWs will involve IVM, including cultural (e.g. encouraging the growth of low-growing, herbaceous species), 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.

4.1 Planting

Where appropriate on the canal ROWs, planting that encourages the development of a stable herbaceous layer and eliminates the presence of woody species along the canal banks may be used. It is anticipated that planting for slope stabilization and erosion and sedimentation control may also be required in areas where tree species are removed by mechanical methods. Planting of wildflower species for habitat and aesthetic benefit may occur along the park ROWs.

4.2 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 render mowing impossible or impractical. Hand cutting may be used at any time of the year.

4.3 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.

4.4 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.

4.5 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. Both are used to apply the herbicide solution to lightly wet the target plants.

Foliar treatments are used on woody plants, grasses, weeds and conifer species, except in wetlands. All tree species less than 12 feet in height will be foliar herbicide treated. Treatment 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.

4.6 Cut Stump Treatment

Cut stump treatments consist of mechanical cutting of target species typically using chain saws immediately followed by a herbicide treatment applied with a squirt bottle or painted on the freshly cut surface of the stump. The herbicide application is limited to the freshly cut surface of the remaining stump. Similar to the hand cutting procedures, target species are cut as close to the ground as practical with stump heights usually not exceeding three inches. Hard or softwoods greater than 12 feet tall will be cut stump treated. Cut stump application is preferred during the dormant period.

4.7 Summary of Control Strategies

Control strategies for the HG&E ROWs can be generally categorized as follows:

Table 1 – Summary of Control Strategies

Target	Techniques	Comments
Poison Ivy	Foliar	No treatment in no spray areas around sensitive areas.
Grasses	Mowing	In most cases, grasses will be mowed.
	Foliar	Spot treatment of grass growing along fencing or cracks where mowing or cutting is not practical, except in no spray area around sensitive areas.
Low Growth	Mowing	In most cases; option for sensitive areas.
	Foliar	Where terrain prevents mowing or hand cutting; rapid resprouting species, except in no spray areas around sensitive areas.
	Hand cutting	Where terrain prevents mowing and resprouting is not a concern option; option for sensitive areas.
Tall Growth	Selective trimming	In cases where the visibility or interference does not warrant removal of entire vegetation; option for sensitive areas.

Target	Techniques	Comments
Tall Growth (continued)	Hand cutting	Terrain prevents mowing; mowing not effective due to stump size; species greater than 12 feet in height that will not resprout; option for sensitive areas.
	Foliar	Used on hardwoods less than 12 feet in height, except in no spray areas around sensitive areas.
	Cut stump	For situations where the size of the vegetation, the potential for off-target drift, or other considerations preclude the use of foliar applications, except in no spray areas around sensitive areas.

5 Justification of Herbicide Applications

The HG&E vegetation management plan supports HG&E's mission of providing reliable electric, steam, and gas service at a reasonable cost to its customers while placing primary importance on health, safety and environmental protection, as well as providing a safe and accessible recreational area at Lower Riverside Park and Gatehouse Park. The use of herbicides on rights-of-way should not cause unreasonable adverse effects to health and the environment when used according to label directions. All herbicides proposed for use are regulated by the U.S. Environmental Protection Agency and approved for use by the Massachusetts Department of Agricultural Resources (MDAR). All herbicides will be applied by contractors that are licensed/certified by the State and in accordance with herbicide label directions and precautions, as well as all applicable Federal and State laws and regulations.

This section describes the relative benefits of herbicide control and describes why herbicide use is justified on the ROWs.

5.1 Regulation of Stem Density and Plant Composition

Prior to initiating the HG&E VMP in the late 1990s, wood vegetation was growing in and adjacent to the HG&E canal walls, threatening to compromise the structural integrity of the walls. Over the past decade, a program of mechanical removal and herbicide application has results in the elimination of woody vegetation and the establishment of grasses.

5.2 Wildlife Habitat

Selective application of herbicides will support the development of a stable plant community. In certain areas of the ROW, this will provide habitat in an otherwise highly urban environment. In other areas, selective herbicide use will develop an edge habitat and environment beneficial to a variety of species including deer and song birds that typically use ROWs for food, cover and travel corridors. In addition,

selective herbicide application will reduce the need for mechanical removal methods and the associated potential for erosion.

5.3 Economics

A VMP utilizing only mechanical removal methods would be cost prohibitive. When hand-cutting or mowing is done without follow-up application of herbicide, the root system of the plant remains alive and is capable of resprouting and the single stem that was removed is replaced by multiple sprouts. This results in a repeated need for clearing due to resprouts, which has a cost that is typically multiple times the cost of a single herbicide application. In addition, the mechanical clearing usually must be performed two to three times more often than selective herbicide treatment, increasing costs. While hand clearing is necessary in some areas (i.e., in restrictive sensitive areas, when the weather conditions are unsuitable for herbicide application, or when woody vegetation is too tall for effective herbicide application), in general, the high per acre cost of mechanical removal coupled with the lack of sprout control and the necessity for more frequent maintenance reduce the long-term effectiveness of mechanical removal methods without accompanying herbicide treatment.

5.4 Erosion Control

Selective herbicide control encourages the development of a dense ground cover that provides soil stabilization and prevents erosion.

5.5 Noise and Air Pollution

Exclusive use of mechanical cutting methods would result in increased air and noise pollution compared to control integrating herbicide application.

5.6 Safety

In several locations the banks of the canal are steep, creating difficult conditions for the operation of mechanical removal equipment. Consequently, selective herbicide treatment that reduces the need for and frequency of mechanical clearing on steep areas of the ROW would lessen the potential for equipment or personnel accidentally entering the canals.

The canals and, in several locations, the utility lines, are located in highly urban areas. Consequently, providing visual and physical access to the ROWs is important to discourage inappropriate activities within the ROWs adjacent to the lines and canals and to facilitate rapid access by HG&E and emergency services personnel in the event of an emergency on or adjacent to one of the lines or canals.

For fire safety reasons, the Massachusetts Department of Public Utilities requires that the area around each gas distribution vault remain clear of sources of ignition. Consequently, vegetation removal is important to reduce the potential for secondary brush fires that could occur around heavily vegetated gas distribution vaults in the event of an emergency resulting from an accidental gas release.

As previously noted, the control of woody vegetation is a primary goal of this VMP. However, elimination of some nuisance vegetation species, such as poison ivy, is also necessary to facilitate safe access to the utility lines and canals for maintenance and inspection by HG&E personnel, as well as providing safe access for the public in Lower Riverside Park and Gatehouse Park. Due to the low growing nature of poison ivy, it is nearly impossible to control it through cultivation, hand pulling or mowing at the height generally used in ROW mowing operations. Moreover, the climbing characteristics of this plant over tree trunks and fences make mechanical control out of the question for safety and economic reasons. Through the selective use of herbicides, the development of herbaceous communities that crowd out poison ivy can be achieved.

6 Sensitive Area Identification and Vegetation Control Strategies within Sensitive Areas

6.1 Methods, References and Sources for Identifying Sensitive Areas

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, state-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.

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.

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 areas). Within those portions of the sensitive area where herbicide application is allowed (i.e. limited spray areas), the use of herbicides and application methods recommended jointly by the MDAR and Massachusetts Department of Environmental Protection (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 the annual YOP.

6.2 Areas Not Readily Identifiable in the Field

Sensitive areas not readily identifiable in the field include public groundwater supplies, private water supplies and public surface water supplies. The reference materials and sources used to identify sensitive areas not readily identifiable in the field include, but are not limited to the following:

- US Geological Survey (USGS) Topographic maps
- City of Holyoke Well List
- Massachusetts DEP Watershed Maps (1:25,000); delineates the perimeter of public watersheds and the location of public wells
- Massachusetts DEP Wetland Conservancy Maps (scale usually 1:1,000)
- Municipal maps and records, including information provided in response to the required municipal notification letters to the Board of Health, Conservation Commission, etc.
- Meetings with municipal officials or street abutters prior to or during treatment operations, and information provided to the HG&E during the public review of the YOP
- Regional Planning Agencies maps and records
- US Fish and Wildlife Services National Wetlands Inventory maps
- Readily available online MassGIS mapping.

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 in the field.
- Place the boundaries of these sensitive areas on 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 boundaries or the boundaries of the appropriate buffer zone.

6.3 Areas Readily Identifiable in the Field

Sensitive areas readily identifiable in the field include surface waters, wetlands, inhabited areas, and agricultural areas. 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.
- Submission of a Request for Determination of Applicability for work within 100 feet of a wetland in the South Hadley parks.
- Appropriate distances will be measured from sensitive areas to identify no herbicide treatment areas and limited herbicide treatment areas.

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

Sensitive Area	No Spray Area	Limited Spray Area	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 and identify on site
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 and identify on site
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
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
	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	
	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	

Sensitive Area	No Spray Area	Limited Spray Area	Where Identified
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 and identify on site
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 and identify on site
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
State-listed Species Habitat	No application within habitat area except in accordance with a Yearly Operational Plan approved in writing by the Massachusetts Division of Fisheries and Wildlife Natural Heritage & Endangered Species Program (NHESP)		YOP Maps

6.4 Control Strategies for Sensitive Areas

The following strategies will be utilized in all areas:

- Herbicides will be used in accordance with the VMP and YOP, which will be carried with the applicator at all times.
- Herbicide treatments will be made only by applicators that are appropriately certified and/or licensed by the MDAR.
- No foliar application will be used to control vegetation greater than 12 feet in height.
- Touch up applications will occur within 12 months of the date of approval of the YOP and no more than 10% of the initially identified target vegetation on the ROW may be treated and the total amount of herbicide applied in any one year shall not exceed the limits specified by the label and the YOP.
- The MDAR; the Holyoke, Chicopee, and South Hadley Conservation Commissions; the Holyoke, Chicopee, and South Hadley Boards of Health; the Mayors of Holyoke and Chicopee, and the South Hadley Board of Selectmen will be notified by registered mail at least 21 days prior to any application.
- Herbicide concentrates shall not be handled, mixed, or loaded on a right-of-way within 100 feet of a Sensitive Area.
- No herbicide shall be applied when the wind velocity is such that there is a high propensity to drift off target and/or during measurable precipitation.

In addition, the following strategies will be utilized in sensitive areas:

- A minimum of 24 months will elapse between herbicide applications in the limited herbicide treatment areas of public ground water supplies, public surface water supplies, and private drinking water supplies.
- A minimum of 12 months will elapse between herbicide applications in the limited herbicide treatment zones of surface waters, wetlands, certified vernal pools, and inhabited and agricultural areas.
- No more than the minimum labeled rate of herbicide appropriate to the site, pest (i.e., target vegetation), and application method will be applied in Sensitive Areas.
- Herbicides recommended for sensitive areas and guidelines for their use will be followed in accordance with the MDAR's list of approved herbicides for sensitive areas on rights-of-way.
- Herbicides shall be applied selectively by low pressure foliar techniques or stem applications. Foliar applications must include the use of appropriate anti-drift agents, and must not result in the off-target drift to non-target species. Cut stump treatments may be conducted in those situations where the size of the vegetation, the potential for off-target drift, or other considerations preclude the use of foliar applications. Cut stump applications shall be restricted, when practicable, to periods when static ground water levels are low or conditions consistent with label restrictions.
- All other limitations placed on Sensitive Areas will be followed as provided by 333 CMR 11.04.

In areas where herbicides are prohibited (No Spray Areas), mechanical methods only will be used.

6.5 Massachusetts Endangered Species Act

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 Division 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 PH areas by the Natural Heritage & Endangered Species Program (NHESP) of the DFW. Pursuant to 333 CMR 11.04(3)(b), the management of vegetation within existing utility rights-of-way is exempt from the requirements of 321 CMR 10.18 through 10.23, provided that the management is carried out in accordance with a YOP approved in writing by the DFW, pursuant to 321 CMR 10.14(12).

A Threatened and Endangered Species Plan was prepared for the canals to comply with the licensing agreement issued by the Federal Energy Regulatory Commission for the Holyoke Hydroelectric Project and this Plan applies to vegetation management within and along the Holyoke Canals, along the Pioneer Valley Railroad, and along the Connecticut River.

A subset of utility ROW areas (including Lower Riverside Park and Gatehouse Park) proposed for vegetation management activities are mapped, in part, for the presence of state-listed snake species, state-

listed salamander species, state-listed turtle species, state-listed plant species, and state-listed lepidoptera (moth and butterfly) species. Specific requirements developed by the NHESP for vegetation management in these areas are detailed in the YOP.

7 Operational Guidelines for Applications

HG&E will contract all of the vegetation management applications to applicators who maintain current appropriate licensure by the Commonwealth of Massachusetts. Applications will be on-site supervised by a certified applicator with a Rights of Way Commercial Certification (Category 40). All contractors will be required to comply with all applicable Local, State and Federal laws and regulations, including 333 CMR 11.00. In addition to the applicable rules and regulation, applicators will adhere to the following operational guidelines.

7.1 Safety

The HG&E VMP will comply with all appropriate Local, State and Federal safety laws and regulations. This includes applicable sections of the MDAR Pesticide Bureau “Storage, Mixing and Loading of Pesticides Guidelines”, and all worker safety related statements and instructions on the herbicide label.

7.2 Weather

Herbicide application will be restricted during certain adverse weather conditions, such as rain, wind or deep snow.

Herbicide applications will not be made during periods of moderate or heavy rainfall. Foliar applications are effective in light mist situations; however, any measurable rainfall that creates leaf runoff will wash the herbicide off the target species. If foliar applications are interrupted by unexpected rainfall, the treatment will not resume until the rain ends and active leaf runoff has ceased.

Excessive wind can create drift during foliar applications. Significant herbicide drift can cause damage to desirable vegetation on or off the ROW. Cut stump treatments are much less affected by wind because they are applied in such a close proximity to the ground.

To minimize off-target drift, the applicator will comply with the following restrictions:

- During periods of wind, which are strong enough to bend the tops of the main stems of tree species on the ROW, the applicator will periodically observe the application of the foliar treatment to insure that there is no significant movement of the herbicide. If the applicator can see the herbicide moving off target, the application will immediately stop until the wind has subsided enough to permit further application.
- All herbicide solutions to be used for a foliar application will contain low drift agents. Low-drift agents will be added to the foliar herbicide solution as per the low-drift agent label. In moderate wind conditions, as per label recommendations, more low-drift agent may be added, at the discretion of the applicator to control drift.

- Foliar treatments will not be made to target vegetation that exceeds approximately twelve feet in height.

7.3 Equipment Calibration

Foliar application equipment will be calibrated at the beginning of the season, prior to any touch-up application treatment, and in accordance with manufacturer's directions. Foliar application equipment will be adjusted to apply a coarse spray. Pressure at the nozzle of hand-pump sprayers, and air speed and throttles on motorized sprayers, will be kept to the minimum setting required to transport the herbicide solution to the tops of each target and penetrate the foliage to the main stem of each target. Cut stump treatment squirt bottle applicators will be adjusted to deliver the herbicide solution in a thin stream to the target zone of the vegetation.

7.4 Disposal

Surplus herbicides and empty herbicide containers shall be disposed of as described on the herbicide manufacturer's label. To reduce herbicide surplus, the applicator should plan the treatment operation to minimize the amount of excess mixture.

7.5 Record Keeping

The Occupational Safety and Health Act (OSHA) of 1970 requires employers of 11 or more employees to maintain records and prepare periodic reports concerning work-related deaths, injuries, and illnesses. In the Commonwealth of Massachusetts, record keeping is required for all certified commercial applicators and licensed applicators. Operational records must include the information specified in 333 CMR 10.14.

7.6 ROW Vegetation Management Width

The HG&E VMP will be applied to remove and/or control all undesirable vegetation within the ROWs.

7.7 Sensitive Area Restrictions

In defined sensitive areas, there exist no spray areas where herbicide use is prohibited and limited spray areas where herbicide use is allowed under certain conditions. In areas around sensitive areas where herbicide use is allowed, only the minimum labeled rate of application for the control of target species can be applied.

7.8 Identification of No Spray Areas

Prior to commencement of herbicide application operations, the treatment crew will be provided the marked mapping included in the YOP. 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 spray areas and limited spray areas. The Certified Applicator or a point person under his/her supervision will mark no spray buffer areas immediately prior to any application taking place, to make sure no herbicide is applied in such areas. No Spray Areas, where the use of herbicides is prohibited include the following:

Water Supplies

- Zone I
- Interim Wellhead Protection Areas
- Class A Surface Water Sources
- Tributaries to a Class A Surface Water Source
- Class B drinking water intakes
- Private wells

Surface Waters

- Wetlands
- Water over wetlands
- Mean annual high water line of a river
- Outer boundary of a riverfront area
- Certified vernal pools

Cultural Sites

- Agricultural areas
- Inhabited areas

Wildlife Areas

- Certified vernal pool habitat
- Priority habitat

7.9 ROW Specifications

The Certified Applicator in coordination with HG&E or its agent will determine which ROWs are to be treated, the range of dates of treatment and the methods, materials and mixing rates to be used, as defined in the YOP.

HG&E will supply the Licensed/Certified Applicator(s) with maps from the YOP indicating treatment restrictions and written instructions outlining any special treatment considerations of instruction for each right-of-way.

No work will be done until the Licensed/Certified Applicator(s) have the appropriate maps, permits, restriction list, mixing rate instructions, daily log sheets, applicable MSDS and pesticide label, and YOP in-hand, unless otherwise authorized by HG&E.

In addition to the specifications listed above, all treatment crews must carry a copy of the VMP, spill mitigation kit, first aid supplies, and a one hundred foot measuring tape.

7.10 General Requirements

Vegetation management operations must be conducted according to this VMP and according to the written instructions of HG&E. Failure to do so is grounds for immediate cessation of operations and disciplinary action, up to and including discharge, at the discretion of HG&E. The following general requirements must also be followed:

- Label Instructions – Adherence to all herbicide label instructions.
- Designation of Approved Herbicide Mixture – Designation of herbicide (including manufacturer and brand name) carrier and mixture to be used will be provided by HG&E or its representative in coordination with the Certified Applicator prior to the start of work.
- Restriction of Herbicide Treatment Application Due to Precipitation – In the event of moderate or heavy precipitation, herbicide treatment shall cease, and shall not resume until stems and foliage are dry.
- Stump Treatment Applications – Do not apply during periods of precipitation.

8 Identification and Qualifications of Individuals Developing and Submitting the VMP

The individual representing HG&E and responsible for submitting and supervising the VMP is:

Christopher Perry
Environmental Health and Safety Coordinator
Holyoke Gas & Electric Department
99 Suffolk Street
Holyoke, MA 01040-5082
Cell: 413-563-9818
Cell: 860-944-4942
Fax: 413-536-9315
Email: CPerry@hged.com

The VMP was developed by Fuss & O'Neill, Inc. Consulting Engineers. The contact person at Fuss & O'Neill is:

Helena Farrell
Environmental Scientist
Fuss & O'Neill, Inc.
1550 Main Street, Suite 400
Springfield, MA 01103
Telephone: 860-646-2469 ext. 4424
hfarrell@FandO.com

Ms. Casioppo has prepared several YOPs for the HG&E canal and electric, gas, and steam system ROWs.

All herbicide treatments will be performed by a contractor licensed to perform such work in the Commonwealth of Massachusetts.

9 Techniques/Programs to Minimize the Amount and Frequency of Herbicide Application

Integrated Vegetation Management (IVM) as it applies to ROW maintenance, involves utilizing a variety of techniques, both chemical and non-chemical, to control unwanted vegetation in the most ecologically based manner. Implementation of IVM will result in a long-term reduced reliance on herbicides by encouraging the establishment and stabilization of desirable vegetation. The resulting cultural controls will continue to reduce the need for herbicides in the future. Vegetation management activities will use the most suitable techniques in light of the goal of controlling the undesirable vegetation and establishing a stable, beneficial vegetation community, where possible. When used, herbicide use will continue to be minimized through timing of applications to maximize control, and avoiding fixed application schedules while protecting non-target organisms and environmentally sensitive sites.

In certain locations, the frequency of application has been reduced since the HG&E program was started over a decade ago. For example, at Lower Riverside Park application was not necessary in 2016. At Gate House Park, no application was required after 2014. Application at Race Street (near the canals) has not occurred since 2013. Achieving less frequent or reduced volume applications continues to be a goal of the VMP.

The specific components of the ROW program are described in the following sections.

9.1 Monitoring

All ROWs will be inspected prior to any scheduled treatment program. Monitoring will be made by foot or by vehicle.

9.2 Record Keeping

In addition to the record keeping requirements of the Pesticide Board regulations (333 CMR 10.14), a log of areas monitored will be kept for future planning and reference. Areas maintained either through mechanical or chemical control will be recorded.

9.3 Action Levels

Decisions to maintain vegetation (either mechanically or chemically) will be based upon the following priority levels:

Priority One:

Vegetation that is encroaching upon electrical conductors or lines, or is inconsistent with the requirements of the Massachusetts Department of Public Utilities relative to gas distribution vaults and/or is located within or is encroaching upon the walls of the canals. Also, vegetation that is impairing emergency vehicle or Americans with Disabilities Act (ADA) access to the park pathway ROWs.

Priority Two:

Vegetation that interferes with visual or physical access to the ROWs.

9.4 Control Tactics

The decision to use one of the vegetation control techniques will depend on evaluating the specific situation. The goal of the control tactic will be to establish an easily maintainable, stable plant population that will not interfere with the canal walls or overhead electrical conductors and will provide visual and physical access to the above-ground electric lines and equipment, the gas distribution vaults, and the canal walls and provide safe access to the pathways in the park area. Emphasis will be given to the control tactic that will address the vegetation problem in the most environmentally sound manner and in a way to minimize vegetation control in the long term. For example, vegetation control on the canal walls is timed to coincide with other maintenance activities that require drawdown of the canals in order to maintain the required setback from standing water for herbicide application. Generally, control tactics include the following:

- Cultural control – Cultural control refers to the use of ecological principles for the regulation of stem density and species composition by encouraging the growth of low-growing, herbaceous species. As the density of low-growing species increases, the need for control of undesirable vegetation is reduced. If in some locations or situations plantings are necessary to stabilize soils and establish a ground cover, appropriate non-invasive species will be planted.

- **Selective Application Techniques** – Selective application is the application of diluted herbicide mixtures directly to target vegetation with precision. These techniques include cut stump treatment that applies herbicide directly to the remaining stump after mechanical cutting and foliar treatments that minimize the amount of herbicide used by using appropriate spray nozzle pressure, spray adjuvants to reduce the chance of off-target drift, and applications directed at individual plants.

9.5 Selective Herbicides

Selective herbicides affect a particular group of plants with little or no effect on others. For example, removal of grasses may be desirable at certain locations and times. At other locations or times, removal of broadleaf species may be the goal.

9.6 Timing of Applications

Proper timing of herbicide applications is critical to achieve both maximum effectiveness of the herbicides and the long-term success of the vegetation management program. Procedures relevant to treatment timing, both seasonal and daily, include:

- Foliar techniques are typically used after leaves are fully developed and while the plant is still actively growing.
- No herbicide application when the wind velocity is sufficient to result in drift of herbicide to non-target species and/or when there is measurable precipitation.

10 Alternative Land Use Provisions or Agreements Minimizing the Need for Herbicides

Unlike many other rights-of-way that consist of easements on properties not owned by the utility company, the canal rights-of-way are entirely owned by the City of Holyoke Gas and Electric Department. Consequently, opportunities for alternative land use provisions and license or maintenance agreements for the canals are extremely limited.

However, HG&E is continuously evaluating alternative vegetation management methods that allow for land use options and agreements to minimize the need for herbicides in the HG&E ROWs. These methods include the following:

Land Use Provisions

The land use beneath electrical transmission and distribution lines may be residential, commercial, industrial or agricultural. In many cases these land uses have created a vegetation cover that restricts the growth of brush and other target species, eliminating the need for herbicide treatment.

Agreements

Some gas distribution vaults are located within residential neighborhoods and may be “adopted” by neighborhood groups for roadside beautification areas. In this case, the area around the regulator is typically mowed and low-growing flowering species have been planted. Such areas are noted by HG&E in the ROW monitoring that occurs and may not require herbicide application if the landscaping is compatible with fire safety requirements for the vaults.

11 Remedial Plan to Address Spills and Related Accidents

This remedial plan is presented as a guide to proper procedures for addressing pesticide accidents. Since every spill or related accident is different, applicators must weigh the specific factors of the situation and use their own judgment to decide the appropriate course of action. Because applicators normally carry only relatively small amounts of herbicides, the potential for a serious spill or accident is relatively small. State and Federal statutes establish emergency response procedures that must be followed by vegetation management contractors in the event of a spill or related accident. Under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), it is the legal responsibility of the applicator to clean up pesticide spills resulting from his/her use and handling of the product. Applicators are liable for damages, subject to penalties, and obligated to clean up and decontaminate areas resulting from pesticide spills.

The following discussion outlines general guidelines to prevent and address spills and related accidents. Transporting 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 shall 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 a strategic location. If a fire is involved, care will be taken to avoid breathing fumes from any burning chemicals.

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

Source

Herbicide Label

Herbicide Fact Sheet

Information

See *Appendix F* of
the current year's YOP

same as above

Herbicide Material Safety Data Sheet

same as above

In the event of a spill, the following contacts and telephone numbers are provided:

Source Telephone Number

Herbicide Manufacturer	BASF (Arsenal) 800-832-4357 DuPont (Escort, Krenite, Oust) 800-441-7515 Dow AgroScience (Glypho-Plus, Rodeo and Garlon 4) 800-992-5994 Monsanto (Roundup) 800-424-9300 NuFarm Americas (AquaNeat, Patriot, Polaris, Razor, Spyder) 800-345-3330 Rainbow Treecare (Cambistat) 952-922-3810
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Holyoke, Chicopee, and South Hadley
Fire and/or Police Departments

911

Holyoke Gas & Electric Department (EH&S Coordinator)

(413) 563-9818

Holyoke Board of Health

(413) 322-5595

Holyoke Conservation Commission

(413) 322-5615

Source

Telephone Number

Chicopee Board of Health

(413) 594-1660

Chicopee Conservation Commission (Planning Dept.)

(413) 594-1515

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 Bureau

(617) 626-1700

Steven E. Antunes-Kenyon

(617) 626-1784

Massachusetts Dept. of Environmental Protection (DEP)

(413) 784-1100 or
(888) 304-1133

Massachusetts Dept. of Public Health, Bureau of
Environmental Health, Toxicology Program (617) 339-8351

Massachusetts Poison Control Center (800) 222-1222

CHEMTREC (800) 262-8200

US Environmental Protection Agency (EPA)
National Pesticide Information Center (800) 858-7378

Spills will be remediated by soaking up the spill with adsorptive clay or other adsorptive material and placing it in leak proof containers for proper disposal. Dry herbicides, such as granulars, will be swept up or shoveled directly into leak proof containers for proper disposal. All contaminated soil will be placed in leak proof containers, removed from the site and disposed of properly. Activated charcoal will be incorporated into the soil at the spill location at a rate of seven pounds per thousand square feet to inactivate any herbicide residue.

In cases where the spill cannot be contained and/or removed by the crew, the DEP Incident Response Unit and the Pesticide Bureau must be contacted. A spill of any size must be reported to the Pesticide Bureau. Emergency first responders (including, but not limited to, fire and police) should be notified of any major spills or a spill of any size that may be considered a potential risk to public health, safety and the environment.

A release of oil, hydraulic fluid and/or hazardous material (OHM) in excess of the Massachusetts Reportable quantities listed in the Massachusetts Contingency Plan (MCP) 310 CMR 40.1600 shall be reported to the MA DEP within the appropriate time frame as specified in 310 CMR 40.0300. Pursuant to 310 CMR 40.0311 ("Releases Which Require Notification Within Two Hours"), persons shall notify the MA DEP as soon as possible, but not more than two hours after obtaining knowledge of "a sudden, continuous or intermittent release to the environment of any hazardous material that is listed at 310 CMR 40.1600 or that exhibits one or more of the characteristics described in 310 CMR 40.0347, when: (a) the quantity of the release is equal to or greater than the applicable Reportable Quantity."

Appendix A

NERC Transmission Vegetation Management Plan

**Available upon request*

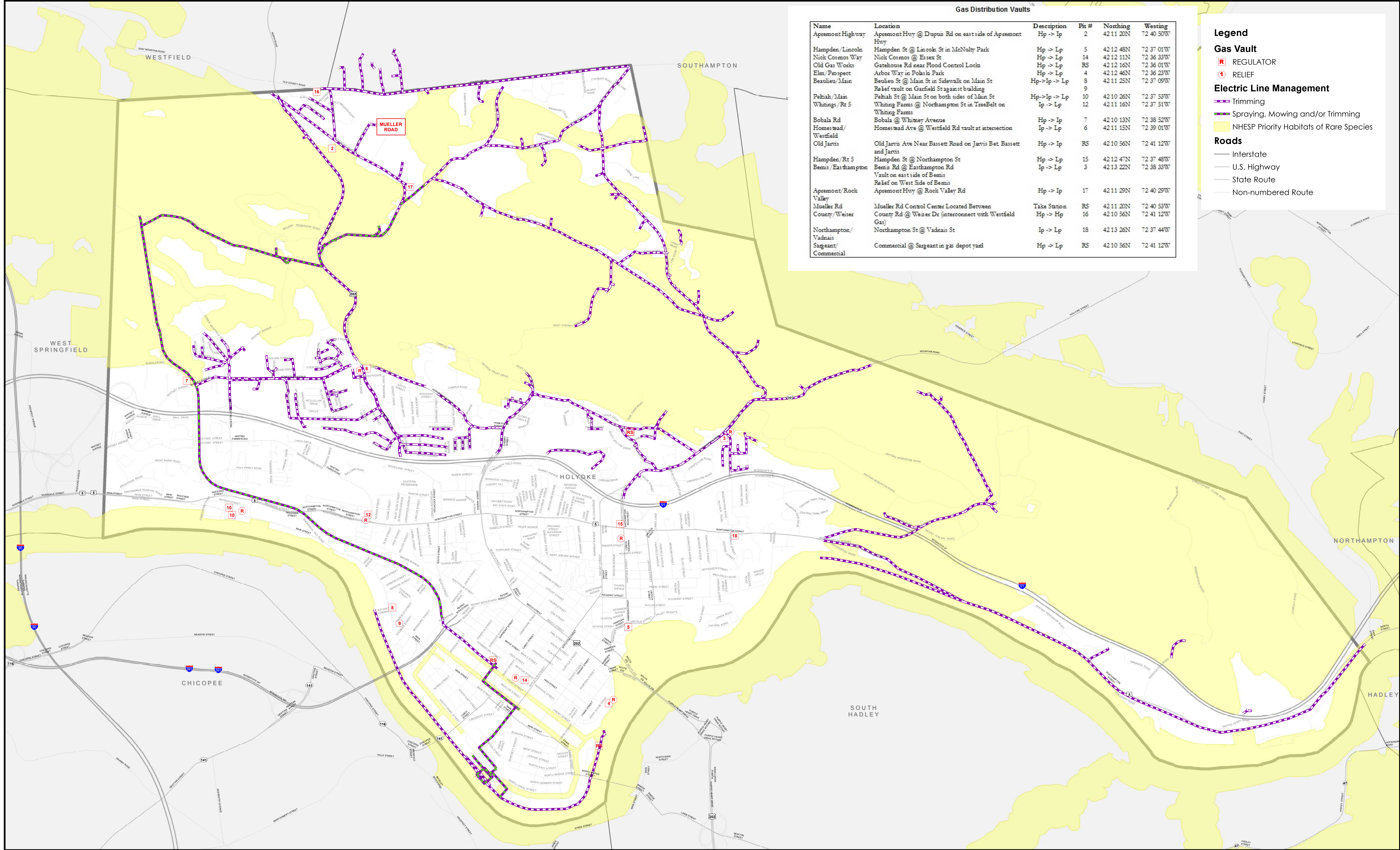
Appendix B

333 CMR 11.00 Rights-of-Way Management Regulations

**Available upon request*

Appendix B

Gas & Electrical Transmission/Distribution ROW Maps



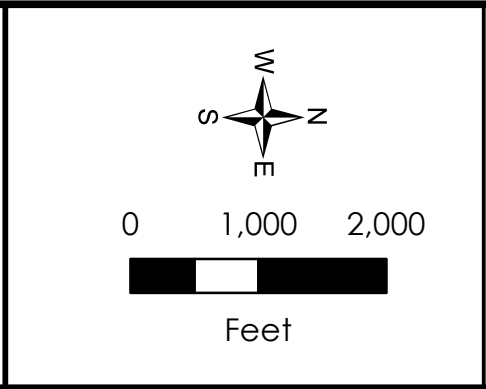
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Sources: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs; Natural Heritage and Endangered Species Program (NHESP); Holyoke Gas & Electric Department.

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Date Printed: 3/10/2014



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Holyoke Gas & Electric Department

Electric Transmission/Distribution System & Gas Distribution System

Yearly Operational Plan (YOP)

HOLYOKEMASSACHUSETTS

PROJ. No. 2000727.A90

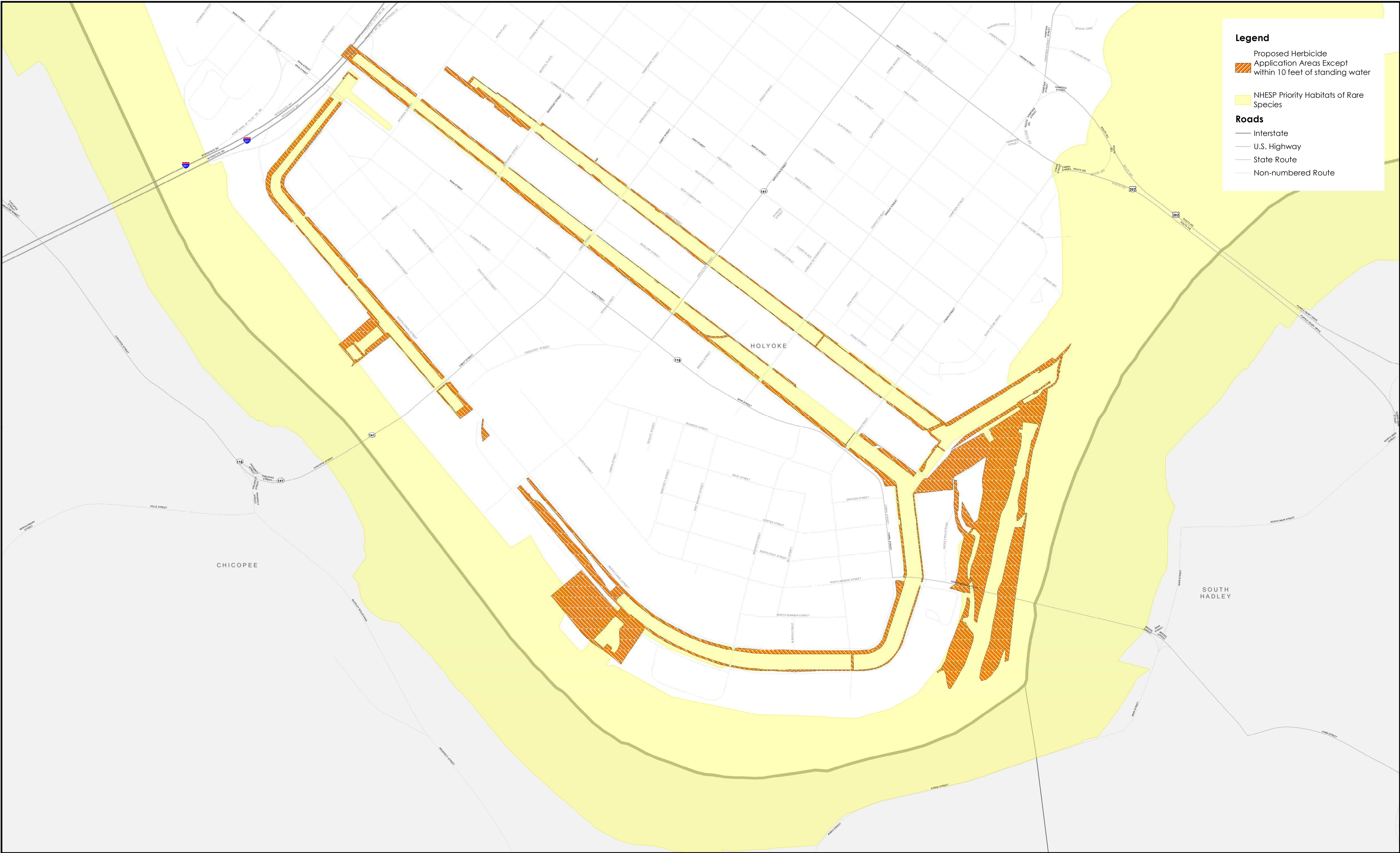
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APP. B

Appendix C

Canal Right of Way Map

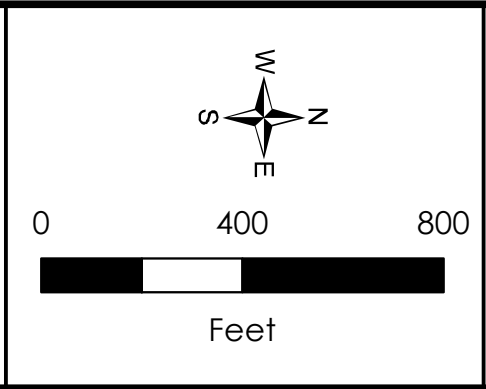
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Canal System Pesticide Application Areas
Yearly Operational Plan (YOP)
HOLYOKE
MASSACHUSETTS

PROJ. No. 2000727.A90
DATE: DEC. 2013

APP. C

Appendix D

Herbicide Fact Sheets



The Official Website of the Executive Office of Energy and Environmental Affairs

Energy and Environmental Affairs

[EEA Home](#) > [Agencies](#) > [Department of Agricultural Resources](#) > [Rights of Way Sensitive Area Materials List](#)

Rights of Way Sensitive Area Materials List

Active Ingredient Use Restrictions	Product Names (EPA #) Registrant	
Aminopyralid	Milestone (62719-519) (Product Review Opensight (62719-597) (Product Review DOW AgroSciences	
Glyphosate Lowest Labeled Rate for all Glyphosate products	Round Up Pro (524-475) Monsanto Aquaneat Aquatic Herbicide (228-365) Razor (228-366) Razor-Pro (228-366) Nu Farm Americas	Glypro-Plus (62719-322) Accord Concentrate or Rodeo (62719-324) DOW AgroSciences
Metsulfuron Methyl Lowest Labeled Rate for all Metsulfuron Methyl Products*	Escort XP (432-1549) Bayer CropScience 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 (432-1552) Bayer CropScience Oust XP (352-601) EI Dupont	Spyder Selective Herbicide (228-408) Nu Farm Americas
Metsulfuron Methyl Sulfometuron Methyl Lowest Labeled Rate*	Oust Extra (432-1557) Bayer CropScience Oust Extra (352-622) EI Dupont	
Ammonium Salt of Fosamine Lowest Labeled Rate*	Krenite S (352-395) EI Dupont	Krenite S (42750-247) Albaugh, Inc.
Imazapyr 3 pints/acre every 3rd year OR 2 pints/acre every other year for all Imazapyr Products	Arsenal (241-346) Arsenal Powerline (241-431) Arsenal Railroad Herbicide (241-273) BASF	Polaris AC Complete Herbicide (228-570) (Product Review Polaris Herbicide (228-534) Nu Farm Americas
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 Tree care	

Contact

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Additional Resources

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

* **Lowest labeled rate** the minimum labeled 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 ecotoxicological 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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EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS



Department of Agricultural Resources

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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 crayfish 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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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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Massachusetts Pesticide Product Registration Information

Product Name: **GARLON 4 ULTRA**

EPA Registration No.: **62719-527**

Expiration Date: 6/30/2018

Registration Status: Approved

Company Name and Reg. No.: [DOW AGROSCIENCES, LLC](#) [62719]

Formulation: Emulsifiable Concentrate

Restricted Use?

Pesticide Type: Herbicide

Click here to show [Active Ingredients](#) in this Product.

Click here to show the [Pests Controlled by this Product](#).

Click here to show the [Sites to which this Product may be Applied](#).

Click here to view the [EPA Stamped Labels](#) for the selected product (external link to EPA.gov website).

If you find erroneous data, please e-mail the department at Steve.Kenyon@state.ma.us. We will respond to all inquiries as soon as possible.

ALWAYS READ AND FOLLOW THE PESTICIDE LABEL DIRECTIONS

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THE COMMONWEALTH OF MASSACHUSETTS

EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS



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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 nonhalagenated, 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 LD50s of greater than 2000 mg/kg (10, 14, 15, 101, 103, 103).

The dermal LD50s 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

mallard 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: $0.3 \times 1.22 \times 64 \text{ m} = 23.4 \text{ m}^3$ (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: $0.15 \times 1 \times 5 \text{ m} = 0.75 \text{ m}^3$ (volume)

DILUTION:

$0.02 \text{ mL into } 0.75 \text{ m}^3 = 0.03 \text{ mL/m}^3$
 $0.03 \text{ mL/m}^3 \times 10^{-3} \text{ m}^3 / \text{L} \times 10^3 \text{ mg/g} \times 1 \text{ g/ml} = \underline{0.03 \text{ mg/L}}$

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:

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

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

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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Paclobutrazol

**Review Conducted by MDAR and MassDEP for Use in Sensitive Areas of
Rights-of-Way in Massachusetts**

January 2012

Active Ingredient Paclobutrazol:
Review Conducted by MDAR and MassDEP for Use in Sensitive Areas
of Rights-of-Way in Massachusetts

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1. INTRODUCTION

The review presented here was initiated by the request for the addition of Cambistat® (EPA Reg. No. 74779-3), containing the active ingredient paclobutrazol, to the Massachusetts Rights-of-Way Sensitive Area Materials List. Paclobutrazol is a tree growth regulator that provides a tool for utility arborists to limit the size and growth of trees and shrubs in power line and utility rights-of-way corridors. Tree growth regulator products such as Cambistat® are regularly applied in high visibility locations such as parks, historic downtowns, residential areas and other areas where trees have a cultural value (Paul Sellers, NSTAR, pers. comm.). The utility industry is seeking approval of Cambistat® for use in sensitive areas in order to have the ability to use this product in the same locations that happen to be located within areas of rights-of-way that are regulated by 333 CMR 11.00.

The regulations specified in 333 CMR 11.00 provide standards, requirements and procedures for the use of herbicides in vegetation management in areas of rights-of-way, while minimizing the potential impacts to human health and the environment. Specific restrictions exist for sensitive areas within rights-of-way, including the list of herbicides that have been specified as acceptable for use in these sensitive areas. The herbicides included on the Sensitive Area Materials List have been evaluated to further scrutinize potential risks to sensitive receptors in these areas. The review presented here is the evaluation of the active ingredient paclobutrazol and products for use in sensitive areas of rights-of-way.

Paclobutrazol (PBZ) was first registered by U.S. EPA in 1985. At the time of preparation of this review in 2011, PBZ was undergoing registration review by U.S. EPA to determine whether it continues to meet the FIFRA standard for registration (U.S. EPA, 2007A). As part of the registration review process, a summary document was issued (U.S. EPA, 2007B). This document includes a factsheet describing the use of this active ingredient, the status of human health and ecological risk assessments, and the problem formulation and scope of work necessary to support the registration review at U.S. EPA.

Additional information was obtained from documents issued by the European Food Safety Authority (EFSA) that evaluated PBZ for use as a plant growth regulator on winter oilseed rape. The evaluation data package of the EFSA assessment included various documents describing data summaries, scientific evaluations, risk assessments, and conclusions of the peer review. The documents consulted for the review presented here included the Draft Assessment Report (DAR) (EFSA, 2006), the Additional Report to the DAR (EFSA, 2010A) and the Conclusion of the Peer Review (EFSA, 2010B).

The secondary review documents generated by the regulatory agencies U.S. EPA and EFSA are primarily based on the consideration of registrant-submitted studies in support of product registration. These studies are generally classified as Confidential Business Information (CBI) and therefore not available for review outside of these agencies. Additional information from scientific publications and other government documents was also considered, when available and as needed, for the assessment described in this review.

This document describes a review of the chemical and physical properties, product use characteristics, environmental fate characteristics and toxicity data. Environmental concentrations of PBZ were estimated using screening-level simulation models and calculation

methods. The risks to classes of organisms that are most likely to be exposed, including aquatic organisms and soil invertebrates, were characterized. The exposure to groundwater resources was also assessed.

The review described herein was conducted according to the established procedures and criteria for review of herbicide products for use within sensitive areas of Rights-of-Way (ROW) (MDAR, 2011). These review procedures and criteria address both the herbicide active ingredients as well as the “inert” or “other” ingredients, more specifically the surfactants.

