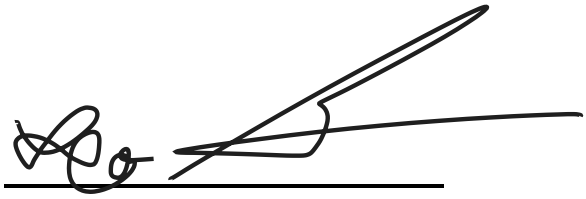
Memorandum Supporting Final Decision to Approve Registration for the New Active Ingredient Isomer, Glufosinate-P

Approved by: 

for Ed Messina, Esq., Director
Office of Pesticide Programs

US Environmental Protection Agency

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I. INTRODUCTION

This memorandum presents the rationale to support the decision of the U.S. Environmental Protection Agency (referred hereafter as EPA or the Agency) to register under 3(c)(5) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), glufosinate-P as new active ingredient (ai), for use on both conventional and glufosinate-resistant varieties of canola, field corn, sweet corn, cotton, and soybean.

Glufosinate-P ((2S)-2-amino-4-(hydroxymethylphosphinyl) butanoic acid; CAS number 35597-44-5) is the enantiomerically-enriched isomer (enantiomer[1]) of glufosinate (2-amino-4-(hydroxymethylphosphinyl) butanoic acid; CAS number 51276-47-2). Glufosinate is currently registered as a pesticide (herbicide) in the United States. Glufosinate (also referred as racemic glufosinate or D/L glufosinate) is comprised of D- and L-stereoisomers. The L-isomer (glufosinate-P) is the herbicidally active part of D/L-glufosinate whereas the D-isomer is not herbicidally active. Glufosinate-P and glufosinate are both broad-spectrum herbicides which act as inhibitors of glutamine synthetase, leading to poisoning of the plant by build-up of excess ammonia and direct inhibition of photosynthesis.

Two forms of glufosinate-P are being registered: glufosinate-P ((*2S*)-2-amino-4-[hydroxy(methyl)phosphoryl] butanoic acid; PC Code 128812) and glufosinate-P ammonium (azanium (*2S*)-2-amino-4-[hydroxy(methyl)phosphoryl] butanoate; PC Code 128300). Glufosinate-P is the acid form and Glufosinate-P-ammonium is the ammonium salt of glufosinate-P and shares all the herbicidal properties for glufosinate-P. In solution at environmentally relevant pH values (pH 5-9), glufosinate-P ammonium and glufosinate-P exist as glufosinate-P. Thus, the Agency considers glufosinate-P ammonium and glufosinate-P as functionally equivalent and glufosinate-P to be the active ingredient for both forms under typical environmental conditions.

Both compounds are enantiomerically enriched forms of the currently registered racemic glufosinate, which is a 50:50 mixture of D and L enantiomers (PC Code 128850). The term "L-glufosinate" in this document refers to both glufosinate-P ammonium and glufosinate-P. The terms "racemic glufosinate" or "racemic glufosinate ammonium" are also used in this document and refer to the racemic mixture. Any subsequent reference to "glufosinate" only (not containing "L" or "P") applies more generically to both racemic glufosinate and L-glufosinate active ingredient (ai) unless otherwise specified. This is also consistent with the International Organization for Standardization (ISO) recognized nomenclature.

The Weed Science Society of America classifies these compounds as glutamine synthetase inhibitor (Group 10) herbicides. Glufosinate- P and glufosinate both have high benefits to users as a nonselective postemergence contact herbicide.

The Agency received applications from BASF Corporation (referred hereafter as BASF) and MITSUI Chemicals Crop & Life Solutions, INC. (referred hereafter as MITSUI) to register L-glufosinate products. The first applicant, BASF, requested the registration of L-glufosinate-ammonium to be formulated into four products. BASF's application included two technical

[1] Enantiomerically enriched compounds are chiral compounds whose enantiomeric ratio is greater than 50:50 but less than 100:0 (IUPAC Compendium of Technology, 2006).

products: BASF L-Glufosinate Ammonium Technical (77.62% glufosinate-P-ammonium) and L-Glufosinate-ammonium Technical Product (89.6% glufosinate-P-ammonium); one manufacturing use product: L-Glufosinate-Ammonium Manufacturing-Use Product (50% glufosinate-P-ammonium); and one end-use product: BASF L-Glufosinate-Ammonium 211 (18.7% glufosinate-P-ammonium). The second applicant, MITSUI, requested the registration of L-glufosinate free acid to be formulated into two products. MITSUI's application included one technical product: L-Glufosinate Free Acid (92.3% glufosinate-P) and, one end-use product: L-Glufosinate Liquid Formulation (10.26% glufosinate-P).

All glufosinate-P end-use products are soluble liquid (SL) formulations applied as a foliar spray for the control of broadleaf and grassy weeds. End-use products are registered for use as a pre-plant burndown on both glufosinate-resistant and non-glufosinate-resistant varieties of canola, field corn, sweet corn, cotton, and soybean; postemergence application on glufosinate-resistant varieties of canola, field corn, sweet corn, cotton, soybean; and, as a postemergence application on non-glufosinate-resistant cotton when using a hooded sprayer.

II. REQUESTED ACTION

BASF Application

On February 25, 2020, the EPA received an application from AgriMetis, LLC to register one technical (EPA File Symbol 93778–R) and three end-use products (EPA File Symbol 93778–E; EPA File Symbol 93778–G; and EPA File Symbol 93778–U) containing L-glufosinate ammonium (CAS number 73777-50-1) for use on the following crop groups: bushberry subgroup 13-07B, citrus fruit group 10-10, pome fruit group 11-10, stone fruit group 12-12, tree nut group 14-12; on the individual crop commodities banana, sugar beet, canola, field corn, sweet corn, cotton, grape, juneberry, lingonberry, olive, potato, salal and soybean; as well as non-crop areas including industrial and residential outdoor areas. Under FIFRA section 3(c)(4), EPA is required to notify the public when a request for registering a new active ingredient is made and allow a 30-day comment period. The EPA published a notice of receipt on September 24, 2020, in the Federal Register for an application requesting the registration of L-glufosinate ammonium. The public comment period closed on October 26, 2020, with one comment received on the notice of receipt. The comment can be found in docket ID EPA-HQ-OPP-2020-0250 at www.regulations.gov. For more information on the public comments refer to Section V: Public Comments. A tolerance petition was not filed for L-glufosinate ammonium since AgriMetis LLC considered the existing tolerances set for racemic glufosinate in 40 CFR Part 180.473 adequate for the uses of L-glufosinate ammonium.

On September 3, 2020, BASF acquired all applications under the pending L-glufosinate ammonium registration action from AgriMetis, LLC. EPA assigned new file symbols (*i.e.*, 7969-UTL, 7969-UTA, 7969-UTT, and 7969-UTI) to the acquired pending products under BASF. Later, on May 18, 2022, the Agency received a second application from BASF to register additional L-glufosinate ammonium products which included one technical (EPA File Symbol 7969-UOI), one manufacturing use (EPA File Symbol 7969-UOO) and an end-use product (EPA File Symbol 7969-LNN).

On December 9, 2022, BASF informed the Agency that they wished to voluntarily withdraw some of the initially requested uses leaving only canola, field corn, sweet corn, cotton, and

soybean for the pending L-glufosinate ammonium registration. Subsequently on March 24, 2023, EPA announced, pursuant to Federal Food, Drug, and Cosmetic Act (FFDCA) section 408(d)(3), 21. U.S.C. 346a(d)(3), the filing of a pesticide petition by BASF requesting the establishment of tolerance regulations for residues of L-glufosinate ammonium in canola, field corn, sweet corn, cotton, and soybean. The public comment period closed on April 23, 2023, with no comments received on the notice of filing.

On September 9, 2023, BASF voluntarily withdrew the three applications for end-use products (7969-UTA, 7969-UTT, and 7969-UTI) submitted as part of initial submission on February 25, 2020.

On November 28, 2023, EPA published a second notice of receipt in the Federal Register for the application requesting the registration of the additional L-glufosinate ammonium products from BASF (EPA File Symbol 7969-UOI, EPA File Symbol 7969-UOO, and EPA File Symbol 7969-LNN) for use on canola, field corn, sweet corn, cotton, and soybean. The public comment period closed on December 28, 2023, and no comments relevant to this chemical were received on the notice of receipt.

MITSUI Application

On May 26, 2020, EPA received an application from Meiji Seika Pharma Co., Ltd. (now MITSUI) to register one technical (EPA File Symbol 94609-R (now 86203-GG)) and one end-use product (EPA File Symbol 94609-E (now 86203-GE)) containing L-glufosinate free acid (CAS number 35597-44-5) for use on the following crops: apple, sugar beet, bushberry subgroup 13B, canola, field corn, sweet corn, cotton, citrus fruit crop group 10–10, pome fruit crop group 11–10, stone fruit crop group 12–12, grape, tree nut crop group 14–12, olive, potato, and soybean. The EPA published a notice of receipt on February 8, 2021, in the Federal Register for an application requesting the registration of L-glufosinate free acid. The public comment period closed on April 9, 2021, with one comment received on the notice of receipt. For more information on the public comment refer to Section V: Public Comments.

On November 21, 2023, EPA announced, pursuant to Federal Food, Drug, and Cosmetic Act (FFDCA) section 408(d)(3), 21 U.S.C. 346a(d)(3), the filing of a pesticide petition by Meiji Seika Pharma CO., Ltd. (now MITSUI), requesting the establishment of tolerance regulations for residues of L-glufosinate free acid in apple, sugar beet, bushberry subgroup 13B, canola, field corn, sweet corn, cotton, citrus fruit crop group 10–10, pome fruit crop group 11–10, stone fruit crop group 12–12, grape, tree nut crop group 14–12, olive, potato, and soybean. The public comment period closed on December 21, 2023, with one comment received on the notice of filing. The comment can be found in docket ID EPA-HQ-OPP-2020-0533 at www.regulations.gov.

On September 18, 2023, MITSUI informed the Agency that they wished to voluntarily withdraw some of the initially requested crop uses leaving only the conventional and glufosinate-resistant varieties of canola, field corn, sweet corn, cotton, and soybean for the pending L-glufosinate free acid registration.

III. USE PROFILE

Table 1 outlines the uses for glufosinate-P. The end-use products are soluble liquid (SL) formulations which will be applied as a foliar spray to control broadleaf and grassy weeds. Depending on the use site, maximum single application rates range from 0.18 to 0.36 pound acid equivalent per acre (lb ae/A) and maximum number of applications range from 1 to 3 per year. The minimum re-treatment interval ranges from 5 to 10 days, and the pre-harvest intervals for applicable use sites/patterns range from 50 to 70 days.

Table 1. Summary of Directions for Use of Glufosinate-P as Soluble Liquid (SL) Formulations using Aerial/Ground boom Applications.					
App. Type	**Max. Single Use Applic. Rate[a] (lb ae/A)**	**Max. No. Applic. per Year**	**Max. Yearly Applic. Rate (lb ae/A)**	**PHI (days)**	**Use Directions and Limitations[b]**
Canola[c]					
Pre-plant burndown	0.36	1	0.73	Not Applicable	• Do not apply more than 3 applications including burndown per year. • Do not apply more than 2 in-season application to glufosinate- resistant canola per year. • Do not apply more than 1 preplant burndown application per year. • Do not apply this product through any type of irrigation system. • Apply at a minimum 15 gallons per acre. • Do not allow a retreatment interval of less than 7 days for in-crop use. • Do not use on glufosinate-resistant canola in the states of AL, DE, GA, KY, MD, NJ, NC, SC, TN, VA, WV. • Do not use in Hawaii and Puerto Rico except for use on glufosinate-resistant canola for Seed Propagation.
In-season application	0.24	2		65	
Seed propagation	0.24	3			
Field Corn[c]					
Pre-plant burndown	0.36	1	0.73	Not Applicable	• Do not apply more than 3 applications per year. • Do not apply more than 2 in-season applications per year to glufosinate resistant field corn. • Do not apply more than 1 preplant burndown application per year. • Do not apply this product through any type of irrigation system. • Must apply a minimum of 15 gallons per acre. • Do not reapply within 7 days of previous application.

