STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY
BOARD OF PESTICIDES CONTROL
28 STATE HOUSE STATION
AUGUSTA, MAINE 04333

JANET T. MILLS
GOVERNOR

AMANDA E. BEAL
COMMISSIONER

BOARD OF PESTICIDES CONTROL

July 19, 2024

9:00 AM Board Meeting

MINUTES

Adams, Bohlen, Ianni, Neavyn

1. Introductions of Board and Staff

   - Staff: Peacock, Boyd, Brown, Couture, Pietroski, Poisson, Vacchiano
   - Assistant Attorney General, Carey Gustanski

2. Public Hearing on Request to Designate Eagle Lake Water District Wellheads as a Critical Pesticide Control Area

   Staff have received a petition to designate Eagle Lake Water District Wellheads as a critical pesticide control area as outlined in Chapter 60: Designation of Critical Pesticide Control Areas. The Board shall conduct rulemaking according to 5 MRSA Ch. 375, subchapter II and allow for local representation on board decisions regarding the designation according to Title 22 § 1471-V. The purpose of this public hearing is to collect public comments related to the petition that may help the Board draft the proposed rule. The comment period for these amendments is open until July 29, 2024 at 11:59PM. All written comments may be submitted by emailing the BPC at pesticides@maine.gov.

   The Board will hear testimony on this petition.

   - Peacock gave the Board an overview of the request and the process for considering it. All comments must be received by July 29 at 11:59 PM. Peacock told the Board that requirements also stipulated that local participation be allowed. The Town of Eagle Lake had designated John Martin as their local participant. Martin had been invited to the Board to participate and vote on deliberations regarding this proposal.
   - The Board opened the floor to public comment.
   - Phil LeBeouf stated he was from Eagle Lake and was one of the landowners that would be affected by this decision. He noted that he used Northern Turf Management to care for his lawn. LeBeouf stated he could not find anything where products used for lawn care were

affecting water supplies. He said he did not see an issue with the products that were being used. He added that there were already a lot of rules in place to protect groundwater within 250 feet of the Shoreland Zone. LeBeouf concluded that if the Board found there was a product being used that they saw as an issue they would be happy to try and find an alternative product.

- John Martin stated that he was a Trustee and the Treasurer of the Lakewater Sewer System, which was not part of the town but functioned under a separate Board as trustees for the water district. He noted that in 2004 the Department of Human Services notified them that the source of their water supply was not suitable. At that time they were getting water from the river that flows into Eagle Lake. They began searching for other sources and eventually found one. The water is now sourced from an aquifer underneath the lake itself. Martin stated they were concerned that pesticide use could impact this water source. He concluded that their goal was to protect the water supply.
- Pat Vaillancourt, owner of Northern Turf Management, stated he had been maintaining LeBeouf's property for several years. He stated that the concerns about the water supply seemed valid and in good faith, but he felt the proper application of pesticides posed little risk to the water. Vaillancourt added that he would like to make the point of other chemicals, like gasoline, that could pose a risk. He said that placing a prohibition on all pesticides within 500 feet of the well would prohibit property owners from addressing problems like invasive species, turf issues, rodents and other pests. Vaillancourt concluded that if enacted this would only affect commercial licensed applicators because people would choose to do what they wanted on their own property.
- Adams thanked those who commented and stated that the public could still submit written comments until July 29 at 11:59 PM.

3. <u>Minutes of the June 7, 2024 Board meeting and March 20, 2024 Emergency Board Meeting</u>

Presentation By: Alex Peacock, Director
Action Needed: Amend and/or Approve

- **Ianni/Bohlen: Moved and seconded to approve the June 7, 2024 minutes**
- **In Favor: Unanimous**

- **Bohlen/Ianni: Moved and seconded to approve the March 20, 2024 minutes**
- **In Favor: Unanimous**

4. <u>Workshop Session to Review the Rulemaking Record on the Proposed Amendments to Chapters 31, 32, and 50</u>

(Note: No additional public comments may be accepted at this time.)

A public hearing was held on June 7, 2024 via a hybrid meeting in Deering Building 101 at 90 Blossom Lane, Augusta and on the Microsoft Teams platform. The written comment period closed on June 17, 2024 at 11:59 PM. Two people spoke at the public hearing and no written comments were received by the close of the comment period. The Board will now review the rulemaking comments and determine how it wishes to proceed with the rulemaking proposals.

Presentation By: Karla Boyd, Policy & Regulations Specialist
Action Needed: Vote on whether to provisionally adopt Chapters 31, 32, and 50

- Boyd stated that the Board heard public comments at the last meeting regarding changes to the three chapters. She noted that Chapters 31 and 32 were mostly related to the certification and training changes that were provisionally accepted by EPA. She said that a couple of small typos had been addressed. Boyd stated that the Basis Statement, the Impact on Small Business, and the Summary of Comments and Responses as written were also included in the Board packet.
- Adams stated that these have been before the Bord three times, and there were no issues. He would like to entertain a motion to approve the rulemaking amendments.

    - **Ianni/Bohlen: Motioned and seconded to adopt Chapter 31, the Basis Statement, the Impact on Small Business, and the Summary of Comments and Responses as written.**
    - **In Favor: Unanimous**

    - **Bohlen/Neavyn: Motioned and seconded to adopt Chapter 32, the Basis Statement, the Impact on Small Business, and the Summary of Comments and Responses as written.**
    - **In Favor: Unanimous**

    - **Ianni/Bohlen: Motioned and seconded to adopt Chapter 50, the Basis Statement, the Impact on Small Business, and the Summary of Comments and Responses as written.**
    - **In Favor: Unanimous**

5. Draft Director Appointment Policy

At the April 5, 2024 Board meeting, members approved the appointment of Alex Peacock as BPC's new director. Further discussion led to a request from the Board to clarify the appointment procedure via policy. At the June 7, 2024 board meeting, the Board asked for changes to the draft policy. Staff have brought forward a draft policy for the Board to review.

Presentation By: Alex Peacock, Director
Action Needed: Discuss; Approve/Disapprove adoption of policy

- Peacock stated that staff made the revisions requested by the Board.

- **Bohlen/Neavyn: Moved and seconded to adopt the new Director Appointment Policy**
- **In Favor: Unanimous**

6. Consideration of a Request for Variance from CMR01-026 Chapter 29 from Green Thumb Lawn Service

Green Thumb Lawn Service is seeking a variance from CMR01-026 Chapter 29, Section 6, to treat a private property to prevent grub damage and broadleaf weeds. Board policy indicates that the Board must consider all first-time variance requests unrelated to invasive or noxious plants.

Presentation By: Alex Peacock, Director
Action Needed: Discuss; Approve/Disapprove Variance Request

- Peacock explained the variance request to the Board.
- Bohlen stated that he had issues with this request and the poor design of having a strip of grass that was that close to the ocean. He added that the proposed active ingredient was toxic to aquatic invertebrates, but he may be open to finding an alternative that would be less hazardous to the marine environment.
- Ianni stated that this was an unnecessary application and that there were other integrated pest management methods that could be employed.
  - **Ianni/Bohlen: Moved and seconded to disapprove the variance request**
  - **In Favor: Unanimous**

7. Consideration of a Request for Variance from CMR01-026 Chapter 29 from Green Thumb Lawn Service

Green Thumb Lawn Service is seeking a variance from CMR01-026 Chapter 29, Section 6, to treat a private property to prevent grubs and cranefly larvae. Board policy indicates that the Board must consider all first-time variance requests unrelated to invasive or noxious plants.

Presentation By: Alex Peacock, Director
Action Needed: Discuss; Approve/Disapprove Variance Request

- The Board had similar concerns with this variance request as the one in the previous agenda item.
  - **Ianni/Neavyn: Moved and seconded to disapprove the variance request**
  - **In Favor: Unanimous**

8. Other Old and New Business

   a. Variance Permit for CMR01-026 Chapter 29, RCL Services, LLC
   b. Variance Permit for CMR01-026 Chapter 29, Bartlett Tree Expert Co.

c. Variance Permit for CMR01-026 Chapter 29, Bartlett Tree Expert Co.
d. Variance Permit for CMR01-026 Chapter 29, Bartlett Tree Expert Co.
e. Worcester Holdings Drone Spray Article
f. Camden Pesticide Ordinance Discussion Article

9. Schedule of Future Meetings

The next scheduled Board meeting dates are September 6, October 25 and December 6. The Board will decide whether to change and/or add dates.

- Peacock thanked Ianni for her service to the Board.
- Ianni stated she had enjoyed her time serving on the Board and had solicited a few others who may apply to fill her position.

10. Adjourn

  - **Neavyn/Bohlen: Moved and seconded to adjourn at 10:00 AM**
  - **In Favor: Unanimous**

MEMORANDUM OF UNDERSTANDING
Between
Maine Center for Disease Control and Prevention (Maine CDC),
The Department of Health and Human Services
and
Board of Pesticides Control,
Department of Agriculture, Conservation, and Forestry

I. Purpose

The purpose of this Memorandum of Understanding (MOU) is to create an agreement between the Maine Center for Disease Control and Prevention (Maine CDC), Department of Health and Human Services (Department) and the Board of Pesticides Control (BPC), Department of Agriculture, Conservation, and Forestry to conduct surveillance for mosquito-borne diseases to protect public health.

II. Introduction/Background

Maine CDC has established activities related to surveillance and control for mosquito-borne diseases. The purpose of surveillance is to describe the magnitude and characteristics of mosquito-borne disease in Maine, prevent human infection, and provide consultation and guidance on prevention and control of mosquito-borne illnesses. The principal statutory authority for Maine CDC to control communicable diseases is established at 22 M.R.S.A. Chapter 250.

The BPC conducts activities related to the use of integrated pest management, including the use of pesticides, to control and prevent mosquitoes and other pests. Rules and regulations exist to ensure pesticides are used and applied appropriately. The principal statutory authority for the Maine Board of Pesticides Control is established at 22 M.R.S.A. Chapter 258-A.

III. Roles and Responsibilities

A. The Department will:

1. In collaboration with partners, conduct surveillance for mosquito-borne diseases through active collection and testing activities each year.
2. Consult with the Maine State Vectorborne Disease Work Group to establish annual collection, sampling, and testing procedures.
3. Publish the results of mosquito surveillance through weekly reports, health alert messages, and other communications.
4. Utilize the results of annual mosquito surveillance to inform disease response planning and interventions.

B. The Department of Agriculture, Conservation, and Forestry (DACF) will:

1. Participate in the Maine State Vectorborne Disease Work Group.
2. Provide technical advice on Integrated Pest Management strategies.
3. Provide personnel to support mosquito surveillance, and planning activities in the event the mosquito control programs are deemed necessary for the protection of the public health.
4. Provide Maine CDC financial support for annual mosquito-borne disease surveillance of at least $25,000 annually, provided that DACF determines that sufficient funding is available for such purposes.

IV. Term of Agreement

This MOU will be effective from the date of the last signature and shall expire on December 31, 2024. The MOU may be amended or revoked at any time at the request of either party, in writing, with at least thirty (30) days' notice to the other party.

V. Payment Details

a. Payment Terms *(Check One):*

   i. ☐ There is no monetary value associated with this MOU.

   ii. ☒ The monetary value associated with this MOU is a minimum of: $25,000, to be paid annually (e.g., monthly, quarterly, annually, fee for service), starting in 2019 (e.g., date) and ending in 2024 (e.g., date).

b. Payment Method *(Check One):*

   i. ☒ This MOU involves **a transfer of funds** from one state agency to another to be administered by the State agency receiving the fund.

      1. Name of State Agency Paying: Board of Pesticides Control

         a. From account: 014-01A-4003-01-2968

      2. Name of State Agency Receiving funds: Maine CDC

         a. To account: 014 10A 2506 03 2526

   ii. ☐ This MOU involves **an exchange of services** from one state agency to another state agency, the services rendered are paid by internal exchange transfer (RE/IET).

      1. DHHS will receive funds into account: Click or tap here to enter text.

      2. DHHS will pay for services from account: Click or tap here to enter text.

   iii. ☐ This MOU is with **a non-state agency or quasi-state agency** and will be paid by a physical check or an electronic funds transfer.

      1. Name of State Agency Paying: Click or tap here to enter text.

         a. From account: Click or tap here to enter text, include relevant CFDA # too.

      2. Name of State Agency Receiving funds: Click or tap here to enter text.

         a. To account: Click or tap here to enter text.

Account Note: When entering accounts, use Fund, Department, Unit, Sub-unit, Object, Program Code, Program Period, and/or Revenue Source Code when applicable; for example, when Federal Funds are involved, 013-10A-2075-03-4911-FOODWIC-F2017; and when General Funds are involved, 010-10A-2075-03-4911. For assistance, call your Program Financial Officer.

VI. Confidentiality

To the extent that the services carried out under this Agreement involve the use, disclosure, access to, acquisition or maintenance of information that actually or reasonably could identify an individual or consumer receiving benefits or services from or through the Department ("Protected Information"), BPC agrees to a) maintain the confidentiality and security of such Protected Information as required by applicable state and federal laws, rules, regulations and Department policy, b) contact the Department within 24 hours of a privacy or security incident that actually or potentially could be a breach of Protected Information and c) cooperate with the Department in its investigation and any required reporting and notification of individuals regarding such incident involving Protected Information. To the extent that a breach of Protected Information is caused by BPC or one of its subcontractors or agents, BPC agrees to pay the cost of notification, as well as any financial costs and/or penalties incurred by the Department as a result of such breach.

VII. Signatures

For the Department of Health and Human Services:

Jeanne L. Lambrew — 8-27-19

Jeanne Lambrew — Date

Commissioner, Department of Health and Human Services

For the Department of Agriculture, Conservation and Forestry

Amanda E. Beal — 9/26/19

Date

Amanda Beal

Commissioner, Department of Agriculture, Conservation, and Forestry centralmaine.com

Maine CDC says Eastern Equine Encephalitis virus found in wild turkey in Burnham

Jake FreudbergMorning Sentinel

3–4 minutes

A wild turkey in Burnham tested positive for the Eastern Equine Encephalitis virus, two state departments said, marking the latest development in what state public health officials say is an “active” mosquito-borne disease season in the Northeast.

The turkey in the Waldo County town was the first animal in Maine to test positive for the mosquito-borne virus this year, according to a news release Tuesday from the Maine Center for Disease Control and Prevention, which monitors the virus with the Maine Department of Inland Fisheries and Wildlife.

There have been no reported cases of the virus, known as EEE, in humans this year in Maine, the Maine CDC said.

The virus spreads to humans and animals through infected mosquitoes. It cannot spread from human to human or from human to animal.

While most cases in humans do not result in symptoms, the virus can cause severe symptoms, such as brain swelling, or encephalitis, and inflammation of the spinal cord, or meningitis, the Maine CDC said. In some cases, EEE can lead to death.

The detection of EEE in the turkey announced Tuesday marks the third mosquito-borne virus found in animals or mosquitoes this year, according to the Maine CDC. The state and the Northeast as a whole are experiencing an "active" season, the agency said.

At the end of July, [the Maine CDC reported six cases of West Nile virus in birds across Maine]. The agency was also investigating a case of the virus in a human in Waldo County who was believed to have acquired it out of state.

This year, as of Tuesday, the Maine CDC and the Department of Inland Fisheries and Wildlife say they have found West Nile virus in 15 birds, EEE in one bird and Jamestown Canyon virus in four mosquito pools in the state, the news release said. A mosquito pool is a group of up to 50 mosquitos tested at various sites during routine surveillance.

"This is the earliest in the year that reports of all three mosquito-borne viruses endemic to Maine have been detected in the state either in mosquito pools or animals," the Maine CDC said. "This is the second consecutive year that all three viruses have been detected in Maine."

A Maine CDC spokesperson did not respond by Tuesday evening to questions sent via email about the geographic distribution of reported cases and factors that may have led to the early and active mosquito-borne disease season.

To protect against the diseases, public health officials recommend wearing long sleeves, using federally approved repellents on skin and clothes, using screens on windows and doors, and draining artificial sources of standing water where mosquitoes may lay eggs. Mosquitoes are most active at dusk and dawn, so precautions are especially encouraged at those times, the Maine CDC said.

"Mosquitoes are a nuisance, yes, but they can also carry dangerous diseases if an infected bug bites a person or an animal," Maine CDC Director Dr. Puthiery Va said in a statement. "We want Maine people and visitors to be aware of the elevated mosquito activity and take precautions to protect themselves and their loved ones."

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PAUL R. LEPAGE
GOVERNOR

WALTER E. WHITCOMB
COMMISSIONER

HENRY S. JENNINGS
DIRECTOR

MEMORANDUM

Date:	September 6, 2013
To:	Board Members
From:	Henry Jennings
Subject:	Policy on Exclusion Areas Relative to Chapter 20, Section 6 Rulemaking Amendments

Background

The Board recently completed provisional adoption of a series of rulemaking amendments covering public-health-related, mosquito-control efforts that may be conducted by governmental agencies. During the course of that effort, the Board determined that it was preferable to identify “exclusion areas”—as they relate to potential aerial applications to control adult mosquitoes—via Board policy, as opposed to codifying them in rule. Using a Board policy allows the Board more flexibility to adjust to concerns as they arise. Adjusting requirements in rule takes several months to accomplish and costs more than a thousand dollars (not including staff time).

The staff reviewed the 2012 emergency rule, Massachusetts’s policy on exclusion areas, and comments received during the rulemaking process as a basis for proposing a Board policy. During the 2012 emergency rulemaking effort for Chapter 20, the Board identified certified organic farms and livestock operations as areas which should be excluded from aerial pesticide applications conducted for public health purposes. The 2012 Operational Response Plan to Reduce the Risk of Mosquito-borne Disease in Massachusetts specifies four types of “no-spray zones”:

1. Certified organic farms
2. Priority habitats for spray-sensitive, state-listed rare species
3. Surface-water-supply resource areas
4. Commercial fish hatcheries/aquaculture

In Maine, we have also heard concerns voiced about conventional agriculture, beehives, and lobsters. In addition, direct and intentional applications over surface water are prohibited under state law and applications which may result in aquatic residues must be covered by a waste discharge license. Information from Massachusetts indicates that state-sponsored, public-health-related, mosquito-control programs do not present significant threats to beehives or agricultural sites. Moreover, since excluding even a point from an aerial spray project results in a minimum of a 23-acre exclusion (due to the commonly used 500-foot buffers), buffering beehives would present practical challenges and result in a significant reduction in mosquito-control efficacy. Marine waters would also be appropriately buffered. This factor, combined with the extremely low application rates and short persistence of the products commonly used in state-sponsored programs, suggests that any potential risks to lobsters would be extremely low.

Board Policy

Based on the considerations described above, the Board adopted the following policy on September 6, 2013:

Government entities conducting aerial, public-health-related, vector-control programs should exclude the five areas listed below from such control programs, as long as usable information has been provided to the governmental entity with sufficient lead time (a minimum of two weeks recommended) to allow for digital mapping of such areas.

When exclusion areas are located within priority vector-control areas, as determined by the Maine Center for Disease Control and Prevention (Maine CDC) and/or the Department, and the Maine CDC and/or the Department determine(s) that exclusion of certain areas would unreasonably reduce the efficacy of the control program, thereby creating an increased risk to human life, the Board recognizes that the governmental entity may elect not to exclude such areas from the vector-control program.

1. Certified organic farms, and farms for which an application for organic certification is pending.

   Digital maps of the crop or livestock areas must be provided to the Department in advance of the control program, in a file type that is compatible with Department software.

2. Other farmland for which the farm operator demonstrates that the potential for pesticide residues presents significant economic risks.

   Digital maps of the crop or livestock areas must be provided to the Department in advance of the control program, in a file type that is compatible with Department software

3. Great ponds, rivers, marine waters, and public water supplies derived from surface waters, as determined by the Department.
4. Documented fish hatcheries and aquaculture sites.
5. Endangered species habitat, as described by county bulletins published by the US Environmental Protection Agency and for which the proposed application presents significant threats.

Report and Plan To the Joint Standing Committee on Agriculture, Conservation and Forestry Pursuant to Resolve 2013, Chapter 13: Directing the Department of Agriculture, Conservation and Forestry To Develop a Plan for the Protection of the Public Health from Mosquito-borne Diseases

Report
To the Joint Standing Committee on Agriculture, Conservation and Forestry

Pursuant to Resolve 2013, Chapter 13

Concerning the Development of A State Plan to Protect the Public Health from Mosquito-borne Diseases

Submitted by the
Maine Department of Agriculture,
Conservation and Forestry
In Cooperation with the
Maine Department of Health and Human Services

December 20, 2013

ACRONYMS USED

Maine Center for Disease Control	ME CDC
Maine Department of Agriculture, Conservation and Forestry	DACF
Vector-borne Working Group	VWG
U.S. Environmental Protection Agency	EPA
U.S. Center for Disease Control	US CDC
Mosquito-borne Diseases	MBD
Maine Department of Environmental Protection	DEP
Integrated Pest Management	IPM
West Nile Virus	WNV
Eastern Equine Encephalitis	EEE
Maine Board of Pesticides Control	BPC

SECTION 1: EXECUTIVE SUMMARY

This report and accompanying plan were prepared as directed by Resolve 2013, Chapter 13 (appendix 2). The resolve was enacted instead of LD 292, which sought to establish state authority to plan, improve readiness and potentially intervene during a mosquito-borne disease outbreak (appendix 3). Mosquito-borne disease (MBD) is expected to become an increasing threat in Maine yet no state agency has explicit authority to plan, prepare or intervene in a MBD outbreak.

A proactive approach on the part of the state will ultimately reduce the incidence of MBD, thereby saving lives and preventing potentially debilitating disease.[1,2,3,4] Currently, the Maine Bureau of Health Center for Disease Control (ME CDC) coordinates implementation of a MBD surveillance and prevention plan. However, this program is inadequate for adequately characterizing the scope or severity of MBD threats. The Department of Agriculture, Conservation and Forestry (DACF) and ME CDC agree that upgrading the state's mosquito monitoring capability is the single most important recommendation for preventing MBD.

The U.S. Center for Disease Control (CDC) has taken the position that the benefits of controlling mosquitoes prior to and during a disease outbreak demonstrably exceed the risks.[1] A coordinated effort and long-term plan would accommodate the use of non-pesticide strategies and lower-risk pesticides than would of necessity be used in an emergency situation.[5] The cost of vector-borne disease prevention is considerably less than the cost of control during an epidemic.[6,7] Mosquito control strategies have been researched extensively and can be refined such that risks to humans and the environment are minimized. Maine is one of the most conservative states in the country relative to pesticide use;[8] DACF and ME CDC fully support and expect this philosophy will continue in the management of MBD. However, Maine is unprepared to mount an effective response to protect people in the event of a MBD outbreak.

In many states, the mosquito control programs are conducted by state-level agencies, or by mosquito control districts with jurisdiction over counties or towns.[9] Maine's current policy of relying entirely on municipalities to conduct their own emergency mosquito control operations is less than ideal, because:

- In general, emergency responses are handled at the state and federal level, especially those that involve multiple jurisdictions;
- Municipalities don't necessarily have the expertise, infrastructure, or funds for emergency responses;
- MBD require a very rapid response to be effective, and it is unclear whether municipalities have the ability to conduct such a response;
- MBD do not follow municipal boundaries.

Entomological expertise within DACF may be of critical importance in enhancing Maine's readiness to prepare or intervene to prevent a MBD outbreak. It is the position of DACF that state authority to coordinate and/or implement emergency MBD responses is in the public interest and will ultimately save lives.

The Maine Legislature should also be aware that—because certain types of mosquito-control activities now must be conducted in accordance with Maine Department of Environmental Protection (DEP) Waste Discharge Laws—wide-area mosquito control programs are currently not practical because of

CMR 06-096, Chapter 2, which requires applicants to demonstrate they have title, rights and interest in the land being sprayed, which is not useful or feasible during a wide-area mosquito control program.

SECTION 2: BACKGROUND INFORMATION

Resolve 2013, Chapter 13

Based on evidence of increasing West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE) activity[10] and the potential for MBD impacts, DACF submitted legislation in 2012 to establish state authority to coordinate and/or conduct mosquito control activities to prevent a mosquito-borne disease outbreak, and to plan a coordinated response in the event such an outbreak occurred.

LD 292 (appendix 3) was not enacted by the 126th Maine Legislature. Instead, a resolve (appendix 2) was enacted directing DACF to develop, within existing resources, and in cooperation with the Maine Department of Health and Human Services (DHHS), a plan for the protection of the public health from MBD. This report explains those planning efforts and discusses a number of associated issues.

Why Should the State Be Concerned About Mosquito-borne Diseases

The incidence of MBD is on the rise across the U.S. and there is evidence that MBD virus activity is increasing in Maine, too. Public health officials and entomologists are particularly concerned that EEE virus has become much more active in Maine. Although EEE is a relatively rare among people, the severity of the illness is high; two-thirds of the people who become ill with EEE die or suffer permanent neurological impairment. Although Maine has not yet had a confirmed human case of EEE, there is concern that could happen in the near future (appendix 4).

These important trends and indicators lead public health officials and entomologists to be concerned about mosquito-borne virus risks in the near future[10]:

- Since its arrival in North America in 1999, WNV has spread steadily throughout the continent, and mosquito testing in Maine confirmed its presence in Maine beginning in 2002.
- The first confirmed human case of WNV occurred in 2012. In addition, in-state mosquito monitoring reveals an overall upward trend.
- Detections of EEE virus—which were unheard of in Maine until recently—have been on the upswing over the last decade. For instance, in 2009, 15 horses, one llama, and three flocks of pheasants all fell victim to EEE. And in 2013, 26 separate mosquito pools tested positive for EEE, plus three horses, one emu and one flock of pheasants. In addition, three mosquito pools tested positive WNV.
- Blood samples taken from moose, deer and turkeys since 2009 reveal that the EEE virus is established in at least 15 of Maine's 16 counties.
- Recent and projected changes in Maine weather patterns suggest conditions will favor increased mosquito-borne virus risk over the next 30 years. Warmer, wetter summers favor increases in mosquito populations. Longer, frost-free warm seasons favor increased virus amplification between birds and mosquitoes.

Both WNV and EEE can cause encephalitis, which is sometimes fatal or can result in permanent neurologic impairment. Either outcome is very costly to the health care system. The cost of a single human case of EEE has been estimated to range from $21,000 for mild, transient illness, to as much $3 million for individuals who suffer permanent neurologic damage.[6] The average medical cost per case of WNV is $36,000.[11]

A study of the 2005 WNV outbreak in California, involving 163 human cases, concluded a total economic impact of $2.28 million. A cost-benefit analysis indicated that only15 cases of West Nile neuroinvasive disease would need to be prevented to make the emergency spray cost-effective.[12]

SECTION 3: STATES' ROLE

How Other States Address Mosquito-borne Diseases

Most states currently address emergency mosquito control activities in statute, in part because municipalities are not well positioned to conduct timely and effective mosquito control projects. In the majority of the states, there are established mosquito-control programs that are most often run at the municipal, county or control district level. Some of these programs date back to the early 1900s. Many of the local-area mosquito control programs were expanded, augmented or redirected over the last decade as state public health officials strove to address the emerging threat of WNV. In some states, state organized wide-area control programs were also instituted when the surveillance data indicated that WNV disease risk was high.[6]

In the five other New England states, some form of government-sponsored mosquito-control program has been conducted over the last few years. Moreover, all five states have established mosquito control districts covering at least a portion of the state.[13]

A New Hampshire legislative task force in 2007[14] reached similar conclusions and made similar recommendations as ME CDC and DACF do in this report. The New Hampshire task force findings included:

- Mosquito surveillance is an important tool, both for detection and for public awareness, and that long-term surveillance is important;
- Maintaining surveillance during years in which human infection is perceived to be low provides early warning, awareness, and educational benefits;
- A state committee would be valuable in providing oversight and coordination of interagency efforts;
- The state should consider taking responsibility for mosquito trapping and development of entomology expertise;
- Revenue for effective long-term mosquito surveillance is necessary.

South of New England, more aggressive and wide-scale mosquito abatement programs are common. According to information provided by the American Mosquito Control Association (AMCA), at least 41 states have organized mosquito-control districts that participate in the AMCA. In addition, at least 15 states have local mosquito control agencies (county or municipal) that participate in the AMCA. Governmental mosquito control programs of some type occur in all 48 contiguous states. A number of publications note that mosquito control programs have expanded or became focused on disease prevention since 1999.[15]

The emergence of WNV has also created a great deal of state legislative activity. According to the National Conference of State Legislatures, 116 mosquito control bills were introduced into state legislatures between 2003 and 2006, the period during which WNV became prevalent across the continental United States.[16]

Maine's Current Approach to Preventing Mosquito-borne Diseases

The Vector Borne Working Group (VBWG) was established by DHHS in 1986 to coordinate state efforts in combating vector-borne diseases. By 2005, the VBWG and the ME CDC had begun developing Maine's first Mosquito-borne Disease Response Plan which later evolved into the "State of Maine Arboviral (Mosquito-borne) Illness Surveillance, Prevention and Response Plan" (Arboviral Plan)(appendix 4). Most states developed similar plans modeled on the US CDC guidance for the prevention of WNV, first published in 2003.[1]

Currently, the ME CDC administers the ME CDC Arboviral Plan which is updated annually. A cornerstone of the ME CDC Arboviral Plan involves disease surveillance. Under this plan, ME CDC conducts a variety of disease surveillance activities, including a small mosquito surveillance program, avian surveillance, non-human mammal surveillance and human disease surveillance. When that surveillance indicates that the disease threat is elevated, ME CDC initiates public education activities intended to help the public reduce the chances of being bitten by vector mosquitoes. Press releases are issued and municipal and school health officials in the affected areas are alerted to the elevated risk and the recommended personal protection steps to reduce those risks.

When surveillance data indicates that the mosquito-borne disease risk is approaching a critical level, ME CDC directly communicates with the municipal and school officials in affected areas, to review and emphasize appropriate disease prevention strategies. To date, insecticide applications have been a very limited part of the response by municipalities, in large part because Maine's disease surveillance network is not adequate to definitively characterize the level and geographic extent of the risk. However, the elevated risk circumstances in Maine have occurred late in the season, when daily temperatures began to discourage mosquito activity, pesticide efficacy was expected to be reduced due to low overnight temperatures, and the likelihood of a mosquito-killing hard frost was increasing.[17]

Under the Maine Arboviral Plan, municipalities bear complete responsibility for mosquito control activities. Maine does not have mosquito control districts and the state has neither authority nor funding to conduct mosquito control. Officials from both ME CDC and DACF have raised questions about the capacity of municipalities to conduct a rapid, coordinated response to a mosquito-borne public health emergency. Concerns about the capacity of municipalities to adequately respond were one of the principle reasons that DACF submitted LD 292 (appendix 3). At least two Maine town governments (Kittery and York) have contracted for mosquito surveillance and preemptive mosquito control services for a number of years.

SECTION 4: POTENTIAL FOR ADVERSE PUBLIC HEALTH IMPACTS FROM USE OF INSECTICIDES FOR THE PREVENTION OF MOSQUITO-BORNE DISEASES

ME CDC and DACF have investigated the potential risks to human health arising from wide-area, public-health related mosquito-control programs. ME CDC conducted a Rapid Health Impact Assessment which involved an epidemiologic literature review of 34 studies (appendix 5). DACF performed a thorough review of the updated human health risk assessments completed by the U.S. Environmental Protection Agency (EPA), the most authoritative source of scientific risk data for pesticides (appendix 6). The whole range of potential risks including acute poisoning, carcinogenicity, allergic, respiratory and other chronic effects were evaluated. Based on these assessments both agencies agree that—when the risk of disease is high—the best available science indicates that the benefits of public health vector control programs far exceed the human health risks, especially when the control programs are conducted using best practices.

The ME CDC literature review concluded:

> "The literature consistently shows that when used at recommended concentrations for ULV applications, pyrethroid insecticides pose very low risks to human health. It also shows that when applied aerially, the risk to human health is lower than when applied by truck mounted sprayers. The products that have been suggested for use in Maine by the Maine BPC in the case of a mosquito-borne public health emergency have active ingredients that are the least acutely toxic of the pyrethroids (d-phenothrin (sumithrin®), further reducing the potential risk for adverse human health effects due to pesticide exposures. Finally, in epidemic arboviral transmission settings, it has been consistently determined that the risk to human health from MBD is greater than the risk of acute pesticide poisoning." (appendix 5)

Both agencies also agree that the potential health risks of applying pesticides should be given serious consideration, and all proven risk-reduction strategies should be promoted and implemented. Those strategies include:

- To the extent feasible, promote and utilize non-chemical strategies for reducing mosquito vector populations before pesticides are used.
- Exercise great caution around any decision to apply insecticides for control of mosquitoes.
- Use careful analysis of the best available science in selecting/recommending products for use in adult mosquito control programs. The EPA has approved several active ingredients for public-health mosquito-control programs. While EPA has determined that the ingredients all have acceptable human health risks when used for this purpose, state agency personnel agree that certain ingredients are preferable from a human health perspective.
- Conduct wide-area control programs at night to reduce human exposure.
- Conduct aggressive public notice campaigns using multiple communication tactics (such as reverse 911 calling, door hangers, radio, TV and newspapers) prior to any wide-area control program so that the public can further reduce any chance of pesticide exposure and increase efficacy.
- Carefully monitor wide-area programs for public health and ecological impacts.

SECTION 5: POTENTIAL FOR ADVERSE ENVIRONMENTAL IMPACTS FROM USE OF INSECTICIDES FOR THE PREVENTION OF MOSQUITO-BORNE DISEASES

Given the value of Maine's natural resources and the importance of protecting our environment it is critical that potential impacts are carefully considered, and steps taken to mitigate them, before any mosquito control activities are conducted in Maine. All control methods of either larval or adult mosquitoes have the potential for adverse environmental impacts. DACF scientists reviewed reports and published literature evaluating potential ecological impacts of various mosquito control methods, as well as impact assessment studies conducted as part of actual mosquito control programs in other states (see appendix 1). In addition, the DACF pesticides toxicologist summarized the risks to terrestrial organisms and aquatic sediment organisms from wide-area public-health mosquito insecticide use (appendix 6). The attached DACF Plan, and the recommendations in this report, are based on the best available science on ecological impacts and impact mitigation strategies of mosquito control activities.

Strict adherence to Integrated Pest Management (IPM) principles will—by definition—serve as a solid basis for minimizing both the use of pesticides and any associated risks. In an IPM program, non-chemical control methods are the first resort and chemical strategies generally are applied only if needed. For example, non-chemical control strategies such as community campaigns to promote elimination of man-made mosquito breeding habitats like bird baths and used tires, have been shown to be effective in reducing WNV risk. However, pesticides are, at present, a critical tool for protecting human health when other strategies are not sufficient. This is especially true of EEE vector mosquitoes which breed primarily in natural wetlands, where non-chemical methods are not feasible and could be more environmentally disruptive.

In Maine, larval mosquito control programs are already tightly regulated under a DEP Waste Discharge License, which limits pesticide use to circumstances where there is a demonstrated public health need. In addition, only approved products such as the bacterial pesticides *Bacillus thuringiensis israeliensis* (*Bti*) or *Bacillus sphericus* (*Bs*) may be used. These biological products have specific targets in the gastro-intestinal tracts of biting flies, including mosquitoes, which limit their effects to non-target organisms.

Public health related adult-mosquito-control activities generally involve insecticide spraying, and should be conducted using extreme caution. The primary ecological concerns surrounding adult mosquito insecticide spraying relates to non-target effects on both aquatic and terrestrial invertebrates. Again, close adherence to IPM principles is of paramount importance in minimizing those risks.

A number of researchers have investigated ecological impacts of public health related mosquito spraying. While there is evidence that certain control protocols can negatively impact honey bee populations, it has been demonstrated that impacts on pollinators can be effectively managed by utilizing the most recent protocol preferred in the Northeast United States, which utilizes extremely short lived synthetic pyrethroids applied at ultra-low rates at night. Bee health monitoring conducted in Massachusetts demonstrated no effects on bee mortality under this protocol.[18] The Northeast protocol also serves to minimize the risks to other invertebrates due to the combination of the extremely short life of the product and the exceptionally low application rate of 0.0036 pounds of active ingredient per acre.

One study of California creeks raises questions about the potential impacts on sediment invertebrates of the synergist piperonyl butoxide, which is used to enhance the efficacy of pyrethrins and pyrethroids.[19] EPA is currently seeking data on piperonyl butoxide and the other pyrethroids regarding effects on sediment dwelling invertebrates. The DACF is mindful of these questions and recommends extra care be exercised, and monitoring for effects should be a component of any public health related mosquito control program. However, overall, the scientific consensus suggests that the ecological risks are low for public health related adult mosquito control programs, and that using the Northeast protocol further reduces the risk.[20] [21]

SECTION 6: STATE AND FEDERAL HEALTH AGENCY POSITION ON PUBLIC HEALTH MOSQUITO CONTROL

The US CDC position on controlling mosquitoes as a means of reducing the incidence of mosquito-borne disease is described in the 2013 revision to the publication, "West Nile Virus in the United States: Guidelines for Surveillance, Prevention and Control."[1] The US CDC position is also articulated in the "Joint Statement on Mosquito Control in the United States from the U.S. Environmental Protection Agency (EPA) and the U.S. Centers for Disease Control and Prevention (CDC)."[22] In summary, the US CDC recognizes when the risk of disease transmission is high that mosquito control is an appropriate intervention strategy for reducing the incidence of human disease. Both the EPA and CDC promote non-chemical strategies for reducing vector mosquito populations before the use of chemicals. Both federal agencies also support carefully planned use of adult mosquito control products when circumstances necessitate such use. The US CDC goes on to state:

> "Insecticides to control larval and adult mosquitoes are registered specifically for that use by the U.S. Environmental Protection Agency (EPA). Instructions provided on the product labels prescribe the required application and use parameters, and must be carefully followed. Properly applied, these products do not negatively affect human health or the environment. Research has demonstrated that ULV application of mosquito control adulticides did not produce detectable exposure or increases in asthma events in persons living in treated areas. The risks from WNV demonstrably exceed the risks from mosquito control practices."[1]

ME CDC has not taken an official position about the propriety of controlling adult mosquitoes to reduce the incidence of MBD; however, the Rapid Health Impact Assessment (an epidemiologic literature review) performed by ME CDC staff came to the conclusion that:

> "In the event that all other options for mosquito control have been exhausted when confronted with a mosquito-borne public health emergency, it would be beneficial for human health to perform aerial insecticide applications in designated high-risk areas. The pesticides that would be used, specifically synthetic pyrethroids, do not appear to have any significant risk to human health when applied using the recommended concentrations." (appendix 5)

SECTION 7: ABOUT THE DACF PLAN

The DACF Plan attached to this report reflects the research and planning conducted by DACF, in cooperation with ME CDC and other experts from across the U.S. This plan was developed to address mosquito-borne illness, within existing resources, as directed by Resolve 2013, Chapter 13 (appendix 2). The plan acknowledges that most of the capacity available through the ME CDC is already described and committed by way of the State of Maine Arboviral Plan (appendix 4). Accordingly, the DACF plan primarily explores opportunities to leverage existing Department expertise to assist the ME CDC in its disease prevention efforts.

SECTION 8: MOSQUITO CONTROL APPROACHES

DACF and ME CDC staff have expended considerable resources researching the best available science around the emergence of MBD in Maine and the best practices for mitigating that threat (appendix 1). Authoritative sources recommend an IPM approach that emphasizes 1) public education to promote personal protection and community engagement to elimination stagnant water sources around the home, 2) control of vector mosquito species in the larval stage using minimum risk pesticides and strategies when possible, and, 3) wide area applications of adulticides to prevent or respond to critical MBD risk. However, larval control of mosquitoes in a rural and wet state like Maine would require enormous resources, and must be initiated prior to the time of year when the threat of MBD can be characterized. Furthermore, while eliminating stagnant water around the home is somewhat effective against WNV vectors, this strategy has limited effect on EEE vectors, which breed primarily in natural habitats such as maple swamps. These factors suggest that relying primarily on larval control strategies to prevent mosquito-borne disease in Maine may be largely impractical.

Historically, Maine has been conservative about the use of pesticides.[8] DACF and ME CDC staffs fully agree it's appropriate to act very cautiously with respect to the use of insecticides in Maine for the purposes of preventing MBD. However, given the impracticality of relying on larval mosquito control for preventing disease in a rural, wet state like Maine, there are some distinct advantages to considering carefully conducted and targeted adult mosquito spraying limited to periods of critical disease risk. Such a strategy allows government agencies to limit the use of insecticides to only those times and location where it's needed most, which reduces unnecessary pesticide use and costs.

The disadvantage of relying on the "critical need only" insecticide use approach is that spraying adult mosquitoes involves greater risks than use of the bacterial insecticides used to control mosquito larvae. However, in New England, adult mosquito-control methodology and product selection (the Northeast protocol) has been demonstrated to effectively reduce the human disease threat while minimizing risks. Improving Maine's preparedness and capability to prevent or respond to an MBD outbreak through the use of limited, targeted, ultra-low volume adulticide applications if necessary will improve our ability to protect human health. [18, 23, 24]

Mosquito ecologists in Maine, Massachusetts and New Hampshire agree that a significant challenge in EEE vector management is that these mosquitoes breed in 'crypts' among the submerged tree roots and cattails in wetlands dispersed across New England. Maine has EEE vector habitats in southern, central and western Maine.[25]

SECTION 9: RECOMMENDATIONS

Based on the considerations outlined in this report and attached plan, and the DACF assessment of the best available science, DACF offers the following recommendations for consideration:

1. **Increase mosquito surveillance.** Because the state does not have an emergency mosquito control role, Maine's ability to prevent MBD relies largely on the ME CDC's disease surveillance program. If the necessary resources can be identified, a more robust monitoring program would allow Maine public health officials to provide more accurate and timely information about the disease threat, thereby allowing the public to take common-sense precautions, such as using repellents and staying indoors when it's most important to do so. Current funding, which comes

with a tenuous future, provides sufficient resources to operate 25 monitoring sites, primarily in York and Cumberland Counties, from July through September. This level of monitoring is grossly inadequate for the purposes of characterizing the severity and the geographic distribution of a mosquito-borne disease threat. **Moreover**, mosquito monitoring offers significant public benefit without any associated risks. DACF and ME CDC agree that if resources can be identified, the single most beneficial improvement that Maine should consider in connection with mosquito-borne disease prevention is enhancement of the mosquito monitoring program.

2. **Provide explicit state authority to DACF to plan and prepare for MBD prevention activities, and to conduct emergency mosquito intervention activities if MBD threat is critical.** Maine citizens and lawmakers have expressed concerns about the potential impacts of pesticide use for controlling mosquitoes. These concerns should not be minimized and state officials must be mindful of the concerns as they consider MDB prevention strategies. However, in the event of a EEE or WNV outbreak, when risks of MBD-caused human and animal fatalities exceed the risks associated with pesticide use, the public interest may be best served by using very limited and precisely targeted ultra-low volume insecticide application to control disease vector mosquitoes. The recent situation in Vermont illustrates the importance of this strategy. Like Maine, Vermont was ill prepared to respond when two people in the same town were killed by EEE in 2012. It took state officials considerable valuable time to obtain the necessary permits, notify the public, develop and approve a contract with an aerial applicator, and conduct the spray operation. Such last minute response increases the likelihood of mistakes, accidents and higher costs. Maine can learn from Vermont's experience by preparing in advance. Such preparation may never be needed, but as with all emergency preparedness, it is much better to be prepared to implement action plans quickly and safely if the emergency arises.

   Currently, no state agency has any explicit statutory authority or responsibility to manage the mosquito-borne disease threat. The responsibility for potential emergency mosquito-control during a disease outbreak falls solely upon municipalities which have limited capacity or expertise, and there is no coordination among communities. The ME CDC presently takes the lead role on MBD in conjunction with its broader disease prevention mandates and because federal public health funding allows for a mosquito-borne disease prevention component. Providing explicit state authority to conduct planning and preparation activities, coupled with authority to conduct emergency intervention activities consistent with legislative policy on use of pesticides, would ensure that the state can respond during a public-health crisis, and that the mosquito-borne disease threat doesn't get lost when state agency resources cannot keep pace with demands. A 2007 New Hampshire Legislative task force reached many of the same conclusions relative to the appropriate state role in preventing MBD.[14]

   If the necessary resources were identified, the following are examples of some activities that would enhance the state's ability to better manage the mosquito-borne disease threat include:
   - Track national research and mosquito monitoring strategies for evolving best practices.
   - Track national research and utilizing in-state resources to identify the lowest risk mosquito control products and strategies.
   - Conduct inter-agency research and planning on the potential for mosquito habitat reduction strategies such as reducing the inadvertent creation of mosquito habitat through construction and road maintenance practices.

- Work with the DEP and other state agencies to investigate potential streamlining of waste discharge licenses required to treat mosquito larvae and for wide-area adult mosquito control activities.
- Explore opportunities to strengthen medical entomology expertise in Maine. Currently there are no medical entomologists at public agencies or universities in Maine.
- Identify and train state agency field staff and develop a plan for utilizing them to assist in an expanded mosquito monitoring program if needed in an MBD outbreak.
- Conduct mock mosquito-borne emergency exercises to identify bottlenecks and weaknesses and improve readiness.
- Develop and maintaining a Geographical Information System database (GIS) of organic farms, fish hatcheries and other sites that should be excluded from a public-health related mosquito-control operation. This database, coupled with in-state capacity to quickly produce digital maps of high risk areas targeted for mosquito control, would enhance the ability of the state to quickly respond if needed.
- Investigate the propriety of entering into mosquito-control contingency contracts in the case of a public-health emergency. Other states have adopted this strategy to eliminate the time-consuming process required for state contract approval and to lock in competitive pricing.

3. **Consider legislation to exempt public health related mosquito control programs from the "Title, Rights and Interest" requirement contained in CMR 06-096, Chapter 2**.This rule requires any governmental agency to demonstrate Title, Rights and Interest in property identified in waste discharge license applications, including public health mosquito control projects. Such a requirement is neither feasible nor useful for a wide-area mosquito control operation if it becomes necessary to address a MBD outbreak.

4. **Provide an opportunity for the Joint Standing Committee on Agriculture, Conservation and Forestry to review the annual Maine MBD surveillance reports prepared by the ME CDC**. This report would keep the Maine Legislature in tune with the evolving disease threat and the state's prevention activities

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State of Maine Department of Agriculture, Conservation and Forestry

Plan to Protect the Public Health from Mosquito-Borne Illness

Pursuant to Resolve 2013, Chapter 13

Presented by the Maine Department of Agriculture, Conservation and Forestry in Cooperation with the Maine Department of Health and Human Services

December 20, 2013

Executive Summary

The threat of mosquito-borne illness is on the rise in Maine and is predicted to increase in the near future. However, the State has a very limited capacity for monitoring threat levels or taking action to reduce those disease threats. Responsibility for managing this public health risk falls primarily to municipalities, most of which lack resources and capacity for monitoring or controlling mosquitoes. Two towns in York County contract with private companies to monitor and control mosquitoes. A few schools rescheduled fall sports games in 2013 to avoid peak mosquito activity when EEE risk was high but the vast majority of Maine's communities are doing very little and are unprepared to address this risk.

Individual landowners can and do purchase and apply pesticides on their properties or they can hire a pest control company to do applications. As mosquito-borne illness threats increase, the potential for pesticide misuse and overuse is also likely to increase. There are more than 1,300 pesticide products, including repellents, currently registered in Maine for use against mosquitoes. The amount and extent to which these pesticides are applied on private properties is not known.

The purpose of this plan is to describe the Maine Department of Agriculture, Conservation and Forestry responsibilities and proposed actions within existing resource levels and authorities, to protect public health from mosquito-borne diseases. Improving Maine's readiness to respond to the increasing threat of mosquito-borne illness will reduce the incidence of serious, sometimes debilitating disease and ultimately save lives.

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About This Plan

This plan was developed by the Maine Department of Agriculture, Conservation and Forestry (DACF) in cooperation with the Maine Department of Health and Human Services, Center for Disease Control and Prevention (ME CDC) as directed by State Legislative Resolve 2013, Chapter 13. The purpose of this plan is to describe the DACF responsibilities and proposed actions, within existing resource levels and authorities and in collaboration with other appropriate agencies and entities, to protect public health from mosquito-borne diseases. This plan addresses specific considerations as directed by the Resolve including 1) ecological and economic impacts of proposed methods for controlling mosquitoes and preventing mosquito breeding, 2) integrated pest management (IPM) techniques, 3) description of the criteria for declaring a mosquito-borne disease public health threat, 4) elements of a response to such a public health threat, and 5) the responsibilities and lines of authority during a public health threat.

This DACF plan is based on a thorough review of information from other states, federal agencies and other reliable sources, as well as scientific research findings including authoritative guidance published by the Association of State and Territorial Health Officials[1] and U.S. Centers for Disease Control and Prevention (US CDC)[2]. This plan complements the State of Maine Arboviral (Mosquito-Borne) Illness Surveillance, Prevention and Response Plan[3] (hereafter referred to as the ME CDC Arboviral Plan) developed and updated annually by ME CDC (appendix 4). Because Resolve 2013, Chapter 13 directs DACF to develop a plan "within existing resources," the Department constructed the DACF plan based on currently existing resources and commitments. Accordingly, it primarily explores opportunities to leverage existing Department expertise to assist ME CDC in its disease prevention efforts. It must be noted that current resource levels and lines of authority significantly limit the State's capabilities to plan, prepare and effectively respond to a mosquito-borne illness outbreak.

Why This Plan is Needed

The threat of mosquito-borne illness is on the rise in Maine and the rest of the continental U.S. There has been a dramatic increase in the prevalence of arboviruses (arthropodborne viruses) in the past decade, beginning with the first reported West Nile Virus (WNV) outbreaks in the U.S. in 1999. WNV is now found in all 48 continental states. In the U.S. there were 5,674 human cases of WNV with 286 deaths in 2012 and 2,300 human cases with 105 deaths in 2013. Maine had its first human case of WNV in 2012.

Another mosquito-borne disease, Eastern Equine Encephalitis (EEE), found primarily in the eastern U.S. (including Maine), is rarer but more lethal. In 2008 a fatal case of EEE was diagnosed in a Massachusetts resident who may have acquired the infection while vacationing in Maine. From 2001 to 2012, evidence of EEE infection in animals and mosquitoes was found in 15 of our 16 counties[3]. In 2012, there were 15 human cases in the U.S., including seven cases, three of them fatal, in Massachusetts, and two cases, both fatal, in Vermont. In 2013, six human cases and three deaths have been reported in five states. In Maine EEE killed 15 animals (horses and llamas) in 2009. Three horses and a flock of pheasants died of EEE in Maine in 2013. Although Maine has a limited arbovirus surveillance program, mosquito sampling and testing indicate that both EEE and WNV activity were high in 2012 and 2013.

In states where mosquitoes have been a historical disease threat, regional and/or local governmental authorities administer both local and wide-area mosquito control programs. There are no state-, county- or district-level mosquito control programs in Maine, and there is not an established process for coordinating mosquito surveillance or control efforts among communities. No state or regional agencies have financial resources or authority to conduct mosquito management activities. Public agency involvement is limited to coordinating a minimal mosquito and wildlife surveillance program, tracking reports of mosquito-borne illness in humans and domestic animals, and disseminating public information. Individual towns are responsible for developing, maintaining and financing local mosquito control actions. With increasing prevalence of EEE and WNV, it is imperative that the State of Maine critically review and assess resources, programs and policies for protecting Maine citizens from these public health threats. This plan is intended to describe DACF capabilities, authorities and responsibilities and to assess our preparedness for a rapid and effective response in the event of disease outbreak. Criteria, response elements and lines of authority for a phased response to increasing arbovirus illness threats are described below and summarized in Table 1.

Integrated Pest Management

Integrated Pest Management (IPM) is a systematic, science-based approach to managing pests, globally recognized as the most effective means of protecting people, our food supply, and other resources from pests while minimizing environmental and economic impacts. When applied to management of mosquitoes, IPM is sometimes referred to as Integrated Vector Management (IVM) or Integrated Mosquito Management (IMM). The key elements of public health IPM are a) education and outreach, b) pest surveillance and threat assessment, c) combinations of pest prevention and control measures when warranted, and d) evaluation of outcomes. The US CDC guidelines[2] highlight the importance of IPM for protecting humans from mosquito-borne illness. This DACF plan, and the ME CDC Arboviral Plan, are based on IPM principles and practices.

Public Health Threat Criteria, Phased Response and Responsibilities

As called for by Resolve 2013, Chapter 13, this plan describes actions DACF will take to protect public health from mosquito-borne illness threats. Table 1 shows the specific steps DACF will take in a phased response to arboviral illness threat levels. The criteria, elements of the proposed phased response, and description of the lines of authority and responsibilities in Table 1 were taken directly from the ME CDC Arboviral Plan. No state entity has explicit authority to declare a 'public health threat', however, as described in the ME CDC Arboviral Plan, 'If risk of outbreak is widespread and covers multiple jurisdictions, ME CDC will confer with local health officials and VBWG to discuss the use of intensive mosquito control methods. A State of Emergency may be declared by the governor pursuant to Title 37-B Chapter 13 Subchapter 2 § 742.' Additional 'critical threat level' criteria described in the ME CDC Arboviral Plan are 1) more than one confirmed human case of EEE or WNV in a community or focal area or, 2) multiple non-human mammal cases of EEE or WNV. Other quantitative measures considered in the determination of human risk levels include early season positive surveillance indicators, sustained elevated mosquito infection rates, high mosquito abundance in key bridge vector species, surveillance indicators from neighboring areas and other states in our region, and current and predicted weather and seasonal conditions (including time to expected mosquito-killing frosts).

Mosquito and Domestic Animal Surveillance

As described in the ME CDC Arboviral Plan[3], ME CDC is the lead agency for arboviral surveillance in mosquitoes, non-human mammals, birds and human illness cases. Testing of domestic animals and birds showing symptoms of arbovirus disease is conducted under the auspices of the DACF State Veterinarian.

Mosquito Surveillance: ME CDC conducts a small mosquito surveillance program through contracted services provided by Maine Medical Center Research Institute Vector-borne Disease Laboratory (MMCRI) and one or more private pest management companies. MMCRI may enlist additional cooperators to assist in mosquito trapping. In 2013, adult mosquitoes were monitored at just 25 sites located primarily in Cumberland and York counties. The monitoring protocol used by MMCRI is described in Table 2. Adult mosquitoes are collected from traps, sorted, and sent weekly from July through September, to ME CDC Health and Environmental Testing Laboratory (HETL) where they are tested for arboviruses. ME CDC tracks, records and disseminates weekly summaries of surveillance results from July through September and issues a final report at the end of the season. In addition, ME CDC tracks and shares arbovirus surveillance data reported from neighboring states and from US CDC reports.

Maine's current mosquito monitoring program, funded through federal grants to ME CDC, is not adequate for the purposes of characterizing the significance and the geographic distribution of a mosquito-borne disease threat. Nor is it adequate for utilizing mosquito surveillance software developed by US CDC[4] and recommended for use at the county or municipal level to provide predictive indicators associated with elevated human risk. Furthermore, ME CDC monitors adult mosquitoes only. Larval mosquito surveillance can serve as an early indicator of population density and expected adult emergence time for the different vector species. Surveillance of larval mosquito populations also provides an opportunity for targeted application of lower risk larvicides. Elimination of human-made larval habitats (such as discarded tires and unmaintained backyard pools) has been shown to reduce risk of human illness.

A more robust mosquito monitoring effort is needed to enable Maine public health officials to provide accurate and timely information about the disease threat, thereby allowing the public to take common sense precautions when it's most important. DACF and ME CDC agree that the single most beneficial improvement that Maine should consider in connection with the mosquito-borne disease threat is expansion of the mosquito monitoring program. In the absence of additional funding, creative solutions are needed.

With current resource levels and authorities, DACF has the following capabilities for mosquito surveillance:

- DACF (including Board of Pesticides Control (BPC)) will collaborate with ME CDC and other experts to review and annually update recommended response action thresholds.

- DACF State Entomologist, in collaboration with ME CDC and other experts, will annually review and document planned mosquito and arboviral surveillance protocols.

- DACF will identify appropriate DACF field staff available to augment contracted mosquito surveillance services if needed when disease threat is critical. Note: at present, DACF entomologists are tasked with other responsibilities and are not routinely engaged in mosquito surveillance activities. Mosquito surveillance is done by service providers contracted by the ME CDC. However, DACF field staff could, with some training, be tasked with deployment and operation of mosquito traps if priorities were shifted away from current responsibilities.

- DACF will work with partners to identify resources to train DACF staff to assist with mosquito monitoring, identification and transport if rapid expansion of mosquito surveillance is needed when risk of arboviral illness is critical.

- DACF will collaborate with ME CDC and other organizations (eg. Maine Office of Geographical Information Services (MEGIS) and/or University of Maine Remote Sensing Laboratory) to identify and develop mapping tools to guide optimal placement of additional mosquito surveillance sites if warranted.

- DACF will partner with ME CDC, the Vector-Borne Working Group (VBWG) and other experts to stay abreast of new research findings, and developments in surveillance and management methods and technologies.

Domestic Animal Surveillance. Some domestic mammals and birds are susceptible to arboviruses. Passive surveillance (reporting and testing of animals showing symptoms of arboviral infection) can provide an additional measure of mosquito and arbovirus activity, thus is an important tool for public health protection.

With current resource levels and authorities, DACF has the following capabilities for passive surveillance of domestic animals:

- The DACF State Veterinarian will continue to collaborate with ME CDC HETL and US CDC to facilitate testing of horses and other domestic animals (including farm-raised birds such as emus and pheasants) displaying symptoms consistent with mosquito-borne disease.

- The DACF State Veterinarian will continue to communicate annually with all Maine-licensed veterinarians describing clinical signs of diseases, prevention measures and reporting processes for reportable vector-borne diseases, such as EEE and WNV. The State Veterinarian will continue to encourage vaccination of domestic animals where appropriate, i.e. in species where vaccines are available.

- The DACF State Veterinarian will continue to facilitate collection of appropriate specimens for diagnostic testing of mosquito-borne disease.

Public Education

Public education is a critical component of mosquito IPM. Residents and visitors should be informed about effective personal protection measures such as staying indoors at dawn and dusk, proper dress for outdoor activities and the use of repellents. Residents must also be informed to recognize and drain man-made mosquito breeding habitats such as toys, tarps, bird baths, and clogged gutters.

With current resource levels and authorities, DACF has the following capabilities:

- DACF will continue to collaborate with ME CDC and other partners to promote public education on personal protection and elimination of man-made mosquito breeding habitat. DACF will continue to maintain the DACF website to ensure links to updated ME CDC information and announcements are readily available to the DACF audiences such as farmers, foresters, domestic animal owners, veterinarians, schools, pesticide applicators, visitors and the general public. DACF will continue to distribute ME CDC printed materials, when they are available, at DACF-sponsored events such as the Agricultural Trades Show, and DACF-staffed venues such as state parks.

- DACF will continue to participate with the VBWG, and to collaborate with ME CDC and other partners, in public education activities.

Mosquito Breeding Habitat Reduction

Communities and property owners can reduce the risk of arboviruses by eliminating and draining shallow sources of standing water such as bird baths, ditches, and clogged gutters. Tires used on farms to anchor tarps covering animal feed should be cut or drilled. Education campaigns and community events have been shown to be effective in addressing WNV. This approach is not as effective in reducing habitat of EEE vectors, which breed primarily in natural habitats that cannot be drained without ecological disruption. Research is needed to develop and demonstrate effective and environmentally sound methods for reducing EEE mosquito habitat. With current resource levels and authorities, DACF has the following capabilities:

- DACF will collaborate with ME CDC and other state agencies to inform farmers, land-owners, land-managers and the general public about recommended habitat reduction methods proven to reduce human risk while minimizing environmental impacts.

- DACF will collaborate with ME CDC, other state agencies and the VBWG to stay abreast of research on effective habitat reduction methods for man-made and natural mosquito breeding sites.

Mosquito Management

Biological Methods. Published research and communication with mosquito managers in other states indicate that effective biological IPM methods for mosquito control are lacking. A pilot program conducted in New Jersey found the use of laboratory-bred copepods as a predator of mosquito larvae to have extremely limited utility, primarily in human-made temporary water sources which can be more effectively eliminated by simply draining or removing them (Mark Mayer, NJ Department of Agriculture, personal communication Sept. 2013). A similar study in New York City showed disappointing results and was abandoned[5]. Relocation of mosquito-eating fish to vector mosquito breeding sites, which are often inaccessible and shallow water around tree roots in maple swamps, is not likely to be feasible or effective. A study showed that stocking dragonflies in Maine wetlands was ineffective in reducing mosquito abundance[6]. This study further showed this practice is likely to result in introduction of non-native species which could negatively impact our ecosystems. However, research may identify effective and practical biological strategies in the future. DACF will stay abreast of developments in this area.

Chemical Control Methods: Although non-chemical methods, such as the elimination of temporary mosquito breeding habitats and public education, are important components of mosquito IPM, it has been demonstrated that well timed and targeted pesticide applications may be critical to protecting people when mosquito-borne illness threats are high. Public health ‘wide area’ adulticide applications use trucks or aircraft equipped with ultra-low-volume (ULV) nozzles to apply very small volumes of a pesticide into the air to kill mosquitoes while they are flying. A product often used in our region is Anvil 10+10 applied at 0.62 fluid ounces (0.0036 lbs active ingredient) per acre. This product is regarded as the lowest risk choice for both humans and the environment because it is applied at such low volume and is very short lived.

The EPA has determined that the insecticides labeled nationally for this type of application do not pose unreasonable health risks to humans, wildlife, or the environment when used according to the label. Pesticides have been widely used to control mosquitoes throughout the U.S., providing ample opportunities to assess effectiveness and develop methods for minimizing negative impacts. Communities in Maine’s neighboring New England states have found it necessary to occasionally conduct wide area adulticide applications when surveillance showed EEE threat was very high. Planning and preparation to enable the safest wide area use of pesticides if needed in the event of a mosquito-borne disease outbreak will save lives.

With current resource levels and authorities, DACF has the following capabilities:

- DACF will collaborate with the VBWG and other experts to stay informed of proven non-pesticide mosquito management methods as they become available and provide recommendations for their use to municipalities, residents, and property owners and -managers.

- DACF will collaborate with ME CDC and other experts to develop guidance for municipalities and the general public on the use of pesticides for management of mosquitoes. BPC will develop and annually update the list of wide area public health ultra-low-volume mosquito adulticide products registered in Maine. The list will be annotated to highlight strategies to mitigate any environmental impacts or human health risks according to product labels and EPA risk assessments and will reflect any EPA-mandated label changes.

- DACF will collaborate with other agencies and experts to develop recommended protocols to assess impacts and efficacy of adulticide applications.

- DACF BPC will explore opportunities with Maine DEP to facilitate permitting processes allowing treatment of mosquito breeding habitats if needed to reduce threats to human health.

- DACF will develop guidance for municipalities seeking to contract for wide area ground or aerial pesticide applicators to enable swift, effective and targeted pesticide applications aimed at protecting human health and minimizing non-target impacts. This will also include updated lists of licensed applicators.

- DACF will explore opportunities for piggy-backing surveillance and outreach activities such as mosquito monitoring, mapping, wildlife disease surveillance and weather monitoring with existing DACF programs.

- DACF will collaborate with other agencies and non-governmental organizations (NGOs) to develop protocols and processes for identifying exclusion zones, such as organic farms and fish hatcheries, from any planned wide area adulticide applications.

- DACF State Apiculturist will cooperate with any planned wide area mosquito adulticide application operations to mitigate adverse effects on managed honey bee colonies.

- DACF will collaborate with other agencies and NGOs and emergency preparedness and response personnel and programs to develop notification procedures to be used to notify farmers, registered apiaries, municipalities, schools, and the Pesticide Notification Registry list in advance of any planned wide area mosquito adulticide applications.

Assessment and Reporting

Ecological Impacts

Natural resources are an important part of Maine's heritage and economy, so it is essential that methods and materials used for mosquito control be evaluated for possible environmental impacts. If pesticide applications are needed to protect human health, priority should be given to use of methods and materials that minimize risks of unintended ecological impacts.

Biological methods of mosquito control also have the potential for negative ecological impacts. For instance, a study conducted in York County showed that stocking dragonflies purchased from commercial suppliers has the potential for introducing non-native dragonfly species[6], which could be ecologically disruptive. Stocking or relocating fish, copepods, or other mosquito predators carries the same risk.

- DACF will continue to network and collaborate with agencies and programs within Maine and across the U.S. to stay abreast of current research on environmental and ecological impacts of mosquito management methods.

- DACF BPC Toxicologist will evaluate available chemical mosquito management methods and materials for their efficacy and potential ecological and human health impacts. BPC will provide an updated list of approved mosquito control pesticide products and recommendations for their use. Guidance will include methods for assessing efficacy of mosquito management activities and assessing and mitigating ecological impacts.

- DACF will collaborate with other appropriate experts and agencies to develop protocols for assessing efficacy and environmental impacts of any planned wide area mosquito control program.

- DACF will collaborate with ME CDC to provide the Joint Standing Committee on Agriculture, Conservation and Forestry an annual mosquito-borne disease surveillance report including records and assessments of any mosquito management actions taken by the State.

Economic Impacts

In 2013, the towns of York and Kittery, ME spent approximately $50,000 to $70,000 per town for contracted mosquito management services including mosquito surveillance, larviciding and adulticiding (Kimberly Foss, Swamp, Inc. personal communication). The cost of aerial pesticide applications conducted in Vermont in 2012 (20,000 acres) and 2013 (8,500 acres) for control of EEE vector mosquitoes (following two fatal human cases in 2012 and mosquito surveillance showing high disease threat in 2013) was approximately $2 per acre.

There are also economic considerations associated with mosquito-borne illness. For instance, it is estimated that medical costs associated with a single case of EEE ranges from $21,000 for mild, transient illness to as much as $3 million for individuals who suffer permanent neurologic damage[3]. An economic analysis of a WNV outbreak in California showed average WNV-associated medical costs were $19,500 per patient. This study compared the number of WNV cases reported inside versus outside an area treated to control mosquitoes and found that approximately 48 cases of WNV were averted by the spray, resulting in an estimated savings of $702,000 after factoring in the cost of the spray operation[7].

Planning ahead for mosquito management improves efficiency and effectiveness, saving money and avoiding the strain placed on local emergency response staffing, equipment and budgets by an emergency mosquito management response[1].

With Current Resource Levels and Authorities, DACF has the following capabilities:

- DACF will collaborate with other appropriate experts and agencies to develop protocols for assessing efficacy (a measure of cost/benefit) and economic impacts of any planned wide area mosquito control program.

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Table 1. Role of DACF in ME CDC Phased Response Plan for a West Nile Virus (Adapted from State of Maine Arboviral Illness Surveillance, Prevention and Response Plan 2013. DACF roles highlighted).

Risk Category	Probability of Human Outbreak	Definition for a Focal Area*	Recommended Response
1	Remote	All of the following conditions must be met: Prior Year No activity detected in a community or focal area. AND Current Year No current surveillance findings indicating EEE or WNV activity in the focal area.	1. Educational efforts directed to the general public on personal protection, such as use of repellents, and source reduction. DACF disseminates information via websites and DACF-sponsored events and other venues as staff time and resources permits. 2. Routine human and non-human mammal surveillance;. DACF State Veterinarian annually communicates with all ME-licensed veterinarians describing clinical signs of diseases, prevention measures and reporting processes for reportable vector-borne diseases, such as EEE and WNV. DACF Animal Welfare Program assists in outreach to domestic animal owners and municipalities through outreach to animal control officers. 3. Assess local ecology for mosquito abundance. DACF program will assist ME CDC by providing maps, GIS layers and expertise. 4. Consider larval and adult mosquito monitoring with routine collection and testing of mosquitoes. DACF will a develop and maintain a contact list of appropriate field staff who can be tasked with deploying and operating additional mosquito traps if ME CDC determines that disease threat warrants enhanced mosquito surveillance.
2	Low	Prior Year (WNV) Virus activity detected in mosquitoes. Prior 2 Years (EEE) Virus activity detected in mosquitoes during either of both of the past two years. OR Current Year	Incorporates previous category response, plus: 1. Expand community outreach and public education programs focused on risk potential and personal protection, emphasizing source reduction. DACF disseminates information via websites and DACF-sponsored events and other venues as staff time and resources permits. 2. Assess mosquito populations, monitor larval and adult mosquito abundance, submit samples to HETL for virus

* Focal area: May incorporate multiple towns or cities. Designation based on factors including mosquito habitat, current and historic virus activity, timing of current virus activity, current weather and seasonal conditions. Known/suspected location of exposure is used for human and non-human animal cases and not necessarily town of residence.

		EEE or WNV identified in a single mosquito trap location AND No non-human mammal or human cases	testing. 3. Use larvicides at specific sources identified by entomologic survey and targeted at vector species. If appropriate, consider source reduction techniques. DACF BPC will assess currently available mosquito control methods and materials and will provide guidance on use of pesticides, including methods for minimizing environmental impacts to municipalities, land-owners, schools and the general public on selection and use of pesticide products. 4. Enhance surveillance of human and non-human mammal surveillance. State Veterinarian collaborates with ME CDC HETL and US CDC to facilitate testing of horses and other domestic animals displaying symptoms consistent with mosquito-borne disease.
3	Moderate	Prior Year Confirmation of human and/or non-human mammal case(s) OR Sustained EEE or WNV activity in mosquitoes. OR Current Year Multiple EEE or WNV mosquito isolates AND No non-human mammal or human cases.	Incorporates previous category response, plus: 1. Increase larval control, source reduction, and public education emphasizing personal protection measures. 2. Actions to prevent disease may include targeted larviciding at likely vectors, and if current year activity, possibly ground adulticiding targeted at likely bridge vector species. DACF will assess currently available methods and materials and will provide guidance on use of pesticides, including methods for minimizing human and environmental impacts. 3. Enhance human surveillance and activities to further quantify epizootic activity. 4. DACF field staff may be directed to assist ME CDC with supplemental mosquito trapping by deploying and operating mosquito traps using predetermined protocols if needed.
4	High	Current Year Surveillance of increasing EEE or WNV activity in mosquitoes OR A single confirmed non-human mammal case of EEE or WNV OR A single confirmed human case of EEE or WNV.	Incorporates previous category response, plus: 1. Intensify public education on personal protection measures a. Utilize multimedia messages including press releases, local newspaper articles, cable channel interviews, etc. b. Actively seek out high-risk populations (nursing homes, schools, etc.) and educate them on personal protection. DACF School IPM Program assists in outreach to schools c. Issue advisory information on adulticide spraying. DACF assists in 2. Consider intensifying larviciding and/or adulticiding control measures as indicated by surveillance. DACF will intensify guidance and training to local officials on selection and use of pesticides.

			3. ME CDC will confer with local health officials to determine if the risk of disease transmission threatens to cause multiple human cases. If surveillance indicates a continuing risk of human disease and potential for an outbreak, intensified ground-based adult mosquito control may be recommended. DACF will assist ME CDC in evaluating disease surveillance indicators and meteorological information in consideration of the biological and ecological factors influencing human disease threats.
5	Critical	Current Year More than 1 confirmed human case of EEE or WNV in a community or focal area OR Multiple confirmed EEE or WNV non-human mammal cases.	Incorporates previous category response, plus: 1. Continued highly intensified public outreach messages through community leaders and the media emphasizing the urgency of personal protection. DACF will assist with messaging to people engaged in agriculture, conservation and forestry activities and the general public. 2. If risk of outbreak is widespread and covers multiple jurisdictions, ME CDC will confer with local health officials and Vectorborne Work Group to discuss the use of intensive mosquito control methods. A State of Emergency may be declared pursuant to Title 37-B Chapter 13 Subchapter 2 §742. DACF staff will participate in these discussions as members of the Vector-borne Work Group The declaration of an emergency may trigger application of mosquito adulticide. ME CDC may define targeted treatment areas for vector control following the declaration of an emergency. DACF will provide guidance in the selection and use of pesticides. 3. Ground-based adulticide applications may be repeated as necessary to achieve adequate control. DACF will provide guidance in the selection and use of pesticides.

Table 2. Field Methods Used for Mosquito Surveillance in Maine.

Light Trapping Adult mosquitoes are trapped using CDC miniature light traps (John W. Hoch Company, Gainesville, Florida) with a 6-volt lead battery. Approximately 5 pounds of dry ice are hung in an insulated cooler above the trap and vented at the bottom so that CO_2 gas drifted slowly from the cooler over the trap. Traps generally are hung in the late afternoon or early evening and situated so that the trap is always out of direct sunlight. Trap locations are chosen in secure places with habitats likely to have mosquitoes (adjacent to wetland habitat). Traps are retrieved in the early morning hours of the following day. Air temperature is recorded on a field data form at the time of trap placement and retrieval. Mosquitoes remain in the mesh and plastic trap and are stored in a cooler with either wet or dry ice for delivery to the laboratory. Mosquitoes from a trap are assigned an accession number and all collection data entered on a laboratory sheet with that number. Each collection site is geo-referenced with latitude and longitude either by GPS, by locating the site on DeLorme 3-D TopoQuads, or through the use of Google Earth.
Resting Boxes Resting boxes are rectangular wooden boxes measuring approximately 12" x 12" x 12",open on one end and painted flat black on the outside and either red or rust brown on the inside. Boxes are placed on the ground in wooded habitats. Mosquitoes utilizing these boxes as resting sites can be collected, identified and tested for arbovirus and serve as a useful indicator, particularly for EEE vector mosquitoes.
Gravid Trapping Gravid trapping is done with Hoch traps (Gainesville. Florida) powered by a 6-volt lead battery. The trap basin is filled with a standard seven-day hay infusion* to within 2 inches of the bottom of the trap. Traps are placed in the late afternoon or early evening and are collected during the early morning of the next day. They are placed so that they would not be in direct sunlight at any time during the trapping session. Air temperature is recorded at the time of trap placement and collection. Site locations are geo-referenced with latitude and longitude coordinates with a Garmin 12 GPS. Trapped mosquitoes are transported to the laboratory in the nets, in coolers with blue ice packets. **Seven-day hay infusion:* Approximately 2.5 ounces (about one small handful) of hay are submerged in a 5-gallon bucket filled with well water. The bucket is covered and left at ambient temperature for seven days. The resulting infusion is decanted and used in restaurant “bus” tubs and gravid trap basins for attracting gravid *Culex* species mosquitoes.

***Culex* species Egg Raft Collection**

Egg rafts of *Culex* species are collected using a different method. Black restaurant “bus” tubs 19”x15”x7” are placed in sites out of direct sunlight during the late afternoon or early evening and filled with one gallon of seven-day hay infusion. The tubs are inspected the following morning for egg rafts. The total number of egg rafts is recorded. Up to twenty-four egg rafts from each tub are collected into separate wells of polystyrene tissue culture plates with a small amount of infusion, and are covered and carefully transported to the lab. Air temperature and infusion temperatures are recorded at the time the tubs are placed and in the morning when egg rafts are collected. Each plate of egg rafts is assigned an accession number upon arrival at the lab and all collection data are recorded on a data sheet with that accession number. The rafts are kept at room temperature and first instar larvae are inspected to determine the species of *Culex*.

Adult Mosquito Identification

All female mosquitoes captured in light or gravid traps are identified by one person using a binocular dissecting microscope. Staff of the Maine Medical Center research Institute received training in mosquito identification from Drs. Howard Ginsberg and Roger LeBrun at the University of Rhode Island in 2005. Standard dichotomous identification keys for mosquitoes of North America and an unpublished key to the mosquitoes of New Hampshire provided by Dr. John Burger of the University of New Hampshire are utilized to aid in mosquito identification. Mosquitoes are frozen at $–20^{0}$C and identified as promptly as possible after collection. All collected mosquitoes that are not sent to the HETL for testing are either pinned as reference specimens or saved in pools by species and accession number for future reference. All environmental data for each trapping and mosquito species identified are entered into a Microsoft Access database for retrieval, manipulation and further study.

Rapid Response Monitoring

Rapid response monitoring is employed after an arbovirus-positive event occurs. This consists of setting multiple CDC mini-light traps with CO2 in the late afternoon, at the site where the positive animal had been found and at several nearby sites where mosquitoes are likely to be trapped. Captured mosquitoes are collected in the early morning and transported to the laboratory in a cooler on blue ice packets. After being briefly exposed to –150C to arrest movement, the mosquitoes are quickly identified alive on pre-chilled plaster of Paris or blue ice packets. Pools of up to 50 mosquitoes of the same species are placed in microcentrifuge tubes and immediately frozen at -70oC. Mosquito pools are then packed on dry ice and shipped overnight by FedEx to the ME CDC HETL for testing.

APPENDIX 1:

RESOURCES USED

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APPENDIX 2:

RESOLVE 2013 CHAPTER 13

APPROVED	CHAPTER
MAY 8, 2013	13
BY GOVERNOR	RESOLVES

STATE OF MAINE

IN THE YEAR OF OUR LORD

TWO THOUSAND AND THIRTEEN

H.P. 201 - L.D. 292

Resolve, Directing the Department of Agriculture, Conservation and Forestry To Develop a Plan for the Protection of the Public Health from Mosquito-borne Diseases

Sec. 1. Department of Agriculture, Conservation and Forestry to develop a plan for the protection of the public health from mosquito-borne diseases. Resolved: That the Department of Agriculture, Conservation and Forestry is directed to develop, within existing resources, a plan for the protection of the public health from mosquito-borne diseases, in cooperation with appropriate personnel from the Department of Health and Human Services and with other state agencies as may be necessary. In developing this plan, the department shall consider, at a minimum, the ecological and economic impacts of proposed methods of controlling mosquitoes and preventing their breeding. These proposed methods must include integrated pest management techniques and other science-based technology that minimizes the risks of pesticide use to humans and the environment. The department shall include in the plan the criteria for declaring a mosquito-borne disease public health threat, the elements of a response to such a threat and a description of the lines of authority and responsibilities during a public health threat; and be it further

Sec. 2. Report. Resolved: That the Department of Agriculture, Conservation and Forestry shall report on its plan for protecting the public health from mosquito-borne diseases to the Joint Standing Committee on Agriculture, Conservation and Forestry by December 15, 2013. The Joint Standing Committee on Agriculture, Conservation and Forestry may report out a bill on the plan for the protection of the public health from mosquito-borne diseases to the Second Regular Session of the 126th Legislature.

APPENDIX 3:

LD 292: AN ACT TO PROTECT THE PUBLIC HEALTH FROM MOSQUITO-BORNE DISEASES

126th MAINE LEGISLATURE

FIRST REGULAR SESSION-2013

Legislative Document	**No. 292**
H.P. 201	House of Representatives, February 7, 2013

An Act To Protect the Public Health from Mosquito-borne Diseases

Submitted by the Department of Agriculture, Conservation and Forestry pursuant to Joint Rule 204.

Reference to the Committee on Agriculture, Conservation and Forestry suggested and ordered printed.

Millicent M. MacFarland
MILLICENT M. MacFARLAND
Clerk

Presented by Representative GIFFORD of Lincoln.
Cosponsored by Senator SHERMAN of Aroostook and
Representatives: BLACK of Wilton, CRAY of Palmyra, SAUCIER of Presque Isle.

Be it enacted by the People of the State of Maine as follows:

Sec. 1. 7 MRSA c. 6-A is enacted to read:

CHAPTER 6-A

CONTROL OF MOSQUITOES

§171. Control of mosquitoes for protection of public health; state policy

It is the policy of the State to undertake appropriate activities to reduce disease-carrying mosquito populations that threaten the health of residents of this State. The State shall use a wide array of integrated pest management techniques and other science-based technology in a manner that minimizes the risks of pesticide use to humans and the environment.

§172. Department lead agency; powers of commissioner

The department is the lead agency of the State for carrying out mosquito-control activities as described in this chapter.

The commissioner may use all lawful methods for the control of mosquitoes and the prevention of their breeding, including conducting or contracting for mosquito-control activities and purchasing necessary equipment for the purposes of carrying out this chapter.

§173. Rules

The commissioner may adopt rules to carry out the purposes of this chapter. Rules adopted pursuant to this section are routine technical rules as described in Title 5, chapter 375, subchapter 2-A.

§174. Duties of commissioner

1. Study; plan; arrange cooperation. The commissioner, in cooperation with appropriate personnel from the Department of Health and Human Services, shall, when sufficient money for such purposes is available in the fund, consider and study mosquito-control problems, including mosquito surveillance; coordinate plans for mosquito-control work that may be conducted by private landowners, groups, organizations, municipalities, counties and mosquito-control districts formed pursuant to section 176; and arrange, so far as possible, cooperation among state departments and with federal agencies in conducting mosquito-control operations within the State.

2. Assist with disseminating information. The commissioner, in cooperation with appropriate personnel from the Department of Health and Human Services, shall, when sufficient money for such purposes is available in the fund, assist private landowners, groups, organizations, municipalities, counties and mosquito-control districts formed pursuant to section 176 with disseminating information to the citizens of the State about ways to reduce mosquito populations, to control breeding sites and to protect themselves from mosquito-borne diseases as well as other relevant information.

3. Implement mosquito-control response. In the event that a mosquito-borne disease public health threat is declared by the Commissioner of Health and Human Services pursuant to Title 22, section 1446, the Commissioner of Agriculture, Conservation and Forestry shall consult appropriate state agency plans and personnel and university and private sector experts to determine and implement an effective control response, which must include a wide array of integrated pest management techniques. The availability of funds must also be considered as part of the response planning.

§175. Maine Mosquito Control Fund

The Maine Mosquito Control Fund, referred to in this chapter as "the fund," is established to carry out the purposes of this chapter. The fund consists of any money received as contributions, grants or appropriations from private and public sources. The fund, to be accounted for within the department, must be held separate and apart from all other money, funds and accounts. Any balance remaining in the fund at the end of a fiscal year must be carried forward to the next fiscal year. The department may expend the money available in the fund and make grants to private landowners, groups, organizations, municipalities, counties and mosquito-control districts to carry out the purposes of this chapter.

§176. Mosquito-control districts

For the purposes of preserving and promoting the public health and welfare by providing for coordinated and effective control of mosquitoes, municipalities may cooperate through the creation of mosquito-control districts.

Sec. 2. 22 MRSA c. 257-B is enacted to read:

CHAPTER 257-B

MOSQUITOES

§1446. Mosquito-borne disease public health threat

When available surveillance information indicates the likelihood of a potential human disease outbreak arising from mosquito-borne pathogens, the commissioner may declare a mosquito-borne disease public health threat for the purposes of alerting the public and other state, local and federal agencies about the existence of the threat so that appropriate actions may be taken.

SUMMARY

This bill authorizes the Department of Agriculture, Conservation and Forestry to conduct appropriate mosquito-control activities in response to mosquito-borne disease public health threats. In addition, the bill authorizes municipalities to cooperate in controlling mosquitoes through the formation of mosquito-control districts. It establishes the Maine Mosquito Control Fund to provide funding for mosquito-control activities. Finally, the bill authorizes the Commissioner of Health and Human Services to declare a mosquito-borne disease public health threat.

APPENDIX 4:

STATE OF MAINE ARBOVIRAL (MOSQUITO-BORNE) ILLNESS SURVEILLANCE, PREVENTION AND RESPONSE PLAN, 2013

Maine Center for Disease Control and Prevention

An Office of the Department of Health and Human Services

Paul R. LePage, Governor   Mary C. Mayhew, Commissioner

DEPARTMENT OF HEALTH & HUMAN SERVICES

MAINE CDC

State of Maine

Arboviral (Mosquito-Borne) Illness

Surveillance, Prevention and Response Plan

2013 Season

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INTRODUCTION

The 2013 Arboviral (Mosquito-borne) Illness Surveillance, Prevention and Response plan provides surveillance and phased response guidance for both Eastern Equine Encephalitis (EEE) virus and West Nile virus (WNV). The purpose of the plan is to provide guidance on operational aspects of surveillance, prevention and response by the State and local communities to control mosquito-borne disease and encourage proactive preparations for the 2013 season. This plan is the result of analysis and review of surveillance data and response plans for Maine, as well as from other State and federal entities. Maine CDC will continue to seek advice from its partners and collaborators and modify the plan, as appropriate.

The Maine Vector-borne Work Group was formed in 1986 in anticipation of the increased threat posed by the emergence of vector-borne diseases in Maine. The expertise provided by the group works to minimize the risk to Maine residents of being exposed to, and infected with, vector-borne diseases. The State Epidemiologist convenes this Work Group bimonthly to develop and collaborate on a statewide coordinated strategy to reduce the risk of vector-borne (mosquito and tick) diseases in Maine. The work group and its sub-groups meet more frequently as warranted with dialogue and updates continuing throughout the year. Information provided from the Maine Vector-borne Work Group meetings is contained herein and aims to guide proactive community planning and actions to reduce the risk of human disease from EEE virus and WNV. Key objectives contained in this plan provide for the monitoring of trends in EEE virus and WNV in Maine, supporting locally-based mosquito plan development and response, providing timely, detailed and summary information on the distribution and intensity of EEE and WNV virus in the environment, laboratory diagnostic testing of EEE and WNV for humans, horses and other animals, and communicating guidelines, advice and support on activities that effectively reduce the risk of disease. This document will be reviewed at least annually.

I. DISEASE BACKGROUND

The two main mosquito-borne viruses (also known as arboviruses, for **ar**thropod-**bo**rne **viruses**) recognized in Maine and known to cause human and animal disease are Eastern Equine Encephalitis (EEE) virus and West Nile virus (WNV). The first potentially Maine acquired human case of EEE was identified in 2008. The first case of indigenously acquired WNV occurred in 2012. Different types of mosquitoes, with species-specific feeding habits (birds and/or mammals) and habitats (environments where they are found) carry these diseases. These differences are important in developing strategies for controlling the mosquitoes involved.

Infected mammals (e.g., humans, horses) are considered “dead-end” hosts for EEE and WNV. This is because mosquitoes that bite humans or equines infected with EEE or WNV do not pick up enough virus particles to transmit the disease to the next human or animal they bite. Risk of disease in humans is directly related to the amount of exposure to infectious mosquitoes.

A. Eastern Equine Encephalitis Virus

EEE virus is an alphavirus, present in some passerine (perching song birds) bird species found in fresh-water swamp habitats. The virus is transmitted among wild birds in these areas primarily by *Culiseta melanura*, a mosquito species that prefers to feed on birds. EEE virus has a cycle of natural infection among wild bird populations with occasional infections of humans, non-human mammals (most often horses) and large domesticated birds (emus, ostriches, etc). Bridge vectors (i.e., a mosquito species that is indiscriminant and will feed on birds or mammals) are responsible for transferring the EEE virus to humans.

Many people infected with EEE virus will not have symptoms of disease, while others may get only a mild flu-like illness with fever and headache. However, for people with infection of the central nervous system, a sudden high fever, severe headache, and stiff neck can be followed quickly by seizures, coma, and death. The cost of a single human case of EEE has been estimated to range from $21,000 for mild, transient illness, to as much as $3 million for individuals who suffer permanent neurologic damage. Human cases of EEE occur sporadically in the United States. Historically, clusters of human cases have occurred in sequential cycles of 2-3 years, with a hiatus of numerous years between outbreak and high-risk years. Between 1964 and 2012, 285 human cases of EEE were reported in the US, with an average of 6 cases per year. Most of the cases reported were from eastern states, primarily Florida (71 cases), Massachusetts (45 cases), Georgia (28 cases), and New Jersey (20 cases).

EEE activity documented in Maine in the last 5 years includes:

Table 1: EEE Activity in Maine, 2008-2012

	2008	2009	2010	2011	2012
Humans	0*	0	0	0	0
Mosquito Pools	1	2	0	0	0
Horse	1	15	0	0	0
Birds	0	3**	1	0	1***
Other animals	0	1 (llama)	0	0	0

*A fatal case of EEE was diagnosed in a Massachusetts resident who may have acquired the infection while vacationing in Maine
**3 separate flocks diagnosed with EEE
***1 pheasant flock diagnosed with EEE

Updated information on arborviral activity in Maine can be found at http://www.maine.gov/dhhs/mecdc/infectious-disease/epi/vector-borne/index.shtml.

The incidence of EEE infection in humans varies by geographic area. Human EEE disease is more common in areas that support dense populations of passerine birds and have favorable habitats for the larvae of the primary mosquito vector. In Maine, these areas consist mainly of large and mature white cedar and red maple swamps. EEE has never been reported in a Maine resident to date. However, in 2008 there was a fatal case of EEE diagnosed in a Massachusetts resident who may have acquired the infection while vacationing in Maine.

From 2001 to 2012, evidence of EEE infection was found in 15 of the 16 counties in Maine. This evidence was obtained through a combination of EEE seroprevalence studies in animals and regular surveillance activities performed by Maine CDC. Seroprevalence indicates previous exposure to the virus, not active illness. Testing has been performed on samples from deer, moose, bear, wild and domestic turkeys, and a variety of songbirds in conjunction with federal CDC.

Additionally, the likelihood of mosquito exposure is a key factor in determining the risk of human EEE infection. The abundance of specific species of mosquitoes at critical periods during the transmission season, in part determined by groundwater levels and the timing of rainfall during the mosquito season, is important in determining the likelihood of mosquito exposure. The use of personal protective measures (avoidance of mosquitoes, use of repellent) by people reduces their risk of exposure and infection.

B. West Nile Virus

WNV is a flavivirus. Similar to EEE, WNV is also maintained in the environment in a cycle that involves birds, with indiscriminant feeding mosquitoes infecting humans and other mammals. WNV causes sporadic disease in humans, and occasionally results in significant outbreaks. In 2012, 2,734 human cases of WNV neuroinvasive disease (West Nile meningitis and West Nile encephalitis) and 2,653 human cases of WNV fever were reported nationwide to the federal Centers for Disease Control and Prevention (CDC).

WNV activity was first identified in Maine in September 2001. WNV activity documented in Maine in the last 5 years includes:

Table 2: WNV activity in Maine, 2008-2012

	2008	2009	2010	2011	2012
Human	0	0	0	0	1
Mosquito Pools	0	1	1	0	7
Birds*	0	0	0	0	0

*Routine testing for WNV in dead birds was discontinued in 2006

Updated information on arborviral activity in Maine can be found at http://www.maine.gov/dhhs/mecdc/infectious-disease/epi/vector-borne/index.shtml.

An estimated 80% of people who become infected with WNV never develop symptoms attributable to the infection. For those who do develop symptoms: severe symptoms can include high fever, headache, neck stiffness, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, and paralysis. These symptoms may last weeks, and neurological effects may be permanent. Up to 20 percent of the people who become infected will display symptoms of WNV fever, including fever, headache, body aches, and can include swollen lymph glands. Symptoms can last for days to months. People over 50 years of age are at a higher risk of developing serious symptoms of WNV.

West Nile virus activity varies from year to year. When there are a high proportion of infected mosquitoes in a relatively small geographic area the risk of transmission of virus to humans will increase. West Nile virus activity in Maine in 2012 was high, with seven mosquito pools testing positive for virus. Maine also had its first human case of WNV in a Maine resident in 2012. The case was a Cumberland County resident who experienced WNV neruoinvasive disease. The resident fully recovered from the illness. Maine discontinued routine dead bird surveillance in 2006, based on the fact that this form of surveillance is no longer considered a useful indicator for WNV.

II. PROGRAM GOALS

Timely and accurate information provided by Maine CDC may offer an early warning of increased risk of EEE and WNV virus infection of humans or non-human mammals. Based on surveillance information, actions to reduce disease transmission can be implemented early when the impact can be lessened.

Maine CDC Specific Program Priorities

1. Active involvement in and maintenance of the Maine Vector-borne Work Group to provide expertise in proactively minimizing the risk to Maine residents of being exposed to and infected with mosquito-borne diseases.
2. Conducting surveillance including laboratory testing of human clinical specimens, and testing of mosquitoes, horses, and other animals to identify EEE virus and WNV.
3. Tracking trends in incidence and prevalence of EEE virus and WNV infections by geographic area.
4. Advising human and animal medical practitioners on the appropriate procedures for detecting and identifying infections and disease caused by mosquito-borne viruses.
5. Providing information to the public on mosquito-borne disease and disease risk, and how to take precautions to reduce the risk of infection.
6. Providing timely surveillance information to communities to assist in developing and implementing local mosquito control and response plans.
7. Participating in the national Arbovirus surveillance network (ArboNet) coordinated by the federal CDC.

Maine CDC works cooperatively with other state agencies, federal agencies, local communities and selected interest groups to identify and support the use of risk reduction and disease prevention methods that are specific to the cause of the diseases, that use the least intrusive and most appropriate prevention methods, and that support planning and practices that minimize the use of pesticides.

III. PREVENTION AND CONTROL

Ultimately, the key to reducing the risk of arboviral disease is education and outreach to the public regarding the need for mosquito-bite prevention and explaining how people can protect themselves from diseases such as EEE and WNV. The emergent public health threat posed by arboviral illness requires a vigilant outreach effort. As the state public health entity, Maine CDC will continue to take a lead role in providing public education efforts to promote prevention, by working with our partners to maximize the opportunity to alert our residents to the dangers posed by mosquito-borne illness. This will include working with the media, local communities, businesses and special populations such as schools, the homeless and others who spend considerable time outdoors, such as those who hunt and fish.

Maine CDC provides information to the public and communities to guide planning and actions to reduce the risk of human disease from EEE virus and WNV. Individuals can take a number of simple steps that will greatly reduce the risk of mosquito-borne viruses to them, their families, and their communities. Choosing to wear protective clothing (e.g., long pants, long-sleeve shirts), using effective Environmental Protection Agency (EPA) approved repellants, and minimizing opportunities for mosquitoes to breed are all important ways individuals can help prevent the spread of EEE and WNV in Maine. Community efforts, such as public education, mosquito surveillance, and integrated pest management (IPM) measures aimed at mosquito larvae may be necessary to decrease the local risk of EEE virus and WNV.

A. Prevention Through Knowledge

The goal of all mosquito-borne virus public information activities is to provide Maine's residents with helpful, accurate and specific advice and information in order to approach this problem with the appropriate level of caution.

Maine CDC's website includes general background information and surveillance updates as well as links to other informational websites including other state and federal agency sites. Printed materials can be ordered through this website: http://www.maine.gov/dhhs/mecdc/infectious-disease/epi/order-form-wn.shtml.

Epidemiologists from Maine CDC are also willing to conduct trainings and give presentations on arboviral diseases.

B. Prevention Action Steps

1. Preventing Mosquito Breeding Opportunities: By reducing exposure to mosquitoes around their homes and by eliminating mosquito breeding grounds, Maine residents can greatly reduce their risk of mosquito-borne virus exposure. Many species of mosquitoes lay their eggs in standing water. Fresh water swamps and coastal areas provide larval habitat for the mosquito species commonly associated with EEE. Weeds, tall grass, and bushes may provide resting areas for the mosquitoes that are most often associated with WNV.

Maine CDC recommends residents take the following steps to reduce opportunities for mosquito breeding:

- Eliminate artificial sources of standing water around residential and commercial areas by discarding outdoor artificial containers such as tin cans, plastic containers, glass bottles, or similar water-holding containers.
- Remove all discarded tires from your property. The used tire is the most common site for mosquito breeding in the United States.
- Dispose of or drill holes in the bottom of containers left outdoors, such as recycling containers or flowerpots. Drainage holes on the sides of containers will still allow enough water for mosquitoes to breed. Do not overlook containers that have become overgrown by aquatic vegetation.
- Make sure roof gutters drain properly. Clean clogged gutters in the spring and fall and as often as necessary to eliminate standing water.
- Clean and chlorinate swimming pools, outdoor saunas, and hot tubs following disinfectant label directions. If not in use, keep them empty and covered. Do not allow these covers to collect standing water.
- Aerate ornamental pools or stock them with native fish. Water gardens become major mosquito producers if they are allowed to stagnate.
- Turn over wheelbarrows and plastic wading pools when not in use. Both provide breeding sites for domestic mosquitoes.
- Change water in birdbaths at least twice weekly.
- Remind or help neighbors to eliminate mosquito breeding sites on their property.
- Consult with local mosquito control companies licensed by the Maine Board of Pesticides Control (BPC) (go to http://www.maine.gov/agriculture/pesticides/public/mosquito_control_list.htm to see an updated list of licensed companies) for additional solutions to decrease mosquito-breeding activity in nearby areas. Products are available that can be used to reduce mosquito populations (see Mosquito Control Activities below).
- The management of ponds, marshlands, and wetlands is regulated under existing state law and administrative rule. Alteration may require the approval of state and possibly federal agencies. Contact the Maine Department of Environmental Protection (DEP) for further information http://www.maine.gov/dep/index.shtml.

2. Personal Protective Measures: Residents can take simple steps to minimize mosquito bites. Such steps are critical in reducing the risk of EEE and WNV infections. Maine CDC recommends that residents take the following steps to protect themselves, particularly from June to October, when mosquitoes are most active:

- If outside during evening, nighttime and dawn hours, or at any time mosquitoes are actively biting, children and adults should wear protective clothing such as long pants, long-sleeved shirts, and socks, and consider the use of personal repellent.
- EPA approved repellents include: DEET, Picaridin (KBR3023), IR3535, and Oil of Lemon Eucalyptus. The length of time a repellent is effective varies with ingredient and concentration. Always follow the manufacturer's instructions on the label.

- Permethrin is an EPA approved repellent product that can be used on clothing or fabrics. This product should not be applied directly to the skin. Always follow the manufacturer's instructions on the label.
- Do not allow young children to apply repellent themselves and do not apply repellent directly to children. Apply to your own hands and then put it on the child's skin.
- Infants and children should be protected by placing mosquito nets over strollers in the evening, nighttime and dawn hours or at any time mosquitoes are actively biting.
- After returning indoors, wash treated skin with soap and water or bathe. Also, wash treated clothing before wearing again.
- Store repellent out of reach of children.
- For additional information about chemicals contained in repellents, visit the National Pesticide Information Center (NPIC) website at http://npic.orst.edu/repel.html. or contact the Maine BPC at 207-287-2731.
- Make sure that doors and windows have tight-fitting screens. Repair or replace all screens in your home that have tears or holes.
- Vitamin B, ultrasonic devices, incense and bug zappers have not been shown to be effective in preventing mosquito bites.

3. Mosquito Control Activities: The objective of public health mosquito control is to prevent transmission of mosquito-borne disease to humans. Reduction of mosquito species is not carried out by Maine public health agencies. It is important to emphasize that local communities make the final decision regarding mosquito control activities. Communities are responsible for developing, maintaining and financing local mosquito control programs. Maine CDC, the Maine Department of Agriculture, Conservation, and Forestry, the Maine Board of Pesticides Control, and the Maine Department of Environmental Protection are available to provide guidance and recommendations to assist municipalities in plan development and when faced with response decisions.

All discussion regarding pesticide applications discussed in this plan will be in accordance with the principles of Integrated Pest Management (IPM). IPM is a sustainable approach to managing mosquitoes by combining biological, physical and chemical tools in a way that minimizes economic, health and environmental risks. IPM involves preventive control and suppressive control, including:

- Source reduction (remove, cover, drain, fill) of larval habitats that are not environmentally sensitive or protected
- Mechanical control (the use of barriers such as screens to prevent the movement of mosquitoes and the use of traps)
- Chemical / Biological Pesticide control (the use of registered pesticides, according to label directions that act against mosquitoes)

Chemical /Biological pesticide controls can be further divided into the application of products aimed at mosquito larvae (larvicide) and those aimed at adult mosquitoes (adulticide). Larvicide involves the application of chemicals or natural bacteria to surface waters (such as ponds or in storm drains) to kill mosquito larvae. Larviciding is a proactive measure that can be useful in reducing the risk of mosquito-borne disease throughout the season. The intent of a larvicide program is to control generations of targeted mosquito species before they reach the adult stage, when they are able to transmit diseases such as EEE and WNV. Larvicide programs typically begin in early spring and continue throughout the season, and may help reduce the potential for human exposure to pesticides. These applications require DEP permits when the "waters of the state" are involved (see DEP pesticide Rules section below).

Adulticides involve the application of fine "mists" of pesticide over a relatively broad area to bring about the rapid reduction of adult mosquitoes. Adulticiding occurs in response to current surveillance activity. Adulticiding can quickly reduce existing, biting adult mosquitoes throughout a spray area, but its effects are relatively short lived, raising the possibility of repeat applications. In addition, adulticide spray sites are most likely to be areas of high human population density increasing the potential for human pesticide exposure. Comprehensive mosquito control programs may utilize both of the control methods, larviciding and adulticiding, if indicated by surveillance data.

Pesticides may pose their own risk to the health of humans, animals, plants, and the environment. Thus pesticides are only one component of a coordinated effort to control mosquitoes. Pesticide treatments and other IPM strategies may be appropriate in certain situations, while each strategy alone may not be adequate.