2. CHEMICAL AND PRODUCT IDENTITY AND PROPERTIES

2.1. Chemical Identity and Properties

- Common Chemical Name: Paclobutrazol (**PBZ** acronym will be used)
- IUPAC name: 2*RS*,3*RS*-1-(4-chlorophenyl)-4,4-dimethyl-2-(1*H*-1,2,4-triazol-1-yl) pentan-3-ol
- CAS No.: 76738-62-0

Paclobutrazol (PBZ) is a plant growth regulator belonging to the triazole chemical class (U.S. EPA, 2007B). The nomenclature is summarized in Table A1.1 in Appendix 1. PBZ is a racemic mixture of the (2*R*, 3*R*) and (2*S*, 3*S*) enantiomers. Chemical and physical properties are listed in Table A1.2 in Appendix 1.

2.2. Formulated Product

The product considered in this review, Cambistat®, is a suspension concentrate containing 22.3% PBZ. The MSDS document (Rainbow Treecare, 2011) for this product indicates that the formulation also contains propylene glycol at an unspecified concentration. No other ingredients were specified in the MSDS document (Rainbow Treecare, 2011).

Propylene glycol (PG) is a colorless, odorless liquid which is generally recognized as safe (GRAS) by the U.S. Food and Drug Administration (FDA) in 21 CFR § 184.1666 for use as a direct food additive under the conditions prescribed. It is approved by the U.S. FDA for certain indirect food additive uses. PG has a wide range of practical applications such as antifreezes, coolants and aircraft deicing fluids; solvents; food; flavors and fragrances; cosmetics and personal care products; pharmaceuticals; chemical intermediates; plasticizers; and thermoset plastic formulations (DOW, 2006). PG is not acutely toxic (single dose, high exposure). It is essentially non-irritating to the skin and mildly irritating to the eyes. Available data indicate that propylene glycol is not a skin sensitizer or a carcinogen. PG is not volatile and is miscible with water. It is not expected to bioaccumulate and it is not acutely toxic to water organisms except at very high concentrations (OECD/SIDS, 2001). Given the characteristics and regulatory status of this ingredient, propylene glycol was not further evaluated for this review.

Proprietary information on the other formulation ingredients was obtained. Two of the proprietary ingredients can be classified as surfactants. One of the surfactants belongs to a class of surfactants that has been approved for use in sensitive areas of rights-of-way in Massachusetts (MDAR, 2010A and B). Consequently, this ingredient did not have to undergo additional review and passed the surfactant policy portion of the review process for the sensitive area materials list. Nevertheless, both surfactants were included in the evaluation of proprietary ingredients.

The proprietary ingredients were evaluated as part of the review process for addition to the Sensitive Area Materials List, but cannot be disclosed here for proprietary reasons. In most cases, a quantitative or semi-quantitative evaluation was conducted based on available toxicity

endpoints and estimates for maximum soil, surface water and ground water concentrations. In some cases, only a qualitative evaluation was possible. Based on these evaluations, it was concluded that these compounds are of a nature and/or present at levels in the product such that use of it as directed would not cause unreasonable adverse effects to human health and the environment.

2.3. Mode of Action

PBZ is a cell elongation and internode extension inhibitor that retards plant growth by inhibition of gibberellins biosynthesis. Gibberellins stimulate cell elongation. When gibberellin production is inhibited, cell division still occurs, but the new cells do not elongate. The result is shoots with the same numbers of leaves and internodes compressed into a shorter length. Reduced growth in the diameter of the trunk and branches has also been observed. Another response of trees to treatment with PBZ is increased production of the hormone abscisic acid and the chlorophyll component phytol, both beneficial to tree growth and health. PBZ may also induce morphological modifications of leaves, such as smaller stomatal pores, thicker leaves, and increased number and size of surface appendages, and increased root density that may provide improved environmental stress tolerance and disease resistance (Chaney, 2005). PBZ also has some fungicidal activity due to its capacity as a triazole to inhibit sterol biosynthesis (Chaney, 2005; U.S. EPA, 2007B; BCPC, 2000).

3. USE PATTERN AND APPLICATION CHARACTERISTICS

3.1. Use as Tree Growth Regulator

The use pattern of PBZ considered in this review is as a tree growth regulator, more specifically as a tree growth retardant (TGR). PBZ was one of the three active ingredients that were used by utility arborists in the 1980s. The products were applied by trunk injection as a formulation containing alcohol solvents. Due to problems associated with trunk injection of these products (e.g., tree injury and wood discoloration) there was a decline of the use of TGRs. In 2005, PBZ was the only remaining TGR for use on trees. Modifications in formulations and application methods, satisfactory performance as a TGR and benefits to overall tree health resulted in a rebound in the use of PBZ. Current formulations of PBZ TGRs such as Cambistat® for TGR use, such as Cambistat®, are applied as a water suspension by soil injection or basal drench (Chaney, 2005).

PBZ is also registered for use on ornamental plants grown in containers in nurseries, greenhouses and interior landscapes. It is also used on turf to control annual grasses and broadleaf weeds, to reduce the mowing frequency and to increase turf density.

3.2. Application Methods and Rates

PBZ formulated as Cambistat® is applied by soil injection or application as a basal drench. The species-specific dose rate is determined by measuring the tree diameter at breast height (DBH). Based on the dose rate information on the product label, it can be calculated that the dose rate of active ingredient is in the range of 4.1 g (0.009 lbs) to 202.5 g (0.446 lbs) PBZ per individual tree. Dose rates may be reduced by 25 to 30% based on consideration of canopy size and structure, stressed or declining tree status, or the presence of a confined or compromised root system. Given the use pattern of treating individual trees, the application rate expressed in mass use per acre has not been established. The water suspension of PBZ can be injected approximately 2-6 inches deep at 50 to 200 psi as close to the tree trunk as possible. Alternatively, the water suspension can be poured into a shallow trench around the tree. Retreatment may be done every 3 years or until the effects from the previous application subside (Rainbow Treecare, 2011).

4. ENVIRONMENTAL FATE OF PACLOBUTRAZOL

4.1. Environmental Fate Parameter Summary

The environmental fate properties of PBZ are summarized in Table A2.1 in Appendix 2. The mobility and persistence characteristics are described in more detail in the following two sections.

4.2. Mobility

PBZ has been characterized as a compound with a moderate potential for mobility in soil and water environments (U.S. EPA, 2007B). The summary document for registration review prepared by U.S. EPA (2007B) documents that laboratory batch equilibrium studies indicated that PBZ has the capacity to be mobile under certain conditions. Studies with nine US soils ranging in texture from sand to silt loam indicated values for the soil adsorption coefficient K_D in the range from 1.3 to 23.0 ml/g. Adsorption appeared to increase with an increase in soil organic matter content and a decrease in soil pH. In the draft assessment report prepared by the United Kingdom (EFSA, 2006) adsorption data for 13 soils are summarized that show K_D values in the range of 0.8 – 21.3 ml/g with a geometric mean of 4.3 ml/g. The ketone metabolite showed on average a slightly higher affinity for adsorption to soil with K_D values in the range of 2.1 – 13.5 with a mean of 8.0 across 6 soils.

Results from laboratory soil column leaching experiments summarized in U.S. EPA (2007B) indicated low mobility in the experiments using methine-labeled PBZ in soils ranging in texture from sand to clay-loam. The experiments using triazole-labeled PBZ showed low mobility in columns of sand and sandy loam soils, and mobility in loamy sand and clay loam soils. In all cases, the majority (58.6 – 90.7%) of applied PBZ aged residue did not leach out of the upper 10 cm of the treated soil columns.

An issue noted in the draft assessment report (EFSA, 2006) was the identification in a column leaching study of the degradate hydroxyl triazole at a concentration of 12 µg/L in the leachate. Even though this degradate was not detected in the soil metabolism experiments, the observation in the column leaching experiment raised concerns for risks to groundwater and a data gap was identified. This data gap was addressed in the additional report to the DAR (EFSA, 2010A). Groundwater exposure modeling using additional soil degradation and adsorption data for the degradate hydroxyl triazole showed a maximum concentration of the degradate in groundwater (80th percentile annual average concentration in leachate leaving the top 1 m soil layer) did not exceed 0.1 µg/L except in one of the six scenarios, where it was modeled at a concentration of 0.1192 µg/L. The modeling study concluded that the potential for the degradate hydroxyl triazole to reach groundwater at high concentrations is low.

PBZ is unlikely to volatilize to any significant extent owing to a low estimated vapor pressure. The octanol-water partitioning coefficient (log K_{OW}) of 3.2 indicates a potential for this chemical to bioaccumulate in fish. A fish bioaccumulation study, which was only conducted for 14 days, showed BCF factors of 20x for edible tissues (day 3), 248x for non edible tissues (day 3), and 44x for whole fish (day 10) (U.S. EPA, 2007B).

Although characterized as moderately mobile in laboratory studies, no significant movement of PBZ was detected in field studies in agricultural soils. In the orchard studies, PBZ residues (parent plus degradate) were detected at 10% or less of total applied in soils with depths of 48 inches in the California study, 24 inches in West Virginia study, and 48 inches in the Florida study. These depths are the maximum depths sampled at each study. No information was provided on the nature or type of soils in the summary document. The PBZ ketone metabolite was predominately detected in the subsurface soil layers, also at insignificant levels (U.S. EPA, 2007B).

A scientific publication by Baris et al. (2010) provided information regarding the potential of PBZ to impact groundwater from its use on turf areas. PBZ was included in a comprehensive evaluation of water quality monitoring data and assessment. This evaluation considered water quality data for a large number of turf-related pesticides from 44 studies involving 80 golf courses in the US over a 20-year period. PBZ was found in 3/440 groundwater samples, with the highest detection at 4.2 µg/L.

4.3. Persistence

PBZ has been characterized as an environmentally stable compound in soil and water environments (U.S. EPA, 2007B). Laboratory studies with US loam and silt-loam soils indicated that PBZ degraded with a half-life of more than 1 year under both aerobic and anaerobic conditions.

Summaries of laboratory half-lives, normalized to 20 °C with moisture content at field capacity, show values in the range of 43 to 618 d with a mean of 183 d (6 soils) (EFSA, 2006). Data from field studies in the UK and Italy indicated dissipation half-lives of 58 to 389 d with a mean of 114 d. Field accumulation studies conducted for a period of 4 to 8 years with annual applications of PBZ showed no apparent build up of PBZ residues except in one of the 7 sites.

The degradation pathway of PBZ, described in EFSA (2006), occurs via the ketone analog, (2RS)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl)-pentan-3-one, which was detected in the aerobic soil metabolism study at approximately 18% of total applied and at less than 10% in other soil studies. The ketone analog is degraded via separation of the 1-H-1,2,4-triazole moiety. The 1,2,3-triazole moiety was only observed at a maximum of 3%. Degradation of the 1,2,4-triazole proceeds via triazole acetic acid and hydroxyl triazole. Hydroxy triazole was identified in a soil column leaching study but was not observed in any of the soil metabolism studies (EFSA, 2006).

The major ketone-metabolite is less persistent than the PBZ parent with half-lives of 23 – 90 d (mean of 54 d) in an aerobic degradation study with 3 soils. A minor metabolite 1,2,4-triazole is even less persistent as indicated by its half-life of 6.3 – 12.3 d (mean 9.5 d) in aerobic soil degradation studies.

Field dissipation studies from the US showed PBZ residues that were persistent and relatively mobile. Half-lives of PBZ residues ranged from 450-950 days for orchard soils in California,

West Virginia, Florida and 25 weeks to 36 weeks in agricultural soils in Mississippi, North Carolina, and Illinois.

Laboratory studies indicated that PBZ is relatively stable to degradation by hydrolysis. More than 94 percent of PBZ was still present after 30 d in pH 4, 7 and 9 solutions, respectively (U.S. EPA, 2007B). PBZ did not undergo appreciable photolysis in water when exposed to light in pH 7 buffer. More than 96 percent of PBZ was still present after 10 d of exposure (U.S. EPA, 2007B). In the presence of light, degradation of PBZ in soil was slightly accelerated with a calculated half-life of 188 d. It was concluded that soil photolysis is unlikely to be a significant route of dissipation (EFSA, 2006).

Degradation in a water-sediment system was reported in EFSA (2006). The data indicate a low degradation rate in both the water and the whole system. The half-life determined for the whole system was 164 d, with most of the PBZ remaining in the water phase.

5. MAMMALIAN TOXICITY

With regard to the existing toxicological data of PBZ, the work plan for registration review by U.S. EPA (2007B) makes reference to RfD/Peer Review reports from 1986 and 1994 among the primary resources for the status update. A more recent review and evaluation of toxicological information was organized by the European Food Safety Authority (EFSA) as part of the peer review of the pesticide risk assessment of PBZ in European Community. The more up-to-date information available in the EFSA-organized peer review documents was the primary source of information for review presented here. The EFSA-organized review was initiated in 2006 (EFSA, 2006), subsequently withdrawn, and then resubmitted along with additional toxicological information, and was completed in 2010 (EFSA, 2010A and B). Information on the mammalian toxicology from registrant-submitted studies considered in these review documents is summarized below.

Acute toxicity, irritation and sensitization

PBZ exhibits moderate acute toxicity by the oral route in the species tested. The LD₅₀ is 1954 mg/kg in male rats and 1336 mg/kg in female rats; 490 mg/kg and 1219 mg/kg in male/female mice, respectively; 542 mg/kg and 400-640 mg/kg in male/female guinea pigs, respectively; and 835 mg/kg and 937 mg/kg in male/female rabbits, respectively. New data for rats indicated an oral LC₅₀ > 2000 mg/kg.

Acute dermal LC₅₀ values are greater than 2000 mg/kg in rats and greater than 1000 mg/kg in rabbits. Overall, PBZ is of low acute toxicity by the dermal route.

Acute inhalation studies showed a 4h-LC₅₀ value of greater than 2 mg/L particulate to rat indicating moderate toxicity by inhalation.

Skin irritation studies with rats (5 repeated applications) and with rabbits (single application) indicated that PBZ is slightly irritating to skin. Eye irritancy studies with rabbits indicated mild irritancy to the eye. PBZ is not a skin sensitizer based on the results of studies with guinea pigs.

Overall, the acute toxicity data indicate that PBZ is of moderate acute toxicity by the oral and inhalation routes and of low acute toxicity by the dermal route. PBZ is slightly irritating to skin and eye and is not a skin sensitizer.

Toxicokinetics

In the rat, absorption was rapid and extensive (88-95%) and did not show saturation at a high dose. Absorbed material was readily oxidized to PBZ diol, which was subject either to excretion or to further oxidation to the carboxylic acid. Biotransformation was limited to the tertiary butyl moiety, with no metabolism detected in either the triazole or chlorinated phenyl rings. Male rats oxidized a greater proportion of PBZ to the carboxylic acid than did female rats.

A small proportion of radioactivity equilibrated into the tissues and was subsequently eliminated. The highest concentrations of radioactivity were seen in the liver after a high or low dose. There was no evidence of bioaccumulation.

Excretion at a low dose was relatively rapid with more than 70% of radioactivity excreted within 48 hours. The delay in excretion in the high dose animals (>70% excretion not achieved until 72 hours after dosing) and the significant amount of radioactivity in faeces (well beyond normal transit time) were due to significant enterohepatic recirculation. In cannulated rats, biliary excretion at a low dose represented >50% and 70% of the administered dose in females and males, respectively. In cannulated rats, 5% was excreted as unchanged parent.

In the dog, following a single oral low dose, radioactivity was rarely absorbed reaching peak concentrations in plasma and blood within 1 hour and declining below the limits of detection by 72 hours. Most of the radioactivity was associated with plasma. Elimination was faster than for rats with >75% of radioactivity eliminated in urine and faeces within 24 hours. At 168 hours after dosing, there was almost a complete absence of radioactivity in all tissues examined (with the exception of the liver in one animal). There was no evidence of bioretention of PBZ or its metabolites in dogs.

Short-term toxicity

The short-term toxicity of PBZ was investigated by the oral route in rats (90 days) and dogs (90 days and 1 year), and by the dermal route in rabbits (21 days).

The liver is the target organ of PBZ oral toxicity in the rat. Signs of liver toxicity (clinical chemistry changes, increased weight and marginal increases in hydropic and fatty changes) were observed in males and females at 1250 ppm (93 and 107 mg/kg/day in males and females, respectively). These effects were accompanied by decreases in food consumption and body weight gain. There were no effects at 250 ppm (20 mg/kg/day). An overall short-term NOAEL of 20 mg/kg/day was identified for the rat from this subchronic study.

Similar findings were observed in the dog. Liver toxicity (clinical chemistry changes, increased weight, enzyme induction and ballooned hepatocytes), accompanied by decreases in food consumption and body weight gain, was observed from a dose of 75 mg/kg/day (in the 1-year study). There were no effects at 15 mg/kg/day (1-year study). Therefore, an overall short-term NOAEL of 15 mg/kg/day was identified for the dog from the chronic study.

A repeat dose dermal toxicity study in rabbits showed no signs of systemic toxicity up to 100 mg/kg bw/day.

No short-term studies in the mouse were available; however, results from the mouse carcinogenicity study do not indicate that the mouse was more sensitive to PBZ than rats or dogs.

Genotoxicity

The mutagenic, clastogenic, and aneugenic potential of PBZ was studied in several *in vitro* test systems using bacteria and mammalian cells and *in vivo* test systems in rats and mice. PBZ was negative in an *in vitro* bacterial reverse mutation assay and an *in vitro* gene mutation test in mouse lymphoma cells. No clastogenic effects were seen in an *in vitro* human lymphocyte cytogenetics test, two *in vivo* rat cytogenetics tests and two *in vivo* mouse micronucleus tests. No evidence of DNA damage or repair was noted in an *in vivo* UDS assay. PBZ had no effect on

either fertility or dominant lethality in mice in a dominant lethality test. Based on these *in vitro* and *in vivo* mutagenicity tests, it was concluded that PBZ is not genotoxic.

Long-term toxicity and carcinogenicity

The chronic toxicity and carcinogenicity of PBZ was investigated in two standard dietary studies in rats and mice.

The liver is the target organ of PBZ oral chronic toxicity in the rat. Signs of liver toxicity (decreases in plasma triglycerides in females and increases in plasma BUN levels in females, increased liver weights in males and females and increased incidence of hepatocyte steatosis/hypertrophy in males and females) were seen at the top dose of 1250 ppm. These were accompanied by decreases in body weight gain and food consumption in females. At 250 ppm, body weight gains were still significantly reduced in females and liver steatosis was still significantly increased in males. There were no toxicologically significant effects at 50 ppm (2.2 and 2.8 mg/kg bw/day in males and females, respectively).

In mice, the target organ of PBZ oral chronic toxicity was also the liver (and related fat metabolism), as indicated by increased liver weights, increased severity of steatosis in males and reduced serum cholesterol in males and triglyceride levels in females at the top dose level of 750 ppm. There were no toxicologically significant effects at 125 ppm (14 and 16 mg/kg bw/day in males and females, respectively).

There was no evidence of carcinogenic effect of PBZ in rats or mice.

Reproductive and developmental toxicity

The reproductive toxicity of PBZ has been investigated in a 2-generation study in the rat and in pre-natal developmental toxicity studies in rats and rabbits.

In the 2-generation study, dietary administration of PBZ caused general toxicity in the parental animals at the top dose of 1250 ppm, observed as increased incidence of chromocryorrhea and thickened eyelids and increases in liver weights and associated histopathology (centrilobular fatty changes). PBZ also caused adverse effects in the young F₁ and F₂ offspring at the top dose of 1250 ppm, observed as a reduction in pup bodyweight gains, increased incidence of chromodacryorrhea, thickened eyelids, dental malocclusion and twisted snout and increases in liver weights and associated histopathology (centrilobular fatty changes). However, fertility mating performance, litter size and pup survival were not affected by treatment. Accordingly, on the basis of this study, it can be concluded that PBZ is not a specific hazard to fertility and reproductive performance, as no effects were seen up to the top dose of 1250 ppm (117 mg/kg/day in males and 124 mg/kg/d in females). Classification for effects on fertility was not required. However, a NOAEL of 250 ppm (23 mg/kg/day in males and 25 mg/kg/day in females) was identified for general parental toxicity and for effects on the offspring.

New information confirmed the increased incidence of dental malocclusion and twisted snout observed in the F₁ and F₂ offspring is unlikely to be a developmental effect of PBZ. As the same finding was detected in the treated adult animals of the F₀ generation with a similar incidence, it

was considered that, at most, it represents a generalized, unspecific toxic effect of PBZ to pups and adult animals.

Two developmental toxicity studies in the rat are available. In the first study, a NOAEL for maternal toxicity of 100 mg/kg bw/day was identified on the basis of reduced food consumption and deaths at the next dose level of 250 mg/kg bw/day (top dose). Developmental toxicity was limited to delayed ossification of a number of bones. A no-effect level for developmental effects could not be established because a statistically significant, dose-related increase in partially ossified 7th transverse process was apparent at all dose levels (from 40 mg/kg bw/day = LOAEL). There was also an increased incidence of cleft palate (1.28% vs 0% in concurrent and historical controls) at the highest dose which may have been the consequence of maternal toxicity (including lethality); however a direct teratogenic effect could not be ruled out.

In a second study, conducted to determine a no-effect level for developmental toxicity, there were no effects on the dams up to the top dose tested (100 mg/kg bw/day = NOAEL for maternal toxicity). Developmental toxicity was limited to an increased incidence of partial ossification of the transverse processes of the 7th cervical vertebra and extra 14th rib at 40 and 100 mg/kg bw/day. There were no developmental effects at 10 mg/kg bw/day (NOAEL for developmental toxicity).

In two separate developmental toxicity studies in the rabbit, there was no evidence of developmental effects up to the top dose tested of 125 mg/kg bw/day at which maternal toxicity (reduced body weight gain and food consumption) was observed. Additional information confirmed that the reported skeletal variants are chance findings unrelated to treatment and that PBZ is not a developmental toxicant in the rabbit up to maternally toxic dose levels.

Overall, therefore, PBZ causes developmental toxicity in rats, manifested as a low incidence of cleft palate (1.28% affected fetuses vs 0% in concurrent and historical controls), seen in a preliminary study at 240 mg/kg bw/day and in one of the two definitive studies at the top dose of 250 mg/kg bw/day. The lack of the observation in the second definitive study is consistent with the findings of the other studies as the highest dose tested in the second study was only 100 mg/kg bw/day. Although the cleft palate occurred in the presence of severe maternal toxicity (including lethality), there is no evidence that the finding is a secondary non-specific consequence of maternal toxicity. PBZ also causes small changes in the incidences of common skeletal variants in the rat (partial ossification of the transverse processes of the 7th cervical vertebra and extra 14th rib). Although these occurred both in the absence of observable maternal toxicity and in the presence of maternal toxicity, they were observed in isolation, did not show a consistent pattern and were not accompanied by any effects on other foetal parameters, such as body weight. Nevertheless, as cleft palate toxicity is very rare in the rat and is not considered to be a secondary non-specific consequence of maternal toxicity, classification for developmental toxicity in a category representing substances with possible risk of harm to the unborn child was considered to be appropriate.

Tolerances and other guidelines

Since there are no food uses of PBZ, no maximum residue levels for PBZ have been established for agricultural commodities in the US (U.S. EPA, 2007A). A drinking water standard is also not

established in the US. The derivation of a maximum allowable concentration in drinking water of 66 µg/L is described in EFSA (2010A). This value is based on an allowable daily intake of 0.022 mg/kg/day.

In the context of the evaluation water quality data and assessment of pesticide impacts, Baris et al. (2010) calculated a lifetime health advisory level following procedures used by U.S. EPA and reported a value of 460 µg/L for PBZ.

6. ECOTOXICITY

Data on the ecotoxicity of PBZ were available in EPA's summary document for registration review (U.S. EPA, 2007B), in the draft assessment report (EFSA, 2006), and in the additional report to DAR (EFSA, 2010A). The toxicity data considered in these regulatory reviews were primarily obtained from registrant-submitted data. Summaries of these studies are available in review documents generated by EFSA (2006 and 2010A). The ecotoxicity information is described below. A data summary table is included in Appendix 3.

6.1. Acute and Chronic Toxicity of Paclobutrazol

Avian

PBZ is slightly toxic to practically non-toxic to avian species based on acute oral toxicity data (see Appendix 3) ranging from >2100 to >7913 mg/kg b.w. and the ecotoxicity categories as defined by U.S. EPA (2011A). The sub-acute dietary toxicity data indicate that PBZ is slightly toxic to mallard and bobwhite quail. The no-observed-effect-concentration (NOEC) corresponded to a daily dose of 3106 mg/kg/d for mallard and 101 mg/kg/d for bobwhite quail, respectively. A reproductive toxicity effect study with mallard ducks indicated a NOEC that corresponded to a daily dose of 38.8 mg/kg bw/d.

Aquatic Species

The acute toxicity data for bluegill sunfish, rainbow trout, mirror carp and sheepshead minnow listed in Appendix 3 show a range of LC₅₀ values from 23.6 to 27.8 mg/L. These data indicate that PBZ is slightly acutely toxic to fish. Aquatic-phase amphibian toxicity data were available from a study with toad tadpoles that indicated a slight toxicity of PBZ with a LC₅₀ value of 11 mg/L.

Chronic toxicity data for rainbow trout indicated a NOEC of 3.3 mg/L. The endocrine activity was studied in zebra fish (*Danio rerio*). No activity was found at levels up to and including the mean measured concentration of 3.2 mg/L. No NOEC could be established. However, statistically significant reductions in vitellogenin levels were observed at all test concentrations in male fish, while non-significant decreases were observed in top dose levels in female fish. Fish gonadal screening assays for endocrine activity in zebra fish showed no histopathological treatment-related effect on the gonads, liver, and kidneys.

Bioaccumulation

Bioaccumulation factors in bluegill sunfish were approximately 44 in whole fish, 20 in muscle, and 248 in viscera. During the depuration period the accumulated residues were rapidly eliminated, with ¹⁴C-residue concentrations returning to background levels within 7 days.

Aquatic invertebrates

The toxicity data for aquatic invertebrates, including water fleas (*Daphnia magna*), mysid shrimp (*M. bahia*), and Pacific oyster larvae (*C. gigas*), indicate that PBZ is slightly toxic to this class of organisms with LC₅₀ data in the range of >9 to 35 mg/L. Chronic toxicity data for water fleas (*D. magna*) indicated a 22-d NOEC value of 0.32 mg/L based on effect on *D. magna* length.

Aquatic plants

For non-vascular aquatic plants, the toxicity of PBZ to green algae (*Selenastrum capricornutum*) the 96-hr E_bC₅₀ and E_rC₅₀¹ for PBZ were 7.2 mg/L and >15.2 mg/L, respectively. For blue-green algae (*Anabaena flos-aquae*) these values were estimated to be greater than 23.2 mg/L. PBZ is more toxic to vascular aquatic plants. The data for duckweed (*Lemna gibba*) 7-d E_bC₅₀ and E_rC₅₀ for PBZ were 8.2 µg/L (0.0082 mg/L) and 28.3 µg/L (0.0283 mg/L), respectively.

Terrestrial Vertebrates

Mammalian toxicity was presented in Section 5. The reader is referred to that section for information relative to the ecotoxicity for terrestrial invertebrates.

Bees

Honey bees (*Apis mellifera*) exposed to PBZ by contact with doses in the range of 2 to 40 µg per bee and orally by dosing at 2 µg per bee indicated contact and oral LD₅₀ values that were determined to be >40 µg/bee and >2 µg/bee, respectively.

Earthworms

Clitellate adult earthworms (*Eisenia foetida*) were exposed at a single test concentration of 1000 mg/kg soil for 14 days. The 14 d LC₅₀ value was >1000 mg/soil. No deaths, abnormalities in behavior or external condition were observed at the test concentration. There was a statistically significant 20% reduction in body weight. The 14 d LC₅₀ value for the ketone degradate was also determined to be >1000 mg/soil.

6.2 Acute and Chronic Toxicity of Metabolites

Metabolites that are considered relevant for ecotoxicological risk assessment are the ketone analog of PBZ, 1,2,4,-triazole and hydroxyl triazole (EFSA, 2006 and 2010). The available toxicity data for these metabolites are listed in Table 6.1. The data for PBZ are included for comparison.

¹ The E_bC₅₀ value is the concentration at which 50% reduction of biomass is observed; the E_rC₅₀ is the concentration at which a 50% inhibition of growth rate is observed (Bergtold and Dohmen, 2011).

Table 6.1. Comparison of acute (LC₅₀/EC₅₀) and chronic (NOEC) ecotoxicity data of paclobutrazol and its metabolites ketone, 1,2,4-triazole, and hydroxy-triazole (EFSA, 2006 and 2010).

Species	Paclobutrazol (mg/L)	Ketone (mg/L)	1,2,4-triazole (mg/L)	Hydroxy- triazole (mg/L)
ACUTE				
Fish (<i>O. mykiss</i> , 96-h LC ₅₀)	23.6	-	498	-
Invertebrates (<i>D. magna</i> , 48-h EC ₅₀)	27.8	-	>100	-
Algae (<i>P. subcapitata</i> , 72-h EC ₅₀)	7.2	-	12	-
Aquatic plants (<i>L. gibba</i> , 7-d EC ₅₀)	0.0283	0.57		>100
CHRONIC				
Fish (<i>O. mykiss</i> , NOEC)	3.3		100	

The data in Table 6.1 show that the metabolites are less toxic than the parent compound PBZ. In the case of the ketone metabolite, only aquatic plants have been tested. Such an approach was considered acceptable in the review by EFSA (2006) as this group of organisms is considered more sensitive to the parent compound than the other aquatic organism groups tested and the ketone is closer in structure to the parent and is formed higher up in the metabolic pathway.

7. EXPOSURE ASSESSMENT

In order to perform an ecological risk assessment, the exposure assessment is needed to estimate the environmental concentrations associated with the application of PBZ. Given the application method of PBZ as tree growth regulator by soil injection around the base of a tree, the exposure assessment was done for the environmental compartments surface water, ground water, and the soil in and immediately adjacent to the injection area. Potential off-site migration routes that are likely to be relevant for the applied product include runoff and leaching through the soil toward surface water and groundwater. Off-target migration through spray drift is not considered given that the application method is by soil injection.

7.1 Surface Water Exposure

The exposure to surface water was estimated using a Tier I screening-level exposure model that is used by the Environmental Fate and Effects Division of U.S. EPA's Office of Pesticide Programs (EFED-OPP) to assess the risk of a pesticide product to the environment. This Tier I model is designed as a coarse screen and estimates expected concentrations from several basic chemical and environmental fate parameters, and application information. This GENeric Expected Environmental Concentration Program (GENEEC) uses a candidate chemical's soil/water partition coefficient and degradation half-life values to estimate runoff from a ten hectare field into a one hectare by two meter deep pond. GENEEC is a program to calculate both acute and chronic generic expected environmental concentration values. It considers reduction in dissolved pesticide concentration due to adsorption of pesticide to soil or sediment, incorporation into the soil, degradation in soil before wash-off to a water body, direct deposition of spray drift into the water body, and degradation of the pesticide within the water body. It is designed to mimic the more sophisticated PRZM-EXAMS model simulation (Tier II model in EFED-OPP) (U.S. EPA, 2011B).

The model requires input values for parameters associated with application and the characteristics of the active ingredient. An application rate for Cambistat expressed in amount of product or active ingredient per acre has not been established because of its use pattern of treating individual trees. The application rate for the model input was set at 3 lbs per acre for a single application. This application rate was based on the annual maximum rate as for applications on turf (4 application per year of 0.75 lbs PBZ per acre = 3 lbs PBZ per acre) as was used with the exposure modeling described in U.S. EPA (2007B). This rate can be considered a reasonable high-end estimate of a per-acre rate considering the use pattern of treating individual trees. Since the product is injected into the soil, the option of granular application was selected in order to not simulate aerial spray drift. The incorporation depth of 6.0 inches was selected to be representative of the recommended injection depth used with the application of this product.

The values of the chemical and environmental fate properties were a K_D of 2.7 (lowest non-sand value in EFSA (2006), soil half-life of 437 days (according to GENEEC manual instructions for selecting conservative parameter value), aquatic half-life of 164 d, and photolysis half-life of 365 d (stable). The GENEEC input and output for this scenario are included in Appendix 4.

The model output shows that the simulated peak generic environmental concentration was 19.98 µg/L (0.01998 mg/L), the maximum concentration was 19.34 µg/L at 21 d and 17.35µg/L at 90

days. It is important to note that the GENEEC model simulates conservative pesticide concentrations for aquatic ecological exposure assessments.

7.2. Groundwater Exposure Assessment

The exposure of herbicides to groundwater was evaluated by using the SCI-GROW model simulations. SCI-GROW (Screening Concentration **In GROWnd Water**) is a screening model which the Office of Pesticide Programs (OPP) in EPA frequently uses to estimate pesticide concentrations in vulnerable ground water (U.S. EPA, 2011C). The model provides an exposure value which is used to determine the potential risk to the environment and to human health from drinking water contaminated with the pesticide. The SCI-GROW estimate is based on environmental fate properties of the pesticide (aerobic soil degradation half-life and linear adsorption coefficient normalized for soil organic carbon content), the maximum application rate, and existing data from small-scale prospective ground-water monitoring studies at sites with sandy soils, low organic matter content (on average <1%) and shallow ground water (on average 14 ft).

Pesticide concentrations estimated by SCI-GROW represent conservative or high-end exposure values because the model is based on ground-water monitoring studies which were conducted by applying pesticides at maximum allowed rates and frequency to vulnerable sites (i.e., shallow aquifers, sandy, permeable soils, and substantial rainfall and/or irrigation to maximize leaching). In most cases, a large majority of the use areas will have ground water that is less vulnerable to contamination than the areas used to derive the SCI-GROW estimate.

The input parameters for SCI-GROW include the application rate, soil degradation (soil half-life value) and a soil mobility parameter (soil organic matter-water partitioning coefficient (K_{OC})). Following the instructions for input value selection, the annual application rate used was 3 lbs PBZ per acre (as described with surface water assessment), the soil half-life was 285 days (see surface water assessment), and the K_{OC} was 106 mL/g (determined from the lowest non-sand K_D value used above with surface water and the corresponding organic carbon content of 2.5%: $K_{OC} = K_D / \text{fraction OC}$).

The SCI-GROW simulated screening-level groundwater concentration using the selected input values as described above was 14.3 µg/L (see also Appendix 5).

7.3. Soil Exposure at the Application Site

The exposure of PBZ in the soil following the injection of the product in a band around the trunk base of a tree was estimated by considering the amount of product applied according to label instruction to a tree with an assumed trunk diameter and assumed dimensions of a soil band around the trunk base of the tree that would receive the initial application of the product. Details on the calculation of the PBZ concentration in the soil of the treated area around a tree are shown in Appendix 6. The initial peak concentration of PBZ in the treated soil band was calculated to be 150 mg/kg dry soil.

8. RISK CHARACTERIZATION

8.1 Ecological Risk Assessment

Ecological risk characterization integrates the results of the exposure and ecotoxicity data to evaluate the likelihood of adverse ecological effects. For most ecological risk assessments, U.S. EPA uses a deterministic approach or the quotient method to compare toxicity to environmental exposure. In the deterministic approach, a risk quotient (RQ) is calculated by dividing exposure estimates by ecotoxicity values, both acute and chronic. RQ values are then compared to established levels of concern (LOCs). The LOCs are criteria used by U.S. EPA to indicate potential risk to non-target organisms. The RQ ratio is a screening-level method that identifies high- or low-risk situations (U.S. EPA, 2011D).

As pointed out earlier, the environmental compartments that are most likely to be exposed to the products or residues thereof are the soil in and adjacent to the treatment area, and surface and ground water. The ecological risk assessment will therefore consider the risk to aquatic organisms and earthworms. Based on the localized application of product in the soil of tree rooting area it can be expected that the exposure to terrestrial vertebrates and birds is going to be minimal. The groundwater is not considered as a relevant environmental compartment for ecological risk, but will be addressed separately for a drinking water assessment.

The RQ values for the groups of organisms considered in this ecological risk assessment are listed in Table 8.1 along with the corresponding toxicity endpoint and EEC data. The RQ are compared with the established LOCs (U.S. EPA, 2011D).

Table 8.1. Ecological risk assessment data for paclobutrazol.

Species	Toxicity Endpoint	Endpoint Value	EEC	RQ	LOC ¹
		(mg/L)	mg/L	EEC/ Endpoint	
AQUATIC INVERTEBRATES					
<i>Daphnia magna</i>	Acute 96-h LC ₅₀	35	0.01998	0.0006	0.5
Mysid Shrimp	Acute 96-h LC ₅₀	>9	0.01998	>0.0022	0.5
Pacific oyster larvae	Acute 48-h EC ₅₀	>10	0.01998	>0.0020	0.5
<i>Daphnia magna</i>	Chronic NOEC	0.32	0.0173	0.0541	1
FISH					
Bluegill sunfish	Acute 96-h LC ₅₀	23.6	0.01998	0.0008	0.5
Rainbow trout	Acute 96-h LC ₅₀	27.8	0.01998	0.0007	0.5
Mirror Carp	Acute 96-h LC ₅₀	26.0	0.01998	0.0008	0.5
Sheepshead minnow	Acute 96-h LC ₅₀	24.3	0.01998	0.0008	0.5
Rainbow trout	Chronic 22-d NOEC	3.3	0.01735	0.0053	1

Species	Toxicity Endpoint	Endpoint Value	EEC	RQ	LOC ¹
AMPHIBIAN (aquatic phase)					
<i>Bufo bufo</i> (toad)	Acute 72-h LC ₅₀	11	0.01998	0.0018	0.5
AQUATIC PLANTS					
Green algae	Growth E _b C50	7.2	0.01988	0.0028	1
	Growth E _r C50	15.2	0.01988	0.0013	1
Blue-green algae	Growth E _b C50	>23.2	0.01988	>0.0009	1
	Growth E _r C50	>23.2	0.01988	>0.0009	1
Duck weed	Growth E _b C50	0.0082	0.01988	2.4244	1
	Growth E _r C50	0.0283	0.01988	0.7025	1
		mg/kg soil	mg/kg soil		
EARTHWORMS					
<i>Eisenia foetida</i>	Acute 14-d LC ₅₀	>1000	150	0.15	0.5

¹ LOC values established by U.S. EPA, 2011D.

Comparison of the RQ values with the established LOCs indicates that all are well below the established LOCs, except for duckweed. The low RQ values indicate low potential for adverse effects on most aquatic organisms. The RQ value for growth effects on duckweed biomass indicates that there is some potential for adverse effects for vascular aquatic plants. This can be expected from exposure of plants to a growth retardant compound. Given the slight exceedance of the LOC and that the effect is on growth, it is not expected that the impact would be detrimental for this group of organisms. In addition, the estimated surface water concentration is a screening-level assessment that is based on conservative assumptions. The screening-level concentration can be considered to be representative of a high-end exposure and will not occur in most situations.

Earthworms are organisms that could be exposed to PBZ following a soil injection application around the perimeter of a tree trunk. However, the level of exposure associated with such an application would not exceed the LOC for this group of organisms. PBZ soil concentration and associated exposure by earthworms would also decrease over time as the PBZ is gradually taken up by the tree.

Acute and chronic risk to mammals from potential exposure to PBZ residues in food was assessed in the review by EFSA (2006). The exposure assessment was based on the application rate of 0.0557 lbs PBZ per acre as proposed for use on an oil seed crop. The food intake rate considered was for a medium-sized herbivorous mammal and residue characteristics were

representative for application to a leafy crop. The estimated theoretical exposure was 2.18 mg PBZ/kg bw/d (acute) and 0.51 mg PBZ/kg bw/d (chronic). The toxicological endpoints used in this risk assessment were the LD₅₀ for male mouse (490 mg PBZ/kg bw) and developmental toxicity NOAEL of 10 mg/kg bw in rat. A developmental end-point was used as this was the lowest longer-term end-point and therefore considered to represent the worst-case scenario. Using this information, EFSA calculated a toxicity exposure ratio (TER) of 224.8 for acute risk and 19.6 for chronic risk. Based on comparison with the levels of concern (TER values of greater than 10 for acute risk and greater than 5 for chronic risk are not of concern), EFSA concluded that the acute and chronic risks to mammals were not a concern.

It should be pointed out that the developmental endpoint is toxicologically not considered a long-term or chronic endpoint. Developmental exposure is typically viewed as being of intermediate exposure. The evaluation of chronic toxicity using a toxicity value based on intermediate exposure is not protective.

Alternative long-term toxicological end-points for mammalian species identified by EFSA were the NOAEL of 23.2 mg/kg bw/d for parental toxicity and 108 mg/kg bw/d for reproductive toxicity. Evaluation of chronic risk based on these endpoints results in TER values of 45 (parental) and 212 (reproductive) which can be considered protective. Given that there was no estimated theoretical exposure of medium duration generated in the EFSA evaluation, it is not possible to properly evaluate the developmental endpoint, (i.e., the most sensitive endpoint) based on the available information. It is likely that if an exposure estimate of intermediate exposure were to be generated, that it would indicate that developmental effects would not be of concern—however, such a conclusion cannot be drawn based on the current information.

The risk to earthworm-eating mammals was assessed by considering the residue estimates in earthworms that were based on estimated bioconcentration factors and concentrations of PBZ in soil. The residue estimates were converted to a daily dose that had a value of 0.18 mg PBZ/kg bw/d. Compared to the long-term NOAEL of 10 mg/kg bw/d, the toxicity exposure ratio was 55.6. This value exceeds the trigger value (level of concern) of 5 (a TER value greater than 5 for chronic risk is not of concern) and therefore it was concluded that the risk to earthworm-eating mammals was not a concern.

The risk assessments described above were done assuming an application scenario representative for the use of PBZ on oilseed crops, which includes broadcast foliar applications resulting in residues that mostly occur on above ground plant material. The use scenario for tree treatments, in contrast, is by soil injection around the tree trunk perimeter, which results in a much more localized application of the material in the soil. It is likely that tree trunk application results in higher concentrations of PBZ occur in soil compared to soil concentrations associated with broadcast foliar applications. However, it is unlikely that small mammals would feed exclusively and permanently in a treated tree trunk area. It is therefore unlikely that the exposure of mammals to PBZ in a tree trunk treatment scenario would exceed the exposure levels as described above in the broadcast oil seed crop scenario. The risks to mammals from PBZ exposure associated with tree trunk applications is not expected to be significant.

8.2 Comparison of Estimated Groundwater Concentration with Drinking Water Standards

The screening-level groundwater concentration of 14.3 ppb is below the maximum allowable concentration in drinking water of 66 µg/L reported in EFSA (2010A). This screening-level concentration is also below the lifetime health advisory level of 460 µg/L calculated by Baris et al. (2010).

With the consideration of the risk to groundwater it is important to consider that the screening-level concentrations generated by the SCI-GROW model represent conservative or high-end exposure. In most cases, the use areas will have ground water that is less vulnerable to contamination than the areas used to derive the SCI-GROW estimate. In addition, the model does not consider buffer zones around a drinking water well as is required by ROW regulations.

9. RISK MITIGATION AND USE PRECAUTIONS

The product label (Rainbow Treecare, 2011) offers a number of precautionary practices that may be taken to mitigate potential risks to non-target organisms. Given that the product is a plant growth inhibitor, non-target plants have the highest potential to be affected by PBZ exposure through off-site movement of applied product. This potential risk to non-target plants is addressed by warning and precautionary language on the label:

Localized stunting or injury of turfgrass or other non-target plants immediately adjacent to the treatment site may occur if the product flows off of the application site.

Avoid basal drench applications on inclines and other areas where treated soil is likely to be washed away from the base of the tree by rainfall or irrigation.

Shrubs and/or herbaceous ornamentals next to treated trees may be affected if their roots extend into the treatment zone.

The risk to aquatic organisms is addressed by language that states that the product should not be applied directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark.

Other label language addresses the treatment of trees that produce products for human consumption such as maple trees, and fruit and nut trees.