Table 1. Summary of Directions for Use of Glufosinate-P as Soluble Liquid (SL) Formulations using Aerial/Ground boom Applications.					
App. Type	**Max. Single Use Applic. Rate[a] (lb ae/A)**	**Max. No. Applic. per Year**	**Max. Yearly Applic. Rate (lb ae/A)**	**PHI (days)**	**Use Directions and Limitations[b]**
In-season application	0.36	2	0.73	Corn forage - 60 days Corn grain and fodder - 70 days	• Do not use in HI, PR except for use on glufosinate-resistant field corn (Field and Silage) seed propagation. • In field corn seed propagation: o A hooded sprayer must be used to protect plants from coming into contact with the herbicide application. o Do not reapply within 10 days of previous application. o Do not use in CA.
Seed propagation	0.18	2	0.36		
Sweet Corn[c]					
Pre-plant burndown	0.36	1	0.36	Not Applicable	• If a pre-plant burndown application is made, do not apply an in-season application. • Do not apply more than 2 applications per year. • Do not apply this product through any type of irrigation system. • Apply at a minimum of 15 gallons per acre. • Do not reapply within 7 days of previous application. • Do not use in CA, HI, or PR.
In-season application	0.18	2		Corn ears - 50 days Stover - 55 days	

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App. Type	**Max. Single Use Applic. Rate[a] (lb ae/A)**	**Max. No. Applic. per Year**	**Max. Yearly Applic. Rate (lb ae/A)**	**PHI (days)**	**Use Directions and Limitations[b]**
Cotton					
Pre-plant/In-season Option 1					• Do not apply this product through any type of irrigation system. • Application to non glufosinate-resistant cotton varieties require the use of hooded spray equipment. • Apply a minimum of 15 gallons per acre. • Do not reapply within 10 days of previous application. • Do not apply more than 3 applications per year at reduced application rate. • Do not apply more than 1 pre-plant burndown application per acre per year. • Do not apply more than 1 postharvest fall burndown per acre per year. • Do not use in HI or PR except for test plots, breeding nurseries or seed propagation. • Do not use in FL south of Tampa.
Pre-plant burndown	0.36	1	0.60	70	
In-season application	0.24	1			
Pre-plant/In-season Option 2					
Pre-plant burndown	0.24	1	0.73	70	
In-season application	0.24	2			
Pre-plant/In-season Option 3					
Pre-plant burndown	None	--	--	--	
In-season application	0.24	3	0.73	70	
Other Application Types					
Postharvest Fall Burndown	0.36	1	0.36	Not Applicable	
Seed propagation	0.24	3	0.73	70	

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App. Type	**Max. Single Use Applic. Rate[a] (lb ae/A)**	**Max. No. Applic. per Year**	**Max. Yearly Applic. Rate (lb ae/A)**	**PHI (days)**	**Use Directions and Limitations[b]**
Soybean[c]					
Pre-plant burndown	0.36	1	0.36	Not Applicable	• Do not apply more than 3 applications per year. • Do not apply more than 1 pre-plant application per year. • Do not graze the treated crop or cut for hay. • Apply at a minimum of 15 gallons per acre. • Do not reapply within 5 days of previous application. • Do not use in HI, PR, for in field soybeans except for seed propagation.
In-season application	0.36	2	0.73	70	
Seed propagation	0.36	2		Not Specified	

PHI = pre-harvest interval.

[a] Rates converted to from lb ai/A to lb ae/A where applicable using a conversion factor of 0.91X (molar mass of L-glufosinate acid/molar mass of L-glufosinate ammonium).

[b] All products require applicators and handlers to wear a minimum of baseline clothing, defined as long-sleeved shirt and long pants, shoes, and socks, plus personal protective equipment (PPE) consisting of chemical-resistant gloves. The Glufosinate-P-ammonium labels also require protective eyewear for all applicators and handlers except ground boom applicators using open cabs to treat cotton; mixer/loaders supporting ground boom applications on corn, canola, soybean, & cotton. Mixer/loaders supporting aerial applications to corn, canola, soybean, and cotton must use closed mixing/loading systems.

[c] In-crop applications limited to glufosinate-resistant crops for canola, field corn, sweet corn, soybean.

IV. EVALUATION

In evaluating a pesticide registration application, the EPA assesses a wide variety of use information (*i.e.*, where and how the pesticide is used) and environmental-fate (*i.e.*, persistence and mobility of the chemical in the environment) and toxicity (*i.e.*, effects on humans and other non-target organisms) studies to determine the likelihood of adverse effects (*i.e.*, risk) from exposures associated with the use of the product. Risk assessments are developed to evaluate the environmental fate of the compound as well as how it might affect a wide range of non-target organisms including humans, terrestrial and aquatic wildlife (plants and animals). In addition, a biological and economic benefits assessment may be conducted. Based on these assessments, the EPA evaluates benefits versus risks and approves language for each pesticide label to ensure the directions for use and safety measures are appropriate to mitigate any potential risk to meet the FIFRA standard of no unreasonable risks to humans or the environment. In this way, the pesticide label communicates essential limitations and mitigations that are necessary for public and environmental safety. It is a FIFRA violation to use a registered pesticide in a manner inconsistent with its labeling. Consistent with Endangered Species Act (ESA) Section 7(a)(2), EPA also assessed the potential effects of the use of glufosinate-P on federally listed threatened or endangered (hereafter referred to as "listed") species and their designated critical habitats (CHs).

Please note that the sections below **A-E** for **Assessment of Risks to Human Health, Assessment of Environmental and Ecological risks, Effects Determination under the Endangered Species Act , Benefits Assessment, and Greater-than-Additive Effects** uses the term "L-glufosinate" which refers to both glufosinate-P-ammonium form (also referred to as L-glufosinate ammonium) and glufosinate-P form (also referred to as L-glufosinate acid) as explained in the introduction section above.

A. Assessment of Risks to Human Health

The EPA requires a wide range of studies to assess a pesticide use scenario. For the uses of glufosinate-P in canola, field corn, sweet corn, cotton and soybean, EPA used data provided for glufosinate, glufosinate-P, and glufosinate-P-ammonium to complete the glufosinate database. EPA uses this complete database to make conclusions regarding glufosinate-P and support the assessment of risk to human health.

This section summarizes EPA's *Glufosinate-P. Human Health Risk Assessment for New Active Ingredient Isomer.* The complete assessment can be found in docket ID number EPA-HQ-OPP-2020-0250 at www.regulations.gov.

1. Toxicology Profile

Glufosinate-P is a non-selective herbicide with a pesticidal mode-of-action that acts via inhibition of glutamine synthetase (GS). This leads to poisoning of plants by the build-up of excess ammonia and a direct inhibition of photosynthesis. Mammals, including humans, are known to express GS in order to catalyze the synthesis of glutamine by condensation of ammonia and glutamate. The expression of this enzyme occurs in a number of tissues including the brain, liver, muscle, adipose tissue, lung, and kidney. However, the mammalian mode-of-action has not been elucidated for glufosinate.

The targets identified following oral exposure to L-glufosinate are the brain and peripheral nervous system (rats, mice, and dogs), kidney (rats and mice), thyroid (rats only), and the adrenals (mice only). EPA examined neurotoxicity in a non-guideline supplemental pharmacology study in which a single gavage dose of L-glufosinate acid was administered to male rats and male and female mice. Adverse clinical signs were observed in both species and included tremors, clonic convulsions, abnormal posture, increased ipsilateral flexor reflex, loss of alertness, abnormal visual placing, loss of touch response, hyperalgesia (*i.e.*, increased sensation of pain), apraxia of gait (*i.e.*, inability to lift feet from floor), muscle weakness, decreased body temperature, and/or decreased respiration, in addition to decreased body weight, decreased motor activity (rats only), and death. The adverse effects seen in mice occurred at a lower dose level as compared to rats when allometric scaling for body weight is taken into consideration.

Clinical signs indicative of neurotoxicity was also observed in the L-glufosinate acid dog studies, with the dog being the more sensitive species (effects occurring at a lower dose level) as compared to rats and mice when allometric scaling for body weight was considered. One male dog was sacrificed early in the chronic dog study due to a number of adverse observations including, but not limited to, tonic convulsions, panting, salivation, inability to maintain body position, and a lack of touch reflex. Slight foot eversion and abnormal gait were observed in the subchronic dog study in both sexes. Neurotoxic clinical signs were not observed in the L-glufosinate ammonium subchronic dog study; however, this may be due to the difference in test compound administration across the studies (capsule vs. dietary) or the possibility that clinical observations were not taken at the proper time during the L-glufosinate ammonium study and therefore went unnoticed. However, given the neurotoxicity observed across the databases and the known expression of GS in the brain, EPA considers the neurotoxicity observed in the L-glufosinate acid studies as adverse.

Following subchronic exposure in the mouse to L-glufosinate acid, alterations in brain weight and slight vacuolation of the cerebrum were noted in both sexes. In the mouse carcinogenicity study, slight to severe vacuolation and nerve cell necrosis were observed in both sexes. Adverse neuropathology was also observed in the L-glufosinate acid subchronic neurotoxicity (SCN) study in rats and included an increased incidence of retinal hypoplasia, glial cell hyperplasia of the optic nerve, anterior synechia (*i.e.*, adhesions between tissues in the eye), and axonal degeneration of the spinal cord. The adverse neuropathology observed in the mouse and SCN studies occurred at dose levels ~13-35X higher than the dose level that caused adverse clinical signs in the dog studies.

A developmental neurotoxicity (DNT) study is available for the registered pesticide, D/L-glufosinate ammonium, in which alterations in brain morphometrics (*i.e.*, a decrease in the mean length of the ventral limb of the dentate hilus), an increase in motor activity, and a decrease in body weight were observed in offspring at a dose level (lowest-observed-adverse-effect-level (LOAEL) = 63 mg/kg/day acid equivalents) that did not elicit maternal toxicity (maternal LOAEL = 266 mg/kg/day acid equivalents). As brain morphometric data are not available for

either L-glufosinate acid or L-glufosinate ammonium, *in vitro* assays were conducted to examine the effects of these compounds on important neurodevelopmental processes and determine their potential comparative hazard for developmental neurotoxicity. The *in vitro* data and limited available comparative *in vivo* data provide evidence that the neurotoxicity across all three chemicals (glufosinate, L-glufosinate ammonium, and L-glufosinate acid) is comparable and that additional DNT *in vivo* data with L-glufosinate acid and/or L-glufosinate ammonium are not necessary to conduct a health protective risk assessment.

Briefly, D/L-glufosinate ammonium, L-glufosinate ammonium, and L-glufosinate acid were tested in a network formation assay in developing rat cortical networks, a neurite outgrowth assay in human induced pluripotent stem cell (IPS)-derived neurons, and an acute neural network function assay in developed rat cortical networks. All tested compounds were without effect on neurite outgrowth in human IPS-derived neurons or neural network formation in rat primary neural cultures. Following an acute 40-minute exposure in the neural network function assay, all tested compounds increased the mean firing rate of mature networks of rat primary neurons between 120-140% of baseline mean firing rates, which indicated that the lack of activity in the network formation and neurite outgrowth assays was not due to a lack of biological activity. No clear or consistent differences were noted between D/L-glufosinate ammonium and L-glufosinate acid or L-glufosinate ammonium in their ability to alter mean firing rate. Taken together, these *in vitro* data indicate that the biological activity of L-glufosinate ammonium salt and L-glufosinate acid, over the tested concentration range (0-30 µM), is similar to that of D/L-glufosinate ammonium for the purpose of assessing the potential impact of chemical exposure on processes related to neurodevelopment.

No adverse effects were identified in the L-glufosinate acid or L-glufosinate ammonium subchronic rat studies up to the highest doses tested (*i.e.*, 199/217 mg/kg/day (M/F) and 169/177 mg/kg/day ae (M/F); respectively). Increased kidney weights and/or alterations in urinalysis parameters were observed; however, they were not considered adverse as there was no corresponding histopathology of the kidney noted in either study. Following a one-year chronic exposure to L-glufosinate acid, hypertrophy of the proximal tubular cells of the pars recta in the kidney and lymphoid cell aggregation was observed with corresponding changes in kidney weight and urinalysis parameters (*i.e.*, specific gravity, bilirubin, pH, protein, and ketones). The alterations in urinalysis parameters were more robust in females as compared to males, and as such, were only considered adverse in females. In addition, slight c-cell thyroid hyperplasia was observed in males. Similar incidences and severity were observed in the kidney and thyroid histopathology conducted in the L-glufosinate acid two- year rat carcinogenicity study. While the effects seen in the rat carcinogenicity study occurred at a lower dose level (45/55 mg/kg/day (M/F)) as compared to the effects in the chronic rat study (162/185 mg/kg/day (M/F)), this may be a reflection of the dose spacing selected for each study, and not a true representation of a progression of toxicity from one to two years of compound exposure. Renal function in male rats was also examined in the non-guideline pharmacology study. After a single gavage dose of L-glufosinate acid, male rats experienced increased chloride excretion (115%), increased osmotic pressure (42%), increased sodium ion excretion (26%), and increased potassium ion excretion (31%) at 600 mg/kg. The toxicity observed in the kidney is supported by the known expression of GS in the straight portion or S3 segment of the proximal tubule.

Hypertrophy of the proximal tubule cells of the pars recta with increased kidney weights was also observed in the L-glufosinate acid subchronic and carcinogenicity mouse studies. Urinalysis was not conducted in either study. While the histopathology severity did not increase with duration of exposure, the incidence did, with nearly ~42% of females in the carcinogenicity study compared to 20% of females in the subchronic study presenting with this effect. Similar to the rat studies, the effects seen in the mouse carcinogenicity study (70/67 mg/kg/day (M/F)) occurred at a lower dose level as compared to the subchronic mouse study (121/142 mg/kg/day (M/F)); however, this may be an artifact of dose selection.

An additional target organ within the mouse studies was the adrenal gland. Toxicity was observed at the same dose level as the brain and kidney microscopic findings and included slight to moderate brown pigment deposition in the cortico-medullary junction, slight subcapsular cell hyperplasia, and increased adrenal weight.

