Ecological Risk Assessment

Section 3
New Uses on Turf and for Control of Aquatic Vegetation in Aquatic Environments

Penoxsulam
(PC Code 119031, CASN 219714-96-2)

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I. EXECUTIVE SUMMARY

A. Nature of Chemical Stressor

Penoxsulam is a systemic, post-emergence herbicide belonging to the triazolopyrimidine sulfonamides chemistry family. The mode of action is by inhibition of acetolactate synthase (ALS), the first enzyme in the biosynthetic pathway for the amino acids leucine, valine, and isoleucine. Penoxsulam is currently registered for application to semi-aquatic environments where rice is grown, including flooded rice paddies (DP288160; DP298227; DP298401; DP298490-2, 2004). For the proposed new uses, penoxsulam may be applied via ground spray, aerial spray, granules, impregnated granular fertilizer, and by direct subsurface injection of water bodies. Maximum application rates for the proposed new uses of penoxsulam are 0.09 lb ai/acre for turf, 0.175 lb ai/acre for exposed sediment, and 150 ppb (maximum concentration) in water bodies.

Environmental fate studies indicate that penoxsulam is very mobile in soil (K_{oc} = 13-305 mL/g), but slightly less mobile in sediment (K_{oc} = 1130 mL/g). Penoxsulam is stable to hydrolysis. Dissipation in aqueous environments is dependent upon water turbidity, pH, and light conditions. Penoxsulam dissipates rapidly in clear, shallow water at a pH above 5, under conditions favorable to aqueous photolysis, and is moderately persistent in terrestrial environments. The major routes of dissipation for penoxsulam when used on turf and aquatic weeds are expected to be through aqueous photolysis ($t_{1/2}$ = 1.5-14 days) and anaerobic metabolism ($t_{1/2}$ = 6.6-11 days). The low mobility in sediment is off-set by rapid degradation under anaerobic conditions, precluding the accumulation of sediment bound penoxsulam. Penoxsulam is moderately persistent in aerobic soil environments ($t_{1/2}$ = 12-118 days), and degrades less rapidly in aerobic aquatic environments. Due to the low vapor pressure and Henry's Law constant, volatilization is not expected to contribute significantly to dissipation. Eleven major degradation products have been identified. Five of these degradation products reach maximum reported concentrations at fate study termination, limiting our ability to fully characterize these degradates, and their respective degradation pathways.

B. Potential Risks to Non-target Organisms

No acute risk to freshwater and marine/estuarine fish and invertebrates, birds, and mammals was supported by the results of this screening risk assessment. Likewise, chronic risk to freshwater and estuarine/marine fish and invertebrates, birds and mammals was not supported by the results of this screening risk assessment. Tables I-B1 through I-B3 provide summaries for the environmental risk conclusions for aquatic animals and plants, terrestrial animals and plants, and listed species, respectively.

This screening risk assessment indicates that there are exceedances of the LOCs for endangered and non-endangered vascular aquatic plants exposed to runoff/drift from the maximum application rates applied via ground spray and granular application to turf, ground spray application to exposed sediment as well as direct application to water. In addition, the non-endangered non-vascular aquatic plant LOC was exceeded for direct application to water.

Table I-B 1. Summary of Environmental Risk Conclusions for Aquatic Animals and Plants		
Assessment Endpoint	**Use Patterns with LOC Exceedances**	**Summarized Risk Characterization**
Acute Risk to Freshwater and Marine/Estuarine Fish and Amphibians	None	At the peak EECs, there were no exceedances of the LOCs for freshwater or marine/estuarine fish. A comparison of the peak EECs in surface water from the simulation scenarios in Table III-B4 to the acute toxicity values for freshwater (FW) and estuarine/marine (E/M) fish indicates that the EEC is three orders of magnitude less than the toxicity values [ranging from 102 to 129 mg/L] for direct application to water and five orders of magnitude less than the toxicity values for application to turf.
Chronic Risk to Freshwater and Marine/Estuarine Fish and Amphibians	None	There were no exceedances of the Chronic Risk LOCs for either taxonomic group. A comparison of the 21- and 60-day EECs in surface water to chronic toxicity values for FW and E/M fish indicates that the highest EEC for direct application to water is two orders of magnitude lower than the lowest toxicity value for the fathead minnow (NOAEC of 10.2 mg/L).
Acute Risk to Freshwater and Marine/Estuarine Invertebrates	None	At the peak surface water EECs, there were no exceedances of the LOCs for FW or E/M invertebrates. A comparison of the peak EECs in surface water from the simulation scenarios in Table III-B4 to the acute toxicity values for FW and E/M invertebrates indicates that the EEC is three orders of magnitude less than the toxicity values [ranging from 102 to 129 mg/L) for direct application to water and five orders of magnitude less than the toxicity values for application to turf.
Chronic Risk to Freshwater and Marine/Estuarine Invertebrates	None	There were no exceedances of the Chronic Risk LOCs for either taxonomic group. A comparison of the 21- and 60-day EECs in surface water to chronic toxicity values for FW and E/M invertebrates indicates that the highest EEC for direct application to water is an order of magnitude lower than the lowest toxicity value for daphnids (NOAEC of 2.95 mg/L).
Risk to Aquatic Plants	Terrestrial use on turf (0.06 and 0.09 lb ai/acre) Application to exposed sediment (0.175 lb ai/acre) Direct application to water (150 ppb max. conc. in water)	There are exceedances of the endangered and non-endangered LOCs for vascular aquatic plants exposed to runoff/drift from ground spray and granular applications to turf, ground spray to exposed sediment and direct application to water. The non-endangered LOC was exceeded for non-vascular plants exposed as the result of the direct application of penoxsulam to water. The risk to aquatic plants in treated water is expected since this is the target organism.

For the terrestrial use of penoxsulam on turf at the maximum single application rate of 0.06 lb ai/acre, and for the use of penoxsulam on exposed sediment at the maximum single application rate of 0.175 lb ai/acre, the non-endangered and endangered LOCs were exceeded for terrestrial plants located in adjacent areas and in semi-aquatic areas primarily as the result of runoff from ground spray applications. Runoff from granular formulations of penoxsulam (unincorporated) applied at 0.06 lb ai/acre also resulted in exceedances of the LOC for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas. Likewise, the LOC for endangered monocots located in dry areas was exceeded as a result of spray drift from ground spray application at the 0.175 lb ai/acre application rate.

Table I-B 2. Summary of Environmental Risk Conclusions for Terrestrial Animals and Plants

Risk Conclusion	Use Patterns with LOC Exceedances	Summarized Risk Characterization
Acute and Chronic Risk to Birds (and Reptiles)	None	When the adjusted LD_{50} values are compared to predicted avian doses on food residues (EEC equivalent dose) following the application of penoxsulam to turf and exposed sediment at the maximum application rates of 0.09 and 0.175 lbs ai/acre respectively, there are no exceedances of the LOCs. Consequently, the acute lethality risk and chronic risk to birds and reptiles following ground spray or a granular application is likely to be very low.
Acute and Chronic Risk to Mammals	None	The acute and chronic RQs for all weight classes of mammals consuming all feed types are less than the LOC indicating adverse effects are not expected from the ground spray or granular application of penoxsulam.
Risk to Non-target Invertebrates	None likely	Low toxicity to bees. Qualitative assessment indicates probable low risk.
Risk to Terrestrial Plants	Terrestrial use on turf (0.06 lb ai/acre)	For the terrestrial use of penoxsulam on turf at the application rate of 0.06 lb ai/acre, the LOC was exceeded for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas primarily as the result of runoff from ground spray application. Also, the LOC for endangered monocots located in dry areas was exceeded as the result of exposure to drift following ground spray application. Runoff from granular formulations of penoxsulam (unincorporated) applied at 0.06 lb ai/acre also resulted in exceedances of the LOC for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas.
	Terrestrial use on exposed sediment (0.175 lb ai/acre)	For the terrestrial use of penoxsulam on exposed sediment at the application rate of 0.175 lb ai/acre, the LOC was exceeded for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas primarily as the result of runoff from ground spray application. Also, the LOC for endangered monocots and dicots located in dry areas was exceeded as the result of exposure to drift following ground spray application to exposed sediment at 0.175 lb ai/acre.

Table I-B 3. Summary of Environmental Risk Conclusions for Listed Species.		
Listed Taxon	**Direct Effects**	**Indirect Effects**
Terrestrial and semi-aquatic plants - monocots	Yes	No
Terrestrial and semi-aquatic plants - dicots	Yes	No
Terrestrial invertebrates	No	Yes through effects to terrestrial and aquatic plants (food and habitat)
Birds	No	Yes through effects to terrestrial and aquatic plants (food and habitat)
Terrestrial-phase amphibians	No	Yes through effects to terrestrial and aquatic plants (food and habitat)
Reptiles	No	Yes through effects to terrestrial and aquatic plants (food and habitat).
Mammals	No	Yes through effects to terrestrial and aquatic plants.
Aquatic non-vascular plants*	Yes	No
Aquatic vascular plants	Yes	No
Freshwater fish	No	Yes through effects to terrestrial plants (stream quality), aquatic plants (food and habitat) and freshwater invertebrates (food)
Aquatic-phase amphibians	No.	Yes through effects to terrestrial plants (stream quality), aquatic plants (food and habitat) and freshwater invertebrates (food)
Freshwater crustaceans	No	Yes through effects to terrestrial plants (stream quality), aquatic plants (food and habitat) and other freshwater invertebrates (food).
Mollusks	No	Yes through effects to terrestrial plants (stream quality) and aquatic plants (food and habitat).
Marine/estuarine fish	No	Yes through effects to terrestrial plants (tributary/estuary quality) and aquatic plants (food and habitat)
Marine/estuarine crustaceans	No	Yes through effects to terrestrial plants (tributary/estuary quality), aquatic plants (food and habitat).

* At the present time no aquatic non-vascular plants are included in Federal listings of threatened and endangered species. The taxonomic group is included here for the purposes of evaluating potential contributions to indirect effects to other taxa and as a record of exceedances should future listings of non-vascular aquatic plants warrant additional evaluation of Federal actions.

C. Conclusions – Exposure Characterization

The herbicide penoxsulam is very mobile in soil, but less mobile in sediment. Penoxsulam does not partition to soil mineral or organic fractions. Thus, there is a potential to leach to groundwater. The major routes of dissipation for penoxsulam residues resulting from these proposed new uses are through aqueous photolysis and anaerobic degradation. Therefore, even though penoxsulam is not expected to move rapidly out of sediment, the rapid degradation under anaerobic conditions would preclude significant accumulation in that particular environmental compartment. Penoxsulam is expected to dissipate quickly in clear, shallow, waters, and under anaerobic conditions. Dissipation is slower under aerobic conditions and in turbid water, in shaded water, and in waters with slightly acidic pH. Penoxsulam is expected to be moderately persistent in aerobic aquatic environments not susceptible to aqueous photolysis, and in terrestrial environments. Eleven major degradation products have been identified, and while some data have been submitted for those degradation products, data available to fully characterize their respective degradation pathways or toxicities are limited to mobility data for three degradation products, and data derived from studies conducted with the parent compound.

Routes of aquatic exposure evaluated in this screening risk assessment focused on deposition, runoff and spray drift from granular application and ground spray on turf; on ground spray application of penoxsulam to exposed sediment, and on direct application to water bodies. The penoxsulam exposure characterization combined the environmental fate data with the Tier I GENEEC2 (ver.2.0) model to simulate the transport of the pesticide after application to turf and exposed sediment. The modeled penoxsulam application rates were 0.06 lb ai/acre (single maximum application rate for turf), 0.09 lb ai/acre (maximum annual application rate for turf), and 0.175 lb ai/acre (single maximum application rate for exposed sediment). Additionally, the aquatic assessment evaluated the direct application of penoxsulam to water bodies with a maximum permitted concentration of 150 ppb.

Routes of exposure for the terrestrial assessment of birds and mammals were evaluated using the T-REX (ver.1.2.3) model to estimate penoxsulam residues on food types as the result of penoxsulam application to turf (ground spray and granular applications) and exposed sediment (ground spray application). Likewise, EECs for non-target terrestrial plants were estimated for ground spray and granular applications using the TerrPlant (ver.1.2.1) model. Additionally, as part of the non-target terrestrial plant assessment, the AgDrift (ver. 2.0.1) model was used to provide further refinement of spray drift dispersion and deposition to plants located in proximity to treated areas.

D. Conclusions – Effects Characterization

Available acute toxicity data for aquatic animals indicate that penoxsulam is practically non-toxic to freshwater and marine/estuarine fish and to marine/estuarine invertebrates and slightly toxic to freshwater invertebrates. Results of chronic studies with penoxsulam indicate that no treatment-related effects to growth and reproduction occurred in freshwater fish at concentrations up to 10.2 ppm ai. In chronic studies with daphnids, penoxsulam significantly reduced the number of live offspring at 9.76 ppm ai (NOAEC = 2.95 ppm ai). Since penoxsulam is not expected to bind to sediment, exposure to sediment-dwelling benthic organisms should not occur.

Penoxsulam is highly toxic to aquatic vascular plants, with an EC_{50} of 0.003 mg/L for duckweed (NOAEC 0.001 mg/L), based on reduction of frond number. Results of Tier II toxicity studies with non-vascular aquatic plants indicate that penoxsulam adversely affected cell density with the freshwater green algae being the most sensitive species (EC_{50} = 0.092 mg/L; NOAEC = 0.005 mg/L). Consequently, penoxsulam presents a potential risk to non-target plants inhabiting aquatic systems, as well as to wetland and riparian habitats along streams and/or ponds in close proximity to treated waters and treated terrestrial areas (turf and exposed sediment).

Available acute toxicity data indicate that penoxsulam is practically non-toxic to upland game birds; no more than slightly toxic to waterfowl by the oral route (LD_{50} >2,025 mg/kg-bw and >1,900 mg/kg-bw, respectively); and no more than slightly toxic to both upland game birds and waterfowl by the subacute dietary route (LC_{50} >4.411 and >4,310 ppm, respectively). In an acceptable chronic study with mallards, reductions in male body weight were observed at the 958 ppm ai treatment level, resulting in a NOAEC of 501 ppm ai. Acute toxicity data indicates that penoxsulam is practically non-toxic to mammals (acute LD_{50} value of >5,000 mg/kg bw). In a 2-generation reproduction study with rats exposed to penoxsulam, kidney lesions were observed in female rats at 100 mg/kg/day, resulting in a parental systemic toxicity NOAEL of 30 mg/kg/day (600 ppm). Preputial separation, an indicator of sexual maturation, was observed in F_1 males at 100 mg/kg/day, resulting in an offspring toxicity NOAEL of 30 mg/kg/day (600 ppm). Acute contact studies indicate that penoxsulam is practically non-toxic to honey bees (LD_{50} >100 µg/bee).

Exposure of terrestrial plants to penoxsulam is assumed to occur through direct spraying, runoff or drift. Terrestrial plant toxicity studies with monocots and dicots indicate that seedling emergence and vegetative vigor are severely impacted by exposure to penoxsulam. In Tier II studies, seedling emergence, based on shoot weight, was adversely impacted in monocots (onion) at an EC_{25} of 1.1 g ai/ha and in dicots (sugar beet) at an EC_{25} of 3.2 g ai/ha. Vegetative vigor in monocots and dicots, based on shoot weight, was adversely impacted at an EC_{25} of 17 g ai/ha in ryegrass and an EC_{25} of 3.8 g ai/ha in soybean. Consequently, penoxsulam presents a potential risk to non-target plants inhabiting forest and edge habitats adjacent to target areas and wetland and riparian habitats along streams and/or ponds in close proximity to treated waters and treated terrestrial areas (turf and exposed sediment).

Data indicate that only 2 of 11 penoxsulam metabolites may result in plant injury. In a laboratory study, penoxsulam and 11 major metabolites were applied to seeds and saplings (2 to 2.5 leaves) of 22 plant species including crops, weeds, grasses and flowering plants. The parent, penoxsulam, caused significant injury to all exposed species when applied to pre-emergent seeds. However, none of the applied 11 major metabolites caused observable injury when applied to pre-emergent seeds. Post-emergent treatment with penoxsulam caused significant injury to all species with the exception of rice, wheat and blackgrass. Only two of the 11 metabolites (5-OH penoxsulam and sulfonyl-formamidine) caused noticeable injury to species during the post-emergence test at the highest tested concentrations (250 and 500 ppm). Oilseed rape, chickweed, lambsquarter, redroot pigweed, velvetleaf and wild buckwheat exhibited minor injury when treated with these two metabolites.

E. Uncertainties and Data Gaps

There are a number of areas of uncertainty in this terrestrial and aquatic organism risk assessment that could potentially cause an underestimation of risk. First, this assessment accounts only for exposure of non-target organisms to penoxsulam, but not to its degradation products. The risks presented in this assessment could be underestimated if degradates also exhibit toxicity under the conditions of use as stated on the label, as limited data are available concerning the toxicity of the 11 major degradates. Second, the risk assessment only considers the most sensitive species tested, and only considers a subset of possible use scenarios. For the terrestrial and aquatic organism risk assessments, there are uncertainties associated with the T-REX and GENEEC2 models, input values, and with the use of surrogate scenarios. The potential impacts of these uncertainties are outlined in the Terrestrial Exposure, the Aquatic Exposure, and the Risk Characterization sections of this document.

II. PROBLEM FORMULATION

A. Stressor Source and Distribution

1. Source and Intensity

Dow AgroSciences is seeking registration of new uses of the herbicide penoxsulam for post-emergence control of annual and perennial broadleaf weeds in established turf, and for control of vegetation in aquatic environments (Table IIA-1). Proposed labels list the following products for turf uses:

> GF-443 SC (liquid product containing 21.7% active ingredient; EPA Reg. No. 62719-LUH);
> GF-907 37.5 g/l SC (liquid product containing 3.68% active ingredient; EPA Reg. No. 62719-LUT);
> Penoxsulam GR 0.04% (granular product containing 0.04% active ingredient; EPA Reg. No. 62719-LLN);
> Penoxsulam FERT 0.04% (granular product containing 0.04% active ingredient and fertilizer; EPA Reg. No. 62719-LUO);
> Penoxsulam GR 0.014% (granular product containing 0.014% active ingredient; EPA Reg. No. 62719-LUG); and
> Penoxsulam FERT 0.014% (granular product containing 0.014% active ingredient and fertilizer; EPA Reg. No. 62719-LUI);

The proposed labels for turf use recommend application for both liquid and granular end-use products of no more than 0.06 lb ai/acre for a single application. Additional applications should not be made within 4 weeks of a previous application, and no more than 0.09 lb ai/acre should be applied per annual year.

Additionally, Dow AgroSciences is seeking registration for a new use of penoxsulam in aquatic environments. It would be used to control aquatic vegetation in a variety of water bodies and transitional areas (Table IIA-1). The proposed end use product for aquatic applications is:

> GF-443 SC (liquid product containing 21.7% active ingredient; EPA Reg. No. 62719-LUH)

The proposed label recommends application rates to aquatic environments to achieve concentrations of no more than 150 ppb ai per annual growth cycle. Application to aquatic environments can be made through aerial application, ground spray application (by driving a truck fitted with spray apparatus along side of a water body, or by walking through wetlands with a backpack sprayer for spot applications), and through sub-surface injection. Sub-surface injection to water bodies should be conducted with the goals of achieving a penoxsulam concentration in the treatment zone of 5 to 150 ppb (for a single application), or 5 to 75 ppb (for split or multiple applications).

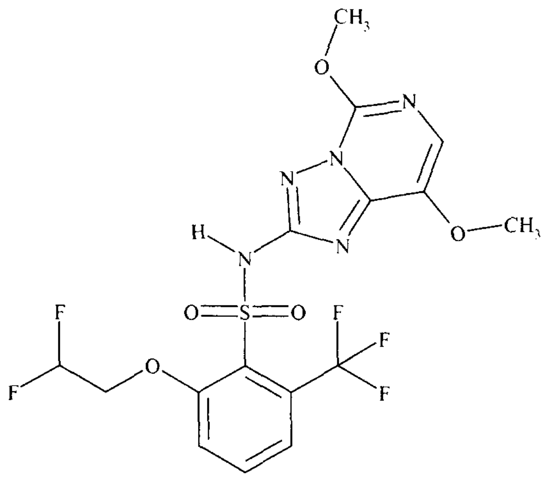
Proposed application rates to aquatic transitional areas and exposed sediment for weed control range from 0.03125 – 0.0875 lb ai/acre for foliar application to floating and emerged weeds and 0.085 to 0.175 lb ai/acre for exposed sediment. Only a single application is allowed for foliar application and for application to exposed sediment.

Table II-A 1. Overview of Proposed Penoxsulam New Uses

Crop Grouping	Representative Use
Terrestrial non-crop	Established turf including residential lawns, golf courses, sports fields, sod farms, around commercial buildings and other commercial turf areas
Aquatic non-crop	Aquatic vegetation management in lakes, reservoirs, ponds, canals, seeps, rivers, streams, swamps, marshes, bogs, transitional areas between terrestrial and aquatic sites and seasonal wet areas

2. Physical, Chemical, Fate and Environmental Transport Properties

A diagram of the chemical structure of penoxsulam is provided below and a summary of selected physical, chemical and environmental fate properties of penoxsulam is presented in Table IIA-2.



Penoxsulam

Table II-A 2. Some physical, chemical and environmental properties of Penoxsulam.	
PROPERTY	**VALUE**
Chemical name	2-(2,2-difluoroethoxy)-N-(5,8-dimethoxy[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)-6-(trifluoromethyl)benzenesulfonamide
Chemical Abstract Service number	219714-96-2
Molecular weight	483.4
Aqueous solubility	5.7 mg/L (pH 5), 410 mg/L (pH 7), 1500 mg/L (pH 9)
pK_a	5.1
Vapor pressure at 25°C	9.55 x 10-14 Pa
Octanol-water partition coefficient (log K_{ow})	1.1 (pH 5), -0.60 (pH 7), -1.4 (pH 9)
Hydrolysis half- life (pH 5, pH 7, pH 9)	Stable
Aqueous photolysis half- life	1.5 - 14 days
Soil photolysis half- life	19 - 109 days
Aerobic metabolism half-lives	12 - 118 days
Anaerobic metabolism half-lives	6.6 - 11 days
Soil-water distribution coefficient (K_{oc})	13 - 305 (1130 sediment) mL/g

Penoxsulam is expected to be stable to hydrolysis. In aerobic aquatic environments, penoxsulam is expected to dissipate rapidly through aqueous photolysis in clear shallow waters, and somewhat more slowly, through biotic degradation, when sunlight has a limited ability to penetrate turbid waters, or when waters are shaded by trees or riparian vegetation. Likewise, dissipation will be slower in slightly acidic waters based on pK_a of 5.1. In anaerobic aquatic environments, penoxsulam is expected to dissipate rapidly through biotic degradation. In terrestrial environments, penoxsulam is expected to be moderately persistent and dissipate somewhat slowly through either aerobic soil degradation or soil photolysis.

Penoxsulam is expected to be very mobile in the environment, not binding strongly to soil, but binding more strongly to sediment, where it is expected to degrade rapidly through anaerobic degradation. Penoxsulam exists almost exclusively in a disassociated state at neutral or higher pH values, but not in aquatic or terrestrial environments where lower pH values (below 5.1) are found. Submitted mobility data for three penoxsulam degradation products (BSTCA, 5-OH-penoxsulam, and BST) indicate environmental mobility roughly equivalent to the parent compound. However, there are no data regarding the mobility either of the remaining transformation products, or for combined parent/degradate residues. Penoxsulam has low volatility indicating that atmospheric transport is, at best, a very minor route of dissipation.

Data are not available to fully characterize the potentially complex degradation pathways of penoxsulam. Submitted laboratory studies demonstrate that penoxsulam transforms by competing mechanisms, and through several generations of degradation products. Examination of the specific transformation products formed in the submitted laboratory studies suggests that the more rapid photolytic transformation proceeds primarily through cleavage of the parent molecule on, or adjacent to, the sulfonamide bridge. The slower biotic degradation pathway proceeds primarily through fragmentation of the pyrimidine ring or its residues. This complex transformation/degradation pathway of penoxsulam produces a large number of transformation/ degradation products. Only the limited fate data presented in metabolism studies conducted with the parent compound are available for the penoxsulam degradation products.

3. Pesticide Type, Class and Mode of Action

Penoxsulam is a systemic, post-emergence herbicide belonging to the triazolopyrimidine sulfonamides chemistry family. The mode of action upon susceptible weeds is by inhibition of acetolactate synthase (ALS), the first enzyme in the biosynthetic pathway for the amino acids leucine, valine, and isoleucine.

4. Overview of Pesticide Usage

This assessment reviewed practices associated with the proposed use of penoxsulam on turf and in aquatic environments to control surface and submerged weeds. Both uses are expected to be extensive across the country, particularly the use on turfgrasses. While applications to aquatic environments are also expected to be national in scope, this use would be more likely in the Northeast, Southeast, and Midwest, where surface water is most prevalent.

Proposed Use on Turf

Application of a liquid formulation (either GF-443 SC or GF 907 37.5 mg/L SC) to established turfgrasses is proposed at a rate of no more than 0.06 lb ai/acre (no more than 0.01 lb ai/acre for perennial ryegrass and tall fescue) for weed control (Table IIA-3). Additional applications should not be made within 4 weeks of a previous application, and no more than 0.09 lb ai/acre should be applied per year. Spray drift to sensitive areas, or to non-target plants, should be avoided. To avoid adverse effects to endangered plant species, the label recommends an untreated buffer zone of 25 feet is specified for ground applications when endangered species are present.

Application of a granular formulation (Penoxsulam GR 0.04%, Penoxsulam FERT 0.04%, Penoxsulam GR 0.014%, or Penoxsulam FERT 0.014%) to established turfgrasses is proposed to be made at a rate of no more than 0.06 lb ai/acre (no more than 0.01 lb ai/acre for perennial ryegrass and tall fescue). Additional applications should not be made within 4 weeks of a previous application, and no more than 0.09 lb ai/acre should be applied per year. Spray drift to sensitive areas or non-target plants should be avoided. These products are to be applied using a drop or rotary-type spreader designed to apply granular herbicides or insecticides.

Although the labels for the granular formulations indicate that only weeds that are emerged at the time of application will be affected by the penoxsulam, it also advises not to re-seed the treated area for at least 3 to 4 weeks after application.

Proposed Use in Aquatic Environments

A liquid solution of GF-443 SC is proposed for use to manage aquatic vegetation in lakes, streams, marshes, and other water bodies. The proposed label recommends that the product be applied directly into water through subsurface injection, or be applied by either ground[1] or aerial spray application, onto emergent foliage of aquatic plants, or onto exposed sediment by ground spray after drawdown.

The proposed labels do not clearly specify the number of applications, the application intervals, or water depth (when applicable) for aquatic uses. In the absence of explicit instructions, assumptions were made for modeling purposes that used one application of maximum rates to minimum water depth. Directions for sub-surface injection specify a target concentration, but are not clear concerning how to determine if that concentration had been achieved. For penoxsulam use on exposed or floating weeds it has been assumed that perennial water bodies would not have a water depth less than 6 inches. Application rates for surface applications to water were used to directly calculate aquatic concentration based upon the volume of water per acre at different water depths. The 150 ppb target concentration for subsurface injection would not be exceeded for direct surface application until water depths fall below 6 inches. Therefore, the environmental effect concentrations (EECs) for penoxsulam resulting from the proposed new uses are assumed not to exceed 150 ppb in the environment. At water depths shallower than six inches, aquatic concentrations would exceed those assumed by this assessment.

Depending on the target plants to be controlled, the proposed labels instruct that the product be applied to achieve a concentration of penoxsulam ranging from 5 to 150 ppb in the treated area. Dow AgroSciences recommends the use of an Enzyme-Linked Immunoassay (ELISA test) for determination of the concentration of active ingredient in the water. Proposed labels also advise that re-treatment may be necessary to ensure efficacy, but the total concentration amount of all applications must not exceed 150 ppb per annual growth cycle (Table IIA-3).

For foliar application to floating and emergent weeds, the proposed label recommends applying GC-443 SC at a rate of 2 to 5.6 fl oz per acre (0.03125 to 0.0875 lb ai/acre). The product would be ground sprayed to exposed sediment at a rate of 0.0875 to 0.175 lb ai/acre. This assessment calculates EECs using GENEEC2 and the ecological pond model.

[1] Ground spray to aquatic environments can be accomplished by either driving a truck fitted with spray apparatus along the side of the water body, or by walking through wetlands wearing a backpack sprayer making spot applications

The proposed label has no restrictions on the use of treated water for recreational purposes (including swimming and fishing) and no restrictions on consumption of treated water for potable use or by livestock, pets, or other animals. GF-443 SC should not be applied through any type of irrigation system, for hydroponic farming, or irrigating greenhouse and nursery plants. GF-443 SC should be mixed with an approved aquatic surfactant other than organo-silicone. The proposed label cautions avoidance of off-target drift movement from aerial applications.

Table II-A 3. Proposed New Use Patterns for Penoxsulam

Use Sites	Timing	Single Application Rate (lb ai/acre)	Minimum # of Days Between Applications	Maximum Annual Application Rate (lb ai/acre)
Turf	Postemergence (liquid formulation) [1]	0.01 – 0.06	28	0.09
	Postemergence (granular formulation) [2]	0.01 – 0.06	not specified	0.09
	Postemergence (granular formulation) [3]	0.01 – 0.06	not specified	0.09
Aquatic Vegetation[1]	Direct application to water (single application)	5 – 150 ppb	not applicable	150 ppb
	Direct application to water (split or multiple applications)	5 – 75 ppb	not specified	150 ppb
	Foliar application to floating/emerged weeds	0.03125 – 0.0875	not specified	not specified
	Preemergent application to exposed sediment	0.0875 – 0.175	not specified	not specified

[1] Information from proposed supplemental label for GF-443 SC (2 lb ai/gallon, 21.7% ai), Dow AgroSciences, 2005. For aquatic vegetation, the maximum concentration allowed in treated waters is 150 ppb per annual cycle.

[2] Information from proposed label for Penoxsulam GR 0.04% (0.02 lb ai/ 50 lb bag) and Penoxsulam GR 0.014% (0.007lb ai/50 lb bag), Dow AgroSciences, 2005.

[3] Information from proposed label for Penoxsulam FERT 0.04% (0.02 lb ai/ 50 lb bag) and Penoxsulam FERT 0.014% (0.007lb ai/50 lb bag), Dow AgroSciences, 2005.

B. Receptors

Registrant-submitted toxicological studies with representative test species will be utilized for this screening level risk assessment for penoxsulam (Table II-B1). Within each broad taxonomic group, an acute and/or chronic measure of effect is selected from the available test data. A complete discussion of all toxicity data available for this risk assessment for penoxsulam and the resulting measurements of effect selected for each taxonomic group are included in Section III.C and Appendix F.

TABLE II-B 1. Taxonomic Groups and Test Species Evaluated for Ecological Effects in Screening Level Risk Assessments.

Taxonomic group	*Example(s) of representative species*
Birds [a]	Mallard duck (*Anas platyrhynchos*) Bobwhite quail (*Colinus virginianus*)
Mammals	Norway Rat (*Rattus norvegicus*)
Insects[b]	Honey bee (*Apis mellifera L.*)
Freshwater fish [c]	Bluegill sunfish (*Lepomis macrochirus*) Rainbow trout (*Oncorhynchus mykiss*) Common Carp (*Cyprinus carpio*) Fathead minnow (*Pimephales promelas*)
Freshwater invertebrates	Water flea (*Daphnia magna*) Midge (*Chironomus* sp.) Amphipod (*Gammarus* sp.)
Estuarine/marine fish	Silverside (*Menidia beryllina*)
Estuarine/marine invertebrates	Eastern oyster (*Crassostrea virginica*) Mysid (*Americamysis bahia*)
Terrestrial plants [d]	Monocots – corn, onion, ryegrass, wheat Dicots – cotton, cucumber, kale, tomato, soybean, sugarbeet
Aquatic plants and algae	Duckweed (*Lemna gibba*) Green algae (*Selenastrum capricornutum*) Blue-green algae (*Anabaena flos-aquae*) Freshwater Diatom (*Navicula pelliculosa*) Marine Diatom (*Skeletonema costatum*)

[a]Birds represent surrogates for amphibians (terrestrial phase) and reptiles.
[b]Honey bee data provides an additional line of evidence for terrestrial invertebrates
[c] Freshwater fish may be surrogates for amphibians (aquatic phase).
[d]Four species of two families of monocots, of which one is corn; six species of at least four dicot families, of which one is soybeans.

1. Aquatic Effects

Terrestrial applications of penoxsulam suggest that spray drift and runoff to adjacent bodies of water are the most likely sources of penoxsulam exposure to nontarget aquatic organisms, including endangered and threatened species. Likewise, direct application of penoxsulam to water bodies will expose nontarget aquatic organisms to the herbicide. Penoxsulam is expected to be very mobile in soils, but less mobile in sediments. In aqueous environments, penoxsulam is stable to hydrolysis, but dissipates rapidly through aqueous photolysis in clear shallow waters, and somewhat more slowly through aerobic degradation when sunlight has a limited ability to penetrate turbid waters, or when waters are shaded by trees or riparian vegetation. Penoxsulam also degrades rapidly under anaerobic conditions, thus precluding accumulation in sediments where penoxsulam is less mobile. Penoxsulam is not expected to bioaccumulate in aquatic organisms. Consequently, risk to benthic-dwelling organisms is likely to be minimal.

For penoxsulam, effects on aquatic organisms are estimated from acute and chronic laboratory studies submitted to the Agency. Acute data are available for freshwater fish (rainbow trout (*Oncorhynchus mykiss)* and bluegill sunfish (*Lepomis macrochirus*); marine/estuarine fish (silverside (*Menidia beryllina*), freshwater invertebrates (water flea (*Daphnia magna*) and marine/estuarine invertebrates (mysid shrimp (*Americamysis bahia*) and eastern oyster (*Crassostrea virginica*). Reproductive or growth effects from chronic exposure are estimated from studies conducted with freshwater fish (fathead minnow) and freshwater invertebrates (water flea and midge). No data are available to evaluate chronic effects on estuarine/marine fish but are available for marine/estuarine invertebrates (mysid shrimp). Toxicity data are available to evaluate the effects of penoxsulam to aquatic vascular (duckweed – *Lemna gibba)* and non-vascular plants (freshwater algae and freshwater and marine diatoms).

2. Terrestrial Effects

The most likely source of exposure for non-target terrestrial organisms, including endangered and threatened species, is from water bodies which have been directly treated with penoxsulam. Ground deposition, spray drift, and wind erosion of soil particles with resulting residues on foliage and on flowers and seeds are the likely sources of penoxsulam exposure to nontarget terrestrial organisms following application to turf. Also, terrestrial non-target organisms which contact treated waters could be exposed via ingestion and dermal contact to penoxsulam and its degradation products. Penoxsulam is moderately persistent in the soil and can be applied as a granule. Thus, birds, small mammals, and soil invertebrates may be exposed through dermal contact or ingestion of soils. Exposure to penoxsulam via inhalation is expected to be low due to its low vapor pressure. The effect of penoxsulam on all bird species is estimated from acute, subacute and chronic studies on two species, bobwhite quail (*Colinus virginianus*) and mallard duck (*Anas platyrhynchos*). These species also act as surrogates for reptiles and terrestrial-phase amphibians. Effects on mammals are estimated from acute and chronic rat studies reviewed by the Health Effects Division (HED).

Spray drift presents a potential risk to non-target semi-aquatic and terrestrial plants inhabiting edge habitats (i.e., transition area between a forest and field) adjacent to target areas and riparian vegetation along streams and/or ponds in close proximity to sprayed areas. Studies (seedling emergence and vegetative vigor) were submitted to evaluate the effects of penoxsulam to terrestrial monocots and dicots.

3. Ecosystems at Risk

The terrestrial ecosystems potentially at risk include the treated area and areas immediately adjacent to the treated area that might receive spray drift, runoff, or wind-erosion of soil particles, and might include other cultivated fields, fence rows and hedgerows, meadows, fallow fields or grasslands, woodlands, and other uncultivated areas. For both terrestrial and aquatic animal species, direct and indirect acute and chronic exposures are considered. Risk will be assessed to terrestrial plants assumed to occur exclusively in areas immediately adjacent to, and in transition areas receiving runoff from treated areas. In addition to terrestrial plants, indirect risks to animals will also be addressed with the endangered species analysis.

The labeled uses of penoxsulam could result in exposure to aquatic and terrestrial animals and plants inhabiting flowing, non-flowing or transient freshwater/marine water bodies, wetlands and transitional areas, and to wildlands (forests and ecotones, such as edge and riparian habitats). For uses in coastal areas, aquatic habitat also includes marine ecosystems including estuaries. For Tier 1 assessment purposes, risk will be assessed to aquatic organisms and plants inhabiting treated waters and those assumed to occur in water bodies receiving runoff and drift from treated areas.

C. Assessment Endpoints

This ecological risk assessment considers single and multiple applications at the maximum penoxsulam application rates to sites that have vulnerable soils to estimate exposure concentrations. In addition, this assessment considers water bodies where the herbicide is directly applied. This assessment is not intended to represent a site- or time-specific analysis. Instead, it is intended to represent high-end exposures at a national level. Likewise, the most sensitive toxicity endpoints are used from surrogate test species to estimate treatment-related direct effects on acute mortality and chronic reproductive, growth and survival assessment endpoints. Toxicity tests are intended to determine effects of pesticide exposure on birds, mammals, fish, terrestrial and aquatic invertebrates, and terrestrial and aquatic plants. These tests include short-term acute, subacute, and reproduction studies and are typically arranged in a hierarchical or tiered system that progresses from basic laboratory tests to applied field studies. The toxicity studies are used to evaluate the potential of a pesticide to cause adverse effects, to determine whether further testing is required, and to determine the need for precautionary label statements to minimize the potential adverse effects to non-target animals and plants (CFR 40 §158.202, 2002). A summary of measurements of effect selected to characterize potential ecological risks associated with exposure to penoxsulam is provided in Table II-C1.

Table II-C 1. Summary of Assessment Endpoints and Measures of Ecological Effects	
Assessment Endpoint	**Measures of Ecological Effect**
1. Abundance (i.e., survival, reproduction, and growth) of individuals and populations of birds, and reptiles and terrestrial phase of amphibians as represented by birds.	1a. Bobwhite quail and mallard duck acute oral LD_{50} 1b. Bobwhite quail and mallard duck subacute dietary LC_{50} 1c. Bobwhite quail and mallard duck chronic reproduction NOAEC and LOAEC
2. Abundance (i.e., survival, reproduction, and growth) of individuals and populations of mammals	2a. Laboratory rat acute oral LD_{50} 2b. Laboratory rat oral reproduction and developmental chronic NOAEC and LOAEC
3. Survival and reproduction of individuals and communities of freshwater fish and invertebrates, and aquatic phase amphibians as represented by fish.	3a. Rainbow trout and bluegill sunfish acute LC_{50} 3b. Rainbow trout chronic (early life-stage) NOAEC and LOAEC 3c. Water flea (and other freshwater invertebrate) acute EC_{50} 3d. Water flea chronic (life cycle) NOAEC and LOAEC
4. Survival and reproduction of individuals and communities of estuarine/marine fish and invertebrates	4a. Sheepshead minnow acute LC_{50} 4b. Chronic fish studies (reserved) 4c. Eastern oyster acute EC_{50} and mysid acute LC_{50} 4d. Mysid chronic NOAEC and LOAEC
5 Perpetuation of individuals and populations of non-target terrestrial plant species (crops and non-crop plant species)	5a. Monocot and dicot seedling emergence and vegetative vigor EC_{25}, EC_{05}, and NOAEC values
6. Survival of beneficial insect populations	6a. Honeybee acute contact LD_{50}
7. Maintenance and growth of individuals and populations of aquatic plants from standing crop or biomass	7a. Algal and vascular plant (i.e., duckweed) EC_{50} and NOAEC values for growth rate and biomass measurements

LD_{50} = Lethal dose to 50% of the test population.
NOAEC = No observed adverse effect concentration.
LOAEC = Lowest observed adverse effect concentration.
LC_{50} = Lethal concentration to 50% of the test population.
EC_{50}/EC_{25} = Effect concentration to 50%/25% of the test population.

D. Conceptual Model

1. Risk Hypotheses

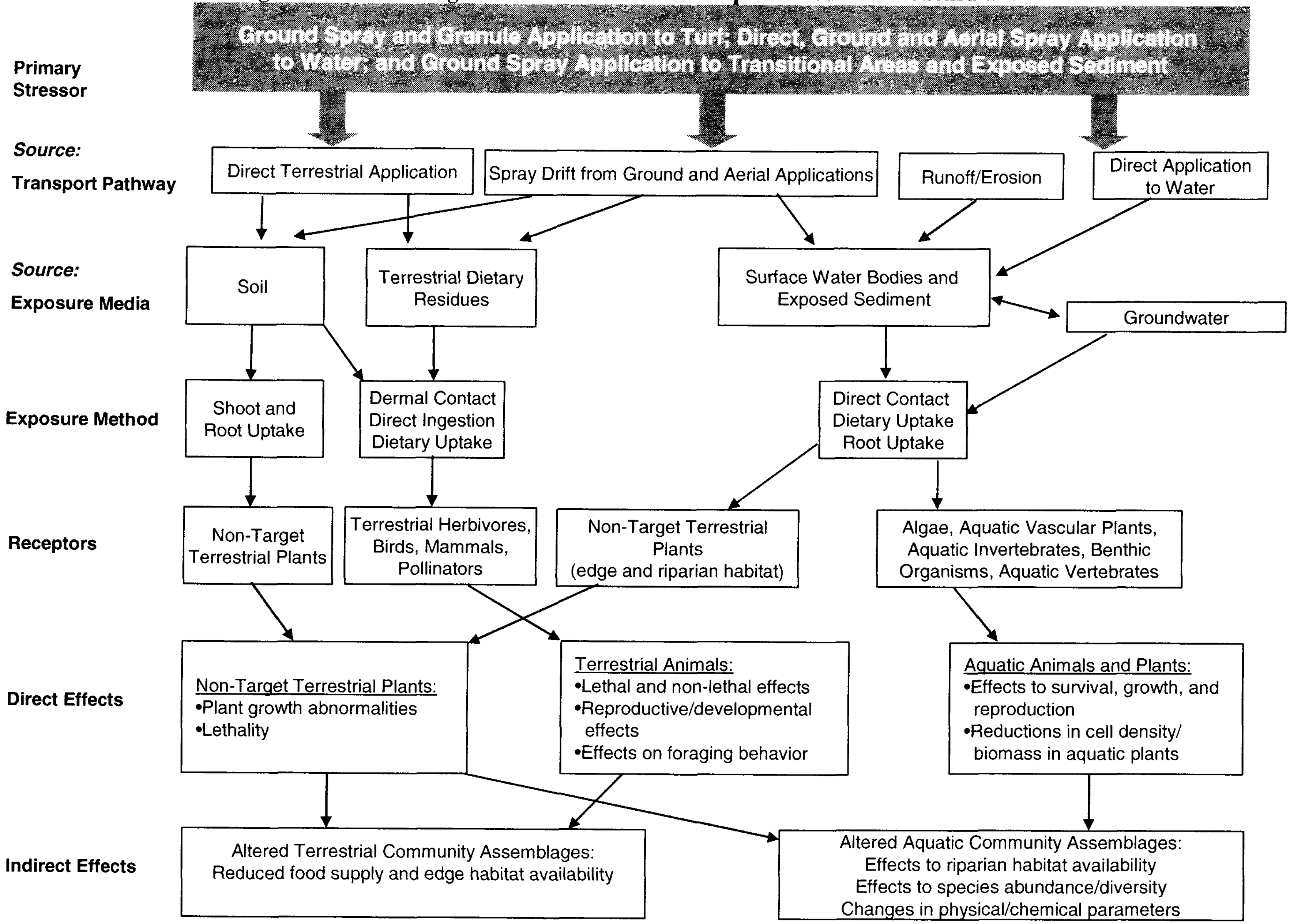
The following risk hypothesis is presumed for this screening level assessment.

The use of penoxsulam as an herbicide on terrestrial non-crop sites may expose non-target terrestrial and aquatic animals and plants via drift and runoff. In addition, direct use of penoxsulam in water bodies will expose aquatic animals and plants to the chemicals. Based on the mobility of penoxsulam, the mode of action, and the food-web of the target aquatic and terrestrial ecosystems, penoxsulam has the potential to cause reduced survival, and/or reproductive and growth impairment for terrestrial and aquatic animals and plants.

2. Conceptual Model

The primary routes of exposure are considered and presented in the conceptual model. The conceptual model shown in Figure II-D1 for ground and aerial spray applications as well as granular applications generally depicts the potential sources of penoxsulam release mechanisms, abiotic receiving media, biological receptor types, and effects endpoints of potential concern. Ground spray to aquatic environments can be accomplished by either driving a truck fitted with spray apparatus along the side of the water body, or by walking through wetlands wearing a backpack sprayer making spot applications. Subsurface application to water bodies is accomplished by holding an application wand under water while sitting on a boat moving back and forth along the surface of the targeted water body.

Figure II D 1. Ecological Risk Assessment Conceptual Model for Penoxsulam



E. Analysis Plan

The Agency's new use science chapter for penoxsulam consists of a deterministic screening level risk quotient analysis. The aquatic and terrestrial assessments focus on the proposed agricultural and non-agricultural use of penoxsulam for weed control in turf and control of aquatic vegetation in lakes, streams, ponds and other water bodies. Potential exposure pathways (i.e., runoff and spray drift) result from ground and aerial application of aqueous penoxsulam formulations as well as granular formulations. Likewise, direct exposure is anticipated after direct application to water bodies.

The Agency reviewed the available laboratory environmental fate data submitted in support of the proposed new use of penoxsulam to determine penoxsulam persistence and mobility. Based on these data, the Agency developed its quantitative aquatic assessment of penoxsulam exposure using the GENEEC2 (Generic Estimated Environmental Concentration model, ver.2, 2001) model to represent potential penoxsulam use areas. Likewise, terrestrial wildlife may be exposed to penoxsulam through the plant or animal material that they contact or consume as food. For ground and aerial spray applications of penoxsulam, exposure to terrestrial wildlife was estimated by relating food item residues to pesticide application using the Kenaga nomogram as modified by Fletcher (Hoerger and Kenaga, 1972; Fletcher *et al.*, 1994). A Terrestrial Residue Exposure computer model (T-REX, ver.1.2.3) was used to predict residues on foliar surfaces and insects. For mammals, the residue concentration was converted to a daily oral dose based on fractions of body weight consumed daily. In addition, exposure to birds and mammals from granular applications of penoxsulam was assessed using the LD_{50} /ft^2 calculations in the T-REX model. Terrestrial non-target plant exposure characterization employed runoff and spray drift scenarios based on penoxsulam use and were estimated using OPP's TerrPlant model (ver.1.2.1) as well as the AgDrift 2.0.1 model to provide further refinement of spray drift dispersion and deposition to terrestrial plants located in proximity to treated areas.

The most sensitive aquatic and terrestrial ecotoxicological values from studies submitted to the Agency were used in this quantitative assessment. Risks were estimated based on a deterministic approach, where a single point exposure estimate is divided by a toxicity endpoint to calculate a risk quotient (RQ). The acute and chronic RQ values for each taxonomic group identified as an assessment endpoint were compared to the Agency's Levels of Concern (LOCs), which are detailed in Appendix C. LOCs serve as criteria for categorizing potential risk to non-target organisms. RQ values were calculated in the risk estimation section for each endpoint, and characterization and interpretation of risk is described in the risk description. Risks for each taxonomic group were described based on available lines of evidence from registrant-submitted studies, open literature, and incident reports. In addition, a preliminary assessment of listed species of concern was also completed.

1. Preliminary Identification of Data Gaps and Methods

Environmental fate data for penoxsulam are mostly complete with the exception of the fate in groundwater (Appendix G). Studies indicate that penoxsulam is very mobile in terrestrial environments, not very persistent in anaerobic environments and in clear shallow water, and is moderately persistent in aerobic environments. As a result, additional information about photodegradation in air, anaerobic soil metabolism, laboratory and field volatility, and accumulation in fish are not needed at this time.

Given its mode of action as an ALS inhibitor, the toxicity dataset for penoxsulam is essentially complete.

The following uncertainties and information gaps were identified as part of the problem formulation:

- Penoxsulam readily degrades by two different mechanisms, producing eleven major transformation products. Toxicity studies for some of the transformation products of penoxsulam are limited to effects on freshwater algae, duckweed, *Daphnia* and some species of monocots and dicots. For some transformation products, no toxicity information is available.

- From a fate perspective, six penoxsulam transformation products (BSTCA, BST, 2-amino-TP, 2-amino TCA, 5,8-diOH , and sulfonamide) reached peak concentrations at study termination. Laboratory data are not available to quantitatively determine degradation rates, and therefore the degree of persistence, for these transformation products under environmental conditions. Furthermore, mobility data submitted for three penoxsulam transformation products (BSTCA, BST, and 5-OH-penoxsulam) indicated mobility roughly equivalent to or slightly greater than that of the parent compound, penoxsulam. However, laboratory data are not available to quantitatively determine the degree of mobility or persistence for the majority of the identified transformation products under environmental conditions.

- Risks to semi-aquatic wildlife via consumption of pesticide-contaminated fish were not evaluated. However, given that bioaccumulation of penoxsulam is expected to be low, ingestion of fish by piscivorus wildlife is not likely to be of concern.

- Risks to top-level carnivores were not evaluated due to a lack of data for these receptors. Ingestion of grass, plants, fruits, insects, and seeds by terrestrial wildlife was considered; however, consumption of small mammals and birds by carnivores was not evaluated. In addition, food chain exposures for aquatic receptors (i.e., fish consumption of aquatic invertebrates and/or aquatic plants) were also not considered.

- Surrogates were used to predict potential risks for species with no data (i.e., reptiles and amphibians). It was assumed that use of surrogate effects data is sufficiently conservative to apply to the broad range of species within taxonomic groups. If other species are more or less sensitive to penoxsulam than the surrogates, risks may be under or overestimated, respectively.

- Finally, there are uncertainties associated with the T-REX and GENEEC2 models, input values, and with the use of surrogate exposure scenarios. The potential impacts of these uncertainties are outlined in the Terrestrial Exposure, the Aquatic Exposure, and the Risk Characterization sections of this document.

2. Measures to Evaluate Risk Hypotheses and Conceptual Model

a. Measures of Exposure

Aquatic Organisms and Plants

Based on the conceptual models presented in Figure II.D1 above, the potential exposure pathways by which penoxsulam may inadvertently affect non-target plant and animal populations in aquatic areas include: drift during aerial and ground application, and runoff/leaching of contaminated water from treated areas to untreated areas and dispersion following direct application to water bodies. In semi-aquatic areas, the exposure routes are: drift during application, runoff events (off-site movement of contaminated water), and wind erosion of contaminated soil particles. There may be exposure to non-target terrestrial plants adjacent to treated areas via drift and runoff from transitional sites or wetlands which may be dry during certain periods, or via wind-blown treated soil particles from those pathways for aquatic species.

As part of the aquatic assessment for terrestrial uses, EFED modeled exposure concentrations of penoxsulam to non-target aquatic organisms and plants from application to turf following labeled use information and application rates (Table IIB-2). EEC calculations were modeled using GENEEC2 to estimate exposure to aquatic organisms and emerged/floating plants inhabiting shallow-water aquatic communities that receive runoff during rainfall events and/or drift from adjacent use sites. Peak, 21-day, 60-day and 90-day concentrations were used to estimate risk to aquatic organisms and plants.

For this screening risk assessment, the potential exposure of penoxsulam to aquatic and terrestrial endpoints was modeled. The GENEEC2 model was used to estimate exposure concentrations for aquatic animals and plants in surface water from: aerial and ground spray application as a result of runoff, sediment transport and spray drift; runoff and sediment transport from the granular uses; and direct application to water bodies.

The GENEEC2 model uses the soil/water partition coefficient and degradation kinetic data to estimate runoff from a ten hectare field into a one hectare by two meter deep "standard" pond. It considers reduction in dissolved pesticide concentration due to adsorption of pesticide to soil or sediment, incorporation, degradation in soil before washoff to a water body, direct deposition of spray drift into the water body, and degradation of the pesticide within the water body. GENEEC2 calculates acute as well as longer-term estimated environmental concentration (EEC) values. For ground and aerial spray applications of penoxsulam to turf, a single application of 0.06 lb ai/acre was modeled using GENEEC2. Likewise, a single application rate of 0.06 lb ai/acre was evaluated for granular uses on turf. In addition, 2 applications of 0.045 lb ai/acre (0.09 maximum annual application rate) were evaluated with a 28 day interval between applications.