IPM dictates that control efforts should be tied to thresholds. This means simply that a certain defined risk needs to exist before particular control methods are recommended. Different responses may be made as different levels of risk are identified. These levels of risk are discussed under the Phased Response section of this plan. In an ideal IPM program, non-chemical methods should be employed to keep pest levels below the risk level that might trigger a pesticide response, meaning that pesticides are a last, rather than first response to a WNV or EEE problem.

Suggested Options for Mosquito Control Activities

Once a community has identified the need for an organized response to the risk of a mosquito-borne disease, it is necessary to decide on the type of response and the magnitude of the effort. These decisions will be impacted by a variety of considerations, such as the severity of the problem, the financial resources of the community, public perceptions and attitudes, and the availability of technical expertise. Listed below are suggested options for local mosquito control programs. It is important to remember mosquito control is a year-round activity; many of these activities can be performed during the "off season." Communities interested in developing or enhancing their mosquito control programs should review the document "Public Health Confronts the Mosquito" available at
http://www.astho.org/WorkArea/DownloadAsset.aspx?id=2333

- Institute a public information program emphasizing personal responsibility, ways in which people can prevent mosquito breeding, and how they can reduce the risk of being bitten by observing personal protection measures.

- Stay up-to-date on statewide and regional virus activity and recommendations by visiting http://www.maine.gov/dhhs/mecdc/infectious-disease/epi/vector-borne/index.shtml.

- Contact insect repellent manufacturers to determine the availability of community or municipal discounts for bulk purchases of repellent products.

- Encourage local reporting to town officials of suspected areas where mosquitoes may be breeding (larval habitats). Such areas may then be evaluated by mosquito control personnel.

- Institute community cleanup programs to eliminate larval habitats from backyards, commercial sites and abandoned premises. Efforts may be aimed at removing, covering, or draining such artificial habitats.

- If needed, develop provisions in the local ordinances to deal with public health nuisances (e.g., unmaintained swimming pools that may serve as mosquito breeding habitat).

- Define the scope of the mosquito control program.
    - Create a clearly defined statement of services or deliverables, and a clear performance evaluation document.
    - Establish what activities will be performed.
    - Determine what resources (equipment, staff, insecticides, etc.) will be needed and what is available.
    - Decide where, when, and how often activities are to occur.
    - Emphasize public education and source reduction, augmented by larval and adult mosquito control, if appropriate.
    - Ensure that all staff are appropriately trained and licensed (see commercial pesticide applicator licensing requirements at http://www.maine.gov/agriculture/pesticides/cert/questions.htm#commercial.)
    - Investigate training opportunities to develop local expertise, such as in mosquito trapping and identification and/or pesticide application.

- Institute basic mosquito population monitoring to define the problem. Monitoring species, abundance, and virus infection rates in adult mosquitoes provides critical early, predictive data for surveillance and control.

- Consider coordinating mosquito control efforts with neighboring jurisdictions.

- Once these decisions have been made, create a community-specific mosquito control plan.

C. Pesticide Control Board Regulations

The use of pesticides in Maine is governed by state law 22MRSA§1471 A-2 and 7MRSA§ 601-625 and by the Administrative Rules of the Board of Pesticides Control, CMR**01-026**. Chapters 10 – 90. These statutes and rules require people applying pesticides, other than homeowners on their own property, hold licenses issued by the Maine Board of Pesticides Control. Municipal employees must be licensed as a commercial pesticide applicator if the use of a pesticide is part of their official duties, and they may only apply pesticides to municipal properties. Municipal entities needing licenses include municipal and quasi-municipal organizations like Parks and Recreation Departments, Public Works, Cemetery Maintenance, Water & Sewer Districts, Housing Authorities, etc.

The Board of Pesticides Control also requires licensing whenever pesticides are applied in areas open to the public. These areas could include parks, campgrounds, apartment or condominium grounds, common areas of apartment buildings and many other areas. If a municipality hires an outside company to do pest control, that municipality must be sure the applicator company has the appropriate commercial pesticide applicator licenses. We recommend obtaining proof of licensure even before entertaining a bid from an outside pest control company.

Pesticides covered by these rules include insecticides to kill mosquito larvae like *Bacillus thuringiensis* (*var. israelensis*) (Bti), *Bacillus sphaericus* (Bs), methoprene, and temephos, and insecticides to kill adult mosquitoes like malathion, naled and the pyrethroids, or any other pest control products both organic and synthetic.

Pesticide applicator licenses are required to handle and apply even the over-the-counter product varieties, like mosquito dunks or natural and organic products, when applications are performed by government employees or in public areas because of the greater potential for public exposure and the added liabilities resulting from that use.   PERSONAL USE OF REPELLENTS DOES NOT REQUIRE A LICENSE

D. Department of Environmental Protection Pesticide Rules

Although certain pesticide products are available for sale in the marketplace to control mosquito larvae, application of these products to any surface waters in Maine is governed through permits obtained from the Maine Department of Environmental Protection. Questions regarding how to apply for such special permits should be directed to the Maine Department of Environmental Protection at 287-7688 (http://www.maine.gov/dep/).

In the event an EEE or WNV threat has been identified, the Commissioner of Health and Human Services may declare a Public Health Emergency and instruct the Department of Environmental Protection to commence the expedited special permit process – that is, provide an application form and other pertinent information to the appropriate town official(s) through the local health officer. The special permit will be issued with the greatest possible speed, preferably within seventy-two (72) hours.

Pesticide Applicator Licenses

A listing of the current Maine licensed pesticide applicators certified to control mosquitoes can be requested from the Maine BPC (287-2731, pesticides@maine.gov or http://www.maine.gov/agriculture/pesticides/public/mosquito_control_list.html.) Successful applications require in-depth knowledge of the community's planned pesticide use for mosquito control. Communities may also decide to license their own staff to apply pesticides. The licensing process for commercial applicators is described on the BPC website at http://www.maine.gov/agriculture/pesticides/cert/questions.htm#commercial

IV. SURVEILLANCE

Arboviral testing available through Maine's Health and Environmental Testing Laboratory (HETL) is outlined below. All laboratory test results should be considered in conjunction with both clinical symptoms and epidemiologic findings. Human samples must meet a set of minimum requirements in order to be tested (submission form required).

Table 3: Testing services available through HETL

Sample	West Nile virus (WNV)	Eastern Equine (EEE)	St. Louis (SLE)	LaCrosse (LE)	Powassan virus
Human serology (IgM)	X	X	X	X*	X*
Human cerebrospinal fluid (IgM)	X	X	X	X*	
Bird tissue (PCR)	X	X			
Mosquitoes (PCR)	X	X			
Non-Human Mammal tissue (PCR)	X**	X**			
Horse serology (IgM)	***	***			

* = Testing is not performed at HETL, but can be forwarded on to the federal CDC upon request. Federal CDC is also able to perform IgG testing if warranted.

** = A rabies test must be performed on mammal specimens before PCR for WNV/EEE can be done. Animals testing positive for rabies will not be tested for WNV/EEE

*** = Testing is not performed at HETL, but is offered by private laboratories

PCR = polymerase chain reaction

Note: The USDA National Veterinary Services Laboratory (NVSL) or federal CDC Laboratory will be used as a confirmatory reference laboratory for results as needed.

A. Mosquito Surveillance for Eastern equine encephalitis and West Nile virus

Mosquitoes are the best early indicator of human risk for arboviral disease. The objective of a mosquito surveillance program is to determine the presence of arboviruses, including EEE and WNV, in mosquito species common to our area. An effective program begins by targeting mosquito species considered to be important in transmitting disease among birds (primary vector) and transmitting disease from birds to humans (bridge vectors). Monitoring mosquito abundance is accomplished through various surveillance methods including but not limited to measuring larvae (dip counts) and adult mosquitoes (use of light/CO2 baited traps, gravid traps and resting boxes). Results must be evaluated by mosquito species, as each species has unique biological characteristics that should be incorporated into control decisions (see Appendix I). Maine CDC uses a comprehensive and flexible strategy that modifies certain surveillance activities in response to trends in disease risk.

Based on historic and current epidemiology in Maine and the United States, Maine CDC may test only particular mosquito species for EEE virus and WNV. Testing decisions will be based on the most current knowledge and fiscal considerations. Such decisions will be announced to Town Officers and mosquito contractors well in advance. Regardless of testing decisions, communities financing mosquito surveillance are encouraged to utilize surveillance from July 1 through October 1 in order to evaluate the relative abundance of particular mosquito species. Mosquito larvae and adult abundance, arboviral testing results, and coverage of mosquito surveillance efforts play a critical decision-making role in overall need, scope, and method of control.

Activities for mosquito surveillance for the 2013 season will consist of routine and rapid response surveillance.

1. Routine Mosquito Surveillance: Maine CDC is the lead agency responsible for mosquito surveillance activities. Maine CDC will work with its partners in coordinating efforts for appropriate placement of traps, collection, packaging and transport of mosquito specimens.

Routine, fixed long-term trap sites provide the best baseline information for detecting trends in mosquito abundance, virus prevalence and estimating the risk of human infection from EEE and WNV. Maine CDC works together with contract employees to determine long term trap sites. If your town or community has interest in collecting mosquitoes locally for testing, please consult with Maine CDC for more information on collection requirements and testing ability.

2. Rapid Response Mosquito Surveillance: In the case of a positive test of an arbovirus in non-human mammals, mosquitoes, or humans, State sponsored activities may include:

- Notifying city and town municipal officials of positive virus isolation or a confirmed case of a mosquito-borne disease.
- Provide for short-term mosquito surveillance and laboratory specimen preparation in the absence of a local health department surveillance or local mosquito control program in predetermined selected areas.
- Coordinating training and lending expertise to local health officials and state personnel.
- Evaluating current trap locations based on criteria including habitats conducive to mosquito breeding and bridge vector collection, and level of human use (e.g., schools, parks, athletic fields).
- Reviewing and determining the need for expanding trapping in the area surrounding the positive identification.

B. Avian Surveillance for West Nile virus and Eastern Equine Encephalitis

National and local analysis suggests dead bird testing for WNV is becoming less useful for early detection and evaluation of WNV risk. Most birds infected with EEE do not succumb to severe disease and do not provide useful data for disease surveillance and response in Maine. For these reasons, Maine has discontinued wild bird testing. Wild bird surveillance is useful in understanding the ecology of arboviruses, and as such, other agency partners (i.e., MMCRI, Wildlife Services, etc.) may conduct surveillance among wild bird and mammal populations to address specific research questions.

In some circumstances, dead birds may be tested for EEE and WNV by the state if the situation warrants (e.g., unusual large die-offs without a known cause). It is the responsibility of the local community to arrange for the transportation of dead birds to the HETL. Birds must be approved for testing prior to delivery by calling Maine CDC's disease reporting line (1-800-821-5821).

Testing and surveillance of domestic birds (e.g., emus) will follow the procedures listed below for mammal (non-human) surveillance.

C. Mammal (Non-human) Surveillance for Eastern Equine Encephalitis (EEE) virus and West Nile virus (WNV)

Under the auspices of the State Veterinarian, Maine Department of Agriculture, Conservation, and Forestry, HETL may conduct testing of horses and other domestic animals (e.g., llamas, alpacas) that have severe neurological disease suspected of being caused by EEE virus or WNV infection. On an annual basis, a letter from the State Veterinarian (Maine Department of Agriculture) describing the case definition, clinical signs of disease, prevention measures, and reporting process will be sent to all licensed veterinarians in the state of Maine. This serves as a reminder to investigate and report neurological illness in animals. Parameters for the evaluation and testing of ill animals will include the following:

- Domestic animals with neurologic signs will initially be referred to private veterinarians for evaluation.
- Veterinarians wishing clinical consultation or information on encephalitic disease testing procedures should contact the State Veterinarian at the Maine Department of Agriculture, Conservation, and Forestry.
- Necropsy specimens, such as animal heads, must be sent to the Maine HETL for processing.
- The State Veterinarian will assure appropriate collection of specimens for diagnostic testing.

Mammals Submitted for Rabies Testing

Unlike an arbovirus, rabies can be transmitted to humans through the bite of an infected animal. It is important that all mammals with neurological symptoms that have had contact with humans, pets, or domestic animals, and that meet guidelines for rabies testing, be submitted for testing in accordance with HETL guidelines. Animals testing positive for rabies will not be tested for EEE virus and WNV.

D. Human Surveillance

1. Passive surveillance: Maine CDC is the lead agency for the conduct of human case surveillance for arboviral encephalitis, meningitis, and meningoencephalitis. Arboviral testing is available at HETL, and requires a "Human Arboviral Specimen Submission Form." Instructions on submitting samples and the submission form can be found online at

http://www.maine.gov/dhhs/mecdc/public-health-systems/health-and-environmental-testing/micro/submitting_samples.htm.

Health care providers who suspect arboviral disease should submit the following specimens for testing (when possible, serum and CSF should be submitted together) along with the Human Arboviral Specimen Submission Form:

- CSF for testing by IgM Multiplex Immunoassay (MIA). All spinal fluid submission must be accompanied by a corresponding serum sample.

- Sera, both acute and convalescent, for testing by IgM Multiplex Immunoassay (MIA).

Note: Severe neurological disease due to an arboviral infection has occurred in patients of all ages. Year-round transmission is possible in some areas of the country. Therefore, arboviral disease should be considered in persons with unexplained encephalitis and meningitis with consistent travel history.

HETL's normal viral testing protocol for arboviruses includes human serology and cerebrospinal fluid assays for WNV, EEE, and SLE (St. Louis Encephalitis). Testing for LAC (LaCrosse Encephalitis) and Powassan virus is referred to the federal CDC for testing if requested.

Maine CDC promotes human surveillance activities by:

- Alerting Maine hospitals and clinicians about the importance, criteria, and requirements for reporting, along with instructions for submission of appropriate laboratory specimens (CSF, acute and convalescent sera for arboviral encephalitis).

- Providing Maine hospitals, neurologists and infectious disease physicians with clinical and epidemiologic information about human cases of WNV and EEE and criteria for reporting and laboratory testing.

All suspect human cases should be reported to Maine CDC at 1-800-821-5821.

2. Enhanced surveillance: If surveillance data indicate an increased risk of human disease, active surveillance or enhanced passive surveillance may be instituted in high-risk areas. This consists of contacting health care providers and facilities surveying for potential cases. Additionally, death records and other available surveillance systems will be utilized to screen for possible human cases of arboviral encephalitis, meningitis, or meningoencephalitis.

E. Communication of Surveillance Information

1. Routine Information: Arboviral information will be available on Maine CDC's website at http://www.maine.gov/dhhs/mecdc/infectious-disease/epi/vector-borne/index.shtml.

2. Positive EEE Virus & WNV Findings: Maine CDC ensures the rapid and accurate dissemination of positive test results. Following an EEE or WNV positive mosquito pool, bird, non-human mammal or human, an investigation will be initiated and an epidemiologist will notify the Town Manager or Selectman as well as the district liaison for that area. The Town Manager or Selectman should notify all pertinent local officials, including high-level elected and appointed officials and, as warranted, the municipal Emergency Management Director and Animal Control Officer. Weekly reports are posted to the website during the arboviral season (http://www.maine.gov/dhhs/mecdc/infectious-disease/epi/vector-borne/index.shtml).

3. Press Releases/ Health Alerts: Maine CDC may issues press releases or health alerts to inform the public of conditions that may warrant additional precautions to reduce the risk of disease. The Health Alert Network (HAN) will be utilized by Maine CDC to disseminate information to health care providers in the State. All HANs are posted to http://www.maine.gov/dhhs/mecdc/.

V. RECOMMENDATIONS FOR A PHASED RESPONSE TO EEE VIRUS AND WNV SURVEILLANCE DATA

The recommendations provided here are based on current knowledge of risk and appropriateness of available interventions to reduce the risk for human disease. Multiple factors contribute to the risk of mosquito-transmitted human disease. Decisions on risk reduction measures should be made after consideration of all surveillance information for that area at that time.

Recommendations regarding the EEE and WNV phased response plan (Table 1) incorporates several components presented in the CDC document "Epidemic/Epizootic West Nile virus in the United States: Guidelines for Surveillance Prevention, and Control", 3rd Revision, 2003, as well as results of analyses of surveillance data collected in Maine and throughout the northeastern United States.

Public awareness of what can be done to reduce risk of infection is of utmost importance. The level of EEE virus and WNV activity may occasionally present a potential for increased virus transmission to humans. Typically, risk is expected to be relatively low, and the routine precautions taken by individuals may be sufficient to avoid infection. These guidelines take into consideration the complexity of reducing risk of human disease from EEE virus and WNV infection and form a framework for decision-making. They are not a set of specific prescriptions.

1. Phased Response: General guidelines are provided for an array of situations that are noted in the Surveillance and Response Plan Table (**Table 4**) that follows. Specific situations must be evaluated and options discussed before final decisions on particular actions are made. The assessment of risk from mosquito-borne disease is complex and many factors modify specific risk factors. Maine CDC works with public health districts, community administrators, health officers, and mosquito control contractors to develop the most appropriate prevention activities to reduce the risk of human disease. There is no single indicator that can provide a precise measure of risk, and no single action that can assure prevention of infection.

When recommending the use of mosquito larvicides or adulticides, Maine CDC works to identify and support the use of risk reduction and disease prevention methods that are specific to the cause of disease, that use the least intrusive and most appropriate prevention methods, and that support planning and practices that reduce the use of pesticides. Technical support from the Board of Pesticides Control will be provided upon request. Ultimately, the decision to apply pesticides is left to the community. Communities that would like to consider pesticide use should identify licensed personnel or locate licensed contractors and consult with the Maine Board of Pesticides Control to determine that the pesticide chosen is properly registered for use in Maine.

Historical local surveillance data is critical in making informed decisions regarding risk and appropriate actions. Communities are urged to review and enhance local surveillance activities to aid in decision-making and early detection of arboviral activity.

2. Maine CDC Guidance: Throughout the arboviral season, Maine CDC will monitor activity in an attempt to ascertain risk levels as outlined in the phased response tables of this plan. Risk levels are defined for focal areas. "Focal Areas" may incorporate multiple communities, towns, or cities. Factors considered in the determination of human risk in a focal area include: mosquito habitat, mosquito abundance, current and historic virus activity, timing of recent isolations of virus in mosquitoes, current and predicted weather and seasonal conditions needed to present risk of human disease. Known/suspected location of exposure is used for human and non-human animal cases and not necessarily town of residence.

Table 4: Guidelines for Phased Response to EEE and WNV Surveillance Data

Risk Category	Probability of Human Outbreak	Definition for a Focal Area*	Recommended Response
1	Remote	All of the following conditions must be met: Prior Year No activity detected in a community or focal area. AND Current Year No current surveillance findings indicating EEE or WNV activity in the focal area.	1. Educational efforts directed to the general public on personal protection, such as use of repellents, and source reduction. 2. Routine human and non-human mammal surveillance;. 3. Assess local ecology for mosquito abundance. 4. Consider larval and adult mosquito monitoring with routine collection and testing of mosquitoes.
2	Low	Prior Year (WNV) Virus activity detected in mosquitoes. Prior 2 Years (EEE) Virus activity detected in mosquitoes during either of both of the past two years. OR Current Year EEE or WNV identified in a single mosquito trap location AND No non-human mammal or human cases	Incorporates previous category response, plus: 1. Expand community outreach and public education programs focused on risk potential and personal protection, emphasizing source reduction. 2. Assess mosquito populations, monitor larval and adult mosquito abundance, submit samples to HETL for virus testing. 3. Use larvicides at specific sources identified by entomologic survey and targeted at vector species. If appropriate, consider source reduction techniques. 4. Enhance surveillance of human and non-human mammal surveillance.
3	Moderate	Prior Year Confirmation of human and/or non-human mammal case(s) OR Sustained EEE or WNV activity in mosquitoes. OR Current Year Multiple EEE or WNV mosquito isolates AND No non-human mammal or human cases.	Incorporates previous category response, plus: 1. Increase larval control, source reduction, and public education emphasizing personal protection measures. 2. Actions to prevent disease may include targeted larviciding at likely vectors, and if current year activity, possibly ground adulticiding targeted at likely bridge vector species. 3. Enhance human surveillance and activities to further quantify epizootic activity.

* Focal area: May incorporate multiple towns or cities. Designation based on factors including mosquito habitat, current and historic virus activity, timing of current virus activity, current weather and seasonal conditions. Known/suspected location of exposure is used for human and non-human animal cases and not necessarily town of residence.

4	High	Current Year Surveillance of increasing EEE or WNV activity in mosquitoes OR A single confirmed non-human mammal case of EEE or WNV OR A single confirmed human case of EEE or WNV.	Incorporates previous category response, plus: 1. Intensify public education on personal protection measures a. Utilize multimedia messages including press releases, local newspaper articles, cable channel interviews, etc. b. Actively seek out high-risk populations (nursing homes, schools, etc.) and educate them on personal protection. c. Issue advisory information on adulticide spraying. 2. Consider intensifying larviciding and/or adulticiding control measures as indicated by surveillance. 3. Maine CDC will confer with local health officials to determine if the risk of disease transmission threatens to cause multiple human cases. If surveillance indicates a continuing risk of human disease and potential for an outbreak, intensified ground-based adult mosquito control may be recommended.
5	Critical	Current Year More than 1 confirmed human case of EEE or WNV in a community or focal area OR Multiple confirmed EEE or WNV non-human mammal cases.	Incorporates previous category response, plus: 1. Continued highly intensified public outreach messages through community leaders and the media emphasizing the urgency of personal protection. 2. If risk of outbreak is widespread and covers multiple jurisdictions, Maine CDC will confer with local health officials and Vectorborne Work Group to discuss the use of intensive mosquito control methods. A State of Emergency may be declared pursuant to Title 37-B Chapter 13 Subchapter 2 §742. The declaration of an emergency may trigger application of mosquito adulticide. Maine CDC may define targeted treatment areas for vector control following the declaration of an emergency. 3. Ground-based adulticide applications may be repeated as necessary to achieve adequate control.

APPENDIX I

BIOLOGY, ARBOVIRAL ACTIVITY, AND CONTROL CONCERNS OF SELECTED MAINE MOSQUITO SPECIES

Below is a review of the main products used for mosquito control and descriptions of the principle mosquito species likely responsible for Eastern Equine Encephalitis (EEE) virus and West Nile virus (WNV) transmission in Maine. The unique biological features pertinent to control and prevention of each species are discussed. Information was obtained from federal, state, and local publications (see reference list below) and results from the Maine and other New England state arboviral testing programs.

Control of Mosquitoes in Maine

Deciding which product and method of application to use will depend on environmental conditions, targeted species, and state/local regulations. For information regarding pesticide rules and regulations, contact the Maine BPC at 287-2731. For legal use, larvicide and adulticide products must be registered in the State of Maine. To check registration status, please contact the Maine BPC at 287-2731 or go to http://state.ceris.purdue.edu/doc/me/stateme.html. To gauge the relative risk of larvicides or adulticides go to the BPC web site at http://www.maine.gov/agriculture/pesticides/wnv/index.htm.

Larviciding. Larviciding is a proactive measure that can be useful in reducing the risk of mosquito-borne disease throughout the season and tends to be more effective at reducing mosquito populations than adulticiding. Larviciding occurs in response to larval mosquito surveillance and habitat identification. The intent of a larvicide program is to control generations of targeted mosquito species before they reach the adult stage, when they are able to transmit diseases such as EEE and WNV. Several materials in various formulations are labeled for mosquito larviciding. Items can be classified as bacteriologic, insect growth regulators, surface films, and organophosphates. Most are effective during particular stages of mosquito development, thus timing of application is important.

(1) Bacteriologic Control: *Bacillus thuringiensis israelensis* (*Bti*) and *Bacillus sphaericus* (*Bs*) are naturally occurring bacteria used as larvicides. When ingested by mosquito larvae, they alter gut permeability killing the larvae. They are believed to pose a minimal risk to non-target species.
(2) Insect Growth Regulators: Methoprene (e.g., Altosid) mimics the action of a mosquito growth-regulating hormone and prevents the larvae from maturing into adults. It has low toxicity to birds and fish.
(3) Surface Films: Petroleum derivatives (e.g., Golden Bear Oil) produce a thin film on the surface of the water that prevents the transfer of oxygen causing the mosquito larvae/pupae to drown. Ethoxylated Alcohols (e.g., Agnique) produce a thin surface film, making it difficult for mosquito larvae, pupae, and emerging adult to attach to the water's surface, causing them to drown. The window of opportunity for use of these agents is limited by the mosquito life cycle, especially when dealing with species that require little or no surface contact for breathing. These

agents also prevent the natural transfer of oxygen into the water body. There are potential impacts to non-target species that rest on the water surface.
(4) Organophosphates: Temephos is the only organophosphate with larvicidal use and inhibits nerve signal transmission. Although it presents relatively low risk to birds and terrestrial species, available information suggests that it is more toxic to aquatic invertebrates than alternative larvicides.

Adulticiding. Adulticide involves the application of fine "mists" of pesticide over a relatively broad area to bring about the rapid knockdown of adult mosquitoes. Adulticiding occurs in response to current adult mosquito surveillance activity. Adulticiding can quickly reduce existing, biting adult mosquitoes throughout a spray area, but its effects are relatively short lived, raising the possibility of repeat applications. In addition, adulticide spray sites are most likely to be areas of high human population density.

Mosquito adulticides are dispersed either by truck-mounted equipment, backpack, or from aircraft. Barrier treatments, using compounds with residual characteristics, may also be used. Adulticides labeled for mosquito control include natural pyrethrins, synthetic pyrethroids, and organophosphates. Insecticide selection and timing of application should be based on the distribution and behavior of the target mosquito species.

- Pyrethrum: A derivative from chrysanthemum flowers that has a relatively low toxicity.
- Synthetic pyrethroids: Synthetic chemical pesticides (e.g. Permethrin, Resmethrin and Sumithrin aka D-phenothrin) that act in a similar manner to pyrethrins. They are relatively low in toxicity. Most break down rapidly in sunlight. Pyrethroids used in mosquito control are typically mixed with a synergist compound, such as Piperonyl Butoxide, which enhances the effectiveness of the active ingredient to kill adult mosquitoes on contact.
- Organophosphates: Organic compounds (e.g., Malathion and Naled) that function as nerve toxins, with the purpose of killing adult mosquitoes. There is potential for acute, and chronic risks to freshwater invertebrates and possibly other species.

Pesticides may pose their own risk to the health of humans, animals, plants, and the environment. Thus pesticides are only one component of a coordinated effort to control mosquitoes.

MAINE MOSQUITO SPECIES OF CONCERN FOR EEE AND WNV

There are 45 mosquito species present in Maine, however less than half of these are considered to be likely vectors for EEE and WNV. Given the short history of arboviral surveillance in Maine, it is difficult to know the specific role each mosquito species plays in EEE and WNV disease transmission. In general, species are identified as vectors based on their local abundance, demonstrated vector competence in the laboratory, and frequent infection with the virus as documented by arboviral surveillance programs. Based on these criteria, the following species are considered to be vectors of concern for EEE and/or WNV in Maine or the surrounding region:

- EEE virus: *Aedes vexans*, *Aedes cinerus, Coquillettidia perturbans, Culex salinarius, Culex pipiens, Culex restuans,Culiseta melanura Culiseta morsitans*,*Culiseta inornata,Ochlerotatus* *canadensis, Ochlerotatus japonicus, Ochlerotatus triseriatus, Ochlerotatus sollicitans, Psorophora ferox*

- WNV: *Anopheles punctipennis, Anopheles walkeri, Aedes vexans, Aedes cinerus, Coquillettidia perturbans, Culex pipiens, Culex restuans, Culex salinarius, Culesita melanura, Ochlerotatus canadensis, Ochlerotatus cantator. Ochlerotatus japonicus, Ochlerotatus sollicitans, Ochlerotatus triseriatus*

Information pertaining to the biology and specific control concerns for these species is provided below.

Aedes cinerus

Larval habitat: Wooded snowmelt pools, semi-permanent bogs and swamps. There are several generations per year.
Overwintering stage: Egg.
Host preference: Mammals. Adults readily bite humans.
Biting times: Dusk to dawn and daytime in wooded areas. Adults rest in shaded areas and will bite if disturbed.
Flight range: 100 to 1000 feet.
Virus isolations: Maine WNV. New Hampshire EEE and WNV. Isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October) from all counties in which surveillance occurred.

Aedes vexans

Larval habitat**:** A floodwater species found in a wide variety of temporary freshwater pools and depression areas (e.g., flooded fields, retention ponds, roadside puddles). There are several generations per year.
Overwintering stage**:** Egg.
Host preference: Mammals. Adults are aggressive human biters. This species will also feed on birds.
Biting times: Dusk to dawn; may also bite during the day.
Flight range: 1-5 miles; some sources cite flight ranges > 15 miles.
Virus isolations: New Hampshire EEE, Maine WNV. Isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October) from all counties in which surveillance occurred.
Control concerns: Thought to be an important bridge vector (able to transmit virus from a bird to a mammal) of EEE and possibly WNV. At warm temperatures (i.e., 77F), larval development is rapid, 4-6 days, followed by a short pupal stage (2 days); this process is longer at cooler temperatures. Hence, the window for effective larval/pupal control is narrow.

Anopheles punctipennis

Larval habitat: Confined bodies of water with aquatic vegetative edges and artificial containers. There are several generations per year.
Overwintering stage: Adult.
Host preference: Birds and Mammals. Major summer pest.
Biting times: Dusk to dawn and daytime. Adults rest in shaded areas and will bite if disturbed.
Flight range: 1 to 2 miles.
Virus isolations: New Hampshire WNV. WNV Isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October) from all counties in which surveillance occurred.

Anopheles walkeri

Larval habitat: Confined bodies of water with aquatic vegetative edges. There are several generations per year.
Overwintering stage: Egg.
Host preference: Mammals.
Biting times: Dusk to dawn and daytime. Adults rest in shaded areas and will bite if disturbed.
Flight range: 1 to 2 miles.
Virus isolations: New Hampshire WNV.
Maine surveillance: Collected throughout the arboviral season (June-October) from all counties in which surveillance occurred. Usually collected during spring and early summer.

Coquillettidia perturbans

Larval Habitat: Permanent bodies of water with muddy substrates and abundant emergent vegetation (e.g., cattails). This species has only one generation per year.
Overwintering stage: Larvae.
Host preference: Birds and mammals. This species readily enters houses and bites humans.
Biting times: Adults readily bite humans in the early morning, at dusk, and in the evening. Adults rest in shaded vegetation during the day and will bite if disturbed.
Flight range: 1-5 miles.
Virus isolations: New Hampshire EEE. EEE and WNV isolations have been found in other northeastern states.
Maine Surveillance: Collected throughout the arboviral season (June-October) from all counties in which surveillance occurred.
Control concerns: This species is an important bridge vector of EEE. Larvae and pupae obtain air by attaching themselves to the roots and stems of emergent plants. When disturbed, they detach and burrow in the mud making them difficult to monitor and control. Larvicides, such as *Bti* and Temephos, might not satisfactorily control this species.

Culex pipiens

Larval habitat: Artificial containers (e.g., catch basins, flower pots, discarded tires) and stagnant, temporary pools with a high organic content. There are several generations per year.
Overwintering stage: Adults overwinter in damp, protected human-made structures.
Host preference: Birds and occasionally mammals.
Biting times: From dusk to dawn. Adults can be found during the day in dark, damp shelters.
Flight range: ¼ - ½ mile.
Virus isolations: Maine EEE and WNV, New Hampshire EEE and WNV. Isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October) from all counties in which surveillance occurred.
Control concerns: This species is an important primary vector for WNV, amplifying WNV in the bird population.

Culex restuans

Larval habitat: Natural and artificial containers (e.g., tree holes, catch basins), woodland and temporary pools. There are several generations per year.
Overwintering stage: Adults overwinter in well-protected natural and manmade enclosures.
Host preference: Birds and occasionally mammals, including humans.
Biting times: Dusk to dawn.
Flight range: 1-2 miles.
Virus isolations: Maine WNV, New Hampshire EEE and WNV. Isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October) from all counties in which surveillance occurred.
Control concerns: This species is an important primary vector for WNV, amplifying WNV in the bird population.

Culex salinarius

Larval habitat: Brackish salt marshes and freshwater wetlands; occasionally collected from artificial containers (e.g., catch basins, discarded tires). There are several generations per year.
Overwintering stage: Adults overwinter in natural and man-made structures.
Host preference: Birds, mammals, reptiles, and amphibians. Adults readily attack humans, often entering houses.
Biting times: Dusk to dawn. Adults can be found during the day in cool, shaded sites.
Flight range: ¼ - 5 miles.
Virus isolations: New Hampshire EEE and WNV. Isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October).
Control concerns: This species is thought to be a bridge vector for EEE and possibly WNV.

Culiseta inornata

Larval habitat: Wooded snowmelt pools, marshes, bogs, swamps. There are several generations per year.
Overwintering stage: Adult
Host preference: Mammals (humans).
Biting times: Dusk to dawn.
Virus isolations: Maine EEE. EEE and WNV isolations have been found in other states.
Maine surveillance: Collected throughout the arboviral season (June-October) in southern coastal areas.

Culiseta melanura

Larval habitat: Underground aquatic crypts or sheltered bodies of water among tree roots in acidic Red maple and Atlantic White Cedar swamps. There are several generations per year.
Overwintering stage: Larvae.
Host preference: Almost exclusively birds, rarely mammals (humans).
Biting times: Dusk to dawn.
Flight range: Sources vary from ½ - 5 miles.
Virus isolations: Maine and New Hampshire both EEE and WNV. Isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October) from all counties in which surveillance occurred.
Control concerns: *Culiseta melanura* is an important primary vector for EEE, amplifying EEE in the bird population. There may be multiple adult emergence peaks during the season, depending on temperature and rainfall conditions. Crypts where larvae develop are not interconnected and often have only small openings making them difficult to treat.

Culiseta morsitans

Larval habitat: Permanent and semi-permanent bogs, swamps, tree root cavities, and boggy margins of lakes. One generation per year.
Overwintering stage: Egg.
Host preference: Almost exclusively birds, rarely mammals (humans).
Virus isolations: New Hampshire EEE. EEE and WNV isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October) from all counties in which surveillance occurred.
Control concerns: This species can be an important primary vector for EEE, amplifying EEE in the bird population.

Ochlerotatus canadensis

Larval habitat: Temporary leaf-lined woodland pools, drainage ditches, and freshwater swamps. It has one large generation in late spring, and then a partial second generation in late summer, depending on the amount of rainfall.

Overwintering stage: Egg.
Host preference: Mammals, birds, reptiles, and amphibians. Adults readily bite humans.
Biting times: Dusk to dawn. Adults rest in shaded areas and will bite if disturbed.
Flight range: Up to ¼ mile.
Virus isolations: Maine WNV, New Hampshire EEE and WNV. Isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October) from all counties in which surveillance occurred.
Control concerns: Possibly a bridge vector for EEE, especially during intense viral activity. Control of this species is difficult because the water bodies in which it breeds are isolated from each other.

Ochlerotatus cantator

Larval habitat: Temporary saline and brackish pools in coastal salt marshes. There are several generations per year.
Overwintering stage: Egg.
Host preference: Mammals (humans), birds.
Biting times: Dusk to dawn and during the day. Adults rest on vegetation during the day and will actively bite if disturbed.
Flight range: 5-40 miles.
Virus isolations: Maine WNV. EEE and WNV isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October).
Control concerns: This species may be a bridge vector of EEE and WNV.

Ochlerotatus japonicus

Larval habitat: Natural and artificial containers including tree holes, catch basins, bird baths, and discarded tires. There are several generations per year.
Overwintering stage: Egg.
Host preference: Birds and mammals.
Biting times: Dusk through dawn and during the day.
Flight range: Less than 1 mile.
Virus isolation in Maine: Maine and New Hampshire WNV. EEE and WNV isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October) from all counties in which surveillance occurred.
Control concerns: This species may be a bridge vector of EEE and WNV. As this species is relatively new to New England, better guidance will be provided pending accumulation of more information about its role in EEE and WNV transmission.

Ochlerotatus sollicitans

Larval habitat: Temporary saline pools in coastal salt marshes. There are several generations per year.

Overwintering stage: Egg.
Host preference: Almost exclusively mammals, rarely birds.
Biting times: Dusk to dawn and during the day. Adults rest on vegetation during the day but will bite if disturbed.
Flight range: 5-40 miles.
Virus isolations: Maine WNV. WNV isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October).
Control concerns: This species may be a bridge vector for EEE.

Ochlerotatus triseriatus

Larval habitat: Tree holes, catch basins, tires, buckets, gutters, other natural and artificial containers. There is one generation per year.
Overwintering stage: Egg.
Host preference: Mammals, birds and reptiles.
Biting times: Dusk to dawn. Adults rest on vegetation and containers during the day but will bite if disturbed.
Flight range: ½ to 1 mile.
Virus isolations: New Hampshire EEE and WNV. Isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (June-October).

Psorophora ferox

Larval habitat: Wooded temporary ground pools, flood-water areas. There is one generation per year.
Overwintering stage: Egg.
Host preference: Mammals (humans).
Biting times: Dusk to dawn. Adults rest on vegetation in wooded areas during the day and will bite if disturbed.
Flight range: Up to 1 mile.
Virus isolations: New Hampshire EEE. EEE and WNV isolations have been found in other northeastern states.
Maine surveillance: Collected throughout the arboviral season (July-October).

Appendix II

Mosquito Testing at Maine Department of Health and Human Services, 2013

Please find below information pertaining to mosquito testing through Maine's Health and Environmental Testing Laboratory (HETL) during 2012. Mosquitoes will be tested for Eastern Equine Encephalitis (EEE) virus and West Nile virus (WNV).

1. Mosquito pools may contain a maximum of 50 mosquitoes. Please be careful not to exceed the 50-mosquito pool size, as there may not be remaining space for adding the necessary reagents. HETL will REJECT for testing any pools that they cannot process due to excessive pool size. These pools will be held at HETL.

2. Please be sure to include detailed information on trap location. Trap location may be used for GIS mapping as well as analyzing location-specific changes over time. Both uses require detailed address information to ensure consistent results and tracking.

3. The mosquito season will begin on July 1, 2013 and go through October 1, 2013. Testing will be performed in the following manner:

a. Phase I - July 1 through October 1, 2013 or first Maine EEE or WNV detection (dates pertain to date of collection):

i. *Cs. melanura, Cx. pipiens, Cx. restuans*, and *Cx. pipiens/restuans:* Only these species will be tested. Any pool size may be submitted for testing but pool size cannot exceed 50 mosquitoes. As soon as EEE or WNV is detected in Maine, mosquito submissions will follow phase II.

ii. Other mosquito species: During the mosquito season, please discard (or hold internally if interested) any mosquitoes that are not *Cs. melanura, Cx. pipiens, Cx. restuans*, or *Cx. pipiens/restuans*. Other mosquito species may be tested on a case by case basis, as resources and time allow. As soon as EEE or WNV is detected in Maine, mosquito submissions will follow phase II.

b. Phase II - First Maine EEE or WNV detection through October 1, 2013 (dates pertain to date of collection):

i. If presence of either EEE or WNV detected in Maine, the testing criteria will be reevaluated and additional species may be tested.

ii. Other mosquito pools not meeting the above criteria: Other mosquito species may be tested on a case by case basis, as resources and time allow. Otherwise, please discard (or hold internally if interested) any mosquitoes that do not meet the above criteria.

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Maine Vector-borne Work Group

Chair: Stephen Sears, Maine Center for Disease Control and Prevention (Maine CDC)

Adams, Justin	Municipal Pest Management
Aherne, Jim	Maine Organic Farmers and Gardeners Association
Campbell, Polly	Nurse, Augusta, Maine
Camuso, Judy	Maine Department of Inland Fisheries and Wildlife
Dill, Jim	Maine Cooperative Extension
Donahue, Charlene	Maine Forest Service
Dube, Nancy	Maine Department of Education
Elias, Susan	Maine Medical Center Research Institute
Fish, Gary	Maine Board of Pesticides Control
Forbes, John	United States Department of Agriculture Wildlife Services
Foss, Kimberly	Municipal Pest Management
Hicks, Lebelle	Maine Board of Pesticides Control
Jennings, Henry	Maine Board of Pesticides Control
Juris, Sherrie	Atlantic Pest Solutions
Kantar, Lee	Maine Department of Inland Fisheries and Wildlife
Keenan, Patrick	Biodiversity Research Institute
Kirby, Clay	Maine Cooperative Extension
Lacombe, Eleanor	Maine Medical Center Research Institute
Lichtenwalner, Anne	University of Maine, Animal Health Laboratory
Lubelczyk, Charles	Maine Medical Center Research Institute
McCutchan, Thomas	Maine Insectary Services
McEvoy, Elizabeth O.	Maine Department of Agriculture, Conservation, and Forestry
Morrison, Mike	Municipal Pest Management
Murray, Kathy	Maine Department of Agriculture, Conservation, and Forestry
Pote, Ken	Maine CDC
Rand, Peter	Maine Medical Center Research Institute
Ravana, Kyle	Maine Department of Inland Fisheries and Wildlife
Ridky, Chip	United States Department of Agriculture
Robinson, Sara	Maine CDC
Saunders, Megan	Maine CDC
St. Amand, Ted	Atlantic Pest Solutions
Sites, Anne	Maine CDC
Smith, Rob	Maine Medical Center Research Institute
Storch, Dick	University of Maine, Environmental Services
Stratton, Robert D.	Maine Department of Inland Fisheries and Wildlife
Struble, Dave	Maine Forest Service
Sullivan, Kelsey	Maine Department of Inland Fisheries and Wildlife
Szantyr, Beatrice	Physician, Lincoln, Maine
Tsomides, Leon	Maine Department of Environmental Protection
Walsh, Michele	Maine Department of Agriculture, Conservation, and Forestry
Webber, Lori	Maine CDC

APPENDIX 5:

A RAPID HEALTH IMPACT ASSESSMENT ON THE HUMAN HEALTH RISKS OF EMERGENCY ADULTICIDING USING PYRETHROID INSECTICIDES FOR THE PREVENTION OF MOSQUITO-BORNE DISEASES IN MAINE

A Rapid Health Impact Assessment on the Human Health Risks of Emergency Adulticiding Using Pyrethroid Insecticides for the Prevention of Mosquito-borne Diseases in Maine

Megan Saunders, MSPH
Maine Center for Disease Control and Prevention (Maine CDC)
University of Southern Maine (USM)

August 1, 2013

Maine Center for Disease Control and Prevention
An Office of the Department of Health and Human Services
Paul R. LePage, Governor   Mary C. Mayhew, Commissioner

Table of Contents

List of Abbreviations:

BPC	Board of Pesticides Control
CDC	Center(s) for Disease Control and Prevention
DHHS	Department of Health and Human Services
DACF	Department of Agriculture, Conservation and Forestry
ED	Emergency departments
EEE	Eastern equine encephalitis
EPA	Environmental Protection Agency
HIA	Health Impact Assessment
PBO	Piperonyl butoxide
ULV	Ultra-low volume
US	United States
WNV	West Nile virus

Executive Summary

L. D. 292

In 2013, Maine's Department of Agriculture, Conservation and Forestry introduced a bill to the 126th Maine State Legislature entitled "An act to protect the public health from mosquito-borne diseases." The bill was put to resolve, directing the Department of Agriculture, Conservation and Forestry to develop a plan for the protection of the public health from mosquito-borne diseases. This resolve allowed for an opportunity to examine the health effects of the policy, specifically the human health risks associated with the insecticides used in emergency mosquito-control operations.

Methodology

The study employed the steps of Health Impact Assessment (HIA) as outlined by the United States Centers for Disease Control and Prevention. HIA is used to examine the health effects that may be associated with specific policies and to help promote decisions based on the actions that are most beneficial for human health[1]. This HIA was performed in a rapid format, which employed a literature review as its main information gathering technique.

Main Findings

In the event that all other options for mosquito control have been exhausted when confronted with a mosquito-borne public health emergency, it would be beneficial for human health to perform aerial insecticide applications in designated high-risk areas. The pesticides that would be used, specifically synthetic pyrethroids, do not appear to have any significant risk to human health when applied using the recommended concentrations. Should emergency mosquito-control applications commence, communications to the public should be focused on avoiding exposures to the insecticides and monitoring for adverse health effects associated with applications should be monitored by Maine CDC.

I. Introduction

Health Impact Assessment (HIA) is a tool used to help objectively evaluate the potential health effects of a project or policy before it is implemented. The goal of HIA is to provide guidance to policy makers on the decisions that may be made so as to promote outcomes that are beneficial to a population's health[1]. HIA also helps to identify appropriate actions to manage said health effects[2]. The purpose of this HIA is to address one of the health impacts related to the resolve of L. D. 292, directing the Department of Agriculture, Conservation and Forestry (DACF) to develop a plan for the protection of the public health from mosquito-borne diseases (Appendix A). The resolve directs the DACF to consider integrated pest management (IPM) strategies that minimize the risks of pesticide use to humans and the environment; however one of the strongest oppositions to the original bill was that emergency pesticide use would pose significant health risks to the population of Maine. Maine Center for Disease Control and Prevention (Maine CDC) became involved with the lawmaking process, along with DACF and the Maine Board of Pesticides Control (Maine BPC), for the reason that it performs surveillance for arboviral diseases, such as Eastern equine encephalitis (EEE) and West Nile virus (WNV), in the state. Maine CDC would be the agency advising the Commissioner of Health and Human Services to declare a state of public health emergency, allowing for emergency response to an arboviral threat – including the use of emergency adulticiding (the process of using aerial pesticide applications to control adult mosquito populations). This HIA addresses the possible human health risks associated with pesticide exposures from mosquito-control operations.

II. Methods

A. Health Impact Assessments

The conduction of a HIA typically consists of 5 major steps[1, 3, 4]:

- Screening – identifying plans, projects or policies for which a HIA would be useful.
- Scoping – identifying which health effects to consider.
- Assessment – using available resources to judge the magnitude and direction of potential health impacts.
- Reporting – presenting results to stakeholders and decision-makers.
- Monitoring – Tracking the effects of the HIA and decisions on the policy involved.

This report will cover the first four steps of the HIA (screening, scoping, assessment, and reporting). Monitoring will occur following the completion of this report.

B. Screening

In 2012, Maine experienced its first case of locally acquired WNV neruoinvasive disease in a Maine resident, as well as having multiple mosquito pools test positive for WNV and a flock of pheasants test positive for EEE[5]. This made 2012 the most active arboviral year in Maine since 2009 when the state experienced a large scale EEE outbreak which killed numerous horses, pheasants and a llama[6]. In response to the increased arboviral activity Maine BPC (an agency within the Maine DACF) realized that currently Maine is unprepared to respond to a mosquito-borne disease threat and proposed a bill entitled "An Act to Protect the Public Health from Mosquito-borne Diseases" (L.D. 292). This bill proposed changes to the duties of the Commissioner of Agriculture, Conservation and Forestry, including studying, planning, and arranging cooperation related to mosquito-control operations in conjunction with appropriate personnel from the Department of Health and Human Services (DHHS), assisting with disseminating information, and implementing mosquito-control response in the event that the Commissioner of Health and Human Services declares a mosquito-borne disease public health threat. Maine CDC is the agency within DHHS that performs mosquito-borne disease surveillance and members of the Division of Infectious Disease would be the personnel advising the Commissioner of Health and Human Services that a public health threat is imminent. The initial bill was put to resolve (Appendix B), asking members from the DACF to convene and develop a physical plan to protect the public health from mosquito-borne diseases, in cooperation with appropriate personnel from DHHS. Many potential health impacts of the plan were discussed within the Maine State Legislature's Committee on Agriculture, Conservation and Forestry and following the sessions it was decided that there was potential for a HIA to be conducted related to the resolve of L.D. 292.

C. Key Stakeholders

The key stakeholders in this HIA are as follows:

- Maine DACF
  - Maine BPC
- Maine DHHS
  - Maine CDC
- The 126th Maine State Legislature
  - Representing the public interest

D. Scoping

The HIA was scoped using a policy pathway to outline the direct impacts and the intermediate and health outcomes related to the policy (Appendix C). This pathway was then focused on a specific statement indicating that the proposed methods examined in the plan "must include IPM techniques and other science-based technology that minimize the risks of pesticide use to humans" (Appendix D). This was then further refined to look at a specific health outcome: the potential for acute human health risks due to pesticide exposure (Appendix E). Other health outcomes were considered; however during the public hearings and work sessions that occurred related to L.D. 292 it was noted that human health risks due to pesticide exposures were the health outcomes of most concern to the population.

Following the choice of the health outcome to be examined by the HIA, it was decided that the best form of HIA to be applied would be the rapid HIA. The methodology for the HIA was decided to be in the form of a literature review.

After discussion with Maine BPC, and examination of current public health mosquito control practices in New England, it was determined that in the event of a public health threat requiring aerial pesticide applications, that a class of pesticides known as pyrethroids would be the logical products to use in a public health response. Pyrethroids are synthetic chemical insecticides that are widely used for controlling various insects. Some examples of synthetic pyrethroids commonly used in mosquito control operations are permethrin, resmethrin, and d-phenothrin (Sumithrin®), and are usually mixed with a synergist such as piperonyl butoxide (PBO) which enhances the effects of the pyrethroids[7]. The products that would be considered by Maine BPC for use in a public health threat or emergency are Anvil ®,10+10 (Sumithrin® + PBO) which is currently registered in Maine, or Duet® (Sumithrin®+ prallethrin + PBO) which is currently not registered in Maine. Based on the choice of insecticides that would be used in response to a mosquito-borne public health threat or emergency, the literature review was focused on studies done on pyrethroids and mosquito control operations in the United States, as well as risk assessments for pyrethroids. The logic behind this decision is based on the fact that outside of the United States, some pyrethroids are used in malaria control operations, whose methods differ from those used for domestic arboviral control programs.

E. Literature Review

Systematic literature searches were undertaken using PubMed, a biomedical literature search engine powered by the US National Library of Medicine and the National Institutes of Health. Multiple word combinations were searched to ensure that the literature was fairly represented. The following combinations were used:

- Aerial mosquito spraying USA human health
- D-phenothrin human health
- Emergency mosquito spraying
- Human health risks pesticide application mosquito control
- Aerial pesticide application West Nile virus
- ULV pyrethroid exposures
- Human health risks WNV insecticides
- Mosquito control pyrethrin human health risks
- Aerial spraying for mosquitoes

Following each search, the articles were reviewed to ensure that only the relevant literature was included in the final literature compilation. The results were also restricted to English language articles.

Sixteen review articles formed the final literature base for the rapid HIA assessing the human health risks of emergency adulticiding for the prevention of mosquito-borne diseases. Of these, twelve were considered highly relevant and four were considered moderately relevant. The moderately relevant articles discussed risk tradeoffs between mosquito-borne disease and pesticide exposures[8, 9], organophosphates exposures and aerial mosquito control operations[10], and health effects associated with chronic pesticide exposures due to agriculture and mosquito control operations [11]. The highly relevant articles discussed acute health effects of pyrethroid insecticides used in mosquito-control[12-23].

III. Results

A. Media and Risk Perception

Since the early 1900s, United States communities and governments have organized mosquito-control programs to protect the public from the vectors that spread diseases such as EEE and WNV. These control programs include surveillance activities, source reduction, larval control strategies and both ground and aerial applications of insecticides to control adult mosquitoes[24]. When WNV emerged in the United States in 1999[25], the relative risks of illness versus insecticide use were introduced into the public eye[8, 9]. During the first year of the outbreak, the risk of WNV to human health was viewed as a higher risk than the use of pesticides; however during the second year of the outbreak the media shifted their interest to the potentially harmful effects of pesticides[8]. The print media was able to influence the public's viewpoint on risk through the use of qualitative statements regarding mortality and morbidity for both WNV and pesticide use[9]. The more accurate and quantitative the information presented by the press, the better the public is prepared to make informed decisions regarding the risks associated with mosquito-borne diseases and pesticide use[9].

B. Pyrethroid Insecticides and Application Methods

Insecticides used to control adult mosquitoes are known as adulticides. The United States Environmental Protection Agency (US EPA) is in charge of registering different products for this use[26]. Two common groups of adulticides used to control mosquitoes during disease outbreaks or epidemics are organophosphates and pyrethroids[8, 9, 10, 11, 12, 15, 16, 17, 26]. There are both organophosphate and pyrethroid insecticides registered for use in Maine[27]; however based on current nationwide practices, in the event of a mosquito-borne disease outbreak a pyrethroid control product (specifically d-phenothrin (sumithrin®))would be used[7]. Pyrethroid insecticides are synthetic versions of a naturally occurring pesticide known as pyrethrin, which naturally occurs in chrysanthemums[7, 28]. Sumithrin® is registered to control mosquitoes over both agricultural and non-agricultural areas[7]. These insecticides are applied by a process known as ultra-low volume (ULV) sprays. ULV applications are performed either by truck mounted sprayers or by aircraft, and dispense very fine aerosolized droplets that stay aloft and kill flying mosquitoes on contact[7, 28]. These applications also use very small concentrations of the insecticide compared to the size of the area being treated to reduce risks to both people and the environment[28]. The US EPA conducts risk assessments for all pesticides that they register. In these risk assessments they use very conservative estimates of concentrations. Based on the most recent risk assessment for pyrethrins and pyrethroids, it was determined that the cumulative risks from existing pyrethroid uses are below the US EPA's level of concern[29]. Similarly, according the United States Centers for Disease Control and prevention (US CDC), aggressive and timely use of adulticides will reduce the incidence of human disease and assist in reducing the abundance of disease vectors[19, 30].

C. Health Effects of Pyrethroid Insecticides

Pesticides and their effects on health and the environment have been topics of public concern since Rachel Carson published *Silent Spring* in 1962. The book addressed the organochlorine pesticide DDT which had severe repercussions to human health and negative environmental impacts, which led to its use being discontinued in the United States[31]. Other pesticides with fewer health effects and environmental effects, such as organophosphates and pyrethroids, are now used in mosquito control operations in the United States[26]. The use of pyrethroids has increased over the past decade with the declining use of organophosphate pesticides, which are more acutely toxic to birds and mammals than the pyrethroids[32]. When used according to the specifications listed on their labels, pyrethroids pose minimal risks to humans and the environment[7].

As the use of pesticides and their human health effects are a continued topic of interest in today's society, especially with persistent WNV transmission in the United States, a number of risk assessments have been performed to investigate the potential for acute health effects due to the use of insecticides in mosquito control operations[17, 19, 20]. In 2005, Peterson et al. performed a human health risk assessment that looked at the effects of insecticides used in mosquito management and the effects of WNV on human health. Using conservative assumptions for exposures, it was determined that none of the concentrations of active ingredients used in ULV applications from truck mounted sprayers exceeded the acceptable daily exposure limits for both acute and subchronic exposures[17]. The lowest acute and lowest subchronic risk quotients were to phenothrin for both adults and infants, meaning that the calculated potential exposures did not exceed or equal the acceptable daily exposure limits for the active ingredients involved. Similarly, with the conservative estimates for their models, actual exposures to the adulticides distributed by ULV methods would likely be less than the calculated risks[17]. In another study evaluating the efficacy and human health risks of aerial ULV applications of pyrethrins and PBO, it was shown that the risk quotients for one truck mounted ULV application are approximately ten times greater than those estimated for three aerial ULV applications, in part because pesticide deposition on the ground is lower after aerial ULV applications compared to truck applications[20]. Overall the risk assessments both show that acute human health risks from exposures to pyrethroids are below the US EPA's levels of concern, so the benefits of the pesticide applications likely exceed the risks. The risk of infection with a mosquito-borne disease was also determined to be greater than the health risks associated with ULV insecticide applications[17, 20]. In a study based out of Sacramento, California it was determined that without aerial ULV adulticide applications, it was likely that more residents would have been infected with WNV – thus the applications prevented increased mortality and morbidity associated with the mosquito-borne illness[19].

Exposures to high concentrations of pyrethroids are known to have acute effects on the dermal, gastrointestinal, and nervous systems[7, 12, 18, 22, 33]; however the public concern for respiratory effects such as asthma exacerbation due to mosquito control operations has increased since the introduction of WNV to the United States[14, 34]. A number of studies have been conducted looking at acute insecticide related illness associated with mosquito control operations[12, 14, 15, 16, 22, 23]. In a study looking at nine states with pesticide poisoning surveillance programs, the majority of persons identified with acute pesticide related illness had low to moderate illness severity associated with either respiratory or neurologic dysfunction. Out of the 133 cases identified from 1999 to 2002, 37 of the cases were reported as being associated with pyrethroid exposures, while the majority of the remaining cases were associated with organophosphate exposures. Overall, the study showed that the risks of acute pesticide-related illnesses associated with mosquito control operations was low for persons living in areas where the insecticides were applied[12]. In another study looking at the effects of large scale ULV applications of various pesticides used in emergency mosquito-control operations in Mississippi, North Carolina, and Virginia, health officials looked at urine pesticide metabolite concentrations to see if persons with exposures had higher concentrations. The findings indicated that the ULV applications of mosquito control products did not lead to increased urine pesticide metabolite concentrations, and therefore did not contribute to substantial or increased human pesticide exposures[15].

Multiple studies have been conducted looking at ULV mosquito control applications and emergency department (ED) visits[14, 16, 22, 23]. Two studies looked at the effects of pesticide spraying on ED asthma visits in New York City as part of the WNV virus response in 1999[16] and 2000[14]. Both studies looked at the rates of visits for asthma on days with spray events and days without spray events, and found that there was no increase in ED visit rates for asthma[14, 16]. The study in looking at the rates of ED asthma visits in 1999 also found that there was no increase in the severity of asthma seen in the ED post pesticide application[16]. These studies suggest that respiratory effects of ULV pyrethroid applications are minimal. A recent study out of California examined the correlation between aerial ULV pyrethrin applications and ED visits in Sacramento, and found that exposures to aerially applied insecticides was not associated with clusters of respiratory, gastrointestinal, skin, eye, or neurologic complaints in the ED[22]. In a study describing the 2012 WNV epidemic in Dallas, Texas, the daily incidence of ED visits for skin rashes and acute respiratory distress was analyzed for a two month period encompassing the month prior to and week following an eight day aerial insecticide treatment period. There was not an upward shift in visits on or following the application days and it was found that aerial pyrethroid applications were not associated with increases in ED visits for asthma or skin rash[23]. Similarly, following an increase in concern over respiratory effects of pyrethrins and pyrethroids the US EPA conducted a review of the registered products to identify any emerging trends associated with these products. They found that there does not appear to be any clear association between pyrethrin and pyrethroid exposures and allergic or asthma responses[34].

The volume of literature examining other health effects of pyrethroid insecticides is significantly sparser; however three articles examining dermal exposures[21], dietary risks[18], and hormonal effects[13] of pyrethroid insecticides were found in the review. In a study examining dermal exposures due to ULV applications for mosquito control, it was found that, similar to the results of other risk assessments[17, 20], the estimated exposures were below the regulatory levels of concern posing little risk to human health[21]. Mosquito-control products may be applied over agricultural crops in the event of a mosquito-borne disease outbreak, which may increase the possibility of ingesting pesticide products. A dietary risk assessment for resmethrin was conducted to explore dietary exposures to this pyrethroid in 2006[18]. It was found that the likelihood of detectable pesticide residues on crops due to aerial mosquito-control applications would be low, especially when compared to residues left in the environment due to traditional agricultural application practices[18]. The investigators also calculated margins of safety from possible reproductive and/or teratogenic effects due to acute dietary exposures to resmethrin using results from animal toxicity studies and found that the margins of safety for all age groups were adequate to protect human health[18]. Finally, there have been concerns of pyrethroids having effects on the endocrine system[8, 13]. In a study that examined *d*-phenothrin's (sumithrin®) effects on estrogenic and (anti-) androgenic activities, it was found that *d*-phenothrin exhibits no adverse estrogenic or (anti-) androgenic effects, implying that exposures to this pyrethroid pose little risk for endocrine disruption[13]. Finally, in a long term exposure study looking at chronic exposures to agricultural pesticides, it was found that there was weak evidence of increased risk for breast cancer associated with less persistent current-use pesticides, but the association could be due to chance[11]. There was also a lack of a persistent pattern observed in odds ratios for proximity to mosquito control operations and breast cancer risk[11]. The less persistent current-use pesticides were defined as those which were not persistent organochlorines and applied after 1975; therefore they could include organophosphates, pyrethroids, or other pesticide categories[11].

IV. Conclusions and Recommendations

The literature consistently shows that when used at recommended concentrations for ULV applications, pyrethroid insecticides pose very low risks to human health. It also shows that when applied aerially, the risk to human health is lower than when applied by truck mounted sprayers. The products that have been suggested for use in Maine by the Maine BPC in the case of a mosquito-borne public health emergency have active ingredients that are the least acutely toxic of the pyrethroids (d-phenothrin (sumithrin®), further reducing the potential risk for adverse human health effects due to pesticide exposures. Finally, in epidemic arboviral transmission settings, it has been consistently determined that the risk to human health from mosquito-borne diseases is greater than the risk of acute pesticide poisoning.

In the event of aerial mosquito-control applications becoming necessary in Maine there are a number of ways to help reduce the public's risk of exposure to the insecticides used in these operations. Applications should be timed to minimize the public's contact with the insecticides. Communication to the public about the operations needs to be the performing agencies' first priority. The agencies should notify the public about when, where and why the insecticides will be applied and how to reduce the likelihood of exposures in a timely manner. Efforts should be made to ensure that the information reaches everyone in the spray zone, and multiple methods of communication should be utilized including print, radio, and television. An informational hotline might be a useful tool to provide information to the public about their concerns, should applications be required. The hotline should be a joint effort between Maine CDC and Maine BPC.

Following any large-scale mosquito-control applications, Maine CDC should implement a system to monitor for any adverse health effects related to insecticide exposures. Currently, very few states have state-monitored pesticide poisoning surveillance systems[12], and Maine currently does not have a system in place. Two potential ways of monitoring for increased pesticide poisoning events following public health mosquito-control operations would be to either use the Northern New England Poison Center (NNEPC)'s call system or using Maine CDC's syndromic surveillance system. If the NNEPC were to be used, a baseline for numbers of calls related to acute pesticide poisoning would need to be established prior to the applications. Any calls on the night of the pesticide application and day following the application received by NNEPC should be logged. These calls would then need to be relayed to Maine CDC and Maine BPC to be examined for any deviations from the normal number of calls received by NNEPC. The limitations to this are that it may not distinguish between agricultural, home pesticide exposures and exposures due to mosquito control applications. If a syndromic surveillance system were to be used to monitor adverse health effects associated with pesticides, the first step would be to create a list of chief complaints associated with pesticide poisoning which could then be used to form a syndrome for surveillance purposes. This syndrome could then be monitored through ED's in the areas surrounding the spray area following the applications. Once again, a baseline for the syndrome being examined would need to be determined. One limitation to this monitoring strategy would be that the more non-specific or common the chief complaints used, the less useful the system would be in identifying adverse health events. Another limitation to this strategy is that currently Maine CDC's syndromic surveillance system does not capture data for all hospitals. If the application event occurred in an area without connected EDs, it would be difficult to monitor for any adverse health events.

In conclusion, in the event of a mosquito-borne public health emergency requiring emergency mosquito-control operations Maine CDC and Maine BPC should work together to reduce human exposures to insecticides, use products that have consistently been found to be at very low risk for human health effects, and monitor for any adverse health effects related to insecticide exposures in the population.

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VI. Appendices

A. Resolve, L.D. 292

B. L.D. 292

C. Policy Pathway

D. HIA Focus Pathway

E. Health Determinant Pathway

Appendix A:

STATE OF MAINE

IN THE YEAR OF OUR LORD

TWO THOUSAND AND THIRTEEN

H.P. 201 - L.D. 292

Resolve, Directing the Department of Agriculture, Conservation and Forestry To Develop a Plan for the Protection of the Public Health from Mosquito-borne Diseases

Sec. 1. Department of Agriculture, Conservation and Forestry to develop a plan for the protection of the public health from mosquito-borne diseases. Resolved: That the Department of Agriculture, Conservation and Forestry is directed to develop, within existing resources, a plan for the protection of the public health from mosquito-borne diseases, in cooperation with appropriate personnel from the Department of Health and Human Services and with other state agencies as may be necessary. In developing this plan, the department shall consider, at a minimum, the ecological and economic impacts of proposed methods of controlling mosquitoes and preventing their breeding. These proposed methods must include integrated pest management techniques and other science-based technology that minimizes the risks of pesticide use to humans and the environment. The department shall include in the plan the criteria for declaring a mosquito-borne disease public health threat, the elements of a response to such a threat and a description of the lines of authority and responsibilities during a public health threat; and be it further

Sec. 2. Report. Resolved: That the Department of Agriculture, Conservation and Forestry shall report on its plan for protecting the public health from mosquito-borne diseases to the Joint Standing Committee on Agriculture, Conservation and Forestry by December 15, 2013. The Joint Standing Committee on Agriculture, Conservation and Forestry may report out a bill on the plan for the protection of the public health from mosquito-borne diseases to the Second Regular Session of the 126th Legislature.

Appendix B:

An Act To Protect the Public Health from Mosquito-borne Diseases

Be it enacted by the People of the State of Maine as follows:

Sec. 1. 7 MRSA c. 6-A is enacted to read:

CHAPTER 6-A

CONTROL OF MOSQUITOES

§ 171. Control of mosquitoes for protection of public health; state policy

It is the policy of the State to undertake appropriate activities to reduce disease-carrying mosquito populations that threaten the health of residents of this State. The State shall use a wide array of integrated pest management techniques and other science-based technology in a manner that minimizes the risks of pesticide use to humans and the environment.

§ 172. Department lead agency; powers of commissioner

The department is the lead agency of the State for carrying out mosquito-control activities as described in this chapter.

The commissioner may use all lawful methods for the control of mosquitoes and the prevention of their breeding, including conducting or contracting for mosquito-control activities and purchasing necessary equipment for the purposes of carrying out this chapter.

§ 173. Rules

The commissioner may adopt rules to carry out the purposes of this chapter. Rules adopted pursuant to this section are routine technical rules as described in Title 5, chapter 375, subchapter 2-A.

§ 174. Duties of commissioner

1. **Study; plan; arrange cooperation.** The commissioner, in cooperation with appropriate personnel from the Department of Health and Human Services, shall, when sufficient money for such purposes is available in the fund, consider and study mosquito-control problems, including mosquito surveillance; coordinate plans for mosquito-control work that may be conducted by private landowners, groups, organizations, municipalities, counties and mosquito-control districts formed pursuant to section 176; and arrange, so far as possible, cooperation among state departments and with federal agencies in conducting mosquito-control operations within the State.

2. **Assist with disseminating information.** The commissioner, in cooperation with appropriate personnel from the Department of Health and Human Services, shall, when sufficient money for such purposes is available in the fund, assist private landowners, groups, organizations, municipalities, counties and mosquito-control districts formed pursuant to section 176 with disseminating information to the citizens of the State about ways to reduce mosquito populations, to

control breeding sites and to protect themselves from mosquito-borne diseases as well as other relevant information.

3. **Implement mosquito-control response.** In the event that a mosquito-borne disease public health threat is declared by the Commissioner of Health and Human Services pursuant to Title 22, section 1446, the Commissioner of Agriculture, Conservation and Forestry shall consult appropriate state agency plans and personnel and university and private sector experts to determine and implement an effective control response, which must include a wide array of integrated pest management techniques. The availability of funds must also be considered as part of the response planning.

§ 175. Maine Mosquito Control Fund

The Maine Mosquito Control Fund, referred to in this chapter as "the fund," is established to carry out the purposes of this chapter. The fund consists of any money received as contributions, grants or appropriations from private and public sources. The fund, to be accounted for within the department, must be held separate and apart from all other money, funds and accounts. Any balance remaining in the fund at the end of a fiscal year must be carried forward to the next fiscal year. The department may expend the money available in the fund and make grants to private landowners, groups, organizations, municipalities, counties and mosquito-control districts to carry out the purposes of this chapter.

§ 176. Mosquito-control districts

For the purposes of preserving and promoting the public health and welfare by providing for coordinated and effective control of mosquitoes, municipalities may cooperate through the creation of mosquito-control districts.

Sec. 2. 22 MRSA c. 257-B is enacted to read:

CHAPTER 257-B

MOSQUITOES

§ 1446. Mosquito-borne disease public health threat

When available surveillance information indicates the likelihood of a potential human disease outbreak arising from mosquito-borne pathogens, the commissioner may declare a mosquito-borne disease public health threat for the purposes of alerting the public and other state, local and federal agencies about the existence of the threat so that appropriate actions may be taken.

SUMMARY

This bill authorizes the Department of Agriculture, Conservation and Forestry to conduct appropriate mosquito-control activities in response to mosquito-borne disease public health threats. In addition, the bill authorizes municipalities to cooperate in controlling mosquitoes through the formation of mosquito-control districts. It establishes the Maine Mosquito Control Fund to provide funding for mosquito-control activities. Finally, the bill authorizes the Commissioner of Health and Human Services to declare a mosquito-borne disease public health threat.

Appendix C:

State Mosquito Policy Pathway as Related to L.D. 292

Policy

- **Department of Agriculture, Conservation and Forestry to Develop a Plan for the Protection of the Public Health from Mosquito-borne Diseases (LD 292)**
  - In developing this plan the department shall consider at a minimum, the ecological and economic impacts of proposed methods of controlling mosquitoes and preventing their breeding
  - Proposed methods must include IPM techniques and other science-based technology that minimize the risks of pesticide use to humans and the environment
  - Plan must include criteria for declaring a mosquito-borne disease threat , the elements of a response to such a threat and a description of the lines of authority and responsibilities during a public health threat

Direct Impact

- **Organization of Response Efforts**
- **Description of State's Authority**
- **Coordination of State Organizations' Efforts**
  - Different Agencies' Roles
- **Determination of Mosquito Control Districts**
- **Definition of Trigger for a Mosquito-borne Public Health Emergency**
- **Arboviral Surveillance**
- **Use of IPM strategies**
  - Larviciding
  - Habitat Modification
  - Biocontrol Exploration
  - Emergency Adulticiding

- Signifies a change

Intermediate Outcomes

- **Outdoor activities**
- **Farming practices**
- **Town planning**
- **Air pollution**
- **Invasive species**
- **Mosquito activity & presence**
- **Environmental changes**
  - Water quality
  - Water retention
  - Greenspaces & visual quality
- **Pesticide use**
- **Economic impacts**
  - Agricultural practices
  - Food purchasing & eating habits

- Signifies a change

Health Outcomes

- **Vector-borne disease**
- **Respiratory diseases**
- **Chronic diseases**
- **Pesticide exposures**
  - Respiratory, gastrointestinal, and dermal conditions
- **Physical activity**
- **Mental health**
  - Stress
- **Nutrition**

- Signifies a change

*__Bold__ indicates an encompassing category within the impacts and outcomes

Appendix D:

Health Impact Assessment Focus Pathway as Related to L.D. 292

Policy

- **Department of Agriculture, Conservation and Forestry to Develop a Plan for the Protection of the Public Health from Mosquito-borne Diseases (LD 292)**
  - Proposed methods must include IPM techniques and other science-based technology that minimize the risks of pesticide use to humans and the environment

Direct Impact

- **Increased use of IPM strategies**
  - Larviciding
  - Habitat Modification
  - Biocontrol
  - Adulticiding (Use of Pesticides)
    - Routine
    - Emergency

Intermediate Outcomes

- **Increased use of pesticides**
  - Aerial applications
- **Decrease mosquito activity**
  - Decrease likelihood of EEE & WNV transmission to humans
- **Decrease presence of mosquitoes**
  - Decrease likelihood of EEE & WNV transmission to humans
- **Decreased air quality**
- **Increased presence of pesticide residue on crops**

Health Outcomes

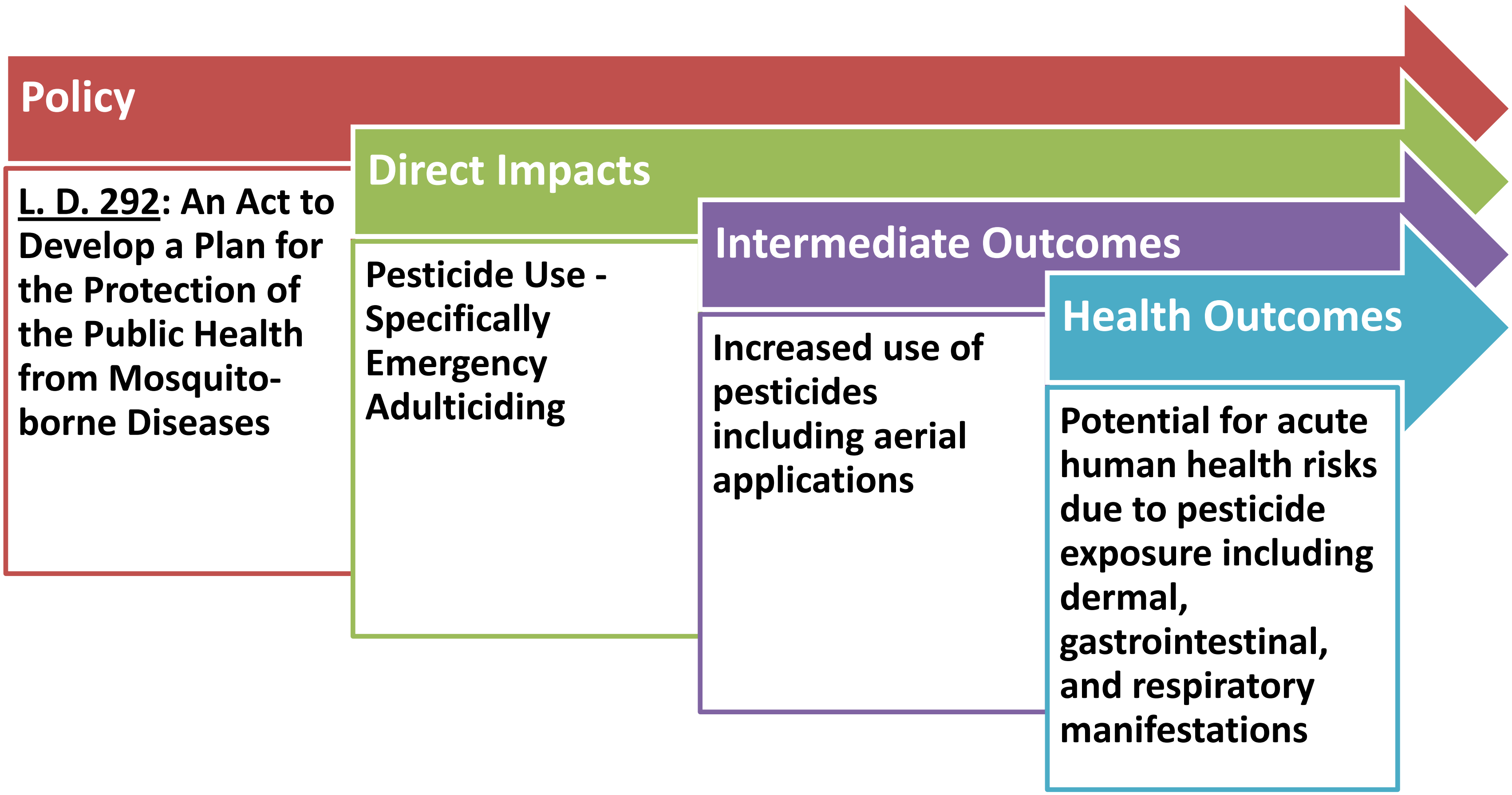
- **Decrease number of human cases of EEE & WNV**
- **Prevent human cases of EEE & WNV**
- **Potential for human health risks due to exposure to pesticides**
  - Acute
    - Dermal
    - Gastrointestinal
    - Respiratory
  - Chronic

**Bold* indicates an encompassing category

**Underlined indicates the topic of interest for the Health Impact Assessment

Appendix E:

Health Determinant Pathway: L. D. 292



APPENDIX 6:

STATUS OF PRODUCTS REGISTERED FOR USE AS WIDE-AREA PUBLIC HEALTH MOSQUITO ADULTICIDES IN MAINE, 2013 and REVIEW OF EPA'S MOST RECENT PUBLIC HEALTH AND ENVIRONMENTAL RISK ASSESSMENTS

Report on the Status of Products Registered for use as Wide Area Public Health Mosquito Adulticides in Maine-2013

And

Summary of EPA's Most Recent Public Health and Environmental Risk Assessments

Lebelle Hicks PhD DABT
Pesticides Toxicologist
Maine Board of Pesticides Control
December 20, 2013

MOSQUITO WIDE AREA PUBLIC HEALTH ADULTICIDES IN MAINE 2013

BACKGROUND

The pesticides registered for use for mosquito control in Maine include:

Adulticides, products which kill adult mosquitoes, ten of which are discussed below

Repellents, products used on human skin, human gear and animals to repel adult mosquitoes

Aquatic larvicides, products added to water at breeding sites to prevent the development of the mosquitoes, these include the biological insecticides, the insect growth regulator methoprene and monomolecular films which mechanically control the larvae

Non-aquatic larvicides, insect growth regulators which are labelled for use indoors, outdoors and on animals

Of the 1,322 products registered for use on mosquitoes in Maine -2013, 1,125 of these products contain at least one adulticide and approximately 30 have specific directions for use in wide area public health uses (NSPIRS 2013). This review is limited to a subset of these products which are registered for use in public health wide area mosquito control projects used to address an outbreak of either Eastern Equine Encephalitis (EEE) or West Nile Virus (WNV). Since the labels are legal documents and are approved by EPA in accordance with their risk assessments, human health and environmental, the label statements limiting the areas of use and specifics of applications go a long way to limiting exposure while providing efficacy in control of adult mosquitoes.

There are two chemical classes of insecticides, pyrethrins-pyrethroids-PBO (including etofenprox, permethrin. piperonyl butoxide (PBO) (synergist), permethrin, phenothrin, prallethrin, pyrethrins and resmethrin) and the organophosphates (chlorpyrifos, malathion and naled). The synergist PBO is found in all but two of the pyrethroid-pyrethrin products and is not in the organophosphate products. A synergist increases the activity of the pyrethroid-pyrethrin insecticides while having no insecticidal efficacy of its own.

HUMAN RISK ASSESSMENT

The human health risks are evaluated by comparing the most sensitive endpoint in lab animals, to expected environmental exposures. The standard measure of human health risk is the 'margin of exposure' (MOE). The MOE is the ratio of the most sensitive toxicity result from the animal study to the expected exposure dose resulting from the use in question. A pesticide product with a higher calculated MOE has a lower risk to humans. EPA has established chemical specific 'levels of concern' (LOC) for short (1 to 7 days) and intermediate (1 to 6 months) term exposures. Risks higher than the LOC are deemed acceptable. Human health risks are evaluated for toddlers for exposure following an application via incidental oral route (putting hands or objects in mouth after playing on grass, or eating grass) and dermal (skin) exposure and inhalation, and for adults via skin and inhalation routes (EPA 2012c).

With regard to the pyrethrins-pyrethroids and piperonyl butoxide (PBO), with the exception of prallethrin (a component of Duet EPA# 1021-1795-8329) the MOE exceed EPA's LOC by approximately ten to over a million times for both aerial and ground applications at the maximum use rate for public health adult mosquito control. EPA has yet to finalize the human health risk assessment for prallethrin. The human health risk associated with the use of these materials is exceedingly low. Mosquito adulticides are applied by ultra-low-volume equipment by air or by ground. For the adulticide products containing pyrethrins-pyrethroids-PBO, risks from aerial applications by ultra-low-volume are lower and efficacy against mosquitoes is better than those made by ground ultra-low-volume.

Given the low risks from exposure to the pyrethrins- pyrethroids-PBO, any could be used in a wide area public health adulticiding program. The phenothrin-PBO containing product, Anvil 10+10 (EPA# 1021-1688-8329) has been used in other states, because of its very low application rate (0.0036lbs ai/A), its low risk to humans, its allowed use over agricultural areas (40 CFR 180.647) and the tolerances in all raw agricultural commodities as a result of mosquito adulticiding.

The three organophosphates, chlorpyrifos, malathion and naled, registered for wide area adult mosquito control have lower margins of exposure (higher risk to people) than do the pyrethrins-pyrethroids-PBO compounds. However, with the exception of chlorpyrifos at 0.01 lb ai/A, the risk of inhalation exposure in both toddlers and adults is higher (the MOE is lower) than EPA's levels of concern for these applications. For air applications of the organophosphate pesticide naled, the calculated risks to toddlers range from 54 times higher than the level of concern for oral exposure to approximately 240 times higher for dermal exposure (EPA 2002a, EPA 2006a). Similar to phenothrin, there is a universal tolerance on agricultural products intended for human consumption for naled residues following wide area mosquito adulticiding applications (40CFR180.215). Among organophosphates, naled and malathion, are considered the lowest risk, effective pesticides and are often used in the southern and mid-western U.S. for wide area mosquito control.

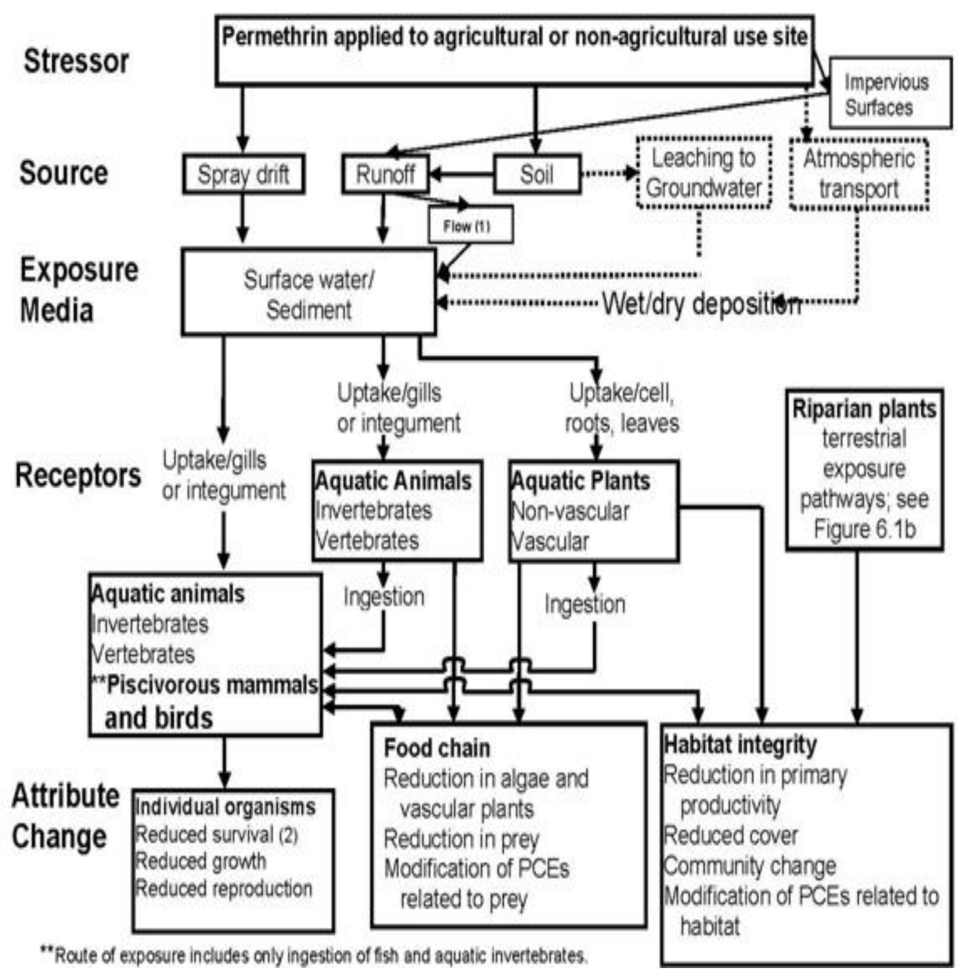
The potential for pesticides to cause an increase in cancer rates in the human population is considered in EPA risk assessments. The cancer potentials for the adulticides are categorized as "not likely" or "no evidence" for phenothrin, and naled, "not likely at low doses" for etofenprox and pyrethrins, suggestive or possible for PBO and malathion, and likely for permethrin and resmethrin (EPA 2012a). However, the cancer risks from exposure to permethrin following ultra-low-volume ULV applications is 3 orders of magnitude (1,000 times) lower than EPA's acceptable risk level of 1 in a million by ground and eleven orders of magnitude lower, when the application is done by air (EPA 2009d). The residential cancer risks following mosquito adulticiding with permethrin both by air and ground are lower than EPA's acceptable risk level 1 in a million (EPA 2006f).

Allergy reactions as a result of insecticide exposure, including asthma exacerbations are difficult to predict. Because of this, the message to the public if a municipal adulticiding application were to occur, would include, persons with allergies, take extra care (stay inside, close windows etc.) to reduce exposure.

Environmental Risk Assessment

Because of the wide variety of ecological niches and species occupying those niches, assessing risks to organisms in the environment is much more complicated (Figure 1) than human health assessments.

Figure 1 Aquatic Conceptual Model of Exposure pathways for Permethrin (EPA 2011h)



Laboratory species are used to determine the critical toxicology value and exposure is estimated using a combination of modeling and environmental sampling. Unlike the human health process, the environmental risks are evaluated using the risk quotient method; estimated environmental concentration divided by the toxicity factor. In this case the lower the risk quotient, the lower the risks. The levels of concern (LOC) used by EPA have been established for acute (short term exposure, LOC = 0.5), chronic (long term exposure, LOC = 1).

Fish and aquatic invertebrates lack the metabolic capability of the mammalian liver and lack the protective barrier found in humans or other mammals, therefore they are generally more sensitive to insecticides. This is reflected in both the toxicity of the insecticides as wells as the risks. Exposure to birds and wild mammals is estimated using the T-REX model (EPA 2012b). The risks to birds and wild-mammals parallels the risks to humans. Because there was no toxicity seen in the animal studies, EPA did not perform risk assessments for etofenprox (EPA 2009a) and phenothrin (d-phenothrin; Sumithrin^{tm}) (EPA 2008f).The other pyrethrins-pyrethroids and PBO risks are within EPA's level of concern of acute and chronic exposures at rates used for mosquito control (EPA 2005g, EPA 2006i, EPA 2006b, EPA 2006d, EPA 2010b, EPA 2011h, EPA 2011i, EPA 2012h, EPA 2012i). The risk quotients for the organophosphates for birds and mammals are generally higher (more risky) than the pyrethrins-pyrethroids-PBO compounds (EPA 2008d, EPA 2008e, EPA 2008g, EPA 2009g) . They are still within EPA's level of concern for acute and chronic exposure.

The data currently in the EPA reviews indicate that the highest risks from ultra-low-volume mosquito adulticiding applications are to freshwater and marine invertebrates living in the water column and to those dwelling in the sediment. The toxicity of the pyrethrins and pyrethroids to sediment dwelling invertebrates is an area of active research. EPA has issued data-call-ins for the pyrethrins and most of the pyrethroids.

EPA's aquatic risk assessments rely on modeling for estimating environmental exposure. The assumptions are for multiple aerial applications 25 to 50 per year with intervals ranging from 1 day (EPA 2011h) to 7 days (EPA 2012h). They also assume that temperature is 85^{o} F and the relative humidity is 90%. Most of the ultra-low-volume mosquito adulticide labels require a temperature of above 50^{o} F. Given the climate in Maine and our relatively short warm season permitting mosquito development, and the fact that EEE and WNV are often not detected in mosquitoes until late in the season, the likelihood of more than one or two applications per year is low.

CONCLUSIONS

Adult mosquito control is only one part of a comprehensive IPM approach that includes education to promote the use of repellents and staying indoors when risk is high, and when possible, eliminating standing water where mosquitoes breed, or treating mosquito breeding habitats with lower risk larvicides. However, the use of adulticides can be a lower risk and necessary means for protecting communities when the risk of WNV or EEE reaches critical levels. When risks of mosquito borne illness are high and mosquito habitat reduction and larval control are infeasible and/or insufficient to reduce adult mosquito populations, aerial or ground-based applications of insecticides are often a necessary component of an integrated mosquito management program (CDC 2003).

The overview of mosquito products and the label review are appended for consultation. The risk assessment information (100+ pages) is compiled and will be made available at your request.

SECTION 1. SCOPE; UNIVERSE OF PESTICIDE PRODUCTS REGISTERED FOR USE ON MOSQUITOES IN MAINE 2013 AND PESTICIDE PRODUCTS LABELED FOR USE AS PUBLIC HEALTH MOSQUITO ADULTICIDES

The 53 active ingredients in the 1,322 products currently registered in Maine with mosquito control on their labels. The active ingredients are summarized in Table 1.1. These products have been grouped as to function: adulticide, aquatic larvicides, insect growth regulators, repellents, and products with multiple uses. When a product has two or more active ingredients in the same group, adulticide, larvicide or repellent, that is consider a single group. For example a product with two pyrethroids would be considered an adulticide, a product with one pyrethroid and an insect growth regulator would be considered a multi-use-product. One thousand one hundred and twenty five of the mosquito products registered in Maine-2013 contain at least one adulticide, 206 products contain at least one insect growth regulator (for purposes this classification products containing methoprene with non-aquatic uses are grouped with the IGRs and aquatic uses are grouped with the aquatic larvicides), 163 contain at least one repellent and 47 are aquatic larvicides. Three hundred and sixty five of these products contain one of two synergists, either PBO (piperonyl butoxide) or MGK 264 (N-Octyl bicycloheptene dicarboximide).

In addition to the active ingredients, pesticide products contain "inert" or "other" ingredients. These ingredients are present to increase the activity of the active ingredient, but they have no pesticidal action against the target pest. A review of the inert ingredients in the public health adulticides, could be undertaken, but was beyond the scope of the current project.

The products included in the current review were limited to the adulticide products with specific directions for wide area public health uses and include pyrethrins, five synthetic pyrethroids (etofenprox, permethrin, phenothrin, prallethrin and resmethrin) and three organophosphates (chlorpyrifos, malathion and naled) (Table 2.1). Future reviews of the other types of mosquito products may be done.

The most common active ingredients in mosquito products are: permethrin is also found in over 300 products, the synergist, PBO (over 300 products) and pyrethrins (over 200 products). These three active ingredients are found in the public health products listed in Table 2.1. Permethrin has uses on human gear, indoor, outdoor and direct uses on animals. PBO and pyrethrins have a variety of indoor, outdoor and direct uses on animal (NSPIRS 2013).

Table 1.1 Overview of Mosquito Products Registered in Maine in 2013; The Active Ingredients in Bold are found in the Public Health Wide Area Mosquito Products

Type	# Products	Active Ingredients	Notes
Biological larvicides	32	Bti-Bs	Microbial disruptors of insect midgut membranes (IRAC 2013)
Repellents	179	DEET	These repellents are registered for use on human skin and are recommended by the federal CDC as mosquito repellents.
		IR3535	
		Oil of Lemon Eucalyptus	
		Picaridin	
		PMD	
		MGK 326 Repellent (Dipropyl isocinchomeronate) is registered for use on human gear in products with indoor and outdoor uses. BPG (Butoxypolypropylene glycol) is found in combination with other repellents pyrethroids and synergist. Registered for agricultural use on livestock. Linalool is registered in impregnated materials (candles torches etc.) to repel mosquitoes outdoors. The linalool products also have indoor uses. Other repellents: Oil of Eucalyptus (can be used on skin), Metofluthrin, Oil of Citronella	
Synergists	455	**PBO (piperonyl butoxide)**	PBO used in most of the pyrethrin-pyrethroid products used in public health wide area projects.
		MGK 264 (N-Octyl bicycloheptene dicarboximide)	MGK 264 is found in a dozen products with human skin and gear on their labels and numerous indoor outdoor and animals use products.
Insect Growth Regulators	258	Methoprene	Methoprene is a juvenile hormone analogue (IRAC 2013) and is found in aquatic larvicide 12 products; the non-aquatic uses of methoprene are on cats and dogs for flea and tick control
		Pyriproxyfen	Pyriproxyfen is a juvenile hormone analogue (IRAC 2013). The primary uses of pyriproxyfen are on cats and dogs for flea and tick control

Table 1.1 Overview of Mosquito Products Registered in Maine in 2013; The Active Ingredients in Bold are found in the Public Health Wide Area Mosquito Products

Type	# Products	Active Ingredients	Notes
Neonicotinoids	38	Acetamiprid, Dinotefuran, Imidacloprid	These compounds activate the insect nicotinic acetylcholine receptor (nAChR) (IRAC 2013).
Organophosphates	39	**Chlorpyrifos, Malathion, Naled**	Organophosphate insecticides act by irreversibly inhibiting the enzyme acetylcholinesterase in the nervous system (IRAC 2013).. These may be used in public health wide area projects.
		DDVP, Tetrachlorvinphos	Six impregnated strips containing 18.6% DDVP.and one DDVP/ tetrachlorvinphos are registered for agricultural uses. DDVP is also found as a metabolite of naled
		Temephos	Temephos is an aquatic larvicide.
Carbamates	10	Carbaryl	Carbamate insecticides act by reversibly inhibiting the enzyme acetylcholinesterase in the nervous system (IRAC 2013
Pyrethrins - Pyrethroids	1181	**Ethofenprox, Permethrin, Phenothrin, Prallethrin, Pyrethrins, Resmethrin**	Pyrethrins and pyrethroids act by modulating the sodium channels in neurons (IRAC 2013). Ethofenprox, Permethrin, Phenothrin, Prallethrin, Pyrethrins, or Resmethrin may be used in public health wide area projects. All of the public health products contain the synergist PBO except for the etofenprox products.
		Other pyrethroids: Allethrins-d and d-trans, Bifenthrin, Bioallethrin-s, Cyfluthrins, Cyhalothrins, Cypermethrins, Deltamethrin, Esfenvalerate, Fluvalinate, Tetramethrin	
Others	148	2-Phenylethyl propionate, d-Limonene, Fipronil, Mineral oil, NEEM, POE isooctadecanol, Soap, Spinosad, Triethylene glycol	Includes two aquatic larvicides with mechanical means of control; mineral oil and POE isooctadecanol. Fipronil acts by blocking the GABA gated chloride channels in nerves. Spinosad acts as a nACh allosteric activator (IRAC 2013)

SECTION 2. TYPICAL ADULTICIDE PRODUCTS LABELED FOR WIDE AREA PUBLIC HEALTH ULV USES

In an effort to summarize the potential for human and environmental hazards associated with public health mosquito abatement programs, a product search was conducted for Maine 2013 registration, followed by a search for active federal registrations for public health mosquito adulticide products. The search terms included: adult mosquito, and aerial or ultra-low volume (ULV) (NSPIR 2013). There were approximately 30 products identified by the search, with the language on their labels specifying:

> "*For use only by federal, state, tribal, or local government officials responsible for public health or vector control, or by persons certified in the appropriate category or otherwise authorized by the state or tribal lead pesticide regulatory agency to perform adult mosquito control applications, or by persons under their direct supervision*"

The EPA registration numbers (EPA#) for the selected public health wide area mosquito adulticide products registered in Maine in 2013 containing synthetic pyrethroids, pyrethrins and PBO, their diluents, are found in Table 2.1. Similar information for the organophosphate containing products is found in Table 2.2.

The review is based on selected products because the number of products could change, with the Maine registration of a federally registered product. The federal search identified 108 products, 27 of which are currently registered Maine. Of the remaining 84 products, 78 have the same mosquito adulticide active ingredients and similar formulations as those registered in Maine-2013. The other six products, may be registered in Maine -2013, but do not have public health mosquito control uses on their labels. Four of these contain the active ingredients carbaryl (one home owner; three agricultural products), 2 contain the synthetic pyrethroid, lambda cyhalothrin. Wide area mosquito adulticiding public health uses are not on these federal labels (Bayer 2009, Tessendro-Kerley 2012, Tessendro-Kerley 2013, Loveland Chemical 2011, Syngenta 2010, LG Lifesciences 2009).

The maximum use rates in pounds pyrethroid-pyrethrins and PBO active ingredient per acre (lbs ai/A) are presented in Table 2.3. The organophosphate active ingredient maximum use rates are found in Table 2.4. The use rates for malathion are 0.23 lbs ai/A by air and 0.11 lbs ai/A by ground (Table 2.4.). Use rates for the synthetic pyrethroids, pyrethrins and the organophosphates chlorpyrifos and naled are the same for both aerial and ground ultra-low volume (ULV) applications.

Table 2.1 Typical Public Health Adult Mosquito Products Containing Pyrethroids-Pyrethrins-Piperonyl Butoxide (PBO) Registered in Maine for 2013 sorted by Active Ingredient (NSPIRS 2013) [(a)]				
Active ingredients	**Percent Active Ingredients**	**Diluent**	**EPA REG #**	**References**
Etofenprox	4% Etofenprox	Ready to use	2724-807	Wellmark 2010a, Wellmark 2010b,
	20% Etofenprox	Oil	2724-791	Wellmark 2009a, Wellmark 2009b,
Permethrin-PBO	2% Permethrin, 2% PBO [(b)]	Ready to use	73748-3	Univar 2013a, Univar 2013b
	< 5% Permethrin, < 5% PBO	Oil	655-898	Prentiss 2012a, Prentiss 2012b
	20% Permethrin, 20% PBO	Water	432-796	Bayer [(c)] 2013a, Bayer 2013b
	20.6% Permethrin, 20.6% PBO	Oil or Water	53883-274	Control Solutions 2010a, Control Solutions 2010b,
	> 30 % Permethrin, > 30% PBO	Oil	73748-5	Univar 2013g, Univar 2013h
Phenothrin-PBO	10% Phenothrin[(d)], 10% PBO	Oil	1021-1688-8329 [(h)]	Clarke [(e)] 2013a, Clarke 2009
Phenothrin- Prallethrin-PBO	5% Phenothrin [(d)], 1% Prallethrin, 5% PBO	Oil	1021-1795-8329 [(h)]	Clarke 2013b, Clarke 2008
Pyrethrins-PBO	5 to 12% Pyrethrins, 25 to 60% PBO	Oil	1021-1199	MGK [(f)] 2013a, MGK 2013b
Resmethrin-PBO	4.14 to 18% Resmethrin, 12.42 to 54% PBO	Oil	432-716	Bayer 2012a, Bayer 2012b

a) Selection of a product for label review does not constitute an endorsement
b) PBO = Piperonyl butoxide, pesticide synergist
c) Bayer = Bayer Environmental EPA Company number 432
d) Phenothrin = Sumithrin

e) The company number for these products is McLaughlin Gormley King (MGK) company number, 1021, the product number varies with the product and 8329 is the company number for the distributer, Clarke Mosquito Products
f) MGK = McLaughlin Gormley King

Table 2.2. Selected Public Health Adult Mosquito Products Containing Organophosphate Insecticides Registered in Maine for 2013 (NSPIRS 2013, Label) [(a)]

EPA REG #	Active Ingredients	Diluent	lbs ai/gal	References
53883-251	19.36% Chlorpyrifos [(b)]	Oil	1.5	Control Solutions 2009a, Control Solutions 2010d
67760-34	96.5% Malathion	Oil	9.9	Cheminova 2011a, Cheminova 2011b,
5481-479	62% Naled	Water	7.5	AMVAC 20012a, AMVAC 20012b
5481-481	78% Naled	None	10.8	AMVAC 2010a, AMVAC 2010b
5481-480	87.4% Naled	Oil	13.2	AMVAC 2009a, AMVAC 2009b

a) Selection of a product for label review does not constitute an endorsement
b) There are a number of other chlorpyrifos containing products registered for public health mosquito adulticide use (NSPIRS 2013)

Table 2.3 Use Rates for Active Ingredients (lbs ai/A and lbs ai/A/year) for Public Health Adult Mosquito Products Containing Pyrethroids-Pyrethrins and PBO

Active Ingredients	Rate (lbs ai/A)	Annual Rate (lbs ai/A/year)	Reference
Etofenprox	0.007	0.18	Wellmark2010a, EPA 2009a
Permethrin	0.007	0.18	Bayer 2011f, EPA 2009c
Phenothrin (Sumithrin)	0.0036	1	MGK 2012a, EPA 2007, EPA 2008
PBO	0.08	2	EPA 2004b
Prallethrin	0.0008	0.02	Clarke Mosquito 2013b
Pyrethrins	0.008	0.2	MGK 2013a, EPA 2006b
Resmethrin	0.007	0.2	Bayer 2012a

Table 2.4 Use Rates for Active Ingredients (lbs ai/A and lbs ai/A/year) for Public Health Adult Mosquito Products Containing Pyrethroids-Pyrethrins and PBO			
Active Ingredients	**Rate (lbs ai/A)**	**Annual Rate (lbs ai/A/year)**	**Reference**
Chlorpyrifos	0.01	0.26	Control Solutions 2009a, Control Solutions 2009b
Malathion (air)	0.23	Not more than 3 times in any one week. More frequent treatments may be to control mosquito-borne diseases in animals or humans	Cheminova 2011a, EPA 2004a, EPA 2009b
Malathion (ground)	0.11		
Naled (air and ground)	0.1	10.73	AMVAC 20012a, AMVAC 20012b

SECTION 3. LABEL REVIEW

Pesticide labels are legal documents. The statement "**It is a violation of Federal Law to use this product in a manner inconsistent with its labeling"** is required on all pesticide labels (EPA 2007 to 2012). The pesticide product label language requirements are spelled out in the EPA Label Review Manual found at: http://www.epa.gov/oppfead1/labeling/lrm/ (EPA 2007 to 2012). These statements are required based on the toxicity databases for the technical grade active ingredient and the pesticide end use product (active and inert ingredients).