Developmental toxicity was examined following exposure to L-glufosinate acid in the rat and L-glufosinate acid and L-glufosinate ammonium in the rabbit. Quantitative susceptibility was observed in the developmental rat study in which decreased fetal body weight in both sexes (7-9%) was observed at the highest dose tested (100 mg/kg/day); however, no maternal toxicity was identified. The L-glufosinate acid rabbit developmental toxicity study presented with increased late resorptions and decreased fetal body weight (5%) at 3 mg/kg/day. Increased post-implantation loss and late fetal resorptions were observed in the L-glufosinate ammonium developmental rabbit study at a similar dose level (2.3 mg/kg/day acid equivalents) as the effects in the acid study. In the L-glufosinate acid range-finding developmental toxicity study in the rabbit, an increase in early resorptions was observed at 10 mg/kg/day. This finding was not observed in the definitive L-glufosinate acid rabbit developmental toxicity study as the highest dose tested was 3 mg/kg/day. Due to the unknown etiology of the post-implantation loss, late fetal resorptions, and early resorptions observed in the rabbit developmental studies, they are considered both maternal and developmental effects.

In the L-glufosinate acid two-generation reproductive toxicity study (rat), parental and offspring effects occurred at the same dose level. Parental toxicity manifested as proximal tubular cell hypertrophy in the pars recta of the kidneys (P and F1 generations; both sexes) and increased absolute and relative kidney weights (P and F1 generations; both sexes). Offspring toxicity exhibited an increase in post-implantation loss and a decreased number of live pups born (F1 and F2 generations). The offspring effects are also considered parental effects due to the unknown etiology. No adverse reproductive effects were observed up to the highest dose tested (61/72 mg/kg/day; male/female). Quantitative susceptibility was observed in a L-glufosinate ammonium dose-range finding DNT study in which maternal effects were not observed up to the highest dose tested (194 mg/kg/day acid equivalents) while offspring toxicity manifested as decreased pup body weight (5-11%) and increased total and ambulatory motor activity counts in males (40 mg/kg/day acid equivalents).

A route specific inhalation study is available for L-glufosinate ammonium in which no adverse systemic or portal-of-entry effects were observed up to the highest concentration tested (0.22 mg/L acid equivalents).

L-glufosinate acid has low acute inhalation (Toxicity Category III) and acute dermal (Toxicity Category III) toxicity. It has high acute oral toxicity (Toxicity Category II). L-glufosinate acid is

a mild eye irritant (Toxicity Category III), is not a skin irritant (Toxicity Category IV), and has sensitizing potential. L-glufosinate ammonium has low acute oral (Toxicity Category III), acute dermal (Toxicity Category III), and acute inhalation toxicity (Toxicity Category III). L-glufosinate ammonium is a mild eye and skin irritant (Toxicity Category IV) and is not a dermal sensitizer.

A summary of the points of departure (POD) selected for human health risk assessments can be found in Table 2. This section, *Assessment of Risks to Human Health*, is a summary of the standard assessment that the agency conducts; the full Human Health Risk Assessment can be found in docket ID number EPA-HQ-OPP-2020-0250 at www.regulations.gov. Additionally, EPA has concluded that no additional estrogen, androgen, or thyroid data are needed at this time. For additional information, please see *Appendix C* of the Human Health Risk Assessment.

Table 2. Summary of Toxicological Doses and Endpoints for L-Glufosinate for Use in Dietary and Non-Occupational Human Health Risk Assessments.

Exposure/ Scenario	**POD**	**Uncertainty/ FQPA Safety Factors**	**RfD, PAD, Level of Concern for Risk Assessment**	**Study and Toxicological Effects**
Acute Dietary (General Population, including Infants and Children)	NOAEL = 50 mg/kg	UF_A = 10X UF_H = 10X FQPA SF = 1X	aRfD = 0.5 mg/kg aPAD = 0.5 mg/kg	L-glufosinate acid supplemental pharmacology study (MRID 51036675) LOAEL = 100 mg/kg based on death in 1/5 female mice and increased ipsilateral flexor reflex in 1/5 male mice

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Exposure/ Scenario	**POD**	**Uncertainty/ FQPA Safety Factors**	**RfD, PAD, Level of Concern for Risk Assessment**	**Study and Toxicological Effects**
Acute Dietary (Females 13-49 years of age)	NOAEL = 3 mg/kg	UF_A = 10X UF_H = 10X FQPA SF = 1X	aRfD = 0.03 mg/kg aPAD = 0.03 mg/kg	L-glufosinate acid developmental toxicity in the rabbit; range finder (MRID 51036659) LOAEL= 10 mg/kg based on increased early resorptions
Chronic Dietary (All Populations)	NOAEL = 1.5 mg/kg/day	UF_A = 10X UF_H = 10X FQPA SF = 1X	cRfD = 0.015 mg/kg/day cPAD = 0.015 mg/kg/day	L-glufosinate acid subchronic and chronic dog (MRIDs 51036651 and 51036654) LOAEL = 5 mg/kg/day based on clinical signs of neurotoxicity and early sacrifice of 1 dog.

Table 2. Summary of Toxicological Doses and Endpoints for L-Glufosinate for Use in Dietary and Non-Occupational Human Health Risk Assessments.				
Exposure/ Scenario	**POD**	**Uncertainty/ FQPA Safety Factors**	**RfD, PAD, Level of Concern for Risk Assessment**	**Study and Toxicological Effects**
Incidental Oral/Adult Oral Short-Term (1-30 days)	NOAEL = 1.5 mg/kg/day	UF_A = 10X UF_H = 10X FQPA SF = 1X	Residential LOC for MOE = 100	L-glufosinate acid subchronic and chronic dog (MRIDs 51036651 and 51036654) LOAEL = 5 mg/kg/day based on clinical signs of neurotoxicity and early sacrifice of 1 dog
Dermal Short-(1-30 days)/ Intermediate-Term (1-6 months)	NOAEL = 1.5 mg/kg/day DAF = 1%	UF_A = 10X UF_H = 10X FQPA SF = 1X	Residential LOC for MOE = 100	L-glufosinate acid subchronic and chronic dog (MRIDs 51036651 and 51036654) LOAEL = 5 mg/kg/day based on clinical signs of neurotoxicity and early sacrifice of 1 dog.

Table 2. Summary of Toxicological Doses and Endpoints for L-Glufosinate for Use in Dietary and Non-Occupational Human Health Risk Assessments.				
Exposure/ Scenario	**POD**	**Uncertainty/ FQPA Safety Factors**	**RfD, PAD, Level of Concern for Risk Assessment**	**Study and Toxicological Effects**
Inhalation Short- (1-30 days)/ Intermediate-Term (1-6 months)	NOAEL = 1.5 mg/kg/day	UF_A = 10X UF_H = 10X FQPA SF = 10X (L-glufosinate acid) FQPA SF = 1X (L-glufosinate)	Residential LOC for MOE = 1,000 (L-glufosinate acid) = 100 (L-glufosinate)	L-glufosinate acid subchronic and chronic dog (MRIDs 51036651 and 51036654) LOAEL = 5 mg/kg/day based on clinical signs of neurotoxicity and early sacrifice of 1 dog. Oral toxicity is assumed to be equivalent to inhalation toxicity
Cancer (oral, dermal, inhalation)	Classification: *"Not Likely to be Carcinogenic to Humans"*			

Point of departure (POD) = A data point or an estimated point that is derived from observed dose-response data and used to mark the beginning of extrapolation to determine risk associated with lower environmentally relevant human exposures. NOAEL = no-observed adverse-effect level. LOAEL = lowest-observed adverse-effect level. UF = uncertainty factor. UF_A = extrapolation from animal to human (interspecies). UF_H = potential variation in sensitivity among members of the human population (intraspecies). UF_L = use of a LOAEL to extrapolate a NOAEL. FQPA SF = Food Quality Protection Act (FQPA) Safety Factor. PAD = population-adjusted dose (a = acute, c = chronic). RfD = reference dose. MOE = margin of exposure. LOC = level of concern.

2. Dietary (Food + Water) Risks

Acute and chronic dietary (food and drinking water) exposure assessments were performed for L-glufosinate. The recommended tolerance levels were used for residues in foods in the acute assessment; the chronic assessment made use of average field trial residue levels for plant commodities, and average calculated residues for livestock commodities. However, those levels, which are the same as those for the racemic mixture D/L-glufosinate (in order to facilitate tolerance enforcement for both glufosinate and L-glufosinate) were scaled by half to adjust for the lower application rate of L-glufosinate compared to D/L-glufosinate; residues of L-

glufosinate in food are expected to be half those of D/L-glufosinate, based on the use patterns. Screening-level modeled estimated drinking water concentrations (EDWCs) were used. The EDWCs modeled are for D/L-glufosinate, so those were also scaled by half to reflect the expected concentrations of L-glufosinate in water; 100% crop treated (CT) was assumed for all crops.

There are no acute dietary (food and drinking water) risk estimates of concern for the general U.S. population and all population subgroups at the 95th percentile of exposure. For the population subgroup females 13-49 years old, the acute risk estimate is 26% of the subgroup- specific aPAD. The most highly exposed population subgroup is all infants (<1 year old) at 4.7% of the aPAD.

There are no chronic dietary (food and drinking water) risk estimates of concern for the general U.S. population and all population subgroups. The most highly exposed population subgroup is children (1-2 years old) at 12% of the cPAD.

3. Occupational Handlers Risks

Based on the anticipated use patterns and labeling, and types of equipment and techniques that can potentially be used, short-term to intermediate-term occupational handler exposure is not of concern from the registered L-glufosinate uses when using the label required personal protective equipment (PPE) consisting of "baseline" (defined as a single layer of clothing consisting of a long-sleeved shirt, long pants, shoes plus socks), protective eyewear, plus chemical-resistant gloves.

There are no occupational post-application risk estimates of concern for L-glufosinate.

4. Non-Occupational Spray Drift Exposure and Risk Estimates

On July 15, 2024, the Agency updated its practice on spray drift to include chemical-specific human health spray drift assessments for the uses through Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) registration actions. For this action, the Agency did not consider spray drift since the human health risk assessment and proposed regulatory decision were completed prior to the announcement date. Consequently, the Agency will conduct human health spray drift assessment for these and future uses of this active ingredient during registration review.

5. Residential Handler Risks

L-glufosinate is not expected to result in any residential exposures, either for residential handlers or residential post-application scenarios, since there are no registered residential uses for this chemical. However, residential exposures to L-glufosinate resulting from the existing residential uses of the racemic mixture D/L-glufosinate have been assessed for aggregate risk by scaling the application rate by 0.5X from the previous D/L- glufosinate assessment (D458863 H. DeLeon, 08-JAN-2021) to reflect residues of L-glufosinate only and the application rate was converted to acid equivalents because the PODs are likewise expressed as acid equivalents. For currently registered uses of racemic mixture D/L- glufosinate, residential handler dermal and inhalation risks are not of concern for L-glufosinate; the dermal MOE is 2,600 [LOC = 100], and the inhalation MOE is 16,000 [LOC = 100]. There are no residential post-application risk

estimates of concern; all MOEs range from 460 to 97,000 [LOC = 100]. For children 1<2 years old, the combined dermal and hand-to-mouth MOE is 310 [LOC = 100] and is not of concern.

6. Aggregate Risk

The acute and chronic aggregate risk assessments include food and drinking water only and are equivalent to the acute and chronic dietary assessments, which are not of concern.

Short-term residential exposures to L-glufosinate resulting from the existing residential uses of the racemic mixture D/L-glufosinate are expected and are included in the aggregate assessment for L-glufosinate. There are no short-term aggregate (residential plus dietary) risks of concern for adults or children for L-glufosinate. The short-term aggregate MOEs for adults (1,100), children 6 to <11 years old (2,600), and children 11 to <16 years old (1,700), and children 1 to < 2 years old (230) are above the LOC (100) and are not of concern.

7. Cumulative Risk

Unlike other pesticides for which EPA has followed a cumulative risk approach based on a common mechanism of toxicity, EPA has not made a common mechanism of toxicity finding as to L-glufosinate and any other substances, and L-glufosinate does not appear to produce a toxic metabolite produced by other substances. For the purposes of this action, therefore, EPA has not assumed that L-glufosinate has a common mechanism of toxicity with other substances.

B. Assessment of Environmental and Ecological Risks

The ecological risk assessment (ERA) examines the potential for adverse effects to non-listed non-target organisms associated with uses of glufosinate-P. EPA also conducted an assessment that evaluates effects on listed species and includes EPA's predictions of the potential likelihood of future jeopardy (J) for listed species or adverse modification (AM) of designated critical habitats (CHs), as well as EPA's assessment of how mitigations are predicted to avoid such findings. However, while EPA is making predictions about the likelihood of J/AM, the U.S. Fish and Wildlife Service or the National Marine Fisheries Service (collectively referred to as the Services) are responsible for making the actual J/AM findings for these species and have the sole authority to do so.

The taxa evaluated in the ERA include mammals, birds (which serve as surrogates for reptiles and terrestrial-phase amphibians), bees, fish (where freshwater fish serve as surrogates for aquatic-phase amphibians), aquatic invertebrates, and aquatic and terrestrial plants. Ecological risk characterization integrates environmental exposure and ecotoxicity data to evaluate the likelihood of adverse ecological effects using a risk quotient (RQ) method. For this method, RQs are calculated by dividing point estimates of exposure (*i.e.*, estimated environmental concentration [EECs]) by point estimates of toxicity (RQ = EEC/toxicity endpoint), for both acute and chronic effects. The RQs are then compared to EPA's acute and chronic risk levels of concern (LOCs) for each taxon. The LOCs are well-established levels used by EPA to indicate potential risk to non-target organisms and are meant to be protective of community-level effects.