As part of the aquatic assessment for direct application of penoxsulam to water bodies, EFED estimated exposure concentrations to non-target aquatic organisms and plants. Direct subsurface application[2] as well as ground and aerial spray to water bodies are allowed. Subsurface injection should be conducted to achieve a maximum concentration of penoxsulam in the treated water body of 150 ppb.

Ground and aerial application of penoxsulam to floating and emergent weeds and exposed sediment (pre-emergent treatment) via ground[3] and aerial application is allowed at rates ranging from 0.03125 to 0.175 lb ai/acre. The GENEEC2 model was used to assess the maximum application rate of 0.175 lb ai/acre for exposed sediment. The resulting EEC values did not exceed the 150 ppb target concentration for subsurface injection.

Further, the proposed labels do not clearly specify the number of applications, the application intervals, or water depth. In the absence of explicit instructions, conservative assumptions were made for modeling purposes that used one application of maximum rates to minimum water depth. For penoxsulam use on exposed or floating weeds, it was assumed that naturally occurring perennial water sources would not have a water depth less than 6 inches. Rates for surface applications to water were used to directly calculate aquatic concentration based upon the volume of water per acre at different water depths. The 150 ppb target concentration for subsurface injection would not be exceeded for direct surface application until water depths fall below 6 inches. Therefore, the environmental effect concentrations (EECs) for penoxsulam resulting from the proposed new aquatic uses are not expected to exceed 150 ppb, and this concentration was used as the aquatic EEC for penoxsulam application to water bodies.

Terrestrial Animals and Plants

The potential exposure pathways for terrestrial plants and animals include deposition from ground and aerial spray applications, ingestion of granules, runoff/leaching from treated areas, spray drift, and wind erosion of soil particles resulting in residues on non-target organisms as well as residues on food items for non-target organisms. As part of the terrestrial assessment, EFED modeled exposure concentrations of penoxsulam to non-target terrestrial plants and animals following the ground, aerial sprat and following granule application rates provided by the registrant for terrestrial uses (Table IIB-2). Similar to the aquatic assessment, a maximum single application rate of 0.06 lb ai/acre for ground and aerial spray application as well as granular application for penoxsulam use on terrestrial sites was modeled using T-REX (ver 1.2.3.). In addition, 2 applications of 0.045 lb ai/acre (maximum annual application rate of 0.09 lb ai/acre and 28 day interval between applications) were modeled to estimate penoxsulam residues on various food items which may be contacted or consumed by wildlife.

[2] Direct application to water by subsurface injection into water bodies is accomplished by holding an application wand under water while sitting on a boat moving back and forth along the surface of the targeted water body.
[3] Ground spray to aquatic environments can be accomplished by either driving a truck fitted with spray apparatus along the side of the water body, or by walking through wetlands wearing a backpack sprayer making spot applications.

As part of the terrestrial assessment for terrestrial use patterns, EFED modeled EECs of penoxsulam to non-target terrestrial plants from application to terrestrial non-cropped and cropped areas. EECs were evaluated for ground and aerial spray, and for granular applications of penoxsulam at the maximum application rates using the TerrPlant 1.2.1 model. EEC calculations were used to estimate exposure to terrestrial plants inhabiting terrestrial communities that receive runoff from a treated acre to an adjacent acre (1:1 ratio) inhabited by plants. Runoff to semi-aquatic areas inhabited by terrestrial plants is assumed from 10 treated acres to a distant low-lying acre (10:1 ratio). Also, the AgDrift 2.0.1 model provided further refinement of spray drift dispersion and deposition to terrestrial plants located in proximity to sites treated with penoxsulam.

b. Measures of Effect

Measures of ecological effects are obtained from registrant-submitted guideline studies conducted with a limited number of surrogate species on penoxsulam. The test species are not intended to be representative of the most sensitive species but rather were selected based on their ability to thrive under laboratory conditions and their standardized use for toxicity studies of a variety of chemicals. Consistent with EPA test guidelines, submitted ecological effects data on technical grade penoxsulam comply with good laboratory testing requirements. These data are summarized in Section III.C and in Appendix F.

As stated above, toxicity testing does not represent all species of birds, mammals, or aquatic organisms. Only a few surrogate species for both freshwater fish and birds are used to represent all freshwater fish (2000+) and bird (680+) species in the United States. For mammals, acute studies are usually limited to the Norway rat. Estuarine/marine testing is usually limited to a crustacean, a mollusk, and a fish. Also, neither reptiles nor amphibian data are available. The risk assessment assumes that avian and reptilian toxicities are similar. The same assumption is used for fish and amphibians.

c. Measures of Ecosystem and Receptor Characteristics

Although not required, field studies would assist in determining indirect effects to plant and animal communities in wetland and riparian habitats along freshwater/marine water bodies near sprayed areas or to forest and edge habitats adjacent to target use areas. An evaluation of modeled EECs and calculated RQs will determine if direct effects to receptor species could result in effects at the higher levels of organization (i.e. population, trophic level, community, and ecosystem).

For the Tier I aquatic assessment using GENEEC2 and the Tier I terrestrial assessment using T-REX, the ecosystems that are modeled are intended to be generally representative of any aquatic or terrestrial ecosystem associated with areas where penoxsulam is used. For aquatic assessment, generally fish and aquatic invertebrates in both freshwater and estuarine/marine environments are represented. For terrestrial assessments, three different size classes of small mammals and birds are represented.

III. ANALYSIS

A. Use Characterization

DowAgroSciences is seeking registration of new uses for the herbicide penoxsulam on established turfgrasses and for control of vegetation in aquatic environments. DowAgroSciences GF-443 SC (liquid product containing 21.7% ai, 2 lb ai/gallon) is currently registered as an herbicide for controlling broadleaf weeds, aquatic plants, and certain grasses in dry- and water-seeded rice. Label specifications for the formulated product for rice result in a rate equivalent to one annual application of 0.044 lb/acre (49 g/ha for the active ingredient). Penoxsulam is a post-emergence, acetolactate synthase (ALS) inhibitor herbicide.

This ecological risk assessment focuses exclusively on the proposed new uses for postemergence control of weeds in established turf and control of aquatic vegetation in water bodies and transitional areas. Proposed maximum use rates are as follows:

Turf: 0.06 lb ai/acre for single maximum application. May be used in a split application using 0.045 lb ai/acre with 28 day interval
Restrictions: Do not exceed a total of 0.09 lb ai/acre/season.
Exposure Assessment: Based on single maximum application of 0.06 lb ai/acre and maximum annual application of 0.09 lb ai/acre (0.045 lb ai/acre in 2 applications with 28 day interval). Label permits ground spray and granular application.

Aquatic Environments: 5 - 150 ppb for single subsurface application in water[4]. 5 - 75 ppb for split or multiple applications in water. 0.03125 – 0.0875 lbs. a.i./acre for ground spray or aerial application to the surface of water
Restrictions: Do not exceed a total of 150 ppb ai in water/season for subsurface application.
Exposure Assessment: Based on 1 application/season at the maximum final concentration in treated water of 150 ppb. Label permits direct application to water, subsurface injection to water bodies, ground and aerial spray for control of floating and emergent weeds in water bodies and transition areas.

Exposed Sediment: 0.0875 - 0.175 lb ai/acre for single maximum application.
Restrictions: Use coarse or coarser nozzle spray quality per S-572 ASABE standard.
Exposure Assessment: Based on single maximum application of 0.175 lb ai/acre to exposed sediment. Label permits spray from boat or truck to target area of exposed sediment.

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[4] Ground spray to aquatic environments can be accomplished by either driving a truck fitted with spray apparatus along the side of the water body, or by walking through wetlands wearing a backpack sprayer making spot applications. -- Direct application to water by subsurface injection into water bodies is accomplished by holding an application wand under water while sitting on a boat moving back and forth along the surface of the targeted water body.

B. Exposure Characterization

The penoxsulam exposure characterization in this assessment combined the environmental fate data with Tier I exposure models to estimate environmental exposure concentrations (EECs). Exposure models estimate EECs following the conceptual diagram of penoxsulam usage and potential exposure endpoints shown in Figure IID.1. The EECs for aquatic endpoints are developed using the GENEEC2 simulation model. This model calculates EECs based on geographic areas nationwide and product use sites in close proximity to water bodies. The input parameters used in this assessment were selected from the environmental fate data submitted by the registrant and in accordance with US EPA-OPP EFED water model parameter selection guidelines, *Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides*, Version II, February 28, 2002. A detailed aquatic resource exposure assessment is attached in Appendix C. EECs for birds and terrestrial mammals were estimated using the T-REX model (ver. 1.2.3, August 8, 2005). The terrestrial exposure assessment evaluated potential exposure resulting from penoxsulam residues on wildlife food items. EECs for terrestrial plants were estimated using the TerrPlant model (ver. 1.2.1) and spray drift buffers were analyzed using the AgDrift 2.0.1 model for ground spray application to turf and exposed sediment as well as aerial spray application to water bodies for control of floating and emergent weeds.

1. Environmental Fate and Transport Characterization

a. Summary of Environmental Fate of Penoxsulam

Penoxsulam is expected to be mobile in soil, and moderately persistent in the aerobic terrestrial environments, and not persistent in anaerobic environments. Fate and transport properties of penoxsulam appear in Table III-B 1, below.

b. Persistence and Transformation

Penoxsulam is expected to dissipate rapidly in clear shallow waters through aqueous photolysis and slower in turbid or shaded waters. Laboratory data indicate that the four photolytic half-lives reported for penoxsulam in water range from 1.5 to 3.1 days between pH 7 and pH 8, and 14 days at pH 5.8. A reported pK_a value of 5.1 suggests that pH may have an effect upon the photolytic half-life. Likewise, penoxsulam is expected to dissipate more slowly through biotic degradation when sunlight has a limited ability to penetrate colored or turbid waters, or when waters are shaded by trees, riparian vegetation, and/or crop canopies. Thus, in turbid, shaded or acidic waters, photolysis of penoxsulam is expected to be slower, and other degradation mechanisms are expected to predominate. In aqueous environments, penoxsulam is stable to hydrolysis at pH 5, 7 and 9.

In terrestrial environments, or when sunlight is not able to degrade penoxsulam, it is expected to be moderately persistent, dissipating through soil photolysis and biotic degradation. Penoxsulam has photolytic half-lives of 19 and 109 days, on the two soils studied at pH 6 ± 0.2. Aerobic soil metabolism was studied in three soils. The resulting three half-lives calculated through linear regression of log transformed data were 34, 43, and 118 days. Aerobic aquatic metabolism was studied in six soil/water test systems. The six total system half-lives calculated through linear regression of log transformed data ranged from 16 to 38 days. Anaerobic aquatic metabolism was studied in three soil/water test systems. The three total system half-lives calculated through linear regression of log transformed data were 5 days, 7 days, and 11 days.

c. Transport and Mobility

Penoxsulam is expected to be very mobile in terrestrial environments, not binding strongly to soil, but binding more strongly to sediments. The soil to water partitioning coefficients (K_d) derived from the seventeen soils and one sediment studied ranged from 0.13 to 4.69, with an average value of 0.92 and a standard deviation of 1.07. However, if one excludes sand, volcanic, and Canadian soils, K_d values range from 0.13 to 1.96, with an average value of 0.62 and a standard deviation of 0.53. The reported K_{oc} value for sediment was 1130 (K_d = 1.4).

Submitted mobility data for three penoxsulam degradation products (BSTCA, 5-OH-penoxsulam, and BST) indicate environmental mobility roughly equivalent to or slightly greater than the parent compound. Penoxsulam has low volatility indicating that atmospheric transport is, at best, a very minor route of dissipation.

The soil to water partitioning coefficients (K_d) for BSTCA derived from the six soils studied ranged from 0.085 to 4.4. The soil to water partitioning coefficients (K_d) for 5-OH-penoxsulam, derived from the eight soils studied ranged from 0.14 to 1.4. The soil to water partitioning coefficients (K_d) for BST derived from the eight soils studied ranged from 0.075 to 0.61. However, there are no data regarding the mobility of neither the remaining transformation products nor the combined parent/degradate residues.

Five of the thirteen identified transformation products reached peak concentrations at study termination: 2-amino-TP, BSTCA, 2-amino-TCA, sulfonamide and 5,8-di-OH penoxsulam. These five compounds are potentially more persistent than the parent compound, and would probably have reached even greater concentrations with increased time. Eleven of the thirteen penoxsulam transformation products reported in laboratory studies are considered major degradates: BSA, 2-amino-TP, TPSA, BSTCA methyl, BSTCA, 2-amino-TCA, 5-OH-penoxsulam, SFA, sulfonamide, 5,8-di-OH and 5-OH 2 amino TP. Two of the thirteen penoxsulam transformation products are considered minor degradates: di-FESA and BST. See Appendix B for the chemical structures, Chemical Abstract Service Names, and additional fate information of the penoxsulam transformation products.

Information regarding the environmental fate studies used in this report is detailed in Appendix A. Table III-B2 summarizes the penoxsulam transformation products identified in the submitted data.

Table III-B 2. Summary of Environmental Fate Properties of Penoxsulam Used in Assessment.

Study Type	Value	Test System	Study MRID	Study Status
Hydrolysis -- $t_{1/2}$	stable	pH 5, 7, 9 buffers / natural waters	458307-21	acceptable
Photodegradation in Water -- $t_{1/2}$	1.5 days, 1.5 days, 3.1 days, 14 days	pH 7 buffer, pH 7.8 natural waters, pH 7 AR pond water, pH 5.8 flooded soil	458348-01, 458307-22	supplemental, supplemental
Photodegradation on Soil -- $t_{1/2}$	19 days, 109 days	flooded silt loam, silty clay loam	458307-23	supplemental
Aerobic Soil Metabolism -- $t_{1/2}$	34 days, 43 days, 118 days	AR silt loam, CA clay loam, ND loam	458307-24	acceptable
Anaerobic Aquatic Metabolism -- $t_{1/2}$ (total system)	5 days, 11 days, 7 days	AR pond water / silt loam clay sediment, AR pond water / silt loam soil, distilled water / silty loam soil (Italy)	458307-25	acceptable
Aerobic Aquatic Metabolism -- $t_{1/2}$ (total system)	16 days, 29 days, 12 days, 38 days, 30 days, 31 days	AR pond water / silt loam clay sediment, AR pond water / silt loam soil, Italian channel water / loam sediment, French lake water / sand sediment, HPLC water / volcanic loam soil (Japan), HPLC water / loam soil (Japan)	458307-26	acceptable
Adsorption/ Desorption – K_d	0.37, 0.56, 0.49, 0.45, 1.96, 0.48, 0.16, 0.32, 1.4, 0.51, 0.64, 0.13	AR Silt loam, (AR, USA) Sandy clay loam (Japan), CA Clay loam, (CA, USA) ND Loam, (ND, USA) Silty clay loam (Italy), Silty clay loam (France), Sandy clay loam (UK), Sandy loam (Italy), AR Silty clay sediment, (AR,USA) Sandy loam (Brazil), Clay loam (Brazil), Sandy clay loam (Brazil)	458308-01, 458348-02 458308-02	acceptable, supplemental, (aged column mobility study of limited value) supplemental (BSTCA, BST, 5-OH-penoxsulam)
Bioconcentration in Aquatic, Non-Target Organisms – BCF	0.02 mL/g	crayfish (*Procambarus clarkii*), 14 days, at 0.5 ppm under flow-through conditions	458300-01	acceptable
Terrestrial Field Dissipation -- $t_{1/2}$	19 days, 6 days	California sandy, loam soil New York loamy, sand soil	467035-01	acceptable
Aquatic Field Dissipation -- $t_{1/2}$ (total system)	16 days, 16 days, 5 days, 10 days, 4 days, 25 days, 35 days	AR bareground plot, dry seeded (liquid), AR cropped plot, dry seeded (liquid), CA bareground plot, water seeded (liquid), CA cropped plot, water seeded (liquid), CA cropped plot, water seeded (granular), FL pond - $t_{1/2}$ water column (liquid) FL pond - $t_{1/2}$ sediment (liquid)	458308-04, 458308-05, 467035-02	supplemental, acceptable, acceptable

Table III-B 3. Summary of Penoxsulam Transformation Products from Environmental Fate Studies					
Study Type	**Degradates**	**Maximum % Applied**	**Major / Minor**	**Maximum at Study Termination***	**Study MRID**
Photodegradation in Water	BSA, 2-amino TP,	36%, 18%,	major, major,	no, no	458348-01
	TPSA, 2-amino-TCA, 5-OH, 2-amino TP, BSTCA methyl, BSTCA, di-FESA	56%, 85%, 32%, 12%, 7.2%, 7.6%	major, major, major, minor, minor, minor	no, yes, no, no, no, no	458307-22
Photodegradation on Soil	BSTCA, 2-amino TP, BSA, $^{14}CO_2$	11%, 10%, 8.1%, 3.2%	major, major, minor, minor	no, yes, no, yes	458307-23
Aerobic Soil Metabolism	BSTCA, 5-OH-penoxsulam, SFA, sulfonamide, $^{14}CO_2$, BSTCA methyl, BST	37%, 63%, 15%, 33%, 16%, 1.4%, 6.3%	major, major, major, major, major, minor, minor	yes, no, yes, yes, yes, no, no	458307-24
Anaerobic Aquatic Metabolism	BSTCA, BSTCA methyl, 5-OH-penoxsulam, 5,8-di OH, BST, $^{14}CO_2$	25%, 13%, 42%, 11%, 4.8%, 1.2%	major, major, major, major, minor, minor	no, no, no, yes, no, yes	458307-25
Aerobic Aquatic Metabolism	5-OH-penoxsulam, BSTCA, $^{14}CO_2$	40%, 39%, 2.4%	major, major, minor	no, yes, yes	458307-26

*Maximum % of applied reported at study termination indicates that amounts may have continued to increased with time

d. Field Dissipation Studies

Terrestrial Field Study

Soil dissipation of penoxsulam under US field conditions was monitored in three bare plots of loam soil in California and in three bare plots of loamy sand soil in New York.

Penoxsulam was applied once at a target rate of 0.11 kg a.i./ha (0.098 lb a.i./acre) to 39 x 7 m and 40 x 8 m replicate plots in California and New York, respectively (MRID 467035-01). Penoxsulam and transformation products were monitored in soil samples collected from Site 1 at 0 thru 327 days post application, and from Site 2 at 0 thru 150 days posttreatment. Soil samples were collected to a depth of 0-90 cm. The half-life of penoxsulam in the loam soil in California was 48.5 days (based on all replicate detections) and 18.8 days (based on 0-92 day data). The calculated DT_{90} was 53 days and the transformation products detected: 5-OH penoxsulam and BSTCA. The half-life of penoxsulam in the loamy sand in New York was 5.9 days (based on all replicate detections). The calculated DT_{90} was 12 days and the major transformation product detected was BSTCA.

Aquatic Field Studies

In the submitted aquatic field dissipation studies, the water half-life for penoxsulam applied by subsurface injection to a pond in Florida to achieve a final concentration of 150 ppb in the 0.3-ha application zone was 24.8 days (MRID 467035-02). Note that 150 ppb is the maximum penoxsulam concentration allowed in a treated water body. The transformation products 5-OH, BSTCA, and TPSA were detected in the pond water at the highest concentrations. 5-OH was detected in the pond water at a maximum concentration of 6.83 ng/mL after 57 days. BSTCA was detected in the pond water at a maximum of 13.57 ng/mL after 57 days. TPSA was initially detected in the pond water at a maximum of 2.12 ng/mL after 57 days. The transformation products BSA, 2-amino-TP, sulfonamide, and 5-OH-2-amino-TP were detected in the pond water at maximum concentrations of 0.26 ng/mL (14 days), 0.63 ng/mL (43 days), 0.71 ng/mL (43 days), and 0.05 ng/mL (253 days), respectively.

In the same study, penoxsulam dissipated in the Florida pond sediment with a half-life of 34.5 days based on detected concentrations following the maximum concentration at 21 days. The transformation products 5-OH and BSTCA were detected in the sediment at levels above the LOQ. 5-OH was detected in the sediment at a maximum of 26.62 ng/g by 7 days while BSTCA was detected at a maximum of 18.33 ng/g by 85 days.

In a supplemental aquatic field dissipation study (MRID 467035-03), penoxsulam was applied via subsurface injection four times at 28-day intervals to achieve a 20 ppb concentration in the 1.2-ha application zone of a Florida pond. Penoxsulam dissipated in the water with half-lives of 15.4, 11.0, 12.1 and 11.7 days, respectively, following each application. Penoxsulam dissipated in the sediment with half-lives of 8.2, 12.9, 7.8, and 21.7 days following each application. Transformation products were not monitored in this study.

2. Aquatic Exposure

a. Aquatic Exposure Modeling

Tier I aquatic Estimated Environmental Concentrations (EECs) for use of penoxsulam on turf were estimated by EFED's GENEEC2 model. GENEEC2 uses the soil/water partition coefficient and degradation kinetic data to estimate runoff from a ten hectare field into a one hectare by two meter deep "standard" pond. It considers reduction in dissolved pesticide concentration due to adsorption of pesticide to soil or sediment, incorporation, degradation in soil before washoff to a water body, direct deposition of spray drift into the water body, and degradation of the pesticide within the water body. GENEEC2 calculates acute as well as longer-term EEC values. Additional information on these models and use scenarios can be found at: http://www.epa.gov/oppefed1/models/water/index.htm .

Tier I aquatic EECs were modeled for ground spray applications of penoxsulam to turf at a single application rate of 0.06 lb ai/acre. Likewise, a single application rate of 0.06 lb ai/acre was evaluated for granular uses on turf. In addition, 2 applications of 0.045 lb ai/acre (0.09

maximum annual application rate) was evaluated with a 28 day interval between applications according to the proposed labels for the Dow AgroSciences end-use products GF-443 SC, Penoxsulam GR 0.04%, Penoxsulam GR 0.014%, Penoxsulam FERT 0.04%, Penoxsulam FERT 0.014% (see Table IIA-3).

In addition to the proposed new use of penoxsulam on turf, direct application of the herbicide to water bodies for control of aquatic vegetation is proposed. As part of the aquatic assessment, EFED estimated exposure concentrations to non-target aquatic organisms and plants following direct application of penoxsulam to water bodies. Direct application[5] as well as ground[6] and aerial spray to water bodies is allowed to achieve a maximum concentration of penoxsulam in the treated water body of 150 ppb.

Application to floating and emergent weeds and exposed sediment (pre-emergent treatment) via ground and aerial application is allowed at rates ranging from 0.03125 to 0.175 lb ai/acre. GENCCE2 estimated EECs below the 150 ppb maximum for subsurface injection when applied to the surface of the standard ecological pond. Therefore, the maximum penoxsulam concentration allowed in treated waters of 150 ppb will be used as the aquatic EEC in this assessment[7] (Table IIA-3).

Based on the environmental fate data described above (Section III.B.1) and penoxsulam ground spray and granular application to turf scenarios, EECs for aquatic exposure were estimated. Input parameters for the GENEEC2 model are presented for penoxsulam in Table III-B3. Aquatic exposure concentrations were estimated for the parent penoxsulam following ground spray application and granular application (Table III-B4) at the maximum single application rate and the maximum annual application rate for the proposed new use on established turf.

[5] Direct application to water by subsurface injection into water bodies is accomplished by holding an application wand under water while sitting on a boat moving back and forth along the surface of the targeted water body.
[6] Ground spray to aquatic environments can be accomplished by either driving a truck fitted with spray apparatus along the side of the water body, or by walking through wetlands wearing a backpack sprayer making spot applications.
[7] However, when applied to the surface of water bodies with a depth of less than six inches, the assumed maximum concentration of 150 ppb will be exceeded.

Table III-B 4. GENEEC2 Input Parameters for Penoxsulam.			
Parameter	**Value**	**Comment**	**Source**
Application Rate to Turf	0.06 lb ai/acre (single application) 0.045 lb ai/acre (2 applications)	maximum single application rate of 0.06 lb ai/acre maximum annual application rate of 0.09 lb a.i/acre	Product Label
Aerobic Soil Metabolism $t_{1/2}$	115 days	estimated upper 90th percentile based on 3 studies	MRID 45830724
Aerobic Aquatic Degradation $t_{1/2}$	36.7 days	estimated upper 90th percentile based on 4 studies	MRID 45830726
Anaerobic Aquatic Degradation $t_{1/2}$	16.4 days	estimated upper 90th percentile based on 2 studies	MRID 45830725
Aqueous Photolysis $t_{1/2}$	3 days	estimated upper 90th percentile based on 3 studies	MRID 45834801 and 45830722
Hydrolysis $t_{1/2}$	Stable	pH 5, 7,9	MRID 45830721
Soil Partition Coefficient (K_d)	1.11 mL/g	average of 18 K_d values from studies with various soil types	MRID 45830801
Molecular Weight	483.4 g/mole		MRID 45830724
Aqueous Solubility, 25°C	408 mg/L		MRID 45830726
Vapor Pressure	7.16 E-16 torr		MRID 45830724
Henry's Law Constant	<2.95 E-7 atm m^3 mol^{-1}		Product Chemistry

Table III-B 5. Aquatic EEC's (surface water) Following Application of Penoxsulam.				
Simulation Scenario	***Concentration (µg/L)***			
Application Method and Rate (lb ai/acre)	Peak	21-day	60-day	90-day
Ground Spray				
Turf - 0.06	3.04	2.71	2.19	1.88
Turf - 0.09[1]	4.19	3.73	3.02	2.59
Exposed sediment - 0.175	8.42	7.52	6.11	5.27
Granular				
Turf - 0.06	2.85	2.54	2.05	1.76
Turf - 0.09[1]	3.94	3.51	2.84	2.44

[1]2 applications of 0.045 lb ai/acre with 28 day interval between applications. Input and output for GENEEC2 modeling is presented in Appendix C.

b. Aquatic Exposure Monitoring and Field Data

Monitoring data are not available for penoxsulam.

3. Terrestrial Exposure

a. Terrestrial Exposure Modeling for Spray Applications

Terrestrial wildlife exposure estimates are typically calculated for bird and mammals, emphasizing a dietary exposure route for uptake of pesticide active ingredients. These exposures are considered as surrogates for terrestrial-phase amphibians as well as reptiles. For exposure to terrestrial wildlife, such as birds and small mammals, pesticide residues on food items are estimated, based on the assumption that organisms are exposed to a single pesticide residue in a given exposure scenario. For this terrestrial exposure assessment, aerial and ground spray application methods for penoxsulam were considered.

For penoxsulam spray applications, estimation of pesticide concentrations in wildlife food items focused on quantifying possible dietary ingestion of residues on vegetative matter and insects. No field residue data or field study information was available for penoxsulam. Therefore, the residue estimates were based on a nomogram that relates food item residues to pesticide application rate. The residue EECs were generated from a spreadsheet-based model (T-REX version 1.2.3) that calculates the decay of a chemical applied to foliar surfaces for single or multiple applications and is based on the methods of Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994). Uncertainties in the terrestrial EECs are primarily associated with a lack of data on interception and subsequent dissipation from foliar surfaces. Residue EECs were calculated for two turf application rates; 0.06 lb ai/acre (maximum single application), and 0.09 lb ai/acre (maximum annual application rate of 2 applications at 0.045 lb ai/acre). EECs were calculated using a foliar dissipation default half-life of 35 days (Willis and McDowell, 1987). Available data indicate penoxsulam is stable to hydrolysis and has the following half-lives: aerobic soil metabolism (115 days), aquatic aerobic metabolism (36.7 days) and anaerobic aquatic metabolism (16.4 days). The frequency of penoxsulam application to turf was 28 days based on the GF-443 SC label.

The EECs on terrestrial food items may be compared directly with dietary toxicity data or converted to an oral dose, as is the case for small mammals. For mammals, the residue concentration is converted to daily oral dose based on the fraction of body weight consumed daily as estimated through mammalian allometric relationships. The risk assessment for penoxsulam uses 90th percentile values of predicted residues as the measure of exposure. The predicted (90th percentile) maximum value and 90th percentile of the mean residues of penoxsulam that may be expected to occur on selected avian or mammalian food items immediately following penoxsulam application are presented in Table III-B5. Values are provided using the maximum single application rate as well as the maximum annual application rate to turf and the maximum application rate to exposed sediment.

Table III-B 6. Terrestrial EEC's (Bird and Mammal) Following Penoxsulam Ground Spray Application to Turf and Exposed Sediment.				
Uses	**# of App. x App. Rate**	**Food Items**	**Maximum EEC (ppm)**	**Mean EEC (ppm)**
Turf	1 x 0.06 lb ai/acre	Short Grass	14.40	5.10
		Tall Grass	6.60	2.16
		Sm. Insects, Broadleaf Plants	8.10	2.70
		Lg. Insects, Fruits, Pods	0.90	0.42
Turf	2 x 0.045 lb ai/acre	Short Grass	17.00	6.02
		Tall Grass	7.79	2.55
		Sm. Insects, Broadleaf Plants	9.56	3.19
		Lg. Insects, Fruits, Pods	1.06	0.50
Exposed Sediment	1 x 0.175 lb ai/acre	Short Grass	42.00	14.88
		Tall Grass	19.25	6.30
		Sm. Insects, Broadleaf Plants	23.63	7.88
		Lg. Insects, Fruits, Pods	2.63	1.23

EECs for granular and granular impregnated fertilizer formulations containing penoxsulam at the maximum single application rate of 0.06 lb ai/acre and maximum annual application rate (2 applications at 0.045 lb ai/acre) were calculated using the T-REX model. EECs for birds and mammals were calculated based on ft^2 for granular broadcast application of penoxsulam granules and are presented in Table III-B6.

Table III-B 7. Terrestrial EEC's (Bird and Mammal) Following Penoxsulam Granular Application to Turf.		
Uses	**# of App. x App. Rate**	**EEC (mg ai/ ft^2)**
Turf	1 x 0.06 lb ai/acre	0.62
Turf	2 x 0.045 lb ai/acre	0.47

Effects on non-target terrestrial plants are most likely to occur as a result of spray drift and/or runoff from aerial and ground applications of penoxsulam as well as runoff from granular applications. Spray drift and runoff is an important factor in characterizing the risk of penoxsulam to non-target plants, which is assumed to reach off-site areas. The TerrPlant model (ver.1.2.1) predicts EECs for terrestrial plants located in dry and semi-aquatic areas adjacent to the treated areas. The EECs are based on the application rate and solubility of the pesticide in water and drift characteristics, which depend on ground or aerial applications. The amount of penoxsulam that runs off is a proportion of the application rate and is assumed to be 5% based on penoxsulam's solubility of >100 ppm in water. Drift from ground and aerial applications are assumed to be 1% and 5%, respectively, of the application rate. For dry areas, the loading of pesticide active ingredient from runoff to an adjacent non-target area is assumed to occur from one acre of treatment to one acre of non-target area and is characterized as "sheet runoff". For terrestrial plants inhabiting semi-aquatic (wetland) areas, runoff is considered to occur from a larger source area with active ingredient loading originating from 10 acres of treated area to a single acre of non-target wetland and is characterized as "channelized runoff". Predicted terrestrial plant EECs following spray and granular applications at the maximum single application rate of 0.06 lb ai/acre are summarized in Table III-B7.

Table III-B 8. EECs for Terrestrial Plants Located Adjacent to Penoxsulam Treated Sites.				
Terrestrial Use	Application Method	Concentration (lb ai/acre)		
		Total Loading to Areas Adjacent to Treated Areas[1]	Total Loading to Semi-Aquatic Areas Adjacent to Treated Areas[2]	Drift to Adjacent Areas[3]
Turf (0.06 lb ai/acre)	Ground Spray[4] Granular[5]	0.0036 0.0030	0.0306 0.0300	0.0006 not applicable
Exposed Sediment (0.175 lb ai/acre)	Ground Spray[4]	0.0105[6]	0.0893[6]	0.0018

[1] EEC = Sheet Runoff + Drift (1% for ground; 5% for aerial)
[2] EEC = Channelized Runoff + Drift (1% for ground; 5% for aerial)
[3] EEC for ground (appl. rate x 1% drift); for aerial (appl. rate x 5% drift)
[4] EEC for Unincorporated Ground Spray Application
[5] EEC for Unincorporated Granular Application
[6] Not a likely scenario, since dry land area down gradient from an area of exposed sediment typically is not expected

C. Ecological Effects Characterization

Appendix F summarizes the results of the registrant-submitted toxicity studies used to characterize effects for this risk assessment. Toxicity studies reported in this section do not represent all species of birds, mammals, or aquatic organisms. Surrogate test species of birds, mammals, fish, aquatic and terrestrial invertebrates and plants are used to estimate treatment-related direct effects on acute mortality and chronic reproduction, growth, and survival of non-target species. Toxicity tests include short-term acute, subacute, and reproduction/chronic studies that progress from basic laboratory tests to applied field studies. In addition, avian species are used as surrogates for reptiles and fish species are used as surrogates for amphibians. Because penoxsulam is an ALS inhibitor (i.e., the mode of action is inhibition of a plant enzyme), it is not expected to be very toxic to aquatic or terrestrial animals. In addition, review of the physical and chemical properties of penoxsulam indicates that it is expected to be very mobile, but moderately persistent, in terrestrial environments. Penoxsulam is expected to be less mobile and to dissipate more rapidly in aqueous environments.

1. Aquatic Effects Characterization

Table III-C1 presents the toxicity endpoint values used to calculate RQs and estimate risk to aquatic receptors from exposure to penoxsulam through direct application and surface runoff/leaching. Details of the registrant-submitted studies for aquatic animals and plants are provided in Appendix F.

Table III-C 1. Penoxsulam Toxicity Endpoint Values for Assessing Risk to Aquatic Organisms.

Exposure Scenario	Species	Exposure Duration	Toxicity Endpoint Value	Endpoint	Reference (Classification)
Freshwater Fish					
Acute	Rainbow trout *Oncorhynchus mykiss*	96 hour	LC_{50} = >102 mg/L NOAEC = 102 mg/L	No mortality or sublethal effects	MRID 458348-04 (Supplemental)
Chronic	Fathead minnow *Pimephales promelas*	Full life cycle	NOAEC = 10.2 mg/L LOAEC = >10.2 mg/L	No treatment-related effects	MRID 458310-27 (Supplemental)
Freshwater Invertebrates					
Acute	Water flea *Daphnia magna*	48 hour	EC_{50} = >98.3 mg/L NOAEC = 98.3 mg/L	Immobilization	MRID 458310-12 (Supplemental)
Chronic	Water flea *Daphnia magna*	21-day	NOAEC = 2.95 mg/L LOAEC = 9.76 mg/L	Reproductive effects	MRID 458310-26 (Acceptable)
Estuarine/Marine Fish					
Acute	Silverside *Menidia beryllina*	96 hour	LC_{50} = >129 mg/L NOAEC = 129 mg/L	Survival	MRID 458310-22 (Supplemental)
Chronic			Reserved		
Estuarine/Marine Invertebrates					
Acute	Saltwater mysid *Americamysis bahia*	96 hour	LC_{50} = >114 mg/L NOAEC = 114 mg/L	Survival	MRID 458310-24 (Acceptable)
Chronic	Saltwater mysid *Americamysis bahia*	28-day	NOAEC = <8.08 mg/L LOAEC = 8.08 mg/L	Reductions in growth	MRID 458310-28 (Supplemental)
Aquatic Plants					
Nonvascular	Green algae *Selenastrum capricornutum*	96-hour	EC_{50} = 0.092 mg/L NOAEC = 0.005 mg/L	Cell density	MRID 458348-05 (Acceptable)
Macrophytes	Duckweed *Lemna gibba*	14-day	EC_{50} = 0.003 mg/L NOAEC = 0.001 mg/L	Frond number	MRID 458311-20 (Acceptable)

Under the proposed new uses, the most likely sources of penoxsulam exposure to nontarget aquatic organisms, including endangered and threatened species, would occur through direct application to lakes, streams, marshes, and other open water bodies and through runoff and spray drift from direct application to turf. Available acute toxicity data for aquatic species indicates that penoxsulam is practically non-toxic to freshwater and marine/estuarine fish and to marine/estuarine invertebrates and slightly toxic to freshwater invertebrates. Results of chronic studies with penoxsulam indicate that no treatment-related effects to growth and reproduction occurred in freshwater fish at concentrations up to 10.2 ppm ai. In chronic studies with daphnids, penoxsulam significantly reduced the number of live offspring at 9.76 ppm ai (NOAEC = 2.95 ppm ai). Penoxsulam also produced a 20% reduction in male body weights of saltwater mysids at 8.1 mg/L in chronic studies. In full life-cycle toxicity studies with chironomids, reductions in the development rate were observed at 15 mg ai/L.

Penoxsulam exhibits toxicity to aquatic vascular plants, with an EC_{50} of 0.003 mg/L for duckweed (NOAEC 0.001 mg/L), based on reduction of frond number. Results of Tier II toxicity studies with non-vascular aquatic plants indicate that penoxsulam adversely affected cell density with the freshwater green algae being the most sensitive species (EC_{50} = 0.092 mg/L; NOAEC = 0.005 mg/L.

Several studies were submitted on the acute toxicity of the penoxsulam degradates to *D. magna*. Seven of them, the studies on BSTCA, BST, 5-hydroxy-XDE-638, 2-amino-8-methoxy, 2-amino-TP, TPSA, (5-OH, 2-amino-TP), and BSA, were acceptable for risk analysis. Their 48-hour EC_{50} values for daphnids ranged from >1.0 ppm to >100 ppm. In addition, studies with the degradates were conducted for aquatic vascular and non-vascular plants. The penoxsulam degradates were not as toxic as the parent material.

2. Terrestrial Effects Characterization

Table III-C2 presents the toxicity endpoint values used to calculate RQs and estimate risk to terrestrial receptors from oral exposure to penoxsulam residues as the result of direct deposition and spray applications to turf. Details of the registrant-submitted studies for terrestrial animals and plants are provided below and in Appendix F.

Ground deposition of liquid or granular formulations, spray drift, and wind erosion of soil particles with resulting residues on foliage and on flowers and seeds are the most likely sources of penoxsulam exposure to nontarget terrestrial organisms, including endangered and threatened species. An additional source of exposure to penoxsulam could be in puddled water on treated fields through preening and grooming, involving the oral ingestion of material from the feathers or fur. Available acute toxicity data indicate that penoxsulam is practically non-toxic to upland game birds, no more than slightly toxic to waterfowl by the oral route (LD_{50} >2,025 mg/kg-bw and >1,900 mg/kg-bw, respectively), and no more than slightly toxic to both upland game birds and waterfowl by the subacute dietary route (LC_{50} >4.411 and >4,310 ppm, respectively). Results of available chronic studies with penoxsulam showed upland game birds as more sensitive than waterfowl, with food consumption and body weight gain being decreased at 501 ppm ai, resulting in a NOAEC of 231 ppm ai. However, these effects might have been attributed to the amount of solvent used in the test diet preparations. Consequently, for this screening risk assessment, the chronic toxicity data for the mallard were used to assess risk. In an acceptable chronic study with mallards, reductions in male body weight were observed at the 958 ppm ai treatment level, with a NOAEC of 501 ppm ai.

Table III-C 2. Penoxsulam Toxicity Endpoint Values for Assessing Risk to Terrestrial Organisms.					
Exposure Scenario	**Species**	**Exposure Duration**	**Toxicity Endpoint Value**	**Endpoint**	**Reference (Classification)**
Mammal					
Acute Oral	Laboratory rat	Single Oral Dose	LD_{50} = >5000 mg/kg-bw	Survival	MRID 458308-12 (Acceptable)
Chronic Reproduction	Laboratory rat	2-generation	NOAEL = 30 mg/kg/day LOAEL= 100 mg/kg/day	Parental tox (F) Reprod/offspring tox (M)	MRID 458309-20 (Acceptable)
Birds					
Acute Oral	Mallard *Anas platyrhynchos*	14 days	LD_{50} = >1900 mg/kg bw NOAEL=1900 mg/kg bw	No mortality or sublethal effects	MRID 458309-28 (Supplemental)
Subacute Dietary	Mallard *Anas platyrhynchos*	8 days	LC_{50} = >4310 ppm NOAEL = <733 ppm	Reduction in body weight gain	MRID 458310-03 (Supplemental)
Chronic	Mallard *Anas platyrhynchos*	one generation	NOAEC = 501 ppm-diet LOAEC = 958 ppm-diet	Reduction in adult male body weight	MRID 462764-01 (Acceptable)
Insects					
Acute Contact	Honey Bee *Apis mellifera*	96 hour	LD_{50} = >100 µg/bee NOEC = 100 µg/bee	Survival	MRID 458311-24 (Acceptable)
Terrestrial Plants					
Seedling Emergence	Monocot – Onion	Tier II	EC_{25} = 1.1 g/ha NOAEC = 0.41 g/ha	Shoot weight	MRID 458311-16 (Acceptable)
Seedling Emergence	Dicot – sugarbeet	Tier II	EC_{25} = 3.2 g/ha NOAEC = 1.2 g/ha	Shoot weight	MRID 458311-16 (Acceptable)
Vegetative Vigor	Monocot – ryegrass	Tier II	EC_{25} = 17 g/ha NOAEC = 0.41g/ha	Shoot weight	MRID 458311-16 (Acceptable)
Vegetative Vigor	Dicot – Soybean	Tier II	EC_{25} = 3.9 g/ha NOAEC = 1.2 g/ha	Shoot weight	MRID 458311-16 (Acceptable)

Acute toxicity data indicate that penoxsulam is practically non-toxic to mammals (acute LD_{50} value of >5,000 mg/kg bw). In a 2-generation reproduction study with rats exposed to penoxsulam, kidney lesions were observed in female rats at 100 mg/kg/day, resulting in a parental systemic toxicity NOAEL of 30 mg/kg/day (600 ppm). Preputial separation, an indicator of sexual maturation, was observed in F_1 males at 100 mg/kg/day, resulting in a reproductive/ offspring toxicity NOAEL of 30 mg/kg/day (600 ppm). Acute contact studies indicate that penoxsulam is practically non-toxic to honey bees (LD_{50} >100 µg/bee). In addition, non-guideline subchronic studies indicate that penoxsulam is practically non-toxic to earthworms with an LD_{50} >1,000 mg/kg.

Exposure of terrestrial plants to penoxsulam is assumed to occur through direct spraying, runoff or drift. Terrestrial plant toxicity studies with monocots and dicots indicate that seedling emergence and vegetative vigor are severely impacted by exposure to penoxsulam. In Tier II studies, seedling emergence, based on shoot weight, was adversely impacted in monocots (onion) at an EC_{25} of 1.1 g ai/ha and in dicots (sugarbeet) with an EC_{25} of 3.2 g ai/ha. Vegetative vigor in monocots and dicots, based on shoot weight, was adversely impacted at an EC_{25} of 17 g ai/ha in ryegrass and an EC_{25} of 3.8 g ai/ha in soybean.

Exposure of terrestrial and aquatic plants to penoxsulam metabolites is also a potential concern. In a laboratory study, penoxsulam and 11 major metabolites were applied to seeds and saplings (2 to 2.5 leaves) of 22 plant species including crops, weeds, grasses and flowering plants. The parent penoxsulam caused significant injury to all exposed species when applied to pre-emergent seeds. However, none of the applied 11 major metabolites caused observable injury when applied to pre-emergent seeds. Post-emergent treatment with penoxsulam caused significant injury to all species with the exception of rice, wheat and blackgrass. Only two of the 11 metabolites (5-OH penoxsulam and sulfonyl-formamidine) caused noticeable injury to species during the post-emergence test at the highest tested concentrations (250 and 500 ppm). Oilseed rape, chickweed, lambsquarter, redroot pigweed, velvetleaf and wild buckwheat exhibited minor injury when treated with these two metabolites.

IV. RISK CHARACTERIZATION

A. Risk Estimation - Integration of Exposure and Effects Data

A deterministic approach was used to evaluate the likelihood of adverse ecological effects to non-target species. In this approach, risk quotients (RQs) were calculated by dividing exposure estimates (EECs) by ecotoxicity values for non-target species, both acute and chronic.

RQ = EXPOSURE/TOXICITY

RQs were then compared to LOCs, which are the criteria used by OPP to indicate potential risk to non-target organisms. LOCs and the RQs for penoxsulam are provided in Appendix C.

1. Non-target Aquatic Animals and Plants

a. Fish and Invertebrates

The proposed labels do not clearly specify the number of applications, the application intervals, or the water depth for aerial and ground spray application to water. In the absence of explicit instructions, assumptions were made for modeling purposes that used one application of maximum rates to minimum water depth. For penoxsulam use on exposed or floating weeds it was assumed that naturally occurring water bodies would not have a water depth less than 6 inches. Rates for surface applications to water were used to directly calculate aquatic concentration based upon the volume of water per acre at different water depths. The 150 ppb target concentration for subsurface injection would not be exceeded for direct surface application until water depths fall below 6 inches, and this concentration was used as the aquatic EEC for penoxsulam application to water bodies. However, if the water depth is below six inches, as would be found in wetlands, this assessment underestimated the risk to aquatic organisms.

Acute Risks

Comparison of estimated peak concentrations in surface water following penoxsulam application to turf to acute toxicity thresholds (LC_{50}/EC_{50}s) for freshwater and marine/estuarine fish and invertebrates are provided in Appendix C. Acute RQs for all taxonomic groups are less than the LOC indicating adverse effects to survival of freshwater and marine/estuarine fish and invertebrates are not expected from ground or granular application of penoxsulam.

Likewise, for the direct application of penoxsulam to water which results in the maximum concentration in water of 150 ppb, the acute RQ is <0.01 for freshwater fish, freshwater invertebrates, estuarine/marine fish and estuarine/marine invertebrates; thus, adverse effects are not expected.

Chronic Risks

Chronic RQs for freshwater fish and freshwater and marine invertebrates based on the 21-day average EEC resulting from penoxsulam application to turf are below the Chronic LOC of 1 (see Appendix C). Adverse effects to growth and reproduction of these taxonomic groups are not expected from the ground or granular application of penoxsulam. Chronic studies with marine/estuarine fish were reserved.

Likewise, chronic RQs for freshwater fish and freshwater and marine invertebrates resulting from penoxsulam application to water are below the chronic LOC of 1.

b. Aquatic Plants

For penoxsulam, there are exceedances of the endangered LOCs for vascular aquatic plants exposed to runoff/drift from ground and granular use for turf and exposed sediment as well as for the direct application of penoxsulam to water at all application rates (Table IV-A 1). There are also exceedances of non-endangered LOCs for the vascular aquatic plants from ground application at the maximum rates of 0.06 and 0.09 lb ai/acre for turf, granular application to turf at 0.09 lb ai/acre, direct application to water, and 0.175 lb ai/acre ground application for exposed sediment. The only risk indicated to aquatic non-endangered non-vascular plants is from the direct application to water. Risk to aquatic plants will be discussed further in the Risk Description section and in the spray drift analysis. Bolded values in the table indicate that the RQ has exceeded the LOC (RQ>1.0).

Table IV-A1. Summarized Aquatic Plant Risk Quotients [1,2]			
Scenario	Endangered	Non-Endangered	
	Vascular	Vascular	Non-vascular
Turf Application			
Ground Spray 0.06 lb ai/acre	**3.04**	**1.01**	0.03
Ground Spray 0.09 lb ai/acre[3]	**4.19**	**1.39**	0.04
Granular 0.06 lb ai/acre	**2.85**	0.95	0.03
Granular 0.09 lb ai/acre[3]	**3.94**	**1.31**	0.04
Direct Application to Water			
0.15 ppm (max. conc.)[4]	**150**	**50**	**1.6**
Exposed sediment Application			
Ground Spray 0.175 lb ai/acre	**8.42**	**2.81**	0.09

[1]Detailed calculations of GENEEC2 modeling are provided in Appendix C.
[2] The endangered toxicity threshold (NOAEC) was 0.001 ppm for vascular plants; acute toxicity thresholds (EC_{50}) were 0.003 ppm (MRID 458311-20) and 0.092 ppm (MRID 448348-05) for freshwater vascular and non-vascular plants, respectively.
[3] Two applications of 0.045 lb ai/acre with a 28 day interval between applications.
[4] Maximum concentration of penoxsulam in water following direct application is 0.15 ppm.
Bolded values indicate exceedence of the plant LOC.

2. Non-target Terrestrial Animals

a. Birds

Acute Risks for Ground Spray Application

Based on the LD_{50} of >1900 mg/kg-bw, none of the Acute Risk LOCs were exceeded for any food type or weight class at either application rate at maximum predicted residue levels. Risk calculations for the acute dietary risk of penoxsulam to avian species calculated using an LD_{50} value of >4310 mg/kg-diet (no exceedances) are provided in Appendix D. Adverse effects are not expected from acute exposures to birds associated with plant residues from the ground spray application of penoxsulam.

Acute Risks for Granular Applications

Based on the LD_{50}/ft^2 exposure method and avian oral LD_{50} of >1900 mg/kg-bw, no Acute Risk LOCs were exceeded for any weight class exposed to granules at either application rate for turf (Appendix D). Adverse effects are not expected from acute exposures to birds associated with plant residues from the granular application of penoxsulam.

Chronic Risks

Assuming the maximum application rate for turf (0.045 lb ai/acre – 2 applications) and maximum predicted residue levels, the Chronic Risk LOC for birds was not exceeded for any food type (Appendix D). Likewise, the Chronic Risk LOC for birds was not exceeded for the maximum application rate for exposed sediment (0.175 lb ai/acre) and maximum predicted residue levels. A discussion of the chronic risk to birds, reptiles, and terrestrial-phase amphibians will be provided in the risk description. Adverse effects are not expected from chronic exposures to birds associated with plant residues from the ground spray application of penoxsulam.

b. Mammals

Acute Risks for Ground Spray and Granular Applications

The acute RQs for all weight classes of mammals consuming all feed types are less than the LOC, indicating adverse effects are not expected from ground spray or granular application of penoxsulam to turf and exposed sediment. The RQs are detailed in Appendix D.

Chronic Risks

Dose-based and dietary-based chronic RQs were calculated using the rat reproductive NOAEL of 30 mg/kg/day. The chronic RQs for all weight classes of mammals consuming all feed types for all application scenarios and maximum application rates for turf and exposed sediment are less than the LOC, indicating adverse effects are not expected. The RQs are detailed in Appendix D.

3. Non-target Terrestrial Plants in Terrestrial and Semi-aquatic Environments

Table IV-A2 presents terrestrial plant RQs based on penoxsulam use on turf for ground spray and granular applications. For ground spray and granular use on turf with an application rate of 0.06 lb ai/acre, the non-endangered and endangered plant LOC was exceeded for monocots and dicots located in adjacent areas and in semi-aquatic areas primarily as the result of runoff from ground applications. Likewise, drift from ground spray application of penoxsulam at a rate of 0.06 lb ai/acre also resulted in exceedances of the endangered LOC for monocots located in areas down wind.

For ground spray use on exposed sediment with an application rate of 0.175 lb ai/acre, the non-endangered and endangered plant LOC was exceeded for monocots and dicots located in adjacent areas and in semi-aquatic areas primarily as the result of runoff from ground spray application (Table IV-A2). Likewise, drift from ground application of penoxsulam at a rate of 0.175 lb ai/acre also resulted in exceedances of the endangered LOC for monocots and dicots located in areas down wind.

Table IV-A2. Terrestrial Plant Risk Quotient Summary for Penoxsulam [1,2,3]						
Scenario	Non-endangered RQs			Endangered RQs		
	Terrestrial Adjacent area	Semi-aquatic Adjacent area	Drift	Terrestrial Adjacent area	Semi-aquatic Adjacent area	Drift
Turf (0.06 lb ai/acre)						
Ground Spray						
Monocot	**3.67**	**31.22**	0.04	**10.0**	**85.0**	**1.67**
Dicot	**1.29**	**10.93**	0.18	**3.27**	**27.82**	0.55
Granular formulation - unincorporated						
Monocot	**3.06**	**30.61**	NA	**8.33**	**83.33**	NA
Dicot	**1.07**	**10.71**	NA	**2.73**	**27.27**	NA
Exposed sediment (0.175 lb ai/acre)						
Ground Spray						
Monocot	**10.71**[4]	**91.07**	0.12	**29.17**[4]	**247.92**	**4.86**
Dicot	**3.75**[4]	**31.88**	0.51	**9.55**[4]	**81.14**	**1.59**

[1] Detailed calculations for RQs and TerrPlant Ver. 1.2.1 input and output are provided in Appendix E.
[2] Non-endangered toxicity thresholds (EC_{25}) were 0.00098, 0.0028, 0.015, and 0.035 lb ai/acre for seedling emergence monocot, seedling emergence dicot, vegetative vigor monocot, and vegetative vigor dicot, respectively.
[3] Endangered toxicity thresholds (NOAEC) were 0.00036, 0.0011, 0.00036, and 0.0011 lb ai/acre for seedling emergence monocot, seedling emergence dicot, vegetative vigor monocot, and vegetative vigor dicot, respectively.
Bolded values indicate exceedence of the plant LOC.
[4] Not a likely scenario, since dry land area down gradient from an area of exposed sediment typically is not expected.