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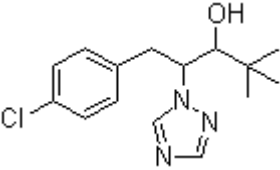
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Appendix 1

Table A1.1. Paclobutrazol structure and nomenclature

Paclobutrazol	
Structure	
Molecular Formula	C ₁₅ H ₂₀ ClN ₃ O
IUPAC Name	(2 <i>RS</i> ,3 <i>RS</i>)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1 <i>H</i> -1,2,4-triazol-1-yl)pentan-3-ol
CAS name	(<i>αR,βR</i>)- <i>rel</i> -β-[(4-chlorophenyl)methyl]-α-(1,1-dimethylethyl)-1 <i>H</i> -1,2,4-triazole-1-ethanol
CAS Number	76738-62-0
PC Code	125601

Source: U.S. EPA, 2007B

Table A1.2. Physical and chemical properties of paclobutrazol

Parameter	Value	Source
Molecular Mass	293.8	EFSA, 2006 ¹⁾
Melting/Boiling point	164 °C/ 384 °C	EFSA, 2006
Density	1.23 g/cm ³ (20 °C)	EFSA, 2006
Vapor Pressure	1.9 × 10 ⁻⁶ Pa (very slightly volatile)	EFSA, 2006
Volatility from water (Henry's constant)	2.39 × 10 ⁻⁵ Pa m ³ mol ⁻¹	EFSA, 2006
Solubility in water	26 mg/L (20 °C)	BCPC, 2000 ²⁾
Octanol-water partitioning constant (Log P)	3.2	BCPC, 2000

1) EFSA, 2006, Section B.2.1; ²⁾ British Crop Protection Council, 2000 (The Pesticide Manual).

Appendix 2

Table A2.1. Environmental fate properties for mobility and persistence of paclobutrazol

Parameter	Value	Source
Hydrolysis	Stable: <6% degradation after 30 d at pH 4,7, and 9	U.S. EPA, 2007B
Photolysis in water	Stable: < 5% degradation after 10 d at pH 7	U.S. EPA, 2007B
Aerobic soil metabolism (half-life)	> 1 yr 43 – 618 d (mean 183 d)	U.S. EPA, 2007B EFSA, 2006 ¹⁾
Anaerobic soil metabolism (half-life)	> 1 yr	U.S. EPA, 2007B
Field dissipation (half-life)	450-950 d in orchard US soils 175 – 252 d in agricultural US soils	U.S. EPA, 2007B EFSA, 2006 ¹⁾
Aquatic metabolism (half-life)	164 d	EFSA, 2007B
Soil Adsorption Coefficient (K _d) mL/g	1.3 – 23.0 0.8 – 21.3 (mean of 4.3)	U.S. EPA, 2007B EFSA, 2006 ¹⁾

¹⁾ EFSA, 2006: Volume 3, Annex B, Section 8.

Appendix 3

Table A3.1. Summary of ecotoxicity data for paclobutrazol. Data were obtained from U.S. EPA (2007B), EFSA (2006) and EFSA (2010).

Species	Toxicity	Endpoint	Values
AVIAN			(mg/kg b.w.)
Mallard	Acute Oral ¹	LD50	>7913
Japanese Quail	Acute Oral	LD50	>2100
Mallard	Sub-acute dietary ²	LD50	>3106
		NOEC	3106
Bobwhite Quail	Sub-acute dietary	LD50	>2791
		NOEC	101
Mallard	Long-term/ Reproductive ³	NOEC	38.8
AQUATIC INVERTEBRATES			mg/L
<i>Daphnia magna</i> (flea)	Acute	48 hr EC50 static	35
Mysid Shrimp	Acute	96 hr EC50 semi- static	>9
Pacific oyster larvae	Acute	48 hr EC50 static	>10
<i>Daphnia magna</i>	Chronic	22-d NOEC semi-static	0.32
FISH			mg/L
Bluegill sunfish	Acute	96 hr EC50 semi- static	23.6
Rainbow trout	Acute	96 hr EC50 semi- static	27.8
Mirror Carp	Acute	96 hr EC50 semi- static	26.0
Sheepshead minnow	Acute	96 hr EC50 static	24.3
Rainbow trout	Chronic	28-d NOEC	3.3
AMPHIBIAN (aquatic phase)			mg/L
<i>Bufo bufo</i> (toad)	Acute	24-h LC50	11
VERTEBRATES (terrestrial)			mg/kg
Rat	Acute Oral ¹	LD50	1954 (male) 1336 (female)
Mouse	Acute Oral	LD50	490 (male) 1219 (female)
Guinea Pig	Acute Oral	LD50	542 (male) 400-640 (female)

Species	Toxicity	Endpoint	Values
Rabbit	Acute Oral	LD50	835 (male) 937 (female)
BEES			µg/bee
Honey bee (<i>Apis mellifera</i>)	Acute	48-hr LD50	>40 (contact) >2 (oral)
EARTHWORMS			mg/kg soil
<i>Eisenia foetida</i>	Acute	14-d LC50	>1000
AQUATIC PLANTS			mg/L
Green algae	Growth	96-h E _b C50	7.2
		96-h E _r C50	15.2
Blue-green algae	Growth	96-h E _b C50	>23.2
		96-h E _r C50	>23.2
Duck weed	Growth	7-d E _b C50	0.0082
		7-d E _r C50	0.0283

¹ Exposed by a single oral dose

² Exposed by diets containing PBZ for 5 d

³ Exposed by diets containing PBZ for 21 wks

Appendix 4

GENEEC Surface Water Model Input and Output:

RUN No.***** FOR Paclobutrazol ON Trees * INPUT VALUES *

```

-----
RATE (#/AC)  No.APPS &  SOIL SOLUBIL  APPL TYPE NO-SPRAY INCORP
ONE(MULT)   INTERVAL    Kd   (PPM )   (%DRIFT)  ZONE(FT) (IN)
-----
3.000( 3.000)  1  1      2.7  26.0  GRANUL( .0)  .0  6.0
  
```

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

```

-----
METABOLIC DAYS UNTIL HYDROLYSIS  PHOTOLYSIS  METABOLIC COMBINED
(FIELD)  RAIN/RUNOFF  (POND)  (POND-EFF)  (POND)  (POND)
-----
437.00    2      N/A  365.00-45260.00  164.00  163.41
  
```

GENERIC EECs (IN MICROGRAMS/LITER (PPB)) Version 2.0 Aug 1, 2001

```

-----
PEAK    MAX 4 DAY    MAX 21 DAY    MAX 60 DAY    MAX 90 DAY
GEEC    AVG GEEC     AVG GEEC     AVG GEEC     AVG GEEC
-----
19.98    19.88      19.34      18.17      17.35
-----
  
```

Appendix 5

SCI_GROW model input and output for Paclobutrazol:

```
SCIGROW
VERSION 2.3
ENVIRONMENTAL FATE AND EFFECTS DIVISION
OFFICE OF PESTICIDE PROGRAMS
U.S. ENVIRONMENTAL PROTECTION AGENCY
SCREENING MODEL
FOR AQUATIC PESTICIDE EXPOSURE
```

```
SciGrow version 2.3
chemical:Paclobutrazol
time is 6/13/2011 16:34:39
```

```
-----
Application   Number of   Total Use   Koc   Soil Aerobic
rate (lb/acre) applications (lb/acre/yr) (ml/g)  metabolism (days)
-----
```

```
3.000         1.0         3.000    1.06E+02   285.0
-----
```

```
groundwater screening cond (ppb) = 1.43E+01
```

```
*****
```


Appendix 6

Estimation of Paclobutrazol concentration in soil band around tree trunk:

Assumptions:

- Diameter of trunk at breast height of 50 inches
- Mass of applied PBZ is 202.5 g (calculated from information on Cambistat Label)
(833 ml product x 1.09 g/ml x 22.3 % PBZ = 202.5 g PBZ)
- Diameter trunk at ground level is 60 inches
- Soil band treated begins 2 inches from trunk resulting in an inside diameter of soil band of 64 inches
- A 1-foot wide band will initially be exposed to product: Outside diameter of band is 76 inches
- Treatment reaches initially a depth of 1 ft
- Dry bulk density of soil to be 1.3 g/ml

<u>Conversions:</u>	Inside diameter:	64 inches =	162.56	cm
	Outside diameter:	76 inches =	193.04	cm
	Depth	12 inches =	30.48	cm

Calculations:

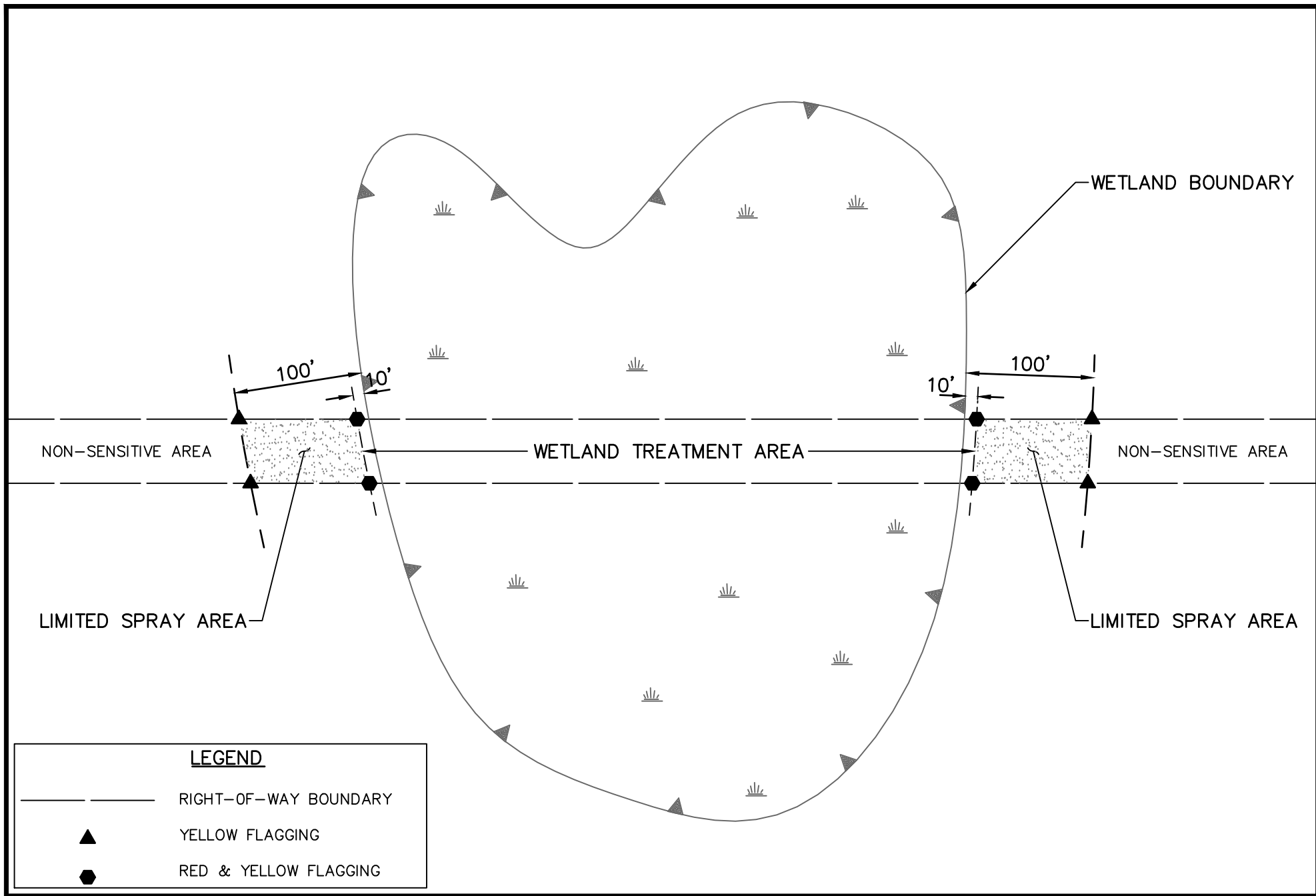
Area of treated soil band: Calculated by subtracting the areas of the circles with outside and inside diameters:

	Outside	Inside		
Circle areas (cm ²):	diameter:	diameter:		
(πR^2)	117069.7	83018.95		
Difference between circle areas is band area:			34050.74	cm ²
Volume of treated soil band: (area x depth):			1037867	cm ³
Mass of dry soil is volume x bulk density:			1349227	g
			1349.227	kg
Mass of applied PBZ in band area of soil:			202.5	g
Concentration of PBZ in soil (mg/kg or ppm)			150.086	ppm

Appendix E

Methods for Flagging in Sensitive Areas

U.S. VIEW: FIG. 1
LIMAN: PLOT
CTB: F&O Standard



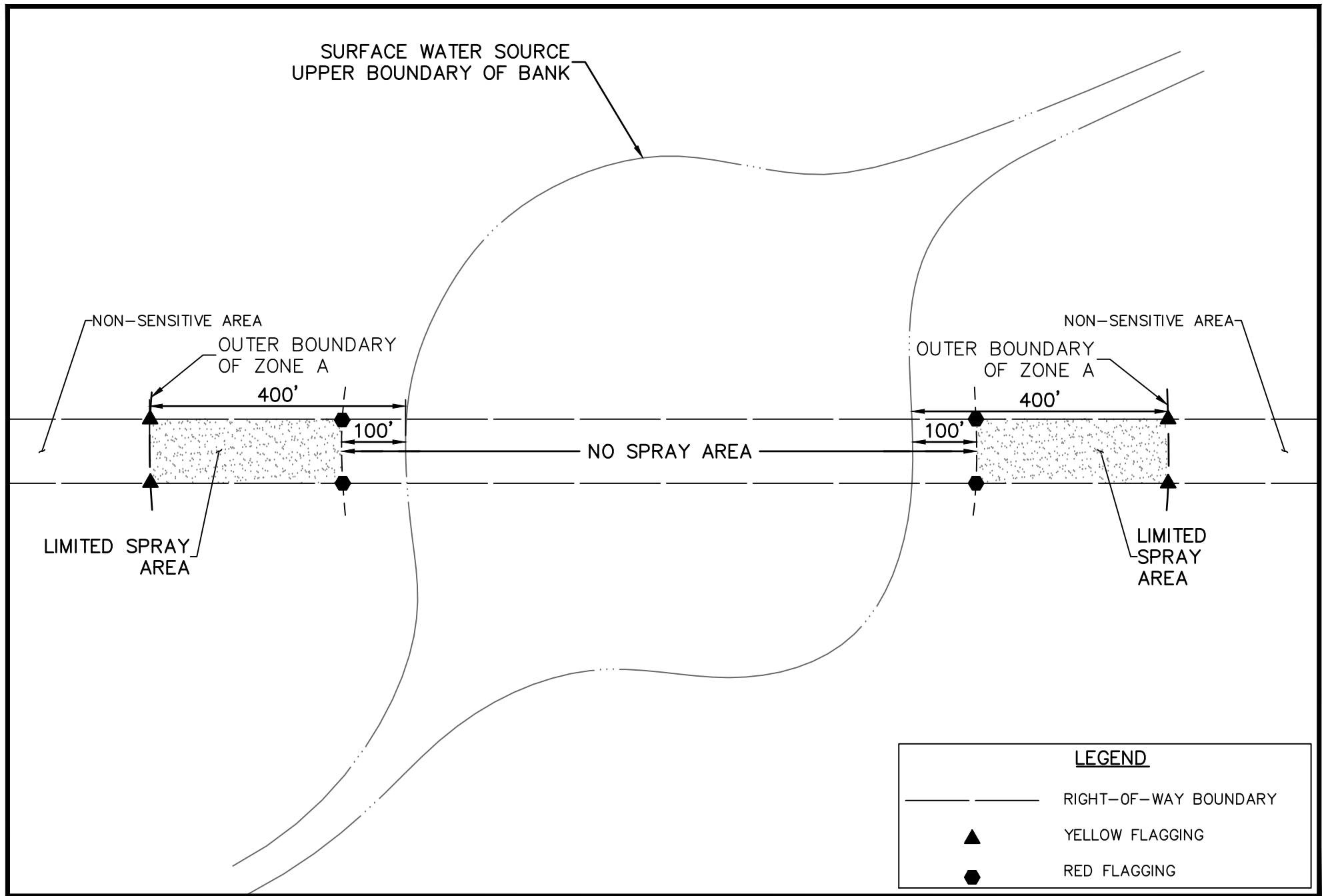
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VERT.: N/A	
DATUM:	
HORZ.: N/A	
VERT.: N/A	
GRAPHIC SCALE	

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HOLYOKE GAS & ELECTRIC DEPARTMENT
METHOD TO FLAG WETLANDS
VEGETATION MANAGEMENT PLAN
HOLYOKE
MASSACHUSETTS

PROJ. No.: 2000727.A89
DATE: APRIL 2013
FIG. 1

UCS: WRLD
IMS VIEW: FIG. 2
LIMAN: PLOT
CTB: F&O Standard



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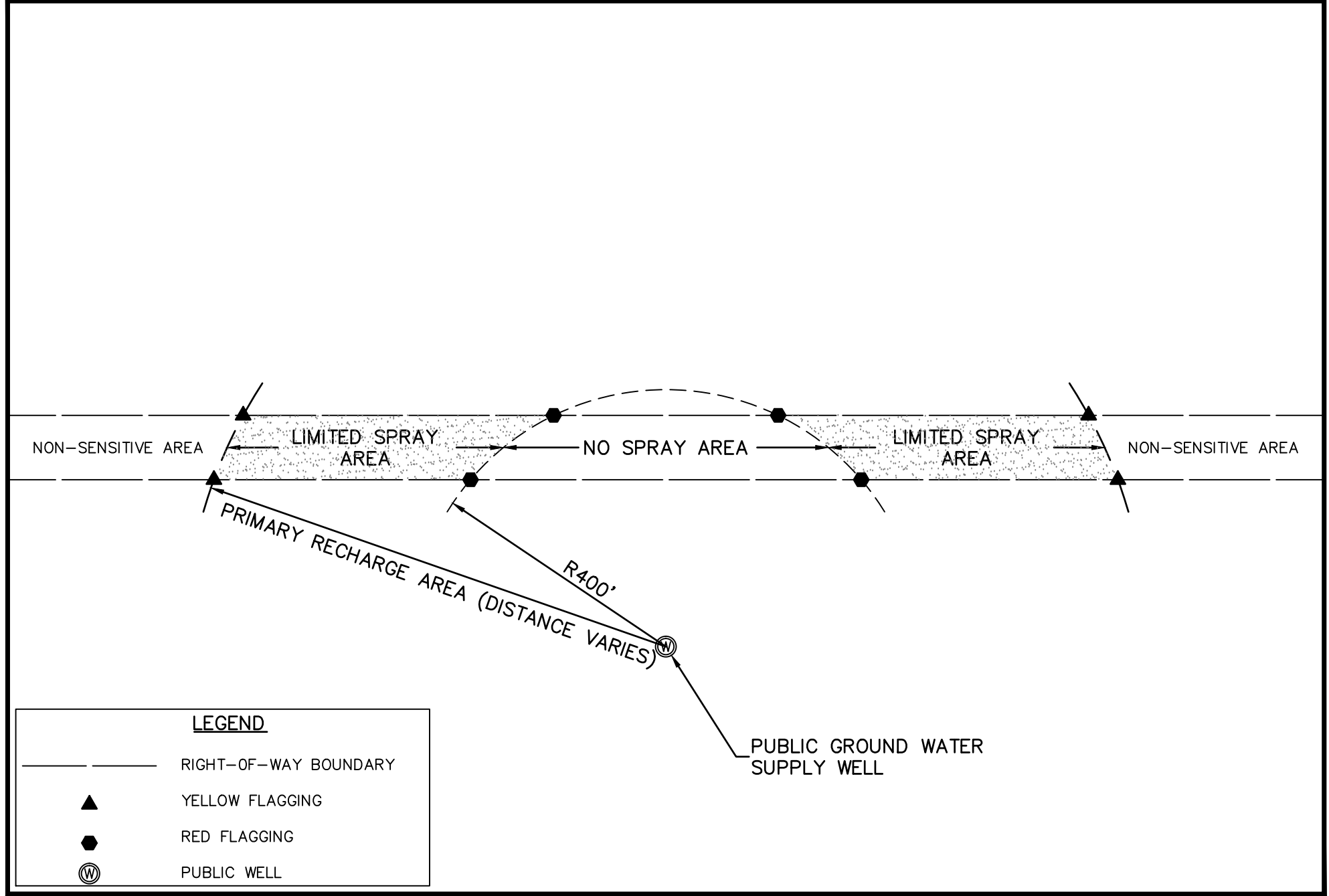
HOLYOKE GAS & ELECTRIC DEPARTMENT
METHOD TO FLAG PUBLIC SURFACE WATER SOURCE
VEGETATION MANAGEMENT PLAN

HOLYOKE

MASSACHUSETTS

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

FIG. 2



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

0

GRAPHIC SCALE

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METHOD TO FLAG PUBLIC GROUND WATER SUPPLY WELL

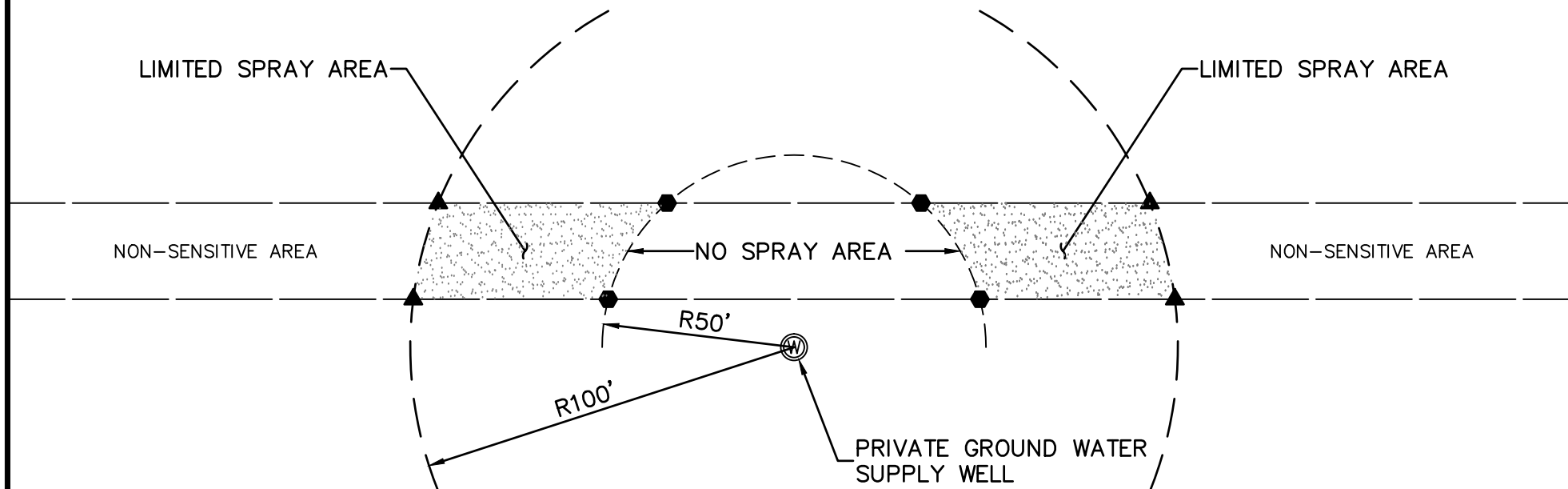
VEGETATION MANAGEMENT PLAN

HOLYOKE




MASSACHUSETTS


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DATE: APRIL 2013

FIG. 3



LEGEND

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

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



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METHOD TO FLAG PRIVATE GROUND WATER SUPPLY WELL
VEGETATION MANAGEMENT PLAN

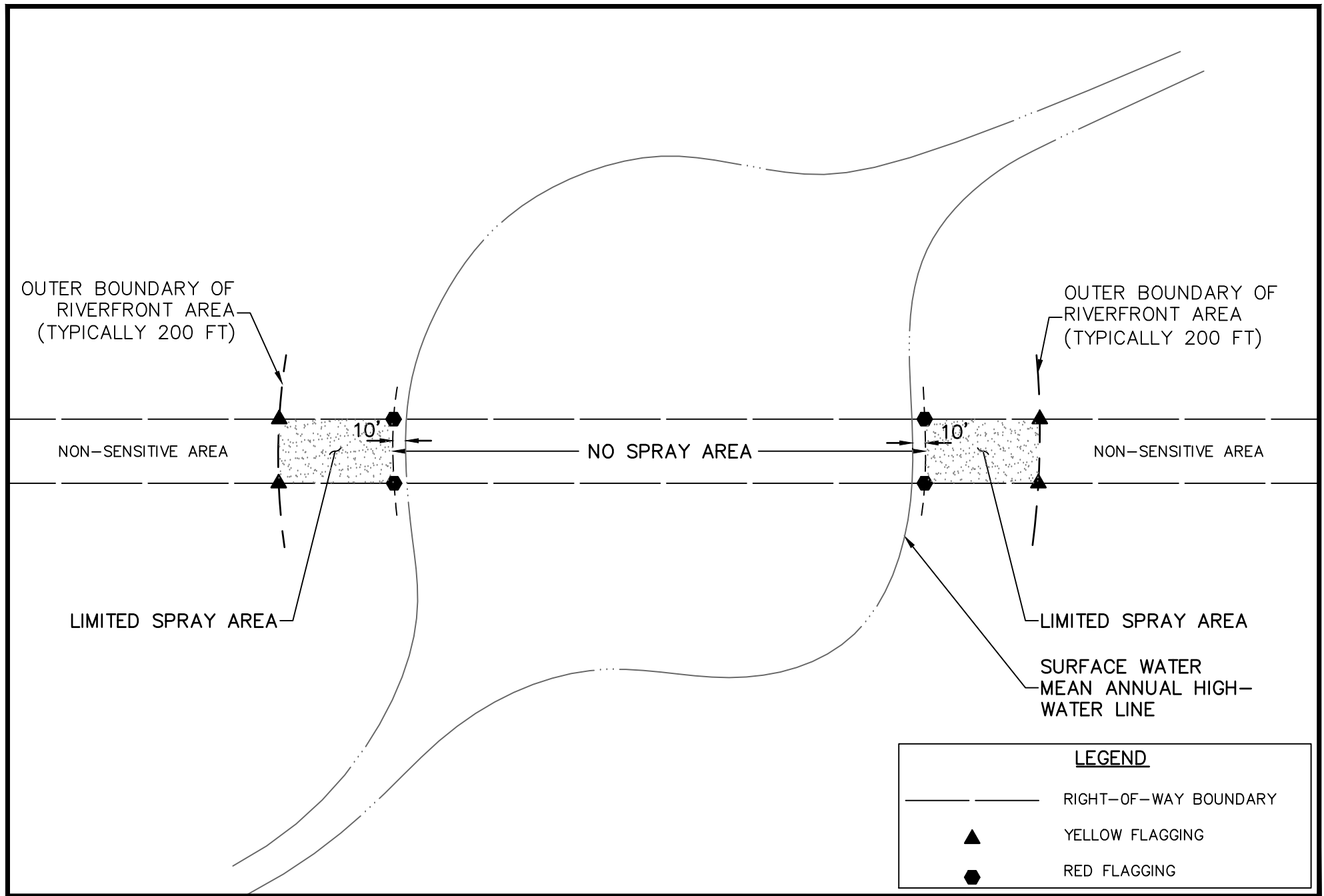
HOLYOKE

MASSACHUSETTS

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DATE: APRIL 2013

FIG. 4

UCS: WRLD
IMS VIEW: FIG. 5
LIMAN: PLOT
CTB: F&O Standard



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 STANDING SURFACE WATER
VEGETATION MANAGEMENT PLAN

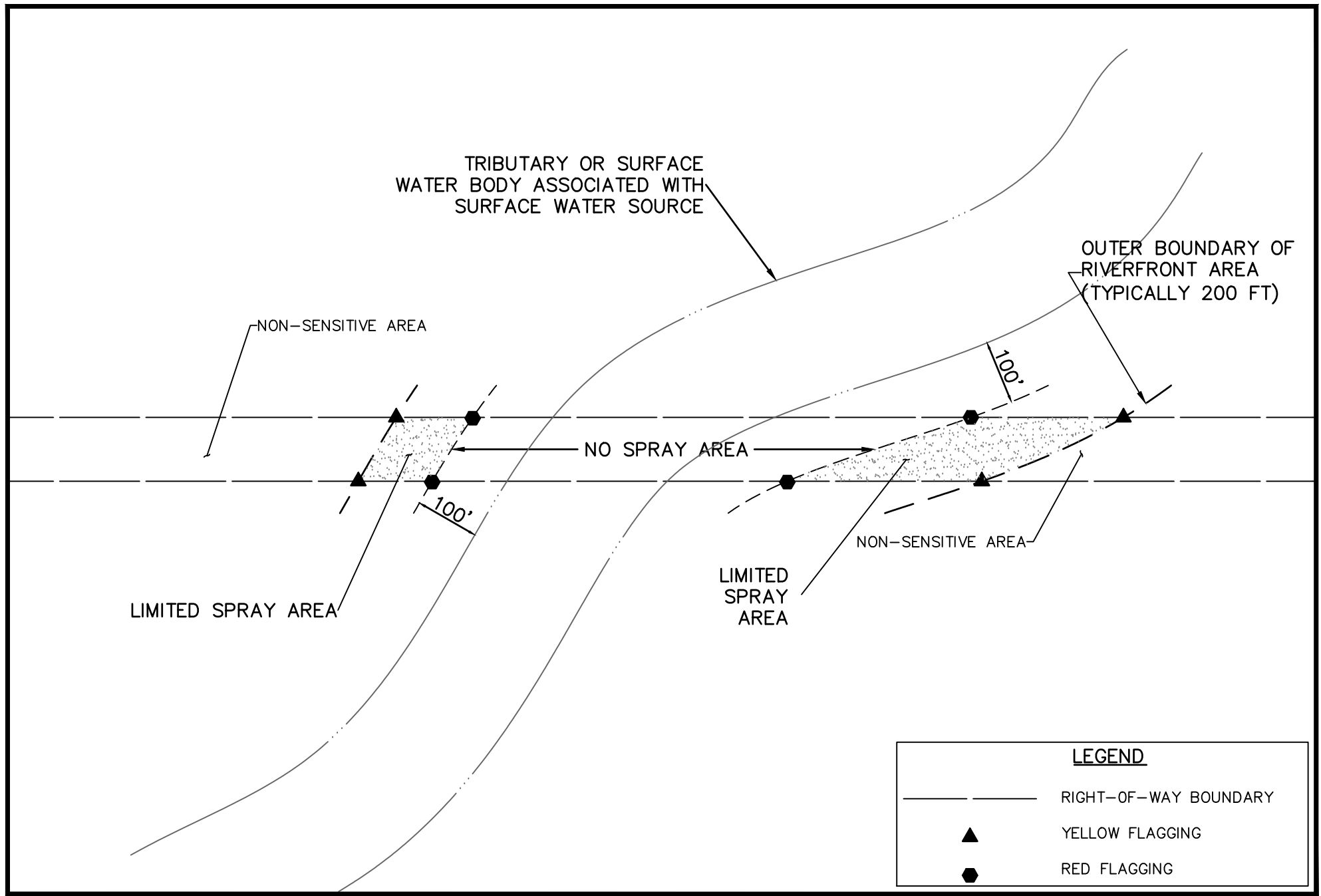
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FIG. 5

U.S. VIEW: FIG. 6
LIMAN: PLOT
CTB: F&O Standard



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



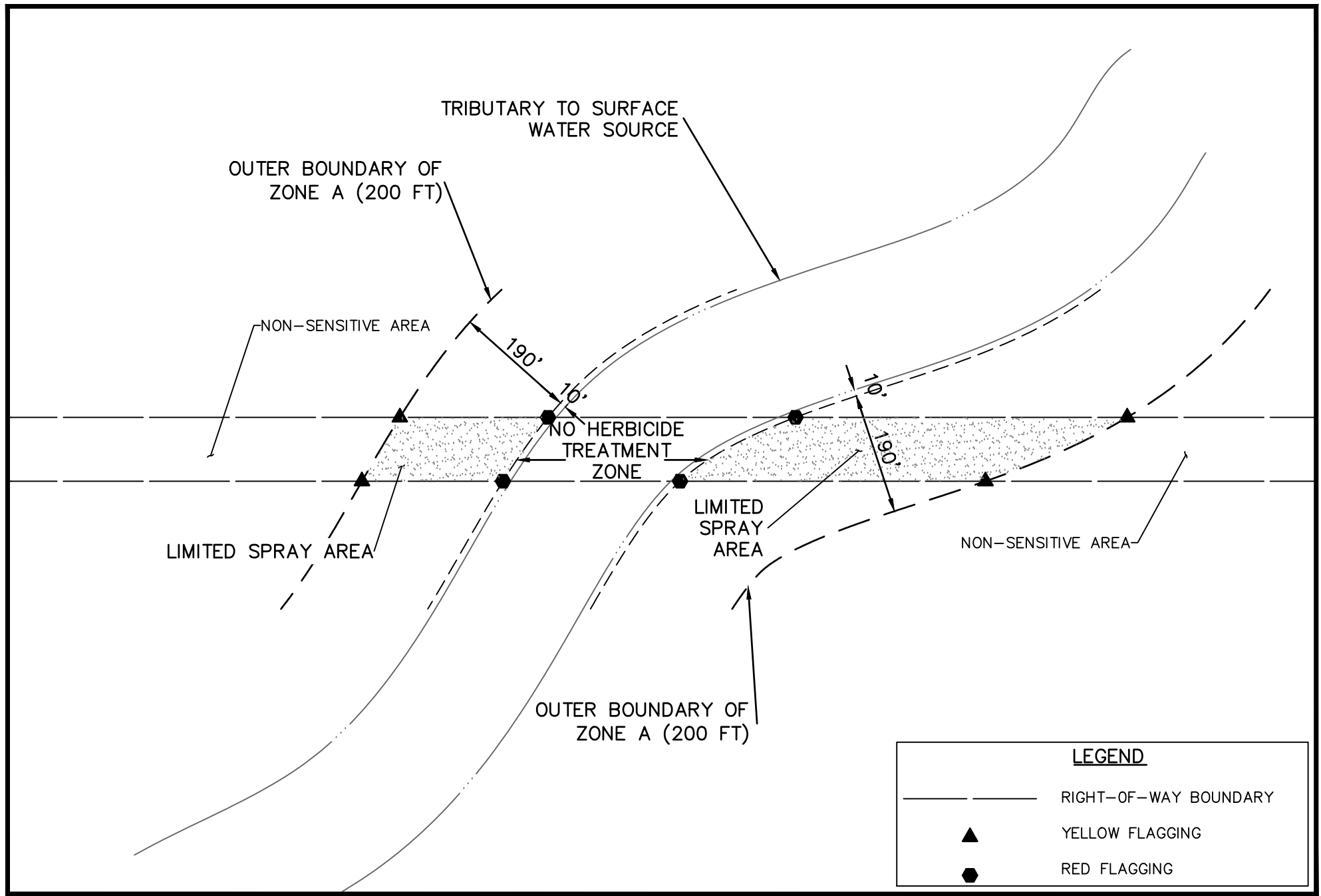
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METHOD TO FLAG TRIBUTARY TO PUBLIC SURFACE WATER SUPPLY
VEGETATION MANAGEMENT PLAN
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MASSACHUSETTS

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FIG. 6

U.S. VIEW: FIG. 7
LIMAN: PLOT
CTB: F&O Standard



LEGEND	
	RIGHT-OF-WAY BOUNDARY
	YELLOW FLAGGING
	RED FLAGGING

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



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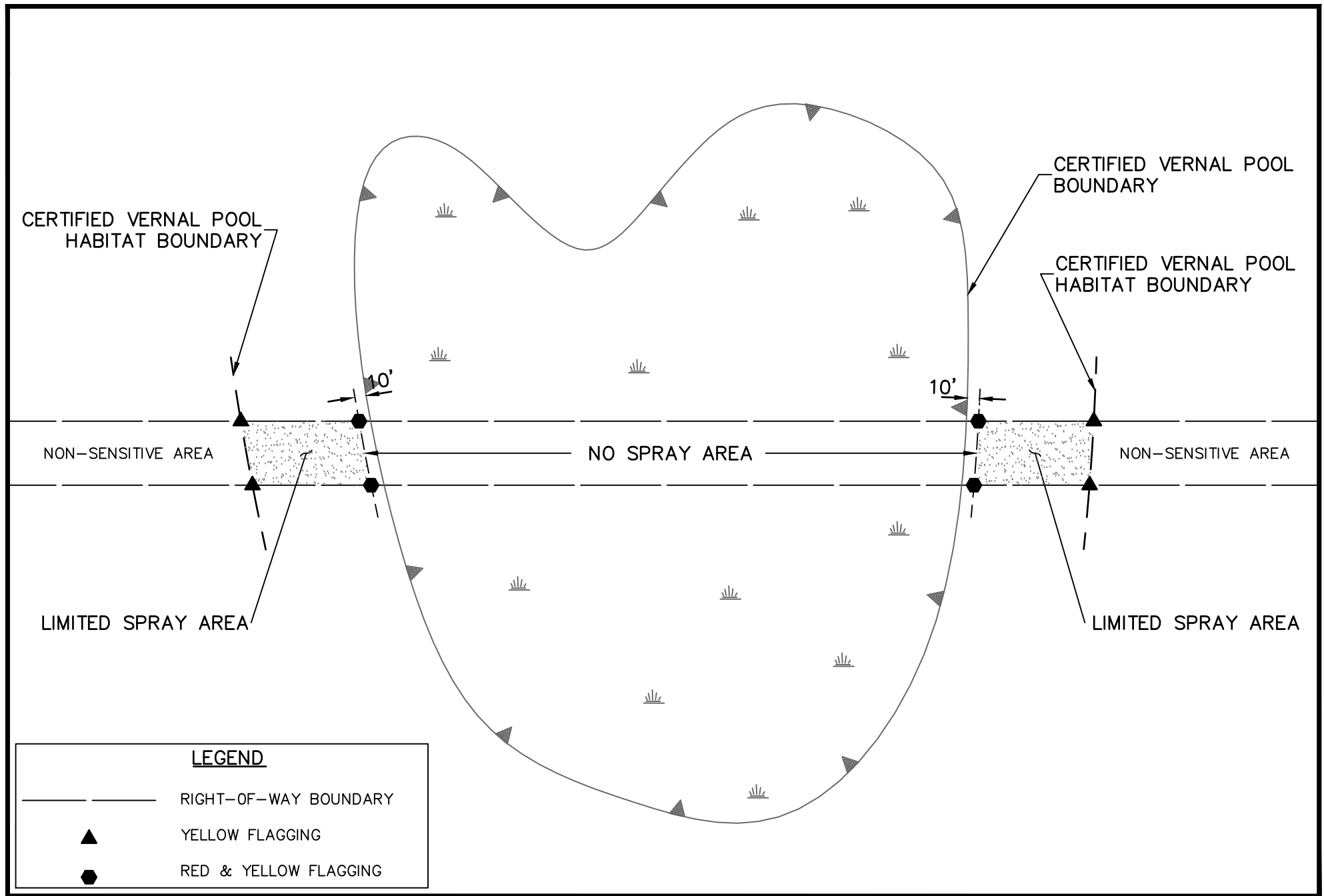
HOLYOKE GAS & ELECTRIC DEPARTMENT
METHOD TO FLAG TRIBUTARY TO PUBLIC SURFACE WATER SUPPLY
OUTSIDE OF A ZONE A
VEGETATION MANAGEMENT PLAN

HOLYOKE
MASSACHUSETTS

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DATE: APRIL 2013

FIG. 7

UCS: WRLD
IMS VIEW: FIG. 8
LIMAN: PLOT
CTB: F&O Standard



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



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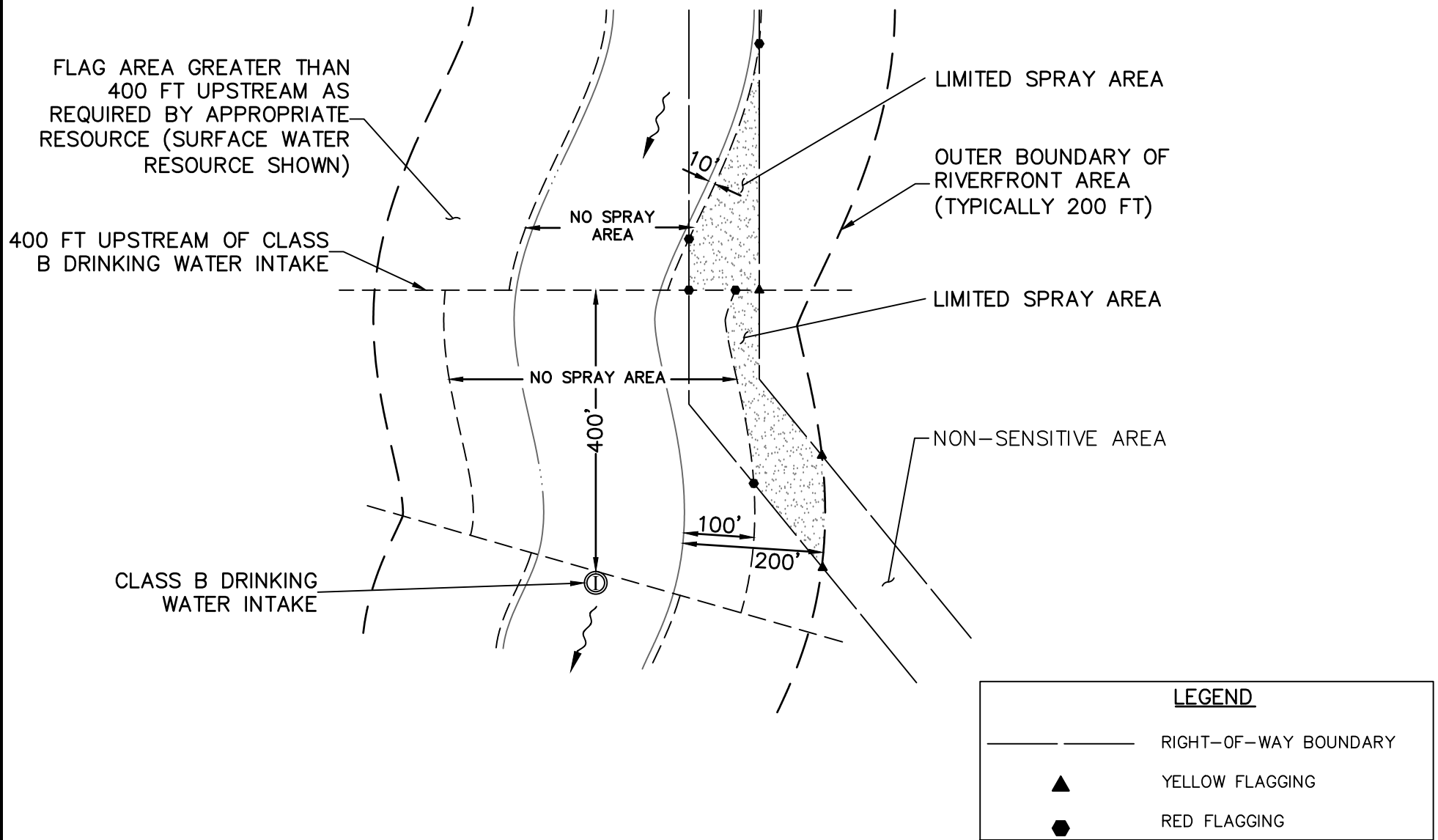
HOLYOKE GAS & ELECTRIC DEPARTMENT
METHOD TO FLAG CERTIFIED VERNAL POOLS
VEGETATION MANAGEMENT PLAN

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MASSACHUSETTS

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

FIG. 8



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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METHOD TO FLAG CLASS B DRINKING WATER INTAKE
VEGETATION MANAGEMENT PLAN

HOLYOKE

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

FIG. 9

Appendix F

Herbicide Labels and SDSs



Material Safety Data Sheet

Dow AgroSciences LLC

Product Name: GARLON* 4 Herbicide

Issue Date: 03/28/2013

Print Date: 03 Apr 2013

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.

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

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
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

Based on information for component(s): In vitro genetic toxicity studies were negative. Animal genetic toxicity studies were negative.

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

LC50, *Lepomis macrochirus* (Bluegill sunfish), static test, 96 h: 0.44 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

ErC50, *Pseudokirchneriella subcapitata*, static test, Growth rate inhibition, 72 h: 36.7 mg/l

Toxicity to Above Ground Organisms

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

oral LD50, *Apis mellifera* (bees): > 230 ug/bee

contact LD50, *Apis mellifera* (bees): > 230 ug/bee

Toxicity to Soil Dwelling Organisms

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

Persistence and Degradability

Data for Component: **Triclopyr-2-butoxyethyl ester**

Chemical degradation (hydrolysis) is expected in the environment. Material is expected to biodegrade only very slowly (in the environment). Fails to pass OECD/EEC tests for ready biodegradability.