The LOC indicates whether a pesticide, when used as directed, has the potential to cause adverse

effects to non-target organisms. RQs below a LOC indicate there are no risks of concern for that taxon. If the RQ exceeds the LOC, then the EPA further characterizes and describes the associated risk of concern.

These findings can also play a role in EPA's assessment of effects to listed species, as required by the Endangered Species Act (ESA). Where RQs have been calculated, if the RQs are below the listed species LOC (indicating potential exposures are below threshold doses) for a particular taxon, then EPA does not expect direct effects to listed species in that taxon. However, further refinement or analysis may be necessary to complete an effects determination for listed species within that taxon because there may also be indirect effects to a listed species from potential direct effects to another taxon on which the listed species depends for pollination, prey, habitat, and/or dispersion (PPHD). In making its effects determinations, EPA evaluates both potential direct and indirect effects to listed species and designated critical habitats.

EPA has determined that all relevant data requirements specified in 40 CFR Part 158 based on the use patterns discussed in this document have been satisfied (completed, waived, or not triggered). The database required to evaluate the environmental fate and ecological effects of the uses of glufosinate-P is complete and is considered adequate.

This section summarizes EPA's *Glufosinate-P and Glufosinate-P-Ammonium: Environmental Fate and Ecological Risk Assessment (ERA) for the FIFRA Section 3 Registration and Biological Evaluation (BE) with Associated Effects Determinations for Federally Listed Endangered and Threatened Species and Designated Critical Habitat.* The complete assessment can be found in docket ID number EPA-HQ-OPP-2020-0250 at www.regulations.gov.

1. Environmental Fate Profile

L-glufosinate is the enantiomerically (chirally) enriched form of the broad-spectrum contact herbicide racemic glufosinate. While the L enantiomer is the herbicidally active isomer, the submitted environmental fate and ecotoxicity data support bridging the fate and toxicity data between the racemic glufosinate and L-glufosinate for assessing potential risk to non-target species. Since the physical-chemical properties of different enantiomers of a compound are identical outside of a chiral environment, except for the direction of rotation of plane polarized light, the physical chemical properties of the racemic mixture and the enriched isomer of glufosinate are expected to the be the same.

Given the log dissociation constant (pK_a<2) for glufosinate, the compound is expected to exist as a free acid at environmentally relevant pH values. Glufosinate is not likely to volatilize from soil or water, based on low measured vapor pressure (<$7.5x10^{-9}$ torr). With organic carbon (OC)-normalized Freundlich sorption coefficients (K_{FOC} range: 16.5 – 605 L/kg_{oc}), glufosinate is classified as mobile to highly mobile in soil based on the Food and Agriculture Organization (FAO) classification system (FAO, 2000). The low log octanal-water partition coefficient (K_{ow}) of <0.1 indicates glufosinate is not likely to bioconcentrate in aquatic organisms. The compound is considered non-persistent to slightly persistent at 20°C in aerobic soils based on the Goring persistence scale (Goring *et al*. 1975) with time to 50% dissipation (DT_{50}) values ranging from 1.71 to 23 days). Glufosinate degrades more rapidly in aerobic aquatic systems (DT_{50} = 1 to 87 days) than in anaerobic aquatic systems (DT_{50} = 415 days). The compound is stable to hydrolysis

at environmentally relevant pH values and to aqueous photolysis at pH 5 and 7. L-Glufosinate did not convert to D-glufosinate in any of the aerobic soil metabolism, aqueous hydrolysis, or aqueous photolysis studies conducted on the enriched isomer.

In terrestrial field dissipation studies conducted in the U.S., glufosinate dissipated with DT_{50} values ranging from 1.1-23 days, which is consistent with the measured aerobic soil metabolism DT_{50} values. While the compound is classified as mobile-to-highly mobile in soil, glufosinate residues were not detected below 6-inch soil depth in loam or clay soils, or below 24-inch soil depth in sandy soil. However, this may be due to the relatively high percentage of organic matter (2%-3%) in the test soils. Glufosinate has been detected at a maximum concentration of 3.2 µg/L in surface water and 4.5 µg/L in groundwater in non-targeted monitoring studies. These detections reflect usage of racemic glufosinate, as there are no currently registered enantiomerically enriched L-glufosinate formulations.

Five major degradates of racemic glufosinate were characterized in the environmental fate studies (*i.e.,* MPP (3-methylphosphinico-propionic acid), MPA (2-methylphosphinico-acetic acid), NAG (2-acetamido-4-methylphosphinico-butanoic acid), HOE 086486 (3-methylphosphinico-3-oxo-propionic acid) and carbon dioxide) and one minor degradate (HOE 065594 (4-methylphosphinico-2-oxo-butanoic acid)). However, the parent compound is the only Residue of Concern (ROC) for ecological risk in this assessment because these compounds are equally or less toxic than racemic glufosinate in mammals and aquatic vertebrates, invertebrates, and plants. For taxa where major degradates have similar toxicity to the parent compound, the EECs are orders of magnitude lower than the parent toxicity endpoint; therefore, including the degradates as a ROC would not influence risk conclusions.

EPA calculated the EECs in surface water, terrestrial areas, and wetlands using the Pesticide in Water Calculator (PWC; version 2.001) and the Plant Assessment Tool (PAT; version 2.2.1.1). The 1-day, 21-day, 60-day average, and peak edge-of-field concentrations range from 2.74 to 28.3 µg/L, from 2.64 to 27.9 µg/L, from 2.49 to 28.1 µg/L, and from 12.8 to 130 µg/L, respectively. The 1-day and 21-day average concentrations represent the chemical concentration in the standard EPA farm pond over the given averaging period, while edge-of-field concentrations represent the 1-day maximum concentration in the runoff from the treated field. Terrestrial and wetland EECs for plant exposure were calculated using PAT. For terrestrial plants in the Terrestrial Plant Exposure Zone (TPEZ), exposure concentrations range from 0.011 to 0.123 lb ae/A. For semiaquatic plants in the Wetland Plant Exposure Zone (WPEZ), EECs ranged from 8.67 to 167 µg/L, respectively.

2. Environmental Effect Profile and Risks

EPA took a comprehensive approach in evaluating potential risk concerns for all taxa (including freshwater and estuarine/marine fish and invertebrates, aquatic vascular and nonvascular plants, birds, mammals, terrestrial invertebrates, and terrestrial plants) using available data. These studies include registrant-submitted acute and chronic toxicity data on L-glufosinate and racemic glufosinate. When available, studies reported in open literature and any incident data which may have been reported are included. Since EPA expects that at environmentally relevant pH values, glufosinate will exist as glufosinate acid, all the toxicity estimates for aquatic and terrestrial organisms are expressed in terms of acid equivalents (ae).

In the following sections, the toxicity of L-glufosinate to various taxonomic groups is summarized. Since L-glufosinate has not been in use in the U.S., no incident data nor open literature studies are available on the compound. However, incidents for racemic glufosinate can provide some information on which taxa could be at risk from glufosinate use given that the L-isomer is a component of the racemic mixture and the use sites for the racemic mixture and enriched isomer are similar. As discussed above, EPA then integrates hazard data with exposure estimates to generate RQ values. Table 3 summarizes LOCs by taxa and Table 4 summarizes RQs and LOC exceedances for listed and non-listed species associated with the uses of L-glufosinate.

Aquatic vertebrates

The available data for aquatic animals indicate that L-glufosinate technical grade active ingredient (TGAI) is practically non-toxic to freshwater and estuarine/marine fish on an acute exposure basis with non-definitive (>) toxicity estimates for both freshwater and estuarine/marine fish. The acute response in freshwater fish is consistent across both warm-water and cold-water species. Since freshwater fish serve as surrogates for aquatic-phase amphibians, with a Rainbow Trout (*Oncorhynchus mykiss*) lethal concentration to 50% of the organisms tested (LC_{50}> 92.9 ae/L, L-glufosinate is classified as practically non-toxic on an acute exposure basis to this life stage of amphibians as well.

Chronic toxicity studies with freshwater fish resulted in a No Observable Adverse Effect Concentration (NOAEC) of 24 mg ae/L above which there was a 12% reduction in post-hatch survival at the Lowest Observable Adverse Effect Concentration (LOAEC) of 46.4 mg ae/L.

The available data suggest that the estuarine/marine Sheepshead Minnow (*Cyprinodon variegatus* LC_{50} >876 mg ae/L) is at least 9-times less sensitive to glufosinate than the most sensitive freshwater fish (*i.e*., Rainbow Trout) and would have to be over an order of magnitude more sensitive than the least sensitive freshwater fish (*i.e*., the Fathead Minnow *Pimephales promelas* with an LC_{50} of 421 mg ae/L) to exceed the Agency's chronic risk LOC. There were no acute or chronic risk LOC exceedances identified for listed or non-listed aquatic vertebrates (Table 4).

Aquatic Invertebrates

L-Glufosinate is practically non-toxic to freshwater invertebrates on an acute exposure basis with a non-definitive 50% effect concentration (EC_{50}) >103 mg ae/L for the Waterflea (*Daphnia magna*). L-glufosinate is classified as moderately toxic to estuarine/marine invertebrates on an acute exposure basis, based on the Mysid Shrimp (*Americamysis bahia*) LC_{50} of 6.9 mg ae/L. The most sensitive chronic effect in freshwater invertebrates resulted in a NOAEC of 28 mg ae/L above which there is a 47% reduction in offspring/female observed at the LOAEC of 49.1 mg ae/L. The data indicate that freshwater invertebrates are at least 3.7-fold more sensitive to glufosinate on a chronic exposure compared to acute exposure. Estuarine/marine invertebrates with a NOAEC = 0.067 mg ae/L, above which there 9% reduction in length, 20% reduction in dry weight and 30% reduction in the number of offspring per female at the LOAEC of 0.173 mg ae/L, are three orders of magnitude more sensitive than freshwater invertebrates on a chronic exposure basis.

The highest RQ values (RQ range 0.58 – 2.01) based on edge-of-field (EOF) exposures indicate that estuarine/marine invertebrates could experience reduced reproduction and growth following chronic exposure. None of the uses represent acute risks of concern to estuarine/marine invertebrates in any of the waterbodies evaluated. (Table 4).

Aquatic Plants

The cyanobacterium *Anabaena flos-aquae* is the most sensitive non-vascular aquatic plant with an exposure concentration resulting in 50% inhibition (*i.e.*, IC_{50}) of 0.026 mg ae/L based on reduced yield. All the uses exceed the Agency's LOC (LOC=1) for risk to non-vascular aquatic plants with RQ values ranging from 0.01 to 6.42 (Table 4).

Terrestrial Vertebrates

Potential dietary exposure for terrestrial wildlife in this assessment is based on consumption of L-glufosinate residues on food items following foliar spray applications.

Birds. L-Glufosinate is characterized as slightly toxic to birds on both an acute oral and subacute dietary exposure basis. On a chronic exposure basis, no adverse effects were observed up to the highest dietary concentration tested (NOAEC=366 mg ae/kg-diet) in the 22-week reproductive toxicity study on the Mallard Duck (*Anas platyrhynchus*). In the 20-week reproductive study with the Bobwhite Quail (*Colinus virginianus*), the NOAEC is 608 mg ai/kg-diet based on a 7% reduction in the ratio of live-to-viable embryos relative to controls at the LOAEC of 874 mg ai/kg-diet, dietary concentration 2.4 times above the highest concentration tested in the Mallard Duck. In lieu of data on reptiles and terrestrial-phase amphibians, toxicity data for birds are used as a surrogate to evaluate risk to these taxa. Both acute and chronic RQ values for birds are below LOCs (Table 4); therefore, there are no direct risks of concern for birds, reptiles, or terrestrial-phase amphibians.

Mammals. With a lethal dose to 50% of the animals tested (*i.e.*, LD_{50}) value of 954 mg ai/kg bw, glufosinate is characterized as slightly toxic to mammals on an acute exposure basis. Chronic exposure resulted in a NOAEL of 5.5 mg ae/kg-bw/day based on 11- 37% reductions in the number of viable pups per litter in both the first and second generation of rats in a two-generation reproductive study at the LOAEL of 16.5 mg ai/kg-bw/day.

Acute risk to mammals is expected to be low as RQs (RQ range <0.01 to 0.07) do not exceed the Agency's acute risk LOC for mammals (LOC=0.5) (Table 4). However, the chronic dose-based RQs (0.04-12.1) generated for all the uses, exceed the Agency's chronic risk LOC of 1.0 for small (15 g), medium- (35 g) and large-sized (1,000 g) mammals that feed on short grass, tall grass, broadleaf plants, or arthropods. Chronic dietary-based RQs (range: 0.05 to 1.40) exceed the LOC for mammals that feed on short grasses. While the mammalian RQ values may overestimate the reliance on food items in treated fields (100% of the diet is assumed to be on the treated field), ingestion of residues (based on upper-bound estimates) in dietary items on the treated field is expected to exceed the chronic risk LOC for up to 90 days. This suggests an increased likelihood of exposure to residues above the NOAEL for mammals that forage on the treated field. Mammals may also be exposed to residues on food items off-site from spray drift during application to the treated field. The RQs exceed the chronic risk LOC for mammals up to

76 feet from the treated field when L-glufosinate is applied via aerial and between 3 and 7 feet from the treated field when applied via ground equipment depending on the boom height. These spray drift estimates assume a droplet size distribution (DSD; aerial = medium to coarse; ground-boom = fine to medium/coarse) and boom height [both high (50 inches from the ground) and low (20 inches from the ground) boom height are modeled) consistent with the label recommendations.