B. Risk Description

The risk hypothesis states that the use of penoxsulam on turf and for aquatic vegetation management to control floating and emergent weeds has the potential to compromise survivorship, reproduction, and/or growth of non-target aquatic and terrestrial animals and plants, including Federally-listed endangered and threatened species. Based on the available ecotoxicity data and predicted environmental exposures, this ecological risk assessment supports the presumption of risk to non-endangered vascular and non-vascular aquatic plants and to non-target terrestrial monocots and dicots. This ecological risk assessment also supports the presumption of risk to endangered species of vascular aquatic plants and non-target terrestrial monocots and dicots. The presumption of acute or chronic risk to freshwater and marine/estuarine fish and invertebrates is not supported by the results of this screening risk assessment. The presumption of acute or chronic risk to birds and mammals is not supported by the results of this screening risk assessment. Based on the use of surrogate data (birds) the presumption of acute or chronic risk to terrestrial-phase amphibians and reptiles is not supported by the results of this screening risk assessment.

1. Risks to Aquatic Organisms

a. Aquatic Animals

Fish and Invertebrates

Available acute toxicity data for aquatic species indicates that penoxsulam is practically non-toxic to freshwater and marine/estuarine fish and to marine/estuarine invertebrates and slightly toxic to freshwater invertebrates. At peak EECs, none of the RQs exceeded LOCs

(Acute Risk, Acute Restricted Use, or Acute Endangered Species) for any of the taxonomic groups (Appendix C). A comparison of the peak EECs in surface water from the simulation scenarios in Table III-B 4 to the acute toxicity values for freshwater and estuarine/marine fish and invertebrates indicates that the toxicity values (ranging from 98.3 to 129 mg/L) average five orders of magnitude higher than the highest EECs for turf application (0.004 mg/L for ground spray application) and three orders of magnitude greater than the maximum allowed concentration from direct application to water (0.15 ppm). Consequently, freshwater and estuarine/marine fish and invertebrates inhabiting surface waters adjacent to treated turf or exposed sediment appear to be at low risk for adverse acute effects on survival and growth when exposed to penoxsulam in surface runoff and/or leachate as a result of ground spray application or direct application to water bodies.

Chronic exposure to penoxsulam showed no treatment-related effects to growth and reproduction in freshwater fish at concentrations up to 10.2 ppm ai. In chronic studies with daphnids, penoxsulam significantly reduced the number of live offspring at 9.76 ppm ai (NOAEC = 2.95 ppm ai). Penoxsulam also produced a 20% reduction in male body weights of saltwater mysids at 8.1 mg/L in chronic studies. In full life-cycle toxicity studies with chironomids, reductions in the development rate were observed at 15 mg ai/L. However, at peak EECs, none of the RQs exceeded the Chronic Risk LOC for any of the taxonomic groups (Appendix C). A comparison of the peak EECs in surface water from the simulation scenarios in Table III-B 4 to the chronic toxicity values for freshwater and estuarine/marine fish and invertebrates indicates that the toxicity values (ranging from 2.95 to 10.2 mg/L) average four orders of magnitude higher than the highest EECs for turf application (0.004 mg/L for ground spray application) and two orders of magnitude greater than the maximum allowed concentration from direct application to water (0.15 ppm). Consequently, freshwater and estuarine/marine fish and invertebrates inhabiting surface waters adjacent to treated turf or exposed sediment appear to be at low risk for adverse chronic effects on growth and reproduction when exposed to penoxsulam in surface runoff and/or leachate as a result of ground spray application or from direct application to water.

b. Aquatic Plants

Penoxsulam exhibits toxicity to aquatic vascular plants, with an EC_{50} of 0.003 mg/L for duckweed (NOAEC 0.001 mg/L), based on reduction of frond number. Results of Tier II toxicity studies with non-vascular aquatic plants indicate that penoxsulam adversely affected cell density with the freshwater green algae being the most sensitive species (EC_{50} = 0.092 mg/L; NOAEC = 0.005 mg/L). There are exceedances of the endangered and non-endangered LOC for vascular aquatic plants exposed to runoff/drift from ground, granular applications to turf (Table IV-A 1) and from direction application to water. Consequently, vascular (endangered and non-endangered) plants inhabiting surface waters or waters adjacent to a treated area would be at risk for adverse effects to growth and development when exposed to penoxsulam in surface runoff and/or leachate as a result of ground application to turf, direct application to water, or application to exposed sediment. The maximum concentration for direct application to water exceeded the LOC for non-endangered aquatic non-vascular plants; therefore, plants inhabiting surface waters would be at risk for adverse effects to growth and development when exposed to penoxsulam.

Table IV-B1 provides a comparison of the peak EECs in surface water to toxicity values for endangered and non-endangered vascular aquatic plants and for non-endangered nonvascular plants for risks associated with exposure of aquatic plants to penoxsulam by surface runoff and/or leaching. Keeping all model parameters constant and assuming that EECs are reduced linearly with application rate reduction, EFED conducted an analysis of the effect of rate reduction on RQs for aquatic plants. To protect endangered vascular plants from risks resulting from ground application to exposed sediment, the application rate of 0.175 lb ai/acre would have to be decreased by 88.1% to 0.021 lb ai/acre to reduce the RQs to below the aquatic plant LOC (1.0). To protect endangered vascular plants from risks resulting from ground spray application to turf, the application rate of 0.09 lb ai/acre would have to be decreased by 75.1% to 0.022 lb ai/acre to reduce the RQs to below the aquatic plant LOC (1.0). To protect non-endangered vascular plants the application rate of 0.175 lb ai/acre for ground application to exposed sediment would have to be reduced by 63.4% to 0.064 lb ai/acre to reduce the RQs to below the aquatic plant LOC (1.0). A complete spray drift analysis for exposures to aquatic plants is provided in Section IV.B.3. The potential risk to endangered vascular aquatic plants will be discussed in greater detail in Section IV.B.6.

Table IV-B 1. Comparison of Peak EECs of Penoxsulam in Surface Water

Simulation Scenario and Peak EEC's (mg/L)			Toxicity Values (mg/L)		
Ground Spray Turf	Granular Broadcast Turf	Ground Spray Exposed Sediment	Endangered Vascular (NOAEC)	Non-endangered Vascular (EC_{50})	Non-endangered Nonvascular (EC_{50})
0.00394	0.00394	0.00842	0.001*	0.003*	0.092

*RQ exceeded LOC.

2. Risks to Terrestrial Organisms

a. Animals

Birds - Acute risks from ground spray and granular applications

Penoxsulam is categorized as practically non-toxic to upland game birds and no more than slightly toxic to waterfowl by the oral route (LD_{50} >2,025 mg/kg-bw and >1,900 mg/kg-bw, respectively) and no more than slightly toxic to both upland game birds and waterfowl by the subacute dietary route (LC_{50} >4,411 and >4,310 ppm, respectively). Acute Risk LOCs were not exceeded for any of the label specified applications modeled for penoxsulam (see Appendix D), indicating that avian species are not at risk for adverse effects to survival and growth from acute oral exposure to penoxsulam as a result of the labeled uses of the pesticide.

Birds – Chronic risks

In a chronic study with mallards, reductions in male body weight were observed at the 958 ppm ai treatment level, resulting in a NOAEC of 501 ppm ai. The chronic Risk LOC was not exceeded for any of the label specified applications modeled for penoxsulam (see Appendix D), indicating that avian species are not at risk to adverse effects to growth and reproduction from chronic oral exposure to penoxsulam as a result of the labeled uses of the pesticide.

Mammals – Acute risks from ground spray and granular applications

Penoxsulam is classified as practically non-toxic to mammals from acute oral exposure (acute LD_{50} value of >5,000 mg/kg bw). The acute RQs for all weight classes of mammals consuming all feed types are less than the LOC; mammalian species are not at risk for adverse effects to survival and growth from acute oral exposure to penoxsulam as a result of the labeled uses.

Mammals – Chronic Risks

In a 2-generation reproduction study with rats exposed to penoxsulam, kidney lesions were observed in female rats at 100 mg/kg/day, resulting in a parental systemic toxicity NOAEL of 30 mg/kg/day (600 ppm). The chronic RQs for all weight classes of mammals consuming all feed types are less than the LOC; therefore, mammalian species are not at risk to adverse effects to growth and reproduction from chronic oral exposure to penoxsulam as a result of the labeled uses of the pesticide.

Non-target Terrestrial-phase Amphibians, Reptiles, and Beneficial Insects

EFED currently uses surrogate data (birds) for non-target terrestrial amphibians and reptiles. Avian toxicity data indicate that terrestrial-phase amphibians and reptiles are not likely to be at risk for adverse effects to survival and growth and reproduction from the acute or chronic oral exposure to penoxsulam as a result of consuming contaminated feed items or ingesting granules at proposed application rates. EFED does not quantify risk to terrestrial non-target insects. Submitted acute contact studies indicate that penoxsulam is practically non-toxic to honey bees (LD_{50} >100 µg/bee); consequently, the potential risk to terrestrial insects is likely to be minimal.

b. Terrestrial Plants

Terrestrial plant toxicity studies with monocots and dicots indicate that seedling emergence and vegetative vigor are severely impacted by exposure to penoxsulam. In Tier II studies, seedling emergence, based on shoot weight, was adversely impacted in monocots (onion) at an EC_{25} of 1.1 g ai/ha and in dicots (sugar beet) at an EC_{25} of 3.2 g ai/ha. Vegetative vigor in monocots and dicots, based on shoot weight, was adversely impacted at an EC_{25} of 17 g ai/ha in ryegrass and an EC_{25} of 3.9 g ai/ha in soybean.

For turf ground spray (0.06 lb ai/acre), turf granular application (0.06 lb ai/acre) and ground spray application to exposed sediment (0.175 lb ai/acre) of penoxsulam, the LOC was exceeded for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas primarily as the result of runoff (Table IV-A5). Consequently, nonendangered and endangered monocots and dicots inhabiting terrestrial and semi-aquatic areas are at risk for adverse effects to growth and development when exposed to penoxsulam as a result of the ground spray or granular application of penoxsulam for turf as well as ground spray application for exposed sediment. As a result of spray drift the LOC was exceeded for endangered monocots from ground spay on turf (0.06 lb ai/acre) and endangered monocots and dicots from treatment of exposed sediment (0.175 lb ai/acre). Consequently, endangered monocots and dicots are at risk for adverse effects to growth and development when exposed to penoxsulam resulting from drift associated with the ground spray for turf or exposed sediment.

A complete spray drift analysis for exposures to non-target terrestrial plants in terrestrial and semi-aquatic areas is provided in Section IV.B.3. The potential risk to endangered monocots and dicots will be discussed in greater detail in Section IV.B.6.

The results of this screening risk assessment indicate that direct effects to plant species could present an indirect risk at the higher levels of organization (i.e. population, trophic level, community, and ecosystem). Field studies are not available to quantify actual risk to plant and animal communities in forest/edge and wetland/riparian habitats. However, in terrestrial and shallow-water aquatic communities, plants are the primary producers upon which the succeeding trophic levels depend. If the available plant material is impacted due to the effects of penoxsulam, this may have negative effects not only on the herbivores, but throughout the food chain. Also, depending on the severity of impacts to the plant communities [i.e., forests, wetlands, ecotones (edge and riparian habitats)], community assemblages and ecosystem stability may be altered (i.e. reduced bird populations in edge habitats; reduced riparian vegetation resulting in increased light penetration and temperature in aquatic habitats, loss of cover and food for fish). In addition, riparian vegetation, which provides habitat (i.e. leaf packs, materials for case-building for invertebrates) and is a significant component of the food supply for aquatic herbivores and detritivores may also be affected.

3. Spray Drift Analysis

a. Spray drift buffer for non-target plants

The AgDrift model (Version 2.0.1) was used to calculate the spray drift buffers that would be needed to avoid adverse effects to non-target and listed terrestrial and aquatic plant species. AgDrift was used to model three application practices with the potential for spray drift: 1) turf application (ground spray), 2) foliar application for treatment of floating and emergent weeds (aerial and ground spray), and 3) exposed sediment application (ground spray). The Tier I modeling feature of AgDrift predicts relatively high end drift deposition values at varying distances (a maximum of 1000 feet downwind is observed). Several inputs such as wind speed (10 mph) and release height (10 ft) are preset in the model to represent 90th percentile values for application. The drift values (drift EECs) at a specific distance obtained from the Tier I model are then compared to the most sensitive plant selected in the seedling emergence, vegetative vigor test and aquatic plant studies with penoxsulam to calculate risk quotients. For each application practice calculations are performed to consider the buffer distance to meet the toxicity level (NOAEC or EC_{25}).

Turf Treatment – Terrestrial Exposure

Point exposures were estimated for AgDrift Tier I assessment (ground-spray only) for non-target terrestrial plants at the single maximum application rate of 0.06 lb ai/acre for turf. Because the label for penoxsulam does not specify release height or droplet size for ground spray applications, the AgDrift model was run for four scenarios (high boom and fine spray, low boom and fine spray, high boom and medium/coarse spray, and low boom and medium/coarse spray) to provide a range of buffer distances. All drop size descriptions are based on ASAE S-572 standard definitions. High and low boom heights are representative of 4 and 2 foot release heights, respectively. In the following assessment the output of the AgDrift model provides distances (in feet) required to dissipate spray drift to the NOAEC (listed toxicity endpoint)and EC_{25} (non-listed toxicity endpoint) levels for the most sensitive monocot and dicot species in seedling emergence (SE) and vegetative vigor (VV) studies (Table IV-B 2).

The results of the Tier I ground AgDrift modeling show that a buffer distance of 358 feet or greater is required to dissipate spray drift to no effect levels for monocots under worst case conditions of fine to medium spray with a high boom. The dissipation distance for monocot plant species decreases to 59 feet, based on the use of a medium/coarse droplet size and a low boom height. Dissipation distances for no effects to dicots are 141 feet or greater for medium to coarse spray/high boom and 20 feet or more for coarse spray/low boom application.

Table IV-B 2. ***Ground Spray*** **Drift Terrestrial Assessment for Penoxsulam Use on Turf**

Species	Test Type	Distance (feet) Required to Dissipate Spray Drift to NOAEC/EC_{25} Levels			
		High boom; fine spray (NOAEC/EC_{25})	Low boom; fine spray (NOAEC/EC_{25})	High boom; med/coarse spray (NOAEC/EC_{25})	Low boom; med/coarse spray (NOAEC/EC_{25})
Onion[1] (Monocot)	SE	358 / 151	167 / 56	121 / 36	59 / 23
Sugarbeet[2] (Dicot)	SE	141 / 52	52 / 20	33 / 10	20 / 7
Ryegrass[3] (Monocot)	VV	358 / 13	167 / 7	121 / 3	66 / 3
Soybean[4](Dicot)	VV	141 / 46	52 / 16	33 / 10	20 / 7

[1]Based on onion EC_{25} of 0.001 lb ai/acre (1.1 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)
[2]Based on sugarbeet EC_{25} of 0.003 lb ai/acre (3.2 g ai/ha) and NOAEC of 0.001 lb ai/acre (1.2 g ai/ha)
[3]Based on ryegrass EC_{25} of 0.015 lb ai/acre (17 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)
[4]Based on soybean EC_{25} of 0.0035 lb ai/acre (3.9 g ai/ha) and NOAEC of 0.001 lb ai/acre (1.2 g ai/ha)

The AgDrift model was used to calculate EECs based on the spray drift associated with specific distances from the edge of the treated area as an indication of buffer zones needed to protect non-target plants. In the terrestrial assessment, the ground spray scenario was modeled for the turf application rate of 0.06 lb ai/acre with a fine spray and high boom. The output (Table IV-B 3) of the AgDrift model provides distances and the associated EECs and RQs based on target toxicity levels (NOAEC and EC_{25}) of the most sensitive species (onion) in seedling emergence or vegetative vigor studies. The model runs and additional spray drift analyses are located in Appendix G. Bold values in the tables indicate that RQ has exceeded the LOC (RQ>1.0).

The AgDrift model predicts LOC exceedances for: *listed* terrestrial plant species from a distance of 0 up to 331 feet and *non listed* terrestrial plants from zero to 148 feet.

Table IV-B 3. Spray Drift Terrestrial Assessment at 0.06 lb ai/acre for Listed and Non-listed Plant Species [1]

No. of Application (0.06 lb a.i/.A)	Distance From Edge of Treated Area	% of Application Rate	EEC (lb ai/acre)	Non-listed RQ	Listed RQ	Spray Method
1	0 feet	100	0.06	**67**	**150**	Ground
1	100 feet	2.5	0.0015	**1.7**	**3.7**	Ground
1	200 feet	1.2	0.0007	0.8	**1.7**	Ground
1	300 feet	0.75	0.0005	0.6	**1.2**	Ground
1	400 feet	0.5	0.0003	0.3	0.7	Ground

[1]Based on onion EC_{25} of 0.001 lb ai/acre (1.1 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)

Turf Treatment –Aquatic Exposure

The AgDrift model was used to calculate aquatic exposures where terrestrial and aquatic plants inhabit the EPA standard pond and standard wetland, from spray drift due to turf use (single application only). A *ground* spray Tier 1 aquatic assessment was performed, assuming high boom application with ASAE fine to medium spray, and 90th percentile drift, at an application rate of 0.06 lb ai/acre. Proposed labels indicate that ground spray application to exposed aquatic weeds can be accomplished by either driving a truck fitted with ground spray apparatus along the side of a target water body or by walking through wetlands with a backpack sprayer spot treating weeds.

Assuming 0.06 lb ai/acre, ASAE fine to medium/coarse *ground* spray and a zero-foot buffer, AgDrift calculated that 6% of the applied mass or 0.0037 lb ai/acre would reach the pond or wetland, resulting in an initial average concentration of 0.21 µg/L in the pond and 2.8 µg/L in the wetland. The results of the AgDrift aquatic exposure assessment are tabulated in Table IV-B 4 for terrestrial and aquatic plants. Bold values in the table are LOC exceedances (RQ>1.0).

The AgDrift model predicts LOC exceedances for: *listed* terrestrial plant species inhabiting ponds and wetlands (distance of 0 up to 239 feet) and *listed* aquatic plants inhabiting wetlands of (zero up to 39 feet). Predicted RQs exceeded LOCs for *non listed* terrestrial plants inhabiting ponds and wetlands from zero to 69 feet.

The estimated spray buffer for *non listed* aquatic plants inhabiting ponds, *non listed* aquatic plants inhabiting wetlands and *listed* aquatic plants inhabiting ponds was 0 feet.

Table IV-B 4. Ground Spray Drift Aquatic Assessment at 0.06 lb ai/acre Penoxsulam for Listed and Non-Listed Plant Species [1,2]					
No. of Application (0.06 lb ai/acre)	**Distance From Edge of Treated Area**	**% of Application Rate**	**EEC**	**Non-listed RQ**	**Listed RQ**
TERRESTRIAL PLANTS INHABITING PONDS and WETLANDS [a]					
1	0 feet	6.1	0.0037 lb ai/acre	**3.7**	**9.2**
1	100 feet	1.3	0.0008	0.8	**2.0**
1	200 feet	0.8	0.0005	0.5	**1.2**
1	300 feet	0.5	0.0003	0.3	0.7
1	400 feet	0.4	0.0002	0.2	0.5
AQUATIC PLANTS INHABITING PONDS[b]					
1	0 feet	6.1	0.21 μg/L	0.07	0.21
1	250 feet	0.6	0.02 μg/L	0.007	0.02
1	500 feet	0.3	0.01 μg/L	0.003	0.01
1	750 feet	0.2	0.006 μg/L	0.002	0.006
AQUATIC PLANTS INHABITING WETLANDS[b]					
1	0 feet	6.1	2.8 μg/L	0.9	**2.8**
1	50 feet	1.9	0.87 μg/L	0.29	0.09
1	250feet	0.6	0.28μg/L	0.09	0.28
1	500 feet	0.3	0.14 μg/L	0.05	0.14
1	750 feet	0.2	0.08μg/L	0.03	0.08

[1]Based on onion EC_{25} of 0.001 lb ai/acre (1.1 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha).
[2] Based on duckweed EC_{25} of 3.0 μg/L and NOAEC of 1.0 μg/L.

Foliar Application for Treatment of Floating and Emergent Weeds – Terrestrial Exposure

Point exposures resulting from aquatic uses for floating and emerging weeds were estimated for AgDrift Tier I assessment (ground spray and aerial spray scenarios) for non-target terrestrial and aquatic plants at the single maximum application rate of 0.0875 lb ai/acre. The label for penoxsulam specifies coarse or coarser droplets but does not specify release height for ground spray applications. The AgDrift model was run for two scenarios with a varied release height (high boom with medium/coarse spray, and low boom with medium/coarse spray) to provide an estimate of the possible range of buffer distances. The output of the AgDrift model (Table IV-B 5) provides distances required to dissipate spray drift to the NOAEC and EC_{25} levels for the most sensitive monocot and dicot species in seedling emergence and vegetative vigor studies.

The results of the Tier I ground AgDrift modeling show that a buffer distance of 190 feet or greater is required to dissipate spray drift to no effect levels for monocots under worst case conditions of medium/coarse spray with a high boom. The dissipation distance for monocot plant species decreases to 112 feet, based on the use of a low boom height. Dissipation distances for no effects to dicots are 49 feet or greater for medium/coarse spray/high boom and 26 feet or more for medium/coarse spray/low boom application.

Table IV-B 5. Penoxsulam Ground Spray Drift Terrestrial Assessment of Aquatic Uses for Floating and Emergent Plants (AgDrift Tier I)			
Species	**Test Type**	**Distance Required to Dissipate Spray Drift to NOAEC/EC_{25} Levels (feet)**	
		High boom; med/coarse spray	**Low boom; med/coarse spray**
Onion[1] (Monocot)	SE	190 / 56	112 / 30
Sugarbeet[2] (Dicot)	SE	49 / 16	26 / 10
Ryegrass[3] (Monocot)	VV	190 / 3	112 / 3
Soybean[4] (Dicot)	VV	49 / 13	26 / 10

[1]Based on onion EC_{25} of 0.001 lb ai/acre (1.1 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)
[2]Based on sugarbeet EC_{25} of 0.003 lb ai/acre (3.2 g ai/ha) and NOAEC of 0.001 lb ai/acre (1.2 g ai/ha)
[3]Based on ryegrass EC_{25} of 0.015 lb ai/acre (17 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)
[4]Based on soybean EC_{25} of 0.0035 lb ai/acre (3.9 g ai/ha) and NOAEC of 0.001 lb ai/acre (1.2 g ai/ha)

The label for penoxsulam provides instructions for aerial application for foliar application to treat floating and emergent weeds in water. For aerial application, the most important factors affecting drift are spray droplet size, release height, and wind speed. The aerial part of the AgDrift model predicts mean values based on the inputs provided. The GF-443 SC label guidelines for aerial application of penoxsulam specify a coarse droplet size category (per S-572 ASABE standard), and a spray volume of 10 gallons per acre. In addition, the distance between the outer most nozzles on the boom must not exceed 70% of the wingspan of fixed-wing aircraft (or 80% of the helicopter rotor width), and it is recommended that nozzles point backward parallel to the air stream and never downward more than 45 degrees. The label recommends a maximum application height of 10 feet and a coarse droplet size for aerial application of penoxsulam. Typical fixed wing aerial application speeds exceed 120 mph, and at these speeds, coarse droplets shatter and produce medium or finer sprays. Thus, it is generally inappropriate to model coarse sprays for fixed wing applications without some restriction on flight speed. For the purpose of AgDrift Tier I modeling, medium/coarse sprays were considered in addition to coarse spray.

The results of the Tier I aerial AgDrift (Table IV-B 6) modeling show that a buffer distance of greater than 1,000 feet is required to dissipate spray drift to no effect levels for monocots under worst case conditions of medium to coarse spray drift. The dissipation distance for monocot plant species decreases from >1,000 feet to >653 feet, based on the use of a coarse droplet size. Dissipation distances for no effects to dicots are >361 feet for medium to coarse sprays and >236 feet for coarse sprays.

Table IV-B 6. Penoxsulam Results of AgDrift Tier I Modeling of Aerial Application for Aquatic Use for Emergent and Floating Weeds			
Species	**Test Type**	**Distance Required to Dissipate Spray Drift to NOAEC/EC_{25} Levels (feet)**	
		Medium/Coarse Spray (NOAEC/EC_{25})	**Coarse Spray (NOAEC/EC_{25})**
Onion[1] (Monocot)	SE	>1000* / 394	653 / 253
Sugarbeet[2] (Dicot)	SE	361 / 161	236 / 115
Ryegrass[3] (Monocot)	VV	>1000* / 26	653 / 20
Soybean[4] (Dicot)	VV	361 / 135	236 / 92

* The maximum dissipation distance from the edge of the treated area in the Tier I aerial model is 1000 feet.
[1]Based on onion EC_{25} of 0.001 lb ai/acre (1.1 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)
[2]Based on sugarbeet EC_{25} of 0.003 lb ai/acre (3.2 g ai/ha) and NOAEC of 0.001 lb ai/acre (1.2 g ai/ha)
[3]Based on ryegrass EC_{25} of 0.015 lb ai/acre (17 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)
[4]Based on soybean EC_{25} of 0.0035 lb ai/acre (3.9 g ai/ha) and NOAEC of 0.001 lb ai/acre (1.2 g ai/ha)

AgDrift Tier II was used to model the aerial use to control emergent and floating weeds in aquatic environments to provide a more refined assessment of buffer distances and the relative effect of application parameters. The GF-443 SC label requirements (spray volume - 10 gal/acre, boom -70% of wingspan, application height – 10 ft) and application rate (0.0875 lb ai/acre) for aerial application were employed in the Tier II assessment. The label does not specify the type of carrier fluid other than that use of an approved surfactant is required. Therefore, two nonvolatile rates were used to provide a range of possible buffer distances dependent on the carrier fluid. A nonvolatile rate of 0.4 lb/acre assumes water as the carrier fluid and that only active and inert ingredients do not evaporate. A nonvolatile rate of 1.94 lb/acre was used based on oil as the carrier fluid and assuming the formulation ingredients and the crop oil do not evaporate.

The results of the Tier II aerial (Table IV-B 7)AgDrift modeling using *water* as the carrier fluid show that a buffer distance of at least 673 feet is required to dissipate spray drift to no effect levels for monocots under worst case conditions of medium to coarse spray drift. The dissipation distance for monocot plant species decreases from 673 feet to 541 feet, based on the use of a coarse droplet size. Dissipation distances for no effects to dicots are 256 feet or greater for medium to coarse sprays and 217 feet or more for coarse sprays.

Table IV-B 7. Penoxsulam Results of AgDrift Tier II Modeling for Aerial Application (Water Carrier) for Aquatic Use for Emergent and Floating Weeds.			
Species	**Test Type**	**Distance Required to Dissipate Spray Drift to NOAEC/EC_{25} Levels (feet)**	
		Medium Coarse Spray (NOAEC/EC_{25})	**Coarse Spray (NOAEC/EC_{25})**
Onion[1] (Monocot)	SE	673 / 272	541 / 230
Sugarbeet[2] (Dicot)	SE	256 / 125	217 / 102
Ryegrass[3] (Monocot)	VV	672 / 13	541 / 10
Soybean[4] (Dicot)	VV	256 / 105	217 / 82

[1]Based on onion EC_{25} of 0.001 lb ai/acre (1.1 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)
[2]Based on sugarbeet EC_{25} of 0.003 lb ai/acre (3.2 g ai/ha) and NOAEC of 0.001 lb ai/acre (1.2 g ai/ha)
[3]Based on ryegrass EC_{25} of 0.015 lb ai/acre (17 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)
[4]Based on soybean EC_{25} of 0.0035 lb ai/acre (3.9 g ai/ha) and NOAEC of 0.001 lb ai/acre (1.2 g ai/ha)

The results of the Tier II aerial AgDrift (Table IV-B 8) modeling using *oil* as the carrier fluid show that a buffer distance of at least 459 feet is required to dissipate spray drift to no effect levels for monocots under worst case conditions of medium to coarse spray drift. The dissipation distance for monocot plant species decreases to 410 feet, based on the use of a coarse droplet size. Dissipation distances for no effects to dicots are 262 feet or greater for medium to coarse sprays and 226 feet or more for coarse sprays.

Table IV-B 8. Penoxsulam Results of AgDrift Tier II Modeling for Aerial Application (Oil Carrier) for Aquatic Use for Emergent and Floating Weeds.			
Species	**Test Type**	**Distance Required to Dissipate Spray Drift to NOAEC/EC_{25} Levels (feet)**	
		Medium Coarse Spray (NOAEC/EC_{25})	**Coarse Spray (NOAEC/EC_{25})**
Onion[1] (Monocot)	SE	459 / 276	410 / 239
Sugarbeet[2] (Dicot)	SE	262 / 138	226 / 115
Ryegrass[3] (Monocot)	VV	459 / 16	410 / 13
Soybean[4] (Dicot)	VV	262 / 118	226 / 95

[1]Based on onion EC_{25} of 0.001 lb ai/acre (1.1 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)
[2]Based on sugarbeet EC_{25} of 0.003 lb ai/acre (3.2 g ai/ha) and NOAEC of 0.001 lb ai/acre (1.2 g ai/ha)
[3]Based on ryegrass EC_{25} of 0.015 lb ai/acre (17 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)
[4]Based on soybean EC_{25} of 0.0035 lb ai/acre (3.9 g ai/ha) and NOAEC of 0.001 lb ai/acre (1.2 g ai/ha)

The AgDrift model was used to calculate EECs based on the spray drift associated with specific distances from the edge of the treated area as an indication of buffer zones needed to protect non target plants. In the terrestrial assessment, the ground (Tier I) and aerial (Tier I and Tier II) application was modeled for the foliar use at a rate of 0.0875lb ai/acre with a medium to course spray (and high boom for ground application). If the Tier I aerial assessment resulted in dissipation distances >1000 feet, a Tier II aerial assessment was performed. The Tier II model assumes water as a carrier with a nonvolatile rate of 0.4 lb/acre, spray volume of 10 gal/acre, boom length 70% of wingspan and boom height of 10 feet. The output (Table IV-B9) of the AgDrift model provides distances and the associated EECs and RQs based on toxicity levels (NOAEC and EC_{25}) of the most sensitive species (onion) in seedling emergence or vegetative vigor studies. The model runs and additional spray drift analyses are located in Appendix G. Bold values in the tables are LOC exceedances (RQ>1.0).

For *listed* terrestrial plant species the AgDrift model predicts LOC exceedances from a distance of 0 up to 679 feet resulting from aerial (Tier II) application and 0 to and 170 feet for ground spray application. For *non-listed* terrestrial plants predicted exposures exceed LOCs from a distance of 0 up to 279 feet from aerial (Tier II) application and 0 to and 55 feet for ground spray application.

Table IV-B 9. Spray Drift Terrestrial Assessment at 0.0875 lb ai/acre for Listed and Non-listed Plant Species Following Foliar Application for Floating and Emergent Weeds [1]

No. of Application (0.0875 lb a.i/.A)	Distance From Edge of Treated Area	% of Application Rate	EEC (lb ai/acre)	Non-listed RQ	Listed RQ
Aerial Tier I Model Results					
1	0 feet	50	0.0437	**44**	**109**
1	100 feet	5.6	0.0049	**4.9**	**12.2**
1	250 feet	1.9	0.0016	**1.6**	**4.0**
1	500 feet	0.9	0.0008	**0.8**	**2.0**
1	1000 feet	>0.5	>0.0005	0.5	**1.2**
Aerial Tier II Model Results (carrier - water)					
1	0 feet	44	0.0387	**39**	**97**
1	100 feet	4.3	0.0037	**3.7**	**9.2**
1	250 feet	1.3	0.0011	**1.1**	**2.7**
1	500 feet	0.5	0.0005	0.5	**1.2**
1	750 feet	0.4	0.0003	0.3	0.75
Ground Spray Tier I Model Results					
1	0 feet	100	0.0886	**89**	**221**
1	50 feet	1.2	0.001	**1.0**	**2.5**
1	100 feet	0.7	0.0006	0.6	**1.5**
1	150 feet	0.5	0.0004	0.4	**1.0**
1	200 feet	0.4	0.0003	0.3	0.75

[1]Based on onion EC_{25} of 0.001 lb ai/acre (1.1 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)

Foliar Application for Treatment of Floating and Emergent Weeds –Aquatic Exposure

The AgDrift model was used to calculate aquatic exposures where terrestrial and aquatic plants inhabit the EPA standard pond and standard wetland, from spray drift due to agricultural use (single application only). A *ground* spray Tier 1 aquatic assessment was performed, assuming high boom application with ASAE medium to coarse spray, and 90th percentile drift, at an application rate of 0.0875 lb ai/acre. The Tier I aerial assessment evaluated the exposure resulting from the use of a medium course spray application. If the Tier I aerial assessment resulted in dissipation distances >1000 feet (as is the case for terrestrial plants inhabiting ponds and wetlands), a Tier II aerial assessment was performed. The Tier II model assumes water as a carrier with a nonvolatile rate of 0.4 lb/acre, medium to coarse spray, spray volume of 10 gal/acre, boom length 70% of wingspan and boom height of 10 feet.

Assuming 0.0875 lb ai/acre, ASAE fine to medium/coarse *ground* spray and a zero-foot buffer, AgDrift calculated that 1.6% of the applied mass or 0.0014 lb ai/acre would reach the pond or wetland, resulting in an initial average concentration of 0.08 µg/L in the pond and 1.1 µg/L in the wetland. The aerial spray with a zero foot buffer resulted in a estimated 8.9% of the applied mass or 0.0078 lb ai/acre would reach the pond or wetland with an average concentration of 0.5 µg/L in the pond and 5.8 µg/L in the wetland. The results the AgDrift aquatic exposure assessment are tabulated in Table IV-B 10. for terrestrial and aquatic plants. Bold values in the table are LOC exceedances (RQ>1.0).

The AgDrift model predicts LOC exceedances for *listed* terrestrial plant species inhabiting ponds and wetlands from a distance of 0 up to 581 feet for aerial (Tier II) application and 0 to 102 feet for ground application. For *listed* aquatic plants inhabiting wetlands, LOCs were exceeded for aerial application (zero up to 209 feet) and ground application (0 to 3.3 feet). Predicted RQs exceeded LOCs for *non listed* terrestrial plants inhabiting ponds and wetlands from zero to 190 feet from aerial application and zero to 7 feet for ground application. The estimated RQs for n*on-listed* aquatic plants inhabiting wetlands exposure due to aerial application exceeded the LOC from 0 to 190 feet. For listed and non-listed aquatic plants inhabiting ponds the RQs did not exceed the LOCs (at distance of 0, dissipation EEC was below LOCs).

Table IV-B 10. Spray Drift Aquatic Assessment at 0.0875 lb ai/acre Penoxsulam for Listed and Non-Listed Plant Species						
No. of Application (0.0875 lb ai/acre)	**Distance From Edge of Treated Area**	**% of Application Rate**	**EEC**	**Non-listed RQ**	**Listed RQ**	**Spray Method**
TERRESTRIAL PLANTS INHABITING PONDS and WETLANDS [1]						
Aerial Tier I Model Results						
1	0 feet	8.9	0.0078lb ai/acre	**7.8**	**19.5**	Aerial
1	250 feet	1.3	0.0011lb ai/acre	**1.1**	**2.7**	Aerial
1	500 feet	0.8	0.0007 lb ai/acre	0.7	**1.7**	Aerial
1	750 feet	0.6	0.0005 lb ai/acre	0.5	**1.2**	Aerial
1	1000 feet	>0.6	>0.0005 lb ai/acre	>0.5	**>1.2**	Aerial
Aerial Tier II Model Results						
1	0 feet	6.6	0.0058	**5.8**	**14.5**	Aerial
1	100 feet	2.0	0.0018	**1.8**	**4.5**	Aerial
1	250 feet	0.8	0.0007	0.7	**1.7**	Aerial
1	500 feet	0.5	0.0004	0.4	**1.0**	Aerial
1	750 feet	0.3	0.0003	0.3	0.7	Aerial
Ground Spray Tier I Model Results						
1	0 feet	1.6	0.0014 lb ai/acre	**1.4**	**3.5**	Ground
1	250 feet	0.2	0.0002 lb ai/acre	0.2	0.5	Ground
1	500 feet	0.1	0.0001 lb ai/acre	0.1	0.2	Ground
1	750 feet	0.09	0.00008 lb ai/acre	0.08	0.2	Ground
AQUATIC PLANTS INHABITING PONDS [2]						
1	0 feet	8.9	0.478 µg/L	0.16	0.478	Aerial
1	250 feet	1.3	0.064 µg/L	0.021	0.064	Aerial
1	500 feet	0.8	0.038 µg/L	0.013	0.038	Aerial
1	750 feet	0.6	0.030 µg/L	0.010	0.030	Aerial
1	0 feet	1.6	0.08 µg/L	0.03	0.8	Ground
1	250 feet	0.2	0.012 µg/L	0.004	0.012	Ground
1	500 feet	0.1	0.007 µg/L	0.002	0.007	Ground
1	750 feet	0.09	0.005 µg/L	0.002	0.005	Ground
AQUATIC PLANTS INHABITING WETLANDS [2]						
1	0 feet	8.9	5.8 µg/L	**1.9**	**5.8**	Aerial
1	250 feet	1.3	0.85 µg/L	0.28	0.85	Aerial
1	500 feet	0.8	0.50 µg/L	0.17	0.5	Aerial
1	750 feet	0.6	0.39 µg/L	0.13	0.4	Aerial
1	0 feet	1.6	1.08 µg/L	0.36	**1.1**	Ground
1	250 feet	0.2	0.16 µg/L	0.05	0.16	Ground
1	500 feet	0.01	0.09 µg/L	0.03	0.09	Ground
1	750 feet	0.009	0.06 µg/L	0.02	0.06	Ground

[1] Based on onion EC_{25} of 0.001 lb ai/acre (1.1 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha).
[2] Based on duckweed EC_{25} of 3.0 µg/L and NOAEC of 1.0 µg/L.

Exposed Sediment Application – Terrestrial Exposure

Point exposures were estimated for AgDrift Tier I assessment (ground spray only) for non-target terrestrial plants at the single maximum application rate of 0.175 lb ai/acre for exposed sediment. The label for penoxsulam does not specify release height, but does indicate a coarse or coarser droplet size for ground applications. The AgDrift model was run for two scenarios (high boom and medium/coarse spray, and low boom and medium/coarse spray) to provide an estimate of the possible range of buffer distances. The output of the AgDrift model provides distances required to dissipate spray drift to the NOAEC and EC_{25} levels for the most sensitive monocot and dicot species in seedling emergence and vegetative vigor studies (Table IV-B.11).

The results of the Tier I ground AgDrift modeling show that a buffer distance of 407 feet or more is required to dissipate spray drift to no effect levels for monocots under worst case conditions of medium to coarse spray with a high boom. The dissipation distance for monocot plant species decreases to 269 feet, based on the use low boom height. Dissipation distances for no effects to dicots are 121 feet or greater for medium to coarse spray/high boom and 66 feet or more for coarse spray/low boom application.

Table IV-B 11. Penoxsulam Ground Spray Drift Terrestrial Assessment of Exposed Sediment Application for Pre-Emergence Control of Aquatic Weeds (AgDrift Tier I)

Species	Test Type	Distance Required to Dissipate Spray Drift to NOAEC/EC_{25} Levels (feet)	
		High boom; med/coarse spray	Low boom; med/coarse spray
Onion[1] (Monocot)	SE	407 /135	269 / 75
Sugarbeet[2] (Dicot)	SE	121 / 36	66 / 20
Ryegrass[3] (Monocot)	VV	407 / 7	269 / 3
Soybean[4] (Dicot)	VV	121 / 26	66 / 16

[1]Based on onion EC_{25} of 0.001 lb ai/acre (1.1 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)
[2]Based on sugarbeet EC_{25} of 0.003 lb ai/acre (3.2 g ai/ha) and NOAEC of 0.001 lb ai/acre (1.2 g ai/ha)
[3]Based on ryegrass EC_{25} of 0.015 lb ai/acre (17 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)
[4]Based on soybean EC_{25} of 0.0035 lb ai/acre (3.9 g ai/ha) and NOAEC of 0.001 lb ai/acre (1.2 g ai/ha)

The AgDrift model was used to calculate EECs based on the spray drift associated with specific distances from the edge of the treated area as an indication of buffer zones needed to protect non target plants. In the terrestrial assessment, the ground application was modeled for use on exposed sediment at a rate of 0.175lb ai/acre with a medium course spray and high boom. The output (Table IV-B 12) of the AgDrift model provides distances required to dissipate spray drift to levels protective of listed (NOAEC) and non-listed (EC_{25}) plants by using the most sensitive species (onion) in seedling emergence or vegetative vigor studies. The model runs and additional spray drift analyses are located in Appendix G. Bold values in the tables are LOC exceedances (RQ>1.0).

The AgDrift model predicts LOC exceedances for: *listed* terrestrial plant species from a distance of 0 up to 407 feet and *non listed* terrestrial plants from zero to 134 feet.

Table IV-B 12. Exposed Sediment Application - Spray Drift Terrestrial Assessment at 0.175 lb ai/acre for Listed and Non-listed Plant Species [1]

No. of Application (0.175 lb a.i/acre)	Distance From Edge of Treated Area	% of Application Rate	EEC (lb ai/acre)	Non-listed RQ	Listed RQ	Spray Method
1	0 feet	100	0.1772	**177**	**443**	Ground
1	200 feet	0.4	0.0007	0.7	**1.7**	Ground
1	400 feet	0.2	0.0004	0.4	**1.0**	Ground
1	600 feet	0.1	0.0002	0.2	0.5	Ground
1	800 feet	0.1	0.0002	0.2	0.5	Ground

[1]Based on onion EC_{25} of 0.001 lb ai/acre (1.1 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha)

Exposed Sediment Application – Aquatic Exposure

The AgDrift model was used to calculate aquatic exposures from spray drift for terrestrial and aquatic plants inhabiting the standard pond and standard wetland. A *ground* spray Tier 1 aquatic assessment was performed, assuming high boom application with ASAE medium to coarse spray, and 90th percentile drift, at an application rate of 0.175 lb ai/acre.

Assuming 0.175 lb ai/acre, ASAE fine to medium/coarse *ground* spray and a zero-foot buffer, AgDrift calculated that 1.6% of the applied mass or 0.0029 lb ai/acre would reach the pond or wetland, resulting in an initial average concentration of 0.16 µg/L in the pond and 2.2 µg/L in the wetland. The results the AgDrift aquatic exposure assessment are tabulated in Table IV-B13. for terrestrial and aquatic plants. Bold values in the table are LOC exceedances (RQ>1.0).

The AgDrift model predicts LOC exceedances for: *listed* terrestrial plant species inhabiting ponds and wetlands (distance of 0 up to 276 feet) and *listed* aquatic plants inhabiting wetlands of (zero up to 20 feet). Predicted RQs exceeded LOCs for *non listed* terrestrial plants inhabiting ponds and wetlands from zero to 49 feet. No exceedances were indicated for listed or non-listed aquatic plants inhabiting ponds or for non-listed aquatic plants inhabiting wetlands.

Table IV-B 13. Spray Drift Aquatic Assessment at 0.175 lb ai/acre Penoxsulam for Listed and Non Listed Plant Species						
No. of Application (0.175 lb ai/acre)	**Distance From Edge of Treated Area**	**% of Application Rate**	**EEC**	**Non-listed RQ**	**Listed RQ**	**Spray Method**
TERRESTRIAL PLANTS INHABITING PONDS and WETLANDS [1]						
1	0 feet	1.6	0.0029 lb ai/acre	**2.9**	**7.2**	Ground
1	250 feet	0.2	0.0004	0.4	**1.0**	Ground
1	500 feet	0.1	0.0002	0.2	0.5	Ground
1	750 feet	0.09	<0.0002	<0.2	<0.5	Ground
AQUATIC PLANTS INHABITING PONDS[2]						
1	0 feet	1.6	0.162 µg/L	0.05	0.162	Ground
1	250 feet	0.2	0.024 µg/L	0.008	0.024	Ground
1	500 feet	0.1	0.014 µg/L	0.005	0.014	Ground
1	750 feet	0.09	0.009 µg/L	0.003	0.009	Ground
AQUATIC PLANTS INHABITING WETLANDS[b]						
1	0 feet	1.6	2.16 µg/L	0.7	**2.2**	Ground
1	20 feet	0.7	0.986 µg/L	0.3	**1.0**	Ground
1	250feet	0.2	0.318 µg/L	0.1	0.32	Ground
1	500 feet	0.01	0.182 µg/L	0.06	0.18	Ground
1	750 feet	0.09	0.122 µg/L	0.04	0.12	Ground

[1] Based on onion EC_{25} of 0.001 lb ai/acre (1.1 g ai/ha) and NOAEC of 0.0004 lb ai/acre (0.41 g ai/ha).
[2] Based on duckweed EC_{25} of 3.0 µg/L and NOAEC of 1.0 µg/L.

To summarize the AgDrift analyses, Table IV-B 14 lists the application scenarios which resulted in dissipation distances greater than zero. The dissipation distances indicate the AgDrift modeled buffer zones necessary for the EECs to meet target toxicity levels.

Table IV-B 14. Summarized AgDrift Dissipation Distances for Non-listed and Listed Plant Species			
Application Scenario (lb ai/acre)	**Dissipation Distance (ft)**		
	Non-listed	**Listed**	From **Table**
Turf – Ground Spray- Terrestrial (0.06)	148	331	IV-B 3
Turf – Ground Spray - Terrestrial Plants in Ponds and Wetlands (0.06)	69	239	IV B 4
Turf – Ground Spray - Aquatic Plants in Wetlands (0.06)	0	39	IV B 4
Foliar - Aerial Tier II -Terrestrial (0.0875)	279	679	IV B 9
Foliar - Ground Spray-Terrestrial (0.0875)	55	170	IV B 9
Foliar - Aerial Tier II - Terrestrial Plants in Ponds and Wetlands (0.0875)	190	581	IV B 10
Foliar – Ground Spray - Terrestrial Plants in Ponds and Wetlands (0.0875)	7	102	IV B 10
Foliar - Aerial Tier II - Aquatic Plants in Wetlands (0.0875)	190	209	IV B 10
Foliar – Ground Spray - Aquatic Plants in Wetlands (0.0875)	0	3.3	IV B 10
Sediment – Ground Spray- Terrestrial (0.175)	134	407	IV B 12
Sediment – Ground Spray - Terrestrial Plants in Ponds and Wetlands (0.175)	49	276	IV B 13
Sediment - Ground Spray- Aquatic Plants in Wetlands (0.175)	0	20	IV B 13

The AgDrift exposure assessment to non-target plants may under-or over estimate if the ASAE spray nozzles or application heights are different from what was used in the model. These factors lend uncertainty to the estimate.

4. Review of Incident Data

a. Incidents Involving Aquatic Organisms

There are no reported incidents involving aquatic organisms.

b. Incidents Involving Terrestrial Organisms

(1) Animals

There are no reported incidents involving terrestrial animals.

(2) Plants

Below lists an incident attributed to the approved agricultural uses of penoxsulam that have been reported to the Agency. A single incident has been documented on one crop following the use of registered penoxsulam.

Formulation	Crop	Date and Location	Species Affected	Area Affected	Residue and Chemical Analysis	Miscellaneous, App. Rate, Method, etc.	Citation
Grasp* SC Herbicide	Rice	April 2003. Lonoke Co., AR	Rice	160 of 300 treated acres	N/A	Aerial 2 oz/acre	I0116962-031

5. Endocrine Effects

EPA is required under the Federal Food, Drug, and Cosmetic Act (FFDCA), as amended by the Food Quality Protection Act (FQPA), to develop a screening program to determine whether certain substances (including all pesticide active and other ingredients) "*may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen, or other such endocrine effects as the Administrator may designate.*" Following the recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there was a scientific basis for including, as part of the program, the androgen and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC's recommendation that the Program include evaluations of potential effects in wildlife. For pesticide chemicals, EPA will use the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and, to the extent that effects in wildlife may help determine whether a substance may have an effect in humans, FFDCA authority to require the wildlife evaluations. As the science develops and resources allow, screening of additional hormone systems may be added to the Endocrine Disruptor Screening Program (EDSP). When the appropriate screening and/or testing protocols being considered under the Agency's EDSP have been developed, penoxsulam may be subjected to additional screening and/or testing to better characterize effects related to endocrine disruption.

6. Federally Threatened and Endangered (Listed) Species Concerns

a. Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. At the initial screening-level, the risk assessment considers broadly described taxonomic groups and so conservatively assumes that listed species within those broad groups are co-located with the pesticide treatment area. This means that terrestrial plants and wildlife are assumed to be located on or adjacent to the treated site and aquatic organisms are assumed to be located in the treated water body or a surface water body adjacent to the treated site. The assessment also assumes that the listed species are located within an assumed area which has the relatively highest potential exposure to the pesticide, and that exposures are likely to decrease with distance from the treatment area. Section II.A.4. presents the pesticide use sites that are used to establish initial collocation of species with treatment areas.

If the assumptions associated with the screening-level action area result in RQs that are below the listed species LOCs, a "no effect" determination conclusion is made with respect to direct effects to listed species in that taxa or for indirect effects to listed species that depend on that taxonomic group, and no further refinement of the action area is necessary. Consequently, for this risk assessment for penoxsulam, a "no effect" determination can be made for listed species of aquatic fish and invertebrates, birds, and mammals since the acute risk RQs for these taxonomic groups did not exceed the Endangered Species LOCs. Furthermore, RQs below the listed species LOCs for a given taxonomic group indicate no concern for indirect effects upon listed species that depend upon the taxonomic group covered by the RQ as a resource. However, in situations where the screening assumptions lead to RQs in excess of the listed species LOCs for a given taxonomic group, a potential for a "may affect" conclusion exists and may be associated with direct effects on listed species belonging to that taxonomic group or may extend to indirect effects upon listed species that depend upon that taxonomic group as a resource. In such cases, additional information on the biology of listed species, the locations of these species, and the locations of use sites could be considered along with available information on the fate and transport properties of the pesticide to determine the extent to which screening assumptions regarding an action area apply to a particular listed organism. These subsequent refinement steps could consider how this information would impact the action area for a particular listed organism and may potentially include areas of exposure that are downwind and downstream of the pesticide use site.

b. Taxonomic Groups Potentially at Risk

The preliminary risk assessment for endangered species indicates that penoxsulam exceeds the Endangered Species LOCs for the specified use scenario for the following taxonomic groups:

- non-target aquatic plants – endangered vascular plants adjacent to treated areas which are exposed to penoxsulam as the result of ground spray and granular applications for turf at

0.06 and 0.09 lb ai/acre (2 applications of 0.045 lb ai/acre) and exposed sediment ground spray application of 0.175 lb ai/acre;

- non-target terrestrial plants – endangered monocots and dicots adjacent to treated areas and in semi-aquatic adjacent areas exposed to penoxsulam as the result of ground spray and granular applications at 0.06 lb ai/acre; endangered monocots in dry areas exposed to spray drift as the result of ground spray application at 0.06 lb ai/acre;

- AgDrift modeling for spray drift associated with turf treatment at the 0.06 lb ai/acre application rate predicts LOC exceedances for *listed* terrestrial plant species at distances up to 331 feet for ground spray applications from the edge of the treated area;

- AgDrift modeling for spray drift associated with the foliar treatment of floating and emergent weeds at the 0.0875 lb ai/acre application rate predicts LOC exceedances for *listed* terrestrial plant species at distances up to 170 feet for ground spray and 679 feet for aerial applications from the edge of the treated area;

- AgDrift modeling for spray drift associated with the treatment of exposed sediment for pre-emergence control of aquatic weeds at the 0.175 lb ai/acre application rate predicts LOC exceedances for *listed* terrestrial plant species at distances up to 407 feet for ground applications from the edge of the treated area;

- AgDrift modeling for spray drift associated with ground spray for turf treatment at the 0.06 lb ai/acre application rate predicts LOC exceedances for *listed* terrestrial plant species inhabiting ponds and wetlands at distances up to 239 feet and for *listed* aquatic plants inhabiting wetlands at distances up to 39 feet from the edge of the treated area;

- AgDrift modeling for spray drift associated with the foliar treatment of floating and emergent weeds at the 0.0875 lb ai/acre application rate predicts LOC exceedances for *listed* terrestrial plant species inhabiting ponds and wetlands at distances up to 102 feet for ground spray and 581 feet for aerial spray; for *listed* aquatic plants inhabiting wetlands at distances up to 3.3 feet for ground spray and 209 feet for aerial spray from the edge of the treated area;

- AgDrift modeling for spray drift associated with the treatment of exposed sediment for pre-emergence control of aquatic weeds at the 0.175 lb ai/acre application predicts LOC exceedances for *listed* terrestrial plant species inhabiting ponds and wetlands at distances up to 276 feet and for *listed* aquatic plants inhabiting wetlands at distances up to 20 feet from the edge of the treated area.