Stability in Water (1/2-life):

8.7 d; 25 °C; pH 7

OECD Biodegradation Tests:

Biodegradation	Exposure Time	Method	10 Day Window
18 %	28 d	OECD 301B Test	fail

Indirect Photodegradation with OH Radicals

Rate Constant	Atmospheric Half-life	Method
2.3E-11 cm ³ /s	5.6 h	Estimated.

Theoretical Oxygen Demand: 1.39 mg/mg

Data for Component: **Kerosene (petroleum)**

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

Indirect Photodegradation with OH Radicals

Rate Constant	Atmospheric Half-life	Method
1.393E-11 cm ³ /s	0.767 d	Estimated.

Biological oxygen demand (BOD):

BOD 5	BOD 10	BOD 20	BOD 28
31.000 %	39.700 %	58.600 %	

Chemical Oxygen Demand: 1.16 mg/mg

Data for Component: **Balance**

No relevant data found.

Bioaccumulative potential

Data for Component: **Triclopyr-2-butoxyethyl ester**

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

Partition coefficient, n-octanol/water (log Pow): 4.62

Bioconcentration Factor (BCF): 110; fish

Data for Component: **Kerosene (petroleum)**

Bioaccumulation: Bioconcentration potential is high (BCF > 3000 or Log Pow between 5 and 7).

Partition coefficient, n-octanol/water (log Pow): 6.1 Measured

Bioconcentration Factor (BCF): 314; Fish; Estimated.

61 - 159; Fish

Data for Component: **Balance**

Bioaccumulation: No relevant data found.

Mobility in soilData for Component: **Triclopyr-2-butoxyethyl ester**

Mobility in soil: Calculation of meaningful sorption data was not possible due to very rapid degradation in the soil., For the degradation product:, Triclopyr., Potential for mobility in soil is very high (Koc between 0 and 50).

Henry's Law Constant (H): 2.9E-03 Pa*m3/mole.

Data for Component: **Kerosene (petroleum)**

Mobility in soil: Expected to be relatively immobile in soil (Koc > 5000).

Partition coefficient, soil organic carbon/water (Koc): 5,900 Estimated.

Henry's Law Constant (H): 8.24E+00 atm*m3/mole; 25 °C Measured

Data for Component: **Balance**

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: Triclopyr, KEROSENE

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

IMDG

Proper Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.

Technical Name: Triclopyr, KEROSENE

Hazard Class: 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 SUBSTANCE, LIQUID, N.O.S.

Technical Name: Triclopyr, KEROSENE

Hazard Class: 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

Identification Number: 50683 / 1016 / Issue Date 03/28/2013 / Version: 15.0

DAS Code: XRM-4714

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. 62719-40

Keep Out of Reach of Children

CAUTION PRECAUTION

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

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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.

SAFETY DATA SHEET

DOW AGROSCIENCES LLC

Product name: GARLON™ 4 Ultra Herbicide

Issue Date: 05/04/2015

Print Date: 05/17/2015

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. IDENTIFICATION

Product name: GARLON™ 4 Ultra Herbicide

Recommended use of the chemical and restrictions on use

Identified uses: End use herbicide product

COMPANY IDENTIFICATION

DOW AGROSCIENCES LLC
9330 ZIONSVILLE RD
INDIANAPOLIS IN 46268-1053
UNITED STATES

Customer Information Number:

800-992-5994

info@dow.com

EMERGENCY TELEPHONE NUMBER

24-Hour Emergency Contact: 800-992-5994

Local Emergency Contact: 352-323-3500

2. HAZARDS IDENTIFICATION

Hazard classification

This material is hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29CFR 1910.1200.

Skin sensitisation - Sub-category 1B

Label elements

Hazard pictograms



Signal word: **WARNING!**

Hazards

May cause an allergic skin reaction.

Precautionary statements**Prevention**

Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

Contaminated work clothing should not be allowed out of the workplace.

Wear protective gloves.

Response

IF ON SKIN: Wash with plenty of soap and water.

If skin irritation or rash occurs: Get medical advice/ attention.

Wash contaminated clothing before reuse.

Disposal

Dispose of contents/ container to an approved waste disposal plant.

Other hazards

no data available

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical nature: Mixture

This product is a mixture.

Component	CASRN	Concentration
Triclopyr-2-butoxyethyl ester	64700-56-7	60.5%
Ethylene glycol monobutyl ether	111-76-2	0.5%
Balance	Not available	39.0%

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.

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: 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. Never 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), any additional important symptoms and effects are described in Section 11: Toxicology Information.

Indication of any immediate medical attention and special treatment needed

Notes to physician: 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.

5. FIREFIGHTING 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. Water fog, applied gently may be used as a blanket for fire extinguishment.

Unsuitable extinguishing media: Do not use direct water stream. May spread fire.

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: Nitrogen oxides. Hydrogen chloride. Carbon monoxide. Carbon dioxide. Phosgene.

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.

Advice for firefighters

Fire Fighting Procedures: Keep people away. Isolate fire and deny unnecessary entry. 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. 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. Water fog, applied gently may be used as a blanket for fire extinguishment. 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. 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

Precautions for safe handling: Keep out of reach of children. Do not swallow. Avoid breathing vapor or mist. Avoid contact with eyes, skin, and clothing. Use with adequate ventilation. Wash thoroughly after handling. See Section 8, EXPOSURE CONTROLS AND PERSONAL PROTECTION.

Conditions for safe storage: Store in a dry place. Store in original container. Keep container tightly closed when not in use. Do not store near food, foodstuffs, drugs or potable water supplies.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure limits are listed below, if they exist.

Component	Regulation	Type of listing	Value/Notation
Triclopyr-2-butoxyethyl ester	Dow IHG	TWA	2 mg/m ³
	Dow IHG	TWA	SKIN, DSEN, BEI
Ethylene glycol monobutyl ether	ACGIH	TWA	20 ppm
	OSHA Z-1	TWA	240 mg/m ³ 50 ppm
	ACGIH	TWA	BEI
	OSHA Z-1	TWA	Absorbed via skin

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.

Exposure controls

Engineering controls: 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.

Individual protection measures

Eye/face protection: Use safety glasses (with side shields).

Skin protection

Hand protection: Use gloves chemically resistant to this material. Examples of preferred glove barrier materials include: Butyl rubber. Chlorinated polyethylene. Neoprene. Polyethylene. Ethyl vinyl alcohol laminate ("EVAL"). Examples of acceptable glove barrier materials include: Natural rubber ("latex"). Viton. Polyvinyl chloride ("PVC" or "vinyl"). Nitrile/butadiene rubber ("nitrile" or "NBR"). 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.

Other 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.

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. For most conditions no respiratory protection should be needed; however, if discomfort is experienced, use an approved air-purifying respirator. The following should be effective types of air-purifying respirators: Organic vapor cartridge with a particulate pre-filter.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Physical state	Liquid.
Color	Yellow
Odor	Mild
Odor Threshold	no data available
pH	3.36 1% <i>pH Electrode</i> (1% aqueous suspension)
Melting point/range	Not applicable
Freezing point	No test data available
Boiling point (760 mmHg)	No test data available
Flash point	closed cup > 100 °C (> 212 °F) <i>Pensky-Martens Closed Cup ASTM D 93</i>
Evaporation Rate (Butyl Acetate = 1)	No test data available
Flammability (solid, gas)	no data available
Lower explosion limit	No test data available
Upper explosion limit	No test data available
Vapor Pressure	No test data available
Relative Vapor Density (air = 1)	No test data available
Relative Density (water = 1)	1.11 at 20 °C (68 °F) <i>Digital Density Meter (Oscillating Coil)</i>
Water solubility	emulsifies

Partition coefficient: n-octanol/water	no data available
Auto-ignition temperature	> 325 °C (> 617 °F)
Decomposition temperature	No test data available
Dynamic Viscosity	23.4 mPa.s at 20 °C (68 °F) 10.8 mPa.s at 40 °C (104 °F)
Kinematic Viscosity	No test data available
Explosive properties	No
Oxidizing properties	No significant increase (>5C) in temperature.
Liquid Density	1.11 g/cm ³ at 20 °C (68 °F) <i>Digital density meter</i>
Molecular weight	no data available

NOTE: The physical data presented above are typical values and should not be construed as a specification.

10. STABILITY AND REACTIVITY

Reactivity: no data available

Chemical stability: Thermally stable at typical use temperatures.

Possibility of hazardous reactions: Polymerization will not occur.

Conditions to avoid: Exposure to elevated temperatures can cause product to decompose. Generation of gas during decomposition can cause pressure in closed systems.

Incompatible materials: Avoid contact with: Strong acids. Strong bases. Strong 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: Hydrogen chloride. Nitrogen oxides. Phosgene.

11. TOXICOLOGICAL INFORMATION

Toxicological information on this product or its components appear in this section when such data is available.

Acute toxicity

Acute oral toxicity

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.

LD50, Rat, female, 3,200 mg/kg

Acute dermal toxicity

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

LD50, Rat, male and female, > 5,000 mg/kg

Acute inhalation toxicity

Prolonged exposure is not expected to cause adverse effects. Based on the available data, respiratory irritation was not observed.

LC50, Rat, male and female, 4 Hour, dust/mist, > 5.05 mg/l No deaths occurred at this concentration.

Skin corrosion/irritation

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

Serious eye damage/eye irritation

May cause slight eye irritation.
Corneal injury is unlikely.

Sensitization

Has demonstrated the potential for contact allergy in mice.

For respiratory sensitization:
No relevant data found.

Specific Target Organ Systemic Toxicity (Single Exposure)

Evaluation of available data suggests that this material is not an STOT-SE toxicant.

Specific Target Organ Systemic Toxicity (Repeated Exposure)

For the active ingredient(s):
In animals, effects have been reported on the following organs:
Kidney.
Liver.

Carcinogenicity

For the minor component(s): In long-term animal studies with ethylene glycol butyl ether, small but statistically significant increases in tumors were observed in mice but not rats. The effects are not believed to be relevant to humans. If the material is handled in accordance with proper industrial handling procedures, exposures should not pose a carcinogenic risk to man. For similar active ingredient(s). Triclopyr. Did not cause cancer in laboratory animals.

Teratogenicity

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.

Mutagenicity

For the active ingredient(s): In vitro genetic toxicity studies were negative. Animal genetic toxicity studies were negative.

Aspiration Hazard

Based on available information, aspiration hazard could not be determined.

Carcinogenicity**Component****Ethylene glycol monobutyl ether****List**

ACGIH

Classification

A3: Confirmed animal carcinogen with unknown relevance to humans.

12. ECOLOGICAL INFORMATION

Ecotoxicological information on this product or its components appear in this section when such data is available.

Toxicity**Acute toxicity to fish**

For similar material(s):

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).

For similar material(s):

LC50, *Lepomis macrochirus* (Bluegill sunfish), 96 Hour, 0.44 mg/l, OECD Test Guideline 203 or EquivalentLC50, *Oncorhynchus mykiss* (rainbow trout), 96 Hour, 0.984 mg/l, OECD Test Guideline 203 or Equivalent**Acute toxicity to aquatic invertebrates**

For similar material(s):

EC50, *Daphnia magna* (Water flea), 48 Hour, 0.35 mg/l, OECD Test Guideline 202 or Equivalent**Acute toxicity to algae/aquatic plants**

For similar material(s):

EbC50, *Pseudokirchneriella subcapitata* (green algae), 72 Hour, Biomass, 11 mg/l, OECD Test Guideline 201 or Equivalent**Toxicity to Above Ground Organisms**

Based on information for a similar material:

Material is slightly toxic to birds on an acute basis (LD50 between 501 and 2000 mg/kg).

Based on information for a similar material:

oral LD50, *Colinus virginianus* (Bobwhite quail), 1,350 mg/kg**Persistence and degradability****Triclopyr-2-butoxyethyl ester****Biodegradability:** Chemical degradation (hydrolysis) is expected in the environment.

Material is expected to biodegrade very slowly (in the environment). Fails to pass OECD/EEC tests for ready biodegradability.

10-day Window: Fail

Biodegradation: 18 %**Exposure time:** 28 d

Method: OECD Test Guideline 301B or Equivalent

Theoretical Oxygen Demand: 1.39 mg/mg

Biological oxygen demand (BOD)

Incubation Time	BOD
	0.004 mg/mg

Stability in Water (1/2-life)

Hydrolysis, half-life, 8.7 d, pH 7, Half-life Temperature 25 °C

Photodegradation

Atmospheric half-life: 5.6 Hour

Method: Estimated.

Ethylene glycol monobutyl ether

Biodegradability: Material is readily biodegradable. Passes OECD test(s) for ready biodegradability. Material is ultimately biodegradable (reaches > 70% mineralization in OECD test(s) for inherent biodegradability).

10-day Window: Pass

Biodegradation: 90.4 %

Exposure time: 28 d

Method: OECD Test Guideline 301B or Equivalent

Theoretical Oxygen Demand: 2.30 mg/mg

Chemical Oxygen Demand: 2.21 mg/g Dichromate

Biological oxygen demand (BOD)

Incubation Time	BOD
5 d	5.2 %
10 d	57 %
20 d	72.2 %

Balance

Biodegradability: No relevant data found.

Bioaccumulative potential

Triclopyr-2-butoxyethyl ester

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

Partition coefficient: n-octanol/water(log Pow): 4.62

Bioconcentration factor (BCF): 110 Fish.

Ethylene glycol monobutyl ether

Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3).

Partition coefficient: n-octanol/water(log Pow): 0.81 Measured

Bioconcentration factor (BCF): 3.2

Balance

Bioaccumulation: No relevant data found.

Mobility in soil

Triclopyr-2-butoxyethyl ester

Calculation of meaningful sorption data was not possible due to very rapid degradation in the soil.

For the degradation product:

Triclopyr.

Potential for mobility in soil is very high (Koc between 0 and 50).

Ethylene glycol monobutyl ether

Potential for mobility in soil is high (Koc between 50 and 150).

Partition coefficient(Koc): 67 Estimated.

Balance

No relevant data found.

13. DISPOSAL CONSIDERATIONS

Disposal methods: 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

Not regulated for transport

Classification for SEA transport (IMO-IMDG):

Proper shipping name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.(Triclopyr-2-butoxyethyl ester)
UN number	UN 3082
Class	9
Packing group	III
Marine pollutant	Triclopyr-2-butoxyethyl ester
Transport in bulk according to Annex I or II of MARPOL 73/78 and the	Consult IMO regulations before transporting ocean bulk

IBC or IGC Code**Classification for AIR transport (IATA/ICAO):**

Proper shipping name	Environmentally hazardous substance, liquid, n.o.s.(Triclopyr-2-butoxyethyl ester)
UN number	UN 3082
Class	9
Packing group	III

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Transportation classifications may vary by container volume and may be influenced by regional or country variations in regulations. 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

Acute Health Hazard
Chronic Health Hazard

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

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.

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

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

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.

United States TSCA Inventory (TSCA)

This product contains chemical substance(s) exempt from U.S. EPA TSCA Inventory requirements. It is regulated as a pesticide subject to Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requirements.

Federal Insecticide, Fungicide and Rodenticide Act

EPA Registration Number: 62719-527

This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets, and for workplace labels of non-pesticide chemicals. Following is the hazard information as required on the pesticide label:

CAUTION

Causes moderate eye irritation

Harmful if swallowed

Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.

16. OTHER INFORMATION

Hazard Rating System**NFPA**

Health	Fire	Reactivity
2	1	0

Revision

Identification Number: 101188950 / A211 / Issue Date: 05/04/2015 / Version: 7.0

DAS Code: GF-1529

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

Legend

Absorbed via skin	Absorbed via skin
ACGIH	USA. ACGIH Threshold Limit Values (TLV)
BEI	Biological Exposure Indices
Dow IHG	Dow Industrial Hygiene Guideline
OSHA Z-1	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
SKIN, DSEN, BEI	Absorbed via Skin, Skin Sensitizer, Biological Exposure Indice
TWA	8-hour, time-weighted average

Information Source and References

This SDS is prepared by Product Regulatory Services and Hazard Communications Groups from information supplied by internal references within our company.

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 Ultra

Specialty Herbicide

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For the control of woody plants and herbaceous broadleaf weeds in non-crop areas, including industrial manufacturing and storage sites, rights-of-way such as electrical power lines, communication lines, pipelines, roadsides, railroads, fence rows, non-irrigation ditch banks, 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 ester60.45%

Other Ingredients39.55%

Total100.00%

Acid Equivalent: triclopyr - 43.46% - 4 lb/gal

Keep Out of Reach of Children

CAUTION

Agricultural Use Requirements

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. Refer to label booklet under "Agricultural Use Requirements" in the Directions for Use section for information about this standard.

Refer to inside of label booklet for additional precautionary information including Directions for Use.

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 at end of label booklet. 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.

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

EPA Reg. No. 62719-527

Precautionary Statements

Hazards to Humans and Domestic Animals

CAUTION

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

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

Personal Protective Equipment (PPE)

Some materials that are chemical-resistant to this product are listed below. If you want more options, follow the instructions for category E on an EPA chemical resistance category selections chart.

Applicators and other handlers who handle this pesticide must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves (≥14 mils) such as barrier laminate, nitrile rubber, neoprene rubber, or viton
- Shoes plus socks

Follow the manufacturer's instructions for cleaning/maintaining PPE. 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 the 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.
- 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.

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 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 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 a poison control center or doctor. Do not give anything by mouth to an unconscious person.

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, 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.

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.

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 (>14 mils) such as barrier laminate, nitrile rubber, neoprene rubber, or viton
- Shoes plus socks

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.

Nonrefillable containers 5 gallons or less:

Container Handling: Nonrefillable container. Do not reuse or refill this container.

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. 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.

Refillable containers 5 gallons or larger:

Container Handling: 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. 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.

Nonrefillable containers 5 gallons or larger:

Container Handling: Nonrefillable container. Do not reuse or refill this container.

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. 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.

General Information

Garlon® 4 Ultra specialty herbicide is recommended for the control of woody plants and herbaceous broadleaf weeds in non-crop areas, including 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, forests and in the establishment and maintenance of wildlife openings. Use on these sites may include application to grazed areas.

General Use Precautions and Restrictions

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

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

Do not apply Garlon 4 Ultra 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 it 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 that are 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 Ultra 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.

Avoid 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 (Helicopter Only): For aerial application on rights-of-way or other areas near susceptible crops, apply through a Microfoil¹ or Thru-Valve¹ 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 boom, 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.

¹ 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 must 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 produces 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 potential when making ground applications near susceptible crops or other desirable broadleaf plants, Garlon 4 Ultra 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. 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. A agriculturally labeled thickening agent may be used to reduce spray drift.

Mixing Directions

Garlon 4 Ultra 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 Ultra 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 Ultra 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 of Garlon 4 Ultra 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.

Oil Mixture Sprays for Basal Treatment

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

Oil Mixtures of Garlon 4 Ultra and Tordon K: Tordon K and Garlon 4 Ultra 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.

Plants Controlled by Garlon 4 Ultra

Woody Plants Controlled

alder	chinquapin
madrone	scotch broom
arrowwood	choke cherry
maples	sumac
ash	cottonwood
mulberry	sweetbay magnolia
aspen	Crataegus (hawthorn)
oaks	sweetgum
bear clover (bearmat)	dogwood
persimmon	sycamore
beech	Douglas fir
pine	tanoak
birch	elderberry
poison ivy	thimbleberry
blackberry	elm
poison oak	tree-of-heaven
blackgum	gallberry
poplar	(<i>Ailanthus</i>) ¹
boxelder ¹	gorse
salmonberry	tulip poplar
Brazilian pepper	hazel
saltbush	wax myrtle
buckthorn	hickory
(<i>Braccharis</i> spp.)	wild rose
cascara	hornbeam
salt cedar ¹	willow
Ceanothus	kudzu ²
sassafras	winged elm
cherry	locust

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

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

Annual and Perennial Broadleaf Weeds

black medic	curly dock
matchweed	sweet clover
bull thistle	dandelion
mustard	vetch
burdock	field bindweed
Oxalis	wild carrot
Canada thistle	goldenrod
plantain	(Queen Anne's lace)
chicory	ground ivy
purple loosestrife	wild lettuce
clover	lambquarters
ragweed	wild violet
creeping beggarweed	lespedeza
smartweed	yarrow

Application Methods

- Apply no more than 2 lb ae of triclopyr (2 quarts of Garlon 4 Ultra) per acre per growing season on range and pasture sites, including rights-of-way, fence rows or any area where grazing or harvesting is allowed.
- On forestry sites, triclopyr may be used at rates up to 6 lb ae (6 quarts of Garlon 4 Ultra) per acre per year.
- Triclopyr may be used at rates up to 8 lb ae (8 quarts of Garlon 4 Ultra) per acre per year on non-crop areas including industrial manufacturing and storage sites, non-grazed portions of rights-of-way including 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.

Use Garlon 4 Ultra 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 Ultra. 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 Ultra alone or in combination with Tordon(r) 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 Ultra in combination with 2,4-D low volatile ester herbicide, generally the higher rates of Garlon 4 Ultra 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

High Volume Foliage Treatment

For control of woody plants, use Garlon 4 Ultra at the rate of 2 to 6 quarts per 100 gallons of spray mixture, or Garlon 4 Ultra 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 Ultra 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 Ultra.

Total Spray Volume (gallons/acre)	Rate of Garlon 4 Ultra	
	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 quarts of Garlon 4 Ultra (6 lb ae of triclopyr) per acre per year.

²Do not exceed the maximum use rate of 8 quarts of Garlon 4 Ultra (8 lb ae of triclopyr) per acre per year for non-grazable areas, or 2 quarts (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.

Low Volume Foliar Treatment

To control susceptible woody plants, mix up to 5% v/v of Garlon 4 Ultra in water and apply 10 to 100 gallons of finished spray. The spray concentration of Garlon 4 Ultra 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.

See Table 1 for relationship between mixing rate, spray volume and maximum application rate.

Tank Mixing: As a low volume foliar spray, up to 12 quarts of Garlon 4 Ultra 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 Ground Equipment

Apply Garlon 4 Ultra using equipment that will assure thorough and uniform coverage at spray volumes applied. See Table 1 for relationship between mixing rate, spray volume and maximum application rate.

Woody Plant Control

Foliage Treatment: Use 4 to 8 quarts of Garlon 4 Ultra in enough water to make 5 gallons or more per acre of total spray, or 1 1/2 to 3 quarts of Garlon 4 Ultra 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 Ultra 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 Ultra 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 Ultra 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.

Aerial Application (Helicopter Only)

Aerial sprays should be applied using suitable drift control (see General Use Precautions and Restrictions).

Foliage Treatment (Utility and Pipeline Rights-of-Way)

Use 4 to 8 quarts of Garlon 4 Ultra alone, or 3 to 4 quarts of Garlon 4 Ultra 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 quarts of Garlon 4 Ultra (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 quarts of Garlon 4 Ultra (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 Ultra 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 Ultra 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. **Mixing with oil requires vigorous agitation to form an oil solution.** Once a solution is formed it will stay stable.

Garlon 4 Ultra Plus Tordon K in Oil Tank Mix: Garlon 4 Ultra 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 Ultra 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 Ultra 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 Ultra, 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 Ultra around each stem or clump. Use a minimum of 2 to 15 milliliters of Garlon 4 Ultra or oil mixture with Garlon 4 Ultra 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 will 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 Ultra 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 Ultra in 2 to 3 gallons of crop oil concentrate or other recommended oil and add this mixture to 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. Garlon 4 Ultra 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 Ultra 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 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 Ultra 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 Ultra. Use an applicator that can be calibrated to deliver the small amounts of material required.

Forest Management Applications

For broadcast applications, apply 1 to 6 quarts of Garlon 4 Ultra 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 one month after treatment with Garlon 4 Ultra at less than 4 quarts per acre or sooner than two 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 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 Ultra 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 Ultra 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 Ultra, alone or in 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 Ultra cannot be tank mixed with any product containing a label prohibition against such mixing.

In 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 Ultra 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 per acre of Garlon 4 Ultra 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 Ultra, 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 Ultra per acre. To broaden the spectrum of species controlled to include fetterbush, staggerbush, titi, and grasses, apply 2 to 3 quarts per acre of Garlon 4 Ultra 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 Ultra 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 Sprays 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 Ultra 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 solutions 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 Ultra per acre. To broaden the spectrum of woody plants controlled to include fetterbush, staggerbush, and titi, apply 2 to 3 quarts of Garlon 4 Ultra 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 Ultra at 4 quarts per acre or by mixtures of Garlon 4 Ultra 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 Ultra 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 Ultra 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 Growing Actively:

Use Garlon 4 Ultra 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 Ultra 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 Ultra 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. To the extent permitted by law, 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 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. Added Mixing Directions section.
2. Added additional directions for high volume foliage treatment.
3. Added stem and cut surface treatments.

SAFETY DATA SHEET

DOW AGROSCIENCES LLC

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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. IDENTIFICATION

Product name: RODEO Herbicide

Recommended use of the chemical and restrictions on use

Identified uses: End use herbicide product

COMPANY IDENTIFICATION

DOW AGROSCIENCES LLC
9330 ZIONSVILLE RD
INDIANAPOLIS IN 46268-1053
UNITED STATES

Customer Information Number:

800-992-5994

info@dow.com

EMERGENCY TELEPHONE NUMBER

24-Hour Emergency Contact: 800-992-5994

Local Emergency Contact: 352-323-3500

2. HAZARDS IDENTIFICATION

Hazard classification

This material is not hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29CFR 1910.1200.

Other hazards

No data available

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical nature: Mixture

This product is a mixture.

Component

CASRN

Concentration

Glyphosate IPA salt

38641-94-0

53.75%

Isopropylamine	75-31-0	5.8%
Balance	Not available	40.45%

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. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

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: 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. Never 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), any additional important symptoms and effects are described in Section 11: Toxicology Information.

Indication of any immediate medical attention and special treatment needed

Notes to physician: 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.

5. FIREFIGHTING MEASURES

Suitable extinguishing media: To extinguish combustible residues of this product use water fog, carbon dioxide, dry chemical or foam. Dry chemical fire extinguishers. Carbon dioxide fire extinguishers. Foam. Straight or direct water streams may not be effective to extinguish fire. General purpose synthetic foams (including AFFF type) or protein foams are preferred if available. Alcohol resistant foams (ATC type) may function.

Unsuitable extinguishing media: No data available

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.

Unusual Fire and Explosion Hazards: This material will not burn until the water has evaporated. Residue can burn. Container may vent and/or rupture due to fire. Electrically ground and bond all equipment. Flammable mixtures of this product are readily ignited even by static discharge. May produce flash fire. Vapors are heavier than air and may travel a long distance and accumulate in low lying areas. Ignition and/or flash back may occur. Flammable mixtures may exist within the vapor space of containers at room temperature.

Advice for firefighters

Fire Fighting Procedures: Keep people away. Isolate fire and deny unnecessary entry. Stay upwind. Keep out of low areas where gases (fumes) can accumulate. Water may not be effective in extinguishing fire. Eliminate ignition sources. Move container from fire area if this is possible without hazard. To extinguish combustible residues of this product use water fog, carbon dioxide, dry chemical or foam. 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. Refer to section 7, Handling, for additional precautionary measures. Keep unnecessary and unprotected personnel from entering the area. Keep personnel out of low areas. No smoking in area. Eliminate all sources of ignition in vicinity of spill or released vapor to avoid fire or explosion. Vapor explosion hazard. Keep out of sewers. For large spills, warn public of downwind explosion hazard. Check area with combustible gas detector before reentering area. Ground and bond all containers and handling equipment. 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. Pump with explosion-proof equipment. If available, use foam to smother or suppress. 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

Precautions for safe handling: Keep away from heat, sparks and flame. No smoking, open flames or sources of ignition in handling and storage area. Electrically bond and ground all containers and equipment before transfer or use of material. Use of non-sparking or explosion-proof equipment may be necessary, depending upon the type of operation. 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. Vapors are heavier than air and may travel a long distance and accumulate in low lying areas. Ignition and/or flash back may occur. Never use air pressure for transferring product. Keep out of reach of children. Do not swallow. Avoid breathing vapor or mist. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling. Keep container closed. Use with adequate ventilation.

Conditions for safe storage: Minimize sources of ignition, such as static build-up, heat, spark or flame. Keep container closed. Do not store in: Carbon steel. Galvanized containers. Steel. Flammable mixtures may exist within the vapor space of containers at room temperature. Store in a dry place. Store in original container. Do not store near food, foodstuffs, drugs or potable water supplies.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure limits are listed below, if they exist.

Component	Regulation	Type of listing	Value/Notation
Isopropylamine	ACGIH	TWA	5 ppm
	ACGIH	STEL	10 ppm
	OSHA Z-1	TWA	12 mg/m3 5 ppm

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.

Exposure controls

Engineering controls: 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.

Individual protection measures

Eye/face protection: Use safety glasses (with side shields).

Skin protection

Hand protection: Use gloves chemically resistant to this material when prolonged or frequently repeated contact could occur. Examples of preferred glove barrier materials include: Butyl rubber. Natural rubber ("latex"). Neoprene. Nitrile/butadiene rubber ("nitrile" or "NBR"). Polyethylene. Ethyl vinyl alcohol laminate ("EVAL"). Polyvinyl chloride ("PVC" or "vinyl"). 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.

Other protection: Wear clean, body-covering clothing.

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. For most conditions no respiratory protection should be needed; however, if discomfort is experienced, use an approved air-purifying respirator.

The following should be effective types of air-purifying respirators: Organic vapor cartridge with a particulate pre-filter.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Physical state	Liquid.
Color	Yellow
Odor	Odorless
Odor Threshold	No data available
pH	4.8 <i>pH Electrode</i>
Melting point/range	Not applicable
Freezing point	No data available
Boiling point (760 mmHg)	No data available
Flash point	closed cup > 93 °C (> 199 °F) <i>Setaflash Closed Cup ASTM D3828</i> none below boiling point
Evaporation Rate (Butyl Acetate = 1)	No data available
Flammability (solid, gas)	No data available
Lower explosion limit	No data available
Upper explosion limit	No data available
Vapor Pressure	No data available
Relative Vapor Density (air = 1)	No data available
Relative Density (water = 1)	1.21 at 22 °C (72 °F) / 4 °C <i>Pyknometer</i>
Water solubility	Soluble
Partition coefficient: n-octanol/water	No data available
Auto-ignition temperature	none below 400 degC
Decomposition temperature	No test data available
Dynamic Viscosity	64.6 mPa.s at 20 °C (68 °F)
Kinematic Viscosity	53.4 mm ² /s at 20 °C (68 °F)
Explosive properties	No
Oxidizing properties	No significant increase (>5C) in temperature.
Liquid Density	1.20 g/cm ³ at 20 °C (68 °F) <i>Digital density meter</i>
Molecular weight	No data available

NOTE: The physical data presented above are typical values and should not be construed as a specification.

10. STABILITY AND REACTIVITY

Reactivity: No dangerous reaction known under conditions of normal use.

Chemical stability: Thermally stable at recommended temperatures and pressures.

Possibility of hazardous reactions: Polymerization will not occur.

Conditions to avoid: Active ingredient decomposes at elevated temperatures. Avoid static discharge.

Incompatible materials: Heat produced by the reaction with water will cause vaporization. Flammable hydrogen may be generated from contact with metals such as:

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

11. TOXICOLOGICAL INFORMATION

Toxicological information appears in this section when such data is available.

Acute toxicity

Acute oral toxicity

Very low toxicity if swallowed. Harmful effects not anticipated from swallowing small amounts.

As product:

LD50, Rat, male and female, > 5,000 mg/kg

Acute dermal toxicity

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

As product:

LD50, Rabbit, male and female, > 5,000 mg/kg

Acute inhalation toxicity

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

As product:

LC50, Rat, male and female, 4 Hour, dust/mist, > 6.37 mg/l No deaths occurred at this concentration.

Skin corrosion/irritation

Brief contact is essentially nonirritating to skin.

Serious eye damage/eye irritation

May cause slight temporary eye irritation.
Corneal injury is unlikely.

Sensitization

Did not cause allergic skin reactions when tested in guinea pigs.

For respiratory sensitization:

No relevant data found.

Specific Target Organ Systemic Toxicity (Single Exposure)

Evaluation of available data suggests that this material is not an STOT-SE toxicant.

Specific Target Organ Systemic Toxicity (Repeated Exposure)

For similar active ingredient(s).

Glyphosate.

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

For the minor component(s):

In animals, effects have been reported on the following organs after inhalation:

Eye.

Respiratory tract.

Carcinogenicity

For similar material(s): Glyphosate. Did not cause cancer in laboratory animals. Weight of evidence evaluation of epidemiology studies supports no association between glyphosate exposure and cancer.

Teratogenicity

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

Mutagenicity

For the active ingredient(s): In vitro genetic toxicity studies were negative in some cases and positive in other cases. Animal genetic toxicity studies were negative in some cases and positive in other cases.

Aspiration Hazard

Based on physical properties, not likely to be an aspiration hazard.

Carcinogenicity**Component**

Glyphosate IPA salt

List

IARC

Classification

Group 2A: Probably carcinogenic to humans

12. ECOLOGICAL INFORMATION

Ecotoxicological information appears in this section when such data is available.

Toxicity**Acute toxicity to fish**

Material is slightly toxic to aquatic organisms on an acute basis (LC50/EC50 between 10 and 100 mg/L in the most sensitive species tested).

LC50, *Oncorhynchus mykiss* (rainbow trout), 96 Hour, > 2,500 mg/l, OECD Test Guideline 203 or Equivalent

Acute toxicity to aquatic invertebrates

EC50, *Daphnia magna* (Water flea), 48 Hour, 918 mg/l, OECD Test Guideline 202 or Equivalent

Acute toxicity to algae/aquatic plants

ErC50, *Pseudokirchneriella subcapitata* (green algae), 72 Hour, 127 mg/l, OECD Test Guideline 201 or Equivalent

Toxicity to Above Ground Organisms

Material is practically non-toxic to birds on an acute basis (LD50 > 2000 mg/kg).

oral LD50, *Colinus virginianus* (Bobwhite quail), > 2000mg/kg bodyweight.

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

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

Persistence and degradability**Glyphosate IPA salt**

Biodegradability: For similar active ingredient(s). Glyphosate. Biodegradation may occur under aerobic conditions (in the presence of oxygen).

Photodegradation

Test Type: Half-life (indirect photolysis)

Sensitizer: OH radicals

Atmospheric half-life: 0.115 d

Method: Estimated.

Isopropylamine

Biodegradability: Material is readily biodegradable. Passes OECD test(s) for ready biodegradability. Material is ultimately biodegradable (reaches > 70% mineralization in OECD test(s) for inherent biodegradability).

10-day Window: Pass

Biodegradation: 70 - 80 %

Exposure time: 28 d

Method: OECD Test Guideline 301F or Equivalent

Theoretical Oxygen Demand: 3.53 mg/mg

Chemical Oxygen Demand: 1,300 - 1,975 mg/g

Biological oxygen demand (BOD)

Incubation Time	BOD
5 d	18.3 %
10 d	54 %
20 d	59 %

Photodegradation

Test Type: Half-life (indirect photolysis)

Sensitizer: OH radicals

Atmospheric half-life: 3.26 Hour

Method: Estimated.

Balance

Biodegradability: No relevant data found.

Bioaccumulative potential

Bioaccumulation: For similar active ingredient(s). Bioconcentration potential is low (BCF < 100 or Log Pow < 3).

Mobility in soil

For similar active ingredient(s).
Expected to be relatively immobile in soil (Koc > 5000).

13. DISPOSAL CONSIDERATIONS

Disposal methods: 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

Not regulated for transport

Classification for SEA transport (IMO-IMDG):

**Transport in bulk
according to Annex I or II
of MARPOL 73/78 and the
IBC or IGC Code**

Not regulated for transport
Consult IMO regulations before transporting ocean bulk

Classification for AIR transport (IATA/ICAO):

Not regulated for transport

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Transportation classifications may vary by container volume and may be influenced by regional or country variations in regulations. 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 not 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

Chronic Health Hazard

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

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.

Pennsylvania (Worker and Community Right-To-KnowAct): 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.

Components	CASRN
Isopropylamine	75-31-0

Pennsylvania (Worker and Community Right-To-KnowAct): 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.

United States TSCA Inventory (TSCA)

This product contains chemical substance(s) exempt from U.S. EPA TSCA Inventory requirements. It is regulated as a pesticide subject to Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requirements.

Federal Insecticide, Fungicide and Rodenticide Act

EPA Registration Number: 62719-324

This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets, and for workplace labels of non-pesticide chemicals. Following is the hazard information as required on the pesticide label:

CAUTION

Harmful if inhaled

16. OTHER INFORMATION

Hazard Rating System**NFPA**

Health	Fire	Reactivity
1	2	0

Revision

Identification Number: 101188488 / A211 / Issue Date: 11/10/2015 / Version: 4.0

DAS Code: NAF-552

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

Legend

ACGIH	USA. ACGIH Threshold Limit Values (TLV)
OSHA Z-1	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
STEL	Short-term exposure limit
TWA	8-hour, time-weighted average

Information Source and References

This SDS is prepared by Product Regulatory Services and Hazard Communications Groups from information supplied by internal references within our company.

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



Dow AgroSciences

Rodeo®

HERBICIDE

®Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

For control of annual and perennial weeds and woody plants in natural and production (plantations), forests for site preparation, mid-rotation release treatments, timber stand improvement activities, noncrop sites including industrial sites, rights-of-way (including roadsides, electric utility and communication transmission lines, pipelines, railroads, airports), irrigation and drainage ditches, canals, reservoirs, natural areas (including wildlife management areas, wildlife openings, wildlife habitats and refuges, parks and recreational areas, campgrounds, trailheads and trails), rangeland, and in and around aquatic sites and wetlands; also 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.

Group	9	HERBICIDE
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Active Ingredient:

glyphosate† N-(phosphonomethyl)glycine, isopropylamine salt	53.8%
Other Ingredients.....	46.2%
Total	100.0%

† Contains 5.4 lb per gallon glyphosate, isopropylamine salt (4 lb per gallon glyphosate acid).

Precautionary Statements

Hazards to Humans and Domestic Animals

EPA Reg. No. 62719-324

CAUTION

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. 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.

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.

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 Handling: Nonrefillable container. Do not reuse or refill this container.

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. 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.

Refillable containers larger than 5 gallons:

Container Handling: 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. 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.

Nonrefillable containers 5 gallons or larger:

Container Handling: Nonrefillable container. Do not reuse or refill this container.

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. 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.

Product Information

This product is a broad spectrum, systemic, postemergent herbicide with no soil residual activity. It is intended for control of annual and perennial weeds and woody plants and brush. It is formulated as a water soluble liquid.

Time to Symptoms: The active ingredient in this product moves through the plant from the point of foliage contact to and into the root system. Visible effects are a gradual wilting and yellowing of the plant that advances to complete browning of above ground growth and deterioration of underground plant parts. Visible effects on most annual weeds occur within two to four days, but on most perennial weeds visible effects may not occur for seven days or more. Extremely cool or cloudy weather

following treatment may slow the activity of this product and delay development of visual symptoms.

Stage of Weeds: Annual weeds are easiest to control when they are small. Best control of most perennial weeds is obtained when treatment is made at late growth stages approaching maturity. Refer to the annual, perennial and woody brush and trees rate tables for specific weeds. Always use the higher rate within the rate range for heavy or dense weed growth or when weeds are growing in an undisturbed (noncultivated) area. When treating weeds with disease or insect damage, weeds heavily covered with dust, or weeds under poor growing conditions, reduced weed control may result.

Cultural Considerations: Reduced control may result when applications are made to annual or perennial weeds that have been mowed, grazed, or cut, and have not been allowed to regrow to the specified stage for treatment.

Rainfastness: Heavy rainfall soon after application may wash off this product from the foliage and a repeat application may be required for adequate control.

Spray Coverage: For best results, spray coverage should be uniform and complete.

Mode of Action: The active ingredient in this product inhibits an enzyme. This enzyme is found only in plants and microorganisms that are essential to forming specific amino acids.

No Soil Activity: Weeds must be emerged at the time of application to be controlled by this product. Weeds germinating from seed after application will not be controlled. Unemerged plants arising from unattached underground rhizomes or rootstocks of perennials will not be affected by the herbicide and will continue to grow.

Biological Degradation: Degradation of this product is primarily a biological process carried out by soil microbes.

Maximum Application Rates: The maximum application rates specified in this label are given in units of volume, either fluid ounces, pints or quarts, of this product per acre. The maximum allowed application rates apply to this product combined with the use of any and all other glyphosate- or sulfosate-containing herbicides, either applied separately or in a tank mix, on the basis of total pounds of glyphosate (acid equivalents) per acre. If more than one glyphosate- or sulfosate-containing product is applied to the same site within the same year, ensure that the total of pounds acid equivalent glyphosate does not exceed the maximum allowed.

Do not apply more than 8 quarts of this product (8 lb glyphosate acid) per acre per year for all use sites listed on this label.

IMPORTANT: When using this product, unless otherwise specified, mix with a surfactant, such as a nonionic 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). Use of this product without surfactant will result in reduced herbicide performance. Ammonium sulfate, drift control additives, or dyes and colorants may be used. See Mixing Directions and the surfactant manufacturer's label for more information.

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, including 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 between 4.5 and 7.5 quarts per acre, no more than 15 percent of the available grazing area may be treated.
- For application rates less than 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.

Herbicide Resistance Management

Glyphosate, the active ingredient in this product, is a group 9 herbicide (inhibitor of EPSP synthase). Some naturally occurring weed biotypes that are tolerant (resistant) to glyphosate may exist due to genetic variability in a weed population. Where resistant biotypes exist, the repeated use

of herbicides with the same mode of action can lead to the selection for resistant weeds. Certain agronomic practices reduce the likelihood that resistant weed populations will develop, and can be utilized to manage weed resistance once it occurs.

To delay the selection for glyphosate resistant weeds, use the following practices:

- Scout fields before and after application to detect weed escapes or shifts in weed species.
- Start with a clean field by applying a burndown herbicide or by tillage.
- Control weeds early when they are small.
- Add other herbicides, including a selective and/or a residual herbicide, and cultural practices, including tillage or crop rotation, where appropriate.
- Use the application rate for the most difficult to control weed in the field. Do not tank mix with other herbicides that reduce this product's efficacy through antagonism or with ones that encourage application rates of this product below those specified on this label.
- Control weed escapes and prevent weeds from setting seeds.
- In situations where resistant weeds are a problem, before moving from one site to another, clean equipment to minimize the spread of weed seeds or plant parts.
- Use new commercial seed that is as free of weed seed as possible.
- Report any incidence of repeated non-performance of this product against a particular weed species to the local retailer, county extension agent, or Dow AgroSciences representative.

The following good agronomic practices are recommended to reduce the spread of confirmed glyphosate-resistant biotypes:

- Tank mix this product or apply it sequentially with an appropriately labeled herbicide with a different mode of action to achieve control if a naturally occurring resistant biotype is present in the site.
- Cultural and mechanical control practices, including crop rotation or tillage, may also be used.
- To control weed escapes, including resistant biotypes, before they set seed, scout treated sites after applying this product.
- Thoroughly clean equipment before leaving any site known to contain resistant biotypes.

Because the presence of glyphosate resistance in weed populations is difficult to detect prior to use, Dow AgroSciences accepts no liability for any losses that may result from the failure of this product to control glyphosate-resistant weeds.

Attention

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.

AVOID DRIFT. Use extreme care 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 injury occurring from the use of this product increases when winds are gusty, as wind velocity increases, when wind direction is constantly changing, or when there are other meteorological conditions that favor spray drift. 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 any manner not consistent with this label may result in injury to persons, animals or crops, or other unintended consequences. Keep container closed to prevent spills and contamination.

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.

- The distance of the outermost nozzles on the boom must not exceed 3/4 the length of the wingspan or rotor.
- 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.

The applicator must be familiar with and take into account the information covered in the Aerial Drift Reduction Advisory.

Aerial Drift Reduction Advisory

This section is advisory in nature and does not supersede the mandatory label requirements.

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 adverse effects from 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. Use the lower spray pressures 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 parallel to the airstream produces 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 must 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 must 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. Do not apply this product when wind speed is 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: Do not apply this product 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: Apply this pesticide only 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 Directions

Use only clean, stainless steel, fiberglass, plastic or plastic-lined steel containers to mix, store and apply spray solutions of this product. 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.

Eliminate any risk of siphoning the contents of the tank mix back into the carrier source while mixing. Use approved anti-back-siphoning devices where required by state or local regulations.

Note: Reduced results may occur if water containing soil is used, including visibly muddy water or water from ponds and ditches that is not clear.

Rodeo – Alone

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 clean water.
2. Add the specified amount of this product and nonionic surfactant near the end of the filling process and mix well.
3. During mixing and application, foaming of the spray solution may occur. To prevent or minimize foaming, avoid the use of mechanical agitators, terminate by-pass and return lines at the bottom of the tank and, if needed, use an approved anti-foam or defoaming agent.