For the public health mosquito adulticide the label sections summarized below are signal words, hazards to humans and domestic animals and personal protective equipment. EPA assigns mammalian toxicity categories for the technical grade active ingredients (TGAI) and the end use products offered for sale and use based on acute toxicity data. The criteria for EPA's toxicity categories are set in 40CFR156.62 and the relationship with required label language are found in Appendix II.

SIGNAL WORDS, HAZARDS TO HUMANS AND DOMESTIC ANIMALS

PYRETHROIDS- PYRETHRINS-PBO PRODUCTS

Signal Words

Etofenprox, Permethrin-PBO, Phenothrin (Sumithrin tm)-PBO, Phenothrin (Sumithrin tm)-PBO-Prallethrin, Pyrethrins-PBO, Resmethrin-PBO

All of the wide area public health mosquito adulticide products containing pyrethrins, pyrethroids and PBO have "caution" signal words indicating low risks to mammals from acute exposure.

Hazards to humans and domestic animal

Etofenprox, Permethrin-PBO, Phenothrin-PBO, (Anvil 10 +10-oil based), Pyrethrins-PBO, Resmethrin-PBO, have warnings for moderate eye irritation. Anvil 10 + 10 (EPA# 1021-1688-8239) also has a warning for moderate eye irritation

Phenothrin-PBO (Aqua Anvil-water based), Phenothrin (Sumithrin tm)-PBO-Prallethrin (Duet-oil based and Aqua Duet-water based) have no eye warnings.

Personal Protective Equipment

In Table 2.1, the Pyrethrins-Pyrethroids-PBO containing products are primarily permethrin-BPO at a variety of concentrations. There are two products with etofenprox as the sole active ingredient, two phenothrin (Sumithrin tm)-PBO products, two phenothrin (Sumithrin tm)-PBO-prallethrin products, three pyrethrins-PBO products and two Resmethrin-PBO containing products. The personal protective equipment statements are found below.

Etofenprox containing products have no personal protective equipment requirements on the labels of the two mosquito adulticide product labels.

Ten of the eleven permethrin-PBO containing products registered for use in Maine 2013 have labels approved by EPA in 2011, 2012 and 2013 with the following personal protective equipment requirements:

"Mixers, loaders, applicators and other handlers must wear:

- Long-sleeved shirt and long pants,
- Shoes plus socks,
- Chemical-resistant gloves for all handlers except for applicators using motorized ground equipment, pilots, and flaggers
- Chemical-resistant apron for mixers/loaders, persons cleaning equipment, and persons exposed to the concentrate"

The other permethrin product, PBO/Permethrin 20:20, (EPA# 53883-274), has no PPE requirements and the label was approved in 2010. Since the RED for permethrin was issued in 2009 (EPA 2009c), most likely the next iteration of this label would incorporate the PPE requirements from the RED.

Anvil 10 + 10 (EPA# 1021-1688-8329), hydrocarbon based, Multicide® Mosquito Adulticiding Concentrate 2705 (EPA# 1021-1688) requires applicators, mixers and loaders to wear: long-sleeve shirt and pants, shoes and socks, and chemical resistant gloves made of barrier laminate nitrile rubber, neoprene rubber or viton.

Aqua Anvil, water based (EPA# 1021-1807-8329)*:* Multicide® Mosquito Adulticiding Concentrate 2807 (EPA# 1021-1807) labels require applicators mixers and loaders wear: long-sleeve shirt and pants and shoes and socks.

Duet (EPA#1021-1795-8329) petroleum base, Multicide Fogging Concentrate 2798 (EPA# 1021-1795) and Aqua Duet (EPA#1021-2562-8329), Multicide Fogging Concentrate 2922 (EPA# 1021-2562) labels require applicators mixers and loaders wear: long-sleeve shirt and pants and shoes and socks.

Two resmethrin products registered in Maine 2013 for adult mosquito control in public health settings are SCOURGE® Insecticide with resmethrin/piperonyl butoxide 18% + 54% MF FORMULA II (EPA# 432-667) and SCOURGE® Insecticide with SBP-1382/Piperonyl Butoxide 4%+12% MF FII (EPA# 432-716).

The personal protective equipment requirements from both labels are:

- Long-sleeved shirt and long pants
- Shoes plus socks
- Chemical-resistant gloves for all handlers except applicators.

The Scourge product label for product with the higher concentrations, (EPA# 432-667), chemical resistant gloves are require for all applicators except applicators using motorized ground equipment pilots and flaggers.

Organophosphates

Signal Words

The organophosphate products containing chlorpyrifos and malathion also have "caution" signal word. The naled containing products have "danger" signal words due to irreversible corrosive effects on the skin and eyes.

Hazards to humans and domestic animal

Chlorpyrifos and Malathion

Technical grade chlorpyrifos is more acutely toxic than technical grade malathion (Table B). The adulticide products are a soluble concentrate containing 19.36% chlorpyrifos (1.5 lbs/gal) product and a ready to use 96.5% malathion (9.9 lbs/gal) product. Both the chlorpyrifos product and the malathion product labels have "caution" as the signal word. The different human and domestic animal hazard sections reflect the differences in potency.

Chlorpyrifos

CSI 1.5 (EPA# 53883-251) human and domestic animal hazard section reads:

"Harmful if swallowed. Avoid contact with skin or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals (Control Solutions 2009a, Control Solutions 2009b)."

The Fyfanon (EPA# 67760-34) malathion containing product label states:

"Harmful by swallowing, inhalation or skin contact. Avoid contact with skin. Avoid breathing spray mist" (Cheminova 2011a, Cheminova 2011b.)"

Naled

All of the naled containing products registered for use as public health mosquito adulticides are classified **RESTRICTED USE PESTICIDE DUE TO EYE AND SKIN CORROSIVITY HAZARD** and have **DANGER** signal words because of corrosiveness to eyes and skin.

Human health hazard statements include:

- "Causes irreversible eye and skin damage.

- Causes skin bums.
- May be fatal if swallowed.
- Harmful if inhaled or absorbed through the skin.
- Do not get in eyes, on skin, or on clothing.
- Do not breathe vapor or spray mist.
- Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals (AMVAC 2009a, AMVAC 2010a, AMVAC 20012a.)"

Personal Protective Equipment Requirements

The organophosphate containing products include one chlorpyrifos, one malathion and three naled products. The personal protective equipment statements are found below.

Chlorpyrifos

CFI 1.5 containing 19.36% chlorpyrifos (1.5 lbs/gal) (EPA# 53883-251) has the following directions for personal protective equipment:

> "Personal Protective Equipment (PPE): All mixers and loaders involved in ground application must wear coveralls over long-sleeved shirt and long pants, shoes plus socks, chemical-resistant gloves, and a NIOSH-approved dust mist filtering respirator with MSHAINIOSH approval number prefix TC21C or a NIOSH-approved respirator with any R, P, of HE filter. Applicators involved in ground ULV application must use an enclosed cab as described in the

Engineering Controls Section of this label and must wear long-sleeved shirt and long pants, shoes plus socks, and chemical-resistant gloves. Aerial applicators and pilots must use an enclosed cockpit and wear long-sleeved shirt, long pants, shoes, and socks (Control Solutions 2009a, Control Solutions 2009b.)"

Malathion

Fyfanon ULV containing 96.5% malathion (9.9 lbs/gal) (EPA# 53883-34) label directions for personal protective equipment are:

"For all formulations and use patterns - mixers, loaders, applicators, flaggers, and other handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves
- Shoes plus socks (Cheminova 2011a, Cheminova 2011b)"

Naled

Personal protective equipment from the naled product labels read:

"If engineering controls are in use:

- Protective eye wear (goggles, face shield, or safety glasses)
- Long-sleeved shirt and long pants
- Socks plus shoes
- Chemical-resistant gloves (barrier laminate, butyl rubber, nitrile rubber, or viton, selection category E) and apron when mixing or loading. See engineering controls for additional requirements

In the absence of engineering controls:

- Protective eye wear (goggles, face shield, or safety glasses)
- Coveralls over long-sleeve shirt and long pants
- Chemical-resistant gloves
- Chemical-resistant footwear plus socks
- Chemical-resistant apron if exposed to the concentrate • Chemical-resistant headgear for overhead exposure
- A respirator with an organic-vapor removing cartridge with a prefilter approved for pesticides (AMVAC 2009a, AMVAC 2010a, AMVAC 20012a.)"

ENVIRONMENTAL HAZARD STATEMENTS

PYRETHROIDS- PYRETHRINS-PBO CONTAINING PRODUCTS

The environmental hazard statement from Zenivex E20 (EPA#2724-791) containing 20% etofenprox label states:

"**This pesticide is toxic to aquatic organisms, including fish and aquatic invertebrates**. Runoff from treated areas or deposition into bodies of water may be hazardous to fish and other aquatic organisms. Do not apply over bodies (of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries), **except when necessary to target areas where adult mosquitoes are present,** and weather conditions will facilitate movement of applied material away from water in order to minimize incidental deposition into the water body. Do not contaminate bodies of water when disposing of equipment rinsate or washwasters. [Emphasis added].

This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Time applications to provide the maximum possible interval between treatment and the next period of bee activity. Do not apply to blooming crops or weeds when bees are visiting the treatment area, **except when applications are 'made to prevent or control a threat to public and/or animal health determined by a state, tribal, or local health or vector control agency on the basis of documented evidence of disease-'causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations**, or if specifically approved by the state or tribe during a natural disaster recovery effort (Wellmark 2010c, Wellmark 2010d.)" [e**mphasis added]**.

Similar extensive environmental hazard warnings are found on all of the pyrethrins-pyrethroid-PBO have warnings similar or identical to the Zenivex E20 (EPA# 2724-791) (Wellmark 2010c, Wellmark 2010d.)"
In addition, the two Scourge products containing resmethrin and PBO are classified as restricted use products because of acute toxicity to fish (Bayer 2012a, Bayer 2012b, Bayer 2012c, Bayer 2012d). The restricted use classification means that certification and licensing are needed to purchase and use the products.

ORGANOPHOSPHATE CONTAINING PRODUCTS

Pyrofos 1.5 ULV Vector Control Insecticide containing 19.36% chlorpyrifos (1.5 lbs/gal) (EPA# 53883-251) has the following environmental hazard statements:

> "This pesticide is toxic to fish, aquatic invertebrates, small mammals and birds. Runoff from treated areas or deposition of spray droplets into a body of water may be hazardous to fish and aquatic invertebrates. Do not apply over bodies of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries) ~ **except when necessary to target areas where adult mosquitoes are present, (emphasis added)** and weather conditions weather facilitate movement of applied material beyond the body of water in order to minimize incidental deposition into the water body. Do not contaminate bodies of water when disposing of equipment rinsate or wash waters.
>
> This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treated area**, except 'When applications are made to prevent or control a threat to public and/or animal health determined by a state, or local health or vector control agency on the basis of documented evidence of disease causing agents in vector mosquitoes, or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort** (**emphasis added)** (Control Solutions 2009a, Control Solutions 2009b**)**."

The environmental hazard section of the Fyfanon ULV containing malathion read much the same as the synthetic pyrethroids:

> "This pesticide is toxic to aquatic organisms, including fish and invertebrates. Use care when applying in or to an area which is adjacent to any body of water, and do not apply when weather conditions favor drift from target area. Poorly draining soils and soils with shallow water tables are more prone to produce runoff that contains this product. When applying as a wide area mosquito adulticide, before making the first application in a season, it is advisable to consult with the state or tribal agency charged with primary responsibility for pesticide regulation to determine if other regulatory requirements exist.
>
> This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply or allow to drift onto blooming crops or weeds while bees are actively visiting the treatment area, **except when applications are made to prevent or control a threat to public**

and/or animal health determined by a state, tribal or local public health or vector control agency on the basis of documented evidence of disease causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort (**emphasis added).**

When applying as a wide area mosquito adulticide, do not apply over bodies of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries), except when necessary to target areas where adult mosquitoes are present, and weather conditions will facilitate movement of applied material away from the water in order to minimize incidental deposition into the water body. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA (Cheminova 2011a, Cheminova 2011b.)"

Another consideration not found on other public health mosquito products is: "undiluted spray droplets of Fyfanon ULV Mosquito will permanently damage vehicle paint finishes unless the aircraft used for the ultra-low volume application meets all of the specifications listed under AERIAL APPLICATION (Cheminova 2011a, Cheminova 2011b).

Regarding non-target toxicity the naled labels read:

"This pesticide is toxic to fish, aquatic invertebrates, and wildlife. Runoff from treated areas or deposition of spray droplets into a body of water may be hazardous to fish and aquatic invertebrates. Before making the first application in a season, consult with the primary State agency responsible for regulating the pesticides to determine if permits are required or regulatory mandates exist. Do not apply over bodies of water (e.g., lakes, swamps, rivers, permanent streams, natural ponds, commercial fish ponds, marshes or estuaries), **except when necessary to target areas where adult mosquitoes are present (emphasis added),** and weather conditions will facilitate movement of applied material away from the water in order to minimize incidental deposition into the water body. Do not contaminate bodies of water when disposing of equipment washwaters or rinsate (AMVAC 2009a, AMVAC 2010a, AMVAC 20012a).

This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. To minimize hazard to bees, it is recommended that the product is not applied more than two hours after sunrise or two hours before sunset, limiting application to times when bees are least active. Do not apply this product or allow it to drift to blooming crops or weeds while bees are visiting the treatment area, except when applications are made to prevent or control a threat to public and/or animal health determined by a state, tribal or local health or vector control agency on the basis of documented evidence of disease causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or the tribe during a: natural disaster recovery effort (AMVAC 2009a, AMVAC 2010a, AMVAC 20012a).

LABEL LANGUAGE FOR USE OVER FARMS AND AGRICULTURAL AREAS

PYRETHROIDS- PYRETHRINS-PBO PRODUCTS

Depending on the existence of US food or feed tolerances (Appendix III), the label language for the pyrethrins-pyrethroid containing adulticides is different.

Piperonyl butoxide (PBO), is present in all of the pyrethrins-pyrethroid products with the exception of the etofenprox products. PBO is exempt from tolerance on raw agricultural commodities when used according to good agricultural practice (40CFR180.905).

There are no tolerances for etofenprox in raw agricultural commodities with the exception of rice (40CFR180.620). Etofenprox containing products have label directions to "Cover exposed drinking water in corrals, feedlots, swine lots cropland or any exposed drinking water" and "do not spray or allow drift onto pastureland, cropland or potable water sources. Given the "cover drinking water" sources for livestock and "do not spray or allow drift" statements on the etofenprox labels, food residues resulting from public health mosquito applications should not be an issue.

Permethrin has many tolerances in raw agricultural commodities (40 CFR180.378) these are for the commodities listed on the permethrin product labels. Permethrin-PBO products, in one form or another have the following label language, "Do not spray this product on or allow it to drift onto cropland (other than crops listed) or potable water supplies (followed by the list of commodities which have tolerances for permethrin and PBO residues). In the treatment of corrals feedlots animal confinements/houses swine lots poultry ranges and zoos cover any exposed drinking water drinking fountains and animal feed before application.

Phenothrin has a universal tolerance 0.01 ppm for raw agricultural commodities (40CFR180.647) and PBO is exempt from tolerance (40CFR180.905). Prallethrin only has a universal tolerance for uses in food and feed establishments and no tolerances on raw agricultural commodities (40CFR180.545). Anvil 10 + 10, oil based and Aqua Anvil, water-based, have the following statement regarding use over agricultural areas: "May be applied over agricultural areas for the control of adult mosquitoes within or adjacent to the treatment areas" Because of the presence of prallethrin and the lack of tolerances, the Duet and Aqua Duet, Phenothrin-PBO-Prallethrin have the following statement regard agricultural areas: "Do not spray this product on or allow it to drift onto rangeland cropland poultry ranges or potable water supplies In treatment of corrals feed lots swine lots and zoos cover any exposed drinking water drinking water fountains and animal feed before application"

Pyrethrins are exempt from tolerance on raw agricultural commodities (40CFR180.905).

Pyrethrins-PBO product labels state: "This concentrate may be diluted or used as supplied for mosquito control programs involving residential, industrial, recreational and agricultural areas where adult mosquitoes are present in annoying numbers in vegetation surrounding swamps, marshes, overgrown waste areas, roadsides and pastures. Use in agricultural areas should be in such a manner as to avoid residues in excess of established tolerances for pyrethrins and PBO on crops or commodities"

Similar to prallethrin, resmethrin has a universal tolerance for uses in food and feed establishments and no tolerances on raw agricultural commodities (40CFR180.525.). Given the site limitations on the resmethrin containing product labels, food residues resulting from public health mosquito applications should not be an issue. The two Scourge products containing resmethrin and PBO labels state: "Scourge is designed for application as an Ultra-Low Volume (ULV) aerosol to control adult mosquitoes and flies in residential industrial urban recreational areas and other areas where the labeled pests are a problem.

ORGANOPHOSPHATE CONTAINING PRODUCTS

There are at least 80 tolerances (40CFR180.342) for chlorpyrifos, given the non-crop-land statement on the chlorpyrifos label, food residues resulting from public health mosquito applications should not be an issue. Chlorpyrifos containing product, CSI 1.5 ULV (EPA# 53883-251) is designed for application either as a thermal fog or as an ultra-low volume (ULV) non-thermal aerosol (cold fog) to control adult mosquitoes in: "Outdoor residential and recreational areas and other non-cropland areas where these insects are a problem"

Malathion has tolerances in over 150 commodities (40CFR180.111). Given the site limitations on the malathion containing product label, food residues resulting from public health mosquito applications should not be an issue. Aerial Applications for Fyfanon ULV are limited to "Rangeland, Pasture, and Other Uncultivated Non-Agricultural Areas (Wastelands, Roadsides). There are no such limits on ground applications.

There are 38 tolerances for naled. In addition, a universal tolerance of 0.5 part per million is established for the pesticide naled in or on all raw agricultural commodities, except those otherwise listed in this section, from use of the pesticide for area pest (mosquito and fly) control (40CFR180.215). Two of the three products containing naled have mosquito (and nuisance fly) uses only, Dibrom Concentrate (EPA# 5481-480) and Trumpet EC (EPA# 5481-481). The third product, Dibrom 8 Emulsive (EPA# 5481-479) has the mosquito, nuisance fly and agricultural uses on its label. The two products with no agricultural uses on their labels have the following directions regarding use over agricultural areas:

> "It is not necessary to avoid farm buildings, dairy barns, pastures, feed or forage areas. Use in agricultural areas must be in a manner as to ensure that residues do not exceed the established federal tolerance for the active ingredient in or on raw agricultural commodities resulting from use for wide area pest control. Treat shrubbery and vegetation where mosquitoes may be present. Shrubbery and vegetation around stagnant pools, marshy areas, swamps, residential areas, municipalities, woodlands, pastures, farm buildings and feedlots may be treated."

The product with both agricultural and mosquito/ nuisance fly uses, Dibrom 8 Emulsive (EPA# 5481-479) in the section on controlling mosquitos reads:

> "It is not necessary to avoid farm buildings. Make applications during peak of infestation and repeat as necessary. See crop recommendation for use limitations near harvest. Treat shrubbery and

vegetation where mosquitoes may rest. Shrubbery and vegetation around stagnant pools, marshy areas, ponds and shorelines may be treated.

References

40CRF180.215, 2013, Tolerances for Naled

40CRF180.647, 2013, Tolerances for Phenothrin (Sumithrin)

AMVAC 2009a, Dibrom Concentrate, EPA# 5481-480, containing 87.4% naled, EPA Label

AMVAC 2009b, Dibrom Concentrate, EPA# 5481-480, containing 87.4% naled, ME-2013 Label

AMVAC 2010a, Trumpet EC Insecticide, EPA# 5481-481, containing 78% naled, EPA Label

AMVAC 2010b, Trumpet EC Insecticide, EPA# 5481-481, containing 78% naled, ME-2013 Label

AMVAC 2012a, Dibrom 8 Emulsive, EPA# 5481-479, containing 62%, naled, EPA Label

AMVAC 2012b, Dibrom 8 Emulsive, EPA# 5481-479, containing 62%, naled, ME-2013 Label

Bayer CropSciences 2009, Sevin Brand RP4 Carbaryl Insecticide, EPA# 264-335, containing 43% Carbaryl EPA Label

Bayer Environmental Services 2011a, Aqua-Permanone, EPA# 432-796, containing 20% permethrin-20% PBO, EPA Label

Bayer Environmental Services 2011b, Aqua-Reslin, EPA# 432-796, containing 20% permethrin-20% PBO, ME-2013 Label

Bayer Environmental Services 2011c, Omen 30-30 ULV, EPA# 432-1235, containing 30% permethrin-30% PBO, EPA Label

Bayer Environmental Services 2011d, Permanone 30-30, EPA# 432-1235, containing 30% permethrin-30% PBO, ME-2013 Label

Bayer Environmental Services 2011e, Permanone Insecticide Concentrate, EPA# 432-1250, containing 31.28% permethrin-66% PBO, EPA Label

Bayer Environmental Services 2011f, Permanone 31-66, EPA# 432-1250, containing 31.28% permethrin-66% PBO, ME-2013 Label

Bayer Environmental Services 2011g, Pyrenone Crop Spray, EPA# 432-1033, EPA Label

Bayer Environmental Services 2012a, Scourge Insecticide w/ Resmethrin/Piperonyl Butoxide 4%+12% MF FII, EPA# 432-716, containing 4.14% resmethrin-12.42% PBO, EPA Label

Bayer Environmental Services 2012b, Scourge Insecticide w/ Resmethrin/Piperonyl Butoxide 4%+12% MF FII, EPA# 432-716, containing 4.14% resmethrin-12.42% PBO ME-2013 Label

Bayer Environmental Services 2012c, Scourge Insecticide w/ Resmethrin/Piperonyl Butoxide 18% + 54% MF FII, EPA# 432-667, containing 18% resmethrin-54% PBO, EPA Label

Bayer Environmental Services 2012d, Scourge Insecticide w/ Resmethrin/Piperonyl Butoxide 18% + 54% MF FII, EPA# 432-667, containing 18% resmethrin-54% PBO, ME-2013 Label

Centers for Disease Control and Prevention (CDC) 2003, Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention and Control

Cheminova 2011a, Fyfanon ULV Mosquito Insecticide, EPA# 67760-34, containing 96.5% malathion, EPA Label

Cheminova 2011b, Fyfanon ULV Mosquito Insecticide, EPA# 67760-34, containing 96.5% malathion, ME-2013 Label

Clarke Mosquito Control 2013a, Anvil 10+10 ULV, EPA# 1021-1688-8329, containing 10% sumithrin (phenothrin)-10% PBO, ME-2013 Label

Clarke Mosquito Control 2013b, Duet EPA# 1021-1795-8329, containing 1% Prallethrin 5% sumithrin (phenothrin)-5% PBO, ME-2013 label

Clarke Mosquito Control 2013c, Aqua Anvil Water Based Adulticide, EPA# 1021-1807-8329, containing 10% sumithrin (phenothrin)-10% PBO, Label from Clarke mosquito Website: http://www.clarke.com/index.php?option=com_content&view=category&layout=blog&id=47&Itemid=126

Clarke Mosquito Control 2013d, Aqua Duet, EPA# 1021-2562, containing 1% Prallethrin 5% sumithrin (phenothrin)-5% PBO, Label from Clarke mosquito Website: http://www.clarke.com/index.php?option=com_content&view=category&layout=blog&id=47&Itemid=126

Control Solutions 2009a, Pyrofos, EPA# 53883-251, containing 19.36% chlorpyrifos (1.5 lbs/gal) EPA Label

Control Solutions 2010e Pyrofos, EPA# 53883-251, containing 19.36% chlorpyrifos (1.5 lbs/gal) ME-2013 Label

Control Solutions 2010a, PBO/Permethrin 20:20, EPA# 53883-274, containing 20.6% permethrin-20.6% PBO, EPA Label

Control Solutions 2010b, Vector-Flex 20:20, EPA# 53883-274, containing 20.6% permethrin,-20.6% PBO, ME-2013 Label

Direct AG Source 2013, Permethrin 3.2 AG, EPA# 83222-3, containing 36.8% Permethrin [3.2 lbs/gal] EPA Label

Dow AgroSciences 2012, Dursban 50W in Water Soluble Packet,s EPA# 62719-72, Wettable Powder in Water Soluble bags Containing 50% Chlorpyrifos EPA Label

EPA 2002a, 2006a, Interim Re-registration Eligibility Decision for Naled; Finalized in 2006

EPA 2005g, Screening Ecological Risk Assessment for the Re-registration of Piperonyl Butoxide Insecticide Synergist

EPA 2006b, Revised Pyrethrins RED Chapter after Additional 60-Day Comment Period Phase 5

EPA 2006d, Re-registration Eligibility Decision (RED) for Resmethrin

EPA 2006f, Revised Occupational and Residential Exposure Assessment and Recommendations for the Re-registration Eligibility Decision (RED) for Resmethrin

EPA 2006i, The Agency Revised Risk Assessment for the Registration Eligibility Decision for Permethrin Following Public comments, Phase III

EPA 2006j,Glyphosate Human Health Risk Assessment for Proposed Use on Indian Mulberry and mended Use on Pea, Dry. PC Code: 417300, Petition No: 5E6987, DP Num: 321992, Decision No. 360557.

EPA 2008d, EFED Registration Review-Preliminary Problem Formulation for the Ecological Risk Assessment of Naled

EPA 2008e, EFED Registration Review – Preliminary Problem Formulation for Ecological Risk and Environmental Fate, Endangered Species and Drinking Water Assessments Chlorpyrifos (PC Code 059101; DP Barcode D355212)

EPA 2008f, EFED Preliminary Environmental Fate And Effects Assessment Science Chapter for the Re-registration Eligibility Deciscion of D-phenothrin (Sumithrin)

EPA 2008g, Risks of Naled Use to Federally Threatened California Red Legged Frog *(Rana aurora drayonii)*

EPA 2009a, Environmental Fate and Ecological Risk Assessment for Etofenprox New Uses on Rice and Vector Control

EPA 2009d, Permethrin: Sixth Revision of the HED Chapter of the Re-registration Eligibility Decision Document (RED)

EPA 2009g, Registration Review Preliminary Problem Formulation for the Ecological Risk, Environmental Fate and Endangered Species Assessments for Malathion (PC code 057701; DP Barcode D359863)

EPA 2010b, EFED Registration Review Problem Formulation for Piperonyl Butoxide

EPA 2011h, EFED Registration Review Preliminary Problem Formulation for Permethrin

EPA 2011i, EFED Registration Review Preliminary Problem Formulation for Pyrethrins

EPA 2012a, Chemicals Evaluated for Carcinogenic Potential, Office of Pesticides Programs 2012

EPA 2012b, Use's Guide to T-REX Version 1.5

EPA 2012c, Standard Operating Procedures for Residential Pesticide Exposure Assessment

EPA 2012h, EFED Registration Review: Preliminary Problem Formulation for Environmental Fate, Ecological Risk, Endangered Species, and Drinking Water Exposure Assessment for Prallethrin

EPA 2012i, EFED Registration Review:Preliminary Problem Formulation for Resmethrin

LG Lifesciences 2009, Lamdastar 1 CS-PCO, EPA# 71532-27, containing 12% lambda cyhalothrin Fed Label

Loveland Chemical 2011, Carbaryl 4L, EPA# 34704-447, containing 43% Carbaryl EPA-Label

McLaughlin Gromley King 2012a, Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7395, EPA# 1021-1570, containing 12% pyrethrins-60% PBO, ME-2013 Label

McLaughlin Gromley King 2012b, Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7395, EPA# 1021-1570, containing 12% pyrethrins-60% PBO, EPA Label 2012

McLaughlin Gromley King 2012c, Multicide Mosquito Adulticiding Concentrate for ULV Fogging 2705, EPA# 1021-1688, containing 10% sumithrin (phenothrin)-10% PBO, EPA-2012 Label

McLaughlin Gromley King 2012d, Multicide Mosquito Adulticiding Concentrate for ULV Fogging 2795, EPA# 1021-1795, containing 1% Prallethrin 5% sumithrin (phenothrin)-5% PBO, EPA-2012 Label

McLaughlin Gromley King 2012c, Multicide Mosquito Adulticiding Concentrate for ULV Fogging 2705, EPA# 1021-1807, containing 10% sumithrin (phenothrin)-10% PBO, EPA-2012 Label

McLaughlin Gromley King 2012d, Multicide Mosquito Adulticiding Concentrate for ULV Fogging 2795, EPA# 1021-2562, containing 1% Prallethrin 5% sumithrin (phenothrin)-5% PBO, EPA-2012 Label

McLaughlin Gromley King 2013a, Pyrocide Fogging Formula 7067, EPA# 1021-1199, containing 5% pyrethrins-25% PBO, EPA Label

McLaughlin Gromley King 2013b, Pyrocide Fogging Formula 7067, EPA# 1021-1199, containing 5% pyrethrins -25% PBO, ME-2013 Label

McLaughlin Gromley King 2013c, Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7396, EPA# 1021-1569, containing 5% pyrethrins-25% PBO, EPA Label

McLaughlin Gromley King 2013d, Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7396, EPA# 1021-1569, containing 5-pyrethrins-,25% PBO, ME-2013 Label

NuFarm Americas 2012, ATERA GC 2+1 SC Insecticide, EPA# 228-557, containing 21.99% [2 lbs/gal] imidacloprid and bifnenthrin 10.654% [1 lb./gal]

Prentiss 2012a, Prentox Perm-X UL 4-4, EPA# 655-898, containing 4% permethrin-4% PBO, EPA Label

Prentiss 2012b, Prentox Perm-X UL 4-4, EPA# 655-898, containing 4% permethrin-4% PBO, ME-2013 Label

Prentiss 2012c, Prentox Perm-X UL 30-30, EPA# 655-811, containing 30% permethrin, 30% PBO, EPA Label

Prentiss 2012d, Prentox Perm-X UL 30-30, EPA# 655-811, containing 30% permethrin-30% PBO, ME-2013 Label

Prentiss 2012e, Prentox Perm-X UL 31-66, EPA# 655-812, containing 31% permethrin-66% PBO, EPA Label

Prentiss 2012f, Prentox Perm-X UL 31-66, EPA# 655-812, containing 31% permethrin-66% PBO, ME-2013 Label

Syngenta 2010, Demand Pest Tabs, EPA# 100-1082, containing 10% lambda-cyhalothrin, EPA Label

Tessendro-Kerley 2012 Sevin Brand 4F Carbaryl Insecticide, PA# 61842-38, containing 43% Carbaryl, EPA-Label

Tessendro-Kerley 2013 Sevin Brand 85 Sprayable Carbaryl Insecticide, EPA# 61842-33, containing 85% Carbaryl, EPA-Label

United Phosphorous 2012, Up-Cyde Pro 2 0 EC Termiticide/lnsecticide (EPA # 70506-19) EPA Label

Univar Environmental Services 2013a, Masterline Kontrol 2-2, EPA# 73748-3, containing 2% permethrin-2% PBO, EPA Label

Univar Environmental Services 2013b, Masterline Kontrol 2-2, EPA# 73748-3, containing 2% permethrin-2% PBO, ME-2013 Label

Univar Environmental Services 2013c, Masterline Kontrol 4-4, EPA# 73748-4, containing 4.6% permethrin-4.6% PBO, EPA Label

Univar Environmental Services 2013d, Masterline Kontrol 4-4, EPA# 73748-4, containing 4.6% permethrin-4.6% PBO, EPA Label

Univar Environmental Services 2013e, Masterline Aqua Kontrol Concentrate, EPA# 73748-1, containing 20% permethrin-20% PBO, ME-2103 Label

Univar Environmental Services 2013f, Masterline Aqua Kontrol Concentrate, EPA# 73748-1, containing 20% permethrin-20% PBO, EPA Label

Univar Environmental Services 2013g, Masterline 30-30, EPA# 73748-5, containing 30% permethrin-30% PBO, ME-2103 Label

Univar Environmental Services 2013f, Masterline 30-30, EPA# 73748-5, containing 30% permethrin-30% PBO, EPA Label

Wellmark International 2010c, Zenivex E20, EPA# 2724-791, containing 20% etofenprox, EPA Label

Wellmark International 2010d, Zenivex E20, EPA# 2724-791, containing 20% etofenprox, ME-2013 Label

Wellmark International 2010a, Zenivex E4 RTU, EPA# 2724-807, containing 4% etofenprox, EPA Label

Wellmark International 2010b, Zenivex E4 RTU, EPA# 2724-807, containing 4% etofenprox, ME-2013 Label

DEC 22 2023 5

Eagle Lake Water & Sewer District
PO Box 137
243 Old Main Street
Eagle Lake, ME 04739-0137
207-444-5441
[elwsd@fairpoint.net]

December 18, 2023

Mr., John Pietroski
Board of Pesticides Control
28 State House Station
Augusta, ME 04333-0028

Dear Mr. Pietroski,

The Board of Trustees of Eagle Lake Water & Sewer District is requesting that the Board of Pesticides Control designate the district's public water supply, which is wellhead protection area along Eagle Lake as a Critical Pesticide Control Area and have a total ban on the use of pesticide and herbicide within this area.

The public water supply is two (2) 16" gravel pack groundwater wells, 42 feet in depth. Wells were installed in 2008 and put in service in January, 2009. In 2008 the district and the town tried to create a wellhead protection plan ordinance but failed. Over the years we have notice that abutting land owners have been active in applying herbicides and pesticides within our wellhead protection area. We have requested the abutting land owners stop this practice, but they have refused. The board of trustees is requesting your help to protect our drinking water supply.

Enclosed is a copy well site management plan, produce by our engineers and approved by the Maine Drinking Water Program, a site map, abutting land owners and mailing addresses.

Should you need additional information please contact district office at (207)-444-5441.

Sincerely,

John L. Martin,

Clerk, ELWSD

(Q). Chapter 60, Sec. 2 (B) – The request asks for a "total ban on the use of pesticide and herbicide within this area." For clarification, is the intent to ban the use of all pesticide chemistries including minimal risk pesticides that are exempt from EPA registration (FIFRA, Section 25b).

Chapter 60, Sec. 2 (D) – The map provided depicts the 200-Day and 2,500-Day Travel Zones. Please clarify if the proposed control area is the 200-Day Travel Zone, 2,500-Day Travel Zone or the 300-foot radius well recharge zone.
(A). We want the proposed zone to cover the 500 ft radius of the well recharge zone.
Justification:

- The purpose of extending the 300 ft radius to 500 ft radius is to cover the entire residential infrastructure which could effect our well recharge zone.
- For reference the recharge zone wells are shallow gravel pack (approx. 40 ft. deep).
- It is unknown if the half-life for the products utilized would allow contaminants it to leach into the well's recharge zone.
- In this sensitive area, it is impossible to monitor pesticide/herbicide application activities.
- Residents or applicators are not forthcoming in notifying our organization when they will occur.
- Applicators do not voluntarily supply SDS (MSDS) information prior to application for our approval.
- Normally, we only witness applicators after they have applied products.
- One of the residents has a perimeter drain around foundation that discharges in the well recharge zone. It is unknown if contaminants are being discharged into the well recharge zone.
- If this pesticide/herbicide restriction is not approved, the Maine Drinking Water Program will require us to conduct pesticide monitoring/sampling.
    - This would be very costly for our organization and would not guarantee contamination to our wells/groundwater.
    - It is more significantly more expensive after contamination than prevention (moving wells or cleanup).
    - Potential for legal action from contamination or sickness in the future.
    - This preventative measure would better protect the town citizens/customers from contamination.

(Q). Chapter 60, Sec. 2 (E) – The request acknowledges abutting landowners use of herbicides and pesticides. Can you elaborate on the purpose for the use of those pesticides, i.e. lawncare, tick & mosquito control, structural pest control, etc.?
(A). The purposes for the applications were for infrastructure pest control (ants/earwigs), herbicide lawncare (weeds), invasive wildlife control (Canada Geese).
Further information:

- We will provide the SDS' for products we were provided and what we know was applied
- It is unknown if further applications are conducted besides the activities witnessed, we are not voluntarily provided with this information.

(Q). Chapter 60, Sec. 2 (G) – The request provides evidence establishing the impacts of "agricultural" pesticides on ground and surface waters and potential risks to human health. Can information be provided regarding the use of pesticides in "residential" settings and their potential impact on ground and surface waters and the potential for adverse effects on human health?
(A). Commercial agriculture is not conducted in the zone and no residential agriculture has been witnessed

- If residential agricultural (gardens) activities are conducted, there is potential for herbicide/pesticide application in these zones.

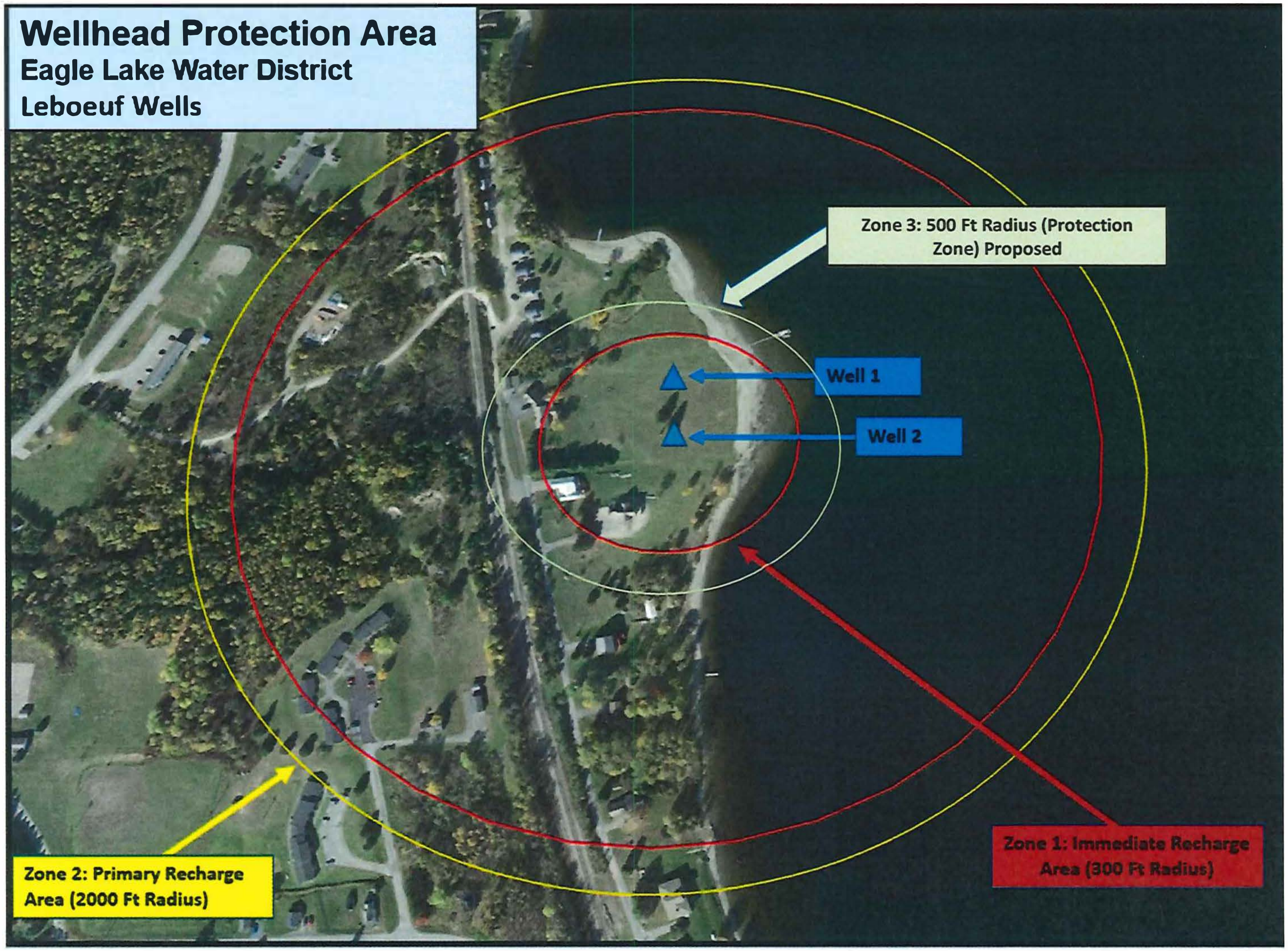
(Q). Chapter 60, Sec. 2 (J) –Please provide a more detailed description of the proposed restrictions on the use of pesticide(s) within the proposed critical area.
(A). We are requesting that no pesticide or herbicides be applied in the 500 ft radius of our well recharge area. Also, we are requesting that no intentional activities or infrastructure be allowed to be discharged in this zone (i.e. stormwater drains, industrial activities, agricultural activities, construction activities, fueling activities, unnecessary vehicle traffic, equipment fueling, residential drainage, etc.)

Please feel free to reach out with any questions regarding this request. Staff does plan to include the pesticide use inspection report completed in September of 2022 with your request for consideration by the Board.
Clarification is requested by the close of business on Tuesday, March 26, 2024, for proper submission to the Board. A copy of Chapter 60 has been attached.
We look forward to working with you on this matter.

Eagle Lake Water & Sewer District
Eagle Lake, Maine (Public Water Source)

Land Owners located within the 200 day travel time Zone of Contribution

Tax Map / Lot	Property Owner Name	Mailing Address
16 / 29	Phillip LeBoeuf Overlook Cabins	PO Box 347, Eagle Lake, ME 04739
16 / 29 -1	ELWSD District Sewer Pumping Station # 2	PO Box 137, Eagle Lake, ME 04739
16 / 30	Phillip LeBoeuf Home	PO Box 347, Eagle Lake, ME 04739
16 / 30A	ELWSD District Wellhead Area	PO Box 137, Eagle Lake, ME 04739
16 / 31 -3	Louis & Lillian Roy Home	PO Box 347, Eagle Lake, ME 04739
16 / 31 -4	Paula Ouellette RV Lot	75 Pleasant St., Fort Kent, ME 04743
16 / 31 -5	Jonathan & Karen Trudo Home	20 Apple Blossom Lane, Kennebunkport, ME 04046
	Maine Northern Railway	103 School Street, Oakfield, ME 04763


Wellhead Protection Area
Eagle Lake Water District
Leboeuf Wells
Zone 3: 500 Ft Radius (Protection Zone) Proposed
Well 1
Well 2
Zone 1: Immediate Recharge Area (300 Ft Radius)
Zone 2: Primary Recharge Area (2000 Ft Radius)

01 DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY

026 BOARD OF PESTICIDES CONTROL

Chapter 60: DESIGNATION OF CRITICAL PESTICIDE CONTROL AREAS

SUMMARY: These regulations establish criteria which the Board will use in deciding if an area should be designated as a critical pesticide control area. In addition, these regulations specify the procedures parties must follow in requesting such a designation. These regulations also define the locations that have been designated as critical areas by the Board.

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1. Procedure

A. The Board shall receive, consider and act upon petitions for designation of critical pesticide control areas in accordance with 5 M.R.S.A., Ch. 375, subchapter II. Citizen petitions shall be allowed in accordance with 5 M.R.S.A. §8055. A municipality or county may make such petition in accordance with 22 M.R.S.A. §1471-M, sub-§ 4. In addition, the Board's staff may initiate such a petition.

B. The Board shall provide public notice and opportunity for public comment on any such petition in accordance with 5 M.R.S.A., Ch. 375, subchapter II.

C. There shall be opportunity for local participation in Board decisions regarding the designation of critical areas, as provided by 22 M.R.S.A. §1471-V.

2. Information required in Petition

Any person or persons petitioning the Board to designate an area as a critical pesticide control area shall submit the following information in support of the petition:

A. The name, address and telephone number of the petitioner(s) and a statement of the petitioner's interest in the proposed designation.

B. The name of the pesticides or group of pesticides for which restrictions are sought. Petitioners may seek restrictions on specific formulations which have enhanced toxicity, rather than on all products containing the active ingredient. For purposes of this regulation, pesticides shall include both active and inert ingredients, and carriers used in any pesticide application.

C. The name(s) and address(es) of the owner(s) of property within the proposed critical area.

D. A map of the proposed critical area.

E. A description of the purposes for which the pesticide(s) is or may be applied within the proposed area (if known).

F. For petitions for designation under criteria of sections 3(A), 3(B) or 3(C), the name(s) of the species for which protection is sought and a summary of the data establishing adverse effects of pesticides upon the species.

G. For petitions for designation under criteria of section 3(D), a copy of any applicable town ordinances, a summary of: evidence establishing that the pesticides may enter ground or surface water, hydrogeologic data which adequately defines the proposed critical area, and evidence establishing that the pesticide(s) may have an adverse effect upon the health of current or future users of the ground or surface water.

H. For petitions for designation under criteria of section 3(E), a summary of medical and/or epidemiological evidence that exposure to the pesticide(s) causes serious and/or longstanding health effects to sensitive individuals or groups of individuals.

I. For petitions for designation under criteria of sections 3(F) or 3(G), a copy of any management plan for the area or species.

J. A description of the petitioner's proposed restrictions on the use of pesticide(s) within the proposed critical area.

3. Criteria for designation

The Board of Pesticides Control will use the following criteria to determine whether to designate a critical pesticide control area. Where the Board is persuaded by the evidence that any of these criteria are met, it may designate a critical pesticide control area and adopt additional pesticide use restrictions, prohibitions or management plans for that area as necessary to protect health, welfare and the environment.

A. Areas where use of pesticide(s), without additional restrictions, is likely to cause the significant destruction or curtailment of the habitat or range of any animal or plant species that:

(1) is listed as endangered pursuant to state or federal law; or

(2) is listed as threatened pursuant to state or federal law; or

(3) is an invertebrate species ranked G1, G2 or S1 under the Natural Heritage Program of The Nature Conservancy and which is, in the Board's judgment, of natural significance.

B. Areas where use of pesticide(s), without additional restrictions, is likely to negatively affect the mortality rate and/or reproductive capability of any animal or plant species that:

(1) is listed as endangered pursuant to state or federal law; or

(2) is listed as threatened pursuant to state or federal law; or

(3) is an invertebrate species ranked G1, G2 or S1 under the Maine Natural Areas Program in the Department of Conservation and which is, in the Board's judgment, of natural significance.

C. Areas where use of pesticide(s), without additional restrictions, is likely to cause the significant destruction or curtailment of significant wildlife habitat. "Significant wildlife habitat" is as identified under the Natural Resources Protection Act, 38 M.R.S.A., Ch. 3, subchapter 1, Art. 5-A.

D. Areas where use of pesticide(s), without additional restrictions, is likely to significantly risk the quality of surface or groundwater supplies used for human consumption.

E. Areas where use of pesticide(s), without additional restrictions, is likely to cause serious and/or longstanding impairment of the health of sensitive individuals or groups of individuals who normally occupy such areas. The Board contemplates that this designation will require verified medical and/or epidemiological documentation of human sensitivity to one or more pesticides.

F. Areas where use of pesticide(s), without additional restrictions, is likely to significantly harm natural or other resources owned or managed by a government agency, or is contrary to the duly adopted management plan for an area owned or managed by a government agency.

G. Areas where use of pesticide(s), without additional restrictions, is likely to significantly harm natural resources within an area which is identified as an exemplary natural community or ecosystem of recognized exceptional qualities and has been designated for long-term ecological research and/or conservation purposes.

4. Designated Critical Pesticide Control Area

A. **Dennys River Critical Pesticide Control Area**

(1) The above entitled matter having come up for public hearing on 7 March, 1978, at 2:00 p.m. before the Pesticides Control Board in Room 102 of the Science Building at the University of Maine in Machias; and the Board, having considered the evidence and arguments presented, and with a quorum present, has this day voted to declare a critical area under provisions of Title 22, Chapter 258-A, Sections 1471-F and 1471-M (2)(A), within which critical area no aerial application of pesticide is to be made without prior approval of the Board of Pesticides Control.

(2) The critical area herein established is described as follows: Commencing at the dam at the foot of Meddybemps Lake and extending down the Dennys River to the Gilman Dam, so-called, the critical area shall include all land within one-half mile of either bank of the Dennys River; commencing at the Gilman Dam, so-called, and extending down the Dennys River to its entrance into Dennys Bay, so-called, the critical area shall include all land within one mile of either bank of the Dennys River.

FISCAL IMPACT: This rule will not impose any fiscal impact on counties or municipalities.

STATUTORY AUTHORITY: 5 M.R.S.A., § 8051 *et seq*. and 22 M.R.S.A., §§ 1471-F and M.

EFFECTIVE DATE:
July 6, 1979

AMENDED:
May 8, 1989

EFFECTIVE DATE (ELECTRONIC CONVERSION):
March 1, 1997

AMENDED:
April 14, 1998
July 12, 2000

MINOR CORRECTION:
November 23, 2000 - citation in § 4(C)(4)

AMENDED:
December 24, 2000 - repealed §4(C)
December 26, 2011 – filing 2011-475

CORRECTIONS:
February, 2014 – agency names, formatting

Summary of Comments Received Regarding Proposed Amendments Rules

Board of Pesticides Control CMR 01-026 Chapter 60

#	Name and Affiliation	Comment	Agency Response
1	Phil LeBoeuf, landowner, Eagle Lake	• Speaking on behalf of affected homeowners. • Understands that there are several issues with PFAS contamination in groundwater, but through some research, he found that this is typically through sludge spreading and not pesticides. Searched the BPC's website and the web for more information related to PFAS in pesticides and groundwater contamination and couldn't find any relevant information. • Reviewed the inspector report by Keith Brown, and agreed with the reports findings. • Currently uses Northern Turf Management's services, which is a	• The Board appreciates the affected homeowners giving public comments. • The Board understands that one of the reasons for PFAS contamination in groundwater is from the application of municipal sludge spread on agricultural sites. It is also understood that some pesticides may contain or be contaminated with PFAS. The state of Maine has taken extraordinary steps to remove PFAS-contaminated products from the channels of trade, pursuant to [38 M.R.S. § 1614](). As a result of our inspections, the pesticides reviewed were used in accordance with the label. Through the pesticide registration review process, EPA determines that no undue harm will come to human health and the environment when the pesticide is used in accordance with the label. • The Board understands that affected homeowners were able to review the inspector reports. • The Board is aware that the pesticide applications in question were

		licensed company with BPC and a licensed applicator is applying the pesticides. • The products they use are federally registered and approved, and are safe to use around wellheads. These wellheads are 150 feet from the area that is being treated with pesticides, and the groundwater aquifer is located deep below the lake. • As shoreline property owners, they are required to abide by the Shoreland Zoning Ordinance, which regulates all activities within 250 ft of the waterfront. • Given that no rules are being broken, products are applied by a licensed professional, and there is no history of lawncare products contaminating the groundwater, the Board should not prohibit the use of legally approved lawncare products to private property in the vicinity of the town wellheads.	inspected by staff. None of the products applied carried groundwater advisories and were applied in accordance with the label. • Shoreland Zoning Ordinances are regulated by municipalities, as required by the Mandatory Shoreland Zoning Act, which is regulated by the Maine Department of Environmental Protection. BPC rules related to water quality are in 01-026 C.M.R. ch. 29. • The BPC's findings on the complaints made for this site are included in the inspector reports prepared by staff, where no violations were found. The Board understands the complexity of this issue and will consider public comment as it moves forward in its decision-making.
2	John Martin, Trustee, Eagle Lake Water and Sewer District	• Gave a brief history of the district, including findings that the last	• The Board understands the historic issues related to finding drinking water

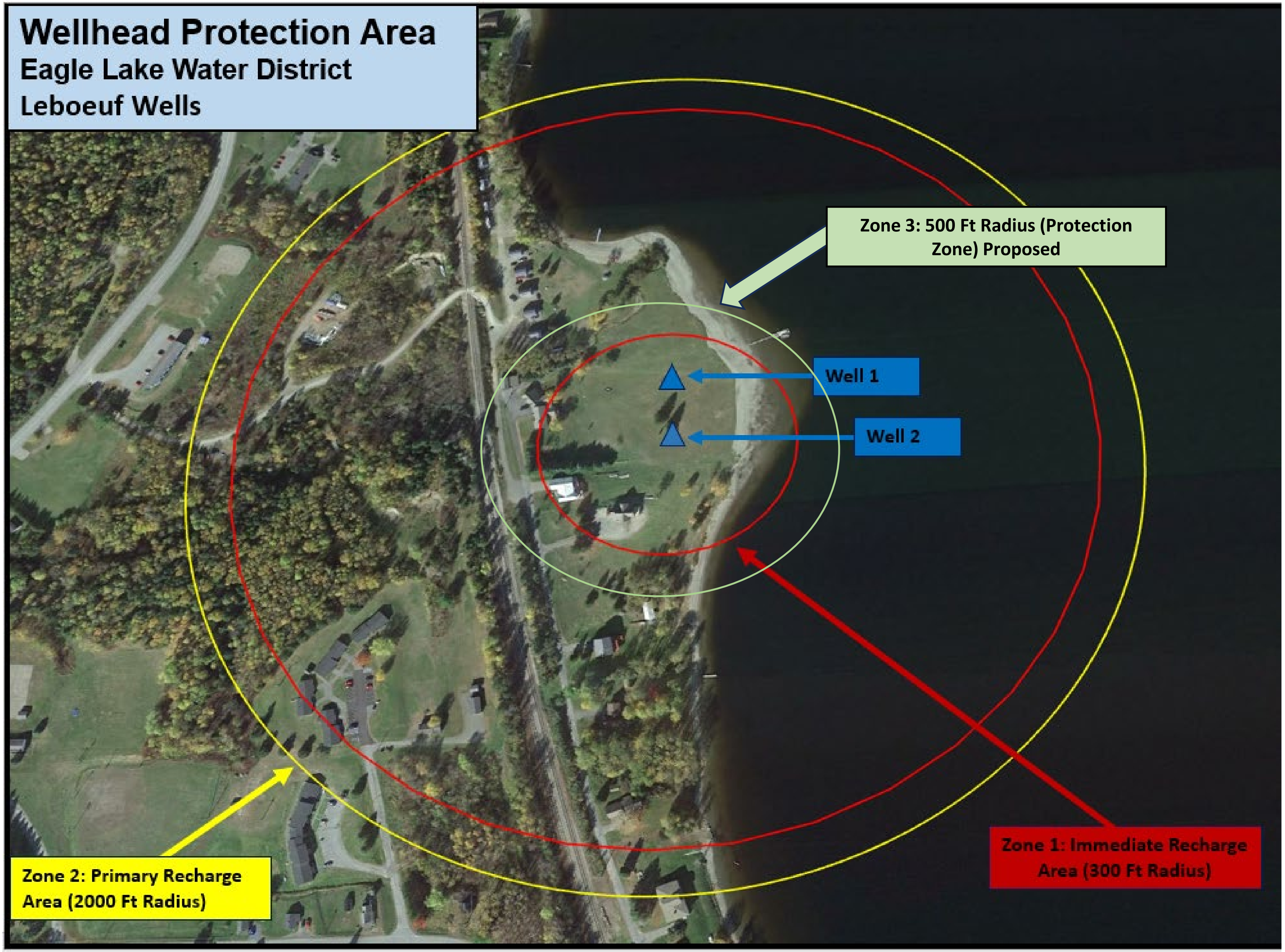
		groundwater source was found to not be suitable in 2004. • The district spent $4 million looking for a new public drinking water source.	sources for Eagle Lake and that this was an expensive endeavor.
		• Actions of the Camden pesticide case is what lead to them seeking the critical pesticide control area designation.	• While the Board understands that the Camden case had widespread media attention, it was a separate case involving blatant off-label use of an herbicide within the shoreland zone that resulted in environmental harm. Enforcement action taken on this case can be found on the Board's website.
		• Understands Mr. LeBoeuf's concerns, they purchased land from the family in order to install the wellheads.	• The BPC understands that the land was purchased privately to secure the property for wellhead installation and maintenance.
		• Wants to ensure that they prevent contamination and protect the water source for the public.	• BPC has a rule related to water quality protection, 01-026 C.M.R. ch. 29. Additionally, all pesticides are reviewed and registered by the EPA then separately registered in Maine for use. These registration processes consider water quality and environmental concerns when registering pesticides to determine if there are risks of environmental contamination related to use. Some labels have additional standards to protect water quality.

3	Patrick Vaillancourt, Owner, Northern Turf Management	• His company has been servicing Mr. LeBoeuf's property for several years. • Discussed their use of IPM, and states that the concerns for groundwater are valid. • When these products are used correctly, in and around private and public water supplies, they have never had any issues or found any in research on the topic. These products do not move past the target pest and using plant health and IPM to reduce groundwater contamination. • Placing a prohibition on using pesticides within 500 feet of public wellheads handicaps private landowners from dealing with pest issues on their own valuable land. Gave examples of tree pests destroying valuable tree stands, rodents that could damage structural integrity, and turf pests that could cause soil erosion which might lead to greater runoff. • The Board must consider the fact that if they act on this prohibition, it would only impact licensed applicators. A person will do what	• BPC understands the history of landscaping services for this site. • BPC understands that applicators in this area are cautious and using integrated pest management to ensure that water quality is not affected by pesticide use. • BPC agrees that when used in accordance with the label, pesticides should not move past the target site and impact non-target sites and organisms. In some cases, pest management can be necessary to not only contain the pest but prevent future issues and property damage from occurring. • While there is no proposed rule at this point, it's likely that any prohibition in place would prohibit pesticide use from both commercial applicators and homeowners in the area affected. The BPC encourages both homeowners and applicators to utilize integrated pest management to evaluate and manage any pest issues they have.

		they need to in order to protect their person property. • This rule would set a dangerous precedent that all pesticides are bad and will impact public drinking sources.	• Anyone can send a petition to the Board for a critical pesticide control area pursuant to [01-026 C.M.R. ch. 60](). This starts a regulatory process adjacent to the Administrative Procedures Act ([5 M.R.S. §§ 8001–11008]()) that is initiated upon receipt of a petition. The BPC follows the process and then makes any necessary determinations about whether to adopt a rule based on the process that includes the opportunity for public feedback on the petition.
4	Robert H. Mann, Senior Director of Technical & Regulatory Affairs, National Association of Landscape Professionals (NALP)	• NALP is commenting on behalf of their members in Maine. • Pesticides on turfgrass and ornamental plants used in accordance with the label does not present a concern for contamination of gravel packed wells. • Concerns related to pesticides used in proximity to drinking water sources is already addressed by EPA during the registration process, as FIFRA requires EPA to investigate such concerns.	• BPC appreciates NALP giving public comment. • All pesticides used in accordance with the label should have low risk of environmental contamination, including those used for turfgrass and ornamental. • BPC agrees that EPA does consider potential environmental contamination when registering and reviewing products, which includes reviewing relevant publications and studies on active ingredients and their

			ability to leach through soil. Through the pesticide registration review process, EPA determines that no undue harm will come to human health and the environment when the pesticide is used in accordance with the label.
		• The district has not presented any evidence that pesticides have been detected in the groundwater, and to outright ban all pesticides in this area is broad and counterproductive.	• The district made the critical pesticide control area designation petition on the basis that there is a potential for groundwater contamination. The district is not required to prove contamination to request a designation. See 01-026 C.M.R. Ch. 60 for details on required materials to make a designation petition.
		• Turfgrass root systems are biochemically active and can remove pollutants from the environment before they reach water sources.	• There is evidence that some plants can uptake contaminants from soil particles, typically referred to as phytoremediation. The amount and efficacy of this depends on the site, soil type, soil condition, and plants used for remediation.
		• Using best management practices and integrated pest management protocols are effective in maximizing environmental benefits of turfgrass while minimizing quantity of fertilizer, pesticides, and water used during maintenance.	• BPC agrees that applicators should be employing integrated pest management and using best management practices when pesticide applications are needed. Additionally, the BPC has a public policy to minimize reliance on pesticides and use integrated pest

			management wherever possible 22 M.R.S. § 1471-X.



Wellhead Protection Area
Eagle Lake Water District
Leboeuf Wells
Zone 3: 500 Ft Radius (Protection Zone) Proposed
Well 1
Well 2
Zone 2: Primary Recharge Area (2000 Ft Radius)
Zone 1: Immediate Recharge Area (300 Ft Radius)

Herbicide Strategy

to Reduce Exposure of Federally Listed Endangered and Threatened Species and

Designated Critical Habitats

from the Use of Conventional Agricultural Herbicides

August 2024

Office of Pesticide Programs
Office of Chemical Safety and Pollution Prevention
U.S. Environmental Protection Agency
Washington, DC

Table of Contents

List of Other Documents Included in the docket to support this final Herbicide Strategy

- Appendix A: Listed plant and obligate information, overlap analysis and species included and excluded from Pesticide Use Limitation Areas
- Appendix B: Pesticide Runoff Vulnerability Mitigation Relief Points
- Application of EPA's Runoff and Erosion and Spray Drift Mitigations Through Scenarios that Represent Crop Production Systems in Support of Endangered Species Strategies, dated August 2024
- Ecological Mitigation Support Document to Support Endangered Species Strategies, Version 1.0, dated July 2024
- Crosswalk of EPA's Ecological Mitigation Measures with USDA NRCS Conservation Practices in Support of EPA's Endangered Species Strategies, Version 1.0, dated August 2024
- Response to Public Comments Received on the Draft Herbicide Strategy, dated August 2024

1. Executive Summary

When the Environmental Protection Agency (EPA or Agency) takes an action on a pesticide registration (*e.g.,* registers a pesticide or reevaluates it in registration review) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Agency is responsible under the Endangered Species Act (ESA) to ensure that the action is not likely to jeopardize the continued existence of federally threatened or endangered (referred to as "listed") species, or result in the destruction or adverse modification of their designated critical habitats. Chemical stressors, such as pesticides, are one of many factors that can contribute to population declines of listed species. Meeting this ESA responsibility is a formidable task, considering the tens of thousands of pesticide products and registration amendments for which EPA is required to review the potential effects for over 1,700 U.S. listed species.

Given these challenges, in April 2022, EPA released a workplan (USEPA, 2022a) and an update to the workplan in November 2022 (USEPA, 2022b) that describe how it plans to meet its ESA obligations as part of pesticide registration processes under FIFRA. The update also describes strategies for identifying early mitigation measures to address potential population-level impacts to listed species across groups of chemicals (*e.g.*, herbicides, rodenticides, insecticides) or in certain regions of the U.S. These strategies intend to more efficiently determine whether, how much, and where mitigations may be needed to protect listed species from many uses of conventional pesticides. This final Herbicide Strategy is another key step in meeting this goal.

This Herbicide Strategy covers only conventional herbicides - an important, widely used tool for growers to prevent or eliminate weeds that compete with crops for light, moisture, and nutrients. EPA focused the strategy on agricultural uses in the lower 48 states because hundreds of millions of pounds of herbicides (and plant growth regulators) are applied each year (USEPA, 2017), which is substantially more than for non-agricultural uses and for other pesticide classes (*e.g.*, insecticides, fungicides). In addition, there are hundreds of species listed by the U.S. Fish & Wildlife Service (FWS)[1] in the contiguous U.S. The mitigations identified in the strategy would address potential impacts to listed plants (terrestrial, wetland, and aquatic), which are the types of species likely to be most impacted by herbicides. By identifying mitigations to protect plants, listed animal species that depend on plants would also be protected. This includes animals that depend on plants for food and shelter (habitat). By identifying and defining mitigations for these listed plant and animal species, EPA will consider and apply this final Herbicide Strategy as appropriate in FIFRA actions, which should result in reductions of population-level impacts to over 900 listed species in the lower 48 states.

The Herbicide Strategy is intended to create a consistent, reasonable, transparent, and understandable approach to assess potential impacts and identify mitigations to reduce potential population-level impacts to listed species from the use of agricultural herbicides. The strategy does not include ESA effects determinations, but instead is meant to identify proactive mitigations that can be applied in registration and registration review actions to reduce pesticide impacts to listed species. The strategy is intended to provide similar and consistent mitigations for herbicides with similar characteristics (*e.g.*,

[1] EPA is separately working with the National Marine Fisheries Service (NMFS) to develop a programmatic consultation process to address potential impacts of herbicides to NMFS' listed species and their critical habitat.

exposure, toxicity, application method) that are applied to the same crops. This approach creates equitable mitigations based on objective criteria and more predictability for applicators, growers, and other stakeholders.

The Herbicide Strategy includes a three-step decision framework for EPA to use when considering FIFRA actions for herbicides (such as new chemical registrations and registration review), including how to apply mitigations from the strategy. **Step 1** establishes the potential for population-level impacts to the listed species as not likely, low, medium, or high. The low, medium, and high categories indicate a potential concern for population-level impacts that may need mitigation. The first step relies on a refined assessment of potential impacts to plants that builds from EPA's longstanding ecological assessments (uses the typical environmental fate and toxicity data submitted by registrants and EPA's standard models for estimating exposures). This strategy refines assessment processes that evaluate effects to individual organisms or small groups of individuals by considering more realistic and less conservative toxicity endpoints that represent impacts to populations and communities of plants. The refined assessment process also considers whether EPA's standard exposure models represent a listed species' habitat and adjusts the identified level of mitigations to address overly conservative assumptions that would not apply to a particular species.

The refined assessment considers direct impacts to listed plants in terrestrial, wetland, and aquatic areas. The assessment also considers indirect impacts to listed animals from loss of their plant habitat and/or diet. EPA begins by considering the proposed and registered uses of the herbicide (*e.g.,* application rates, crops, application methods), fate in the environment (*e.g.,* major transport routes off field and degradation), likely exposures for listed species to the herbicide, and the toxicity of the herbicide to listed species and habitats of listed species.

In **Step 2** of the Herbicide Strategy, EPA uses the potential for population-level impacts to plants identified in **Step 1** to identify levels of mitigations needed to reduce spray drift and runoff/erosion to non-target habitats to levels that are not likely to impact populations of listed species. EPA developed menus of spray drift and runoff/erosion mitigations from practices that EPA has deemed effective at reducing spray drift or runoff into these habitats, and that are available to growers and other applicators in different parts of the country. The menus in this final Herbicide Strategy improve on those in the draft strategy by incorporating feedback EPA received on the draft strategy from a variety of groups. The amount of mitigation identified in **Step 2** depends on the potential for population-level impacts identified in **Step 1** (*e.g.,* low impacts would be addressed with less mitigation than medium or high potential impact classifications). To mitigate spray drift exposure, EPA would generally identify a spray drift buffer with a length that increases as the corresponding potential for population-level impacts increases. To address impacts from runoff/erosion, EPA would identify mitigation points: 3 points of mitigation for low impacts, 6 points for medium impacts, and 9 points for high impacts. In developing this point system, EPA incorporated several refinements into the mitigation approach, including considering variability in runoff intensity across the U.S. to account for differences in runoff mitigation needed.[2]

[2] This approach incorporated concepts from EPA's refined assessment methods, such as the Spatial Aquatic Model, to identify areas where lower levels of exposure compared to its conservative screening models would result in less need for mitigation.

EPA updated the mitigation menus based on public comment on the draft strategy that was released in July 2023. EPA also worked with the U.S. Department of Agriculture (USDA) and other organizations to identify and add other effective and practical measures to the menus for growers of different crops in different areas of the country. In May 2024, for example, the EPA and USDA hosted a workshop with agricultural stakeholders to identify other possible measures to add to the menus, particularly for specialty crops. The mitigation menus in this final Herbicide Strategy include more mitigation options to provide flexibility for growers, while still protecting listed species.

The strategy reduces the level of mitigation needed (fewer points needed for run-off and erosion and reduced buffer distances for spray drift) for growers who have already implemented certain measures to reduce pesticide runoff (*e.g.,* installed tailwater return systems), who are in areas less prone to pesticide runoff such as flat lands and regions with less rain to carry pesticides off fields, or who use measures to reduce pesticide drift (*e.g.,* use larger droplet sizes or have drift barriers downwind of the application). EPA assigned two points of mitigation relief to counties with medium runoff potential, three points to counties with low runoff potential, and six points to counties with very low runoff potential. Thus, for example, if six mitigation points were identified for a specific use of an herbicide but application is in a geographic area with very low runoff potential, then no mitigation points associated with this strategy would be needed for that use. **Figure 9** in this strategy depicts the runoff potential of each county in the contiguous U.S.

In **Step 3** of the Herbicide Strategy, EPA identifies where in the contiguous U.S. the mitigations identified in **Step 2** would apply. In some cases, EPA expects the mitigations would apply across the full spatial extent of a use pattern (*e.g.,* specific crops) within the contiguous U.S. In other cases, through its FIFRA actions, EPA plans to require any necessary mitigations only in geographically-specific areas (referred to as Pesticide Use Limitation Areas or PULAs). Pesticide applicators would be responsible for reviewing these specific areas located on the EPA's Bulletins Live! Two (BLT) website to determine whether they are required to abide by any geographically-specific mitigations. Further, EPA is in the process of refining maps for these PULAs so that any resulting mitigations are targeted to protect listed species while minimizing impacts to users.

Taken together, the three-step framework includes many refinements to EPA's standard process to assessing the potential for population-level impacts for listed species and identifying mitigations to address those impacts. The refinements consider concepts such as variability in exposure across geography, usage, and differences in listed species biology and habitats when evaluating potential impacts to listed species. The strategy will allow EPA to confidently identify when the uses of an herbicide are likely to cause impacts to listed species populations. These refinements will result in identifying restrictions for use of herbicides only where they would be needed.

This final Herbicide Strategy is not self-implementing. EPA will implement the strategies through its FIFRA actions in registration and registration review. This document explains how EPA plans to consider and apply the strategy to conventional new active ingredient registration actions and conventional registration review actions. As is current practice, EPA will seek public comment on these new chemical registration and registration review actions that would include, among other things, descriptions of how a specific strategy (*e.g.,* herbicide, insecticide, rodenticide, Hawaii, etc.) was applied to the action.

For this strategy, when appropriate, EPA may propose label language as part of a FIFRA action that directs a user to access the BLT website for geographically specific mitigations through Bulletins. The Agency may propose label language that requires mitigation measures irrespective of where the pesticide is applied. EPA may also propose label language that requires a specific level of mitigation and directs the user to a mitigation menu website. EPA may propose one or more of these for FIFRA actions. Using a website allows EPA to update the menu over time with additional mitigation options, which allows applicators to use the most up-to-date mitigations without requiring pesticide product labels to be amended each time new measures become available. Further, EPA may determine that additional mitigations would be appropriate for some listed species beyond the mitigations on the general pesticide product label. Those additional mitigations would be identified on Bulletins accessed through EPA's BLT website. Thus, mitigation measures may appear in up to three places: on a product label, on a mitigation menu website, and in Bulletins.

EPA understands that some pesticide users may find the spray drift and runoff/erosion mitigation described in this strategy complicated. EPA has developed a document, "Application of EPA's Technical Runoff and Spray Drift Mitigations Through Scenarios that Represent Crop Production Systems in Support of Endangered Species Strategies," that details multiple real-world examples to illustrate how a pesticide applicator could comply with the listed species mitigation measures or benefit from the mitigation relief described in this document. To help applicators consider their options, EPA is also developing a calculator that applicators could use to help them determine what mitigations are already in place and what further actions they may need to take. EPA also plans to continue to develop educational materials to help applicators, growers, and other agricultural stakeholders understand and employ listed species mitigation. EPA may also apply other ESA strategies (*e.g.*, Hawaii Strategy) and the Vulnerable Species Pilot to an herbicide action once these are final. EPA continues to work with stakeholders to identify potential offset opportunities for herbicides and other types of pesticides.

To help pesticide users properly implement the runoff/erosion measures identified in this strategy, EPA encourages users to consider seeking help from technical experts or participating in a soil and water conservation program that can help implement those measures. The strategy includes one (1) mitigation relief point for those who use an expert that meets the three characteristics specified in the strategy. The strategy also includes two (2) mitigation relief points for those who participate in a conservation program that meets the five characteristics specified in the strategy. Additionally, the strategy includes one (1) point for those who keep written record of the measures they implement under this strategy.

To summarize, a user would follow the directions for use on the label and any subsequent steps to determine the total number of runoff mitigation points needed to achieve prior to applying a herbicide product:

- For a particular use, start with the number of runoff mitigation points (3, 6, or 9) needed, if any, as indicated on the pesticide label.

- Subtract the number of mitigation relief points, if any, for farming conducted in geographic areas determined to have limited runoff potential, or other reasons specified in this strategy.
- Subtract the number of mitigation relief points, if any, for working with an expert, participating in a conservation program, and/or tracking mitigation measures.
- Subtract the number of mitigation points, if any, for mitigation measures from EPA's menu that the user has already implemented.
- The result is the total number of points that a user would need to achieve to apply the herbicide product. After these subtractions, if mitigation points are still greater than or equal to 1, the user would need to find enough measures from the mitigation menu to meet or exceed those remaining mitigation points. In other situations, a user might not need to employ any additional mitigations measures from this strategy before applying a pesticide. For example, if a grower applies a pesticide that specifies 6 points of runoff mitigation in a county with very low runoff potential (6 points of mitigation relief), that grower would not need to employ any additional runoff mitigation measures. EPA has identified 462 counties across 12 states with very low potential that would receive 6 points of mitigation relief, 780 counties across 37 states with low potential that would receive 3 points of mitigation relief, and 1536 counties across 44 states with medium potential that would receive 2 points of mitigation relief (**Appendix B**).

Similar to runoff mitigation, the user would rely upon the product label and BLT to identify the level of spray drift mitigation required and where it would apply. Additional information on spray drift mitigations may also be located on EPA's mitigation menu website. In many instances, the user could reduce the size of a spray drift buffer, if a label specifies one, by employing any of the several spray drift buffer reduction mitigation options as described in the strategy. However, the maximum buffer distance may still be needed for some applications. For other applications, the surrounding conditions and/or buffer reduction mitigations may eliminate the need for a spray drift buffer altogether. Pesticide labeling will more precisely describe what measures would be needed and where additional information describing the measures can be found, if necessary.

Finally, this strategy should increase the efficiency of future pesticide consultations with FWS. EPA has coordinated with FWS on the development of this final strategy. EPA and FWS expect to formalize their collective understanding of how this strategy can inform future biological evaluations and consultations. Thus, implementing the Herbicide Strategy through FIFRA actions would provide earlier mitigation measures to protect the listed species most impacted by herbicides even before effects determinations are made or consultations are completed, thereby accelerating EPA's ability to meet its ESA obligations for all conventional herbicides, reduce the legal vulnerability of EPA's pesticide decisions, and better ensure the continued availability of pesticides.

2. Introduction

2.1 Background

> **<u>Plant Type Definitions</u>**
>
> A **dicotyledon (dicot)** is a flowering plant species that has 2 seed leaves and flower parts are in 4s or 5s. Dicots are often referred to as "broadleaves." Examples of dicots are violets, roses, sunflowers and milkweed.
> A **monocotyledon (monocot)** is a flowering plant species with one seed leaf and flower plants are in 3s. Examples of monocots include grasses, orchids and lilies.
> A **non-flowering plant** does not produce flowers. Examples of non-flowering plants are ferns and lichens.

EPA regulates the sale, distribution, and use of pesticides under FIFRA and the Federal Food, Drug, and Cosmetic Act. EPA considers applications for pesticide products containing new active ingredients and new uses of currently registered pesticides and decides whether to register these products. If the application meets the standard for registration under FIFRA section 3, EPA approves the application with any necessary restrictions on its sale, distribution, or use. FIFRA section 3(g) requires that EPA periodically reevaluates existing registered pesticides as part of registration review. In addition to EPA's obligations under FIFRA to regulate pesticides, EPA also has obligations under the ESA. Under ESA Section 7(a)(1), all federal agencies shall "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species." Under Section 7(a)(2), federal agencies shall insure that their actions are "not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species." Where appropriate for a FIFRA action, EPA may be required to consult with the FWS and National Marine Fisheries Service (NMFS) (the Services) to ensure that the relevant actions are not likely to jeopardize the continued existence of listed species or adversely modify their designated critical habitats.

In past decades, the Agency has had trouble meeting its Section 7(a)(2) obligations for the thousands of pesticide actions it completes annually under FIFRA. The entire process, including consulting with the Services to implement protections they determine are necessary through biological opinions, can take years for a single pesticide. EPA expects that thousands of FIFRA actions could require an ESA review over the next decade. EPA has been unable to keep pace with its ESA workload, resulting in the need for more efficient approaches for integrating listed species evaluations and protections into pesticide registration activities even before ESA effects determinations are made or consultations with the Services are completed.

In its April 2022 workplan (USEPA, 2022a), "Balancing Wildlife Protection and Responsible Pesticide Use: How EPA's Pesticide Program Will Meet its Endangered Species Act Obligations" (the "workplan"), EPA described several challenges to implementing timely and effective strategies for specifically protecting listed species from possible pesticide impacts. The workplan also described how EPA is working to 1) improve assessment of potential impacts to listed species in its pesticide evaluations, 2) increase efficiency of the consultation processes, and 3) implement through registration and registration review actions protections for listed species prior to completion of effects determinations or consultations, if necessary. In November 2022, EPA released an update to the workplan (USEPA, 2022b) which described EPA's efforts to reduce pesticide exposure to non-target organisms, including listed species, during the FIFRA registration and registration review processes.

As described in the update, EPA is developing a series of strategies that group mitigations by pesticide type, use site, location, or other consideration. These strategies are intended to inform EPA's registration and registration review decisions to address landscape level exposures and impacts to listed species. This strategy is intended to identify early protections for hundreds of FWS listed species. Once implemented through FIFRA actions, the protections would substantially improve the efficiency of mitigating and consulting on pesticides, and result in conservation actions being implemented sooner and at a landscape scale. As part of the development of this strategy, EPA worked with FWS and continues to do so. This coordination lays a foundation for further efficiencies in the FIFRA-ESA consultation process. The Herbicide Strategy focuses on listed species under the jurisdiction of FWS as they have authority over approximately 95% of the listed species in the contiguous U.S. EPA is separately working with the National Marine Fisheries Service (NMFS) to develop a programmatic consultation process to address potential impacts of herbicides to NMFS' listed species and their critical habitat.

This strategy supports EPA's commitment to achieve early protections for over 900 listed species and their critical habitat potentially directly or indirectly affected by conventional herbicides. The strategy incorporates improvements based on public comments on the draft Herbicide Strategy to increase flexibility and improve ease of implementation while still protecting listed species. EPA identified mitigations focused on those that would reduce spray drift and runoff/erosion transport to non-target areas from agricultural uses in the contiguous U.S. and on mitigating impacts to species that are similar to the target pests of the pesticides (*i.e.,* for herbicides, mitigations focus on non-target plants).

The Herbicide Strategy takes a different approach to mitigating direct impacts to listed species that are taxonomically similar to the target pests than the approach for mitigating impacts to listed animal species that rely on a variety of plants (generalists). Often less mitigation is identified for these generalists than for listed plants or species that are "obligate" listed species (*i.e.,* they rely on one (or a small number) of listed plant species that may be directly affected by the use of a specific herbicide). The literature may refer to obligate species using different terms, such as 'specialist.' This document will refer to these types of species as obligates. Further, in this final strategy, EPA assumes that listed plants or other non-target plants do not need on field mitigations because the majority of species are not likely to occur on highly managed agricultural areas.

2.2 Scope and Goals of the Final Herbicide Strategy

This strategy covers conventional herbicides and plant growth regulators (referred to as "herbicides" throughout this document) and is focused on agricultural uses[3] of herbicides in the contiguous United States (CONUS). The strategy focuses on mitigating population-level impacts on listed species that may be caused by impacts to listed plants. The two major mitigation components for listed species are: mitigating direct impacts on listed plants and mitigating impacts on listed animals that depend on listed

[3] To include cultivated land (including orchards, vineyards, Christmas trees, row crops, specialty crops, and flooded crops) but not pasture/grass or range lands.

plants for food (diet) or shelter (habitat). Based on this, EPA included in this strategy 450 listed plant species[4,5] (**Figure 1**), most of which are broadleaf plants, which are a type of flowering plants referred to in this document as "dicots." Other types of listed plants include monocot flowering plants (*e.g.*, orchids, grasses) and non-flowering plants (*e.g.*, lichens[6], ferns, pines). Examples of monocots and dicots are included in **Figure 3**. There are nearly 580 listed animal species in the contiguous U.S. (under FWS authority) that depend on plants for food or shelter (**Figure 2**).

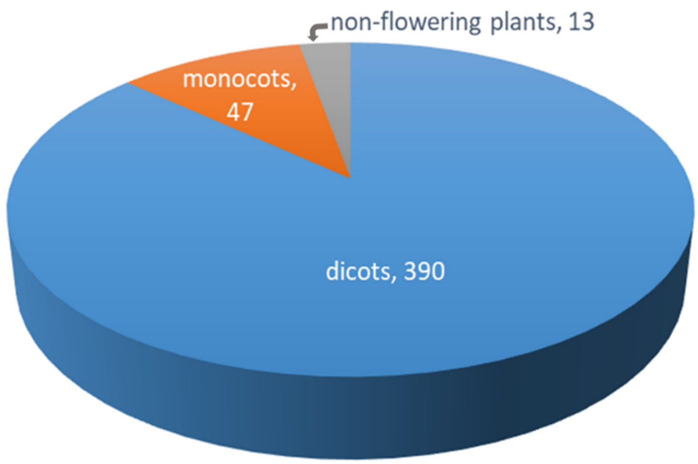


Figure 1. Number of dicot, monocot, and non-flowering listed plant species in contiguous United States. Dicots and monocots are types of flowering plants.

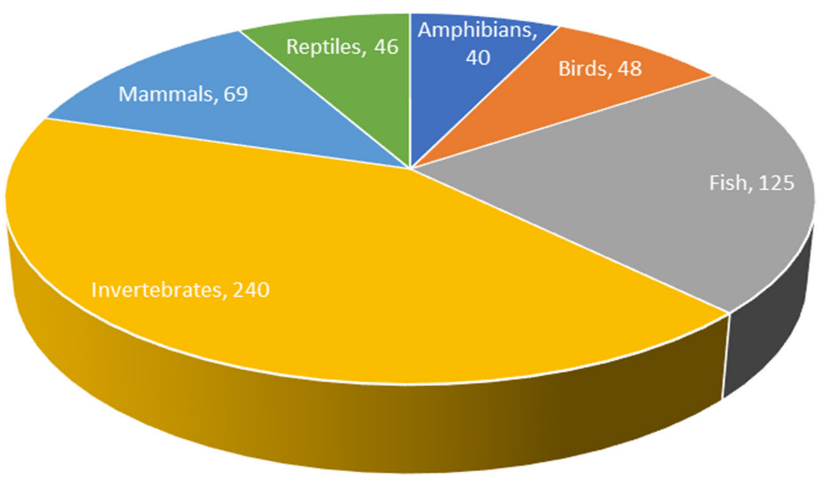


Figure 2. Types (*i.e.,* taxa) and numbers of listed animal species that depend on plants for food or shelter.

[4] This total reflects the number of unique listed species as of December 1, 2023. This includes federally listed endangered, threatened, and proposed species.

[5] Listed species being considered under EPA's Vulnerable Species Pilot are also excluded from consideration in the Herbicide strategy.

[6] Lichen are organisms that consist of a fungal and algal symbiotic relationship. The closest toxicity data surrogate EPA has for lichen are plants therefore they are lumped together with the non-flowering plants.

Figure 3. Examples of listed plant species. Top: Kincaid's lupine, a dicot. Bottom left: eastern prairie fringed orchid, a monocot. Bottom right: Florida bristle fern, a non-flowering plant. Images from FWS.[7,8,9]

[7] https://www.fws.gov/species/kincaids-lupine-lupinus-sulphureus-ssp-kincaidii?aggregated_content_type=%5B%22Image%22%5D
[8] https://ecos.fws.gov/ecp/species/601
[9] https://www.fws.gov/media/castellow-bristle-fern-heather-hitt-usfwsjpg

The Herbicide Strategy focused on agricultural uses (*e.g.,* row crops, orchards) given the high degree of herbicide usage in these areas and the similarity of mitigation measures that apply to these uses. In 2022, approximately 264 million acres of cropland were treated with herbicides according to the Census of Agriculture.[10] In this strategy EPA focused on agricultural uses, which account for more than half of the U.S. land base.[11] Despite covering only agricultural uses, this strategy is expected to make great strides in protecting listed species. The primary goals of the Herbicide Strategy include:

1. Identifying mitigations for listed species likely impacted at the population-level by the agricultural use of conventional herbicides;
2. Considering mitigations that would reduce major routes of herbicide exposure to listed species;
3. Improving the efficiency of future ESA consultations on conventional herbicides including, where appropriate, applying the final strategy to future registration and registration review actions; and
4. Increasing regulatory certainty for growers and other stakeholders regarding the use and availability of conventional herbicides.

Each of these goals is discussed more below. Goal three is described in the implementation section of this document.

Identifying Early Protections. This strategy focuses on developing and implementing mitigations to protect listed species earlier in the registration and registration review process before EPA makes ESA effects determinations or completes any necessary consultation with FWS for more than 450 listed plants. It also includes identifying mitigations to protect nearly 580 listed species that depend on plants for food or shelter and explaining how the strategy would be implemented in FIFRA actions. The goal of the mitigations are to minimize exposure from the use of conventional agricultural herbicides that EPA registers or reevaluates. This effort would reduce the potential for population-level impacts, which could reduce the likelihood of future jeopardy or adverse modification and increase efficiency in future consultations with FWS. EPA expects that implementation of this final strategy through FIFRA actions will protect listed species from potential population-level herbicide impacts.

Reducing Major Routes of Exposure. EPA identified mitigation measures for conventional agricultural herbicides that have the potential to reduce off-field pesticide exposure via spray drift (pesticide movement as spray droplets at the time of application) and runoff and/or erosion (pesticide movement with water and/or soil) that would likely result in exposure of listed species and impact their populations. EPA focused on measures to reduce spray drift, runoff, and erosion transport because FIFRA risk assessments commonly identify risk concerns for plants in terrestrial, wetland, and/or aquatic habitats due to offsite transport of herbicides via these exposure pathways. This strategy does not cover other potential exposure routes for a chemical or species (*e.g.*, volatilization, bioaccumulation in aquatic food webs). This strategy also does not include evaluation processes or describe mitigations associated with protecting human health. These types of considerations would be included in the FIFRA registration or registration review actions along with all other non-target ecological exposures (*e.g.*, to fish, birds, mammals) that are not included in this strategy, as appropriate for the specific chemical and use.

[10] www.nass.usda.gov/AgCensus

[11] https://www.ers.usda.gov/topics/farm-economy/land-use-land-value-tenure/

Improving Efficiency of ESA Consultations. EPA expects this strategy will help improve the efficiency of future pesticide consultations with FWS.[12] Currently, the process for assessing and mitigating effects to listed species takes many years to complete. This process typically starts with EPA conducting a chemical-specific effects determination that is included in a biological evaluation. The assessment analyzes the potential effects of the FIFRA action (*e.g.,* assessment of all uses for a particular active ingredient) to one or more individuals of all listed species. If EPA finds that effects may occur to one or more individuals of a listed species or to the physical and biological features of designated critical habitat, EPA initiates consultation (informal or formal) with the responsible Service. EPA initiates informal consultation when it concludes that its action may affect but is not likely to adversely affect listed species or their designated critical habitat. At the end of informal consultation, the Service will either provide concurrence with EPA's finding that the effects are not likely to adversely affect a listed species or destroy or adversely modify designated critical habitat and the process ends, or the Service may recommend EPA initiate formal consultation.

EPA initiates formal consultation when it concludes that its actions are likely to adversely affect one or more listed species or its designated critical habitat. More recently, consistent with the ESA counterpart regulations[13], EPA provides to the Service(s) predictions of the potential likelihood of future jeopardy or adverse modification for such species in the biological evaluation or during formal consultation. During formal consultation, the Service(s) determine whether the action is likely to result in jeopardy to the listed species or destruction or adverse modification of designated critical habitat. In addition, during formal consultation, EPA, the Service(s), and the pesticide applicant/registrants discuss needed measures to mitigate likely jeopardy, destruction, or adverse modification determinations made by FWS in the draft Biological Opinion. At the end of formal consultation, the Service(s) will generate a final biological opinion where it documents its evaluation, including agreed upon conservation measures, reasonable and prudent measures, and/or reasonable and prudent alternatives as applicable. Before Biological Opinions are finalized, EPA solicits public comments on draft versions of the opinions to ensure that the public has an opportunity to review and comment on them.

Historically, EPA and the Services have completed the consultation process for relatively few conventional herbicides due in part to the complexity and length of the ESA consultation process. This strategy involves a substantial and necessary change in process to identify and mitigate potential impacts from agricultural uses of conventional herbicides using a streamlined analysis even before EPA makes effects determinations or initiates/completes consultation. To this end, FWS provided input on the development of this strategy.

EPA and FWS expect to formalize their collective understanding of how this strategy can be used to inform future biological evaluations and consultations. EPA is working with FWS to develop a plan to: 1) help further the conservation and recovery of listed species by reducing pesticide exposures and resultant impacts to listed species, which includes this strategy; and 2) streamline section 7(a)(2) consultations on specific actions based on the analysis described in this strategy. Implementation of the

[12] Listed species overseen by the National Marine Fisheries Service are currently being address through programmatic consultation.
[13] 50 CFR Part 402, subpart D

Herbicide Strategy would identify mitigations to be used in FIFIRA actions to protect the listed species most impacted by herbicides more quickly and accelerate the EPA's ability to meet its ESA obligations for a particular herbicide and across the herbicide classes.

Regulatory Certainty. The Herbicide Strategy will also provide greater regulatory certainty about the level and type of mitigation EPA would consider in future registration and registration review decisions. EPA further expects these efforts could reduce the legal vulnerability of the pesticide actions that include them, and thus lead to continued availability of these herbicides.

2.3 Public and State Input

EPA released the draft Herbicide Strategy for public comment on July 24, 2023. EPA received more than 18,000 comments from a variety of groups, including states, other federal agencies, the pesticide industry (*e.g.*, pesticide companies, applicators), grower groups, environmental groups, academics, and individuals. EPA received approximately 250 unique comments, with the remainder being from mail-in campaigns that either supported or opposed the draft strategy. In general, commenters reiterated the importance of protecting listed species from herbicides. Commenters also identified concerns with specific aspects of the draft strategy and suggested revisions. See accompanying response to comment document.

In addition to public comment on the draft Herbicide Strategy, the final strategy incorporates information and suggestions that EPA gathered during meetings with growers and grower groups, pesticide applicators, environmental groups, extension agents, registrants, mitigation measure providers, and certified crop advisors. EPA has also been working with the State FIFRA Issues Research and Evaluation Group (SFIREG) and the Association of American Pesticide Control Officials (AAPCO), to discuss, among other things, potential implementation challenges. EPA also hosted or participated in various conferences and workshops including an Interagency Workgroup Group Roundtable Meeting in February 2024 to obtain input on EPA's efforts to comply with the ESA for pesticide decisions, and a May 2024 Mitigation Workshop (which EPA co-hosted with USDA) to identify other effective and practical measures for growers of different crops in different parts of the country to add to the mitigation menus.

2.4 Case Studies

The draft Herbicide Strategy was informed by case studies of herbicides representing diverse modes of action, agricultural uses, environmental fate profiles and impacts. EPA conducted the case studies for illustrative purposes only and EPA does not intend to use them to support a future FIFRA action for a particular herbicide. Rather, the case studies allowed EPA to develop, evaluate, and revise the draft strategy. For example, the case studies helped EPA to identify differences in the sensitivity of different taxa. The case studies also helped EPA consider how these differences in sensitivity can allow EPA to identify more mitigation for more sensitive species and less mitigation for other species. This allowed EPA to protect listed species from population-level impacts while minimizing impacts of mitigation on growers in areas with less sensitive species. Not all herbicides will have the same amount of data, so it is not possible to differentiate sensitivities and mitigation levels of all species in those cases. The case studies were valuable for developing a decision framework for the strategy that is flexible and uses available information and refinements for herbicides to identify the level of mitigation and where they would be expected to apply, as well as lessen mitigations when appropriate. The case studies developed to support this strategy are available in the docket. These case studies reflect the draft Herbicide Strategy, but each case study may not reflect all aspects of the final strategy.

2.5 Organization of This Document and Supporting Documents

The Herbicide Strategy is composed of two major parts: the framework for identifying mitigations and the plan for implementing the final strategy. **Section 3** explains the three-step framework that EPA will use to identify potential population-level impacts, identify mitigation measures to address these impacts, and determine the geographic extent of the mitigation measures in FIFRA actions. **Section 4** describes EPA's plan for implementing the strategy in FIFRA actions. This document includes several supporting appendices with more information on the 3-step strategy framework.

This strategy is informed by Version 1.0 of the *Ecological Mitigation Support Document to Support Endangered Species Strategies*[14] (referred to throughout this document as the "**Ecological Mitigation Support Document**"). The **Ecological Mitigation Support Document** contains supporting information on potential mitigation measures EPA identified to date and for which EPA has data on their efficacy in reducing exposure. The development of the support document includes consideration of stakeholder feedback and information collected during the development of the Herbicide Strategy. EPA expects the Ecological Mitigation support document to evolve as other strategies are developed and as the Agency obtains additional information on potential mitigations to add to the strategies. EPA expects to provide updated versions of the **Ecological Mitigation Support Document** in the future.

3. Herbicide Strategy Framework for Identifying Mitigation Measures

The decision framework in this strategy identifies the need for, level of, and extent of mitigation that could be needed when considering conventional agricultural herbicide FIFRA actions (**Figure 4**). EPA developed this strategy to identify mitigation measures that could be applied consistently to decrease pesticide exposure, and thereby reduce the potential for population-level impacts to listed species from the use of conventional agricultural herbicides.

[14] This document replaces USEPA 2023. Draft Technical Support for Runoff, Erosion, and Spray Drift Mitigation Measures to Protect Non-Target Plants and Wildlife, released July 2023 in support of the draft Herbicide Strategy. https://www.regulations.gov/document/EPA-HQ-OPP-2023-0365-0007. EPA took comment on the earlier version of this document during the proposal of the draft Herbicide Strategy.

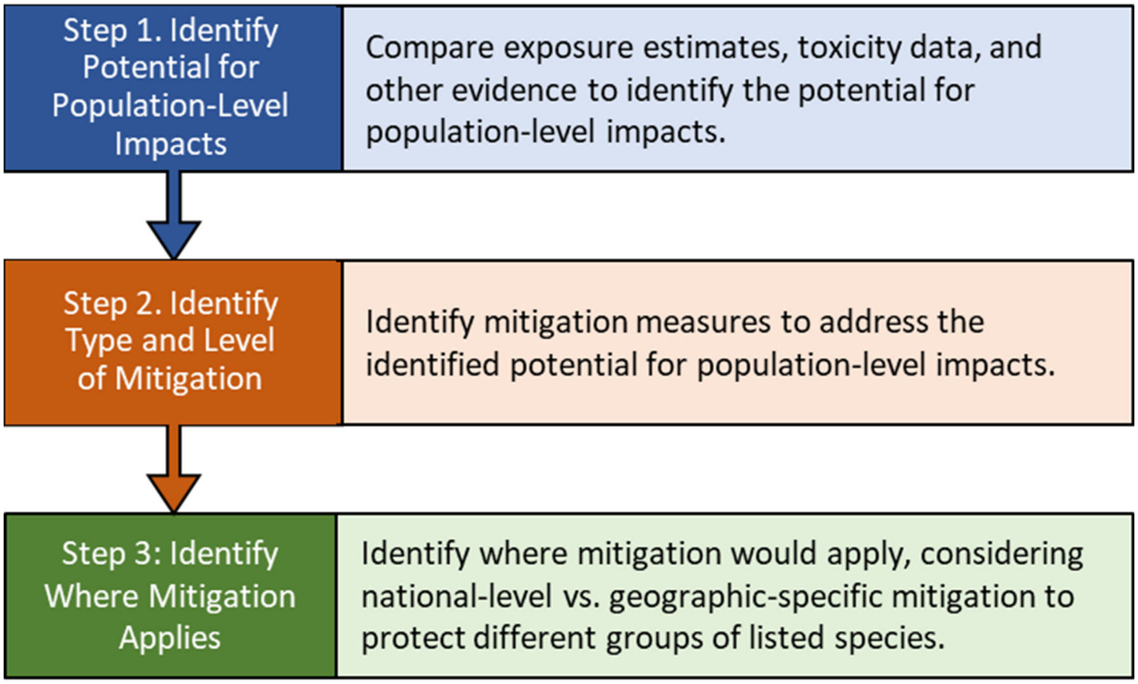


Figure 4. Overview of the Herbicide Strategy 3-step framework.

Step 1 establishes the process for assessing the potential for population-level impacts to the listed species. This step is based on long standing FIFRA risk assessment approaches EPA uses to identify potential ecological risk to non-target species, with additional considerations to refine the typical FIFRA risk assessment to account for evaluations of population level effects. In this strategy, EPA considers the use pattern and environmental fate characteristics of an herbicide to estimate exposures in aquatic, wetland, and terrestrial environments. EPA then compares these exposure estimates to toxicity data that are most relevant to the herbicide and relevant listed species. This comparison of exposure to toxicity is considered by EPA for determining the potential for population-level impacts to occur from an herbicide's registered or proposed use to listed species. In the assessments, EPA supplements this analysis with other information including available incident and monitoring data in addition to how well exposure and toxicity estimates reflect important characteristics of the listed species. This process results in the designation of not likely, low,[15] medium or high potential for population-level impacts to the grouped listed species, which are commensurate with a level of mitigation (**Step 2**).

Step 2 involves identifying the level of mitigation to reduce exposure via drift or runoff/erosion to address the potential for any identified population-level impacts. EPA identified a greater level of mitigation where the potential for population-level impacts is higher and less mitigation where there is a lower potential for population-level impacts. For reducing exposure from spray drift transport, EPA typically identifies a buffer. The distance associated with that buffer increases with the level of mitigation (low, medium, and high). If a buffer is identified, EPA identified other mitigation measures that a pesticide applicator could use to reduce that buffer distance. For reducing exposure from herbicide runoff/erosion, EPA identified a level of mitigation (none, low, medium, and high) as points, up

[15] A low potential for population-level impacts is a concern because there are still potential impacts. Low potential for impacts is associated with less mitigation.

to 9 points of mitigation. The point system allows for greater flexibility and inclusion of mitigation measures that have different levels of efficacy to address pesticides with different levels of potential impacts to different species. With few exceptions, the mitigations available for herbicides are expected to be the same as those available for insecticides because the application methods and approaches for reducing off-site transport are similar for both types of pesticides. The goals for spray drift and runoff/erosion mitigations are the same - mitigate potential for population-level impacts. Different approaches are used to communicate the level of mitigations and flexibility of options because of differences in the types of mitigations available, effectiveness of practices, and nature of exposure.

Step 3 involves identifying where in the contiguous U.S. the different mitigations for listed species identified in **Step 2** would apply. In some cases, EPA expects the mitigations would apply across the full spatial extent of a use pattern (*e.g.,* specific crops) within the contiguous U.S., specifying the mitigations on the general pesticide product label. In other cases, EPA expects the mitigations would apply in geographically specific areas only (referred to as Pesticide Use Limitation Areas or PULAs) through Bulletins using its web-based system, Bulletins Live! Two (BLT).

Taken together, the 3-step framework includes many refinements to EPA's standard process for assessing potential impacts and to identify mitigations to protect listed species from potential population-level impacts. The strategy considers higher tier concepts such as variability in exposure across geography and differences in listed species impacts and habitats beyond the typical FIFRA ecological assessment for non-target organisms. This strategy is intended as a process for EPA to identify when the uses of an herbicide have the potential for population-level impacts to listed species and how to identify effective and reasonable mitigations that are flexible and practical for growers of different crops and in different parts of the country. Additional information on each step is provided below.

EPA incorporated elements of FWS's approach to developing biological opinions for pesticides and identifying mitigations (*e.g.,* FWS 2022, FWS 2024) into the 3-step framework. For example, FWS assesses potential population-level effects by considering multiple factors such as pesticide exposures and impacts from direct toxicity and loss of diet or habitat, overlap with potential use sites, and usage of pesticides. FWS considers a combination of species-specific mitigations that could be included on pesticide product labeling, including directing applicators to EPA's BLT system as well as general label mitigations. EPA incorporated elements from FWS's approaches to align this strategy where there is a potential for population-level impacts and what early mitigations could be applied to address those impacts.