1. Discussion of Risk Quotients

The Agency's LOC for endangered and threatened aquatic vascular plants and non-target terrestrial plants is exceeded for the use of penoxsulam as outlined in previous sections. Should estimated exposure levels occur in proximity to listed resources, the available screening level information suggests a potential concern for direct effects on listed species within these taxonomic groups listed above associated with the use of penoxsulam as described in Section II.A.4. The registrant must provide information on the proximity of Federally-listed aquatic vascular plants and non-target terrestrial plants to the penoxsulam use sites. This requirement may be satisfied in one of three ways: 1) having membership in the FIFRA Endangered Species Task Force (Pesticide Registration [PR] Notice 2000-2); 2) citing FIFRA Endangered Species Task Force data; or 3) independently producing these data, provided the information is of sufficient quality to meet FIFRA requirements. The information will be used by the OPP Endangered Species Protection Program to develop recommendations to avoid adverse effects to listed species.

2. Probit Dose Response Relationship

A probit dose response evaluation was not deemed necessary in this assessment of penoxsulam as there were no animal, bird, or fish taxa for which RQs exceeded acute LOCs. The acute toxicity studies did not result in a definitive median lethal toxicity concentration or a response slope, so a probit analysis could not be done.

3. Data Related to Under-represented Taxa

Effects data from other analyzed sources (ECOTOX Database, PAN Database) were not obtained for this screening risk assessment.

4. Implications of Sublethal Effects

Chronic studies were available for birds and mammals. RQs for chronic risk were below the LOC for birds for all food types at all modeled application rates. Dose-based RQs for mammals did not exceed the chronic risk LOC for any weight class (15 g, 35 g, and 1000g) for consumption of short grasses, tall grasses and broadleaf forage/small insects at the 0.06 lb ai/acre or 0.09 lb ai/acre (2 applications of 0.045 lb ai/acre) application rates modeled and maximum predicted residue levels.

c. Indirect Effects Analysis

Modeled exposures for birds and mammals indicate no LOC exceedances for any animal weight or food type; consequently, there is a negligible potential for indirect effects to listed species dependent upon birds or mammals for food, pollination or seed dispersal, or use burrows for shelter and breeding habitat. In addition, since birds serve as the surrogate for terrestrial-phase amphibians and reptiles, there is no concern for potential indirect effects to listed species dependent on listed terrestrial-phase amphibians and reptiles.

The Endangered species LOC is exceeded for aquatic vascular plants for runoff/drift from ground and aerial spray applications, as well as direct application to water. The Endangered species LOC is also exceeded for terrestrial monocots and dicots located adjacent to treated areas, in semi-aquatic areas, and by drift for the scenarios analyzed. Damage to non-target plants may be sufficient to prevent the plant from competing successfully with other plants for resources and water. Endangered plant species may be especially impacted by exposure to penoxsulam because of the impact of the loss of a few individuals to the population. Consequently, there is a potential concern for listed species with either broad or narrow dependencies on impacted plant species/populations/communities for habitat, feeding or cover requirements. In terrestrial and shallow-water aquatic communities, plants are the primary producers upon which the succeeding trophic levels depend. If the available plant material is impacted due to the effects of penoxsulam, this may have negative effects not only on the herbivores, but throughout the food chain. Also, depending on the severity of impacts to the plant communities [i.e., forests, wetlands, ecotones (edge and riparian habitats)], community assemblages and ecosystem stability may be altered (i.e. reduced bird populations in edge habitats; reduced riparian vegetation resulting in increased light penetration and temperature in aquatic habitats, loss of cover and food for fish).

d. Critical Habitat

In the evaluation of pesticide effects on designated critical habitat, consideration is given to the physical and biological features (constituent elements) of a critical habitat identified by the U.S Fish and Wildlife and National Marine Fisheries Services as essential to the conservation of a listed species and which may require special management considerations or protection. The evaluation of impacts for a screening level pesticide risk assessment focuses on the biological features that are constituent elements and is accomplished using the screening-level taxonomic analysis (risk quotients, RQs) and listed species levels of concern (LOCs) that are used to evaluate direct and indirect effects to listed organisms.

The screening-level risk assessment has identified potential concerns for indirect effects on listed species for those organisms dependent upon aquatic vascular plants, and terrestrial and semi-aquatic plants. In light of the potential for indirect effects, the next step for EPA and the Service(s) is to identify which listed species and critical habitat are potentially implicated. Analytically, the identification of such species and critical habitat can occur in either of two ways. First, the agencies could determine whether the action area overlaps critical habitat or the occupied range of any listed species. If so, EPA would examine whether the pesticide's potential impacts on non-endangered species would affect the listed species indirectly or directly affect a constituent element of the critical habitat. Alternatively, the agencies could determine which listed species depend on biological resources, or have constituent elements that fall into, the taxa that may be directly or indirectly impacted by the pesticide. Then EPA would determine whether use of the pesticide overlaps the critical habitat or the occupied range of those listed species. At present, the information reviewed by EPA does not permit use of either analytical approach to make a definitive identification of species that are potentially impacted indirectly or critical habitats that are potentially impacted directly by the use of the pesticide. EPA and the Service(s) are working together to conduct the necessary analysis.

This screening-level risk assessment for critical habitat provides a listing of potential biological features that, if they are constituent elements of one or more critical habitats, would be of potential concern. These correspond to the taxa identified above as being of potential concern for direct effects and include the following: aquatic vascular plants, and terrestrial and semi-aquatic plants. This list should serve as an initial step in problem formulation for further assessment of critical habitat impacts outlined above, should additional work be necessary.

e. Co-occurrence Analysis

The Endangered Species LOCs for aquatic vascular plants and terrestrial monocots and dicots are exceeded for the use of penoxsulam. Because LOCs for endangered species for these plants were exceeded, a potential concern also arises in all areas for species with both narrow (i.e., species that are obligates or have very specific habitat requirement) and general dependencies (i.e., cover type requirements). In addition, there may be a concern for potential indirect effects to listed species dependent upon vascular aquatic and/or terrestrial plants as feed items or habitat. The potential for both turf use and use on aquatic vegetation exists in all counties in all states.

As a consequence of the above, species with potential concern for indirect effects extend across all counties in all states and are too numerous for an accurate count. The LOCATES database was searched, however, for those listed species of plants where direct effects are of potential concern. The following list tabulates count data by state for listed aquatic vascular plants and terrestrial monocots and dicots.

Species Occurrence in Selected States and Selected Taxa

No species were excluded
All Medium Types Reported

Dicot, Monocot, Ferns, Conf/cycds, Lichen

AL, AK, AZ, AR, CA, CO, CT, DE, DC, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, PR, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY

Alabama	(16) species
Alaska	(1) species
Arizona	(19) species
Arkansas	(4) species
California	(181) species
Colorado	(13) species
Connecticut	(2) species
Delaware	(2) species
Florida	(54) species
Georgia	(20) species
Hawaii	(267) species
Idaho	(3) species
Illinois	(9) species
Indiana	(5) species
Iowa	(6) species
Kansas	(2) species
Kentucky	(10) species
Louisiana	(3) species
Maine	(3) species

Maryland	(6) species
Massachusetts	(3) species
Michigan	(8) species
Minnesota	(4) species
Mississippi	(3) species
Missouri	(8) species
Montana	(2) species
Nebraska	(3) species
Nevada	(9) species
New Hampshire	(2) species
New Jersey	(5) species
New Mexico	(13) species
New York	(6) species
North Carolina	(27) species
North Dakota	(1) species
Ohio	(6) species
Oklahoma	(2) species
Oregon	(14) species
Pennsylvania	(2) species
Puerto Rico	(49) species
Rhode Island	(2) species
South Carolina	(20) species
South Dakota	(1) species
Tennessee	(21) species
Texas	(30) species
Utah	(24) species
Vermont	(2) species
Virginia	(17) species
Washington	(7) species
West Virginia	(5) species
Wisconsin	(6) species
Wyoming	(2) species

No species were selected for exclusion.
Dispersed species included in report.

C. Description of Assumptions, Limitations, Uncertainties, Strengths, and Data Gaps

1. Uncertainties, assumptions, and limitations associated with models

Aquatic Models

Extrapolating the risk conclusions from the standard pond scenario modeled by GENEEC2 may either underestimate or overestimate the potential risks. Major uncertainties with the standard runoff scenario are associated with the physical construct of the watershed and representation of vulnerable aquatic environments for different geographic regions. The physicochemical properties (pH, redox conditions, etc.) of the standard farm pond are based on a Georgia farm pond. These properties are likely to be regionally specific because of local hydrogeological conditions. Any alteration in water quality parameters may impact the environmental behavior of the pesticide. The modeled pond represents a well mixed, static water body. The assumption of uniform mixing does not account for stratification due to thermoclines (e.g., seasonal stratification in deep water bodies). Modeling the pond as a static water body (no flow through), does not account for pesticide removal through flow through or accidental water releases and provides an environmental condition for accumulation of persistent pesticides. Additionally, the physical construct of the standard runoff scenario assumes a watershed:pond area ratio of 10. This ratio is recommended to maintain a sustainable pond in the Southeastern United States. The use of higher watershed:pond ratios (as recommended for sustainable ponds in drier regions of the United States) may lead to higher pesticide concentrations when compared to the standard watershed:pond ratio.

The standard pond scenario assumes that uniform environmental and management conditions exist over the standard 10 hectare watershed. Soils can vary substantially across even small areas, and thus, this variation is not reflected in the model simulations. Additionally, the impact of unique soil characteristics (e.g., fragipan) and soil management practices (e.g., tile drainage) are not considered in the standard runoff scenario. The assumption of uniform site and management conditions is not expected to represent some site-specific conditions. Extrapolating the risk conclusions from the standard pond scenario to other aquatic habitats (e.g., marshes, streams, creeks, and shallow rivers, intermittent aquatic areas) may either underestimate or overestimate the potential risks in those habitats.

Terrestrial Models

The data available to support the terrestrial exposure assessment for penoxsulam are substantially complete, with the exception of a foliar dissipation study, which is an input variable for modeling of risks to birds and mammals (i.e.,T-REX). The terrestrial modeling was conducted using a default foliar half-life value of 35 days. Use of this default value could over- or underestimate the foliar half-life for penoxsulam, giving higher or lower terrestrial EECs, and risk. However, it should be noted that because the EEC represents the concentration immediately following a direct application, the foliar half-life variable is only influential for scenarios involving multiple applications.

As discussed earlier in the exposure section of this document, the Agency relies on the work of Fletcher et al. (1994) for setting the assumed pesticide residues in wildlife dietary items. The Agency believes that these residue assumptions reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to quantify. It is important to note that the field measurement efforts used to develop the Fletcher estimates of exposure involve highly varied sampling techniques. It is entirely possible that much of these data reflects residues averaged over entire above ground plants in the case of grass and forage sampling. Depending upon a specific wildlife species' foraging habits, whole aboveground plant samples may either underestimate or overestimate actual exposure.

The acute and chronic characterizations of risk rely on comparisons of wildlife dietary residues with LC_{50} or NOAEC values expressed in concentrations of pesticides in laboratory feed. These comparisons assume that ingestion of food items in the field occurs at rates commensurate with those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the increased mass in fresh-weight wildlife food intake estimates, it does not allow for gross energy and assimilative efficiency differences between wildlife food items and laboratory feed. On gross energy content alone, direct comparison of a laboratory dietary concentration-based effects threshold to a fresh-weight pesticide residue estimate would result in an underestimation of field exposure by food consumption by a factor of 1.25 - 2.5 for most food items. Only for seeds would the direct comparison of dietary threshold to residue estimate lead to an overestimate of exposure. Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods do not account for a potentially important aspect of food requirements. Depending upon species and dietary matrix, bird assimilation of wild diet energy ranges from 23 - 80%, and mammal's assimilation ranges from 41 - 85% (U.S. Environmental Protection Agency, 1993). If it is assumed that laboratory chow is formulated to maximize assimilative efficiency (e.g., a value of 85%), a potential for underestimation of exposure may exist by assuming that consumption of food in the wild is comparable with consumption during laboratory testing. In the screening process, exposure may be underestimated because metabolic rates are not related to food consumption.

For the terrestrial organism risk assessment, the EECs on food items generated using T-REX may be compared directly with dietary toxicity data or converted to an oral dose to calculate chronic dose-based RQs, as is the case for small mammals. The screening-level risk assessment for penoxsulam uses upper bound predicted residues as the measure of exposure. For mammals, the residue concentration is converted to daily oral dose based on the fraction of body weight consumed daily as estimated through mammalian allometric relationships. Converting to the oral dose-based chronic RQs from the reported mammalian dietary chronic endpoint allows EFED to evaluate the risk to different size-classes of mammals with varying feeding habits. However, this extrapolation method for generating dose-based chronic RQs for smaller animals based on dietary-based data for larger animals, may also increase uncertainty in this risk assessment.

For the non-target terrestrial plant risk assessment, TerrPlant modeling results are based on the assumption of a single application. The model does not have the capability to estimate exposure concentrations and risk to non-target terrestrial plants from multiple applications. If the label specifies multiple applications to target areas, risks to non-target terrestrial plants may be underestimated.

Finally, the screening procedure does not account for situations where the feeding rate may be above or below requirements to meet free living metabolic requirements. Gorging behavior is a possibility under some specific wildlife scenarios (e.g., bird migration) where the food intake rate may be greatly increased. Kirkwood (1983) has suggested that an upper-bound limit to this behavior might be the typical intake rate multiplied by a factor of 5. In contrast is the potential for avoidance, operationally defined as animals responding to the presence of noxious chemicals in their food by reducing consumption of treated dietary elements. This response is seen in nature where herbivores avoid plant secondary compounds.

2. Uncertainties, assumptions, and limitation associated with exposure scenarios

Screening-level risk assessments for spray applications of pesticides consider dietary exposure alone. Other potential routes of exposure to penoxsulam for terrestrial organisms, are discussed below.

<u>Incidental soil ingestion exposure</u>

This risk assessment does not consider incidental soil ingestion. Available data suggests that up to 15% of the diet can consist of incidentally ingested soil depending on the species and feeding strategy (Beyer et al., 1994). A simple first approximation of soil concentration of pesticide from spray application shows that ingestion of soil at an incidental rate of up to 15% of the diet would not increase dietary exposure.

<u>Inhalation exposure</u>

The screening risk assessment does not consider inhalation exposure. Such exposure may occur through three potential sources: (1) spray material in droplet form at the time of application (2) vapor phase pesticide volatilizing from treated surfaces, and (3) airborne particulate (soil, vegetative material, and pesticide dusts).

Available data suggest that inhalation exposure at the time of application is not an appreciable route of exposure for birds. According to research on mallards and bobwhite quail, respirable particle size in birds (particles reaching the lung) is limited to a maximum diameter of 2 to 5 microns. The spray droplet spectra covering the majority of pesticide application situations (AgDrift model scenarios for very-fine to coarse droplet applications) suggests that less than 1% of the applied material is within the respirable particle size.

Theoretically, inhalation of pesticide's active ingredient in the vapor phase may be another source of exposure for some pesticides under some exposure situations. However, volatilization of penoxsulam from water and soil surfaces is not expected; therefore, inhalation should not be an important exposure pathway.

The impact from exposure to dusts contaminated with the pesticide cannot be assessed generically because soil properties (chemical and physical), which impact the estimation of such exposures are highly site-specific.

Dermal Exposure

The screening assessment does not consider dermal exposure, except as it is indirectly included in calculations of RQs based on lethal doses per unit of pesticide treated area. Dermal exposure may occur through three potential sources: (1) direct application of spray to terrestrial wildlife in the treated area or within the drift footprint, (2) incidental contact with contaminated vegetation, or (3) contact with contaminated water or soil.

Data which address dermal exposure of wildlife to pesticides in a quantitative fashion are extremely limited. The Agency is actively pursuing modeling techniques to account for dermal exposure via direct application of spray and by incidental contact with vegetation.

Drinking Water Exposure

The exposure of a target organism to a pesticide's active ingredient may be the result of consumption of surface water, groundwater or consumption of the pesticide in dew or other water on the surfaces of treated vegetation or in puddled water on treated fields. For the active ingredients of a pesticide there is a potential to dissolve in runoff and puddles on the treated field which may contain the chemical.

3. Uncertainties, assumptions, and limitation associated with the toxicity data

Species Selection and Sensitivity

There are a number of areas of uncertainty in the terrestrial and the aquatic organism risk assessments that could potentially cause an underestimation of risk. Use of toxicity data on representative species does not provide information on the potential variability in susceptibility to acute and chronic exposures. For screening terrestrial risk assessments, a generic bird or mammal is assumed to occupy either the treated field or adjacent areas receiving the pesticide at a rate commensurate with the treatment rate on the field. The actual habitat requirements of any particular terrestrial species are not considered, and it is assumed that species occupy, exclusively and permanently, the treated area being modeled. This assumption leads to a maximum level of exposure in the risk assessment.

Although the screening risk assessment relies on a selected toxicity endpoint from the most sensitive species tested, it does not necessarily mean that the selected toxicity endpoints reflect sensitivity of the most sensitive species existing in a given environment. The relative position of the most sensitive species tested in the distribution of all possible species is a function of the overall variability among species to a particular chemical. In the case of listed species, there is uncertainty regarding the relationship of the listed species' sensitivity and the most sensitive species tested.

Surrogates were used to predict potential risks for species with no data (i.e., reptiles and amphibians). It was assumed that the use of surrogate effects data is sufficiently conservative to apply to the broad range of species within taxonomic groups. If other species are more or less sensitive to penoxsulam than the surrogates, risks may be under- or overestimated, respectively.

<u>Age class and sensitivity of effects thresholds</u>

Scientists generally recognize that the age of the test organism may have a significant effect on the observed sensitivity to a toxicant. In a screening-level assessment of acute toxicity in fish, data are collected on juveniles weighing 0.1 to 5 grams. For aquatic invertebrates, the recommended acute testing is performed on immature age classes (e.g., first instar for daphnids, second instar for amphipods, stoneflies and mayflies, and third instar for midges). Similarly, acute dietary testing with birds is also performed on juveniles, with mallard ducks tested at 5-10 days of age and quail at 10-14 days of age.

Testing of juveniles may overestimate the toxicity of direct acting pesticides in adults. As juvenile organisms do not have fully developed metabolic systems, they may not possess the ability to transform and detoxify xenobiotics equivalent to the older/adult organism. The screening risk assessment has no current provisions for a generally applied method that accounts for this uncertainty. In so far as the available toxicity data may provide ranges of sensitivity information with respect to age class, the risk assessment uses the most sensitive life-stage information as the conservative screening endpoint.

4. Uncertainties and assumptions associated with gaps in environmental fate and toxicity data

The following data gaps and uncertainties were identified with respect to the submitted ecotoxicity effects data:

- Penoxsulam readily degrades by two different mechanisms, producing eleven major transformation products. Toxicity studies for some of the transformation products of penoxsulam are limited to effects on freshwater algae, duckweed, *Daphnia* and some species of monocots and dicots but toxicity information of transformation products for birds and mammals is not available. Furthermore, for some transformation products, no toxicity information is available.

- From a fate perspective, six penoxsulam transformation products (BSTCA, BST, 2-amino-TP, 2-amino TCA, 5,8-diOH , and sulfonamide) reached peak concentrations at study termination. Laboratory data are not available to quantitatively determine degradation rates, and therefore the degree of persistence, for these transformation products under environmental conditions. Furthermore, mobility data submitted for three penoxsulam transformation products (BSTCA, BST, and 5-OH-penoxsulam) indicated mobility roughly equivalent to or slightly greater than that of the parent compound, penoxsulam. However, laboratory data are not available to quantitatively determine the degree of mobility or persistence for the majority of the identified transformation products under environmental conditions.

- Current data were not provided to determine the potential exposure to birds, mammals, and pollinators from residues on foliage, flowers, and seeds.

- Dermal contact and soil ingestion pathways for terrestrial mammals and birds were not evaluated because these routes of exposure are not considered in deterministic risk assessments. Uncertainties associated with exposure pathways for terrestrial animals are discussed in greater detail in Section 4.4.3.

- Risks to semiaquatic wildlife via consumption of pesticide-contaminated fish were not evaluated. However, given that bioaccumulation of penoxsulam is expected to be low, ingestion of fish by piscivorus wildlife is not likely to be of concern.

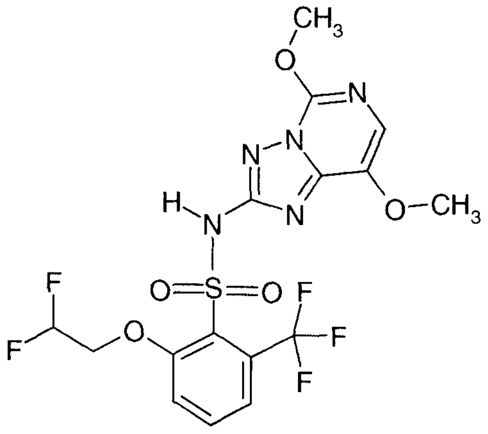
- Risks to top-level carnivores were not evaluated due to a lack of data for these receptors. Ingestion of grass, plants, fruits, insects, and seeds by terrestrial wildlife was considered; however, consumption of small mammals and birds by carnivores was not evaluated. In addition, food chain exposures for aquatic receptors (i.e., fish consumption of aquatic invertebrates and/or aquatic plants) were also not considered.

- Surrogates were used to predict potential risks for species with no data (i.e., reptiles and amphibians). It was assumed that use of surrogate effects data is sufficiently conservative to apply to the broad range of species within taxonomic groups. If other species are more or less sensitive to penoxsulam than the surrogates, risks may be under or overestimated, respectively.

Appendix A. Environmental Fate Studies

Environmental Fate Summary

Based on submitted laboratory data and field studies (a more detailed description of the individual study reports data appears below), penoxsulam dissipates quickly in aqueous environments with clear, shallow water, and more slowly in turbid and/or shaded waters. Penoxsulam is expected to be mobile, and modernly persistent in terrestrial environments. Penoxsulam is expected to be less mobile in sediments, but less persistent in anaerobic aquatic environments and in aquatic environments where sunlight is able to easily penetrate clear, shallow waters.



Penoxsulam degrades by two competing mechanisms in the environment. The major routes of dissipation in aqueous environments are expected to be aqueous photolysis (half-lives of 1.5 to 14 days, with the longer half-life reported at the lowest pH) and anaerobic degradation (half-lives of 5 to 11 days). Following application to terrestrial environments, the slower aerobic degradation processes (half-lives of 12 to 118 days) would dominate.

The aqueous photolysis study author (MRID 458307-22) suggested that the longer, 14 day photolytic half-life in the flooded soil was due to the turbidity of the samples. It was proposed that the suspended soil reduced the amount of light available for photodegradation. However, it is also plausible that the pH of the test system affected the photolytic half-life. At a pH at or above 7, as reported in the three remaining photolytic test systems, ≥99% penoxsulam exists in an ionized form, as calculated with the Henderson-Hasselbach equation from a reported pK_a of 5.1. At the flooded soil system pH of 5.8, only 83% of the penoxsulam exists in an ionized form. The remaining 17% exists as the associated species. Because the most labile proton in penoxsulam is located near both of the sulfonamide bridge cleavage sites observed for photolytic transformation, it is possible that this change in speciation, from the ionized to the associated form, could influenced phototransformation. Additionally, trees, riparian vegetation and crop canopies shading treated waters would reduce the significance of photolysis as a degradation route for penoxsulam. This is especially true when penoxsulam is directly applied to natural water bodies where the aforementioned aquatic environmental conditions would limit photolysis.

Photolysis on soil could be an important route of dissipation in terrestrial environments (half-lives of 19 to 109 days). However, photolysis is limited to the shallow depth of soil that can be penetrated by sunlight. Once penoxsulam moves from the upper soil layer, aerobic degradation will become the dominate route of environmental dissipation (half-lives of 12 to 118 days).

In the submitted aquatic field dissipation studies, the water half-life for penoxsulam applied by subsurface injection to pond water in Florida to achieve a final concentration of 150 ppb in the 0.3-ha application zone was 24.8 days (MRID 467035-02). Note that 150 ppb is the maximum penoxsulam concentration allowed in a treated water body. Penoxsulam dissipated in the Florida pond sediment with a half-life of 34.5 days based on detected concentrations following the maximum concentration at 21 days. In a supporting aquatic field dissipation study, penoxsulam was applied four times at 28-day intervals to achieve a 20 ppb concentration in the 1.2-ha application zone of a Florida pond. Penoxsulam dissipated in the water with half-lives of 15.4, 11.0, 12.1 and 11.7 days respectively following each application. Penoxsulam dissipated in the sediment with half-lives of 8.2, 12.9, 7.8, and 21.7 days following each application. Penoxsulam is stable to hydrolysis at all environmental pHs. Mineralization is not a major route of dissipation for penoxsulam.

Characterization of the transformation products reported in the submitted laboratory studies indicates that the degradation of penoxsulam proceeds through two competing pathways. Photolysis proceeds through a mechanism that initiates cleavage of the sulfonamide bridge of the parent molecule. Biotic degradation proceeds through the degradation of the pyrimidine ring and its substitutes. This complex degradation pathway of penoxsulam produces a large number of degradation products. Environmental fate data are not available to fully characterize either these degradation products or their respective potential degradation pathways.

Only mobility data are available for some of the penoxsulam transformation products, and fate date derived from studies conducted with the parent compound. Five of the thirteen identified transformation products (see Table A-1 and Appendix B for the structure and full Chemical Abstract Service Name of the penoxsulam transformation products) reached peak concentrations at study termination: 2-amino-TP, BSTCA, 2-amino-TCA, sulfonamide and 5,8-di-OH penoxsulam. These five compounds are potentially more persistent than the parent compound, and would probably have reached even greater concentrations with time. Eleven of the thirteen penoxsulam transformation products reported in laboratory studies are considered major degradates: BSA, 2-amino-TP, TPSA, BSTCA methyl, BSTCA, 2-amino-TCA, 5-OH-penoxsulam, SFA, sulfonamide, 5,8-di-OH and 5-OH 2 amino TP. Two of the thirteen penoxsulam transformation products are considered minor degradates: di-FESA and BST (see Table A-1).

Three degradation products were determined to be of potential ecological concern. An examination of chemical structure of identified degradation products revealed a sulfonamide residue which was not hindered by stearic factors in three degradates (SFA, Sulfonamide, BSA). Ecological endpoints were calculated for these three degradation products, along with the parent compound, with the EPA structural analysis program, Estimation Program Interface (EPI) Suite[1].

[1]2000, U.S. Environmental Protection Agency

Comparison of the predicted ECOSAR class endpoints for the three degradation products with those of penoxsulam indicate these thee degradation products are not expected to be of toxicological concern (see EFED science chapter for use of Penoxsulam on Rice, 2004).

In addition, six of the penoxsulam degradation products have been identified by the Health Effects Division as residues of concern for the water assessment.

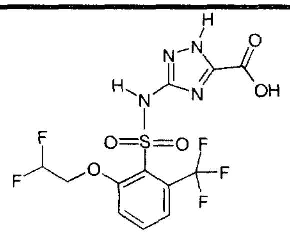
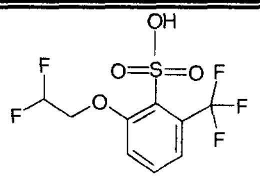
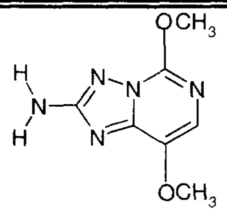
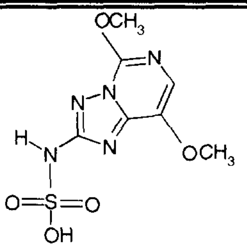
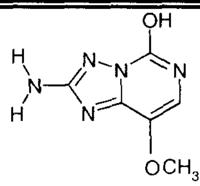
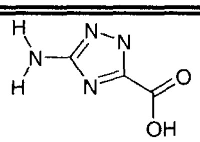
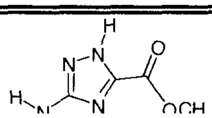
Based on submitted laboratory data, penoxsulam is expected to have a high degree of mobility in the environment. However, penoxsulam susceptibility to both photolytic and biotic degradation limits the potential for the parent compound to accumulate in the environment. Based upon a reported (MRID 45830705) vapor pressure of 9.55×10^{-14} Pa at 25°C, penoxsulam is expected to have low volatility under environmental conditions. A pK_a value of 5.1 indicates that penoxsulam will exist predominately in its anionic form in all but strongly acidic soils, making it susceptible to the repulsive interactions responsible for the tendency of anions to be weakly sorbed to most soils. Reported soil to water partitioning coefficients between 0.13 and 4.7, with a median K_d value of 0.54, indicates a substantial potential for off-site movement. Reported K_{oc} values were generally between 13 and 305, with one K_{oc} value reported as 1130, and a median K_{oc} value of 40. No strong correlation was demonstrated between mobility and clay content, organic matter content, or pH for the soils tested. The possibility of transport exists through runoff, leaching, sediment erosion during a rainfall event, and through the windblown movement of soil in terrestrial environments. Likewise, transport and dispersion in water bodies is likely following direct application or subsurface injection.

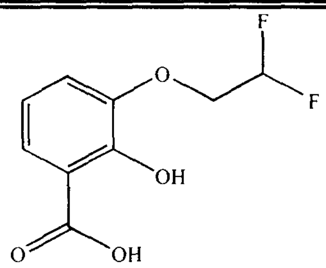
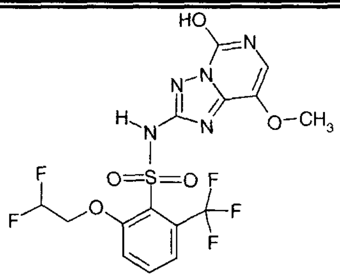
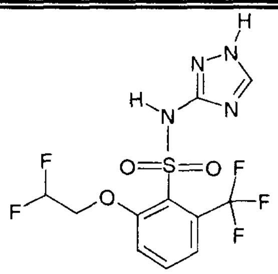
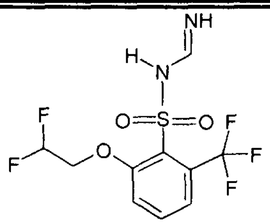
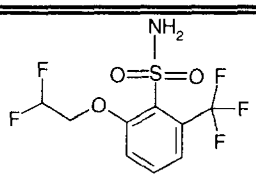
Mobility data has been submitted for three penoxsulam degradates (BSTCA, 5-OH-penoxsulam, and BST) indicating that each is expected to display mobility roughly equal to or slightly greater than that of the parent compound.

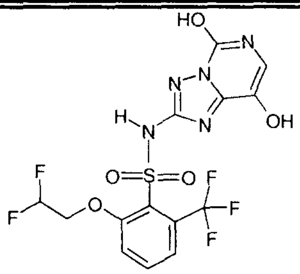
Results from submitted aquatic field dissipation studies were consistent with submitted laboratory data. It was interested to note that the dissipation of penoxsulam application to bareground and terrestrial field studies was dominated by soil kinetics, while the dissipation of penoxsulam application to flooded bareground and pond waters was dominated by water kinetics.

Summaries of the individual Data Evaluation Reports (DER) for the submitted environmental fate studies supporting the proposed new use of penoxsulam for turf and control of aquatic vegetation in aquatic environments are provided below.

Table A-1. Maximum Reported Amounts of Specific Degradation Products in Fate Studies

Degradate Name	Structure	Maximum % Applied	Study Type
BSTCA 3-[[[2-(2,2-Difluoroethoxy)-6-(trifluoromethyl)phenyl]-sulfonyl]amino]-1H-1,2,4-triazole-5-carboxylic acid		11.1% 7.2% 39.4%* 37.2%* 25.4%	soil photolysis aqueous photolysis aerobic aquatic metabolism aerobic soil metabolism anaerobic aquatic metabolism
BSA 2-(2,2-difluoroethoxy) -6-(trifluoromethyl) benzenesulfonic acid		8.1% 36.1%	soil photolysis aqueous photolysis
2-amino-TP 5,8-dimethoxy [1,2,4]triazolo[1,5-c] pyrimidin-2-amine		10.4%* 18.2%	soil photolysis aqueous photolysis
TPSA (5,8-dimethoxy [1,2,4]triazolo-[1,5-c]pyrimidin-2-yl-sulfamic acid)		56%	aqueous photolysis
5-OH, 2-Amino TP 8-methoxy-[1,2,4]triazolo[1,5-c]pyrimidin-5-ol-2-amine		32%	aqueous photolysis
2-Amino TCA 2-amino-1,2,4-triazole carboxylic acid		85%*	aqueous photolysis
BSTCA methyl Methyl 5-[[[2-(2,2-		12% 1.4%	aqueous photolysis aerobic soil metabolism

Degradate Name	Structure	Maximum % Applied	Study Type
difluoroethoxy)-6-(trifluoromethyl)phenyl] sulphony]amino], 1H-1,2,4-triazole-3-carboxylic acid)		12.8%	anaerobic aquatic metabolism
Di-FESA 3-(2,2-Difluoroethoxy) -2-hydroxybenzoic acid		7.6%	aqueous photolysis
5-OH-penoxsulam 2-(2,2-Difluoroethoxy) -N-(5,6-dihydro-8-methoxy-5-oxo[1,2,4] triazolo[1,5-c] pyrimidin-2-yl)-6-(trifluoromethyl) benzenesulfonamide		40.3% 62.6% 41.6%	aerobic aquatic metabolism aerobic soil metabolism anaerobic aquatic metabolism
BST 2-(2,2-Difluoroethoxy) -N-1H-1,2,4-triazole-3-yl-6-(trifluorom ethyl) benzenesulfon amide		6.3% 4.8%	aerobic soil metabolism anaerobic aquatic metabolism
SFA 2-2,2-Difluoroethoxy)-N-(iminomethyl-6-(trifluoromethyl)-benzenesulfonamide		14.7%*	aerobic soil metabolism
Sulfonamide 2-(2,2-Difluoroethoxy) -6-(trifluoromethyl)-benzenesulfonamide		33.0%*	aerobic soil metabolism

Degradate Name	Structure	Maximum % Applied	Study Type
5,8-diOH 2-(2,2-Difluoroethoxy) - 6-trifluoromethyl-N-(5,8-dihydroxy-[1,2,4] triazolo[1,5-c] pyrimidin-2-yl) benzenesulfonamide		11.0%*	anaerobic aquatic metabolism
$^{14}CO_2$		not reported	aqueous photolysis
		3.2%*	soil photolysis
		16.1%*	aerobic soil metabolism
		1.2%*	anaerobic aquatic metabolism
		2.4%*	aerobic aquatic metabolism
Non-extractable Residues		30.1%*	aqueous photolysis (over sediment)
		30.9%*	soil photolysis
		55.5%	aerobic soil metabolism
		57.9%*	aerobic aquatic metabolism
		55.5%	anaerobic soil metabolism

*Maximum % of applied reported at study termination indicating that amounts may have continued to increase with time.

Table A-2. Summary of Degradation and Metabolism of Penoxsulam in Fate Studies

Study MRID	Study Type	System	Parent half-life	Maximum transformation products (% of applied)												
				BSTCA	BSA	2-amino TP	TPSA	5-OH 2-amino TP	2-amino-TCA	BSTCA methyl	di-FESA	5-OH-penoxsulam	BST	SFA	Sulfonamide	5,8-diOH
45830721	Hydrolysis (161-1)	Sterile aqueous buffers / natural waters	stable	--	--	--	--	--	--	--	--	--	--	--	--	--
45834801	Photodegradation in Water (161-2)	Sterile aqueous buffers (pH 7)	1.5 days	7.0	36.1	18.2	56	--	85	1.2	5.1	--	--	--	--	--
		Natural waters (pH 7.8)	1.5 days	7.2	33.5	17.8	53	--	81.7	4.4	7.6	--	--	--	--	--
45830722	Photodegradation in Water (161-2)	AR pond water (pH 7)	3.1 days	--	--	17	--	--	--	3.7	--	--	--	--	--	--
		Flooded silt loam soil (pH 5.8)	14 days	--	--	9.4	--	--	--	12	--	--	--	--	--	--
45830723	Photodegradation on Soil (161-3)	Flooded silt loam	19 days	11.1	80.1	10.4	--	--	--	--	--	--	--	--	--	--
		Silty clay loam	109 days	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr
45830724	Aerobic Soil Metabolism (162-1)	AR silt loam	34 days	37.2	--	--	--	--	--	1.3	--	62.6	6.3	14.7	33.0	--
		CA clay loam	43 days	32.4	--	--	--	--	--	1.4	--	40.9	4.5	3.3	1.4	--
		ND loam	118 days	20.6	--	--	--	--	--	--	--	25.0	1.8	--	--	--
45830725	Anaerobic Aquatic Metabolism (162-3) (total system)	AR pond water / silt loam clay sediment	5 days	25.4	--	--	--	--	--	12.8	--	38.6	4.8	--	--	11.0
		AR pond water / silt loam soil	11 days	20.5	--	--	--	--	--	--	--	41.6	2.9	--	--	--

		distilled water / silty loam soil (Italy)	7 days	18.7	--	--	--	--	--	4.6	--	32.6	3.0	--	--	--
45830726	Aerobic Aquatic Metabolism (162-4)	AR pond water / silt loam clay sediment	16 days	39.4	--	--	--	--	--	--	--	32.3	--	--	--	--
	(total system)	AR pond water / silt loam soil	29 days	29.7	--	--	--	--	--	--	--	22.7	--	--	--	--
		Italian channel water / loam sediment	12 days	24.0	--	--	--	--	--	--	--	22.0	--	--	--	--
		French lake water / sand sediment	38 days	12.8	--	--	--	--	--	--	--	29.7	--	--	--	--
		HPLC water / volcanic loam soil (Japan)	30 days	10.4	--	--	--	--	--	--	--	32.2	--	--	--	--
		HPLC water / loam soil (Japan)	31 days	25.7	--	--	--	--	--	--	--	40.3	--	--	--	--
46703501	Terrestrial Field Dissipation (164-1)	Loam soil (California)	19 days (92 day data)	20.2	--	--	--	--	--	--	--	14.7	--	--	--	--
		Loamy sand soil (New York)	6 days	14.3	--	--	--	--	--	--	--	--	--	--	--	--
46703502	Aquatic Field Dissipation (164-2)	Florida pond (subsurface injection)														
		Water	25 days	>0.01	--	--	--	--	--	--	--	>0.01	--	--	--	--
		Sediment	35 days	0.01								0.02				

nr = not reported

Table A-3. Mobility Properties of Penoxsulam (MRID # 458308-01)

Soil	% Organic Carbon	K_d (mL/g)	K_{oc} (mL/g)
NC Sand	0.40	0.27	76
AR Silt loam	0.97	0.37	40
Volcanic Loam (Japan)	3.7	0.59	22
Sandy clay loam (Japan)	2.2	0.56	40
Volcanic Loam (Japan)	3.4	4.69	305
Volcanic Loam (Japan)	1.3	1.55	194
CA Clay loam	2.5	0.49	20
ND Loam	2.8	0.45	21
Silty clay loam (Italy)	0.99	1.96	253
Silty clay loam (France)	0.97	0.48	66
Sandy clay loam (UK)	1.6	0.16	13
Sandy loam (Italy)	0.85	0.32	46
AR Silty clay sediment	0.12	1.4	1130
Sandy loam (Brazil)	1.5	0.51	35
Clay loam (Brazil)	4.8	0.64	14
Sandy clay loam (Brazil)	1.0	0.13	13
Clay loam (Canada)	2.0	1.4	73
Clay loam (Canada)	3.6	0.67	19
Median Value		**0.54**	**40**

Table A-4. Mobility Properties of BSTCA (Penoxsulam Metabolite) (MRID 458308-02)

Soil	% Organic Carbon	K_d (mL/g)	K_{oc} (mL/g)
Silty clay loam (France)	0.97	0.72	74
NC Sand	0.4	0.19	46
AR Silt loam	0.97	1.5	156
CA Clay loam	2.5	0.61	25
Silty clay loam (Italy)	0.99	4.4	444
Sandy clay loam (UK)	1.6	0.085	5
Median Value		**0.67**	**60**

Table A-5. Mobility Properties of BST (Penoxsulam Metabolite) (MRID 458308-02)

Soil	% Organic Carbon	K_d (mL/g)	K_{oc} (mL/g)
NC Sand	0.4	0.14	34
AR Silt loam	0.97	0.59	61
CA Clay loam	2.5	0.42	18
ND Loam	2.7	0.5	21
Silty clay loam (Italy)	0.99	0.84	85
Silty clay loam (France)	0.97	0.47	48
Sandy clay loam (UK)	1.6	0.075	5
Sandy loam (Italy)	0.86	0.61	71
Median Value		**0.49**	**41**

Table A-6. Mobility Properties of 5-OH-penoxsulam (Penoxsulam Metabolite) (MRID 458308-02)

Soil	% Organic Carbon	K_d (mL/g)	K_{oc} (mL/g)
NC Sand	0.4	0.14	34
AR Silt loam	0.97	0.33	34
CA Clay loam	2.5	0.46	18
ND Loam	2.7	1	38
Silty clay loam (Italy)	0.99	1.4	144
Silty clay loam (France)	0.97	0.4	42
Sandy clay loam (UK)	1.6	0.28	18
Sandy loam (Italy)	0.86	0.3	34
Median Value		**0.37**	**34**

Hydrolysis 161-1 (MRID 458307-21, Study Status: Acceptable)

Penoxsulam (1 mg ai/L) was stable to hydrolysis in the dark, at 25°C in sterile aqueous buffered solutions at pH 5 (acetate), pH 7 (piperazineethanesulfonic acid), pH 9 (borate), and in natural water from White River, ID (pH 8.0). No major or minor transformation products were identified in any of the test systems. Volatiles were not measured. Hydrolysis is expected to be an insignificant route of dissipation in the environment. This study is *acceptable* and satisfies the hydrolysis data requirement.

Aqueous Photolysis 161-2 (MRID 458307-22, Study Status: Supplemental)

The photodegradation of penoxsulam was studied at 23°C for 28 days, in nonsterile AR pond water at pH 7 at a concentration of 0.1 mg ai/L, and for 59 days in flooded AR silt loam soil at pH 5.8 at a concentration of 0.1 mg ai/g. Penoxsulam degraded when irradiated outdoors under natural light in a neutral pH solution, with a half-life of 3.1 days, and in a flooded, aerobic soil system with a half-life of 14.2 days. The study author suggested that the longer half-life in the flooded soil was due to the turbidity of the samples. However, it is also plausible that the pH of the test system affected the photolytic half-life. Volatiles were not measured. Samples were analyzed by HPLC, with further analysis using MS.

The major transformation products in natural water were 5-OH 2-Amino TP, and 2-amino TP (see Table B6 for full Chemical Abstract Service names of transformation products). The major transformation products in flooded soil were 5-OH 2-amino TP, BST, and BSTCA. The minor transformation products in natural water were BSTCA, BSTCA-methyl, 5-OH 2-Amino TP, and di-FESA. An unidentified peak believed to consist of multiple polar compounds was a maximum 64% of the applied at study termination. The minor transformation product in flooded soil was 2-amino TP.

In a supplementary study conducted under similar conditions using [^{14}C-phenyl]penoxsulam, it was demonstrated that 20.5% of the applied was evolved as $^{14}CO_2$ from the buffer solution and 11.7% was evolved from the natural water by 14 days posttreatment. Two proposed major routes of degradation involved the cleavage of the sulfonamide group at different sites. The proposed minor route of degradation involved the opening of the pyrimidine ring. All transformation pathways end with the formation of more than 15 polar photodegradation products.

This study is classified *supplemental* because the study was conducted using either nonsterile unbuffered pond water or flooded soil. Additionally, environmental conditions during outdoor incubation were not adequately described (i.e., cloud cover, hours of sunlight). However, no additional date is required at this time.

Aqueous Photolysis 161-2 (MRID 45834801, Study Status: Supplemental)

Penoxsulam degraded rapidly when irradiated in neutral pH solutions, with environmental phototransformation half-lives of 1.5 days in both test systems. The photo degradation of penoxsulam was studied for the equivalent of 28 days of 12 hour light/12 hour dark cycles under a Xenon lamp, at 25 ± 2°C in sterile pH 7 aqueous phosphate buffer and in pH 7.8 natural water (Letcombe, England) at a nominal concentration of 0.15 g ai/mL under continuous irradiation, using a UV-filtered xenon lamp. Volatiles were not measured. Samples were analyzed directly by LSC and HPLC.

The major transformation products were BSA, TPSA, 2-amino TP, BSA, 5-OH 2-amino TP, and 2-amino TCA (see Table B6 for full Chemical Abstract Service names of transformation products). Minor transformation products were BSTCA, BSTCA-methyl, 5-OH, 2-amino TP, and di-FESA. Polar compounds totaled a maximum of 74% of the applied at 28 days posttreatment. In a supplementary study conducted under similar conditions using [^{14}C-phenyl] penoxsulam, it was demonstrated that 21% of the applied was evolved as $^{14}CO_2$ from the buffer solution and 12% was evolved from the natural water by 14 days posttreatment. Two proposed major routes of degradation involved the cleavage of the sulfonamide group at different sites. The proposed minor route of degradation involved the opening of the pyrimidine ring. All transformation pathways end with the formation of more than 15 polar photodegradation products.

This study is classified *supplemental* because material balances in the phenyl-labeled experiment were incomplete. Additionally, the portion of this study using natural water does not fulfill requirements because the CO_2 data are contradictory. However, no additional date is required at this time.

Soil Photolysis 161-3 (MRID 45830723, Study Status: Supplemental)

Penoxsulam degraded photolytically with calculated environmental phototransformation half-lives of 31 days on Italian silty clay loam soil, and 19.1 days on AR silt loam soil. The photodegradation of penoxsulam was studied for 20 days under a 12 hour light/12 hour dark cycle at 18.9 ± 1.6 °C on silty clay loam soil from Italy, and for 37 days under continuous irradiation at 24.1 ± 2.0 °C on silt loam soil from Arkansas at approximately 50 g ai/ha under a UV-filtered Xenon arc lamp. The soil extracts, extracted soils, and volatile traps were analyzed for total radioactivity using LSC. The soil extracts were also analyzed for penoxsulam and its transformation products using HPLC by comparison to unlabeled reference standards that were co-chromatographed with the samples. Further identification of isolated compounds was done with LC-MS.

The major transformation products in AR silt loam soil were 2-amino TP and BSTCA (see Table B6 for full Chemical Abstract Service names of transformation products). There were no minor transformation products identified in AR silt loam soil. No major or minor transformation products were identified in the Italian silty clay loam soil. A maximum of 3.2% of the applied was evolved as $^{14}CO_2$ in the AR test systems. Volatiles were not measured in the Italian test system.

This study is classified supplemental, and does not satisfy the soil photolysis data requirement. The study is scientifically valid, but the mass balance for one test system dropped to <90% of the applied, the temperature was not maintained at 25 ± 1°C either of the soil studies, the moisture content was not maintained or adjusted in one soil study, and transformation products were identified in the Italian silty clay loam soil. However, no additional data is required at this time.

Aerobic Soil Metabolism 162-1 (MRID 458307-24, Study Status: Acceptable)

Penoxsulam degraded aerobically with a calculated half-lives of 33.8 days in an pH 5.8 Arkansas silt loam soil, 43.4 days in a pH 6.5 California clay loam soil, and 117.5 days in a pH 6.9 North Dakota loam soil. The biotransformation of [phenyl-U-^{14}C]- and [triazolopyrimidine-2-^{14}C]-labeled penoxsulam was studied in three United States soils for 365 days, at an application rate equivalent to 150 g ai/ha, under aerobic conditions in darkness at 25 ± 1°C and soil moisture 75% at 1/3 bar. Soil extracts, extracted soil and volatile trapping solutions were analyzed for total radioactivity using LSC. Extracts were analyzed for [^{14}C]penoxsulam and its transformation products by reverse-phase HPLC. [^{14}C]Compounds were identified by comparison to reference standards. Identifications of penoxsulam degradates were confirmed using LC/MS.

Among the three soil systems, major transformation products include: 5-OH-penoxsulam, BSTCA, SFA, and CO_2. Minor transformation products include: BST, sulfonamide, BSTCA methyl, and CO_2.

In a supplementary study to provide degradation information for future residue studies carried out in Japan, an additional two Japanese loam soils (pH 5.5 and pH 5.3) were studied for 120 days at 25 ± 1°C and soil moisture 40% of moisture holding capacity. Based on first-order linear regression analysis, the half-lives are reported to be 50.2 and 41.0 days.

A possible transformation pathway for the degradation of penoxsulam (see Table B6 for full Chemical Abstract Service names of transformation products) in aerobic soil was proposed by the study author. Penoxsulam could degrade via demethylation of the methoxy group in the 5-position of the triazolopyrimdine ring to 5-OH-penoxsulam. 5-OH-penoxsulam could then degrade via the BSTCA methyl transformation product to BSTCA. BSTCA could, in turn, degrade to BST, and then to SFA. This proposed transformation pathway is consistent with submitted laboratory studies. This study is classified *acceptable* and can be used to fulfill the aerobic soil metabolism data requirement for penoxsulam.

Aerobic Aquatic Metabolism 162-4 (MRID 458307-26, Study Status: Acceptable)

Penoxsulam degraded aerobically under aquatic conditions with calculated, total system half-lives of: 16 days (13 to 23 days at the 90% confidence interval) in AR pond water- silty clay sediment (pH 6.3), 29 days (23 to 38 days at the 90% confidence interval) in AR pond water- silt loam soil (pH 5.8), 12 days (11 to 15 days at the 90% confidence interval) in Italian channel water-loam sediment (pH 7.7), 38 days (27 to 64 days at the 90% confidence interval) in French lake water-sand sediment (pH 6.6), 30 days (28 to 32 days at the 90% confidence interval) in HPLC water-Japanese volcanic loam soil (pH 6.9), and 31 days (28 to 35 days at the 90% confidence interval in HPLC water-Japanese non-volcanic loam soil (pH 5.3).

All incubations were conducted for 99 days under aerobic conditions in darkness either at 25°C (Arkansas and Japan systems) or 20°C (Italy and France systems). Based on the water volume, [^{14}C]penoxsulam was applied at a nominal rate of either 0.1 mg ai/L (Arkansas, Italy and France systems) or 0.04 mg ai/L (Japan systems), with a sediment/soil:water ratio of 1:4. Sodium hydroxide solution in a sidearm flask was used for the passive collection of CO_2, but volatile organic compounds were not trapped. The water-sediment/soil systems were pre-incubated 14 days, except for the 0-day Arkansas soil, France sediment and Japan soil (volcanic and nonvolcanic) systems which were prepared and treated the same day.

[^{14}C]Residues partitioned from the water layer to the sediment/soil with distribution ratios (water:sediment/soil) between 1:3 and 1:1 at 3 months. Major nonvolatile transformation products for both labels in all six systems were identified via LC/MS as 5-OH-penoxsulam and BSTCA (see Table B6 for full Chemical Abstract Service names of transformation products). With the exception of CO_2, no minor transformation products were positively identified. A possible transformation pathway was proposed by the study authors. Under aerobic aquatic conditions, the 5-methoxy group on the triazolopyrimdine ring could be converted to a hydroxy group to yield 5-OH-penoxsulam. 5-OH-penoxsulam could then degrade to BSTCA. This proposed transformation pathway is consistent with submitted laboratory studies.

This study is classified *acceptable*, and can be used toward the fulfillment of the aerobic aquatic metabolism guideline data requirements for penoxsulam.