Rodeo – Tank Mix

This product does not provide residual weed control. For residual weed control or an alternate mode of action, tank mix this product with other herbicides. Read and carefully observe the precautionary statements and all other information appearing on the labels of all herbicides used. Use according to the most restrictive label directions for each product in the mixture.

Under certain conditions, at certain growth stages, and/or under other circumstances, some tank mix products have the potential to cause injury. Read all labels for products used in the tank mix prior to using them to determine the potential for crop injury.

Tank mixing with other herbicides, insecticides, fungicides, micronutrients or foliar fertilizers may result in reduced weed control or injury. Do not use these products in applications with this product unless otherwise noted in this label. Buyer and all users are responsible for all loss or damage in connection with the use or handling of mixtures of this product with herbicides or other materials that are not expressly specified in this labeling. Mixing this product with herbicides or other materials not specified on this label may result in reduced performance.

The user is responsible for ensuring that the specific application being made is included on the label of the product used in the tank mix when a tank mixture with a generic active ingredient, including 2,4-D, atrazine, dicamba, diuron, or pendimethalin, is used.

Read all individual product labels for all products in the tank mix and observe all precautions and restrictions on the label. Use according to the most restrictive directions for each product in the tank mix. Always predetermine the compatibility of all tank mix products, together in the carrier, by mixing small proportional quantities in advance of mixing and applying them to the use site. Add the tank mix product to the tank as directed by the label. Maintain agitation and add the required amount of this product.

Maintain good agitation at all times until the contents in the tank are sprayed. If the mixture is allowed to settle, thorough agitation is required to resuspend the mixture before spraying resumes. Keep the bypass line on or near the bottom of the tank to minimize foaming. The screen size in the nozzle or line strainers must be no finer than 50 mesh.

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.

Hand-Held Sprayers

Prepare the desired volume of spray solution by mixing the amount of this product in water as shown in the following table:

Nonionic Surfactant

When using this product, unless otherwise specified, mix with a surfactant, including a nonionic surfactant containing 80% or more 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. Using this product without surfactant will result in reduced herbicide performance.

Colorants or Dyes

Agriculturally-approved colorants or marking dyes may be added to 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 directions.

Drift Control Additives

Drift control additives may be used with all equipment types except wiper applicators, sponge bars and CDA equipment. When a drift control additive is used, read and carefully observe the precautionary statements and all other information appearing on the additive label.

Application Equipment and Application Methods

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

Apply spray solutions in properly maintained and calibrated equipment capable of delivering desired volumes.

This product may be applied with the following application equipment and application methods.

Aerial Application

Equipment: Fixed wing and helicopter

Do not apply this product using aerial spray equipment except under conditions as specified within this label.

Avoid drift. Do not apply when winds are gusty or under any other condition which favors drift. Drift may cause damage to any vegetation contacted to which treatment is not intended. To prevent injury to adjacent desirable vegetation, maintain appropriate buffer zones.

Do not directly apply to any body of water.

Use the specified rates of this herbicide in 3 to 25 gallons of water per acre unless otherwise specified on this label. Refer to the specific use directions of this label for volumes and application rates.

Coarse sprays are less likely to drift; therefore, do not use nozzles or nozzle configurations that dispense spray as fine spray droplets. Do not angle nozzles forward into the airstream and do not increase spray volume by increasing nozzle pressure. A drift control additive may be used. When a drift control additive is used, carefully read and observe the precautionary statements and all other information specified on the additive label.

Ensure uniform application. To avoid streaked, uneven or overlapped application, use appropriate marking devices.

Aerial Application Restrictions in California Only

AVOID DRIFT: Do not apply when winds are gusty or under any other condition which favors 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.

Do not aerially apply this product in a tank mix with dicamba in California.

Make aerial applications with helicopter only. To ensure uniform application, avoid streaking, uneven, or overlapped application, and use appropriate marking devices.

Use the following guidelines when aerial applications are made near crops or desirable perennial vegetation after budbreak and before total leaf drop, and/or near other desirable vegetation or annual crops:

- Do not apply this product using aerial equipment in residential areas.
- Do not apply within 100 feet of all desirable vegetation or crop(s).
- If wind up to 5 miles per hour is blowing toward desirable vegetation or crop(s), do not apply within 500 feet of the desirable vegetation or crop(s).
- Winds blowing from 5 to 10 miles per hour toward desirable vegetation or crop(s) may require buffer zones in excess of the 500-foot minimum buffer.
- Do not apply when winds are in excess of 10 miles per hour or when inversion conditions exist.

Use only coarse sprays to minimize drift. Do not use nozzles or nozzle configurations that dispense spray as fine spray droplets. Do not angle nozzles forward into the airstream and do not increase spray volume by increasing nozzle pressure above the manufacturer's directions.

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 is most susceptible. The maintenance of an organic coating (paint) which meets aerospace specification MIL-C-38413 may prevent corrosion.

ADDITIONAL LIMITATIONS FOR AERIAL APPLICATION IN FRESNO COUNTY, CALIFORNIA ONLY

Always read and follow the label directions and precautionary statements for all products used in the aerial application.

The following information applies only from February 15 through March 31 within the following boundaries of Fresno County, California:

North: Fresno County line
South: Fresno County line
East: State Highway 99 West

Observe the following directions to minimize off-site movement during aerial application of this product. Minimization of off-site movement is the responsibility of the grower, Pest Control Advisor and aerial applicator.

Written Directions

Written directions MUST be submitted by or on behalf of the applicator to the Fresno County Agricultural Commissioner 24 hours prior to the application. These written directions MUST state the proximity of surrounding crops and that conditions of each manufacturer's product label and this label have been satisfied.

Aerial Applicator Training and Equipment

Aerial application of this product is limited to pilots who have successfully completed a Fresno County Agricultural Commissioner and California Department of Pesticide Regulation approved training program for aerial application of herbicides. All aircraft must be inspected, critiqued in flight and certified at a Fresno County Agricultural Commissioner approved fly-in. Test and calibrate spray equipment at intervals sufficient to insure that proper rates of herbicides and adjuvants are being applied during commercial use. Applicator must document such calibrations and testing. Demonstration of performance at Fresno County Agricultural Commissioner approved fly-ins constitutes such documentation, or other written records showing calculations and measurements of flight and spray parameters acceptable to the Fresno County Agricultural Commissioner.

Applications at Night – Do not apply this product by air earlier than 30 minutes prior to sunrise and/or later than 30 minutes after sunset without prior permission from the Fresno County Agricultural Commissioner.

To report known or suspected misuse of this product, call 1-800-332-3111.

For additional information on the proper aerial application of this product in Fresno County, call 916-784-1718.

Aquatic and Noncrop Sites

When this product is applied under the conditions described, it controls or partially controls the labeled weeds growing in the following industrial, recreational, and public areas or other similar sites.

Aquatic sites includes all bodies of fresh and brackish water that may be flowing, nonflowing, or transient including lakes, rivers, streams, ponds, seeps, irrigation and drainage ditches, canals, reservoirs, estuaries 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 that 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 and state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.
- 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 that would permit the turning off of an active potable water intake for a minimum period of 48 hours after the application.

Restrictions:

- Do not apply this product 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 a lake, pond, or reservoir.

Spray Solution:

Desired Volume	Amount of This Product								
	0.5	0.75	1	1.25	1.5	2	5	8	10
1 gal	2/3 fl oz	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	13 fl oz
25 gal	1 pt	1 1/2 pt	1 qt	1 1/4 qt	1 1/2 qt	2 qt	1 1/4 gal	2 gal	2 1/2 gal
100 gal	2 qt	3 qt	1 gal	1 1/4 gal	1 1/2 gal	2 gal	5 gal	8 gal	10 gal

2 Tablespoons = 1 fl oz

Ground Application

Equipment: Boom or boomless systems, pull-type sprayer, floaters, pick-up sprayers, spray coupes and other ground broadcast equipment.

Use the specified rates of this product in 3 to 40 gallons of water per acre as a broadcast spray unless otherwise specified on this label. As density of weeds increases, increase the spray volume within the rate range to ensure complete coverage. Carefully select proper nozzles to avoid spraying a fine mist. For best results with ground application equipment, use flat fan nozzles. Check for even distribution of spray droplets.

Broadcast Application for Control of Undesirable Competitive Vegetation in Larch (*Larix* spp.) Plantations in Maine

Apply this product to control or reduce competition from undesirable vegetation in Larch (*Larix* spp.) plantations in the state of Maine.

Application Timing

Apply only after lignification has occurred in 50% or more of the current year's terminal growth.

Application Directions

Broadcast Spray: Use 1 to 3 quarts of this product per acre. Apply in a total spray volume of 10 to 60 gallons per acre using ground equipment or 5 to 15 gallons per acre if applied aerially. Up to 30 fl oz of Entry II surfactant may be added.

Directed Sprays: This product may be applied as a directed spray for competitive release of larch. Avoid contact of spray drift, mist or drips with foliage, green bark or non-woody surface roots of desirable plants. See Application Equipment and Application Methods of the product label.

Injury to larch may occur, especially where spray patterns overlap or higher rates of this product or surfactant were applied. Damage can be accentuated if application is made when larch is actively growing or is under stress. Make applications only if some level of injury to larch is acceptable.

Hand-Held and High-Volume Including Backpack Application

Equipment: Knapsack and backpack sprayers, pump up pressure sprayers, handguns, hand wands, mistblowers, lances, and other hand-held and motorized spray equipment used to direct the spray onto weed foliage. **Note:** This product is not registered in Arizona or California for use in mistblowers.

Apply to foliage of vegetation to be controlled. Do not spray to the point of runoff for applications made on a spray to wet basis. Use coarse sprays only. For best results, cover the top half of the plant and at least half of the total foliage. To ensure adequate spray coverage, spray both sides of large or tall woody brush and trees, when foliage is thick and dense, or where there are multiple sprouts.

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.

Make applications on a spray to wet basis with uniform and complete spray coverage. 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 zigzag 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. Treat small, open-branched trees only from one side. If the foliage is thick or there are multiple root sprouts, apply from several sides to ensure adequate spray coverage. Prepare the desired volume of spray solution by mixing the amount of this product in water as shown in the following table.

For best results when using knapsack sprayers, mix the specified amount of product with water in a larger container. Fill the knapsack sprayer with the solution and add the correct amount of surfactant.

Selective Equipment

Equipment: Recirculating sprayers, shielded and hooded sprayers, wiper applicators and sponge bars.

Do not contact desirable vegetation with herbicide. Droplets, mist, foam, or splatter of the herbicide settling on desirable vegetation is likely to result in discoloration, stunting or destruction.

Better results are obtained when more of the weed is exposed to the herbicide solution. Weeds not contacted by the herbicide solution will not be affected. This may occur in dense clumps, severe infestations, or when the height of weeds varies so that not all weeds are contacted. If this occurs, repeat treatment may be necessary.

Shielded and Hooded Applicators: A shielded or hooded applicator directs the herbicide solution onto weeds while shielding desirable vegetation from the herbicide. Use nozzles that provide uniform coverage within the treated area. Keep shields on these sprayers adjusted to protect desirable vegetation. **Exercise extreme care to avoid contact of the herbicide with desirable vegetation.**

Wiper Applicators: Wiper applicators are devices that physically wipe appropriate amounts of this product directly onto the weed. Equipment must be designed, maintained and operated to prevent the herbicide solution from contacting desirable vegetation.

Adjust wiper applicators used over the top of desirable vegetation so that the wiper contact point is at least 2 inches above the desirable vegetation. Better results are obtained when more of the weed is exposed to the herbicide solution. Weeds should be a minimum of 6 inches above the desirable vegetation. Adjust the applicator height to ensure adequate contact with weeds as weeds not contacted by the herbicide solution will not be affected. Poor contact may occur when weeds are growing in dense clumps, in severe weed infestations, or when weed height varies dramatically. If this occurs, repeat treatment may be necessary.

Operate this equipment at ground speeds no more than 5 mph. Performance may be improved by reducing speed in areas of heavy weed infestations to ensure adequate wiper saturation. Better results may be obtained if two applications are made in opposite directions.

Droplets, mist, foam, or splatter of the herbicide settling onto desirable vegetation may result in discoloration, stunting or destruction. Avoid leakage or dripping onto desirable vegetation. Adjust height of applicator to ensure adequate contact with weeds. Keep wiping surfaces clean. Be aware that on sloping ground the herbicide solution may migrate, causing dripping on the lower end and drying of the wicks on the upper end of a wiper applicator.

Do not use wiper equipment when weeds are wet.

Mix only the amount of solution to be used during a one-day period as reduced activity may result from use of leftover solutions. Clean wiper parts by thoroughly flushing with water immediately after using this product.

For best results, use a nonionic surfactant at a rate of 10 percent by volume of total herbicide solution for all wiper applications.

Injection Systems

Equipment: Aerial or ground injection sprayers.

This product may be used in aerial or ground injection spray systems. It may be used as a liquid concentrate or diluted prior to injecting into the spray stream. Do not mix this product with the concentrate of other products when using injection systems.

Controlled Droplet Applicator (CDA)

Equipment: Hand-held or boom-mounted applicators that produce a spray consisting of a narrow range of droplet sizes.

The rate of this product applied per acre by vehicle-mounted CDA equipment must not be less than the amount specified on this label when applied by conventional broadcast equipment. For vehicle-mounted CDA equipment, apply 3 to 15 gallons of water per acre.

For the control of annual weeds with hand-held CDA units, apply a 20 percent solution of this product at a flow rate of 2 fl oz per minute and a walking speed of 1.5 mph (1 1/2 pints of product per acre). For control of perennial weeds, apply a 20 to 40 percent solution of this product at a flow rate of 2 fl oz per minute and a walking speed of 0.75 mph (3 to 6 pints of product per acre).

CDA equipment produces a spray pattern that is not easily visible. Exercise extreme care to avoid spray or drift contacting the foliage or any other green tissue of desirable vegetation as damage or destruction may result.

Use Sites

Use this product in noncrop areas, including airports, apartment complexes, aquatic sites, Christmas tree farms, commercial sites, Conservation Reserve Program (CRP) areas, ditch banks, driveways, dry ditches, dry canals, fencerows, golf courses, greenhouses, habitat management, industrial areas, lumber yards, manufacturing sites, municipal sites, natural areas, office complexes, ornamentals, parking areas, parks, pastures, petroleum tank farms and pumping installations, plant nurseries, public areas, railroads, rangeland, recreation areas, utility rights-of-way, roadsides, shadehouses, sod or turf seed farms, sports complexes, storage areas, substations, turfgrass areas, utility sites, warehouse areas, wildlife habitat management areas, and in grazed areas on these sites.

Aquatic Sites

This product may be applied to emerged weeds in all bodies of fresh and brackish water that may be flowing, nonflowing or transient including 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 that 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 and state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.
- 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 application.
- For treatments after draw down of water or in dry ditches, allow 7 days or more after treatment before reintroduction of water to achieve maximum weed control. Apply this product within 1 day after draw down 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.

Restrictions:

- 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 a lake, pond or reservoir. This restriction does not apply to intermittent inadvertent overspray of water in terrestrial use sites.

Wetland Sites

This product may be applied to undesirable vegetation in and around water (aquatic areas) and wetlands found in forestry, utility rights-of-way sites or other site listed on the label, including where these sites are adjacent to or surrounding domestic water supply reservoirs, supply streams, lakes and ponds.

If wetland sites are present, read and observe the following directions:

- There is no restriction on the use of treated water for irrigation, recreation or domestic purposes.
- Consult local public water control authorities before applying this product in and around public water. Permits may be required to treat in such areas.

Restrictions:

- 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 a lake, pond or reservoir. 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. Do not apply more than 3 3/4 quarts per acre in a single over water broadcast application except in stream crossings in utility right-of-way or where applications will result in less than 20 percent of the total water area being treated. In either of these locations, any specified rate may be applied:

Christmas Tree Plantations

Broadcast Application (Oregon and Washington Only)

Broadcast apply this product over the established Christmas tree species Douglas fir (*Pseudotsuga menziesii*), fir species (*Abies* spp.), pine species (*Pinus* spp.) (except eastern white, loblolly, longleaf, shortleaf, slash), and spruce species (*Picea* spp.). Use 1 quart of this product per acre in 5 to 30 gallons of water per acre. For best results, add up to 10 fl oz of Entry II surfactant per acre. If using a different surfactant, follow the manufacturer's directions for use and ensure conifer safety has been adequately tested for that surfactant. Apply after trees have completed at least a full growing season since planting or transplanting.

Apply only in the fall after the formation of the final conifer resting buds or in the spring prior to initial bud swell. Final resting buds must be fully hardened and in the dormant stage. Applying this product at any other time may result in unacceptable injury to the Christmas trees. Avoid spray pattern overlap as injury may occur.

In some areas, 1 to 2 quarts of this product per acre may be used. Consult your local representative for specific use instructions if rates greater than 1 quart per acre are required.

For best results, do not use drift control additives as they may increase injury to Christmas trees.

Precautions and Restrictions:

- Preharvest Interval:** Do not apply within 1 full year prior to tree harvest.
- Ensure that adequate buffers are maintained to prevent drift onto nearby desirable crops or vegetation.

Cut Stump

Treat cut stumps in any noncrop site listed on this label. This product will control regrowth of freshly cut stumps and resprouts of many types of woody brush and tree species, some of which are listed below. Apply this product using suitable equipment to ensure coverage of the entire cambium. Cut trees or resprouts close to the soil surface. Apply a 50 to 100 percent solution of this product to freshly cut surface immediately after cutting. Delays in application may result in reduced performance. For best results, make applications 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</i> spp.
coyotebrush ¹	<i>Baccharis pilularis</i>
dogwood ¹	<i>Cornus</i> spp.
eucalyptus	<i>Eucalyptus</i> spp.
hickory ¹	<i>Carya</i> spp.
madrone, Pacific	<i>Arbutus menziesii</i>
maple ¹	<i>Acer</i> spp.
oak	<i>Quercus</i> spp.
peppertree, Brazilian	<i>Schinus terebinthifolius</i>
Australian-pine,	<i>Casuarina equisetifolia</i>
poplar ¹	<i>Populus</i> spp.
reed, giant	<i>Arundo donax</i>
saltcedar	<i>Tamarix ramosissima</i>
sweetgum ¹	<i>Liquidambar styraciflua</i>
sycamore ¹	<i>Platanus occidentalis</i>
tan oak	<i>Lithocarpus densiflorus</i>
willow	<i>Salix</i> spp.

¹Do not use this product on these species in the state of California.

Precautions and Restrictions:

- Do not make cut stump applications when the roots of desirable woody brush or trees may be grafted to the roots of the cut stump. Some sprouts, stems, or trees may share the same root system.
- Adjacent trees that are of a similar age, height and spacing may indicate shared roots.
- Injury is likely to occur to non-treated stems or trees when one tree or more that shares a common root is treated.

Injection and Frill (Woody Brush and Trees)

Woody vegetation may be controlled by injection or frill application of this product. Apply this product using suitable equipment that penetrates into the living tissue. Apply the equivalent of 1 mL of this product per each two to three inches of trunk diameter at breast height (DBH). This is best achieved by applying 50 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 diluted material to a continuous frill or more closely spaced cuttings. Do not make any applications that allow runoff to occur from frilled or cut areas in species that exude sap freely. In species such as this, make frill or cuts at an oblique angle to produce a cupping effect and use a 100 percent undiluted concentration of this product. For best results, apply during periods of active growth and full leaf expansion.

This product controls the following woody species:

Common Name	Scientific Name
oak	<i>Quercus</i> spp.
poplar	<i>Populus</i> spp.
sweetgum	<i>Liquidambar styraciflua</i>
sycamore	<i>Platanus occidentalis</i>

This product suppresses the following woody species:

Common Name	Scientific Name
blackgum ¹	<i>Nyssa sylvatica</i>
dogwood	<i>Cornus</i> spp.
hickory	<i>Carya</i> spp.
maple, red	<i>Acer rubrum</i>

¹Do not use this product on these species in the state of California.

Forestry Site Preparation

This product is for the control or partial control of woody brush, trees, and herbaceous weeds in forestry. This product is also for use in preparing or establishing wildlife openings within these sites and maintaining logging roads.

In forestry sites, use this product in site preparation prior to planting any tree species including Christmas trees, eucalyptus, hybrid tree cultivars and silvicultural nursery sites. Unless otherwise specified, make applications of this product for control or partial control of herbaceous weeds, woody brush and trees listed in the Weeds Controlled section.

Application Rates

Method of Application	Rate	Spray Volume (gal/acre)
Broadcast		
aerial	1.5 - 7.5 qt/acre	5 - 30
ground		10 - 60
Spray to Wet		
handgun, backpack	0.75 - 2%	spray to wet
mistblower	by volume	
Low Volume Directed Spray ¹		
handgun, backpack	5 - 10%	partial coverage
mistblower	by volume	

¹ For low volume directed spray applications, coverage should be uniform with at least 50% of the foliage contacted. For best results, coverage of the top one-half of the plant, including the growing tip, is important (over the top and down coverage). To ensure adequate spray coverage, spray all sides of large or tall woody brush and trees, when foliage is thick and dense, or where there are multiple sense or tall sprouts.

Use a higher rate in the rate range 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 leaf drop. Use increased rates within the rate range to control perennial herbaceous weeds from emergence up to the appearance of seedheads, flowers or berries. Use a lower rate in the 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.

This product has no herbicidal or residual activity in the soil. Where repeat applications are necessary, do not apply more than 8 quarts of product per acre per year.

Tank Mixes

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 in the mixture. Any specified 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.

Any specified rate of this product may be used in a tank mix with the following products for forestry site preparation:

Product	Method of Application	Rate
Milestone VM ¹	broadcast ³	5 – 7 fl oz/acre
Garlon 3A ²		1 – 4 qt/acre
Garlon 4		
Arsenal Applicators Concentrate		2 – 16 fl oz/acre
Escort		1/2 – 1 1/2 oz/acre
Chopper		4 – 32 fl oz/acre
Oust XP		1 – 4 oz/acre
Arsenal Applicators Concentrate	spray to wet	1/32 – 1/2% by volume
Arsenal Applicators Concentrate	low volume directed spray	1/8 – 1/2% by volume

¹Use Milestone VM only in those states that have a Special Local Need label for use in forestry.

²Ensure 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.

³When using a tank mix partner, up to the maximum labeled rate for a treatment site may be applied in combination with this product.

For control of herbaceous weeds, use the lower specified tank mixture rates. For control of dense stands or difficult to control woody brush and trees, use the higher specified rates.

Aerial Application

Aerially apply this product by helicopter only in forestry sites. See Aerial Application in Application Equipment and Application Methods for more details.

Ground Application

Apply this product using suitable ground equipment for broadcast applications in forestry sites. See Ground Application in Application Equipment and Application Methods for more details. Unless otherwise specified, apply the specified rates of this product as a broadcast spray in sufficient spray volume to provide complete and uniform coverage of plant foliage. Check for even distribution throughout the spray pattern.

Hand-Held and Backpack Application

Apply this product using handgun and backpack equipment in forestry sites. See Hand-Held and Backpack Application in Application Equipment and Application Methods for more details. For spray to wet applications, coverage should be uniform and complete, but not to the point of runoff.

This product may be used for low volume directed sprays for spot treatment of trees and brush. It is most effective in areas where there is a low density of undesirable trees or brush. For flat fan and cone nozzles, spray 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, apply from several sides to ensure adequate spray coverage.

Forestry Conifer and Hardwood Release

Directed Sprays and Selective Equipment

Apply this product as a directed spray or with selective equipment in forestry conifer and hardwood sites, including Christmas tree plantations and silvicultural nurseries. A surfactant must be used with this product. Use only surfactants approved for conifer release and specified on the surfactant label as safe for use in conifer release (pine release). Using this product without a surfactant will result in reduced herbicide performance. See Mixing Directions and Application Equipment and Application Methods sections.

Avoid contact of spray drift, mist or drips with foliage, green bark or non-woody surface roots of desirable plant species.

Tank Mixes: 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 in the mixture.

Broadcast Application Outside Area of Southeastern United States

Apply this product as a broadcast application for release of Douglas fir (*Pseudotsuga menziesii*), fir (*Abies* species), hemlock (*Tsuga* species), pines (*Pinus* species) (includes all species except loblolly, longleaf, shortleaf, or slash), and California redwood (*Sequoia* species) outside the area of the southeastern United States. Apply this product as a broadcast application only after formation of final conifer resting buds in the fall or prior to initial bud swelling in the spring. Note: Except where specified, make broadcast applications of this product only where conifers have been established for more than one year.

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, are under stress from drought, flood water, improper planting, insects, animal damage or diseases.

Apply 3/4 to 1 1/2 quarts per acre as a broadcast spray. Apply 3/4 to 1 1/8 quarts of this product per acre to release Douglas fir, pine and spruce species at the end of the first growing season (except California). Ensure all conifers are well hardened off.

A surfactant must be used with this product for optimum weed control. Use only surfactants approved for use in over the top release applications. Using this product without a surfactant will result in reduced herbicide performance. For best results, do not use a surfactant for release of hemlock species or California redwood. In mixed conifer stands, injury to these species may result if a surfactant is used. See Mixing Directions and Application Equipment and Application Methods sections.

For release of Douglas fir, a nonionic surfactant for over the top foliar spray may be used. To avoid possible conifer injury, use nonionic surfactants at 2 fl oz per acre at elevations above 1500 feet, or 1 fl oz per acre in the coastal range or at elevations below 1500 feet. Using a higher rate of surfactant may result in unacceptable conifer injury. Ensure the nonionic surfactant has been adequately tested for safety to Douglas fir before using.

Tank Mixes with Oust XP: Apply 3/4 to 1 1/2 quarts of this product with 1 to 3 oz of Oust XP per acre to release jack pine and white. Use 1 to 1 1/2 oz of Oust XP per acre with this product to release white pine. Make applications to actively growing weeds as a broadcast spray over the top of established conifers. Make applications after formation of conifer resting buds in the late summer or fall.

Tank Mixes with Arsenal Applicators Concentrate: Apply 3/4 to 1 1/8 quarts of this product with 2 to 6 fl oz of Arsenal Applicators Concentrate per acre to release Douglas fir. Apply 1 1/2 quarts of this product with 1 to 2 1/2 fl oz of Arsenal Applicators Concentrate per acre to release balsam fir and red spruce.

In **Maine** and **New Hampshire**, apply up to 2 1/4 quarts of this product per acre to control or suppress difficult to control hardwood species. 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, this product may be tank mixed with 1 to 2 1/2 fl oz of Arsenal Applicators Concentrate and 1 to 3 oz of Oust XP per acre. Apply this mix as a broadcast spray.

Broadcast Application in Southeastern United States

Apply this product as a broadcast application for release of loblolly pine (*Pinus taeda*), eastern white pine (*Pinus strobus*), shortleaf pine (*Pinus echinata*), slash pine (*Pinus elliottii*), Virginia pine (*Pinus virginiana*), and longleaf pine (*Pinus palustris*) in the southeastern United States.

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 tank mix.

Tank Mixes with Arsenal Applicators Concentrate: For conifer release, apply 3/4 to 1 1/2 quarts of this product with 2 to 16 fl oz 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 specified rates for dense tough to control wood brush and trees.

Herbaceous Release

When applied as directed, this product plus listed residual herbicides provide 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.

Use a surfactant labeled for use in over the top herbaceous release applications. Using this product without a surfactant will result in reduced herbicide performance. See Mixing Directions and Application Equipment and Application Methods sections on this label.

Weed control may be reduced if spray solution water volumes exceed 25 gallons per acre for these treatments.

Tank Mixes with Oust XP: Apply 12 to 18 fl oz of this product with 2 to 4 oz of Oust XP per acre to release loblolly pines. Apply 9 to 12 fl oz of this product with 2 to 4 oz of Oust XP per acre to release slash pines.

Tank Mix with Atrazine: Apply 3/4 quarts of this product with 4 lb ai of atrazine per acre to release Douglas fir. 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 mix.

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 of this product per acre may be tank mixed with 1 to 3 oz of Oust XP to control grass, herbaceous weeds and woody brush. Apply this mix as a broadcast spray.

Mid-Rotation Conifer Release and Spot Treatments for Crop Tree Release and Timber Stand Improvement

This product is applied as a ground broadcast or directed spray application for mid-rotation release applications under the canopy of pines (and other conifers) and hardwoods. Make applications using application techniques that prevent or minimize direct contact to the foliage of crop trees (including in stands of pine, other conifers, or hardwood). This may be accomplished using directed sprays and ground equipment with nozzles oriented to target only undesirable understory vegetation below the crop tree canopy. This product is applied as a spot, individual plant treatment for woody and herbaceous weeds (see Hand-Held and Backpack Application in Application Equipment and Application Methods section). When making spot applications, do not allow spray to contact the foliage of desirable crop trees.

Noncrop Areas and Industrial Sites

See the rate tables in the Annual Weeds, Perennial Weeds, and Woody Brush and Trees sections for specific application rates. This product has no herbicidal or residual activity in the soil. Where repeat applications are necessary, do not apply more than 8 quarts of this product per acre per year.

Use a higher rate in the rate range 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 rate range for difficult to control species, where dense stands occur, or where conditions for control are not ideal and to control perennial herbaceous weeds from emergence up to the appearance of seedheads, flowers or berries. Use a lower rate in the 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 Mixing for Noncrop Areas

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 in the mixture. Any specified rate of this product may be used in a tank mix.

Maintain good agitation at all times during the mixing process and application. Ensure that the tank mix product(s) is well mixed with the spray solution before adding this product. Mix only the amount of spray solution that will be used during the same day. Reduced weed control may result if a tank mixture is allowed to stand overnight. If the spray mix is allowed to settle, thorough agitation is required to resuspend the mixture before spraying is resumed.

Weed Control, Trim and Edge, and Bare Ground

This product may be used in general noncrop and non-food areas. It may be applied with any application equipment described in this label. This product may be used to trim and edge around objects in noncrop sites, for spot treatment of unwanted vegetation, and to eliminate unwanted weeds growing in established shrub beds or ornamental plantings. This product may be used prior to planting an area to ornamentals, flowers, turfgrass (sod or seed), or prior to laying asphalt or beginning construction projects.

To maintain bare ground, repeated applications of this product may be used.

This product provides control of emerged annual weeds and control or partial control of emerged perennial weeds, woody brush and trees when applied in a tank mix to bare ground.

Turfgrass Renovation, Seed or Sod Production

This product controls most existing vegetation prior to renovating turfgrass areas or establishing turfgrass grown for seed or sod. For maximum control of existing vegetation, delay planting or sodding to determine if any regrowth from escaped underground plant parts occurs. When repeat treatments are necessary, sufficient regrowth must be attained prior to application. For warm season turfgrass, including bermudagrass, summer or fall applications provide the best control. Where existing vegetation is growing under mowed turfgrass management, apply this product after omitting at last one regular mowing to allow sufficient growth for good interception of the spray.

Do not disturb soil or underground plant parts before treatment. Delay tillage or renovation techniques, including vertical mowing, coring, or slicing, for seven days after application to allow translocation into underground plant parts.

Desirable turfgrass may be planed following the above procedures.

Hand-held equipment may be used for spot treatment of unwanted vegetation growing in existing turfgrass. Broadcast or hand-held equipment may be used to control sod remnants or other unwanted vegetation after sod is harvested.

Do not feed or graze turfgrass grown for seed or sod production for eight weeks following application.

Ornamentals and Plant Nurseries

Post-Direct and Trim and Edge

This product may be used as a post-directed spray around established woody ornamental species, including arborvitae, azalea, boxwood, crabapple, euonymus, fir, Douglas fir, jojoba, hollies, lilac, magnolia, maple, oak, provet, pine, spruce and yew. This product may also be used to trim and edge around trees, buildings, sidewalks and roads, potted plants and other objects in a nursery setting.

Desirable plants may be protected from the spray solution by using shields or coverings made of cardboard or other impermeable material. Do not use this product for any over the top broadcast spray in ornamentals. Exercise care to avoid contact of spray, drift or mist with foliage or green bark of established ornamental species.

Site Preparation

This product may be used prior to planting any ornamental, nursery or Christmas tree species.

Greenhouse/Shadehouse

This product may be used to control weeds growing in and around greenhouses and shadehouses. Desirable vegetation must not be present during application and air circulation fans must be turned off.

Wildlife Habitat Management

This product may be used to control exotic and other undesirable vegetation in habitat management and natural areas, including rangeland and wildlife refuges. Apply to allow recovery of native plant species, prior to planting desirable native species, and for broad spectrum vegetation control. Apply spot treatments to selectively remove unwanted plants for habitat enhancement.

Wildlife Food Plots

This product may be used as a site preparation treatment to control annual and perennial weeds prior to planting wildlife food plots. Any wildlife food species may be planted after applying this product, or native species may be allowed to repopulate the area. If tillage is needed to prepare a seedbed, wait 7 days after application before tilling to allow translocation into underground plant parts.

Hollow Stem Injection

Apply this product to control giant knotweed (*Polygonum sachalinense*), Japanese knotweed (*Polygonum cuspidatum*), or other invasive knotweeds using individual stem treatment. Use a hand-held injection device that delivers the specified amount of this product into these hollow stem plants.

Make a hole through both sides of the stem about 6 inches above the ground, just below a node, using an awl or other pointed tool. Inject 5 mL of undiluted product directly into this hole in the hollow stem. Treat each stem of the knotweed plant.

Restrictions:

- Do not apply more than a total of 8 quarts of this product per acre for all treatments combined. At 5 mL per stem, 8 quarts will treat approximately 1420 stems per acre.

Parks, Recreational and Residential Areas

Use this product in parks, recreational and residential areas. Apply it with any application equipment described in this label. Use this product to

trim and edge around trees, fences, paths, around buildings, sidewalks, and other objects in these areas. This product may be used for spot treatment of unwanted vegetation, eliminate unwanted weeds growing in established shrub beds or ornamental plantings, and prior to planting an area to ornamentals, flowers, turfgrass (sod or seed), or prior to laying asphalt or beginning construction projects.

All of the label instructions apply to park and recreational areas.

Railroads

All of the instructions in the Noncrop Areas and Industrial Sites and Roadside sections apply to railroads.

Bare Ground, Ballast and Shoulders, Crossings, and Spot Treatment

Use this product to maintain bare ground on railroad ballast and shoulders. Repeat applications of this product may be used as weeds emerge to maintain bare ground. Use this product to control tall growing weeds to improve line of sight at railroad crossings and reduce the need for mowing along rights-of-way.

Brush Control

Apply 3 to 8 quarts of this product per acre as a broadcast spray, using boom-type or boomless nozzles. Applications up to 80 gallons of spray solution per acre may be used. Apply a 3/4 to 1.5 percent solution of this product when using high volume spray to wet applications. Apply a 5 to 10 percent solution of this product when using low volume directed sprays for spot treatment.

Roadsides

All of the instructions in the Noncrop Areas and Industrial Sites and Railroads sections apply to roadsides.

Shoulder Treatments

Use this product on road shoulders. Apply it with boom sprayers, shielded boom sprayers, high volume off-center nozzles, OC nozzle clusters, manifold nozzle systems, hand-held equipment, and similar equipment, and under-deck mowing plus herbicide systems..

Guardrails and Other Obstacles to Mowing

Use this product to control weeds growing under guardrails and around signposts and other objects along the roadside.

Spot Treatment

Use this product as a spot treatment to control unwanted vegetation growing along roadsides.

Tank Mixes: This product may be used in tank mix combination with other herbicide products to broaden the spectrum of vegetation controlled and for residual weed control. Follow applicable use directions, precautions and limitations on the respective product labels. Use according to the most restrictive precautionary statements for each product in the mixture. Any specified rate of this product may be used in a tank mix.

Chemical Mowing

Perennials: This product suppresses perennial grasses listed in this section to serve as a substitute for mowing. Use 4.5 fl oz of this product per acre when treating Kentucky bluegrass, tall fescue, fine fescue, orchardgrass, or quackgrass. Apply 12 fl oz of this product per acre when treating bermudagrass. Apply 4.5 to 8 fl oz of this product per acre when treating bahiagrass. Use the higher rates when grass is under heat stress. Apply 3 pints of this product per acre when treating torpedograss or paragrass. Apply treatments in 10 to 20 gallons of spray solution per acre.

Annuals: For growth suppression of some annual grasses, including annual ryegrass, wild barley and wild oats growing in coarse turfgrass on roadsides or other industrial areas, apply 3 to 3.75 fl oz of this product in 10 to 40 gallons of spray solution per acre. Apply when annual grasses are actively growing and before the seedheads are in the boot stage of development. Treatments may cause injury to the desired grasses.

Release of Dormant Bermudagrass or Bahiagrass

Apply 6 to 48 fl oz of this product per acre in 10 to 40 gallons of water per acre. Use only in areas where bermudagrass or bahiagrass are desirable groundcovers and where some temporary injury or discoloration can be tolerated. Treatments of more than 12 fl oz per acre may result in injury or delayed greenup in highly maintained areas, including golf courses and lawns.

For best results on winter annuals, treat when weeds are in an early growth stage (less than 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.

Tank Mixes: This product may be used in tank mix combination with other herbicide products to broaden the spectrum of vegetation controlled and for residual weed control. When tank mixing, read and follow all applicable use directions, precautions, and limitation on the respective product labels. Use according to the most restrictive precautionary statements for each product in the mixture. Any specified rate of this product may be used in a tank mix.

Actively Growing Bermudagrass

Use this product to control or partially control many annual and perennial weeds for effective release of actively growing bermudagrass. Use only in areas where some temporary injury or discoloration can be tolerated. Use only on well-established bermudagrass. Bermudagrass injury may result from the treatment, but regrowth will occur under moist conditions. Repeat applications of the tank mix in the same season are not specified since severe injury may occur.

Apply up to 2.25 pints of this product in 10 to 40 gallons of spray solution per acre. Use the lower rate when treating annual weeds less than 6 inches in height (or runner length). Use the higher rate as weeds increase in size or as they approach flower or seedhead formation.

Actively Growing Bahiagrass

For suppression of vegetable growth and seedhead inhibition of bahiagrass for approximately 45 days, apply 4.5 fl oz of this product in 10 to 40 gallons of water per acre. Apply one to two weeks after full greenup or after mowing to a uniform height of 3 to 4 inches. Make this application prior to seedhead emergence. For suppression up to 120 days, apply 3 fl oz of this product per acre, followed by an application of 1.5 to 3 fl oz per acre about 45 days later. Make no more than two applications per year.

Tank Mixes: This product may be used in tank mix combination with other herbicide products to broaden the spectrum of vegetation controlled and for residual weed control. When tank mixing, read and follow all applicable use directions, precautions, and limitation on the respective product labels. Use according to the most restrictive precautionary statements for each product in the mixture. Any specified rate of this product may be used in a tank mix.

Utility Sites

Use this product for control of brush, tree, and weed control and side trimming in areas including electrical power, pipeline and telephone rights-of-ways, and other sites associated with these rights-of-ways including substations, roadsides, and railroads. This product may be applied with any application equipment or method described on this label unless specifically prohibited.

Tank Mixes: This product may be used in tank mix combination with other herbicide products to broaden the spectrum of vegetation controlled and for residual weed control. When tank mixing, read and follow all applicable use directions, precautions, and limitation on the respective product labels. Use according to the most restrictive precautionary statements for each product in the mixture. Any specified rate of this product may be used in a tank mix.

Rangelands

Use this product to control or suppress many annual weeds growing in perennial cool and warm season grass rangelands. Preventing weed seed production is critical to the successful control of annual grassy weeds invading these perennial grass sites. Eliminate most of the viable seeds with follow up applications in sequential years. Delay grazing of treated areas to encourage growth of desirable perennials. Allowing desirable perennials to flower and reseed in the treated area will encourage successful transition.

Bromus: Use this product to control or suppress downy brome/cheatgrass (*Bromus tectorum*), Japanese brome (*Bromus japonicus*), soft chess (*Bromus mollis*), cheat (*Bromus secalinus*), cereal rye and jointed goatgrass. Apply 6 to 12 fl oz of this product per acre as a broadcast treatment.

For best results, coincide treatments with early seedhead emergence of the most mature plants. Delaying the application until this growth stage maximizes the emergence of other weedy grass flushes. Make applications to the same site each year until seed banks are depleted and the desirable perennial grasses become established on the site.

Medusahead: Apply 12 fl oz of this product per acre to control or suppress medusahead at the 3-leaf stage when plants are actively growing. Delaying applications beyond this stage results in reduced or unacceptable control. Repeat applications in subsequent years to eliminate the seed bank before reestablishing desirable perennial grasses. Apply in the fall or spring.

Apply by ground or air. Make aerial applications for these uses with fixed wing or helicopter equipment. For aerial applications, apply in 2 to 10 gallons of water per acre. For ground applications, apply in at least 10 to 20 gallons of water per acre.

Spot Treatment and Wiper Application

Apply this product in rangeland, pastures, or industrial sites as a spot treatment or over the top of desirable grasses using wiper applicators to control tall weeds. See Wiper Application section for specific instructions. Make repeat applications in the same area at 30-day intervals.

The entire site or any portion of it may be treated when using 2.25 quarts or less of this product per acre for spot treatments or wiper applications. No more than 10 percent of the total site may be treated at any one time when using more than 2.25 quarts of this product per acre for spot treatments or wiper applications. To achieve maximum performance, remove domestic livestock before application and wait 7 days after application before grazing livestock or harvesting for feed.

Pastures

Type of Pastures: Bahiagrass, bermudagrass, bluegrass, brome, fescue, orchardgrass, ryegrass, timothy, wheatgrass, alfalfa, clover

Spot Treatment and Wiper Application

This product may be applied as a spot treatment or as a wiper application. Make applications in the same area at 30-day intervals. See Wiper Application section for specific instructions.

Precautions and Restrictions:

- For spot treatment and wiper applications, the entire field or any portion of it may be treated when using a rate of 2.25 quarts or less per acre.
- Do not treat more than 10 percent of any acre at one time if applying more than 2.25 quarts per acre as a spot treatment or wiper application.
- To achieve maximum performance, remove domestic livestock before application and wait 14 days after application before grazing livestock or harvesting.

Preplant, Preemergence, and Pasture Renovation

Apply this product prior to planting or emergence of forage grasses and legumes. In addition, this product may be used to control perennial pasture species listed on this label prior to re-planting.

Precautions and Restrictions:

- If the application rates total 2.25 quarts or less per acre, there is no waiting period between treatment and feeding or livestock grazing is required.
- If the application rates total more than 2.25 quarts per acre, remove domestic livestock before application and wait eight weeks after application before grazing or harvesting.
- Crops listed for treatment in this label may be planted into the treated area at any time. Wait 30 days between application and planting for all other crops.

Bamboo

Use this product on roadside rights-of way to control or suppress bamboo. Use the higher rate in the rate range for dense stands and larger plants. Mow or cut bamboo and allow it to resprout to have sufficient foliage in order for the spray solution to completely cover the foliage. Optimum control or suppression of bamboo is achieved when this product is applied between August and October (prior to frost). One application of this product plus a surfactant will not eradicate bamboo. Several mowings and applications are required to completely control bamboo.

Apply the specified rate plus a surfactant (1/4 to 1/2% v/v), such as a nonionic surfactant containing 80% active ingredient or more. Using this product without a surfactant results in reduced performance.

Application Method	Rate	Spray Volume (gal/acre)
ground broadcast	1.5 – 7.5 qt/acre	10 - 60
handgun spray to wet	0.75 – 2%	spray to wet
handgun or backpack low volume directed spray	4 – 10%	spray to cover

Restrictions:

- Do not apply more than a total of 8 quarts of this product per acre per year.

Annual Weeds, Perennial Weeds, and Woody Brush and Trees

Annual Weeds

Apply 24 fl oz of this product per acre if weeds are less than 6 inches in height or runner length. Use 1.25 to 3 quarts of this product per acre if weeds are more than 6 inches in height or runner length or when weeds are growing under stressed conditions. Use a higher rate in the rate range for tough to control species regardless of the size of the weed at the time of application. Treat tough to control weeds when they are relatively small. Tank mix this product with only those products that are labeled for application at the target site. Refer to the label of the tank mix partner for use sites and application rates.

Apply a 0.4 percent solution of this product as a spray to wet application to weeds less than 6 inches in height or runner length.

Use a 0.7 to 1.5 percent solution for annual weeds more than 6 inches tall or for smaller weeds growing under stressed conditions. Use the higher concentration for tough to control species or for weeds more than 24 inches tall. Apply prior to seedhead formation in grass or bud formation in broadleaf weeds.