3.1 Step 1. Identify Potential for Population-level Impacts

The first step in the Herbicide Strategy is to identify potential population-level impacts of an herbicide's agricultural uses to listed plants (*i.e.,* direct impacts) and listed species that depend on plants (*i.e.,* indirect impacts). The population-level refined analysis in this strategy builds on EPA's standard FIFRA ecological risk assessment process for pesticides. Similar to the FIFRA ecological risk assessment (which generally assess impacts at an individual-level), the analysis for this strategy includes calculations of ratios of exposure to toxicity estimates for species grouped by toxicity and different exposures by habitat for population-level impacts.

A key component of this step is calculating the Magnitude of Difference (MoD) for each of the assessed herbicide uses. The MoD is the ratio of the herbicide exposure, known as the estimated environmental concentration (EEC), to its corresponding toxicity threshold value. MoDs are calculated for different types of exposures (spray drift, runoff/erosion), different types of habitats (*e.g.,* terrestrial, wetland and aquatic), and different groupings of species (referred to as "taxa", *e.g.*, dicots and monocots) when they differ substantially in their sensitivity to an herbicide. MoDs are also typically calculated for each labeled use (or groups of uses) of a pesticide, which may consider different application methods.

MoDs for assessing direct impacts to listed plants are based on toxicity thresholds for population-level impacts to a single species. Listed plant species relevant to the strategy include any listed plant species in terrestrial, wetland, or aquatic habitats that are likely exposed to herbicides from spray drift and/or

<u>Key Definitions for</u>
<u>Step 1 of the Herbicide strategy Framework</u>

Magnitude of Difference (MoD): The MoD is the ratio of pesticide exposure to toxicity. Higher MoDs indicate greater potential for species/population-level impacts. For listed plants with direct impacts from herbicides (and listed obligate species), the denominator reflects the relevant population-level toxicity threshold. The MoD informs the potential for population-level impacts. For species that are generalists, the denominator reflects the relevant community-level impact threshold (*i.e.,* multiple species populations) since generalists depend on a community of species.
Direct Impacts: Adverse impacts to listed plants that may occur from direct exposure to herbicides. Examples include contact with herbicide spray droplets on plant tissues (*e.g.*, stems, roots, leaves) or plant uptake of contaminated runoff from a treated agricultural field.
Indirect Impacts to Obligates: In this analysis, obligate listed species are those that depend exclusively on a plant species or genus to survive. For example, the Karner Blue Butterfly (*Plebejus samuelis*) depends on wild lupine (*Lupinus perennis*) for its diet and is considered an obligate listed species to wild lupine. There are approximately 30 listed animal obligate species.
Indirect Impacts/Generalists: In this analysis, generalist listed species are those that depend broadly on aquatic, wetland, or terrestrial plants for its survival. For example, the Mississippi Sandhill Crane (*Grus canadensis pulla*) relies on many different types of terrestrial, wetland, and aquatic plants for diet and habitat and, therefore, is considered to have a generalist relationship with plants. The majority (~550 of 580) of listed animal species are generalists.

runoff/erosion from agricultural areas (examples in **Figure 3**).

MoDs for assessing indirect impacts to listed animal species which obligately depend on one or a few species of plants for survival (*i.e.,* “obligates”) are also based on the same population-level toxicity thresholds as those for assessing direct impacts. This is because the survival of obligates depends on one or a few populations of plants. Examples of obligate species are the Fender’s Blue Butterfly (*Icaricia icarioides fenderi*) and the Karner blue butterfly (**Figure 5**), which relies on Lupine (*Lupinus spp.*). The majority of listed species that are known obligates to listed plants are invertebrates, specifically butterflies. There are also listed birds and mammals that are obligate to plants, such as the Gunnison Sage-Grouse (*Centrocercus minimus*) and the Columbia Basin Pygmy Rabbit (*Brachylagus idahoensis*) which are obligate to sagebrush (*Artemisia spp.*).

Figure 5. Examples of listed animals that depend on plants. Left: Karner blue butterfly, which is an example of a listed animal species that is obligate to a plant species (wild lupine). Center: Mississippi sandhill crane is a listed generalist species. Right: California tiger salamander is also a listed generalist species[16,17,18]

Listed species of animals that generally depend on many different plant species for food or shelter are referred to as “generalists” (examples in **Figure 5**). MoDs for assessing indirect impacts of herbicides on generalists are based on toxicity thresholds for community-level impacts for plants. Typically, as EPA moves from protecting populations to communities, the relevant toxicity endpoints increase in concentration (*i.e.,* are less sensitive), and MoDs decrease. Sometimes the population- and community-level toxicity thresholds (and associated MoDs) are similar due to factors such as high toxicity across multiple plant species.

The MoD is comparable to the risk quotients (RQs) that EPA calculates and compares to regulatory Levels of Concern (LOC) in FIFRA assessments. RQs and MoDs are similar in that they both are a ratio of exposure to toxicity; however, they differ by the toxicity endpoint, estimated exposures, and how they are interpreted. RQs typically rely upon toxicity information more representative of potential effects to an individual organism. RQs also include assumptions of exposure in terrestrial, wetland and aquatic environments that represent potential exposure of an individual. EPA’s standard LOC also looks at potential effects to an individual of a species (USEPA, 2004). When interpreting RQs, if the LOC is

[16] https://www.fws.gov/media/male-karner-blue-butterfly
[17] https://www.fws.gov/media/mississippi-sandhill-crane-3
[18] https://www.fws.gov/media/california-tiger-salamander-headshot

exceeded, EPA concludes that there is a potential risk and additional refinement is needed to determine the potential that adverse effects will occur. The RQ approach is conservative, deterministic, and intended to be used as a screen, where additional refinements can be done if appropriate.

MoDs and their interpretation for identifying mitigations (in **Step 2**) represent a more refined approach. MoDs use toxicity information, such as endpoints from a species sensitivity distribution as described later in this document, to represent potential population- or community-level impacts. Interpretation of MoDs considers concepts relevant to variability in exposures and responses, and to where the EPA standard FIFRA models may overpredict exposures (bias of the model's parameters in representing exposures to small ponds and wetlands when applied to other habitats, such as fast-moving streams and large rivers used by listed species). This refined approach is intended to help EPA confidently identify pesticide uses that have the potential for population-level impacts to a listed species. This refined approach also establishes the potential level of impacts (not likely, low, medium and high) to listed species' populations. That way, EPA can adjust the levels of mitigations to address the potential levels of impacts associated with the specific pesticides use.

EPA investigated the degree of variability of various data and analyses (*e.g.,* variability in laboratory testing, exposure estimates) and determined that when levels of potential population-level impacts are more than an order of magnitude (10x) different from each other, EPA has higher confidence that the impacts are actually different. Ultimately, EPA uses the MoD and other information to determine the potential population-level (or community-level) impacts according to **Table 1**.

Table 1. Relationship between the magnitude of difference and potential for population-level effects.

Magnitude of Difference (MoD)[1]	Potential for Population-Level Impacts[2]
<1	Not Likely
1 to <10	Low
10 to <100	Medium
≥100	High

[1] The MoD is the ratio of the exposure estimate to the relevant toxicity threshold value for population-level impacts (listed invertebrates and listed obligates) or community-level impacts (listed generalists).
[2] Other evidence being considered in the analysis may alter the assignment of categories of population/community-level impacts to the MoD ranges shown here. In some cases, bias in exposure or toxicity estimates, typically due to modeling assumptions, may increase the categories by 10X. In rare cases, the categories may be lowered by 10X.

MoDs that are >1 but less than 10 are classified as 'low' potential for population-level impacts to species. EPA considers other factors such as how EPA's standard modeling approach relates to species' habitats as described in the following paragraph when determining if a low level of mitigation is appropriate for a 'low' MoD.

In addition to the MoD ranges, EPA considers other information such as the level of confidence and bias in exposure or toxicity threshold estimates when assigning the potential for population/community-level impact to a listed species. For example,, EPA's EECs for the standard farm pond are typically used as a proxy to represent exposure of listed species in rivers and streams since EPA currently lacks a reliable exposure model for these flowing water systems. Previous analyses indicate that EPA's pond-based EECs tend to overestimate exposures in rivers and streams by an order of magnitude or more (USEPA 2016). Similarly, EPA may base an MoD calculation on a wetland habitat, in these cases, EPA would use a higher MoD category to indicate a potential for population level impacts to account for expected lower exposure levels in such habitats relative to wetlands. Also, the model used to estimate spray drift tend to overestimate exposure for some habitats where substantial interception of spray droplets is expected (*e.g.,* forests, shrubland). Therefore, for listed species that live in such habitats, the potential for population-level impact categories shown in **Table 1** are assigned higher MoD ranges by one category (*i.e.,* an MoD range of 10 to <100 would equate to low potential for population-level impacts, representing the lower exposure and potential for population-level impacts in these habitats).

3.1.1 Developing Exposure Estimates for the MoD

The first step in estimating exposures for MoD ratios is to estimate the exposure level or EEC for a particular exposure route. EPA starts its exposure analysis by considering the currently registered or proposed uses of an herbicide. This includes the relevant crops, application rates, and methods of application. EPA also considers any existing or proposed mitigations that the registrant(s)/applicant(s) included on the pesticide product label or committed to in writing to amend their registration or application.

EPA uses its models to calculate EECs to which listed species may be exposed. EPA uses different models to calculate EECs depending on the exposure route and whether the species resides in an aquatic or terrestrial habitat. More specifically, EPA evaluates exposures for listed species using established standardized exposure models[19] to calculate aquatic and terrestrial EECs based on:

- Relevant application parameters (*e.g.,* application rates, application method, equipment) for the chemical
- Chemical-specific environmental fate characteristics (*e.g.,* ability to bind to soil particles or remain in water, half lives in soil and water)
- Ecological scenario (based on soil, climatic and agronomic practices to determine runoff)
- Modeled habitat where the listed species lives (*e.g.,* terrestrial area, wetland)
- Degree to which the habitat for a given listed species reflects EPA's modeling assumptions.

A list of exposure models that EPA typically uses is provided in **Table 2.** When this strategy is implemented to inform a particular registration or registration review decision, EPA will use the most recent exposure model. Additional details on the exposure modeling approaches included in the Herbicide Strategy can be found in **Appendix A**.

[19] Current models and their user guides can be found at https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment and https://www.epa.gov/endangered-species/models-and-tools-national-level-listed-species-biological-evaluations

Table 2. EPA's standard models currently used to assess exposure to herbicides.

Environment	Exposure/Transport Pathway (Relevant Habitat)	Models or Assumption
Terrestrial	Off-field spray drift exposure	AgDRIFT®
	Runoff and drift to terrestrial areas adjacent to treated areas	PAT (TPEZ)
Wetland	Off-field spray drift exposure	AgDRIFT®
	Runoff and drift to wetlands (includes vernal pools, non-riparian wetlands, and similar systems)	PAT (WPEZ)
Aquatic	Runoff and drift for EPA farm pond or larger waterbody (includes riparian wetlands, medium/fast flowing waters, ponds, lakes, reservoirs)	PWC

PAT = Plant Assessment Tool version 2.8 available online at: https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological#pat;
PWC = Pesticide in Water Calculator, available online at: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#PWC
AgDRIFT® version 2.1.1 available online at: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#AgDrift

In the Herbicide Strategy, EPA relied on these standard, conservative EECs to calculate MoDs. Variability associated with exposures and the conservative bias of the model estimates are all considered when interpreting the MoDs. EPA also considered cases where the habitat (*e.g.*, coastal, forest, desert) of a listed species is likely to result in overestimated exposures due to the type of habitat of the species and lower expected exposures compared to EPA's standard models. So, although the MoD includes conservative exposures for some habitats, EPA included refinements when it interprets these MoDs. EPA also accounts for assumptions it needs to make with respect to evaluating label directions when conducting an assessment at a national scale that may not apply to all users across the country. For example, EPA may assume that a user applies a pesticide at the maximum application rate. EPA understands that the actual application rate may vary by region and pest pressure but cannot exceed the maximum on the label. Therefore, users that apply a pesticide at lower rates or fewer number of times may need less mitigation to protect against population level impacts. EPA accounts for these and some other localized practices and environments through EPA's mitigation menus. These factors are described later in Section 3.2 of this document and in greater detail in the **Ecological Mitigation Support Document**.

For listed plant species in terrestrial habitats (and listed species that have an obligate relationship to a terrestrial plant), EPA assumes the primary route of exposure is from spray drift and runoff/erosion exposure off the treated field. EPA use the Pesticide in Water Calculator (PWC) and the Terrestrial Plant Exposure Zone (TPEZ) module of the Plant Assessment Tool (PAT) to calculate runoff/erosion herbicide concentrations in the identified terrestrial habitats. EPA uses the AgDRIFT® model to estimate deposition of pesticides via spray drift onto downwind areas. For the MoD, EECs represent exposures at the edge of the treated area. EPA uses a similar approach for wetland species, where the Wetland Plant Exposure Zone (WPEZ) module of PAT is used to estimate runoff/erosion. For aquatic habitats, EPA currently uses the PWC to calculate runoff/erosion herbicide concentrations. EPA uses standard PWC agricultural crop scenarios with weather information to assess runoff/erosion potential from vulnerable agricultural use sites. The PWC model generates high-end EECs associated with a particular pesticide, aquatic habitat, and use pattern within a specific geographic region. Each scenario is specific to an area where the use occurs (*i.e.*, where a crop is commonly grown). The EECs generated represent maximum annual concentrations that occur once every 10 years and consider the runoff/erosion and spray drift pathways of exposure. EPA considered the habitat requirements of currently listed plants, as well as any obligates, and identified which of EPA's standard model scenarios is most representative of the expected exposures for that species. In some cases, the standard model is a reasonably good fit for the habitat of the species in other cases, EPA expects that the model will overestimate exposures to the species' habitat (*e.g.,* the standard pond will likely have much higher exposures than rivers with larger volumes, dilution, and flow). When interpreting MoDs, EPA considers how well or how poorly the models estimate exposures for listed plants in the habitat being evaluated.

Similarly, the AgDRIFT® model for spray drift assumes a bare field with no interception which will overestimate site-specific exposures if the landscape contains features that would intercept spray drift. For example, spray drift exposure from a treated field to a listed species located in a forest is unlikely because the trees would intercept the spray drift. Therefore, before deciding on the potential for population-level impacts, EPA would consider the habitat of the species (and the representativeness of the exposure estimates from its models).

The scope of the Herbicide Strategy includes herbicide applications made via broadcast spray using ground or aerial equipment, soil treatment, and granular formulations. Runoff/erosion transport pathways are a potential concern for all application methods. For spray drift, as described in the **Ecological Mitigation Support Document,** several application methods would likely not result in population-level impacts, irrespective of the characteristics of a particular herbicide. Therefore, EPA would not evaluate the potential for population-level impacts for these application methods (**Table 3**).

Table 3. Herbicide application methods and relevant exposure pathways for this strategy.

Application Method	Spray Drift	Runoff/Erosion
Foliar Applications[1]	Yes	Yes
Soil Treatment	Yes[2]	Yes
Granular formulations	No	Yes

[1] Foliar applications include those made by aerial broadcast spray, ground broadcast spray, airblast and chemigation.
[2] As described in the **Ecological Mitigation Support Document**, soil treatment with certain equipment (*e.g.,* drip tape, in-furrow sprays) are not expected to result in meaningful exposures of spray drift that would have the potential to result in population-level impacts.

Additional details on the exposure modeling approaches included in the Herbicide Strategy can be found in **Appendix A**.

3.1.2 Developing Toxicity Thresholds for the MoD

The toxicity values selected for MoD calculations are intended to represent either potential impacts to: 1) a population for direct toxicity or impacts to a species with an obligate relationship to a plant species or 2) a community (*i.e.,* multiple species' populations) for species with a general relationship with plants. In general, different toxicity thresholds are used to represent population and community level impacts, where population-level impacts are assumed to occur at lower levels of exposure.

EPA relies on standardized toxicity data that are submitted to the Agency during the registration (or registration review) process for deriving its toxicity threshold values used to calculate an MoD.[20] EPA also supplements these submitted toxicity data with data obtained from the scientific (open) literature.[21] For plants, a variety of toxicity data are available from submitted data and the open literature. These studies involve different types of species habitats (aquatic, wetland, and terrestrial), exposure routes (spray drift and/or runoff), durations (seedling emergence (SE) and vegetative vigor (VV), growth stages (seedlings and young plants), and type of species (*i.e.,* monocot, dicot; vascular, nonvascular).

For terrestrial plants, EPA matches up the available toxicity data to represent different types of listed species. For example, SE and VV studies are required to include 4 monocots and 6 dicots. EPA also uses other reliable toxicity endpoints from the scientific literature when available, but these typically fall into the same growth stages of the SE and VV studies. Seedling emergence studies begin at the seed germination growth stages and continue into early seedling development. Vegetative vigor studies are conducted when plants are 2-3 weeks old seedlings and are carried out for 28 days after exposure. These growth stages of plants are considered sensitive to herbicides, such that the establishment of endpoints based on this early exposure has been shown to be protective of effects observed at later growth stages and for reproductive effects (USEPA 2020b; USEPA 2022). In the landscape, exposure to plants may occur at different times, meaning that different plant life stages may be exposed. EPA uses the most sensitive of these endpoints and assumes that exposure occurs at the relevant life stage for the assessed plants. Since plants grow over the course of the season and herbicides are applied at different times, it is important to consider that herbicide exposures could occur during less sensitive plant life stages, and vice versa.

[20] EPA's standard ecological toxicity data requirements are defined in 40 CFR Part 158 subpart G (https://www.ecfr.gov/current/title-40/chapter-I/subchapter-E/part-158/subpart-G)

[21] Toxicity data obtained from the open literature are reviewed according to OPP's open literature guidelines and classified as to whether they are of sufficient quality to be used in deriving toxicity thresholds in regulatory risk assessment (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/evaluation-guidelines-ecological-toxicity-data-open).

A similar approach is used for aquatic plants, where available vascular and nonvascular *(i.e.*, algal) toxicity data are considered and matched to these types of listed species. In some cases, larger amounts of data are available to represent the toxicity of an herbicide to multiple species within a taxon. In that case, EPA will consider the full set of data in a species sensitivity distribution (SSD)[22] (a ranking of the different species toxicities). This distribution is helpful in selecting population-level endpoints (HC_{05}) that represent more sensitive species. In addition, SSDs are useful for deriving community-level endpoints (HC_{25}) that represent levels where multiple species may be impacted and result in an impact to a generalist species.

The following sections summarize the process for deriving toxicity thresholds for calculating MoD values.

3.1.2.1 Assessing Species Sensitivity Differences

EPA relates the sensitivity of particular groups of listed plants to species that have toxicity test data available if those data show meaningful differences in sensitivity to an herbicide. The majority of listed plants in the contiguous U.S. are considered dicots, with some monocots and non-flowering plants. The majority of listed plants use terrestrial areas as habitats, with many of these species also in wetlands. Because the physiology of a species may be linked to the type of species, it is reasonable to expect that some groups of listed plants may differ in their sensitivity to a given herbicide compared to other plant groups. Furthermore, some herbicides are developed to target specific groups of pests (*e.g.,* broadleaf plants, which are dicots), which supports the notion that differences in sensitivity of different plant groups may occur. Given this expectation of broad sensitivity differences among listed plants groups for some herbicides, it is prudent to ensure that any identified mitigations for an herbicide also reflect such differences in sensitivity (*i.e.,* for the same exposure, greater mitigation would generally be needed for more sensitive species types vs. less sensitive species types).

When deriving toxicity thresholds for MoD ratios, EPA determines whether the toxicity data for various groups of species (*e.g.,* monocot or dicot) suggests different sensitivity to the pesticide, or if they could be lumped together (*e.g.,* all flowering plants). In some cases, EPA has found differences in sensitivity of herbaceous versus woody plants. The extent to which EPA is able to assess potential different sensitivities to a pesticide is limited by the available data. EPA considers available information to identify if differences in sensitivity likely exist across taxonomic groups of listed plants. These differences are particularly impactful if an herbicide's mode of action (MoA) targets certain groups of plants. In some cases, additional information may be used to supplement available toxicity data. Additional details are provided in **Appendix A**.

Based on the available dataset, EPA determines whether it is appropriate to derive separate toxicity thresholds (and MoD) for different plant groups. Terrestrial, wetland and aquatic plants are distinguished here because the exposure routes for these types of habitats are different and, therefore,

[22] Species Sensitivity Distributions (SSD) are a common tool used for setting limits on exposure to a chemical or stressor. SSDs model the variation in the sensitivity of different species to a chemical and fit equations to understand the distribution of species sensitivity to a chemical. EPA uses the SSD Toolbox to generate SSDs. The Toolbox is available at: https://www.epa.gov/chemical-research/species-sensitivity-distribution-ssd-toolbox.

so are the toxicity data. Different toxicity thresholds and MoDs may be calculated for the following groups:

- Terrestrial
    - Listed dicot plants (includes obligates)
    - Listed monocot plants (includes obligates)
    - Listed woody plants (includes obligates)
    - Terrestrial plant communities
- Wetland
    - Listed dicot plants (includes obligates)
    - Listed monocot plants (includes obligates)
    - Listed woody plants (includes obligates)
    - Wetland plant communities
- Aquatic
    - Aquatic plant communities

3.1.2.2 Toxicity Thresholds Supporting MoDs for Assessing Impacts to Listed Plants and Obligates

Once EPA determines whether or not the toxicity data support calculating distinct toxicity thresholds for different listed plant groups, EPA then calculates toxicity thresholds for supporting MoDs for direct population-level impacts to listed plants. The approach for setting these toxicity thresholds depends on how much toxicity data are available for the plant species within each group and their corresponding MoDs. MoDs generated for terrestrial, wetland, and aquatic plants are used in **Step 2** to consider runoff/erosion and spray drift mitigations.

When toxicity data are available for enough species within a group for a given herbicide, EPA uses a SSD to set the toxicity threshold used in the MoD for evaluating direct population-level impacts on listed plants. EPA does not use aquatic plant endpoints to represent direct impacts to currently listed plants. EPA assesses those impacts using monocot and dicot endpoints only. This is because all of the currently listed plants that may occur in aquatic habitats also occur in wetlands and are more taxonomically and structurally relevant to the monocot and dicot endpoints. EPA used aquatic plant toxicity data to evaluate the potential impacts to habitat and diet for the relevant listed animals, all of which are generalists.

SSDs reflect a ranking of species by their sensitivity (*i.e.,* toxicological response to an herbicide) from most to least sensitive. A statistical procedure is used to describe this ranking such that a concentration can be identified which corresponds to a desired percentile of the SSD. For example, a concentration corresponding to the 5^{th} percentile of an SSD means that 5% of the tested species are equally or more sensitive than this concentration and 95% are less sensitive. Therefore, setting a toxicity threshold at the 5^{th} percentile of an SSD would be protective of 95% of tested species. SSDs require toxicity data from a relatively large number of species to be scientifically robust (*e.g.,* generally 8 or more species within a group). Since species can vary widely in their sensitivity to chemicals and toxicity data are mostly available for standard test species rather than listed species themselves, the HC_{05} is considered protective in that it assumes the listed species are highly sensitive with respect to most of the tested species.

When data are not sufficient to derive an SSD (which is typically the case for aquatic plants), consistent with common risk assessment practice, EPA sets the toxicity threshold using data on the most sensitive species for which reliable toxicity data are available. Furthermore, EPA bases the population-level toxicity endpoint for that species on the IC_{25} (EC_{50} for aquatic plants), which corresponds to a concentration or dose that resulted in a 25% or 50%, effect, respectively, to the tested individuals. Use of the most sensitive test species or 5^{th} percentile of the SSD is conservative for the majority of species; however, EPA does not know where specific listed species fall on the SSD. Therefore, to consider the potential for population-level impacts to listed plants that may be anywhere on the SSD, EPA used the most sensitive test species or 5^{th} percentile from the SSD to identify when mitigation is needed. In general, sufficient data are often available to generate an SSD for terrestrial/wetland plants and rarely available to generate an SSD for aquatic plants.

The same toxicity thresholds used for assessing direct impacts to populations of listed plants are also used for listed species that obligately depend on a species or genus of plants. The rationale for using the same toxicity endpoints determined for assessing direct impacts to populations reflects the expectation that population-level impacts to obligate listed species only requires impacts to one or a few plant species. Therefore, the protection goals for assessing direct impacts to populations of listed plants and listed obligate species are the same.

3.1.2.3 Toxicity Thresholds Supporting MoDs for Assessing Impacts to Listed Generalists and Plant Communities

Toxicity thresholds used to assess indirect population-level impacts to listed generalists that depend on plants broadly (rather than a specific plant species) are intended to protect against impacts to the plant community as a whole since listed generalists may depend on many different plant species for survival. When sufficient data are available to develop an SSD, EPA uses the 25^{th} percentile (also called the HC_{25} or community-level endpoint) to set this toxicity threshold. A higher percentile (lower sensitivity) of the SSD is used to evaluate potential population-level impacts to listed generalists compared to direct impacts described in **Section 3.1.2.2** because such impacts are presumed to occur at the community level, rather than for a population of a single species.

If available toxicity data are not sufficient to derive an SSD, EPA sets the toxicity threshold for listed generalists at a level that most closely approximates the expected lower quartile of species sensitivity. In many cases, this is represented by a toxicity threshold slightly above the most sensitive IC_{25} (EC_{50} for aquatic species) value when very few species have been tested. In 2023, the case studies released with the draft Herbicide Strategy included SSDs for 10 different chemicals. When comparing the HC_{05}, HC_{25}, and the most sensitive IC_{25}, EPA was able to develop an adjustment factor to calculate a toxicity threshold for plant communities and populations of generalists when SSDs could not be calculated. This factor (5x) is applied to the most sensitive IC_{25} when an SSD cannot be derived. In 2011[23], EPA compared the most sensitive of the typical aquatic plant test species submitted under FIFRA to SSDs generated using available aquatic plant toxicity data. In general, the most sensitive test species is similar to (within 2x) the 25th percentile of the SSD. The evaluation of the 2011 dataset concluded that the most sensitive EC_{50} was a reasonable estimation of the HC_{25} when an SSD was available. Therefore, no adjustment factor is applied for aquatic plants. EPA considers other information (*e.g.,* ECOTOX data and SSDs published in the scientific literature) when selecting the most appropriate IC_{25} or EC_{50} value to apply these adjustment factors and to represent a threshold for community-level impacts. The goal is to select a toxicity threshold that can reasonably represent the lower quartile of the SSD (HC_{25}).

3.1.3 Assigning Potential for Population-Level Impacts

MoDs represent numerical comparisons of estimated exposure levels to population-level toxicity thresholds. A list of exposure estimates and toxicity thresholds used to calculate MoD values in this strategy is shown in **Table 4.** EPA is using MoDs to inform the potential for population-level impacts to listed plant species and community-level impacts to species that rely on multiple plant species for diet or habitat. For this strategy, EPA calculates MoDs for each labeled use (or groups of labeled uses) as well as for the major exposure routes associated with mitigation (spray drift, runoff/soil erosion). MoDs are categorized into four levels associated with the potential for population-level impacts to a listed species. The levels range from “not likely” to “high” (**Table 1**). Before deciding the potential for population-level impacts, EPA also considers several lines of evidence, including the habitat of the species (and the representativeness of the exposure estimates).

[23] USEPA 2012. FIFRA Science Advisory Panel Meeting: Appendix F. Estimating Aquatic Plant Community Hazard Concentrations for Pesticide Effects. Dated December 20, 2011. https://www.regulations.gov/document/EPA-HQ-OPP-2011-0898-0012

Table 4. Summary of magnitude of difference calculations for different species groups.

Species Group (also includes CHs)	Magnitude of Difference (MoD) = Ratio of the Estimated Environmental Concentration (EEC) to the Toxicity Endpoint	
	EEC (Model)	**Toxicity Endpoint**
Terrestrial Habitats (Represented by the Terrestrial Plant Exposure Zone)		
Listed **terrestrial dicots** and listed animals with an obligate relationship to terrestrial dicots	1-in-10 year daily average Terrestrial EEC in units of lbs a.i./A (PAT) Spray drift point deposition in units of lbs a.i./A (AgDRIFT®)	5^{th} percentile of SSD of IC_{25} or lowest IC_{25} for dicots
Listed **terrestrial monocots** and listed animals with an obligate relationship to terrestrial monocots		5^{th} percentile of SSD of IC_{25} or lowest IC_{25} for monocots
Listed **terrestrial woody plants** and listed animals with an obligate relationship to terrestrial woody plants		Most sensitive woody plant IC_{25}, or lowest IC_{25} across monocots and dicots, or 5^{th} percentile of SSD of IC_{25} for monocots and dicots
Plant communities, CH and Listed **animals** that use terrestrial habitats and have a generalist relationship to plants in these habitats		25^{th} Percentile of SSD of IC_{25} values or 5x lowest IC_{25} for terrestrial plants
Wetland Habitats (Represented by the Wetland Plant Exposure Zone)		
Listed **wetland dicots** and listed animals with an obligate relationship to wetland dicots	1-in-10 year daily average Wetland EEC in units of lbs a.i./A (PAT) Spray drift point deposition in units of lbs a.i./A (AgDRIFT®)	5^{th} percentile of SSD of IC_{25} or lowest IC_{25} for dicots
Listed **wetland monocots** and listed animals with an obligate relationship to wetland monocots		5^{th} percentile of SSD of IC_{25} or lowest IC_{25} for monocots
Plant communities, CH and Listed **animals** that use wetland habitats and have a generalist relationship to plants in these habitats		25^{th} Percentile of SSD of IC_{25} or 5x lowest IC_{25} for dicot or monocot plants
	1-in-10 year daily average Standard Pond EEC in units of µg a.i./L (PAT)	25^{th} Percentile of SSD of EC_{50} or lowest EC_{50} for aquatic non-vascular plants
Aquatic Habitats (Represented by the Standard Pond)		
Plant communities, CH and Listed **animals** that use aquatic habitats and have a generalist relationship to plants in these habitats	1-in-10 year daily average Standard Pond EEC in units of µg a.i./L (PWC)	25^{th} Percentile of SSD of EC_{50} or lowest EC_{50} for aquatic non-vascular plants

CH=designated Critical Habitat; EEC = estimated environmental concentration; IC_{25} = concentration resulting in 25% inhibition in growth; EC_{50} = concentration resulting in 50% inhibition in growth; PAT = Plant Assessment Tool; PWC = Pesticide in Water Calculator; SSD = Species Sensitivity Distribution

Looking closer at the listed plant species within the scope of the final Herbicide Strategy, there is a large diversity of habitats where these listed species can occur. Terrestrial species can be found in meadows adjacent to agriculture, at high elevation mountainous regions, remote areas like cliff faces and waterfalls, and in nearby forests. Wetland and aquatic species can be found in small vernal pools that seasonally dry up, prairie potholes that are interspersed with agriculture, small and large wetlands, ponds, lakes, and streams and rivers. Since EPA has a finite set of exposure models to represent such a large diversity of aquatic and terrestrial habitats of listed plants, an important consideration when assigning the potential for population-level impacts is how well its models represent these habitats. For example, EPA's previous analyses indicate that its exposure estimates for the farm pond have a tendency to overestimate concentrations in streams and rivers with substantial flow regimes by an order of magnitude or more (USEPA 2016). Similarly, exposure estimates generated for wetland areas are expected to overestimate exposures for flowing wetlands (*e.g.*, riparian areas associated with streams and rivers). Since exposure estimates for the wetland are used as a proxy for flowing wetlands, the potential for population-level impacts begins at a MoD of 10 in these environments rather than 1 as shown previously in **Table 1** in recognition of the upward bias in the wetland exposure estimates for these habitats. A similar situation exists when considering estimates of spray drift for species that live in areas where pesticide sprays may be intercepted by trees, shrubs, and other obstacles to direct contact with spray droplets. EPA's spray drift estimates assume relatively little or no interception of spray droplets as they move from the treated field. In such cases, EPA allows a spray drift buffer distance reduction when these habitat types are downwind of the treated field.

With respect to toxicity, EPA also considers the uncertainty and potential bias in toxicity data when assigning the potential for population-level impacts. The MoD ranges shown in **Table 1** could conceivably be lowered when other information indicates the available toxicity test data does not adequately capture the expected sensitivity of one or more types of listed plants. Conversely, the MoD ranges may be increased if information suggests the opposite situation is likely to occur.

Finally, EPA considers information such as data on pesticide residues in environmental media (*i.e.,* monitoring data) in conjunction with model-based estimates of exposure. Generally, monitoring data can support the model-based exposure estimates when concentrations are reasonably similar; however, monitoring data often are not targeted to when and where herbicides are applied, so lack of agreement does not usually impact the MoD ranges associated with the potential for potential population-level impacts. Ecological incident data reported to EPA also represent a similar confirmatory line of evidence as monitoring data.

In summary, EPA decides on the potential for population-level impacts (not likely, MoD<1; low, MoD 1 to <10; medium, 10 to <100; high, $\geq$100) by considering multiple factors, including:

- MoDs
- Representativeness (or lack thereof) of exposure estimates of species habitat
- Representativeness of toxicity estimates of surrogate test species
- Monitoring and incident data as confirmation

The potential for population-level impacts is used to identify the level of mitigation in **Step 2** of the strategy, which is discussed in the next section.

3.2 Step 2. Identify Type and Level of Mitigation Measures

Step 2 involves relating the MoD to the appropriate level and type of mitigation measures. The mitigation goals are to reduce spray drift, and runoff/erosion exposure pathways such that population-level impacts are not likely. In this step, as described earlier, EPA also considers any existing or proposed mitigations that the registrant(s) included on the pesticide product label or committed to in writing. When EPA identifies the potential for population-level impacts for a particular exposure pathway to be low, medium, or high, it similarly identifies mitigations to address those impacts as shown in **Table 5**. The mitigations associated with a low, medium, or high level of identified mitigation depend on the exposure route and are described below in **Sections 3.2.1 and 3.2.2**.

Table 5. Relationship between the potential for population-level impacts and mitigation identified.

Potential for Population-Level Impacts[2]	**Level of Mitigation Identified**	**Magnitude of Reduction in Exposure to Result in a Not Likely for Population-Level Impact Conclusion**
Not Likely	None	None
Low	Low	10 x
Medium	Medium	100 x
High	High	1000 x

When identifying mitigations to reduce the off-field transport of herbicides in spray drift and runoff/ erosion, EPA considered whether the mitigation measures would be effective at reducing exposure and would not in themselves be so burdensome to prevent the intended use. EPA identified mitigations that are already used by various applicators and growers and included as many measures as possible (meaning EPA had enough information to evaluate it for potential inclusion here) to ensure flexibility and allow growers to use mitigations that are economically and technologically feasible to them. The mitigations identified in this strategy improve on those in the FIFRA Interim Ecological Risk Mitigations (IEM) measures discussed in the ESA Workplan Update and the draft Herbicide Strategy by incorporating feedback from stakeholders.

As detailed in the **Ecological Mitigation Support Document,** for each of these mitigation measures, EPA evaluated their effectiveness at reducing offsite transport. EPA relied upon multiple sources of information about mitigations that are commonly utilized in agriculture for spray drift and runoff/ erosion. EPA also included information about other landscape management practices that may effectively achieve similar reductions in exposure. While runoff/erosion mitigation practices may have previously been installed to reduce transport of nutrients and/or soil, they would also be effective in reducing transport of pesticides. This also applies to mitigation measures such as windbreaks which can be installed to protect wind-sensitive crops and control soil-wind erosion, but they can also be effective in reducing pesticide spray drift. The process EPA followed for considering the inclusion of a mitigation in this strategy was based on the following:

- Scientific principles, the mitigation resulted in meaningful reductions in pesticide spray drift, and runoff/erosion based upon the design, placement, and characteristics of the mitigation;
- Existing EPA models indicated a potential reduction in environmental exposure if the mitigation were in place;
- Empirical studies described the reductions in pesticide concentration as a result of the mitigation;
- The mitigation is similar to other mitigations such that they are functionally equivalent.

Sections 3.2.1 and 3.2.2 discuss the spray drift mitigation measures and runoff/erosion mitigation measures, respectively, that EPA identified in this strategy to address potential population-level impacts to listed species.

3.2.1 Spray Drift Mitigation Measures

Spray drift exposures are a potential concern for pesticide applications made via broadcast spray (aerial and ground equipment), airblast, and some chemigation methods (overhead sprayers such as center pivot and traveler sprayers). This section first describes a suite of baseline mitigation measures applicable to most herbicides to reduce exposure to non-target species via spray drift (**Section 3.2.1.1**). The remainder of this section discusses use of a combination of buffers and/or other mitigations to reduce low, medium, or high potential for population-level impacts associated with spray drift identified in **Step 1**. The currency of spray drift mitigations to address potential population-level impacts is expressed as a distance from the edge of the field (where there are population-level concerns and exposures need to be reduced). **Section 3.2.1.2** explains how EPA selects that distance based on the MoDs calculated in **Step 1** and **Section 3.2.1.3** discusses mitigation measures for reducing exposures within that distance so that there are no longer concerns for population-level impacts to listed species. **Section 3.2.1.4** also explains how, if a buffer is used to represent that distance, what types of areas can represent that buffer so that in-field buffers are not needed in all fields. **Section 3.2.1.5** discusses spray drift mitigations for some mitigation methods (*e.g.*, overhead sprinklers).

There are herbicide application methods in addition to ground, aerial, airblast, and overhead/traveler sprayer chemigation. EPA's evaluation described in the **Ecological Mitigation Support Document** indicates that spray drift exposure from these application methods would be limited and thus the potential for population-level impacts is unlikely. These application methods include:

- Chemigation methods, including: micro-sprinklers, drip-tape, drip emitters, subsurface or flood, and under non-permeable plastic surfaces;
- In-furrow sprays when nozzle height is <8 inches above soil surface;
- Tree trunk drench, tree trunk paint, tree injection;
- Soil injection;
- Solid formulations that are used as a solid; and
- Less than 1/10 acre (<4356 square feet) treated and Spot treatment: <1000 square feet treated (*e.g.,* when applied with backpack or hand held sprayers).

3.2.1.1 Baseline Spray Drift Mitigations

EPA has identified several mitigations that it generally includes on pesticide product labels to reduce spray drift exposure to non-target species. When considering the potential for population-level impacts, EPA includes these mitigations as baseline application assumptions. These common mitigations typically include:

- restricting the maximum windspeed to 10 to 15 miles per hour,
- prohibiting applications during temperature inversions,
- boom length restrictions and swath displacements for aerial applications,
- maximum release heights for ground and aerial applications, and
- directing sprays into the canopy for airblast and turning off the outer nozzles at the last row.

3.2.1.2 Spray Drift Mitigation Distances

If EPA determines the potential for population-level impacts (MoD category) associated with spray drift exposure to be low, medium, or high, EPA then identifies the level of mitigation needed to address the potential for population-level impacts. To address potential ecological impacts via spray drift exposure, EPA typically identifies a spray drift buffer. For this strategy, for aerial, ground, and airblast sprays, the distance associated with that buffer increases with the level of mitigation (low, medium, and high) and that the buffer be located on the downwind edge of the field. EPA is also identifying mitigation measures (described in **Section 3.2.1.3**) that a pesticide applicator can employ to reduce any identified buffer distance because these mitigation measures are likely to reduce exposure within that buffer distance. For chemigation, EPA did not identify a spray drift distance, but rather mitigation measures to reduce exposure to non-target areas. The **Ecological Support Document** describes how EPA determined the efficacy of the mitigation measures included, which EPA expresses as a percentage decrease in any identified buffer distance.

To address a low potential for population-level impacts for aerial, airblast and ground applications, EPA has identified what it refers to as lower limit buffers. If EPA identifies a medium potential for population-level impacts for aerial, airblast and ground applications, EPA identifies that buffer distance by calculating a chemical-specific distance based on the toxicity of the pesticide and estimated off-field deposition. If EPA identifies a high potential for population-level impacts for aerial, airblast and ground applications, EPA identifies a maximum buffer distance that varies depending on the application method. See **Table 6**.

EPA recognizes that for a pesticide application, droplet size can impact the distance which spray drift travels, with larger droplets generally not traveling further than finer droplet sizes. As shown in **Table 6**, EPA identified a single distance based on how pesticides are typically applied for each type of application method. If a smaller droplet size is needed for a particular pesticide, EPA may identify a larger buffer distance. If a pesticide applicator can use a larger droplet size or a low boom, as described in **Section 3.2.1.3**, they would be able to decrease the identified buffer distance. The text below and the

Ecological Support Document provide additional discussion and details about the distances to mitigate potential low, medium and high population-level impacts.

Table 6. Potential for population-level impacts identified in Step 1 and corresponding spray drift distance to reduce impacts.

Potential for Population-Level Impacts from Step 1	Distance from Edge of Treated Area (ft)		
	Aerial Spray[1]	Ground[2] Spray	Airblast
Not Likely	None	None	None
Low	50	10	25
Medium	Calculated for specific chemical[3]		
High	320	230	160

MoD = Magnitude of Difference

[1] EPA based aerial distances on the assumption that most aerial applications in agricultural settings will use a medium droplet size distribution. If very fine or fine applications are needed for a pesticide, EPA may increase the distance. There are mitigation measures for reducing this distance when using droplets larger than medium.

[2] EPA based these distances on the assumption that ground applications are made using a high boom and very fine to fine droplet size distribution. There are options for reducing this distance when using larger droplets and a low boom.

[3]EPA anticipates that chemical specific buffers will be between the lower limit (used for low potential population-level impacts) and at or lower than the maximum (used for high impacts) buffer distances.

Where there is a low potential for population-level impacts, EPA identifies a low level of mitigation for aerial, airblast, and ground applications using a lower limit distance. EPA based the identified distances in **Table 6** on the distance where the deposition fraction is estimated to be 10% of the application rate for the different application methods. This equates to 50, 25, and 10 feet, for aerial, airblast, and ground applications, respectively. EPA based these distances on the common droplet size distribution for aerial (medium), the common droplet size distribution for ground (fine) and high boom and on the sparse orchard setting for airblast.

Where EPA identifies medium potential for population-level impacts, EPA uses AgDRIFT® to calculate the chemical specific buffer distance for aerial, airblast, and ground applications. EPA will calculate the distance where the deposition exposure is equal to the toxicity threshold (discussed above for **Step 1, Section 3.1.3**).

Where EPA identifies high potential for population-level impacts, the Agency identifies a maximum spray drift distance beyond which exposure does not substantially change using the AgDRIFT® model for aerial, airblast, and ground applications. The main reasons for determining a maximum buffer distance include:

1) The impact of the buffer in reducing exposure decreases with distance, such that at distances far offsite there is only a small change in the spray drift deposition,
2) Uncertainty for exposure estimates predicted by the model increases with distance, and
3) The larger a buffer distance is, the less feasible it is to implement for many applicators.

In many cases, the likelihood that spray drift will be partially intercepted by a drift barrier (*e.g.,* trees, crop canopy or other vegetation, buildings) increases with distance, and, as such, the model may overestimate the maximum spray drift buffer because it assumes a bare treated area with no obstructions to intercept spray droplets that drift off-field. The maximum spray drift buffer will be different for different application equipment (*i.e.*, aerial, ground and airblast).

3.2.1.3 Spray Drift Mitigation Measures for Reducing Buffer Distance

EPA reviewed available mitigation measures for reducing the distance of identified ecological spray drift buffers on a site-specific basis. Mitigation measures for reducing the distance include application parameters (such as specific application equipment, reducing application rate, and/or droplet size distribution), the width of the treated area, use of a windbreak/ hedgerow or forested/shrubland area as a physical barrier or the relative humidity. While many of these measures apply to all spray drift application methods, some application parameters are specific to the application method. For example, the applicator may choose larger droplet size distributions to reduce the aerial or ground drift, and buffer, distances. For ground applications, the applicator may reduce the buffer distance by using hooded sprayers or drop nozzles that result in applications under the crop canopy. For all types of applications, the buffer distance can be reduced by using a lower application rate than the maximum rate on the label or by using a windbreak or hedgerow on the downwind side of the application area. **Tables 7-9** summarize the ecological spray drift mitigation measures for reducing the distances associated with aerial, ground and airblast applications. The **Ecological Mitigation Support Document** has detailed information describing the basis for each percent reduction in distance.

Table 7. Mitigation measures identified when making broadcast aerial applications.

Mitigation Measures	% Reduction in Distance[5]
Application Parameters	
Reduced single application rate	% reduction corresponds to application rate reduction from maximum on pesticide product label[2]
Coarse DSD[1]	20%
Very coarse DSD[1]	40%
Spray drift reducing adjuvants, Medium DSD	30%
Spray drift reducing adjuvants, Coarse or Very coarse DSD	15%
Reduced Proportion of Field Treated (# of Airplane/Helicopter Passes)[3]	
1 pass	55%
2-4 passes	20%
5-8 passes	10%
Other Mitigation Measures	
Downwind windbreak[4]/hedgerow/riparian/forest/ woodlots/shrubland	50% for basic windbreak/hedgerow 75% for advanced windbreak/hedgerow 100% for riparian/forests/woodlots/shrubland $\geq$ 60 ft width
Relative humidity is 60% or more at time of application	10%

DSD = droplet size distribution

[1] This % reduction is based on the assumption/baseline of using medium droplet size for aerial.

[2] Example 10% reduction in the spray drift buffer for 10% lower single application rate than labeled maximum single application rate.

[3] A spray drift buffer applies to downwind non-target areas. The reduced number of passes applies to the upwind part of the treated field.

[4] Artificial windbreaks (*e.g.,* a curtain or netting) are also applicable.

[5] After mitigation reductions in the spray buffer are applied, round to the nearest 5ft increment (*e.g.*, 50ft, 35ft)

Table 8. Mitigation measures identified when making broadcast ground applications.

Mitigation Measures	% Reduction in Distance[5]
Application Parameters	
Reduced single application rate	% reduction corresponds to application rate reduction from maximum on pesticide product label[2]
High boom, fine to medium-coarse DSD[1]	55%
High boom, coarse DSD[1]	65%
Low boom, very fine to fine DSD[1]	40%
Low boom, fine to medium-coarse DSD[1]	65%
Low boom, coarse DSD[1]	75%
Over-the-top Hooded Sprayer	50%
Row-middle Hooded Sprayer	75%
Sprays below crop using drop nozzles or layby nozzles	50%
Spray drift reducing adjuvants, Medium DSD	30%
Spray drift reducing adjuvants, Coarse or Very coarse DSD	15%
Reduced Proportion of Field Treated (Number of Ground Application Equipment Passes)[3]	
1 pass	75%
2-4 passes	35%
5-10 passes	15%
Other Mitigation Measures	
Downwind windbreak[4]/hedgerow/riparian/forest/woodlots/shrubland	50% for basic windbreak/hedgerow 75% for advanced windbreak/hedgerow 100% for riparian/forests/woodlots/shrubland $\geq$ 60 ft width
Relative humidity is 60% or more at time of application	10%

DSD = droplet size distribution
Low boom height=release height is less than 2 feet above the ground
high boom=release height is greater than 2 feet above the ground

[1] This % reduction assumes use of high boom, very fine to fine droplet size for ground.

[2] Example 10% reduction in the spray drift buffer for 10% lower single application rate than labeled maximum single application rate.

[3] A spray drift buffer applies to downwind non-target areas. The reduced number of passes applies to the upwind part of the treated field.

[4] Artificial windbreaks (*e.g.*, a curtain or netting) are also applicable.

[5] After mitigation reductions in the spray buffer are applied, round to the nearest 5ft increment (*e.g.*, 50ft, 35ft)

Table 9. Mitigation measures identified when making airblast applications

Mitigation Measure	% Reduction in Distance[3]
Application Parameters	
Reduced single application rate	Divide % reduction in application rate by 2
Reduced Proportion of Orchard Treated (Number of Treated Rows[1])	
1 row	70%
2-4 rows	30%
5-10 rows	15%
Other Mitigation Measures	
Downwind windbreak[2]/hedgerow/riparian/forest/woodlots/shrubland	50% for basic windbreak/hedgerow 75% for advanced windbreak/hedgerow 100% for riparian/forests/woodlots/shrubland ≥ 60 ft width

[1] A spray drift buffer applies to downwind non-target areas. The reduced number of passes applies to the upwind part of the treated field.
[2] Artificial windbreaks (*e.g.,* a curtain or netting) are also applicable.
[3] After mitigation reductions in the spray buffer are applied, round to the nearest 5ft increment (*e.g*., 50ft, 35ft)

For aerial, ground and airblast applications, EPA based the ecological spray drift buffer distances (**Table 6**) on assumed swath widths and the number of passes, flight lines, or rows treated. EPA assumes the size and number of pesticide application equipment passes for the airplane/helicopter, tractor and airblast sprayer results in spray drift that deposits on the downwind side of the field/orchard. On a site-specific basis for a broadcast application, if the number of rows treated for an orchard is fewer than EPA's assumptions, there will be less spray drift deposition in the non-target area on the downwind side of the field. For aerial, ground and airblast applications, the applicator could reduce any identified spray drift buffer by the percent shown in **Tables 7-9** depending on the number of passes or treated rows (parallel to the wind direction, perpendicular to the downwind side of the treated field/non-target area). **Figure 6** illustrates such an example. **Tables 7-9** includes the percent reductions associated with different numbers of passes/treated rows of the treated field/orchard.

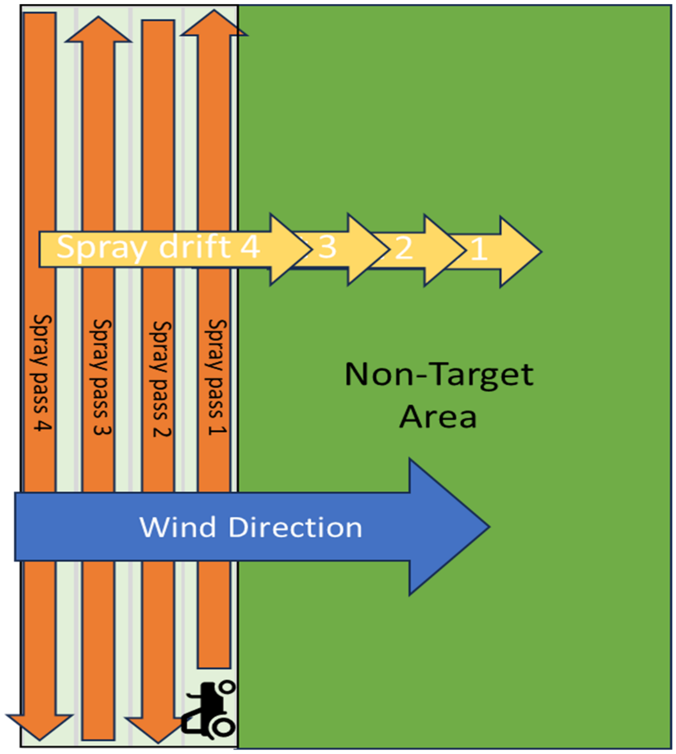


Figure 6. Cumulative spray drift in non-target area from tractor passes on four parallel rows on treated area. For example, if this was a ground application and the applicator only made 4 passes of their field, then they could reduce identified spray drift buffer distance by 35%.

To use mitigation measures to reduce the spray drift distance (**Tables 7-9**), the applicator should first consider the application equipment that they plan to use for the application. With this information and the directions for use on the pesticide labeling, the applicator could identify the appropriate spray drift distance for the pesticide and use (determined by EPA as either lower limit, chemical specific or maximum, **Table 6**). The applicator could then select from any of the appropriate mitigation measures relevant to the application type (either aerial, airblast, or ground). The applicator could add up the corresponding percent reductions for all the mitigation measures selected. This total percent could be applied to the spray drift buffer distance. If the percent is 100% or more, the applicator would not need a buffer as the mitigations put in place already address the potential for population-level impacts. If the percent is above zero and less than 100%, a buffer would be identified but the distance could be reduced from that specified on the pesticide product label. For example, if the pesticide product label specifies a 230-foot buffer and there is a downwind windbreak (50% reduction) and the relative humidity is 70% at the time of the application (10% reduction), the label would allow for a 60% (50%+10%) reduction in the buffer. The remaining spray drift distance would be 90 feet (100%-60% = 40% * 230 ft)[24]. If the applicator used a low boom instead of a high boom, an additional 40% reduction in distance could be used and no buffer distance would be identified (50%+10%+40% = 100%).

[24] After applying mitigations to reduce the spray drift buffer distance, the final calculated distance should be rounded to nearest 5 ft increment. (*e.g.,* 32 ft is rounded to 30 ft; 48 ft is rounded to 50 ft)

3.2.1.4 Description of Managed Areas that can be Subtracted from Spray Drift Distances

As described above, EPA relies upon the AgDRIFT® model for ground and aerial spray drift estimations. The models for ground and aerial drift were developed based on several underlying assumptions, including drift depositing onto a bare field, no obstructions to intercept spray droplets that drift off-field, and a prevailing wind direction. In practice, farms may have managed lands in areas adjacent to a pesticide application. While these managed practices may not be intentionally created for the purpose of mitigating pesticides, their composition and size on the landscape could act like a buffer (*e.g.,* roads) or intercept spray drift (which the model does not take into account) and reduce the distance it may travel. Therefore, to the extent that such managed areas are downwind and immediately adjacent to a pesticide application (provided that people are not present in those areas and they themselves not being treated with the pesticide), EPA has included these areas in what can be considered within the buffer distance. In other words, growers/applicators could subtract managed areas immediately adjacent to treated field from their identified buffer distance. See **Table 10**.

Table 10. Downwind managed areas that can represent ecological spray drift buffers.

When spray drift buffers are identified as mitigations, the following managed areas can be included in the buffer if they are immediately adjacent/contiguous to the treated field in the downwind direction and people are not present in those areas (including inside closed buildings/structures). Any label requirements that prohibit or restricts spray drift in any of these specific managed areas (*e.g.,* to protect human health) must also be followed. a. Agricultural fields, including untreated portions of the treated field; b. Roads, paved or gravel surfaces, mowed grassy areas adjacent to field, and areas of bare ground from recent plowing or grading that are contiguous with the treated area; c. Buildings and their perimeters, silos, or other man-made structures with walls and/or roof; d. Areas maintained as a mitigation measure for runoff/erosion or drift control, such as vegetative filter strips (VFS), field borders, hedgerows, Conservation Reserve Program lands (CRP)[1], and other mitigation measures identified by EPA on the mitigation menu; e. Managed wetlands including constructed wetlands on the farm; and f. On-farm contained irrigation water resources that are not connected to adjacent water bodies, including on-farm irrigation canals and ditches, water conveyances, managed irrigation/runoff retention basins, and tailwater collection ponds.

[1]Growers may need to ensure that pesticide use does not cause degradation of the CRP habitat.

In some cases, areas maintained as a mitigation measure for spray drift or runoff/erosion control, managed areas, and CRP lands could potentially represent habitat for listed species. There can be significant benefits of these habitats to listed species, with a net gain to the species when considering benefits vs. impacts of pesticides. Not all of these areas represent high quality habitat for listed species (*e.g.*, listed plants are not expected to occur within these areas). In some cases, individuals of a species may be attracted to an area that represents habitat (*e.g.*, insects may be attracted to habitat created for pollinators); however, not enough individuals are expected to be impacted within the portion of the exposed area of the habitat such that there would be an impact on the population that would outweigh the overall benefit provided by creation of the habitat. EPA does not want to disincentivize grower/applicators from providing such habitats, which may have considerable benefits to species, their environment, and pesticide use reductions. Therefore, managed areas that include habitat may be part or all of the spray drift buffer.

Figures 7 and 8 represent examples of how ecological spray drift buffers can be reduced where a pesticide product label identifies a 50-foot downwind spray drift buffer. The grower/applicator could subtract the 10 foot off-field area downwind where the grower has CRP land and the 20-foot-wide downwind windbreak, leaving only a 20 foot in-field buffer to meet the identified buffer distance (**Figure 7**). In contrast, if the off-field downwind areas of the CRP land and windbreak totaled 50 feet or more this would equal the identified spray drift buffer distance (as shown **Figure 8**).

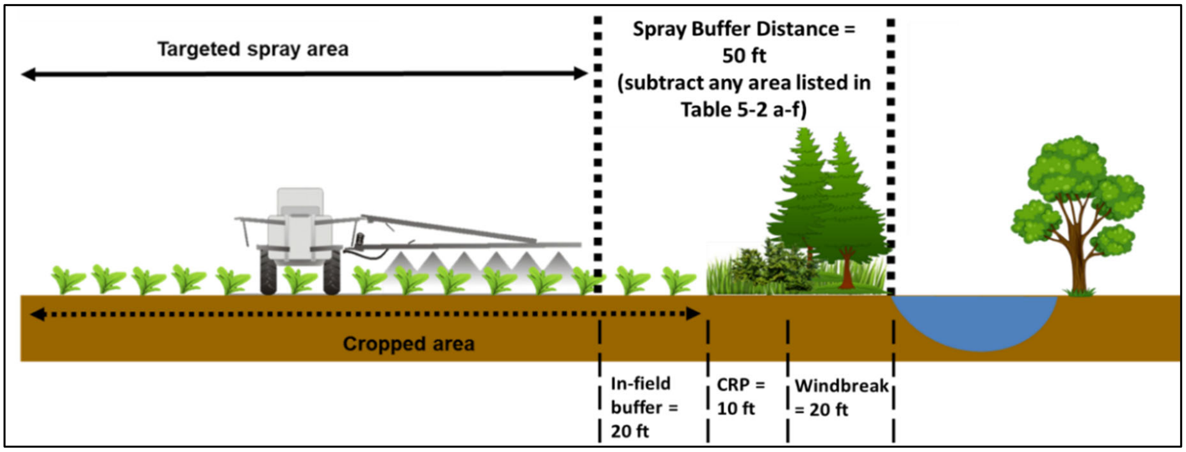


Figure 7. Diagram of the field (cropped area) with a downwind ecological spray drift buffer which includes a portion of the cropped area because the adjacent managed areas are less than the identified spray drift buffer distance.[25]

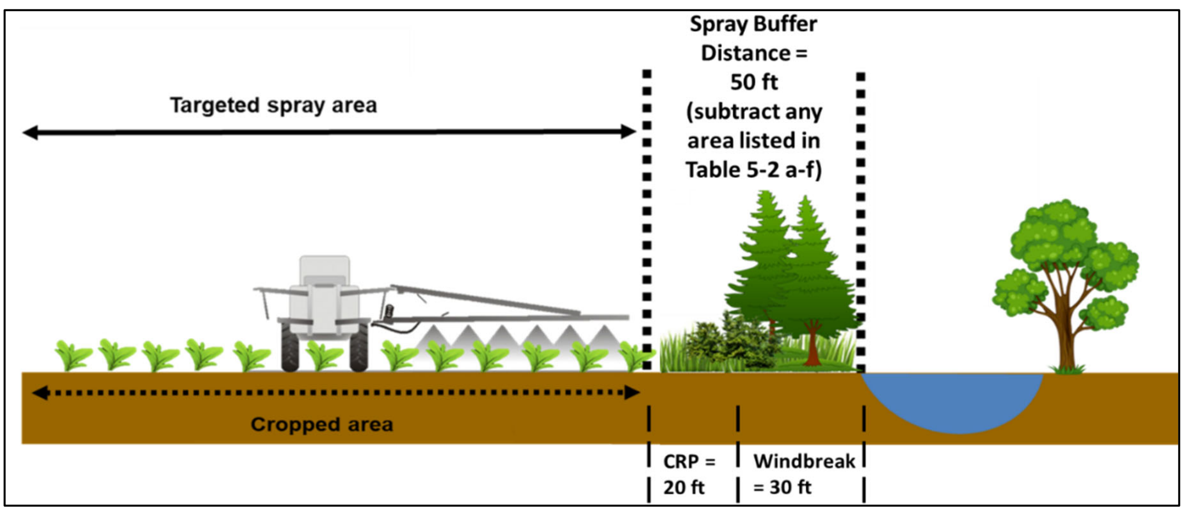


Figure 8. Diagram of the field (cropped area) with no cropped area included in the downwind ecological spray drift buffer because adjacent managed areas are equal to the identified spray drift buffer distance.[25]

[25] This figure is based on a diagram from the Pest Management Regulatory Agency of Health Canada (2020), which EPA was permitted to reproduce. The original figure is available at: https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/growers-commercial-users/drift-mitigation/protecting-habitats-spray-drift.html. EPA has edited the original figure to provide an example of the areas that can be subtracted from spray drift buffer distances.

3.2.1.5 Spray Drift Exposure Associated with Overhead and Impact Sprinkler Chemigation Systems

Overspray from overhead and impact sprinkler chemigation systems can expose non-target species to herbicides. EPA identified mitigation measures for overhead and impact sprinkler chemigation equipment to address identified potential for population-level impacts to listed species. The measures are listed below in **Table 11**. Unlike aerial/ground or airblast applications, it does not include identified spray drift distances (buffers), but rather measures intended to reduce the potential for irrigation overspray into non-target areas. The type and extent of the identified measures depends on the level of the potential for population-level impacts as well as the type of chemigation equipment. The table below and the **Ecological Mitigation Support Document** provides additional discussion and details about the measures identified to mitigate low, medium and high population-level impacts.

Table 11. Mitigation measures identified when making pesticide applications via overhead and impact sprinkler chemigation systems.

<table>
<tr><th rowspan="2">Potential for Population-level Impacts from Step 1</th><th colspan="2">Mitigation Measures</th></tr>
<tr><th>Overhead Chemigation[1]</th><th>Non-End Gun Impact Sprinklers</th></tr>
<tr><td>Not Likely</td><td>None</td><td>None</td></tr>
<tr><td>Low</td><td>No end gun</td><td rowspan="2">Limit throw distance to edge of field (treated area)[2]</td></tr>
<tr><td>Medium</td><td>No end gun and one of the following: reduce pressure (<20 psi); reduce release height (<5 ft); have a windbreak[3]</td></tr>
<tr><td>High</td><td>No end gun and two of the following: reduce pressure (<20 psi); reduce release height (<5 ft); have a downwind windbreak[3]</td><td>Limit throw distance to edge of field (treated area) AND have downwind windbreak[3]</td></tr>
</table>

[1] Refers to *e.g.*, center pivot, overhead systems, traveler systems that have sufficient pressure/end guns.
[2] This can be accomplished by either reduced pressure and/or reduced throw angle.
[3] This can be a windbreak/hedgerow/riparian/forest/shrubland/woodlots. See Ecological Mitigation Support Document for additional details.

3.2.2 Runoff/Erosion Mitigation Measures

EPA developed a runoff/erosion mitigation menu that included mitigations for non-target species, including listed species. As this strategy is implemented through FIFRA actions, pesticide product labeling would direct the user to the mitigation menu website (see **Section 3.2.2.2**). EPA elected to develop a mitigation menu to provide flexibility for growers/applicators to use mitigations that are best for their situation when a pesticide product they want to use includes the requirement to achieve a level of mitigation and directs the user to the menu. These measures are identified in **Table 13** and described in more detail in the **Ecological Mitigation Support Document** Version 1.0. EPA categorized these runoff/erosion mitigation measures as follows:

- **Application Parameters** that growers/applicators may elect to employ to reduce potential pesticide runoff and erosion (annual application rate reduction, partial field treatment, soil incorporation).
- **Field Characteristics** that are likely to indicate the field will have less runoff and erosion than other fields and thus need fewer mitigation measures to reduce runoff/erosion transport (*e.g.,*

fields with a low slope likely have less runoff/erosion, permeable sandy soils have less runoff than high clay content soils).

- **In-field Mitigation Measures** that users may elect to employ to reduce potential pesticide runoff and erosion are those that involve the management of the field. (*e.g.,* management of irrigation water, cover crops, or reduced tillage).
- **Adjacent to the Field Mitigation Measures** are those that occur next to the field and down-gradient from where the pesticide application occurs and between the treated field and species' habitat (*e.g.,* grassed waterway, VFS). Some measures may occur on the field and also adjacent to the field, so they are included in both categories (*e.g.,* VFS).
- **Systems that Capture Runoff and Discharge** are those that capture, collect, and discharge runoff through discrete conveyances (*e.g.,* water retention systems such as ponds and sediment basins).
- **Other Mitigation Measures** are those that may be considered but that do not fit into the categories above.

Additional considerations associated with the extent of mitigation associated with any particular field/area include:

- **Pesticide Runoff Vulnerability**: an analysis of pesticide runoff vulnerability across the lower 48 states that may influence the amount of runoff/erosion mitigation for a particular site.
- **Areas 1000 feet Down-Gradient from Application Areas**: areas where there is not a potential for population-level impacts from off-site exposure to runoff/erosion from pesticide applications.
- **Conservation Program and Runoff/Erosion Specialists/Mitigation Tracking:** recognition that growers/applicators that work with a runoff/erosion specialist or participate in a conservation program would likely achieve higher than average mitigation measure efficacy and benefits of mitigation tracking.

As described in **Section 3.2.2.5,** EPA has identified several mitigation measures that when employed on a field by themselves, would result in runoff/erosion exposures that would not likely have a potential for population-level impacts. If the following mitigation measures are employed, then no further runoff/erosion mitigations would be needed:

- systems with permanent berms;
- tailwater return systems; and
- subsurface tile drains, *with* controlled drainage structures

In addition, EPA's evaluation indicated the run-off/erosion exposure from several herbicide application methods would be limited and thus the potential for population-level impacts is unlikely. These application methods include the following:

- tree injection;
- some chemigation methods, including subsurface and under non-permeable plastic surfaces;
- soil injection; and

- less than 1/10 acre (<4356 square feet) treated and spot treatment (<1000 square feet treated) (*e.g.*, when applied with backpack or hand-held sprayers;

As detailed in the **Ecological Mitigation Support Document,** for each of the measures included in the runoff/erosion mitigation menu, EPA evaluated their effectiveness at reducing offsite transport via runoff/erosion (high, medium, or low). In general, a mitigation with a low, medium, or high efficacy achieves an average of 10-30%, 30-60%, and greater than or equal to 60% reduction, respectively. EPA's evaluation of the efficacy for each mitigation measure is based on empirical evidence, modeling, the efficacy of functionally equivalent measures, and EPA's best professional judgment of the mitigation's potential to be effective at reducing offsite transport of pesticides.

In order to include as many options as feasible across dozens of measures with varying degrees of efficacy, EPA utilized a point system for runoff/erosion mitigations to 1) associate the number of points with each MoD category for runoff/erosion; and 2) assign lower or higher point values to mitigation practices that are less or more effective, respectively, in reducing runoff/erosion. EPA assigned efficacy points to each of the measures on the runoff/erosion mitigation menu based on the efficacy of reducing exposure of the mitigation measure. High efficacy mitigation measures are worth 3 points, medium efficacy measures are worth 2 points, and low efficacy measures are worth 1 point (**Table 13**).

3.2.2.1 Level of Mitigation Identified for Runoff/Erosion

Where EPA determines a potential for listed species population-level impacts associated with runoff/erosion to be low, medium, or high, EPA would identify the level of mitigation needed to reduce exposures so that population-level impacts are no longer likely. EPA determines this first based upon the MoDs associated with the use of the pesticide being evaluated, which are related to the potential for population-level impacts. Mitigation measures (or combination of mitigation measures) that achieve three points are functionally equivalent to approximately an order of magnitude (*i.e.,* 10x) reduction in off-field exposure concentrations of pesticides transported via runoff. For erosion-prone chemicals, and those bound to sediment, EPA adjusts the points required to achieve an order of magnitude reduction in exposure concentrations. For erosion, 2 points are generally equivalent to an order of magnitude reduction in exposure concentration given the lower mobility of soil particles relative to water and increased effectiveness of mitigation practices at reducing soil in runoff. This order of magnitude reduction is equivalent to the reduction needed to drop from one category of potential for population-level impacts to a lower category (*e.g.,* from high to medium). **Table 12** presents the number of points EPA has identified to address potential for population-level impacts of runoff/erosion to wetland and aquatic habitats used by plants.

Table 12. Number of mitigation points identified to reduce exposure via runoff and erosion.

Potential for Population-level Impacts	Magnitude of Reduction in Exposure Needed to Result in a Not Likely Potential for Population-Level Impacts Conclusion	Mitigation Points Identified	
		Runoff-Prone [K_{OC} <1000 or K_d <50][1]	Erosion-Prone [K_{oc} $\geq$1000 or K_d $\geq$50][1]
Not Likely	None	None	
Low	10 x	3	2
Medium	100 x	6	4
High	1000 x	9	6

[1] The soil-water distribution coefficient (K_d) and organic-carbon normalized soil-water distribution coefficient (K_{OC}) are measures of the propensity of a chemical to be dissolved in water or sorbed to soil or sediment. K_{OC} and K_d values are measured in studies conducted under OCSPP Guideline 835.1230 (USEPA, 2008). The average K_{OC} or K_d is used to distinguish between runoff-prone and erosion-prone pesticides.

While a multitude of factors determine the fate and transport of a pesticide in the environment, one fundamental physio-chemical property of a pesticide is the sorption coefficient, otherwise known as the Koc[26]. This property describes whether a chemical tends to adsorb (*i.e.,* bind to) to soil particles or remain in water (USEPA, 2006). Chemicals with a higher Koc tend to adsorb to soil and are more likely to be transported by soil erosion, while chemicals with lower Koc tend to partition to water and are more likely to be present in runoff. Several of the runoff/erosion mitigation measures listed in the **Ecological Mitigation Support Document** function by removing soil, and therefore soil-sorbed pesticides, from runoff. This difference between chemicals results in runoff and erosion mitigations being inherently more effective for erosion prone pesticides. Examples of this phenomena can be seen in the literature for various mitigation measures, including vegetative filter strips, sedimentation basins, and cover crops/mulching. Across these three examples, the mitigations were found to be 20-30% more efficacious for erosion-prone pesticides compared to runoff-prone pesticides (**Ecological Mitigation Support Document**). EPA used this difference as the basis for the reducing the number of mitigation points erosion-prone pesticides.

3.2.2.2 Runoff and Erosion Mitigation Measures Menu

EPA identified runoff/erosion mitigations that would be included on EPA's mitigation menu website for growers/applicators to employ when EPA identifies mitigations for non-target species, including listed species, are needed to address population-level impacts from runoff/erosion. EPA assigned efficacy points to each of the runoff/erosion mitigation measures based on the efficacy of the mitigation measure to reduce exposure. The mitigation menu website will show the efficacy points assigned to each mitigation. The identified mitigation measures included on the menu and associated point values are presented in **Table 13.** EPA will update the menu with additional mitigation measures when appropriate (see **Section 4.0**).

[26] The organic-carbon normalized soil-water distribution coefficient (K_{OC}) is a measure the propensity of a pesticide to be dissolved in water or sorbed to soil or sediment. For some pesticides, sorption is described using the soil-water distribution coefficient (K_d) without organic-carbon normalization. K_{OC} and K_d values are measured in studies conducted under OCSPP Guideline 835.1230 (USEPA, 2008).

Mitigation measures that have been identified as of July 2024 are described in the **Ecological Mitigation Support Document** Version 1.0, and the mitigation list and point system outlined in that document are expected to be incorporated into the mitigation menu website later in 2024.

EPA has identified runoff/erosion mitigations for which efficacy data is available to provide options and flexibility to the grower.[27] EPA welcomes input on the efficacy of additional measures that growers may be using that the Agency did not include. EPA acknowledges that the mitigation menu will continue to evolve over time and the Agency plans to update the mitigation menu website with additional measures or refinements to those identified to date as new information becomes available.

[27] The Herbicide Strategy provides mitigation points for measures growers/applicators already employ if the measures are known to be efficacious for reducing runoff/erosion. If a grower/applicator is already implementing a mitigation measure on the menu, they may be able to implement fewer additional measures on their field to achieve the identified by the Herbicide Strategy.

Table 13. Runoff/erosion mitigation measures and associated point-values for reducing exposures. [28]

Mitigation Measure Title[1]	Conditions that Qualify[1,2]	Efficacy Classification	Points
Application Parameters			
Annual Application Rate Reduction	Any application 10% to <30% less than the maximum labeled annual application rate	Low	1
	Any application 30% to <60% less than the maximum labeled annual application rate	Medium	2
	Any application ≥60% less than the maximum labeled annual application rate	High	3
Reduction in Proportion of Field Treated[29]	10 to <30% of Field Area treated (Banded application, partial treatment, precision sprayers)	Low	2
	30 to <60% of Field Area treated (Banded application, partial treatment, precision sprayers)	Medium	3
	≥60% of Field Area treated (Banded application, partial treatment, precision sprayers)	High	4
Soil incorporation	Watering-in or mechanical incorporation before runoff producing rain event	Low	1
Field Characteristics[3]			
Field with slope ≤ 3%	Naturally low slope or flat fields; flat laser leveled fields	Medium	2
Predominantly Sandy Soils[4]	Fields with sand, loamy sand, or sandy loam soil without a restrictive layer that impedes the movement of water through the soil	Medium	2
In-Field Mitigation Measures[3]			
Reduced Tillage Management	Reduced tillage, mulch tillage, strip till, ridge tillage	Medium	2
	No-till	High	3
Reservoir Tillage	Reservoir tillage, furrow diking, basin tillage	High	3
Contour Farming	Contour farming, contour tillage, contour orchard and perennial crops	Medium	2
In-field Vegetative Strips	Inter-row vegetated strips, strip cropping, alley cropping, prairie strips, contour buffer strips, contour strip cropping, prairie strip, alley cropping, vegetative barrier (occurring in a contoured field)	Medium	2
Terrace Farming	Terrace farming, terracing, field terracing	Medium	2

[28] Current as of Herbicide Strategy Publication Date. The actual menu should be consulted from the website: https://www.epa.gov/pesticides/mitigation-menu At the time of the release of this document, the website reflects the ecological mitigation associated with the FIFRA IEM effort. EPA will periodically update the website with additional mitigation measures as the mitigation options and efficacy evaluation evolves. EPA will also provide details on how this website should be used for these strategies.

[29] See the **Ecological Mitigation Support Document** for an explanation of the points for this mitigation measure.

Mitigation Measure Title[1]	Conditions that Qualify[1,2]	Efficacy Classification	Points
Cover Crop/Continuous Ground Cover	Cover crop, double cropping, relay cropping	Low (tillage used)	1
		Medium (no tillage, short term)	2
		High (no tillage, long term)	3
Irrigation Water Management	Use of soil moisture sensors/evapotranspiration meters with center pivots & sprinklers; above ground drip tape, drip emitters; micro-sprinklers	Medium (general irrigation management)	2
	Below tarp irrigation, below ground drip tape; dry farming, non-irrigated lands	High (subsurface irrigation; no Irrigation)	3
Mulching with Natural and Artificial Materials	Mulching with artificial materials (*i.e.,* landscape fabrics, synthetic mulches)	Low	1
	Mulching with natural materials	High	3
Erosion Barriers	Wattles, Silt Fences	Medium	2
Adjacent to Field Mitigations[5]			
Grassed Waterway	Grassed waterway	Medium	2
Vegetative Filter Strips - Adjacent to the Field	20 to <30 ft Vegetative filter strip (VFS), field border	Low	1
	30 to <60 ft Vegetative filter strip (VFS), field border	Medium	2
	≥60 ft Vegetative filter strip (VFS), field border	High	3
Vegetated Ditch	Vegetated ditch	Low	1
Riparian Area	20 to <30 ft Riparian forest buffer, riparian herbaceous cover Riparian forest buffer, riparian herbaceous cover	Low	1
	30 to <60 ft Riparian forest buffer, riparian herbaceous cover	Medium	2
	≥60 ft Riparian forest buffer, riparian herbaceous cover	High	3
Constructed and Natural Wetlands	Constructed wetlands, Wetland and Riparian Landscape/Habitat Improvement	High	3
Terrestrial Habitat Landscape Improvement	20 to <30 ft Terrestrial Landscape/habitat improvement	Low	1
	30 to <60 ft Terrestrial Landscape/ habitat improvement	Medium	2
	>60 ft Terrestrial Landscape/ habitat improvement	High	3
Filtering Devices with Activated Carbon or Compost Amendments	Filters, sleeves, socks, or filtration units containing activated carbon	High	3
	Filters, sleeves, socks, or filtration units containing compost	Low	1
Systems that Capture Runoff and have Controlled Discharges			
Water Retention Systems	Retention pond, sediment basins, catch basins, sediment traps	Medium	2
Subsurface Drainages and Tile Drainage Installed *without* Controlled Drainage Structure	Subsurface tile drains, tile drains	Low	1

Mitigation Measure Title[1]	Conditions that Qualify[1,2]	Efficacy Classification	Points
Other Mitigation Measures			
Mitigation measures from multiple categories (*i.e*., in-field, adjacent to the field, or water retention systems) are utilized.[6]	See measures in categories above.	Low	1

[1] Proposed mitigation measures descriptions specific to pesticides were published in the Ecological Mitigation Support Document to Support Endangered Species Strategies Version 1.0 (USEPA, 2024). Not all measures are applicable to all fields and crops.

[2] Only one of the practices that qualify from a 'mitigation measure' can be used. For example, a user could get mitigation points for cover cropping or double cropping but not both.

[3] Multiple field characteristics may apply to an individual field.

[4] Soil texture is as defined by USDA's soil classification system. See USDA's Web Soil Survey tool to determine soil texture: https://websoilsurvey.nrcs.usda.gov/app/.

[5] Adjacent to the field mitigations should be located downgradient from a treated field to effectively reduce pesticide exposure in runoff and erosion.

[6] For example, if a cover cropping and adjacent to the field VFS are both utilized, the efficacy of the mitigation measures in combination may be increased.

3.2.2.3 Mitigation Relief based on Pesticide Runoff Vulnerability

The amount of runoff and erosion transport differs across the contiguous U.S., especially due to differences in frequency and amount of rainfall. EPA evaluated the scientific literature and developed analyses to differentiate geographical areas by runoff vulnerability and reduced the amount of runoff/erosion mitigation identified in those areas. In practice, this is county level relief points that reduces the amount of additional mitigation that would be needed in areas that do not have high pesticide runoff vulnerability. A list of counties and associated relief points (**Appendix B**) will be provided on the mitigation menu website[30]. As described in more detail in the **Ecological Mitigation Support Document**, EPA evaluated the relative vulnerability of areas across the lower 48 states to pesticide runoff using PWC. EPA used a generic runoff-prone chemical with approximately three million scenarios across the lower 48 states to rank runoff vulnerability relative to the modeled maximum scenario. The scale of this modeling simulation was conducted at a much finer resolution than that of EPA's standard aquatic modeling for regulatory actions (*i.e.,* 2-digit HUC resolution).

The evaluation of this information resulted in a determination that pesticide runoff vulnerability can be defined at a county level with four categories (very low, low, medium and high) representing spatially where exposures of pesticides in runoff may be representative of EPA's upper bound estimates (*e.g.,* high pesticide runoff vulnerability counties) compared to areas where concentrations in pesticide runoff are likely being overestimated (*e.g.,* counties with very low pesticide runoff vulnerability). The relative level of pesticide runoff vulnerability that EPA expects for each of these categories is summarized in **Table 14**.

Counties classified as highly vulnerable to pesticides occurring in runoff would reflect those that have greater potential for population-level impacts. EPA chose the county level scale to communicate runoff vulnerability to balance ease of communication, data resolution, and environmental variability. For medium, low, and very low vulnerability areas, EPA's evaluation shows the potential for population-level impacts may be increasingly overestimated. To account for this overestimation, EPA will provide mitigation relief in the form of points. EPA assigned relief[31] points to all counties with medium (2 points), low (3 points), or very low (6 points) pesticide runoff vulnerability (**Table 14, Figure 9; Appendix B**). This county-level relief reduces the amount of additional mitigation that would be identified in areas that do not have high pesticide runoff vulnerability. This approach represents a spatially refined analysis (compared to EPA's national-level screening assessments; **Ecological Mitigation Support Document**) where EPA can consider differences in exposure across the country and the amount of relief points align with the magnitude of difference methodology described in **Step 2 (Figure 9)**. Just as in **Step 2**, each order of magnitude reduction is equivalent to 3 relief points, so EPA assigned areas with very low pesticide runoff vulnerability 6 relief points (approximately 2 orders of magnitude reduction), 3 relief points to areas with low pesticide runoff vulnerability (approximately 1 order of magnitude reduction), and 2 relief points to areas with medium pesticide runoff vulnerability (approximately ½ order of magnitude reduction).

[30] Mitigation menu website: https://www.epa.gov/pesticides/mitigation-menu

[31] EPA defines relief as a level of reduction for required points of a given pesticide and is based on a field's geographic location.

EPA estimates that these relief points may reduce the additional runoff mitigation burden (level of mitigation points identified) for approximately 80% of cultivated agriculture acres and 95% of specialty and minor crop production acres. Relief points can be used when mitigations are implemented on the general pesticide product label or on PULAs that fall within counties where relief points are available.

Table 14. Categories of magnitude of difference from nationwide maximum pesticide runoff vulnerability score with corresponding percentiles and classifications.

Order of Magnitude Lower than Max	Pesticide Runoff Vulnerability	
	Percentile	Classification
~2	0 – 9%	Very low
~1	10 – 49%	Low
~Half	50 – 84%	Medium
Maximum	85 – 100%	High

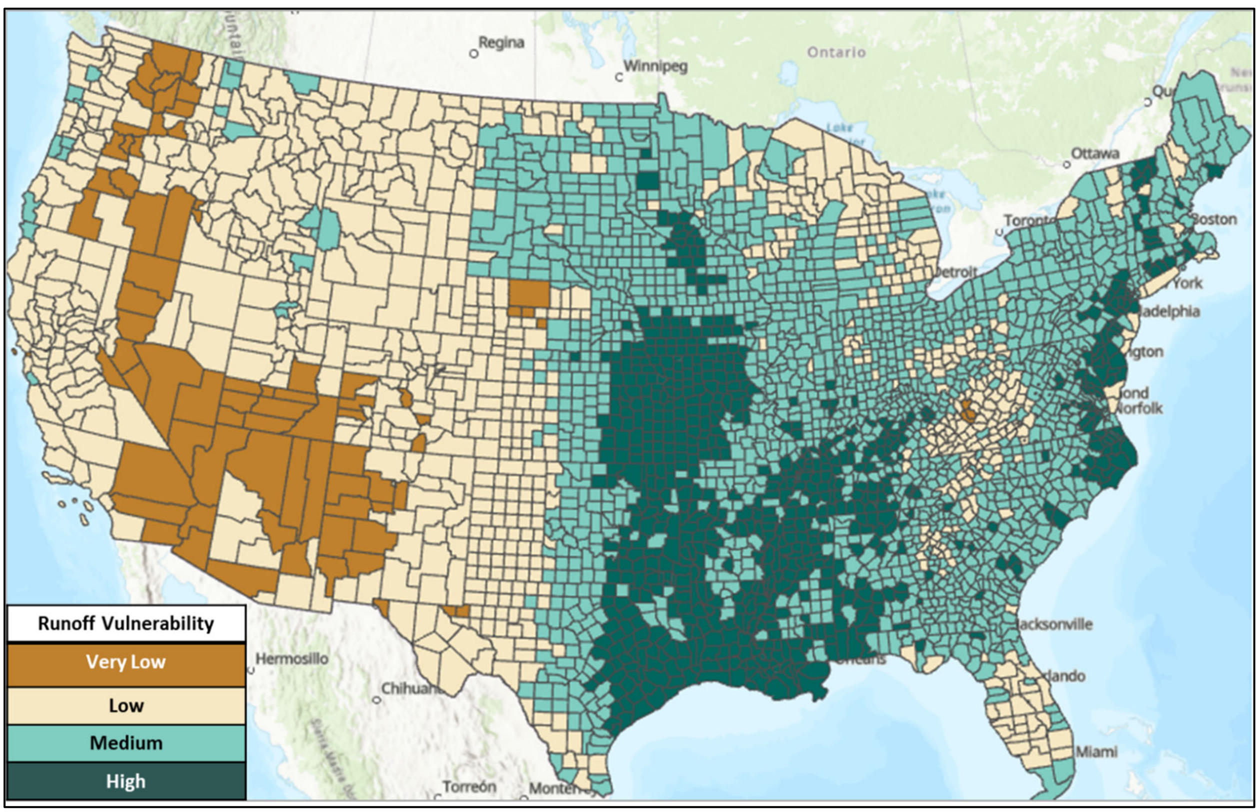


Figure 9. Pesticide runoff vulnerability at the county level.

3.2.2.4 Run-Off/Erosion Mitigation Relief for Areas 1000 feet Down-Gradient from Application Areas

Pesticide exposure to non-target organisms and their habitat via runoff/erosion is highest the closer the non-target species are to the pesticide application area. Runoff and erosion are directional, meaning off-site transport occurs when an adjacent area is at a lower elevation than a pesticide application area. As described in the **Ecological Mitigation Support Document**, based on an analysis of overland flow and sheet flow and the distance to various watersheds and waterbodies, EPA concluded that pesticide concentrations in runoff that have the potential to rise to population-level impacts can extend up to 1,000 feet downslope from a pesticide application. Accordingly, areas beyond 1,000 feet are likely to receive less runoff and erosion from the treated field, if at all, making the potential for population-level impacts unlikely. EPA does not identify runoff/erosion mitigations for pesticide applications areas more than 1,000 feet downwind from a terrestrial or aquatic habitat for listed species. EPA received comments from a wide variety of stakeholders that EPA should not rely on habitat descriptions to determine if an application is within 1,000 feet of such habitats because stakeholders could not readily identify them based on those descriptions. When EPA develops PULAs for geographically specific runoff/erosion mitigations, it ensures the geographic extent of the mitigations does not extend beyond 1,000 feet from those areas it identifies for conservation of a listed species and its critical habitat (See **Section 3.3.3** for additional information on PULA development). However, in **Step 3** of the Herbicide Strategy and as described in **Section 3.3.1**, in some cases, when this strategy is applied to a FIFRA action, EPA expects to identify mitigations for listed species that would apply across the full spatial extent of a use pattern (*e.g.*, specific crops) within the contiguous U.S., specifying the mitigations on the general pesticide product label. In this case, EPA's assessment similarly does not show that growers/pesticide applicators should need to implement mitigations unless they are within 1,000 feet of habitat or a waterbody. To account for this and in light of the stakeholder comments, rather than describe habitats, EPA is relying on managed lands as described in **Section 3.2.1.4** above for spray drift. Many farms have highly managed lands in areas adjacent to a pesticide application and EPA does not expect these managed lands to contain sufficiently suitable species habitat that enough individuals would be exposed to rise to a potential population-level impact. This similarly extends to mitigation measure for drift or runoff/erosion or drift control, and CRP lands (See **Section 3.2.1.4**). Therefore, to the extent that managed areas represent the entirety of 1,000 feet downslope and immediately adjacent to a pesticide application (and they themselves not being treated with the pesticide), EPA did not identify a potential for population-level impacts. Therefore, EPA did not identify runoff/erosion mitigations. **Table 15** describes the managed areas that EPA has identified for purposes of runoff/erosion mitigation.

Table 15. Downslope managed areas within 1000 feet downslope of treated area where runoff/erosion mitigations were not identified.

a. Agricultural fields, including untreated portions of the treated field; b. Roads, paved or gravel surfaces, mowed grassy areas adjacent to field, and areas of bare ground from recent plowing or grading that are contiguous with the treated area; c. Buildings and their perimeters, silos, or other man-made structures with walls and/or roof; d. Areas maintained as a mitigation measure for runoff/erosion or spray drift control, such as vegetative filter strips (VFS), field borders, hedgerows, Conservation Reserve Program lands (CRP)[32], and other mitigation measures identified by EPA on the mitigation menu; e. Managed wetlands including constructed wetlands on the farm; and f. On-farm contained irrigation water resources that are not connected to adjacent water bodies, including on-farm irrigation canals and ditches, water conveyances, managed irrigation/runoff retention basins, and tailwater collection ponds.

3.2.2.5 Mitigation Measures that in and of Themselves Reduce Exposure Such That Potential Population-Level Impacts are Unlikely

In some instances, EPA may determine that growers and applicators would not need additional runoff/erosion mitigation measures because a particular measure in and of itself reduces exposure such that potential population-level impacts are unlikely. Each of these measures is described in more detail in the **Ecological Mitigation Support Document** and summarized below.

Systems with permanent berms are treated fields that are surrounded by an elevated border or perimeter (*e.g.,* berms) are in place at the time of application and carried through the cropping season. Under these conditions rainfall and irrigation water is expected to be kept on the treated field. Example cropping systems include cranberry bogs, rice paddies, and drainage ditch & berm systems.

For treated fields with irrigation tailwater return systems, all runoff water from rainfall or irrigation is collected and stored on site for later use. Thus, runoff and/or erosion offsite from the field is not expected. Tailwater return systems are frequently paired with furrow and border-strip irrigation systems in both row and field crop agriculture.

If the field has subsurface drainage installed and maintained (*e.g.*, tile drains), runoff from the field will be greatly reduced. To maintain protection of non-target taxa, the subsurface tile drains must release the effluent (water) into water-controlled drainage structures or a saturation buffer zone that do not release water into downstream off-farm aquatic areas. Runoff from the entire field would need to be controlled and directed into a pond/saturation zone.

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[32] Although some areas associated with mitigation or conservation measures (*e.g.,* Conservation Reserve Program (CRP), Agricultural Conservation Easement Program (ACEP) areas) may be attractive to species such as pollinators, these areas may be included in the identified buffer distance because EPA does not want to disincentivize growers from providing such habitats, which may have considerable benefits to species, their environment, and pesticide use reductions. Growers may need to ensure that pesticide use does not degrade the degradation of the CRP habitat.

3.2.2.6 Conservation Program, and Runoff/Erosion Specialist, and Mitigation Tracking

EPA's evaluation of available efficacy data for many of the runoff/erosion mitigation measures demonstrates that the efficacy of many mitigations is highly variable from one study to the next (and from site to the next). For example, for some measures, studies show that efficacy may range from 0% to 100%. For any given mitigation measure, a range of efficacy is expected depending on the specific implementation of the measure, the environmental conditions of the area, site and soil characteristics of the treated field, maintenance, upkeep of the mitigation measure, and the physical-chemical properties of the pesticide.

Often, grower/applicators work with a technical expert in runoff/erosion control or a conservation program with a goal of reducing runoff/erosion. Because these experts consider and make recommendations for the site-specific conditions, when a grower/applicator installs a runoff/erosion measure to the specifications from such an expert, EPA has higher confidence that mitigation measures identified and implemented at the field level would achieve the higher end of the available efficacy data. As such, EPA identified mitigation points available for grower/applicators that work with a qualifying technical expert **or** participate in a qualifying conservation program.

A grower/applicator may receive mitigation points working with a technical expert or participating in a conservation program, but not both. The grower/applicator would receive points for any of their fields that are included in the expert consultation or conservation program, which could be an entire farm or a fraction of it (*e.g.*, some fields, but not all within a farm). The grower/applicator would not get additional points for both working with an expert/specialist and for participating in a conservation program, since the expert/specialist is inherently part of the program. Additionally, these points are not applicable to each mitigation measure but rather would be in addition to the points a grower/applicator obtains from other mitigation menu items (*e.g.*, if the farm is located in an area of low pesticide runoff vulnerability) and for implementing mitigation measures. Each of these options and the associated mitigation points are described in more detail below.

3.2.2.6.1 Follow Recommendations from a Runoff/Erosion Specialist

Grower/applicators may work with a technical expert to develop mitigation plans that work for their field and that are efficacious in reducing runoff and/or erosion. As described above, when a grower/applicator is working with a technical expert who embodies the characteristics below, EPA expects that the mitigation measures would be selected and implemented considering site-specific conditions, including the soil type, field slope, hydrology, local climate, crop(s) grown, pest concerns, drainage systems, irrigation needs, and equipment availability. Specific cropping systems and regions have established norms and practices based on real-world experience that on-site professionals (*i.e*., technical experts) can account for in the planning process. In this case, EPA expects the efficacy of runoff/erosion mitigation measures would be on the higher end of the range of efficacy. To account for this, EPA identified **one runoff/erosion mitigation point** available to grower/applicators that work with a runoff/erosion technical expert that meets the characteristics described below. The point for working with the technical expert is in addition to the points for implementing mitigation measures identified in the strategy.

EPA has reviewed available information regarding characteristics that often apply to meet the description of a technical expert. At a minimum, there is usually an education (and a continuing education) and an experience component. Based on this review, EPA identified three benchmarks for technical experts, which include:

- Have technical training, education and/or experience in an agricultural discipline, water or soil conservation, or other relevant discipline that provides training and practice in the area of runoff or erosion mitigation technologies/measures; **And**
- Participate in continued education or training in the area of expertise which should include run off and erosion control; **And**
- Have experience advising on conservation measures designed to develop site specific runoff and erosion plans that include mitigation measures described in EPA's Mitigation Website.[33]

EPA has identified the following examples of technical experts: NRCS and similar state or regional level program staff, Certified Crop Advisor, Pesticide Control Advisor, Certified Professional Agronomist, National Alliance of Independent Crop Consultants (NAICC), EnviroCert International, Inc., Certified Professionals in Erosion and Sediment Control, Technical Service Providers, and extension agents. **EPA acknowledges that this list is not exhaustive, and the inclusion of an organization should not be construed as an endorsement of any particular group by EPA.**

3.2.2.6.2 Participate in a Conservation Program

Conservation programs provide technical expertise as described above, as well as additional support to grower/applicators. Based on EPA's review of available information on existing programs, this support may include oversight in the form of a review of design, installation, and upkeep/maintenance plan for the identified mitigations. In addition, the programs typically include documentation demonstrating the site-specific plan meets any program requirements.

While conservation programs are not solely designed to reduce offsite transport of pesticides, several of the same types of mitigations that reduce offsite transport of nutrients and/or soil erosion from an agricultural field also reduce offsite transport of pesticides. Evaluating a field for the purpose of reducing nutrients in runoff and/or soil erosion is likely to result in similar recommended mitigations as those included in the runoff mitigation menu.

However, with few exceptions, EPA is not aware of any conservation programs that are designed specifically to reduce offsite transport to an extent where population-level impacts to listed species are unlikely. Therefore, while existing conservation programs may recommend similar mitigation measures, these measures may or may not be enough to address potential impacts to listed species. In addition, data is not readily available on the extent to which grower/applicators that participate in these conservation programs (and participation is voluntary) implement all program recommendations. For

[33] EPA's mitigation menu is available at: https://www.epa.gov/pesticides/mitigation-menu and a description of the mitigations is available at https://www.epa.gov/pesticides/menu-measure-descriptions.

these reasons and given the goals of the strategies, EPA is not able to provide a full exemption for these programs at this time. Rather, EPA identified **two runoff/erosion mitigation points** available to grower/applicators that participate in a conservation program. The additional mitigation point for participation in a conservation program over consulting a technical expert is because programs include some additional minimum characteristics summarized below.

EPA has developed the following minimum characteristics for a conservation program to receive the two points. Only programs that include all of these characteristics are eligible for the points.

- The program provides advice from individuals who meet the same benchmarks provided above for technical experts; **And**
- The program provides site-specific guidance tailored to the grower/applicator's crop and/or location; **And**
- The program focuses on reducing or managing runoff and/or erosion (including for example, soil loss, soil conservation, water quality protection) from agricultural fields or other pesticide use sites; **And**
- The program provides documentation of program enrollment. EPA is **not** suggesting that this documentation be provided to EPA; **And**
- The program includes verification of implementation of the recommended measures or activities (measures were established and maintained). Verification can be done through the conservation program and provided to the program enrollee. Verification is **not** required to be submitted to EPA.

Note: EPA identified that mitigation points should be available for past participation in programs that meet the minimum characteristics, provided that measures are currently on the field, have been maintained over time, and are recertified by a runoff and erosion technical expert [federal, state, or local; *e.g.*, Certified Crop Advisor, Pesticide Control Advisor, Conservation Crop Protector, Certified Professional Agronomist, National Alliance of Independent Crop Consultants (NAICC), agronomists that are part of grower cooperatives].

3.2.2.6.3 Mitigation Tracking

All of the mitigation measures identified for the Herbicide Strategy and described in the Mitigation Support Document have been determined by EPA to provide some level of reduction of the potential for population-level impacts to listed species from pesticide exposure in runoff/erosion. Consistent with typical agricultural practices, EPA expects that mitigation tracking would be done on paper or on an electronic format. Tracking the mitigations a grower/applicator employs at the field and farm level could provide several benefits to the grower/applicator. Tracking of the employed mitigation measures could help a grower/applicator ensure that they are achieving the number of points to satisfy any labeling requirements that include mitigations to address population-level impacts. Additionally, tracking the mitigations employed could assist with future planning of farm needs, and is generally aligned with the concepts of agricultural best management practices (commonly known as BMPs). Where a grower/applicator has a well thought out plan for the growing season which includes the tracking of mitigation measures employed, EPA would have increased confidence that measures have been implemented and properly accounted for. Therefore, EPA is assigning **one point** for any grower/applicator who tracks their mitigations on paper or in electronic format in addition to any points for working with a specialist or participating in a conservation program. Working with a runoff/erosion specialist or participation in a program is not required to be eligible for this point, and therefore this point is available for any grower/applicator that tracks their mitigation measures.

3.3 Step 3. Identify Geographic Extent of Mitigation

For the Herbicide Strategy, EPA intends to apply mitigations, when appropriate, broadly across the full spatial extent of a use pattern (*e.g.,* specific crops) within the contiguous U.S., specifying the mitigations on the general pesticide product label. Through FIFRA actions, where EPA identifies mitigations that would apply in geographically specific areas only (referred to as Pesticide Use Limitation Areas or PULAs). Depending on the herbicide, EPA may use both or one or the other option or a combination of both. As discussed below, where mitigations are identified for listed generalists, these measures would be included on the general label, and labeling statement directing a user to BLT when additional mitigations are identified for listed plants.

EPA expects that applicants/registrants include mitigations on their proposed general pesticide product label where mitigations broadly apply (*e.g.,* cover large geographic areas, for generalists) instead of to certain geographic areas (*e.g.,* PULAs).

Where EPA identifies mitigations specific to certain geographic areas, it generally uses Geographic Information System (GIS) mapping information to identify where a pesticide limitation applies to a listed species or group of species. Such areas, along with a description of the use directions applicable to that area for a pesticide, are called PULAs. PULAs focus on areas where pesticide exposures are likely to impact the continued existence of a listed species, which may include a reduction in survival or recovery of the species. Thus, the purpose of a PULA is to identify geographic areas where pesticide mitigations apply to conserve a

Key Definitions for Step 3 of the Herbicide Strategy Framework

Bulletins Live! Two (BLT): BLT is the web-based application to access Endangered Species Protection Bulletins (Bulletins). EPA uses BLT to communicate where additional pesticide use directions may be needed to protect listed species in geographically specific areas.
Pesticide Use Limitation Areas (PULAs): A PULA is the specific geographic area associated with particular pesticide mitigations for a listed species, groups of listed species, or designated critical habitat. PULAs are used in BLT to provide pesticide applicators with specific locations where use restrictions may apply to their intended pesticide application to protect listed species or their designated critical habitat.
Endangered Species Protection Bulletins: A bulletin is the printed copy from the BLT application that provides the geographically specific mitigations for the pesticide application. The general pesticide product labeling directs applicators to the BLT system. Bulletins typically include both the PULA and the mitigations that apply within that PULA. Once PULAs are developed, each PULA # that applies for a pesticide product would be on the general pesticide product label and the BLT system will be used to help the applicator identify which PULA # applies to their location. When directed by the label to Bulletins these become enforceable pesticide use limitations to protect listed species or designated critical habitat.

listed species and designated critical habitat. EPA develops PULAs so applicators can determine if their intended pesticide application falls within a location where additional use restrictions apply to protect listed species or critical habitat. These geographic-specific restrictions are published in Bulletins that are accessed through the BLT website. In other words, where the pesticide product labeling directs an applicator to BLT, the information in BLT informs the applicator where and/or what additional restrictions or mitigations must be followed to protect listed species for a particular location. To date, EPA has typically used this system to mitigate for specific pesticide products and individual species. Pesticide product labels direct applicators to BLT and follow any applicable Bulletins. The BLT system allows EPA to reduce complexity on pesticide product labels and limit geographically specific listed species protections to only where they would apply. Bulletins typically include: 1) the geographic extent (PULA) of the area where the same set of mitigations apply, and 2) a description of additional mitigations that apply within the PULA (referred to as "pesticide use limitations"). In the Herbicide Strategy, when the mitigation measures apply only to a limited geographic area, EPA would publish a specific PULA representing the area that would have additional use restrictions in BLT.

There are approximately 1030 listed species under FWS authority located within the contiguous U.S. Of those species, EPA has identified approximately 550 listed species that are listed generalists for the Herbicide Strategy (examples in **Figure 5**). These species range across the majority of the contiguous U.S. (**Figure 10**), therefore, as explained above, when EPA determines a potential for community-level impacts for a listed generalist species (or groups of listed generalist species), mitigations for listed generalists would apply across the full spatial extent of a use pattern within the contiguous U.S. In addition, as described in **Section 3.3.2**, EPA identified approximately 230 listed plants and listed animals that are obligate to a plant that may have a potential for population-level impacts from direct exposures to off-site transport of spray drift or runoff/erosion. The following sections describe how the general pesticide product label and PULAs (using BLT) may both be used to identify mitigations associated with this strategy. The following sections describe how the general pesticide product label and PULAs (using BLT) may both be used to identify mitigations associated with this strategy. This geographic framework is relevant to both runoff/erosion mitigation measures and spray drift mitigation measures.