Anaerobic Aquatic Metabolism 162-3 (MRID 458307-25, Study Status: Supplemental)

Penoxsulam degraded anaerobically under aquatic conditions with calculated, total system half-lives of: 4.8 days (4.3 to 5.4 days at the 90% confidence interval) in AR pond water-silty clay sediment (pH 6.3 water, pH 5.1 sediment), 11 days (9.6 to 12 days at the 90% confidence interval) in AR pond water- silt loam soil (soil pH 5.8), and for 6.6 days (6.0 to 7.3 days at the 90% confidence interval) distilled water- Italian silty clay loam soil (soil pH 6.2).

The biotransformation of penoxsulam was studied in darkness, for one year in AR pond water- silty clay sediment at 25°C, and for 120 days in AR pond water- silt loam soil at 25°C, and distilled water- Italian silty clay loam soil at 20°C, all at an application rate based on water volume of 0.1 mg ai/L. The sediment:water ratio used was 1:3 and the soil:water ratio was 1:2. The water-sediment/soil systems were pre-incubated 29 days. Sodium hydroxide solution in a sidearm flask was used for the passive collection of CO_2, but volatile organic compounds were not trapped.

Water layers, sediment/soil extracts, extracted sediment/soil and trapping solutions were analyzed for total radioactivity using LSC. Water layers and sediment/soil extracts were analyzed for [^{14}C]penoxsulam and its transformation products by reverse-phase HPLC. [^{14}C]Compounds were identified by comparison to unlabeled reference standards. Identifications were confirmed using LC/MS.

[^{14}C]Residues partitioned from the water layer to the sediment/soil with distribution ratios (water:sediment/soil) between 1:2 after 3 months. Major nonvolatile transformation products for both labels in any test system were identified as 5-OH-penoxsulam, BSTCA, BSTCA-methyl and 5,8-di-OH (see Table B6 for full Chemical Abstract Service names of transformation products). Minor transformation products were BSTCA-methyl, BST, and CO_2.

A transformation pathway was proposed by the study authors. Under anaerobic conditions, the 5-methoxy group on the triazolopyrimdine ring is converted to a hydroxy group to yield 5-OH-penoxsulam (see Table B6 for full Chemical Abstract Service names of transformation products). 5-OH-penoxsulam can yield either 5,8-di-OH or BSTCA-methyl. BSTCA-methyl then degrades to BSTCA which then yields BST. This proposed transformation pathway is consistent with submitted laboratory studies. In a supplemental experiment, the presence of penoxsulam, at 0.1 mg/L, had no impact on the microbial viability of the water-sediment/soil systems.

The portions of this study conducted using the Arkansas pond water-silty clay sediment system and the Arkansas pond water-silt loam soil system are classified *acceptable* and can be used towards fulfillment of the anaerobic aquatic metabolism guideline data requirements for penoxsulam. The portion of this study conducted using the Italian distilled water-silty clay loam soil system is classified as *supplemental*. That portion of the study is scientifically valid, but cannot be used towards fulfillment of the anaerobic aquatic metabolism guideline data requirements for penoxsulam because an inappropriate test water was used for the distilled water-silty clay loam soil system.

Adsorption/Desorption 163-1 (MRID 458308-01, Study Status: Acceptable)

The adsorption/desorption characteristics of [triazolopyrimidine-2-^{14}C]-labeled penoxsulam were studied in a batch equilibrium experiment in a sand soil from North Carolina (pH 5.6), a silt loam soil from Arkansas (pH 5.8), a clay loam soil from California (pH 6.5), a loam soil from North Dakota (pH 6.9), a silty clay sediment from Arkansas (pH 5.1), a loam soil from Japan (pH 6.9), a sandy clay loam soil from Japan (pH 6.3), two loam soils from Japan (pH 5.5 and pH 5.3), a sandy loam soil from Brazil (pH 6.0), a clay loam soil from Brazil (pH 6.7), a sandy clay loam soil from Brazil (pH 7.3), two clay loam soils from Canada (pH 6.0 and pH 8.1), a silty clay loam from Italy (pH 6.2), a sandy loam soil from Italy (pH 6.3), a silty clay loam soil from France (pH 6.2) and a sandy clay loam soil from the UK (pH 8.0). The adsorption phase of the study was carried out in 12 of the 18 soils by equilibrating moist soil with [triazolopyrimidine-2-^{14}C]penoxsulam at nominal concentrations of 0.08, 0.4, 2.0, and 10.0 mg a.i/kg soil at 20°C for 24 hours. The adsorption phase of the study was carried out for the remaining 5 foreign soils and one domestic sediment by equilibrating moist soil with [triazolopyrimidine-2-^{14}C]penoxsulam at a nominal concentration of 2.0 mg ai/kg soil at 20EC for 24 hours.

The desorption phase of the study was carried out by twice replacing the adsorption solution with an equivalent volume of pesticide-free 0.01M $CaCl_2$ solution and equilibrating for 24 hours 20°C. After adsorption and desorption, the supernatant solution was separated by centrifugation, decanted, and were analyzed for total radioactivity using LSC. Following desorption, the soils were extracted two or three time, centrifuged, and analyzed using LSC. [^{14}C]Residues remaining in the extracted soil were quantified by LSC following combustion..

[^{14}C]Penoxsulam was stable in the adsorption supernatants and first desorption solutions, based on HPLC analyses. Greater than 90% was unchanged parent compound. Several second desorption and extraction samples showed 85-90% unchanged penoxsulam. After 24 hours of equilibration, between 11 and 86% of the applied [^{14}C]penoxsulam was adsorbed.

Simple adsorption K_d values were 0.33, 0.34, 0.95, 0.80, 9.4, 2.4, 0.63, 0.60, 2.5, 0.60, 0.19, 0.37, 1.4, 0.51, 0.636, 0.13, 1.4, and 0.67 for the NC sand, AR silt loam, Japanese loam, Japanese sandy clay loam, Japanese loam, Japanese loam, CA clay loam, ND loam, Italian silty clay loam, French silty clay loam, sandy clay loam from the UK, Italian sandy loam soils, AR silty clay sediment, Brazilian sandy loam, Brazilian clay loam, Brazilian sandy clay loam, Canadian clay loam, and Canadian clay loam soils, respectively. Freundlich K_{ads} values were 0.27, 3.71, 0.59, 0.56, 4.69, 1.55, 0.49, 0.45, 1.96, 0.48, 0.16, and 0.32 for the same 12 soils, for the NC sand, AR silt loam, Japanese loam, Japanese sandy clay loam, Japanese loam, Japanese loam, CA clay loam, ND loam, Italian silty clay loam, French silty clay loam, sandy clay loam from the UK, and Italian sandy loam soils, respectively. Freundlich K_{oc} values were 76, 40, 22, 40, 305, 194, 20, 21, 253, 66, 13, and 46 for the NC sand, AR silt loam, Japanese loam, Japanese sandy clay loam, Japanese loam, Japanese loam, CA clay loam, ND loam, Italian silty clay loam, French silty clay loam, sandy clay loam from the UK, Italian sandy loam soils, respectively. Simple K_{oc} values were 130, 35, 14, 13, 73, and 19 for the silty clay sediment from AR silty clay sediment, Brazilian sandy loam, Brazilian clay loam, Brazilian sandy clay loam, Canadian clay loam, and Canadian clay loam soils, respectively.

At the end of the desorption phase, between 4.7 and 82.8% of the applied ^{14}C was desorbed. Freundlich K_{des} values were 1.56, 0.55, 4.16, 2.97, 20.77, 5.44, 2.88, 2.28, 5.09, 2.05, 0.87, and 0.86 for the NC sand, AR silt loam, Japanese loam, Japanese sandy clay loam, Japanese loam, Japanese loam, CA clay loam, ND loam, Italian silty clay loam, French silty clay loam, sandy clay loam from the UK, Italian sandy loam soils, respectively. Freundlich K_{oc} values were 296, 197, 279, 193, 2156, 713, 156, 150, 720, 264, 192, and 169 for the same 12 soils, NC sand, AR silt loam, Japanese loam, Japanese sandy clay loam, Japanese loam, Japanese loam, CA clay loam, ND loam, Italian silty clay loam, French silty clay loam, sandy clay loam from the UK, Italian sandy loam soils, respectively. No correlation was found for the relationship between Kd and percent organic carbon, pH or percent clay.

This study is classified as *acceptable*, and can be used to fulfill the data requirements for a mobility study for penoxsulam using unaged soil.

Adsorption/Desorption 163-1 (MRID 458308-02, Study Status: Supplemental)

The adsorption/desorption characteristics of three major penoxsulam metabolites, BSTCA, BST, and 5-OH-penoxsulam (see Table B6 for full Chemical Abstract Service names of transformation products), were studied in a batch equilibrium experiment in a NC sand soil (pH 5.6), an AR silt loam soil (pH 5.8), a CA clay loam soil (pH 6.5), a ND loam soil (pH 6.9), an Italian silty clay loam (pH 6.2), an Italian sandy loam soil (pH 6.3), a French silty clay loam soil (pH 6.2), and a UK sandy clay loam soil (pH 8.0).

The adsorption phase of the study was carried out by equilibrating soil with [^{14}C]BSTCA/BST and [^{14}C]5-OH-penoxsulam at a nominal concentration of 0.4 mg a.i/kg soil at 20°C in a 0.01M $CaCl_2$ solution with soil/solution ratios of 1:2 (w:v) for all soils. BSTCA was unstable in solution and continued to degrade to BST throughout the study. Desorption was not studied. The supernatants were analyzed for total radioactivity using LSC. The soil extracts were analyzed for total radioactivity using LSC. Portions of the extracts were further analyzed using HPLC. [^{14}C]Residues remaining in the extracted soil were quantified by LSC following combustion.

After 2 hours of equilibration, between 1.4 and 24.6% of the applied [^{14}C]BSTCA was adsorbed to the NC sand, AR silt loam, CA clay loam, Italian silty clay loam, French silty clay loam, and UK sandy clay loam soils, respectively. Calculated simple adsorption K_d values were 0.185, 1.515, 0.605, 4.395, 0.720, and 0.085 for the NC sand, AR silt loam, CA clay loam, Italian silty clay loam, French silty clay loam, and UK sandy clay loam soils, respectively. Corresponding K_{oc} values were 46, 156, 25, 444, 74, and 5.

After 2 hours of equilibration, between 3.2 and 33.5% of the applied [^{14}C]BST was adsorbed to the NC sand, AR silt loam, CA clay loam, ND loam, Italian silty clay loam, French silty clay loam, UK sandy clay loam, and Italian sandy loam soils, respectively. Calculated adsorption K_d values were 0.135, 0.590, 0.420, 0.545, 0.840, 0.470, 0.075, and 0.610 for the NC sand, AR silt loam, CA clay loam, ND loam, Italian silty clay loam, French silty clay loam, UK sandy clay loam, and Italian sandy loam soils, respectively. Corresponding K_{oc} values were 34, 61, 18, 21, 85, 48, 5, and 71.

After 24 hours of equilibration, between 6.6 and 39.6% of the applied [^{14}C]5-OH-penoxsulam was adsorbed to the NC sand, AR silt loam, CA clay loam, ND loam, Italian silty clay loam, French silty clay loam, UK sandy clay loam, and Italian sandy loam soils, respectively. Calculated K_d values were 0.140, 0.325, 0.455, 1.030, 1.425, 0.400, 0.280, and 0.295 for the NC sand, AR silt loam, CA clay loam, ND loam, Italian silty clay loam, French silty clay loam, UK sandy clay loam, and Italian sandy loam soils, respectively. Corresponding K_{oc} values were 34, 34, 18, 38, 144, 42, 18, and 34. No correlation was found for the relationship between Kd and percent organic carbon, pH or percent clay.

This study is classified as *supplemental*. The study cannot be used toward the fulfillment of the mobility data requirement guideline requirement for penoxsulam, because (1) the study was conducted using transformation products of penoxsulam rather than the parent compound. Additionally, desorption was not studied.

Leaching/Aged Column 163-1 (MRID 458348-02, Study Status: Supplemental)

In the preliminary study, [^{14}C]penoxsulam was applied to three of the four definitive study soils (Japanese sandy silt loam, Nagaoka clay loam, and Arkansas silt loam). After two days at room temperature, the [^{14}C]penoxsulam-treated soils were extracted, the extracts were analyzed by LSC.

Leaching - Unaged Column

The column leaching of [triazolopyrimidine-2-^{14}C]penoxsulam was studied in the dark for 48 hours in four unaged soils: Japanese sandy silt loam (pH 6.5), Japanese clay loam (pH 5.8), AR silt loam (pH 5.7) and Italian sandy loam (pH 6.4). Two types of unaged soil column leaching experiments were performed in the study: a free-draining experiment and a saturated (flooded) experiment. All four soils were used in the free-draining experiment. Only the Japanese clay loam and the Italian sandy loam soils were used in the saturated experiment.

In the free-draining experiment, the flow of 0.01M $CaCl_2$ solution was controlled at the top of the column and uncontrolled at the bottom. In the saturated experiment, the flow of aqueous solution was restricted to maintain a 5 cm layer of the solvent on the top of the column.

The application rate of penoxsulam was equivalent to 71 g/ha (approximately twice the maximum field application rate). The soils of the free-draining experiment were extracted, purified, and further analyzed by LSC and reverse-phase HPLC. The extracted soils were then combusted, analyzing for total radioactivity using LSC. Leachates were analyzed for total radioactivity using LSC and reverse-phase HPLC.

Free-draining experiment:

In unaged Japanese sandy silt loam soil treated with [triazolopyrimidine-2-^{14}C]penoxsulam, the distribution of total radioactivity was 40%, 26%, 20%, 13%, 1.5%, and not detected (the 0-5 cm, 5-10 cm, 10-15 cm, 15-20 cm, 20-25 cm, and 25-30 cm soil column depths, respectively. A minor, uncharacterized transformation product was only measured in the 5-10 cm and 10-15 cm soil column depths at < 1% of the applied respectively.

In unaged Japanese clay loam soil treated with [triazolopyrimidine-2-^{14}C]penoxsulam, the distribution of total radioactivity was 103% for the 0-5 cm and below the level of detection in all other soil column depths. The minor transformation product observed in the other test systems was not detected in any soil column depths.

In unaged Arkansas silt loam soil treated with [triazolopyrimidine-2-^{14}C]penoxsulam, the distribution of total radioactivity was 86% for the 0-5 cm soil layer, 12% for the 5-10 cm soil layer, and below the limit of detection in all other soil layers. A minor transformation product was reported at a maximum of 2% of the applied in the 0-5 cm soil column depth, accounted for 1% in the 5-10 cm, and was not detected in any other soil column depths.

In unaged Japanese sandy silt loam soil treated with [triazolopyrimidine-2-^{14}C]penoxsulam, the distribution of total radioactivity was 10%, 20%, 23%, 19%, 12%, and 13% for the 0-5 cm, 5-10 cm, 10-15 cm, 15-20 cm, 20-25 cm, and 25-30 cm soil column depths, respectively. A minor transformation product was reported at a maximum of 0.9% of the applied in the 10-15 cm soil layer.

Volatile [^{14}C]organic compounds, $^{14}CO_2$, and bound residues were not measured individually in the free-draining experiment.

Saturated experiment:

In unaged Japanese clay loam soil treated with [triazolopyrimidine-2-^{14}C]penoxsulam, the distribution of total radioactivity was 36%, 16%, 15%, 10%, 15%, and 6% for the 0-5 cm, 5-10 cm, 10-15 cm, 15-20 cm, 20-25 cm, and 25-30 cm soil column depths, respectively.

In unaged Japanese sandy loam soil treated with [triazolopyrimidine-2-^{14}C]penoxsulam, the distribution of total radioactivity was 21%, 28%, 25%, 15%, 7%, and 1.5% for the 0-5 cm, 5-10 cm, 10-15 cm, 15-20 cm, 20-25 cm, and 25-30 cm soil column depths, respectively.

Total extractable [^{14}C]residues, nonextractable [^{14}C]residues, volatile [^{14}C]organic compounds, $^{14}CO_2$, and bound residues were not measured individually in either soil column of the saturated soil leaching experiment.

This study is classified *supplemental*. Both portions of this study, conducted using [triazolopyrimidine-2-^{14}C]penoxsulam in a free-draining and saturated leaching conditions, are scientifically valid, but do not satisfy data requirements for a mobility study using aged soil because: (1) only one ring in penoxsulam was radiolabeled, (2) the required minimum of four test soils were not studied in all portions of the primary study, (3) three test soils were foreign in origin and not completely characterized or compared to U.S. soils, (4) no test soil contained an organic matter content less than 1%, and (5) the test soils were leached with 20 cm of $CaCl_2$ solution, rather than the required 50.8 cm.

Terrestrial Field Dissipation 164-1 (MRID 467035-01, Study Status: Acceptable)

Soil dissipation of penoxsulam under US field conditions was conducted in three bare plots of loam soil in California (Site 1) and in three bare plots of loamy sand soil in New York (Site 2). The experiment was carried out in accordance with the USEPA Pesticide Assessment Guidelines Subdivision N, §164-1, and in compliance with the USEPA FIFRA (40 CFR, Part 160) standards. Penoxsulam was applied once at a target rate of 0.11 kg a.i./ha (0.098 lb a.i./acre) to 39 x 7 m and 40 x 8 m replicate plots in California and New York, respectively. The proposed maximum annual use rate was reported to be 0.100 kg a.i./ha (0.089 lb a.i./acre). At Site 1, total water input during the 11-month study period was 36.48 inches or 340% of the normal precipitation. At Site 2, total water input during the 5-month study period was 28.74 inches or 173% of the normal precipitation. At each site, a control plot was located 15 m from the treated plots.

The application rate was verified for the test application at both sites using fifteen 24-cm filter paper circles that were randomly placed in the treated plots prior to the test application. Mean recovery of penoxsulam from the application rate monitors was equivalent to an application rate of 109.8 ± 32.5 g a.i./ha or a calculated 99.8% of the 110 g a.i./ha target for Site 1 and 105.6 ± 14.9 g a.i./ha or a calculated 96.0% of the target for Site 2. Field spikes were not prepared to determine the stability of the parent and transformation products during transport and storage.

Soil samples were collected from Site 1 at 0 thru 327 days post application, and from Site 2 at 0 thru 150 days posttreatment. Soil samples were collected to a depth of 0-90 cm. The soil samples were extracted by shaking with acetonitrile:1.0 N hydrochloric acid (90:10, v:v). An aliquot of the extraction solvent was diluted with 0.1 N hydrochloric acid, purified using an HLB solid phase extraction plate, and analyzed for penoxsulam and the transformation products 5-OH-XDE-638 (6-(2,2-difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo-s-triazolo[1,5-c]pyrimidin-2-yl)-α,α,α-trifluoro-o-toluene sulfonamide); BSTCA (3-[6-(2,2-difluoroethoxy)-α,α,α-trifluoro-o-toluenesulfonamido]-s-triazole-5-carboxylic acid); BSA (2-(2,2-difluoroethoxy)-6-(trifluoromethyl)benzenesulfonic acid); sulfonamide (2-(2,2-difluoroethoxy)-6-(trifluoromethyl)-benzenesulfonamide); and 2-amino-TP (5,8-dimethoxy[1,2,4] triazolo[1,5-c]pyrimidin-2-amine) by LC/MS/MS. The LOD and LOQ were 0.001 ppm and 0.003 ppm, respectively, for all analytes. Soil samples were stored frozen for up to 166 days (CA samples) and 175 days (NY samples) prior to analysis.

Results from Site 1

Location/soil type: Fresno County, California/Loam (0-60 cm) over sandy loam (60-90 cm).

Half-life: 48.5 days (r^2 = 0.6638; calculated based on all replicate detections).
18.8 days (r^2 = 0.9362; calculated based on 0-92 day data).
DT_{90}: 53 days (calculated).
Major transformation products detected: 5-OH-XDE-638 and BSTCA.
Dissipation routes: Transformation.

Results from Site 2
Location/soil type: Wayne County, New York/Loamy sand (0-75 cm).
Half-life: 5.9 days (r^2 = 0.8907; calculated based on all replicate detections).
DT_{90}: 12 days (calculated).
Major transformation products detected: BSTCA.
Dissipation routes: Transformation.

Aquatic Field Dissipation 164-2 (MRID 467035-02, Acceptable)

Penoxsulam (GF-443 SC SF, 21.4% a.i.) was applied once by subsurface injection to an approximately 0.9-ha pond in Florida to achieve a whole-pond water concentration of 150 µg penoxsulam/L to an approximately 0.3-ha application zone. The maximum proposed single use rate was reported as 150 µg penoxsulam/L. Water and sediment samples were collected for analysis of penoxsulam and the transformation products 5-OH (6-(2,2-difluoroethoxy)-N-(5,6-dihydro-8-methoxy-5-oxo-s-triazolo[1,5-c]pyrimidin-2-yl)-α,α,α-trifluoro-o-toluene sulfonamide); BSTCA (3-[6-(2,2-difluoroethoxy)- α,α,α-trifluoro-o-toluenesulfonamido]-s-triazole-5-carboxylic acid); BSA (2-(2,2-difluoroethoxy)-6-(trifluoromethyl)benzenesulfonic acid); sulfonamide (2-(2,2-difluoroethoxy)-6-(trifluoromethyl)-benzenesulfonamide); and 2-amino-TP (5,8-dimethoxy[1,2,4]triazole[1,5-c]pyrimidin-2-amine). Water samples were also analyzed for the transformation products TPSA (5,8-dimethoxy[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)sulfamic acid) and 5-OH-2-amino-TP (2-amino-8-methoxy[1,2,4]triazolo[1,5-c]pyrimidin-5-ol). Water samples were collected at multiple depths from three sampling locations at 1, 3, 7, 14, 21, 28, 43, 57, 85, 114, 141, 169, 195, 223, 253, and 296 days posttreatment. Sediment samples were collected at the same sampling intervals for water. All samples were analyzed within 380 days of collection.

Penoxsulam dissipated in the water with a calculated half-life of 24.8 days (r^2 = 0.7313). The half-life was calculated using linear regression analysis performed on a plot of ln-transformed penoxsulam concentrations vs. time and the equation $t_{½} = -ln\ 2 / k$, where k is the rate constant.

The mean measured penoxsulam concentration in water was initially 167.05 ng/mL or 111% of the target concentration at 1 day, decreased to 130.29-134.04 ng/mL by 7-14 days, 74.22 ng/mL by 43 days, 16.40 ng/mL at 85 days, and was last detected at 3.73 ng/mL at 114 days posttreatment. Vertical mixing was accomplished by 3 days posttreatment at the two shallow-depth sampling stations, and at approximately 4 weeks posttreatment at the sampling station located in the deepest area of the pond. The study authors attributed the slow vertical mixing at the deep sampling station to the temperature gradient, adding that vertical mixing of penoxsulam was not complete until a significant rainfall event of 5.15 cm at 3.5 weeks posttreatment.

The transformation products 5-OH, BSTCA, and TPSA were detected in the pond water at the highest concentrations. 5-OH was initially detected in the pond water at a mean concentration of 0.23 ng/mL at 3 days, increased to a maximum of 6.83 ng/mL by 57 days, and was last detected at 1.46 ng/mL at 114 days. BSTCA was initially detected in the pond water at a mean concentration of 0.13 ng/mL at 3 days, increased to a maximum of 13.57 ng/mL by 57 days, then decreased to 2.04 ng/mL by 141 days, and was last detected at 0.03 ng/mL at 223 days. TPSA was initially detected in the pond water at a mean concentration of 0.31 ng/mL at 14 days, increased to a maximum of 2.12 ng/mL by 57 days, and was last detected at 0.06 ng/mL at 114 days. The transformation products BSA, 2-amino-TP, sulfonamide, and 5-OH-2-amino-TP were detected in the pond water at maximum concentrations of 0.26 ng/mL (14 days), 0.63 ng/mL (43 days), 0.71 ng/mL (43 days), and 0.05 ng/mL (253 days), respectively.

Table A-1. Average penoxsulam and transformation product concentrations in pond water, expressed as ng/mL.

Days post-treatment	Average concentration (ng/mL)							
	Penoxsulam	5-OH	BSTCA	BSA	2-Amino-TP	Sulfonamide	TPSA	5-OH-2-amino-TP
1	**167.05**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	**160.83**	0.23	0.13	0.04	0.00	0.00	0.00	0.00
7	**130.29**	0.91	0.10	0.00	0.00	0.00	0.00	0.00
14	**134.04**	2.00	2.16	0.26	0.13	0.00	0.31	0.00
21	**121.00**	**3.22**	**3.17**	0.00	0.00	0.00	1.12	0.00
28	**94.13**	**3.73**	**4.61**	0.00	0.10	0.00	1.12	0.00
43	**74.22**	**5.71**	**10.35**	0.00	0.63	0.71	2.04	0.00
57	**59.41**	**6.83**	**13.57**	0.00	0.54	0.00	2.12	0.00
85	**16.40**	**3.98**	**13.52**	0.00	0.26	0.00	0.89	0.00
114	**3.73**	1.46	**4.78**	0.00	0.00	0.00	0.06	0.00
141	0.00	0.00	2.04	0.00	0.00	0.00	0.00	0.00
169	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
195	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
223	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
253	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
296	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Values in bold are above the LOQ (3.0 ng/mL).

Penoxsulam dissipated in the sediment with a calculated half-life of 34.5 days (r^2 = 0.5307), based on detections following the maximum concentration at 21 days. The half-life was calculated using linear regression analysis performed on a plot of ln-transformed penoxsulam concentrations vs. time and the equation $t_{½} = -ln\ 2 / k$, where k is the rate constant.

The mean measured penoxsulam concentration in sediment was initially 2.63 ng/g at 1 day, increased to a maximum of 18.08 ng/g by 21 days, then decreased to 13.25 ng/g by 43 days and 4.41-4.59 ng/g by 57-85 days, and was last detected at 0.50 ng/g at 141 days (excluding a single replicate detection at 2.87 ng/g at 253 days).

The transformation products 5-OH and BSTCA were detected in the sediment at levels above the LOQ, 2-amino-TP was detected twice at levels below the LOQ, and BSA and sulfonamide were not detected in any sediment samples. 5-OH was initially detected in the sediment at 14.08 ng/g at 1 day, increased to a maximum of 26.62 ng/g by 7 days, ranged from 15.39-20.20 ng/g from 14 to 28 days, decreased to 7.17 ng/g by 43 days, 1.01 ng/g by 141 days, and was last detected at 0.72 ng/g at 253 days. BSTCA was initially detected in the sediment at

0.98 ng/g at 7 days, increased to a maximum of 18.33 ng/g by 85 days, decreased to 7.17 ng/g by 141 days, and ranged from 4.10 to 7.13 ng/g from 169-296 days. The registrant-calculated half-lives of 5-OH and BSTCA in sediment were 28.6 days and 84.9 days, respectively.

Table A-2. Average penoxsulam and transformation product concentrations in pond sediment, expressed as ng/g.

Days posttreatment	Average concentration (ng/g)					
	Penoxsulam	5-OH	BSTCA	BSA	2-Amino-TP	Sulfonamide
1	2.63	**14.08**	0.00	0.00	0.00	0.00
3	**9.68**	**10.75**	0.00	0.00	0.00	0.00
7	**5.22**	**26.62**	0.98	0.00	0.00	0.00
14	**17.37**	**15.39**	**3.08**	0.00	0.00	0.00
21	**18.08**	**18.04**	**8.32**	0.00	1.56	0.00
28	**13.83**	**20.20**	2.85	0.00	1.47	0.00
43	**13.25**	**7.17**	**9.82**	0.00	0.00	0.00
57	**4.41**	**4.98**	**12.56**	0.00	0.00	0.00
85	**4.59**	**3.39**	**18.33**	0.00	0.00	0.00
114	1.34	1.65	**10.22**	0.00	0.00	0.00
141	0.50	1.01	**7.17**	0.00	0.00	0.00
169	0.00	0.00	**7.00**	0.00	0.00	0.00
195	0.00	0.00	**5.58**	0.00	0.00	0.00
223	0.00	0.00	**4.62**	0.00	0.00	0.00
253	2.87	0.72	**4.10**	0.00	0.00	0.00
296	0.00	0.00	**7.13**	0.00	0.00	0.00

Values in bold are above the LOQ (3.0 ng/g).

Total rainfall during the 9.5-month study period was 132.79 cm or 124% of the pro-rated annual historical rainfall total. The study authors stated that water quality parameters (pH range of approximately 5.2-7; dissolved oxygen range of 0.1-8.3 mg/L; conductivity range of 0.03 to 0.09 mS/cm) were typical for small water bodies in Florida, and that visibility readings indicated that the pond moved from a hypereutrophic state to a eutrophic state during the course of the study. The study authors stated that the test substance application had no obvious influence on water quality.

Aquatic Field Dissipation (MRID 467035-03, Study Status: Supplemental.)

Penoxsulam (GF-443 SC SF, 21.4% a.i.) was applied four times, at approximately 28-day intervals by subsurface injection, to a 1.2-ha application zone of an approximately 12.2-ha lake in Florida. Each application was made to achieve a whole-lake water concentration of approximately 20 µg penoxsulam/L. The maximum proposed single use rate was reported as 150 µg penoxsulam/L. The fourth application was made concurrently with the conservative tracer Rhodamine WT dye to determine the three-dimensional dispersal pattern in the lake water. Water and sediment samples were collected for analysis of penoxsulam only. Composite water samples were collected within 1.5-6 hours following each application in an attempt to estimate the penoxsulam application rate. Water samples (both mid-depth in the water column and 25 cm from lake bottom) were then collected from nine sampling locations at approximately 1, 3, 7, 10, 20, and 27 days after the first three applications, and at 1, 3, 7, 11, 21, 28, 43, 55, 83, 109, 137, 167, and 210 days after the fourth application. Samples were also collected from three additional sampling stations installed prior to the fourth application, within the emergent vegetation zone of the lake. Sediment samples were collected at the same sampling intervals for water. All samples were analyzed within 349 days of collection.

The Rhodamine WT dye dispersion analysis results indicated that Rhodamine dye had become widely dispersed throughout the lake by 6 hours posttreatment, and that complete lateral and vertical mixing was achieved by approximately 1 day posttreatment.

Penoxsulam dissipated in the water with calculated half-lives of 15.4 days ($r^2 = 0.9849$), 11.0 days ($r^2 = 0.9957$), 12.1 days ($r^2 = 0.9786$), and 11.7 days ($r^2 = 0.9928$) following each of the four applications, respectively, calculated using linear regression analysis performed on a plot of ln-transformed penoxsulam concentrations vs. time and the equation $t_{½} = -ln\ 2 / k$, where k is the rate constant.

The mean measured penoxsulam concentration in water was initially 23.15-34.25 ng/mL at 0-1 days following each of the first three applications, and decreased to 5.35-8.30 ng/mL by 27-28 days posttreatment (0-1 days prior to the subsequent application). Following the fourth application, penoxsulam was detected at a mean concentration of 26.27-27.47 ng/mL from 0 to 3 days, decreased to 13.13 ng/mL by 11 days, 4.99 ng/mL by 28 days, 0.85 ng/mL by 55 days, and was last detected at 0.01 ng/mL at 137 days posttreatment. Results showed that spatial distribution was accomplished by 3 days after each application. Mean penoxsulam concentrations at 3 days posttreatment ranged from 19.85 to 26.39 ng/mL or 99.3-132% of the target lake concentration. Vertical mixing was accomplished by 1-3 days posttreatment. Mean concentrations of penoxsulam residues in water are presented in the table below.

Table A-3. Penoxsulam concentrations in water, expressed as ng/mL.

Days posttreatment	Average concentration (ng/mL)	Range (mid water column depth)	Range (25 cm above sediment)
Application 1			
0	28.71	4.17-78.9	3.97-45.2
1	29.14	18.0-41.0	15.8-45.5
3	26.28	25.6-33.7	22.1-26.0
7	21.83	20.1-23.6	20.7-22.9
10	20.67	19.1-22.7	18.1-23.2
20	13.26	11.8-13.8	12.0-14.3
27	8.30	7.64-9.13	6.92-8.92
Application 2			
0	34.25	8.02-126	8.59-45.6
1	29.80	24.6-35.0	21.4-38.9
3	25.59	24.3-27.8	22.6-26.7
7	19.79	19.2-20.5	19.4-20.4
10	16.96	16.3-17.2	16.6-17.5
20	9.63	8.98-9.67	4.86-18.5
28	5.35	5.23-5.60	4.94-5.52
Application 3			
0	24.63	12.8-44.6	7.33-35.9
1	23.15	20.2-29.6	19.1-26.3
3	19.85	19.4-20.8	16.3-20.8
7	17.29	16.4-19.2	14.8-18.6
11	14.90	12.3-17.6	13.6-16.9
20	6.77	4.88-13.4	6.27-6.91
27	5.58	4.57-10.6	4.38-5.92
Application 4			
0	26.27	3.76-104	4.15-46.0
1	27.47	2.32-36.1	21.7-35.7
3	26.39	11.3-34.3	19.4-28.7
7	16.73	3.15-18.6	14.4-19.7
11	13.13	7.40-14.6	9.04-14.6
21	8.38	6.02-8.76	7.90-8.66
28	4.99	1.88-5.15	4.62-5.12
43	1.33	0.796-1.46	1.06-1.74

55	0.85	0.665-0.963	0.614-1.02
83	0.12	0.0879-0.179	0.0731-0.153
109	0.05	0.0500-0.0607	0.0479-0.0580
137	0.01	ND-0.0212	ND-0.0255
167	ND	ND	ND
210	ND	ND	ND-0.0176

Penoxsulam dissipated in the sediment with calculated half-lives of 8.2 days (r^2 = 0.9046), 12.9 days (r^2 = 0.7256), 7.8 days (r^2 = 0.7225), and 21.7 days (r^2 = 0.7019) following the four applications, respectively, calculated using linear regression analysis performed on a plot of ln-transformed penoxsulam concentrations vs. time and the equation $t_{½} = -\ln 2 / k$, where k is the rate constant.

Penoxsulam concentrations in sediment mirrored those seen in the water. The mean measured penoxsulam concentration in sediment was initially 10.86 ng/g at 1 day following the first application and decreased to 0.80 ng/g by 27 days posttreatment, was initially 2.94 ng/g immediately following the second application, and decreased to 0.81 ng/g by 28 days posttreatment, and was initially 6.96 ng/g immediately following the third application and decreased to 0.51 ng/g by 27 days posttreatment. Following the fourth application, penoxsulam was detected at a mean concentration of 2.13 ng/g at 1 day, was a maximum of 3.75 ng/g at 3 days, then decreased to 1.53 ng/g by 21 days, and was last detected above the LOD at 1.18 ng/g at 28 days.

Table A-4. Penoxsulam concentrations in sediment, expressed as ng/g.

Days posttreatment	Average concentration (ng/g)	Range (ng/g)
Application 1		
1	10.86	3.14-29.9
3	3.82	1.84-5.51
7	4.09	1.36-12.9
10	3.57	2.16-6.22
20	1.46	ND-2.78
27	0.80	ND-2.87
Application 2		
1	2.94	1.42-9.89
3	5.02	ND-13.2
7	3.08	1.95-4.14
10	4.51	2.41-6.15
20	2.11	ND-4.83
28	0.81	ND-3.01
Application 3		
1	6.96	ND-16.7
3	4.55	1.65-10.5
7	0.85	ND-1.97
11	2.28	ND-8.81
20	0.74	ND-2.54
27	0.51	ND-2.09
Application 4		
1	2.13	ND-3.73
3	3.75	ND-8.41
7	2.26	ND-5.97
11	2.60	1.57-7.31
21	1.53	ND-2.82
28	1.18	ND-3.13
43	ND	ND

55	ND	ND
83	ND	ND
109	ND	ND
137	ND	ND
167	ND	ND
210	ND	ND

Total rainfall during the 9.5-month study period was 136.43 cm or 127% of the pro-rated annual historical rainfall total. The authors stated that water quality parameters (pH range of approximately 6-8; dissolved oxygen range of 0.6-13.5 mg/L; conductivity range of 0.03 to 0.05 mS/cm) were typical of Florida lakes and that visibility readings indicated that the lake moved from a eutrophic state to a hypereutrophic state during the course of the study.

This study is classified as supplemental as transformation products were not monitored and the target application rate was 13% of the maximum single use rate of 150 ppb.

Aquatic Field Dissipation (MRID 458308-04, Study Status: Supplemental)

Penoxsulam, formulated as a liquid, was applied once at an application rate of 100 g ai/ha (2 times the current proposed label rate) onto a bareground and a dry-seeded rice plot of Amagon silt loam soil in Arkansas, and onto a bareground and a wet-seeded rice plot of Oswald clay soil in California. The plots at the CA filed were flooded at application, while the AR field site were flooded 11 days after application, with both sites remaining flooded through the growing season.

Water samples were collected for analysis of penoxsulam and seven transformation products: 5-OH-penoxsulam, 2-amino-TP, BSTCA, BSA, TPSA, sulfonamide, and 5-OH-2-amino-TP (see Table B6 for full Chemical Abstract Service names of transformation products). Soil samples were collected for the analysis of penoxsulam and five transformation products: 5-OH-penoxsulam, 2-amino-TP, BSTCA, BSA, and sulfonamide for up to one year after application. The LOQ in water and soil were 0.003 μg/mL and 0.003 μg/g, respectively, for all analyates.

Arkansas field site

Dissipation of penoxsulam in the AR test plots was dominated by soil kinetics following application to bareground and dry-seeded rice plots. Calculated half-life values for penoxsulam in soil were 13 days for the bareground plot and 14 days for the cropped plot. Penoxsulam dissipated in the paddy water with a calculated half-life value of 3.5 days in the bareground plot and 3.8 days in the cropped plot. Penoxsulam dissipated from the total system with a calculated half-life value of 16 days in both the bareground plot and in the cropped plot.

Penoxsulam dissipated in the 0 to 3 inch soil depth from a maximum concentration of 80-88 ppm at 1day, to 26-47 ppm by 7-13 days, and to less than the LOQ by 55 days posttreatment (bareground and cropped plots). Residues of penoxsulam and its transformation products were generally confined to the upper 9 inches of soil layers, but were detected above the LOQ in the cropped plot as deep as the 12 to 15 inch soil depth. The only transformation products detected in the soil were BSTCA, and 5-OH-penoxsulam, and BSA. The transformation products 2-amino-TP and sulfonamide were not detected in either test plot.

Penoxsulam was detected in the paddy water 2 days following flooding at maximum concentrations of 5 ppm in the bareground plot and 15 ppm in the cropped plot, then quickly dissipated. With the exception of BSTCA 7 days after flooding, penoxsulam transformation products were not detected in the paddy water at any sampling interval.

California field site

Dissipation of penoxsulam in the CA test plots was dominated by water kinetics following application to flooded bareground and wet-seeded rice plots. Calculated half-life values for penoxsulam in paddy water were 5 days in the bareground plot and 7 days in the cropped plot. Calculated half-life values for penoxsulam in soil were 14 days for the bareground plot and 26 days for the cropped plot. Penoxsulam dissipated from the total system with a calculated half-life value of 5 days in the bareground plot and 10 days in the cropped plot.

The only transformation products detected in the paddy water at a mean concentration above the LOQ were BSTCA and TPSA. The transformation product BSA was detected in the bareground plots, but was not detected above the LOQ. The transformation products 5-OH DE-638, sulfonamide, 2-amino-TP, and 5-OH-2-amino-TP were not detected in either test plots.

Penoxsulam dissipated in the 0 to 3 inch soil depth from a maximum concentration of 13-14 ppm at day 0 to less than the LOQ by 14 days in the bareground plot and by 60 days in the cropped plot. Residues of penoxsulam and its transformation products were generally confined to the upper 3 inch soil layer, but were detected above the LOQ in the cropped plot as deep as the 3 to 6 inch soil depth. The only transformation products detected in the soil were BSTCA and 5-OH-penoxsulam. The transformation product BSA was detected once in the cropped plot, below the LOQ, and the transformation products 2-amino-TP and sulfonamide were not detected in either test plot.

This study is classified *supplemental* and does not satisfy the data requirements for aquatic field dissipation because it was not possible to determine if the penoxsulam degradation products, which may be of toxicological concern, that formed in the paddy water through aqueous photolysis partitioned into the sediment. However, no additional data is required at this time.

Aquatic Field Dissipation 164-2 (MRID 458308-05, Study Status: Acceptable)

Penoxsulam, formulated as a granule mixture, was applied once at an application rate of 56 g ai/ha onto a flooded plot of Oswald clay soil in Sutter County, California which had been planted with rice. Following application, water samples were collected for analysis of penoxsulam and seven transformation products: 5-OH-penoxsulam, 2-amino-TP, BSTCA, BSA, TPSA, sulfonamide, and 5-OH-2-amino-TP through 92 days after application (when the permanent floods were drained). Soil samples were collected for analysis of penoxsulam and the transformation products 5-OH-penoxsulam, 2-amino-TP, BSTCA, BSA, and sulfonamide through 306 days posttreatment.

Penoxsulam dissipated in the paddy water with a first-order calculated half-life value of 4 days. Penoxsulam was detected in the paddy water at 33 ppm at day 0, decreased to 10 ppm by 7 days, and was below the LOQ by 14 days posttreatment. Transformation products of penoxsulam were not detected in the paddy water at any sampling interval except for a single detection of BSTCA at the LOD at 21 days posttreatment.

Penoxsulam was detected in the 0 to 3 inch depth of the soil at a maximum of 4.6 ppm at 2 days, and was below the LOQ by 21 days posttreatment. The only two transformation products detected in the soil at a mean concentration above the LOD were 5-OH-penoxsulam and BSTCA. 5-OH-penoxsulam was detected in the 0 to 3 inch soil depth at a maximum of 1.2 ppm at 14 days, and was not detected in soil following 30 days posttreatment. BSTCA was detected in the 0 to 3 inch soil depth at a maximum of 3 ppm at 14 days, and decreased to 2 ppm by 306 days. No analytes were detected below the 3 inch soil depth except for BSTCA, which was detected once in the 3 to 6 inch depth, at 1 pm at 306 days posttreatment. The data did not allow for the calculation of a half-life value for penoxsulam in soil.

This study is classified *acceptable* and partially satisfies the guideline data requirements for aquatic field dissipation.

Bioconcentration in Aquatic, Non-target Organisms 165-5 (MRID 458300-01, Study Status: Acceptable)

The bioaccumulation of penoxsulam was studied in crayfish (*Procambarus clarkii*) at a concentration of 0.5 ppm under flow-through aquarium conditions. The test system consisted of two glass aquaria fitted with overflows to maintain a volume of 135 L (average flow rate of 94 mL/minute) at a loading rate of 70 crayfish per vessel. The exposure period was 14 days, and the subsequent depuration period was 7 days. The maximum concentration of total [^{14}C]residues in crayfish tail muscle was 14.4 µg/kg at 11 days.

The average steady-state calculated bioconcentration factor (BCF) was 0.02 mL/g. [^{14}C]Residues in the tissues were not characterized. After 5 days of depuration, total [^{14}C]residues were not detected in the crayfish tissue. [^{14}C]Residues in the crayfish during depuration were not characterized.

This study is classified as *acceptable*. The study is scientifically valid, and can be used towards fulfillment of the bioconcentration in aquatic, non-target organism data requirement for penoxsulam.

Storage Stability (MRID 458307-18)

The stability of penoxsulam was studied in soil that was treated at 0.03 mg ai/kg and stored frozen (*ca.* -20°C) for up to 327 days. The penoxsulam transformation products: 5-OH-penoxsuolam, BSA, sulfonamide, BSTCA and 2-amino-TP (see Table B-6 for full Chemical Abstract Service names of transformation products) were also studied in soil that was treated at 0.03 mg ai/kg and stored frozen (*ca.* -20°C) for up to 327 days.

No significant degradation was observed during the frozen storage of penoxsulam, 5-OH, sulfonamide, BSA and 2-amino-TP. BSTCA degrade from an average of 89% of the applied at day 0 to 77% at 327 days.

Storage Stability (MRID 458308-03)

The stability of penoxsulam was studied in water that was treated at 0.03 mg ai/L and stored refrigerated (*ca*. 4°C) for up to 284 days, or frozen (-20°C) for up to 221 days. The penoxsulam transformation products: 5-OH-penoxsulam, BSA, sulfonamide, BSTCA, 2-amino-TP, TPSA and 5-OH-2-amino-TP (see Appendix B for full Chemical Abstract Service names of transformation products) were also studied in water that was treated at 0.03 mg ai/L and stored refrigerated (*ca*. 4°C) for up to 284 days.

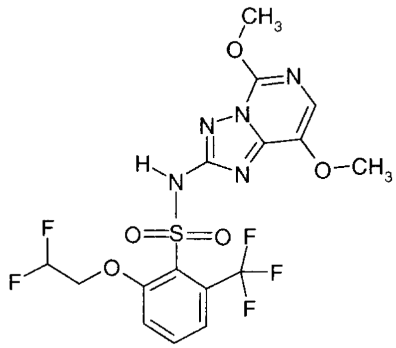
No significant degradation was observed during storage of the refrigerated transformation products. Penoxsulam showed no significant degradation for 130 days when stored refrigerated and no significant degradation was observed in frozen storage for up to 221 days.

Ground and Surface Water Contamination Modeling (MRID 458308-11)

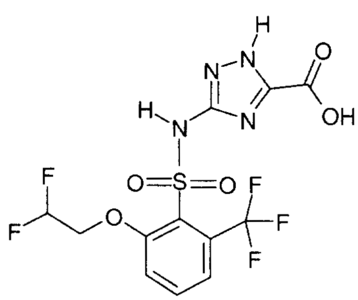
Dow AgroSciences has submitted modeling that addresses both ground and surface water contamination from Penoxsulam applied to rice. For ground water, the registrant used SCI-GROW and generated EECs of 0.0014 and 0.0042 µg/L. Dow assumed effective "holding times" when estimating surface water concentrations. For ecological effects from surface water (Table 1 in Dow document), the highest estimated concentrations for ecological effects occurred in wet-seeded rice in Louisiana on the Gulf Coast. Without imposing mandatory holding times, the highest peak concentration was 42.7 µg/L, which declined to 1.56 µg/L by 21 days after application, and 0.0031 µg/L by 60 days after application. For drinking water, the highest reported peak concentration in the Index Reservoir from all scenarios was 0.26 µg/L after a 78 day effective "holding time", and the maximum chronic (365-day average) concentration was 0.005 µg/L. This concentration also occurred in the water-seeded rice grown on the Gulf Coast in Louisiana. The submitted estimates are of questionable value due to the use of inappropriate values for both degradation and partitioning, because the residues identified by HED as being of toxicological concern were not considered in the calculated half-life estimates, and because of the assumption of effective "holding times" not indicated on the label. This study can not be classified because it has not been submitted to be used towards fulfillment OPP data requirements for penoxsulam.

Appendix B. Chemical Structures of Penoxsulam and Major Transformation Products

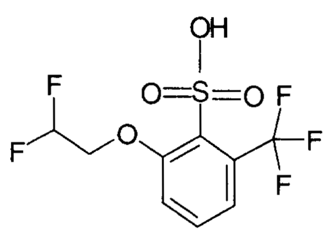
Penoxsulam
CAS Name: 2-(2,2-Difluoroethoxy)-N-(5,8-dimethoxy[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)-6-
IUPAC Name: 3-(2,2-Difluoroethoxy)-N-(5,8-dimethoxy[1,2,4]triazolo[1,5-c]pyrimidin-2-yl)-α,α,α-trifluorotoluene-2-sulfonamid
CAS No: 219714-96-2
Dow Number : X638177
Acronym: XDE-638



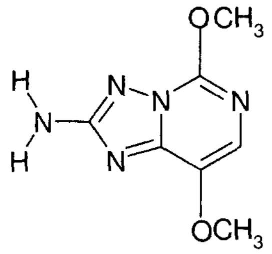
BSTCA
CAS Name: 3-[[[2-(2,2- Difluoroethoxy)-6- (trifluoromethyl)pheny l]-sulfonyl]amino]-1H- 1,2,4-triazole-5-carboxylic acid
Dow Number: X768359
Acronym: BSTCA



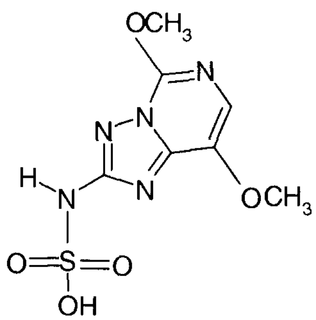
BSA
CAS Name: 2-(2,2-difluoroethoxy) -5-(trifluoromethyl) benzenesulfonic acid
Dow Number: X741277
Acronym: BSA



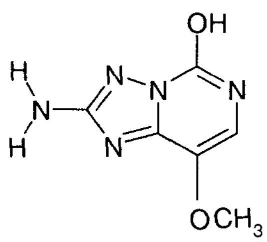
2-amino-TP
Cas Name: 5,8-dimethoxy [1,2,4]triazolo[1,5-c] pyrimidin-2-amine
Dow Number: X514901
Acronym: 2-amino-TP



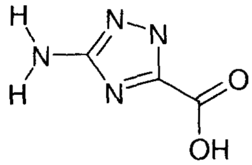
TPSA
CAS Name: (5,8-dimethoxy [1,2,4]triazolo-[1,5- c]pyrimidin-2-yl) sulfamic acid
Dow Number: X776130
Acronym: TPSA



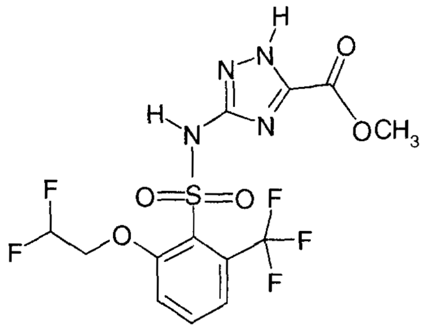
5-OH, 2-Amino TP
CAS Name: 2-Amino-8-methoxy- [1,2,4]triazolo[1,5- c]pyrimidin-5(6H)-one
Dow Number: X732143
Acronym: 5-OH-2-amino TP



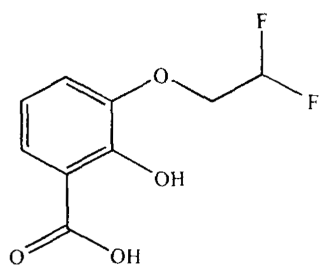
2-Amino TCA
2-amino-1,2,4-triazole carboxylic acid



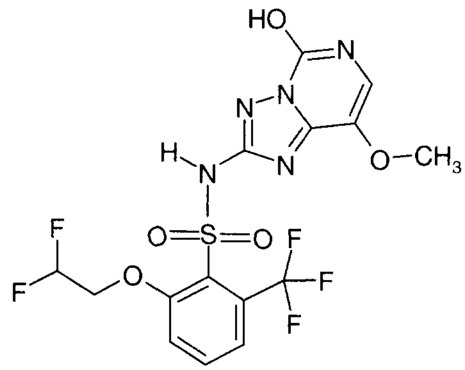
BSTCA methyl
CAS Name: Methyl 5-[[[2-(2,2- difluoroethoxy)-6- (trifluoromethyl)phenyl]sulphony]amino]-1H-1,2,4-triazole-5 carboxylate
Dow Number: X776128
Acronym: BSTCA methyl



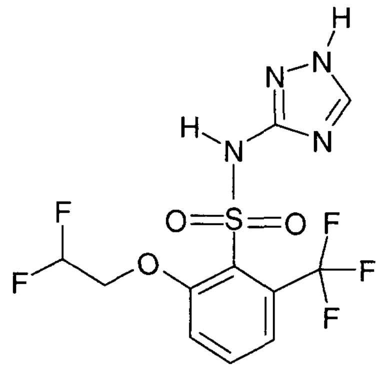
Di-FESA
3-(2,2-Difluoroethoxy) -2-hydroxybenzoic acid



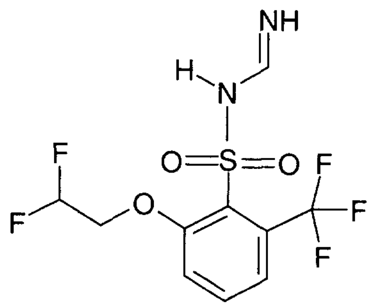
5-OH-penoxsulam
2-(2,2-Difluoroethoxy) -N-(5,6-dihydro-8- methoxy-5-oxo[1,2,4] triazolo[1,5-c] pyrimidin-2-yl)-6-(trifluoromethyl) benzenesulfonamide



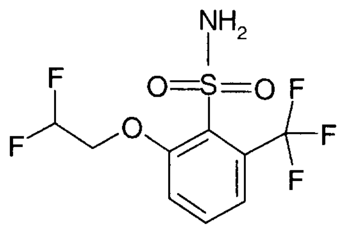
BST
CAS Name: 2-(2,2-Difluoroethoxy) -N-1H-1,2,4-triazole- 3-yl-6-(trifluoromethyl)-benzenesulfonamide
Dow Number: X697134
Acronym: BST



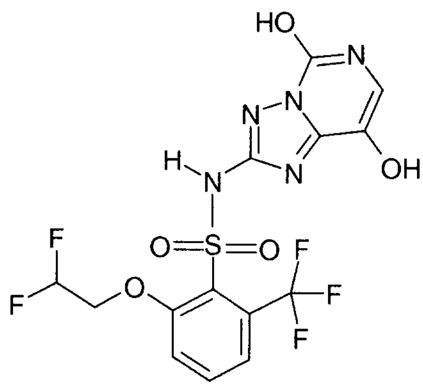
Sulfonyl-formamidine
CAS Name: 2-(2,2-Difluoroethoxy)- N-(iminomethyl-6-(trifluoromethyl)- benzenesulfonamide
Dow Number: X776129
Acronym: SFA



Sulfonamide
Cas Name: 2-(2,2-Difluoroethoxy) -6-(trifluoromethyl)- benzenesulfonamide
Dow Number: X768360



5-OH XDE638
Cas Name: 2-(2,2-Difluoroethoxy)-6-trifluoromethyl-N- (5,8-dihydroxy-[1,2,4] triazolo[1,5-c] pyrimidin-2-yl) benzenesulfonamide
Dow Number: X689643
Acronym: 5,8-diOH



Appendix C. Aquatic Exposure and Risk Analysis

(GENEEC2 Modeling and Risk Quotient Calculations)

GENEEC 2 Modeling (Version 2.0, May 1, 2001)

Ground Spray - 0 ft buffer
0.06 lb ai/A
RUN No. 1 FOR Penoxsulam ON Turf * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL	SOIL Kd	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY ZONE(FT)	INCORP (IN)
.060(.060)	1 1	1.1	408.0	GRHIFI(6.6)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
115.00	2	N/A	3.00- 372.00	36.70	33.40

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

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
3.04	2.99	2.71	2.19	1.88

Ground Spray - 0 ft buffer
0.045 lb ai/A x 2 applications with 28 day interval
RUN No. 1 FOR Penoxsulam ON Turf * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL	SOIL Kd	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY ZONE(FT)	INCORP (IN)
.045(.083)	2 28	1.1	408.0	GRHIFI(6.6)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
115.00	2	N/A	3.00- 372.00	36.70	33.40

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

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
4.19	4.12	3.73	3.02	2.59

Penoxsulam
Ground spray application to sediment
1 application at 0.175 lb ai/A

RUN No. 2 FOR Penoxsulam ON Sediment * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL		SOIL Kd	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY ZONE(FT)	INCORP (IN)
.175(.175)	1	1	1.1	408.0	GRHIME(1.2)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)		METABOLIC (POND)	COMBINED (POND)
497.00	2	N/A	4.30-	533.20	36.60	34.25

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

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
8.42	8.28	7.52	6.11	5.27

```
Granular Application
0.06 lb ai/A
   RUN No.   1 FOR Penoxsulam       ON   Turf          * INPUT VALUES *
   --------------------------------------------------------------------
   RATE (#/AC)   No.APPS &   SOIL  SOLUBIL   APPL TYPE  NO-SPRAY INCORP
    ONE(MULT)    INTERVAL     Kd   (PPM )    (%DRIFT)   ZONE(FT)  (IN)
   --------------------------------------------------------------------
   .060(   .060)   1   1       1.1  408.0   GRANUL(   .0)    .0    .0

   FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
   --------------------------------------------------------------------
   METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
    (FIELD)   RAIN/RUNOFF   (POND)     (POND-EFF)     (POND)     (POND)
   --------------------------------------------------------------------
    115.00        2          N/A      3.00-  372.00    36.70     33.40

   GENERIC EECs (IN MICROGRAMS/LITER (PPB))     Version 2.0 Aug 1, 2001
   --------------------------------------------------------------------
       PEAK       MAX 4 DAY     MAX 21 DAY    MAX 60 DAY    MAX 90 DAY
       GEEC       AVG GEEC       AVG GEEC      AVG GEEC      AVG GEEC
   --------------------------------------------------------------------
        2.85        2.80          2.54          2.05          1.76


Granular Application
0.045 lb ai/A
   RUN No.   2 FOR penoxsulam       ON   Turf          * INPUT VALUES *
   --------------------------------------------------------------------
   RATE (#/AC)   No.APPS &   SOIL  SOLUBIL   APPL TYPE  NO-SPRAY INCORP
    ONE(MULT)    INTERVAL     Kd   (PPM )    (%DRIFT)   ZONE(FT)  (IN)
   --------------------------------------------------------------------
   .045(   .083)   2  28       1.1  408.0   GRANUL(   .0)    .0    .0

   FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
   --------------------------------------------------------------------
   METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
    (FIELD)   RAIN/RUNOFF   (POND)     (POND-EFF)     (POND)     (POND)
   --------------------------------------------------------------------
    115.00        2          N/A      3.00-  372.00    36.70     33.40

   GENERIC EECs (IN MICROGRAMS/LITER (PPB))     Version 2.0 Aug 1, 2001
   --------------------------------------------------------------------
       PEAK       MAX 4 DAY     MAX 21 DAY    MAX 60 DAY    MAX 90 DAY
       GEEC       AVG GEEC       AVG GEEC      AVG GEEC      AVG GEEC
   --------------------------------------------------------------------
        3.94        3.87          3.51          2.84          2.44
```

Risk Quotients and Analysis

When a deterministic approach is used to evaluate the likelihood of adverse ecological effects to non-target species, risk quotients (RQs) are calculated by dividing exposure estimates (EECs) by ecotoxicity values for non-target species, both acute and chronic.