Use a 4 to 7 percent solution of this product for low volume directed spray applications. Spray coverage should be uniform with at least 50 percent of the foliage contacted. For best results, cover the top one-half of the plant. To ensure adequate spray coverage, spray both sides of large or tall weeds when foliage is thick and dense or where there are multiple sprouts.

Common Name

anoda, spurred
balsamapple¹
barley
barnyardgrass
bassia, fivehook
bittercress
bluegrass, annual
bluegrass, bulbous
brome, downy/cheatgrass
brome, Japanese
buttercup
Carolina foxtail
Carolina geranium
castorbean
chamomile, mayweed
cheat
chervil
chickweed
cocklebur, common
coreopsis, plains
corn, volunteer
crabgrass
dwarf dandelion, Virginia
eastern mannagrass
eclipta
falsedandelion
falseflax, smallseed
fiddleneck
field pennycress
fleabane, annual
fleabane, hairy
fleabane, rough
Florida pusley
foxtail
goatgrass, jointed
goosegrass
groundsel, common
henbit
horseweed/marestail
itchgrass
johnsongrass
jungerice
knotweed
kochia²
lambsquarters, common
mallow, little
medusahead
morningglory
mustard, blue
mustard, tumble
mustard, wild
oats, wild
panicum, fall
pigweed, redroot
pigweed, smooth
prickly lettuce
puncturevine
purslane, common
ragweed, common
ragweed, giant
rocket, London
Russian-thistle
rye, cereal
ryegrass, Italian³
sandbur, field
sesbania, hemp
shattercane
shepherd's-purse
sicklepod
signalgrass, broadleaf
smartweed, Pennsylvania
sowthistle, annual
Spanishneedles³
speedwell, corn
speedwell, purslane
sprangletop
spurge, annual

Scientific Name

Anoda cristata
Momordica charantia
Hordeum vulgare
Echinochloa crus-galli
Bassia hyssopifolia
Cardamine spp.
Poa annua
Poa bulbosa
Bromus tectorum
Bromus japonicus
Ranunculus spp.
Alopecurus carolinianus
Geranium carolinianum
Ricinus communis
Anthemis cotula
Bromus secalinus
Anthriscus cerefolium
Cerastium vulgatum
Xanthium strumarium
Coreopsis tinctoria
Zea mays
Digitaria spp.
Krigia virginica
Glyceria spp.
Eclipta prostrata
Pyrrhopappus carolinianus
Camelina microcarpa
Amsinckia spp.
Thlaspi arvense
Erigeron annuus
Conyza bonariensis
Erigeron strigosus
Richardia scabra
Setaria spp.
Aegilops cylindrica
Eleusine indica
Senecio vulgaris
Lamium amplexicaule
Conyza canadensis
Rottboellia cochinchinensis
Sorghum halepense
Echinochloa colona
Polygonum spp.
Kochia scoparia
Chenopodium album
Malva parviflora
Taeniatherum caput-medusae
Ipomoea spp.
Chorisporea tenella
Sisymbrium altissimum
Sinapis arvensis
Avena fatua
Panicum dichotomiflorum
Amaranthus retroflexus
Amaranthus hybridus
Lactuca serriola
Tribulus terrestris
Portulaca oleracea
Ambrosia artemisiifolia
Ambrosia trifida
Sisymbrium irio
Salsola tragus
Secale cereale
Lolium perenne
Cenchrus spinifex
Sesbania herbacea
Sorghum bicolor
Capsella bursa-pastoris
Senna obtusifolia
Urochloa platyphylla
Polygonum pennsylvanicum
Sonchus oleraceus
Bidens bipinnata
Veronica arvensis
Veronica peregrina
Leptochloa spp.
Chamaesyce spp.

Common Name (Cont.)

spurge, prostrate
 spurge, spotted
 spurry, umbrella
 stinkgrass
 sunflower, common
 tansymustard, pinnate
 teaweed/sida, prickly
 Texas panicum
 velvetleaf
 Virginia pepperweed
 wheat
 witchgrass
 woolly cupgrass
 yellow rocket

¹Apply with hand-held equipment only.

²Do not treat kochia in the button stage.

³Apply 3 pints of product per acre.

Perennial Weeds

Best results are obtained when perennial weeds are treated after they reach the reproductive stage of growth (seedhead initiation in grasses and bud formation in broadleaves). Best results are obtained when non-flowering plants are treated when they reach a mature stage of growth. In many situations, applications are required prior to these growth stages. Under these conditions, use a higher rate in the rate range.

When using spray to wet treatments with hand-held equipment, ensure thorough coverage of the plant. For best results, use a 1.5 percent solution on harder to control perennials including bermudagrass, dock, field bindweed, hemp dogbane, milkweed and Canada thistle.

Use a 4 to 7 percent solution of this product in low volume directed spray applications. Spray coverage should be uniform with at least 50 percent of the foliage contacted. For best results, cover the top one-half of the plant. To ensure adequate spray coverage, spray both sides of large or tall weeds when foliage is thick and dense or where there are multiple sprouts.

Allow 7 days or more after application before tillage.

Common Name

alfalfa
 alligatorweed¹
 anise/fennel
 artichoke, Jerusalem
 bahiagrass
 beachgrass, European
 bentgrass
 bermudagrass
 bindweed, field
 bluegrass, Kentucky
 blueweed, Texas
 brackenfern
 brome, smooth
 bursage, woollyleaf
 canarygrass, reed
 cattail
 clover, red
 clover, white
 cogongrass
 cordgrass
 cutgrass, giant¹
 dallisgrass
 dandelion
 dock, curly
 dogbane, hemp
 fescue
 fescue, tall
 German ivy
 guineagrass
 horsetail
 horseradish
 iceplant, crystalline
 johnsongrass
 kikuyugrass
 knapweed, Russian
 lantana, largeleaf
 lespedeza, common
 lespedeza, sericea
 loosestrife, purple
 lotus, American
 maidencane
 milkweed
 muhly, wirestem
 mullein, common
 napiergrass
 nightshade, silverleaf
 nutsedge, purple
 nutsedge, yellow
 orchardgrass

Scientific Name

Chamaesyce humistrata
Chamaesyce maculata
Holosteum umbellatum
Eragrostis cilianensis
Helianthus annuus
Descurainia pinnata
Sida spinosa
Panicum spp.
Abutilon theophrasti
Lepidium virginicum
Triticum aestivum
Panicum capillare
Eriochloa villosa
Barbarea vulgaris

Scientific Name

Medicago sativa
Alternanthera philoxeroides
Foeniculum vulgare
Helianthus tuberosus
Paspalum notatum
Ammophila arenaria
Agrostis spp.
Cynodon dactylon
Convolvulus arvensis
Poa pratensis
Helianthus ciliaris
Pteridium aquilinum
Bromus inermis
Ambrosia grayi
Phalaris arundinacea
Typha spp.
Trifolium pratense
Trifolium repens
Imperata cylindrica
Spartina spp.
Zizaniopsis miliacea
Paspalum dilatatum
Taraxacum officinale
Rumex crispus
Apocynum cannabinum
Festuca spp.
Lolium arundinaceum
Senecio mikanioides
Urochloa maxima
Solanum carolinense
Armoracia rusticana
Mesembryanthemum crystallinum
Sorghum halepense
Pennisetum clandestinum
Acrotilon repens
Lantana camara
Kummerowia striata
Lespedeza cuneata
Lythrum salicaria
Nelumbo lutea
Panicum hemitomon
Asclepias spp.
Muhlenbergia frondosa
Verbascum thapsus
Pennisetum purpureum
Solanum elaeagnifolium
Cyperus rotundus
Cyperus esculentus
Dactylis glomerata

Common Name

pampasgrass
 paragrass
 phragmites²
 poison-hemlock
 quackgrass
 reedvine
 reed, giant
 ryegrass, perennial
 smartweed, swamp
 sowthistle, perennial
 spatterdock
 starthistle, yellow
 sweet potato, wild¹
 thistle, artichoke
 thistle, Canada
 timothy
 torpedograss¹
 trumpetcreeper
 tules, common
 vaseygrass
 velvetgrass
 water fern³
 waterhyacinth
 waterlettuce
 waterprimrose
 wheatgrass, western

¹ Partial control.

² Partial control in southeastern states.

³ Not for use in California

Woody Brush and Trees

Apply this product after full leaf expansion unless otherwise directed. 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 applications are 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.

See Low Volume Directed Spray Application section of label. Spray coverage should be uniform with at least 50 percent of the foliage contacted. For best results, cover the top half to 2/3 of the plant foliage. Spray both sides of large or tall woody brush and trees to ensure adequate spray coverage when foliage is thick and dense or where there are multiple sprouts. Symptoms may not appear prior to frost or senescence with fall treatments.

Allow seven days or more 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.

Note: If brush has been mowed or tilled, or trees have been cut, do not treat until regrowth has reached the specified stage of growth.

This product will control, partially control, or suppress the following woody brush and trees.

Common Name

alder
 ash¹
 aspen, quaking
 bearclaw, bearmat
 beach
 birch
 bittercherry
 blackberry
 blackgum
 blue gum, Tasmanian
 brackenfern
 broom, French
 broom, Scotch
 buckwheat, California¹
 cascara¹
 catclaw-vine¹
 ceanothus
 chamise
 cherry
 cherry, black
 cherry, pin
 copperleaf, hophornbeam
 coyotebrush
 deer vetch
 dewberry, southern
 dogwood

Scientific Name

Cortaderia selloana
Urochloa mutica
Phragmites spp.
Conium maculatum
Elymus repens
Brunnichia ovata
Arundo donax
Lolium perenne
Polygonum amphibium
Sonchus arvensis
Nuphar lutea
Centaurea solstitialis
Ipomoea pandurata
Cynara cardunculus
Cirsium arvense
Phleum pratense
Panicum repens
Campsis radicans
Scirpus acutus
Paspalum urvillei
Holcus spp.
Salvinia spp.
Eichornia crassipes
Pistia stratiotes
Ludwigia spp.
Pascopyrum smithii

Scientific Name

Alnus spp.
Fraxinus spp.
Populus tremuloides
Ceanothus prostratus
Fagus spp.
Betula spp.
Prunus emarginata
Rubus spp.
Nyssa sylvatica
Eucalyptus globulus
Pteridium aquilinum
Genista monspessulana
Cytisus scoparius
Eriogonum fasciculatum
Frangula purshiana
Macfadyena unguis-cati
Ceanothus spp.
Adenostoma fasciculatum
Prunus spp.
Prunus serotina
Prunus pennsylvanica
Acalypha ostryifolia
Baccharis pilularis
Lotus unifoliolatus
Rubus trivialis
Cornus spp.

Common Name (Cont.)

elderberry
elm¹
gorse
hasardia¹
hawthorn
hazel
hickory
holly, Florida
honeysuckle
hornbeam, American
kudzu
locust, black¹
madrone, Pacific
manzanita
maple
maple, red¹
maple, sugar
maple, vine¹
monkeyflower¹
oak
oak, black¹
oak, pin
oak, post
oak, red
oak, southern red
oak, white¹
peppertree, Brazilian
persimmon¹
pine
poison-ivy, eastern
poison-oak
poison-sumac¹
prunus
raspberry
redbud, eastern
rose, multiflora
Russian-olive
sage,: black, white
sagebrush, California
salmonberry
saltcedar¹
saltbush, sea myrtle
sassafras
sourwood¹
sumac, smooth¹
sumac, dwarf¹
sweetgum
swordfern¹
tallowtree, Chinese
oak, tanbark resprouts
thimbleberry, western
tobacco, tree¹
trumpetcreeper
Virginia-creeper¹
waxmyrtle, southern¹
willow
yellow-poplar¹
yerba santa
¹Partial control

Scientific Name

Sambucus nigra
Ulmus spp.
Ulex europaeus
Haplopappus squamosus
Crataegus spp.
Corylus spp.
Carya spp.
Schinus terebinthifolius
Lonicera spp.
Carpinus caroliniana
Pueraria montana
Robinia pseudoacacia
Arbutus menziesii
Arctostaphylos spp.
Acer spp.
Acer rubrum
Acer saccharum
Acer circinatum
Mimulus guttatus
Quercus spp.
Quercus kelloggia
Quercus palustris
Quercus stellata
Quercus rubra
Quercus falcata
Quercus alba
Schinus terebinthifolius
Diospyros spp.
Pknus spp.
Toxicodendron radicans
Toxicodendron spp.
Toxicodendron vernix
Prunus spp.
Rubus spp.
Cercis canadensis
Rosa multiflora
Elaeagnus angustifolia
Salvia spp.
Artemisia californica
Rubus spectabilis
Tamarix ramosissima
Baccharis halimifolia
Sassafras albidum
Oxydendrum arboreum
Rhus glabra
Rhus copallinum
Liquidambar styraciflua
Polystichum munitum
Triadica sebifera
Lithocarpus densiflorus
Rubus parviflorus
Nicotiana glauca
Campsis radicans
Parthenocissus quinquefolia
Myrica cerifera
Salix spp.
Liriodendron tulipifera
Eriodictyon californicum

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. TO THE EXTENT PERMITTED BY LAW, 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 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.

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 Limitation of Remedies in any manner.

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Produced for
Dow AgroSciences LLC
9330 Zionsville Road
Indianapolis, IN 46268

Label Code: D02-148-007
Replaces Label: D02-148-006
LOES Number: 010-01471
EPA accepted 08/20/15

Revisions:

1. Updated trademark
2. Glypro Tank Mix: Revised last sentence before NOTE to read, "The screen size in the nozzle or line strainers must be no finer than 50 mesh."
3. Added section on Additional Limitations for Aerial Application in Fresno County, California Only.
4. Add salvinia under Perennial Weeds
5. Rolled supplemental labels for Non-Ag uses into Section 3 label

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, to the extent permitted by law, use by the buyer or any other user constitutes acceptance of the terms under Warranty Disclaimer, Inherent Risks of Use and Limitations of Remedies.



ESCORT® XP HERBICIDE

Version 2.0 / USA
102000030324

1/10
Revision Date: 09/01/2015
Print Date: 09/01/2015

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product identifier

Trade name ESCORT® XP HERBICIDE

Product code (UVP) 84100846

SDS Number 102000030324

EPA Registration No. 432-1549

Relevant identified uses of the substance or mixture and uses advised against

Use Herbicide

Restrictions on use See product label for restrictions.

Information on supplier

Supplier Bayer Environmental Science
2 T.W. Alexander Drive
Research Triangle PK, NC 27709
United States

Responsible Department Email: SDSINFO.BCS-NA@bayer.com

Emergency telephone no.

Emergency Telephone Number (24hr/ 7 days) 1-800-334-7577

Product Information Telephone Number 1-800-331-2867

SECTION 2: HAZARDS IDENTIFICATION

Classification in accordance with regulation HCS 29CFR §1910.1200

This material is not hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29CFR 1910.1200.

Other hazards

No particular hazards known.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous Component Name	CAS-No.	Concentration % by weight
Metsulfuron-methyl	74223-64-6	60.0
Sulfonated aromatic polymer, sodium salt	68425-94-5	3.2



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Revision Date: 09/01/2015
Print Date: 09/01/2015

SECTION 4: FIRST AID MEASURES

Description of first aid measures

General advice	When possible, have the product container or label with you when calling a poison control center or doctor or going for treatment.
Inhalation	Move 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 physician or poison control center immediately.
Skin contact	Take off contaminated clothing and shoes immediately. Wash off immediately with plenty of water for at least 15 minutes. Call a physician or poison control center immediately.
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 physician or poison control center immediately.
Ingestion	Call a physician or poison control center immediately. Rinse out mouth and give water in small sips to drink. DO NOT induce vomiting unless directed to do so by a physician or poison control center. Never give anything by mouth to an unconscious person. Do not leave victim unattended.

Most important symptoms and effects, both acute and delayed

Symptoms To date no symptoms are known.

Indication of any immediate medical attention and special treatment needed

Treatment Appropriate supportive and symptomatic treatment as indicated by the patient's condition is recommended. There is no specific antidote.

SECTION 5: FIREFIGHTING MEASURES

Extinguishing media

Suitable	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Unsuitable	High volume water jet

Special hazards arising from the substance or mixture Dangerous gases are evolved in the event of a fire.

Advice for firefighters

Special protective equipment for fire-fighters Firefighters should wear NIOSH approved self-contained breathing apparatus and full protective clothing.

Further information Keep out of smoke. Fight fire from upwind position. Cool closed containers exposed to fire with water spray. Do not allow run-off from fire fighting to enter drains or water courses. Whenever possible, contain fire-fighting water by diking area with sand or earth.



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Flash point	not applicable
Autoignition temperature	> 400 °C / > 752 °F
Lower explosion limit	not applicable
Upper explosion limit	not applicable
Explosivity	no data available

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Precautions Keep unauthorized people away. Isolate hazard area. Avoid contact with spilled product or contaminated surfaces.

Methods and materials for containment and cleaning up

Methods for cleaning up Sweep up or vacuum up spillage and collect in suitable container for disposal. Clean contaminated floors and objects thoroughly, observing environmental regulations. Contaminated soil may have to be removed and disposed.

Additional advice Use personal protective equipment. Do not allow to enter soil, waterways or waste water canal. Do not allow product to contact non-target plants.

Reference to other sections Information regarding safe handling, see section 7.
Information regarding personal protective equipment, see section 8.
Information regarding waste disposal, see section 13.

SECTION 7: HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling Ensure adequate ventilation. Handle and open container in a manner as to prevent spillage.

Hygiene measures Wash hands thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, using the toilet or applying cosmetics.
Remove Personal Protective Equipment (PPE) immediately after handling this product. Remove soiled clothing immediately and clean thoroughly before using again. Wash thoroughly and put on clean clothing.

Conditions for safe storage, including any incompatibilities



ESCORT® XP HERBICIDE

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102000030324

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Revision Date: 09/01/2015
Print Date: 09/01/2015

Requirements for storage areas and containers

Keep containers tightly closed in a dry, cool and well-ventilated place. Store in a cool, dry place and in such a manner as to prevent cross contamination with other crop protection products, fertilizers, food, and feed. Store in original container and out of the reach of children, preferably in a locked storage area.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Components	CAS-No.	Control parameters	Update	Basis
Sucrose	57-50-1	10 mg/m3 (TWA)	02 2012	ACGIH
Sucrose (Total)	57-50-1	10 mg/m3 (REL)	2010	NIOSH
Sucrose (Respirable.)	57-50-1	5 mg/m3 (REL)	2010	NIOSH
Sucrose (Respirable fraction.)	57-50-1	5 mg/m3 (PEL)	02 2006	OSHA Z1
Sucrose (Total dust.)	57-50-1	15 mg/m3 (PEL)	02 2006	OSHA Z1
Sucrose (Respirable fraction.)	57-50-1	5 mg/m3 (TWA)	1989	OSHA Z1A
Sucrose (Total dust.)	57-50-1	15 mg/m3 (TWA)	1989	OSHA Z1A
Sucrose (Total dust.)	57-50-1	15 mg/m3 (TWA)	06 2008	TN OEL
Sucrose (Respirable fraction.)	57-50-1	5 mg/m3 (TWA)	06 2008	TN OEL
Sucrose	57-50-1	5ug/m3 (AN ESL)	03 2014	TX ESL
Sucrose	57-50-1	50ug/m3 (ST ESL)	03 2014	TX ESL

Exposure controls

Personal protective equipment

In normal use and handling conditions please refer to the label and/or leaflet. In all other cases the following recommendations would apply.

Respiratory protection

When respirators are required, select NIOSH approved equipment based on actual or potential airborne concentrations and in accordance with the appropriate regulatory standards and/or industry recommendations.

Hand protection

Chemical resistant nitrile rubber gloves

Eye protection

Safety glasses with side-shields

Skin and body protection

Wear long-sleeved shirt and long pants and shoes plus socks.

General protective measures

Follow manufacturer's instructions for cleaning/maintaining PPE. If



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no such instructions for washables, use detergent and warm/tepid water.
Keep and wash PPE separately from other laundry.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	light brown
Physical State	granular
Odor	slight
Odour Threshold	no data available
pH	5.0 at 1 % (as aqueous solution)
Vapor Pressure	no data available
Vapor Density (Air = 1)	no data available
Bulk density	690 kg/m ³ (bulk density tapped)
Evaporation rate	not applicable
Boiling Point	not applicable
Melting / Freezing Point	not applicable
Water solubility	dispersible
Minimum Ignition Energy	no data available
Decomposition temperature	no data available
Partition coefficient: n-octanol/water	not applicable
Viscosity	not applicable
Flash point	not applicable
Autoignition temperature	> 400 °C / > 752 °F
Lower explosion limit	not applicable
Upper explosion limit	not applicable
Explosivity	no data available



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SECTION 10: STABILITY AND REACTIVITY

Reactivity

Thermal decomposition	no data available
Chemical stability	Stable under normal conditions.
Possibility of hazardous reactions	No hazardous reactions when stored and handled according to prescribed instructions.
Conditions to avoid	no data available
Incompatible materials	no data available
Hazardous decomposition products	No decomposition products expected under normal conditions of use.

SECTION 11: TOXICOLOGICAL INFORMATION

Exposure routes Eye contact, Inhalation, Ingestion, Skin contact

Immediate Effects

Eye Causes eye irritation.

Information on toxicological effects

Acute oral toxicity	LD50 (rat) > 5,000 mg/kg
Acute inhalation toxicity	LC50 (rat) > 5.0 mg/l Exposure time: 4 h The value mentioned relates to the active ingredient metsulfuron methyl.
Acute dermal toxicity	LD50 (rabbit) > 5,000 mg/kg
Skin irritation	No skin irritation (rabbit)
Eye irritation	Slight irritation (rabbit)
Sensitisation	Non-sensitizing. (guinea pig) OECD Test Guideline 406, Buehler test

ACGIH

None.

NTP

None.

IARC

None.

OSHA

None.



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Further information

Only acute toxicity studies have been performed on the formulated product.

SECTION 12: ECOLOGICAL INFORMATION

Toxicity to fish	LC50 (Oncorhynchus mykiss (rainbow trout)) > 150 mg/l Exposure time: 96 h The value mentioned relates to the active ingredient metsulfuron methyl.
	LC50 (Lepomis macrochirus (Bluegill sunfish)) > 150 mg/l Exposure time: 96 h The value mentioned relates to the active ingredient metsulfuron methyl.
Toxicity to aquatic invertebrates	EC50 (Daphnia (water flea)) > 120 mg/l Exposure time: 48 h The value mentioned relates to the active ingredient metsulfuron methyl.
Toxicity to aquatic plants	EC50 (Anabaena flos-aquae (cyanobacterium)) 0.066 mg/l Exposure time: 72 h The value mentioned relates to the active ingredient metsulfuron methyl.
	EC50 (Lemna minor (Common duck-weed)) 0.00036 mg/l Exposure time: 14 d The value mentioned relates to the active ingredient metsulfuron methyl.
Environmental precautions	Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate surface or ground water by cleaning equipment or disposal of wastes, including equipment wash water.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste treatment methods

Product	Do not contaminate water, food, or feed by disposal. Dispose of unused product by incineration at a licensed incineration plant, in accordance with all applicable national and local regulations.
Contaminated packaging	Consult state and local regulations regarding the proper disposal of container. Follow advice on product label and/or leaflet.
RCRA Information	Characterization and proper disposal of this material as a special or hazardous waste is dependent upon Federal, State and local laws and are the user's responsibility. RCRA classification may apply.



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SECTION 14: TRANSPORT INFORMATION

49CFR Not dangerous goods / not hazardous material

IMDG

UN number **3077**
Class **9**
Packaging group **III**
Marine pollutant **YES**
Proper shipping name **ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (METSULFURON-METHYL MIXTURE)**

IATA

UN number **3077**
Class **9**
Packaging group **III**
Environm. Hazardous Mark **YES**
Proper shipping name **ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (METSULFURON-METHYL MIXTURE)**

This transportation information is not intended to convey all specific regulatory information relating to this product. It does not address regulatory variations due to package size or special transportation requirements.

SECTION 15: REGULATORY INFORMATION

EPA Registration No. 432-1549

US Federal Regulations

TSCA list

Sulfonated aromatic polymer, sodium salt 68425-94-5

US. Toxic Substances Control Act (TSCA) Section 12(b) Export Notification (40 CFR 707, Subpt D)

None.

SARA Title III - Section 302 - Notification and Information

None.

SARA Title III - Section 313 - Toxic Chemical Release Reporting

None.

US States Regulatory Reporting

CA Prop65

This product does not contain any substances known to the State of California to cause cancer.

This product does not contain any substances known to the State of California to cause reproductive harm.

US State Right-To-Know Ingredients

None.

Canadian Regulations



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Canadian Domestic Substance List

None.

Environmental

CERCLA

None.

Clean Water Section 307 Priority Pollutants

None.

Safe Drinking Water Act Maximum Contaminant Levels

None.

EPA/FIFRA Information:

This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets, and for workplace labels of non-pesticide chemicals. Following is the hazard information required on the pesticide label:

Signal word: Caution!

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

SECTION 16: OTHER INFORMATION

Abbreviations and acronyms

49CFR	Code of Federal Regulations, Title 49
ACGIH	US. ACGIH Threshold Limit Values
CAS-Nr.	Chemical Abstracts Service number
EINECS	European inventory of existing commercial substances
ELINCS	European list of notified chemical substances
IARC	US. IARC Monographs on Occupational Exposures to Chemical Agents
IATA	International Air Transport Association
IMDG	International Maritime Dangerous Goods
N.O.S.	Not otherwise specified
NTP	US. National Toxicology Program (NTP) Report on Carcinogens
OECD	Organization for Economic Co-operation and Development
TDG	Transportation of Dangerous Goods
TWA	Time weighted average
UN	United Nations
WHO	World health organisation

Bayer Environmental Science

SAFETY DATA SHEET



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NFPA 704 (National Fire Protection Association):

Health - 1 Flammability - 1 Instability - 0 Others - none

HMIS (Hazardous Materials Identification System, based on the Third Edition Ratings Guide)

Health - 1 Flammability - 1 Physical Hazard - 0 PPE -

0 = minimal hazard, 1 = slight hazard, 2 = moderate hazard, 3 = severe hazard, 4 = extreme hazard

Reason for Revision: New Safety Data Sheet.

Revision Date: 09/01/2015

This information is provided in good faith but without express or implied warranty. The customer assumes all responsibility for safety and use not in accordance with label instructions. The product names are registered trademarks of Bayer.

GROUP 2 HERBICIDE



Escort[®] XP

HERBICIDE

Dry Flowable

Active Ingredient

Metsulfuron methyl
2-ylamino]-carbonyl]amino]sulfonyl]benzoate

By Weight

60%
40%
TOTAL 100%

EPA Reg. No. 432-1549
EPA Est. No. 065604-AR-001

Nonrefillable Container

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.)

See inside leaflet for complete First Aid Instructions,
Precautionary Statements, Directions for Use and
Storage and Disposal Instructions.

Net Weight

1 Pound
84122394

A01798371 150622AV4

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

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 1-800-334-7577 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.

Produced for:

Bayer Environmental Science
A Division of Bayer CropScience LP
2 T. W. Alexander Drive
Research Triangle Park, NC 27709

Bayer

DIRECTIONS FOR USE

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

Escort® XP Herbicide must be used only in accordance with instructions on this label or in separately published Bayer CropScience LP instructions.

Bayer CropScience LP 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 Herbicide 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 Herbicide 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 Herbicide controls weeds and woody plants primarily by post-emergent activity. Although Escort® XP Herbicide has preemergence activity, best results are generally obtained when Escort® XP Herbicide is applied to foliage after emergence or dormancy break. Generally, for the control of annual weeds, Escort® XP Herbicide 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 Herbicide 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 Herbicide 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 effect on perennial weeds and woody plants occurs in the growing season following application.

Warm, moist conditions following treatment promote the activity of Escort® XP Herbicide, 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 Herbicide 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

Escort® XP Herbicide, 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 bio-types. 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 Herbicide 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 Herbicide. This evaluation is particularly critical where desirable vegetation or crops are grown on neighboring land for which the use of Escort® XP Herbicide 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 Herbicide.

Before applying Escort® XP Herbicide 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 1-800-331-2867.

TANK MIXES

Escort® XP Herbicide 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

Escort® XP Herbicide 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 Herbicide 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 Herbicide 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 Herbicide 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. Bayer CropScience LP 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 Herbicide.

Glyphosate (4 pound active per gallon)

Tank mix 1 to 2 ounces of Escort® XP Herbicide 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 Herbicide 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 Herbicide with 16 to 64 fluid ounces of glyphosate and 10 to 12 fluid ounces of imazapyr per acre. Slash and loblobly 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.

Velpar® L [VU] Herbicide or Velpar® DF [VU] Herbicide

Tank mix 1 to 2 ounces of Escort® XP Herbicide per acre with Velpar® L [VU] Herbicide or Velpar® DF [VU] Herbicide at the rates specified on the container for various soil textures. Loblobly and slash pines may be transplanted the planting season following application. Refer to the product container for a list of species controlled.

Oust® Extra Herbicide

Tank mix 1/2 to 1 1/2 ounces of Escort® XP Herbicide with 2 to 3 ounces of Oust® Extra Herbicide 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. Loblobly and slash pines may be transplanted the planting season following application. Tank mix 2 ounces of Escort® XP Herbicide with 3 ounces of Oust® Extra Herbicide 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 Herbicide may be used for application over the top of established slash and loblobly 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 Herbicide.

Imazapyr (4 pound active per gallon)

Tank mix 1 to 2 ounces of Escort® XP Herbicide with 8 to 16 fluid ounces of imazapyr per acre for application to loblobly 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, hophorn-

beam, oaks (red, white and water), sassafras, sweetgum, Vaccinium species, and suppresses blackberry, dogwood, elms, myrtle dahoon, hickories, persimmon, and red maple.

Velpar® L [VU] Herbicide or Velpar® DF [VU] Herbicide

Tank mix 1 to 2 ounces of Escort® XP Herbicide with Velpar® L [VU] Herbicide or Velpar® DF [VU] Herbicide at the rates specified on the container for various soil textures. This combination may be applied to loblobly and slash pines.

Release--Herbaceous Weed Control

Escort® XP Herbicide may be applied to transplanted loblobly 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 Herbicide 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 Herbicide.

Imazapyr (4 pound active per gallon)

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

Velpar® L [VU] Herbicide or Velpar® DF [VU] Herbicide

Tank mix 1/2 to 1 ounce of Escort® XP Herbicide with Velpar® L [VU] Herbicide or Velpar® DF [VU] Herbicide at the rates specified on the container for various soil textures. This combination may be applied to loblobly 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 Herbicide 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 Herbicide spray solution away from the conifer foliage.

NOTE:

Escort® XP Herbicide may cause temporary yellowing and or growth suppression when the spray solution contacts conifer foliage. The use of a surfactant with Escort® XP Herbicide may improve brush control results. When using a surfactant with Escort® XP Herbicide, 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 Escort® XP Herbicide 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 Herbicide 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 Herbicide to conifers grown as ornamentals.
- Escort® XP Herbicide 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 Herbicide 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 Herbicide 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 Herbicide may be tank mixed with other herbicides labeled for this use.

Escort® XP Herbicide 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 Herbicide 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 Herbicide is applied just before weed emergence until shortly after weed emergence.

Tank Mix Combinations—

Tank mix 1/2 ounce of Escort® XP Herbicide with 4 to 6 pints of Velpar® L [VU] Herbicide as directed on the package label for "RELEASE—HERBACEOUS WEED CONTROL" in pine plantations in the eastern U.S. Follow the Velpar® L [VU] Herbicide label directions regarding altering the application rate by soil texture.

IMPORTANT PRECAUTIONS—HARDWOOD PLANTATIONS ONLY

- Application of Velpar® L [VU] Herbicide and Escort® XP Herbicide 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 Herbicide 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.

PASTURE, RANGELAND, AND CONSERVATION RESERVE PROGRAM (CRP)

Escort® XP Herbicide is registered for the control of broadleaf weeds, brush and several woody vine species in the establishment, maintenance, and restoration of pasture, rangeland, and Conservation Reserve Program (CRP).

Escort® XP Herbicide may be tank mixed with other pesticides labeled for use in pasture, rangeland, and CRP. Read and follow the labels on all products used in the tank mix. Observe the most restrictive precautions on each of the product's labels. Application of Escort® XP Herbicide to pasture, rangeland and CRP may be made by ground or air. Use a sufficient volume of water to ensure thorough coverage of the targeted weeds with the equipment being used. In Idaho, Oregon and Washington use a minimum application volume of 3 gallons of spray solution per acre.

APPLICATION INFORMATION FOR GRASS ESTABLISHMENT IN PASTURE, RANGELAND, AND CONSERVATION RESERVE PROGRAM (CRP)

Escort® XP Herbicide is registered for the control or suppression of broadleaf weeds to aid in the establishment of the following perennial native or improved grasses planted in pasture, rangeland, and acres enrolled in the Conservation Reserve Program (CRP):

Blue Gramma	Sideoats gramma
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 of other government agencies or local experts concerning planting techniques and other cultural practices. Performance from Escort® XP Herbicide 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 in Pasture, Rangeland and CRP Preplant (prior to planting) or Preemergence (after planting but before grass emergence)

Do not use more than 1/10 ounce/acre of Escort® XP Herbicide for grass establishment in pasture, rangeland, and CRP. Apply Escort® XP Herbicide at 1/10 ounce/acre on all labeled grasses except orchardgrass and Russian wildrye grass. Do not apply Escort® XP Herbicide preplant or preemergence to orchardgrass and Russian wildrye grass as severe crop injury may result.

Early postemergence to new plantings

Apply Escort® XP Herbicide at 1/10 ounce/acre, plus a non-ionic surfactant at the rate of 2 to 4 pints/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 Escort® XP Herbicide at 1/10 ounce/acre plus a non-ionic surfactant at the rate of 2 to 4 pints/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 IN PASTURE, RANGELAND, AND CONSERVATION RESERVE PROGRAM (CRP)

Use Rates for Established Grasses in Pasture, Rangeland, and CRP

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

Refer to the Weeds Controlled section of the section 3 label for a listing of the weeds controlled by Escort® XP Herbicide and the appropriate use rate to obtain control.

Application Timing – Established Grasses in Pasture, Rangeland, and CRP

Escort® XP Herbicide 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:

Grass	Minimum time from Grass establishment Escort® XP Herbicide application
Bermudagrass	2 months
Bluegrass, bromegrass, Orchardgrass	6 months
Timothy	12 months
Fescue	24 months

Rotation Intervals in Pasture, Rangeland, and CRP for Overseeding and Renovation

Location	Crop or Grass Species	Maximum Escort® XP Herbicide Rate on Pasture, Rangeland, and CRP (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

(continued)

Rotation Intervals in Pasture, Rangeland, and CRP for Overseeding and Renovation (continued)

Location	Crop or Grass Species	Maximum Escort® XP Herbicide Rate on Pasture, Rangeland, and CRP (oz per A)	Minimum Rotation Interval (months)
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
	Alkali sacaton, mountain brome, blue grama, thickspike wheatgrass	1/10 to 1	1
	Sideoats grama, switchgrass	1/10 to 1/2	2
ALL AREAS WITH SOIL PH OF 7.9 OR LESS	Western wheatgrass	1/10 to 1	2
	Sideoats grama, switchgrass, big bluestem	1/10 to 1	3

Fescue Precautions:

Note that Escort® XP Herbicide may temporarily stunt tall fescue, cause it to turn yellow, or cause seedhead suppression. To minimize these symptoms, take the following precautions:

- Do not use more than 4/10 ounce/acre of Escort® XP Herbicide.
- Tank mix Escort® XP Herbicide with 2,4-D.
- Use the lowest specified rate for target weeds.
- Use a non-ionic surfactant at 1/2 to 1 pint per 100 gallons of spray solution.
- Make application later in the spring after the new growth is 5 to 6 inches tall, or in the fall.
- Do not use surfactant when liquid nitrogen is used as a carrier.
- Do not use a spray adjuvant other than non-ionic surfactant.

The first cutting yields may be reduced due to seedhead suppression resulting from treatment with Escort® XP Herbicide.

Timothy Precautions:

Timothy should be at least 6 inches tall at application and be actively growing. Applications of Escort® XP Herbicide to timothy under any other conditions may cause crop yellowing and/or stunting. To minimize these symptoms, take the following precautions:

- Do not use more than 4/10 ounce/acre Escort® XP Herbicide.
- Tank mix Escort® XP Herbicide with 2, 4-D.
- Use the lowest specified rate for target weeds.
- Use a non-ionic surfactant at 1/2 pint per 100 gallons of spray solution (1/16%).
- Make applications in the late summer or fall.
- Do not use surfactant when liquid nitrogen is used as a carrier.
- Do not use spray adjuvant other than non-ionic surfactant.

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

Other Pasture and Rangeland Grasses

Varieties and species of forage grasses differ in their tolerance to herbicides. When using Escort® XP Herbicide on a particular grass for the first time, limit use to a small area. If 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 Herbicide and will be severely stunted or injured by Escort® XP Herbicide.

SPOT TREATMENTS

Escort® XP Herbicide may be used for use as spot treatment to control noxious and troublesome weeds on pasture, rangeland and CRP.

Application Information

Escort® XP Herbicide may be used to control many species of weeds, including noxious weeds, in forage grasses growing on pasture, rangeland, and CRP. Refer to the "Weeds Controlled" section of the package label or supplemental labeling for a listing of susceptible weed species. If the sprayer is calibrated, consult the package label or other supplemental labeling to select the application rate per acre of Escort® XP Herbicide appropriate for the target weeds. Or mix one gram of Escort® XP Herbicide per one gallon of water along with a suitable surfactant. Spray to the point of wetting the entire surface of the target weeds, approximately 40 gallons of solution per acre. When applied in this manner there is no grazing restrictions following the use of Escort® XP Herbicide. Applications may be made at anytime of the year, except when the soil is frozen.

CROP ROTATION

Before using Escort® XP Herbicide, carefully consider your crop rotation plans and options. For rotational flexibility, do not treat all of your pasture, rangeland or CRP acres at the same time.

Minimum Rotational Intervals

Minimum rotation intervals* are determined by the rate of breakdown of Escort® XP Herbicide applied. Escort® XP Herbicide 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 Herbicide breakdown in soil, while high soil pH, low soil temperature, and low soil moisture slow Escort® XP Herbicide 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, soil temperatures and soil moisture should be monitored regularly when considering 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 Herbicide should 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 Herbicide 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 Herbicide.

Checking Soil pH

Before using Escort® XP Herbicide, 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 Herbicide. 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 Bayer CropScience LP representative for information detailing the field bioassay procedure.

GRAZING/HAYING

When used as directed, there is no grazing or haying restriction for use rates of 1 2/3 ounces per acre and less. Coveralls, shoes plus socks must be worn if cutting within 4 hours of treatment.

IMPORTANT PRECAUTIONS

- Do not apply more than 1 2/3 ounces of Escort® XP Herbicide per acre per year on pasture, rangeland or CRP.
- Grass species or varieties may differ in their response to various herbicides. Bayer CropScience LP recommends that you first consult your state experiment station, university, or extension agent as to sensitivity to any herbicide. If no information is available, limit the initial use of Escort® XP Herbicide to a small area. Components in a grass seed mixture will vary in tolerance to Escort® XP Herbicide 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 Herbicide application, temporary discoloration and/or grass injury may occur. Escort® XP Herbicide should not be applied to grass that is stressed by severe weather conditions, drought, low fertility, water-saturated soils, disease, or insect damage as grass injury may result. Severe winter stress, drought, disease, or insect damage before or following application also may result in grass injury.
- Applications of Escort® XP Herbicide to pasture, rangeland, and CRP 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 Herbicide.
- Applications made to some established grasses may cause temporary stunting, yellowing or seedhead suppression (i.e. fescue, timothy).
- Applications made to newly established grasses less than 2 years from seeding may result in injury or loss.
- Do not apply to forage grasses known to be sensitive to Escort® XP Herbicide such as ryegrass (Italian and perennial), bahia or Garrison's creeping foxtail.
- Broadleaf forage species, such as alfalfa and clover, are highly sensitive to Escort® XP Herbicide and will be severely injured or killed.
- 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 should improve weed control under these conditions.

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 Herbicide 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.

Escort® XP Herbicide 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 Herbicide 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) brome grasses (meadow), buffalograss, green sprangletop, indiangrass, 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 Herbicide 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
	Red clover, white clover, and sweet clover	1/10 to 2/10	12
	Bermudagrass, bluegrass, ryegrass	1/10 to 2/10	6
ALL STATES NOT INCLUDED ABOVE	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
	Russian wildrye	1/10 to 1/2	1
	Green needlegrass, switchgrass, sheep fescue	1/10 to 1	1
ALL AREAS WITH SOIL PH OF 7.5 OR LESS	Meadow brome, smooth brome, alta fescue, red fescue, meadow foxtail, orchardgrass, Russian wildrye, timothy	1/10 to 1	2

(continued)

Rotation Intervals for Overseeding and Renovation *(continued)*

Location	Crop or Grass Species	Maximum Escort® XP Herbicide Rate (oz per A)	Minimum Rotation Interval (months)
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 Escort® XP Herbicide at the rate of 1/10 ounce per acre for the control and suppression* of bur buttercup (testiculate), common purslane, common sunflower*, cutleaf eveningprimrose*, flixweed*, lambsquarters* (common and slimleaf), maretail*, 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 Herbicide to a small area. Components in a grass seed mixture will vary in tolerance to Escort® XP Herbicide, 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 Herbicide application, temporary discoloration and/or grass injury may occur. Injury may result when Escort® XP Herbicide 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 Herbicide 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
	1/2—1	2
Orchardgrass	1—2	4
	1/2—1	1
Russian wildrye	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
Gramma, Blue	1/2—2	1
Gramma, 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 Escort® XP Herbicide 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 Herbicide. If species other than those listed above are to be planted into areas treated with Escort® XP Herbicide, 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 Herbicide 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 – big	Switchgrass – blackwell
little	Wheatgrasses – bluebunch
plains	crested
sand	intermediate
VW spar	pubescent
Buffalograss	Siberian
Green sprangletop	slender
Kleingrass	steambank
Lovegrasses – atherstone	tall
sand	thickspike
weeping	Western
wilman	Wildrye grass – Russian
Orchardgrass	

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

Performance from Escort® XP Herbicide 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 Herbicide for grass establishment.

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

Early postemergence to new plantings

Apply Escort® XP Herbicide 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 Escort® XP Herbicide 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 Herbicide 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 Herbicide per acre per year.

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

Application Timing – Established Grasses

Escort® XP Herbicide 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:

Grass	Minimum time from Grass establishment Escort® XP Herbicide application	
	Escort® XP Herbicide application	Minimum time from Grass establishment
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 Herbicide 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 Herbicide applications.
- Apply Escort® XP Herbicide 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 Herbicide 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 Herbicide on a particular grass for the first time, limit use to a small area. If 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 Herbicide and will be severely stunted or injured by Escort® XP Herbicide.

CROP ROTATION

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

Minimum Rotational Intervals

Minimum rotation intervals* are determined by the rate of breakdown of Escort® XP Herbicide applied. Escort® XP Herbicide 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 Herbicide breakdown in soil, while high soil pH, low soil temperature, and low soil moisture slow Escort® XP Herbicide 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 Herbicide 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 Herbicide 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 Herbicide.

Checking Soil pH

Before using Escort® XP Herbicide, 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 Herbicide. 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 Bayer CropScience LP 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 Herbicide to a small area.

- Components in a grass seed mixture will vary in tolerance to Escort® XP Herbicide 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 Herbicide application, temporary discoloration and/or grass injury may occur. Escort® XP Herbicide 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 Herbicide 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 Herbicide.
- 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	Corn cockle
Aster	Cow cockle
Bahiagrass	Crown vetch
Beebalm	Dandelion
Bittercress	Dogfennel
Bitter sneezeweed	False chamomile
Blackeyed-susan	Fiddleneck tarweed
Blue mustard	Field pennycress
Bur buttercup	Flixweed
Chicory	Goldenrod
Clover	Lambsquarters
Cocklebur	Marestail/horseweed****
Common chickweed	Maximillion sunflower
Common groundsel	Miners lettuce
Common purslane	Pennsylvania smartweed
Common yarrow	Plains coreopsis
Conical catchfly	Plantain

(continued)

WEEDS CONTROLLED (continued)

1/3 to 1/2 ounce per acre

Redroot pigweed
Redstem filaree
Rough fleabane
Shepherd's purse
Silky crazyweed (locoweed)
Smallseed falseflax
Smooth pigweed
Sweet clover
Tansymustard

Treacle mustard
Tumble mustard
Wild carrot
Wild garlic
Wild lettuce
Wild mustard
Woody croton
Wood sorrel
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
Roserig 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 Escort® XP Herbicide and may be controlled with rates of 1/4 to 1/2 ounce per acre. Treatments of Escort® XP Herbicide may be applied from rosette through bloom stages of development.