3.3.1 Mitigations to Apply Broadly

When EPA identifies mitigation that would cover an entire use area in the contiguous U.S., such restrictions would likely appear on the general pesticide product label. When EPA identifies mitigation that would cover an entire use area in the contiguous U.S., such restrictions would likely appear on the general pesticide product label. In general, EPA expects mitigations would apply broadly when there is potential for population-level impacts to entire plant communities (*e.g.,* multiple species with impacts) that would lead to impacts to listed generalists (listed species that depend on plant communities). EPA expects to identify less mitigation for such generalists compared to listed plant species that are directly affected by herbicides or obligate listed species that depend on a single (or very few) plant species. This is because a population-level impact to generalists is expected to occur only when more than just a very few species of plants within a community are impacted whereas a population-level impact to a listed plant or obligate is expected to occur when just a single, or very few, species are impacted. **Figure 10** below shows the distribution (based on range data from FWS) within the contiguous U.S. of the ~550 listed animal generalists that depend on plants for diet or habitat. This does not mean that EPA has determined that a particular herbicide would have a potential for population-level impacts to these species as that determination is chemical-specific as described in **Step 1** of the Herbicide Strategy and could result in a determination that the potential for population-level impacts for some or all of these species is unlikely. Rather, it means that these ~550 listed generalist species represent the maximum number of generalists species where EPA may find a potential for population-level impacts for a particular herbicide and to demonstrate the geographic extend of generalists and why it may be appropriate to include such mitigations on the general product label.

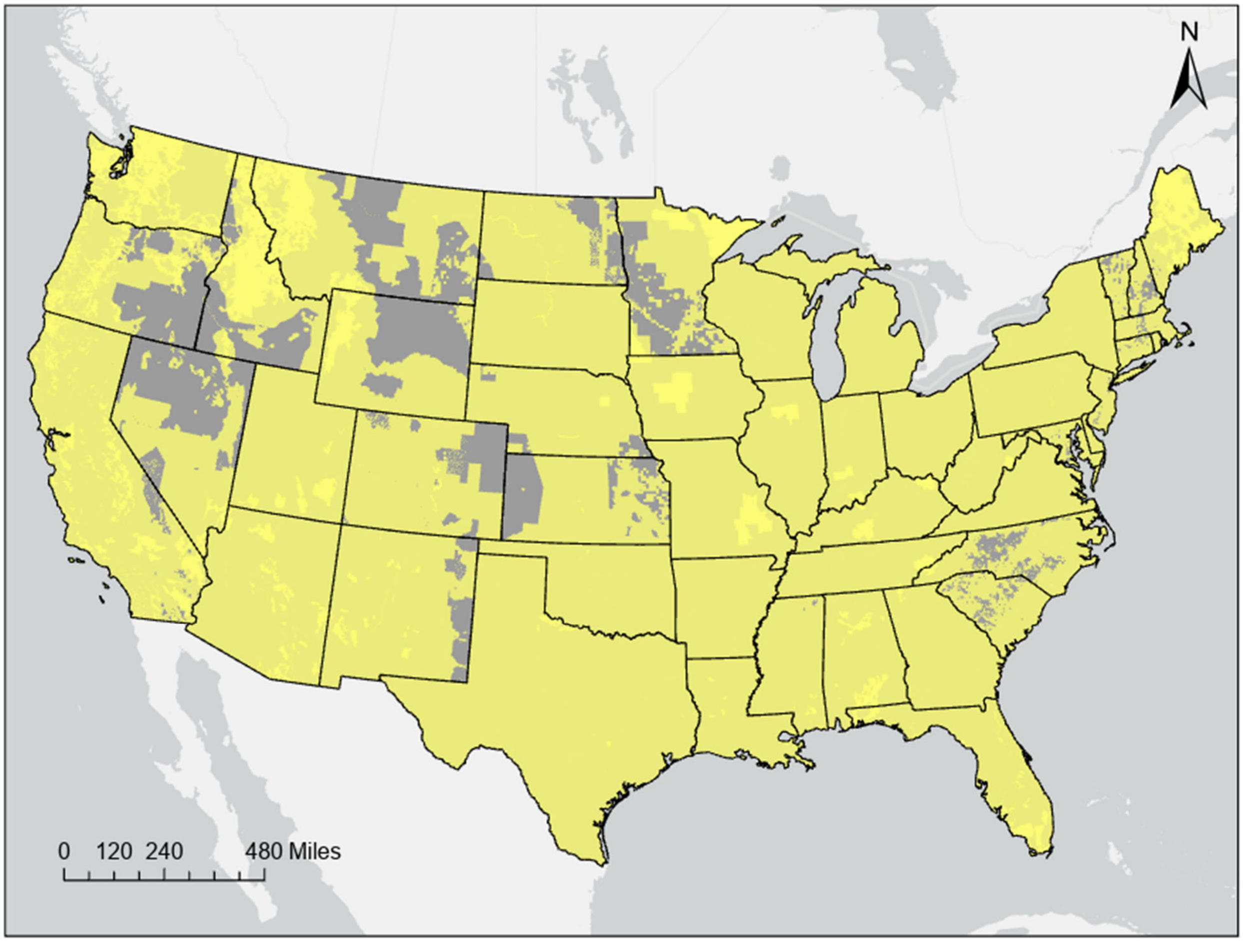

Figure 10. Yellow areas represent the distributions within the contiguous U.S. of listed animal generalists that depend on listed plants for diet or habitat. This map includes the ranges and critical habitats of approximately 550 listed animal species (generalists) under the jurisdiction of FWS.

3.3.2 Mitigations That Apply In Geographically Limited Areas (identified using BLT)

3.3.2.1 Listed Plants and Obligate Animals

There are currently 450 listed (endangered, threatened and proposed) plant species under FWS authority within the contiguous U.S. Most of these species are flowering plants that are dicots (*e.g.*, sunflowers) or monocots (*e.g.*, orchids), with some non-flowering plants (*e.g.*, ferns). There are also approximately 30 listed animal species that are obligate to plants (most of which are listed butterflies).

EPA predicts that herbicides are likely to cause population-level impacts from direct exposures for some of these species, but not all. This depends on numerous factors including species characteristics, pesticide properties, and use patterns. In this strategy, EPA's evaluation of the potential for population-level impacts for these listed species is based on similar analyses that EPA and FWS have conducted (*e.g.,* EPA Biological Evaluation and FWS Biological Opinion for Enlist, USEPA 2022c and USFWS 2023c, respectively). To evaluate if a listed species might rise to the level of population-level impacts from agricultural uses of herbicides, EPA first conducted an analysis by considering the degree of overlap of a species range with cultivated land (areas reported by USDA where crops are grown; 1000 ft buffer added to account for spray drift and runoff/erosion transport). If that overlap for a species was less than 5% after taking into account available usage data from Census of Agriculture and California Department of Pesticide Regulation, EPA did not consider that species to have a potential for population-level impacts. For those species with a 5% or higher overlap, EPA also considered whether there were species-specific factors that would limit exposure such that there would not be a population-level concern.[34,35] EPA similarly applied this approach to listed animals with obligate relationships to plants. EPA identified 227 species of listed plants or obligate species that may have a potential for population-level impacts, meaning EPA would likely identify mitigations to address those impacts (**Table 16**). This does not mean that EPA has determined that a particular chemical would have a potential for population-level impacts to these species. Rather, it means that these 227 listed species (of plants and obligate animals) represent the maximum number of species where EPA may find a potential for population-level impacts and therefore, identify mitigations[36]. EPA expects the list of species included in the Herbicide Strategy PULAs to evolve over time. EPA anticipates updating this list of species through lessons learned during consultations with FWS, as new information becomes available for species, and as the listing status of species change. EPA also anticipates updating overlap analyses and revisiting species over time as data sets that describe where commodities are produced, pesticide usage, and where listed species are located evolve.

The current ranges and critical habitats of these 227 listed plants and obligate animals are presented in **Figure 11.** This figure shows that the spatial extent of these species is much smaller than the spatial extent of the generalist species, so where EPA finds a potential for population-level impacts for these species, mitigations to address these impacts would be in limited geographic areas and communicate the locations where mitigations would apply in BLT. In this case, the pesticide product label would direct applicators to the BLT system. **Appendix A** includes more detail on how EPA evaluated the 450 listed plant species and any obligate species to identify the 227 species that could have a potential for population-level impacts. EPA notes that **Figure 11** represents the maximum spatial extent because it is currently developing a process to refine PULAs and EPA expects the result will be that many PULAs will be smaller than the species ranges. See **Section 3.3.3** for more information.

[34] EPA used spatial data representing the listed species range and designated critical habitat locations provided by the FWS as of December 1, 2023 (USFWS, 2022).

[35] This is referred to as "modifiers" because we considered factors relevant to species life history and habitats that could modify the standard exposure assumptions such that exposure would be limited.

[36] For these ~290 species, EPA might identify additional mitigations that would be incorporated into the general label throughout the contiguous US (to address effects to ~550 generalists).

Table 16. Summary of number of species of listed plants where mitigations may involve bulletins on Bulletins Live! Two. Also included are listed animals that are obligate to plant species for diet and habitat.

Taxon	Number of Species
Dicots	178
Monocots	32
Non-flowering plants	3
Insects (obligates; primarily butterflies)	10
Birds (obligates)	3
Mammals (obligates)	1
Total	**227**

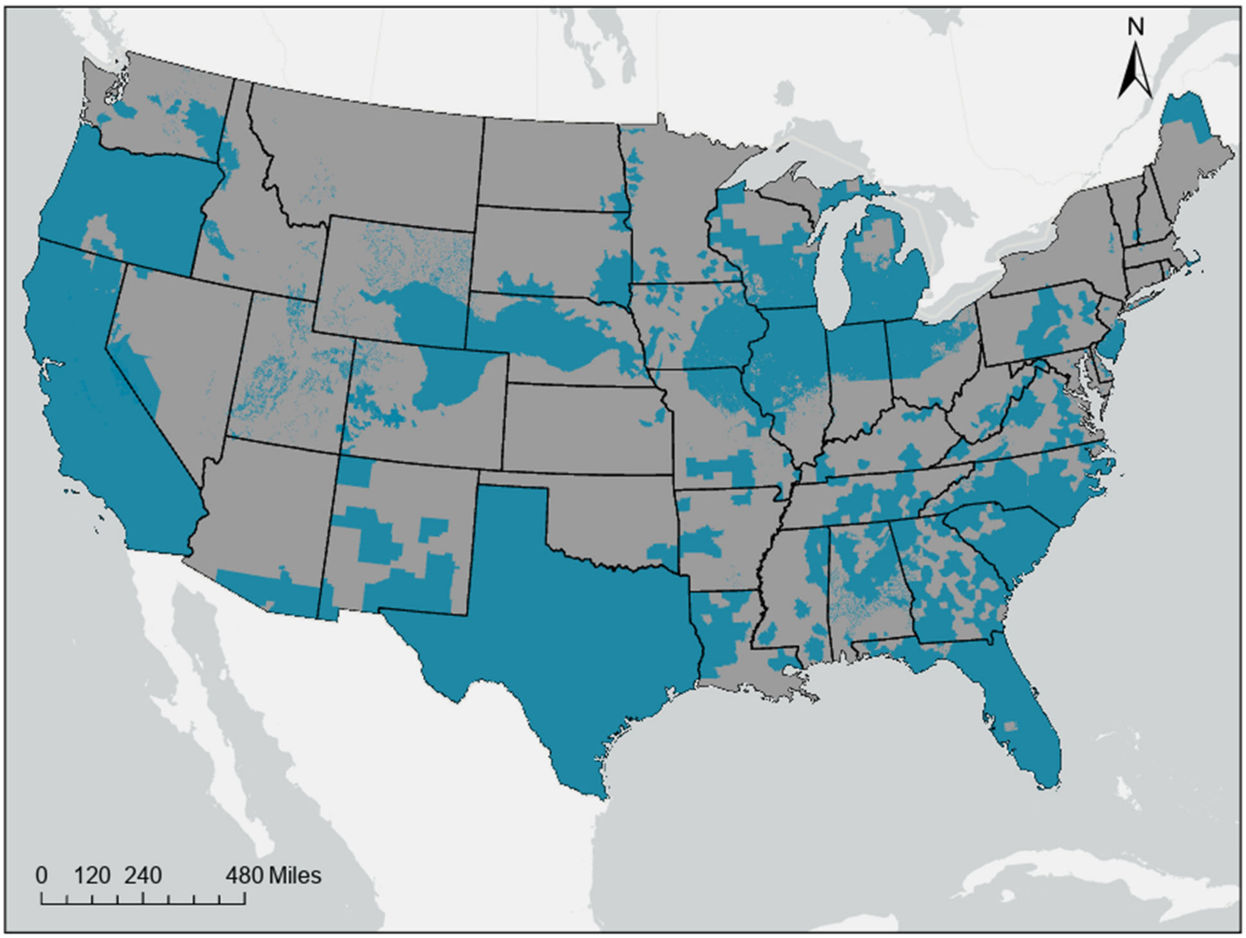

Figure 11. Blue areas represent geographic extent of species range and designated critical habitats for 227 listed plant species and animal species with obligate relationships with plants in the Herbicide Strategy.

3.3.2.2 PULAs Representing Groups of Species with Similar Mitigations

Many of the 227 listed species described above will likely share the same level of mitigation for a particular herbicide. This is because they share similar modeled habitats and/or population-level endpoints based on the assessment of sensitivity differences among species groupings. While the mitigations identified may vary across herbicides, EPA anticipates the level of mitigation for a particular pesticide would be the same. Therefore, EPA plans to group these species into common PULAs. Where multiple species share the same levels of mitigations, EPA is expecting to group the areas important for the conservation of each of those species into one aggregated PULA. EPA has identified 8 possible groups where listed species would generally have the same mitigations due to similarity of habitat and taxonomy. To differentiate impacts to different types of listed plants (*i.e.*, monocots, dicots, and woody plants), EPA needs sufficient toxicity data, which depends on a chemical by chemical (or chemical class) basis. Where possible, EPA grouped species that allow for the appropriate level of mitigation when identified including areas where less mitigation may be appropriate as EPA's standard modeling is expected to overestimate population-level impacts due to factors such as unlikely runoff and erosion exposure or flowing wetlands greater dilution potential. These groupings are based on the concepts incorporated in **Step 1** where EPA identifies the potential for population-level impacts based on different considerations of exposure, species habitat, taxonomy and characterization of the expected differences in EPA's exposure models and exposures in species habitats. **Table 17** summarizes the 8 groups. Specific species that fall into each group are included in **Appendix A**.

Over time, the list of species may change (as the listing status of species change) or as available information and categories for a species changes (*e.g.,* through consultation, through PULA development). Therefore, EPA expects to revisit the species included in the grouped PULAs and update them as needed. EPA may also change the groupings based after it gains experience in implementing ESA strategies. EPA is currently developing a process on how best to communicate the groupings and associated mitigations on pesticide product labels, BLT, and other possible platforms (such as EPA's website).

Table 17. Summary of eight herbicide species groups for Herbicide Strategy PULAs.

HS Group (PULA) #	# of Species Currently Included in Group	Habitat Description	Taxon	Toxicity Surrogate Used to Derive Buffer	EPA Standard Habitat Used to Calculate EECs	MoD Level Where There is Potential for Population-Level Impacts	Types of Mitigations[1]
1	32	Terrestrial	All taxa[2]	HC_{05}	Near field	≥1	Spray drift
2	108		Dicots + non-flowering plants	Dicots or HC_{05}	Near field, Terrestrial (TPEZ)	≥1	Spray drift and runoff/erosion
3	12		Monocots + non-flowering plants	Monocots or HC_{05}			
4	20		Woody plants	Dicots, monocots, HC_{05} or woody plant			
5	40	Wetlands	Dicots[3]	Dicots or HC_{05}	Near field, Wetland (WPEZ)	≥1	Spray drift and runoff/erosion
6	24		Monocots	Monocots or HC_{05}			
7	21	Flowing wetlands and riparian areas	Dicots[3] + non-flowering plants	Dicots or HC_{05}	Near field, Wetland (WPEZ)	≥10 (wetland)	Spray drift and runoff/erosion[4]
8	10		Monocots + non-flowering plants	Monocots or HC_{05}			

[1] For this type of mitigations, applicators would use BLT to identify the mitigations needed (in place of the mitigations on the general label).
[2]The majority of these species are dicots. For simplicity, all taxa are included in one group.
[3]Herbaceous and woody plants are lumped into this group due to a low number of woody plant species.
[4]EPA anticipates that 2-3 fewer runoff erosion points will be needed for these PULAs compared to the wetland PULAs (5 and 6) because the MoD representing potential population level impacts is an order of magnitude higher.

3.3.3 Plan for Developing PULAs for the Herbicide Strategy

As EPA noted in its update on the Herbicide Strategy[37], EPA is developing an approach to refine maps that EPA plans to use for PULAs. EPA received comments on the draft Vulnerable Species Pilot[38] and the draft Herbicide Strategy that asked EPA to reconsider the maps that EPA plans to use when identifying geographically specific locations for mitigations to address population-level impacts to a given listed species. Commenters stated that using entire species ranges as the basis for a PULA overburdens pesticide applicators unnecessarily because this captures many areas that are not needed to protect listed species at a population-level. Commenters requested that EPA refine PULAs that are overly broad, such that they minimize impacts on agriculture. In response, EPA is developing an approach to refine maps to develop PULAs so that when the Agency applies the strategy to a FIFRA action, those areas where mitigations would apply are to conserve a listed species and its critical habitat (if designated) and reduce the potential for including extraneous areas. This approach is being developed with input from FWS, USDA and other technical experts. EPA expects that for many species, the refined PULAs would represent parts of the range, not the entire range. Therefore, refining the PULAs would provide more realistic locations and lessen their impact for growers/applicators. This approach focuses on identifying those areas most critical to conserve a listed species and then adding buffers (1000 feet or less) to account for potential offsite transport from a treated field). Most of these species are not expected to occur on agricultural fields, so, EPA would identify mitigations only for those parts of fields located within the extent of the buffered PULA.

Through this developing approach, PULAs would be created for the species relevant to the Herbicide Strategy EPA would then create grouped PULAs by combining the species specific PULAs where the same mitigations have been identified (groups described above, species in each group provided in **Appendix A**). EPA expects this approach would be used by other strategies (*e.g.,* insecticide strategy) and the Vulnerable Species Pilot.

As EPA further works on its strategies, the Agency expects hundreds of PULAs would need to be developed. EPA is currently prioritizing PULA development that relate to the Vulnerable Species Pilot and Herbicide Strategy. EPA has identified approximately 230 species needing PULAs for the Herbicide Strategy. EPA is prioritizing PULA development for the Herbicide Strategy species with ranges that fall within the high runoff zones, that have high overlap with specialty crops and that have >1-million-acre ranges. EPA has chosen to prioritize these species because refinement of the spatial footprint captured by the PULAs is expected to reduce the impact of these PULAs on growers/applicators and focus mitigations where they are needed for these species. If needed, EPA may revise the specific species included in the Herbicide Strategy or the groupings based on lessons learned from development of the species-specific PULAs. EPA will provide updates on its progress in the development of all PULAs across the different strategies on its website.

[37] https://www.epa.gov/system/files/documents/2024-04/hs-public-update-4-16-24.pdf

[38] Additional information on the vulnerable species pilot is available at: https://www.epa.gov/endangered-species/implementing-epas-workplan-protect-endangered-and-threatened-species-pesticides

4. Plan for Implementing the Final Herbicide Strategy

The strategy itself is not self-implementing. Rather, EPA will consider the applicability of this strategy to inform conventional active ingredient registration and registration review actions. This section describes EPA's plan for implementing the final Herbicide Strategy through these actions.

As EPA considers applications for new conventional active ingredients and works on conventional registration review actions, the Agency will continue its current practice of providing opportunities for public input on proposed decisions, including mitigation that may come from this strategy. EPA expects to consider the appropriateness of applying the Herbicide Strategy for other actions on already registered active ingredients (*e.g.,* new uses).

EPA may propose label language as part of a FIFRA action that directs a user to access the BLT website for geographically specific mitigations through Bulletins. The Agency may also propose label language that requires mitigation measures irrespective of where the pesticide is applied. The label language proposed in either of these scenarios may require a specific level of mitigation and direct the user to the Mitigation Measure Menu Website. EPA may propose one or more of these for FIFRA actions.

Through the FIFRA registration or registration review action, EPA will decide what type(s) of mitigation language is needed. Pesticide product labeling would direct the user to EPA's mitigation menu website[39], which will describe the runoff/erosion mitigation measures from which the user can select to achieve the necessary level of mitigation specified on the label. EPA is not including a mitigation menu on the label itself because the Agency plans to update the menu with additional measures systematically, on a defined timeline as data to support additional measures is reviewed. Only by posting the menu online can EPA easily update the menu. The current mitigation menu website only reflects ecological mitigation for FIFRA IEM. EPA plans to revise the website to reflect how it could be used with this final strategy. EPA also plans to provide educational outreach and support to stakeholders as EPA begins implementing this strategy through FIFRA actions.

EPA also plans to continue its discussions with FWS to streamline ESA consultations. The development of this strategy and the future issuance of other strategies is expected to inform these processes. Finally, this section describes how this strategy interplays with FIFRA IEMs and other strategies and efforts (*e.g.*, the Insecticide Strategy, the Vulnerable Species Pilot, offsets).

4.1 Registration Review and Registration Decisions

The conventional pesticide registration review workload includes hundreds of pesticide active ingredients, which represent thousands of individual products. EPA is regularly updating its registration review schedule, which takes into consideration the expected timing of the issuance of the final herbicide, insecticide, and rodenticide strategies. However, there may be instances where the timing of herbicide reviews does not coincide with the timing of the final Herbicide Strategy due to other risk mitigation priorities (*e.g.*, human health protection), existing consultation schedules, litigation, and/or Agency resource constraints. Overall, however, the Agency's efforts to align its registration review

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[39] The website is available at https://www.epa.gov/pesticides/mitigation-menu. Currently the website provides information relevant to FIFRA IEM and has not yet incorporated information for any strategies.

schedule with the timing of the final strategy should improve efficiency and consistency in the consideration and application of early mitigations for the protection of listed species in EPA's registration review work.

As part of the registration review process, EPA issues a Proposed Interim Registration Review Decision (PID) or Proposed Final Registration Review Decision (PFD) with proposed mitigation measures before issuing an Interim Registration Review Decision (ID) or Final Registration Review Decision (FD). Stakeholders can comment on proposed decisions that would include proposed mitigation measures, including those that will be informed by the final Herbicide Strategy. After comments received on the PID or PFD are considered, EPA would determine whether any changes are needed to what was proposed before issuing any ID or FD.

As indicated in its April 2022 Workplan, EPA is prioritizing making effects determinations, and consulting as appropriate, for new conventional active ingredient actions. Typically, as part of the process for reviewing a new active ingredient, EPA takes comment on a proposed decision. The proposed decision would include a discussion of mitigation determined to be necessary, including measures to protect listed species. EPA would then consider comments received before making the final registration decision. In addition, EPA determine that applying the strategy is appropriate in other registration actions (*e.g.* new uses).

When EPA identifies mitigation to address population-level impacts using this strategy, a proposed decision associated with that action would include information on the mitigation. EPA may propose spray drift restrictions on use, such as spray drift buffers based on the application method, as well as runoff/erosion mitigation. As described in **Section 3.3**, in some cases, EPA expects to propose that the mitigations would apply across the full spatial extent of a use pattern (*e.g.*, specific crops) within the contiguous U.S., specifying the mitigation requirements on the general pesticide product label. In other cases, EPA plans to propose mitigations in geographically specific areas only.

When EPA identifies the need for runoff/erosion mitigation for a particular conventional herbicide new active ingredient registration or registration review action, the proposed decision would discuss product label statements related to these mitigations. The statements may include directions for use that require mitigation measures to achieve the minimum number of mitigation points for that pesticide. There could also be a statement on the pesticide product labeling directing the user to the mitigation menu website and/or BLT. EPA may also propose that the labeling include specific mitigation measures to be followed such as application restrictions within certain distances around water bodies or holding times for treated fields that use flood-irrigation systems. The mitigation points on product labeling would be specific to the approved agricultural uses for that product.

If a label requires a minimum number of mitigation points to be achieved, it will direct users to access EPA's mitigation menu website for detailed information on what mitigation measures a pesticide user could choose from (and the points associated with each measure) to meet the minimum points. The mitigation menu website is also expected to contain options that provide mitigation relief and their corresponding points. Currently, the website has a helpful section describing many of the mitigation measures being considered in this strategy.[40] The current version of the mitigation menu website does not have the associated points for each mitigation measure (EPA plans to upload this information in the Fall 2024). Therefore, please refer to **Table 13** and **Section 3.2** in this document for that information.

[40] Available at this pinpoint site https://www.epa.gov/pesticides/mitigation-menu#measures

For example, a pesticide product label could include a requirement that three runoff/erosion mitigation points must be achieved prior to an application to an agricultural crop (*e.g.*, corn) across the lower 48 states, but could also direct the user to BLT where a Bulletin requires six points to be achieved prior to applications to fields located in a PULA. This same label could state a different number of points to be achieved for a different crop (*e.g.*, soybean). For more detailed examples, see "Application of EPA's Runoff and Erosion and Spray Drift Mitigations Through Scenarios that Represent Crop Production Systems in Support of Endangered Species Strategies," located in the Herbicide Strategy Docket on www.regulations.gov for more detailed examples.

When a pesticide product label directs a user to the mitigation menu website for measures to meet the associated points on the label, the measure would need to be employed consistent with the description on the website. EPA has been working with USDA on the descriptions of the mitigation measures. In the fall of 2024, EPA will provide information on the Agency's descriptions and the cross-references to NRCS conservation practices. Providing a mitigation measure menu on a website allows EPA to update and expand the menu as the Agency receives more information on the efficacy of additional potential mitigation measures and to incorporate emerging and future technologies. EPA can therefore provide up-to-date available mitigations in a timely manner, providing for more flexibility for applicators and growers. As a result, applicators and growers would likely have multiple options when deciding what mitigation measures to apply to achieve the total number of points required by a product's labeling. It is essential that EPA communicates with applicators, farm managers, and landowners in the agricultural community. Likewise, communication among applicators, farm managers, and landowners on necessary mitigation measures is essential when planning an application.

EPA understands that many pesticide applicators use multiple pesticides on the same field at the same time. In this case, if a pesticide user applies more than one pesticide at the same time to a field, then the user would need to comply with the most restrictive set of mitigations among the pesticides that they plan to apply. This principle applies to listed species mitigation and all other use restrictions on the label, as these other use restrictions may be associated with ecological and/or human health risks identified by the Agency.

EPA understands that the spray drift and runoff/erosion mitigation can be complicated. While complex, providing a mitigation menu allows for much greater flexibility to growers to meet the mitigation needs for individual pesticides. EPA's aforementioned "Application of EPA's Runoff and Erosion and Spray Drift Mitigations Through Scenarios that Represent Crop Production Systems in Support of Endangered Species Strategies" details multiple real-world examples of how a pesticide user would comply with pesticide product labeling requirements. To help growers/applicators consider their options, EPA is also developing a calculator that growers and applicators could use to help determine what mitigation relief measures apply to them and their associated points for runoff/erosion, number of points associated with mitigations they may already have in place, and what further actions they may need to take to meet the total required points. EPA plans to develop other resources that could further help applicators, farm managers, and landowners work through the label complexity.

4.2 Education and Outreach

EPA acknowledges the critical need for additional education and outreach as this and other strategies are finalized and implemented in pesticide decisions. This section describes EPA's education and outreach efforts over the past two years and describes EPA's next steps.

Various educational webinars were held in 2022 and 2023 that pertain to early listed species mitigation efforts under FIFRA and help users navigate Bulletins Live! Two. In November 2022, EPA organized a webinar to present the Workplan Update. The webinar covered the FIFRA Interim Ecological Mitigation measures, draft section 3 label language that directs users to the BLT system for implementing geographically specific mitigation measures, and current and future initiatives to prioritize mitigation for listed species. The Workplan Update webinar can be accessed online at: https://www.youtube.com/watch?v=ENMUQdPdvyY.

In July 2023, EPA and USDA OPMP held a webinar to introduce the Draft VSP. The webinar covered the pilot species, the draft mitigation measures, the draft implementation plan, and a StoryMap demonstration (where a vulnerable species range is overlapped with crop data and draft pesticide use limitation areas). The VSP webinar recording can be accessed online at: https://www.youtube.com/watch?v=H8FmuN7AEY4.

In August 2023, another similar webinar was held by EPA and USDA OPMP to introduce the draft Herbicide Strategy. The webinar covered the draft Herbicide Strategy, including draft mitigation measures, implementation plan, example crop scenarios, and topics for public comment. The draft Herbicide Strategy webinar recording can be accessed online at: https://www.youtube.com/watch?v=vmm_oTmxdLU.

In November 2023, EPA organized a webinar to provide an overview of the BLT system. The November 2023 webinar described how Bulletins relate to the general label, explained how to use BLT, demonstrated how to look for geographically specific mitigation, and addressed frequently asked questions. Materials from the November 2023 webinar can be accessed online at: https://www.epa.gov/endangered-species/materials-november-2023-bulletins-live-two-webinar.

In 2023 and 2024, EPA also met with affected stakeholders, including various crop/commodity groups, to understand the grower perspective and potential land/crop management challenges associated with implementation of the strategy.

In spring 2024, EPA and USDA hosted a workshop on ecological risk mitigation. EPA also hosted stakeholder workshops to discuss PULA refinements and offsets.

On June 18, 2024, EPA held another public webinar to introduce the first version of the mitigation menu website (currently being used for FIFRA IEM) and seek stakeholder feedback.[41,42]

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[41] June 18th, 2024 public webinar recording, transcript, and slides on the mitigation menu webpage: https://www.epa.gov/pesticides/mitigation-menu.

[42] June 18th, 2024 public webinar YouTube recording link: https://www.youtube.com/watch?v=kVkjWlX03go

Additional educational webinars are being considered as other strategies are finalized and as the strategies are implemented in pesticide decisions.

EPA continues to work with external stakeholders, such as the states through the State FIFRA Issues Research and Evaluation Group (SFIREG) and the Association of American Pesticide Control Officials (AAPCO), to discuss the enforcement perspective and potential implementation challenges.

EPA plans to compile existing and develop new communication and education materials. These materials are intended to support awareness of new label requirements resulting from implementation of the Herbicide Strategy and of the new types of mitigations included in the strategies and efforts. Because pesticide users may have been using these products for several years or decades, awareness of any changes in how these pesticides may be used is key to their ability to comply.

EPA has developed and is planning to create various educational materials, including handouts, presentations, webpages, and informational webinars. EPA also recognizes that the main sources of information for many growers/applicators are the states, crop consultants, extension agents, and pesticide distributors and that it needs to partner with them to improve grower/pesticide user awareness. EPA believes that providing the appropriate support materials to the professionals that advise pesticide applicators will help improve compliance with label restrictions, including bulletins, and thus help decrease pesticide exposures to listed species. EPA is planning to create a webpage that will serve as a repository of education materials.

4.3 Consultation with FWS

One of the goals of the Herbicide Strategy is to help increase the efficiency of the pesticide section 7(a)(2) consultation process. In coordination with FWS, EPA plans to use this, other strategies and other activities, as outlined in the Workplan (and Update), to develop a conservation plan consistent with Section 7(a)(1) of the ESA for furthering the recovery of listed species. This will be accomplished, in part, by working with FWS to proactively protect listed species from pesticides, resulting in a streamlined section 7(a)(2) consultation process on individual pesticide actions.

EPA expects that its work with the Services will result in a more efficient tiered approach that includes both ESA section 7(a)(1) (proactive conservation for many species and groups of pesticides) and ESA section 7(a)(2) consultations that could include mitigation for specific species that are informed by the strategies. EPA has been working with FWS on broad landscape scale approaches to reduce pesticide exposure in ways that can further benefit the recovery of many species and designated critical habitat within the U.S. Identification and implementation of these approaches earlier in the FIFRA and ESA process could serve as a filter where impacts to many species can be reduced, leaving a limited number of remaining impacts to focus upon in a streamlined section 7(a)(2) consultation. This approach would also be a more effective and efficient use of agency resources to maximize protections of listed species in a timely manner. **Figure 12** depicts how EPA envisions incorporating the strategies into registration review decisions and how this could help streamline section 7(a)(2) consultations because mitigations could be incorporated into the action prior to initiating or completing any necessary consultation. Throughout this process, there are multiple opportunities for input from the public during comment periods. This will allow EPA and FWS to consider important feedback from stakeholders on assessments and mitigations.

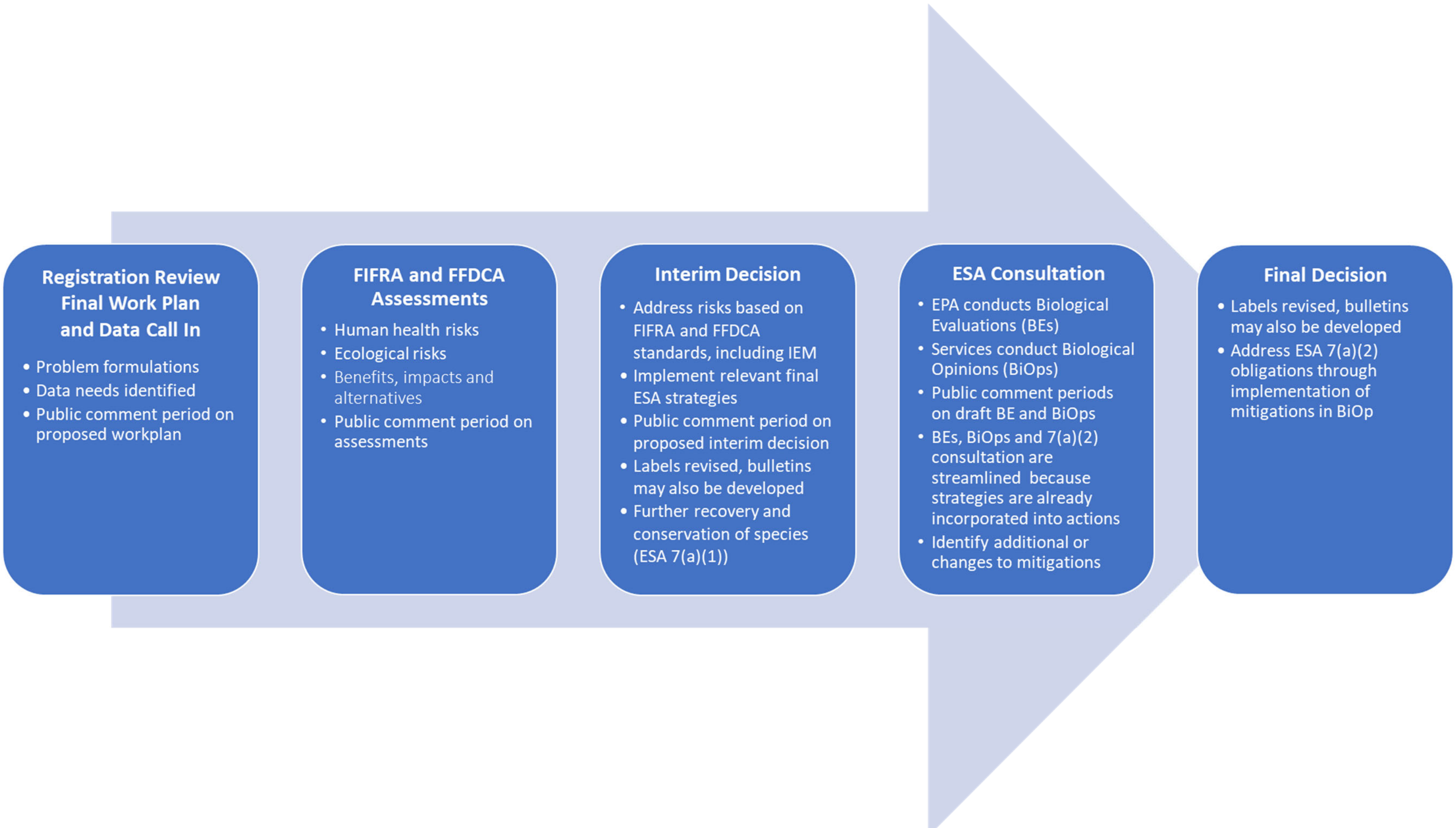

Figure 12. Tiered approach where mitigation strategies are incorporated into registration review of specific pesticides (individual or groups). The application of pesticide exposure reduction strategies early in the process allows EPA to further the recovery and conservation of species.

4.4 Interaction between FIFRA Interim Ecological Measures and the Herbicide Strategy

EPA released in its Workplan Update the FIFRA Interim Ecological Mitigation (IEM) that may be identified as necessary in registration review decisions and registration actions. The FIFRA IEM was released for public comment from November 16, 2022 to February 14, 2023. EPA received comments from over 100 individual stakeholders and stakeholder groups as well as two mass mail campaigns for a total of over 7,700 public comment submissions. EPA subsequently reviewed the comments received and updated the FIFRA IEM measures. EPA considered the need to be consistent across the FIFRA IEM and strategy mitigations to the extent appropriate. To that end, EPA is using the same runoff/erosion "mitigation menu" for FIFRA IEM and the strategy and is considering how the "mitigation menu" approach could work for other types of mitigation across strategies in the future (*e.g.*, insecticide strategy).

There are differences between the FIFRA IEM measures and the strategy mitigations related to the factors considered in determining the type, level, and extent of mitigations. For example, when considering whether mitigations are identified for conventional agricultural uses on herbicides, EPA expects that the level of mitigation in the strategy would supersede the FIFRA IEM for those uses. Refining the example further, both the strategy and FIFRA IEM include mitigations for spray drift and runoff/erosion exposure. For most herbicides, EPA expects to apply any spray drift, runoff/erosion requirements, based on the strategy, instead of the FIFRA IEM, because the mitigations for the strategy, which focus on addressing the potential for population-level impacts to listed species, would be at least as stringent as the IEM. It is possible that some aspects of FIFRA IEM may be appropriate for herbicides (*e.g.,* mitigation that reduces wildlife exposures when planting pesticide-treated seed), even if the spray drift or runoff/erosion requirements are superseded by the strategy. Also, a given pesticide may have unique properties or exposure pathways that EPA evaluates that may result in different types of FIFRA or ESA mitigations. EPA plans to make clear in its regulatory decision documents, which mitigations EPA considered appropriate for the herbicide and why, given the context of different yet overlapping efforts of FIFRA IEM and the strategies. Ultimately, applicators will only need to follow the label directions, as the process for developing label mitigation requirements will generally not be apparent on the label.

Lastly, EPA is in the process of developing the Insecticide Strategy, for which a draft was released for public comment in July 2024. This strategy does which does not impact herbicides directly, but may impact pesticide applications in general, particularly when multiple pesticides are used in the field. As already the case, when multiple pesticide products are used, users will need to check requirements across all products being used and comply with the most restrictive measures.

4.5 Consideration of Other Strategies

This strategy is one of several that EPA is developing to group mitigations by pesticide type, use site, location, or other consideration. These strategies are intended to inform EPA's registration and registration review decisions when addressing population-level exposures and impacts relevant to listed species. FWS has authority over the majority of listed species including plants, insects, mussels, fish, birds, mammals, reptiles and amphibians. These species are diverse in their life history, locations, and potential for pesticide exposures. However, many species can be grouped in terms of what types of impacts may be expected from types of pesticides and the types of mitigations to address those impacts. Pesticide impacts to a given species may vary based on its life history (*e.g.*, diet, migration). Pesticide uses and potential impacts also vary across the U.S. based on crops grown, non-agricultural use sites (*e.g.,* forestry, residential areas) and associated pest pressures. For example, pesticide usage in the contiguous U.S. (CONUS) is much different than in Hawaii. Pesticide impacts vary from pesticide to pesticide, with unintended survival, growth or reproductive effects to non-target animals and plants (*e.g.,* a particular herbicide may cause reproductive effects to fish, multiple insecticides with the same mode of action may decrease survival in birds). Often classes of chemicals have similar impacts, especially considering their target pests (*e.g.*, rodenticides may impact non-target mammals, herbicides may impact non-target plants). The various strategies are intended to account for the characteristics of the individual chemical and identify landscape scale mitigations, as appropriate, based on location, pesticide class, species or use site (**Table 18**). Grouping species or pesticide uses based on their similarities will allow EPA to more efficiently and effectively identify and implement mitigations at a landscape scale through FIFRA registration and registration review actions. This will allow EPA to further its goals to reduce pesticide exposures and impacts to listed species, further the conservation of listed species, and streamline 7(a)(2) consultations on specific actions. Like this Herbicide Strategy, EPA plans to implement the other strategies as they become final. The final strategies are expected to inform registration and registration review decisions. For more information on the strategies identified in **Table 18**, see EPA's website.

Table 18. Summary of mitigation strategies that EPA is developing or has committed to develop.

Mitigation Strategy	Location[1]	Use Site	Conventional Pesticide Type
Herbicides	CONUS	Agriculture	Herbicides
Insecticides	CONUS	Agriculture	Insecticides
Rodenticides	U.S. and Territories	All	Rodenticides
Fungicides	CONUS	Agriculture	Fungicides
Vulnerable species pilot	CONUS	Agriculture Mosquito adulticide Rights of Way Forestry Rangeland	All
Hawaii	Hawaii	All	All

[1]CONUS = contiguous U.S.

4.6 Consideration of Offsets

The Herbicide Strategy includes mitigations that focus on minimization of exposure and impacts. At times, other federal agencies have used offsets to meet ESA obligations[43] (also known as compensatory mitigation) to address the impacts of their actions that cannot be avoided or minimized. Offsets are considered after feasible avoidance and minimization measures have been exhausted but more is needed to protect species. This could include actions such as habitat preservation or restoration, invasive species control, and species reintroductions. These actions can directly further species recovery

[43] FWS defines offsets as measures to *"compensate for, or offset, remaining unavoidable impacts after all appropriate and practicable avoidance and minimization measures have been applied by replacing or providing substitute resources or environments through the restoration, establishment, enhancement, or preservation of resources and their values, services, and functions…." (USFWS, 2023b)*.

(sometimes more than on-site avoidance and minimization) and can provide even greater flexibility by creating more options for EPA to meet its ESA obligations. EPA plans to identify opportunities for offsets to complement traditional avoidance and minimization measures. Although a process still needs to be developed, EPA plans to do so through a multi-step process that would include working with the Services to develop general guidance on using offsets for pesticide consultations, working with registrants and/or other stakeholders to identify and adopt offsets for specific pesticides and species, ensuring that adopted offsets are legally binding as a condition of a FIFRA registration, and working with the Services to oversee implementation of offsets.

5. Conclusions and Next Steps

EPA developed the final Herbicide Strategy to identify and implement early protections for listed species by reducing the potential for population-level impacts to listed plants and species that depend on plants. This strategy has two components: a decision framework and an implementation plan. The strategy decision framework is intended to provide EPA a process for confidently identifying when the uses of an herbicide have a potential for population-level impacts and how to identify effective and reasonable mitigations that are flexible and practical for growers of different crops and different parts of the country. This strategy is designed to reduce exposure to listed plants (and listed species that depend on plants) from spray drift and runoff/erosion. This strategy incorporates valuable insights, information, experience and comments provided by stakeholders on the draft strategy. The implementation plan discusses EPA's plan for how the Final Herbicide Strategy can be applied to FIFRA registration and registration review actions. This strategy includes EPA's implementation expectations on how pesticide applicators will be able to understand necessary mitigations by using the general pesticide product label, a mitigation menu website, and BLT. EPA plans on communicating and educating stakeholders and applicators so that they understand applicable mitigations for their intended herbicide applications. This final strategy is one of many other ESA strategies and efforts that the Agency is developing to efficiently identify early mitigations for listed species. EPA will continue to develop additional mitigation measures, such as offsets, that may increase the types of mitigations that effectively protect listed species and flexibility available to growers and applicators. This strategy is part of a process that EPA has undertaken with FWS, where EPA will identify early protections for listed species that should result in more efficient and effective herbicide specific consultations under ESA 7(a)(2).

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7. Abbreviations

a.i.	active ingredient
AAPCO	Association of American Pesticide Control Officials
ACEP	Agricultural Conservation Easement Program
AgDrift	AgDRIFT® version 2.1.1, a spray drift model
BE	Biological Evaluation
BiOp	Biological Opinion
BLT	EPA's Bulletins Live! Two website
CFR	Code of Federal Regulations
CH	designated critical habitat
CONUS	contiguous (or conterminous) United States
CRP	Conservation Reserve Program
DSD	droplet size distribution
EC_{50}	50% Effect Concentration
ECOS	FWS Environmental Conservation System
EEC	Estimated Environmental Concentration
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
°F	degrees Fahrenheit
FD	Final Decision
FFDCA	Federal Food, Drug, and Cosmetic Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
ft	feet
FWS	United States Fish and Wildlife Service
GIS	Geographic Information System
ha	hectare
HC_{05}	5^{th} percentile threshold from SSD
HC_{25}	25^{th} percentile threshold from SSD
HUC	Hydrologic Unit Code
IC^{25}	25% Inhibition Concentration
ID	Interim Decision
IEM	Interim Ecological Mitigations
in	inch
Kd	solid-water distribution coefficient where the solid is soil or sediment
KOC	organic-carbon normalized solid-water distribution coefficent where the solid is soil or sediment
lb(s)	pound(s)
m	meters
MOA	Mode of Action
MoD	Magnitude of Difference/ratio of exposure estimate to population-level toxicity endpoint
mph	miles per hour
NAICC	National Alliance of Independent Crop Consultants
NASS	National Agricultural Statistics Service
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

NRCS	Natural Resource Conservation Service
OCSPP	Office of Chemical Safety and Pollution Prevention
OPMP	USDA’s Office of Pest Management Policy
OPP	Office of Pesticide Programs
PAT	Plant Assessment Tool
PFD	Proposed Final Decision
PID	Proposed Interim Decision
psi	pounds per square inch
PULA	Pesticide Use Limitation Area
PWC	Pesticide in Water Calculator
RH	Relative Humidity
RQ	Risk Quotient
SE	Seedling Emergence
SFIREG	State FIFRA Issues Research and Evaluation Group
SSD	Species Sensitivity Distribution
sq ft	square feet
TPEZ	Terrestrial Plant Exposure Zone
U.S.	United States
UDL	Use Data Layer
µg	microgram
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
VFS	vegetative filter strip
VSP	Vulnerable Species Pilot
VV	Vegetative Vigor
WPEZ	Wetland Plant Exposure

7

Adopted 11/20/90
Revised 12/12/97

Board of Pesticides Control

CRITERIA FOR CONSIDERING PESTICIDE PRODUCTS

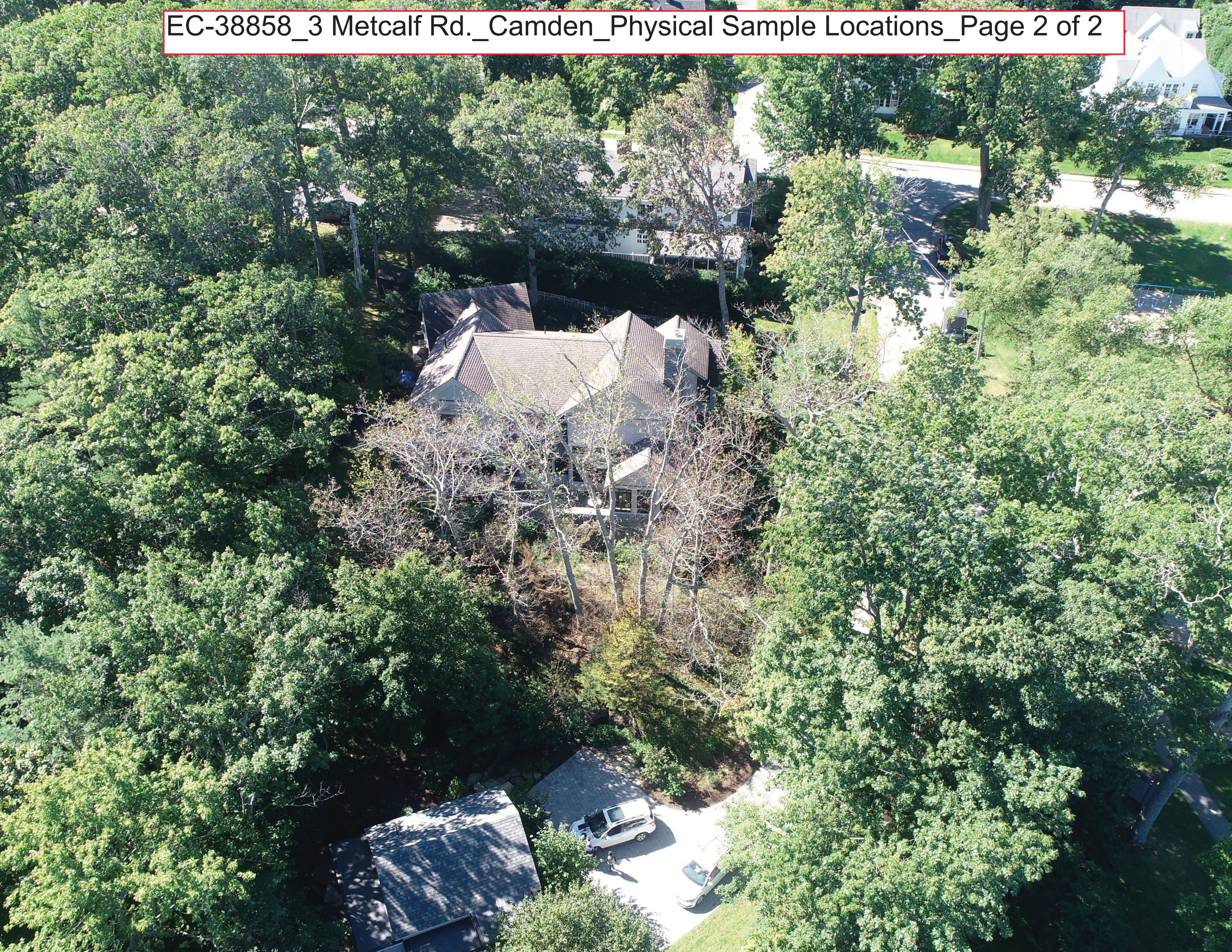
FOR STATE RESTRICTED USE STATUS

The Board has established the following criteria as policy for considering placement of pesticides on the state restricted use list. Since the criteria are adopted as policy and not regulation, the Board may amend them as the need arises at future meetings.

1. Products that are classified by EPA as Federally Restricted Use.
2. Products that the Board determines have a high potential for exposure in the hands of a non-certified individual. For example, a product that has been reviewed by the Board and a determination made that personal protective equipment such as respirator, goggles, impermeable gloves is necessary to reduce exposure and long term risks.
3. Products that the Board determines have a history of misuse or accidents.
4. Products the Board determines have significant acute toxicity or chronic health effects identified at reasonably expected use patterns.
5. Products that the Board determines (a) have been confirmed at levels of concern or are widespread in ground and surface water as a result of routine uses or (b) have a high potential for leaching or surface runoff under normal expected use patterns.
6. Products that the Board determines are toxic to fish or wildlife or have other adverse environmental effects under normal expected use patterns.
7. Pesticide products which are no longer federally registered will not be included on the state restricted use list.


EC-38858_3 Metcalf Rd._Camden_Physical Sample Locations_Page 1 of 2
1 Metcalf Rd.
3 Metcalf Rd.

EC-38858_3 Metcalf Rd._Camden_Physical Sample Locations_Page 2 of 2



TEBUTHIURON 20 P

Specimen Label

A herbicide for preemergence and postemergence use.
Controls woody plant species, brush and weeds in non-crop areas, including rangeland, permanent grass pastures, fencerows, rights-of-way, and clearings for wildlife habitat.

Not for sale, distribution, or use in Nassau and Suffolk counties in New York State. This product will kill trees and shrubs. Carefully read the precautions before using.

ACTIVE INGREDIENT:
Tebuthiuron: *N*-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-*N*-*N'*-dimethylurea 20.0%
OTHER INGREDIENTS: 80.0%
TOTAL: 100.0%

Contains 0.2 pounds active ingredient per pound of product

EPA Reg. No. 81927-41

EPA Est. No. 11603-ISR-001[A]; 81927-AL-001[PM] 39578-TX-001[ST]; 5905-IA-001[HD]
Letter(s) in lot number correspond(s) to superscript in EPA Est. No.

KEEP OUT OF REACH OF CHILDREN

CAUTION / PRECAUCÍON

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.)

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 doctor. • Do not give anything by mouth to an unconscious person.
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.
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.
HOT LINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-424-9300 for emergency medical treatment information.	

Manufactured for:
Alligare, LLC
13 N. 8th Street
Opelika, AL 36801

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

Caution. Harmful if swallowed, inhaled, or absorbed through the skin. Causes moderate eye irritation. Avoid contact with skin, eyes and/or clothing. Avoid breathing dust. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco or using the toilet. Remove contaminated clothing and wash before reuse.

Environmental Hazards

Do not use Alligare Tebuthiuron 20 P herbicide in any area where desirable species are in the vicinity of the plants to be controlled. A small amount of Alligare Tebuthiuron 20 P in contact with the roots of desirable trees or other woody species may cause severe injury or death. The roots of such plants may extend far beyond their drip lines.

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 or rinsate.

Spills: To prevent unintended damage to non-target vegetation or contamination of ground water, cover spills with waterproof covering if in outdoor areas; then carefully collect and dispose of spilled pellets, whether in storage areas, vehicles or on the soil surface. (See Product Information section for remedial action after accidental application or spill). In outdoor areas, **do not** cover soil or incorporate spilled material into the soil surface.

Ground Water Advisory: This product is known to leach through soil into ground water under certain conditions as a result of registered (rangeland and non-crop) uses. Use of this product in areas where soils have rapid to very rapid permeability, particularly where the water table is shallow, may result in ground water contamination.

Use Restrictions for Groundwater Protection
Vulnerable Sites: To minimize any movement of tebuthiuron to subsurface water, do not exceed the application rates specified below on treatment sites where soils have a sand or loamy sand texture throughout the soil profile and all of the following characteristics:
1. Rapid to very rapid permeability.
2. Absence of well-defined organic layers or a textural B-horizon (restricting layer of fine-textured soil).
3. The water table of an underlying aquifer† is shallow.

The maximum use rates for Alligare Tebuthiuron 20 P in areas described above are:
- **Less than 20 inches annual precipitation:** Do not apply more than 5 lb/acre Alligare Tebuthiuron 20 P.
- **Greater than 20 inches annual precipitation:** Do not apply more than 10 lb/acre Alligare Tebuthiuron 20 P.
  Refer to the “Woody Plants Controlled” section of this label for plant species controlled at these application rates.

†An aquifer is defined as “an underground saturated, permeable, geologic formation capable of producing significant quantities of water to a well or spring.” It is the ability of the saturated zone, or portion of that zone, to yield water which makes it an aquifer (American Chemical Society, 1983). Local agricultural agencies can provide further information on the type of soil in your area and the location of shallow ground water aquifers.

Do not apply Alligare Tebuthiuron 20 P in areas where the water table is predominantly shallow (5 feet or less), such as marshy or sub-irrigated areas, or areas immediately adjacent to streams or lakes which are periodically flooded, unless such use is allowed under a state-approved pesticide management program. Note: Also on such areas, woody plants rooted directly in a shallow water table are minimally affected by applications of tebuthiuron and poor woody plant control will result.

Do not apply Alligare Tebuthiuron 20 P where bedrock is continuously exposed or in areas of bedrock overlain by soils that are shallow or discontinuous.

Do not apply Alligare Tebuthiuron 20 P in areas adjacent to sinkholes or depressions lacking external drainage, which occur within areas of karst topography.

Do not apply Alligare Tebuthiuron 20 P to high shrink/swell soils (vertisols) which develop deep cracks upon drying.

Do not apply Alligare Tebuthiuron 20 P within areas identified by state or local authorities as protected groundwater recharge zones.

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 through any type of irrigation system.

Not for residential use.

Product Information
Alligare Tebuthiuron 20 P is a surface applied, soil-active product intended for control of woody plants (trees, shrubs and vines). Treatments become effective after sufficient rainfall has occurred to move the active ingredient in Alligare Tebuthiuron 20 P into the root zone. Herbicidal symptoms appear more rapidly when applied just before seasonal rainfall.

Treated trees and shrubs (brush) exhibit leaf chlorosis and browning followed by defoliation. Woody plants may undergo several defoliation cycles, usually following significant rainfall before death occurs. Time required to achieve control of woody vegetation depends on susceptibility of target species, rainfall and soil conditions and may vary from a single growing season to several years. Increased application rates and additional time is required to achieve consistent woody plant control under the following conditions: 1) the treated area contains deep, medium-to-fine textured, or high organic matter soils; 2) the target species are deep-rooted; or 3) the vegetation consists of species tolerant to Alligare Tebuthiuron 20 P.

For best brush control results with Alligare Tebuthiuron 20 P, do not disturb intact plants by practices such as wood cutting, chaining, or burning for two years after application. Resprouting is more likely to occur if plants are disturbed before complete woody plant control occurs.

Use Precautions and Restrictions
Alligare Tebuthiuron 20 P is intended for control of unwanted woody vegetation such as trees, shrubs and vines. Alligare Tebuthiuron 20 P will also control herbaceous broadleaf plants such as clover or lespedeza. Grasses in the area immediately adjacent to pellets may be temporarily damaged. Dormant season application is recommended to minimize herbicidal effects on grasses and other herbaceous plants. The herbicidal activity of Alligare Tebuthiuron 20 P in soil may prevent the growth of trees, shrubs and other broadleaf vegetation for several years after treatment.

Do not apply Alligare Tebuthiuron 20 P to interior ditchbanks (areas which slope toward the drainage). Do not apply to ditches used to transport irrigation to potable water.

Not for sale, distribution, or use in Nassau and Suffolk Counties in New York State

Use Restrictions in the State of Florida: In Broward, Collier, Dad, Hendry, Lee, Monroe, and Palm Beach Counties of Florida, Alligare Tebuthiuron 20 P may be applied only in accordance with supplemental labeling

Maximum Application Rate for Grazing or Haying: If the treated area is to be used for haying, do not apply more than 20 pounds per acre of Alligare Tebuthiuron 20 P. If treated area is to be used for haying, do not apply more than 10 pounds per acre of Alligare

Tebuthiuron 20 P in areas receiving 20 inches or less average annual rainfall, or more than 20 pounds per acre of Alligare Tebuthiuron 20 P in areas receiving more than 20 inches average annual rainfall. There are no grazing restrictions following application of Alligare Tebuthiuron 20 P at labeled rates.

Haying Restriction: Do not cut hay for livestock feed for one year after an Alligare Tebuthiuron 20 P application.

Effects on Herbaceous Vegetation: Alligare Tebuthiuron 20 P may injure or suppress certain herbaceous vegetation in the treated area. Therefore, do not apply where such injury cannot be tolerated. Injury to most herbaceous perennial plants is reduced if Alligare Tebuthiuron 20 P is applied when this vegetation is dormant.

Do not apply Alligare Tebuthiuron 20 P more than once per year.

Safe use of Alligare Tebuthiuron 20 P requires the following guidelines to be carefully followed:

Treatment Setback: Do not apply Alligare Tebuthiuron 20 P in the vicinity of desirable plants. Exposure of even a small part of a plant root system to Alligare Tebuthiuron 20 P may cause severe plant injury or death. Plant roots usually occupy an area much larger than the aerial portion of the plant. Treatment setback distance should be 1 to 2 times the height or width of adjacent non-target vegetation, whichever is greater. For example, if adjacent non-target vegetation is 25 feet tall, the treatment setback should be 50 feet.

An Arborculturist (tree expert) should be consulted to help you to determine if there is a question about the appropriate setback distance or if the area of proposed application is free of all roots of desirable vegetation.

Potential Product Movement: Alligare Tebuthiuron 20 P or soil containing Alligare Tebuthiuron 20 P may be moved from treated areas by flowing water, wind, or mechanical means. Do not apply Alligare Tebuthiuron 20 P in areas where overland flow of water might move Alligare Tebuthiuron 20 P or soil containing Alligare Tebuthiuron 20 P from the treated area. Do not apply where wind erosion may cause movement of soil containing Alligare Tebuthiuron 20 P from the treated area unless the surface has been stabilized with a gravel mulch or some other means. Do not apply in areas where soil may be redistributed by mechanical means to non-treated areas.

Cleaning of Equipment: Thoroughly clean all traces of Alligare Tebuthiuron 20 P from application equipment after use. Do not empty residues cleaned from application equipment on areas where they may come in contact with the roots of desirable vegetation or the water source for such vegetation.

Remedial Action After Accidental Application or Spill: Take action to minimize the effects of an accidental application or spill immediately. **Once rainfall has moved Alligare Tebuthiuron 20 P into the plant root zone, the effect on woody plants is irreversible.** Damage from accidental application or spill may be prevented only if soil containing Alligare Tebuthiuron 20 P is carefully removed before rainfall has moved Alligare Tebuthiuron 20 P into the root zone. Apply a waterproof covering to the affected area until cleanup is accomplished. Carefully collect Alligare Tebuthiuron 20 P pellets and/or soil containing Alligare Tebuthiuron 20 P with appropriate equipment and dispose at an approved landfill site. If rainfall has occurred, remove surface soil in the affected are to the depth of Alligare Tebuthiuron 20 P penetration.

Frequency of Application and Maximum Use Rates

Broadcast Applications (Aerial or Ground Equipment):

- The maximum use rate and frequency of application is 1 to 2 lb a.i./acre once every three years for vulnerable sites where soils are sandy and depth to water table is shallow. (Refer to Environmental Hazards section under "Use Restrictions for Ground Water Protection".)
- For all other areas, the maximum use rate and frequency of application is up to 4 lb. a.i./acre once every three years, and no more than two treatments totaling 6 lb a.i./acre in any 6 year period.

Spot treatments (Hand Application or Hand-held Equipment): May be applied at rates up to 6 lb a.i./acre when needed.

Factors in Herbicidal Response

Soil Texture, Soil Depth, and Organic Matter: Poor control or erratic results are likely to occur when Alligare Tebuthiuron 20 P is applied to soils containing more than 5% organic matter or more than 30% clay. Do not apply to "blackland" or other heavy clay soils which crack extensively upon drying. Other deep, medium, and fine-textured soils supporting deep-rooted woody plant species require higher application rates within rate ranges for consistent control. Woody plants growing in shallow, coarse, or rocky soils with low organic matter are normally more susceptible due to increased soil availability of the herbicide and shallow rooting depth. Application rates at the low end of the rate range may be used under these conditions.

Woody Plant Size and Density: The height and density of woody vegetation is a reliable indicator of soil conditions. Woody vegetation is generally taller and denser where soils are deep and/or of medium to fine texture and where soil moisture conditions are more favorable. Higher rates in the rate range are required on such sites. Woody vegetation will be smaller and less dense on sites with coarse, shallow, or rocky soils with less favorable soil moisture conditions. Lower rates in the rate range may be used on such sites. Where a high level of woody plant control is required and application rates cannot be adjusted for changes in soils, plant size, or density, apply Alligare Tebuthiuron 20 P at a rate sufficient to control the tallest and most dense woody vegetation in the treatment area.

Application Timing: Alligare Tebuthiuron 20 P may be applied anytime except when the soil is frozen or is saturated with moisture. For optimum results, applications should be made prior to the resumption of active seasonal growth in the spring or before expected seasonal rainfall. In areas receiving greater than 25 inches of annual rainfall, late summer and fall applications may require a higher application rate in the indicated rate range to achieve consistent control.

Alligare Tebuthiuron 20 P is recommended for control of brush regrowth after dozing or shredding, provided the regrowth has reached an average height of five feet or more prior to application. Alligare Tebuthiuron 20 P works best when there is an abundance of active leaf area to stimulate water and herbicide during the season following application. Taller regrowth will tend to respond with faster and more consistent brush control.

Alligare Tebuthiuron 20 P may cause temporary herbicidal symptoms to appear on perennial grasses. Dormant season application is recommended to minimize herbicidal effects on desirable forage grasses.

Effect of Shallow Groundwater on Woody Plant Control: Do not apply Alligare Tebuthiuron 20 P to areas where the water table is predominantly shallow (5 feet or less), such as marshy or sub-irrigated areas, or areas immediately adjacent to streams or lakes which are periodically flooded. On such sites, where roots extend directly to a shallow water table, woody plants are minimally affected by applications of tebuthiuron and poor control will result.

RANGELAND AND PASTURE MANAGEMENT INFORMATION

There are no label restrictions which require livestock grazing to be delayed following an application of Alligare Tebuthiuron 20 P. Alligare Tebuthiuron 20 P is a pelleted formulation and does not adhere to plants. Therefore significant plant residues do not occur as a result of application. However, at the time of application forage species may be sparsely distributed and in a low state of vigor due to competition from woody plants. Under such circumstances, the density and vigor of forage species may be enhanced by deferment of grazing following application of Alligare Tebuthiuron 20 P.

Grazing Management: For optimum perennial forage grass response, desirable species should be present in the area to be treated at a minimum of 10% of normal plant density (density = plants per unit area) compared to similar rangeland or pasture sites not dominated by woody plants. To encourage forage response, grazing should be deferred during the entire active growing season following application. Poor vegetative vigor or inadequate rainfall may necessitate additional grazing deferment during periods of active forage growth. Light grazing of mature forage after seed maturity will not harm grass recovery and can aid in seed dispersal. Forage grass production usually increases as woody plant competition for water and nutrients is reduced. However, increased forage production is also dependent on adequate rainfall and a sound grazing management program.

Precaution: The density of cool season grass stands such as fescue and crested wheatgrass may be reduced after application of Alligare Tebuthiuron 20 P. Factors which may contribute to the possibility of stand reduction include excessive application rates, areas of shallow or rocky soil, and low brush density.

Rangeland and Pasture Overseeding: Apply Alligare Tebuthiuron 20 P at specified rates. Overseeding involving burning or chaining of treated brush should not be attempted for at least two growing seasons after application. Apply seed and fertilizer at recommended rates into ash as soon as possible after burning or just prior to chaining. Cool season grasses are normally seeded in early fall and warm season grasses in the spring after the expected frost-free date. Aerial seeding without burning or chaining may be attempted in the fall or spring following an application of Alligare Tebuthiuron 20 P, but natural seedbed conditions must be relied upon for seeding establishment. Consult local range management specialists for recommendations on locally adapted species, seeding time and grazing management.

Application of Alligare Tebuthiuron 20 P

Individual Plant Treatments

Individual plants, multistem clumps, or small stands of woody vegetation may be hand treated. For individual plant treatments, apply Alligare Tebuthiuron 20 P evenly over the area occupied by the target plant(s).

Pasture and Rangeland:

- In areas receiving 20 inches or less average annual rainfall: Apply Alligare Tebuthiuron 20 P at a rate of 3/8 oz. per 100 sq. ft. (equivalent broadcast rate = 10 pounds per acre)
- In areas receiving more than 20 inches average annual rainfall: Apply Alligare Tebuthiuron 20 P at a rate of ¾ oz. per 100 sq. ft. (equivalent broadcast rate = 20 pounds per acre).

Non-Cropland:

- Apply Alligare Tebuthiuron 20 P at a rate of 3/8 to 1 1/8 oz. per 100 sq. ft. (equivalent broadcast rate = 10 to 30 pounds per acre).

Broadcast Treatments

Alligare Tebuthiuron 20 P must be applied with ground or aerial application equipment capable of accurate calibration and able to provide a uniform distribution of pellets on the soil surface. Use of equipment not capable of confining the spread of pellets to the target area may result in injury or death of vegetation outside the intended treatment area. Contact an Alligare sales representative for recommendations on application equipment or different use situations.

Alligare Tebuthiuron 20 P may be applied by ground or air broadcast by/or under the supervision of U.S. Government Agencies.

Broadcast Application Rates

Pasture and Rangeland: Do not apply more than 10 pounds per acre Alligare Tebuthiuron 20 P in areas receiving 20 inches or less average annual rainfall. Do not apply more than 20 pounds per acre in areas receiving 20 inches or more average annual rainfall.

Non-Cropland: Do not apply more than 20 pounds per acre of Alligare Tebuthiuron 20 P on non-cropland.

Note: Refer to Product Information section for limitations on maximum use rates, frequency of application, and total application rates allowed during a given period of time. Refer to Environmental Hazards section under "Use Restrictions for Ground Water Protection: for other ate limitations on "vulnerable" sites.

Woody Plants Controlled by Alligare Tebuthiuron 20 P

Rangeland, Pastureland and Non-Cropland

Apply Alligare Tebuthiuron 20 P at 3.75 to 5 lb per acre on the following woody plant species (Note: On rangeland and pastureland, apply 3.75 to 5 lb/acre of Alligare Tebuthiuron 20 P where a higher degree of control is required (see "Factors in Herbicidal Response of Woody Plants" in the "Product Information" section of this label). Alligare Tebuthiuron 20 P may be applied at rates as low as 2.5 lb per acre on sites with shallow, rocky and coarse textured soils having low organic matter content, or where partial control is desired.):

Common Name	Scientific Name
burrowed (density less than 1 per sq. ft.)	*Haplopappus tenuisectus*
ceniza	*Leucophyllum frutescens*
creosotebush	*Larrea tridentata*
mimosa, catclaw (wait-a-minute-bush)	*Mimosa pigra*
Paloverde	*Cercidium spp.*
sagebrush, big	*Artemisia tridentata*
sagebrush, sand	*Artemisia filifolia*
snakeweed, broom (density less than 1/sq ft)	*Gutierrezia sarothrae*
tarbush	*Flourensia cernua*
whitethorn	*Acacia constricta*

Rangeland, Pastureland and Non-Cropland

Apply Alligare Tebuthiuron 20 P at 2.5 to 10 lb per acre on the following woody plant species:

Common Name	Scientific Name
oak, sand shinnery†	*Quercus havardii*

†**Note:** A wide range is provided to accommodate the broad range of soil and climatic variations which occurs in areas occupied by sand shinnery. Use the lowest application rate only on shallow sands in southern part of species range or where partial control is desired. Use a higher dose in indicated rate range for deeper sands and dunes, and on shinnery varieties with tall and dense growth habit which become more prevalent in the mid-to-northern part of the species range (see "Factors in Herbicidal Response of Woody Plants" in the "Product Information" section of this label).

Rangeland, Pastureland and Non-Cropland

Apply Alligare Tebuthiuron 20 P at 5 to 10 lb per acre on the following woody plant species:

Common Name	Scientific Name
oak, bigelow† (partial control)	*Quercus durandi*
oak, mohr† (partial control)	*Quercus mohriana*
oak, running live† (partial control)	*Quercus virginiana*
whitebrush	*Aloysia lycoides*
wolfberry, Berlandier	*Lycium berlanderi*

†**Note:** Use a higher dosage in indicated rate range on tall and dense stands.

Rangeland, Pastureland and Non-Cropland

Apply Alligare Tebuthiuron 20 P at 10 to 20 lb per acre on the following woody plant species:

Common Name	Scientific Name
acacia, blackbrush	*Acacia rigidula*
acacia, catclaw	*Acacia greggii*
acacia, twisted	*Acacia tortuosa*
apple-of-sodom	*Solanum sodomeum*
birch, gray	*Betula populifolia*
blueberry	*Vaccinium spp.*
bluewood (Brazil)	*Condalia obovata*
buckbrush	*Symphoricarpos orbiculatus*
cherry, bitter	*Prunus emarginata*
dogwood, roughleaf	*Cornus drummondii*
elm, American	*Ulmus americana*
elm, winged	*Ulmus alata*
guajillo	*Acacia berlanderi*
guava	*Psidium guajava*
hackberry, spiny (granjeno)	*Celtis palida*
hackberry, western	*Celtis occidentalis*
hawthorn	*Crataegus spp.*
huckleberry	*Gaylussacia spp.*
koa haole	*Leucaena leucophylla*
locust, black	*Robinia pseudoacacia*
manzanita	*Arctostaphylos spp.*
mulberry, red	*Morus rubra*
oak, black	*Quercus velutina*
oak, blackjack	*Quercus marilandica*
oak, blue	*Quercus douglasii*
oak, bur	*Quercus macrocarpa*
oak, post	*Quercus stellata*
oak, shrub live	*Quercus turbinella*
oak, southern red	*Quercus falcata*
oak, white	*Quercus, alba*
rose, multiflora	*Rosa multiflora*
sage, black	*Salvia melifera*
sumac, dwarf	*Rhus copallina*
sumac, littleleaf	*Rhus microphylia*
sumac, skunkbush	*Rhus trilobata*
sumac, smooth	*Rhus glabra*
sumac, staghorn	*Rhus typhina*
thornapple, desert	*Datura discolor*
yaupon	*Ilex vomitoria*
yaupon, desert	*Schaefferia cuneifolia*

Rangeland, Pastureland and Non-Cropland

Apply Alligare Tebuthiuron 20 P at 20 lb per acre on the following woody plant species:

Common Name	Scientific Name
alder, red	*Alnus rubra*
alder, speckled‡	*Alnus rugosa*
aspen, bigtooth	*Populus grandidentata*
beech, American	*Fagus grandifolia*
blackberry	*Rubus spp.*
boxelder	*Acer negundo*
chamise	*Adenostoma fasciculatum*
cherry, black	*Prunus serotina*
chokecherry, common	*Prunus virginiana*
colubrina, Texas	*Colubrina texensis*
cottonwood, eastern ‡	*Populus deltoides*
creeper, Virginia	*Parthenocissus quinquefolia*
dogwood, flowering	*Cornus florida*
douglasfir	*Pseudotsuga menziesii*
fir, balsam‡	*Abies balsamea*
guayacan	*Porlieria angustifolia*
hardhack‡	*Spiraea tomentosa*
hickory, bitternut	*Caraya cordiformis*
hickory, black	*Caraya texana*
hickory, pignut	*Caraya glabra*
hickory, shagbark	*Caraya ovata*
huisache‡	*Acacia farnesiana*
kidneywood, Texas	*Eysenhardtia texana*
kudzu	*Pueraria lobata*
leatherstem	*Jatropha dioica*
lotbush (condalia)	*Ziziphus obtusifolia*
maple, bigleaf	*Acer macrophyllum*
maple, sugar‡	*Acer saccharum*
melaleuca‡	*Melaleuca quinquenervia*
mountain mahogany, birchleaf	*Cercocarpus betuloides*
oak, Califonia scrub	*Quercus dumosa*
oak, live	*Quercus virginiana*
oak, pin	*Quercus palustris*
oak, red	*Quercus rubra*
oak, white	*Quercus alba*
pine, Australian	*Casuarina spp.*
pine	*Pinus spp.*
poplar, balsam‡	*Populus balsamifera*
raspberry, black	*Rubus occidentalis*
rose, Macartney‡	*Rosa bracteata*
spruce, white‡	*Picea glauca*
sweetgum	*Liquidambar styraciflua*
tamarack‡	*Larix laricina*
trumpetcreeper	*Campsis radicans*
willow	*Salix spp.*

‡**Note:** Use a higher dosage in indicted rate range on all sites.

Rangeland, Pastureland, and Non-Cropland (Individual Plant Treatment Only):

Common Name	***Scientific Name***
Ash, green	*Fraxinus pennsylvanica*
Ash, white	*Fraxinus americana*
Blackberry, cutleaf	*Rubus laciniatus*
Ceanothus, wedgeleaf	*Ceanothus cuneatus*
Chaparral, whitehorn	*Ceanothus leucodermis*
Coyotebush	*Baccharis pilularis*
Elm, Chinese	*Ulmus parvifolia*
Elm, slippery	*Ulmus rubra*
Greenbrier, roundleaf	*Smilax rotundifolia*
Hawthorn, cockspur	*Crataegus crus-galii*
Lantana	*Lantana camara*
Manzanita, greenleaf	*Arctostaphylos patula*
Maple, Norway	*Acer platanoides*
Maple, silver	*Acer saccharium*
Maple, vine	*Acer circinatum*
Peppertree, Brazilian	*Schinus terebinthifolius*
Privet	*Ligustrum spp.*
Redcedar, eastern	*Juniperus virginiana*
Russianolive	*Elaeagnus angustifolia*
Salal	*Gaultheria shallon*
Sumac, laurel	*Rhus laurina*
Sycamore, American	*Platanus occidentalis*
Tallowtree, Chinese	*Sapium sebiferum*
Tuliptree	*Liriodendron tulipifera*

STORAGE AND DISPOSAL

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

Pesticide Storage: The herbicidal properties of Alligare Tebuthiuron 20 P require caution in handling, storage, and transportation of this product. Store in original container only. In case of leak or spill, contain material and dispose as waste.

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

Container Disposal: **Nonrefillable Container (flexible-bag-all weights):** Nonrefillable container. Do not reuse or refill this container. Completely empty bag into application equipment. Then offer for recycling, if available, or dispose of empty bag in a sanitary landfill or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

CONDITION OF SALE AND LIMITATION OF WARRANTY AND LIABILITY

To the extent consistent with applicable law, upon purchase or use of this product, purchaser and user agree to the following terms:

Warranty: Alligare, LLC (the Company) warrants that this product conforms to the chemical description on the label in all material respects and is reasonably fit for the purpose referred to in the directions for use, subject to the exceptions noted below, which are beyond the Company's control. To the extent consistent with applicable law, the Company makes no other representation or warranty, express or implied, concerning the product, including no implied warranty of merchantability or fitness for a particular purpose. To the extent consistent with applicable law, no such warranty shall be implied by law, and no agent or representative is authorized to make any such warranty on the Company's behalf.

Terms of Sale: The Company's directions for use of this product must be followed carefully. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, and the manner of use or application (including failure to adhere to label directions), all of which are beyond the Company's control. To the extent consistent with applicable law, all such risks are assumed by the user.

Limitation of Liability: To the extent consistent with applicable law, the exclusive remedy against the Company for any cause of action relating to the handling or use of this product is a claim for damages, and in no event shall damages or any other recovery of any kind exceed the price of the product which caused the alleged loss, damage, injury or other claim. To the extent consistent with applicable law, under no circumstances shall the Company be liable for any special, indirect, incidental or consequential damages of any kind, including loss of profits or income. Some states do not allow the exclusion or limitation of incidental or consequential damages.

The Company and the seller offer this product, and the purchaser and user accept this product, subject to the foregoing warranty, terms of sale and limitation of liability, which may be varied or modified only by an agreement in writing signed on behalf of the Company by an authorized representative.

EPA 20091103

BOARD OF PESTICIDES CONTROL
APPLICATION FOR VARIANCE PERMIT
(Pursuant to Chapter 29, Section 6 of the Board's Regulations)

I. Jeremy Legasse — (207) 989-1433
Name — Telephone Number

Green Thumb Lawn Service
Company Name

64 Stevens Rd — Brewer — ME — 04412
Address — City — State — Zip

II. Jeremy Legasse — CMA-3240
Master Applicator (if applicable) — License Number

36 Aspen Way — Brewer — ME — 04412
Address — City — State — Zip

III. **As part of your application, please send a revegetation plan and digital photos showing the target site and/or plants and the surrounding area, particularly showing proximity to wetlands and water bodies, to pesticides@maine.gov**

IV. Area(s) where pesticide will be applied:
Amy Miller, 106 Books Rd, Eddington, ME 04428
Approximately 400 sqft of frontage of Davis Pond.

V. Pesticide(s) to be applied:(Including EPA Registration Number)
Aquamaster 524-343

VI. Purpose of pesticide application:
To manage Poison Ivy

VII. Approximate dates of spray application:
Between June 1, 2024 - August 31st, 2024.

VIII. Application Equipment:
Low pressure hand hand pump tank

IX. Standard(s) to be varied from:
Within 25' of open water (Davis Pond)

X. Method to ensure equivalent protection:
We will be treating on a day with minimal wind and using a low pressure hand can sprayer. This will be a spot treatment only for the patch of ivy that is present.

XI. Revegetation Plan (attach separately if necessary)
Natural recovery.

Signed: Amy Jnom Date: 5.24.2024

Return completed form to: **Board of Pesticides Control, 28 State House Station, Augusta, ME 04333-0028**
OR E-mail to: pesticides@maine.gov

STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY
BOARD OF PESTICIDES CONTROL
28 STATE HOUSE STATION
AUGUSTA, MAINE 04333

JANET T. MILLS
GOVERNOR

AMANDA E. BEAL
COMMISSIONER

July 24, 2024

Jeremy Legasse
Green Thumb Lawn Service
64 Stevens Rd
Brewer, ME 04412

RE: Variance permit for CMR 01-026 Chapter 29, Green Thumb Lawn Service- 106 Brooks Rd, Eddington, ME 04428

Greetings,

The Board of Pesticides Control considered your application for variance from Chapter 29. The variance is approved, with the condition that all products to be used are currently registered in the State of Maine or were registered at the time of purchase and any application is made above the high-water line.

The Board authorizes the issuance of two-year permits for Chapter 29, therefore this permit is valid until December 31, 2025, as long as applications are consistent with the information provided on the variance request. Please notify the Board in advance of changes, particularly if you plan to use a different product from those listed.

Please bear in mind that your permit is based upon your company adhering to the precautions listed in Section X of your Chapter 29 variance request.

I will alert the Board at its next meeting that the variance permit has been issued. If you have any questions concerning this matter, please feel free to contact me at 287-2731.

Sincerely,

Alexander Peacock

Alexander Peacock
Director

ALEXANDER PEACOCK, DIRECTOR
90 BLOSSOM LANE, DEERING BUILDING

PHONE: (207) 287-2731
THINKFIRSTSPRAYLAST.ORG

BOARD OF PESTICIDES CONTROL
APPLICATION FOR VARIANCE PERMIT
(Pursuant to Chapter 29, Section 6 of the Board's Regulations)

I. Jeremy Legasse — (207) 989-1433
Name — Telephone Number

Green Thumb Lawn Service
Company Name

64 Stevens Rd — Brewer — ME — 04412
Address — City — State — Zip

II. Jeremy Legasse — CMA-3240
Master Applicator (if applicable) — License Number

36 Aspen Way — Brewer — ME — 04412
Address — City — State — Zip

III. **As part of your application, please send a revegetation plan and digital photos showing the target site and/or plants and the surrounding area, particularly showing proximity to wetlands and water bodies, to pesticides@maine.gov**

IV. Area(s) where pesticide will be applied:
Dallas Gerow 99 Birch Tree Dr. Hudson. ME 04449
Waterfront, dock, and rock wall area

V. Pesticide(s) to be applied:(Including EPA Registration Number)
Aquamaster 524-343

VI. Purpose of pesticide application:
To manage poison ivy

VII. Approximate dates of spray application:
Between July 11, 2024 to Sept. 30, 2024

VIII. Application Equipment:
Low pressure pump tank

IX. Standard(s) to be varied from:
within 25ft of open water

X. Method to ensure equivalent protection:
Low pressure sprayer, directed application.

XI. Revegetation Plan (attach separately if necessary)
Natural Recovery

Signed: [signature] Date: 7.10.2024

Return completed form to: **Board of Pesticides Control, 28 State House Station, Augusta, ME 04333-0028**
OR E-mail to: pesticides@maine.gov

STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY
BOARD OF PESTICIDES CONTROL
28 STATE HOUSE STATION
AUGUSTA, MAINE 04333

JANET T. MILLS
GOVERNOR

AMANDA E. BEAL
COMMISSIONER

August 2, 2024

Jeremy Legasse
Green Thumb Lawn Service
64 Stevens Rd
Brewer, ME 04412

RE: Variance permit for CMR 01-026 Chapter 29, Green Thumb Lawn Service- 99 Birch Tree Dr, Hudson, ME 04428

Greetings,

The Board of Pesticides Control considered your application for variance from Chapter 29. The variance is approved, with the condition that all products to be used are currently registered in the State of Maine or were registered at the time of purchase and any application is made above the high-water line. To prevent drift onto other established native plants, use non-powered low-volume equipment and consider wipe applications on single plants of poison ivy nearest the water's edge.

The Board authorizes the issuance of two-year permits for Chapter 29, therefore this permit is valid until December 31, 2025, as long as applications are consistent with the information provided on the variance request. Please notify the Board in advance of changes, particularly if you plan to use a different product from those listed.

Please bear in mind that your permit is based upon your company adhering to the precautions listed in Section X of your Chapter 29 variance request.

I will alert the Board at its next meeting that the variance permit has been issued. If you have any questions concerning this matter, please feel free to contact me at 287-2731.

Sincerely,

Alexander Peacock

Alexander Peacock
Director

9c

BOARD OF PESTICIDES CONTROL
APPLICATION FOR VARIANCE PERMIT
(Pursuant to Chapter 29, Section 6 of the Board's Regulations)

I. Aaron Engebreth ( ) 617-290-8835

Name Telephone Number

Company Name

8 Chester Street Portland, Me 04103

Address City State Zip

II. Noah Tucker CMA-4242

Master Applicator (if applicable) License Number

9 Washington Avenue Scarborough, ME 04074

Address City State Zip

III. **As part of your application, please send a revegetation plan and digital photos showing the target site and/or plants and the surrounding area, particularly showing proximity to wetlands and water bodies, to pesticides@maine.gov**

IV. Area(s) where pesticide will be applied:

Product will be applied on the slope between the house and water from northern most to the southern most property line

V. Pesticide(s) to be applied:(Including EPA Registration Number)

Sightline EPA REG 74779-8

VI. Purpose of pesticide application:

Product will be used to eliminate the Japanese Knotweed that has taken over the hillside.

The goal is to restore native vegetation to the area.

VII. Approximate dates of spray application:

Product will be applied once in the early fall after the plant has bloomed.

VIII. Application Equipment:

Non-powered low pressure backpack

IX. Standard(s) to be varied from:

Chapter 29 Section 6 A

X. Method to ensure equivalent protection:

In order to prevent run off, we will be cutting down the plant and injecting the product into the stem of each individual plant. This will keep the volume of pesticide applied as low as possible and eliminating chance of drift while achieving desired control.

XI. Revegetation Plan (attach separately if necessary)

Revegetation Plan will be enacted by Audet Enterprises after adequate suppression has been achieved.

Signed: ______________________ Date: 8/11/24

Return completed form to: **Board of Pesticides Control, 28 State House Station, Augusta, ME 04333-0028**
OR E-mail to: pesticides@maine.gov

VII. Approximate dates of spray application:

Product will be applied once in the early fall after the plant has bloomed.

VIII. Application Equipment:

Non-powered low pressure backpack

IX. Standard(s) to be varied from:

Chapter 29 Section 6 A

X. Method to ensure equivalent protection:

In order to prevent run off, we will be cutting down the plant and injecting the product into the stem of each individual plant. This will keep the volume of pesticide applied as low as possible and eliminating chance of drift while achieving desired control.

XI. Revegetation Plan (attach separately if necessary)

Revegetation Plan will be enacted by Audet Enterprises after adequate suppression has been achieved.

Signed: [signature] Date: 8/11/24

Return completed form to: **Board of Pesticides Control, 28 State House Station, Augusta, ME 04333-0028**
OR E-mail to: pesticides@maine.gov

Rev. 8/2013

From: Tyler Smith <tyler.smith@bartlett.com>
Sent: Friday, August 2, 2024 1:06 PM
To: Peacock, Alexander R <Alexander.R.Peacock@maine.gov>
Subject: RE: Application for pesticide treatment - 8 Chester Street Portland, ME 04103

EXTERNAL: This email originated from outside of the State of Maine Mail System. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Alex,

I hope you are well. I wanted to reach out about some updates regarding this variance approval. Unfortunately, the city of Portland's waiver processed delayed us and kept us from treating the knotweed at the appropriate time. As a result, we did not treat, and are now hoping to treat this fall when the plants are flowering. To do this, the product and application method will need to change to avoid drift (the plants are now 6-8 feet tall). We will now cut and inject the knotweed stems with Sightline (EPA 74779-8) after the plants flower.
Let me know if there is a process I need to follow to make sure this is approved by the Board of Pesticides, or if there is any documentation I need to fill out.
Thanks for your help,

Tyler Smith
TYLER SMITH ARBORIST REPRESENTATIVE

BARTLETT TREE EXPERTS
9 Washington Avenue #3, Scarborough, ME 04074 p (207) 883-3340 (office)
e tyler.smith@bartlett.com
bartlett.com

STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY
BOARD OF PESTICIDES CONTROL
28 STATE HOUSE STATION
AUGUSTA, MAINE 04333

JANET T. MILLS
GOVERNOR

AMANDA E. BEAL
COMMISSIONER

August 27, 2024

Noah Tucker
F A Bartlett Tree Expert Co.
9 Washington Ave, Ste. 3
Scarborough, ME 04074

RE: Variance permit for CMR 01-026 Chapter 29, F A Bartlett Tree Expert Co.

Dear Mr. Tucker,

The Board of Pesticides Control considered your application for variance from Chapter 29. The variance is approved, with the condition that all products to be used are currently registered in the State of Maine or were registered at the time of purchase.

The Board authorizes the issuance of two-year permits for Chapter 29, therefore this permit is valid until December 31, 2025, as long as applications are consistent with the information provided on the variance request. Please notify the Board in advance of changes, particularly if you plan to use a different product from those listed.

Please bear in mind that your permit is based upon your company adhering to the precautions listed in Section X of your Chapter 29 variance request.

I will alert the Board at its next meeting that the variance permit has been issued. If you have any questions concerning this matter, please feel free to contact me at 287-2731.

Sincerely,

Alexander Peacock

Alexander Peacock
Director

BOARD OF PESTICIDES CONTROL
APPLICATION FOR VARIANCE PERMIT
(Pursuant to Chapter 29, Section 6 of the Board's Regulations)

I. Erik Lema (207) 518-8442

Name | Telephone Number

Basswood Environmental LLC

Company Name

32 Brentwood Rd | Cape Elizabeth | ME | 04107

Address | City | State | Zip

II. Erik Lema | CMA-5752

Master Applicator (if applicable) | License Number

Same as above

Address | City | State | Zip

III. **As part of your application, please send digital photos showing the target site and/or plants and the surrounding area, particularly showing proximity to wetlands and water bodies, to pesticides@maine.gov**

IV. Area(s) where pesticide will be applied:

Callahan Mine Superfund Site, restoration reas

Brooksville, Maine

V. Pesticide(s) to be applied:

Alligare Glyphosate 5.4 (aquatic label)

VI. Purpose of pesticide application:

Treatment of invasive Phragmites monoculture on formerly tidal marsh

VII. Approximate dates of spray application:

Late August and Early September, 2024. Follow-up spot treatment in 2025

VIII. Application Equipment:

Intitial application will be with a high-volume sprayer in areas of the main infestation away from open water. Low-volume backpack sprayer will be used near sensitive areas, along leading edge of infestation, and among other desirable species on margins.

IX. Standard(s) to be varied from:

Broadcast spraying within 25-feet of water line.

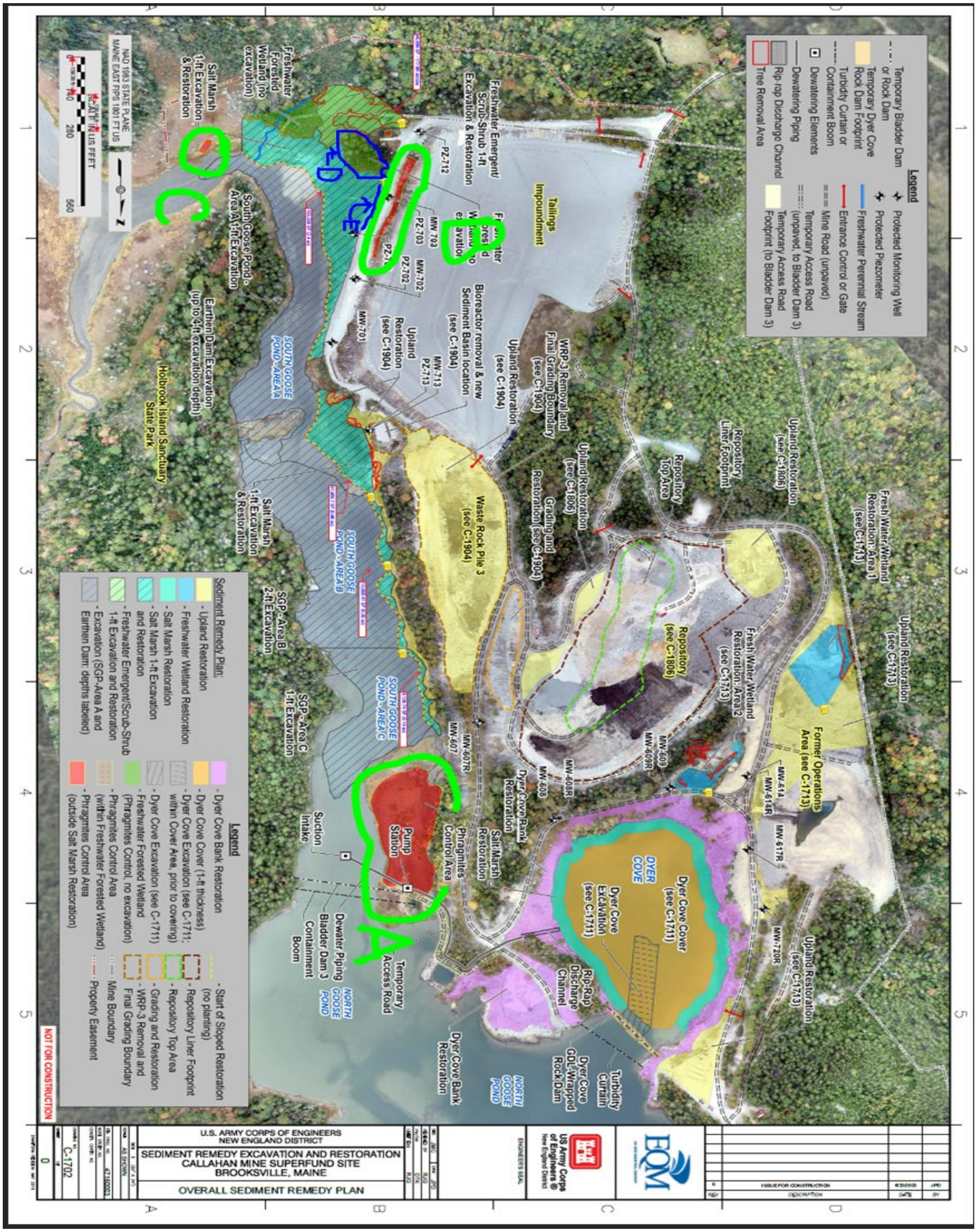
X. Method to ensure equivalent protection:

The formerly tidal inlet is now artificially controlled by the superfund restoration effort. All spraying will be performed later in the season when the water level is lowered and the infestation is in the dry. A 1-2% solution will be used to limit the amount of active ingredient introduced to the system while allowing for some control. Multiple years of treatment are proposed to establish control of the infestation.

Restoration efforts across the site include intensive revegetation. This site is under the syupervision of the U.S. Army Corps of Engineers and slated for full planting of native species when the invasives are controled. Reduction of tidal influence will help reduce the erosive forces on site until this revegetation takes hold.

Signed: Erik Lem Date: 7/8/24

Return completed form to: **Board of Pesticides Control, 28 State House Station, Augusta, ME 04333-0028**
OR E-mail to: pesticides@maine.gov



Areas A-E are Phragmites infestations to be managed. A is the largest (~1.7ac) and in the most sensitive area

Area A, outer edge.

Area A, July 12, 2023. On temporary dam/access road.

Area A, mowed on August 24, 2023.

Area C

GROUP 9 HERBICIDE

ALLIGARE

GLYPHOSATE 5.4

Specimen Label

AVOID CONTACT OF HERBICIDE WITH FOLIAGE, GREEN STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES BECAUSE SEVERE INJURY OR DESTRUCTION MAY RESULT.

ACTIVE INGREDIENT:
Glyphosate*, N-(phosphonomethyl)glycine,
in the form of its isopropylamine salt 53.8%
OTHER INGREDIENTS: 46.2%
TOTAL: 100.0%

*Contains 648 grams per litre or 5.4 pounds per U.S. gallon of the active ingredient glyphosate, in the form of its isopropylamine salt. Equivalent to 480 grams per litre or 4 pounds per U.S. gallon of the acid, glyphosate.

EPA Reg. No. 81927-8

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID	
IF INHALED:	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. • Call a poison control center or doctor for further treatment advice.
HOT LINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-424-9300 for emergency medical treatment information.	

Manufactured for: Alligare, LLC
13 N. 8th Street
Opelika, AL 36801

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Harmful if inhaled. Avoid breathing spray mist. Remove and wash contaminated clothing before reuse.

DOMESTIC ANIMALS: This product is considered to be relatively nontoxic to dogs and other domestic animals; however, ingestion of this product or large amounts of freshly sprayed vegetation may result in temporary gastrointestinal irritation (vomiting, diarrhea, colic, etc.). If such symptoms are observed, provide the animal with plenty of fluids to prevent dehydration. Call a veterinarian if symptoms persist for more than 24 hours.

PERSONAL PROTECTIVE EQUIPMENT

Applicators and other handlers must wear:
- Long-sleeved shirt and long pants;
- Shoes plus socks

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

ENGINEERING CONTROL STATEMENT

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 thoroughly after handling, and 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.
- 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

For Aquatic Uses: Do not contaminate water when 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.

For Terrestrial Uses: 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 disposing of equipment washwaters.

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. 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, waterproof gloves, 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 to prevent transfer of this product onto desirable vegetation.

STORAGE AND DISPOSAL

Do not contaminate water, foodstuffs, 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 68ºF (20˚C) for several days to redissolve and roll or shake container or recirculate in mini-bulk or bulk container to mix well before using.
Pesticide Disposal: Wastes resulting from the 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. Emptied container retains vapor and product residue. Observe all labeled safeguards until container is cleaned, reconditioned, or destroyed.
Container Handling:
[NONREFILLABLE CONTAINERS]
Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying.
(Nonrefillable container ≤ 5 gallons): 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 if available 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.
(Nonrefillable > 5 gallons): 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 offer for recycling if available 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.
[REFILLABLE CONTAINERS]
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 mix tank. Fill the container about 10 percent full with water. Agitate vigorously or recirculate water with the pump for 2 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, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

Read the entire label before using this product.
Use only according to label instructions.
Not all products listed on this label are registered for use in California. Check the registration status of each product in California before using.
Read the "CONDITIONS OF SALE AND WARRANTY" statement at the end of the label before buying or using. If terms are not acceptable, return at once unopened.

RESISTANCE MANAGEMENT

Glyphosate 5.4 is a Group 9 herbicide. Any weed population may contain or develop plants naturally resistant to Glyphosate 5.4 and other Group 9 herbicides. Weed species with acquired resistance to Group 9 may eventually dominate the weed population if Group 9 herbicides are used repeatedly in the same field or in successive years as the primary method of control for targeted species. This may result in partial or total loss of control of those species by Glyphosate 5.4 or other Group 9 herbicides.

To delay herbicide resistance consider:

- Avoiding the consecutive use of Glyphosate 5.4 or other target site of action Group 9 herbicides that might have a similar target site of action, on the same weed species.
- Using tank mixtures or premixes with herbicides from different target site of action Groups as long as the involved products are all registered for the same use, have different sites of action and are both effective at the tank mix or premix rate on the weed(s) of concern.
- Basing herbicide use on a comprehensive Integrated Pest Management (IPM) program.
- Monitoring treated weed populations for loss of field efficacy.
- Contacting your local extension specialist, certified crop advisors and/or manufacturer for herbicide resistance management and /or integrated weed management recommendations for specific crops and resistant weed biotypes.

AQUATIC AND NON-CROP USES

USE INFORMATION

This product, a water-soluble liquid, mixes readily with water and nonionic surfactant to be applied as a foliar spray for the control or destruction of many herbaceous and woody plants.

This product moves through the plant from the point of foliage contact to and into the root system. Visible effects on most annual weeds occur within 2 to 4 days but on most perennial brush species may not occur for 7 days or more. Extremely cool or cloudy weather following treatment may slow the activity of this product and delay visual effects of control. Visible effects are a gradual wilting and yellowing of the plant which advances to complete browning of above-ground growth and deterioration of underground plant parts.

Unless otherwise directed on this label, delay application until vegetation has emerged and reached the stages described for control of such vegetation under the "Weeds Controlled" section of this label.

Unemerged plants arising from unattached underground rhizomes or root stocks of perennials or brush will not be affected by the spray and will continue to grow. For this reason best control of most perennial weeds or brush is obtained when treatment is made at late growth stages approaching maturity.

Always use the higher rate of this product per acre within the specified range when vegetation is heavy or dense.