RQ = EXPOSURE/TOXICITY

RQs are then compared to LOCs, which are the criteria used by OPP to indicate potential risk to non-target organisms as well as the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on non-target organisms. LOCs currently address the following risk presumption categories: (1) acute - potential for acute risk is high, regulatory action may be warranted in addition to restricted use classification, (2) acute restricted use - the potential for acute risk is high, but this may be mitigated through restricted use classification, (3) acute endangered species - the potential for acute risk to endangered species is high, regulatory action may be warranted, and (4) chronic risk - the potential for chronic risk is high, regulatory action may be warranted. Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to non-target insects, or chronic risk from granular/bait formulations to mammalian or avian species.

For acute studies on taxa where no effects were observed at any concentration level, the RQ was not calculated. For acute studies on taxa where an LC/LD_{50} was not established due to insufficient mortality but which reported some mortality in the study, an RQ was not calculated and the study is discussed further in the Risk Description section.

The ecotoxicity test values (i.e., measurement endpoints) used in the acute and chronic risk quotients were derived from the results of required studies. Examples of ecotoxicity values derived from the results of short-term laboratory studies that assess acute effects are: (1) LC_{50} (fish) (2) LD_{50} (birds and mammals) (3) EC_{50} (aquatic plants and aquatic invertebrates) and (4) EC_{25} (terrestrial plants). An example of a toxicity test effect level derived from the results of long-term laboratory study that assesses chronic effects is: NOAEC (birds, fish and aquatic invertebrates).

Risk presumptions, along with the corresponding RQs and LOCs are tabulated below:

Risk Presumptions for Terrestrial Animals		
Risk Presumption	**RQ**	**LOC**
Birds:		
Acute Risk	EEC[1]/LC_{50} or LD_{50}/sqft[2] or LD_{50}/day[3]	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or $LD_{50} < 50$ mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1
Wild Mammals:		
Acute Risk	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or $LD_{50} < 50$ mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1

[1]EEC=abbreviation for Estimated Environmental Concentration (ppm) on avian/mammalian food items

[2] $\frac{\text{mg/ft}^2}{LD_{50} * \text{wt. of bird}}$ [3] $\frac{\text{mg of toxicant consumed/day}}{LD_{50} * \text{wt. of bird}}$

Risk Presumptions for Aquatic Animals		
Risk Presumption	**RQ**	**LOC**
Acute Risk	EEC[1]/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Endangered Species	EEC/LC_{50} or EC_{50}	0.05
Chronic Risk	EEC/MATC or NOAEC	1

[1]EEC = (ppm or ppb) in water

Risk Presumptions for Plants		
Risk Presumption	**RQ**	**LOC**
Terrestrial Plants in Terrestrial and Semi-Aquatic Areas:		
Non-Endangered Species	EEC[1]/EC_{25}	1
Endangered Species	EEC/EC_{05} or NOAEC	1
Aquatic Plants:		
Non-Endangered Species	EEC[2]/EC_{50}	1
Endangered Species	EEC/EC_{05} or NOAEC	1

[1]EEC = lb ai/acre

[2]EEC = (ppm or ppb) in water

TABLE C-1. Summarized Acute Aquatic Fish and Invertebrate Risk Quotients [a,b,c]				
Scenario	**Freshwater Fish**	**Freshwater Invertebrate**	**Estuarine/Marine Fish**	**Estuarine/Marine Invertebrate**
Ground Spray 0.06 lb ai/acre	<0.01	<0.01	<0.01	<0.01
Ground Spray 0.09 lb ai/acre[d]	<0.01	<0.01	<0.01	<0.01
Ground Spray 0.175lb ai/acre	<0.01	<0.01	<0.01	<0.01
Granular 0.06 lb ai/acre	<0.01	<0.01	<0.01	<0.01
Granular 0.09 lb ai/acre[d]	<0.01	<0.01	<0.01	<0.01

[a] Detailed calculations of GENEEC2 modeling are provided in Appendix C.
[b] Acute toxicity threshold was >102 ppm (LC_{50})for freshwater fish and >98.3 ppm (EC_{50})for freshwater invertebrates
[c] Acute toxicity threshold was >129 ppm (LC_{50})for estuarine/marine fish and >114 ppm (LC_{50}) for estuarine/marine invertebrates.
[d] Two applications of 0.045 lb ai/acre with a 28 day interval between applications.

TABLE C-2. Summarized Chronic Aquatic Fish and Invertebrate Risk Quotients [a,b,c.]				
Scenario	**Freshwater Fish**	**Freshwater Invertebrate**	**Estuarine/Marine Fish**	**Estuarine/Marine Invertebrate**
Ground Spray 0.06 lb ai/acre	<0.01	<0.01	NA	<0.01
Ground Spray 0.09 lb ai/acre[d]	<0.01	<0.01	NA	<0.01
Ground Spray 0.175lb ai/acre	<0.01	<0.01	<0.01	<0.01
Granular 0.06 lb ai/acre	<0.01	<0.01	NA	<0.01
Granular 0.09 lb ai/acre[d]	<0.01	<0.01	NA	<0.01

[a] Detailed calculations of GENEEC2 modeling are provided in Appendix C.
[b] Chronic toxicity threshold was 10.2 ppm (NOAEC)for freshwater fish and 2.95 ppm (NOAEC)for freshwater invertebrates
[c] There was no (reserved) chronic toxicity threshold for estuarine/marine fish and the chronic threshold was <8.08 ppm (NOAEC) for estuarine/marine invertebrates.
[d] Two applications of 0.045 lb ai/acre with a 28 day interval between applications.

Appendix D. Terrestrial Bird and Mammal Exposure Analysis

(T-REX Modeling and Results)

TABLE D 1. Avian Dose-Based Acute Risk Quotient Summary [a,b]				
Food Type	**Weight class (g)**	**Predicted maximum residues**		
		0.06 lb ai/acre	**0.045 lb ai/acre (2 applications)**	**0.175 lb ai/acre**
short grass	20	0.02	0.02	0.05
	100	0.01	0.01	0.02
	1000	<0.01	<0.01	0.01
tall grass	20	0.01	0.01	0.02
	100	<0.01	<0.01	0.01
	1000	<0.01	<0.01	<0.01
broadleaf forage, small insects	20	0.01	0.01	0.03
	100	<0.01	<0.01	0.01
	1000	<0.01	<0.01	<0.01
fruit, pods, seeds, large insects	20	<0.01	<0.01	<0.01
	100	<0.01	<0.01	<0.01
	1000	<0.01	<0.01	<0.01

[a] Acute toxicity threshold was LD50 >1900 mg/kg-bw.
[b] Detailed calculations of the T-REX model (Ver.1.2.3) and Acute RQs are provided in Appendix D.

TABLE D 2. Avian Acute Risk Quotient Summary for Granular Application [a]		
Weight Class	**0.06 lb ai/acre**	**0.045 lb ai/acre (2 applications)**
20 g	0.03	0.02
100 g	<0.01	<0.01
1,000 g	<0.01	<0.01

[a] Detailed calculations of the T-REX model (Ver.1.2.3) are provided in Appendix D.

TABLE D 3. Avian Chronic Risk Quotient Summary [a,b]			
Food Type	**Predicted maximum residues**		
	0.06 lb ai/acre	**0.045 lb ai/acre (2 applications)**	**0.175 lb ai/acre**
short grass	0.03	0.03	0.08
tall grass	0.01	0.02	0.04
broadleaf forage, small insects	0.02	0.02	0.05
fruit, pods, seeds, large insects	<0.01	<0.01	0.01

[a] Chronic toxicity threshold was NOAEC = 501 mg/kg-diet (MRID 46276401).
[b] Detailed calculations of the T-REX model (Ver.1.2.3) and Chronic RQs are provided in Appendix D.

TABLE D 4. Mammalian Dose-Based Chronic Risk Quotient Summary[a,b]							
Food type	**Weight class (g)**	**0.06 lb ai/acre**		**0.045 lb ai/acre (2 applications)**		**0.175 lb ai/acre**	
		maximum residues	**mean residues**	**maximum residues**	**mean residues**	**maximum residues**	**mean residues**
Short grass	15	0.21	0.07	0.25	0.09	0.61	0.21
	35	0.18	0.06	0.21	0.07	0.52	0.18
	1000	0.10	0.03	0.11	0.04	0.28	0.10
Tall grass	15	0.10	0.03	0.11	0.04	0.28	0.09
	35	0.08	0.03	0.10	0.03	0.24	0.08
	1000	0.04	0.01	0.05	0.02	0.13	0.04
Broadleaf forage, small insects	15	0.12	0.04	0.14	0.05	0.34	0.11
	35	0.10	0.03	0.12	0.04	0.29	0.10
	1000	0.05	0.02	0.06	0.02	0.16	0.05
Fruit, large insects	15	0.01	0.01	0.02	0.01	0.04	0.02
	35	0.01	0.01	0.01	0.01	0.03	0.02
	1000	0.01	<0.01	0.01	<0.01	0.02	0.01
Seeds, pods	15	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
	35	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
	1000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

[a] Chronic reproductive toxicity NOAEL = 30 mg/kg/day.
[b] Detailed calculations of the T-REX model (Ver.1.2.3) and Chronic RQs are provided in Appendix D.

TABLE D 5. Mammalian Dietary-Based Chronic Risk Quotient Summary for Ground Spray Application [a,b]			
Food Type	**Predicted maximum residues**		
	0.06 lb ai/acre	**0.045 lb ai/acre (2 applications)**	**0.175 lb ai/acre**
short grass	0.02	0.03	0.07
tall grass	0.01	0.01	0.03
broadleaf forage, small insects	0.01	0.02	0.04
fruit, pods, seeds, large insects	<0.01	<0.01	<0.01

[a] Chronic reproductive toxicity NOAEL = 30 mg/kg/day.
[b] Detailed calculations of the T-REX model (Ver.1.2.3) and Chronic RQs are provided in Appendix D.

T-REX (Version 1.2.3, August 8, 2005)
Penoxsulam – single maximum application rate of 0.06 lb ai/acre to turf

TREX MODEL INPUTS

These values will be used in the calculation of exposure estimates for foliar, granular, liquid and/or seed applications of pesticides.

Chemical Name:	Penoxsulam	
Use:	Turf	
Product name and form:	GF-443 SC (27% ai, 2 lb ai/gallon)	
% A.I.:	100	
Application Rate (lbs/A):	0.06	0.06
Half-life (days):	35	
Application Interval (days):	0	
Number of Applications:	1	

Note: Sources of wildlife diet are assumed to be available for less than one year for this model.

Endpoints

Avian

		Indicate test species below	Optional Test Organism Body weight (g)	Optional Test Species Name
LD50 (mg/kg-bw)	1900.00	Mallard duck		
LC50 (mg/kg-diet)	4310.00	Mallard duck		
NOAEL (mg/kg-bw)	0.00	Mallard duck		
NOAEC (mg/kg-diet)	501.00	Bobwhite quail		
Enter the Mineau et al. Scaling Factor	1.15			

Mammals

LD50 (mg/kg-bw)	5000.00	
LC50 (mg/kg-diet)		
Reported Chronic Endpoint	600.00	mg/kg-diet
Estimated Chronic Diet Concentration Equivalent to Reported Chronic Daily Dose	30	mg/kg-bw based on standard FDA lab rat conversion

LD50 ft-2

Application Type:	Broadcast	1	Make sure to enter an application rate above
	Granular	1	

Upper Bound Kenaga Residues For RQ Calculation

Chemical Name:	Penoxsulam
Use	Turf
Formulation	GF-443 SC (27% ai, 2 lb ai/gallon)
Application Rate	0.06 lbs a.i./acre
Half-life	35 days
Application Interval	0 days
Maximum # Apps./Year	1
Length of Simulation	1 year

Acute and Chronic RQs are based on the Uppe Kenaga Residues.

The maximum single day residue estimation is both the acute and reproduction RQs.

RQs reported as "0.00" in the RQ tables below should be noted as <0.01 in your assessment. This is due to rounding and significant figure issues in Excel.

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	1900.00
	Mallard duck)	LC50 (mg/kg-diet)	4310.00
	Mallard duck	NOAEL(mg/kg-bw)	0.00
	Bobwhite quail	NOAEC (mg/kg-diet)	501.00
Mammals		LD50 (mg/kg-bw)	5000.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	14.40
Tall Grass	6.60
Broadleaf plants/sm Insects	8.10
Fruits/pods/seeds/lg insects	0.90

Avian Results

Avian Class	Body Weight (g)	Ingestion (Fdry) (g bw/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Small	20	5	23	114	2.28E-02
Mid	100	13	65	65	6.49E-02
Large	1000	58	291	29	2.91E-01

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	986.63
100	1255.90
1000	1774.91

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights		
	small 20 g	mid 100 g	large 1000 g
Short Grass	16.40	9.35	4.19
Tall Grass	7.52	4.29	1.92
Broadleaf plants/sm Insects	9.23	5.26	2.36
Fruits/pods/seeds/lg insects	1.03	0.58	0.26

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs		
	20 g	100 g	1000 g
Short Grass	0.02	0.01	0.00
Tall Grass	0.01	0.00	0.00
Broadleaf plants/sm Insects	0.01	0.00	0.00
Fruits/pods/seeds/lg insects	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	RQs	
	Acute	Chronic
Short Grass	0.00	0.03
Tall Grass	0.00	0.01
Broadleaf plants/sm Insects	0.00	0.02
Fruits/pods/seeds/lg insects	0.00	0.00

Mammalian Results

Mammalian Class	Body Weight	Ingestion (Fdry) (g bw/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Herbivores/ insectivores	15	3	14	95	1.43E-02
	35	5	23	66	2.31E-02
	1000	31	153	15	1.53E-01
Grainvores	15	3	3	21	3.18E-03
	35	5	5	15	5.13E-03
	1000	31	34	3	3.40E-02

Mammalian Class	Body Weight	Adjusted LD50	Adjusted NOAEL
Herbivores/ insectivores	15	10989.15	65.93
	35	8891.40	53.35
	1000	3845.80	23.07
Grainvores	15	10989.15	65.93
	35	8891.40	53.35
	1000	3845.80	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight					
	Herbivores/ insectivores			Granivores		
	15 g	35 g	1000 g	15 g	35 g	1000 g
Short Grass	13.73	9.49	2.20			
Tall Grass	6.29	4.35	1.01			
Broadleaf plants/sm Insects	7.72	5.34	1.24			
Fruits/pods/seeds/lg insects	0.86	0.59	0.14	0.19	0.13	0.03

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	15 g mammal		35 g mammal		1000 g mammal	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	0.00	0.21	0.00	0.18	0.00	0.10
Tall Grass	0.00	0.10	0.00	0.08	0.00	0.04
Broadleaf plants/sm Insects	0.00	0.12	0.00	0.10	0.00	0.05
Fruits/pods/lg insects	0.00	0.01	0.00	0.01	0.00	0.01
Seeds (granivore)	0.00	0.00	0.00	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs	
	Acute	Chronic
Short Grass	#DIV/0!	0.02
Tall Grass	#DIV/0!	0.01
Broadleaf plants/sm insects	#DIV/0!	0.01
Fruits/pods/seeds/lg insects	#DIV/0!	0.00

Mean Kenaga Residues

Chemical Name:	Penoxsulam
Use	Turf
Formulation	GF-443 SC (27% ai, 2 lb ai/gallon)
Application Rate	0.06 lbs a.i./acre
Half-life	35 days
Application Interval	0 days
Maximum # Apps./Year	1
Length of Simulation	1 year

For Risk De

Note that the ratio c
endpoints are terme
Caution should be e
values to the Agenc

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	1900.00
	Mallard duck)	LC50 (mg/kg-diet)	4310.00
	Mallard duck	NOAEL (mg/kg-bw)	0.00
	Bobwhite quail	NOAEC (mg/kg-diet)	501.00
Mammals		LD50 (mg/kg-bw)	5000.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	5.10
Tall Grass	2.16
Broadleaf plants/sm Insects	2.70
Fruits/pods/seeds/lg insects	0.42

Avian Results

Avian Class	Body Weight	% body wgt consumed	Adjusted LD50
Small	20	114	986.53
Mid	100	65	1255.90
Large	1000	29	1774.01

Dose-based EEC (mg/kg-bw)	Avian Classes and Body Weights		
	small 20 g	mid 100 g	large 1000 g
Short Grass	5.81	3.32	1.48
Tall Grass	2.46	1.40	0.63
Broadleaf plants/sm Insects	3.08	1.76	0.78
Fruits/pods/lg insects	0.48	0.27	0.12

Dose-based RQs (Dose-based EEC/LD50)	Avian Acute "RQs"		
	20 g	100 g	1000 g
Short Grass	0.01	0.00	0.00
Tall Grass	0.00	0.00	0.00
Broadleaf plants/sm Insects	0.00	0.00	0.00
Fruits/pods/lg insects	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	"RQs"	
	Acute	Chronic
Short Grass	0.00	0.01
Tall Grass	0.00	0.00
Broadleaf plants/sm Insects	0.00	0.01
Fruits/pods/lg insects	0.00	0.00

Mammalian Results

Mammalian Class	Body Weight	% body wgt consumed	Adjusted LD50	Adjusted NOAEL
	15	95	10989.15	65.93
Herbivores/ Insectivores	35	66	8891.40	53.35
	1000	15	3845.60	23.07
	15	21	10989.15	65.93
Grainvores	35	15	8891.40	53.35
	1000	3	3845.60	23.07

Dose-based EEC (mg/kg-bw)	Mammalian Classes and Body weight					
	Herbivores/ insectivores			Granivores		
	15 g	35 g	1000 g	15 g	35 g	1000 g
Short Grass	4.85	3.37	0.77			
Tall Grass	2.05	1.43	0.32			
Broadleaf plants/sm Insects	2.57	1.78	0.41			
Fruits/pods/seeds/lg insects	0.40	0.28	0.06	0.09	0.06	0.01

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	15 g mammal		35 g mammal		1000 g mammal	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	0.00	0.07	0.00	0.06	0.00	0.03
Tall Grass	0.00	0.03	0.00	0.03	0.00	0.01
Broadleaf plants/sm Insects	0.00	0.04	0.00	0.03	0.00	0.02
Fruits/pods/lg insects	0.00	0.01	0.00	0.01	0.00	0.00
Seeds (granivore)	0.00	0.00	0.00	0.00	0.00	0.00

Dietary-based "RQs" (EEC/LC50 or NOAEC)	Mammal "RQs"	
	Acute	Chronic
Short Grass	#DIV/0!	0.01
Tall Grass	#DIV/0!	0.00
Broadleaf plants/sm Insects	#DIV/0!	0.00
Fruits/pods/seeds/lg insects	#DIV/0!	0.00

Chemical: Penoxsulam

LD50 ft-2

INPUTS	Do not overwrite these numbers.	
Application Rate:	0.06	lbs ai/acre
% A.I.:	1	
Avian LD50 (20g):	986.53	mg/kg bw
(100g)	1255.90	
(1000g)	1774.01	
Mammalian LD50 (15g):	10989.15	mg/kg bw
(35g)	8891.40	
(1000g)	3845.80	
Row Spacing:	0	inches
Bandwidth:	0	inches
Unincorporation:	100%	

Changes to the inputs must made in the "INPUTS" works

Row/Band/In-furrow applications

Granular

Intermediate Calculations	
# rows acre-1:	N/A
row length (ft):	N/A
lb ai/1000 ft row:	N/A
bandwidth (ft):	N/A
mg ai/ft2:	N/A
exposed mg ai/ft2:	N/A

LD50 ft-2	wgt class	
Avian	20 g	N/A
	100 g	N/A
	1000 g	N/A
Mammal	15 g	N/A
	35 g	N/A
	1000 g	N/A

Liquid

Intermediate Calculations	
mg a.i./1000 ft row:	N/A
bandwidth:	N/A
mg a.i./ft2:	N/A
exposed mg a.i./ft2:	N/A

LD50 ft-2	wgt class	
Avian	20 g	N/A
	100 g	N/A
	1000 g	N/A
Mammal	15 g	N/A
	35 g	N/A
	1000 g	N/A

Broadcast applications

Granular

Intermediate Calculations	
mg ai/ft2:	0.62

LD50 ft-2	wgt class	
Avian	20 g	0.03
	100 g	0.00
	1000 g	0.00
Mammal	15 g	0.00
	35 g	0.00
	1000 g	0.00

T-REX (Version 1.2.3)
Penoxsulam – 2 applications at 0.045 lb ai/acre to turf

TREX MODEL INPUTS

These values will be used in the calculation of exposure estimates for foliar, granular, liquid and/or seed applications of pesticides.

Chemical Name:	Penoxsulam
Use:	Turf
Product name and form:	GF-443 SC (27% ai, 2 lb ai/gallon)
% A.I.:	100
Application Rate (lbs/A):	0.045
Half-life (days):	35
Application Interval (days):	28
Number of Applications:	2

0.045

Note: Sources of wildlife diet are assumed to be available for less than one year for this model.

Endpoints

Avian

		Indicate test species below	Optional Test Organism Body weight (g)	Optional Test Species Name
LD50 (mg/kg-bw)	1900.00	Mallard duck		
LC50 (mg/kg-diet)	4310.00	Mallard duck		
NOAEL (mg/kg-bw)	0.00	Bobwhite quail		
NOAEC (mg/kg-diet)	501.00	Bobwhite quail		
Enter the Mineau et al. Scaling Factor	1.15			

Mammals

LD50 (mg/kg-bw)	5000.00	
LC50 (mg/kg-diet)		
Reported Chronic Endpoint	600.00	mg/kg-diet
Estimated Chronic Diet Concentration Equivalent to Reported Chronic Daily Dose	30	mg/kg-bw based on standard FDA lab rat conversion

LD50 ft-2

Application Type:	Broadcast	1	Make sure to enter an
	Granular	1	application rate above

Upper Bound Kenaga Residues For RQ Calculation

Chemical Name:	Penoxsulam
Use	Turf
Formulation	GF-443 SC (27% ai, 2 lb ai/gallon)
Application Rate	0.045 lbs a.i./acre
Half-life	35 days
Application Interval	28 days
Maximum # Apps./Year	2
Length of Simulation	1 year

Acute and Chronic RQs are based on the Upper Bound Kenaga Residues.

The maximum single day residue estimation is used for both the acute and reproduction RQs.

RQs reported as "0.00" in the RQ tables below should be noted as <0.01 in your assessment. This is due to rounding and significant figure issues in Excel.

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	1900.00
	Mallard duck)	LC50 (mg/kg-diet)	4310.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Bobwhite quail	NOAEC (mg/kg-diet)	501.00
Mammals		LD50 (mg/kg-bw)	5000.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	17.00
Tall Grass	7.79
Broadleaf plants/sm Insects	9.56
Fruits/pods/seeds/lg insects	1.06

Avian Results

Avian Class	Body Weight (g)	Ingestion (Fdry) (g bw/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Small	20	5	23	114	2.28E-02
Mid	100	13	65	65	6.49E-02
Large	1000	58	291	29	2.91E-01

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	965.53
100	1255.90
1000	1774.01

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights small 20 g	mid 100 g	large 1000 g
Short Grass	19.36	11.04	4.94
Tall Grass	8.88	5.06	2.27
Broadleaf plants/sm Insects	10.89	6.21	2.78
Fruits/pods/seeds/lg insects	1.21	0.69	0.31

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs 20 g	100 g	1000 g
Short Grass	0.02	0.01	0.00
Tall Grass	0.01	0.00	0.00
Broadleaf plants/sm Insects	0.01	0.00	0.00
Fruits/pods/seeds/lg insects	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	RQs Acute	Chronic
Short Grass	0.00	0.03
Tall Grass	0.00	0.02
Broadleaf plants/sm Insects	0.00	0.02
Fruits/pods/seeds/lg insects	0.00	0.00

Mammalian Results

Mammalian Class	Body Weight	Ingestion (Fdry) (g bwt/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Herbivores/ Insectivores	15	3	14	95	1.43E-02
	35	5	23	66	2.31E-02
	1000	31	153	15	1.53E-01
Grainvores	15	3	3	21	3.18E-03
	35	5	5	15	5.13E-03
	1000	31	34	3	3.40E-02

Mammalian Class	Body Weight	Adjusted LD50	Adjusted NOAEL
Herbivores/ Insectivores	15	10989.15	65.93
	35	8891.40	53.35
	1000	3845.80	23.07
Grainvores	15	10989.15	65.93
	35	8891.40	53.35
	1000	3845.80	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight					
	Herbivores/ insectivores			Granivores		
	15 g	35 g	1000 g	15 g	35 g	1000 g
Short Grass	16.21	11.20	2.60			
Tall Grass	7.43	5.14	1.19			
Broadleaf plants/sm Insects	9.12	6.30	1.46			
Fruits/pods/seeds/lg insects	1.01	0.70	0.16	0.23	0.16	0.04

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	15 g mammal		35 g mammal		1000 g mammal	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	0.00	0.25	0.00	0.21	0.00	0.11
Tall Grass	0.00	0.11	0.00	0.10	0.00	0.05
Broadleaf plants/sm Insects	0.00	0.14	0.00	0.12	0.00	0.06
Fruits/pods/lg insects	0.00	0.02	0.00	0.01	0.00	0.01
Seeds (granivore)	0.00	0.00	0.00	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs	
	Acute	Chronic
Short Grass	#DIV/0!	0.03
Tall Grass	#DIV/0!	0.01
Broadleaf plants/sm Insects	#DIV/0!	0.02
Fruits/pods/seeds/lg insects	#DIV/0!	0.00

Mean Kenaga Residues

Chemical Name:	Penoxsulam
Use	Turf
Formulation	GF-443 SC (27% ai, 2 lb ai/gallon)
Application Rate	0.045 lbs a.i./acre
Half-life	35 days
Application Interval	28 days
Maximum # Apps./Year	2
Length of Simulation	1 year

For Risk Description Purposes

Note that the ratio of exposure and effects endpoints are termed "RQs" in this output. Caution should be exercised in relating these values to the Agency Levels of Concern

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	1900.00
	Mallard duck)	LC50 (mg/kg-diet)	4310.00
	Bobwhite quail)	NOAEL (mg/kg-bw)	0.00
	Bobwhite quail	NOAEC (mg/kg-diet)	501.00
Mammals		LD50 (mg/kg-bw)	5000.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	6.02
Tall Grass	2.55
Broadleaf plants/sm Insects	3.19
Fruits/pods/seeds/lg insects	0.50

Avian Results

Avian Class	Body Weight	% body wgt consumed	Adjusted LD50
Small	20	114	986.53
Mid	100	65	1255.90
Large	1000	29	1774.01

Dose-based EEC (mg/kg-bw)	Avian Classes and Body Weights		
	small 20 g	mid 100 g	large 1000 g
Short Grass	6.86	3.91	1.75
Tall Grass	2.91	1.66	0.74
Broadleaf plants/sm Insects	3.63	2.07	0.92
Fruits/pods/lg insects	0.57	0.32	0.14

Dose-based RQs (Dose-based EEC/LD50)	Avian Acute "RQs"		
	20 g	100 g	1000 g
Short Grass	0.01	0.00	0.00
Tall Grass	0.00	0.00	0.00
Broadleaf plants/sm Insects	0.00	0.00	0.00
Fruits/pods/lg insects	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	"RQs"	
	Acute	Chronic
Short Grass	0.00	0.01
Tall Grass	0.00	0.01
Broadleaf plants/sm Insects	0.00	0.01
Fruits/pods/lg insects	0.00	0.00

Mammalian Results

Mammalian Class	Body Weight	% body wgt consumed	Adjusted LD50	Adjusted NOAEL
Herbivores/ insectivores	15	95	10989.15	65.93
	35	66	8891.40	53.35
	1000	15	3845.80	23.07
Granivores	15	21	10989.15	65.93
	35	15	8891.40	53.35
	1000	3	3845.80	23.07

Dose-based EEC (mg/kg-bw)	Mammalian Classes and Body weight					
	Herbivores/ insectivores			Granivores		
	15 g	35 g	1000 g	15 g	35 g	1000 g
Short Grass	5.72	3.97	0.90			
Tall Grass	2.42	1.68	0.38			
Broadleaf plants/sm Insects	3.03	2.10	0.48			
Fruits/pods/seeds/lg insects	0.47	0.33	0.07	0.10	0.07	0.01

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	15 g mammal		35 g mammal		1000 g mammal	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	0.00	0.09	0.00	0.07	0.00	0.04
Tall Grass	0.00	0.04	0.00	0.03	0.00	0.02
Broadleaf plants/sm Insects	0.00	0.05	0.00	0.04	0.00	0.02
Fruits/pods/lg insects	0.00	0.01	0.00	0.01	0.00	0.00
Seeds (granivore)	0.00	0.00	0.00	0.00	0.00	0.00

Dietary-based "RQs" (EEC/LC50 or NOAEC)	Mammal "RQs"	
	Acute	Chronic
Short Grass	#DIV/0!	0.01
Tall Grass	#DIV/0!	0.00
Broadleaf plants/sm Insects	#DIV/0!	0.01
Fruits/pods/seeds/lg insects	#DIV/0!	0.00

Chemical: Penoxsulam

LD50 ft-2

INPUTS	Do not overwrite these numbers.	
Application Rate:	0.045	lbs ai/acre
% A.I.:	1	
Avian LD50 (20g):	986.53	mg/kg bw
(100g)	1255.90	
(1000g)	1774.01	
Mammalian LD50 (15g):	10989.15	mg/kg bw
(35g)	8891.40	
(1000g)	3845.80	
Row Spacing:	0	inches
Bandwidth:	0	inches
Unincorporation:	100%	

Changes to the inputs must
made in the "INPUTS" works

Row/Band/In-furrow applications

Granular

Intermediate Calculations	
# rows acre-1:	N/A
row length (ft):	N/A
lb ai/1000 ft row:	N/A
bandwidth (ft):	N/A
mg ai/ft2:	N/A
exposed mg ai/ft2:	N/A

LD50 ft-2	wgt class	
Avian	20 g	N/A
	100 g	N/A
	1000 g	N/A
Mammal	15 g	N/A
	35 g	N/A
	1000 g	N/A

Liquid

Intermediate Calculations	
mg a.i./1000 ft row:	N/A
bandwidth:	N/A
mg a.i./ft2:	N/A
exposed mg a.i./ft2:	N/A

LD50 ft-2	wgt class	
Avian	20 g	N/A
	100 g	N/A
	1000 g	N/A
Mammal	15 g	N/A
	35 g	N/A
	1000 g	N/A

Broadcast applications

Granular

Intermediate Calculations	
mg ai/ft2:	0.47

LD50 ft-2	wgt class	
Avian	20 g	0.02
	100 g	0.00
	1000 g	0.00
Mammal	15 g	0.00
	35 g	0.00
	1000 g	0.00

T-REX (Version 1.2.3, August 8, 2005)
Penoxsulam – single maximum application rate of 0.175 lb ai/acre to exposed sediment

TREX MODEL INPUTS

These values will be used in the calculation of exposure estimates for foliar, granular, liquid and/or seed applications of pesticides.

Chemical Name:	Penoxsulam
Use:	Sediment
Product name and form:	GF-443 SC (27% ai, 2 lb ai/gallon)
% A.I.:	100
Application Rate (lbs/A):	0.175
Half-life (days):	35
Application Interval (days):	0
Number of Applications:	1

0.175

Note: Sources of wildlife diet are assumed to be available for less than one year for this model.

Endpoints

Avian

		Indicate test species below	Optional Test Organism Body weight (g)	Optional Test Species Name
LD50 (mg/kg-bw)	1900.00	Mallard duck		
LC50 (mg/kg-diet)	4310.00	Mallard duck		
NOAEL (mg/kg-bw)	0.00	Mallard duck		
NOAEC (mg/kg-diet)	501.00	Bobwhite quail		
Enter the Mineau et al. Scaling Factor	1.15			

Mammals

LD50 (mg/kg-bw)	5000.00	
LC50 (mg/kg-diet)		
Reported Chronic Endpoint	600.00	mg/kg-diet
Estimated Chronic Diet Concentration Equivalent to Reported Chronic Daily Dose	30	mg/kg-bw based on standard FDA lab rat conversion

LD50 ft-2

Application Type: Broadcast 1; Granular 1

Make sure to enter an application rate above

Do not use this input

Do not use this input

Do not use this input

Do not use this input

Upper Bound Kenaga Residues For RQ Calculation

Chemical Name:	Penoxsulam
Use	Sediment
Formulation	GF-443 SC (27% ai, 2 lb ai/gallon)
Application Rate	0.175 lbs a.i./acre
Half-life	35 days
Application Interval	0 days
Maximum # Apps./Year	1
Length of Simulation	1 year

Acute and Chronic RQs are based on the Uppe Kenaga Residues.

The maximum single day residue estimation is both the acute and reproduction RQs.

RQs reported as "0.00" in the RQ tables below should be noted as <0.01 in your assessment. This is due to rounding and significant figure issues in Excel.

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	1900.00
	Mallard duck)	LC50 (mg/kg-diet)	4310.00
	Mallard duck	NOAEL(mg/kg-bw)	0.00
	Bobwhite quail	NOAEC (mg/kg-diet)	501.00
Mammals		LD50 (mg/kg-bw)	5000.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	42.00
Tall Grass	19.25
Broadleaf plants/sm Insects	23.63
Fruits/pods/seeds/lg insects	2.63

Avian Results

Avian Class	Body Weight (g)	Ingestion (Fdry) (g bw/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Small	20	5	23	114	2.28E-02
Mid	100	13	65	65	6.49E-02
Large	1000	58	291	29	2.91E-01

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	986.53
100	1255.90
1000	1774.01

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights		
	small 20 g	mid 100 g	large 1000 g
Short Grass	47.83	27.28	12.21
Tall Grass	21.92	12.50	5.60
Broadleaf plants/sm Insects	26.91	15.34	6.87
Fruits/pods/seeds/lg insects	2.99	1.70	0.76

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs		
	20 g	100 g	1000 g
Short Grass	0.05	0.02	0.01
Tall Grass	0.02	0.01	0.00
Broadleaf plants/sm Insects	0.03	0.01	0.00
Fruits/pods/seeds/lg insects	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	RQs	
	Acute	Chronic
Short Grass	0.01	0.08
Tall Grass	0.00	0.04
Broadleaf plants/sm Insects	0.01	0.05
Fruits/pods/seeds/lg insects	0.00	0.01

Mammalian Results

Mammalian Class	Body Weight	Ingestion (Fdry) (g bw/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Herbivores/ Insectivores	15	3	14	95	1.43E-02
	35	5	23	66	2.31E-02
	1000	31	153	15	1.53E-01
Grainvores	15	3	3	21	3.18E-03
	35	5	5	15	5.13E-03
	1000	31	34	3	3.40E-02

Mammalian Class	Body Weight	Adjusted LD50	Adjusted NOAEL
Herbivores/ Insectivores	15	10989.15	65.93
	35	8891.40	53.35
	1000	3845.90	23.07
Grainvores	15	10989.15	65.93
	35	8891.40	53.35
	1000	3845.90	23.07

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight					
	Herbivores/ Insectivores			Granivores		
	15 g	35 g	1000 g	15 g	35 g	1000 g
Short Grass	40.04	27.68	6.42			
Tall Grass	18.35	12.68	2.94			
Broadleaf plants/sm Insects	22.52	15.57	3.61			
Fruits/pods/seeds/lg Insects	2.50	1.73	0.40	0.56	0.38	0.09

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	15 g mammal		35 g mammal		1000 g mammal	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	0.00	0.61	0.00	0.52	0.00	0.28
Tall Grass	0.00	0.28	0.00	0.24	0.00	0.13
Broadleaf plants/sm Insects	0.00	0.34	0.00	0.29	0.00	0.16
Fruits/pods/lg insects	0.00	0.04	0.00	0.03	0.00	0.02
Seeds (granivore)	0.00	0.01	0.00	0.01	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs	
	Acute	Chronic
Short Grass	#DIV/0!	0.07
Tall Grass	#DIV/0!	0.03
Broadleaf plants/sm Insects	#DIV/0!	0.04
Fruits/pods/seeds/lg Insects	#DIV/0!	0.00

Mean Kenaga Residues

Chemical Name:	Penoxsulam
Use	Sediment
Formulation	GF-443 SC (27% ai, 2 lb ai/gallon)
Application Rate	0.175 lbs a.i./acre
Half-life	35 days
Application Interval	0 days
Maximum # Apps./Year	1
Length of Simulation	1 year

For Risk Description Purposes

Note that the ratio of exposure and effects endpoints are termed "RQs" in this output. Caution should be exercised in relating these values to the Agency Levels of Concern

Endpoints

Avian	Mallard duck	LD50 (mg/kg-bw)	1900.00
	Mallard duck)	LC50 (mg/kg-diet)	4310.00
	Mallard duck	NOAEL (mg/kg-bw)	0.00
	Bobwhite quail	NOAEC (mg/kg-diet)	601.00
Mammals		LD50 (mg/kg-bw)	5000.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	30.00
		NOAEC (mg/kg-diet)	600.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	14.88
Tall Grass	6.30
Broadleaf plants/sm Insects	7.88
Fruits/pods/seeds/lg insects	1.23

Avian Results

Avian Class	Body Weight	% body wgt consumed	Adjusted LD50
Small	20	114	986.53
Mid	100	65	1255.90
Large	1000	29	1774.01

Dose-based EEC (mg/kg-bw)	Avian Classes and Body Weights		
	small 20 g	mid 100 g	large 1000 g
Short Grass	16.96	9.67	4.31
Tall Grass	7.18	4.10	1.83
Broadleaf plants/sm Insects	8.98	5.12	2.28
Fruits/pods/lg insects	1.40	0.80	0.36

Dose-based RQs (Dose-based EEC/LD50)	Avian Acute "RQs"		
	20 g	100 g	1000 g
Short Grass	0.02	0.01	0.00
Tall Grass	0.01	0.00	0.00
Broadleaf plants/sm Insects	0.01	0.00	0.00
Fruits/pods/lg insects	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	"RQs"	
	Acute	Chronic
Short Grass	0.00	0.03
Tall Grass	0.00	0.01
Broadleaf plants/sm Insects	0.00	0.02
Fruits/pods/lg insects	0.00	0.00

Mammalian Results

Mammalian Class	Body Weight	% body wgt consumed	Adjusted LD50	Adjusted NOAEL
Herbivores/ insectivores	15	95	10969.15	65.93
	35	66	8891.40	53.35
	1000	15	3845.90	23.07
Grainvores	15	21	10969.15	65.93
	35	15	8891.40	53.35
	1000	3	3845.90	23.07

Dose-based EEC (mg/kg-bw)	Mammalian Classes and Body weight					
	Herbivores/ insectivores			Granivores		
	15 g	35 g	1000 g	15 g	35 g	1000 g
Short Grass	14.13	9.82	2.23			
Tall Grass	5.99	4.16	0.95			
Broadleaf plants/sm Insects	7.48	5.20	1.18			
Fruits/pods/seeds/lg insects	1.16	0.81	0.18	0.26	0.18	0.04

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	15 g mammal		35 g mammal		1000 g mammal	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	0.00	0.21	0.00	0.18	0.00	0.10
Tall Grass	0.00	0.09	0.00	0.08	0.00	0.04
Broadleaf plants/sm Insects	0.00	0.11	0.00	0.10	0.00	0.05
Fruits/pods/lg insects	0.00	0.02	0.00	0.02	0.00	0.01
Seeds (granivore)	0.00	0.00	0.00	0.00	0.00	0.00

Dietary-based "RQs" (EEC/LC50 or NOAEC)	Mammal "RQs"	
	Acute	Chronic
Short Grass	#DIV/0!	0.02
Tall Grass	#DIV/0!	0.01
Broadleaf plants/sm Insects	#DIV/0!	0.01
Fruits/pods/seeds/lg insects	#DIV/0!	0.00

Appendix E. Terrestrial Plant Exposure Analysis
(TerrPlant Modeling and Results)

Terrestrial Plant EECs and Acute Non Endangered RQs
(November 9, 2005; version 1.2.1)

Chemical: Penoxsulam

	Input Values
Application Rate (lb a.i./acre)	0.06
Runoff Value (0.01, 0.02, or 0.05 if chemical solubility <10, 10-100, or >100 ppm, respectively)	0.05
Minimum Incorporation Depth (inches)	1
Seed Emerg Monocot EC25 (lb a.i./acre)	0.00098
Seed Emerg Dicot EC25 (lb a.i./acre)	0.0028
Veg Vigor Monocot EC25 (lb a.i./acre)	0.015
Veg Vigor Dicot EC25 (lb a.i./acre)	0.0034

Estimated Environmental Concentrations (EECs) for NON-GRANULAR formulation applications (lbs a.i./acre)

Application Method	Total Loading to Adjacent Areas (EEC = Sheet Runoff +Drift)	Total Loading to Semi-aquatic Areas (EEC = Channelized Runoff + Drift)	DRIFT EEC (for ground: application rate x 0.01) (for aerial: application rate x 0.05)
Ground Unincorp.	0.0036	0.0306	0.0006
Ground Incorp	0.0036	0.0306	0.0006
Aerial, Airblast, Spray Chemigation	0.0060	0.0330	0.0030

Risk Quotients (RQs) for NON-GRANULAR formulation applications

Emergence RQs, Adjacent Areas RQ = EEC/Seedling Emergence EC25		Emergence RQs, Semi-aquatic Areas RQ = EEC/Seedling Emergence EC25		Drift RQs RQ = Drift EEC/Vegetative Vigor EC25	
Monocot	Dicot	Monocot	Dicot	Monocot	Dicot
3.673	1.29	31.22	10.93	0.04	0.18
3.67	1.29	31.22	10.93	0.04	0.18
6.12	2.14	33.67	11.79	0.20	0.88

EECs for GRANULAR formulation applications (lbs a.i./acre)

Application Method	Total Loading to Adjacent Areas (EEC = Sheet Runoff)	Total Loading to Semiaquatic Areas (EEC = Channelized Runoff)
Unincorp.	0.0030	0.0300
Incorp.	0.0030	0.0030

RQs for GRANULAR formulation applications

Emergence RQs, Adjacent Areas RQ = EEC/Seedling Emergence EC25		Emergence RQs, Semiaquatic Areas RQ = EEC/Seedling Emergence EC25	
Monocot	Dicot	Monocot	Dicot
3.06	1.07	30.61	10.71
3.06	1.07	3.06	1.07

Terrestrial Plant EECs and Acute Endangered RQs
(November 9, 2005; version 1.2.1)

Chemical: Penoxsulam

Input Values	
Application Rate (lb a.i./acre)	0.06
Runoff Value (0.01, 0.02, or 0.05 if chemical solubility <10, 10-100, or >100 ppm, respectively)	0.05
Minimum Incorporation Depth (inches)	1
Seed Emerg Monocot EC05 or NOAEC (lb	0.00036
Seed Emerg Dicot EC05 or NOAEC (lb a.i./acre)	0.0011
Veg Vigor Monocot EC05 or NOAEC (lbs a.i./acre)	0.00036
Veg Vigor Dicot EC05 or NOAEC (lb a.i./acre)	0.0011

Estimated Environmental Concentrations (EECs) for NON-GRANULAR formulation applications (lbs a.i./acre)			
Application Method	Total Loading to Adjacent Areas (EEC = Sheet Runoff + Drift)	Total Loading to Semi-aquatic Areas (EEC = (Channelized Runoff + Drift)	DRIFT EEC (for ground: application rate x 0.01) (for aerial: application rate x 0.05)
Ground Unincorp.	0.0036	0.0306	0.0006
Ground Incorp	0.0036	0.0306	0.0006
Aerial, Airblast, Spray Chemigation	0.0060	0.0330	0.0030

Risk Quotients (RQs) for NON-GRANULAR formulation applications					
Emergence RQs, Adjacent Areas RQ = EEC/Seedling Emergence EC05 or NOAEC		Emergence RQs, Semi-aquatic areas RQ = EEC/Seedling Emergence EC05 or NOAEC		Drift RQs RQ = EEC/Vegetative Vigor EC05 or NOAEC	
Monocot	Dicot	Monocot	Dicot	Monocot	Dicot
10.000	3.27	85.00	27.82	1.67	0.55
10.00	3.27	85.00	27.82	1.67	0.55
16.67	5.45	91.67	30.00	8.33	2.73

EECs for GRANULAR formulation applications (lbs a.i./acre)		
Application Method	Total Loading to Adjacent Area (EEC = Sheet Runoff)	Total Loading to Semi-aquatic Areas (EEC = (Channelized Runoff)
Unincorp.	0.0030	0.0300
Incorp.	0.0030	0.0300

RQs for GRANULAR formulation applications			
Emergence RQs, Adjacent Areas, RQ = EEC/Seedling Emerg. EC05 or NOAEC		Emergence RQs, Semi-aquatic Areas, RQ = EEC/Seedling Emergence EC05 or NOAEC	
Monocot	Dicot	Monocot	Dicot
8.33	2.73	83.33	27.27
8.33	2.73	83.33	27.27

Terrestrial Plant EECs and Acute Non Endangered RQs (November 9, 2005; version 1.2.1)

Chemical: Penoxsulam

	Input Values
Application Rate (lb a.i./acre)	0.175
Runoff Value (0.01, 0.02, or 0.05 if chemical solubility <10, 10-100, or >100 ppm, respectively)	0.05
Minimum Incorporation Depth (inches)	1
Seed Emerg Monocot EC25 (lb a.i./acre)	0.00098
Seed Emerg Dicot EC25 (lb a.i./acre)	0.0028
Veg Vigor Monocot EC25 (lb a.i./acre)	0.015
Veg Vigor Dicot EC25 (lb a.i./acre)	0.0034

Estimated Environmental Concentrations (EECs) for NON-GRANULAR formulation applications (lbs a.i./acre)			
Application Method	Total Loading to Adjacent Areas (EEC = Sheet Runoff +Drift)	Total Loading to Semi-aquatic Areas (EEC = Channelized Runoff + Drift)	DRIFT EEC (for ground: application rate x 0.01) (for aerial: application rate x 0.05)
Ground Unincorp.	0.0105	0.0893	0.0018
Ground Incorp	0.0105	0.0893	0.0018

Risk Quotients (RQs) for NON-GRANULAR formulation applications					
Emergence RQs, Adjacent Areas RQ = EEC/Seedling Emergence EC25		Emergence RQs, Semi-aquatic Areas RQ = EEC/Seedling Emergence EC25		Drift RQs RQ = Drift EEC/Vegetative Vigor EC25	
Monocot	Dicot	Monocot	Dicot	Monocot	Dicot
10.714	3.75	91.07	31.88	0.12	0.51
10.71	3.75	91.07	31.88	0.12	0.51

Terrestrial Plant EECs and Acute Endangered RQs (November 9, 2005; version 1.2.1)

Chemical: Penoxsulam

Input Values	
Application Rate (lb a.i./acre)	0.175
Runoff Value (0.01, 0.02, or 0.05 if chemical solubility <10, 10-100, or >100 ppm, respectively)	0.05
Minimum Incorporation Depth (inches)	1
Seed Emerg Monocot EC05 or NOAEC (lb	0.00036
Seed Emerg Dicot EC05 or NOAEC (lb a.i./acre)	0.0011
Veg Vigor Monocot EC05 or NOAEC (lb a.i./acre)	0.00036
Veg Vigor Dicot EC05 or NOAEC (lb a.i./acre)	0.0011

Estimated Environmental Concentrations (EECs) for NON-GRANULAR formulation applications (lbs a.i./acre)			
Application Method	Total Loading to Adjacent Areas (EEC = Sheet Runoff + Drift)	Total Loading to Semi-aquatic Areas (EEC = (Channelized Runoff + Drift)	DRIFT EEC (for ground: application rate x 0.01) (for aerial: application rate x 0.05)
Ground Unincorp.	0.0105	0.0893	0.0018
Ground Incorp	0.0105	0.0893	0.0018

Risk Quotients (RQs) for NON-GRANULAR formulation applications					
Emergence RQs, Adjacent Areas RQ = EEC/Seedling Emergence EC05 or NOAEC		Emergence RQs, Semi-aquatic areas RQ = EEC/Seedling Emergence EC05 or NOAEC		Drift RQs RQ = EEC/Vegetative Vigor EC05 or NOAEC	
Monocot	Dicot	Monocot	Dicot	Monocot	Dicot
29.167	9.55	247.92	81.14	4.86	1.59
29.17	9.55	247.92	81.14	4.86	1.59

Appendix F. Ecological Effects Data

Available Ecological Toxicity Data

In this risk assessment, surrogate test species of birds, mammals, fish, aquatic and terrestrial invertebrates and plants are used to estimate treatment-related direct effects on acute mortality and chronic reproduction, growth, and survival of non-target species. Toxicity test values (*i.e.*, measures of effect) are derived from the results of registrant-required animal toxicity studies that are consistent with and meet toxicity testing guidelines (FIFRA 40 CFR Part 158 and 160). Toxicity tests include short-term acute, subacute, and reproduction/chronic studies that progress from basic laboratory tests to applied field studies. In addition, avian species are used as surrogates for reptiles and fish species are used as surrogates for amphibians.