Terrestrial invertebrates- Bees

L- Glufosinate is practically non-toxic to young adult Western honeybees (*Apis mellifera*, which serve as surrogates for both *Apis* and non-*Apis* bees) on both an acute contact and oral exposure basis and the compound is practically non-toxic to larval honeybees on an acute oral exposure basis.

There are potential chronic risks of concern for bees based on model-generated residue values in diet. The chronic RQs for adult (RQ = 40.8) and larval bees (RQ = 1.90) for all the uses exceed the Agency's chronic risk LOC of 1.0 for bees (Table 4). The chronic LOAEL (0.005 mg ae/larva/day) for larval bees is based on a 19% reduction in adult bee emergence and is two times above the NOAEL (0.0026 mg ae/larva/day) used to calculate the RQs. The chronic LOAEL (0.00689 mg ae/bee/day) for adult bees is based on a 30% reduction in food consumption at the lowest dose tested, which is an order of magnitude above the EC_{10} of 0.000283 mg ae/bee/day used as a surrogate for a NOAEL to calculate the chronic RQs for adult bees. At the exposure levels estimated in the environment, it is likely that most or all the uses will result in reduced adult emergence in larval bees and reduced food consumption in adults. Chronic risks of concern for adult bees extend up to 203 feet and 13 to 23 feet from the treated field when L- glufosinate is applied via aerial equipment and ground equipment, respectively, based on the same spray DSD and boom height assumptions considered in the mammal spray drift assessment.

Other Terrestrial Invertebrates

Potential risks of concern are identified for terrestrial invertebrates other than bees based on a screening-level assessment with upper-bound residue values for both contact and dietary exposure. Chronic dietary RQs for all the uses exceed the Agency's chronic risk LOC (1.0) for adult (RQ range: 0.30-6.49) and larval (RQ range: 0.08-2.38) non-bee terrestrial invertebrates (Table 4). There are no acute dietary-based risks of concern for non-bee terrestrial invertebrates; however, contact exposure from all the uses pose an acute risk to non-bee terrestrial invertebrates. The identified risks are based on effects in individuals; however, semi-field studies further suggest that adverse effects resulting from exposure due to the L-glufosinate uses may manifest in non-bee terrestrial invertebrate populations and communities.

Terrestrial Plants

The uses for L-glufosinate pose a potential risk to upland terrestrial (LOC = 1.0; RQ range: 0.53-7.13) and semi-aquatic (LOC = 1.0; RQ range: 0.80-13.1) dicotyledonous (dicot) and monocotyledonous (monocot) plants (Table 4). Exposure from spray drift alone exceeds the Agency's LOC to terrestrial plants up to 89 and 10 feet from the field for aerial and ground applications, respectively, when considering spray drift requirements on the label.

Table 3. Risk quotient (RQ) and levels of concern (LOC) for non-listed and federally listed threatened/endangered species by taxon.				
Taxon	**Exposure duration**	**Listed/non-listed**	**RQ[1]**	**LOC[1]**
Fish and aquatic-phase amphibians	Acute	Non-listed, general PPHD effects	1-in-10-year, Daily EEC/LC_{50}	0.5
		Listed direct effects & obligate PPHD effects	1-in-10-year, Daily EEC/LC_{50}	0.05
	Chronic	Listed and non-listed, general, and obligate PPHD effects	1-in-10-year, 60-day EEC/NOAEC	1
Aquatic invertebrates	Acute	Non-listed, general PPHD effects	1-in-10-year, Daily EEC/LC_{50}	0.5
		Listed direct effects & obligate PPHD effects	1-in-10-year, Daily EEC/LC_{50}	0.05
	Chronic	Listed and non-listed, general, and obligate PPHD effects	1-in-10-year, 21-day EEC/NOAEC	1
Birds, terrestrial-phase amphibians, reptiles	Acute	Non-listed, general PPHD effects	Upper bound EEC/LC_{50} (Dietary) Upper bound EEC /LD_{50} (Dose)	0.5
		Listed direct effects & obligate PPHD effects	Upper bound EEC /LC_{50} (Dietary) Upper bound EEC /LD_{50} (Dose)	0.1
	Chronic	Listed and non-listed, general, and obligate PPHD effects	Upper bound EEC /NOAEC	1
Mammals	Acute	Non-listed, general PPHD effects	Upper bound EEC /LD_{50} (Dose)	0.5
		Listed direct effects & obligate PPHD effects	Upper bound EEC /LD_{50} (Dose)	0.1
	Chronic	Listed and non-listed, general, and obligate PPHD effects	EEC^{1}/NOAEC (Dietary) EEC^{1}/NOAEL (Dose)	1

Table 3. Risk quotient (RQ) and levels of concern (LOC) for non-listed and federally listed threatened/endangered species by taxon.				
Taxon	**Exposure duration**	**Listed/non-listed**	**RQ[1]**	**LOC[1]**
Terrestrial invertebrates	Acute	Non-listed, general PPHD effects	EEC/LD_{50} (contact) EEC/LD_{50} (diet)	0.4[2]
		Listed direct effects & obligate indirect effects	EEC/LD_{50} (contact) EEC/LD_{50} (diet)	0.05[3]
	Chronic	Listed and non-listed, general, and obligate PPHD effects	EEC/NOAEC (diet)	1[2]
Aquatic plants	Not applicable	Non-listed, general PPHD effects	1-in-10-year, Daily EEC/ IC/EC_{50}	1
		Listed direct effects & obligate PPHD effects	1-in-10-year, Daily EEC/ NOAEC	1
Terrestrial plants	Not applicable	Non-listed, general PPHD effects	EEC/ IC_{25}	1
		Listed direct effects & obligate PPHD effects	EEC/ NOAEC	1

EC_{50}= 50% effect concentration; EEC=estimated environmental concentration; IC_{25}=Concentration resulting in 25% inhibition; LC_{50}=lethal concentration for 50% of the organisms tested; LD_{50}=lethal dose for 50% of the organisms tested; NOAEC=no-observed adverse effect concentration; PPHD= prey, pollination, habitat and/or dispersal.

[1]USEPA 2004.

[2]USEPA, PMRA, CDPR 2014.

[3]USEPA 2007.

Table 4. Summary of Risk Quotients (RQs) for Taxonomic Groups from the Uses of L-glufosinate on Conventional and Glufosinate-tolerant Field corn, Sweet corn, Soybean, Cotton, and Canola.				
Taxa	**Exposure Duration**	**Risk Quotient (RQ) Range[1]**	**RQ Exceeding the LOC**	**Additional Information/ Lines of Evidence**
Freshwater Fish	Acute	Not calculated	No	RQs are not calculated due to non-definitive endpoint – no mortality in study. Daily mean EECs are over three orders of magnitude below the highest concentration tested in the study where no mortality was observed.
	Chronic	<0.01	No	The RQs are based on a NOAEC above which there was a statistically significant ($p<0.05$) 12% reduction in post-hatch survival at the LOAEC.
Estuarine/ Marine Fish	Acute	Not calculated	No	RQs are not calculated due to non-definitive endpoint – no mortality in study. Daily mean EECs are over three orders of magnitude below the highest concentration tested in the study.
	Chronic	No data	No data	Estimated that estuarine/marine fish would have to be over an order of magnitude more sensitive than freshwater fish to exceed the Agency's chronic risk LOC.
Freshwater Invertebrates (Water-Column Exposure)	Acute	Not calculated	No	Daily mean EECs are over three orders of magnitude below the highest concentration tested in the acute toxicity study where no mortality was observed.
	Chronic	<0.01	No	The RQs are based on a NOAEC above which there was a statistically significant ($p<0.05$) 47% reduction in number of offspring per female at the LOAEC.
Estuarine/ Marine Invertebrates	Acute	<0.01	No	--
	Chronic	FP: <0.01-0.42 EOF: 0.58-**2.01**	Yes, EOF only	RQ is based on a NOAEC, there is a 30% reduction in offspring/female, 9% decrease in length, and 22% decrease in dry weight at the LOAEC. LOC exceedances based on edge-of-field EECs only.

Table 4. Summary of Risk Quotients (RQs) for Taxonomic Groups from the Uses of L-glufosinate on Conventional and Glufosinate-tolerant Field corn, Sweet corn, Soybean, Cotton, and Canola.				
Taxa	**Exposure Duration**	**Risk Quotient (RQ) Range[1]**	**RQ Exceeding the LOC**	**Additional Information/ Lines of Evidence**
Freshwater and Estuarine/Marine Invertebrates (Sediment Exposure)	Acute and Chronic	No data	No data	Based on the chemical/physical characteristics of L-glufosinate, benthic invertebrate toxicity data are not triggered. Exposure in the sediment pore water/overlying water is expected to be similar or lower than the water column; therefore, water column-based risk estimates are considered protective for benthic invertebrates.
Mammals	Acute	Dose-based: <0.01 – 0.07	No	RQs based on upper-bound exposure estimates fall below the LOC for acute risk to mammals for all uses. The RQ is based on a rat LD_{50} of 954 mg ae/kg bw. There are no exceedances for non-listed species.
	Chronic	Dose-based: 0.04 **– 12.1** Dietary-based: 0.05 **– 1.40**	**Yes**	Dose-based RQs exceed chronic risk LOC for all the uses. The RQ is based on a NOAEL above which there was statistically significant ($p<0.05$) reduction in the number of viable pups/litter (11-37%) across two generations at the LOAEL. RQs exceed the Agency's chronic risk LOC for all the uses when calculated based on the LOAEL. Chronic LOC exceedances for all the uses are still observed when using mean Kenaga nomogram values. Residues on food items are expected to result in risk estimates which exceed the Agency chronic risk LOC for up to 90 days (varies based on food item and the use). RQs exceeds the Agency chronic risk LOC up to 76 and 7 feet from the treated field when L-glufosinate is applied with aerial and ground equipment, respectively.

Table 4. Summary of Risk Quotients (RQs) for Taxonomic Groups from the Uses of L-glufosinate on Conventional and Glufosinate-tolerant Field corn, Sweet corn, Soybean, Cotton, and Canola.				
Taxa	**Exposure Duration**	**Risk Quotient (RQ) Range[1]**	**RQ Exceeding the LOC**	**Additional Information/ Lines of Evidence**
Birds	Acute	Not calculated	No	RQs not calculated due to non-definitive endpoint – 10-40% mortality in dietary study at concentrations 3 times above the upper-bound dietary EECs.
	Chronic	Dietary-based: 0.01 – 0.42	No	The RQs are based on a NOAEC from an avian reproduction study. No statistically significant effects were detected in the study; therefore, the NOAEC is the highest concentration tested. There is some uncertainty in RQs estimated based on the NOAEC because no data are available to evaluate chronic toxicity at higher dietary concentrations; however, based on the uses and rates, dietary-based EECs are not anticipated to exceed the dietary concentrations tested in the available study. Reproductive effects were observed in other avian species tested but only at dietary concentrations 3 times above the avian dietary EECs.
Bees[2]	Acute Adult	Not calculated	No	No mortality in either acute contact or oral toxicity studies with adult bees.
	Chronic Adult	**20.0-40.8**	**Yes**	RQs exceed chronic risk LOC for all the uses. A NOAEL could not be established in the study due to statistically significant ($p<0.05$) reductions in food consumption at all dose levels; therefore, the RQs are based on the EC_{10} (which was determined to be protective of the lowest detectable difference from controls). There is a 30% decrease in food consumption at the lowest observed adverse effect level (LOAEL). RQs exceed the chronic risk LOC when based on the LOAEL. These results demonstrate that the exposure from most uses could result in decreased food consumption which may also impact growth and foraging behavior.

Table 4. Summary of Risk Quotients (RQs) for Taxonomic Groups from the Uses of L-glufosinate on Conventional and Glufosinate-tolerant Field corn, Sweet corn, Soybean, Cotton, and Canola.				
Taxa	**Exposure Duration**	**Risk Quotient (RQ) Range[1]**	**RQ Exceeding the LOC**	**Additional Information/ Lines of Evidence**
	Acute Larval	Not calculated	No	An acute (single dose) larval toxicity study is not available; therefore, the acute larval risk assessment is based on the 8-day larval LD_{50} value from the chronic (repeat dose) larval toxicity study based on EPA's retrospective analysis demonstrating that larval chronic (repeat dose) toxicity study is protective for the acute (single-dose) toxicity study. RQs not calculated due to non-definitive endpoint – maximum 31% mortality in study.
	Chronic Larval	**0.94-1.90**	**Yes**	RQs exceed chronic risk LOC for all the uses. The RQ is based on a NOAEL above which there was a statistically significant ($p<0.05$) reduction in adult bee emergence (19%) at the LOAEL.
Terrestrial Invertebrates (non-bees)	Acute	Not Calculated	See Additional Information	Acute oral toxicity endpoints are non-definitive; therefore, RQs could not be estimated. Application of L-glufosinate at the maximum rates for all uses is expected to produce residues on-field that will cause significant mortality to terrestrial invertebrate species that encounter surfaces impacted by the spray application. Residues that drift off-site during spray application are expected to exceed the acute toxicity endpoint up to 7 and 53 feet from the field for ground and aerial applications, respectively.
	Chronic	Dietary-based: Adult = **0.30 -6.49** Larval = **0.08 - 2.38**	**Yes**	RQs exceed chronic risk LOC for all the uses. Semi-field studies further suggest that adverse effects resulting from L-glufosinate applications may manifest in non-bee terrestrial invertebrate populations and communities.