Do not treat weeds or brush under poor growing conditions such as drought stress, disease or insect damage, as reduced control may result. Reduced results may also occur when treating weeds or brush heavily covered with dust.

Reduced control may result when applications are made to any weed or brush species that have been mowed, grazed or cut, and have not been allowed to regrow to the specified stage for treatment.

Rainfall or irrigation occurring within 6 hours after application may reduce effectiveness. Heavy rainfall or irrigation within 2 hours after application may wash the product off the foliage and a repeat treatment may be required.

When this product comes in contact with soil (on the soil surface or as suspended soil or sediment in water) it is bound to soil particles. Under specified use situations, once this product is bound to soil particles, it is not available for plant uptake and will not harm off-site vegetation where roots grow into the treatment area or if the soil is transported off-site. Under specified use conditions, the strong affinity of this product to soil particles prevents this product from leaching out of the soil profile and entering ground water. The affinity between this product and soil particles remains until this product is degraded, which is primarily a biological degradation process carried out under both aerobic and anaerobic conditions by soil microflora.

This product does not provide residual weed control. For subsequent residual weed control, follow a label-approved herbicide program. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used.

The maximum use rates stated throughout this product's labeling apply to this product combined with the use of all other herbicides containing glyphosate or sulfosate as the active ingredient, whether applied as mixtures or separately. Calculate application rates and ensure that **the total use** of this and other glyphosate or sulfosate containing products does not exceed stated maximum use rate.

To the extent consistent with applicable law, buyer and all users are responsible for all loss or damage in connection with the use or handling or mixtures of this product or other materials that are not expressly listed in this label. Mixing this product with herbicides or other materials not specified in this label may result in reduced performance.

ATTENTION

AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants or other areas on which treatment was not intended. The likelihood of 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.

MIXING AND APPLICATION INSTRUCTIONS

APPLY THESE SPRAY SOLUTIONS IN PROPERLY MAINTAINED AND CALIBRATED EQUIPMENT CAPABLE OF DELIVERING DESIRED VOLUMES. HAND-GUN APPLICATIONS SHOULD BE PROPERLY DIRECTED TO AVOID SPRAYING DESIRABLE PLANTS. NOTE: REDUCED RESULTS MAY OCCUR IF WATER CONTAINING SOIL IS USED, SUCH AS WATER FROM PONDS AND UNLINED DITCHES.

Mixing

This product mixes readily with water. Mix spray solutions of this product as follows: fill the mixing or spray tank with the required amount of water while adding the required amount of this product (see the "Directions for Use" and "Weeds Controlled" sections of this label). Near the end of the filling process, add the required surfactant and mix well. Remove hose from tank immediately after filling to avoid siphoning back into the water source. During mixing and application, foaming of the spray solution may occur. To prevent or minimize foam, avoid the use of mechanical agitators, place the filling hose below the surface of the spray solution, terminate by-pass and return lines at the bottom of the tank and if needed use an approved anti-foam or defoaming agent.

Keep by-pass line on or near bottom of tank to minimize foaming. Screen size in nozzle or line strainers should be no finer than 50 mesh. Carefully select correct nozzle to avoid spraying a fine mist. For best results with conventional ground application equipment, use flat fan nozzles. Check for even distribution of spray droplets.

When using this product, mix 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution. Use a nonionic surfactant labeled for use with herbicides. The surfactant must contain 50 percent or more active ingredient.

Always read and follow the manufacturer's surfactant label recommendations for best results.

These surfactants should not be used in excess of 1 quart per acre when making broadcast applications.

Colorants or marking dyes approved for use with herbicides may be added to spray mixtures of this product. Colorants or dyes used in spray solutions of this product may reduce performance, especially at lower rates or dilutions. Use colorants or dyes according to the manufacturer's label recommendations.

Clean sprayer and parts immediately after using this product by thoroughly flushing with water and dispose of rinsate according to labeled use or disposal instructions.

Carefully observe all cautionary statements and other information appearing in the surfactant label.

APPLICATION EQUIPMENT AND TECHNIQUES

Aerial Equipment

Use the specified rates of this product and surfactant in 3 to 20 gallons of water per acre as a broadcast spray, unless otherwise specified. See the "Weeds Controlled" section of this label for specific rates. Aerial applications of this product may only be made as specifically directed in this label.

AVOID DRIFT – DO NOT APPLY DURING INVERSION CONDITIONS, WHEN WINDS ARE GUSTY OR UNDER ANY OTHER CONDITION WHICH WILL ALLOW DRIFT. DRIFT MAY CAUSE DAMAGE TO ANY VEGETATION CONTACTED TO WHICH TREATMENT IS NOT INTENDED. TO PREVENT INJURY TO ADJACENT DESIRABLE VEGETATION, APPROPRIATE BUFFER ZONES MUST BE MAINTAINED.

Coarse sprays are less likely to drift; therefore, do not use nozzles or nozzle configurations which dispense spray as fine spray droplets. Do not angle nozzles forward into the airstream and do not increase spray volume by increasing nozzle pressure.

Drift control additives may be used. When a drift control additive is used, read and carefully observe the cautionary statements and all other information appearing in the additive label.

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

Thoroughly wash aircraft, especially landing gear, after each day of spraying to remove residues of this product accumulated during spraying or from spills. PROLONGED EXPOSURE OF THIS PRODUCT TO UNCOATED STEEL SURFACES MAY RESULT IN CORROSION AND POSSIBLE FAILURE OF THE PART. LANDING GEAR ARE MOST

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

AERIAL SPRAY DRIFT MANAGEMENT

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 is responsible for considering all these factors when making decisions.

The following drift management requirements must be followed to avoid off-target movement from aerial applications to agricultural field crops. These requirements do not apply to forestry applications, public health uses or to applications using dry formulations.

1. The distance of the outer most nozzles on the boom must not exceed ¾ the length of the wingspan or rotor.
2. Nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees.

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

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

Aerial Drift Reduction Advisory
[This section is advisory in nature and does not supersede the mandatory label requirements.]

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 ¾ 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 target plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces exposure of droplets to evaporation and wind.

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

WIND
Drift potential is lowest between wind speeds of 2-10 mph. However, many factors, including droplet size and equipment type determine drift potential at any given speed. Do not apply 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 must not occur during a temperature inversion because drift potential is high. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud. This cloud can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a 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 must 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).

For Aerial Application in California Only

Aquatic and Other Noncrop Sites:
When applied as directed and under the conditions described in the "Weeds Controlled" section of this label booklet, this product will control or partially control the labeled weeds growing in the following industrial, recreational and public areas or other similar sites.

Aquatic Sites – Including all bodies of fresh and brackish water which may be flowing, nonflowing, or transient. This includes 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:

There is no restriction on the use of treated water for irrigation, recreation, or domestic purposes.

Consult local state fish and game agency and water control authorities before applying this product to public water. Permit may be required to treat such water.

NOTE: Do not apply this product within ½ mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within ½ mile of an active potable water intake in a standing body of water such as lake, pond, or reservoir. To make aquatic applications around and within ½ 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 part 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.

This product does not control plants which are completely submerged or have a majority of their foliage under water.

Aerial Applications:
Aerial applications may be made with helicopters only.

Use the following guidelines when aerial applications are to be made near perennial crops after bud break and before total leaf drop and/or near emerged annual crops.
1. Do not apply within a minimum of 100 feet of all crops.
2. If wind up to 5 miles per hour is blowing toward the crop(s), do not apply within a minimum of 500 feet of the crop(s).
3. Winds blowing from 5 to 10 miles per hour toward the crops(s) may require buffer zones in excess of the 500 feet minimum.
4. Do not apply when winds are in excess of 10 miles per hour or when inversion conditions exist.

For Aerial Application in Fresno County, California Only From February 15 through March 31 Only

Applicable Area:
The area contained inside the following boundaries within Fresno County, California.

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

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

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 Recommendations:
A written recommendation MUST be submitted by or on behalf of the applicator to the Fresno County Agricultural Commissioner 24 hours prior to the application. This written recommendation MUST state the proximity of surrounding crops, and that conditions of each manufacturer's applicable 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 ensure 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.

Note: For aerial application from April 1 through February 14, refer to the "**For Aerial Application in California Only**" section of this label.

Boom Equipment

For control of weed or brush species listed in this section using conventional boom equipment – Use the specified rates of this product and surfactant in 3 to 30 gallons of water per acre as a broadcast spray, unless otherwise specified. See the "Weeds Controlled" section of this label for specific rates. As density of vegetation increases, spray volume should be increased within the specified range to ensure complete coverage. Carefully select correct nozzle to avoid spraying a fine mist. For best results with ground application equipment, use flat fan nozzles. Check for even distribution of spray droplets.

Hand-Held and High-Volume Equipment

Use Coarse Sprays Only

For control of weeds listed in this section using knapsack sprayers or high-volume spraying equipment utilizing handguns or other suitable nozzle arrangements – Prepare a ¾ 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 of this label.

Applications should be made on a spray-to-wet basis. Spray coverage should be uniform and complete. Do not spray to point of runoff.

This product may be used as a 5 to 8 percent solution 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. 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. Small, open-branched trees need only be treated from one side. If the foliage is thick or there are multiple root sprouts, applications must be made from several sides to ensure adequate spray coverage.

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

Spray Solution

Desired Volume	Amount of Glyphosate 5.4					
	3/4%	1%	1 1/4%	1 1/2%	5%	8%
1 Gal	1 oz	1 1/3 oz	1 2/3 oz	2 oz	6 1/2 oz	10 1/4 oz
25 Gal	1 1/2 pt	1 qt	1 1/4 qt	1 1/2 qt	5 qt	2 gal
100 Gal	3 qt	1 gal	1 1/4 gal	1 1/2 gal	5 gal	8 gal

2 tablespoons = 1 fluid ounce

For use in knapsack sprayers, it is suggested that the specified amount of this product be mixed with water in a larger container. Fill sprayer with the mixed solution and add the correct amount of surfactant.

WEEDS CONTROLLED

Annual Weeds

Apply to actively growing annual grasses and broadleaf weeds.

Allow at least 3 days after application before disturbing treated vegetation. After this period the weeds may be mowed, tilled or burned. See "Directions for Use," "Product Information" and "Mixing and Application Instructions" for labeled uses and specific application instructions.

Broadcast Application – Use 1 ½ pints of this product per acre plus 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution if weeds are less than 6 inches tall. If weeds are greater than 6 inches tall, use 2 ½ pints of this product per acre plus 2 or more quarts of an approved nonionic surfactant per 100 gallons of spray solution.

Hand-Held, High-Volume Application – Use a ¾ percent solution of this product in water plus 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution and apply to foliage of vegetation to be controlled.

When applied as directed under the conditions described in this label, this product plus nonionic surfactant WILL CONTROL the following ANNUAL WEEDS:

Balsamapple**
Momordica charantia
Barley
Hordeum vulgare
Barnyardgrass
Echinochloa crus-galli
Bassia, fivehook
Bassia hyssopifolia
Bluegrass, annual
Poa annua
Bluegrass, bulbous
Poa bulbosa
Brome
Bromus spp.
Buttercup
Ranunculus spp.
Cheat
Bromus secalinus
Chickweed, mouseear
Cerastium vulgatum
Foxtail, Carolina
Alopecurus carolinianus
Groundsel, common
Senecio vulgaris
Horseweed/Marestail
Conyza canadensis
Kochia
Kochia scoparia
Lambsquarters, common
Chenopodium album
Lettuce, prickly
Lactuca serriola
Morningglory
Ipomoea spp.
Mustard, blue
Chorispora tenella
Mustard, tansy
Descurainia pinnata
Mustard, tumble
Sisymbrium altissimum
Rye
Secale cereale
Ryegrass, Italian*
Lolium multiflorum
Sandbur, field
Cenchrus spp.
Shattercane
Sorghum bicolor
Shepherdspurse
Capsella bursa-pastoris
Signalgrass, broadleaf
Brachiaria platyphylla
Smartweed, Pennsylvania
Polygonum pensylvanicum
Sowthistle, annual
Sonchus oleraceus
Spanishneedles*
Bidens bipinnata
Stinkgrass
Eragrostis cilianensis
Cocklebur
Xanthium strumarium
Corn, volunteer
Zea mays
Crabgrass
Digitaria spp.
Dwarfdandelion
Krigia cespitosa
Falseflax, smallseed
Camelina microcarpa
Fiddleneck
Amsinckia spp.
Flaxleaf fleabane
Conyza bonariensis
Fleabane
Erigeron spp.
Foxtail
Setaria spp.
Mustard, wild
Sinapis arvensis
Oats, wild
Avena fatua
Panicum
Panicum spp.
Pennycress, field
Thlaspi arvense
Pigweed, redroot
Amaranthus retroflexus
Pigweed, smooth
Amaranthus hybridus
Ragweed, common
Ambrosia artemisiifolia
Ragweed, giant
Ambrosia trifida
Rocket, London
Sisymbrium irio
Sunflower
Helianthus annuus
Thistle, Russian
Salsola kali
Spurry, umbrella
Holosteum umbellatum
Velvetleaf
Abutilon theophrasti
Wheat
Triticum aestivum
Witchgrass
Panicum capillare

*Apply 3 pints of this product per acre.
**Apply with hand-held equipment only.

Annual weeds will generally continue to germinate from seed throughout the growing season. Repeat treatments will be necessary to control later germinating weeds.

Perennial Weeds

Apply this product as follows to control or destroy most vigorously growing perennial weeds. Unless otherwise directed, allow at least 7 days after application before disturbing vegetation.

Add 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution to the rates of this product given in this list. See the "Product Information," "Directions for Use" and "Mixing and Application" sections in this label for specific uses and application instructions.

NOTE: If weeds have been mowed or tilled, do not treat until regrowth has reached the specified stages. Fall treatments must be applied before a killing frost.

Repeat treatments may be necessary to control weeds regenerating from underground parts or seed.

When applied as directed under the conditions described, this product plus surfactant WILL CONTROL the following PERENNIAL WEEDS:

Alfalfa
Medicago sativa
Alligatorweed*
Alternanthera philoxeroides
Anise/Fennel
Foeniculum vulgare
Artichoke, Jerusalem
Helianthus tuberosus
Bahiagrass
Paspalum notatum
Beachgrass, European***
Ammophila arenaria
Bermudagrass
Cynodon dactylon
Bindweed, field
Convolvulus arvensis
Bluegrass, Kentucky
Poa pratensis
Blueweed, Texas
Helianthus ciliaris
Brackenfern
Pteridium spp.
Bromegrass, smooth
Bromus inermis
Canarygrass, reed
Phalaris arundinacea
Cattail
Typha spp.
Clover, red
Trifolium pratense
Clover, white
Trifolium repens
Cogongrass
Imperata clylindrica
Quackgrass
Agropyron repens
Reed, giant
Arundo donax
Ryegrass, perennial
Lolium perenne
Smartweed, swamp
Polygonum coccineum
Spatterdock
Nuphar luteum
Starthistle, yellow
Centaurea solstitialis
Sweet potato, wild*
Ipomoea pandurata
Thistle, artichoke
Cynara cardunculus
Thistle, Canada
Cirsium arvense
Cordgrass
Spartina spp.
Cutgrass, giant*
Zizaniopsis miliacea
Dallisgrass
Paspalum dilatatum
Dandelion
Taraxacum officinale
Dock, curly
Rumex crispus
Dogbane, hemp
Apocynum cannabinum
Fescue
Festuca spp.
Fescue, tall
Festuca arundiracea
Guineagrass
Panicum maximum
Hemlock, poison
Conium maculatum
Horsenettle
Solanum carolinense
Horseradish
Armoracia rusticana
Ice Plant
Mesembryanthemum crystallinum
Johnsongrass
Sorghum halepense
Kikuyugrass
Pennisetum clandestinum
Knapweed
Centaurea repens
Lantana
Lantana camara
Timothy
Phleum pratense
Torpedograss*
Panicum repens
Tules, common
Scirpus acutus
Vaseygrass
Paspalum urvillei
Velvetgrass
Holcus spp.
Waterhyacinth
Eichornia crassipes
Waterlettuce
Pistia stratiotes
Waterprimrose
Ludwigia spp.
Wheatgrass, western
Agropyron smithii
Lespedeza: common, serices
Lespedeza striata
Lespedeza cuneata
Loosestrife, purple
Lythrum salicaria
Lotus, American
Nelumbo lutea
Maidencane
Panicum hematomon
Milkweed
Asclepias spp.
Muhly, wirestem
Muhlenbergia frondosa
Mullein, common
Verbascum thapsus
Napiergrass
Pennisetum purpureum
Nightshade, silverleaf
Solanum elaeagnifolium
Nutsedge: purple, yellow
Cyperus rotundus
Cyperus esculentus
Orchardgrass
Dactylis glomerata
Pampasgrass
Cortaderia jubata
Paragrass
Brachiaria mutica
Phragmites**
Phragmites spp.

*Partial control.
**Partial control in southeastern states. See specific directions below.
***Washington and Oregon only.

Alligatorweed – Apply 6 pints of this product per acre as a broadcast spray or as a 1¼ percent solution with hand-held equipment to provide partial control of alligatorweed. Apply when most of the target plants are in bloom. Repeat applications will be required to maintain such control.

Beachgrass, European (Washington and Oregon only) – Best results are obtained when applications are made when European beachgrass is actively growing through the boot to the full heading stages of growth. Applications should be made prior to the loss of more than 50% green leaf color in the fall.

Applications made during any period of plant (drought) stress, or beyond the recommended active growth period in the fall, will likely result in reduced performance.

Repeat applications of Glyphosate 5.4 may be necessary to treat skips. Monitor treated acres prior to reseeding of desirable vegetation.

Spray-to-Wet Applications:
Apply an 8 percent solution of this product plus 0.5 to 1.5 percent nonionic surfactant on a spray-to-wet basis for control of European beachgrass.

Spray coverage should be uniform and complete but not to the point of runoff.

Wiper Applications:
For selective control of European beachgrass, apply a 33 1/3 percent solution of this product plus 1 to 2.5 percent nonionic surfactant during active growth. Avoid contact of herbicide solution with desirable vegetation. Wiping the plants in opposite directions may improve performance. Maximizing the amount of individual leaf tissue contacted with the wiping equipment will result in optimal performance.

Bermudagrass – Apply 7 ½ pints of this product per acre as a broadcast spray or as a 1½ percent solution with hand-held equipment. Apply when target plants are actively growing and when seed heads appear.

Bindweed, field/Silverleaf Nightshade/Texas Blueweed – Apply 6 to 7 ½ pints of this product per acre as a broadcast spray west of the Mississippi River and 4 ½ to 6 pints of this product per acre east of the Mississippi River. With hand-held equipment, use a 1 ½ percent solution. Apply when target plants are actively growing and are at or beyond full bloom. For silverleaf nightshade, best results can be obtained when application is made after berries are formed. Do not treat when weeds are under drought stress. New leaf development indicates active growth. For best results apply in late summer or fall.

Brackenfern – Apply 4 ½ to 6 pints of this product per acre as a broadcast spray or as a ¾ to 1 percent solution with hand-held equipment. Apply to fully expanded fronds which are at least 18 inches long.

Cattail – Apply 4 ½ to 6 pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Apply when target plants are actively growing and are at or beyond the early-to-full bloom stage of growth. Best results are achieved when application is made during the summer or fall months.

Cogongrass – Apply 4 ½ to 7 ½ pints of this product per acre as a broadcast spray. Apply when cogongrass is at least 18 inches tall and actively growing in late summer or fall. Allow 7 or more days after application before tillage or mowing. Due to uneven stages of growth and the dense nature of vegetation preventing good spray coverage, repeat treatments may be necessary to maintain control.

Cordgrass – Broadcast Applications (Air) – Apply 4 to 7 ½ pints of this product in 5-20 gallons of spray solution per acre. Add 1 to 2 quarts of nonionic surfactant per 100 gallons of spray solution.

Broadcast Applications (Ground) – Apply 4 to 7 ½ pints of this product in 10 to 60 gallons of spray solution per acre. For best results, ensure that complete coverage of cordgrass clumps is achieved. Add 1 to 2 quarts of a nonionic surfactant per 100 gallons of spray solution.

Hand-Held and High Volume Equipment - Apply a 2 to 8 percent solution of this product. Ensure that complete coverage of cordgrass clumps is achieved. Do not spray to the point of run-off. Add 1 to 2 quarts of a nonionic surfactant per 100 gallons of spray solution.

Wiper Applications - For wick or wiper applications, mix 1 gallon of this product with 2 gallons of clean water to make a 33 percent solution. Addition of a nonionic surfactant at a rate of 10 percent by volume of the total herbicide solution is recommended.

In heavy stands, a double application in opposite directions may improve results.

Application Conditions - Schedule applications in order to allow 6 hours before treated plants are covered by tidewater. Rainfall or immersion within 6 hours after application may reduce effectiveness.

The presence of debris and silt on the cordgrass plants will reduce performance of this product. It may be necessary to wash targeted plants prior to application to improve uptake of this product into the plant. Where cordgrass has been cut or mowed prior to application with Glyphosate 5.4, ensure adequate regrowth of cordgrass occurs to allow for interception or absorption of the herbicide solution.

Cutgrass, giant – Apply 6 pints of this product per acre as a broadcast spray or as a 1 percent solution with hand-held equipment to provide partial control of giant cutgrass. Repeat applications will be required to maintain such control, especially where vegetation is partially submerged in water. Allow for substantial regrowth to the 7 to 10-leaf stage prior to retreatment.

Dogbane, hemp/Knapweed/Horseradish – Apply 6 pints of this product per acre as a broadcast spray or as a 1-½ percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth. For best results, apply in late summer or fall.

Fescue, tall – Apply 4 ½ pints of this product per acre as a broadcast spray or as a 1 percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained.

Guineagrass – Apply 4 ½ pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Apply when target plants are actively growing and when most have reached at least the 7-leaf stage of growth.

Johnsongrass/Bluegrass, Kentucky/Bromegrass, smooth/Canarygrass, reed/Orchardgrass/Ryegrass, perennial/Timothy/Wheatgrass, western – Apply 3 to 4 ½ pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained. In the fall, apply before plants have turned brown.

Lantana – Apply this product as a ¾ to 1 percent solution with hand-held equipment. Apply to actively growing lantana at or beyond the bloom stage of growth. Use the higher application rate for plants that have reached the woody stage of growth.

Loosestrife, purple – Apply 4 pints of this product per acre as a broadcast spray or as a 1 to 1-½ percent solution using hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost.

Lotus, American – Apply 4 pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost. Repeat treatment may be necessary to control regrowth from underground parts and seeds.

Maidencane/Paragrass – Apply 6 pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Repeat treatments will be required, especially to vegetation partially submerged in water. Under these conditions, allow for regrowth to the 7 to 10-leaf stage prior to retreatment.

Milkweed, common – Apply 4 ½ pints of this product per acre as a broadcast spray or as a 1-½ percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth.

Nutsedge: purple, yellow – Apply 4 ½ pints of this product per acre as a broadcast spray, or as a ¾ percent solution with hand-held equipment to control existing nutsedge plants and immature nutlets attached to treated plants. Apply when target plants are in flower or when new nutlets can be found at rhizome tips. Nutlets which have not germinated will not be controlled and may germinate following treatment. Repeat treatments will be required for long-term control.

Pampasgrass – Apply a 1-½ percent solution of this product with hand-held equipment when plants are actively growing.

Phragmites – For partial control of phragmites in Florida and the counties of other states bordering the Gulf of Mexico, apply 7 ½ pints per acre as a broadcast spray or apply a 1-½ percent solution with hand-held equipment. In other areas of the U.S., apply 4 to 6 pints per acre as a broadcast spray or apply a ¾ percent solution with hand-held equipment for partial control. For best results, treat during late summer or fall months when plants are actively growing and in full bloom. Due to the dense nature of the vegetation, which may prevent good spray coverage and uneven stages of growth, repeat treatments may be necessary to maintain control. Visual control symptoms will be slow to develop.

Quackgrass/Kikuyugrass/Muhly, wirestem – Apply 3 to 4 ½ pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment when most quackgrass or wirestem muhly is at least 8 inches in height (3 to 4-leaf stage of growth) and actively growing. Allow 3 or more days after application before tillage.

Reed, giant/ice plant – For control of giant reed and ice plant, apply a 1-½ percent solution of this product with hand-held equipment when plants are actively growing. For giant reed, best results are obtained when applications are made in late summer or fall.

Spatterdock – Apply 6 pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment. Apply when most plants are in full bloom. For best results, apply during the summer or fall months.

Sweet potato, wild – Apply this product as a 1-½ percent solution using hand-held equipment. Apply to actively growing weeds that are at or beyond the bloom stage of growth. Repeat applications will be required. Allow the plant to reach the specified stage of growth before retreatment.

Thistle: Canada, artichoke – Apply 3 to 4 ½ pints of this product per acre as a broadcast spray or as a 1 ½ percent solution with hand-held equipment for Canada thistle. To control artichoke thistle, apply a 2 percent solution as a spray-to-wet application. Apply when target plants are actively growing and at or beyond the bud stage of growth.

Torpedograss – Apply 6 to 7 ½ pints of this product per acre as a broadcast spray or as a ¾ to 1 ½ percent solution with hand-held equipment to provide partial control of torpedograss. Use the lower rates under terrestrial conditions, and the higher rates under partially submerged or a floating mat condition. Repeat treatments will be required to maintain such control.

Tules, common – Apply this product as a 1-½ percent solution with hand-held equipment. Apply to actively growing plants at or beyond the seedhead stage of growth. After application, visual symptoms will be slow to appear and may not occur for 3 or more weeks.

Waterhyacinth – Apply 5 to 6 pints of this product per acre as a broadcast spray or apply a ¾ to 1 percent solution with hand-held equipment. Apply when target plants are actively growing and at or beyond the early bloom stage of growth. After application, visual symptoms may require 3 or more weeks to appear with complete necrosis and decomposition usually occurring within 60 to 90 days. Use the higher rates when more rapid visual effects are desired.

Waterlettuce – For control, apply a ¾ to 1 percent solution of this product with hand-held equipment to actively growing plants. Use higher rates where infestations are heavy. Best results are obtained from mid-summer through winter applications. Spring applications may require retreatment.

Waterprimrose – Apply this product as a ¾ percent solution using hand-held equipment. Apply to plants that are actively growing at or beyond the bloom stage of growth, but before fall color changes occur. Thorough coverage is necessary for best control.

Other perennials listed on this label – Apply 4 ½ to 7 ½ pints of this product per acre as a broadcast spray or as a ¾ to 1 ½ percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached early head or early bud stage of growth.

WOODY BRUSH AND TREES

When applied as specified under the conditions described, this product plus surfactant CONTROLS or PARTIALLY CONTROLS the following woody brush plants and trees:

Alder
Alnus spp.

Ash*
Fraxinus spp.
Aspen, quaking
Populus tremuloides
Bearclover, Bearmat
Chamaebatia foliolosa
Birch
Betula spp.
Blackberry
Rubus spp.
Broom:
French
Cytisus monspessulanus
Cherry:
Bitter
Prunus emarginata
Black
Prunus serotina
Pin
Prunus pensylvanica
Coyote brush
Baccharis consanguinea
Creeper, Virginia*
Parthenocissus quinquefolia
Dewberry
Rubus trivialis
Dogwood
Cornus spp.
Elderberry
Sambucus spp.
Elm*
Ulmus spp.
Eucalyptus, bluegum
Eucalyptus globules
Hasardia*
Haplopappus squamosus
Hawthorn
Crataegus spp.
Hazel
Corylus spp.
Hickory
Carya spp.
Holly, Florida; Brazilian Peppertree
Schinus terebinthifolius
Honeysuckle
Lonicera spp.
Hornbeam, American
Carpinus caroliniana
Kudzu
Pueraria lobata
Locust, black*
Robinia pseudoacacia
Manzanita
Arctostaphylos spp.
Sage: black, white
Salvia spp.
Sagebrush, California
Artemisia californica
Salmonberry
Rubus spectabilis
Salt cedar*
Tamarix spp.

Broom:
Scotch
Cytisus scoparius
Buckwheat, California*
Eriogonum fasciculatum
Cascara*
Rhamnus purshiana
Catsclaw*
Acacia greggi
Ceanothus
Ceanothus spp.
Chamise
Adenostoma fasciculatum

Maple:
Red**
Acer rubrum
Sugar
Acer saccharum
Vine*
Acer circinatum
Monkey Flower*
Mimulus guttatus
Oak:
Black*
Quercus velutina
Northern pine
Quercus palustris
Post
Quercus stellata
Red
Quercus rubra
Southern red
Quercus falcata
White*
Quercus alba
Persimmon*
Diospyros spp.
Poison Ivy
Rhus radicans

Poison Oak
Rhus toxicodendron
Poplar, yellow*
Liriodendron tulipifera
Prunus
Prunus spp.
Raspberry
Rubus spp.
Redbud, eastern
Cercis canadensis
Rose, multiflora
Rosa multiflora
Russian-olive
Elaeagnus angustifolia
Sweet gum
Liquidambar styraciflua
Swordfern*
Polystichum munitum
Tallowtree, Chinese
Sapium sebiferum
Thimbleberry
Rubus parviflorus
Tobacco, tree*
Nicotiana glauca

Saltbush, Sea myrtle
Baccharis halimifolia
Sassafras
Sassafras aibidum
Sourwood*
Oxydendrum arboreum
Sumac:
Poison*
Rhus vernix
Smooth*
Rhus glabra
Winged*
Rhus copallina

Trumpetcreeper
Campsis radicans
Waxmyrtle, southern*
Myrica cerifera
Willow
Salix spp.

*Partial Control
**See below for control or partial control instruction.

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.

Apply the specified rate of this product plus 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution when plants are actively growing and, unless otherwise directed, after full-leaf expansion. Use the higher rate for larger plants and/or dense areas of growth. On vines, use the higher rate for plants that have reached the woody stage of growth. Best results are obtained when application is made in late summer or fall after fruit formation.

In arid areas, best results are obtained when application is made in the spring or early summer when brush species are at high moisture content and are flowering. Ensure thorough coverage when using hand-held equipment. Symptoms may not appear prior to frost or senescence with fall treatment.

Allow 7 or more days after application before tillage, mowing or removal. Repeat treatments may be necessary to control plants regenerating from underground parts or seed. Some autumn colors on undesirable deciduous species are acceptable provided no major leaf drop has occurred. Reduced performance may result if fall treatments are made following a frost.

See the “Directions for Use” and “Mixing and Application Instructions” sections in this label for labeled use and specific application instructions.

Applied as a 5 to 8 percent solution as a directed application as described in the “Hand-Held and High-Volume Equipment” section, this product will control or partially control all species listed in this section of this label. Use the higher rate of application for dense stands and larger woody brush and trees.

Apply the product as follows to control or partially control the following woody brush and trees.

Alder/Blackberry/Dewberry/Honeysuckle/Oak, Post/Raspberry – For control, apply 4 ½ to 6 pints per acre as a broadcast spray or as a ¾ to 1 ¼ percent solution with hand-held equipment.

Aspen, Quaking/Hawthorn/Trumpetcreeper – For control, apply 3 to 4 ¼ pints of this product per acre as a broadcast spray or as a ¾ to 1 ¼ percent solution with hand-held equipment.

Birch/Elderberry/Hazel/Salmonberry/Thimbleberry – For control, apply 3 pints per acre of this product as a broadcast spray or as a ¾ percent solution with hand-held equipment.

Broom: French, Scotch – For control, apply a 1 ¼ to 1 ½ percent solution with hand-held equipment.

Buckwheat, California/Hasardia/Monkey Flower/Tobacco, Tree – For partial control of these species, apply a ¾ to 1 ½ percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Catsclaw – For partial control, apply a 1 ¼ to 1 ½ percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Cherry: Bitter, Black, Pin/Oak, Southern Red/Sweet Gum/Prunus – For control, apply 3 to 7 ½ pints of this product per acre as a broadcast spray or as a 1 to 1 ½ percent solution with hand-held equipment.

Coyote brush – For control, apply a 1 ¼ to 1 ½ percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Dogwood/Hickory/Salt cedar – For partial control, apply a 1 to 2 percent solution of this product with hand-held equipment or 6 to 7 ½ pints per acre as a broadcast spray.

Eucalyptus, bluegum – For control of eucalyptus resprouts, apply a 1-½ percent solution of this product with hand-held equipment when resprouts are 6 to 12-feet tall. Ensure complete coverage. Apply when plants are actively growing. Avoid application to drought-stressed plants.

Holly, Florida (Brazilian peppertree (*Schinus terebinthifolius*)) – For partial control, apply this product as a 1-½ percent solution with hand-held equipment.

Alternatively, when applied as directed, this product with QuikSorb™ Penetrant will control or partially control Brazilian peppertree in areas such as dry drainage ditches and canals, wildlife habitat restoration and management areas, roadsides, railroads, fence rows, and similar non-crop areas.

The recommended application technique is directed spot treatment of Brazilian peppertree using hand-held equipment only. Apply this product using backpack, hand-held, handgun or similar equipment. Use flat fan, cone, or similar nozzles that will provide effective spray coverage of target vegetation. Do not apply to Brazilian peppertree growing in water. The use of aerial, boom-type or other broadcast spray equipment is not recommended. These applications are more effective on small brush less than 15 feet in height or 3-inch stem diameter.

Basal and Selective Stem Application:
Apply a solution consisting of 25% v/v of this product and 75% v/v of QuikSorb™ penetrant. Completely cover the lower 18-24 inches of the brush stems or trunks. For larger stems over 3 inches in diameter, treat up to 48 inches or higher from the ground level. For better control of large trees, apply spray solution directly to upper foliage of plant canopy. Spray coverage should be uniform, covering at least 40 to 60% of the upper foliage and stems. Application is best when made to young, actively growing stems, branches and foliage. Spray-to-wet but not to the point of run-off.

Read and carefully observe the label claims, cautionary statements, and all information on the labels of all products used in this tank mixture.

Kudzu – For control, apply 6 pints of this product per acre as a broadcast spray or as a 1-½ percent solution with hand-held equipment. Repeat applications will be required to maintain control.

Maple, Red – For control, apply as a ¾ to 1 ¼ percent solution with hand-held equipment when leaves are fully developed. For partial control, apply 2 to 7 ½ pints of this product per acre as a broadcast spray.

Maple, Sugar/Oak: Northern Pin, Red – For control, apply as a ¾ to 1 ¼ percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Poison Ivy/Poison Oak – For control, apply 6 to 7 ½ pints of this product per acre as a broadcast spray or as a 1-½ percent solution with hand-held equipment. Repeat applications may be required to maintain control. Fall treatments must be applied before leaves lose green color.

Rose, multiflora – For control, apply 3 pints of this product per acre as a broadcast spray or as a ¾ percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Sage, black/Sagebrush, California/Chamise/Tallowtree, Chinese – For control of these species apply as a ¾ percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Saltbush, Sea myrtle – For control, apply this product as a 1 percent solution with hand-held equipment.

Waxmyrtle, southern – For partial control, apply this product as a 1-½ percent solution with hand-held equipment.

Willow – For control, apply 4 ½ pints of this product per acre as a broadcast spray or as a ¾ percent solution with hand-held equipment.

Other woody brush and trees listed in this label – For partial control, apply 3 to 7 ½ pints of this product per acre as a broadcast spray or as a ¾ to 1 ½ percent solution with hand-held equipment.

INDUSTRIAL, RECREATIONAL, PUBLIC AREAS, AQUATIC AND TERRESTRIAL SITES

When applied as directed and under the conditions described in the "Weeds Controlled" section in this label, this product will control or partially control labeled weeds growing in the following industrial, recreational, public areas, aquatic and terrestrial sites.

NOTE: When applying this product to water, only use surfactants known to be non-toxic to aquatic species.

Aquatic Sites – This product may be applied to emerged weeds in all bodies of fresh and brackish water which may be flowing, nonflowing or transient. This includes lakes, rivers, streams, ponds, estuaries, rice levees, seeps, irrigation and drainage ditches, canals, reservoirs, wastewater treatment facilities, wildlife habitat restoration and management areas.

If aquatic sites are present in the noncrop area and are part of the intended treatment, read and observe the following directions:

This product does not control plants which are completely submerged or have a majority of their foliage under water.

There is no restriction on the use of treated water for irrigation, recreation or domestic purposes.

Consult local state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.

NOTE: Do not apply this product directly to water within ½ mile up-stream of an active potable water intake in flowing water (i.e., river stream, etc.) or within ½ mile of an active potable water intake in a standing body of water such as lake, pond or reservoir. To make aquatic applications around and within ½ mile of active potable water intakes, the water intake must be turned off for a minimum period of 48 hours after application. The water intake may be turned on prior to 48 hours if the glyphosate level in the intake water is below 0.7 parts per million as determined by laboratory analysis. These aquatic applications may be made ONLY in those cases where there are alternative water sources or holding ponds which would permit the turning off of an active potable water intake for a minimum period of 48 hours after the applications. This restriction does not apply to intermittent inadvertent overspray of water in terrestrial use sites.

For treatments after drawdown of water or in dry ditches, allow 7 or more days after treatment before reintroduction of water to achieve maximum weed control. Apply this product within 1 day after drawdown to ensure application to actively growing weeds.

Floating mats of vegetation may require retreatment. Avoid wash-off of sprayed foliage by spray boat or recreational boat backwash or by rainfall within 6 hours of application. Do not re-treat within 24 hours following the initial treatment.

Applications made to moving bodies of water must be made while traveling upstream to prevent concentration of this herbicide in water. When making any bankside applications, do not overlap more than 1 foot into open water. Do not spray in bodies of water where weeds do not exist. The maximum application rate of 7 ½ 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.

Other Noncrop-Type Sites – This product may be used to control the listed weeds in terrestrial noncrop sites and/or in aquatic sites within these areas.
Airports
Golf Courses
Habitat Restoration & Management Areas
Highways & Roadsides
Industrial Plant Sites
Lumberyards
Parking Areas
Parks
Petroleum Tank Farms
Pipeline, Power, Telephone & Utility Rights-of-Way
Pumping Installations
Railroads
Schools
Storage Areas
Similar Sites

TANK MIXTURES

NOTE: Read and carefully observe the label directions, cautionary statements and all information on the labels of products used in these tank mixtures before proceeding with these directions. Additional precautionary statements are made in these labels. Use according to the most restrictive label directions for each product in these mixtures.
When used in combination as recommended by Alligare, LLC, the liability of Alligare, LLC shall in no manner extend to any damage, loss or injury not directly caused by the inclusion of the Alligare product in such combination use.

GLYPHOSATE 5.4 plus GARLON® 4 or Alligare Triclopyr 4

For burndown and partial control or suppression of woody brush and weeds in industrial sites:

When applied as directed for "Noncrop Uses" under the conditions described, this product, and an approved surfactant plus Garlon® 4 or Alligare Triclopyr 4, provides burndown and partial control or suppression of woody brush and vegetation labeled for this product. Use this tank mixture on rights-of-way (utility, railroad, highway, pipeline), fencerows, roadsides, nonirrigation ditchbanks, wasteland and similar noncrop or industrial sites.

Hand-Held and High-Volume Applications:
Use 3 to 6 pints of Glyphosate 5.4 herbicide and 2 or more quarts of an approved surfactant, plus 1 to 2 quarts of Garlon® 4 or Alligare Triclopyr 4 per 100 gallons of spray solution and apply to foliage of actively growing woody brush and weeds. Applications should be made on a spray to wet basis. Spray coverage should be uniform and complete. Do not spray to point of runoff.

Broadcast Applications with Ground Equipment:
Use 3 to 6 pints of Glyphosate 5.4 plus ½ to 2 quarts of Garlon® 4 or Alligare Triclopyr 4 in sufficient water and make 20 to 100 gallons of total spray per acre. Use 2 to 4 quarts of an approved surfactant per 100 gallons of spray solution with this product.

Aerial Application (Helicopter Only):
Use 3 to 6 pints of Glyphosate 5.4 plus surfactant plus 1 to 2 quarts of Garlon® 4 or Alligare Triclopyr 4 and apply in a total spray volume of 10 to 20 gallons per acre. Aerial sprays should be applied using suitable drift control. Use 2 to 4 quarts of an approved surfactant per 100 gallons of spray solution with this product.

Apply when plants are actively growing and after full leaf expansion of woody brush. Use the higher rates of these products where vegetation is heavy or dense, or where hard-to-control brush species are prevalent. Repeat applications may be necessary to maintain control and to suppress areas where canopying of vegetation prevents good spray coverage and penetrations.

Drift control additives may be used. When a drift control additive is used, read and carefully observe the cautionary statements and all other information appearing on the additive label.

GLYPHOSATE 5.4 plus ARSENAL® 2 WSL

When applied as directed, this tank mixture will control or partially control labeled woody brush, trees and herbaceous weeds in noncrop areas. In addition to the weeds listed on this label, this tank mixture will control arrowweed, salt cedar and yaupon.

Hand-Held and High-Volume Applications:
Use 6 to 12 pints of Glyphosate 5.4 plus ½ to 4 pints Arsenal® 2 WSL per 100 gallons of spray solution. Add 2 to 4 quarts of nonionic surfactant per 100 gallons of spray solution. Apply to foliage of actively growing vegetation. Applications should be made on a spray-to-

wet basis. Spray coverage should be uniform and complete. Do not spray to the point of runoff.

Broadcast Applications with Ground Equipment:
Use 3 to 7 ½ pints of Glyphosate 5.4 plus ½ to 4 pints Arsenal® 2 WSL in sufficient water to apply in a total spray volume of 10 to 20 gallons per acre. Add 2 to 4 quarts of nonionic surfactant per 100 gallons of spray solution. Apply to foliage of actively growing vegetation.

Apply to woody brush and trees after full leaf expansion until initiation of fall color.

Avoid direct applications to any body of water. Do not apply on ditches used to transport irrigation water.

GLYPHOSATE 5.4 plus 2,4-D AMINE

When applied as a tank mixture, this product will control the annual weeds listed in this label booklet. This tank mixture will control or partially control the listed perennial weeds, woody brush and trees.

Use 1 ½ to 2 ½ pints of this product plus 2 to 4 pints of 2,4-D amine (4 lb ai per gallon, labeled for aquatic sites) for control of annual weeds.

Use 3 to 7 ½ pints of this product plus 2 to 4 quarts of 2,4-D amine (4 lb ai per gallon, labeled for aquatic sites) for control or partial control of perennial weeds, woody brush and trees. The tank mixture may be used on alligatorweed, smartweed, waterprimrose, waxmyrtle and other labeled weeds.

When using this product, mix 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution. Always read and follow the surfactant manufacturer's label recommendations.

Always predetermine the compatibility of the tank mixtures of this herbicide and 2,4-D amine by mixing small proportional quantities in advance.

Mix in the following sequence: Fill sprayer tank one-half full with water, add Glyphosate 5.4, then 2,4-D amine and finally surfactant. Fill sprayer tank to final volume with water.

NOTE: DO NOT MIX GLYPHOSATE 5.4 AMINE CONCENTRATES WITHOUT WATER CARRIER. DO NOT MIX GLYPHOSATE 5.4 AND 2,4-D AMINE IN BYPASS INJECTOR-TYPE SPRAY EQUIPMENT.

WETLAND SITES

This product may be used in and around water (aquatic areas) and wetlands found in forestry and in power, telephone and pipeline rights-of-way sites, including where these sites are adjacent to or surrounding domestic water supply reservoirs, supply streams, lakes and ponds. Read and observe the following before making applications in and around water.

Consult local public water control authorities before applying this product in and around public water.

Permits may be required to treat such areas.

There is no restriction on the use of treated water for irrigation, recreation or domestic purposes.

Restriction: Do not apply this product directly to water within ½ mile up-stream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within ½ mile of an active potable water intake in a standing body of water such as lake, pond or reservoir. To make aquatic applications around and within ½ mile of active potable water intakes, the water intake must be turned off for a minimum period of 48 hours after the application. These aquatic applications may be made ONLY in those cases where there are alternative water sources or holding ponds which would permit the turning off of an active potable water intake for a minimum period of 48 hours after the applications. This restriction does not apply to intermittent inadvertent overspray of water in terrestrial use sites.

Do not spray open bodies of water where woody brush, trees and herbaceous weeds do not exist. The maximum application rate of 3.75 quarts per acre must not be exceeded in a single over-water broadcast application except as follows, where any labeled rate may be applied:

- Stream crossings in utility rights-of-way.
- Where applications will result in less than 20 percent of the total water area being treated.

WILDLIFE HABITAT RESTORATION AND MANAGEMENT AREAS

This product can be used for the restoration and/or maintenance of native habitat and in wildlife management areas.

Habitat Restoration and Maintenance – When applied as directed, exotic and other undesirable vegetation may be controlled in habitat management areas. Applications may be made to allow recovery of native plant species, to open up water to attract waterfowl, and for similar broad-spectrum vegetation control requirements in habitat management areas. Spot treatments may be made to selectively remove unwanted plants for habitat enhancement. For spot treatments, care should be exercised to keep spray off of desirable plants.

Wildlife Food Plots – This product may be used as a site preparation treatment prior to planting wildlife food plots. Apply as directed to control vegetation in the plot area. Any wildlife food species may be planted after applying this product, or native species may be allowed to reinfest the area. If tillage is needed to prepare a seedbed, wait 7 days after applying this product before tilling to allow for maximum effectiveness.

WIPER APPLICATIONS

For wick or wiper applications, mix 1 gallon of this product with 2 gallons of clean water to make a 33 percent solution. Addition of a nonionic surfactant at a rate of 10 percent by volume of total herbicide solution is recommended.

Wiper applications can be used to control or suppress annual and perennial weeds listed on this label. In heavy weed stands, a double application in opposite directions may improve results. See the "Weeds Controlled" section in this label for timing, growth stage and other instructions for achieving optimum results.

Bromegrass (smooth), Canarygrass (reed), Dock (curly), Mullein (common), Quackgrass and Canada thistle: This product may be applied through a wiper applicator after dilution with water and thorough mixing to these weeds growing in or along aquatic sites.

Wiper applicators, including wick devices, apply the herbicide solution by rubbing the weed with an absorbent material containing the herbicide solution.

Contact of the herbicide solution with desirable vegetation may result in damage or destruction. Applicators used above desired vegetation should be adjusted so that the lowest wiper contact point is at least two (2) inches above this vegetation. Application made above desirable vegetation should be made when the weeds are a minimum of six (6) inches above this vegetation.

Best results may be attained when more of the weed is exposed to the herbicide solution. Weeds not contacted (wiped) with the herbicide solution will not be affected. This may occur in dense clumps, severe infestations, or when the height of the weed varies so that not all weeds are contacted.

In severe infestations, reduce equipment ground speed to ensure that adequate amounts of this herbicide solution are wiped onto the weeds. When wiping moderate weed infestations an adequate flow rate should be 3 to 4 quarts of herbicide solution per mile of canal (wiping 4 foot band). For best results, do not allow wiper applicator to contact water.

Note:
- Maintain wiper equipment in good operating condition.
- Adjust height of wiper applicator to ensure adequate contact with weeds.
- Keep wiping surfaces clean.
- Keep wiper material at proper degree of saturation with herbicide solution.
- DO NOT use wiper equipment when weeds are wet or under conditions where wave action or other water immersions will wash the solution off the weed.
- DO NOT operate equipment at ground speeds of greater than 5 MPH. As weed density increases, reduce equipment ground speed to ensure good coverage of weeds.
- Be aware that on sloping ground, the herbicide solution may migrate, causing dripping on the lower end and drying on the upper end of the wiper applicator.
- Variation in equipment design may affect weed control. With wiper applicators, the wiping material and its orientation must allow delivery of sufficient quantities of the specified herbicide solution directly to the weeds.
- Mix only the amount of solution to be used during a one day period as reduced activity may result from use of leftover solutions.

Mixing Instructions:
Mix 2 ½ gallons of Glyphosate 5.4 herbicide with 7 ½ gallons of water to prepare a 25 percent solution. Add 1 quart of an approved surfactant per 10 gallons of herbicide solution (2 ½ percent surfactant by total volume). Apply this solution to weeds listed above.

CUT STUMP APPLICATION

Woody vegetation may be controlled by treating freshly cut stumps of trees and resprouts with this product. Apply this product using suitable equipment to ensure coverage of the entire cambium. Cut vegetation close to the soil surface. Apply a 50 to 100 percent solution of this product to freshly cut surface immediately after cutting. Delay in applying this product may result in reduced performance. For best results, trees should be cut during periods of active growth and full leaf expansion.

When used according to directions for cut stump application, this product will CONTROL, PARTIALLY CONTROL, or SUPPRESS most woody brush and tree species, some of which are listed below:

Alder
Alnus spp.
Coyote brush*
Baccharis consanguinea
Dogwood*
Cornus spp.
Eucalyptus
Eucalyptus spp.
Hickory*
Carya spp.
Madrone
Arbutus menziesii
Maple*
Acer spp.
Oak
Quercus spp.
Poplar*
Populus spp.
Reed, giant
Arundo donax
Salt cedar
Tamarix spp.
Sweet gum*
Liquidambar styraciflua
Sycamore*
Platanus occidentalis
Tan oak
Lithocarpus densiflorus
Willow
Salix spp.

*This product is not approved for this use on these species in the state of California.

INJECTION AND FRILL APPLICATIONS

Woody vegetation may be controlled by injection or frill application of this product. Apply this product using suitable equipment which must penetrate into living tissue. Apply the equivalent of 1 mL of this product per 2 to 3 inches of trunk diameter. This is best achieved by applying 25 to 100 percent concentration of this product either to a continuous frill around the tree or as cuts evenly spaced around the tree below all branches. As tree diameter increases in size, better results are achieved by applying dilute material to a continuous frill or more closely spaced cuttings. Avoid application techniques that allow runoff to occur from frill or cut areas in species that exude sap freely after frills or cutting. In species such as these, make frill or cut at an oblique angle so as to produce a cupping effect and use undiluted material. For best results, applications should be made during periods of active growth and full leaf expansion.

This treatment WILL CONTROL the following woody species:
Oak
Quercus spp.
Poplar
Populus spp.
Sweet gum
Liquidambar styraciflua
Sycamore
Platanus occidentalis
This treatment WILL SUPPRESS the following woody species:
Black gum*
Nyssa sylvatica
Dogwood
Cornus spp.
Hickory
Carya spp.
Maple, red
Acer rubrum
*This product is not approved for this use on these species in the state of California.

INDUSTRIAL TURF

Apply 3 to 5 fluid ounces of this product per acre alone or in a recommended tank mixture. Use spray volumes of 10 to 40 gallons per acre.

When using this product, mix 2 quarts of a nonionic surfactant per 100 gallons of spray solution.

This product can be used for growth and seedhead suppression of:
Tall Fescue
Smooth Brome

For best results, apply this product in a recommended tank mixture to actively growing turfgrasses after greenup in the spring of the year. For suppression of seedheads, applications must be made before boot-to-seedhead stage of development. Applications made from seedhead emergence until maturity may result in turf discoloration or injury.

After mowing or removal of seedheads, this product in a recommended tank mixture may also be used to suppress the growth of certain turfgrasses. Allow turf to recover from stress caused by heat, drought or mowing before making applications. Applications made to turf under stress may increase the potential for discoloration or injury.

Annual Grasses

For growth suppression of some annual grasses such as annual ryegrass, wild barley and wild oats, apply 3 to 4 ounces of this product in 10 to 40 gallons of spray solution per acre. Applications should be made when annual grasses are actively growing and before the seedheads are in the boot stage of development. Treatments made after seedhead emergence may cause injury to the desired grasses.

TANK MIXTURES FOR INDUSTRIAL TURFGRASSES

For the following tank mixtures, consult each product label for weeds controlled and the proper stage of application. Do not treat turf under stress.

Tank Mixtures plus 2,4-D Amine

For additional weed control benefits, up to 1 quart per acre of 2,4-D amine may be added to the following tank mixtures.

TALL FESCUE
Glyphosate 5.4 plus Telar® or Alligare Chlorsulfuron 75

For suppression of tall fescue growth and seedheads, and control or partial control of some annual weeds, apply this tank mixture after greenup and prior to boot-to-seedhead stage of development. Use up to ½ ounce of Telar® or Alligare Chlorulfuron 75 per acre.

This tank mixture can also be applied after mowing or removal of tall fescue seedheads for turf growth suppression and control or partial control of some annual weeds. Make only one of the above applications per growing season.

Glyphosate 5.4 plus Oust® or Alligare SFM 75

For suppression of tall fescue growth and seedheads, and control or partial control of some annual weeds, apply this tank mixture after greenup and prior to boot-to-seedhead stage of development. Use up to ¼ ounce of Oust® or Alligare SFM 75 per acre.

Glyphosate 5.4 plus Escort® or Alligare MSM 60

This tank mixture can be applied after mowing or removal of tall fescue seedheads for turf growth suppression and control or partial control of some annual weeds. Use up to 1/3 ounce of Escort® or Alligare MSM 60 per acre.

SMOOTH BROME
Glyphosate 5.4 plus Oust® or Alligare SFM 75

For suppression of smooth brome growth and seedheads and control or partial control of some annual weeds, apply this tank mixture after greenup and prior to boot-to-seedhead stage of development. Use up to ¼ ounce of Oust® or Alligare SFM 75 per acre.

RELEASE OF BERMUDAGRASS OR BAHIAGRASS ON NONCROP SITES

RELEASE OF DORMANT BERMUDAGRASS AND BAHIAGRASS

When applied as directed, this product will provide control or suppression of many winter annual weeds and tall fescue for effective release of dormant bermudagrass or bahiagrass. Make applications to dormant bermudagrass or bahiagrass.

For best results on winter annuals, treat when weeds are in an early growth stage (below 6 inches in height) after most have germinated. For best results on tall fescue, treat when fescue is in or beyond the 4 to 6-leaf stage.

WEEDS CONTROLLED

Rates for control or suppression of winter annuals and tall fescue are listed below. Apply the listed rates of this product in 10 to 25 gallons of water per acre plus 2 quarts nonionic surfactant per 100 gallons of total spray volume.

WEEDS CONTROLLED OR SUPPRESSED

NOTE: C = Control
S = Suppression

	Glyphosate 5.4 oz/acre					
WEED SPECIES	**6**	**9**	**12**	**18**	**24**	**48**
Barley, little *Hordeum pusillum*	S	C	C	C	C	C
Bedstraw, catchweed *Galium aparine*	S	C	C	C	C	C
Bluegrass, annual *Poa annua*	S	C	C	C	C	C
Chervil *Chaerophyllum tainturieri*	S	C	C	C	C	C
Chickweed, common *Stellaria media*	S	C	C	C	C	C
Clover, crimson *Trifolium incarnatum*	•	S	S	C	C	C
Clover, large hop *Trifolium campestre*	•	S	S	C	C	C
Speedwell, corn *Veronica arvensis*	S	C	C	C	C	C
Fescue, tall *Festuca arundinacea*	•	•	•	•	S	S
Geranium, Carolina *Geranium carolinianum*	•	•	S	S	C	C
Henbit *Lamium amplexicaule*	•	S	C	C	C	C
Ryegrass, Italian *Lolium multiflorum*	•	•	S	C	C	C
Vetch, common *Vicia sativa*	•	•	S	C	C	C

*These rates apply only to sites where an established competitive turf is present.

RELEASE OF ACTIVELY GROWING BERMUDAGRASS

NOTE: USE ONLY ON SITES WHERE BAHIAGRASS OR BERMUDAGRASS ARE DESIRED FOR GROUND COVER AND SOME TEMPORARY INJURY OR YELLOWING OF THE GRASSES CAN BE TOLERATED.

When applied as directed, this product will aid in the release of bermudagrass by providing control of annual species listed in the "Weeds Controlled" section in this label, and suppression or partial control of certain perennial weeds.

For control or suppression of those annual species listed in this label, use ¾ to 2 ¼ pints of this product as a broadcast spray in 10 to 25 gallons of spray solution per acre, plus 2 quarts of a nonionic surfactant per 100 gallons of total spray volume. Use the lower rate when treating annual weeds below 6 inches in height (or length of runner in annual vines). Use the higher rate as size of plants increases or as they approach flower or seedhead formation.

Use the higher rate for partial control or longer-term suppression of the following perennial species. Use lower rates for shorter-term suppression of growth.

Bahiagrass
Dallisgrass
Fescue (tall)
Johnsongrass**
Trumpetcreeper*
Vaseygrass
*Suppression at the higher rate only.
**Johnsongrass is controlled at the higher rate.

Use only on well-established bermudagrass. Bermudagrass injury may result from the treatment but regrowth will occur under moist conditions. Do not make repeat applications in the same season since severe injury may result.

BAHIAGRASS SEEDHEAD AND VEGETATIVE SUPPRESSION

When applied as directed in the "Noncrop Sites" section in this label, this product will provide significant inhibition of seedhead emergence and will suppress vegetative growth for a period of approximately 45 days with single applications and approximately 120 days with sequential applications.

Apply this product 1 to 2 weeks after full green-up of bahiagrass or after the bahiagrass has been mowed to a uniform height of 3 to 4 inches. Applications must be made prior to seedhead emergence. Apply 5 fluid ounces per acre of this product, plus 2 quarts of an approved nonionic surfactant per 100 gallons of total spray volume in 10 to 25 gallons of water per acre.

Sequential applications of this product plus nonionic surfactant may be made at approximately 45-day intervals to extend the period of seedhead and vegetative growth suppression. For continued vegetative growth suppression, sequential applications must be made prior to seedhead emergence.

Apply no more than 2 sequential applications per year. As a first sequential application, apply 3 fluid ounces of this product per acre plus nonionic surfactant. A second sequential application of 2 to 3 fluid ounces per acre plus nonionic surfactant may be made approximately 45 days after the last application.

ANNUAL GRASS GROWTH SUPPRESSION

For growth suppression of some annual grasses, such as annual ryegrass, wild barley and wild oats growing in coarse turf on roadsides or other industrial areas, apply 3 to 4 ounces of this product in 10 to 40 gallons of spray solution per acre. Mix 2 quarts of a nonionic surfactant per 100 gallons of spray solution. Applications should be made when annual grasses are actively growing and before the seedheads are in the boot stage of development. Treatments made after seedhead emergence may cause injury to the desired grasses.

AGRICULTURAL USES

USE INFORMATION

Product Description: This product is a postemergent, systemic herbicide with no soil residual activity. It is generally non-selective and gives broad-spectrum control of many annual weeds, perennial weeds, woody brush and trees. It is formulated as a water-soluble liquid. It may be applied through most standard industrial or field-type sprayers after dilution and thorough mixing with water or other carriers according to label instructions.

Surfactant may be included in the tank mixture if desired and should only be done so based on field experience or further instructions from your local extension service, crop consultant or field representative.

Time to Symptoms: This product moves through the plant from the point of foliage contact to and into the root system. Visible effects on most annual weeds occur within 2 to 4 days, but on most perennial weeds may not occur for 7 days or more. Extremely cool or cloudy weather following treatment may slow activity of this product and delay development of visual symptoms. Visible effects are a gradual wilting and yellowing of the plant which advances to complete browning of aboveground growth and deterioration of underground plant parts.

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, woody brush and trees rate tables for recommendations for specific weeds.

Always use the higher rate of this product per acre within the specified range when weed growth is heavy or dense or weeds are growing in an undisturbed (non-cultivated) area.

Do not treat weeds under poor growing conditions such as drought stress, disease or insect damage, as reduced weed control may result. Reduced results may also occur when treating weeds heavily covered with dust.

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 this product off of the foliage and a repeat application may be required for adequate control.

Spray Coverage: For best results, spray coverage should be uniform and complete. Do not spray weed foliage to the point of runoff.

Mode of Action: The active ingredient in this product inhibits an enzyme found only in plants that is essential to formation of 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 root stocks of perennials will not be affected by the herbicide and will continue to grow.

When this product comes in contact with soil it is bound to soil particles. Under specified use situations, once this product is bound to soil particles, it is not available for plant uptake and will not harm off-site vegetation where roots grow into the treated area or if the soil is transported off-site. The strong affinity of this product to soil particles prevents this product from leaching out of the soil profile and entering ground water.

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

Volatility: Glyphosate 5.4 is non-volatile. Therefore, it cannot move as a vapor after application to affect nearby vegetation.

Toxicology Testing: Exposure to workers and other applicators generally is expected to pose minimal risks based on results of short-term toxicity studies. Glyphosate has been thoroughly tested and determined not to cause cancer or other adverse long-term health effects.

Tank Mixing: This product does not provide residual weed control. For subsequent residual weed control, follow a label-approved herbicide program. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used. Use according to the most restrictive label directions for each product in the mixture.

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 label. Mixing this product with herbicides or other materials not specified on this label may result in reduced performance.

Annual Maximum Use Rate: Except as otherwise specified in a crop section of this label, the combined total of all treatments must not exceed 6 quarts of this product per acre per year.

For non-agricultural uses, the combined total of all treatments must not exceed 8 quarts of this product per acre per year.

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. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants or other areas on which treatment was not intended. The likelihood of 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.

MIXING

Clean sprayer parts immediately after using this product by thoroughly flushing with water. NOTE: REDUCED RESULTS MAY OCCUR IF WATER CONTAINING SOIL IS USED, SUCH AS VISIBLY MUDDY WATER OR WATER FROM PONDS AND DITCHES THAT IS NOT CLEAR.

Mixing with Water

This product mixes readily with water. Mix spray solutions of this product as follows: Fill the mixing or spray tank with the required amount of water. Add the specified amount of this product near the end of the filling process and mix well. Use caution to avoid siphoning back into the carrier source. Use approved anti-back-siphoning devices where required by state or local regulations. During mixing and application, foaming of the spray solution may occur. To prevent or minimize foam, 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.

Surfactant

Surfactant may be included in the tank mixture if desired and should only be done so based on field experience or further recommendation of your local extension service, crop consultant or field representative.

Tank Mixing Procedure

Mix labeled tank mixtures of this product with water as follows:

1. Place a 20 to 35-mesh screen or wetting basket over filling port.
2. Through the screen, fill the spray tank one-half full with water and start agitation.
3. If a wettable powder is used, make a slurry with the water carrier, and add it SLOWLY through the screen into the tank. Continue agitation.
4. If a flowable formulation is used, premix one part flowable with one part water. Add diluted mixture SLOWLY through the screen into the tank. Continue agitation.
5. If an emulsifiable concentrate formulation is used, premix one part emulsifiable concentrate with two parts water. Add diluted mixture slowly through the screen into the tank. Continue agitation.
6. Continue filling the spray tank with water and add the required amount of this product near the end of the filling process.
7. When using nonionic surfactant add it to the spray tank before completing the filling process.
8. Add individual formulations to the spray tank as follows: wettable powder, flowable, emulsifiable concentrate, drift control additive and water soluble liquid followed by surfactant.

Maintain good agitation at all times until the contents of the tank are sprayed. If the spray mixture is allowed to settle, thorough agitation is required to resuspend the mixture before spraying is resumed.

Keep by-pass line on or near the bottom of the tank to minimize foaming. Screen size in nozzle or line strainers should be no finer than 50 mesh.

Always predetermine the compatibility of labeled tank mixtures of this product with water carrier by mixing small proportional quantities in advance.

Refer to the “Tank Mixing” section for additional precautions and directions.

Mixing for 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:

Desired Volume	Amount of Glyphosate 5.4					
	3/4%	1%	1 1/2%	2%	5%	10%
1 Gal	1 fl oz	1 1/3 fl oz	2 fl oz	2 2/3 fl oz	6½ fl oz	13 fl oz
25 Gal	1 1/2 pts	1 qt	1½ qts	2 qts	5 qts	10 qts
100 Gal	3 qts	1 gal	1½ gals	2 gals	5 gals	10 gals

2 tablespoons = 1 fluid ounce

For use in knapsack sprayers, it is suggested that the specified amount of this product be mixed with water in a larger container. Fill sprayer with the mixed solution.

Ammonium Sulfate

The addition of 1 to 2 percent dry ammonium sulfate by weight or 8.5 to 17 pounds per 100 gallons of water may increase the performance of this product, particularly when tank mixed with certain residual herbicides on annual and perennial weeds. The equivalent rate of ammonium sulfate in a liquid formulation may also be used. Ensure that ammonium sulfate is completely dissolved in the spray tank before adding herbicides. Thoroughly rinse the spray system with clean water after use to reduce corrosion.

NOTE: When using ammonium sulfate, apply this product at rates listed in this label. Lower rates will result in reduced 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 recommendations.

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 cautionary statements and all other information appearing on the additive label.

APPLICATION EQUIPMENT AND TECHNIQUES

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

This product may be applied with the following application equipment:

Aerial – Fixed Wing and Helicopter

Ground Broadcast Spray – Boom or boomless systems, pull-type sprayer, floaters, pick-up sprayers, spray coupes and other ground broadcast equipment.

Hand-Held and High-Volume Spray Equipment – Knapsack and backpack sprayers, pump-up pressure sprayers, handguns, handwands, mistblowers*, lances and other hand-held and motorized spray equipment used to direct the spray onto weed foliage.

*This product is not registered in California or Arizona for use in mistblowers.

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

Injection Systems – Aerial or ground injection sprayers.

Controlled Droplet Applicator (CDA) – Hand-held or boom-mounted applicators which produce a spray consisting of a narrow range of droplet sizes.

APPLY THESE SPRAY SOLUTIONS IN PROPERLY MAINTAINED AND CALIBRATED EQUIPMENT CAPABLE OF DELIVERING DESIRED VOLUMES.

AERIAL SPRAY DRIFT MANAGEMENT

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 is responsible for considering all these factors when making decisions.

The following drift management requirements must be followed to avoid off-target movement from aerial applications to agricultural field crops. These requirements do not apply to forestry applications, public health uses or to applications using dry formulations.

1. The distance of the outer most nozzles on the boom must not exceed ¾ the length of the wingspan or rotor.
2. Nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees.

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

The applicator should 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.]

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 ¾ 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 target plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces exposure of droplets to evaporation and wind.

SWATH ADJUSTMENT

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

WIND

Drift potential is lowest between wind speeds of 2-10 mph. However, many factors, including droplet size and equipment type determine drift potential at any given speed. Do not apply 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 must not occur during a temperature inversion because drift potential is high. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud. This cloud can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a 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 must 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).

Aerial Equipment

DO NOT APPLY THIS PRODUCT USING AERIAL SPRAY EQUIPMENT EXCEPT UNDER CONDITIONS AS SPECIFIED WITHIN THIS LABEL. This product plus dicamba tank mixtures may not be applied by air in California.

Use the specified rates of this herbicide in 3 to 15 gallons of water per acre unless otherwise specified on this label. Unless otherwise specified, do not exceed 1 quart per acre. Aerial applications of this product may be made in annual cropping conventional tillage systems, fallow and reduced tillage systems and preharvest applications. Refer to the individual use area sections of this label for specific volumes and application rates.

Avoid direct application to any body of water.

AVOID DRIFT – DO NOT APPLY DURING LOW-LEVEL INVERSION CONDITIONS, 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.

Coarse sprays are less likely to drift; therefore, do not use nozzles or nozzle configurations which dispense spray as fine spray droplets. Do not angle nozzles forward into the airstream and do not increase spray volume by increasing nozzle pressure.

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

Thoroughly wash aircraft, especially landing gear, after each day of spraying to remove residues of this product accumulated during spraying or from spills. PROLONGED EXPOSURE OF THIS PRODUCT TO UNCOATED STEEL SURFACES MAY RESULT IN CORROSION AND POSSIBLE FAILURE OF THE PART. LANDING GEAR ARE MOST SUSCEPTIBLE. The maintenance of an organic coating (paint), which meets aerospace specification MIL-C-38413, may prevent corrosion.

For Aerial Application in California Only

Aerial applications of this product are allowed in the following situations:

1. In fallow and reduced tillage systems prior to the emergence or transplanting of labeled crops.
2. In alfalfa and pasture renovation applications.
3. Over-the-top applications in Roundup Ready® corn and cotton.
4. Preharvest in alfalfa, corn, cotton, wheat, Roundup Ready® corn and Roundup Ready® cotton.

Do not plant subsequent crops other than those listed in the label booklet for 30 days following application.

When tank mixing this product with 2,4-D for aerial applications, only 2,4-D amine formulations may be used. This tank mixture may be used for fallow and reduced tillage systems and alfalfa and pasture renovation applications only.

DO NOT EXCEED A MAXIMUM RATE OF 2 QUARTS PER ACRE OF THIS PRODUCT WHEN MAKING APPLICATIONS BY AIR IN FALLOW AND REDUCED TILLAGE SYSTEMS AND ALFALFA AND PASTURE RENOVATION APPLICATIONS.

DO NOT EXCEED A MAXIMUM RATE OF 1 QUART PER ACRE OF THIS PRODUCT WHEN MAKING APPLICATIONS BY AIR IN ALFALFA, CORN, COTTON, WHEAT, ROUNDUP READY® CORN AND ROUNDUP READY® COTTON PRIOR TO HARVEST. THIS RESTRICTION ALSO APPLIES TO OVER-THE-TOP APPLICATIONS IN ROUNDUP READY® CORN AND COTTON.

Aerial Equipment

Use the specified rates of this product in 3 to 15 gallons of water per acre.

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

1. Do not apply within 100 feet of all desirable vegetation or crop(s).
2. 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).
3. Winds blowing from 5 to 10 miles per hour toward desirable vegetation or crop(s) may require buffer zones in excess of 500 feet.
4. Do not apply when winds are in excess of 10 miles per hour or when inversion conditions exist.

For Aerial Application in Fresno County, California Only From February 15 through March 31 Only

Applicable Area:

The area contained inside the following boundaries within Fresno County, California.

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

Product Information:

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

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.

Note: For aerial application from April 1 through February 14, refer to the "**For Aerial Application in California Only**" section of this label.

FOR AERIAL APPLICATIONS IN MISSISSIPPI

Aerial Application Restrictions:

Aerial application is prohibited in Zone I, south of Highway 8 in the counties listed below, from March 15 through April 30, except by permit from an authorized employee of the Mississippi Department of Agriculture and Commerce, Bureau of Plant Industry (Ph. 1-888-257-1285).

Aerial application is prohibited in Zone II, north of Highway 8 in the counties listed below, from March 25 through April 30, except by permit from an authorized employee of the Mississippi Department of Agriculture and Commerce, Bureau of Plant Industry (Ph. 1-888-257-1285).

The Bureau of Plant Industry may at anytime, based on current planting and environmental conditions modify the above restrictions for either zone or county therein.

Zone I: South of Highway 8 in the counties of Bolivar, Sunflower, Leflore, and Grenada plus the entire counties of Carroll, Holmes, Humphreys, Washington, Sharkey, Issaquena, Yazoo and Warren.

Zone II: North of Highway 8 in the counties of Bolivar, Sunflower, Leflore, and Grenada plus the entire counties of Tallahatchie, Tate, Quitman, Coahoma, Tunica, Panola and Desoto.

FOR AERIAL APPLICATION IN ARKANSAS ONLY

AVOID DRIFT. DO NOT APPLY INTO STILL AIR WHERE THERE IS A TEMPERATURE INVERSION LAYER LOW ENOUGH FOR FINE SPRAY PARTICLES TO BECOME SUSPENDED AND MOVE OUTSIDE THE TARGET AREA WHEN THE INVERSION LAYER MOVES. DO NOT APPLY WHEN WINDS ARE GUSTY OR UNDER ANY OTHER CONDITION THAT FAVORS DRIFT. DRIFT IS LIKELY TO CAUSE DAMAGE TO ANY VEGETATION CONTACTED. TO PREVENT INJURY TO ADJACENT DESIRABLE VEGETATION, APPROPRIATE BUFFER ZONES MUST BE MAINTAINED.

Use the labeled rate of this product in 3 to 15 gallons of water per acre.

Use sufficient carrier volume and appropriate equipment set-up to form droplets large enough to avoid drift potential. Coarse droplets in the 300 to 500 (VMD) micron range are recommended.

Applications are typically to be made with the nozzle release point at 8 to 15 feet above the top of the target plants unless a greater height is required for aircraft safety.

The distance of the outermost nozzles on the boom must not exceed 75 percent of the length of the wingspan or rotor. In many cases, reducing this distance to 65 percent of the length of the wingspan or rotor will improve drift control without affecting the swath width.

Nozzles must always discharge backward parallel with the air stream and never discharge downwards more than 45 degrees on fixed wing aircraft or forward of the prevailing airflow on rotary winged aircraft. Avoid the use of nozzles with wide-angle discharge.

Do not apply this product when winds are in excess of 10 mph.

Do not apply when there is a low-level inversion where fine spray particles could be suspended in still air and move outside the target area when the inversion layer moves. These conditions may occur when wind speeds are less than 2 mph.

Use the following guidelines when applications are made near crops or other desirable vegetation:

1. Do not apply within 100 feet of any desirable vegetation or crops.
2. If wind up to 5 mph is blowing towards desirable vegetation or crops, do not apply within 500 feet upwind of the desirable vegetation or crops.

Winds blowing from 5 to 10 mph toward desirable vegetation or crops will likely require buffer zones in excess of 500 feet.

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. As density of weeds increases, spray volume should be increased within the specified 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.

Hand-Held and High-Volume Equipment

Apply to foliage of vegetation to be controlled. For applications made on a spray-to-wet basis, spray coverage should be uniform and complete. Do not spray to the point of runoff. Use coarse sprays only.

For control of weeds listed in the annual weeds rate tables, apply a 0.5 percent solution of this product to weeds less than 6 inches in height or runner length. Apply prior to seedhead formation in grass or bud formation in broadleaf weeds. For annual weeds over 6 inches tall, or unless otherwise specified, use a 1 percent solution.

For best results, use a 1 ½ percent solution on harder-to-control perennials, such as bermudagrass, dock, field bindweed, hemp dogbane, milkweed and Canada thistle.

When using application methods which result in less than complete coverage, use a 3.75 percent solution for annual and perennial weeds and a 3.75 to 5 percent solution for woody brush and trees.

Selective Equipment

This product may be applied through recirculating spray systems, shielded applicators, hooded sprayers, wiper applicators or sponge bars after dilution and thorough mixing with water to listed weeds growing in any non-agricultural use site specified on this label and only when specifically listed in cropping systems.

A recirculating spray system directs the spray solution onto weeds growing above desirable vegetation, while spray solution not intercepted by weeds is collected and returned to the spray tank for reuse.

A shielded or hooded applicator directs the herbicide solution onto weeds, while shielding desirable vegetation from the herbicide.

A wiper or sponge applicator applies the herbicide solution onto weeds by rubbing the weed with an absorbent material containing the herbicide solution.

AVOID CONTACT OF HERBICIDE WITH DESIRABLE VEGETATION.

Contact of the herbicide solution with desirable vegetation may result in damage or destruction. Applicators used above desirable vegetation should be adjusted so that the lowest spray stream or wiper contact point is at least 2 inches above the desirable vegetation. Droplets, mist, foam or splatter of the herbicide solution settling on desirable vegetation may result in discoloration, stunting or destruction.

Applications made above the crops should be made when the weeds are a minimum of 6 inches above the desirable vegetation. Better results may be 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 the weeds varies so that not all weeds are contacted. In these instances, repeat treatment may be necessary.

Shielded and hooded applicators
Use nozzles that provide uniform coverage within the treated area. Keep shields on these sprayers adjusted to protect desirable vegetation. EXTREME CARE MUST BE EXERCISED TO AVOID CONTACT OF HERBICIDE WITH DESIRABLE VEGETATION.

Wiper applicators and sponge bars
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. Operate this equipment at ground speeds no greater 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 2 applications are made in opposite directions.

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 1-day period, as reduced activity may result from use of leftover solutions. Clean wiper parts immediately after using this product by thoroughly flushing with water.

Nonionic surfactant at a rate of 10 percent by volume of total herbicide solution is recommended with all wiper applications.

For Rope or Sponge Wick Applicators – Mix 3 quarts of this product in 2 gallons of water to prepare a 25 percent solution. Apply this solution to weeds listed in this section.

For Porous-Plastic Applicators – Solutions ranging from 25 to 100 percent of this product in water may be used in porous-plastic wiper applicators.

When applied as specified, this product CONTROLS the following weeds:

Corn, volunteer	Sicklepod
Panicum, Texas	Spanishneedles
Rye, common	Starbur, bristly
Shattercane	

When applied as specified, this product SUPPRESSES the following weeds:

Beggarweed, Florida	Ragweed, common
Bermudagrass	Ragweed, giant
Dogbane, hemp	Smutgrass
Dogfennel	Sunflower
Guineagrass	Thistle, Canada
Johnsongrass	Thistle, musk
Milkweed	Vaseygrass
Nightshade, silverleaf	Velvetleaf
Pigweed, redroot	

Injection Systems

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.

CDA Equipment

The rate of this product applied per acre by vehicle-mounted CDA equipment must not be less than the amount listed in 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 fluid ounces per minute and a walking speed of 1.5 mph (1 ½ pints per acre). For the control of perennial weeds, apply a 20 to 40 percent solution of this product at a flow rate of 2 fluid ounces per minute and a walking speed of 0.75 mph (3 to 6 pints per acre).

Controlled droplet application equipment produces a spray pattern which is not easily visible. Extreme care must be exercised to avoid spray or drift contacting the foliage or any other green tissue of desirable vegetation, as damage or destruction may result.

CROPS (Alphabetical)

This section is organized alphabetically by crop category. There may be several labeled crops listed in a crop category.

Unless otherwise specified, applications may be made to control any weeds listed in the annual, perennial and woody brush tables. Also refer to the "SELECTIVE EQUIPMENT" section.

The maximum use rates stated throughout this products labeling apply to this product combined with the use of all other herbicides containing glyphosate or sulfosate as the active ingredient, whether applied as mixtures or separately. Calculate application rates and ensure that the total use of this and other glyphosate or sulfosate containing products does not exceed stated maximum use rate.

For any crop not listed in this "CROPS" section, applications must be made at least 30 days prior to planting.

For broadcast postemergent treatments, do not harvest or feed treated vegetation for 8 weeks following application, unless otherwise specified.

When applying this product prior to transplanting crops into plastic mulch, residues may be removed from the plastic by 0.5 inches of water via sprinkler irrigation or natural rainfall.

Alfalfa, Clover, and Other Forage Legumes

LABELED CROPS: Alfalfa, clover, kudzu, lespedeza, lupin, sainfoin, trefoil, velvet bean, vetch, crown vetch, milk vetch

TYPES OF APPLICATIONS: Preplant, preemergence, at-planting, spot treatment (alfalfa and clover only), wiper applicators (alfalfa and clover only), renovation, preharvest (alfalfa only)

Preplant, Preemergence and At-planting
USE INSTRUCTIONS: This product may be applied before, during or after planting alfalfa and clover. Applications must be made prior to emergence of the crop.

RESTRICTION: Remove domestic livestock before application and wait 8 weeks after application before grazing or harvesting.

Preharvest (Alfalfa only)
USE INSTRUCTIONS: This product may be used in declining alfalfa stands or any stand of alfalfa where crop destruction is acceptable. This application will severely injure or destroy the stand of alfalfa. This product will control annual and perennial weeds including quackgrass, when applied prior to the harvest of alfalfa. The treated crop and weeds can be harvested and fed to livestock after 36 hours. Allow a minimum of 36 hours between application and harvest. Use up to 1 quart of this product per acre. Applications may be made at any time of the year. Make only one application to an existing stand of alfalfa per year. For control of quackgrass, apply in the spring, late summer or fall when quackgrass is actively growing. Treatments for quackgrass must be followed by deep tillage for complete control.

RESTRICTIONS: Do not apply more than 1.5 pints of this product per acre as a preharvest treatment. Do not use for alfalfa grown for seed, as a reduction in germination or vigor may occur.

Spot treatment or Wiper applications (Alfalfa and Clover only)
USE INSTRUCTIONS: This product may be applied as a spot treatment in alfalfa or clover. This product may be applied with wiper applicators to control or suppress the weeds listed under "WIPER APPLICATORS" in the "SELECTIVE EQUIPMENT" section of this label. Applications may be made in the same area at 30-day intervals.

For spot treatment and wiper applications, apply in areas where the movement of domestic livestock can be controlled.

RESTRICTIONS: No more than one-tenth of any acre should be treated at one time. Remove domestic livestock before application and wait 14 days after application before grazing livestock or harvesting.

Renovation
USE INSTRUCTIONS: This product may be applied as a broadcast spray to existing stands of alfalfa, clover, and other labeled forage legumes. Labeled crops may be planted into the treated area.

RESTRICTION: Remove domestic livestock before application and wait 8 weeks after application before grazing or harvesting.

Asparagus

TYPES OF APPLICATIONS: Preplant, preemergence, spot treatment, postharvest

Preplant, Preemergence
USE INSTRUCTIONS: This product may be applied prior to emergence of asparagus.
RESTRICTION: Do not apply within a week before the first spears emerge.

Spot treatment
USE INSTRUCTIONS: This product may be applied immediately after cutting, but prior to the emergence of new spears.

RESTRICTIONS: Do not treat more than 10 percent of the total field area to be harvested. Do not harvest within 5 days of treatment.

Postharvest
USE INSTRUCTIONS: This product may be applied after the last harvest and all spears have been removed. If spears are allowed to regrow, delay application until ferns have developed. Delayed treatments should be applied as a directed or shielded spray in order to avoid contact of the spray with ferns, stems or spears.

PRECAUTIONS: Direct contact of the spray with the asparagus may result in serious crop injury. Select and use specified types of spray equipment for postemergence postharvest applications. A directed spray is any application where the spray pattern is aligned in such a way as to avoid direct contact of the spray with the crop. A shielded spray is any application where a physical barrier is positioned and maintained between the spray and the crop to prevent contact of spray with the crop.

Canola

TYPES OF APPLICATIONS: Preplant, preemergence

USE INSTRUCTIONS: This product may be applied before, during or after planting canola. Applications must be made prior to emergence of the crop.

RESTRICTION: Do not apply more than 1.5 quarts of this product per acre by ground.

Cereal Crops

LABELED CROPS: Barley, Buckwheat, Millet (Pearl, Proso), Oats, Rice, Rye, Teosinte, Triticale, Wheat (All), Wild rice.

TYPES OF APPLICATIONS: Preplant, preemergence, at-planting, spot treatment (except rice), post-harvest, preharvest (wheat only), wiper applicators (wheat only)

Do not treat rice fields or levees when the field contains floodwater.

Preplant, Preemergence and At-planting
USE INSTRUCTIONS: This product may be applied before, during or after planting of cereal crops. Applications must be made prior to emergence of the crop.

Spot treatment (except rice)
USE INSTRUCTIONS: This product may be applied as a spot treatment in cereal crops. Apply this product before heading in small grains.

RESTRICTIONS: Do not treat more than 10 percent of the total field area to be harvested. The crop receiving spray in the treated area will be killed. Do not allow drift or spray outside target area for the same reason.

Postharvest
USE INSTRUCTIONS: This product may be applied after harvest of cereal crops. Higher rates may be required for control of large weeds which were growing in the crop at the time of harvest. Tank mixtures with 2,4-D or dicamba may be used.

RESTRICTIONS: For any crop not listed on this label, applications must be made at least 30 days prior to planting the next crop. Do not harvest or feed treated vegetation for 8 weeks following application.

Preharvest (wheat only)
USE INSTRUCTIONS: This product provides weed control when applied prior to harvest of wheat. Apply after the hard-dough stage of grain (30% or less grain moisture) and at least 7 days prior to harvest. Wheat stubble may be grazed immediately after harvest.

This product may be applied using either aerial or ground spray equipment. For ground applications, apply this product in 10 to 20 gallons of water per acre. For aerial applications, apply this product in 3 to 10 gallons of water per acre.

RESTRICTIONS: Do not apply more than 1.5 pints of this product per acre. Do not apply to wheat grown for seed, as a reduction in germination or vigor may occur.

Wiper applications (wheat only)
USE INSTRUCTIONS: Wiper applications may be used in wheat. To control common rye or cereal rye, apply after the weeds have headed and achieved maximum growth, when the rye is at least 6 inches above the wheat crop.

RESTRICTIONS: Allow at least 35 days between application and harvest. Do not use roller applicators.

For nonselective control of listed annual weeds in small grain cropping systems (South Dakota only)

USE INSTRUCTIONS: For ground applications, use 3 to 5 gallons of water per acre. For aerial applications, use 2 to 3 gallons of water per acre.

PRECAUTIONS: The likelihood of injury occurring from the use of this product is greatest when winds are gusty or in excess of 5 miles per hour or when other conditions, including lesser wind velocities, will allow spray drift to occur. Adjust boom height on ground equipment to prevent streaked, overlapped or uneven applications. Avoid spraying when weeds are subject to moisture stress, when dust is on foliage, or when straw canopy covers the weeds.

Red Rice Control Prior To Planting Rice
USE INSTRUCTIONS: Apply 1.5 pints of this product in 5 to 10 gallons of water per acre. Flush fields prior to application to obtain uniform germination and stand of red rice. Make application when the majority of the red rice plants are in the 2-leaf stage and no more than 4 inches tall. Red rice plants with less than 2 true leaves may only be partially controlled.
PRECAUTION: Avoid spraying during low humidity conditions, as reduced control may result.

RESTRICTION: DO NOT TREAT RICE FIELDS OR LEVEES WHEN THE FIELDS CONTAIN FLOOD WATER. DO NOT RE-FLOOD TREATED FIELDS FOR 8 DAYS FOLLOWING APPLICATION.

Christmas Trees

TYPES OF APPLICATIONS: Post-directed, spot treatment, site preparation

Post-directed, Spot treatment

USE INSTRUCTIONS: This product may be used as a post-directed spray and spot treatment around established Christmas trees.

PRECAUTIONS: Desirable plants may be protected from the spray solution by using shields or coverings made of cardboard or other impermeable material. Care must be exercised to avoid contact of spray, drift or mist with foliage or green bark of established Christmas trees.

RESTRICTION: DO NOT USE THIS PRODUCT AS AN OVER-THE-TOP BROADCAST SPRAY IN CHRISTMAS TREES.

Site preparation
USE INSTRUCTIONS: This product may be used prior to planting Christmas trees.
PRECAUTION: Precautions should be taken to protect nontarget plants during site preparation applications.

Citrus Crops

LABELED CROPS: Calamondin, Chironja, Citron, Citrus Hybrids, Grapefruit, Kumquat, Lemon, Lime, Mandarin (tangerine), Orange (All), Pummelo, Tangelo, Tangor

TYPES OF APPLICATIONS: Weed control, middles (between rows of trees), strips (in row of trees), selective equipment

NOTE: FOR USE DIRECTIONS, SEE THE "TREE, NUT AND VINE (GENERAL)" SECTION. THE FOLLOWING DIRECTIONS ARE SPECIFIC TO CITRUS CROPS.

Florida and Texas only: For burndown or control of the weeds listed below, apply the specified rates of this product in 3 to 30 gallons of water per acre. Where weed foliage is dense, use 10 to 30 gallons of water per acre.

For goatweed, apply 3 to 4.5 pints of this product per acre. Apply in 20 to 30 gallons of water per acre when plants are actively growing. Use 3 pints per acre when plants are less than 8 inches tall and 4.5 pints per acre when plants are greater than 8 inches tall. If goatweed is greater than 8 inches tall, the addition of Krovar® II or Karmex® may improve control. Refer to the individual product labels for specific crops, rates, geographic restrictions and precautionary statements.

Perennial weeds:
S=Suppression B=Burndown
PC=Partial Control C=Control

Weed Species	**Glyphosate 5.4 Rate Per Acre**			
	1.5 PT	**3 PT**	**4.5 PT**	**7.5 PT**
Bermudagrass	B	-	PC	C
Guineagrass				
Texas and Florida Ridge	B	C	C	C
Florida Flatwoods	-	B	C	C
Paragrass	B	C	C	C
Torpedograss	S	-	PC	C

RESTRICTION: Allow a minimum of 1 day between last application and harvest.

Conservation Reserve Program (CRP)

TYPES OF APPLICATIONS: Renovation (rotating out of CRP), site preparation, dormant, wiper

Rotating out of CRP, Site preparation
USE INSTRUCTIONS: This product may be used to prepare CRP land for crop production.

Dormant, Wiper
USE INSTRUCTIONS: This product may be used to suppress competitive growth and seed production of undesirable vegetation in CRP acres. Such applications may be made with wiper application equipment or as a broadcast or spot treatment to dormant CRP grasses. For selective applications with broadcast spray equipment, apply 9 to 12 fluid ounces of this product per acre in early spring before desirable CRP grasses, such as crested and tall wheatgrass, break dormancy and initiate green growth. Late fall applications can be made after desirable perennial grasses have reached dormancy.

PRECAUTION: Some stunting of CRP perennial grasses will occur if broadcast applications are made when plants are not dormant.

Corn

TYPES OF CORN: Field corn, seed corn, sweet corn and popcorn

TYPES OF APPLICATIONS: Preplant, preemergence, at-planting, spot treatment, hooded sprayers, preharvest, post-harvest

Preplant, Preemergence and At-planting
USE INSTRUCTIONS: This product may be applied before, during or after planting corn. Applications must be made prior to emergence of the crop.

The following tank mixtures may be applied before, during or after planting in conventional tillage systems, into a cover crop, established sod or in previous crop residue.

Apply these tank mixtures in 10 to 20 gallons of water or 10 to 60 gallons of nitrogen solution per acre. For Southern states, do not apply in nitrogen solutions to tough-to-control grasses such as barnyardgrass, fall panicum, broadleaf signalgrass, annual ryegrass and any perennial weeds. See the map in the Annual Weeds section of this label for areas included in this recommendation.

ATRAZINE	EXTRAZINE®	LOROX®
BANVEL®	FRONTIER®	MICRO-TECH®
BICEP®	GUARDSMAN®	PARTNER®
BICEP® II	HARNESS®	PROWL®
BROADSTRIKE®	HARNESS® XTRA	SIMAZINE
BULLET®	HARNESS® XTRA 5.6L	SURPASS®
DUAL®	LARIAT®	SURPASS® 100
DUAL® II	LASSO®/ALACHLOR	TOPNOTCH®
	LINEX®	

For improved burndown, this product may be tank mixed with 2,4-D or dicamba.

Annual weeds – For difficult-to-control weeds such as fall panicum, barnyardgrass, crabgrass, shattercane and broadleaf signalgrass up to 2 inches tall, and Pennsylvania smartweed up to 6 inches tall, apply this product at 1.5 pints per acre in these tank mixtures. For other labeled annual weeds, apply 12-18 fluid ounces of this product per acre when weeds are less than 6 inches tall, and 1.5 to 2.25 pints when weeds are over 6 inches tall.

RESTRICTIONS: Applications of 2,4-D or dicamba must be made at least 7 days prior to planting corn.

The tank mix recommendations in this section are not registered in California.

Spot treatment
USE INSTRUCTIONS: For spot treatments, apply this product prior to silking of corn.
RESTRICTIONS: Do not treat more than 10 percent of the total field area to be harvested. The crop receiving spray in the treated area will be killed. Do not allow drift or spray outside target area for the same reason.

Hooded Sprayers
USE INSTRUCTIONS: This product may be used through hooded sprayers for weed control between the rows of corn (all), including field corn, sweet corn and popcorn. Only hooded sprayers that completely enclose the spray pattern may be used.

When applying to corn that is grown on raised beds, ensure that the hood is designed to completely enclose the spray solution. If necessary, extend the front and rear flaps of the hoods to reach the ground in deep furrows.

Follow these requirements:
- The spray hoods must be operated on the ground or skimming across the ground.
- Do not apply more than 1.5 pints of this product per acre per application.
- Corn must be at least 12 inches tall, measured without extending leaves.
- Leave at least an 8 inch untreated strip over the drill row. For example, if the crop row width is 38 inches, the maximum width of the spray hood should be 30 inches.
- Maximum tractor speed: 5 mph.
- Maximum wind speed: 10 mph.
- Use low-drift nozzles.

Crop injury may occur when the foliage of treated weeds comes into direct contact with leaves of the crop. Do not apply this product when the leaves of the crop are growing in direct contact with weeds to be treated. Droplets, mist, foam or splatter of the herbicide solution may contact the crop and cause discoloration, stunting or destruction.

PRECAUTIONS: Contact of this product in any manner to any vegetation to which treatment is not intended may cause damage. Such damage shall be the sole responsibility of the applicator.

RESTRICTIONS: Do not graze or feed corn forage or fodder following applications of this product through hooded sprayers. Do not apply more than 4.5 pints of this product per acre per year for hooded sprayer applications.

Preharvest
USE INSTRUCTIONS: Make applications at 35 percent grain moisture or less. Ensure that maximum kernel fill is complete and the corn is physiologically mature (black layer formed). For ground applications, apply up to 4.5 pints of this product per acre. For aerial applications, apply up to 1.5 pints of this product per acre.

RESTRICTIONS: Do not treat corn grown for seed because a reduction in germination or vigor may occur. Allow a minimum of 7 days between application and harvest.

Post-harvest
USE INSTRUCTIONS: This product may be applied after harvest of corn. Higher rates may be required for control of large weeds which were growing in the crop at the time of harvest. Tank mixtures with 2,4-D or dicamba may be used.

RESTRICTION: Do not harvest or feed treated vegetation for 8 weeks following application.

Cotton

TYPES OF APPLICATIONS: Preplant, preemergence, at-planting, hooded sprayer, selective equipment, spot treatment, preharvest

Preplant, Preemergence, and At-planting
USE INSTRUCTIONS: This product may be applied before, during or after planting cotton. Applications must be made prior to emergence of the crop.

Hooded sprayer, Selective equipment
USE INSTRUCTIONS: This product may be applied through hooded sprayers, recirculating sprayers, shielded applicators or wiper applicators in cotton. Allow at least 7 days between application and harvest.

See the "SELECTIVE EQUIPMENT" part of the "APPLICATION EQUIPMENT AND TECHNIQUES" section of this label for information on proper use and calibration of this equipment.

Spot treatment
USE INSTRUCTIONS: For spot treatments, apply this product prior to boll opening of cotton.

RESTRICTIONS: Do not treat more than 10 percent of the total field area to be harvested. The crop receiving spray in treated area will be killed. Do not allow drift or spray outside target area for the same reason.

Preharvest
USE INSTRUCTIONS: This product provides weed control and cotton regrowth inhibition when applied prior to harvest of cotton. For weed control, apply at rates given in the annual, perennial and woody brush tables. Apply 12 fluid ounces to 3 pints of this product per acre for cotton regrowth inhibition. Allow a minimum of 7 days between application and harvest of cotton.

This product may be applied using either aerial or ground spray equipment. For ground applications, apply this product in 10 to 20 gallons of water per acre. For aerial applications, apply this product in 3 to 10 gallons of water per acre.

Apply after sufficient bolls have developed to produce the desired yield of cotton. Applications made prior to this time could affect maximum yield potential.

This product may be tank mixed with DEF® 6, Folex®, or Prep™ to provide additional enhancement of cotton leaf drop.

RESTRICTIONS: Do not feed or graze treated cotton forage or hay following preharvest applications. DO NOT APPLY MORE THAN 1.5 PINTS OF THIS PRODUCT PER ACRE BY AIR. Do not apply more than 1.5 quarts of this product per acre by ground. Do not apply to cotton grown for seed, as a reduction in germination or vigor may occur.

Fallow Systems

TYPES OF APPLICATIONS: Chemical fallow, preplant fallow beds, aid-to-tillage.

Chemical fallow
USE INSTRUCTIONS: This product may be applied during the fallow period prior to planting or emergence of any crop listed on this label. For any crop not listed on this label, applications must be made at least 30 days prior to planting. This product may be used as a substitute for tillage to control annual weeds in fallow fields. Also, broadcast or spot treatments will control or suppress many perennial weeds in fallow fields. Ground or aerial application equipment may be used. Tank mixtures with 2,4-D and dicamba may be used.

RESTRICTION: DO NOT APPLY BANVEL® TANK MIXTURES BY AIR IN CALIFORNIA.

Refer to the specific product labels for crop rotation restrictions and cautionary statements of all products used in tank mixtures. Some crop injury may occur if Banvel® is applied within 45 days of planting.

Preplant fallow beds
USE INSTRUCTIONS: This product may be applied to fallow beds prior to planting or emergence of any crop listed on this label. For any crop not listed on this label, applications must be made at least 30 days prior to planting. This product will control weeds listed in the annual, perennial and woody brush tables.

In addition, 9 fluid ounces of this product plus 2 to 4 oz of Goal® 2XL per acre will control the following weeds with the maximum height or length indicated: 3" – common cheeseweed, chickweed, groundsel; 6" – London rocket, shepherdspurse.

12 fluid ounces of this product plus 2 to 4 oz of Goal® 2XL per acre will control the following weeds with the maximum height or length indicated: 6" – common cheeseweed, groundsel, marestail *(Conyza canadensis)*, 12" – chickweed, London rocket, shepherdspurse.

Aid-to-tillage
USE INSTRUCTIONS: This product may be used in conjunction with tillage practices in fallow systems or preplant to labeled crops to control downy brome, cheat, volunteer wheat, tansy mustard and foxtail. Apply 6 fluid ounces of this product in 3 to 10 gallons of water per acre. Make applications before weeds are 6 inches in height. Application must be followed by conventional tillage practices no later than 15 days after treatment and before regrowth occurs. Allow at least 1 day after application before tillage.

PRECAUTION: Tank mixtures with residual herbicides may result in reduced performance.

Grain Sorghum (Milo)

TYPES OF APPLICATIONS: Preplant, preemergence, at-planting, spot treatment, wiper applicators, preharvest, post-harvest

Preplant, Preemergence, At-planting
USE INSTRUCTIONS: This product may be applied before, during or after planting grain sorghum. Applications must be made prior to emergence of the crop.

Spot treatment and Wiper applications
USE INSTRUCTIONS: This product may be applied as a spot treatment in grain sorghum. Make spot treatments before heading of milo. This product may be applied with wiper applicators to control or suppress the weeds listed under "WIPER APPLICATORS" in the "SELECTIVE EQUIPMENT" section of this label.

RESTRICTIONS: For spot treatment, do not treat more than 10 percent of the total field area to be harvested. The crop receiving spray in treated area will be killed. Do not allow drift or spray outside target area for the same reason.

For wiper applicators, allow at least 40 days between application and harvest. Do not use roller applicators. Do not feed or graze treated milo fodder. Do not ensile treated vegetation.

Hooded Sprayers
USE INSTRUCTIONS: This product may be used through hooded sprayers for weed control between the rows of milo. Only hooded sprayers that completely enclose the spray pattern may be used.

When applying to milo that is grown on raised beds, ensure that the hood is designed to completely enclose the spray solution. If necessary, extend the front and rear flaps of the hoods to reach the ground in deep furrows.

Follow these requirements:
- The spray hoods must be operated on the ground or skimming across the ground.
- Do not apply more than 1.5 pints of this product per acre per application.
- Milo must be at least 12 inches tall, measured without extending leaves. Treat before milo sends tillers between the drill rows. If such tillers are contacted with the spray solution, the main plant may be killed.
- Leave at least an 8 inch untreated strip over the drill row. For example, if the crop row width is 38 inches, the maximum width of the spray hood should be 30 inches.
- Maximum tractor speed: 5 mph.
- Maximum wind speed: 10 mph.
- Use low-drift nozzles.

Crop injury may occur when the foliage of treated weeds comes into direct contact with leaves of the crop. Do not apply this product when the leaves of the crop are growing in direct contact with weeds to be treated. Droplets, mist, foam or splatter of the herbicide solution may contact the crop and cause discoloration, stunting or destruction.

RESTRICTIONS: Contact of this product in any manner to any vegetation to which treatment is not intended may cause damage. Such damage shall be the sole responsibility of the applicator. Do not graze or feed milo forage or fodder following applications of this product through hooded sprayers. Do not apply more than 4.5 pints of this product per acre per year for hooded sprayer applications.

Preharvest
USE INSTRUCTIONS: Make applications at 30% grain moisture or less.

RESTRICTIONS: Do not apply more than 3 pints of this product per acre. Allow a minimum of 7 days between application and harvest of sorghum. Do not treat sorghum grown for seed as a reduction in germination or vigor may occur. The use of this product for preharvest grain sorghum (milo) is not registered in California.

Post-harvest
USE INSTRUCTIONS: This product may be applied after harvest of grain sorghum. Higher rates may be required for control of large weeds which were growing in the crop at the time of harvest. Tank mixtures with 2,4-D or dicamba may be used.

This product may be applied to grain sorghum (milo) stubble following harvest to suppress or control regrowth. Apply 1.5 pints of this product per acre for control, or 1.25 pints of this product per acre for suppression.

RESTRICTION: Do not harvest or feed treated vegetation for 8 weeks following application.

Grass Seed Production

TYPES OF APPLICATIONS: Preplant, preemergence, renovation, site preparation, shielded sprayers, wiper applicators, spot treatments, creating rows in annual ryegrass

USE INSTRUCTIONS: This product may be applied before, during, or after planting or renovation of turf or forage grass areas grown for seed production. Applications MUST be made prior to the emergence of the crop to avoid crop injury. For maximum control of existing vegetation, delay planting to determine if any regrowth from escaped underground plant parts occurs. Where repeat treatments are necessary, sufficient regrowth must be attained prior to application. For warm-season grasses, such as bermudagrass, summer or fall applications provide best control.