Toxicity to Aquatic Animals

Table E-1. Freshwater Fish - Acute and Chronic Aquatic Toxicity Data.

Species and Chemical	Acute Toxicity		Chronic Toxicity	
	96-hr LC_{50} (ppm)	Toxic Category (MRID)	NOAEC (mg/L)	Endpoints (MRID)
Rainbow Trout (*Oncorhynchus mykiss*)				
Technical grade	>102	Practically Nontoxic (458348-04)	None	
Degradates and End-use products	None			
Bluegill sunfish (*Lepomis macrochirus*)				
Technical grade	>103	Practically Nontoxic (458310-10)	None	
GF-443 (EUP 21.9%)	>147	Practically Nontoxic (458310-11)		
Degradate	None			
Common Carp (*Cyprinus carpio*)				
Technical grade	>101	Practically Nontoxic (458310-09)	None	
Degradates and End-use products	None		None	
Fathead minnow (*Pimephales promelas*)				
Technical grade	None	None (458310-27)	10.2	None (458310-27)

[1]GF-443 is the liquid formulation containing 21.7% penoxsulam

72-1 Freshwater Fish Acute

Common Carp. MRID 458310-09. In a 96-hour acute toxicity study with juvenile common carp, fish were exposed to mean-measured concentrations of <10 (LOQ, controls) and 101 ppm ai. After 96 hours of exposure, no mortality or sub-lethal effects were observed in any control or test group. The 96-hour LC_{50} was >101 ppm ai, which categorizes XDE-638 as practically nontoxic to juvenile common carp (*Cyprinus carpio*) on an acute toxicity basis. The NOAEC and LOAEC were 101 and >101 ppm ai, respectively. This study is scientifically sound. However, since the common carp is not recognized as an acceptable species for use in an acute toxicity study with freshwater fish (§72-1), this study is classified as SUPPLEMENTAL.

Bluegill Sunfish. MRID 458310-10. In a 96-hour acute toxicity study with the bluegill sunfish, mean-measured concentrations were <12 (LOQ, controls) and 103 ppm ai. After 96 hours of exposure, there was 7% mortality in the solvent control and 103 ppm ai treatment group. No mortality occurred in the control. No significant sub-lethal effects were observed. The LC_{50} was >103 mg ai/L, which categorizes it as practically nontoxic to juvenile bluegill sunfish on an acute toxicity basis. The NOAEC and LOAEC were 103 and >103 ppm ai, respectively. Since the mean fish weight of 0.199 g was less than the required initial weight range of 0.5 to 5 g, this study does not fulfill guideline requirements for an acute toxicity study with the bluegill sunfish (§72-1a) and is classified SUPPLEMENTAL, but need not be repeated.

Rainbow trout. MRID 458348-04. In a 96-hour acute toxicity study with rainbow trout, trout were exposed under static conditions to mean-measured concentrations of <12 (LOQ, controls) and 102 ppm ai. No mortality or sub-lethal effects were observed in any control or test group. The 96-hour LC_{50} was >102 ppm ai, which categorizes it as practically nontoxic to juvenile rainbow trout on an acute toxicity basis. The NOAEC and LOAEC were 102 and >102 ppm ai, respectively. Since the mean fish weight of 0.287 g was less than the required initial weight range of 0.5 to 5 g, this study does not fulfill guideline requirements for an acute toxicity study with the rainbow trout (§72-1c) and is classified SUPPLEMENTAL, but it need not be repeated.

Rainbow trout. MRID 458310-11 In a 96-hour acute toxicity of an EUP to the rainbow trout, fish were exposed under static conditions to GF-443 [an end-use product containing 22%] at mean-measured concentrations of <5.91 (LOQ, negative control), 13.3, 20.8, 37.1, 57.0, 91.4, and 147 ppm ai. Ten percent mortality was observed in the 91.4 ppm ai treatment group. No other mortalities or sub-lethal effects were observed. The LC_{50} was >147 ppm ai, which categorizes GF-443 as practically nontoxic to juvenile Rainbow trout on an acute toxicity basis. The NOAEC (for mortality) was 91.4 ppm ai. This study was classified as SUPPLEMENTAL because of turbidity and aeration, but it need not be repeated. It is scientifically sound and fulfills the guideline requirements for an acute toxicity test with freshwater fish (72-1c) using an end-use product.

72-4a Freshwater Fish Early Life Stage

Fathead Minnow. MRID 458310-27. The chronic toxicity of XDE-638 (penoxsulam) to the early life-stage of fathead minnows (*Pimephales promelas)* was studied under flow-through conditions for 36 days. Fertilized eggs/embryos (100 embryos/treatment), approximately 18-22 hours old, were exposed to XDE-638 at mean-measured concentrations of <0.08 (<LOQ, control), 0.802, 1.28, 2.09, 3.65, 6.19, and 10.2 ppm ai. Hatching commenced on Day 3 and was

complete by Day 5, with no treatment-related differences observed in the day-to-mean hatch. No treatment-related effects on the percent hatch, or the survival of post-hatch larvae were observed. At test termination, all surviving larvae were normal, and no treatment-related effects on terminal growth (dry weight and length) were observed. The NOAEC and LOAEC were 10.2 and >10.2 ppm ai. Since no endpoint was affected by treatment up to 10.2 ppm ai, this study does not fulfill guideline requirements for an early life-stage toxicity study with the fathead minnow (§72-4a) and is classified SUPPLEMENTAL, but it need not be repeated.

Table E-2. Freshwater Invertebrates - Acute and Chronic Aquatic Toxicity Data.

Species and Chemical	Acute Toxicity		Chronic Toxicity	
	48-hr EC_{50} (ppm)	Toxicity Category (MRID)	NOAEC (ppm)	Endpoints (MRID)
Water flea (*Daphnia magna*)				
Technical grade	>98	Slightly Toxic (458310-12)	2.95 LOAEC = 9.8	Mortality Live young (458310-26)
BSTCA	>100	Practically Nontoxic (458310-14)		
BST	>96	Slightly Toxic (45831018)		
5-hydroxy-XDE-638	>1	Moderately Toxic (458310-13)		
2-amino-TP	>1	Moderately Toxic (458310-14)		
TPSA	>1.4	Moderately Toxic (458310-18)		
5-OH,2amino-TP	>1	Moderately Toxic (458310-16)		
BSA	>1.6	Moderately Toxic (458310-17)		
Midge (*Chironomus* sp.)				
Technical grade	> 140	Practically Nontoxic (458311-02)	7.1	Development (458311-02)
Amphipod (*Gammarus* sp.)				
Technical grade	>126	Practically Nontoxic (458310-21)		

72-2 Freshwater Invertebrate Acute

Daphnia. MRID 458310-12. In a 48-hour acute toxicity study, daphnids were exposed to the test material under static conditions at mean-measured concentrations of <12 (LOQ, negative and solvent controls) and 98.3 ppm ai. After 48 hours, no immobilization was observed in the controls or 98.3 ppm ai treatment group. The 48-hour LC/EC_{50} was >98.3 ppm ai, which categorizes it as slightly toxic to the water flea on an acute toxicity basis. The 48-hour NOAEC level, based on mortality and immobilization, was 98.3 ppm ai, the only concentration tested. This study is scientifically sound and satisfies the guideline requirements. Because of the very high water hardness, this study is classified as SUPPLEMENTAL, but it need not be redone.

Daphnia. MRID 458310-19. The 48-hour acute toxicity of 2-AMINO-TP (a metabolite of penoxsulam) to *Daphnia magna*, was studied under static conditions. Daphnids were exposed to the study material at a single nominal concentration 1.0 ppm with a negative control. The mean-measured concentration was not determined. No mortality or immobilization was observed in either the control or study group during the 48-hour study. The 48-hour LC/EC_{50} was >1.0 ppm, which categorizes 2-AMINO-TP as moderately toxic to *Daphnia magna* on an acute toxicity basis. The 48-hour NOAEC level, based on mortality or immobilization, was 1.0 ppm, the only concentration studied. This study is scientifically sound. However, since only ten daphnids were used in a limit study and analytical measurements of metabolite in the dilution water was not performed, this study does not fulfill guideline requirements. The study is classified SUPPLEMENTAL.

Daphnia. MRID 458310-14. The 48-hour acute toxicity of XDE-638 Metabolite (BSTCA; a metabolite of penoxsulam) *Daphnia magna*, was studied under static conditions. Mean-measured concentrations were <0.70 (LOQ, controls), 6.4, 13, 25, 51, and 100 ppm ai. No immobilization or sub-lethal effects were observed. The 48-hour LC/EC_{50} was >100 ppm ai., which categorizes BSTCA as practically nontoxic to the *Daphnia magna* on an acute toxicity basis. The 48-hour NOAEC level was 100 ppm ai. This study is scientifically sound and satisfies the guideline requirements. This study is classified as ACCEPTABLE.

Daphnia. MRID 458310-18. The 48-hour acute toxicity of XDE-638 Metabolite TPSA (a metabolite of penoxsulam) to *Daphnia magna*, was studied under static conditions. Ten Daphnids were exposed to the test material at a single nominal concentration 1.4 ppm with a negative control. The mean-measured concentration was not determined. No mortality or immobilization was observed in either the control or test group during the 48-hour study. The 48-hour LC/EC_{50} was >1.4 ppm, which categorizes TPSA as moderately toxic to *Daphnia magna* on an acute toxicity basis. The 48-hour NOAEC, was 1.4 ppm, the only concentration tested. This study is scientifically sound. However, since analytical measurements of metabolite in the dilution water was not performed and only ten daphnids were used per level in a limit study, this study does not fulfill guideline requirements for an acute toxicity study with the daphnia (§72-2) using a metabolite of penoxsulam and is classified SUPPLEMENTAL.

Daphnia. MRID 458310-15. The 48-hour acute toxicity of XDE-638 Metabolite BST to *Daphnia magna*, was studied under static conditions. Daphnids were exposed to the test material at mean-measured concentrations of <0.52 (LOQ, controls), 5.2, 13, 26, 51, and 96 ppm ai recommended. No immobilization or sub-lethal effects were observed at any control or test level during the 48-hour study. The 48-hour LC/EC_{50} was >96 ppm ai, which categorizes XDE-638 metabolite (BST; a metabolite of penoxsulam) as slightly toxic to *Daphnia magna* on an acute toxicity basis. The 48-hour NOAEC level was 96 ppm ai. This study is scientifically sound and satisfies the guideline requirements for an acute toxicity study with freshwater invertebrates (§72-2) using a metabolite of penoxsulam. This study is classified as ACCEPTABLE.

Daphnia. MRID 458310-17. The 48-hour acute toxicity of XDE-638 Metabolite BSA to *Daphnia magna*, was studied under static conditions. Daphnids were exposed to the test material at a single nominal concentration 1.6 ppm with a negative control. The mean-measured concentration was not determined. No mortality or immobilization was observed in either the control or test group during the 48-hour study. The 48-hour LC/EC_{50} was >1.6 ppm, which categorizes BSA as moderately toxic to *Daphnia magna* on an acute toxicity basis. The 48-hour NOAEC level, based on mortality or immobilization, was 1.6 ppm, the only concentration tested. This study is scientifically sound. However, since analytical measurements of metabolite in the dilution water was not performed, this study does not fulfill guideline requirements for an acute toxicity study with the daphnia (§72-2) using a metabolite of penoxsulam and is classified SUPPLEMENTAL.

Daphnia. MRID 458310-16. The 48-hour acute toxicity of 5-OH,2-AMINO-TP to *Daphnia magna*, was studied under static conditions. Daphnids were exposed to the test material at a single nominal concentration 1.0 ppm with a negative control. After 48 hours, 3% mortality or immobilization was observed in the 1.0 ppm treatment group and no mortality or immobility was observed in the control. The 48-hour LC/EC_{50} was >1.0 ppm, which categorizes 5-OH,2-AMINO-TP as moderately toxic to *Daphnia magna* on an acute toxicity basis. The 48-hour NOAEC level, based on mortality or immobilization, was 1.0 ppm, the only concentration tested. This study is scientifically sound. However, since only ten daphnids were used in this limit study and since analytical measurements of metabolite in the dilution water was not performed, this study does not fulfill guideline requirements for an acute toxicity study with the daphnia (§72-2) using a metabolite of penoxsulam and is classified as SUPPLEMENTAL.

Daphnia. MRID 458310-13. The 48-hour acute toxicity of 5-Hydroxy-XDE-638 (a metabolite of penoxsulam) to *Daphnia magna*, was studied under static conditions. Daphnids were exposed to mean-measured concentrations of <0.54 (LOQ, controls), 5.8, 13, 26, 50, and 100 ppm ai. No sub-lethal effects were observed. The 48-hour LC/EC_{50} was >100 ppm ai, which categorizes 5-Hydroxy-XDE-638 as practically nontoxic to *Daphnia magna* on an acute toxicity basis. The 48-hour NOAEC level was 100 ppm ai. This study is scientifically sound, but, since the water hardness was higher than recommended and there were only four treatment levels with only five daphnids each., it does not satisfy the guideline requirements for an acute toxicity study with freshwater invertebrates (§72-2) using a metabolite of penoxsulam. This study is classified as SUPPLEMENTAL, but it need not be repeated.

Daphnia. MRID 458310-20. The 48-hour acute toxicity of GF-443 [an end-use product containing 22% penoxsulam] to *Daphnia magna*, was studied under static conditions. Daphnids were exposed to the test material at mean-measured concentrations were <0.6 (LOQ, negative control), 7.92, 13.3, 22.2, 36.5, 58.0, and 90.1 ppm ai. The water hardness was higher than recommended. No mortality was observed during the study. Incidental immobilization was observed at 5, 10, 10, and 5% in the 13.3, 22.2, 36.5, and 58.0 ppm ai test levels. No immobilization was observed in the negative control group, the 7.92 ppm ai test group, or the highest level tested, 90.1 ppm ai. The 48-hour LC/EC_{50} was >90.1 ppm ai, which categorizes GF-443 as slightly toxic to *Daphnia magna* on an acute toxicity basis. The 48-hour NOAEC level, based on mortality or immobilization, was 90.1 ppm ai. This study is classified as SUPPLEMENTAL, but it need not be repeated. It is scientifically sound and fulfills the guideline requirements for an acute toxicity test with freshwater invertebrate (72-2) using an end-use product.

Gammarus. MRID 458310-21. In an acute toxicity to the amphipod, *Gammarus pseudolimnaeus*, gammarids were exposed to the test material at mean-measured concentrations of <0.00902 (LOQ, negative control), 16.3, 26.9, 44.6, 75.5, and 126 ppm ai. The study found a wide range of mortality; there were some deaths in every concentration level, including the control. After 96 hours, survival was 95% in the control and 16.3 ppm ai test group, 75% in the 26.9 ppm ai test group, 70% in the 44.6 and 75.5 ppm ai test groups, and 55% in the 126 ppm ai test group. The 96-hour LC_{50} was >126 ppm ai, which categorizes it as practically nontoxic to the gammarid on an acute toxicity basis. No sub-lethal effects were observed during the study. The LC_{50} could be determined visually because mortality did not exceed 50% in this study. The NOAEC could not be determined, but the LOAEC was 16.3. This study is scientifically sound but does not satisfy the guideline requirements for an acute toxicity study with freshwater invertebrates (§72-2) because of the range of mortality. This study is classified as SUPPLEMENTAL, but it need not be repeated, because it is not a required study.

72-4b Freshwater Invertebrate Life Cycle
Daphnia. MRID 458310-26. The 21-day chronic toxicity of XDE-638 (penoxsulam) to *Daphnia magna* was studied under static renewal conditions. Daphnids were exposed to mean-measured concentrations of <0.01(LOQ, control), 0.040, 0.111, 0.376, 0.942, 2.95, and 9.76 ppm ai. Immobility was observed in 10% of daphnids in the 0.942 and 2.95 ppm ai treatment groups; no other sub-lethal effects were observed. No treatment-related effects were observed on the day of first eggs observed, the day to first brood release, the total number of offspring produced, and the number of offspring per adult or terminal lengths. However, a statistically-significant reduction in the number of live offspring produced was observed at the 9.76 ppm ai level compared to the control group (922 versus 1395). The 21-day LC_{50} was >9.76 ppm ai. The 21-day EC_{50} was >9.76 ppm ai. Based on the number of live offspring (the only endpoint affected), the NOAEC and LOAEC values were 2.95 and 9.76, respectively. This study is scientifically sound, fulfills the guideline requirements for an aquatic invertebrate life cycle test with *Daphnia magna* (§ 72-4b), and is classified ACCEPTABLE.

OPPTS DRAFT 850.1735. Chironomid. MRID 458311-02. In a full life-cycle toxicity study to the midge (*Chironomus riparius*) under static conditions using spiked sediment and spiked water, mean-measured concentrations of XDE-638 were <0.33 (<LOQ; control), 7.1, 15, 31, 61, and 140 mg ai/L. No treatment-related effects on percent emergence were observed; mean percent emergence ranged from 90-96% for all test and control groups. Based on reductions in the development rate, the NOAEC and LOAEC were 7.1 and 15 mg ai/L, respectively. This study was designed to fulfill OECD DRAFT Guidelines 218 and 219, and does not fulfill any current U.S. EPA guideline. This study is scientifically sound, and provides useful information on the 28-day toxicity of XDE-638 Technical to the midge, *Chironomus riparius*, under static conditions. Dry weight by sex, which has been found to be the most sensitive endpoint (MRID 45831028) was not assessed. This study is classified as SUPPLEMENTAL.

Table E-3. Estuarine and Marine Animals - Acute and Chronic Toxicity Data.				
	Acute Toxicity		Chronic Toxicity	
Species and Chemical	96-hr LC_{50} (ppm)	Toxicity Category (MRID)	NOAEC (mg/L)	Endpoints
Silverside (*Menidia beryllina*)				
Technical grade	>129	Practically Nontoxic (458310-22)		
Eastern oyster (*Crassostrea virginica*)				
Technical grade	>127	Practically Nontoxic (458310-23)		
Mysid America (*Americanmysis bahia*)				
Technical grade	114	Practically Nontoxic (458310-24)	<8.1	Male dry weight

72-3a Estuarine/Marine Fish Acute
Silverside. MRID 458310-22. In a 96-hour acute toxicity study, juvenile silverside (*Menidia beryllina*) were exposed under static conditions to XDE-638 (penoxsulam) at mean measured concentrations were <0.0553 (LOQ, negative control), 17.0, 28.5, 44.5, 76.0, and 129 ppm ai. After 96 hours of exposure, mortality was 5% in the 44.5 ppm ai treatment group. No other mortalities were observed in the control or treatment groups, therefore, the mortality is not considered significant. The 96-hour LC_{50} was >129 ppm ai, which categorizes penoxsulam as practically nontoxic to the silverside, *Menidia beryllina*, on an acute toxicity basis. No sub-lethal effects were observed during the study. Based on lack of effects, the NOAEC and LOAEC were 129 and >129 ppm ai, respectively. This study is scientifically sound. However, since the average terminal control wet fish weight was less than the required initial weight of 0.5-5 g, this study does not fulfill guideline requirements for an acute toxicity study with the silverside (§72-3a). This study provides useful information, and is classified SUPPLEMENTAL, but it need not be repeated.

72-3b Estuarine/Marine Invertebrate Acute
Eastern Oyster. MRID 458310-23. In this 96-hour, flow-through acute EC_{50} test with an estuarine/marine mollusk, the eastern oyster (*Crassostrea virginica*) was exposed to XDE-638 (penoxsulam) at mean-measured concentrations of ≤0.00673 (LOQ, control), 15.8, 26.4, 45.4, 73.6, and 127 ppm ai (99-106% of nominal values). After 96 hours of exposure, there was one mortality in the control and no mortalities in the treatment groups. No significant reductions were shell deposition were observed at any test level. Mean shell growth was 2.4 mm for the negative control, and 2.4, 2.4, 2.6, 2.6, and 2.1 mm for the 15.8, 26.4, 45.4, 73.6, and 127 mg ai/L groups, respectively. The EC_{50} is >127 ppm ai, which categorizes XDE-638 (penoxsulam) as practically nontoxic to the eastern oyster on an acute toxicity basis. The NOAEC was 127 ppm ai. This study is scientifically valid and fulfills the requirements of an acute toxicity test with an estuarine/marine mollusk (§72-3b). This study is classified as ACCEPTABLE.

Mysid. MRID 458310-24. The 96-hour acute toxicity of XDE-638 (penoxsulam) to the saltwater mysid, *Americamysis bahia*, was studied under static conditions. Mysids were exposed to mean-measured concentrations of <0.0270 (LOQ; control), 14.4, 25.6, 42.8, 71.1, and 114 ppm ai (90-100% of nominal values). After 96 hours, mortality was 5% in the 114 ppm ai test level. No other mortality or sub-lethal effects were observed in any control or test level. The 96-hour LC_{50} value was >114 ppm ai, which categorizes XDE-638 as practically nontoxic to the saltwater mysid, *Americamysis bahia*, on an acute toxicity basis. Based on mortality and sub-lethal effects, the NOAEC value was 114 ppm ai, the highest concentration tested. This study is scientifically valid and fulfills the requirements of an acute LC_{50} test with an estuarine/marine organism (§72-3c). This study is classified as ACCEPTABLE.

72-4d Estuarine/Marine Invertebrate Life Cycle

Mysid. MRID 458310-28. In a 28-day life-cycle test, *Americamysis bahia* neonates were exposed under flow-through conditions to XDE-638 (penoxsulam) to mean-measured concentrations <0.0881 (LOD, control), 8.08, 15.2, 29.4, 59.3, and 119 ppm ai. First-generation mysids were observed for mortality and signs of abnormal behavior once daily throughout the study.. Data endpoints included percent survival of first-generation mysids at study termination (Day 28; combined sexes), number of young produced per female, and length, wet weight, and dry weight of surviving first-generation mysids (Day 28; sex-specific and combined sexes). Dry weights males averaged 0.64 mg for the negative control group, and ranged from 0.46 to 0.54 mg for the treatment groups. In addition, a treatment-related reduction in length was observed in combined sexes at the 119 ppm ai test level compared to the control group (8.4 versus 9.2 mm). No other treatment-related effects were observed during the study. Based on significant reductions in dry weights of males, the NOAEC and LOAEC values were <8.08 and 8.08 ppm ai, respectively. This study is scientifically sound. However, since the survival of male mysids following pairing was not monitored, since offspring were not maintained and observed for 4 days, and since a NOAEC was not established, this study does not fulfill the guideline requirements for an aquatic invertebrate life-cycle toxicity test using the *Americamysis bahia* (72-4c), and is classified SUPPLEMENTAL, but it need not be repeated

<u>Toxicity to Aquatic Plants</u>

Table E-4. Aquatic Plants - Acute Toxicity Data

Species and Chemical	MRID	Acute EC_{50} (mg/L)	NOAEC (mg/L)	EC_{05} (mg/L)	Affected Endpoint
Vascular plants- Duckweed (*Lemna gibba*)					
Technical grade	458311-20	0.003	0.001	0.0007	Number of fronds
BSTCA	458311-06	>10	10	ND	None
5-hydroxy-XDE-638	458311-04	>11	0.22	0.095	Number of fronds
BST	458311-05	>6.2	ND<0.1	ND	Number of fronds Growth rate
2-amino-8-methoxy Tier 1	458311-08	>1.25	1.25	ND	None
2-amino-TP Tier 1	458311-11	>1.0	1.0	ND	None

BSA Tier 1	458311-10	>1.6	1.6	ND	None
TPSA Tier 1	458311-09	>1.4	1.4	ND	None
Nonvascular plants- Green algae (*Selenastrum capricornutum*)					
Technical grade	458348-05	0.092	0.005	0.007	Cell density
GF-443 (EUP)	458311-07	0.094	0.009	0.005	Biomass
BSTCA	458311-19	>10	10	>10ND	None
BST	458311-17	>9.6	3.9	ND	Growth rate Biomass
5-hydroxy-XDE-638	458311-18	>10	10	0.58ND	None
TPSA	458311-13	>1.4	1.4	ND	None
5-OH,2-amino-TP	458311-14	>1.0	1.0	ND	None
BSA	458311-12	>1.6	1.6	ND	None
2-Amino TP	458311-15	>1.0	1.0	ND	None
Nonvascular plants- Freshwater diatom (*Navicula pelliculosa*)					
Technical grade	458311-21	>49.6	49.6	ND	None
Nonvascular plants- Freshwater alga (*Anabaena flos-aquae*)					
Technical grade	458311-22	0.27	0.194	0.027	Cell density Biomass
Nonvascular plants Tier I Saltwater diatom (*Skeletonema costatum*)					
Technical grade	458311-23	>46.7	2.33	0.43	Cell Density Biomass
TPSA	458311-13	>1.4	1.4	ND	None
5-OH, 2-amino-TP	458311-14	>1.0	1.0	ND	None
2-Amino TP	458311-15	>1.0	1.0	ND	None
BSA	458311-12	>1.6	1.6	ND	None

ND = Not determined because non-monotonic response.

122-2 Tier I Aquatic Plant

Green algae. MRID 458311-13. In a 96-hour acute toxicity study, cultures of *Selenastrum capricornutum* were exposed to penoxsulam metabolite, TPSA, under static conditions. A single nominal concentration was tested (1.4 mg ai/L), which was compared to a dilution water control; analytical verification of the nominal test concentration was not conducted. The 96-hour cell density, growth rates, and biomass percent inhibitions were -12.4, -2.0, and -8.3%, respectively, in the 1.4 mg ai/L treatment group (negative values indicate stimulations, no inhibitory effect). The EC_{50} was >1.4 mg ai/L, the EC_{05} could not be determined, and the NOAEC was 1.4 mg ai/L for all endpoints. This toxicity study is scientifically sound, however, it does not satisfy the

Guideline §122-2 because the nominal test concentration was not analytically verified and the concentrations were too low. As a result, this study is classified as SUPPLEMENTAL.

Green algae. MRID 458311-14. In a 96-hour acute toxicity study, cultures of *Selenastrum capricornutum* were exposed to penoxsulam metabolite, 5-OH,2-AMINO-TP, under static conditions. A single nominal concentration was tested (1.0 mg ai/L), which was compared to a dilution water control; analytical verification of the nominal test concentration was not conducted. The 96-hour cell density and growth rate percent inhibitions were -9.2 and -1.5%, respectively, in the 1.0 mg ai/L treatment group (negative values indicate stimulations, no inhibitory effect). The mean area under the growth curve (biomass) had 2.0% inhibition. The EC_{50} was >1.0 mg ai/L, the EC_{05} could not be determined, and the NOAEC was 1.0 mg ai/L for all endpoints. This toxicity study is scientifically sound, however, it does not satisfy §122-2 because the nominal test concentration was not analytically verified. As a result, this study is classified as SUPPLEMENTAL.

Green algae. MRID 458311-12. In a 96-hour acute toxicity study, cultures of *Selenastrum capricornutum* were exposed to penoxsulam metabolite, BSA, under static conditions. A single nominal concentration was tested (1.6 mg ai/L), which was compared to a dilution water control; analytical verification of the nominal test concentration was not conducted. The 96-hour cell density, growth rates, and biomass percent inhibitions were -9.7, -1.6, and -9.5%, respectively, in the 1.6 mg ai/L treatment group (negative values indicate stimulations, no inhibitory effect). The EC_{50} was >1.6 mg ai/L, the EC_{05} could not be determined, and the NOAEC was 1.6 mg ai/L for all endpoints. This toxicity study is scientifically sound, however, it does not satisfy guideline §122-2 because the nominal test concentration was not analytically verified. As a result, this study is classified as SUPPLEMENTAL.

Green algae. MRID 458311-15. In a 96-hour acute toxicity study, cultures of *Selenastrum capricornutum* were exposed to penoxsulam metabolite, 2-AMINO-TP, under static conditions. A single nominal concentration was tested (1.0 mg ai/L), which was compared to a dilution water control; analytical verification of the nominal test concentration was not conducted. The 96-hour cell density, growth rates, and biomass percent inhibitions were -7.2, -1.3, and -3.0%, respectively, in the 1.0 mg ai/L treatment group (negative values indicate stimulations, no inhibitory effect). The EC_{50} was >1.0 mg ai/L, the EC_{05} could not be determined, and the NOAEC was 1.0 mg ai/L for all endpoints. This toxicity study is scientifically sound, however, it does not satisfy guideline §122-2 because the nominal test concentration was not analytically verified. As a result, this study is classified as SUPPLEMENTAL.

Duckweed. MRID 458311-09. In a 14-day acute toxicity study, freshwater aquatic vascular plants Duckweed, *Lemna gibba* G3, were exposed to penoxsulam metabolite TPSA at a single, nominal concentration of 1.4 mg ai/L under static conditions. The mean frond numbers, dry weights, areas under the growth curve, and growth rates were not affected in the 1.4 mg ai/L treatment group compared to the control. The NOAEC was 1.4 mg ai/L, but the EC_{05} could not be determined. The frond number EC_{50} was >1.4 mg ai/L. This toxicity study is scientifically sound, but it does not satisfy guideline §122-2 because the single nominal test concentration was not analytically determined. As a result, this study is classified as SUPPLEMENTAL.

Duckweed. MRID 458311-08. In a 14-day acute toxicity study, freshwater aquatic vascular plants Duckweed, *Lemna gibba* G3, were exposed to penoxsulam metabolite 5-OH,2-AMINO-TP at a single, nominal concentration of 1.25 mg ai/L under static conditions. The mean frond numbers, areas under the growth curve, and growth rates were not affected in the 1.25 mg ai/L treatment group compared to the control. The dry weight percent inhibition was 0.7% for the 1.25 mg ai/L treatment group. The NOAEC was 1.25 mg ai/L. The frond number EC_{50} was >1.25 mg ai/L. The EC_{05} could not be determined. This toxicity study is scientifically sound, but it does not satisfy guideline §122-2 because the single nominal test concentration was not analytically determined. As a result, this study is classified as SUPPLEMENTAL.

Duckweed. MRID 458311-11. In a 14-day acute toxicity study, freshwater aquatic vascular plants Duckweed, *Lemna gibba* G3, were exposed to penoxsulam metabolite 2-AMINO-TP at a single, nominal concentration of 1.0 mg ai/L under static conditions. The mean frond numbers, dry weights, areas under the growth curve, and growth rates were not affected in the 1.0 mg ai/L treatment group compared to the control. The NOAEC as 1.0 mg ai/L and the EC_{50} was >1.0 mg ai/L. The EC_{05} could not be determined. This toxicity study is scientifically sound, but it does not satisfy guideline §122-2 because the single nominal test concentration was not analytically determined. As a result, this study is classified as SUPPLEMENTAL.

Duckweed. MRID 458311-10. In a 14-day acute toxicity study, freshwater aquatic vascular plants Duckweed, *Lemna gibba* G3, were exposed to penoxsulam metabolite BSA at a single, nominal concentration of 1.6 mg ai/L under static conditions. The mean frond numbers, dry weights, areas under the growth curve, and growth rates were not affected in the 1.6 mg ai/L treatment group compared to the control. The NOAEC/EC_{05} was 1.6 mg ai/L and the EC_{50} was >1.6 mg ai/L, but the EC_{05} could not be determined. This toxicity study is scientifically sound, but it does not satisfy guideline §122-2 because the single nominal test concentration was not analytically determined. As a result, this study is classified as SUPPLEMENTAL.

123-2 Tier II Aquatic Plant
Green algae. MRID 458311-07. In a 96-hour acute toxicity study, cultures of *Selenastrum capricornutum* were exposed to GF-443 under static conditions. The mean measured concentrations were <1.77 (control), 8.76, 15.8, 27.9, 41.2, 86.7, and 168 µg ai/L. Biomass was the most sensitive endpoint, with an EC_{50} of 94 µg ai/L; the NOAEC for biomass was 8.76 µg ai/L. The EC_{05} was 5.1 µg ai/L and the EC_{50} 94 µg ai/L. The study is scientifically sound and satisfies guideline §123-2 for an aquatic nonvascular plant study with *Selenastrum capricornutum*. This study is classified as ACCEPTABLE.

Green algae. MRID 458348-05. In a 96-hour acute toxicity study, cultures of *Selenastrum capricornutum* were exposed to penoxsulam, as XDE-638, under static conditions. The mean measured concentrations were 4.62, 11.3, 14.6, 34.9, 74.3, 122, and 233 µg ai/L. The 96-hour cell density percent inhibitions were 9.7, 10.1, 16.2, 20.6, 34.6, 44.2, 58.3, and 75.5% for the 4.62, 11.3, 14.6, 34.9, 74.3, 122, and 233 µg ai/L treatment groups, respectively. The solvent control had 9.7% inhibition compared to the negative (dilution water) control. Cell density was significantly reduced at treatment levels equal to and greater than 11.3 µg ai/L. The cell density EC_{50} was 92.0 µg ai/L, the EC_{05} was 6.5 µg ai/L, and the NOAEC was 4.62 µg ai/L. The study is scientifically sound and satisfies guideline §123-2 for an aquatic nonvascular plant study with *Selenastrum capricornutum.* This study is classified as ACCEPTABLE.

Freshwater algae. MRID 458311-19 In a 96-hour acute toxicity study, cultures of *Pseudokirchneriella subcapitata* were exposed to penoxsulam metabolite BSTCA under static conditions. The mean measured concentrations were <0.026 (LOQ, negative and solvent controls), 0.10, 0.27, 0.64, 1.7, 4.2, and 10 mg ai/L. No endpoint was significantly affected by treatment. The EC_{50} was >10 mg ai/L the EC_{50} could not be determined for cell density or biomass, but was >10 mg ai/L for growth rate, and the NOAEC was 10 mg ai/L. The study is scientifically sound and satisfies guideline §123-2 for an aquatic nonvascular plant study with *Pseudokirchneriella subcapitata.* This study is classified as ACCEPTABLE.

Freshwater algae. MRID 458311-18. In a 96-hour acute toxicity study, cultures of *Pseudokirchneriella subcapitata* were exposed to penoxsulam metabolite 5-Hydroxy-XDE-638, under static conditions. The mean measured concentrations were <0.014-0.015 (<LOQ, negative and solvent controls), 0.10, 0.25, 0.62, 1.5, 4.0, and 10.0 mg ai/L. The EC_{50} was >10 mg ai/L for all endpoints, the EC_{05} was 0.58 mg ai/L, and the NOAEC was 10.0 mg ai/L. The study is scientifically sound and satisfies the guideline, §123-2 for an aquatic nonvascular plant study with *Pseudokirchneriella subcapitata.* This study is classified as ACCEPTABLE.

Freshwater algae. MRID 458311-17. In a 96-hour acute toxicity study, cultures of *Pseudokirchneriella subcapitata* were exposed to penoxsulam, as its metabolite (BST), under static conditions. The mean measured concentrations were <0.011-0.012 (LOQ, negative and solvent controls), 0.093, 0.22, 0.58, 1.4, 3.9, and 9.6 mg ai/L. There were significant effects on growth rate and biomass in the 9.6 mg ai/L treatment group; however, no reductions exceeded 50% for any endpoint. The EC_{50} was >9.6 mg ai/L and the NOAEC was 3.9 mg ai/L (based on biomass and growth rate). The EC_{05}: could not be determined. The study is scientifically sound and satisfies guideline §123-2 for an aquatic nonvascular plant study with *Pseudokirchneriella subcapitata.* This study is classified as ACCEPTABLE.

Marine diatom. MRID 458311-23. In a 120-hour acute toxicity study, cultures of *Skeletonema costatum* were exposed to penoxsulam, as XDE-638, under static conditions. The 0-hour measured concentrations were <0.12 (LOQ, negative control), 1.14, 2.33, 4.62, 9.42, 21.0, and 46.7 mg ai/L; 0-hour measured concentrations were used to determine toxicity values because measured concentrations after 120 hours declined below 70% of nominal. There were effects on cell density in the 4.62, 9.42, and 46.7 treatment groups. Neither cell density nor biomass was inhibited greater than 50%, so the EC_{50} value for these endpoints was >46.7 mg ai/L. The NOAEC based on cell density was 2.33 mg ai/L and the EC_{05} is 0.43 mg ai/L. The study is scientifically sound and satisfies guideline §123-2 for an aquatic nonvascular plant study with *Skeletonema costatum.* This study is classified as ACCEPTABLE.

Freshwater diatom. MRID 458311-21. In a 120-hour acute toxicity study, cultures of *Navicula pelliculosa* were exposed to penoxsulam, as XDE-638, under static conditions. The mean measured concentrations were <0.12 (LOQ, negative control), 1.38, 2.65, 5.2, 10.7, 24, and 49.6 mg ai/L. The 120-hour cell density percent inhibitions were 24.0, 28.5, 15.9, 28.0, 32.8, and 18.6% for the 1.38, 2.65, 5.20, 10.7, 24.0, and 49.6 mg ai/L treatment groups, respectively. There were no significant effects on cell density. The EC_{50} was >49.6 mg ai/L, the EC_{05}: could not be determined, and the NOAEC was 49.6 mg ai/L for cell density. The study is scientifically sound; however, because the replicate number was lower than recommended and there was high cell density variability within and among the treatment groups, this study does not satisfy guideline §123-2 for an aquatic nonvascular plant study with *Navicula pelliculosa*. As a result, this study is classified as SUPPLEMENTAL.

Blue-green algae. MRID 458311-22. In a 120-hour acute toxicity study, cultures of *Anabaena flos-aquae* were exposed to penoxsulam under static conditions. The mean measured concentrations were <0.01 (LOQ, negative control), 0.100, 0.194, 0.387, 0.788, 1.59, and 3.22 mg ai/L. The 120-hour cell density percent inhibitions were -27.5, 15.9, 75.1, 88.8, 88.1, and 86.6% for the 0.100, 0.194, 0.387, 0.788, 1.59, and 3.22 mg ai/L treatment groups, respectively. There were significant effects on cell density in the 0.387, 0.788, 1.59, and 3.22 mg ai/L treatment groups. Cell density was the more sensitive endpoint, with an EC_{50} of 0.27 mg ai/L; the NOAEC was 0.194 mg ai/L. The study is scientifically sound and satisfies guideline §123-2 for an aquatic nonvascular plant study with *Anabaena flos-aquae*. This study is classified as ACCEPTABLE.

Duckweed. MRID 458311-20. In a 14-day acute toxicity study, freshwater aquatic vascular plants Duckweed, *Lemna gibba* G3, were exposed to XDE-638 (penoxsulam) at mean measured concentrations of 0.491, 1.05, 1.93, 3.84, 7.21, and 14.5 µg ai/L under static conditions. Nominal concentrations were 0 (negative and solvent controls), 0.5, 1, 2, 4, 8, and 16 µg ai/L. The NOAEC, EC_{05} , and EC_{50} values for frond number were 1.05, 0.74, and 3.0 µg ai/L, respectively. This toxicity study is scientifically sound and satisfies guideline §123-2 for an aquatic vascular plant study with *Lemna gibba*. As a result, this study is classified as ACCEPTABLE.

Duckweed. MRID 458311-04. In a 14-day acute toxicity study, freshwater aquatic vascular plants Duckweed, *Lemna gibba* G3, were exposed to penoxsulam metabolite 5-Hydroxy-XDE-638 at mean measured concentrations <0.013-0.016 (<LOQ, negative and solvent controls), 0.081, 0.22, 0.62, 1.6, 4.6, and 11 mg ai/L under static conditions. The most sensitive variable was frond numbers. The NOAEC was 0.22 mg/L, LOAEC was 0.62 mg/L/L, EC_{05} was 0.095 mg/L, and the EC_{50} >11 mg/L. This toxicity study is scientifically sound and satisfies the guideline §123-2 for an aquatic vascular plant study with *Lemna gibba*. The study is classified as ACCEPTABLE.

Duckweed. MRID 458311-05. In a 14-day acute toxicity study, freshwater aquatic vascular plants Duckweed, *Lemna gibba* G3, were exposed to penoxsulam metabolite (BST) at mean measured concentrations <0.014 (<LOQ, negative and solvent controls), 0.10, 0.27, 0.68, 1.7, 4.2, and 6.2 mg ai/L under static conditions. The percent reductions for frond number were significant in all treatment groups, however, significance did not exceed 10% in the highest treatment group. The percent reduction for growth rate was significantly reduced at the lowest treatment level and not significantly reduced for dry weight at any treatment level. The NOAEC and EC_{50} were not determined, the LOAEC was 0.10 mg/L, and the EC_{50} was >6.2 mg/L. This toxicity study is scientifically sound, but it does not satisfy guideline §123-2 for an aquatic vascular plant study with *Lemna gibba* because a NOAEC could not be determined (for frond number and growth rate) and the US EPA-recommended Probit method (for determining EC_x

values) could not be used to determine EC_{05} values, due to the non-monotonic nature of the responses. As a result, this study is classified as SUPPLEMENTAL.

Duckweed. MRID 458311-06. In a 14-day acute toxicity study, freshwater aquatic vascular plants Duckweed, *Lemna gibba* G3, were exposed to penoxsulam metabolite (BSTCA) at mean measured concentrations <0.027 (<LOQ, negative and solvent controls), 0.11, 0.27, 0.65, 1.6, 4.1, and 10 mg ai/L under static conditions. The percent reductions for number of fronds, growth rate, and dry weight were not significant in any treatment group. The NOAEC was 10 mg ai/L, the EC_{50} >10 mg ai/L, but the EC_{05} could not be determined. This toxicity study is scientifically sound and satisfies guideline §123-2 for an aquatic vascular plant study with *Lemna gibba*. As a result, this study is classified as SUPPLEMENTAL.

Toxicity to Terrestrial Animals

Table E-5. Acute and Chronic Toxicity for Terrestrial Animals.

	Acute Toxicity		Dietary Toxicity		Chronic Toxicity	
Species and Chemical	LD_{50} (ppm)	Category (MRID)	LC_{50} (mg/kg)	Category (MRID)	NOAEC (ppm) (MRID)	Endpoints
Northern bobwhite quail (*Colinus virginianus*)						
Technical grade	>2,025	Practically Nontoxic (458309-28)	>4,411	Slightly Toxic (45831002)	231 (458310-06)	Food consumption, Male & female body weight gain
EUP GF-443	>22,190000	Practically Nontoxic (458310-01)				
Mallard duck (*Anas platyrhynchos*)						
Technical grade	>1,900	Practically Nontoxic (458309-29)	>4310	Slightly Toxic (45831003)	501 (462764-01)	Adult male body weight
EUPGF-443	None					
Norway Rat (*Rattus norvegicus*)						
Technical Grade	>5000 mg/kg bw	(458310-28)			600 (458309-20)	kidney lesions (preputial separation
Honey bee (*Apis meliferus*) Acute Contact						
Technical grade	>100 µg/bee contact	(458311-24)				
EUP GF-443	>22 µg/bee contact	(458311-27)				
Earthworm (*Eisenia foetida*)						
Technical grade	>1,000 mg/kg	(458308-06)				
EUP GF-443	>2,190 mg/kg	(458308-07)				

71-1 Avian Acute Oral
Bobwhite quail. MRID 458309-28. In a 14-da acute oral study with northern bobwhite quail, no mortalities or treatment-related sub-lethal effects were observed during the study. There were no significant differences in body weights or feed consumption, and no abnormalities were observed at terminal necropsy. The 14-day acute oral LD_{50} is >2025 mg ai/kg bw, which categorizes XDE-638 as practically nontoxic to Northern Bobwhite quail. This study is classified as ACCEPTABLE.

Mallard. MRID 458309-29. In a 14-day acute oral study with mallard ducks, no mortalities or treatment-related sub-lethal effects were observed during the study. There were no significant differences in body weights or feed consumption, and no abnormalities were observed at terminal necropsy. The 14-day acute oral LD_{50} is >1900 mg ai/kg bw, which categorizes penoxsulam as practically nontoxic to Mallard ducks on an acute oral basis. This toxicity study is scientifically sound but does not fulfill the guideline requirements for an acute toxicity study using the Mallard duck (§71-1), because the experimental concentrations were not determined. This study is classified as SUPPLEMENTAL. Since the nominal concentrations are very high, the study need not be repeated. The NOAEL, *etc.* will be recorded as > 1,900 mg ai/kg bw.

Bobwhite quail. MRID 458310-01. The acute oral toxicity of GF-443(a 21.9% EUP) to 21-week-old Northern Bobwhite quail (*Colinus virginianus*) was assessed for 14 days. GF-443 was administered to the birds via gavage at nominal concentrations of the active ingredient of 170, 283,473, 778, 1314, 2190 mg ai/kg. No mortalities or treatment-related sub-lethal effects or significant differences in body weights were observed. A statistically-significant reduction in feed consumption was observed on Days 0-3 at the 2190 mg ai/kg bw dose group compared to the control (15 versus 19 g/bird/day). Feed consumption recovered for the remainder of the study. No treatment-related abnormalities were observed at terminal necropsy. The 14-day acute oral LD_{50} is >2190 mg ai/kg bw, which categorizes GF-443 as practically nontoxic to Northern Bobwhite quail on an acute oral basis. This study is classified as ACCEPTABLE.

71-2 Avian Subacute Dietary
Bobwhite quail. MRID 458310-02. In an acute dietary toxicity bobwhite quail, mean-measured concentrations were <LOD (control), 877, 1456, 2091, 3110, and 4411 ppm ai, respectively. No mortalities occurred during the 8-day study, there were no sub-lethal signs of toxicity, or treatment-related effects on body weights or feed consumption. No significant gross pathological findings were observed. The 8-day acute dietary LC_{50} was >4411 ppm ai, the highest concentration tested, which categorizes it as slightly toxic to the Bobwhite quail on an acute dietary basis. This toxicity study is scientifically sound. However, since the concentration of acetone used in the preparation of the treated feed was not reported, this study does not fulfill the guideline requirements for an avian dietary study using the Northern Bobwhite quail (§71-2a). This study is classified as SUPPLEMENTAL, but need not be repeated.

Mallard. MRID 458310-03. In an acute dietary toxicity to the mallard duck, mean-measured concentrations were <LOD (control), 733, 1210, 1870, 2620, and 4310 ppm ai. No mortalities occurred, there were no sub-lethal signs of toxicity, or treatment-related effects on feed consumption. Statistically-significant reductions in body weight gains were observed at the 2620

ppm ai level after the exposure period, and at all test levels after the recovery period. No significant gross pathological findings were observed. The 8-day acute dietary LC_{50} was >4310 ppm ai, the highest concentration tested, which categorizes it as slightly toxic to the Mallard duck on an acute dietary basis. Based on reductions in body weight gains, the NOAEC was <733 ppm ai, the lowest concentration tested. The study is scientifically sound. However, since the concentration of acetone used in the preparation of the treated feed was not reported, this study does not fulfill the guideline requirements for an avian dietary study using the Mallard duck (§71-2b). This study is classified as SUPPLEMENTAL, but it need not be repeated.

71-3 Avian Reproduction
Bobwhite quail. MRID 458310-06. In a chronic reproduction study with bobwhite quail, XDE-638 was administered to the birds in the diet at mean-measured concentrations of <1.10 (<LOQ, control), 231, 501, and 958 ppm ai. There were no significant treatment-related effects on any reproductive parameter; however, adult food consumption, and male and female body weights were adversely affected. There was a significant reduction in food consumption at the 501 ppm ai treatment level and significant reductions in male and female body weight gain at the highest treatment level. The NOAEC and LOAEC levels were 231 and 501 ppm ai diet, respectively. This toxicity study is scientifically sound. However, because the amount of solvent (acetone) used in the test diet preparations was not specified, nor was it stated that the acetone was allowed to completely evaporate prior to offering, and because the only endpoints adversely affected (*e.g.*, food consumption and male and female body weight gain) may have been related to this deviation, this study is classified as SUPPLEMENTAL but need not be redone.

Mallard. MRID 462764-01. In a chronic reproduction study with mallard ducks, Penoxsulam was administered in the diet at mean-measured concentrations of <70.7 (<LOQ, control), 231, 501, and 958 ppm ai. Adult male body weight gain was adversely affected at the highest treatment level. There were no other significant adverse effects on any adult parameter. In addition, no treatment-related effects were observed on egg production or quality, fertility, embryonic development, hatchability, or survival of hatchlings. No treatment-related effects on hatchling body weights were observed; however, 14-day-old body weights of ducklings were statistically-reduced compared to the control at all test levels. The mean body weights of the 14-day old ducklings were 240, 218, 211, and 215 g in the control, 250, 500, and 1000 ppm test groups, respectively. A hatchling brooder density test was provided as a supplement to this study (MRID 46276402) and it provided strong evidence that brooder density may have been the primary factor contributing to the survivor body weight reductions. As a result, the LOAEC for this study is defined by reductions in adult male body weight at the 958 ppm ai treatment level. The NOAEC was 501 ppm ai. This study is scientifically sound, fulfills guideline requirements for the reproductive toxicity of penoxsulam to Mallard duck (§71-4b), and is classified as ACEPTABLE.

81-1 Acute Mammalian Oral
Laboratory rat. MRID 458310-28. In an acute oral toxicity study in rats, five male and 5 female Fischer 344 rats were used in the study (Age: 10 weeks. Weight: males 170-211g, females 122-149g). On the day before study initiation animals were weighed and fasted overnight. On day "0" of the study a single dose of XDE-638 was administered by gavage to both sexes; for

administration the test article was mixed with 0.5% w/v methylcellulose in distilled water. The dosage was at 10 mL/kg. Animals were observed for signs of clinical abnormalities twice on day "0" and daily thereafter. Health and mortality checks were made twice daily. Body weights were taken on day -1, prior to test substance ingestion and again on days 7 and 14. No animals died during the study. Clinical abnormalities (transient, and only in a few animals) observed during the study included dark material around the mouth during the first 2 days of the study, mucoid stools, abnormal colored feces, and fecal/urine stain. At necropsy, "3 incidences of foci on the lungs were observed on day 14. The relationship of these foci to the test material could not be determined." The Oral LD_{50} is greater than 5000 mg/kg for both male and female rats. Penoxsulam is classified as Toxicity Category IV for acute oral toxicity based on the lack of mortality in male and female rats following dosage at 5000 mg/kg.