Table 4. Summary of Risk Quotients (RQs) for Taxonomic Groups from the Uses of L-glufosinate on Conventional and Glufosinate-tolerant Filed Corn, Sweet corn, Soybean, Cotton, and Canola.

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC	Additional Information/ Lines of Evidence
Aquatic Plants	N/A	Non-listed FP: 0.01 – **1.09** WL/EOF: 0.07 – **6.42**	**Yes**	Wetland and EOF RQs exceed LOC for non-listed non-vascular species for all the uses. Farm pond RQs also exceed the non-listed non-vascular species LOC for use on GMO-corn. Blue-green algae are the most sensitive non-vascular aquatic species tested by several orders of magnitude. Given the low likelihood of adverse effects to other non-vascular aquatic plant species, impacts to non-vascular plant communities are not expected. Aquatic vascular plants are ~23 times less sensitive than non-vascular aquatic plants. There are no other LOC exceedances for vascular plant species anticipated from the uses.
Terrestrial Plants	N/A	Non-listed Upland: 0.53-**5.66** Semi-Aquatic: 0.80-**10.4**	**Yes**	RQs for all the uses for L-glufosinate are greater than the LOC for risk to non-target non-listed upland terrestrial and semi-aquatic dicotyledonous and monocotyledonous plants. Exposure from spray drift alone exceeds the Agency's LOC for terrestrial plants up to 89 and 10 feet from the field for aerial and ground applications, respectively from the field edge when considering spray drift requirements on the label.

ae = acid equivalent; EC_{10}=concentration resulting in 10% effect relative to controls; EEC=estimated environmental concentration; EOF=edge of field; FP = farm pond; GMO=genetically modified organism; LOAEC=lowest observed adverse effect concentration; LOAEL=lowest observed adverse effect level; NOAEC= no observed adverse effect concentration; NOAEL=no observed adverse effect level; WL = wetland.

Level of Concern (LOC) Definitions: Terrestrial Vertebrates: Acute =0.5; Chronic=1.0 Terrestrial Invertebrates: Acute=0.4; Chronic=1.0 Aquatic Animals: Acute=0.5; Chronic=1.0 Plants: 1.0

[1] RQs reflect exposure estimates for parent and maximum application rates allowed on labels.

[2] RQs for terrestrial invertebrates are applicable to Western honeybees (*Apis mellifera*), which are also a surrogate for other species of *Apis* and non-*Apis* bees. Risks to other terrestrial invertebrates (*e.g.*, earthworms, beneficial arthropods) are only characterized when toxicity data are available.

C. Effects Determination under the Endangered Species Act

Consistent with ESA Section 7(a)(2), EPA assessed the potential effects of L-glufosinate on listed species and designated critical habitats (CHs). The federal action area is the overall geographic extent or footprint of the federal action plus any additional areas where effects are reasonably expected to occur and is based on the agricultural uses on glufosinate- resistant field corn, sweet corn, soybean, cotton, and canola, as well as non-resistant varieties of these same crops. EPA conducted an overlap analysis to determine which listed species and designated CHs occur within this action area. EPA also considered life history (including factors such as diet and body weight), toxicity, and exposure information to determine whether L-glufosinate will have No Effect (NE) or May Affect (MA) to a member of each listed species or a designated critical habitat.

Based on EPA's screening-level assessment, EPA identified risk concerns for aquatic invertebrates (chronic RQ range: <0.01-2.01), bees (chronic RQ range: 0.94-40.8), non-bee terrestrial invertebrates (chronic RQ range: 0.08 – 6.49), mammals (chronic RQ range: 0.04-12.1), non- vascular aquatic plants (RQ range: 0.01-6.42), upland terrestrial (RQ range: 0.53-5.66, and semi- aquatic plants (RQ range: 0.8 -10.4).

The effects determination identified 1,713 listed species and 825 designated CHs within the action area. Of those species, EPA made NE determinations for 665 listed species and 476 designated CHs. EPA's NE determinations were made when likely overlap of exposure sites and range/CH from the labeled uses is less than (<) 1% (based on overlap analysis) or no direct or indirect effects are expected (including effects to the physical or biological features [PBFs] of any CH). EPA made MA determinations for the remaining 1,048 listed species and 349 designated CHs.

For those listed species and designated CHs with MA determinations, EPA further distinguished whether L-glufosinate is not likely to adversely affect (NLAA) or likely to adversely affect (LAA) an individual of the listed species or any designated CH. EPA made NLAA determinations for 411 listed species and 152 CHs. EPA made these NLAA determinations when exposure is considered highly unlikely due to the habitat of the species or when PBFs are not likely to be adversely impacted by the registered use of L-glufosinate. EPA made LAA determinations for 637 listed species and 197 CHs. For those species with LAA determinations, the species ranges, or CHs have >1% overlap with areas where potential exposure to L-glufosinate may occur. For all designated CHs with LAA determinations, the following are PBFs that may be affected by the use of L-glufosinate: habitat quality of listed insects, insect prey, and insect pollinators. Table 5 summarizes the effects determinations by taxon for listed species and for designated CHs.

EPA further evaluated the LAA species and CH, adopting an approach based on existing methodology to predict the potential likelihood of future jeopardy (J) to any listed species or adverse modification (AM) of any CH from the use of L-glufosinate before implementation of mitigations. Of the species with LAA determinations, EPA initially predicted a potential likelihood of future jeopardy for 60 listed species. EPA also initially predicted a potential likelihood of future adverse modification of 38 CHs. These were identified primarily for plants and CHs that are either directly impacted or highly dependent on plants and have a high to medium overlap with at least one agricultural use data layer (UDL) within the likely exposure

area. The predicted potential likelihood of future J/AM for listed species and designated CHs is summarized in Table 5. EPA determined several mitigations for the uses of L- glufosinate were needed to avoid the predicted potential likelihood of future J/AM and to reduce incidental take and adverse effects to plants which are likely to result from this action without these mitigations. The mitigations are described in Section VI.C.

Table 5. Number of Listed Species Effects Determinations and Predictions of Potential Likelihood of Future Jeopardy or Adverse Modification by Taxon[1].

Taxon[2]	**Number of Species/CH[2]**	**NE**	**NLAA**	**LAA, Not Likely J/AM**	**LAA, Likelihood of J/AM**
Amphibians[3]	38	10	4	21	3
Aquatic Invertebrates	174	0	39	134	1
Birds	98[*]	17	49	31	1
Fish	169[*]	1	63	98	7
Mammals	94	24	42	26	2
Plants	938	533	175	195	35
Reptiles[3]	45	8	16	19	2
Terrestrial Invertebrates[4]	157	72	23	53	9
Total Listed Species	1,713	665	411	577	60
Designated Critical Habitat	825[*]	476	152	159	38

[*]The total number of listed species and designated critical habitat were 1,715 and 826, respectively, as of February 2022. One bird species and one fish species have been delisted due to recovery since that date. Additionally, the delisted fish species had designated critical habitat (CH). Delisted species and CH did not receive determinations; therefore, the total number of species and CH evaluated in this Biological Evaluation (BE) are 1,713 and 825, respectively.

[1] CH = critical habitat; NE = no effect; NLAA = not likely to adversely affect; LAA = likely to adversely affect; J = jeopardy; AM = adverse modification

[2] Reflects the species federally listed as endangered or threatened and critical habitats designated as of February 16, 2022.

[3] "Amphibians" and "Reptiles" include those species that have both a terrestrial and aquatic phase.

[4] "Terrestrial Invertebrates" includes species with both a terrestrial and aquatic phase.

D. Benefits Assessment

As part of the registration process, EPA provides a review regarding the benefits of the registration of L-glufosinate. EPA assesses the benefits of the new pesticide as compared to available conventional herbicide control methods based on information submitted by the applicant, state extension weed control guides from multiple crops and regions and publicly available scientific literature to verify registrant's claims, using racemic glufosinate as a proxy for L-glufosinate.

The L-glufosinate products will be applied at use rates with approximately half the amount of total glufosinate as in racemic glufosinate products, but with the same amount of the herbicidally active L-glufosinate isomer applied. L-glufosinate is functionally the same herbicide as racemic glufosinate, and the benefits to users would be almost identical to racemic glufosinate in registered use sites. Racemic glufosinate has high benefits to users as a nonselective postemergence contact herbicide in both glufosinate-resistant and non-resistant crops. If registered, L-glufosinate products could be used in place of racemic glufosinate in existing weed control programs, including as a part of Herbicide Resistance Management (HRM) and Integrated Pest Management (IPM) programs. Similar to racemic glufosinate, L-glufosinate could be used to control emerged broadleaf and grass weeds in field corn, sweet corn, soybean, cotton, and canola, including problematic weeds such as Palmer amaranth, water hemp, and ragweed that are resistant to glyphosate or other herbicide modes of action. In glufosinate-tolerant crop varieties, L-glufosinate could be used similar to racemic glufosinate for weed control after crop emergence.

For more detailed information on benefits for L-glufosinate refer to the following document in the docket EPA-HQ-OPP-2020-0250 *"Assessment of Benefits for the New Registrations of the Enriched Isomer Herbicides Glufosinate-P-Ammonium (PC Code 128300) and Glufosinate-P (PC Code 128812), Also Known As L-glufosinate Ammonium and L- Glufosinate Acid".*

E. Greater-than-Additive Effects

The technical registrants (BASF and MITSUI) conducted independent analyses of U.S. patents (Cain and Lorenz 2022; Pennino and Setliff 2022) to identify any incidence of greater-than-additive (GTA; synergy) claims for L-glufosinate with other agricultural chemicals The registrant based their analysis on the EPA interim guidance document entitled "*Process for Receiving and Evaluating Data Supporting Assertions of Greater Than Additive (GTA) Effects in Mixtures of Pesticide Active Ingredients and Associated Guidance for Registrants*" (USEPA 2019). Based on the registrants' analyses of the patent search results, none of the identified patents met all the conditions discussed in the EPA guidance document. Therefore, based on the information provided through the analyses of U.S. patents, there are no data at this time to support claims of GTA or synergistic interactions of L-glufosinate with other active ingredients nor did the applicants request approval of any claims of synergy.

V. PUBLIC COMMENTS

On September 24, 2020, EPA published a Notice of Receipt (NOR) in the Federal Register (Docket ID: EPA-HQ-OPP-2020-0250) notifying that EPA was in receipt of an application to register pesticide products containing the active ingredient L-glufosinate ammonium, not

included in any currently registered pesticide products and announced a public comment period of 30 days. EPA received one comment on the NOR from the Center for Biological Diversity. The comment can be found in docket ID EPA-HQ-OPP-2020-0250 at www.regulations.gov. On November 28, 2023, EPA published a second NOR in the Federal Register for an additional application requesting the registration of three new L-glufosinate ammonium products from BASF for use on canola, field corn, sweet corn, cotton and soybean. The public comment period closed on December 28, 2023, with no relevant comments received on the NOR.

On February 8, 2021, EPA published a NOR in the Federal Register (Docket ID: EPA-HQ-OPP-2020-0533) notifying receipt of an application to register pesticide products containing the active ingredient L-glufosinate Free Acid, not included in any currently registered pesticide products; the NOR announced a public comment period of 30 days. EPA received one comment on the NOR from the Center for Biological Diversity. The comment can be found in docket ID EPA-HQ-OPP-2020-0533 at www.regulations.gov.

On May 9, 2024, EPA published the Memorandum Supporting Proposed Decision to Approve Registration for the New Active Ingredient Isomer, Glufosinate-P. The proposed decision announced a public comment period of 30 days. All comments received on this proposed decision can be found in EPA-HQ-OPP-2020-0250.

The comments will be addressed in Response to Public Comments on EPA's Registration of the New Active Ingredient, Glufosinate-P (Docket IDs: EPA-HQ-OPP-2020-0250 and EPA-HQ-OPP-2020-0533), in order to respond to all comments on these actions comprehensively, including comments received during the 30-day public process.

VI. FINAL REGULATORY DECISION

In accordance with FIFRA, EPA registers a pesticide unconditionally when it determines that it will not cause unreasonable adverse effects on humans or the environment, while taking into account the economic, social, and environmental costs and benefits of the use of the pesticide. Under FIFRA, EPA is charged with balancing risks posed by the use of a pesticide against its benefits. EPA must determine if the benefits in light of its use outweigh the risks for EPA to register the pesticide.