RESTRICTIONS: Do not disturb soil or underground plant parts before treatment. Tillage or renovation techniques such as vertical mowing, coring or slicing should be delayed for 7 days after application to allow proper translocation into underground plant parts. Do not feed or graze treated areas for 8 weeks following application.

Shielded Sprayers
USE INSTRUCTIONS: Apply 1.5 pints to 4.5 pints of this product as a broadcast spray in 10 to 20 gallons of water per acre to control weeds in the rows. Uniform planting in straight rows aids in shielded sprayer applications. Best results are obtained when the grass seed crop is small enough to easily pass by or through the protective shields.

PRECAUTION: Contact of this product in any manner to any vegetation to which treatment is not intended may cause damage. Such damage shall be the sole responsibility of the applicator.

Wiper Applications
PRECAUTIONS: Contact of the herbicide solution with desirable vegetation may result in damage or destruction. Applicators must be adjusted so that the wiper contact point is at least two (2) inches above the desirable vegetation. Weeds should be a minimum of six (6) inches above the desirable vegetation. Better results may be 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 height of weeds varies so that not all weeds are contacted. In these instances, repeat treatments may be necessary. Better results may be obtained if 2 applications are made in opposite directions.

Spot Treatments
USE INSTRUCTIONS: Use a 1 to 5 percent solution on a volume to volume basis with water. See the "SELECTIVE EQUIPMENT" section for additional application recommendations.

RESTRICTIONS: Apply this product prior to heading of grasses. Do not treat more than 10 percent of the total field to be harvested. The crop receiving the spray in the treated area will be killed. Do not allow drift or spray outside the target area for the same reason.

Creating Rows in Annual Ryegrass
USE INSTRUCTIONS: Use 12-24 fluid ounces of this product per acre mixed with water. Use the higher rate when the ryegrass is greater than 6 inches tall. Best results are obtained when applicators are made before the ryegrass reaches 6 inches in height.

Set nozzle heights to allow the establishment of the desired row spacing while preventing spray droplets, spray fines, or drift to contact the ryegrass plants not treated. Use low-pressure nozzles, or drop nozzles designed to target the application over a narrow band.

Grower assumes all responsibility for crop losses from misapplication.

Herbs

TYPES OF HERBS: Peppermint, spearmint

USE INSTRUCTIONS: This product may be used as a spot treatment in spearmint and peppermint. Apply spray-to-wet with hand-held equipment, such as backpack and knapsack sprayers, pump-up pressure sprayers, hand-guns, hand-wands or any other hand-held or motorized spray equipment used to direct the spray solution on to a limited area. Further applications may be made in the same area at 30-day intervals.

RESTRICTIONS: Allow at least 7 days between application and harvest. No more than one-tenth of any acre should be treated at one time. The crop receiving spray in the treated area will be killed. Do not allow drift or spray outside the target area for this reason.

Pastures

TYPES OF PASTURES: Bahiagrass, bermudagrass, bluegrass, brome, fescue, orchardgrass, ryegrass, timothy, wheatgrass, alfalfa and clover.

TYPES OF APPLICATIONS: Spot treatment, wiper application, preplant, preemergence, pasture renovation

Spot treatment and Wiper Application
USE INSTRUCTIONS: This product may be applied as a spot treatment or with wiper applicators in pastures. Applications may be made in the same area at 30-day intervals. For spot treatment and wiper applications, apply in areas where the movement of domestic livestock can be controlled.

RESTRICTIONS: No more than one-tenth of any acre should be treated at one time. Remove domestic livestock before application and wait 14 days after application before grazing livestock or harvesting.

Preplant, Preemergence and Pasture renovation
USE INSTRUCTIONS: This product may be applied 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.

RESTRICTION: Remove domestic livestock before application and wait 8 weeks after application before grazing or harvesting.

Peanuts

TYPES OF APPLICATIONS: Preplant, preemergence, at-planting

USE INSTRUCTIONS: This product may be applied before, during or after planting peanuts. Applications must be made prior to the emergence of the crop.

Small Fruits and Berries

LABELED CROPS: Blackberry, Blueberry, Boysenberry, Cranberry, Currant, Dewberry, Elderberry, Gooseberry, Huckleberry, Loganberry, Olallieberry, Raspberry (Black, Red), Youngberry

TYPES OF APPLICATIONS: Preplant, preemergence, directed spray (except cranberry), wiper application

USE INSTRUCTIONS: This product may be applied as a preplant or preemergence broadcast application or as a wiper application for crops listed in this section. Directed sprays may be applied to any crop except cranberries. For wick or wiper applicators, mix 3 quarts of this product in 4 gallons of water. In severe infestations, reduce equipment ground speed to ensure that adequate amounts of this product are wiped on the weeds. A second treatment in the opposite direction may be beneficial.

RESTRICTIONS: Do not permit herbicide solution to contact desirable vegetation, including green shoots, canes or foliage. Allow a minimum of 30 days between last application and harvest of cranberries. For other small fruits and berries, allow a minimum of 14 days between last application and harvest.

Soybeans

TYPES OF APPLICATIONS: Preplant, preemergence, at-planting, spot treatment, preharvest, selective equipment, hooded sprayers

Preplant, Preemergence and At-planting
USE INSTRUCTIONS: This product may be applied before, during or after planting soybeans. Applications must be made prior to emergence of the crop.

The following tank mixtures may be applied before, during or after planting in conventional tillage systems, into a cover crop, established sod or in previous crop residue.

CANOPY®	LASSO®/ALACHLOR	PROWL®
COMMAND®	LINEX®	PURSUIT®
DUAL®	LOROX®/LINURON	PURSUIT® PLUS
DUAL® II	LOROX® PLUS	SCEPTER®
FRONTIER®	MICRO-TECH®	SENCOR®/LEXONE®
FUSION®	PARTNER®	SQUADRON®
GEMINI®	PREVIEW®	TURBO®

For improved burndown, this product may be tank-mixed with 2,4-D or 2,4-DB. See the 2,4-D label for intervals between application and planting.

Annual weeds: For difficult-to-control weeds such as fall panicum, barnyardgrass, crabgrass, shattercane and broadleaf signalgrass up to 2 inches tall, and Pennsylvania smartweed up to 6 inches tall, apply this product at 1.5 pints per acre in these tank mixtures. For other labeled annual weeds, apply 12 fluid ounces to 18 fluid ounces of this product per acre when weeds are less than 6 inches tall, and 1.5 to 2.25 pints when weeds are over 6 inches tall.

RESTRICTION: The tank mix recommendations in this section are not registered in California.

Spot treatment
USE INSTRUCTIONS: For spot treatments, apply this product prior to initial pod set in soybeans.

RESTRICTIONS: Do not treat more than 10 percent of the total field area to be harvested. The crop receiving spray in treated area will be killed. Do not allow or spray outside target area for the same reason.

Preharvest
USE INSTRUCTIONS: This product provides weed control when applied prior to harvest of soybeans.

Apply at rates given in the annual, perennial and woody brush tables. This product may be applied using either aerial or ground spray equipment. For ground applications, apply this product in 10 to 20 gallons of water per acre. For aerial applications, apply this product in 3 to 10 gallons of water per acre.

Apply after pods have set and lost all green color. Allow a minimum of 7 days between application and harvest of soybeans. Care should be taken to avoid excessive seed shatter loss due to ground application equipment.

RESTRICTIONS: Do not graze or harvest treated crop for livestock feed within 25 days of last preharvest application. DO NOT APPLY MORE THAN 4 QUARTS PER ACRE OF THIS PRODUCT FOR PREHARVEST APPLICATIONS. DO NOT APPLY MORE THAN 1.5 PINTS PER ACRE OF THIS PRODUCT BY AIR. Do not apply to soybeans grown for seed as a reduction in germination or vigor may occur.

Selective equipment
USE INSTRUCTIONS: This product may be applied through recirculating sprayers, shielded applicators, hooded sprayers, wiper applicators or sponge bars in soybeans. Allow at least 7 days between application and harvest.

See the “SELECTIVE EQUIPMENT” part of the “APPLICATION EQUIPMENT AND TECHNIQUES” section of this label for information on proper use and calibration of this equipment.

Sugarcane

TYPES OF APPLICATIONS: Preplant, preemergence, spot treatment, fallow, hooded sprayers

Preplant, Preemergence
USE INSTRUCTIONS: This product may be applied in or around sugarcane fields or in fields prior to the emergence of plant cane.

RESTRICTION: Do not apply to vegetation in or around ditches, canals or ponds containing water to be used for irrigation.

Spot Treatment
USE INSTRUCTIONS: This product may be applied as a spot treatment in sugarcane. For control of volunteer or diseased sugarcane, make a 3/4 percent solution of this product in water and spray to wet the foliage of vegetation to be controlled. Volunteer or diseased sugarcane should have at least 7 new leaves.

RESTRICTIONS: Avoid spray contact with healthy cane plants since severe damage or destruction may result. Do not feed or graze treated sugarcane foliage following application.

Fallow treatments
USE INSTRUCTIONS: This product may be used as a replacement for tillage in fields that are lying fallow between sugarcane crops. This product may also be used to remove the last stubble of ratoon cane. For removal of last stubble of ratoon cane, apply 3 to 3 ¾ quarts of this product in 10 to 40 gallons of water per acre to new growth having at least 7 new leaves. Allow 7 or more days after application before tillage.

Hooded sprayers
USE INSTRUCTIONS: This product may be used through hooded sprayers for weed control between the rows of sugarcane. A hooded sprayer is a type of shielded applicator. The spray pattern is completely enclosed on the top and all 4 sides by a hood, thereby shielding the crop from the spray solution.

Minimize the potential for spray particles to escape from under the hood by operating the sprayer at appropriate ground speeds, nozzle pressures and wind speeds. Operation on rough or sloping ground may result in spray particles escaping from the hood.

When applying to sugarcane that is grown on raised beds, ensure that the hood is designed to completely enclose the spray. If necessary, extend the front and rear flaps of the hoods to reach the ground in furrows between the rows.

Equipment must be designed, maintained and operated to prevent the herbicide solution from contacting the crop. Contact of this product in any manner to any vegetation to which treatment is not intended may cause damage. Such damage shall be the sole responsibility of the applicator.

PRECAUTION: Droplets, mist, foam or splatter of the herbicide solution settling on the crop may result in discoloration, stunting or destruction.

RESTRICTION: Do not allow treated weeds to come into contact with the crop.

Sunflowers

TYPES OF APPLICATIONS: Preplant, preemergence

USE INSTRUCTIONS: This product may be applied before, during or after planting sunflowers. Applications must be made prior to emergence of the crop.

A tank mixture with Prowl may be applied before, during or after planting in conventional tillage systems, into a cover crop, established sod or in previous crop residue.

RESTRICTIONS: Do not apply more than 24 fluid ounces (1.5 pints) of this product per acre for sunflowers. Make only one preplant or preemergent application per year. Do not feed or graze sunflower forage following application of this product.

Tree, Nut and Vine

TYPES OF APPLICATIONS: Weed control, middles (between rows of trees), strips (in row of trees), selective equipment (except kiwi), perennial grass suppression

NOTE: THIS SECTION GIVES DIRECTIONS THAT APPLY TO ALL CITRUS CROPS, TREE FRUITS, TREE NUTS AND VINE CROPS. SEE THE INDIVIDUAL CROP SECTIONS FOR INSTRUCTIONS, PREHARVEST INTERVALS, PRECAUTIONS AND RESTRICTIONS FOR SPECIFIC CROPS.

This product may be applied in middles, strips and for weed control in established citrus groves, tree fruit and tree nut orchards, and vineyards. Apply at rates given in the annual, perennial and woody brush tables. Repeat applications may be made up to a maximum of 8 quarts per acre per year. This product may also be used for site preparation prior to transplanting these crops. Allow a minimum of 3 days between application and transplanting. Applications may be made with boom equipment, CDA, shielded sprayers, hand-held and high-volume wands, lances, orchard guns or with wiper applicator equipment, except as directed.

Middles (between rows)
USE INSTRUCTIONS: This product will control or suppress annual and perennial weeds and ground covers growing between the rows of labeled tree and vine crops. If weeds are under drought stress, irrigate prior to application. Reduced control may result if weeds have been mowed prior to application.

A tank mixture of this product plus Goal® 2XL may be used for annual weeds in middles between rows of citrus crops, tree fruits, tree nuts and vine crops. Use this mixture when weeds are stressed or growing in dense populations. 12 to 24 oz/A of this product plus 3 to 12 oz/A of Goal® 2XL will control annual weeds with a maximum height or diameter of 6 inches, including crabgrass, hairy fleabane *(Conyza bonariensis)*, common groundsel, junglerice, common lambsquarters, redroot pigweed, London rocket, common ryegrass, shepherdspurse, annual sowthistle, common cheeseweed (malva), filaree (suppression), horseweed/marestail *(Conyza canadensis)*, stinging nettle and common purslane (suppression). 9 to 24 oz/A of this product plus 3 to 12 oz/A of Goal® 2XL will control common cheeseweed (malva) with a maximum height or diameter of 3 inches.

Strips (in rows)
USE INSTRUCTIONS: This product may be applied in rows of tree or vine crops and may also be tank mixed with the following products.

DEVRINOL® 50 DF	PRINCEP® CALIBER 90
DIREX® 4L	SIMAZINE 4L
GOAL® 2XL	SIMAZINE 80W
KARMEX® DF	SIM-TROL™ 4L
KROVAR® I	SOLICAM® DF
KROVAR® II	SULFLAN®AS
PROWL®	SURFLAN® 75W

Do not apply these tank mixtures in Puerto Rico.

Refer to the individual product labels for specific crops, rates, geographic restrictions and precautionary statements.

Apply 12 fluid ounces to 7.5 pints of this product per acre in these tank mixtures. Use rates at the higher end of the specified rate range when weeds are stressed, growing in dense populations or are greater than 12 inches tall.

Perennial grass suppression
This product will suppress perennial grasses such as bahiagrass, bermudagrass, tall fescue, orchardgrass, Kentucky bluegrass, and quackgrass that are grown as ground covers in tree and vine crops.

For suppression of tall fescue, fine fescue, orchardgrass and quackgrass, apply 6 fluid ounces of this product in 10 to 20 gallons of water per acre.

For suppression of Kentucky bluegrass covers, apply 4.5 fluid ounces of this product per acre. Do not add ammonium sulfate.

For best results, mow cool season grass covers in the spring to even their height and apply this product 3 to 4 days after mowing.

For suppression of vegetative growth and seedhead inhibition of bahiagrass for approximately 45 days, apply 4.5 fluid ounces of this product in 10 to 25 gallons of water per acre. Apply 1 to 2 weeks after full green-up or after mowing to a uniform height of 3 to 4 inches. This application must be made prior to seedhead emergence.

For suppression up to 120 days, apply 3 fluid ounces of this product per acre, followed by an application of 1.5 to 3 fluid ounces per acre about 45 days later. Make no more than 2 applications per year.

For burndown of bermudagrass, apply 1.5 pints to 3 pints of this product in 3 to 20 gallons of water per acre. Use this treatment only if reduction of the bermudagrass stand can be tolerated. When burndown is required prior to harvest, allow at least 21 days to ensure sufficient time for burndown to occur.

For suppression of bermudagrass, apply 4.5 to 12 fluid ounces of this product per acre east of the Rocky Mountains and 12 fluid ounces of this product per acre west of the Rocky Mountains. Apply in a total spray volume of 3 to 20 gallons per acre, no sooner than 1 to 2 weeks after full green-up. If the bermudagrass is mowed prior to application, maintain a minimum of 3 inches in height. Sequential applications may be made when regrowth occurs and bermudagrass injury and stand reduction can be tolerated. East of the Rocky Mountains, rates of 4.5 to 7.5 fluid ounces per acre should be used in shaded conditions or where a lesser degree of suppression is desired.

Selective equipment
Shielded and wiper applicators may be used in tree crops and grapes. Refer to the individual crop sections for time interval between application and harvest.

RESTRICTIONS: For citron and olives, apply as a post-directed spray only.

EXTREME CARE MUST BE EXERCISED TO AVOID CONTACT OF HERBICIDE SOLUTION, SPRAY, DRIFT OR MIST WITH FOLIAGE OR GREEN BARK OF TRUNK, BRANCHES, SUCKERS, FRUIT OR OTHER PARTS OF TREES AND VINES. CONTACT OF THIS PRODUCT WITH OTHER THAN MATURED BROWN BARK CAN RESULT IN SERIOUS CROP DAMAGE.

AVOID PAINTING CUT STUMPS WITH THIS PRODUCT AS INJURY RESULTING FROM ROOT GRAFTING MAY OCCUR IN ADJACENT TREES.

Tree Fruits

LABELED CROPS: Apple, Apricot, Cherry (Sweet, Sour), Crabapple, Loquat, Mayhaw, Nectarine, Olive, Peach, Pear, Plum/Prune (All), Quince

TYPES OF APPLICATIONS: Weed control, middles (between rows of trees), strips (in row of trees), selective equipment

NOTE: FOR USE DIRECTIONS, SEE THE "TREE, NUT AND VINE (GENERAL)" SECTION. THE FOLLOWING DIRECTIONS ARE SPECIFIC TO TREE FRUITS.

Restrictions on application equipment
For cherries, any application equipment listed in this section may be used in all states.
For citron and olives, apply as a post-directed spray only.

Any application equipment listed in this section may be used in apricots, nectarines, peaches and plums/prunes growing in Arizona, California, Colorado, Idaho, Kansas, Kentucky, New Jersey, North Dakota, Oklahoma, Oregon, Texas, Utah and Washington, except for peaches grown in the states specified in the following paragraph. In all other states use wiper equipment only.

For PEACHES grown in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina and Tennessee only, apply with a shielded boom sprayer or shielded wiper applicator, which prevents any contact of this product with the foliage or bark of trees. Apply no later than 90 days after first bloom. Applications made after this time may result in severe damage. Remove suckers and low-hanging limbs at least 10 days prior to application. Avoid applications near trees with recent pruning wounds or other mechanical injury. Apply only near trees which have been planted in the orchard for 2 or more years. EXTREME CARE MUST BE TAKEN TO ENSURE NO PART OF THE PEACH TREE IS CONTACTED.

RESTRICTION: Allow a minimum of 1 day between last application and harvest for apple, crabapple, loquat, mayhaw, pear, quince.

Allow a minimum of 17 days between last application and harvest for apricot, cherry, nectarine, olive, peach, plum/prune.

Tree Nuts

LABELED CROPS: Almond, Beechnut, Brazil nut, Butternut, Cashew, Chestnut, Chinquapin, Filbert (Hazelnut), Hickory nut, Macadamia, Pecan, Pistachio, Walnut (Black, English)

TYPES OF APPLICATIONS: Weed control, middles (between rows of trees), strips (in row of trees), selective equipment.

NOTE: FOR USE DIRECTIONS, SEE THE "TREE, NUT AND VINE (GENERAL)" SECTION. THE FOLLOWING DIRECTIONS ARE SPECIFIC TO TREE NUTS.

RESTRICTION: Allow a minimum of 3 days between last application and harvest of tree nuts.

Tropical Crops

LABELED CROPS: Atemoya, Avocado, Banana, Barbados Cherry (acerola), Breadfruit, Canistel, Carambola, Cherimoya, Cocoa beans, Coconuts, Coffee, Dates, Figs, Guava, Jaboticaba, Jackfruit, Longan, Lychee, Mango, Marmaladebox (genip), Papaya, Passion fruit, Persimmon, Pineapple, Plantain, Pomegranate, Sapodilla, Sapote (black, mamey, white), Soursop, Sugar apple, Tamarind, Tea.

USE INSTRUCTIONS: This product may be applied for weed control or for site preparation prior to transplanting crops listed in this section. In coffee and banana, delay applications 3 months after transplanting to allow the new coffee or banana plant to become established.

RESTRICTIONS: Allow a minimum of 14 days between last application and harvest of acerola, atemoya, avocado, breadfruit, canistel, carambola, cherimoya, cocoa beans, coconuts, dates, figs, genip, jaboticaba, jackfruit, longan, lychee, mango, mayhaw, passion fruit, persimmon, pomegranate, sapodilla, sapote, soursop, sugar apple, tamarind, and tea.

Allow a minimum of 28 days between last application and harvest of coffee.

Allow a minimum of 1 day between last application and harvest of banana, guava, and papaya and plantain.

Do not feed or graze treated pineapple forage following application.

Vegetable Crops

LABELED CROPS: Amaranth, Arrugula, Artichoke (Jerusalem), Beans (All), Beet greens, Garden beets, Broccoli (All), Brussels sprouts, Cabbage (All), Cabbage (Chinese), Cantaloupe, Cardoon, Cavalo Broccolo, Carrot, Cauliflower, Casaba melon, Celery, Celery (Chinese), Celeriac, Celtuce, Chard (Swiss), Chayote, Chervil, Chick peas, Chicory, Chrysanthemum, Collards, Corn salad, Crenshaw melon, Cress, Cucumber, Dandelion, Dock (sorrel), Eggplant, Endive, Fennel (Florence), Garlic, Gherkin, Ginseng, Gourds, Ground cherry, Guar, Honeydew melon, Honey ball melon, Horseradish, Kale, Kohlrabi, Leek, Lentils, Lettuce, Mango melon, Melons (All), Mizuna, Muskmelon, Mustard greens, Okra, Onion, Oriental radish, Parsley, Parsnips, Peas (All), Pepinos, Pepper (All), Persian melon, Potato (Irish), Pumpkin, Purslane, Radish, Rape greens, Rhubarb, Rutabaga, Salsify, Shallot, Spinach (All), Mustard Spinach, Squash (Summer, Winter), Sugar beets, Sweet potato, Tomatillo, Tomato, Turnip, Watercress, Watermelon, Yams.

USE INSTRUCTIONS: This product may be applied prior to the emergence of direct seeded vegetables or prior to transplanting vegetables.

PRECAUTIONS: When applying this product prior to transplanting crops into plastic mulch, care must be taken to remove residues of this product from the plastic prior to transplanting. Residues can be removed by 0.5 inch natural rainfall or by applying water via a sprinkler system.

For the following crops, apply only prior to planting. Allow at least 3 days between application and planting of cantaloupe, casaba melon, crenshaw melon, cucumber, eggplant, garlic, gherkin, gourds, ground cherry, honeydew melon, honey ball melon, mango melon, melons (all), muskmelon, pepper (all), persian melon, pumpkin, squash (summer, winter), tomatillo, tomato, watercress, and watermelon.

Nonbearing Ginseng: This product may be used for weed control in established non-bearing ginseng. Direct applications so that there is no contact of this product with the ginseng plant. Applications may be made with boom equipment, CDA, shielded sprayers, hand-held and high volume wands, lances, orchard guns or with wiper application equipment. Applications must be made at least one year prior to harvest. Extreme care must be exercised to avoid contact of herbicide solution, spray, drift or mist with foliage or green bark of trunk, branches, suckers, fruit or other parts of desirable plants. Contact of this product with other than matured brown bark can result in serious crop damage.

Wiper applicators may be used in rutabagas. Allow at least 14 days between application and harvest.

Vine Crops

LABELED CROPS: Grapes (raisin, table, wine), Kiwi fruit

TYPES OF APPLICATIONS: Weed control, middles (between rows), strips (in row), selective equipment

NOTE: FOR USE DIRECTIONS, SEE THE "TREE, NUT AND VINE (GENERAL)" SECTION.

THE FOLLOWING DIRECTIONS ARE SPECIFIC TO VINE CROPS.

Applications should not be made when green shoots, canes or foliage are in the spray zone.

In the northeast and Great Lakes regions, applications must be made prior to the end of bloom stage of grapes to avoid injury, or make applications with shielded sprayers or wiper equipment.

RESTRICTION: Allow a minimum of 14 days between last application and harvest.

Roundup Ready® Crops

The following instructions include applications which can be made onto Roundup Ready crops during the complete cropping season. Do NOT combine these instructions with other recommendations made for crop varieties which do not contain the Roundup Ready gene, in the CROPS (ALPHABETICAL) section of this label.

USE THIS PRODUCT FOR POSTEMERGENCE APPLICATION ONLY ON CROP VARIETIES DESIGNATED AS CONTAINING THE ROUNDUP READY GENE.

Applying this product to crop varieties with are not designated as Roundup Ready will result in severe crop injury and yield loss. Avoid contact with foliage, green stems, or fruit of crops, or any desirable plants which do not contain the Roundup Ready gene, since severe injury or destruction will result. The Roundup Ready designation indicates that the crop variety contains a patented gene which provides tolerance to this product. Information on Roundup Ready crop varieties may be obtained from your seed supplier.

Spray Drift Management
AVOID DRIFT. EXTREME CARE MUST BE TAKEN WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

See the MIXING and APPLICATION EQUIPMENT AND TECHNIQUES sections of this labeling for additional directions and restrictions on the application of this product.

DO NOT exceed a maximum rate of 24 fluid ounces per acre of this product when making applications by air unless otherwise directed. For aerial application in California and Arkansas, refer to the “For Aerial Application in California Only” and “For Aerial Application in Arkansas Only” sections of this label.

Tank mixtures with other herbicides, insecticides, or fungicides may result in reduced weed control or crop injury and are NOT recommended for over-the-top applications of this product.

Sprayer Preparation: It is important that sprayer, lines, filters, and mixing equipment be clean and free of pesticide residue before making applications of this product to Roundup Ready crops. Follow the cleaning procedures specified on the label of the product(s) previously used. Many crops can be very sensitive to herbicides at extremely low concentrations and care must be taken to thoroughly clean all equipment prior to use.

NOTE: The following directions are based on a clean start at planting by using a burn down application or tillage to control existing weeds before crop emergence. In no-till and stale seedbed systems, a preplant burn-down treatment of 18 to 48 fluid ounces per acre of this product is required to control existing weeds prior to crop emergence.

There are no rotational crop restrictions following application of this product.

For over-the-top uses on Roundup Ready crop varieties, crop safety and weed control performance are not warranted by Alligare, LLC when this product is used in conjunction with “brown bag” or “bin run” seed saved from previous year’s production and replanted.

CANOLA WITH THE ROUNUP READY GENE

TYPES OF APPLICATIONS: Preplant, preemergence, postemergence

USE INSTRUCTIONS:

Maximum Allowable Combined Application Quantities Per Season:

1. Preplant and preemergence applications:	48 fluid ounces per acre
2. Total in-crop application from emergence to 6-leaf:	24 fluid ounces per are

For ground applications with broadcast equipment, apply this product in 5 to 20 gallons of spray solution per acre. Carefully select proper nozzle and spray pressure to avoid spraying a fine mist. For best results with ground application equipment use flat fan nozzles. Check for even distribution of spray droplets.

For aerial applications apply this product in 3 to 15 gallons of water per acre.

Over-the-top applications: This product may be applied by aerial or ground application equipment postemergence to Roundup Ready canola from emergence through the six-leaf stage of development. To maximize yield potential spray canola early to eliminate competing weeds. Any single over-the-top broadcast application should not exceed 10 ounces per acre. No more than two over-the-top broadcast applications may be made from crop emergence through the six-leaf stage of development. Sequential over-the-top applications of this product must be at least 10 days apart.

Weeds controlled: For specific rates of application and instructions for control of various annual and perennial weeds, refer to the “ANNUAL” and “PERENNIAL” weed rate tables on this label.

Some weeds with multiple germination times or suppressed (stunted) weeds may require sequential applications of this product for control. The second application should be made after some regrowth has occurred and at least 10 days after a previous application of this product.

This product will control or suppress most perennial weeds. For some perennial weeds, repeat applications may be required to eliminate crop competition throughout the growing season.

Allow a minimum of 60 days between last application and canola harvest.

CORN WITH THE ROUNDUP READY GENE

TYPES OF APPLICATIONS: Preplant, preemergence, at-planting, postemergence, spot treatment, post-harvest

When applied as directed, this product controls labeled annual grass and broadleaf weeds in Roundup Ready corn. Many perennial grasses and broadleaf weeds will be controlled or suppressed with one or more applications of this product. Applications must be made to actively growing weeds before they reach the maximum size listed in the “ANNUAL” and “PERENNIAL” weed rate tables. Refer to the “MIXING” section of this labeling for the proper use instructions.

This product may be applied postemergence to Roundup Ready corn from emergence through the V8 stage (8 leaves with collars) or until corn height reaches 30 inches, whichever comes first. Single in-crop applications of this product are not to exceed 24 fluid ounces per acre. Sequential in-crop applications of this product from emergence through the V8 stage or 30 inches must not exceed 48 fluid ounces per acre per growing season.

Maximum Allowable Application Rates	
1. Combined total per year for all applications	6 quarts per acre
2. Preplant, Preemergence applications	3.755 quarts per acre
3. Total in-crop applications from emergence through the V8 stage or 30 inches	48 fluid ounces per acre
4. Maximum preharvest application rate after maximum kernel fill is complete and the crop is physiologically mature(black layer formation) until 7 days before harvest	24 fluid ounces per acre

The addition of 1 to 2 percent dry ammonium sulfate by weight or 8.5 to 17 pounds per 100 gallons of water may increase the performance of this product under hard water conditions, drought conditions or when tank mixed with Bullet®, Micro-Tech®, or Partner® Herbicides. Ensure that ammonium sulfate is completely dissolved in the spray tank before adding herbicides. Thoroughly rinse the spray system with clean water after use to reduce corrosion. The addition of other additives, including fertilizers and micronutrients are not recommended with this product since this may result in increased potential for crop injury.

For ground applications: Use the labeled rates of this product in 5 to 20 gallons of spray solution per acre as a broadcast spray. Carefully select correct nozzles and spray pressure to avoid spraying a fine mist. Check for even distribution of spray droplets.

For aerial applications: Use the labeled rates of this product in 3 to 15 gallons of spray solution per acre.

Allow a minimum of 50 days between application of this product and harvest of corn forage and 7 days between application and harvest of corn grain. Allow a minimum of 10 days between in-crop applications of this product.

Weed Control Directions
Apply 18 to 24 fluid ounces of this product per acre for control of labeled grasses and broadleaf weeds in conventional and no-till corn production systems. Refer to the “ANNUAL WEED RATE TABLE” of this label for specific annual weeds. This product, applied at up to 24 fluid ounces per acre will control or suppress the growth of perennial weeds such as: bermudagrass, Canada thistle, common milkweed, field bindweed, hemp dogbane, horsenettle, nutsedge, quackgrass, rhizome johnsongrass, redvine, trumpetcreeper, swamp smartweed, and wirestem muhly. For additional information on perennial weeds, see the “PERENNIAL WEED RATE TABLE” in this label.

Preemergence followed by Postemergence Weed Control Program: This product may be applied postemergence in-crop following any labeled preemergence herbicide application. The post application of this product should be made before the weeds reach a height and/or density that the weeds become competitive with the crop. A single in-crop application of this product at the specified rate will provide control of emerged weeds listed on the label. This product may be applied postemergence to Roundup Ready corn from emergence through the V8 stage (8 leaves with collars) or until corn height reaches 30 inches (free standing), whichever comes first.

Postemergence Only Weed Control Program: This product may be applied alone as a postemergence in-crop application to provide control of emerged weeds listed on this label. The postemergence application of this product must be made before the weeds reach a height and/or density that the weeds become competitive with the crop. If new flushes of weeds occur, a sequential application of 18 to 24 fluid ounces per acre will control labeled grasses and broadleaf weeds. This product may be applied postemergence to Roundup Ready corn from emergence through the V8 stage or until corn height reaches 30 inches (free standing), whichever comes first.

This product may be applied in tank mixture with a labeled rate of Bullet, Harness, Harness Xtra, Harness Xtra 5.6L, Micro-Tech, Partner, Permit or Atrazine. Refer to the specific product label and observe all precautions and limitations on the label for all products used in tank mixtures, including application timing restrictions, soil restrictions, minimum recropping interval and rotational guidelines - the more restrictive requirements apply.

Tank-mix Partner	Maximum Height Of Corn For Application
Harness Harness Xtra Harness Xtra 5.6	11 inches
Bullet* Micro-Tech* Partner*	5 inches
Permit	24 inches
atrazine	12 inches

*Bullet, Micro-Tech and Partner are not registered for use as a postemergence application in Texas.

COTTON WITH THE ROUNDUP READY GENE

TYPES OF APPLICATIONS: Preplant, preemergence, at-planting, over-the-top, post-directed, hooded sprayer, preharvest

ATTENTION: This product is for use only over-the-top or directed onto improved cotton varieties that are designated as cotton with the Roundup Ready gene. SEVERE INJURY OR DEATH OF COTTON WILL RESULT IF ANY COTTON VARIETIES NOT PROPERLY DESIGNATED AS HAVING THE ROUNDUP READY GENE ARE SPRAYED WITH THIS PRODUCT. ROUNDUP READY COTTON VARIETIES MUST BE PURCHASED FROM AN AUTHORIZED LICENSED SEED SUPPLIER. THE DESIGNATION, "ROUNDUP READY," INDICATES THE COTTON VARIETY CONTAINS A PATENTED PROPRIETARY TRAIT.

USE INSTRUCTIONS:

Maximum Allowable Yearly Rates	
1. Combined total per year for all applications	6 quarts/A
2. Preplant, Preemergence applications	3.75 quarts/A
3. Total in-crop applications from cracking to layby	3 quarts/A
4. Maximum preharvest application rate	1.5 quarts/A

For ground applications with broadcast equipment, apply this product in 5 to 20 gallons of spray solution per acre. Carefully select proper nozzle and spray pressure to avoid spraying a fine mist. For best results with ground application equipment, use flat fan nozzles. Check for even distribution of spray droplets.

For aerial applications apply this product in 3 to 15 gallons of water per acre.

The combined total application from crop emergence until harvest must not exceed 4.5 quarts per acre.

Over-the-top applications: This product may be applied by aerial or ground application equipment postemergence to Roundup Ready cotton from the ground cracking stage until the four leaf (node) stage of development (until the fifth true leaf reaches the size of a quarter). Over-the-top applications made after the four leaf (node) stage of development may result in boll loss, delayed maturity and/or yield loss. Any single over-the-top broadcast application should not exceed 24 fluid ounces per acre. No more than two over-the-top broadcast applications may be made from crop emergence through the four leaf (node) stage of development. Sequential over-the-top applications of this product must be at least 10 days apart and cotton must have at least two nodes of incremental growth between applications.

Post-directed or hooded applications: This product may be applied using precision post-directed or hooded sprayers to Roundup Ready cotton through layby. At this stage, post-directed equipment should be used which directs the spray to the base of the cotton plants. Contact of the spray with cotton leaves must be avoided to the maximum extent possible. To minimize spray onto the leaves of the cotton plants, place nozzles in a low position directing a horizontal spray pattern under the cotton leaves to contact weeds in the row, and maintain low spray pressure (less than 30 PSI). For best results, make applications while weeds are small (less than 3 inches). Any single post-directed application must not exceed 24 fluid ounces per acre of this product. No more than two applications can be made from the fifth leaf through layby. Sequential in-crop applications of this product must be at least 10 days apart and cotton must have at least two nodes of incremental growth between applications.

ATTENTION: USE OF THIS PRODUCT IN ACCORDANCE WITH LABEL DIRECTIONS IS EXPECTED TO RESULT IN NORMAL GROWTH OF ROUNDUP READY COTTON, HOWEVER, VARIOUS ENVIRONMENTAL CONDITIONS, AGRONOMIC PRACTICES AND OTHER FACTORS MAKE IT IMPOSSIBLE TO ELIMINATE ALL RISKS ASSOCIATED WITH THIS PRODUCT, EVEN WHEN APPLICATIONS ARE MADE IN ACCORDANC WITH THE LABEL SPECIFICATIONS. IN SOME CASES, THESE FACTORS CAN RESULT IN BOLL LOSS, DELAYED MATURITY AND/OR YIELD LOSS.

Salvage Treatment: This treatment may be used after the four leaf stage of development and must only be used where weeds threaten to cause the loss of the crop. 24 fluid ounces per acre may be applied either as an over-the-top application or as a post-directed treatment sprayed higher on the cotton plants and over the weeds. NOTE: SALVAGE TREATMENTS WILL RESULT IN SIGNIFICANT BOLL LOSS, DELAYED MATURITY AND/OR YIELD LOSS. MAKE MORE THAN ONE SALVAGE TREATMENT PER GROWING SEASON.

Weeds controlled: For specific rates of application and instructions for control of various weed species, refer to the "ANNUAL" and "PERENNIAL" weed rate tables of this label. This product applied at 24 fluid ounces per acre will burndown or suppress the growth of the following perennial weeds and reduce crop competition: yellow and purple nutsedge, rhizome johnsongrass, common bermudagrass, silverleaf nightshade, trumpet creeper, and redvine. Fall preharvest applications may be required for control of these perennial weeds.

Some weeds with multiple germination times or suppressed (stunted) weeds may require sequential applications of this product for control.

Preharvest applications: This product may be applied for preharvest annual and perennial weed control as a broadcast treatment to Roundup Ready cotton after 20% boll crack. Allow a minimum of 7 days between application and harvest of cotton or feeding of cotton forage or hay.

NOTE: This product will not enhance the performance of harvest aids when applied to Roundup Ready cotton. DO NOT APPLY GLYPHOSATE 5.4 PREHARVEST TO CROPS GROWN FOR SEED.

ROUNDUP READY FLEX COTTON

The instructions provided in this section are specific to, and must only be used with, varieties designated as Roundup Ready Flex cotton. Applications described in this section over the top of cotton other than Roundup Ready Flex cotton will cause crop injury and reduce yields. DO NOT combine the instructions in this section with those in the "Roundup Ready Cotton" section of this label, or with any other Roundup Ready cotton or Roundup Ready Flex cotton instructions on labeling for this or other glyphosate-containing products. Drift of this product from applications made to Roundup Ready Flex cotton onto adjacent fields of post 4-leaf (node) Roundup Ready cotton may cause extensive crop injury, including boll loss, delayed maturity and/or yield loss.

TYPES OF APPLICATION: Preplant, At-Planting, Preemergence, Postemergence (In-crop), Preharvest

USE INSTRUCTIONS: Refer to the following table for maximum application rates of this product with Roundup Ready Flex cotton.

Maximum Application Rates	
Combined total per year for all applications	6 quarts per acre
Total of all Preplant, At-Planting, Preemergence applications	3.75 quarts per acre
Total of all In-crop applications from cracking to 60 percent open bolls	4.5 quarts per acre
Total of all In-crop applications between layby and 60 percent open bolls	1.5 quarts per acre
Total of all In-crop applications from 60 percent open bolls to 7 days prior to harvest	1.5 quarts per acre
Total of all In-crop applications from emergence through harvest	4.5 quarts per acre

See the "**ROUNDUP READY CROPS**" section of this label for precautionary instructions for use in Roundup Ready crops.

TYPES OF APPLICATIONS: Preplant, At-Planting, Preemergence

USE INSTRUCTIONS: This product may be applied before, during or after planting Roundup Ready Flex cotton.

TANK MIXTURES: This product may be tank-mixed with 2,4-D or Clarity and applied prior to planting only. This product may be tank-mixed with the following products and applied prior to crop emergence.

Ensure that the specific product being used is labeled for application prior to emergence of cotton. Read and follow label directions of all products in the tank mixture.

2,4-D,
clomazone (Aim),
dicamba,
diuron (Direx, Karmex),
flumioxan (Chateau, Valor),
fluometuron (Cotoran, Meturon),
fomesafen (Reflex),
metolachlor,
norflurazone (Solicam),
s-metolachlor (Dual Magnum, Dual II Magnum),
pendimethalin (Prowl, Prowl H2O),
prometyrn (Caparol, Cotton-Pro),
pyrithiobac-sodium (Staple)

Maximum quantity of this product that may be applied for all preplant, at-planting and preemergence applications combined is 3.75 quarts per acre per season. Refer to individual tank-mix product label for restrictions and precautions; use according to the most restrictive precautionary statements for each product in the tank mixture.

Postemergence (In-crop)

USE INSTRUCTIONS: This product may be applied to control annual grasses and broadleaf weeds listed on this label. To maximize yield potential, eliminate competing weeds early. Many perennial weeds will be controlled or suppressed with one or more applications of this product. Use an initial application of 25 fluid ounces per acre on 1 to 3 inch tall annual grass and broadleaf weeds. This product may be applied postemergence to Roundup Ready Flex cotton using ground application equipment at rates up to 36 fluid ounces per acre per application. In addition to broadcast application, post-directed spray equipment may be used to achieve more thorough weed coverage.

TANK MIXTURES: This product may be tank-mixed with the following products and applied postemergence (in-crop) over the top of Roundup Ready Flex cotton. Ensure that the specific product being used is labeled for application postemergence (in-crop) to cotton. Read and follow label directions of all products in the tank mixture.

clethodim,
fluazifop-P-butyl (Fusilade DX),
fomesafen (Reflex),
metolachlor (Stalwart),
s-metolachlor (Dual Magnum),
pyrithiobac-sodium (Staple),
quizalofop-p-ethyl (Assure II),
sethoxydim (Poast Plus),
trifloxysulfuron-sodium (Envoke)

Staple may cause leaf yellowing and/or leaf crinkling when applied postemergence (in-crop) in Roundup Ready Flex cotton. Dual MAGNUM and Stalwart applied over the top of Roundup Ready Flex cotton may cause leaf injury in the form of necrotic spotting.

This product can be tank-mixed with the following products for in-crop application using precision post-directed or hooded sprayers. Ensure that the specific product being used is labeled for postemergence (in-crop) application to cotton. Read and follow label directions of all products in the tank mixture.

Refer to the individual tank-mix product label for restrictions and precautions; use according to the most restrictive precautionary statements for each product in the tank mixture.

carfentrazone-ethyl (Aim),
diuron (Direx),
flumioxazin (Chateau, Valor),
fluometuron (Cotoran),
linuron (Layby-Pro),
pendimethalin Prowl H2O,
prometyrn (Caparol),
pyrithiobac-sodium (Staple),
trifloxysulfuron-sodium (Envoke)

The maximum single, in-crop application rate of this product to Roundup Ready Flex cotton using ground application equipment is 36 fluid ounces per acre. In-crop application rates above 25 fluid ounces per acre made alone or with the addition of other crop chemical products containing surfactant may cause a crop response including leaf speckling or leaf necrosis. Do not exceed a maximum rate of 25 fluid ounces of this product per acre when making application by air. Between layby and 60 percent open bolls, the maximum combined total application rate of this product is 48 fluid ounces per acre. The maximum combined total of all application of this product made from crop emergence to 60 percent open bolls must not exceed 4.5 quarts per acre. **DO NOT ADD ADDITIONAL SURFACTANT OR ADDITIVES CONTAINING SURFACTANT TO THIS PRODUCT FOR OVER-THE-TOP APPLICATION TO ROUNDUP READY FLEX COTTON.**

Preharvest
USE INSTRUCTIONS: This product may be applied to Roundup Ready Flex cotton at up to 48 fluid ounces per acre for annual and perennial weed control prior to harvest after 60 percent boll crack.

This product will not enhance the performance of harvest aids when applied to Roundup Ready Flex cotton.

Allow a minimum of 7 days between application and harvest of Roundup Ready Flex cotton.

ATTENTION: USE OF THIS PRODUCT IN ACCORDANCE WITH LABEL DIRECTIONS IS EXPECTED TO RESULT IN NORMAL GROWTH OF ROUNDUP READY FLEX COTTON. HOWEVER, DUE TO THE SENSITIVITY OF COTTON FRUITING TO VARIOUS ENVIRONMENTAL CONDITIONS, AGRONOMIC PRACTICES AND OTHER FACTORS, IT IS IMPOSSIBLE TO ELIMINATE ALL RISKS ASSOCIATED WITH THIS PRODUCT, EVEN WHEN APPLICATIONS ARE MADE IN CONFORMANCE WITH THE LABEL SPECIFICATIONS. IN SOME CASES, THESE FACTORS CAN RESULT IN BOLL LOSS, DELAYED MATURITY AND/OR YIELD LOSS.

SOYBEANS WITH THE ROUNDUP READY GENE

TYPES OF APPLICATIONS: Preplant, preemergence, at-planting, postemergence, preharvest, post-harvest

USE INSTRUCTIONS: When applied as directed, this product will control labeled annual grasses and broadleaf weeds in Roundup Ready soybeans. Many perennial grasses and broadleaf weeds will be controlled or suppressed with one or more applications of this product.

Maximum Allowable Application Rates

1. Combined total per year for all applications	6 quarts per acre
2. Preplant, Preemergence applications	3.75 quarts per acre
3. Total in-crop applications from emergence throughout flowering	2.25 quarts per acre
4. Maximum preharvest application rate	24 fluid ounces per acre

RESTRICTIONS: The combined total application from crop emergence through harvest must not exceed 2.25 quarts per acre. The maximum rate for any single in-crop application is 48 fluid ounces per acre. The maximum combined total of this product which can be applied during flowering is 48 fluid ounces per acre. Allow a minimum of 14 days between final application and harvest or feeding of soybean grain, forage or hay.

The use of this product for in-crop applications over Roundup Ready soybeans is not registered in California.

Annual Weed Rate Tables
The following rates will provide control of labeled grasses and broadleaf weeds in conventional and no-till Roundup Ready soybean production systems. Refer to the "ANNUAL WEED RATE TABLES" of this label for rates for specific annual weeds.

Alligare, LLC will not warrant crop safety or weed control when Roundup Ready soybeans are treated with herbicides not specified on this label. Because of the potential for: 1) crop injury, 2) poor weed control from antagonism, and/or 3) rotational crop restrictions, herbicides not specified on this label should not be used, whether applied preemergence or applied postemergence as a tank mixture with this product.

This product may be used up to 48 fluid ounces per acre in any single in-crop application for control of annual weeds, where heavy weed densities exist.

Midwest/Mid-Atlantic Instructions
Narrow row or drilled soybeans: A single in-crop application of this product will provide effective control of labeled weeds. Use an initial application of 24 fluid ounces per acre, on 4-8" weeds. Weeds will generally be 4-8" tall 3 to 5 weeks after planting. If the initial application is delayed and weeds are 8-18" tall, use 36 fluid ounces per acre.

Under adverse growing conditions such as drought, hail, wind damage or a poor soybean stand that slows or delays canopy closure, a sequential application of this product at 18 to 24 fluid ounces per acre may be necessary to control late flushes of weeds.

Wide row soybeans: An in-crop application of this product will provide effective control of the initial stand of labeled weeds. Use an initial application of 24 fluid ounces per acre, on 4-8" weeds. Weeds will generally be 4-8" tall 3 to 5 weeks after planting. If new flushes of weeds occur, they can be controlled by sequential applications of this product.

Initial and Sequential (if needed) Applications

Weed Height (inches)	Rate (fl oz/A)
1-3	18
4-8	24
8-18	36

Giant ragweed: Apply 24 fluid ounces per acre when the weed is 8-12" tall to avoid the need for sequential application.

Black nightshade, Pennsylvania smartweed, ladysthumb smartweed, velvetleaf and waterhemp: Apply 24 fluid ounces per acre to weeds 3-6" tall and 36 fluid ounces per acre when weeds are up to 12 inches tall. For Morningglory species apply 24 fluid ounces per acre when weeds are up to 4 inches tall, and 36 fluid ounces per acre when weeds are up to 6 inches tall.

Some weeds, such as black nightshade, woolly cupgrass, shattercane, wild proso millet, burcumber, and giant ragweed, with multiple germination times may require a sequential application of this product. Suppressed or stunted weeds may also require sequential applications. Sequential applications should be made after some regrowth has occurred. Use a minimum of 18 fluid ounces of this product per acre for sequential applications.

Southeast Instructions
Narrow row, drilled, or wide-row soybeans: An in-crop application of this product will provide effective control of the initial stand of labeled weeds. Use an initial application of 24 fluid ounces per acre, on 3-6" weeds. Weeds will generally be 3-6" tall 2 to 3 weeks after planting.

Initial Treatment

Weed Height (inches)	Rate (fl oz/A)
3-6	24
6-12	36

Under adverse growing conditions such as drought, hail, wind damage or a poor soybean stand that slows or delays canopy closure, a sequential application of this product at 12 to 24 fluid ounces per acre may be necessary to control late flushes of weeds.

Sequential Application (if needed)

Weed Height (inches)	Rate (fl oz/A)
2-3	12
3-6	18
6-12	24

Florida pusley, hemp sesbania, and spurred anoda: Apply 24 fluid ounces per acre to weeds 2-4" for the initial application. Apply 24 fluid ounces per acre when these weeds are 3-6" tall if a sequential application is necessary.

Morningglory, black nightshade, groundcherry, and Pennsylvania smartweed: Apply 18 fluid ounces per acre on 1-3" weeds, 24 fluid ounces per acre on 3-6" weeds, or 36 fluid ounces per acre on 6-12" weeds for the initial application.

Some weeds, such as black nightshade, broadleaf signalgrass, Texas Panicum, burcumber, and sicklepod, with multiple germination times may require a sequential application of this product. Suppressed or stunted weeds may also require sequential applications. Sequential applications of this product should made after some regrowth has occurred. Use a minimum of 12 fluid ounces of this product per acre for sequential applications.

Delta/Mid-South Instructions
Narrow row, drilled or wide row soybeans: An in-crop application of this product will provide effective control of the initial stand of labeled weeds. A sequential application will be required to control new flushes of weeds. Use an initial application of 24 fluid ounces per acre, on 2-4" weeds. Weeds will generally be 2-4" tall 2 to 3 weeks after planting.

Initial Treatment

Weed Height (inches)	Rate (fl oz/A)
2-4	24
5-12	36

Sequential Application

Weed Height (inches)	Rate (fl oz/A)
2-3	12
3-6	18
6-12	24

Hemp sesbania and spurred anoda: Apply a sequential treatment of 24 fluid ounces per acre on 3-6" weeds if necessary.

Some weeds, such as black nightshade, broadleaf signalgrass, Texas Panicum, burcumber, and sicklepod, with multiple germination times may require a sequential application of this product. Suppressed or stunted weeds may also require sequential applications. Sequential applications should be made after some regrowth has occurred. Use a minimum of 12 fluid ounces of this product per acre for sequential applications.

Perennial Weeds Rate Instructions
A 24 to 48 fluid ounces per acre rate (single or multiple applications) of this product will control or suppress perennial weeds such as: bermudagrass, Canada thistle, common milkweed, field bindweed, hemp dogbane, Horsenettle, marestail (horseweed), nutsedge, quackgrass, rhizome johnsongrass, redvine, trumpetcreeper, swamp smartweed, and wirestem muhly.

Allow perennial weed species to achieve at least 6" of growth before spraying with this product.

ALFALFA WITH THE ROUNDUP READY GENE

AVOID CONTACT OF HERBICIDE WITH FOLIAGE, GREEN STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS (EXCEPT AS SPECIFIED FOR INDIVIDUAL ROUNDUP READY CROPS), DESIRABLE PLANTS AND TREES, BECAUSE SEVERE

INJURY OR DESTRUCTION MAY RESULT.

See “USE INFORMATION” AND “MIXING” sections of this label for essential product performance information.

USE THIS PRODUCT ONLY FOR POSTEMERGENCE APPLICATION ON ALFALFA VARIETIES DESIGNATED AS CONTAINING A ROUNDUP READY GENE.

The Roundup Ready designation indicates that the alfalfa contains a patented gene, which provides tolerance to this product.

Information on Roundup Ready alfalfa varieties may be obtained from your seed supplier or Alligare, LLC representative. Roundup Ready crop varieties must be purchased from an authorized licensed seed supplier.

See the “ROUNDUP READY CROPS” section of this label for precautionary instructions for use in Roundup Ready crops. Do NOT combine these instructions with other directions made for crop varieties that do not contain a Roundup Ready gene listed in the “AGRICULTURAL USES” section of this label.

Application Instructions
This product will control many troublesome emerged weeds with over-the-top applications in Roundup Ready alfalfa. Allow a minimum of 5 days between the last application and grazing, or, cutting and feeding of alfalfa forage and hay.

For ground applications with broadcast equipment, apply this product in 3 to 40 gallons of spray solution per acre. Carefully select proper nozzle and spray pressure to avoid spraying a fine mist. For best results with ground application equipment, use flat fan nozzles. Check for even distribution of spray droplets.

For aerial application: Use the directed rates of this product in 3 to 15 gallons of spray solution per acre.

DO NOT EXCEED 1.5 QUARTS OF THIS PRODUCT PER ACRE WHEN MAKING APPLICATIONS BY AIR. AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS WHICH DO NOT CONTAIN A ROUNDUP READY GENE. Do not apply during low-level inversion conditions, when winds are gusty or under any other conditions that favor 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.

See the “APPLICATION EQUIPMENT AND TECHNIQUES” section of the label booklet for procedures to avoid spray drift that may cause injury to any vegetation not intended for treatment.

Sprayer Preparation: It is important that sprayer and mixing equipment be clean and free of pesticide residue before making applications of this product to Roundup Ready alfalfa. Follow the cleaning procedures specified on the label of the product(s) used. Alfalfa can be very sensitive to many herbicides at extremely low concentrations and care should be taken to thoroughly clean all equipment prior to use.

Types of applications: Preplant, At-planting, Preemergence and Postemergence.

MAXIMUM ALLOWABLE APPLICATION RATES

Combined total per year for all applications, including preplant during year of establishment	5.75 quarts per acre
Combined total per year for in-crop applications for newly established and established stands	4.5 quarts per acre (144 fl. oz. per acre)
Preplant, At-planting and Preemergence single applications	1.5 quarts per acre
A. New Stand Establishment (seeding year)	
Prior to First Cutting During New Stand Establishment	
From emergence up to 4 trifoliate leaves	1.5 quarts per acre
From 5 trifoliate leaves up to 5 days before first cutting	1.5 quarts per acre
After First Cutting in Newly Established Stands:	
In-crop application, per cutting, up to 5 days before cutting.	1.5 quarts per acre
B. Established Stands (non-seeding year)	
In-crop application, per cutting, up to 5 days before cutting.	1.5 quarts per acre

There are no rotational crop restrictions following applications of this product. For any crop NOT listed in the label booklet, applications must be made at least 30 days prior to planting.

Over-the-top applications: This product may be applied postemergence to Roundup Ready alfalfa from emergence until 5 days prior to cutting. Any single over-the-top application of this product should not exceed 1.5 quarts per acre. Sequential applications of this product should be at least 7 days apart.

Attention: Where Roundup Ready alfalfa is grown with a companion or cover crop, or is overseeded with a second species, over-the-top applications of this product will eliminate the non-Roundup Ready species.

During stand establishment, due to the biology and breeding constraints of alfalfa, up to 10 percent of the seedlings may not contain a Roundup Ready gene and will not survive after the first application of this product. To eliminate the undesirable effects of stand gaps created by the loss of plants not containing a Roundup Ready gene, a single application of at least 0.75 quart per acre of this product should be applied at or before the 3 to 4 trifoliate growth stage.

In both newly seeded and established stands, in order to maximize yield and quality potential of forage and hay, applications of this product should be made after weeds have emerged but before alfalfa growth or re-growth interferes with application spray coverage of the target weeds.

Weeds controlled: For specific rates of application and instructions for control of various annual and perennial weeds, refer to the “ANNUAL WEEDS RATE TABLE” and the “PERENNIAL WEEDS RATE TABLE” in this label. Some weeds with multiple germination times or suppressed (stunted) weeds may require a second application of this product for complete control. The second application should be made after some re-growth of weeds has occurred.

In addition to those weeds listed in this label booklet, this product will suppress or control the parasitic weed, Dodder (*Cuscuta* spp.) in Roundup Ready alfalfa. Repeat applications may be necessary for complete control.

RESTRICTIONS: Any single over-the-top application of this product must not exceed 1.5 quarts (48 fluid ounces) per acre. Sequential applications of this product should be at least 7 days apart. The combined total per year for all in-crop applications in newly established and established stands must not exceed 4.5 quarts (144 fluid ounces) per acre. Remove domestic livestock before application and wait a minimum of 5 days after last application before grazing, or cutting and feeding of Roundup Ready alfalfa forage and hay.

For over-the-top uses on Roundup Ready crop varieties, crop safety and weed control performance are not warranted by Alligare, LLC when this product is used in conjunction with “brown bag” or “big run” seed saved from previous year’s production and replanted.

ROUNDUP READY SUGAR BEETS

TYPES OF APPLICATIONS: Preplant, Preemergence, At-Planting, Postemergence (In-Crop).

MAXIMUM ALLOWABLE APPLICATION RATES

Combined total per year for all applications	192 fluid ounces per acre
Preplant, Preemergence applications	120 fluid ounces per acre
Emergence to 8-leaf stage	60 fluid ounces per acre
Between 8-leaf stage and canopy closure	48 fluid ounces per acre

PRECAUTIONS: See the “ROUNDUP READY CROPS” section of this label for precautionary instructions for use in Roundup Ready crops.

Preplant, Preemergence, At-planting

USE INSTRUCTIONS: This product may be applied before, during or after planting of Roundup Ready sugar beets.

RESTRICTION: Maximum quantity of this product that may be applied for all preplant, at-planting and preemergence applications combined is 120 fluid ounces per acre per season.

Postemergence (In-crop)
USE INSTRUCTIONS: This product may be applied postemergent over-the-top to Roundup Ready sugar beets from emergence to 30 days prior to harvest. To maximize yield potential spray sugar beets early to eliminate competing weeds. Up to 4 sequential applications of this product may be made with at least 10 days between applications. Refer to the “ANNUAL WEEDS RATE TABLE” in this label for the labeled rates for specific annual weeds. This product will control or suppress most perennial weeds. For some perennial weeds, repeat applications may be required to eliminate crop competition throughout the growing season.

RESTRICTIONS: The combined total application from crop emergence through harvest must not exceed 108 fluid ounces per acre. The maximum rate for any single application between emergence to the 8 leaf stage is 36 fluid ounces per acre. The maximum rate for any single application between the 8 leaf stage and canopy closure is 24 fluid ounces per acre. Allow a minimum of 30 days between last application and sugar beet harvest. For any crop not listed in on this label, applications must be at least 30 days prior to planting.

FARMSTEADS

TYPES OF APPLICATIONS: Nonselective weed control, trim-and-edge, chemical mowing, cut stumps, habitat management.

Nonselective weed control, Trim-and-edge

USE INSTRUCTIONS: This product may be used to control annual weeds, perennial weeds and woody brush which are found in any part of the farmstead, including building foundations, along and in fences, in dry ditches and canals, along ditchbanks, farm roads, shelterbelts, prior to landscape plantings and equipment storage areas.

This product may be tank mixed with the following products. Refer to these product labels for approved farmstead sites and application rates. For annual weeds, use 1.5 pints per acre of this product when weeds are less than 6 inches tall and 2.25 pints per acre when weeds are greater than 6 inches tall. For perennial weds, apply 3 to 7.5 pints per acre in these tank mixes. For tank mixtures with these products through backpack sprayers, handguns or other high-volume spray-to-wet applications, see the “HAND-HELD AND HIGH VOLUME EQUIPMENT” section of this label for labeled rates.

Arsenal®	Plateau®
Banvel®	Princep® DF
Barricade® 65WG	Princep® Liquid
Diuron	Ronstar® 50 WP
Endurance®	Sahara®
Escort®	Simazine
Karmex® DF	Surflan®
Krovar® I DF	Telar®
Oust®	Vanquish®
Pendulum® 3.3 EC	2,4-D
Pendulum® WDG	

Banvel mixtures may not be applied by air in California.

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

Chemical Mowing
USE INSTRUCTIONS: This product will suppress perennial grasses listed in this section to serve as a substitute for mowing. Apply this product at a rate of 4.5 to 6 fluid ounces per acre. Use 6 fluid ounces of this product per acre when treating tall fescue, fine fescue, orchardgrass or quackgrass covers. Use 4.5 fluid ounces of this product per acre when treating Kentucky bluegrass. Apply treatments in 10 to 20 gallons of spray solution per acre. Chemical mowing applications may be made along farm ditches and other parts of farmsteads.

Use only in areas where some temporary injury or discoloration of perennial grasses can be tolerated.

Cut Stumps
TYPES OF APPLICATIONS: Treating cut stumps in any noncrop site listed on this label.
USE INSTRUCTIONS: This product will control regrowth of 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 the freshly cut surface immediately after cutting. Delays in application may result in reduced performance. For best results, applications must be made during periods of active growth and full leaf expansion.

Alder	Salt-cedar
Eucalyptus	Sweetgum
Madrone	Tan oak
Oak	Willow
Reed, giant	

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. INJURY RESULTING FROM ROOT GRAFTING MAY OCCUR IN ADJACENT WOODY BRUSH OR TREES.

Habitat Management
TYPES OF USES: Habitat restoration and maintenance, wildlife food plots

Habitat restoration and maintenance

USE INSTRUCTIONS: This product may be used to control exotic and other undesirable vegetation in habitat management areas. Applications can be made to allow recovery of native plant species, prior to planting desirable native species, and for similar broadspectrum vegetation control requirements in habitat management areas. Spot treatments can be made to selectively remove unwanted plants for habitat maintenance and enhancement. The tank mixtures listed in this section of the label may be used for habitat restoration and maintenance.

Wildlife food plots
USE INSTRUCTIONS: 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 tillage.

Rangelands
TYPES OF APPLICATIONS: Postemergence

USE INSTRUCTIONS: This product will control or suppress many annual weeds growing in perennial cool and warm season grass rangelands.

Preventing viable seed production is key to the successful control and invasion of annual grassy weeds in rangelands. Follow-up applications in sequential years should eliminate most of the viable seeds. Grazing of treated areas should be delayed to encourage growth of desirable perennials. Allowing desirable perennials to flower and reseed in the treated area will encourage successful transition.

RESTRICTIONS: Do not use ammonium sulfate when spraying rangeland grasses with this product. Do not make more than one application per year.

Postemergence

Apply 9-12 fluid ounces of this product to control or suppress many weeds, including downy brome, cheat grass, cereal rye and jointed goatgrass in rangelands. Apply when most mature brome plants are in early flower and before the plants including seedheads turn color. Allowing for secondary weed flushes to occur in the spring following rain events further depletes the seed reserve, and encourages perennial grass conversion on weedy sites. Fall applications are possible, and recommended where spring moisture is usually limited and fall germination allows for good weed growth.

Apply 12 fluid ounces when the medusahead has reached the 3-leaf stage. Delaying applications beyond this stage will result in reduced or unacceptable control. Fire may be useful in eliminating the thatch layer produced by slow decaying culms prior to application. Allow new growth to occur before spraying after a burn. Repeat applications in subsequent years may be necessary to eliminate the seedbank before reestablishing desirable perennial grasses in medusahead-dominated rangelands.

Slight, discoloration of the desirable grasses may occur, but they will regreen and regrow under moist soil conditions as effects of this product wear off.

SILVICULTURAL SITES AND UTILITY RIGHTS-OF-WAY

TYPES OF APPLICATIONS: This product is labeled for the control or partial control of woody brush, trees and herbaceous weeds. This product is labeled for use in forestry and utility sites. This product can also be used for use in preparing or establishing wildlife openings within these sites and maintaining logging roads, and for side trimming along utility rights-of-way.

In forestry, use this product for site preparation prior to planting any tree species, including Christmas trees and silvicultural nursery sites.

In utilities, this product can be used along electrical power, pipeline and telephone rights-of-way, and in other utility sites associated with these rights-of-way, such as substations.

APPLICATION RATES AND TIMING:

Application	Glyphosate 5.4	Spray Volume (Gal/A)
Broadcast		
Aerial	1.5 to 7.5 qts./A	5 to 30
Ground	1.5 to 7.5 qts./A	10 to 60
Spray-to-Wet		
Handgun, Backpack, Mistblower	0.6% to 2% by volume	spray-to-wet
Low Volume Directed Spray		
Handgun, Backpack, Mistblower	4% to 7.5% by volume	partial coverage*

*For low volume directed spray applications, coverage should be uniform with at least 50 percent of the foliage contacted. Coverage of the top one-half of the plant is important for best results.

In forestry site preparation and utility rights-of-way applications, this product requires use with a nonionic surfactant. Use a nonionic surfactant with greater than 80 percent active ingredient and labeled for use with herbicides. Use of this product without surfactant will result in reduced performance. Refer to the "MIXING" section of this label for more information.

Mix 2 or more quarts of the nonionic surfactant per 100 gallons of spray solution (0.5 percent or more by spray volume). Do not use surfactant concentrations greater than 1.5 percent by spray volume with handgun applications or 2.5 percent by spray volume with broadcast applications.

Use higher rates of this product within the specified 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. Increase rates within the specified range for control of perennial herbaceous weeds any time after emergence and before seedheads, flowers or berries appear.

Use the lower rates of this product within the specified range for control of annual herbaceous weeds and actively growing perennial herbaceous weeds after seedheads, flowers or berries appear. Apply to the foliage of actively growing annual herbaceous weeds any time after emergence.

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

Tank Mixtures
Tank mixtures of this product may be used to increase the spectrum of vegetation controlled. When tank mixing, read and carefully observe the label claims, cautionary statements and all information on the labels of both products used. Use according to the most restrictive precautionary statements for each product in the mixture. Any listed rate of this product may be used in a tank mix.

NOTE: For forestry site preparation, make sure the tank-mix product is approved for use prior to planting the desired species. Observe planting interval restrictions. For side trimming treatments in utility rights-of-way, do not use tank mixtures with Arsenal® 2WSL. For side trimming treatments, use this product alone, or as a tank mixture with Garlon® 4 or Triclopyr 4 EC.

Product	Broadcast Rate	Use Sites
Arsenal® Applicators Concentrate or Imazapyr 4 SL**	2 to 16 fl. oz./A	Forestry site preparation
Chopper® or Rotary**	4 to 32 oz./A	Forestry site preparation
Escort®** or Metsulfuron Methyl DF**	½ to 3 ½ oz./A	Forestry site preparation
Oust® or SFM 75	1 to 4 oz./A	Forestry site preparation, Utility sites
Garlon® 3A*, Garlon® 4, Triclopyr 4 EC**, Triclopyr 3A**	1 to 4 qts.	Forestry site preparation, Utility sites
Arsenal® 2WSL**	4 to 32 fl. oz./A	Utility sites

Product	Spray-to-Wet Rates	Use Sites
Arsenal® Applicators Concentrate or Imazapyr 4 SL**	1/32 % to ½ % by volume	Forestry site preparation
Arsenal® 2WSL**	1/16 % to ½ % by volume	Utility sites

Product	Low Volume Directed Spray Rates	Use Sites
Arsenal® Applicators Concentrate or Imazapyr 4 SL**	1/8 % to ½ % by volume	Forestry site preparation
Arsenal® 2WSL**	1/8 % to ½ % by volume	Utility sites

*Ensure that Garlon® 3A (or Triclopyr 3A) are thoroughly mixed with water according to label directions before adding this product. Have spray mixture agitating at the time this product is

added to avoid spray compatibility problems.
**Not registered in the state of California.

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

FORESTRY CONIFER AND HARDWOOD RELEASE

Directed Spray and Selective Equipment
This product may be applied as a directed spray or by using selective equipment in forestry conifer and hardwood sites, including Christmas tree plantations and silvicultural nurseries. Mix 2 to 6 quarts of a nonionic surfactant per 100 gallons of spray solution (0.5 to 1.5 percent by spray volume) for all spray applications. Use a surfactant with greater than 80 percent active ingredient.

In hardwood plantations, tank mixtures with Oust® (or SFM 75) may be used. In pine plantations, tank mixtures with Garlon® 4 (or Triclopyr 4 EC) or Arsenal® AC (or Imazapyr 4 SL) may be used. Comply with all site restrictions, forestry species limitations and precautions on the tank mix product label.

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

See all sections in the "APPLICATON EQUIPMENT AND TECHNIQUES" portion of this label for specific equipment and precautions.

For spray-to-wet applications, use a 1.5 percent spray solution for the control of undesirable woody brush and trees. To control herbaceous weeds, use a 0.75 to 1.5 percent solution. For low volume directed spray applications, use a 4 to 7.5 percent spray solution. Coverage should be uniform with at least 50 percent of the foliage contacted. Coverage of the top one-half of the unwanted vegetation is important.

For equipment calibrated for broadcast applications, use 1.5 to 7.5 quarts of this product per acre. Apply in 10 to 60 gallons of clean water per acre. Shielded application equipment may be used to avoid contact of the spray solution with desirable plants. Shields should be adjusted to prevent spray contact with the foliage or green bark of desirable vegetation.

Wiper application equipment may be used. 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. Operate this equipment at ground speeds no greater 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 2 applications are made in opposite directions.

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 1-day period, as reduced activity may result from use of leftover solutions. Clean wiper parts immediately after using this product by thoroughly flushing with water.

Use a nonionic surfactant at a rate of 10 percent by volume of total herbicide solution with all wiper applications.

For Rope or Sponge Wick Applicators – Mix 3 quarts of this product in 2 gallons of water to prepare a 25 percent solution. Apply this solution to weeds listed in this section.

For Porous-Plastic Applicators – Solutions ranging from 25 to 100 percent of this product in water may be used in porous-plastic wiper applicators.

Broadcast Spray
Except where specified below, use only where conifers have been established for more than one year.

Application must be made after formation of final conifer resting buds in the fall or prior to initial bud swelling in the spring.

Injury may occur to conifers treated for release, especially where spray patterns overlap or the higher rates are applied. Damage can be accentuated if applications are made when conifers are actively growing, or are under stress from drought, flood water, improper planting, insects, animal damage or diseases.

This product may require use with a surfactant. Follow the instructions under the "MIXING AND APPLICATION INSTRUCTIONS" portion of this label.

For release of the following conifer species outside the Southeastern United States:

Douglas fir *Pseudotsuga menziesii*	**Pines*** *Pinus spp.*
Fir *Abies spp.*	**Redwood, California**** *Sequoia spp.*
Hemlock** *Tsuga spp.*	**Spruce** *Picea spp.*

*Includes all species except loblolly pine, longleaf pine, shortleaf pine or slash pine.
**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.

Apply 0.75 to 1.5 quarts of this product per acre as a broadcast spray.

Note: For release of Douglas fir with this product or specified tank mixtures of this product, Entry™ II or a nonionic surfactant labeled for over-the-top foliar sprays may be used. To avoid possible conifer injury, Entry™ II rates should not exceed 20 fluid ounces per acre at elevations above 1500 feet, or 10 fluid ounces per acre in the coastal range or at elevations below 1500 feet in Washington and Oregon. Nonionic surfactants may be used at 2 fluid ounces per acre at elevations above 1500 feet, or 1 fluid ounce per acre in the coastal range or at elevations below 1500 feet. Use of surfactant rates exceeding those listed above may result in unacceptable conifer injury and are not recommended. Ensure that the nonionic surfactant has been adequately tested for Douglas fir safety before use.

In Maine, up to 2.25 quarts per acre of this product or a tank mix with 1 fl. oz./A of Arsenal® Applicators Concentrate (or Imazapyr 4 SL) may be used for the control of difficult species. To release Douglas fir, pine and spruce species at the end of the first growing season (except in California), apply 0.75 to 1.125 quarts of this product per acre. Ensure that the conifers are well hardened off.

Oust® (or SFM 75) Tank Mixtures – To release jack pine, white pine and white spruce, apply 0.75 to 1.5 quarts of this product with 1 to 3 fl. oz. (1 to 1.5 for white pine) of Oust® (or SFM 75) per acre. Make applications to actively growing weeds as a broadcast spray over the top of established conifers. Applications at these rates should be made after formation of conifer resting buds in the late summer or fall.

Arsenal® Applicators Concentrate (or Imazapyr 4 SL) Tank Mixtures – This product may be tank mixed with Arsenal® Applicators Concentrate (or Imazapyr 4 SL) for release of Douglas fir. Use 0.75 to 1.125 quarts of this product tank mixed with 2 to 6 fluid ounces of Arsenal® (or Imazapyr 4 SL) per acre. For release of balsam fir and red spruce, apply a mixture of 1.5 quarts of this product and 1 to 2.5 fluid ounces of Arsenal® Applicators Concentrate (or Imazapyr 4 SL) per acre.

For release of the following conifer species in the Southeastern United States:

Eastern white pine *Pinus strobus*	**Shortleaf pine** *Pinus echinata*
Loblolly pine *Pinus taeda*	**Slash pine** *Pinus elliottii*
Longleaf pine *Pinus palustris*	**Virginia pine** *Pinus virginiana*

Apply 1.125 to 1.875 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 0.75 quart per acre of this product alone or in a recommended tank mixture.

Arsenal® Applicators Concentrate (or Imazapyr 4 SL) Tank Mixtures – Apply 0.75 to 1.5 quarts of this product with 2 to 16 fluid ounces of Arsenal® Applicators Concentrate (or Imazapyr 4 SL) per acre as a broadcast spray for conifer release. Use only on conifer species that are labeled for over-the-top sprays for both products. Use the higher specified rates for dense, tough-to-control woody brush and trees.

Read and carefully observe the label claims, cautionary statements and all information on the labels of each product used in these tank mixtures. Use according to the most restrictive precautionary statements for each product in the mixture.

HERBACEOUS RELEASE

When applied as directed, this product plus listed residual herbicides provides postemergence control of the annual weeds and control or suppression of the perennial weeds listed in this label, and residual control of the weeds listed in the residual herbicide label. Make applications to actively growing weeds as a broadcast spray over the top of labeled conifers.

Oust® (or SFM 75) Tank Mixtures – To release loblolly pines, apply 12 to 18 fluid ounces of this product, plus 2 to 4 ounces of Oust® (or SFM 75) per acre. To release slash pines, apply 9 to 12 fluid ounces of this product, plus 2 to 4 ounces of Oust® (or SFM 75) per acre.

Mix up to 3.2 fluid ounces per acre of Entry™ II with the specified rate of this product plus Oust® (or SFM 75). Applications can be made over newly planted pines after the emergence of herbaceous weeds in the spring or early summer. Best results are obtained from applications made in May and June.

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

Atrazine Tank Mixtures – To release Douglas fir, apply 0.75 quart of this product, plus 4 pounds active ingredient of atrazine per acre. Apply only over Douglas fir that has been established for at least one full growing season. Apply in the early Spring, usually mid-March through early April. Injury will occur if applications are made after bud swell in the Spring. Do not add surfactant to this mix for this use.

Always read and follow the manufacturer's label recommendations for all herbicides and surfactants used.

ANNUAL WEEDS RATE TABLES ALPHABETICALLY BY SPECIES

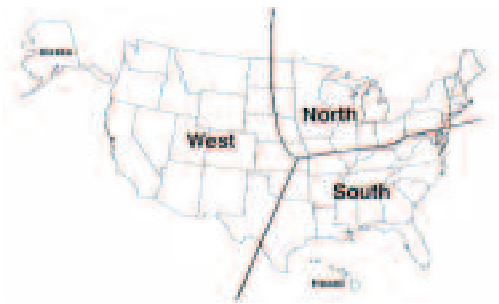
Use water carrier volumes of 3 to 10 gallons per acre for ground applications and 3 to 5 gallons per acre for aerial applications.

Apply to actively growing annual weeds.

Do not tank mix with soil residual herbicides when using these rates unless otherwise specified.

For weeds that have been mowed, grazed or cut, allow regrowth to occur prior to treatment. For those rates less than 36 fluid ounces per acre, this product may be used up to 36 fluid ounces per acre where heavy weed densities exist.

Refer to this map for location of the regions listed in the annual weed tables below.



ANNUAL WEEDS RATE TABLE, NORTH AND SOUTH REGIONS

WEED SPECIES	REGION	RATE (FLUID OUNCES PER ACRE) 9	12	18	24	30	36
		MAXIMUM HEIGHT/LENGTH					
Annoda, spurred		-	1”	2”	3”	5”	8”
Barley		-	18”	18”+	-	-	-
Barnyardgrass	South	-	3”	5”	7”	9”	12”
	North	-	-	6”	12”	-	-
Bassia, fivehook					6”		
Bittercress		-	12”	20”	-	-	-
Bluegrass, annual		-	10”	-	-	-	-
Brome, downy		6”	-	-	-	-	-
Brome, Japanese		-	6”	-	24”	-	-
Browntop panicum		-	6”	8”	12”	-	24”
Burcucumber		-	-	6”	12”	-	-
Buttercup		-	12”	20”	-	-	-
Carolina foxtail		-	20”	-	-	-	-
Carolina geranium		-	-	-	4”	-	9”
Carpetweed		-	-	6”	12”	-	-
Cheat		-	6”	20”	-	-	-
Chervil		-	20”	-	-	-	-
Chickweed		-	12”	18”	-	-	-
Cocklebur		-	12”	18”	24”	-	-
Copperleaf, hophornbeam		-	1”	2”	3”	4”	6”
Copperleaf, Virginia		-	1”	2”	3”	4”	6”
Corn		-	12”	20”	-	-	-
Corn speedwell		-	12”	-	-	-	-
Crabgrass		-	12”	18”	-	-	-
Cutleaf evening primrose		-	-	-	3”	3”	6”
Dwarfdandelion		-	20”	-	-	-	-
Eastern mannagrass		-	8”	12”	-	-	-
Eclipta		-	4”	8”	12”	-	-
Fall panicum	South	-	4”	6”	8”	12”	24”
	North	-	6”	12”	18”	-	-
Falsedandelion		-	20”	-	-	-	-
Falseflax, smallseed		-	12”	-	-	-	-
Fiddleneck		-	-	-	6”	6”	12”
Field pennycress		-	6”	12”	-	-	-
Filaree		-	-	-	-	-	12”
Fleabane, annual		-	6”	20”	-	-	-
Fleabane, hairy (*Conyza bonariensis*)		-	6”	-	-	-	-
Fleabane, rough		-	3”	6”	12”	-	-
Florida pusley		-	-	-	4”	4”	6”
Foxtail	South	-	8”	12”	20”	-	-
	North	18”	18”+	-	-	-	-
Goatgrass, jointed		-	6”	-	-	-	-
Goosegrass		-	3”	5”	8”	-	18”
Grain sorghum (milo)		-	6”	12”	20”	-	-
Groundsel, common		-	6”	-	-	-	-
Hemp sesbania		-	-	2”	4”	6”	8”
Henbit		-	-	-	6”	-	20”
Horseweed/Marestail (*Conyza canadensis*)	South	-	-	12”	30”	-	-
	North	-	6”	12”	18”	-	-
Itchgrass		-	6”	12”	18”	-	-
Johnsongrass, seedling	South	-	-	18”	-	-	-
	North	-	12”	18”	-	-	-
Junglerice		-	3”	5”	7”	9”	12”
Knotweed			-	3”	8”	12”	- 20”
Kochia[1]		-	3 to 6”	12”	-	-	-
Lambsquarters		-	6”	8”	12”	-	20”
Little barley		-	20”	-	-	-	-
London rocket		-	6”	-	-	-	-
Mayweed		-	-	2”	6”	12”	18”
Morningglory (*Lpomoea spp.*)		-	-	2”	4”	-	6”
Mustard, blue		6”	-	-	-	-	-
Mustard, tansy		6”	12”	20”	-	-	-
Mustard, tumble		6”	-	-	-	-	-
Mustard, wild		6”	12”	18”	-	-	-
Nightshade, black		-	6”	12”	-	-	-
Nightshade, hairy		-	6”	12”	-	-	-
Oats		-	-	6”	20”	-	-
Pigweed		-	12”	18”	24”	-	-
Prickly lettuce		-	6”	12”	20”	-	-
Purslane		-	-	-	6”	6”	12”
Ragweed, common	South	-	4”	6”	8”	-	11”
	North	-	6”	12”	18”	-	-
Ragweed, giant		-	-	4”	6”	-	11”
Red rice		-	-	-	4”	-	-
Russian thistle		-	-	-	6”	-	-
Rye	South	-	6”	20”	60”	-	-
	North	-	18”	18”+	-	-	-
Ryegrass		-	-	-	6”	-	7”+
Sandbur, field		12”	-	-	-	-	-
Shattercane		-	12”	18”	-	-	-
Shepherdspurse		-	6”	12”	-	-	-
Sicklepod		-	-	2”	4”	-	8”
Signalgrass, broadleaf		-	3”	5”	7”	9”	12”
Smartweed, ladysthumb		-	4”	6”	8”	-	12”
Smartweed, Pennsylvania		-	4”	6”	8”	-	12”
Sowthistle, annual		-	-	-	6”	-	12”
Spanishneedles		-	-	-	8”	-	18”
Speedwell, purslane		-	12”	-	-	-	-
Sprangletop		-	6”	12”	20”	-	-
Spurge, prostrate		-	6”	12”	20”	-	-
Spurge, spotted		-	6”	12”	20”	-	-
Spurry, umbrella		6”	-	-	-	-	-
Stinkgrass		12”	-	-	-	-	-
Sunflower		-	12”	18”	-	-	-
Teaweed/Prickly sida		-	1”	2”	3”	4”	6”
Texas panicum		-	6”	8”	12”	-	24”
Velvetleaf	South	-	2”	3”	4”	5”	8”
	North	-	3”	6”	12”	-	-
Virginia pepperweed		-	18”	-	-	-	-
Waterhemp		-	-	6”	12”	-	-
Wheat	South	-	6”	30”	-	-	-
	North	-	18”	18”+	-	-	-
Wheat (overwintered)		-	6”	18”	-	-	-
Wild Proso Millet		-	-	6”	12”	12”	18”
Witchgrass		-	12”	-	-	-	-
Woolly cupgrass		-	6”	12”	-	-	-
Yellow rocket		-	-	12”	20”	-	-

[1]Do not treat kochia in the button stage.

ANNUAL WEEDS RATE TABLE, WEST REGION

WEED SPECIES	RATE (FLUID OUNCES PER ACRE) 9	12	18	24	36
	MAXIMUM HEIGHT/LENGTH				
Barley	12”	-	-	-	-
Barnyardgrass	6”	-	-	-	-
Bluegrass, annual	6”	-	-	-	-
Bluegrass, bulbous	-	6”	-	-	-
Brome, downy[1]	6”	-	-	-	-
Buttercup	-	12”	-	-	-
Cheat	-	6”	-	-	-
Chickweed	-	6”	-	-	-
Cocklebur	-	12”	-	-	-
Corn	-	6”	-	-	-
Crabgrass	-	12”	-	-	-
Dwarfdandelion	-	12”	-	-	-
Fall panicum	-	12”	-	-	-
Falseflax, smallseed	-	12”	-	-	-
Field pennycress	-	6”	-	-	-
Filaree	-	-	-	-	12”
Fleabane, hairy *(Conyza bonariensis)*	-	6”	-	-	-
Florida pusley	-	-	-	12”	-
Foxtail	6 fl. oz. for up to 12”				
Goatgrass, jointed	-	6”	-	-	-
Groundsel, common	-	6”	-	-	-
Henbit	-	6”	-	-	-
Horseweed/Marestail *(Conyza canadensis)*	-	6”	-	-	-
Johnsongrass, seedling	-	12”	-	-	-
Lambsquarters	-	6”	-	-	-
London rocket	-	6”	-	-	-

WEED SPECIES	RATE (FLUID OUNCES PER ACRE) 9	12	18	24	36
	MAXIMUM HEIGHT/LENGTH				
Morningglory *(Lpomoea spp.)*	-	2”	-	-	-
Mustard, blue	6”	-	-	-	-
Mustard, tansy	6”	-	-	-	-
Mustard, tumble	6”	-	-	-	-
Mustard, wild	6”	-	-	-	-
Pigweed	-	12”	-	-	-
Rye	12”	-	-	-	-
Ryegrass, Italian	-	6”	-	-	-
Sandbur, field	12”	-	-	-	-
Shattercane	12”	-	-	-	-
Shepherdspurse	-	6”	-	-	-
Sowthistle, annual	-	6”	-	-	-
Spurge, annual	-	6”	-	-	-
Stinkgrass	12”	-	-	-	-
Texas panicum	-	12”	-	-	-
Wheat	18”	-	-	-	-
Wild oats	-	12”	-	-	-
Witchgrass	-	12”	-	-	-

[1]For control of Downy brome in no-till systems, use 12 fluid ounces per acre.

Annual Weeds – Water Carrier Volumes of 10 to 40 Gallons Per Acre

Apply 1 ½ pints to 2 ¼ pints of this product per acre. Use 1 ½ pints per acre if weeds are less than 6 inches tall and 2 ¼ pints per acre if weeds are over 6 inches tall.

These rates will provide control of weeds listed in the annual weed control tables when water carrier volumes are 10 to 40 gallons per acre for ground applications.

Annual Weeds – Tank Mixtures with 2,4-D or Banvel®

9 to 12 fluid ounces of this product plus 0.25 pounds a.i. of Banvel® or 0.5 pounds a.i. of 2,4-D per acre will control the following weeds with the maximum height or length indicated: 6” – prickly lettuce, marestail/horseweed (*Conyza canadensis*), morningglory (*Ipomoea* spp.), kochia (Banvel® only); 12” – cocklebur, lambsquarters, pigweed, Russian thistle.

12 fluid ounces of this product plus 0.5 pounds a.i. of 2,4-D per acre will control the following weeds when they are a maximum height or length of 6 inches: common ragweed, giant ragweed, Pennsylvania smartweed, and velvetleaf.

9 fluid ounces of this product plus 0.25 pounds a.i. of Banvel® or 0.5 pounds a.i. of 2,4-D per acre will control foxtail up to 18”.

Refer to the specific product labels for crop rotation restrictions and cautionary statements of all products used in tank mixtures. Some crop injury may occur if Banvel® is applied within 45 days of planting.

DO NOT APPLY BANVEL TANK MIXTURES BY AIR IN CALIFORNIA.

PERENNIAL WEEDS RATE TABLE ALPHABETICALLY BY SPECIES

Apply to actively growing perennial weeds.

NOTE: If weeds have been mowed or tilled, do not treat until plants have resumed active growth and have reached the specified stages.

Repeat treatments may be necessary to control weeds regenerating from underground parts or seed. Repeat treatments must be made prior to crop emergence.

Unless otherwise stated, allow 7 or more days after application before tillage.

Do not treat when weeds are under drought stress as good soil moisture is necessary for active growth.

Weed Species	Rate (PT/A)	Water Volume	Hand-Held % Solution	Comments
Alfalfa	1.5-3	3-10	1.5%	Make applications after the last hay cutting in the fall. Allow alfalfa to regrow to a height of 6 to 8 inches or more prior to treatment. Applications should be followed with deep tillage at least 7 days after treatment, but before soil freeze-up.
Alligatorweed	6	3-20	1.25%	Partial control. Apply when most of the plants are in bloom. Repeat applications will be required to maintain control.
Anise (fennel)	-	-	0.75-1.5%	Apply as a spray-to-wet treatment. Optimum results are obtained when plants are treated at the bud to full-bloom stage of growth.
Bahiagrass	4.5-7.5	3-20	1.5%	Apply when most plants have reached the early head stage.
Bentgrass	2.25	10-20	1.5%	For suppression in grass seed production areas. For ground applications only. Ensure entire crown area has resumed growth prior to a fall application. Bentgrass should have at least 3 inches of growth. Tillage prior to treatment should be avoided. Tillage 7 to 10 days after application produces the best results.
Bermudagrass	4.5-7.5	3-20	1.5%	For control, apply 7.5 pints of this product per acre. For partial control, apply 4.5 pints per acre. Treat when bermudagrass is actively growing and seedheads are present. Retreatment may be necessary to maintain control.
Bermudagrass, water (knotgrass)	1.5-2.25	5-10	1.5%	Apply 2.25 pints of this product in 5 to 10 gallons of water per acre. Apply when water bermudagrass is 12 to 18 inches in length. Allow 7 or more days before tilling, flushing or flooding the field. Fall applications only: Apply 1.5 pints of this product in 5 to 10 gallons of water per acre. Fallow fields should be tilled prior to application. Apply prior to frost on water bermudagrass that is 12 to 18 inches in length. This product is not registered in California for use on water bermudagrass.
Bindweed, field	0.75-7.5	3-20	1.5%	Do not treat when weeds are under drought stress as good soil moisture is necessary for active growth. For control, apply 6 to 7.5 pints of this product per acre west of the Mississippi River and 4.5 to 6 pints east of the Mississippi River. Apply when the weeds are at or beyond full bloom. For best results, apply in late summer or fall. Fall treatments must be applied before a killing frost. Also for control, apply 3 pints of this product plus 0.5 pounds a.i. of Banvel® in 10 to 20 gallons of water per acre. Do not apply by air. For suppression on irrigated agricultural land, apply 1.5 to 3 pints of this product plus 1 pound a.i. of 2,4-D in 10 to 20 gallons of water per acre with ground equipment only. Applications should be made following harvest or in fall fallow ground when the bindweed is actively growing and the majority of runners are 12 inches or more in length. The use of at least one irrigation will promote active bindweed growth. For suppression, apply 12 fluid ounces of this product plus 0.5 pound a.i. 2,4-D in 3 to 10 gallons of water per acre for ground applications and 3 to 5 gallons of water per acre for aerial applications. Apply by air in fallow and reduced tillage systems only. Applications should be delayed until maximum emergence has occurred and when vines are between 6 to 18 inches in length. In California only, apply 1.5 to 7.5 pints of this product per acre. Actual rate needed for suppression or control will vary within this range depending on local conditions. For suppression on irrigated land where annual tillage is performed, apply 1.5 pints of this product in 3 to 10 gallons of water per acre. Apply to bindweed that has reached a length of 12 inches or greater. Allow maximum weed emergence and runner growth. Allow 3 or more days after application before tillage.
Bluegrass, Kentucky	1.5-3	3-40	1.5%	Apply 3 pints of this product in 10 to 40 gallons of water per acre when most plants have reached boot-to-early seedhead stage of development. For partial control in pasture or hay crop renovation, apply 1.5 to 2.25 pints of this product in 3 to 10 gallons of water per acre. Apply to actively growing plants when most have reached 4 to 12 inches in height.
Blueweed, Texas	4.5-7.5	3-40	1.5%	Apply 6 to 7.5 pints of this product per acre west of the Mississippi River and 4.5 to 6 pints per acre east of the Mississippi River. Apply when plants are at or beyond full bloom. New leaf development indicates active growth. For best results, apply in late summer or fall. Fall treatments must be applied before a killing frost.
Brackenfern	4.5-6	3-40	0.75-1.5%	Apply to fully expanded fronds which are at least 18 inches long.
Bromegrass, smooth	1.5-3	3-40	1.5%	Apply 3 pints of this product in 10 to 40 gallons of water per acre when most plants have reached boot-to-early seedhead stage of development. For partial control in pasture or hay crop renovation, apply 1.5 to 2.25 pints of this product in 3 to 10 gallons of water per acre. Apply to actively growing plants when most have reached 4 to 12 inches in height.
Bursage, woolly-leaf	-	3-20	1.5%	For control, apply 3 pints of this product plus 1 pint of Banvel® per acre. For partial control, apply 1.5 pints of this product plus 1 pint of Banvel® per acre. Apply when plants are producing new active growth which has been initiated by moisture for at least 2 weeks and when plants are at or beyond flowering.

Weed Species	Rate (PT/A)	Water Volume	Hand-Held % Solution	Comments
Canarygrass, reed	3-4.5	3-40	1.5%	For best results, apply when most plants have reached the boot-to-head stage of growth.
Cattail	4.5-7.5	3-40	1.5%	Apply when most plants have reached the early head stage.
Clover; red, white	4.5-7.5	3-20	1.5%	Apply when most plants have reached the early bud stage.
Cogongrass	4.5-7.5	10-40	1.5%	Apply when cogongrass is at least 18 inches tall in late summer or fall. Due to uneven stages of growth and the dense nature of vegetation preventing good spray coverage, repeat treatments may be necessary to maintain control.
Dallisgrass	4.5-7.5	3-20	1.5%	Apply when most plants have reached the early head stage.
Dandelion	4.5-7.5	3-40	1.5%	Apply when most plants have reached the early bud stage of growth. Also for control, apply 12 fluid ounces of this product plus 0.5 pound a.i. 2,4-D in 3 to 10 gallons of water per acre.
Dock, curly	4.5-7.5	3-40	1.5%	Apply when most plants have reached the early bud stage of growth. Also for control, apply 12 fluid ounces of this product plus 0.5 pound a.i. 2,4-D in 3 to 10 gallons of water per acre.
Dogbane, hemp	6	3-40	1.5%	Apply when most plants have reached the late bud to flower stage of growth. Following crop harvest or mowing, allow weeds to regrow to a mature stage prior to treatment. For best results, apply in late summer or fall. For suppression, apply 12 fluid ounces of this product plus 0.5 pound a.i. of 2,4-D in 3 to 10 gallons of water per acre for ground applications and 3 to 5 gallons of water per acre for aerial applications. Delay applications until maximum emergence of dogbane has occurred.
Fescue (except tall)	4.5-7.5	3-20	1.5%	Apply when most plants have reached the early head stage.
Fescue, tall	1.5-4.5	3-40	1.5%	Apply 4.5 pints of this product per acre when most plants have reached boot-to-early seedhead stage of development. Fall applications only: Apply 1.5 pints of this product in 3 to 10 gallons of water per acre. Apply to fescue in the fall when plants have 6 to 12 inches of new growth. A sequential application of 12 fluid ounces per acre of this product will improve long-term control and control seedlings germinating after fall treatments or the following spring.
Guineagrass	4.5	3-40	0.75%	Apply when most plants have reached at least the 7-leaf stage of growth. Ensure thorough coverage when using hand-held equipment.
Horsenettle	4.5-7.5	3-20	1.5%	Apply when most plants have reached the early bud stage.
Horseradish	6	3-40	1.5%	Apply when most plants have reached the late bud to flower stage of growth. For best results, apply in late summer or fall.
Iceplant	-	-	1.5%	Iceplant should be at or beyond the early bud stage of growth. Thorough coverage is necessary for best control.
Jerusalem artichoke	4.5-7.5	3-20	1.5%	Apply when most plants are in the early bud stage.
Johnsongrass	0.75-4.5	3-40	0.75%	In annual cropping systems apply 1.5 to 3 pints of this product per acre. Apply 1.5 pints of this product in 3 to 10 gallons of water per acre. Use 3 pints of this product when applying 10 to 40 gallons of water per acre. In non-agricultural, or areas where annual tillage (no-till) is not practiced, apply 3 to 4.5 pints of this product in 10 to 40 gallons of water per acre. For best results, apply when most plants have reached the boot-to-head stage of growth or in the fall prior to frost. Allow 7 or more days after application before tillage. Do not tank mix with residual herbicides when using the 1.5 pint per acre rate. For burndown of Johnsongrass, apply 12 fluid ounces of this product in 3 to 10 gallons of water per acre before the plants reach a height of 12 inches. For this use, allow at least 3 days after treatment before tillage. Spot treatment (partial control or suppression) – Apply a 3/4 percent solution of this product when Johnsongrass is 12 to 18 inches in height. Coverage should be uniform and complete.
Kikuyugrass	3-4.5	3-40	1.5%	Spray when most kikuyugrass is at least 8 inches in height (3 or 4-leaf stage of growth). Allow 3 or more days after application before tillage.
Knapweed	6	3-40	1.5%	Apply when most plants have reached the late bud to flower stage of growth. For best results, apply in late summer or fall.
Lantana	-	-	0.75-1.0%	Apply at or beyond the bloom stage of growth. Use the higher application rate for plants that have reached the woody stage of growth.
Lespedeza	4.5-7.5	3-20	1.5%	Apply when most plants have reached the early bud stage.
Milkweed, common	4.5	3-40	1.5%	Apply when most plants have reached the late bud to flower stage of growth.
Muhly, wirestem	1.5-3	3-40	1.5%	Use 1.5 pints of this product in 3 to 10 gallons of water per acre. Use 3 pints of this product when applying 10 to 40 gallons of water per acre or in pasture, sod, or non-agricultural areas. Spray when the wirestem muhly is 8 inches or more in height. Do not till between harvest and fall applications or in the fall or spring prior to spring applications. Allow 3 or more days after application before tillage.
Mullein, common	4.5-7.5	3-20	1.5%	Apply when most plants are in the early bud stage.
Napiergrass	4.5-7.5	3-20	1.5%	Apply when most plants are in the early head stage.
Nightshade, silverleaf	3	3-10	1.5%	Applications should be made when at least 60 percent of the plants have berries. Fall treatments must be applied before a killing frost.
Nutsedge; purple, yellow	0.75-4.5	3-40	0.75-1.5%	Apply 4.5 pints of this product per acre or apply a ¾ to 1 ½ percent solution for control of nutsedge plants and immature nutlets attached to treated plants. Treat when plants are in flower or when new nutlets can be found at rhizome tips. Nutlets which have not germinated will not be controlled and may germinate following treatment. Repeat treatments will be required for long-term control of ungerminated tubers. Sequential applications: 1.5 to 3 pints of this product in 3 to 10 gallons of water per acre will also provide control. Make applications when a majority of the plants are in the 3 to 5-leaf stage (less than 6 inches tall). Repeat this application, as necessary, when newly emerging plants reach the 3 to 5-leaf stage. Subsequent applications will be necessary for long-term control. For partial control of existing plants, apply 12 fluid ounces to 3 pints of this product in 3 to 40 gallons of water per acre. Treat when plants have 3 to 5 leaves and most are less than 6 inches tall. Repeat treatments will be required to control subsequent emerging plants or regrowth of existing plants.
Orchardgrass	1.5-3	3-40	1.5%	Apply 3 pints of this product in 10 to 40 gallons of water per acre when most plants have reached boot-to-early seedhead stage of development. For partial control in pasture or hay crop renovation, apply 1.5 to 2.25 pints of this product in 3 to 10 gallons of water per acre. Apply to actively growing plants when most have reached 4 to 12 inches in height. Orchardgrass sods going to no-till corn: Apply 1.5 to 2.25 pints of this product in 3 to 10 gallons of water per acre. Apply to orchardgrass that is a minimum of 12 inches tall for spring applications and 6 inches tall for fall applications. Allow at least 3 days following application before planting. A sequential application of atrazine will be necessary for optimum results.
Pampasgrass	-	-	1.5%	Pampasgrass should be at or beyond the boot stage of growth. Thorough coverage is necessary for best control.
Paragrass	4.5-7.5	3-20	1.5%	Apply when most plants are in the early head stage.
Phragmites	4.5-7.5	10-40	0.75-1.5%	For partial control. For best results, treat during late summer or fall months or when plants are actively growing and in full bloom. Treatment before or after this stage may lead to reduced control. Due to the dense nature of the vegetation, which may prevent good spray coverage or uneven stages of growth, repeat treatments may be necessary to maintain control. Visual control symptoms will be slow to develop.