84-3 Mammalian Reproduction
Laboratory rat. MRID 458309-20. In a two-generation reproduction toxicity study, penoxsulam (97.7% ai) was administered to 30 male and 30 female rats at dietary concentrations that provided 0, 30, 100, or 300 mg/kg/day. One litter was produced in each generation. F_0 and F_1 parental animals were administered test or control diets for 10 weeks prior to mating, throughout mating, gestation, and lactation and until sacrifice. At necropsy, mid- and high-dose males of both generations had increased and/or relative liver weights due to slight hepatocellar hypertrophy that was not considered to be adverse. High-dose females of both generations had significantly increased absolute and relative kidney weights. Microscopic lesions of the kidney of high-dose F_0 and F_1 females included epithelial hyperplasia, inflammation, and crystal formation in the pelvis and tubular degeneration. The incidences (severity) of kidney lesions in control and high-dose females were 1-2/30 (1.00) and 25-26 (1.58-2.04), respectively, for hyperplasia, 0/30 and 7-8/30 (1.25-2.14), respectively, for inflammation, and 3/30 (1.00) and 20-21/30(1.62-1.85), respectively, for degeneration. Crystals were observed in 0, 0, 2, and 16 F_0 females and in 2, 1, 7, and 11 F_1 females in the control, low-, mid-, and high-dose groups, respectively. The parental systemic toxicity LOAEL for female rats is 100 mg/kg/day based on kidney lesions (crystals) and for male rats is 300 mg/kg/day based on reduced absolute body weights of the F_1 males. The parental systemic toxicity NOAEL for female rats is 30 mg/kg/day and for male rats is 100 mg/kg/day. Preputial separation, an indicator of sexual maturation, was significantly ($p \leq 0.05$) delayed in mid- and high-dose F_1 males. The mean age at which preputial separation was attained for the control, low-, mid-, and high-dose groups was 43.6, 44.0, 45.5, and 46.0 days, respectively. This delay was considered to be a treatment-related effect. The reproductive/offspring toxicity LOAEL is 100 mg/kg/day based on delay is preputial separation in F_1 males. The reproduction/offspring toxicity NOAEL is 30 mg/kg/day. The study is ACCEPTABLE and satisfies the guideline requirement for a two-generation reproduction study in rats.

141-1. Acute Honey Bee Contact
Honey Bee. MRID 458311-24. The honey bee, *Apis mellifera*, was exposed to XDE-638 for 48 hours, at a single nominal concentration of 100 µg ai/bee. By 48 hours, mortality was 13% in the 100 µg ai/bee treatment group. There was 3% negative control mortality and 0% solvent control mortality. No sublethal effects were observed during the study. The LD_{50} value was >100 µg ai/bee. As a result, XDE-638 is categorized as practically nontoxic to honey bees on an acute

contact basis. This study is scientifically sound and it satisfies the EFED concerning the guideline requirements. It is ACCEPTABLE.

Honey Bee. MRID 458311-27 In an acute oral toxicity test, the honey bee, *Apis mellifera*, was exposed to GF-443 for 48 hours, at nominal concentrations of 0.1, 1.0, 10, and 100 µg ai/bee. Since GF-443 is only 21.9% ai, penoxsulam, the test concentrations were 0.02, 0.22, 2.19, and 21.9 µg ai/bee. The LD_{50} was >22 µg ai/bee and the NOAEC was 22 µg ai/bee. This study is scientifically sound but does not fully satisfy the EFED guideline requirements for a contact toxicity test with honey bees (§141-1 or 850.3020). It is classified as SUPPLEMENTAL. It can be used for a risk assessment and need not be repeated.

Honey Bee. MRID 458311-25. In a nonguideline acute oral toxicity test, the honey bee, *Apis mellifera*, was exposed to XDE-638 for 48 hours, at two vehicle concentrations (1% and 1.7%) due to solubility constraints. The 1.7% vehicle concentration test had nominal concentrations of 6.5, 13, 25, 50, and 100 µg ai/bee. Actual ingested doses were 5.2, 13.7, 29, 33.3, and 85.3 µg ai/bee, respectively. By 48 hours, mortality was 10, 3, 17, 0, and 0% in the 1.7% treatment groups. The LD_{50} value was >100 µg ai/bee. As a result, XDE-638 is categorized as practically nontoxic to honey bees on an acute oral basis. This study is scientifically sound, but it is not a guideline study and does not fulfill an OPP requirement. It is classified as SUPPLEMENTAL.

Honey Bee. MRID 458311-27. In a non-guideline acute oral toxicity test, the honey bee, *Apis mellifera*, was exposed to GF-443 for 48 hours, at test concentrations of 0.10, 1.0, 10, and 100 µg GF-44./bee. Actual ingested doses were 0.095, 1.1, 3.8, and 96.7 µg GF-443/bee, respectively. There was no mortality and no sublethal effect observed in the treatment groups or in the negative control. The LD_{50} value was >21.2 µg ai/bee, and the NOAEL concentration was 21.2 µg ai/bee. This study is scientifically sound, but it is not a guideline study and does not fulfill an OPP requirement. It is classified as SUPPLEMENTAL.

Non-Guideline OPPTS 850.6200. Acute Earthworm

Earthworm. MRID 458308-06. The earthworm, *Eisenia foetida*, was exposed to XDE-638 at a single nominal test concentration of 1,000 mg/kg. By 14 days, there was no mortality in the control or 1,000 mg/kg treatment group. Average reductions in body weight by day 14 were 9.6 and 5.1% in the control and 1,000 mg/kg treatment group. The LD_{50} value was >1000 mg/kg; a NOAEC value was estimated as 1,000 mg/kg. OPPTS guidelines exist for subchronic toxicity testing with earthworms, and there were several deviations from these experimental protocols in this study. U.S. EPA does not presently require subchronic toxicity testing with earthworms for pesticide registration, so SEP guidelines do not exist. The results of this study are useful for risk assessment purposes and are classified as SUPPLEMENTAL.

Earthworm. MRID 458308-07. The earthworm, *Eisenia foetida*, was exposed to GF-443 at a single nominal test concentration of 10,000 TEP/kg (2,190 mg a.i/kg). By 14 days, there was no mortality in the control or the 2,190 mg ai/kg treatment group. Average reductions in body weight by day 14 were 5.1 and 1.6% in the control and 2,190 mg ai/kg treatment groups. The LD_{50} value was >2,190 mg ai/kg; a NOAEC value was estimated as 2,190 mg a.i/kg. OPPTS guidelines exist for subchronic toxicity testing with earthworms, and there were several deviations from these experimental protocols in this study. U.S. EPA does not presently require subchronic toxicity testing with earthworms for pesticide registration, so SEP guidelines do not exist. The results of this study are useful for risk assessment purposes and are classified as SUPPLEMENTAL.

Non-Guideline OECD 216 and 217 Soil Microflora Activity
Soil microflora. MRID 458311-03. XDE-638 was applied to a loamy sand agricultural soil at a rate of 0.13 or 0.67 mg ai/kg dry soil (equivalent to 2X and 10X the maximum single application rate of 50 g ai/ha soil. As indicators of soil microbial biomass metabolic activity, carbon mineralization was measured over a 29-day period and nitrogen transformation was measured over a 42-day period. Lucerne meal (3.25% nitrogen) was used to amend the experimental soil in the nitrification portion of the study. XDE-638 had no lasting effects on respiration and nitrification processes at the concentrations studied. Compared to untreated control soil, microbial respiration (mg O_2/kg dry soil/hr) of soil treated with 0.67 mg ai/kg XDE-638 deviated by 0, -13, 13, and 9% on days 0, 7, 14, and 29 respectively. Only the difference on day 7 was statistically significant. Nitrate transformation rates in soil treated with 0.67 mg ai/kg deviated from control values by -26.0, 0.1, 25.2, and 7.7% on days 7, 14, 28, and 42 respectively. A transient accumulation of ammonium occurred. This study is scientifically sound, but it is not a guideline study and does not fulfill an OPP requirement. The results of this study are useful for risk assessment purposes and are classified as SUPPLEMENTAL.

Toxicity to Terrestrial Plants

123-1 Tier II Seedling Emergence and Vegetative Vigor
Monocots (4 species) and Dicots (6 species). MRID 458311-16. The effect of XDE-638 on the seedling emergence and vegetative vigor of dicot (*Gossypium hirsutum,* cotton; *Cucumis sativus,* cucumber; *Beta vulgaris altissima,* sugarbeet; *Brassica oleracea acephala,* kale; *Glycine max,* soybean; and *Lycopersicon esculentum,* tomato) and monocot (*Zea mays,* corn; *Triticum aestivum,* wheat; *Lolium perenne,* ryegrass; and *Allium cepa*, onion) crops was studied at nominal concentrations of 0.14, 0.41, 1.2, 3.7, 11.1, 33.3, and 100 g ai/ha. The growth medium used in the seedling emergence and vegetative vigor test was natural soil (sandy loam, pH 6.4, organic carbon 1.2%). On day 21, the surviving plants per pot were recorded and cut at soil level for measuring the plant height and dry weight in the seedling emergence and vegetative vigor test, respectively.

The **seedling emergence** test was performed at rates of 0.14, 0.41, 1.2, 3.7, 11.1, 33.3, and 100 g ai/ha (for corn and wheat), 0.046, 0.14, 0.41, 1.2, 3.7, 11.1, and 33.3 g ai/ha (for cotton, cucumber, kale, onion, ryegrass, soybean, and tomato), and 0.015, 0.046, 0.14, 0.41, 1.2, 3.7, and 11.1 g ai/ha (soybean). Corn, cotton, cucumber, ryegrass, soybean, and wheat were not sensitive to treatment (as defined by inhibition of 25% or greater for at least one endpoint). Of the species that were sensitive to treatment with penoxsulam, onion (a monocot) was the most sensitive species (based on shoot weight) with an EC_{25} of 1.1 g ai/ha; the NOAEC value for this species was 0.41 g ai/ha. The most sensitive dicot was sugarbeet (based on shoot weight) with an EC_{25} of 3.2 g ai/ha; the NOAEC value for this species was 1.2 g ai/ha.

The **vegetative vigor** test was performed at rates of 0.14, 0.41, 1.2, 3.7, 11.1, 33.3, and 100 g ai/ha (for corn, cotton, cucumber, onion, ryegrass, tomato, and wheat), and 0.015, 0.046, 0.14, 0.41, 1.2, 3.7, and 11.1 g ai/ha (for kale, soybean, and sugarbeet). Corn and wheat were not sensitive to treatment. Of the species that were sensitive to treatment with penoxsulam, soybean (a dicot) was the most sensitive species (based on shoot weight) with an EC_{25} of 3.9 g ai/ha; the NOAEC value for this species was 1.2 g ai/ha. The most sensitive monocot was ryegrass (based on shoot weight) with an EC_{25} of 17.0 g ai/ha; the NOAEC value for this species was 0.41 g ai/ha.

This study fulfills the US EPA guideline requirements for seedling emergence and vegetative vigor studies (Subdivision J, §123-1, a & b; TIER II). This study is classified as ACCEPTABLE.

Table E-6. Terrestrial Plants- Tier II Data, Seedling Emergence.

Species	Shoot length (g ai/ha)			Shoot weight (g ai/ha)			Most Sensitive Parameter	Slope
	NOAEC	EC_{05}	EC_{25}	NOAEC	EC_{05}	EC_{25}		
Dicots								
Sugarbeet	1.2	2.5	5.5	1.2***	1.1	3.2*	Weight	2.216
Cotton	33.3	8.0ND	>33.3	33.3	ND15	>33.3	None	n/a
Soybean	33.3	1.5ND	>33.3	33.3	0.85ND	>33.3	None	n/a
Cucumber	33.3	18ND	>33.3	33.3	7.5ND	>33.3	None	n/a
Kale	3.70	3.9	11	3.70	2.3	6.7	Weight	2.105
Tomato	3.70	4.9	18	3.70	3.2	1111.0	Weight	1.78
Monocots								
Onion	3.70	0.28	6.2	0.41****	0.066	1.1**	Weight	0.7986
Wheat	100	53ND	>100	100	39ND	>100	None	n/a
Corn	100	64ND	>100	100	2.2ND	>100	None	n/a
Ryegrass	33.3	ND	>100	33.3	ND	>33.3	None	n/a

*Most sensitive EC_{25} dicot
** Most sensitive EC_{25} monocot
*** Most sensitive NOAEC dicot
**** Most sensitive NOAEC monocot

Table E-7. Terrestrial Plants- Tier II, Vegetative Vigor.								
Species	Shoot length (g ai/ha)			Shoot weight (g ai/ha)			Most Sensitive Parameter	Slope
	NOAEC	EC_{05}	EC_{25}	NOAEC	EC_{05}	EC_{25}		
Dicots								
Soybean	3.7	1.9	4.4	1.2***	2.1	3.9*	Weight	3.766
Sugarbeet	11.1	6.4	20	1.2***	1.7	4.6	Weight	2.328
Tomato	3.7	1.5	8.0	1.2***	3.0	8.1	Length	1.33
Cotton	3.7	11	73	33.3	35	>100	Length	1.219
Cucumber	33.3	32	63	33.3	21	49	Weight	n.d.
Kale	3.70	3.2	10	3.7	3.6	8.6	Weight	2.658
Monocots								
Ryegrass	33.3	ND	>100	0.41****	0.08	17**	Weight	0.4219
Corn	100	75ND	>100	10033.3	ND41	>100	None	n/a
Wheat	100	>100ND	>100	100	ND6.4	>100	None	n/a
Onion	3.7	7.8	36	11.1	20	310.6	Length Weight	n.d.

*Most sensitive EC_{25} dicot
** Most sensitive EC_{25} monocot
*** Most sensitive NOAEC dicot
**** Most sensitive NOAEC monocot

Non-Guideline - Penoxsulam Metabolite Toxicity to Plants
In a laboratory study, penoxsulam and 11 metabolites were applied to seeds and saplings (2 to 2.5 leaves) of 22 plant species including crops, weeds, grasses and flowering plants (MRID 467583-01). Tested species were; soybean, oilseed rape, chickweed, cocklebur, lambsquarter, ivyleaf morninglory, redroot pigweed, velvetleaf, field pansy, wild buckwheat, wild poinsettia, Canada thistle, corn, rice wheat, blackgrass, wild oat, barnyard grass, large crabgrass, giant foxtail, Rox orange sorghum and yellow nutsedge The parent penoxsulam, caused significant injury to all exposed species when applied to pre-emergent seeds. However, none of the applied 11 metabolites caused observable injury when applied to pre-emergent seeds. Post-emergent treatment with penoxsulam caused significant injury to all species with the exception of rice, wheat and blackgrass. Only two of the 11 metabolites (5-OH penoxsulam and sulfonyl-formamidine) caused noticeable injury to species during the post-emergence test at the highest tested concentrations (250 and 500 ppm). Oilseed rape, chickweed, lambsquarter, redroot pigweed, velvetleaf and wild buckwheat exhibited minor injury when treated with these two metabolites.

Also, as sensitive indicators for broadleaf weed control, *Arabidopsis thaliana* and *Lemna minor* were tested with penoxsulam and the 11 metabolites (MRID 467583-01). Percent injury ratings for pre-emergent *Arabidopsis thaliana* seed treatment at nominal concentrations of 0.000128, 0.00064, 0.0032, 0.016, 0.08, 0.4, 2, 10 and 50 ppm penoxsulam were 0, 7, 25, 65, 88, 93, 95 97 and 99% respectively, clearly indicating a dose-response relationship. However, 5 of the 11 metabolites did not result in deleterious effects. The six remaining metabolites (3-amino TCA, 5-OH XDE638, BSA, sulfonamide, BSTCA-methyl, TPSA) caused some visible damage at the highest treatment levels (40 and 50 ppm). For *Lemna minor*, penoxsulam resulted in 95% injury score at the 10 ppm test concentration. Metabolites 5-OH XDE638 and BST were tested at 10 ppm as well; however, they caused no noticeable effect. BSA was tested at 25 ppm and also caused no damage.

Appendix G. Data Requirements Tables

TABLE of Environmental Fate Data Requirements for Penoxsulam				
Guideline #	**Data Requirement**	**MRID #**	**Study Classification**	**Are more data needed?**
161-1	Hydrolysis	458307-21	Acceptable	No
161-2	Photodegradation in Water	458307-22 458348-01	Supplemental Supplemental	No
161-3	Photodegradation on Soil	458307-23	Supplemental	No
161-4	Photodegradation in Air	No study		No
162-1	Aerobic Soil Metabolism	458307-24	Acceptable	No
162-2	Anaerobic Soil Metabolism	No study		No
162-3	Anaerobic Aquatic Metabolism	458307-25	Acceptable	No
162-4	Aerobic Aquatic Metabolism	458307-26	Acceptable	No
163-1	Leaching-Adsorption/Desorption XDE-638 (parent) BSTCA, BST, and 5-OH-XDE-638 degradates XR-638 (parent)	458308-01 458308-02 458348-02	Acceptable Supplemental Supplemental	No
163-2	Laboratory Volatility	No study		No
163-3	Field Volatility	No Study		No
164-1	Terrestrial Field Dissipation	467035-01	Acceptable	No
164-2	Aquatic Field Dissipation GF-443 SC SF (EUP) DE-638 GF-239 GF-443 SC SF (EUP) XDE-638 GF-520	467035-02 458308-04 467035-03 458308-05	Acceptable Supplemental Supplemental Acceptable	No
165-4	Accumulation in Fish	No Study		No
165-5	Accumulation in aquatic non-target organism (crayfish)	458311-01	Acceptable	No
166-1	Ground Water- small scale prospective	No Study		No

TABLE of Ecological Toxicity Data Requirements for Penoxsulam				
Guideline #	Data Requirement	MRID #	Classification	Are more data needed?
71-1	Avian acute oral LD_{50} (bobwhite quail) (mallard duck) (bobwhite quail)	 458309-28 458309-29 458310-01	 Acceptable Supplemental Acceptable	No
71-2	Avian subacute dietary LC_{50} (bobwhite quail) (mallard duck)	 458310-02 458310-03	 Supplemental Supplemental	No
71-4	Avian reproduction (bobwhite quail) (mallard duck) (mallard duck)	 458310-06 462764-01 458301-01	 Supplemental Acceptable Invalid	No
72-1	Freshwater fish acute LC_{500} (common carp) (bluegill sunfish) (rainbow trout) (rainbow trout)	 458310-09 458310-10 458310-11 458348-04	 Supplemental Supplemental Supplemental Supplemental	No
72-2	Freshwater invertebrate acute EC_{50} XDE-638 (daphnia) XDE-638 (Ramshorn snail) 5-Hydroxy-XDE-638 degradate (daphnia) BSTCA degradate (daphnia) XDE-638 (amphipod) 2-Amino-TP metabolite (daphnia) TPSA metabolite (daphnia) BST metabolite (daphnia) BSA metabolite (daphnia) 5-OH, 2-Amino-TP metabolite (daphnia) GF-443 (EUP) (daphnia)	458310-12 458310-25 458310-13 458310-14 458310-21 458310-19 458310-18 458310-15 485310-17 458310-16 458310-20	Supplemental Supplemental Supplemental Acceptable Supplemental Supplemental Supplemental Acceptable Supplemental Supplemental Supplemental	No
72-3a	Estuarine/marine fish acute LC_{50} (silverside)	458310-22	Supplemental	No
OPPTS 850.1735	Freshwater invertebrate sediment toxicity	No study		No
72-3b	Estuarine/marine invertebrate acute EC_{50} (eastern oyster)	458310-23	Acceptable	No
72-3c	Estuarine/marine invertebrate acute LC_{50} (mysid)	458310-24	Acceptable	No
72-4a	Freshwater fish early life stage (fathead minnow)	458310-27	Supplemental	No
72-4b	Freshwater invertebrate life cycle (daphnia) Freshwater invertebrate life cycle (mysid)	458310-26 458310-28	Acceptable Supplemental	No

72-4c	Estuarine/marine fish life cycle (sheepshead minnow)	No study		No
72-4d	Estuarine/marine invertebrate life cycle (mysid)	458310-28	Supplemental	No
72-5	Freshwater fish full life cycle	458310-27	Supplemental	No
72-7	Aquatic Field Study	No study		No
81-1	Acute mammalian oral LD_{50}	458308-12	Acceptable	No
83-3	Mammalian Developmental (rat)	458309-20	Acceptable	No
83-4	Mammalian Reproduction (rat)	458309-20	Acceptable	No
122-1(a) 122-1 (b)	Seedling Emergence – Tier I Vegetative Vigor – Tier I	No study		No
123-1(a)	Seedling Emergence - Tier II	458311-16	Acceptable	No
123-1(b)	Vegetative Vigor - Tier II	458311-16	Acceptable	No
122-2	Aquatic plant growth – Tier I			No
	XDE-638 metabolite BSA (*Selenastrum capricornutum*)	458311-12	Supplemental	
	XDE-638 metabolite TPSA (*Selenastrum capricornutum*)	458311-13	Supplemental	
	5-OH,2-AMINO-TP metabolite (*Selenastrum capricornutum*)	458311-14	Supplemental	
	2-AMINO-TP metabolite (*Selenastrum capricornutum*)	458311-15	Supplemental	
	2-amino-8-methoxy XDE-638 metabolite (duckweed)	458311-08	Supplemental	
	XDE-638 metabolite TPSA (duckweed)	458311-09	Supplemental	
	XDE-638 metabolite BSA (duckweed)	458311-10	Supplemental	
	XDE-638 metabolite 2-AMINO-TP (duckweed)	458311-11	Supplemental	

123-2	Aquatic plant growth (EC_{50}) – Tier II XDE-638 *(Selenastrum capricornutum)* GF-443 (EUP) (*Selenastrum capricornutum*) XDE-638 Metabolite (BST) *(Pseudokirchneriella subcapitata)* 5-Hydroxy-XDE-638 metabolite *(Pseudokirchneriella subcapitata)* XDE-638 Metabolite (BSTCA) *(Pseudokirchneriella subcapitata)* XDE-638 (*Navicula peliculosa*) XDE-638 (*Anabaena flos-aquae*) XDE-638 *(Skeletonema costatum)* XDE-638 (duckweed) 5-Hydroxy-XDE-638 metabolite (duckweed) BST metabolite (duckweed) BSTCA metabolite (duckweed)	458348-05 458311-07 458311-17 458311-18 458311-19 458311-21 458311-22 458311-23 458311-20 458311-04 458311-05 458311-06	Acceptable Acceptable Acceptable Acceptable Acceptable Supplemental Acceptable Acceptable Acceptable Acceptable Supplemental Acceptable	No
141-1	Acute honey bee contact LD_{50}	458311-24 458311-26	Acceptable Supplemental	No
Non-guideline	Acute honey bee oral LD_{50} GF-443 (EUP) XDE-638	458311-27 458311-25	Supplemental Supplemental	No
141-2	Honey Bee Residue on Foliage	No study		No
141-5	Honey Bee Field Testing for Pollinator	No study		No
Non-guideline	Chronic toxicity (*Chironomus riparius*)	458311-02	Supplemental	No
Non-guideline	Soil microflora metabolic activity	458311-03	Supplemental	No
Non-guideline	Earthworm subchronic toxicity (*Eisenia foetida*) XDE-638 GF-443 (EUP)	458308-06 458308-07	Supplemental Supplemental	No

Appendix H. Environmental Fate Bibliography

Abiotic Hydrolysis (161-1)
Simon, K., and J. K. Smith. 2001. Hydrolysis of XDE-638 in buffered and natural water as a function of pH. Unpublished study performed, sponsored, and submitted by Global Environmental Chemistry Laboratory-Indianapolis Lab, Dow AgroSciences LLC, 9330. Zionsville Road, Indianapolis, Indiana 46268-1054. Study No.: 000134.
MRID 458307-21

Direct Photolysis in Water (161-2)
Byrne, S.L., S.K. Embrey, R.N. Yoder and D.O. Duebelbeis. 1999. Natural water photolysis and outdoor aerobic aquatic metabolism and photolysis of the experimental rice herbicide XDE-638. Unpublished study performed by Global Environmental Chemistry Laboratory, Dow AgroSciences LLC, Indianapolis, IN; sponsored and submitted by Dow AgroSciences, LLC, Indianapolis, IN. Study ID: GH-C 4932.
MRID 458307-22

Knowles, S., and D. Portwood. 1999. Photolysis of XDE-638 in sterile aqueous buffer and natural surface water. Unpublished study performed, sponsored, and submitted by Dow AgroSciences, Letcombe Laboratory, Oxon, U.K. Study No.: E99-099/990139. Report No: GHE-P-8084.
MRID 458348-01

Direct Photolysis in Soil (161-3)
Rutherford, L.A., R.N. Yoder, and J.L. Balcer. 2002. Photodegradation of XDE-638 on aerobic soil. Unpublished study performed, sponsored, and submitted by Regulatory Laboratories-Indianapolis Lab, Dow AgroSciences LLC, Indianapolis, IN. Laboratory Study No.: 000137.
MRID 458307-23

Aerobic Soil Metabolism (162- 1)
Krieger, M.S., T.J. Meitl and J.L. Balcer. 2002. Aerobic soil degradation of ^{14}C-XDE-638. Unpublished study performed by Global Environmental Chemistry Laboratory, Dow AgroSciences LLC, Indianapolis, IN; sponsored and submitted by Dow AgroSciences, LLC, Indianapolis, IN. Study ID: 990051.
MRID 458307-24

Anaerobic Soil Metabolism (162-3)
Krieger, M.S., T.J. Meitl and J.L. Balcer. 2002. Anaerobic soil and sediment degradation of ^{14}C-XDE-638. Unpublished study performed, sponsored and submitted by Dow AgroSciences LLC, Indianapolis, IN. Dow AgroSciences Study No.: 990052.
MRID 458307-25

Anaerobic Aquatic Metabolism (162-3)
Cook, W.L. and K.P. Smith. 2002. Aerobic aquatic degradation of XDE-638 in six matrices. Unpublished study performed, sponsored and submitted by Dow AgroSciences LLC, Indianapolis, IN. Dow AgroSciences Study No.: 990061.
MRID 458307-26

Leaching – Soil Adsorption/Desorption (163-1)
Yoder, R.N. 2000. Batch equilibrium adsorption/desorption of XDE-638 on seventeen soils and one sediment. Unpublished study performed, sponsored and submitted by Global Environmental Chemistry Laboratory- Indianapolis Lab, Dow AgroSciences LLC, Indianapolis, Indiana. Laboratory Study ID: 990058.
MRID 458308-01

Yoder, R.N. 2002. Batch equilibrium adsorption of XDE-638 metabolites, 5-OH-XDE-638, BSTCA, and BST. Unpublished study performed, sponsored and submitted by Regulatory Laboratories- Indianapolis Lab, Dow AgroSciences LLC, Indianapolis, Indiana. Laboratory Study ID: 010092.
MRID 458308-02

Terrestrial Field Dissipation (164-1)
Roberts, D.W. and G.E. Schelle. 2005. Terrestrial field dissipation of penoxsulam in the U.S.A. Unpublished study performed by Dow AgroSciences LLC, Indianapolis, IN (study director and residue analyst), Dow AgroSciences, Western U.S. Research Center, Fresno, CA (field investigator), Agricultural Chemicals Development Services Research, North Rose, NY (field investigator); and Agvise Laboratories, Inc. Northwood, ND (Soil and Water Characterization Analysis); and submitted by Dow AgroSciences LLC, Indianapolis, IN (p.6). Laboratory Study ID: 040043.
MRID 467035-01

Aquatic Field Dissipation (164-2)
Newcombe, A.C., J.A. Knuteson and D.G. Petty. 2005. Penoxsulam aquatic dissipation in Florida after whole-pond treatment. Unpublished study performed by LFR Levine-Fricke, Tallahassee, FL; Pyxant Laboratories, Inc., Colorado Springs, CO; Enviro-Test Laboratories, Inc., Alberta, Canada; and Agvise Laboratories, Inc., Northwood, ND; and submitted by SePRO Corporation, Carmel, IN (p.16). Laboratory Study ID: PD-2004-01.
MRID 467035-02

Newcombe, A.C., J.A. Knuteson and D.G. Petty. 2005. Penoxsulam aquatic dissipation following multiple treatments to a Florida lake. Unpublished study performed by LFR Levine-Fricke, Tallahassee, FL; Pyxant Laboratories, Inc., Colorado Springs, CO; and Agvise Laboratories, Inc., Northwood, ND; and submitted by SePRO Corporation, Carmel, IN (p.16). Laboratory Study ID: LK-2004-01.
MRID 467035-03

Knuteson, J.A. and G.E. Schelle. 2002. Environmental fate field study of DE-638 herbicide in direct-seeded and water-seeded rice culture systems in the USA. Unpublished study performed by Dow AgroSciences LLC, Indianapolis, IN, Agricultural Advisors, Inc., Live Oak, CA, G & H Associates, Inc., Stuttgart, AK, and Agvise Laboratories, Inc., Northwood, ND, and submitted by Dow AgroSciences LLC, Indianapolis, IN. Laboratory Study ID: 000285.
MRID 458308-04

Roberts, D.W., S.C. Dolder and G.E. Schelle. 2002. Field dissipation of XDE-638 granule in California rice agriculture. Unpublished study performed by Dow AgroSciences LLC, Indianapolis, IN, AGVISE Laboratories, Inc., Northwood, ND and Agricultural Advisors, Inc., Live Oak, CA, and submitted by Dow AgroSciences LLC, Indianapolis, IN. Laboratory Study ID: 010072.
MRID 458308-05

Accumulation in Aquatic Non-target Organism (165-5)

Rick, D.L. and T.A. Marino. 2002. The bioconcentration of XDE-638 in edible tissue of the crayfish, *Procambarus clarkii*. Unpublished study performed by Toxicology & Environmental Research and Consulting, Dow Chemical Co., Midland, MI; sponsored and submitted by Dow AgroSciences, LLC, Indianapolis, IN. Study ID: 021063.
MRID 458311-01

Terrestrial Field Dissipation (164-1)

Roberts, D.W. and G.E. Schelle. 2005. Terrestrial field dissipation of penoxsulam in the U.S.A. Unpublished study performed by Dow AgroSciences LLC, Indianapolis, IN (study director and residue analyst), Dow Agrosciences, Western U.S. Research Center, Fresno, CA (field investigator), Agricultural Chemicals Development Services Research, North Rose, NY (field investigator); and Agvise Laboratories, Inc. Northwood, ND (Soil and Water Characterization Analysis); and submitted by Dow AgroSciences LLC, Indianapolis, IN (p.6). Laboratory Study ID: 040043.
MRID 467035-01

Appendix I. Ecological Effects Bibliography

Aquatic Organisms
Fish
Marino, T.A., *et al.* 2001. Revised Report for XDE-638: An Acute Toxicity Study with the Common Carp, *Cyprinus carpio* Linnaeus. Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, MI. Laboratory Study No. 001223R. Study submitted by Dow AgroSciences, LLC, Indianapolis, IN. MRID 458310-09

Marino, T.A., *et al.* 2000. XDE-638: An Acute Toxicity Study with the Bluegill Sunfish, *Lepomis macrochirus* Rafinesque Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, MI. Laboratory Study No. 991213. Study submitted by Dow AgroSciences, LLC, Indianapolis, IN. MRID 458310-10

Marino, T.A., *et al.* 2002. GF-443: An Acute Toxicity Study with the Rainbow Trout, *Oncorhynchus mykiss* Walbaum. Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, MI. Laboratory Study No. 021024. Study submitted by Dow AgroSciences LLC, Indianapolis, IN.
MRID 458310-11

Marino, T.A., *et al.* 2000. XDE-638: An Acute Toxicity Study with the Rainbow Trout, *Oncorhynchus mykiss* Walbaum. Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, MI. Laboratory Study No. 991214. Study submitted by Dow AgroSciences, Indianapolis, IN.
MRID 458348-04

Marino, T.A., *et. al.* 2002. XDE-638: Toxicity to the Early Life Stages of the Fathead Minnow, *Pimephales promelas* Rafinesque. Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, MI. Laboratory Study No. 011018. Study submitted by Dow AgroSciences LLC, Indianapolis, IN. MRID 458310-27

Ward, T.J., *et al.* 2000. XDE-638: Acute Toxicity to the Silverside (*Menidia beryllina).* Unpublished study performed by T.R. Wilbury Laboratories, Inc., Marblehead, MA. Laboratory Study No. 1999-DO. Study submitted by The Dow AgroSciences LLC, Indianapolis, IN. MRID 458310-22

Invertebrates
Marino, T.A., *et al.* 2000. XDE-638: An Acute Toxicity Study with the Daphnia, *Daphnia magna* Straus. Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, MI. Laboratory Study No. 991215. Study submitted by Dow AgroSciences, Indianapolis, IN.
MRID 458310-12

Putt, A.E. 2002. 5-Hydroxy-XDE-638 - Acute Toxicity to Daphnids *(Daphnia magna)* Under Static Conditions. Unpublished study performed by Springborn Laboratories, Inc., Wareham,

MA. Laboratory Study No. 12550.6166. Study submitted by The Dow Chemical Company for Dow AgroSciences LLC, Midland, MI.
MRID 458310-13

Putt, A.E. 2002. XDE-638 Metabolite (BSTCA) - Acute Toxicity to Daphnids (Daphnia magna) Under Static Conditions. Unpublished study performed by Springborn Laboratories, Inc., Wareham, MA. Laboratory Study No. 12550.6174. Study submitted by The Dow Chemical Company for Dow AgroSciences LLC, Midland, MI.
MRID 458310-14

Putt, A. 2002. XDE-638 Metabolite (BST)--Acute Toxicity to Daphnids (Daphnia magna) under Static Conditions. Unpublished study prepared by Springborn Laboratories, Inc., Wareham, MA. Lab Project Number: 12550.6170: 011236. Study submitted by The Dow Chemical Company for Dow AgroSciences LLC, Midland, MI.
MRID 458310-15

Marino, T.; Yaroch, A. 2002. XDE-638 Metabolite 5-OH,2-Amino-TP: An Acute Toxicity Study with the Daphnid, (Daphnia magna) Straus. Unpublished study prepared by The Dow Chemical Company and submitted by Dow AgroSciences, Indianapolis, IN. Lab Project Number: 021050.
MRID 458310-16

Marino, T.; Yaroch, A. 2002. XDE-638 Metabolite BSA: An Acute Toxicity Study with the Daphnid, (Daphnia magna) Straus. Unpublished study prepared by The Dow Chemical Company and submitted by Dow AgroSciences, Indianapolis, IN. Lab Project Number: 021051.
MRID 458310-17

Marino, T.; Yaroch, A. 2002. XDE-638 Metabolite TPSA: An Acute Toxicity Study with the Daphnid, (Daphnia magna) Straus: Unpublished study prepared by The Dow Chemical Company and submitted by Dow AgroSciences, Indianapolis, IN. Lab Project Number: 021052.
MRID 458310-18

Marino, T.; Yaroch, A. 2002. XDE-638 Metabolite 2-Amino-TP: An Acute Toxicity Study with the Daphnid, (Daphnia magna) Straus: Unpublished study prepared by The Dow Chemical Company and submitted by Dow AgroSciences, Indianapolis, IN. Lab Project Number: 021049.
MRID 458310-19

Marino, T.; McClymont, E.; Hales, C.; et. al. 2002. GF-443: An Acute Toxicity Study with the Daphnid, (Daphnia magna) Straus: Unpublished study prepared by The Dow Chemical Company and submitted by Dow AgroSciences, Indianapolis, IN. Lab Project Number: 021025.
MRID 458310-20

Boeri, R.; Ward, T. 2000. XDE-638: Acute Toxicity to the Gammarid, Gammarus pseudolimnaeus: Unpublished study prepared by T.R. Wilbury Laboratories, Inc. Marblehead, Massachusetts. Lab Project Number: 1846-DO: 990127. Study submitted by Dow AgroSciences LLC, Indianapolis, IN.

MRID 458310-21

Boeri, R.L., *et al.* 2000. XDE-638 -- Flow-Through Mollusc Shell Deposition Test. T.R. Wilbury Laboratories, Inc. Marblehead, Massachusetts. Laboratory Report ID 1847-DO. Study submitted by Dow AgroSciences LLC, Indianapolis, IN.
MRID 458310-23

Ward, T.J. et al. 2000. XDE-638 – Acute Toxicity to Mysid, *Americamysis bahia*. Unpublished study performed by T.T. Wilbury Laboratories, Inc.,Marblehead, MA 01945. Laboratory Study No. 1998-DO. Study submitted by The Dow Chemical Company for Dow AgroSciences LLC, Midland, MI.
MRID 458310-24

Boeri, R.L., *et al.* 2001 (amendment). XDE-638: Acute Toxicity to the Ramshorn Snail, *Planorbella trivolvis*. Unpublished study performed by T.R. Wilbury Laboratories, Inc., Marblehead, MA. Laboratory Study No. 1845-DO. Study submitted by The Dow AgroSciences LLC, Indianapolis, IN.
MRID 458310-25

Kirk, H.D., *et. al.* 2000. XDE-638: 21-Day Chronic Toxicity Test with the Daphnid, *Daphnia magna* Straus. Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, MI. Laboratory Study No. 001018. Study submitted by Dow AgroSciences LLC, Indianapolis, IN.
MRID 458310-26

Marino, T.A., *et. al.* 2002. XDE-638: Toxicity to the Early Life Stages of the Fathead Minnow, *Pimephales promelas* Rafinesque. Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, MI. Laboratory Study No. 011018. Study submitted by Dow AgroSciences LLC, Indianapolis, IN.
MRID 458310-27

Boeri, R.L., *et al.* 2001. XDE-638: Chronic Toxicity to Mysid, *Americamysis bahia* Unpublished study performed by T.R. Wilbury Laboratories, Inc., Marblehead, MA. Laboratory Study No. 2202-DO. Study submitted by The Dow AgroSciences LLC, Indianapolis, IN.
MRID 458310-28

<u>*Plants*</u>
Hoberg, J.R. 2002. 5-Hydroxy-XDE-638 - Toxicity to Duckweed, *Lemna gibba*. Unpublished study performed by Springborn Laboratories, Inc., Wareham, Massachusetts. Laboratory Project Identification No. 12550.6167/Project No. 011234. Study submitted by The Dow Chemical Company for Dow AgroSciences, LLC Midland, Michigan.
MRID 458311-04

Hoberg, J.R. 2002. XDE-638 Metabolite (BST) - Toxicity to Duckweed, *Lemna gibba*. Unpublished study performed by Springborn Laboratories, Inc., Wareham, Massachusetts.

Laboratory Project Identification No. 12550.6171/Project No. 011237. Study submitted by The Dow Chemical Company for Dow AgroSciences, LLC Midland, Michigan.
MRID 458311-05

Hoberg, J.R. 2002. XDE-638 Metabolite (BSTCA) - Toxicity to Duckweed, *Lemna gibba.* Unpublished study performed by Springborn Laboratories, Inc., Wareham, Massachusetts. Laboratory Project Identification No. 12550.6175/Project No. 011240. Study submitted by The Dow Chemical Company for Dow AgroSciences, LLC Midland, Michigan
MRID 458311-06

Hahne, R. 2002. GF-443: Growth Inhibition Test with the Green Alga, *Selenastrum capricornutum*. Unpublished study performed by ABC Laboratories, Inc., Columbia, Missouri. Laboratory Project Identification No. 47287/Dow Study No. 021048. Study submitted by The Dow Chemical Company, Midland, Michigan for Dow AgroSciences, LLC, Indianapolis, Indiana
MRID 458311-07

Herrera, R. 2002. XDE Metabolite 5-OH,2-AMINO-TP (TSN 101837): Growth Inhibition Test with the Freshwater Aquatic Plant, *Lemna gibba* L. G3. Unpublished study performed by ESG International Inc., Guelph, Ontario, Canada. Laboratory Study No. S2289-01. Study submitted by The Dow Chemical Company, Midland, Michigan, U.S.A. for Dow AgroSciences, LLC, Indianapolis, Indiana, U.S.A. Dow Study No. 021098.
MRID 458311-08

Herrera, R. 2002. XDE-638 Metabolite TPSA (TSN 103594): Growth Inhibition Test with the Freshwater Aquatic Plant, *Lemna gibba* L. G3. Unpublished study performed by ESG International Inc., Guelph, Ontario, Canada. Laboratory Study No. S2289-04. Study submitted by The Dow Chemical Company, Midland, Michigan, U.S.A. for Dow AgroSciences, LLC, Indianapolis, Indiana, U.S.A. Dow Study No. 021095.
MRID 458311-09

Herrera, R. 2002. XDE-638 Metabolite BSA (TSN 101980): Growth Inhibition Test with the Freshwater Aquatic Plant, *Lemna gibba* L. G3. Unpublished study performed by ESG International Inc., Guelph, Ontario, Canada. Laboratory Study No. S2289-02. Study submitted by The Dow Chemical Company, Midland, Michigan, U.S.A. for Dow AgroSciences, LLC, Indianapolis, Indiana, U.S.A. Dow Study No. 021096.
MRID 458311-10

Herrera, R. 2002. XDE-638 Metabolite 2-AMINO-TP (TSN 101824): Growth Inhibition Test with the Freshwater Aquatic Plant, *Lemna gibba* L. G3. Unpublished study performed by ESG International Inc., Guelph, Ontario, Canada. Laboratory Study No. S2289-05. Study submitted by The Dow Chemical Company, Midland, Michigan, U.S.A. for Dow AgroSciences, LLC, Indianapolis, Indiana, U.S.A. Dow Study No. 021097.
MRID 458311-11

Herrera, R. 2002. XDE-638 Metabolite BSA (TSN 101980): Growth Inhibition Test with the Freshwater Green Alga, *Selenastrum capricornutum* PRINTZ. Unpublished study performed by ESG International Inc., Guelph, Ontario, Canada. Laboratory Study No. S2288-02. Study submitted by The Dow Chemical Company, Midland, Michigan, U.S.A. for Dow AgroSciences, LLC, Indianapolis, Indiana, U.S.A. Dow Study No. 021092.
MRID 458311-12

Herrera, R. 2002. XDE-638 Metabolite TPSA (TSN 103594): Growth Inhibition Test with the Freshwater Green Alga, *Selenastrum capricornutum* PRINTZ. Unpublished study performed by ESG International Inc., Guelph, Ontario, Canada. Laboratory Study No. S2288-04. Study submitted by The Dow Chemical Company, Midland, Michigan, U.S.A. for Dow AgroSciences, LLC, Indianapolis, Indiana, U.S.A. Dow Study No. 021091.
MRID 458311-13

Herrera, R. 2002. XDE-638 Metabolite 5-OH,2-AMINO-TP (TSN 101837): Growth Inhibition Test with the Freshwater Green Alga, *Selenastrum capricornutum* PRINTZ. Unpublished study performed by ESG International Inc., Guelph, Ontario, Canada. Laboratory Study No. S2288-01. Study submitted by The Dow Chemical Company, Midland, Michigan, U.S.A. for Dow AgroSciences, LLC, Indianapolis, Indiana, U.S.A. Dow Study No. 021094.
MRID 458311-14

Herrera, R. 2002. XDE-638 Metabolite 2-AMINO-TP (TSN 101824): Growth Inhibition Test with the Freshwater Green Alga, *Selenastrum capricornutum* PRINTZ. Unpublished study performed by ESG International Inc., Guelph, Ontario, Canada. Laboratory Study No. S2288-05. Study submitted by The Dow Chemical Company, Midland, Michigan, U.S.A. for Dow AgroSciences, LLC, Indianapolis, Indiana, U.S.A. Dow Study No. 021097.
MRID 458311-15

Hoberg, J.R. 2002. XDE-638 Metabolite (BST): Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata*. Unpublished study performed by Springborn Laboratories, Inc., Wareham, Massachusetts. Laboratory Project Identification No. 12550.6169/Dow Study No. 011235. Study submitted by The Dow Chemical Company for Dow AgroSciences, LLC Midland, Michigan.
MRID 458311-17

Hoberg, J.R. 2002. 5-Hydroxy-XDE-638: Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata*. Unpublished study performed by Springborn Laboratories, Inc., Wareham, Massachusetts. Laboratory Project Identification No. 12550.6165/Dow Study No. 011232. Study submitted by The Dow Chemical Company for Dow AgroSciences, LLC Midland, Michigan.
MRID 458311-18

Hoberg, J.R. 2002. XDE-638 Metabolite (BSTCA): Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata*. Unpublished study performed by Springborn Laboratories, Inc., Wareham, Massachusetts. Laboratory Project Identification No. 12550.6173/Dow Study

No. 011238. Study submitted by The Dow Chemical Company for Dow AgroSciences, LLC Midland, Michigan.
MRID 458311-19

H.D. Kirk, M.M Gilles, E.L. McClymont, and L.G. McFadden. 2000. Effect of XDE-638 on the Growth of the Freshwater Aquatic Plant, *Lemna gibba* L. G-3. Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan. Laboratory Project Identification No. 991205. Study submitted by Dow AgroSciences, LLC, Indianapolis, Indiana.
MRID 458311-20

H.D. Kirk, M.M Gilles, E.L. McClymont, and L.G. McFadden. 2000. XDE-638: Growth Inhibition Test with the Freshwater Diatom, *Navicula pelliculosa*. Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan. Laboratory Project Identification No. 001001. Study submitted by Dow AgroSciences, LLC, Indianapolis, Indiana.
MRID 458311-21

H.D. Kirk, M.M Gilles, E.L. McClymont, and L.G. McFadden. 2000. XDE-638: Growth Inhibition Test with the Blue-green Alga, *Anabaena flos-aquae*. Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan. Laboratory Project Identification No. 001002. Study submitted by Dow AgroSciences, LLC, Indianapolis, Indiana.
MRID 458311-22

H.D. Kirk, M.M Gilles, E.L. McClymont, and L.G. McFadden. 2000. XDE-638: Growth Inhibition Test with the Saltwater Diatom, *Skeletonema costatum*. Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan. Laboratory Project Identification No. 001003. Study submitted by Dow AgroSciences, LLC, Indianapolis, Indiana.
MRID 458311-23

H.D. Kirk, M.M Gilles, E.L. McClymont, and L.G. McFadden. 2000. Effects of XDE-638 on the Growth of the freshwater green alga, *Selenastrum capricornutum* PRINTZ. Unpublished study performed by Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan. Laboratory Project Identification No. 991177. Study submitted by Dow AgroSciences, LLC, Indianapolis, Indiana.
MRID 458348-05

Terrestrial Organisms

<u>*Birds*</u>

Troup, R.R. and B.A. Medlicott. 1999. XDE-638: Avian Acute Oral Toxicity Test with Northern Bobwhite (*Colinus virginianus*). Unpublished study performed by Genesis Laboratories, Inc., Wellington, CO. Laboratory Study No. 99023. Study sponsored by Dow AgroSciences LLC, Indianapolis, IN.
MRID 458309-28

Troup, R.R. 2001. XDE-638: Avian Acute Oral Toxicity Test with Mallard Ducks (*Anas platyrhynchos*). Unpublished study performed by Genesis Laboratories, Inc., Wellington, CO. Laboratory Study No. 01005. Study sponsored by The Dow Chemical Company for Dow AgroSciences LLC, Midland, MI.
MRID 458309-29

Mach, J.J. 2002. Avian Single-Dose Oral LD_{50} Test with GF-443 in Northern Bobwhite (*Colinus virginianus*). Unpublished study performed by Genesis Laboratories, Inc., Wellington, CO. Laboratory Study No. 02004. Study sponsored by The Dow Chemical Company for Dow AgroSciences LLC, Indianapolis, IN.
MRID 458310-01

Troup, R. and B.A. Medlicott. 2002. XDE-638: Avian Acute Dietary Toxicity Test with Northern Bobwhite (*Colinus virginianus*). Unpublished study performed by Genesis Laboratories, Inc., Wellington, CO. Laboratory Study No. 99025. Study sponsored by Dow AgroSciences LLC, Indianapolis, IN.
MRID 458310-02

Troup, R.; Medlicott, B. 2000. XDE-638: Avian Acute Dietary Toxicity Test with Mallard (Anas platyrhynchos): Unpublished study prepared by Genesis Laboratories, Inc., Wellington, CO. Lab Project Number: 990118: 99024: 30498019. Study sponsored by Dow AgroSciences LLC, Indianapolis, IN.
MRID 458310-03

Medlicott, B.A., and J.J.Mach. 2001. XDE-638: Avian Reproduction Study with Northern Bobwhite (*Colinus virginianus*). Unpublished study performed by Genesis Laboratories, Inc., Wellington, CO. Laboratory Study No. 00012. Study submitted by Dow Chemical Company, Midland, MI for Dow AgroSciences LLC, Indianapolis, IN.
MRID 458310-06

Mach, J.J. 2002. XDE-638: Avian Reproduction Study in Mallard (*Anas platyrhynchos*). Unpublished study performed by Genesis Laboratories, Inc., Wellington, CO. Laboratory Study No. 02014. Study submitted by The Dow Chemical Company, Midland, MI for Dow AgroSciences LLC, Indianapolis, IN.
MRID 458310-01

Mach, J.J., and B.A. Medlicott. 2004 (Amended Final Report). XDE-638: Avian Reproduction Study with the Mallard (*Anas platyrhynchos*). Unpublished study performed by Genesis Laboratories, Inc., Wellington, CO. Laboratory Study No. 00013. Study sponsored by The Dow Chemical Company, Midland, MI for Dow AgroSciences LLC, Indianapolis, IN.
MRID 462764-01

Mammals
Bonnette, Kimberly L. 2000. XDE-638: An Acute Oral Toxicity Study in Rats. Springborn Laboratories, Inc., Spencerville, Ohio. SLI Study No. 3504.19. Study sponsored by Dow AgroSciences LLC, Indianapolis, IN.
MRID 458308-12

Bonnette, Kimberly L. 2000. GF-881: An Acute Oral Toxicity Study in Fischer 344 Rats. Springborn Laboratories, Inc., Spencerville, Ohio. SLI Study No. 3504.287. Study sponsored by Dow AgroSciences LLC, Indianapolis, IN.
MRID 458308-13

Yano, B.L., Brooks, K.J. and Radtke, B.J. 2002. GF-443: acute oral toxicity in Fischer 344 rats. Toxicology & Environmental Research and Consulting, The Dow Chemcial Company, Midland, Michigan. Laboratory Report Number 011169. Study sponsored by Dow AgroSciences LLC, Indianapolis, IN.
MRID 458308-14

Carney, E.; Stebbins, K.; Zablotny, C. 2002. XDE-638: Two Generation Dietary Reproduction Toxicity Study in CD Rats: Lab Project Number: 001125. Unpublished study prepared by The Dow Chemical Company.
MRID 458309-20

Beneficial Insects
Kranzfelder, J.A. 2000. XDE-638: Acute Contact Toxicity Test with the Honeybee, *Apis mellifera*. ABC Laboratories, Columbia, MO, 65202. ABC Study No. 45473/Dow Study No. 990122. Study sponsored by The Dow Chemical Company, Midland, MI for Dow AgroSciences LLC, Indianapolis, IN.
MRID 458311-24

Kranzfelder, J.A. 2000. XDE-638: Acute Oral Toxicity Test with the Honeybee, *Apis mellifera*. ABC Laboratories, Columbia, MO, 65202. ABC Study No. 45474/Dow Study No. 990123. Study sponsored by The Dow Chemical Company, Midland, MI for Dow AgroSciences LLC, Indianapolis, IN.
MRID 458311-25

Hahne R. and J. Aufderheide. 2002. GF-443: Acute Contact Toxicity Test with the Honeybee, *Apis mellifera*. ABC Laboratories, Columbia, MO, 65202. ABC Study No. 47288/Dow Study No. 021046. Study sponsored by The Dow Chemical Company, Midland, MI for Dow AgroSciences LLC, Indianapolis, IN.
MRID 458311-26

Hahne R. and J. Aufderheide. 2002. GF-443: Acute Oral Toxicity Test with the Honeybee, *Apis mellifera*. ABC Laboratories, Columbia, MO, 65202. ABC Study No. 47289/Dow Study No. 021047. Study sponsored by The Dow Chemical Company, Midland, MI for Dow AgroSciences LLC, Indianapolis, IN.
MRID 458311-27

Plants
Schwab, D. 2001. Penoxsulam: Effects of XDE-638 on the Emergence and Vegetative Vigor of Non-Target Terrestrial Plants (Tier II). Unpublished study performed by ABC laboratories, Inc., Columbia, MO. Laboratory Project No. 46089. Study submitted by Dow AgroSciences LLC, Indianapolis, IN.
MRID 458311-16

Earthworms
Ward, T.J., Magazu J.P., and Boeri, R.L. 1999. XDE-638: Acute Toxicity to the Earthworm, *Eisenia foetida.* Unpublished study performed by T.T. Wilbury Laboratories, Inc.,Marblehead, MA 01945. Laboratory Study No. 1848-DO. Study submitted by The Dow Chemical Company for Dow AgroSciences LLC, Midland, MI.
MRID 458308-06

Ward, T.J., Magazu J.P., and Boeri, R.L. 1999. GF-443: Acute Toxicity to the Earthworm, *Eisenia foetida* Unpublished study performed by T.T. Wilbury Laboratories, Inc.,Marblehead, MA 01945. Laboratory Study No. 1849-DO. Study submitted by The Dow Chemical Company for Dow AgroSciences LLC, Midland, MI.
MRID 458308-07