**** Certain biotypes of mareetail/horsetail are less sensitive to Escort® XP Herbicide 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 Herbicide and herbicides with the same mode of action, the following tank mixes may be used.

Dicamba + 2,4-D

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

In addition to conventional spray equipment, Escort® XP Herbicide may also be applied with invert emulsion equipment. When using an invert emulsion, mix the prescribed rate of Escort® XP Herbicide 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 Escort® XP Herbicide (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 Herbicide 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 Herbicide 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 Herbicide 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 Herbicide 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 Herbicide is applied to turfgrass that is under stress from drought, insects, disease, cold temperatures (winter injury) or poor fertility.
- Escort® XP Herbicide is not recommended for use on bahiagrass.

BRUSH CONTROL

Application Information

Escort® XP Herbicide 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 Herbicide 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	Broadcast
	Rate (ounces/100 gallon)	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 (Holodiscus)	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 (Ailanthus)	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 Escort® XP Herbicide per 100 gallons of spray solution.

Application Timing

Make a foliar application of the specified rate of Escort® XP Herbicide 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 Herbicide 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 Herbicide 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 Herbicide 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 Herbicide 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 Herbicide, 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 Herbicide 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, rebud, 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 Escort® XP Herbicide by mixing 1 ounce per gallon of water. Mix vigorously until the Escort® XP Herbicide 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 Herbicide 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 Herbicide can kill or severely injure most crops. Following an Escort® XP Herbicide application, the use of spray equipment to apply other pesticides to crops on which Escort® XP Herbicide 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 Herbicide.
3. Continue agitation until the Escort® XP Herbicide is fully dispersed, at least 5 minutes.
4. Once the Escort® XP Herbicide is fully dispersed, maintain agitation and continue filling tank with water. Escort® XP Herbicide 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 Herbicide spray preparations are stable if they are pH neutral or alkaline and stored at or below 100° F.
8. If Escort® XP Herbicide and a tank mix partner are to be applied in multiple loads, pre-slurry the Escort® XP Herbicide 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 Herbicide.

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 Herbicide may injure or kill most crops. Injury may be more severe when the crops are irrigated. Do not apply Escort® XP Herbicide 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 Herbicide.
- Do not treat frozen or snow covered soil.
- Leave treated soil undisturbed to reduce the potential for Escort® XP Herbicide 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 Escort® XP Herbicide 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 Herbicide 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 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 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.

STORAGE AND DISPOSAL *(continued)*

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 Escort® XP Herbicide 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 Escort® XP Herbicide 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 Bayer CropScience LP 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 Bayer CropScience LP 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 rinseate into application equipment or rinseate 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 rinseate 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 Bayer CropScience LP at 1-800-334-7577, day or night.

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Read the entire Directions for Use, Conditions, Disclaimer of Warranties and Limitations of Liability before using this product. If terms are not acceptable, return the unopened product container at once.

By using this product, user or buyer accepts the following Conditions, Disclaimer of Warranties and Limitations of Liability.

CONDITIONS: The directions for use of this product are believed to be adequate and must be followed carefully. However, it is impossible to eliminate all risks associated with the use of this product. Ineffectiveness, plant injury, other property damage, as well as other unintended consequences may result because of factors beyond the control of Bayer CropScience LP. Those factors include, but are not limited to, weather conditions, presence of other materials or the manner of use or application. All such risks shall be assumed by the user or buyer.

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For product information call: 1-800-331-2867

Produced for:
Bayer Environmental Science
A Division of Bayer CropScience LP
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Bayer

GROUP 2 HERBICIDE



Escort[®]
XP

HERBICIDE

Dry Flowable	
Active Ingredient	By Weight
Mesulfuron methyl	
Methyl 2-[[[4-methoxy-6-methyl-1,3,5-triazin-2-yl]amino]-carbonyl]amino/sulfonylbenzoate	60%
Other Ingredients	40%
TOTAL	100%
EPA Reg. No. 432-1549	EPA Est. No. 065604-AP-001
Nonrefillable Container	

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.)

Net Weight
1 Pound
84122394
A01796371 150622AV4

See inside leaflet for complete First Aid instructions, Precautionary Statements, Directions for Use and Storage and Disposal instructions.

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 relating to the standards 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

OPEN HERE

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 1-800-334-7577 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 affected from drift and run-off.

Produced for:
Bayer Environmental Science
A Division of Bayer CropScience LP
21 W. Alexander Drive
Research Triangle Park, NC 27709

Bayer

PROOF

THIS PROOF IS TO BE CHECKED FOR ACCURACY

Please review and approve **Text, Spelling, Copy Placement, Size, Shape, Colors and Deline.**







Authorized signature accepts responsibility for accuracy of all copy, color break and artwork. Cimarron Label is not liable for any discrepancies subsequently identified.

PLEASE NOTE: Due to color variance between printers/monitors, the colors represented by this proof cannot be deemed accurate. Please refer to a color matching system such as the Pantone Matching System for a truer representation of spot colors.

THIS PROOF IS NOT ACCURATE FOR COLOR-MATCH.
Deline does not print.



4201 North Westport Ave. • Sioux Falls, SD 57107
Phone: (605) 978-0451 • Fax: (605) 978-0463

DATE 8/25/15	JOB NUMBER 109798	CUSTOMER DUPONT USA/BAYER
LABEL SIZE 5.0" X 11.125"	BOOKLET SIZE 5.0" X 7.75"	TEMPLATE # #1423
LABEL COLORS  BLACK	BOOKLET COVER COLORS  BLACK  CYAN  MAG  YELLOW	BOOKLET INSIDE COLORS  BLACK
PATTERN VARNISH: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Front cover has .5" extended tab. Finish size is 5.0" x 8.25"		

Form: CS 006B - 11/8/2011

☐ **ARTWORK IS APPROVED** ☐ **REVISED PROOF NEEDED**

WE CANNOT PROCESS

THIS ORDER WITHOUT AN

AUTHORIZED SIGNATURE **Signed** _____ **Date** _____

**1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION****Product Name:** Polaris® Herbicide**EPA Reg. No.:** 228-534**Product Type:** Herbicide**Company Name:** Nufarm Americas Inc.
11901 S. Austin Avenue
Alsip, IL 60803
1-800-345-3330**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

This product is an EPA FIFRA registered pesticide. Some classifications on this SDS are not exactly the same as on the FIFRA label. Certain sections are superseded by federal law governed by EPA for a registered pesticide. Please see Section 15. REGULATORY INFORMATION for explanation.

2. HAZARDS IDENTIFICATION**PHYSICAL HAZARDS:**

Not hazardous

HEALTH HAZARDS:

Not hazardous

ENVIRONMENTAL HAZARDS:

Not hazardous

SIGNAL WORD:

None Required

HAZARD STATEMENTS:

Not hazardous in accordance with 29CFR 1910.1200 (Hazcom 2012)

PRECAUTIONARY STATEMENTS

Use with appropriate protective equipment.

3. COMPOSITION / INFORMATION ON INGREDIENTS**COMPONENTS**

Isopropylamine Salt of Imazapyr

Other Ingredients

CAS NO.

81510-83-0

Trade Secret

% BY WEIGHT

22 – 23.3

Trade Secret

Synonyms: 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid

Ingredients not precisely identified are proprietary or non-hazardous. Values are not product specifications.

4. FIRST AID MEASURES**If Inhaled:** Move person to fresh air. Seek medical attention if symptoms develop.**If in Eyes:** Hold eye open and rinse slowly and gently with water for sever minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Seek medical attention if irritation persists.**If on Skin or Clothing:** Take off contaminated clothing. Rinse skin immediately with plenty of water. Seek medical attention if irritation persists.**If Swallowed:** 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. Seek medical attention if symptoms develop.**Most Important symptoms/effects, acute and delayed:** None expected.

Indication of Immediate medical attention and special treatment if needed: Immediate medical attention is not generally required. For ingestion there is no specific antidote available. Treat symptomatically.

5. FIRE FIGHTING MEASURES

Extinguishing Media: Use media that is suitable for the surrounding fire.

Special Fire Fighting Procedures: Firefighters should wear NIOSH 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: This product is not flammable or combustible. 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.

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. Absorb residues with an inert material and place in a suitable container 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:

Avoid contact with skin, eyes, or clothing. Avoid breathing spray mist. 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.

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: To avoid contact with eyes, wear chemical goggles or shielded safety glasses. **Skin Protection:** To avoid contact with skin wear long-sleeved shirt and long pants, shoes plus socks, chemical-resistant gloves made of any waterproof material. Washing facilities 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.

SAFETY DATA SHEET

Polaris® Herbicide

Exposure Guidelines:

Component	OSHA		ACGIH		Unit
	TWA	STEL	TWA	STEL	
Imazapyr	NE	NE	NE	NE	
Other Ingredients	NE	NE	NE	NE	

NE = Not Established

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Blue liquid
Odor:	Faint ammonia like
Odor threshold:	No data available
pH:	6.26 (1% w/w dilution in DIW)
Melting point:	No data available
Initial boiling point and boiling range	No data available
Flash point:	>212° F (>100° C)
Evaporation rate:	No data available
Flammability (solid, gas):	No data available
Upper/lower flammability or explosive limits:	No data available
Vapor pressure:	No data available
Vapor density:	No data available
Relative density:	1.057 g/mL @ 20° C
Solubility(ies):	No data available
Partition coefficient: n-octanol/water:	No data available
Autoignition temperature:	No data available
Decomposition temperature:	No data available
Viscosity:	3.766 cSt @20° C; 1.988 cSt @ 40° C
VOC Emission Potential (%):	-0.13 (TGA)

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

Reactivity: Not reactive.

Chemical Stability: This material is stable under normal handling and storage conditions.

Possibility of Hazardous Reactions: Will not occur

Conditions to Avoid: Excessive heat. Do not store near heat or flame. Do not mix or store this product or solutions of this product in unlined steel containers

Incompatible Materials: Strong oxidizing agents: bases and acids.

Hazardous Decomposition Products: Under fire conditions may produce gases such as oxides of carbon, hydrogen and nitrogen.

11. TOXICOLOGICAL INFORMATION

Likely Routes of Exposure: Eye contact, Skin contact

Eye Contact: Minimally irritating. May cause irritation, redness and tearing.

Skin Contact: Slightly toxic and no more than mildly irritating based on toxicity studies.

Ingestion: Low toxicity based on toxicity studies.

Inhalation: Low toxicity based on toxicity studies.

Delayed, immediate and chronic effects of exposure: None expected.

Toxicological Data:

Data from laboratory studies conducted on Imazapyr Technical:

Oral: Rat LD₅₀: >5,000 mg/kg

Dermal: Rabbit LD₅₀: >5,000 mg/kg

Inhalation: Rat 4-hr LC₅₀: >2.07 mg/l (no mortalities highest dose attainable)

Eye Irritation: Rabbit: Minimally irritating (MMTS= 6.0)

Skin Irritation: Rabbit: Slightly irritating (PDII=0.8)

Skin Sensitization: Not a contact sensitizer in guinea pigs following repeated skin exposure.

Subchronic (Target Organ) Effects: For imazapyr, 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 with imazapyr gave no indication of a fertility impairing effect.

Developmental Toxicity: No indications of a developmental toxic / teratogenic effect were seen in animal studies with imazapyr.

Genotoxicity: For imazapyr, no mutagenic effect was found in various tests with microorganisms and mammals.

Assessment Carcinogenicity: None listed with ACGIH, IARC, NTP or OSHA.

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
14-day EC ₅₀ Duckweed:	0.024 mg/l	Mallard Duck Oral LD ₅₀ :	>2,150 mg/kg
7-day EC ₅₀ Green Algae:	71 mg/l	Honey Bee LD ₅₀ :	>100 mg/bee

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:

Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

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.

14. TRANSPORTATION INFORMATION

Follow the precautions indicated in Section 7: HANDLING AND STORAGE of this SDS.

DOT

Not Regulated

IMDG

Not Regulated

IATA

Not Regulated

15. REGULATORY INFORMATION

EPA FIFRA INFORMATION

This chemical is a pesticide product registered by the United States Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets (SDS), and for workplace labels of non-pesticide chemicals. The hazard information required on the pesticide label is reproduced below. The pesticide label also includes other important information, including directions for use.

CAUTION. No human or domestic animal hazard statements are required. Follow instructions for Personal Protective Equipment and User Safety Recommendations.

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):

Not hazardous

Section 313 Toxic Chemical(s):

None

Reportable Quantity (RQ) under U.S. CERCLA:

None

RCRA Waste Code:

Under RCRA, it is the responsibility of the product user to determine at the time of disposal, whether a material containing the product or derived from the product should be classified as a hazardous waste.

State Information:

Other state regulations may apply. Check individual state requirements.

California Proposition 65: Not Listed.

16. OTHER INFORMATION**National Fire Protection Association (NFPA) Hazard Rating:****Rating for this product: Health: 1 Flammability: 0 Reactivity: 0**

Hazards Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

This Safety Data Sheet (SDS) serves different purposes than and DOES NOT REPLACE OR MODIFY THE EPA-ACCEPTED PRODUCT LABELING (attached to and accompanying the product container). This SDS 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 AND ALL SUCH WARRANTIES ARE HEREBY SPECIFICALLY DISCLAIMED.

Date of Issue: April 12, 2015**Supersedes:** October 16, 2013

Polaris is a registered trademark of Nufarm Americas Inc.

GROUP 2 HERBICIDE

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 label with you when calling a poison control center or doctor or going for treatment.

In the State of New York, Aquatic Uses are Not Allowed.

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 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.
11901 S. Austin Avenue
Alsip, IL 60803



**PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION / PRECAUTION**

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.

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.

RESTRICTIONS

DO NOT use on food or feed crops.

DO NOT apply this product within 0.5 miles upstream of an active potable water intake in flowing water (i.e. river, stream, etc.) or within 0.5 miles of an active potable water intake in a standing body of water, such as a lake, pond or reservoir.

DO NOT apply to water used for irrigation except as described in USE PRECAUTIONS AND RESTRICTIONS section of this label.

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.

Noncropland Sites

- DO NOT apply more than 1.5 pounds acid equivalent Imazapyr (equivalent to 6 pints) per acre per year.

Pasture/Rangeland Sites

- DO NOT apply more than 0.75 pound acid equivalent Imazapyr (equivalent to 3 pints) per acre per year.
- DO NOT treat more than 1 /10 of the available area to be grazed or cut for hay.
- For spot treatment only.

Aquatic Sites

- DO NOT apply more than 1.5 pounds acid equivalent Imazapyr (equivalent to 6 pints) per acre per year.

Aerial application - Aerial application to aquatic sites is restricted to helicopter only.

Irrigation water - Application to water used for irrigation that results in residues greater than 1.0 part per billion (ppb) MUST NOT be used for irrigation purposes for 120 days after application or until residue levels of this product are determined by laboratory analysis or other appropriate means of analysis to be 1.0 ppb or less. When applications are made within 500 feet of an active irrigation intake, DO NOT irrigate for at least 24 hours following application to allow for dissipation.

Restrictions for potable water intakes. DO NOT apply this product directly to water within 0.5 miles upstream of an active potable water intake in flowing water (i.e. river, stream, etc.) or within 0.5 miles 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 0.5 miles 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 that 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 that 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.

PRECAUTIONS

Applications may be made for the control of undesirable vegetation growing within specified aquatic, pasture/rangeland, industrial noncropland sites, and railroad, utility, and highway rights-of-way, fence rows and other noncropland sites as listed on the label. Aquatic sites consist of standing and flowing water, estuarine/marine, wet-land and riparian areas. Industrial noncropland sites include utility plant sites, petroleum tank farms, pumping installations, fence rows, storage areas, and nonirrigation ditchbanks. 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, for use under certain paved surfaces and other locations specified on this label.

Aquatic Sites

Permitting - 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.

Public waters - Application of this product to water 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.

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.

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.

Quiescent or Slow-moving Waters. In lakes and reservoirs, DO NOT apply this product within 1 mile of an active irrigation water intake during the irrigation season. Applications less than 1 mile from an active irrigation water intake may be made during the off-season, provided that the irrigation intake will remain inactive for a minimum of 120 days after application or until residue levels of this product are determined by laboratory analysis or other appropriate means of analysis to be 1.0 ppb or less.

PRODUCT INFORMATION

This product is an aqueous solution to be mixed with water and a surfactant and applied as a spray solution to control undesirable vegetation growing within specified aquatic, pasture/rangeland, industrial noncropland sites, and railroad, utility, and highway rights-of-way, and fence rows. Aquatic sites consist of standing and flowing water, estuarine/marine, wetland, and riparian areas. Industrial noncropland sites include utility plant sites, petroleum tank farms, pumping installations, fence rows, storage areas, and nonirrigation ditchbanks. 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, for use under certain paved surfaces and other locations specified on this label.

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 may 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 aircraft (aerial applications to aquatic sites must be made 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 must 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 1.5 pounds acid equivalent Imazapyr (equivalent to 6 pints) per acre 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).

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.

RESTRICTION: 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 can 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 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 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 1.5 pounds acid equivalent Imazapyr (equivalent to 6 pints) per acre per year. 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 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 1.5 pounds acid equivalent Imazapyr (equivalent to 6 pints) per acre per year in aquatic and non-cropland sites and 0.75 pounds acid equivalent Imazapyr (equivalent to 3 pints) per acre per year 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.

BASAL APPLICATION

This product is an aqueous formulation that requires mixing with **basal oil containing at least 15% emulsifier or will require the addition of an emulsifier, for application to the basal area** of brush and trees to control undesirable vegetation in the following noncropland areas: access roads; airfields; airports; along forest roads; around commercial or industrial structures or outbuildings; around farm and ranch structures and outbuildings; bare ground; construction sites; ditch banks; 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; natural areas; paved areas; petroleum & other tank farms; pumping installations; pipeline, power, telephone & utility rights-of-way; power stations; railroad rights-of way; refineries; resorts; storage areas; substations; uncropped farmstead areas; uncultivated non-agricultural areas; vacant lots; walkways; wastelands; & wildlife habitat areas.

Thinline Basal and Stem Application

- This product may be applied as a thinline basal or arcing application to the stems of susceptible species such as big leaf maple (*Acer macrophyllum*), willow (*Salix* spp.) and Eucalyptus (*Eucalyptus* spp.) with a stem ground line diameter of 3 inches or less. Mix 24 to 48 ounces of this product in one gallon of **basal oil containing at least 15% emulsifier**. Maintain uniform mixtures with frequent agitation. Direct a thin line of the spray solution to the stems beginning a few feet from the ground and descending toward the base of the tree making a zig-zag motion. Do not over apply causing puddling.

Low Volume Basal Bark Treatments

- This product, at the rate of 8 to 12 ounces per gallon, may be applied for low volume basal bark treatments. This product at 3.0 to 5.0% is recommended to be tank mixed with Relegate™ or Garlon® 4 or other basal products to broaden the spectrum of control. Consult the herbicide labels for rates and susceptible brush species. Mixing with basal requires compatibility tests prior to mixing large quantities. Mixing aids (such as emulsifiers, etc.) and ongoing agitation are required to attain a homogenous tank mix.
- Basal application should be made to the lower 12" to 18" of the target brush and go to the soil. Care should be taken to not puddle or over treat the stem. Basal application is best suited for low density brush sites, where stems do not exceed 700 stems per acre.

For Basal Application – It is advisory to mix only the intended amount of mixture that is to be sprayed that day. Adequate agitation must be maintained with all emulsion mixtures to prevent phase separation. Prior to tank mixing with other products, herbicides and oils, you must determine the compatibility of the proposed mixture (See **COMPATIBILITY** section).

SPRAY SOLUTION MIXING GUIDE FOR BASAL BARK APPLICATIONS						
AMOUNT OF SPRAY SOLUTION BEING PREPARED	NUFARM POLARIS		NUFARM POLARIS WHEN TANK MIXING		RELEGATE or GARLON 4	
	8.0 oz	12.0 oz.	3.0%	5.0%	15%	20%
1 Gallon	8.0 oz.	12.0 oz.	3.8 oz.	6.4 oz.	1.2 pts.	1.6 pts.
3 Gallons	1.5 pts.	2.25 pts.	11.5 oz.	1.2 pts.	1.8 qts.	2.4 qts.
4 Gallons	1.0 qt.	1.5 qts.	15.4 oz.	1.6 pts.	2.4 qts.	3.2 qts.
5 Gallons	1.25 qts.	1.0 qt. + 28.0 oz.	1.2 pts.	1.0 qt.	3.0 qts.	1.0 gal.
50 Gallons	3.0 gals. + 1.0 pt.	4.0 gals. + 2.75 qts.	1.5 gals.	2.5 gals.	7.5 gals.	10.0 gals.
100 Gallons	6.0 gals. + 1.0 qt.	9.0 gals. + 1.5 qts.	3.0 gals.	5.0 gals.	15.0 gals.	20.0 gals.
16 ounces = 1 pint : 2 pints = 1 quart : 4 quarts = 1 gallon						

COMPATIBILITY

Before full-scale mixing of this product with other pesticides, emulsifiers, fertilizers, surfactants or oils, determine the compatibility of the proposed mixture. Use proportionate quantities of each ingredient and mix in a small container. Always mix one product thoroughly with the diluent before adding another product. If no incompatibility is evident after 30 minutes, the mixture is generally compatible for spraying. To evaluate potential short term effects of applying the mixture, test the tank mix combination on a few plants or a small area before larger-scale treatments. Wait at least 2 to 3 days for problems to become apparent.

IMPORTANT: MIXING WITH OTHER SUBSTANCES MAY INCREASE THE RISK OF MIXING INCOMPATIBILITIES, REDUCED EFFECTIVENESS AND/OR CAUSE CROP INJURY OR LOSS. ANY LIABILITY FOR LOSS, INJURY OR DAMAGE RESULTING FROM A MIXTURE NOT SPECIFIED ON THIS LABEL OR IN MANUFACTURER'S SUPPLEMENTAL LABELING DISTRIBUTED FOR THIS PRODUCT IS SPECIFICALLY DISCLAIMED BY MANUFACTURER.

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; 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 sale 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® or AquaNeat® 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 BAHAGRASS 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 fluid ounce 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 fluid ounces per acre when the Bermudagrass is dormant. Apply this product at 6 to 8 fluid ounces 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 fluid ounces per acre plus Roundup® or Razor® at 12 fluid ounces 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 fluid ounces 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 (*Galium spp.*)

Bishopweed (*Ptilimnium capillaceum*)

Buttercup (*Ranunculus parviflorus*)

Carolina geranium (*Geranium carolinianum*)

Fescue (*Festuca spp.*)

Foxtail (*Setaria spp.*)

Little barley (*Hordeum pusillum*)

Seedling Johnsongrass (*Sorghum*

halepense)

Wild carrot (*Daucus carota*)

White clover (*Trifolium repens*)

Yellow woodsorrel (*Oxalis stricta*)

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 fluid ounces 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 fluid ounces per acre plus 0.25% nonionic surfactant. For increased suppression, this product may be tank-mixed with such products as Campaign® (24 fluid ounces per acre) or Embark® (8 fluid ounces 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 preemergence 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 preemergence or postemergence applications of this product. For established biennials and perennials postemergence 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 must 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.

TERRESTRIAL WEEDS CONTROLLED		
COMMON NAME	SCIENTIFIC NAME	GROWTH HABIT ²
GRASS WEEDS		
Apply 2 to 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>Lotium multiflorum</i>	A
Johnsongrass ⁴	<i>Sorghum halepense</i>	P
Kentucky bluegrass	<i>Poa pratensis</i>	P
Napier grass ⁵	<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
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

(continued)

TERRESTRIAL WEEDS CONTROLLED (continued)		
COMMON NAME	SCIENTIFIC NAME	GROWTH HABIT ²
GRASS WEEDS (continued)		
Apply 3 to 4 pints per acre¹		
Barnyardgrass	<i>Echinochloa crus-galli</i>	A
Beardgrass	<i>Andropogon</i> spp.	P
Bluegrass, annual	<i>Poa annua</i>	A
Bulrush ⁵	<i>Scirpus validus</i>	P
Cheat	<i>Bromus secalinus</i>	A
Cogongrass	<i>Imperata cylindrica</i>	P
Crabgrass	<i>Digitaria</i> spp.	A
Crowfootgrass	<i>Dactyloctenium aegyptium</i>	A
Fall panicum	<i>Panicum dichotomiflorum</i>	A
Goosegrass	<i>Eleusine indica</i>	A
Itch grass	<i>Rottboellia exaltata</i>	A
Lovegrass ⁴	<i>Eragrostis</i> spp.	P
Maidencane ⁵	<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
Sandbur, field	<i>Cenchrus incertus</i>	A
Signalgrass	<i>Brachiaria platyphylla</i>	A
Wild barley	<i>Hordeum</i> spp.	A
Woolly cupgrass	<i>Eriochloa villosa</i>	A

(continued)

TERRESTRIAL WEEDS CONTROLLED (continued)		
COMMON NAME	SCIENTIFIC NAME	GROWTH HABIT ²
GRASS WEEDS (continued)		
Apply 4 to 6 pints per acre¹		
Bahiagrass	<i>Paspalum notatum</i>	P
Bermudagrass ^{3,4}	<i>Cynodon dactylon</i>	P
Big bluestem	<i>Andropogon gerardii</i>	P
Dallisgrass	<i>Paspalum dilatatum</i>	P
Feathertop	<i>Pennisetum villosum</i>	P
Guineagrass	<i>Panicum maximum</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
¹ Use higher rate where heavy or well-established infestations occur. ² Growth Habit: A = Annual, P = Perennial ³ Use a minimum of 75 GPA. ⁴ Use higher labeled rates. ⁵ Use not permitted in California unless otherwise directed by supplemental labeling.		

(continued)

TERRESTRIAL WEEDS CONTROLLED (continued)		
COMMON NAME	SCIENTIFIC NAME	GROWTH HABIT ²
BROADLEAF WEEDS		
Apply 2 to 3 pints per acre¹		
Burdock	<i>Arctium</i> spp.	B
Carolina geranium	<i>Geranium carolinianum</i>	A
Carpeweed	<i>Mollugo verticillata</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
Dogfennel	<i>Eupatorium capillifolium</i>	A
Filaree	<i>Erodium</i> spp.	A
Fleabane	<i>Erigeron</i> spp.	A
Hoary vervain	<i>Verbena stricta</i>	P
Indian mustard	<i>Brassica juncea</i>	A
Kochia	<i>Kochia scoparia</i>	A
Lambsquarters	<i>Chenopodium album</i>	A
Lespedeza ³	<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
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 saliva</i>	B
Wild turnip	<i>Brassica campestris</i>	B
Woollyleaf bursage	<i>Franseria tomentosa</i>	P
Yellow woodsorrel	<i>Oxalis stricta</i>	P

(continued)

TERRESTRIAL WEEDS CONTROLLED (continued)

COMMON NAME	SCIENTIFIC NAME	GROWTH HABIT ²
BROADLEAF WEEDS (continued)		
Apply 3 to 4 pints per acre¹		
Broom snakeweed	<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
Dock	<i>Rumex</i> spp.	P
Fiddleneck	<i>Amsinckia intermedia</i>	A
Goldenrod	<i>Solidago</i> spp.	P
Henbit	<i>Lamium amplexicaule</i>	A
Knotweed, prostrate	<i>Polygonum aviculare</i>	A/P
Pokeweed	<i>Phytolacca americana</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
Shepherdspurse	<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 to 6 pints per acre¹		
Arrowwood	<i>Pluchea sericea</i>	A
Canada thistle	<i>Cirsium arvense</i>	P
Giant ragweed	<i>Ambrosia trifida</i>	A
Gray 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
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>	P
Sowthistle	<i>Sonchus</i> spp.	A
Texas thistle	<i>Cirsium texanum</i>	P

¹ Use higher labeled rate where heavy or well-established infestations occur.

² Growth Habit: A = Annual, B = Biennial, P = Perennial

³ Use not permitted in California unless otherwise directed by supplemental labeling.

⁴ For best results, early postemergence applications are required.

(continued)

TERRESTRIAL WEEDS CONTROLLED (continued)

COMMON NAME	SCIENTIFIC NAME	GROWTH HABIT ²
VINES AND BRAMBLES		
Apply 1 pint per acre		
Field bindweed	<i>Convolvulus arvensis</i>	P
Hedge bindweed	<i>Calystegia sepium</i>	A
Apply 2 to 3 pints per acre¹		
Wild buckwheat	<i>Polygonum convolvulus</i>	P
Apply 3 to 4 pints per acre¹		
Greenbriar	<i>Smilax</i> spp.	P
Honeysuckle ³	<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 ³ Including: Multiflora rose Macartney rose	<i>Rosa</i> spp. <i>Rosa multiflora</i> <i>Rosa bracteata</i>	P P P
Apply 4 to 6 pints per acre¹		
Trumpet creeper	<i>Campsis radicans</i>	P
Virginia creeper	<i>Parthenocissus quinquefolia</i>	P
Wild grape	<i>Vitis</i> spp.	P

¹ Use higher labeled rate where heavy or well-established infestations occur.

² Growth Habit: A = Annual, B = Biennial, P = Perennial

³ Use higher labeled rate.

(continued)

TERRESTRIAL WEEDS CONTROLLED (continued)		
COMMON NAME	SCIENTIFIC NAME	GROWTH HABIT ²
BRUSH SPECIES		
Apply 2 to 4 pints per acre¹		
Brazilian peppertree	<i>Schinus terebinthifolius</i>	P
Chinese tallow tree Popcorn tree	<i>Sapium sebiferum</i>	P
Russian olive	<i>Elaeagnus angustifolia</i>	P
Sumac	<i>Rhus</i> spp.	P
Willow	<i>Salix</i> spp.	P
Apply 4 to 6 pints per acre¹		
Alder	<i>Alnus</i> spp.	P
American beech	<i>Fagus grandifolia</i>	P
Ash ³	<i>Fraxinus</i> spp.	P
Aspen	<i>Populus</i> spp.	P
Autumn olive	<i>Elaeagnus umbellata</i>	P
Bald cypress	<i>Taxodium distichum</i>	P
Bigleaf maple	<i>Acer macrophyllum</i>	P
Birch ³	<i>Betula</i> spp.	P
Black gum ⁴	<i>Nyssa sylvatica</i>	P
Black oak	<i>Quercus kelloggii</i>	P
Boxelder	<i>Acer negundo</i>	P
Ceanothis	<i>Ceanothis</i> spp.	P
Cherry ^{3, 4}	<i>Prunus</i> spp.	P
Chinaberry	<i>Melia azedarach</i>	P
Chinquapin	<i>Castanopsis chrysophylla</i>	P
Cottonwood	<i>Populus trichocarpa</i> <i>P. deltoides</i>	P
Cypress	<i>Taxodium</i> spp.	P
Dogwood ³	<i>Cornus</i> spp.	P
Elm	<i>Ulmus</i> spp.	P
Eucalyptus	<i>Eucalyptus</i> spp.	P
Hawthorn	<i>Crataegus</i> spp.	P
Hickory ³	<i>Carya</i> spp.	P
Huckleberry	<i>Gaylussacia</i> spp.	P
Lyonia spp. Including: Fetterbush Staggerbush	<i>Lyonia lucida</i> <i>Lyonia mariana</i>	P P
Madrone	<i>Arbutus menziesii</i>	P
Maple	<i>Acer</i> spp.	P
Melaleuca	<i>Melaleuca quinquenervia</i>	P
Mulberry ^{3, 6}	<i>Morus</i> spp.	P

(continued)

TERRESTRIAL WEEDS CONTROLLED (continued)		
COMMON NAME	SCIENTIFIC NAME	GROWTH HABIT ²
BRUSH SPECIES (continued)		
Apply 4 to 6 pints per acre¹ (continued)		
Oak ⁷	<i>Quercus</i> spp.	P
Persimmon ⁴	<i>Diospyros virginiana</i>	P
Poison oak	<i>Rhus diversiloba</i>	P
Poplar	<i>Populus</i> spp.	P
Privet	<i>Ligustrum vulgare</i>	P
Red alder	<i>Alnus rubra</i>	P
Red maple	<i>Acer rubrum</i>	P
Saltcedar	<i>Tamarix pentandra</i>	P
Sassafras	<i>Sassafras albidum</i>	P
Sourwood ⁴	<i>Oxydendrum arboreum</i>	P
Sweetgum	<i>Liquidambar styraciflua</i>	P
Sycamore	<i>Platanus occidentalis</i>	P
Tanoak ³	<i>Lithocarpus densiflorus</i>	P
Titi ⁸	<i>Cyrilla racemiflora</i>	P
Tree of heaven	<i>Ailanthus altissima</i>	P
Vaccinium spp. Including: Blueberry Sparkleberry	<i>Vaccinium</i> spp. <i>Vaccinium arboreum</i>	P P
Water willow ⁹	<i>Justicia americana</i>	P
Yellow poplar ³	<i>Liriodendron tulipifera</i>	P

¹ Use higher labeled rate where heavy or well-established infestations occur.
² Growth Habit: A = Annual, B = Biennial, P = Perennial
³ Use higher labeled rate.
⁴ Best control with applications before formation of fall leaf color.
⁵ Tank mix with glyphosate.
⁶ Degree of control may be species dependent.
⁷ For water oak (*Quercus nigra*) laurel oak (*Quercus lauriflora*) willow oak (*Quercus phellos*) and live oak (*Quercus virginiana*) use higher labeled rates.
⁸ Suppression only.
⁹ Use not permitted in California unless otherwise directed by supplemental labeling.

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 1.5 pounds acid equivalent Imazapyr (equivalent to 6 pints) 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 1.5 pounds acid equivalent Imazapyr (equivalent to 6 pints) per acre per year. Not for aquatic use sites in the states of Massachusetts and New York.

COMMON NAME	SCIENTIFIC NAME	USE RATES AND APPLICATION DIRECTIONS
Floating Species		
*Floating heart	<i>Nymphodes</i> spp.	2-4 pints/acre (0.5% to 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.
*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.

*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
Emergent Species (continued)		
*Parrot feather	<i>Myriophyllum aquaticum</i>	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 chestnut	<i>Trappa natans</i>	2-4 pints/acre (0.5 to 1% solution) applied in 100 GPA water mix. Ensure 100% 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.
Terrestrial/Marginal		
*Aquatic nightshade Soda apple	<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.
*Beach, vitex	<i>Vitex rotundifolia</i>	5% solution + 1% MSO foliar spray / 17% solution stem injection (hack and squirt)
Brazilian pepper; Christmasberry	<i>Schinus terebinthifolius</i>	2-4 pints/acre applied to foliage
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
Cogongrass	<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 umbellatus</i> L.	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	<i>Polygonum cuspidatum</i>	3-4 pints/acre applied postemergence to actively growing 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 <i>(continued)</i>		
Melaleuca; Paperbark Tree	<i>Melaleuca quinquenervia</i>	<p>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.</p> <p>For ground foliar application, uniformly apply to ensure 100% coverage.</p> <p>For broadcast foliar control, apply aerially in a minimum of two passes at 10 gallons/acre applied cross treatment.</p> <p>For spot treatment, use a 25% this product + 25% solution of + glyphosate + 1.25% MSO in water applied as a frill or stump treatment.</p>
*Nutgrass; Kili'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
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:

NOTE: This product is available in multiple containers. Refer to the Net Contents section of this products labeling for the applicable "Nonrefillable" or "Refillable" designation. Follow the container disposal [handling] instructions below that apply to your container type / size.

[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.

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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.

(RV022614-1)

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SECTION 1: Product and Company Identification

1.1. Product identifier

Trade name : CAMBISTAT
Product code : EPA Reg. No. 74779-3

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.2.1. Relevant identified uses

Use of the substance/preparation : Plant Growth Regulator

1.2.2. Uses advised against

No data available

1.3. Details of the supplier of the safety data sheet

Rainbow Treecare Scientific Advancements
11571 K-Tel Drive
Minnetonka, MN 55343
Phone: 1-(877) 272-6747 (toll free)
www.treecarescience.com

1.4. Emergency telephone number

Emergency number : (800)-424-9300 (CHEMTREC)

SECTION 2: Hazards identification

Hazard Symbols :



Signal word : WARNING

Hazard statements (health) : Harmful if swallowed, absorbed through the skin or inhaled.

Precautionary statements : Avoid contact with skin, eyes, or clothing.
Avoid breathing spray mist.

Hazard statements (environmental) : Do not apply directly to water, 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 wash water or rinsate.

Hazard statements (physical/chemical) : Do not store near heat or open flame.

SECTION 3: Composition/information on ingredients

Chemical Name	CAS Number	%/wt.
Paclobutrazol	76738-62-0	22.3

Ingredients not precisely identified are proprietary or non-hazardous.

SECTION 4: First aid measures

4.1. Description of first aid measures

IF SWALLOWED

: Call physician or Poison Control Center immediately for treatment advice. Have the person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by a Poison Control Center or a physician. Do not give anything by mouth to an unconscious person.

IF INHALED

: Move 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 treatment advice.

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 physician for 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 poison control center or doctor for 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 the National Poison Control Hotline at 1-800-222-1222 for emergency medical treatment information 24 hours a day, seven days a week.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Dry chemical, foam, or CO₂ extinguishing media.

5.2. Special hazards arising from the substance or mixture

Specific Hazards : This product will burn with flames if ignited. This product has a minimum ignition energy between 100 and 300 millijoules. Mechanical sparks, open flames, and certain hot surfaces can serve as ignition sources for this material. Eliminate the presence of mechanical sparks and other ignition sources where dust clouds of this material could form. During a fire, irritating and possibly toxic gases may be generated by thermal decomposition or combustion.

5.3. Advice for firefighters

Protective Equipment : Wear full protective clothing and self-contained breathing apparatus with full facepiece.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions: Refer to **Section 8 "Exposure controls/personal protection"**

6.2. Environmental precautions

This material should be prevented from contaminating soil or from entering sewage and drainage systems and bodies of water.

6.3. Methods and materials for cleaning up

Control the spill at its source. Contain the spill to prevent from spreading or contaminating soil, or from entering sewage and drainage systems or any body of water. Clean up spills immediately, observing precautions outlined in section 8. Cover entire spill with absorbing material and place into compatible disposal container. Scrub area



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with hard water detergent (e.g. commercial products such as Tide, Joy, Spic and Span). Pick up wash liquid with additional absorbent and place into compatible storage container. Once all material is cleaned up and placed in a disposal container, seal the container and arrange for disposition. This material should be prevented from contaminating soil or from entering sewage and drainage systems and bodies of water.

SECTION 7: Handling and storage

KEEP OUT OF REACH OF CHILDREN!

7.1. Precautions for safe handling

Precautions for safe handling : Use in a well-ventilated area.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Do not contaminate water, food or feed by storage or disposal. Keep container closed when not in use. Do not store near food or feed. Protect from freezing. In case of spill or leak on floor or paved surfaces, soak up with sand, earth, or synthetic absorbent. Remove to chemical waste area.

SECTION 8: Exposure controls/personal protection

8.1. Personal protective equipment

Exposure Limit:

OSHA PEL: Not Listed

ACIGH TLV: Not Listed

Individual protection measures:

Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Wear long sleeved shirt and long pants, socks, shoes, and gloves. Remove and wash contaminated clothing before reuse.

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 state or tribal agency responsible for pesticide regulation.

EYE PROTECTION – Use chemical splash goggles. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.

CLOTHING – Wear chemical-resistant (such as nitrile or butyl) gloves, coveralls, socks and chemical-resistant footwear. For overhead exposure, wear chemical-resistant headgear.

GLOVES – Wear chemical-resistant gloves, such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, natural rubber, polyvinyl chloride (PVC), viton.

RESPIRATOR – A respirator is not normally required when handling this substance. Use effective engineering controls to comply with the occupational exposure limits.

Discard clothing and other absorbent materials that have been heavily contaminated with this product. Do not reuse them. Follow manufacturer's instructions for cleaning and maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry. Use a self-contained breathing apparatus in cases of emergency spills, when exposure levels are unknown, or under circumstances where air-purifying respirators may not provide adequate protection. In case of emergency spills, use a NIOSH approved respirator with any N, R, P or HE filter.

8.2. Exposure controls

Engineering Controls:

No applicable information available.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	: Off-white/beige liquid
Odor	: No data available
Odor threshold	: No data available
pH	: No data available
Melting/freezing point	: No data available
Boiling point	: Approx. 212 °F
Flash point	: Does not flash
Flammability	: No data available
Explosive properties	: No data available
Vapor pressure	: Paclobutrazol: $7.5 \times 10(-9)$ mmHg @ 68 °F (20 °C)
Vapor density	: No data available
Relative density	: 1.09 g/ml
Solubility(ies)	: Water: 26 mb/l @ 20 °C Fat: No applicable information available
Partition coefficient	: No data available
Auto-ignition temperature	: No data available
Decomposition temperature	: No data available
Viscosity	: No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

No applicable information available

10.2. Chemical stability

Stable under standard conditions.

10.3. Possibility of hazardous reactions

No applicable information available

10.4. Conditions to avoid

None known

10.5. Incompatible materials

Oxidizing agents (e.g. chlorates, nitrates)

10.6. Hazardous decomposition products

Can decompose at high temperatures forming toxic gas.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Based on an evaluation of the ingredients and/or similar products.

ACUTE TOXICITY		
Oral	LD50 rat	>2000 mg/kg body weight
Inhalation	LC50 rat	>250 mg/M ³ air
Dermal	LD50 rat	>2000 mg/kg body weight
Irritation		
Eye Contact	Rabbit	Slightly irritating
Skin Contact	Rabbit	Non-irritating
Respiratory tract	-	No applicable information available
Sensitization	unknown	Not a sensitizer

Carcinogenicity	: No evidence of carcinogenicity in 2-year rodent studies.
Mutagenicity	: No applicable information available.
Reproductive Toxicity	: Dose-related increase in minor skeletal defects and evidence of fetotoxicity in rat studies (urogenital defects). No adverse effects seen on reproductive parameters or reproductive organs in a 2-generational rat study. Liver effects were noted at the highest dose level in the FO females and male and female offspring (active ingredient).
Chronic Toxicity	: Evidence of liver toxicity in repeat dose rodent studies at high dose levels. (1250 ppm, 90 day and 2 year tests). No effects noted in rabbit studies. No adverse health effects are expected in humans at airborne levels below the occupational exposure limit.
NTP/IARC/OSHA listing(s)	: No applicable information available.

SECTION 12: Ecological information

12.1. Toxicity

ECOTOXICITY:

Fish: LC ₅₀	: 23.6 ppm
Daphnia: EC ₅₀	: 33.2 ppm
Bird (8-day dietary – Bobwhite Quail): LC ₅₀	: >20,000 ppm
Bees: LC ₅₀	: >50 ug/bee

12.2. Persistence and degradability

No applicable information available.

12.3. Bioaccumulative potential

Soil DT50 0.5-1.0 y in general; in calcareous clay loam (pH 8.8, 14% o.m.), DT50<42 d.; in coarse sandy loam (pH 6.8, 4% o.m.), DT50>140 d. Stable in water. Mixes in water (after 24 h).

12.4. Mobility in soil

No applicable information available.



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SECTION 13: Disposal considerations

13.1. Waste treatment methods

Pesticide disposal:

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

Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law. If these cannot be disposed of by use according to label instructions, contact your state pesticide or environmental control agency, or the hazardous waste representative at the nearest EPA regional office for guidance.

Container disposal:

Less than or equal to 5 gallons: Non-refillable container. Do not reuse this container to hold materials other than pesticides or dilute pesticides (rinsate). After emptying and cleaning, it may be allowable to temporarily hold rinsate or other pesticide-related materials in the container. Contact your state regulatory agency to determine allowable practices in your state. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into the application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container $\frac{1}{4}$ 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, if available, or puncture and dispose of in a sanitary landfill, or by incineration. Do not burn unless allowed by state and local ordinances.

Over 5 gallons: Non-refillable container. Do not reuse this container to hold materials other than pesticides or dilute pesticides (rinsate). After emptying and cleaning, it may be allowable to temporarily hold rinsate or other pesticide-related materials in the container. Contact your state regulatory agency to determine allowable practices in your state. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into the application equipment or a mix tank. Fill the container $\frac{1}{4}$ 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. 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 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.

SECTION 14: Transport information

UN number	: Not applicable
Proper shipping name	: Plant growth inhibitor, modified or regulator
Class	: Not applicable
Packaging group	: Not applicable
NMFC number/class	: 101685/65
Marine pollutant	: Not applicable

SECTION 15: Regulatory information

This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets, and for workplace labels of non-pesticide chemicals. Following is the hazard information as required on the pesticide label.