FIFRA 3(c)(5) requires EPA to approve registration if the Agency determines that:

(a) its composition is such as to warrant the claims for it;
(b) its labeling and other material required to be submitted comply with the requirements of this subchapter;
(c) it will perform its intended function without unreasonable adverse effects on the environment; and
(d) when used in accordance with widespread and commonly recognized practice it will not generally cause unreasonable adverse effects on the environment.

A. Rationale and Risk Mitigation

EPA is issuing unconditional registrations under FIFRA section 3(c)(5) for the following products for use on both conventional and glufosinate-resistant varieties of canola, field corn, sweet corn, cotton, and soybean:

- BASF L-Glufosinate Ammonium Technical (EPA Registration Number 7969-475) as a TGAI.
- L-Glufosinate-ammonium Technical Product (EPA Registration Number 7969-498) as a TGAI.
- L-Glufosinate-Ammonium Manufacturing-Use Product (EPA Registration Number 7969-499) as a MUP.
- BASF L-Glufosinate-Ammonium 211(EPA Registration Number 7969-500) as an end use product.
- L-Glufosinate Free Acid (EPA Registration Number 86203-32) as a TGAI.
- L-Glufosinate Liquid Formulation (EPA Registration Number 86203-33) as an end use product.

To determine whether the products will cause unreasonable adverse effects under FIFRA, EPA is charged with considering the economic, social, and environmental costs and benefits of the use of the pesticide. To determine the risks and benefits, the Agency reviewed a large body of information to determine how these products will be used according to the final labeling. EPA determines whether a product will generally cause unreasonable adverse effects by considering whether the benefits of the product outweigh any potential risks of concern or adverse impacts from its use.

EPA has determined that the database is complete for assessment of risks to human health and the environment for the glufosinate-P agricultural crop uses. Based on these data, EPA has not identified any dietary or aggregate risks of concern for human health. Additionally, EPA has not identified any risks of concern for non-listed birds, reptiles, terrestrial- and aquatic-phase amphibians, freshwater invertebrates, and freshwater and estuarine/marine fish on an acute or chronic exposure basis. There were no acute risks to non-listed mammals, bees, or estuarine/marine invertebrates. However, EPA identified risks of concern for terrestrial and aquatic plants and chronic risk to mammals, bees and non-bee terrestrial invertebrates that forage in treated fields and may be exposed to residues on food items off-site from spray drift during application to the treated field. To address the identified risk of concerns for listed species, the Agency believes the mitigations to reduce runoff and spray drift described in the ESA section below, will avoid the potential likelihood of future jeopardy for listed species and/or adverse modification of designated critical habitat at the population level. These mitigations will also further reduce the likelihood of adverse effects to individual listed and non-listed species including bees.

Glufosinate-P is the enriched L-isomer form of racemic glufosinate and is a non-selective foliar herbicide for post-emergence control of annual and perennial grass and broadleaf weeds. Glufosinate-P and glufosinate-P-ammonium products could be used in place of racemic glufosinate in existing weed control programs, including as a part of Herbicide Resistance Management (HRM) and Integrated Pest Management (IPM) programs.

The Agency finds the benefit of having a broad spectrum, non-selective broadcast applied herbicide for control of broadleaf weeds, grasses, and sedge weeds as a rotational tool warrant the registration of the products and that the mitigation measures address identified environmental risks. EPA reviewed the compositions of the products and determined that the claims made are warranted as the data and product label support the approval of the

registrations. The final labeling, which has been revised to include additional mitigation measures to address ecological risks, contains all the necessary requirements and restrictions, and complies with the requirements of FIFRA.

Therefore, considering the assessed risk to human health and the environment, consistent with the requirements of FIFRA section 3(c)(5), EPA concludes that glufosinate-P meets the regulatory standard under FIFRA and concludes that registering the products and the use of glufosinate-P as a non-selective foliar herbicide for weed control in conventional and glufosinate-resistant varieties of canola, field corn, sweet corn, cotton and soybean, would not cause unreasonable adverse effects on human health or the environment when the herbicides are used in accordance with the labels, and widespread and commonly recognized practice.

B. Endangered Species Assessment

ESA section 7(a)(2) provides that "[*e]ach Federal agency shall, in consultation with [FWS] ensure that any action authorized, funded, or carried out by such agency. . . is 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. . . .*"

EPA completed the effects determinations for federally listed threatened and endangered species (listed species) for the uses of glufosinate-P in terms of acid equivalents (ae) in the areas where it may be applied. EPA evaluated whether the registration of the products containing this active ingredient pose any reasonable expectation of discernible effects to listed species and designated critical habitats within the action area in the listed species effects determination. The ESA effects determination makes use of the best available scientific and commercially available information and considers both direct and indirect effects. The term "direct effects" refers to decreases in the survival, growth, or reproduction of individuals of a listed species due to exposure to glufosinate-P. The term "indirect effects" refers to impacts on individuals of a listed species that may be the result of the effects of glufosinate-P on organisms on which the listed species depends upon for prey, pollination, habitat, and/or dispersal.

In the effects determination (*Glufosinate-P and Glufosinate-P-Ammonium: Environmental Fate and Ecological Risk Assessment (ERA) for the FIFRA Section 3 Registration and Biological Evaluation (BE) with Associated Effects Determinations for Federally Listed Endangered and Threatened Species and Designated Critical Habitat)*, EPA preliminarily concluded that the use of the glufosinate-P products may affect and are Likely to Adversely Affect (LAA) multiple listed species and designated critical habitats. When considering an action (*e.g.*, the registration of a pesticide product), the ESA directs federal agencies to avoid jeopardizing listed species or adversely modifying their designated critical habitats. An LAA determination is not equivalent to a jeopardy determination; however, EPA can assess the potential likelihood for future jeopardy or adverse modification (J/AM) to help inform the formal consultation with the Services and resulting Biological Opinions developed by the Services. *See 50 C.F.R. 402.40(b)(1).* The purpose of EPA evaluation of the potential likelihood of future J/AM is to inform mitigations to avoid and minimize exposures to listed species earlier in the consultation process. Therefore, for those species and critical habitats with preliminary LAA determinations, EPA further assessed the potential likelihood that the glufosinate-P products would lead to future J/AM. The Services will make the final determination as to any jeopardy to listed species and any adverse modification to designated critical habitats.

In the effects determination, EPA initially predicted that the labeled uses were likely to jeopardize 60 species and adversely modify 38 CH. Based on the LAA determinations, EPA also concluded the uses could result in incidental take of individuals for an additional 382 listed animal species and affect individuals of an additional 197 listed plant species. Direct effects to plants at the use site and up to 60 meters (197 ft) from the field are the main drivers of population-level effects and adverse modification of CH predicted for listed species. While glufosinate-P is not predicted to adversely affect populations of listed animal species through direct effects, adverse effects to the species vegetative habitat and sources of forage are predicted to jeopardize certain species' existence.

To address the predicted potential likelihood of future jeopardy of listed species and adverse modification of designated critical habitat, EPA used the Herbicide Strategy framework to inform the level of mitigations necessary to reduce runoff/erosion. To determine the level of mitigation, EPA used the Magnitude of Difference analysis. That analysis showed that one order of magnitude reduction in exposure, equating to 3 points of mitigation, would sufficiently reduce exposure from runoff/erosion by a factor of 10x to avoid predicted likelihood of future jeopardy of listed species and adverse modification of designated critical habitat. Users must select mitigations that total three points from the website (https://www.epa.gov/pesticides/mitigation-menu). While many of the animal species with LAA determinations may occupy, move through, or forage at use sites, it is unlikely that any of the species would regularly use these sites thereby limiting the number of individuals affected such that effect would result in jeopardy to the population.

Off-site transport from spray drift and runoff are the main drivers of exposure for the majority of listed plant species that are predicted to have a potential likelihood of future jeopardy from the uses. Only two listed plant species (*i.e.*, Spring Creek bladderpod (*Lesquerella perforata*) and the whorled sunflower (*Helianthus verticillatus*)) have been identified by EPA as particularly vulnerable[2] and likely to establish on agricultural fields where glufosinate-P is labeled for use. Spray drift and runoff from both ground and aerial applications led to LAA determinations and predicted potential likelihood of future jeopardy or adverse modification. Please note that EPA has reexamined some of the AgDRIFT® parameters for aerial application as a response to comments received for Memorandum Supporting Proposed Decision to Approve Registration for the New Active Ingredient Isomer, Glufosinate-P published on May 9, 2024. The buffer distances mentioned under label statement section below is consistent with this revised aerial spray drift assessment and informed by the final herbicide strategy.

EPA has identified the following avoidance and minimization mitigation options to reduce exposure to plants to address EPA's prediction of potential likelihood of future jeopardy/adverse modification, reduce incidental take, and reduce adverse effects to plant individuals. Since the Spring Creek bladderpod is likely to establish on managed agricultural fields, avoidance mitigations include measures tailored specifically to this species life history to reduce exposure during the months when the species is present on the field. EPA has identified whorled

[2] EPA defines a vulnerable species as a listed species that is particularly vulnerable to pesticides due to a combination of factors including a declining population trend, small number of individuals or small number of populations (*e.g.*, groups of individuals or sub-populations), limited distribution (*e.g.*, endemic, constrained and/or isolated populations), and occurrence in areas that may be exposed to pesticides (https://www.epa.gov/endangered-species/implementing-epas-workplan-protect-endangered-and-threatened-species-pesticides#species).

sunflower to be a particularly vulnerable species, that has a potential likelihood of future jeopardy or adverse modification of designated critical habitat because of glufosinate-P use. This is consistent with recent FWS biological opinions issued for pesticides with similar environmental fate properties and application methods. So necessary avoidance mitigations specific to whorled sunflower restricting the use of glufosinate-P within the use limitation area is necessary. Before using glufosinate-P products, any applicable Endangered Species Protection Bulletins (Bulletins) must be obtained within six months prior to or on the day of application.

Minimization mitigations focused on reducing off-site transport and exposure are intended to broadly address the potential likelihood of future J/AM to limit direct effects to listed plant species and PPHD effects to listed animal species that rely on plants. The registrants have agreed to the label mitigations described in Section VI.C., which include avoidance and minimization mitigation options to reduce exposure to plants.

EPA determined that including the mitigation measures on these registrations and labeling address the Agency's predictions of potential likelihood of future J/AM from the use of these products. The Services make the final determination of whether these registration actions will likely cause jeopardy of any listed species or adverse modification of any designated CHs. The Services provide their determinations in their biological opinions and EPA may determine that additional mitigations are necessary.

In cases where EPA determines that initiating formal consultation is appropriate on a FIFRA action, as here, the Agency may still be able to proceed with the action before completing consultation if it determines that doing so will not result in "any irreversible or irretrievable commitment of resources . . . [that] has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures which would not violate [ESA section 7(a)(2)]." See 16 U.S.C. § 1536(d). As stated above, EPA initiated formal consultation with the Services on October 17, 2024. EPA will work with the Services to complete the consultation process as expeditiously as possible. Acknowledging that the final determination on jeopardy and adverse modification is made by the Services and that either (or both) of the Services may not fully adopt EPA's prediction that this action will avoid jeopardy and adverse modification, the registration includes a term to allow EPA to address any further mitigation determined to be necessary following consultation. The Agency has also concluded that granting the registrations for glufosinate-P prior to the completion of formal consultation with the Services will not result in any irreversible or irretrievable commitment of resources that would have the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures, in accordance with ESA section 7(d)[3].

C. Label Statements

The following statements are included on the end-use product labels.

The following label mitigation have been added to the product labels (EPA file Symbol 7969-500 and EPA File Symbol 86203-33) to mitigate environmental risks:

[3] Endangered Species Act Section 7(d) Consistency Determination with Respect to the Application for the Registration of Products Containing the New Active Ingredient Glufosinate-P

1. For all use sites:

    a. "DO NOT apply using chemigation."

2. For non glufosinate-resistant crops, the label specify:

    a. "DO NOT allow this product to be applied to or come into contact with crop foliage.

    b. DO NOT apply aerially."

3. To reduce exposure from the labeled uses of glufosinate-P, EPA is relying on a combination of measures to minimize or avoid exposure. The following language is included under Directions for Use Section with a '**MANDATORY SPRAY DRIFT MITIGATIONS**' header.

MANDATORY SPRAY DRIFT MITIGATIONS

For Aerial and Ground Boom Applications:

- Do not apply when wind speeds exceed 15 miles per hour at the application site.
- Select nozzle and pressure that deliver medium or coarser spray droplets as indicated in nozzle manufacturer's catalogues and in accordance with American Society of Agricultural & Biological Engineers standards 572.1 and 641 (ASABE S572 and S641).
- During application, the Sustained Wind Speed, as defined by the National Weather Service (standard averaging period of 2 minutes) must register between 3 and 15 miles per hour.
- Wind speed must be measured at the release height or higher, in an area free from obstructions such as trees, buildings, and farm equipment.
- Do not apply during temperature inversions.