Weed Species	Rate (PT/A)	Water Volume	Hand-Held % Solution	Comments
Poison hemlock	-	-	0.75-1.5%	Apply as a spray-to-wet treatment. Optimum results are obtained when plants are treated at the bud to full-bloom stage of growth.
Pokeweed, common	1.5	3-40	1.5%	Apply to actively growing plants up to 24 inches tall.
Quackgrass	1.5-4.5	3-40	1.5%	In annual cropping systems, or in pastures and sods followed by deep tillage: Apply 1.5 pints of this product in 3 to 10 gallons of water per acre. For 10 to 40 gallons of water per acre, apply 3 pints of this product. Do not tank mix with residual herbicides when using the 1.5 pint rate. Spray when quackgrass is 6 to 8 inches in height. Do not till between harvest and fall applications or in fall or spring prior to spring application. Allow 3 or more days after application before tillage. In pastures or sods, use a moldboard plow for best results. In pastures, sods or non-agricultural areas where deep tillage does not follow application: Apply 3 to 4.5 pints of this product in 10 to 40 gallons of water per acre when the quackgrass is greater than 8 inches tall.
Redvine	1.25-3	5-10	1.5%	For suppression, apply 18 fluid ounces of this product per acre at each of two applications 7 to 14 days apart or a single application of 3 pints per acre. Apply specified rates in 5 to 10 gallons of water per acre. Apply in late September or early October to plants which are at least 18 inches tall and have been growing 45 to 60 days since the last tillage operation. Make applications at least 1 week before a killing frost.
Reed, giant	-	-	1.5%	Best results are obtained when applications are made in late summer to fall.
Ryegrass, perennial	1.5-4.5	3-40	0.75%	In annual cropping systems apply 1.5 to 3 pints of this product per acre. Apply 1.5 pints of this product in 3 to 10 gallons of water per acre. Use 3 pints of this product when applying 10 to 40 gallons of water per acre. In non-agricultural, or areas where annual tillage (no-till) is not practiced, apply 3 to 4.5 pints of this product in 10 to 40 gallons water per acre. For best results, apply when most plants have reached the boot-to-head stage of growth or in the fall prior to frost. Do not tank-mix with residual herbicides when using the 1.5 pint per acre rate.
Smartweed, swamp	4.5-7.5	3-40	1.5%	Apply when most plants have reached the early bud stage of growth. Also for control, apply 12 fluid ounces of this product plus 0.5 pound a.i. 2,4-D in 3 to 10 gallons of water per acre in the late summer or fall.
Sowthistle, perennial	3-4.5	3-40	1.5%	Apply when most plant are at or beyond the bud stage of growth. After harvest, mowing or tillage in the late summer or fall, allow at least 4 weeks for initiation of active growth and rosette development prior to the application of this product. Fall treatments must be applied before a killing frost. Allow 3 or more days after application before tillage.
Spurge, leafy	-	3-10	1.5%	For suppression, apply 12 fluid ounces of this product plus 0.5 pound a.i. 2,4-D in 3 to 10 gallons of water per acre in the late summer or fall. If mowing has occurred prior to treatment, apply when most of the plants are 12 inches tall.
Starthistle, yellow	3	10-40	1.5%	Best results are obtained when applications are made during the rosette, bolting and early flower stages.
Sweet potato, wild	-	-	1.5%	Partial control. Apply to plants that are at or beyond the bloom stage of growth. Repeat applications may be required.
Thistle, artichoke	-	-	1.5%	Partial control. Apply to plants that are at or beyond the bloom stage of growth. Repeat applications may be required.
Thistle, Canada	3-4.5	3-40	1.5%	Apply when most plants are at or beyond the bud stage of growth. After harvest, mowing or tillage in the late summer or fall, allow at least 4 weeks for initiation of active growth and rosette development prior to the application of this product. Fall treatments must be applied before a killing frost. Allow 3 or more days after application before tillage. For suppression, apply 1.5 pints of this product, or 12 fluid ounces of this product plus 0.5 pound a.i. 2,4-D, in 3 to 10 gallons of water per acre in the late summer or fall after harvest, mowing or tillage. Allow rosette regrowth to a minimum of 6 inches in diameter before treating. Applications can be made as long as leaves are still green and plants are actively growing at the time of application. Allow 3 or more days after application before tillage.
Timothy	3-4.5	3-40	1.5%	For best results, apply when most plants have reached the boot-to-head stage of growth.
Torpedograss	6-7.5	3-40	1.5%	For partial control. Apply when most plants are at or beyond the seedhead stage of growth. Repeat applications will be required to maintain control. Fall treatments must be applied before frost.
Trumpetcreeper	3	5-10	1.5%	Partial control. Apply in late September or October, to plants which are at least 18 inches tall and have been growing 45-60 days since the last tillage operation. Make applications at least 1 week before a killing frost.
Vaseygrass	4.5-7.5	3-20	1.5%	Apply when most plants are in the early head stage.
Velvetgrass	4.5-7.5	3-20	1.5%	Apply when most plants are in the early head stage.
Wheatgrass, western	3-4.5	3-40	1.5%	For best results, apply when most plants have reached the boot-to-head stage of growth.

WOODY BRUSH AND TREES RATE TABLE ALPHABETICALLY BY SPECIES

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 to early summer when brush species are at high moisture content and are flowering.

Ensure thorough coverage when using hand-held equipment. Symptoms may not appear prior to frost or senescence with fall treatments.

Allow 7 or more days after application before tillage, mowing or removal. Repeat treatments may be necessary to control plants regenerating from underground parts or seed. Some autumn colors on undesirable deciduous species are acceptable provided no major leaf drop has occurred. Reduced performance may result if fall treatments are made following a frost.

Weed Species	Rate (PT/A)	Water Volume	Hand-Held % Solution	Comments
Alder	4.5-6	3-40	0.75-1.5%	For control
Ash	3-7.5	3-40	0.75-1.5%	Partial control
Aspen, quaking	3-4.5	3-40	0.75-1.5%	For control
Bearmat (Bearclover)	3-7.5	3-40	0.75-1.5%	Partial control
Beech	3-7.5	3-40	0.75-1.5%	Partial control
Birch	3	3-40	0.75%	For control
Blackberry	4.5-6	10-40	0.75-1.5%	For control. Make applications after plants have reached full leaf maturity. Best results are obtained when applications are made in late summer or fall. Applications may also be made after leaf drop and until a killing frost or as long as stems are green. After berries have set or dropped in late fall, blackberry can be controlled by applying a ¾ percent solution of this product. For control of blackberries after leaf drop and until a killing frost or as long as stems are green, apply 4.5 to 6 pints of this product in 10 to 40 gallons of water per acre.
Blackgum	3-7.5	3-40	0.75-1.5%	For control
Bracken	3-7.5	3-40	0.75-1.5%	For control
Broom; French, Scotch	-	-	1.5%	For control
Buckwheat, California	-	-	0.75-1.5%	For partial control. Thorough coverage of foliage is necessary for best results.
Cascara	3-7.5	3-40	0.75-1.5%	Partial control
Catsclaw	-	-	0.75-1.5%	Partial control
Ceanothus	3-7.5	3-40	0.75-1.5%	Partial control
Chamise	-	-	0.75%	For control. Thorough coverage of foliage is necessary for best results.

Weed Species	Rate (PT/A)	Water Volume	Hand-Held % Solution	Comments
Cherry; bitter, black, pin	3-4.5	3-40	0.75-1.5%	For control
Coyote brush	-	-	1.5%	For control. Apply when at least 50 percent of the new leaves are fully developed.
Dogwood	3-7.5	3-40	0.75-1.5%	Partial control
Elderberry	3	3-40	0.75%	For control
Elm	3-7.5	3-40	0.75-1.5%	Partial control
Eucalyptus	-	-	1.5%	For control of eucalyptus resprouts, apply when resprouts are 6 to 12 feet tall. Ensure complete coverage. Avoid application to drought-stressed plants.
Florida holly (Brazilian Peppertree)	3-7.5	3-40	0.75-1.5%	Partial control
Gorse	3-7.5	3-40	0.75-1.5%	Partial control
Hasardia	-	-	0.75-1.5%	Partial control. Thorough coverage of foliage is necessary for best results.
Hawthorn	3-4.5	3-40	0.75-1.5%	For control
Hazel	3	3-40	0.75%	For control
Hickory	3-7.5	3-40	0.75-1.5%	Partial control
Honeysuckle	3-6	3-40	0.75-1.5%	For control
Hornbeam, American	3-7.5	3-40	0.75-1.5%	Partial control
Kudzu	6	3-40	1.5%	For control. Repeat applications may be required to maintain control.
Locust, black	3-6	3-40	0.75-1.5%	Partial control
Madrone resprouts	-	-	1.5%	Partial control. Apply to resprouts that are 3 to 6 feet tall. Best results are obtained with spring/early summer treatments.
Manzanita	3-7.5	3-40	0.75-1.5	Partial control
Maple, red	3-6	3-40	0.75-1.5	For control, apply a 0.75 to 1.5 percent solution when at least 50 percent of the new leaves are fully developed. For partial control, apply 3 to 6 pints of this product per acre.
Maple, sugar	-	-	0.75-1.5%	For control. Apply when at least 50 percent of the new leaves are fully developed.
Monkey flower	-	-	0.75-1.5%	Partial control. Thorough coverage of foliage is necessary for best results.
Oak; black, white	3-6	3-40	0.75-1.5%	Partial control
Oak, post	4.5-6	3-40	0.75-1.5%	For control
Oak; northern, pin	-	-	0.75-1.5%	For control. Apply when at least 50 percent of the new leaves are fully developed.
Oak, southern, red	3-4.5	3-40	0.75-1.5%	For control
Persimmon	3-7.5	3-40	0.75-1.5%	Partial control
Pine	3-7.5	3-40	0.75-1.5%	For control
Poison ivy/ Poison oak	4-5	3-40	2%	For control. Repeat applications may be required to maintain control. Fall treatments must be applied before leaves lose green color.
Poplar, yellow	3-7.5	3-40	0.75-1.5%	Partial control
Redbud, eastern	3-7.5	3-40	0.75-1.5%	For control
Rose, multiflora	3	3-40	0.75%	For control. Treatments should be made prior to leaf deterioration by leaf-eating insects.
Russian olive	3-7.5	3-40	0.75-1.5%	Partial control
Sage, black	-	-	0.75%	For control. Thorough coverage of foliage is necessary for best results.
Sage, white	3-7.5	3-40	0.75-1.5%	Partial control
Sage brush, California	-	-	0.75%	For control. Thorough coverage of foliage is necessary for best results.
Salmonberry	3	3-40	0.75%	For control
Salt-cedar	3-7.5	3-40	0.75-1.5%	For control
Sassafras	3-7.5	3-40	0.75-1.5%	Partial control
Sourwood	3-7.5	3-40	0.75-1.5%	Partial control
Sumac; poison, smooth, winged	3-6	3-40	0.75-1.5	Partial control
Sweetgum	3-4.5	3-40	0.75-1.5	For control
Swordfern	3-7.5	3-40	0.75-1.5%	Partial control
Tallowtree, Chinese	-	-	0.75%	For control. Thorough coverage of foliage is necessary for best results.
Tan oak resprouts	-	-	1.5%	For partial control. Apply to resprouts that are less than 3 to 6 feet tall. Best results are obtained with fall applications.
Thimbleberry	3	3-40	0.75%	For control
Tobacco, tree	-	-	0.75-1.5%	Partial control
Trumpetcreeper	3-4.5	3-40	0.75-1.5%	For control
Vine maple	3-7.5	3-40	0.75-1.5%	Partial control
Virginia creeper	3-7.5	3-40	0.75-1.5%	For control
Waxmyrtle, southern	3-7.5	3-40	0.75-1.5%	Partial control
Willow	4.5	3-40	0.75%	For control

CONDITION OF SALE AND LIMITATION OF WARRANTY AND LIABILITY

To the extent consistent with applicable law, upon purchase or use of this product, purchaser and user agree to the following terms:

Warranty: Alligare, LLC (the Company) warrants that this product conforms to the chemical description on the label in all material respects and is reasonably fit for the purpose referred to in the directions for use, subject to the exceptions noted below, which are beyond the Company's control. To the extent consistent with applicable law, the Company makes no other representation or warranty, express or implied, concerning the product, including no implied warranty of merchantability or fitness for a particular purpose. No such warranty shall be implied by law, and no agent or representative is authorized to make any such warranty on the Company's behalf.

Terms of Sale: The Company's directions for use of this product must be followed carefully. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, and the manner of use or application (including failure to adhere to label directions), all of which are beyond the Company's control. To the extent consistent with applicable law, all such risks are assumed by the user.

Limitation of Liability: To the extent consistent with applicable law, the exclusive remedy against the Company for any cause of action relating to the handling or use of this product is a claim for damages, and in no event shall damages or any other recovery of any kind exceed the price of the product which caused the alleged loss, damage, injury or other claim. To the extent consistent with applicable law, under no circumstances shall the Company be liable for any special, indirect, incidental or consequential damages of any kind, including loss of profits or income, and any such claims are hereby waived. Some states do not allow the exclusion or limitation of incidental or consequential damages.

The Company and the seller offer this product, and the purchaser and user accept this product, subject to the foregoing warranty, terms of sale and limitation of liability, which may be varied or modified only by an agreement in writing signed on behalf of the Company by an authorized representative.

Arsenal® and Chopper® are registered trademarks of BASF.
Garlon® is a registered trademark of Dow AgroSciences LLC.
Escort®, Oust®, and Telar® are registered trademarks of E.I. duPont de Nemours and Company.

EPA 20150619

STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY
BOARD OF PESTICIDES CONTROL
28 STATE HOUSE STATION
AUGUSTA, MAINE 04333

JANET T. MILLS
GOVERNOR

AMANDA E. BEAL
COMMISSIONER

July 25, 2024

Basswood Environmental, LLC
Erik Lema
32 Brentwood Rd
Cape Elizabeth, ME 04107

RE: Variance permit for CMR 01-026 Chapter 29, Basswood Environmental, LLC- Callahan Mine Superfund

Greetings,

The Board of Pesticides Control considered your application for variance from Chapter 29. The variance is approved, with the condition that all products to be used are currently registered in the State of Maine or were registered at the time of purchase and any application is made above the high-water line during the driest conditions possible.

The Board authorizes the issuance of two-year permits for Chapter 29, therefore this permit is valid until December 31, 2025, as long as applications are consistent with the information provided on the variance request. Please notify the Board in advance of changes, particularly if you plan to use a different product from those listed.

Please bear in mind that your permit is based upon your company adhering to the precautions listed in Section X of your Chapter 29 variance request.

I will alert the Board at its next meeting that the variance permit has been issued. If you have any questions concerning this matter, please feel free to contact me at 287-2731.

Sincerely,

Alexander Peacock

Alexander Peacock
Director

BOARD OF PESTICIDES CONTROL
APPLICATION FOR VARIANCE PERMIT
(Pursuant to Chapter 29, Section 6 of the Board's Regulations)

I. Justin Adams (603-255-3782)
Name Telephone Number

Northeast Vegetation and Mosquito Control
Company Name

63 Epping St. Raymond NH 03077
Address City State Zip

II. Damian Andrada BPC_IND-55596
Master Applicator (if applicable) License Number

1157 Front Street Manchester NH 03102
Address City State Zip

III. **As part of your application, please send a revegetation plan and digital photos showing the target site and/or plants and the surrounding area, particularly showing proximity to wetlands and water bodies, to pesticides@maine.gov**

IV. Area(s) where pesticide will be applied:

Treatment in mapped areas of canal sides. Fencelines will be sprayed to remove all vegetation to aid in canal maintenance. Individual woody plants will be controlled by cut stump treatment or frill and girdle treatment depending on plant diameter. When broadcast spraying is needed, all treatment will be facing away from canals to avoid drift. When cut stump treatment is needed, herbicide will be painted directly to stump.

V. Pesticide(s) to be applied:(Including EPA Registration Number)
Roundup Custom Aquatic Herbicide - EPA REG 524-343
Alligaire Triclopyr 4 Herbicide - EPA REG 81927-11

VI. Purpose of pesticide application:
Roundup Custom will be used to control vegetation along fences and new growth of bittersweet.
Alligaire Triclopyr will be used only for direct treatment to cut stumps/stems. Herbicide treatment is neccesary to maintain canals for stormwater passage. Additionally, several Invasive species have been observed, primarily Oriental bittersweet. Herbicide application is required to control hardy species and prevent canal system deterioration.

VII. Approximate dates of spray application:

Application is requested by client as soon as possible as some brush has been cleared.

Estimated to take place August 15th or so, depending on approval window.

VIII. Application Equipment:

Manual Solo backpack sprayers. Wick applicator and/or sponges will be used to apply

to cut stumps.

IX. Standard(s) to be varied from:

Treatment is anticipated to edge of canals. In Downtown areas, treatment will be 10-20 feet above the canal, but less than 10 feet from the edge. In Jepson brook and Hart brook canals,

treatment will approach less than 5 feet from water, on concrete only, to reduce structural degradation.

X. Method to ensure equivalent protection:

Roundup Custom aquatic herbicide has been selected due to it's relative safety near water.

Cut stump/stem treatments will be applied by hand to prevent drift or off target vegetation kill.

When broadcast treatment is needed, manual backpacks will be kept to lowest effective pressure and sprayed facing away from the canals.

XI. Revegetation Plan (attach separately if necessary)

Revegetation is not anticipated as these are existing stormwater infrastructure and the

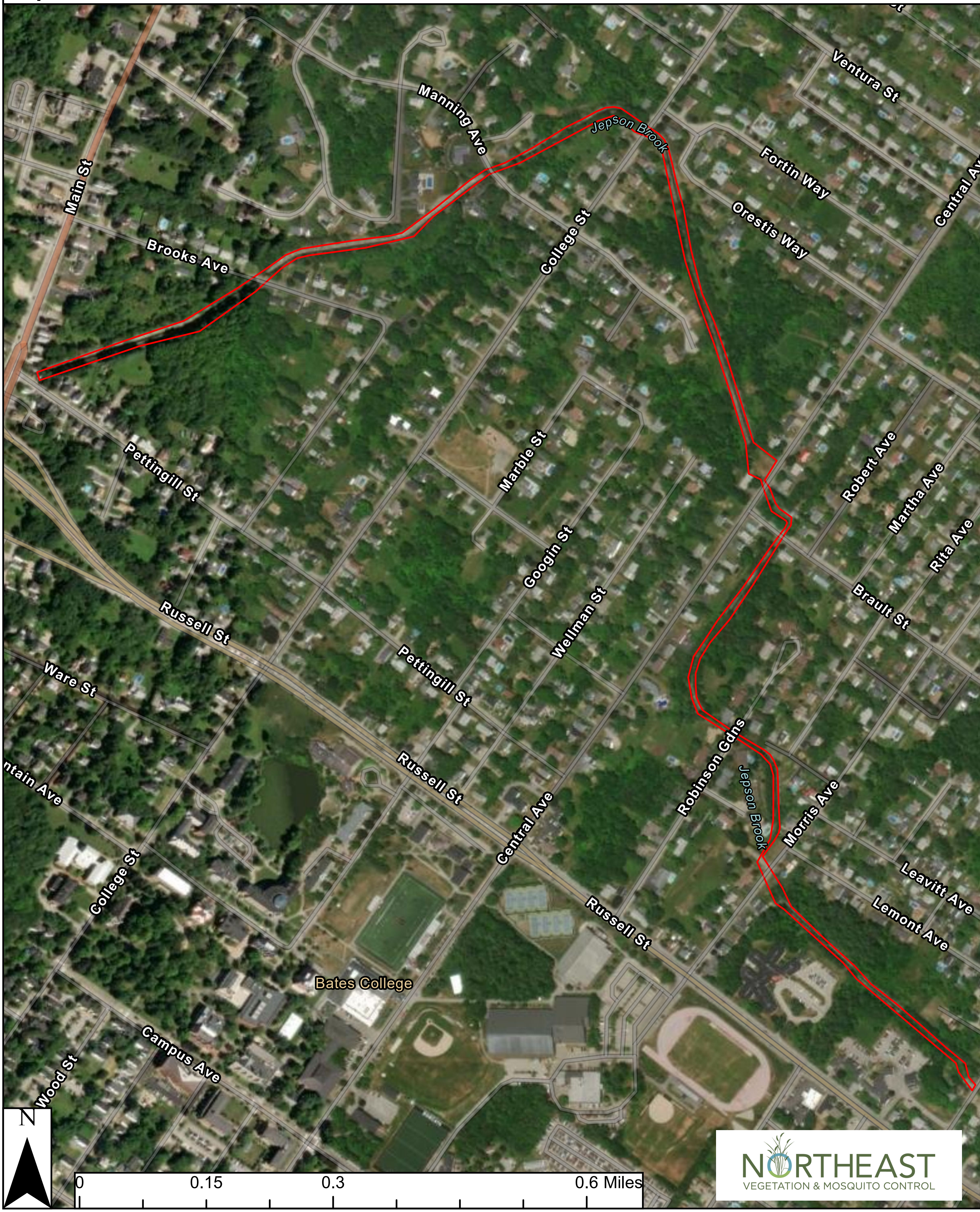
goal is elliminate woody plants and invasive vegetation from degrading the canal walls.

Signed:____Date:____________________

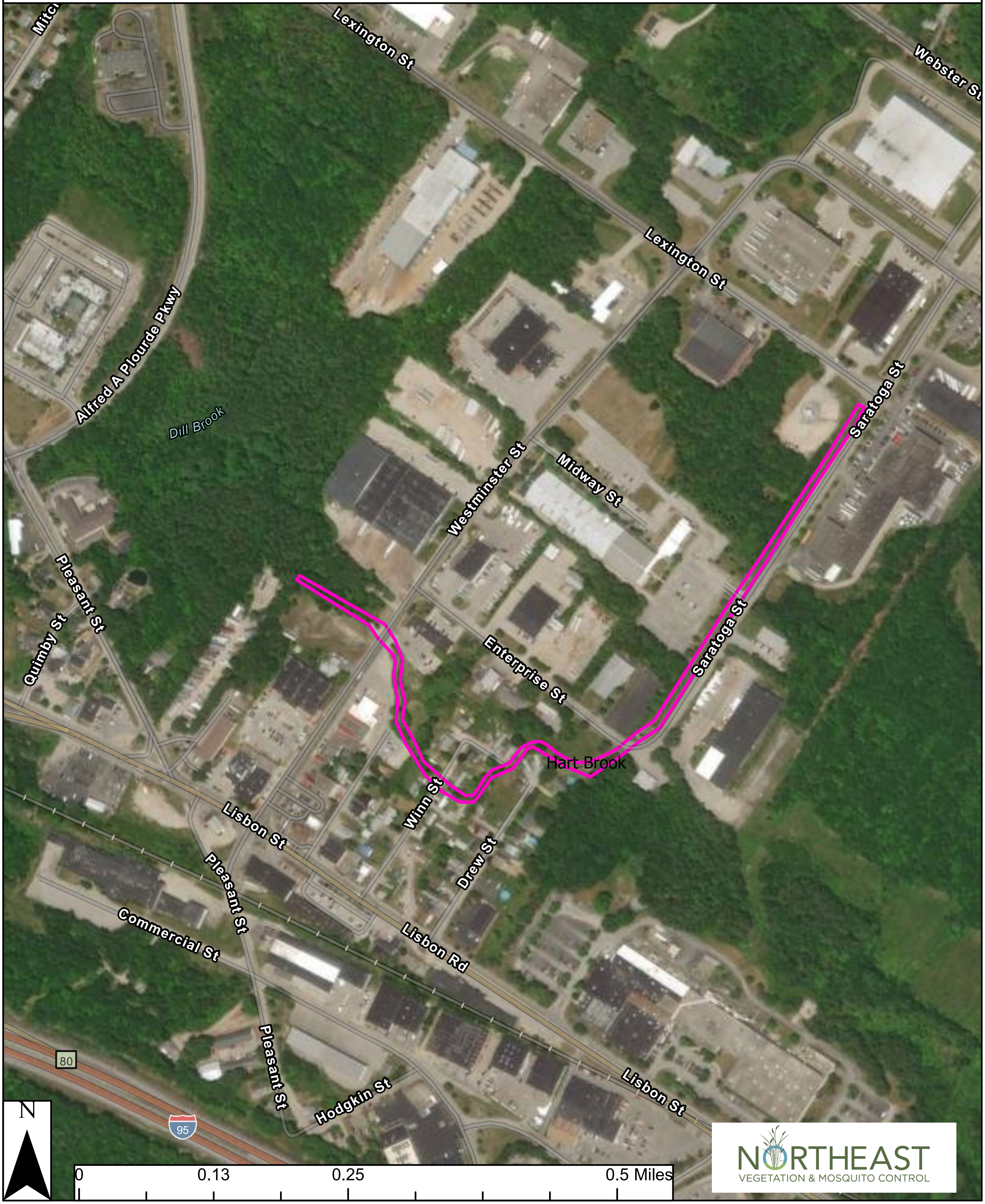
Return completed form to: **Board of Pesticides Control, 28 State House Station, Augusta, ME 04333-0028**
OR E-mail to: pesticides@maine.gov

Lewiston, ME Canal Vegetation Control Map 1
Downtown Section - NVMC

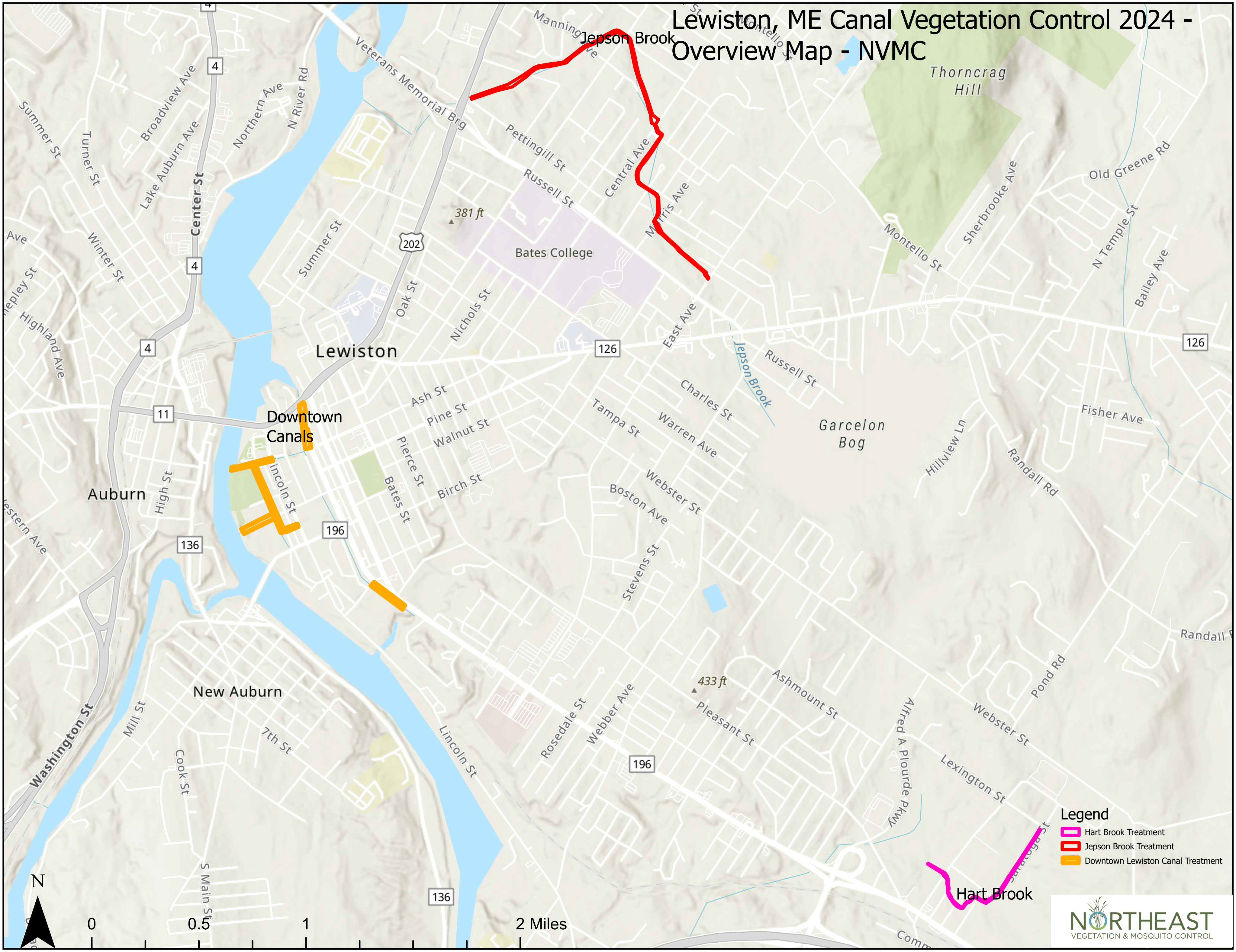
Lewiston, ME Canal Vegetation Control Map 2
Jepson Brook - NVMC



Lewiston, ME Canal Vegetation Control Map 3
Hart Brook - NVMC



Lewiston, ME Canal Vegetation Control 2024 - Overview Map - NVMC



STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY
BOARD OF PESTICIDES CONTROL
28 STATE HOUSE STATION
AUGUSTA, MAINE 04333

JANET T. MILLS
GOVERNOR

AMANDA E. BEAL
COMMISSIONER

August 26, 2024

Justin Adams
Northeast Vegetation and Mosquito Control
63 Epping St.
Raymond, NH 03102

RE: Variance permit for CMR 01-026 Chapter 29, Northeast Vegetation and Mosquito Control

Dear Mr. Adams,

The Board of Pesticides Control considered your application for variance from Chapter 29. The variance is approved, with the condition that all products to be used are currently registered in the State of Maine or were registered at the time of purchase.

The Board authorizes the issuance of two-year permits for Chapter 29, therefore this permit is valid until December 31, 2025, as long as applications are consistent with the information provided on the variance request. Please notify the Board in advance of changes, particularly if you plan to use a different product from those listed.

Please bear in mind that your permit is based upon your company adhering to the precautions listed in Section X of your Chapter 29 variance request.

I will alert the Board at its next meeting that the variance permit has been issued. If you have any questions concerning this matter, please feel free to contact me at 287-2731.

Sincerely,

Alexander Peacock

Alexander Peacock
Director

ALEXANDER PEACOCK, DIRECTOR
90 BLOSSOM LANE, DEERING BUILDING

PHONE: (207) 287-2731
THINKFIRSTSPRAYLAST.ORG

BOARD OF PESTICIDES CONTROL
APPLICATION FOR VARIANCE PERMIT
(Pursuant to Chapter 29, Section 6 of the Board's Regulations)

I. Robert Rowse — (207) 415-2718
Name — Telephone Number

Company Name

809 Depot Street — Union — ME — 04862
Address — City — State — Zip

II. Not available yet*
Master Applicator (if applicable) — License Number

Address — City — State — Zip

III. **As part of your application, please send a revegetation plan and digital photos showing the target site and/or plants and the surrounding area, particularly showing proximity to wetlands and water bodies, to pesticides@maine.gov**

IV. Area(s) where pesticide will be applied:
There is a path about 250' long by the lake shore with patches of poison ivy in various sections. Most of the path is within 25 feet of high water. The area will be used by young kids next summer.

V. Pesticide(s) to be applied: (Including EPA Registration Number)
Round UP Custom (EPA Reg. No. 524-343)

VI. Purpose of pesticide application:
Eradicate poison ivy

VII. Approximate dates of spray application:

Mid to late August

VIII. Application Equipment:

Backpack sprayer

IX. Standard(s) to be varied from:

N/A

X. Method to ensure equivalent protection and Revegetation Plan:

Applicator will be on foot with a backpack sprayer thereby able to target very specific areas. As a precaution, we will ensure that winds are coming out of the south or east, blowing northwesterly to avoid drift of spray toward lake.

XI. Revegetation Plan (attach separately if necessary)

There are no large enough sections that will not revegetate easily on their own from surrounding ferns, grasses, and other ground cover. After spraying, we will cover the affected areas with hay to prevent any erosion and foster regrowth of grass.

Signed: Rob Rowse Date: 7/23/2024

Return completed form to: **Board of Pesticides Control, 28 State House Station, Augusta, ME 04333-0028**
OR E-mail to: pesticides@maine.gov

Rev. 2/2022

ArcGIS Web Map

7/25/2024, 8:31:09 AM

Maine Parcels Organized Towns

1:4,514

0 150 300 600 ft

0 45 90 180 m

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Web AppBuilder for ArcGIS

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STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY
BOARD OF PESTICIDES CONTROL
28 STATE HOUSE STATION
AUGUSTA, MAINE 04333

JANET T. MILLS
GOVERNOR

AMANDA E. BEAL
COMMISSIONER

August 27, 2024

Kyle Rosenberg
Forest to Shore
7 Wagg Rd.
Bowdoin, ME 04287

RE: Variance permit for CMR 01-026 Chapter 29, Forest to Shore

Dear Mr. Rosenberg,

The Board of Pesticides Control considered your application for a variance from Chapter 29. The variance is approved, provided that all products to be used are currently registered in the State of Maine or were registered at the time of purchase.

The Board authorizes the issuance of two-year permits for Chapter 29, therefore this permit is valid until December 31, 2025, as long as applications are consistent with the information provided on the variance request. Please notify the Board in advance of changes, particularly if you plan to use a different product from those listed.

Please bear in mind that your permit is based upon your company adhering to the precautions listed in Section X of your Chapter 29 variance request.

I will alert the Board at its next meeting that the variance permit has been issued. If you have any questions concerning this matter, please feel free to contact me at 287-2731.

Sincerely,

Alexander Peacock

Alexander Peacock
Director

9g

Maine Obsolete Pesticide Collection Program

scan me

WHAT IS IT?

Do you have an old shed with unusable pesticides? An old can of raid under the sink? An unknown barrel of something inherited from the previous owner? Sign up for the Obsolete Pesticide Collection Program today to safely and responsibly remove hazardous waste from your property. Available to Maine residents, gardeners, and small family-owned farms.

HOW TO PARTICIPATE

All participants must fill out a registration form with a list of all pesticides/adjuvants that they would like to submit. Forms can be submitted on our on-line application or emailed to pesticides@maine.gov. To fill out our on-line application, visit thinkfirstspraylast.org or scan the QR code. All participants will be notified in early October via mail of the program date, time, and location. Any unknown pesticides must be verified prior to acceptance. For more information, visit thinkfirstspraylast.org or contact us. Applications will be accepted until Wednesday, September 25, 2024.

- Collections are **FREE** for Maine residents, gardeners, and small family-owned farms
- Collections take place in mid October
- Sites are in Portland, Augusta, Bangor, and Presque Isle
- Registration is required by **September 25, 2024**

CONTACT US

207-287-2731

pesticides@maine.gov

BOARD OF PESTICIDES CONTROL · Think First... Spray Last! · STATE OF MAINE

DEPARTMENT OF ENVIRONMENTAL PROTECTION · STATE OF MAINE

TOWN OF ATHENS HERBICIDE NOTIFICATION ORDINANCE

SECTION 1. PURPOSE.

The purpose of the Town of Athens Herbicide Notification Ordinance is to safeguard the health, welfare, drinking water, and property of the residents of Athens by requiring notification of landowners when the manager of a utility right-of-way plans to conduct vegetation management activities that involve the use of herbicides.

SECTION 2. AUTHORITY

Pursuant to 22 M.R.S.A. section 1471-U, Maine municipalities may enact ordinances that apply to herbicide storage, distribution, or use. In order to safeguard the public's health, safety, and welfare, this ordinance is adopted to meet these goals.

SECTION 3. DEFINITIONS

The following words, terms and phrases, when used in this ordinance, shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:

HERBICIDE: "Herbicide" has the same definition as specified by 22 M.R.S.A. section 258-A, and means any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any weed.

NO-SPRAY ZONE: The section of a right-of-way abutting the property of a landowner who has requested that non-herbicide based vegetation management methods be used instead of herbicides. Unless otherwise requested by the abutting landowner, the no-spray zone shall include the entire length of the right-of-way abutting the property, and the entire width of the right-of-way running through the property, even if the owner of the opposite side of the right-of- way is different than the landowner requesting non-herbicide based vegetation management. No herbicides may be applied in the No-spray zone.

NON-HERBICIDE BASED VEGETATION MANAGEMENT. Mechanical and manual vegetation management methods, such as mowing vegetation and cutting trees and brush, which do not involve the application of any herbicides.

RIGHT-OF-WAY: A type of easement that allows a utility company to use a certain portion of another person's property for construction and maintenance of electricity distribution systems.

SPRAY CONTRACTING FIRM: A person or company employed or contracted by a utility or transmission corridor right-of-way manager to conduct herbicide application.

TOWN: The Town of Athens.

TRANSMISSION CORRIDOR. A tract of land owned, occupied, or leased by a utility transmission provider, or covered by an easement or right-of-way held by a utility transmission provider, where an electric transmission line is constructed, operated, or maintained.

UTILITY: Any electrical transmission and distribution utility that is subject to the jurisdiction of the Maine Public Utilities Commission.

WEED: Any plant which grows where not wanted.

SECTION 4. REQUIREMENTS

A Utility that owns, operates, maintains or manages a transmission corridor in the Town of Athens must mail written notice of intent to apply herbicides along the transmission corridor, to all landowners whose property abuts the transmission corridor right-of-way, at least three weeks (21 days) prior to scheduled vegetation management that may include herbicide application.

The herbicide application notification letter must list the date(s) that vegetation management is planned to occur, the name(s) and EPA registration number(s) of herbicides that may be used, and list any herbicides to be used which contain glyphosates.

The Utility must also provide written notice to the Town of Athens at least three weeks prior to scheduled herbicide application on a transmission corridor, listing the names and addresses of property owners who were mailed herbicide application notifications.

No Utility or spray contracting firm may apply herbicides to a section of the transmission corridor if an abutting landowner requests that vegetation management along the right-of-way abutting the landowner's property be conducted without use of herbicides.

Upon landowner request, a no-spray zone must apply to the entire length of right-of-way abutting the landowner's property. The cost of using non-herbicide based vegetation management methods shall be covered by the Utility or Transmission Corridor manager, and no fee for costs of non-herbicide based vegetation management shall be imposed upon a landowner requesting a No-Spray zone along the section of right-of-way abutting the landowner's property.

SECTION 5. ENFORCEMENT.

This Ordinance shall be enforced by the Town's Code Enforcement Officer and the Board of Selectmen. The Town of Athens may apply to any court of competent jurisdiction to enjoin any planned, anticipated or threatened violation of this Ordinance.

A fine of $1,000 per violation shall be imposed if a Utility or Transmission Corridor Manager or Spray Contracting Firm fails to honor a landowner request for a no-spray zone or if a Utility or Transmission Corridor Manager fails to notify an abutting landowner at least three weeks prior to scheduled herbicide application. Each failure to honor a no-spray request and each failure to notify an abutting landowner shall be treated as a separate violation.

SECTION 6. SEVERABILITY.

Should any section or provision of this Ordinance be declared by the courts to be invalid, such decision shall not invalidate any other section or provision of this Ordinance.

SECTION 7. CONFLICTS

Whenever a provision of this Ordinance conflicts with or is inconsistent with another provision of any other ordinance, regulation or statute, the more restrictive provision shall control. The Town of Athens Herbicide Notification Ordinance repeals and replaces the Town of Athens Herbicide Application Notification Ordinance that was previously adopted at Town Meeting on June 4, 2024.

SECTION 8. EFFECTIVE DATE

This Ordinance becomes effective as of July 30, 2024 if this Ordinance receives approval by the majority of voters at Town Meeting. This Ordinance shall remain in effect until terminated or amended by a majority vote of a Town Meeting.

A Section 508–conformant HTML version of this article is available at https://doi.org/10.1289/EHP13954.

Forever Pesticides: A Growing Source of PFAS Contamination in the Environment

Nathan Donley,[1] Caroline Cox,[2] Kyla Bennett,[3] Alexis M. Temkin,[4] David Q. Andrews,[4] and Olga V. Naidenko[4]

[1]Center for Biological Diversity, Portland, Oregon, USA
[2]Center for Environmental Health (retired), Oakland, California, USA
[3]Public Employees for Environmental Responsibility, Silver Spring, Maryland, USA
[4]Environmental Working Group, Washington, District of Columbia, USA

Background: Environmental contamination by fluorinated chemicals, in particular chemicals from the per- and polyfluoroalkyl substances (PFAS) class, has raised concerns around the globe because of documented adverse impacts on human health, wildlife, and ecosystem quality. Recent studies have indicated that pesticide products may contain a variety of chemicals that meet the PFAS definition, including the active pesticide ingredients themselves. Given that pesticides are some of the most widely distributed pollutants across the world, the legacy impacts of PFAS addition into pesticide products could be widespread and have wide-ranging implications on agriculture and food and water contamination, as well as the presence of PFAS in rural environments.

Objectives: The purpose of this commentary is to explore different ways that PFAS can be introduced into pesticide products, the extent of PFAS contamination of pesticide products, and the implications this could have for human and environmental health.

Methods: We submitted multiple public records requests to state and federal agencies in the United States and Canada and extracted relevant data from those records. We also compiled data from publicly accessible databases for our analyses.

Discussion: We found that the biggest contributor to PFAS in pesticide products was active ingredients and their degradates. Nearly a quarter of all US conventional pesticide active ingredients were organofluorines and 14% were PFAS, and for active ingredients approved in the last 10 y, this had increased to 61% organofluorines and 30% PFAS. Another major contributing source was through PFAS leaching from fluorinated containers into pesticide products. Fluorination of adjuvant products and "inert" ingredients appeared to be limited, although this represents a major knowledge gap. We explored aspects of immunotoxicity, persistence, water contamination, and total fluorine load in the environment and conclude that the recent trend of using fluorinated active ingredients in pesticides may be having effects on chemical toxicity and persistence that are not given adequate oversight in the United States. We recommend a more stringent risk assessment approach for fluorinated pesticides, transparent disclosure of "inert" ingredients on pesticide labels, a complete phase-out of post-mold fluorination of plastic containers, and greater monitoring in the United States. https://doi.org/10.1289/EHP13954

Introduction

Pesticides are commonly used in the United States and around the world to kill or suppress certain organisms on farmland and in areas where people live and work. Although pesticides are often efficacious at killing or preventing the growth of target organisms, they are widely regarded as causing serious unintended harms to both humans and nontarget biota. In the United States alone, roughly 450 million kg of pesticide active ingredients were applied in an estimated 5.3 million cumulative km^2-treatments of farmland throughout the country in 2021.[1]

Therefore, the enormous potential for human exposure and environmental contamination belies the importance of understanding complete product compositions and their environmental fate and transport. Pesticide products generally contain two types of ingredients: active and "inert." Active ingredients are the primary components in pesticide products that kill or suppress the targeted organism.[2] "Inerts" are every other ingredient added to the pesticide product, including emulsifiers, solvents, carriers, aerosol propellants, fragrances, and dyes.[3] However, far from being inert, many of these ingredients have chemical properties that can influence the toxicity or alter the bioavailability of the active ingredient or have unintended off-target effects themselves to people and wildlife.[4,5] Unlike active ingredients, "inerts" are not required to be publicly disclosed on the pesticide label[6] and toxicity testing is limited.[5] This lack of transparency and insufficient toxicity testing—in the pesticide context and many others—accomplishes two things from a public health perspective: It can *a*) hamper the ability of medical professionals to effectively treat patients who fall ill following pesticide exposure and *b*) shield companies from accountability regarding the harms from their products.[5,7,8]

In agriculture, pesticide products are commonly applied with adjuvants, which are separate products that can reduce drift/volatilization, facilitate application, or enhance pesticidal effects of pesticide products.[9] Adjuvant ingredients are widely used in US agriculture, as demonstrated by an analysis of usage data in the state of California.[9]

Fluorination is used to modify chemical attributes, such as stability and lipophilicity, improve stereochemical specificity, and increase residual activity of pesticide ingredients.[10] Pesticide active ingredients are commonly fluorinated, with insecticides and

Address correspondence to Nathan Donley, Center for Biological Diversity, P.O. Box 11374, Portland, OR 97211 USA. Email: ndonley@biologicaldiversity.org

Supplemental Material is available online (https://doi.org/10.1289/EHP13954).

N.D.'s employer, the Center for Biological Diversity, currently has active litigation against the US EPA involving some active ingredients that happen to be PFAS for failure to consult under the Endangered Species Act and failure to comply with the Federal Insecticide, Fungicide, and Rodenticide Act. The PFAS classification and extent of fluorination of the active ingredients are not at issue in the litigation. N.D. has provided scientific support for these lawsuits. K.B.'s employer, Public Employees for Environmental Responsibility (PEER), currently has active litigation against Inhance Technologies, LLC, involving formation of PFAS during the fluorination of plastic containers contrary to EPA regulations. K.B. is a Declarant in the lawsuit and has provided scientific support for this lawsuit. K.B., on behalf of PEER, has publicly taken the position that post-mold fluorination of plastic containers is dangerous to human health and the environment and should be discontinued. K.B. and PEER are also representing current and former government scientists on issues relating to PFAS, and PFAS in pesticides. K.B. and PEER have also been involved with Freedom of Information Act (FOIA) litigation against EPA for PFAS related issues. All other authors declare they have nothing to disclose.

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acaricides more likely to be highly fluorinated.[11] Fluorination can contribute to the molecular stability of active ingredients—both *in vivo* and in the broader environment—and can influence lipophilicity, which can alter membrane permeability and binding to target proteins.[10] The most common chemotype for fluorinated active ingredients is a trifluoromethyl ($-CF_3$) group followed by a monofluoromethyl group ($-CFH2$).[11]

Numerous patents have demonstrated ways in which fluorinated "inerts" can expedite dispersal of the sprayed pesticide on targeted surfaces such as leaves, aid in surfactancy, and facilitate the penetration of the pesticide into living organisms.[12] The fluorination of inert ingredients can help prevent the formation of foam in the pesticide formulation to ensure efficient spreading of the pesticide after spraying,[12,13] and fluorinated inerts are also used as propellants in aerosol pesticide products.[14] Given that many adjuvant and inert ingredients perform similar functions, it is assumed that at least some adjuvant ingredients are fluorinated.[15]

One subset of fluorinated molecules is per- and polyfluoroalkyl substances (PFAS). PFAS are a serious environmental health concern owing to their highly persistent nature,[16] often potent toxicities,[17] potential to bioaccumulate,[18] and widespread presence in people, animals, and the broader environment.[19,20] Through its PFAS Strategic Roadmap, the US Environmental Protection Agency (EPA) in 2021 committed to not only facilitate the remediation of legacy PFAS contamination but also to intervene to limit the introduction of unnecessary new PFAS into the environment.[21]

A widely used definition of PFAS comes from the Organisation for Economic Cooperation and Development (OECD) and encompasses almost any chemical with at least one perfluorinated methyl group ($-CF_3$) or a perfluorinated methylene group ($-CF_2-$).[22,23] Given the broad nature of this definition, PFAS are often subcategorized by the length of their carbon chain. For the purposes of this commentary, we have further classified PFAS as long-chain, short-chain, or ultrashort-chain, which respectively contain ≥ 6, 4–5, and ≤ 3 fully fluorinated carbon atoms. Although all PFAS are considered extremely persistent owing to the strength of the carbon–fluorine bond, some may differ significantly in other chemical properties, such as mobility, lipophilicity, and potential to bioaccumulate.[24]

Given the diverse array of health impacts that have been linked to PFAS exposure,[25] it is important to understand the extent to which the inclusion of carbon–fluorine bonds within pesticide ingredients is impacting persistence and toxicity. When proposing drinking water limits for six PFAS, the US EPA found that reduced exposure would result in a lower prevalence of kidney cancers, heart attacks, strokes, and developmental effects, as well as a general reduction in harms to the immune, developmental, cardiovascular, hepatic, endocrine, metabolic, reproductive, and musculoskeletal systems of US residents.[26] The majority of studies on PFAS toxicity have focused on just a few compounds, but efforts to catalog the toxicity of other PFAS have indicated shared toxicity end points.[27,28]

The purpose of this commentary is to explore ways that PFAS can be introduced into pesticide products, the extent of PFAS contamination, and the implications this could have for human and environmental health. Here we have identified multiple pathways by which PFAS are introduced into pesticide products—both intentionally and unintentionally—and the regulatory shortcomings that prevent a faithful accounting of the risks posed by this class of chemicals. By focusing on pathways of PFAS introduction, our goal with this commentary is to ultimately identify ways that regulators could reduce PFAS in these products and more fully account for their human and environmental health harms in the pesticide registration process.

Methods

Information Sources Used in This Commentary

Information on the number of currently registered active ingredients, fluorinated inert ingredients, and fluorinated adjuvant ingredients were obtained from public records requests to various state-level government agencies in the United States, US federal agencies, and Canadian agencies and are cited in text in the "Methods" or "Discussion" sections. Multiple publicly accessible databases were also searched for relevant adjuvant ingredient information and water detections of fluorinated active ingredients and are also cited in text in the "Methods" and "Discussion" sections. Data sources used in this commentary can be found in Table 1.

Additional Analyses Conducted for Active Ingredients

As of 31 December 2021, the US EPA had 1,157 pesticidal active ingredients registered with the agency (Excel Table S1).[29] Active ingredients fell into three different categories: biopesticide, antimicrobial, and conventional. Biopesticides[48] are naturally occurring chemicals or living organisms—often used in organic agriculture—that do not contain carbon–fluorine bonds. Antimicrobials[49] are often used indoors in relatively lower amounts. Conventional active ingredients[50] are often thought of as "typical" pesticides—mainly synthetic chemicals used widely in agriculture, around people's homes and in green spaces to kill unwanted insects, plants, rodents, or fungi. These ingredients have a higher potential for broader environmental contamination because they are often used outdoors and in higher quantities than biopesticides or antimicrobials.[51,52] Therefore, we curated the list of active ingredients we received in our public records request down to 471 unique, conventional active ingredients to determine how many were organofluorines or PFAS (Excel Tables S1–S3).

In curating our list of 1,157 pesticidal active ingredients down to 471 unique, conventional active ingredients, we

- Mined US EPA's Pesticide Product and Label System (PPLS) database,[53] the Pesticide Chemical Search tool,[54] and other online materials to identify and exclude any active ingredient

Table 1. Public records, communications, and database sources used in this commentary.

Section	Sources
Active ingredients	US EPA FOIA response[29]
Inert ingredients	US EPA FOIA responses,[30,31] US EPA InertFinder Database,[32] Health Canada PMRA List of Formulants,[33] email communication with Health Canada's Senior Scientific Screening Officer (N. Donley, personal communication)
Adjuvant ingredients	TELUS Label Search,[34] California Department of Pesticide Regulation Public Records Act Request,[35] Washington State Department of Agriculture Spray Adjuvant Ingredients List[36]
Storage container leaching	Analytical testing reports from Eurofins Lancaster Laboratories Env, LLC.[37–42] and Alpha Analytical,[43] US EPA. Analysis of PFAS in selected mosquito control products from the Maryland Department of Agriculture,[44] US EPA. Verification Analysis for PFAS in Pesticide Products[45]
Water contamination	USGS. Dissolved Pesticides in Weekly Water Samples from the NAWQA Regional Stream Quality Assessments (2013–2017)[46]
Pesticide usage	USGS. Preliminary estimated annual agricultural pesticide use for counties of the conterminous United States[47]

Note: EPA, Environmental Protection Agency; FOIA, Freedom of Information Act; NAWQA, National Water-Quality Assessment; PFAS, per- and polyfluoroalkyl substances; PMRA, Canada's Pest Management Regulatory Agency; USGS, US Geological Survey.

that met the definition of an antimicrobial or biopesticide. Antimicrobial pesticides are substances or mixtures of substances used to destroy or suppress the growth of harmful microorganisms, such as bacteria, viruses, or fungi, on inanimate objects and surfaces. Biopesticides are any plant incorporated protectant (PIP), live organism, or naturally occurring extracts from live organisms (e.g., peptides, alcohols, oils, pheromones, extracts). We also excluded any active ingredient whose sole purpose was not for pesticidal use, such as nitrogen stabilization.

- Identified and excluded different precursor forms of the same pesticide because the active pesticide molecule was identical (e.g., dicamba was only represented once in our list even though it had many different registered salt forms). We also identified and excluded different purified isomers or enantiomers that were present in mixtures of a previously registered active ingredient (e.g., alpha-cypermethrin and zeta-cypermethrin were excluded from our list because they were simply two isomers that were present in the previously registered cypermethrin). We also identified and excluded active ingredients that were structurally identical but in a different phase from an active ingredient on our list (e.g., amorphous silica and silicon dioxide were reduced down to a single entry on our list).
- Identified and removed products that only had "technical" or "manufacturing use only" products registered, because we were interested only in active ingredients used in end-use products.

US Geological Survey Water Data Analysis

Between 2013 and 2017, the US Geological Survey (USGS) analyzed 482 wadable streams for pesticide contaminants in five regions of the United States (Northwest, California, Midwest, Southeast, and Northeast). The methodology used is described in five regional reports,[55–59] and data are available for downloading from the USGS website.[46] We manually identified all analyzed active ingredients that met the OECD PFAS definition, as well as degradates (metabolites) of those active ingredients, in the site's Table 3 text file and extracted the available detection and water concentration data on those chemicals from Data Tables 4–8 on the same site.[46] Data extracted and compiled included the number of positive detections and maximum detected concentrations for 29 analytes (13 PFAS active ingredients plus 16 fluorinated degradates).

Discussion

How PFAS Are Introduced into Pesticides

We sought to document and understand ways in which PFAS were introduced into pesticides and the extent of PFAS contamination in pesticide products. The following sections detail our analyses. There are multiple ways that PFAS can be introduced into pesticide products, which can facilitate their deposition into the environment. We have broadly categorized these PFAS contamination pathways as intentional and unintentional. Below are examples of each.

Intentional addition of PFAS. **Active ingredients.** Of the 471 unique, conventional active ingredients that were currently registered in the United States, 107 (23%) contained at least one carbon–fluorine bond and 66 (14%) met the OECD definition[22] of PFAS (Figure 1 and Table 2; Excel Tables S3–S5) (see the "Methods" section for details). Of the 54 conventional active ingredients that had been approved in the most recent 10 y, the proportion of fluorination increased dramatically with 33 (61%) classified as organofluorines and 16 (30%) as PFAS (Figure 1 and Table 2; Excel Tables S3–S5).

The trend of increasing fluorination of active ingredients in the United States in recent years was consistent with trends in other countries[10] and with the ability of fluorination to impart chemical properties on pesticides that were desirable to manufacturers and users, particularly the addition of a $-CF_3$ moiety.[11] In fact, most of the PFAS active ingredients contained a $-CF_3$ group as the sole criteria for their inclusion as PFAS in this commentary (Table 2 and Figure 2; Excel Tables S4 and S5).

Two active ingredients stood out as having a significantly higher degree of fluorination than the others: broflanilide and pyrifluquinazon (Figure 2; Excel Tables S4 and S5). Both contain a highly fluorinated side chain that is structurally similar to hexafluoropropylene oxide,[62] a component of the highly toxic, known water contaminant GenX. However, despite both having a similar degree of fluorination, the parent molecules differ in their relative persistence as designated by the US EPA. Broflanilide is considered highly persistent, with the parent molecule having soil and aqueous half-lives in the range of 5–6 y.[63] The US EPA has found that the parent broflanilide and its fluorinated degradates have the potential to bioconcentrate and are likely to accumulate in the environment over time.[63] Despite these alarming chemical properties, the US EPA concluded that the pesticide met the registration standard under US pesticide

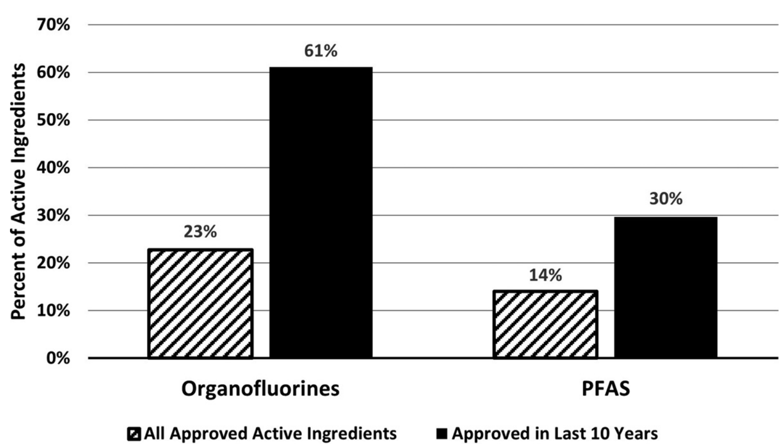

Figure 1. Percentage of conventional US pesticide active ingredients that were organofluorines or PFAS. The striped bars denote the percentage of all US-approved active ingredients ($n = 471$) that were organofluorines (left) or PFAS (right) as of 2021. The solid bars denote the percentage of active ingredients approved between 2012 and 2021 ($n = 54$) that were organofluorines (left) or PFAS (right). For all active ingredients, 107/471 (23%) were organofluorines and 66/471 (14%) were PFAS. For active ingredients approved between 2012 and 2021, 33/54 (61%) were organofluorines and 16/54 (30%) were PFAS. Note: PFAS, per- and polyfluoroalkyl substances.

law.[63] The parent molecule of pyrifluquinazon, on the other hand, is classified by the US EPA as nonpersistent, with soil and aqueous half-lives ranging from 1–16 d.[64] Extractable degradates were similarly short-lived; however, sediment-bound degradates were characterized as very persistent.[64] No studies on the terminal fluorinated degradates of pyrifluquinazon were analyzed by the US EPA, prompting US EPA scientists to convey that "we are concerned that the total accumulation of all PFAS degradates both known and unknown will be a risk issue."[65]

Table 2. PFAS active ingredients approved in the United States and associated registration dates.

CAS No.	Registration date	Active ingredient name[a]
50594-66-6; 62476-59-9	20 August 2018; 20 March 1987	Acifluorfen; sodium acifluorfen
1861-40-1	22 March 1972	Benfluralin
352010-68-5	24 April 2015	Bicyclopyrone
82657-04-3	2 October 1985	Bifenthrin
1207727-04-5	14 January 2021	Broflanilide
63333-35-7	3 October 1985	Bromethalin
122453-73-0	19 January 2001	Chlorfenapyr
180409-60-3	27 June 2012	Cyflufenamid
400882-07-7	9 May 2014	Cyflumetofen
97886-45-8	18 June 1991	Dithiopyr
55283-68-6	2 May 1989	Ethalfluralin
120068-37-3	1 May 1996	Fipronil
104040-78-0	14 May 2007	Flazasulfuron
158062-67-0	26 September 2003	Flonicamid
79241-46-6	25 August 1986	Fluazifop-P butyl
79622-59-6	10 August 2001	Fluazinam
181274-17-9	29 September 2000	Flucarbazone-sodium
131341-86-1	5 October 1995	Fludioxonil
142459-58-3	8 April 1998	Flufenacet
62924-70-3	27 May 1983	Flumetralin
2164-17-2	28 May 1974	Fluometuron
239110-15-7	30 January 2008	Fluopicolide
658066-35-4	2 February 2012	Fluopyram
59756-60-4	31 March 1986	Fluridone
56425-91-3	4 December 1989	Flurprimidol
958647-10-4	13 March 2018	Flutianil
66332-96-5	12 March 1996	Flutolanil
69409-94-5	25 March 1983	Fluvalinate
72178-02-0; 108731-70-0	11 September 1987; 10 April 1987	Fomesafen; sodium salt of fomesafen
76703-62-3; 91465-08-6	31 March 2004; 13 May 1988	gamma-Cyhalothrin; lambda-cyhalothrin
86479-06-3	10 March 1994	Hexaflumuron
67485-29-4	30 September 1982	Hydramethylnon
173584-44-6	30 October 2000	Indoxacarb
141112-29-0	15 September 1998	Isoxaflutole
77501-63-4	1 April 1987	Lactofen
1417782-03-6	26 June 2019	Mefentrifluconazole
139968-49-3	3 August 2007	Metaflumizone
27314-13-2	19 March 1975	Norflurazon
116714-46-6	25 September 2001	Novaluron
121451-02-3	21 September 2001	Noviflumuron
1003318-67-9	31 August 2015	Oxathiapiprolin
42874-03-3	15 June 1981	Oxyfluorfen
219714-96-2	27 September 2004	Penoxsulam
183675-82-3	29 February 2012	Penthiopyrad
117428-22-5	30 November 2012	Picoxystrobin
29091-21-2	7 February 1992	Prodiamine
94125-34-5	3 May 1995	Prosulfuron
365400-11-9	9 August 2007	Pyrasulfotole
179101-81-6	24 April 2008	Pyridalyl
337458-27-2	3 January 2013	Pyrifluquinazon
447399-55-5	15 February 2012	Pyroxasulfone
422556-08-9	27 February 2008	Pyroxsulam
372137-35-4	3 September 2009	Saflufenacil
946578-00-3	6 May 2013	Sulfoxaflor
79538-32-2	17 January 1989	Tefluthrin
335104-84-2	29 November 2007	Tembotrione
112281-77-3	14 April 2005	Tetraconazole
1229654-66-3	10 March 2021	Tetraniliprole
88-30-2	21 August 1964	TFM
1220411-29-9	25 September 2020	Tiafenacil
122454-29-9	2 May 2007	Tralopyril
141517-21-7	20 September 1999	Trifloxystrobin
290332-10-4	29 September 2003	Trifloxysulfuron-sodium
68694-11-1	24 October 1991	Triflumizole
1582-09-8	4 December 1968	Trifluralin
126535-15-7	4 June 1996	Triflusulfuron-methyl

Note: CAS, Chemical Abstracts Service; EPA, Environmental Protection Agency; PFAS, per- and polyfluoroalkyl substances; TFM, 3-trifluoromethyl-4-nitrophenol.
[a]Data in the table were extracted from a public records request to the US EPA.[29] From this list, PFAS pesticides were manually identified and extracted for this table (see the "Methods" section for more detail).

"Inert" ingredients. A public records request to the US EPA, which the agency responded to in December of 2022, indicated that the agency had 24 registered inert ingredients that it had identified as PFAS or that the agency suspected may be PFAS.[30] The provided list appeared to have been compiled of both PFAS inerts and fluorinated inerts that were not PFAS. Since the US EPA produced the list of 24, the agency canceled 12 that were not in any currently registered pesticide products[66] and we identified one as not having any carbon–fluorine bonds, leaving 11 currently registered organoflourine inert ingredients (Table 3). We confirmed this list of 11 by searching for "fluoro" in the ingredient name field on the US EPA's Inert Finder database.[32]

Of the 11 US EPA-registered organofluorine inert ingredients, 8 met the OECD definition of PFAS (Table 3 and Figure 2). Four of these 11 ingredients were approved for both food and nonfood use, whereas the rest were only for nonfood use.[32] All the food-use organofluorine inerts had been exempted from a tolerance,[67,68] meaning that any level of these ingredients was legal on food. Interestingly, 5 of these organofluorine inerts were not in any US-registered pesticide products, whereas 6 were present in 1–67 currently registered products (Table 3).[31] Information on which specific products contained these ingredients was considered "confidential business information" by the US EPA, so it was unclear whether these products were widely used or how they were used.

Canada's Pest Management Regulatory Agency (PMRA) has compiled a list of currently registered inerts (which it calls "formulants") and updates that public list every 6 months.[33] As of 1 October 2022, there were eight organofluorine inert ingredients registered in the country, with seven being PFAS (Table 3). These eight organofluorine inerts were present in anywhere from 1 to 20 Canadian pesticide products (N. Donley, personal communication) (Table 3).

Notably, one inert ingredient approved in both the United States and Canada for both food and nonfood use was the incredibly persistent polytetrafluoroethylene (PTFE), known by the brand name Teflon (Table 3 and Figure 2). Although chemical manufacturers and their consultants consider fluoropolymers like PTFE to be less toxic than their nonpolymeric PFAS counterparts,[69] other researchers have identified serious concerns with their production and use.[70] For instance, PTFE can often be contaminated with nonpolymeric PFAS—at concentrations in the parts-per-million range, well above human toxicity thresholds.[70] This, coupled with its extreme persistence and the inability to recover PTFE once it has been dispersed, makes its use particularly problematic.

During peer review of this manuscript, the US EPA revised the number of products it believes contain PTFE from the 14 it

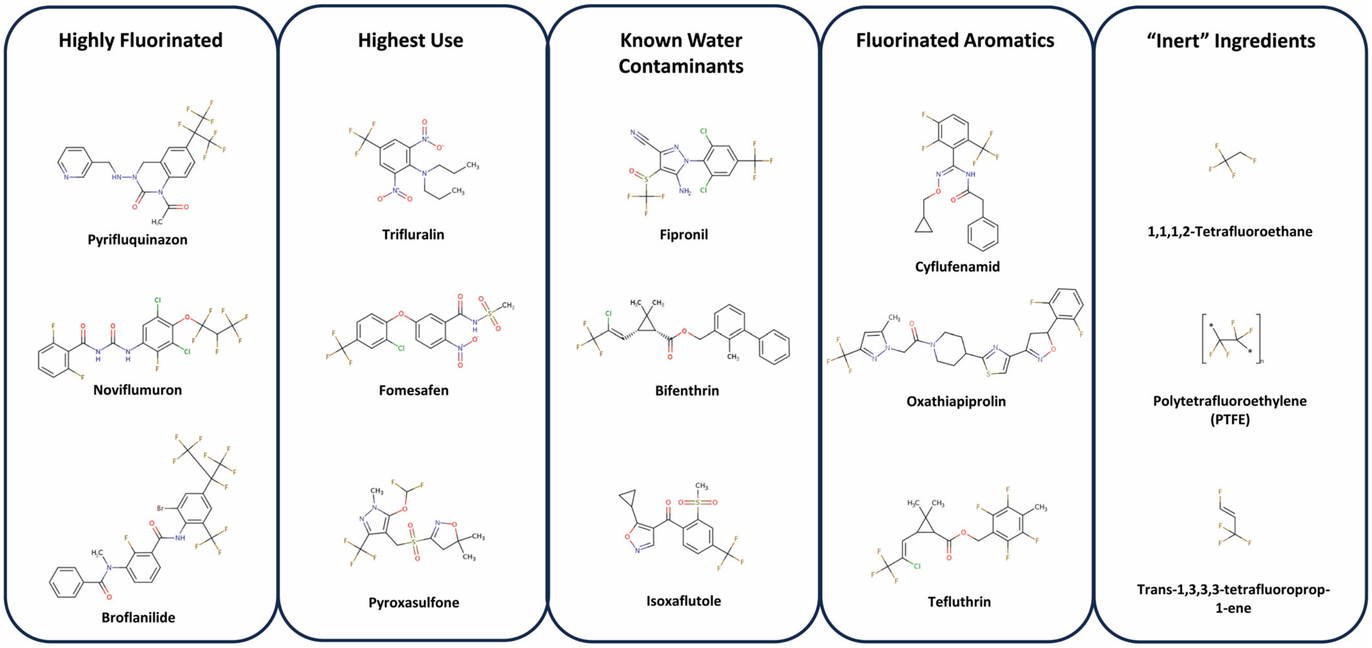

Figure 2. Examples of PFAS chemicals approved for use in US pesticide products. The "highly fluorinated" grouping is the approved PFAS active ingredients with the longest fluorinated chains. The "highest use" grouping is the approved PFAS active ingredients with the highest use by volume, as estimated by the US Geological Survey (Excel Table S6). The "known water contaminants" grouping is the approved PFAS active ingredients that have been widely reported in the literature and identified by government monitoring to be major water contaminants in the United States. The "fluorinated aromatics" grouping displays a few examples of the approved PFAS active ingredients that have fluorinated aromatic structures in addition to a $-CF_3$ moiety. The "'inert' ingredients" grouping displays the US- and Canada-approved inert ingredients that are present in the most pesticide products (Table 3). Structure images were obtained from US EPA's CompTox Chemicals Dashboard.[60,61] Note: EPA, Environmental Protection Agency; PFAS, per- and polyfluoroalkyl substances.

told us in our earlier public records request (Table 3) to zero and proposed to remove PTFE from its list of approved inert pesticide ingredients.[71] We believe this is good news for public health and hope the agency is successful in finalizing that action.

Adjuvants. The US federal government does not regulate adjuvants as pesticides.[9] If an adjuvant product is to be used on food crops, its ingredients may require a tolerance or exemption from a tolerance under the Federal Food, Drug and Cosmetic Act (FFDCA), but there is very little federal oversight.[72]

Some US states regulate adjuvant products. The most robust system is in California, which requires adjuvants to be registered as pesticides, submission of formulation information, and reporting of adjuvant use.[9,73] Adjuvants are widely used in California: Forty-one of the most widely applied 100 pesticide ingredients

Table 3. A list of organofluorine and PFAS inert ingredients approved in the United States and Canada and the number of registered products that contain them.

CAS No.	Ingredient name[a]	PFAS	Food use	Approved in the USA	Approved in Canada	Products in the USA (*n*)	Products in Canada (*n*)
75-37-6	1,1-Difluoroethane	N	Y	Y	Y	67	3
811-97-2	1,1,1,2-Tetrafluoroethane	Y	Y	Y	Y	37	15
9002-84-0	Polytetrafluoroethylene (PTFE; Teflon)	Y	Y	Y	Y	14[b]	2
29118-24-9	*trans*-1,3,3,3-Tetrafluoroprop-1-ene	Y	Y	Y	Y	3	20
188027-78-3	5H-1,3-Dioxolo[4,5-f]benzimidazole, 6-chloro-5-[(3,5-dimethyl-4-isoxazolyl)sulfonyl]-2,2-difluoro	Y	N	Y	N	0	NA
24937-79-9	Ethene, 1,1-difluoro-, homopolymer	N	N	Y	N	0	NA
42557-13-1	Poly(oxy(methyl(3,3,3-trifluoropropyl)silylene)), alpha-(trimethylsilyl)-omega((trimethylsilyl)oxy)-	Y	N	Y	N	0	NA
593-70-4	Fluorochloromethane	N	N	Y	N	3	NA
63148-56-1	Siloxanes and silicones, Me 3,3,3-trifluoropropyl	Y	N	Y	N	1	NA
67786-14-5	2-Naphthalenesulfonic acid, 6-amino-4-hydroxy-5-{{2-(trifluoromethyl)phenyl}azo}-, monosodium salt	Y	N	Y	N	0	NA
88795-12-4	1-Butanol, 4-(ethenyloxy)-, polymer with chlorotrifluoroethene, (ethenyloxy)cyclohexane, and ethoxyethene	Y	N	Y	N	0	NA
98-56-6	Parachlorobenzotrifluoride	Y	INO	N	Y	NA	1
65530-85-0	Alpha-(cyclohexylmethyl)- omega-hydro-poly (difluoromethylene)	Y	INO	N	Y	NA	1
131324-06-6	PTFE, alpha-chloro-omega-(1-chloro-1-fluoroethyl)-	Y	INO	N	Y	NA	1
163440-89-9	PTFE, alpha-hydro-omega-(2,2-dichloro-2-fluoroethyl)-	Y	INO	N	Y	NA	1

Note: CAS, Chemical Abstracts Service; INO, information could not be obtained; Me, methyl; N, no; NA, not applicable; PFAS, per- and polyfluoroalkyl substances; Y, yes.
[a]Data in this table were obtained through database searches, personal communications, and public records requests.[31–33]
[b]After formally responding that 14 products contained PTFE, the US EPA has since publicly stated that zero products contain PTFE and has proposed to remove it from the list of approved inert ingredients in the United States.

are adjuvant ingredients.[74] The high use of these ingredients indicates that they may be a source of PFAS contamination in the environment.

The only sources of information on adjuvant ingredients we found came from the agrochemical industry and the few state-level agencies in the United States that regulate them. The industry views this information as proprietary, so publicly available information is scant. TELUS, a producer of agricultural industry software, maintained a label database[34] that at our date of search encompassed 1,343 adjuvant products. An advanced search for "adjuvant" products containing active ingredients with the term "fluoro" returned zero results. However, it was unclear whether all ingredients were disclosed on this database and whether full chemical names were listed.

We also received public records from California and Washington State. An inquiry to the California Department of Pesticide Regulation (CDPR) asking whether any adjuvants contained fluorinated ingredients elicited the response that "there are no adjuvant products currently registered by DPR which contain fluorinated chemical ingredients."[35] In 2020, the Washington State Department of Agriculture developed a list of spray adjuvant ingredients that identified 313 ingredients in state-registered adjuvant products.[36] The Washington State Department of Agriculture requires only the top three ingredients in adjuvant products to be disclosed to the state,[75] and our search of this partial ingredient list identified no fluorinated ingredients.

Although we found no evidence to indicate that adjuvant products contained fluorinated ingredients or PFAS, our dataset was incomplete and regional, and we concluded that it does not provide strong evidence that no adjuvant ingredients are fluorinated. Rather, the lack of transparency and oversight of adjuvants meant that a robust dataset was not available.

Unintentional addition of PFAS. **Leaching from storage containers.** The practice of fluorinating polyethylene plastic containers to prevent permeability of aromatic chemicals started as early as 1958.[76] Today hundreds of millions of high density polyethylene (HDPE) containers that contain agricultural products, personal care products, household cleaning supplies, home improvement products, and food are fluorinated each year.[77] The most common method of fluorinating hydrocarbon-based plastics is post-mold fluorination,[78] where already molded containers are treated with fluorine gas under high temperature and pressure.

The goal of post-mold fluorination is to swap out the carbon–hydrogen bonds of the HDPE to carbon–fluorine bonds in a thin layer on the surface of the plastic to enhance its barrier properties. If there is any oxygen or water in the fluorination chamber, then the fluorination process will form perfluorinated structures.

In 2011, researchers discovered that a subset of PFAS, perfluorinated carboxylic acids (PFCAs), were formed during the direct post-mold fluorination of HDPE containers when trace amounts of oxygen were present.[77] Eight years later, Public Employees for Environmental Responsibility (PEER) discovered that the insecticide Anvil 10+10 contained perfluorooctanoic acid (PFOA) and hexafluoropropylene oxide dimer acid (HFPO-DA).[79] This finding spurred the US EPA to test the leaching potential of fluorinated HDPE containers that were used to store pesticides, and the agency identified eight PFCAs leaching from various containers—with total concentrations in the 10–60 ppb range.[80] The US EPA's findings that fluorinated HDPE containers leach PFCAs has been reproduced by other groups and is now a well-established contamination pathway for contents stored in these containers.[81] It is estimated that 20%–30% of all hard plastic containers used in the agricultural sector are fluorinated,[82] elevating concerns about widespread PFAS contamination.

Since PEER's initial testing of Anvil 10-10 found PFAS, many other groups have tested and found long- and short-chain PFAS in multiple pesticide products in a manner that is consistent with container leaching (Table 4). It should be noted that the results of this testing by different groups have produced conflicting results that appear to depend on the analytical methodology used and where the testing was conducted, affirming the difficulty of testing complex mixtures such as pesticide products for PFAS.

In late 2023, the US EPA used its authority under the Toxic Substances Control Act (TSCA) to prohibit the production of multiple PFAS in the container fluorination process.[83] Although we believe this strong action would have been an enormous benefit for public health, the US EPA's action was overturned by a federal appellate court, and it is unclear whether the agency will pursue further action under a different legal mechanism.[84]

Other potential sources. Although leaching of PFAS from fluorinated containers appears to be the primary contamination pathway of long- and short-chain PFAS into pesticide products, the testing that has been conducted to date indicates there are other sources of contamination. Multiple groups have found that some pesticides contain perfluorinated sulfonic acids (PFSAs) (Table 4). As mentioned above, container fluorination has only been demonstrated to generate PFCAs that are available for leaching.[80] Therefore, the presence of PFSAs in some products—none of which were approved active or inert ingredients (Table 3; Excel Table S1)—indicates that there are other sources of unintentional contamination.

A recent study on serum levels of long-chain PFAS found that both PFSAs and PFCAs were significantly higher in female Danish greenhouse workers compared with a female Danish urban population measured during the same time period.[85] The authors concluded that this disparity was likely due to differences in exposure to agricultural pesticide formulations and proposed that pesticides may be an important source of long- and short-chain PFAS exposure to agricultural workers.

More research is needed to examine other potential sources for introduction of long- and short-chain PFAS into pesticide products. It is possible that the solvents or other components used in the preparation of some pesticide products could unknowingly be contaminated with PFAS.

Manufacturing by-products and impurities are another potential source of PFAS in pesticides. US EPA regulations allow pesticide products to contain impurities as long as they are <1,000 ppm and not of "toxicological significance."[6] Toxicological significance is defined with regard to impurities that also happen to be known pesticides[86]; however, its meaning is not formally defined for other impurities. The US EPA views any concentration of an impurity meeting the agency's PFAS definition as toxicologically significant, requiring disclosure.[87] Yet it is unclear whether this reporting requirement is known among the industry or whether companies even know about PFAS impurities in their products, given that many pesticide products contain undisclosed PFAS ingredients (Table 4).[88]

Consequences of PFAS in Pesticides

In addition to documenting sources of PFAS in pesticide products, we sought to understand how PFAS in pesticide products could be impacting human and environmental health in the United States and beyond. Although a lot of knowledge gaps still exist, the available data are cause for concern. It is our view that PFAS in pesticides, particularly PFAS active ingredients, may be having unintended impacts on environmental and public health that must be mitigated or eliminated to prevent irreversible impacts. Below are examples of potential impacts we have identified.

Immunotoxicity. The immune system is highly vulnerable to exposure to chemical toxicants, particularly during development

Table 4. Compilation of studies analyzing long- and short-chain PFAS detections in pesticide products, estimated PFAS concentration found, where the products were tested, and the analytical methodology used.

Date	Product name	US EPA registration no.	PFAS found	Estimated concentration or range	Units	Samples tested (n)	Where tested	Analytical method used
27 August 2020[37]	Anvil 10-10	8329-62	Perfluorooctanoic acid (PFOA)	ND–250	ng/L	2	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
			Hexafluoropropylene oxide dimer acid (HFPO-DA)	410–500	ng/L			
15 September 2020[38]	Anvil 10-10	8329-62	ND	NA	NA	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
23 October 2020[39]	Anvil 10-10	8329-62	HFPO-DA	ND–260	ng/L	2	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
19 November 2020[43]	Anvil 10-10	8329-62	Perfluorobutanoic acid (PFBA)	52.8–716	ng/L	9	Alpha Analytical	Modified US EPA method 533
			Perfluoropentanoic acid (PFPeA)	35.2–296	ng/L			
			Perfluorohexanoic acid (PFHxA)	17.6–132	ng/L			
			Perfluoroheptanoic acid (PFHpA)	ND–53.4	ng/L			
			Perfluorohexanesulfonic acid (PFHxS)	ND–59.2	ng/L			
			1H,1H,2H,2HPerfluorooctanesulfonic acid (6:2FTS)	ND–31.6	ng/L			
			PFOA	ND–25.7	ng/L			
			Perfluoroheptanesulfonic acid (PFHpS)	ND–138	ng/L			
			Perfluorooctanesulfonic acid (PFOS)	ND–141	ng/L			
19 March 2021[40]	Permanone 30-30	432-1235	PFOA	3,500	ng/L	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
			HFPO-DA	630	ng/L			
13 May 2021[41]	Frontline Plus for dogs	65331-5	PFHxA	530	ng/L	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
			PFHpA	270	ng/L			
			PFHpS	390	ng/L			
			HFPO-DA	1,200	ng/L			
	Seresto Collar	11556-155	Perfluorododecanesulfonic acid (PFDoS)	0.25	ng/g	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
21 October 2021[44]	Permanone 30-30	432-1235	ND	NA	NA	6	US EPA–Fort Meade	Modified US EPA method 537.1 (oily matrix)
	PermaSease 30-30	53883-459-86291	ND	NA	NA	1	US EPA–Fort Meade	Modified US EPA method 537.1 (oily matrix)
28 March 2023[42]	Malathion 5EC	19713-217	PFOA	510	ng/L	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
			PFHpS	680	ng/L			
	Oberon 2SC	264-719	PFBA	1,500	ng/L	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
	Intrepid 2F	62719-442	Perfluorobutanesulfonic acid (PFBS)	350	ng/L	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
	Ultra-Pure Oil	69526-5-499	ND	NA	NA	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
	Avid 0.15 EC	100-896	ND	NA	NA	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
	Pedestal	53883-419-59807	ND	NA	NA	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
	Ortho Home Defense	239-2717	ND	NA	NA	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
	Triazicide granules	9688-250-8845	ND	NA	NA	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)
	Marathon 1% granular	59807-15	ND	NA	NA	1	Eurofins Lancaster	Modified US EPA method 537 (537 IDA)

Table 4. (*Continued.*)

Date	Product name	US EPA registration no.	PFAS found	Estimated concentration or range	Units	Samples tested (n)	Where tested	Analytical method used
18 May 2023[45]	AVID 0.15 EC	NP	ND	NA	NA	2	US EPA–Fort Meade	Two modifications of SW846 test method 8327
	Pedestal	NP	ND	NA	NA	2	US EPA–Fort Meade	Two modifications of SW846 test method 8327
	Ultra-Pure Oil	NP	ND	NA	NA	1	US EPA–Fort Meade	Two modifications of SW846 test method 8327
	Marathon 1%	NP	ND	NA	NA	2	US EPA–Fort Meade	Two modifications of SW846 test method 8327
	Oberon	NP	ND	NA	NA	2	US EPA–Fort Meade	Two modifications of SW846 test method 8327
	Malathion 5EC	NP	ND	NA	NA	1	US EPA–Fort Meade	Two modifications of SW846 test method 8327
	BotaniGard 22WP	NP	ND	NA	NA	1	US EPA–Fort Meade	Two modifications of SW846 test method 8327
	Overture 35WP	NP	ND	NA	NA	1	US EPA–Fort Meade	Two modifications of SW846 test method 8327
	Conserve	NP	ND	NA	NA	1	US EPA–Fort Meade	Two modifications of SW846 test method 8327
	XXpire	NP	ND	NA	NA	1	US EPA–Fort Meade	Two modifications of SW846 test method 8327

Note: EPA, Environmental Protection Agency; IDA, isotope dilution anion (exchange solid phase); NA, not applicable; ND, not detected; NP, not provided; PFAS, per- and polyfluoroalkyl substances.

and in older adults.[89] Long- and short-chain PFAS that have been extensively studied—such as PFOA, PFOS, and perfluorohexanesulfonic acid (PFHxS)—are known to harm the immune system, weaken the antibody response to vaccinations, and increase the risk of infectious disease.[90,91] Studies of impacts on the immune system indicate that it is one of the most sensitive targets of PFAS exposure,[23,92] and both the US EPA and the European Food Safety Authority (EFSA) have identified immunotoxicity as the most potent adverse effect to humans from exposure to certain PFAS.[90] Given the documented sensitivity of the immune system to PFAS exposure, and that immunotoxicity studies are commonly waived during pesticide registration reviews,[93] our analysis focused on this specific health end point. However, we note that with the myriad health effects linked to PFAS exposure, other health end points will likely be of additional interest with regard to fluorinated pesticides.

In 2007, following recommendations from the National Research Council and the US EPA's Science Advisory Panel,[94] the US EPA required all pesticide active ingredients to be subject to T cell–dependent antibody response testing—which the agency uses as a surrogate for immunotoxicity in general.[95] Six years after imposing this requirement, the pesticide industry requested that the US EPA conduct a retrospective analysis of the usefulness of the immunotoxicity assay in pesticide registration decisions.[96] In its 2012 analysis, the US EPA found that, of a representative sample of 155 pesticides that had immunotoxicity testing, the agency only considered 15 (10%) to be immunotoxic.[96] The US EPA's analysis further found that the 15 immunotoxicity findings did not influence the outcome of the pesticides' risk assessment. Following this analysis, the US EPA indicated that it would be receptive to waiving immunotoxicity studies for pesticide active ingredients.[96] Reflecting this position, between 2012 and 2018, the US EPA granted 223 of 229 waiver requests (97%) for immunotoxicity testing of pesticide active ingredients.[93]

However, lost in the US EPA's retrospective analysis, conducted before much of the public or regulatory awareness of the health risks of PFAS, was the fact that 7 of the 15 immunotoxic active ingredients (47%) were organofluorines and 6 of 15 (40%) were PFAS.[96] That compares with 20% and 13% of conventional pesticide active ingredients that were respectively organofluorines or PFAS as of 2012 (Excel Table S3). Immunotoxic effects have also been reported in the peer-reviewed literature for several fluorinated pesticides, including bifenthrin, fipronil, flupyradifurone, and flonicamid.[10]

Troublingly, the number of active ingredients that are fluorinated or that meet the definition of PFAS has increased considerably from 2012 to the present (Figure 1)—the very time period that the US EPA granted 97% of waiver requests for immunotoxicity study requirements.[93] This suggests that fluorinated or PFAS active ingredients may be more likely to be immunotoxic than other types of active ingredients and that any associated immunotoxicity may not be accounted for owing to the lack of requirement for scientific study.

Environmental fate. All PFAS contain perfluoroalkyl moieties that are highly stable in the environment.[16] Even a single $-CF_3$ or a difluoromethylene ($-CF_2$) moiety in a pesticide active ingredient can resist degradation under highly stringent conditions.[97] This all but assures that most PFAS molecules will persist in the environment in perpetuity or break down into a degradate that will similarly persist in perpetuity.[16]

This makes it particularly important to fully understand the metabolic life cycle of fluorinated pesticides *in vivo* and in the environment. For example, highly persistent, fluorinated degradates of the PFAS pesticide fipronil are often found at much higher concentrations in human serum, plasma, and urine[98–100] and are widespread in the environment.[101,102] These fluorinated degradates are also more persistent[103] and more toxic to a wide range of taxa, including mammals, than the parent pesticide ingredient.[100,104,105] Therefore, a faithful accounting of the pesticide degradates that form within organisms and in the broader environment is essential for proper risk evaluation, particularly for degradates that are highly persistent.

In assessing risk to humans and the environment from the use of a pesticide, the US EPA will estimate exposure to the parent active ingredient and some of its degradates. Which degradates to analyze in the risk assessment is determined via multiple degradation studies—often hydrolysis and photodegradation studies to understand abiotic breakdown and biotic metabolism studies in the terrestrial and aquatic environment.[106] According to US EPA guidelines, the suggested duration of these degradation experiments range from 5 to 30 d for the abiotic degradation studies[107,108] and 100 to 120 d for the biotic metabolism studies.[109,110]

Analyzing the degradation of a chemical over the span of 1–4 months gives the risk assessor an incomplete picture of chemical transformations that happen months or years later. For persistent pesticides and those with persistent degradates, there can be significant uncertainty around what the intermediate and terminal degradates are and how long it takes for terminal degradates to form.[111,112] Current test guidelines were not designed with highly persistent substances in mind, and test duration is specifically cited as one way that limits our understanding of how chemical metabolism proceeds from the parent molecule to its terminal degradates.[113,114]

Even known highly persistent degradates are sometimes omitted from US EPA risk assessments of active and inert pesticide ingredients. The US EPA will often identify which degradates are of toxicological concern either by assessing the acute toxicity of the degradate(s) or conducting a quantitative structure activity relationship to predict toxicity to certain taxa.[115] However, this practice can end up essentially ignoring the release of highly persistent chemicals into the environment. For example, with the PFAS active ingredient sulfoxaflor, the US EPA found that highly persistent fluorinated degradates were expected to contaminate ground and surface water; however, it concluded that the only chemical relevant to assessing ecological risk was the parent molecule because the other degradates were less acutely toxic to aquatic organisms.[116] Similarly, the US EPA conducted a quantitative structure activity relationship for the fluorinated degradates of the PFAS active ingredient bicyclopyrone and determined that the only chemical of ecotoxicological concern was the parent molecule.[117]

The persistence and toxicity of degradates are rarely, if ever, accounted for in the approval of fluorinated "inert" ingredients. A public records request for the degradate/metabolite studies reviewed by the US EPA to support the approval or continued approval of five PFAS inert ingredients [Chemical Abstracts Service (CAS) numbers 42557-13-1, 9002-84-0, 63148-56-1, 67786-14-5, and 188027-78-3] returned no relevant records.[118]

We believe that basing the ecotoxicological relevance of a highly persistent degradate on a limited number of acute toxicity studies or the presence/absence of an active structural site is likely to miss key risks. Pesticide degradates are widespread in the environment[119] and, in many cases, are found in concentrations higher than the parent molecule.[120] There can be serious consequences if the uncertainty involved in a pesticide approval decision ultimately leads to an underestimation of risk coming from pesticide degradates. The generation of fluorinated degradates that have half-lives in the decades or centuries means that any release into the environment will likely be irreversible and will be of ongoing concern if those degradates are found to be more toxic than previously thought. This has led some researchers to propose introducing new regulatory hazard categories that accurately reflect relative persistence of a chemical and its degradates and that high persistence alone should be a basis for regulation irrespective of the toxicities that have thus far been identified.[121,122]

Water contamination. Although most PFAS active ingredients (Table 2) have not been monitored for their presence in the environment across the United States, some older PFAS active ingredients have been actively monitored and found throughout the country. Bifenthrin and fipronil, first approved in 1985 and 1996, respectively, are among the most widely detected pesticides in US streams, lakes, and rivers, and both are often found at levels that exceed aquatic safety thresholds.[101,123–125] In beeswax samples taken from commercial beehives in multiple US states, 98% contained the 1980s-era PFAS pesticide fluvalinate.[126] The older PFAS pesticides isoxaflutole and penoxsulam, and their fluorinated degradates, have been detected in groundwater near sites where they are used.[127,128] Despite making up only 1% of the total applied mass of pesticides that are found in California waters, the PFAS pesticides cyhalothrin and bifenthrin account for 90% of the applied toxicity to aquatic life, indicating they are likely having an outsized impact on aquatic health.[129]

To look more generally at the environmental presence of PFAS active ingredients, we compiled and analyzed USGS data that tested for the presence of a wide variety of pesticides in nearly 500 streams across five regions of the United States between 2013 and 2017 (see the "Methods" section for details).[46] Of the 225 pesticide compounds tested in water samples, 13 were PFAS active ingredients and 16 were their fluorinated degradates (29 total PFAS analytes). Of those tested, 27 PFAS analytes (93%) from 12 PFAS active ingredients were found in US streams (Table 5). Fipronil and isoxaflutole were most prevalent, whereas isoxaflutole and trifloxystrobin were found in the highest concentrations. Only 1 of the 13 tested PFAS active ingredients had >453,000 kg of annual use in US agriculture during the tested time period and many had <45,300 kg of annual use,[130] indicating that these are not highly used active ingredients relative to many others used in agriculture. This suggests that the prevalence of these fluorinated pesticides and degradates in waterways cannot be explained by high agricultural use alone.

Only 13 PFAS active ingredients—of 66 conventional active ingredients that are currently registered (Table 2)—have been actively tracked in surface water across the United States in recent years, and 12 have been found (Table 5). Nearly all of these 13 tested PFAS active ingredients have been registered for >20 y (Excel Table S3), suggesting that the increase in fluorinated pesticide approvals in recent years (Figure 1) is having unknown consequences with regard to water quality. Because of this, we believe that in-depth, targeted monitoring studies of all PFAS pesticides and their fluorinated degradates in the United States is critical.

Total organic fluorine in the environment. Increasing scrutiny of PFAS contamination of drinking water, and sources for drinking water, has led to increasing research on organic fluorine compounds in the environment and biota. Analytical measurements of PFAS have typically been limited to targeted testing for a few dozen PFAS chemicals. Studies that have done targeted PFAS testing in conjunction with total organic fluorine measurements have found that targeted testing is capturing only a small portion of the total organofluorine load in the environment and biota.[131] Not only have many studies found that levels of total organic fluorine are increasing, but the fraction of samples attributed to unknown organofluorine chemicals is often high and has also been increasing in recent years.[131–133]

Table 5. PFAS analytes tested in US surface waters by the USGS between 2013 and 2017, how often they were detected, and the maximum concentration identified.

Active ingredient[a]	Fluorinated analyte	Detections (n)[b]	Max conc (ng/L)
Bifenthrin	Bifenthrin	10	10.7
	cis-Cyhalothric acid[c]	17	961.4
Fipronil	Fipronil	847	61.8
	Desulfinylfipronil	342	10.6
	Fipronil sulfide	441	10.6
	Fipronil sulfone	754	18.1
	Dechlorofipronil	0	—
	Desulfinylfipronil amide	29	14.0
	Fipronil amide	762	84.1
	Fipronil sulfonate	8	72.5
Flubendiamide[d]	Flubendiamide	79	148.9
	Deiodo flubendiamide	2	4.9
Fluometuron	Fluometuron	8	229.5
	Hydroxy mono demethyl fluometuron	2	6.4
	4-Hydroxy-*tert*-fluometuron	1	7.4
	Hydroxyfluometuron	1	3.9
	Demethyl fluometuron	5	5.1
Indoxacarb	Indoxacarb	1	3.4
Isoxaflutole	Isoxaflutole	11	660.1
	Isoxaflutole acid RPA 203328	271	928.4
	Diketonitrile isoxaflutole	496	2,134.90
Lactofen	Lactofen	0	—
Norflurazon	Norflurazon	111	318.6
	Demethyl norflurazon	137	541.8
Novaluron	Novaluron	2	14.5
Oxyfluorfen	Oxyfluorfen	4	70.4
Prosulfuron	Prosulfuron	3	9.5
Tetraconazole	Tetraconazole	56	62.0
Trifloxystrobin	Trifloxystrobin	151	3,670.80

Note: —, not applicable; max conc, maximum concentration detected; PFAS, per- and polyfluoroalkyl substances; USGS, United States Geological Survey.
[a]Data in this table were obtained from the USGS.[46]
[b]The USGS sampled 482 streams between 4 and 12 times each during the 6-to 14-wk study period. Number of detections denotes the number of times the analyte was detected in a sampling event.
[c]Also a metabolic product of lambda-cyhalothrin and tefluthrin, two PFAS active ingredients that were not monitored by the USGS.
[d]Flubendiamide was canceled in the United States in 2016 and is not currently registered.

This indicates that new or unidentified PFAS are increasingly contributing to the overall organofluorine exposure to people and the environment. Increasingly, this unknown total organic fluorine fraction is thought to be coming from short- and ultrashort-chain PFAS,[134–136] which we have defined as respectively containing 4–5 and ≤3 fully fluorinated carbon atoms. Short- and ultrashort-chain PFAS are also generally more difficult to remove from contaminated water sources by commonly used filtration methods, making any resulting contamination potentially more difficult to rectify.[137,138] Importantly, the presence of ultrashort-chain PFAS in the environment does not correlate well with the presence of long- and short-chain PFAS, indicating that ultrashort-chain PFAS are coming from different sources.[135,139]

Given that most of the PFAS active pesticide ingredients in the United States contain a $-CF_3$ moiety, it is possible that many of these active ingredients will eventually break down into ultrashort-chain PFAS as their terminal fluorinated degradates. One such degradate is trifluoroacetic acid (TFA), a highly persistent and mobile chemical that is a known water[135,139] and food[140] contaminant and has been detected in several wildlife species.[141,142] A study of Norwegian wildlife found TFA to be a major contributor to total organic fluorine levels in animals.[141] TFA is abundant in human serum and urine samples,[143,144] and exposure to people is thought to occur primarily via contaminated drinking water and indoor household dust.[144]

TFA is a known metabolic by-product of some fluorinated pesticides,[24,97] and TFA levels in waterways and food even correlate strongly with pesticide use.[140,145] Organically grown food has also been found to have lower levels of TFA than food grown with synthetic pesticides.[140] A study by the German Environment Agency found that, when considering the 28 pesticide active ingredients approved in Germany that have a $-CF_3$ group (and could potentially metabolize into TFA), up to 500 metric tons of TFA pollution could be generated annually in the country just from pesticide degradation.[146]

With 66 PFAS active ingredients approved in the United States—and the United States having much higher pesticide use than all countries in the European Union combined[147]—the potential TFA pollution in the United States coming from pesticides is likely significantly greater than that of Germany. The USGS estimates that anywhere from 10.4 to 15.9 million kg of PFAS active ingredients are used across the United States each year (Excel Table S6)[47]—the vast majority of which contain at least one $-CF_3$ group and could potentially metabolize into TFA or other persistent, fluorinated water contaminants. Given the annual volume of use, pesticide active ingredients have the potential to contribute significantly to the presence of ultrashort-chain PFAS and, by extension, the total organic fluorine load in the environment and biota.

Regulatory Recommendations

- Based on ample research and scientific testing, we believe that post-mold fluorination of plastic containers cannot be done without producing harmful PFAS that are available for leaching. This practice should be discontinued and substituted with other options, such as barrier methods for plastic that do not use fluorine, and possibly in-mold fluorination if it is found not to produce PFAS.
- The United States and other countries must require that all pesticide ingredients, including inerts, and their relative proportions be disclosed on pesticide labels and material safety data sheets. The American Medical Association made this same suggestion nearly 30 y ago in an effort to protect the public, to no avail.[148] It is our view that the pesticide industry should not be allowed to hide behind spurious claims of confidentiality at the expense of the public's knowledge of the potentially harmful chemicals in widely available products.
- Immunotoxicity studies should no longer be waived for fluorinated active ingredients or inerts, and the US EPA should issue a data call-in for any pesticide ingredients that do not have the necessary testing in place.
- All PFAS pesticides, and all intermediate and terminal degradates, must be fully evaluated for environmental persistence, and the most persistent ones, such as broflanilide, should be mitigated heavily and targeted for replacement with nonchemical or less persistent alternatives. This can be modeled after a P-sufficient framework[121] to prevent potential devastating consequences of releasing highly persistent chemicals with no means for recovery.
- The US federal government must expand environmental monitoring and biomonitoring programs to include all PFAS pesticides to gather timely data on their bioaccumulation and their potential impact on human and ecosystem health.
- Once it identifies all terminal and intermediate degradates from PFAS pesticides, the US EPA must assess the cumulative impacts from fluorinated degradates that are common to multiple active ingredients, such as TFA. The US EPA must also assess how the cumulative use of all fluorinated pesticides can impact the total organic fluorine load in the environment and food.

Conclusions

Pesticide products increasingly contain fluorinated ingredients, and this is happening via multiple pathways. A major contributor of long- and short-chain PFAS (>3 fully fluorinated carbon atoms) into pesticide products was through leaching of PFAS from fluorinated containers (Table 4). The polymer PTFE is also an approved inert ingredient in the United States and Canada, but its use currently appears to be limited to about a dozen products (Table 3). The available data also pointed to unknown sources of long- and short-chain PFAS contamination in pesticide products, which have yet to be identified (Table 4).

The biggest contributor of ultrashort-chain PFAS (≤3 fully fluorinated carbon atoms) in pesticide products was active ingredients and their degradates (Table 2). Although 23% of US conventional pesticide active ingredients were organofluorines and 14% were PFAS, those percentages jumped to 61% organofluorines and 30% PFAS when looking just at active ingredients approved in the past 10 y (Figure 1). In our review of US EPA risk assessment documents, these PFAS active ingredients are either extremely persistent themselves or break down into intermediate or terminal degradates that are extremely persistent. The majority of PFAS active ingredients contained a single $-CF_3$ moiety and the few that had been monitored are known to pollute waterways across the United States (Table 5; Excel Tables S4 and S5).

We believe these data indicate that some pesticide products contain complex mixtures of ultrashort-chain to long-chain PFAS that are present in parts-per-billion concentrations for some of the long- and short-chain PFAS and up to parts-per-hundred concentrations for some of the ultrashort-chain PFAS active ingredients. The long-term impacts of using mixtures of extremely persistent chemicals on potentially hundreds of millions of acres of US land every year is, to us, a cause for concern. Most, if not all, PFAS in pesticide products or their degradates are going to be chronic persistent pollutants[16] for the foreseeable future of humanity, and their ultimate impact on human and environmental health are largely unknown. Here we have identified steps the US government can take to mitigate potential impacts of fluorinated components in pesticides with the ultimate goal of eliminating or reducing their use altogether.

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Pesticide Update

EPA's Office of Chemical Safety and Pollution Prevention

EPA Announces Voluntary Cancellation for the Pesticide Dacthal

Contact: EPA Press Office (press@epa.gov)

WASHINGTON – Today, Aug. 28, following the U.S. Environmental Protection Agency's emergency suspension of the pesticide dimethyl tetrachloroterephthalate (DCPA or Dacthal), the agency is initiating a process to cancel all products containing DCPA. On Aug. 19, 2024, EPA received a letter from AMVAC Chemical Corporation (AMVAC) stating its intent to voluntarily cancel the remaining pesticide products containing DCPA in the United States, and subsequently announced it intended to cancel all international registrations as well.

"Today's announcement is a critical step towards protecting unborn babies from the serious health risks of this dangerous pesticide," **said Assistant Administrator for the Office of Chemical Safety and Pollution Prevention Michal Freedhoff**. "AMVAC's decision to voluntarily and quickly cancel their DCPA registrations is a huge win for public health and will ensure pregnant women are no longer exposed to a chemical that could cause their babies to experience irreversible lifelong health problems."

The August 2024 emergency suspension was the first time in almost 40 years EPA has taken this type of emergency action, following several years of efforts by the agency to require the submission of data that was due in January 2016 and then assess and address the risk this pesticide poses. EPA took this action because unborn babies whose pregnant mothers are exposed to DCPA, sometimes without even knowing the exposure has occurred, could experience changes to fetal thyroid hormone levels, and these changes are generally linked to low birth weight, impaired brain development, decreased IQ and impaired motor skills later in life, some of which may be irreversible. For this decision, EPA relied on the best available science, which included robust studies that all demonstrate thyroid toxicity.

A registrant can cancel the registration of a pesticide product at any time under Section 6(f) of the Federal Insecticide, Fungicide, and Rodenticide Act. Tomorrow, Aug. 29, 2024, EPA will publish a notice in the Federal Register to take public comments on the voluntary cancellation. At the conclusion of the comment period, EPA plans to publish the final cancellation order. Currently, all products containing DCPA are suspended following EPA's temporary emergency suspension order announced on Aug. 6, 2024, and the action announced today will ensure that the registrations will be permanently cancelled.

The emergency suspension prohibits anyone from distributing, selling, shipping or carrying out other similar activities for any pesticide product containing DCPA. It also means that no person can continue using existing stocks of those products. EPA is working closely with AMVAC, the sole manufacturer of DCPA, on a return program for existing DCPA products. AMVAC is developing a comprehensive plan designed to identify existing stocks held by distributors, retailers, and end-users, track any remaining DCPA products, and coordinate an effective and efficient collection process. EPA and AMVAC are regularly communicating on the status of the return program. AMVAC has shared preliminary information on a return program with EPA, including plans for regular communication with stakeholders and EPA. Distributors, retailers, and growers who hold existing product should contact AMVAC directly to determine the best options for managing existing stocks.

Read the public inspection version of the Federal Register notice on the voluntary cancellation of DCPA.

For answers to frequently asked questions about DCPA, please see the DCPA Questions and Answers webpage. For additional background on the DCPA and Biden-Harris Administration efforts to assess and address risks, see the Aug. 6, 2024, press release.