CAMBISTAT

Safety Data Sheet

US and GHS

Revision date: May 29, 2015

Version: 1.0

EPA signal word

: CAUTION

Precautionary statements

: **HAZARDS TO HUMANS AND DOMESTIC ANIMALS**

CAUTION. Harmful if swallowed, absorbed through the skin, or inhaled. Avoid contact with skin, eyes, or clothing. Avoid breathing spray mist. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Wear long sleeved shirt and long pants, socks, shoes, and gloves. Remove and wash contaminated clothing before reuse

Pictograms/symbols

: None

SECTION 16: Other information

MSDS US

Disclaimer: The information provided by Rainbow Treecare Scientific Advancements. contained herein is given in good faith and correct to the best of our knowledge. However, the information given is designed only as guidance for safe handling, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification.

REVISED DATE: May 2015

REVISED FOR: GHS Compliance

Cambistat[®]

Tree Growth Regulator

Available in:

1 gallons
(3785ml)

2 Liters
(2000ml)

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 the label, find someone to explain it to you in detail.)

See Side/Back Panel for Additional Precautionary Statements, First Aid and Directions for Use

Cambistat[™] is a plant growth regulator that slows the vegetative growth of plants by inhibiting gibberellin biosynthesis. Cambistat[™] is designed to gently and predictably slow the growth of trees. A single application provides a long lasting reduction of vegetative growth, effectively extending the trimming cycle of trees and reducing the amount of woody growth that must be removed. In addition, use of Cambistat[™] may cause other plant growth effects that are beneficial for trees such as increased root density, improved drought and heat resistance, and higher tolerance to insects and diseases. Cambistat will also benefit trees that are too large for their growing site and increase the longevity of trees growing in stressful environments.

Active Ingredient

Pacllobutrazol (R*, R*)-(?)-?-[4-chlorophenyl] Methyl]-?-(1,1-dimethylethyl)- 1H-1,2,4-triazole-1-ethanol	22.3%
Other Ingredients...	77.7%
Total	100%

EPA Reg. No. 74779-3

EPA Est. No. 63416-MN-001

Distributed by:



Rainbow Treecare Scientific Advancements

11571 K-Tel Dr

Minnetonka, MN 55343

1-877-272-6747

www.treecarescience.com

FIRST AID:

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 a doctor.
- Do not give anything by mouth to an unconscious person.

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 poison control center or doctor immediately for treatment advice.

IF ON SKIN OR CLOTHING

- Take off contaminated clothing.
- Rinse skin immediately with plenty of water for 15-20 minutes.
- Call poison control center or doctor immediately for treatment advice.

Have the product container or label with you when calling a poison control center or doctor or going for treatment.

HOT LINE NUMBER

For 24 hour medical emergency assistance (human or animal), or chemical emergency assistance (spill, leak or accident).

Call CHEMTREC at 1-800-424-9300.

NOTES TO PHYSICIAN

No specific antidote is available. Treat the patient symptomatically.

PRECAUTIONARY STATEMENT

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Harmful if swallowed or absorbed through the skin. Avoid contact with skin, eyes, or clothing.

Personal Protective Equipment (PPE)

Some materials that are chemical-resistant to this product are listed below. If you want more options, follow the instructions for category F on an EPA chemical resistance category selection chart.

Applicators and other handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves made of any water proof material
- Shoes plus socks

Applicators and other handlers are also recommended to wear protective eyewear.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, 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.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- 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.

Environmental Hazards

Do not apply directly to water, 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 wash water.

Physical or Chemical Hazards

Do not use or store near heat or open flame.

DIRECTIONS FOR USE

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

FAILURE TO FOLLOW THE USE DIRECTIONS AND PRECAUTIONS ON THIS LABEL MAY RESULT IN PLANT INJURY OR LESS THAN OPTIMAL GROWTH REDUCTION.

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.

General Information

Cambistat™ is a plant growth regulator that slows the vegetative growth of plants by inhibiting gibberellin biosynthesis. Cambistat™ is designed to gently and predictably slow the growth of trees. A single application provides a long lasting reduction of vegetative growth, effectively extending the trimming cycle of trees and reducing the amount of woody growth that must be removed. In addition, use of Cambistat™ may cause other plant growth effects that are beneficial for trees such as increased root density, improved drought and heat resistance, and higher tolerance to insects and diseases. Cambistat will also benefit trees that are too large for their growing site and increase the longevity of trees growing in stressful environments. Cambistat™ may be applied by soil injection or basal soil drench.

Cambistat™ may be used on utility rights-of-way, residential areas, urban areas, and other non-crop areas.

Indications of Tree Response:

Cambistat™ is readily absorbed by plant roots and is translocated to the actively growing points. Initially, an intense greening of the foliage may occur in response to Cambistat™ treatment. Long-term effects include: shortened internodes and smaller, thicker leaves. Visible results may be seen in as little as 2 months but measurable growth reduction may take as long as a year to occur.

General Use Precautions

- Apply at recommended rates and follow safety precautions.
- Non-fruit or nut bearing trees that are not specified on this label may be treated if all other label directions are followed.
- The degree and duration of Cambistat™ applications can be affected by local soil and environmental conditions. Carefully read and follow label instructions to ensure effectiveness.
- Retreat every 3 years or wait until the effects from the previous application subside.
- Heavily compacted soils around trees may need to be vertical mulched, aerated or receive other remedial soil compaction treatments for Cambistat™ to effectively promote root growth.

General Use Precautions -continued

- Localized stunting or injury of turfgrass or other non-target plants immediately adjacent to the treatment site may occur if Cambistat flows off of the application site.
- Avoid Cambistat™ basal drench applications on inclines and other areas where treated soil is likely to be washed away from the base of the tree by rainfall or irrigation.
- Shrubs and/or herbaceous ornamentals next to treated trees may be affected if their roots extend into the treatment zone.
- Do not treat sugar maple trees or any other trees if they could be or will be tapped for sugar.
- Do not treat fruit or nut trees that will be harvested within one year.
- Do not treat severely stressed trees or trees in rapid decline.
- Do not apply Cambistat™ through any irrigation system.

DOSING

It is important to apply the proper dose to the tree you are treating. Use the following steps to determine the required dose:

- 1) Correctly identify the tree species.
- 2) Measure tree diameter at breast height (DBH). (See determining DBH)
- 3) Locate the correct dosage rate category for your species (See tables 2 and 3).
- 4) Locate the amount of material to use based on the category and DBH of your species (See tables 4 and 5).
- 5) Determine if any rate reductions are necessary (See Dosage Reduction Considerations).

DETERMINING DBH

Single Stem: Measure the standard DBH of the tree at 4' 6" above the soil.

Multiple Individual Trees Growing in Close Proximity: For trees that have grown close together, measure the DBH of each stem and treat each tree individually. You may need to make rate reductions due to the overlapping canopies (See Dosage Reduction Considerations). Also, because of close proximity of trees, it may be necessary to apply Cambistat to outer perimeter of clumped trees.

Multi-stem Split Below DBH: For a tree that has multiple stems splitting below DBH, measure the tree at the narrowest point between the root flare and the split.

Stem Clusters: For trees that are grown too close together to be treated as individual trees, measure the DBH of each stem and add the measurements together. You may need to make rate reductions due to overlapping canopies (see Dosage Reduction Considerations). Also, because of close proximity of trees, it may be necessary to apply Cambistat to outer perimeter of clumped trees.

Tree Splits at DBH: For a tree that splits into two or more stems at DBH, measure and add the diameter of the stems and measure the narrowest point below the split. Take the average of these values.

DOSAGE REDUCTION CONSIDERATIONS

Canopy Missing: Look at the canopy of the tree and compare it to a "normal" canopy for that trunk diameter. For example, if a tree is missing large branches from storm damage or utility line clearance pruning it is necessary to estimate the percentage of canopy missing and subtract this percentage from the dosage amount. i.e. subtract 30% from dosage if 30% is missing from the canopy.

Canopy Suppression: Trees growing in close proximity to other trees, multi-stemmed trees, and trees growing in clusters may have overlapping canopies. Your judgment is required to compare the canopies of these trees to the "normal" canopy for trees with similar trunk diameter. It may be necessary to reduce the dosage amount based on the percent of suppression and canopy overlap.

DOSAGE REDUCTION CONSIDERATIONS - continued

Stressed or Declining Trees: Dosage rates for trees that have lost canopy from construction damage, storm damage, insects, disease, girdling roots and/or other types of stress must be reduced to minimize the risk of over-regulation. A full dose of Cambistat applied to a tree with small, thin, or declining canopy may result in smaller leaves and a sparse canopy.

- Reduce the dosage rate on highly stressed trees by 25% or more
- Trees that show significant stress and are in rapid decline are NOT good candidates for treatment.
- For stressed trees, consider that additional canopy may decline before treatment response begins so you may need to reduce the dose by more than what is presently missing.

Trees with Confined or Compromised Root Systems: Trees in sidewalk boxes, above ground planters, and new transplants may absorb Cambistat from the treatment area in a higher proportion than a tree with a full root system. Reduce the dosage rate by 25% or more.

MIXING PROCEDURE

Dilute 1 part Cambistat with 11 parts water. To make a large Ready to use solution, combine 1 quart of Cambistat with 11 quarts of water to make 3 gallons of solution. See table 1 for additional examples. When mixing large amounts of Cambistat, mix only the amount that will be used within that day. Cambistat is best applied with equipment that has constant agitation.

Table 1. Examples of the volumes of Cambistat and Water needed to make Ready-to-Use solution.

Volume of Cambistat	Volume of Water	Makes
1 qt	11 quarts	3 gallons
1 gallon	11 gallons	12 gallons
4 gallons	44 gallons	48 gallons

If applying mixture to compacted soils, high clay content soils, or other hard-to-wet soils, use a nonionic, organosilicone wetting agent (surfactant) to increase penetration of the soil. Mix approximately ½ ounce surfactant per 3 gallons or 1 pint surfactant per 100 gallons. Follow all label directions and precautions on the surfactant product label.

APPLICATION METHODS

Soil Injection

Inject the Ready to Use solution approximately 2-6 inches deep at 50-200 psi using the volumes in Table 5. Orient injection orifices to release the diluted product horizontally at the point of injection. Divide the required dose evenly among injection sites spaced as uniformly as possible around the base of the tree. Position the injection sites to release the diluted Cambistat™ as close as possible to the point of contact between the soil and the tree beneath the soil so that the solution is readily absorbed by the tree (Figure 1). Locate injection sites next to buttress roots (Figure 1). For trees less than 6 inches DBH, use at least 4 injection sites evenly spaced around the tree.

Soil Basal Drench

Carefully dig a shallow furrow 2 – 6 inches deep around the base of the tree. If treating an individual tree, use the volumes determined in Table 4. If treating multiple trees, a Ready-To-Use solution can be created by using the volumes in Table 5. Carefully pour the Ready-To-Use solution evenly around the tree into the furrow using an applicator that provides a controlled flow. Make the application at the point of contact between the soil and the tree trunk (Figure 2). After the diluted product has been absorbed by the soil, refill the furrow with untreated soil. Note: If making an application on a slope, a soil dam may be created to contain the application within the furrow.

APPLICATION TIMING

For a more manicured look, apply Cambistat™ to trees 30 to 180 days before they are pruned. To allow some regrowth and a more natural look, apply Cambistat™ at the time of pruning.

Soil applications can be made throughout the year, except when the soil is frozen or saturated with water. Note: When applied to the soil, Cambistat™ is absorbed by tree roots and translocated to the growing points (sub-apical meristems) in response to evaporative water loss (transpiration). If applications are made after leaf drop, uptake of Cambistat™ will not occur until development of new leaves and resumption of transpiration.

For questions, contact Rainbow Treecare Scientific Advancements at 877-272-6747.

Table 6. Partial hole volumes for soil injection
(based on 250 ml delivered per hole)

Partial hole	Volume
.1	25 ml
.2	50 ml
.3	75 ml
.4	100 ml
.5	125 ml
.6	150 ml
.7	175 ml
.8	200 ml
.9	225 ml

STORAGE AND DISPOSAL

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

Pesticide Storage: Keep container closed when not in use. Do not store near food or feed. Protect from freezing. In case of spill or leak on floor or paved surfaces, soak up with sand, earth, or synthetic absorbent. Remove to chemical waste area.

Pesticide Disposal: Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law. If these cannot be disposed of by use according to label instructions, contact your state pesticide or environmental control agency, or the hazardous waste representative at the nearest EPA regional office for guidance.

Container Disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

CONDITIONS OF SALE AND LIMITATION OF WARRANTY AND LIABILITY

Notice: Read the entire Directions For Use and Conditions of Sale and 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.

Follow the Directions For Use carefully. It is impossible to eliminate all risks inherently associated with the use of this product. Tree injury, ineffectiveness or other unintended consequences may result because of such factors as manner of use or application, weather or tree conditions, presence of other materials or other influencing factors in the use of the product, which are beyond the control of RAINBOW TREECARE SCIENTIFIC ADVANCEMENTS or seller. To the extent consistent with applicable law, all such risks shall be assumed by Buyer and User, and Buyer and User agree to hold RAINBOW TREECARE SCIENTIFIC ADVANCEMENTS and Seller harmless for any claims relating to such factors.

RAINBOW TREECARE SCIENTIFIC ADVANCEMENTS warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated in the Directions For Use, subject to the inherent risks referred to above, when used in accordance with directions under normal use conditions. This warranty does not extend to the use of the product contrary to label instructions, or under abnormal conditions or under conditions not reasonably foreseeable to or beyond the control of Seller or RAINBOW TREECARE SCIENTIFIC ADVANCEMENTS, and Buyer and User assume the risk of any such use. RAINBOW TREECARE MAKES NO WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE NOR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

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Patent Pending

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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. 1 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 Boatlook 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

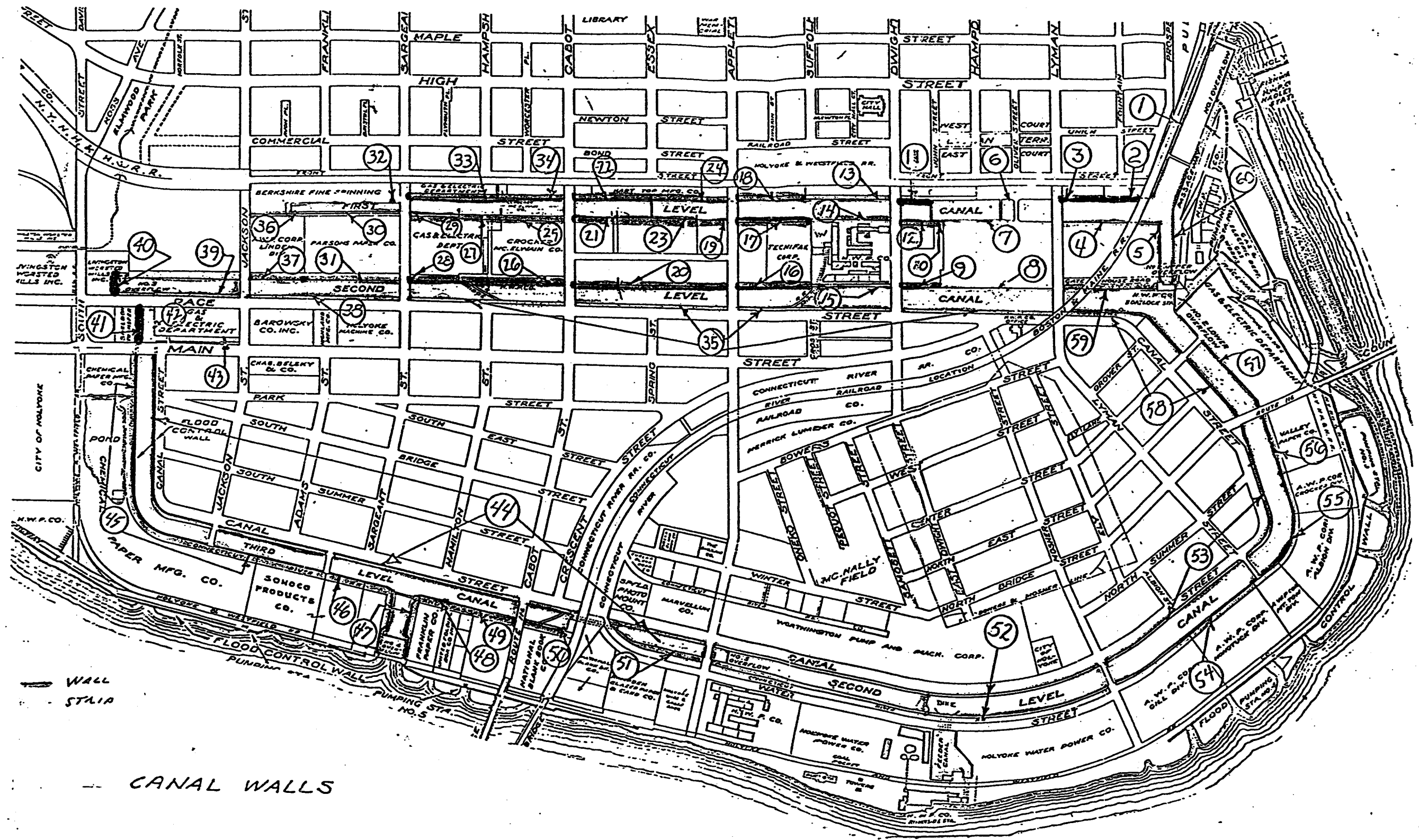
3/30/67

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.		" " "



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 | treco

HOLYOKE PROJECT (FERC NO. 2004)

THREATENED AND ENDANGERED SPECIES PROTECTION PLAN

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**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.

LARGE-FORMAT IMAGES

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Number of page(s) in set: 1

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 withstand 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).

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.

1

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 &	6/1 - 7/31 (adult)
Blueback herring	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 9/15 - 11/15
American shad & Blueback herring	4/1 - 7/15
Shortnose sturgeon	6/1 - 11/15
American eel	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.

Interpretive Contacts and Beach User Impact

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*

arvense, *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 larvae 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

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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 conservation 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	³ <u>\$9,025.00</u>
Project total		\$16,325.00

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CNWR27

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 imbecilis*, 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*.

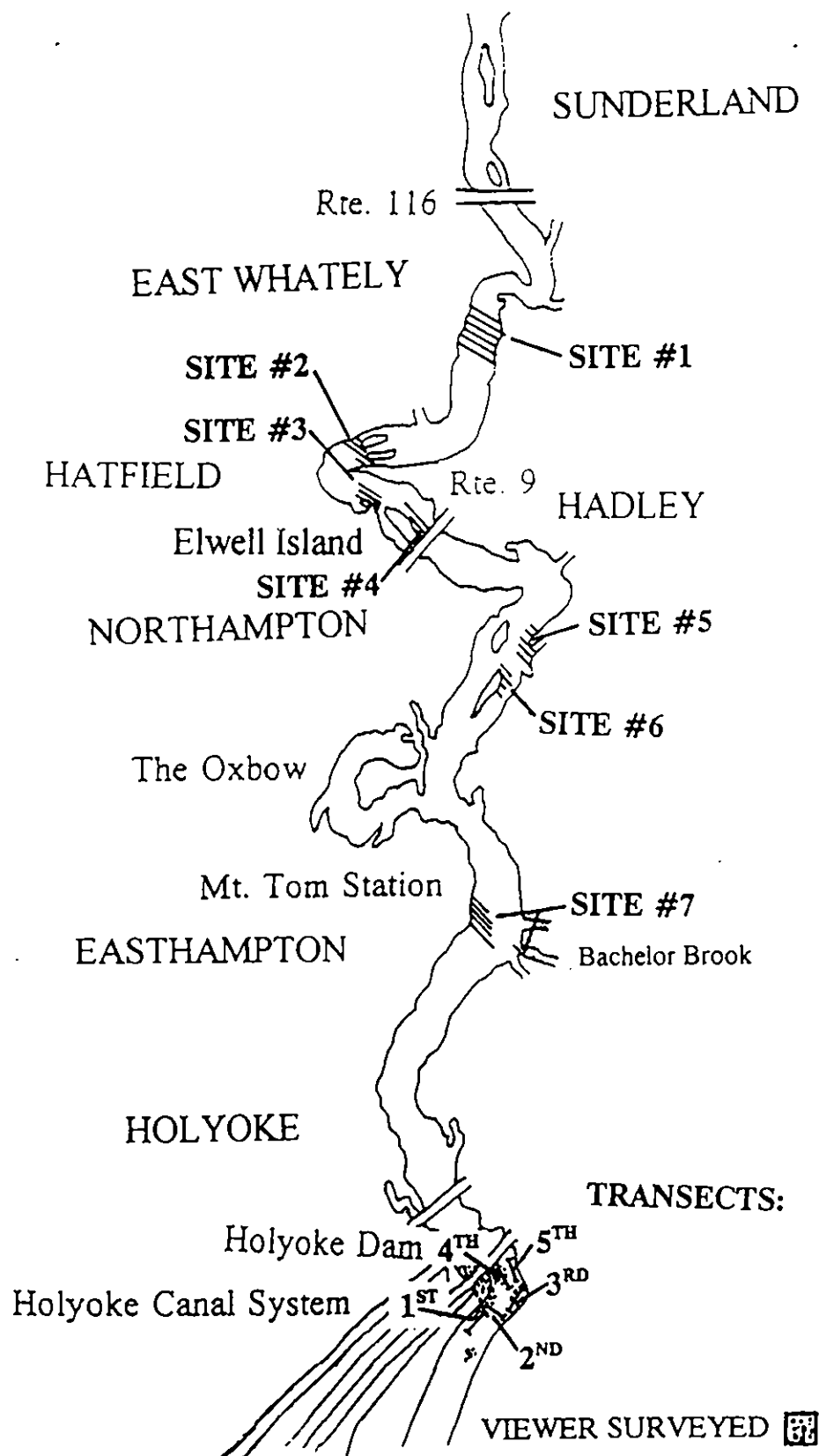


FIGURE 1. The sites and transects on the Connecticut River that were surveyed on August 14 and 15, 1995, respectively, for presence of the yellow lampmussel, *Lampetlis cariosa*.

TABLE 1 General site descriptions and relative abundances of the eastern ellipso, *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.

m

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 m^2), moderate ($1-50$ mussels m^2), and heavy (> 50 mussels m^2)

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 implexata</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. implexata</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

APPENDIX D

MEETING NOTES RELEVANT TO T&E PLAN

MEETING NOTES SUMMARY

ATTENDEES: Paul Ducheny-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 Ducheny 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.

Holyoke Meeting Notes
December 19, 2001

2.

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.

Holyoke Meeting Notes
December 19, 2001

3.

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,

Holyoke Meeting Notes

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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 H&G&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 Vonoepi is the USFWS contact for Puritan tiger beetles

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December 19, 2001

6.

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 Vonoceppi (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.

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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 Duchency-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.

HG&E Meeting Notes

February 7, 2002

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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 (Gooseneck 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

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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 Ducheney-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 Ducheney 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:

Holyoke Meeting Notes

April 3, 2002

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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 lower 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 Ducheney-HG&E
John Warner-USFWS
Caleb Slater-MDFW
Chris Tomichuk
Joe Clark-HG&E
Tom Miner-CRWC
John O'Leary-MAE/OEA
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.

HG&E Meeting Notes

June 14, 2002

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- 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

HG&E Meeting Notes

June 14, 2002

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- 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

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- 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 Tomichuk-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

Holyoke Meeting Notes

June 27, 2002

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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 glochidia 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 CRI.MP 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

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- 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

HG&E Proposed Schedule for Threatened & Endangered Species Plan

Task Number	Task Name	Start	End	2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
				M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2
1	Task 1: Initial Assessment	Mon 12/31/01	Mon 12/31/01																										
2	Task 2: Initial Assessment	Tue 1/1/02	Wed 1/2/02																										
3	Task 3: Initial Assessment	Thu 1/1/02	Fri 1/2/02																										
4	Task 4: Initial Assessment	Mon 1/1/02	Tue 1/2/02																										
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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 "Werle 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, EOEA
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.

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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

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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.

-3-

Recommended Conservation Measures

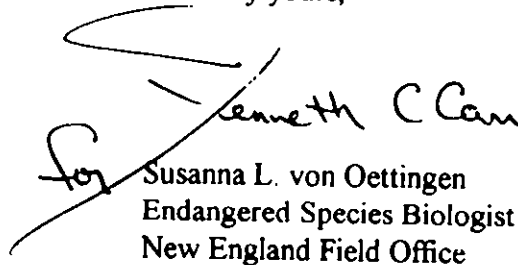
In order to comply with the conditions of the FERC license and develop an endangered species plan that addresses recovery actions as well as actions that would minimize adverse effects resulting from dam operations, we recommend that the following be incorporated into a revision of the draft plan:

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

-4-

CC: Reading File
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United States Department of the Interior

FISH AND WILDLIFE SERVICE
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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.

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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.

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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.

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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,

A handwritten signature in cursive script, reading "William J. Neidermyer".

William J. Neidermyer
Assistant Supervisor, Federal Activities
New England Field Office

Appendix I

NHESP Management Recommendations



DIVISION OF FISHERIES & WILDLIFE

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June 22, 2021

Christopher Perry
Holyoke Gas & Electric Department (HG&E)
99 Suffolk Street
Holyoke MA 01040

Diane Mas
Fuss & O'Neill, Inc
1550 Main Street, Suite 400
Springfield MA 01103

RE: Applicant: Holyoke Gas & Electric Department (HG&E)
 Project Description: Guidelines for Yearly Operational Plan (YOP)– 2021
 File Number: 21-40033

Dear Mr. Perry & Ms. Mas:

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 Division's annual review and approval of a vegetation management plan (VMP) (321 CMR 10.14 (16)). We evaluated your 2021 Yearly Operational Plan (YOP) and its associated shapefiles. Below, we provide best management practices to avoid and minimize harm to state-listed species (e.g. rare plants) and their habitats associated with YOP/VMP activities scheduled to occur within Priority Habitat. These areas are identified and labeled in a shapefile that the Division is providing as an attachment herein. The best management practices listed below shall be incorporated into the YOP/VMP and followed by crews in the field unless otherwise approved by the Division in advance. Provided that the best management practices contained herein, and in the 2021 YOP/VMP shapefile ("HGE_YOP2021_NHESP.shp"), are adhered to the YOP/VMP for 2021 shall meet the requirement for exemption from review under 321 CMR 10.18 through 10.23 and is hereby approved.

General Best Management Practices

The following best management practices (BMPs) shall be incorporated into the YOP/VMP and shall be implemented within all mapped *Priority Habitat* of state-listed species as indicated in the enclosed shapefile:

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

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- 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. Within areas labeled as “Turtle Habitat” the Best Management Practices (BMPs) described in the document **“ROW Vegetation Management in State-listed Turtle Habitat”** (attached) shall be implemented. 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”** (attached) shall be implemented. Please note that this document has been revised from previous years.
 5. A subset of ROW areas proposed for vegetation management activities are mapped 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. For all species other than state-listed turtles and vernal pool associated species, refer to the management guidelines described in the document **“Vegetation Management of Existing Right-of-Ways (ROW) in Priority Habitat for State-listed Plant, Lepidoptera, Bird, Bat and Snake Species Guidance and Best Management Practices”** (attached) and presented in the shapefile must be implemented.
 6. Data Sensitive Species: A subset of ROW areas proposed for vegetation management activities are mapped 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 one (1) year 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 Division for any vegetation management activities not shown in the current VMP. The Division will respond with any procedures or conditions necessary to protect state-listed rare species and their habitats. Additionally, emergency vegetation management activities within PH may be conducted without prior Division notification. However, the Division 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 Division be notified in advance of emergency vegetation 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*.

This approval of the 2021 HG&E YOP/VMP is valid for one (1) year from the date of issuance of this letter. If you have any questions or suggestions, please contact Lauren Glorioso, Endangered Species Review Biologist, at (508) 389-6361 (lauren.glorioso@mass.gov) or David Paulson, Senior Endangered Species Review Biologist, at (508) 389-6366 (david.paulson@mass.gov).

Sincerely,

A handwritten signature in black ink, reading "Everose Schlüter". The signature is fluid and cursive, with the first name "Everose" and last name "Schlüter" clearly distinguishable.

Everose Schlüter, Ph.D.
Assistant Director

cc: Clayton Edwards, Pesticide Board



DIVISION OF FISHERIES & WILDLIFE

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February 2021

Vegetation Management of Existing Right-of-Ways (ROW) in Priority Habitat for State-listed Plant, Lepidoptera, Bird, Bat and Snake Species Guidance and Best Management Practices

Right-of-Way vegetation management (VM) activities occurring within Priority Habitat (PH) and in accordance with a Division-approved YOP/VMP, must implement measures to minimize the mortality of state-listed species. This document is intended to accompany the Division's General Best Management Practices and annual YOP shapefile of state-listed species habitat, and is meant to provide guidance to ROW managers preparing YOP/VMP activities for these areas. Below is an outline of procedures that shall be implemented to safeguard state-listed plant, lepidoptera, bird, and snake species. **Best Management Practices for state-listed turtles and vernal pool species are found in separate accompanying documents to the YOP/VMP approval.**

A subset of species protected under the MESA has been determined by the Division to be **"Data Sensitive"** (denoted in the "Data_Sens" column of the shapefile). These species are highly susceptible to collection and are therefore of high concern to the Division. 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 Division (See Massachusetts Public Records law: M.G.L. chapter 66 section 17D).

State-listed Plants

State-listed plants occur in a variety of habitats across the Commonwealth, including along utility ROW including in wetlands, dry forests, on banks of streams or ponds, grasslands and shrublands, seasonally flooded depressions, and wet meadows. Many state-listed plant species will thrive in low-shrub and herbaceous communities that are compatible with ROW VM goals. 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 are management guidelines for areas identified to contain state-listed plant species found along the ROW scheduled for VM activities which correspond with the accompanying shapefile.

Management Guidelines

1. **Sensitive Dates:** 15 April - 1 Nov is the growing season for most plants and VM activities are most likely to cause harm during this period. **Please note certain plants have year-round sensitive dates.** Refer to the shapefile "Sens_date" column for this information. In general, VM activities, excluding the broadcast application of herbicides, conducted 2 Nov - 14 April (the "dormant season") will pose minimal or no risk to state-listed plants and can proceed **unless the plant species "Sens_date" is Year-round.**

- a. VM activities conducted 15 April - 1 November (the "Growing season") may cause harm to state-listed plants and the guidelines below must be implemented.
2. **VM activities occurring during the Sensitive Dates** for state-listed plants must implement measures to avoid 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.
3. **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, surveys must be conducted by a qualified botanist. The Division-approved botanist will be required to identify the extent and condition of populations of state-listed plants, flag populations for work crews. Crews must avoid these delineated areas to the greatest extent practicable. If work must occur **within these delineated areas crews must be careful to not directly impact the state-listed plants**. If plant impacts cannot be avoided, crews must contact the Division prior to commencement of VM in these areas for further guidance.
 - a. **Reporting:** Observed state-listed plants shall be reported through the VPRS online reporting system within 90 days of completion of the survey. Any surveys resulting in a "failed to find" must also be reported to the Division and include a map and description of the area that was surveyed. A copy of the Division Botanical Survey Protocols and the Rare Plant Observation Form are included with this document.
4. **Avoid herbicide on grasses/sedges, ferns or forbs:** In areas where herbicides must be used, extra caution should be used to avoid over-spray onto grasses/sedges, ferns or forbs when targeting other species. Activities which necessitate use of herbicide on these plants may require botanical surveys as described under "Delineate population and avoid" above.
5. **Avoid herbicide on grasses/sedges, ferns, forbs or vines:** In areas where herbicides must be used, extra caution should be used to avoid over-spray onto grasses/sedges, ferns, forbs **or vines** when targeting other species. Activities which necessitate use of herbicide on these plants may require botanical surveys as described under "Delineate population and avoid" above.
6. **Avoid herbicide on grasses/sedges, ferns, forbs or mosses:** In areas where herbicides must be used, extra caution should be used to avoid over-spray onto grasses/sedges, ferns, forbs **or mosses** when targeting other species. Activities which necessitate use of herbicide these plants may require botanical surveys as described under "Delineate population and avoid" above.
7. **Leave unmowed during sensitive dates:** Certain state-listed plants require some disturbance to survive and propagate and/or are easily outcompeted by other species. Mowing during the growing season can harm the plant and should be avoided. Therefore, 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 the Division must be contacted to alternative avoidance methods or control techniques.

8. **Treat only where necessary:** Certain state-listed plants are trees or shrubs which may be required to be removed to maintain the ROW. **Where these plants do not interfere with the regular maintenance of the ROW, they should not be cut or treated.** If extensive areas of these species must be treated the Division must be contacted to determine alternative avoidance methods or control techniques.
9. **Avoid herbicide in open water:** In areas where herbicides must be used, extra caution should be used to avoid over-spray into open water when targeting other species. VM which necessitates use of herbicide in open water may require further consultation with the Division.
10. **No heavy machinery in wetland:** In areas where certain plant species are found within wetland habitats, extra caution must be used to avoid impacts from heavy equipment. Use of heavy equipment in wetlands within state-listed plant areas of ROW may require further consultation with the Division.

Based on these efforts and information currently found in the Division database, subsequent annual management guidelines may be revised.

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. Below are management guidelines for areas identified to contain state-listed moth and butterfly species in order to protect and maintain the host plants found along ROW scheduled for VM:

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 VM 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. **Sensitive Dates:** 15 April - 1 Nov is the “growing season” for most host plants and VM activities are most likely to cause harm during this period. Refer to the shapefile “Sens_date” column for this information. In general, VM activities, *excluding the broadcast application of herbicides*, conducted 2 Nov - 14 April (the “dormant season”) will pose minimal or no risk to host plants and can proceed as proposed.
2. If VM 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 VM 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 Division should be contacted and alternative methods of managing these areas shall be developed.

3. **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.**
4. **Leave unmowed during sensitive dates:** The caterpillars or pupae of certain state-listed moths and butterflies may be present on the host plant during the sensitive dates shown in the accompanying shapefile. Impacts to the host plants will then directly harm the state-listed moths or butterflies found on them. These host plants should be avoided to the greatest extent practical and not be mowed between 15 April and 1 November. If these areas must be mowed during the sensitive dates, the Division must be contacted and alternative solutions shall be developed.
5. **Avoid herbicide on grasses/sedges, ferns or forbs:** The caterpillars of certain state-listed moths and butterflies feed on specific plants that should not be targeted with herbicides. In areas where herbicides must be used, extra caution should be used to avoid over-spray onto grasses/sedges, ferns or forbs when targeting other species.

State-listed Birds

State-listed birds occur in a variety of habitats across the Commonwealth of Massachusetts, including along utility ROW. Certain state-listed bird species thrive in the early successional habitats that are maintained through the removal of overstory trees and shrubs. However, these birds can also be negatively impacted by the disturbances associated with VM activities. Below and in the accompanying shapefile, the Division provides management guidelines for the areas identified to contain state-listed bird species found along the ROW scheduled for VM activities.

Management Guidelines

Some state-listed bird species are timid creatures that establish territories in the spring, nest in spring and summer, and fledge their young by late summer. They are very sensitive to disturbance throughout this time period.

1. **Sensitive Dates:** Breeding period varies by species. Refer to shapefile table for species-specific breeding periods. Typically, sensitive dates begin in April/May and conclude in August/September.
2. **Avoid work during sensitive dates (breeding season):** Extra care should be taken to avoid disturbing breeding birds. All VM activities should be avoided during the "Sens_Date" time periods. If VM must occur during the breeding season, the Division must be contacted.

State-listed Snakes

A subset of ROW areas proposed for VM activities are mapped, in part, for the presence of state-listed snake species. Crew members should be aware that any snakes observed during VM 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). The Division recommends 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

Management Guidelines

1. **Sensitive Dates:** Active Season (1 April – 1 Nov.)- VM activities occurring during the active season may cause harm to state-listed snakes and measures must be taken to avoid such harm.
 - a. The reptile Inactive Season 2 Nov. – 31 March) In general, VM activities conducted between 2 Nov - 31 March will **pose minimal or no risk** to state-listed snakes and can proceed as described in the submitted VMP.
2. **Consult with NHESP for further guidance:** No less than two weeks (14 days) prior to the desired start of vegetation management, contact Lauren Glorioso at lauren.glorioso@mass.gov or 508-389-6361 or David Paulson at david.paulson@mass.gov or 508-389-6366 for guidance on avoidance measures specific to the work location, snake species and activity.

Based on these efforts and information currently found in the Division database, subsequent annual management guidelines may be revised.

State-listed Bats

A subset of ROW areas proposed for VM activities are mapped, in part, for the presence of state-listed bat species.

Management Guidelines

1. **Consult with NHESP and USFWS for further guidance:** No less than two weeks (14 days) prior to the desired start of vegetation management, contact Lauren Glorioso (508-389-6361 lauren.glorioso@mass.gov) or David Paulson (508-389-6366 (david.paulson@mass.gov)) for guidance on avoidance measures specific to the work location, bat species and activity.

BEST MANAGEMENT PRACTICES:

ROW Vegetation Management in State-listed Turtle Habitat



BEST MANAGEMENT PRACTICES: **ROW Vegetation Management in State-listed Turtle Habitat**

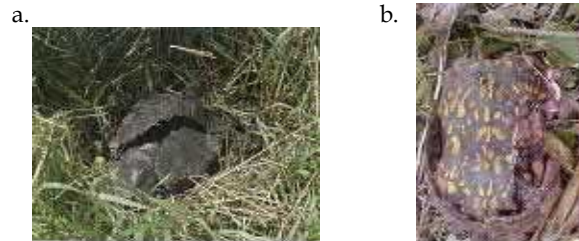
Freshwater turtles in Massachusetts are increasingly threatened by habitat loss, road mortality, increases in the density of certain predators associated with suburban sprawl (e.g. skunks & raccoons), and other factors. Because turtles naturally suffer high rates of nest failure and hatchling/juvenile 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

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 Lauren Glorioso at (508) 389-6361 or lauren.glorioso@mass.gov

Jan 2019



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.

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Data Manager, Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife, Rt. 135, Westborough, MA 01581



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

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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.**

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):

<u>Age Classes Present</u>	<u>Reproductive Condition of the Population on this Date</u>	
___Seedlings	___Vegetative	___Mature fruit
___Immature plants	___In bud	___Seed dispersing
___Mature plants	___In flower	___Senescent
___Plants of unknown age	___Immature fruit	___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:

<u>Landform/Topography</u>	<u>Aspect (°)</u>	<u>Slope (%)</u>	<u>Light</u>	<u>Soil Moisture Regime</u>
summit/crest	N NE	flat	open	xeric
upper slope	E SE	gentle	filtered	dry
mid slope	S SW	average	shade	mesic
lower slope	W NW	steep		wet
rolling terrain/plain	flat/variable	very steep		inundated
floodplain/terrace		abrupt		
wetland				
shore/lake/stream				

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:

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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 #: _____

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STATE-LISTED SPECIES HABITAT ASSESSMENT AND SURVEY

GUIDELINES: PLANTS

The Massachusetts Division of Fisheries and Wildlife's Natural Heritage and Endangered Species Program (the Division) may request a Habitat Assessment and Survey for state-listed imperiled plants, which shall follow the guidelines and reporting and submittal requirements provided below.

PRIOR TO HABITAT ASSESSMENT AND SURVEY

1. **Qualified Botanist:** The Division must pre-approve the botanist who will conduct the assessment and survey. The botanist must demonstrate the ability to locate and definitively identify the state-listed plant species and their habitat(s).
2. **Pre-Approval of Protocols:** The Division must pre-approve the assessment and survey protocol. The assessment should evaluate the entire project site, not just the portion within the proposed project "footprint," unless otherwise approved by the Division. Surveys need only occur within all areas of suitable habitat on the property for each target species. The methods and timing of surveys for each target plant species also need to be described in the protocol. Multiple visits may be necessary for larger properties, for sites with multiple plant species, or for species in which definitive identification is contingent on the presence of determinative, short-lived plant parts. A description of the salient identification features for each species, as well as how it is distinguished from closely related or look-alike species, is required. Required equipment includes a camera (minimum 5MP resolution), a metric ruler (minimum 15cm in length), and a modern, handheld GPS unit set in decimal degrees, NAD 83 datum.
3. **Scientific Collection Permits:** If the survey botanist and/or the Division anticipate that state-listed plant specimens may need to 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 \(revised December 2015\)](#).

REPORTING REQUIREMENTS

After the assessment and survey, a summary document MUST be submitted that includes the following:

1. **Existing Conditions:** A description of important site features such as existing developed or disturbed areas, general vegetation cover types, non-native invasive species, and all suitable habitat for state-listed plant species. All features should be identified on a map overlaid on an ortho-photo of the property. For each state-listed species found, include a plant community description with ten associated species (in forested habitats, describe canopy, shrub and herbaceous species) and notes on soil type, bedrock or glacial deposits, slope and aspect, deer or insect herbivory, evidence of recent disturbance such as fire, flood or storm damage, and hydrology.
2. **Summary of Survey Methodology:** (a) A map of the survey area extent and the route taken during the survey, including a GPS track file; (b) a detailed summary of any deviations from the approved survey protocol; and (c) a list of botanical references, herbaria, experts and any other resources used for identification, botanical nomenclature and authority.
3. **Summary of Survey Results:** (a) A map showing any state-listed plants and/or plant populations located; (b) GPS waypoints for each plant and/or plant population found; (c) a count or estimate of population size (if a count is not feasible); and (d) notes on individual plant and/or population vigor, including more detailed observations of co-occurring species and habitat conditions. All state-listed species observed on the property must be reported.
4. **Representative Photographs:** Photographs of suitable habitats, unsuitable habitats, any state-listed plants or plant populations observed, and any closely related or look-alike species. State-listed plants must be photographed at appropriate scales with a reference ruler to capture its size and habit as well as any determinative plant parts such as the flower, fruit, bark, leaf morphology, etc. Indicate

photograph locations on a map of the property, or provide coordinates for each photo location (in Massachusetts State Plane Coordinate System (meters) or decimal degrees), and the cardinal direction of view.

5. **Impact Analysis:** An analysis of the proposed project's impacts to state-listed plants and their habitat(s), including calculations of proposed habitat disturbance, the number of plants to be impacted (directly or indirectly), and recommendations for potential design changes and protective measures to avoid and/or minimize impacts. Provide recommendations regarding potential avoidance and mitigation strategies where direct impact to state-listed species is proposed.

SUBMITTAL REQUIREMENTS

Survey data and reports shall be submitted using the Vernal Pool & Rare Species (VPRS) Information System via the Survey Tool (www.mass.gov/dfw/nhesp/vprs). For more information on how to create a survey and to review all of its functions, please see the Survey Tutorial on our website:

<http://www.mass.gov/eea/docs/dfg/nhesp/species-and-conservation/survey-tutorial.pdf>

Please also follow the guidelines below:

1. Create a new Survey
2. Survey Name: Include the NHESP Tracking/File Number
3. Survey Description: brief description of project and survey
4. Select target group (plants) and map the habitat assessment/survey area(s)
5. Attach report and associated documents through the Photos/Documents tab
6. If ArcGIS shapefiles containing field data are available, email them to the VPRS Administrative Coordinator (contactvprsadmin@state.ma.us); shapefiles cannot be uploaded via VPRS. Alternatively, save the .dbf as a .xls or .xlsx and upload to VPRS through the Photos/Documents tab; data should be in Massachusetts State Plane Coordinate System (meters)
7. Indicate Survey Number in all associated Animal, Plant and/or Vernal Pool Observation Reports
8. When complete, close the survey by clicking the "Close" button in the bottom left corner

Surveys can be reopened and reused if a site is surveyed across multiple years. Be sure to "Close" the Survey once it is ready for the Division's review. Once the report has been submitted through VPRS, send an email to the relevant Endangered Species Review Biologist to confirm submission.

All state-listed species observations (rare plants or animals) must be submitted to the Division via NHESP VPRS.



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
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 every 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. No new private drinking water wells were installed within that area in 2017. Herbicide application crews will attempt to field-identify other private drinking water wells in this area.

Chicopee – The Chicopee Health Department was first 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. Moreover, in 2016 the Department stated that permits for drinking water wells are no longer granted - only permits for irrigation wells.

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.

Appendix L

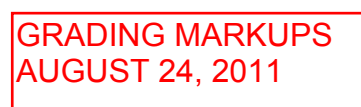
Public Notice and MDAR YOP Approval Letter

Appendix M

Lower Riverside Park ROW Map

Appendix N

Gatehouse Park ROW Map

[illegible]