For Aerial Application:

- When applying to crops via aerial application equipment, the spray boom must be mounted on the aircraft to minimize drift caused by wing tip or rotor blade vortices.
- Wind speed and direction must be measured on location using a windsock, an anemometer (including systems to measure wind speed or velocity on an aircraft), or an aircraft smoke system.
- When the wind speed is between 11-15 miles per hour, the boom length must be 65% or less of the wingspan for fixed wing aircraft and 75% or less of the rotor diameter for helicopters. Otherwise, the boom length must be 75% or less of the wingspan for fixed-wing aircraft and 90% or less of the rotor diameter for helicopters.
- When the wind speed is between 11-15 miles per hour, applicators must use a minimum of ¾ swath displacement upwind at the downwind edge of the field. Otherwise, applicators must use a minimum of ½ swath displacement upwind at the downwind edge of the field.

- Do not release spray at a height greater than 10 ft above the crop canopy unless a greater application height is required for pilot safety.

For Ground Boom Application:

- Spray at the appropriate boom height based on nozzle selection and nozzle spacing, but do not exceed a boom height of 24 inches above target pest or crop canopy. Set boom to lowest effective height over the target pest or crop canopy based on equipment manufacturer's directions.
- Wind speed and direction must be measured on location using a windsock or anemometer (including systems to measure wind speed or velocity using application equipment).

Mandatory Spray Drift Buffers

For aerial and ground applications, maintain a downwind buffer between the last spray row and the protection area as follows:

Application Method	Droplet Size Distribution (DSD)	Minimum Buffer Distance
Aerial	medium	50 ft
Ground	medium or coarser	10 ft

Protection areas include all areas with the following exceptions which can be included in the buffer footage, provided that people are not present within the application exclusion zone during the application, and they will not be contacted by the pesticide, either directly or through drift (see 40 CFR 170.405(a) and 40 CFR 170.505(a)):

- Agricultural fields, including untreated portions of the treated field.
- 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.
- Buildings and their perimeters, silos, or other man-made structures with walls and/or roof.
- 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), and other mitigation measures identified by EPA on the mitigation menu.[1]
- Managed wetlands including constructed wetlands on the farm.
- 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 must ensure that pesticide use does not cause degradation of the CRP habitat.*

Aerial Spray Drift Buffer Reduction Options:

- A 20% (*i.e.*, 10-foot) reduction in the required wind-directional buffer distance can be made if the applicator selects a nozzle and pressure that deliver coarse or coarser droplets in accordance with ASABE s572.
- A 35% (i.e., 18-foot) reduction can be made if the applicator selects a nozzle and pressure that delivers coarse droplets and uses an oil emulsion drift reducing adjuvant that constitutes 2.5% of the volume of the finished spray tank mix. A reduction in the required wind-directional buffer distance can be made if a windbreak or shelterbelt (*e.g.*, trees or riparian hedgerows) between the application site and non-managed area is present and meets the criteria listed in the **'Windbreak-Shelterbelt Criteria'** section of this label. The reduction is 50% (*i.e.*, 25 feet) if the windbreak or shelterbelt meets the basic windbreak-shelterbelt criteria and is 75% (*i.e.*, 38 feet) if the windbreak or shelterbelt meets the advanced windbreak-shelterbelt criteria.
- The percent reduction in wind-directional buffer distances may be added if you use one droplet size buffer reduction option (coarse or coarse with an oil emulsion drift reducing adjuvant that constitutes 2.5% of the volume of the finished spray tank mix) and one windbreak-shelterbelt option (basic or advanced). The maximum buffer reduction that can be achieved by a combination of buffer reduction options is 100% (i.e., no drift buffer).

Ground Boom Spray Drift Buffer Reduction Options:

Any of the following options can reduce the ground buffer distance to 0 feet:

- Use of an oil emulsion drift reducing adjuvant that constitutes 2.5% of the volume of the finished spray tank mix.
- Application is made using an over-the-top hooded sprayer, as a layby application, or is made below the crop canopy using drop nozzles.
- Use of a row-middle hooded sprayer.
- If a windbreak or shelterbelt (*e.g.*, trees or riparian hedgerows) between the application site and non-managed area is present and meets the criteria listed in the **'Windbreak-Shelterbelt Criteria'** section of this label.

Windbreak-Shelterbelt Criteria

Both basic and advanced windbreaks or shelterbelts (*e.g.*, trees or riparian hedgerows) between the application site and non-managed area must be present and meet the following criteria for 50% and 75% wind-directional buffer distance reductions, respectively:

- The windbreak or shelterbelt must be downwind between the pesticide application and the non-managed area.
- The windbreak or shelterbelt must run the full length of the treated area with no significant breaks in the vegetation.
- The windbreak or shelterbelt foliage must be sufficiently dense such that the non-managed area is not visible from the upwind side at the time of application.
- The windbreak or shelterbelt must be planted according to local/regional/federal conservation program standards; however, no state or federally listed noxious or invasive trees or shrubs should be planted.

- The windbreak or shelterbelt must be maintained such that their functionality is not compromised.
- For basic windbreaks (50% reduction)
  - The height of the trees in the windbreak or shelterbelt must be at the same height or above the release height of the application.
  - The windbreak must have a minimum of one row of trees and/or shrubs or a 4-foot-wide strip of non-woody vegetation.
  - A semi-permeable manmade structure, curtain, or netting that is raised prior to application can be used instead of a windbreak or shelterbelt. This structure must be downwind between the pesticide application and the non-managed area, cover the entire distance of field adjacent to non-managed area, and at the same height or higher as the release height of the application.

- For advanced windbreak-shelterbelt (75% reduction)
  - The height of the trees in the windbreak or shelterbelt must be at a height that is at least twice as high as the release height of the application.
  - The windbreak or shelterbelt must have a minimum of two or more rows of trees and/or shrubs with a mixture of vegetation types (*e.g.*, trees, shrubs, herbs), or that have 8 or more feet of depth for herbaceous (non-woody) vegetation.
  - A semi-permeable manmade structure, curtain, or netting that is raised prior to application can be used instead of a windbreak or shelterbelt. This structure must be downwind between the pesticide application and the non-managed area, cover the entire distance of field adjacent to non-managed area, and at a height that is at least twice as high as the release height of the application.

SEE "ADDITIONAL SPRAY DRIFT INFORMATION" section below for more details.

ADDITIONAL SPRAY DRIFT INFORMATION:

This section is intended to provide additional information for applicators to assist in implementing the mandatory spray drift mitigations above. THE APPLICATOR IS RESPONSIBLE FOR AVOIDING OFF-SITE SPRAY DRIFT. Be aware of nearby non-target sites and environmental conditions.

Importance of droplet size

An effective way to reduce spray drift is to apply large droplets. Consider the largest droplets that provide target pest control. While applying larger droplets will reduce spray drift, the potential for drift will be greater if applications are made improperly or under unfavorable environmental conditions.

Controlling Droplet Size – Ground boom

• Volume – Increasing the spray volume so that larger droplets are produced will reduce spray drift. Consider using the highest practical spray volume for the application. If a greater spray volume is needed, consider using a nozzle with a higher flow rate.

• Pressure – Using the lowest spray pressure recommended for the nozzle will produce the target spray volume and droplet size.

• Spray Nozzle – Consider using a spray nozzle that is designed for the intended application, as well as using nozzles designed to reduce drift.

Controlling Droplet Size – Aircraft

• Adjust Nozzles – Applicators should follow nozzle manufacturers' recommendations for setting up nozzles. Generally, to reduce fine droplets, nozzles should be oriented parallel with the airflow in flight.

Release height – Ground Boom

For ground equipment, the boom should remain level with the crop and have minimal bounce. Automated boom height controllers are recommended with large booms to better maintain optimum nozzle to canopy height. Excessive boom height will increase the potential for spray drift.

Release height – Aircraft

Higher release heights increase the potential for spray drift.

Hooded (or shielded) sprayers

Shielding the boom or individual nozzles can reduce spray drift. Consider using hooded sprayers. Applicators should verify that the shields are not interfering with the uniform deposition of the spray on the target area.

Temperature and humidity

When making applications in hot and dry conditions, consider using larger droplets to reduce effects of evaporation.

Temperature inversions

Drift potential is high during a temperature inversion. Temperature inversions are characterized by increasing temperature with altitude and are common on nights with limited cloud cover and light to no wind. The presence of an inversion can be indicated by ground fog or 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. Avoid applications during temperature inversions.

Wind

Drift potential generally increases with wind speed.

Applicators need to be familiar with local wind patterns and terrain that could affect spray drift.

Measuring wind speed and wind direction

Applicators should check and acquire the predicted wind speed and direction for the application site within 12 hours prior to conducting applications to determine the time periods wind speed is likely to fall outside the applicable thresholds.

- Applicators should reassess wind speed and direction at the application site every 15 minutes while applications are in progress.
- Measuring wind speed and direction can be done by:

- Relying on equipment on the application equipment that measures wind speed (e.g., aerial equipment).
- Using a tower anemometer with telemetry or handheld anemometer. Users should read user manual on how to calibrate, operate and interpret the output from an anemometer. Ground applicators should stop every 15 minutes to take a reading with a tower anemometer with telemetry or handheld anemometer. Some anemometers may have software that would allow users to view wind measurements in real time while making an application, and, those cases, applicators would not have to stop to take measurements.
- Using a windsock. Wind can be estimated with a windsock using the strips on a windsock. The applicator should consult the user manual for the windsock on wind speed estimation and direction of wind. Applicators should look at the sock at least every 15 minutes to estimate wind speed and direction. The windsock should be pointed in the opposite direction of the windbreak and the non-managed area.
- Using an aircraft smoke system. Laying down several puffs of smoke along different lines using an aircraft smoke system can provide an accurate view of what the wind speed and direction for the application.
- Checking behind the spray rig at least every 15 minutes to see if the spray has changed direction from when the application started.

4. To inform the mitigations identified to address runoff/erosion risks, EPA considered the Herbicide Strategy framework. EPA determined the margin of difference for glufosinate-P placed this pesticide in the low category; therefore, EPA identified that three mitigation points is needed to avoid effects to listed species. The following language will be included on the label to specify the label runoff/erosion mitigation measures required.

MANDATORY RUNOFF MITIGATION:

- DO NOT appl when soils are saturated or above field capacity.
- DO NOT apply during rain.

You must achieve a minimum of three points for the crop uses listed on this label unless otherwise stipulated below.

Applicators must access and search Bulletins Live! Two (BLT) at https://www.epa.gov/pesticides/bulletins within six months of the application to determine whether the application site falls within a Pesticide Use Limitation Area (PULA) that has a Bulletin in BLT. If you are located inside a PULA, follow the instructions in the bulletin.

If the application site is located outside a PULA, runoff/erosion mitigation is required for this product unless certain field/application parameters are present at the time of application (i.e., subsurface or tile drains with controlled outlet, perimeter berm systems, irrigation tailwater return systems, spot treatment, etc). Access EPA's Mitigation Menu Website at www.epa.gov/pesticides/mitigation-menu for a full list of field/application parameters to evaluate whether your field is subject to runoff/erosion mitigation.

If the application does not meet the specified field/application parameters, a minimum of three points for the crop uses listed on this label must be achieved. The applicator must choose among the mitigation and/or mitigation relief measures on EPA's Mitigation Menu

Website to meet or exceed these points before applying this product. The website includes the full menu of runoff/erosion mitigation and mitigation relief measures. The following are examples:

- Location in a very low, low, or medium runoff vulnerability county
- Field slope
- Soil incorporation
- Conservation tillage
- Vegetative strips
- Cover crop or continuous ground cover
- Irrigation water management
- Mulching
- Grassed waterway
- Vegetated ditch
- Constructed and natural wetlands
- Water retention systems
- Following recommendations from a runoff/erosion specialist or participating in a qualifying conservation program (see the www.epa.gov/pesticides/mitigation-menu for minimum elements).

To achieve mitigation points for the application, the mitigation and mitigation relief measures must be:

- Employed in accordance with the instructions and descriptions on EPA's Mitigation Menu Website.
- In place during the application unless a different timing (such as before or after application) is specifically provided in the measure's description on EPA's Mitigation Menu Website.

EPA may periodically update the Mitigation Menu Website, for example, by adding new mitigation measures or updating a mitigation measure description.

5. When tank mixing, the most restrictive of the products' label or bulletin requirements must be followed (e.g., use prohibition, timing restriction, application method restriction, sandy soil application restriction)." To address the potential effects to non-target vulnerable species, specifically the listed plant species Spring Creek bladderpod and whorled sunflower, included in the "Bulletins Live! Two" web-based system (BLT), the end-use product directs all users to access the BLT prior to application, according to the label statement below:

ENDANGERED AND THREATENED SPECIES PROTECTION REQUIREMENTS*:* Before using this product, you must obtain any applicable Endangered Species Protection Bulletins (Bulletins) within six months prior to or on the day of application. To obtain Bulletins, go to Bulletins Live! Two (BLT) at https://www.epa.gov/pesticides/bulletins. When using this product, you must follow all directions and restrictions contained in any applicable Bulletin(s) for the area where you are applying the product including any restrictions on application timing if applicable. It is a violation of Federal law to use this product in a manner inconsistent with its labeling, including this labeling instruction to follow all directions and restrictions contained in any applicable Bulletin(s). For general questions or technical help, call 1-844-447-3813, or email ESPP@epa.gov.

VII. SUPPORTING DOCUMENTS

All supporting documents can be found in docket ID number EPA-HQ-OPP-2020-0250 at regulations.gov.