Environmental Fate and Effects Division's Risk Assessment for the Reregistration Eligibility Document for 2-methyl-4-chlorophenoxyacetic acid (MCPA)

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I. Environmental Risk Conclusions

Environmental Risks Summary

EFED established a strategy for bridging the environmental fate data requirements for the MCPA ethylhexyl ester (EHE) and MCPA dimethylamine salt (DMAS) to the MCPA acid. Bridging data were submitted to verify that MCPA DMAS and MCPA EHE will be rapidly converted to the free acid in the environment. These studies confirmed that MCPA DMAS completely dissociated to MCPA acid and dimethylammonium ion within 1.5 minutes, that in sterile buffers the hydrolysis of MCPA EHE to MCPA acid was pH dependent (half-life $\leq$117 hours at pH 9 but there was no hydrolysis at pH 5 and 7), and that in a non-sterile soil:$CaCl_2$ system at pH 5.6 and 6.8, MCPA EHE adsorbed to the soil particles, but was available for degradation to MCPA acid with a half-life of $\leq$12 hours. Therefore, EFED determined that studies conducted with the acid provide "surrogate data" for the MCPA DMAS and MCPA EHE compounds. Data submitted by the MCPA Task Force subsequent to establishment of the environmental fate bridging strategy supports the strategy.

Open literature data indicate that carboxylic acid esters can be prone to both surface-catalyzed hydrolysis and microbial mediated hydrolysis. Microbial-mediated hydrolysis of carboxylic acid esters is an enzymatic controlled process (Schwarzenbach, et al.1993). Paris, et al (1981) found that the rate of microbial degradation of 2,4-D BEE in waters typical of natural conditions and at concentrations normally encountered in rivers had an estimated mean half life of 2.6 hours and that degradation kinetics could be described using second order kinetics. Available data indicate rapid degradation of 2,4-D esters in natural waters, although microbial mediated hydrolysis rates in soils may be dependent on clay mineralogy, organic carbon content, temperature, and moisture content (Wolfe, et al, 1989 and Wolfe, 1990).

However, there is evidence for the phenoxy herbicides as a class in registrant submitted studies and in published literature which suggests that the esters of the phenoxy herbicides may persist under certain conditions. Specifically, a study by Smith and Hayden suggest that MCPA esters persist in soil under dry conditions at 15% of field capacity, while data submitted in support of 2,4-D indicate that 2,4-D EHE remains present in soil in terrestrial field dissipation studies with half lives for the ester ranging between 1 and 14 days. These facts coupled with the pH dependent hydrolysis of the ester and the increased toxicity (see below) for certain organisms necessitated an assessment of the ester exposure and risks to non-target organisms.

Similarly, EFED established a strategy for ecological toxicity studies submitted in support of MCPA and its formulations. In this document, the term formulation is used to refer to the MCPA Task Force supported technical formulations listed above, while the term end use product is used to refer to any formulated product including mixtures of pesticide sold in the US. For fish, invertebrates, and aquatic plants, data evaluating MCPA acid, sodium salt and DMAS have been bridged, while the data evaluating MCPA EHE was assessed separately. Most of the toxicity endpoints are within one order of magnitude when comparing the MCPA acid, sodium salt and DMAS. When compared to the acid and the salts, the toxicity of MCPA EHE tends to be two to three orders of magnitude greater for fish and invertebrates and one to two orders of magnitude greater for aquatic plants. For terrestrial toxicity assessments, data evaluating MCPA acid, sodium salt, DMAS, and EHE have been bridged. Within an organism group, the variation in the toxicity endpoints is less than two orders of magnitude, and for some groups, the variation is less than one order of magnitude. A limitation on these comparisons is that no studies have been submitted for birds using MCPA EHE. For this risk assessment, EFED assumed that the relationship among technical formulations of MCPA that was exhibited in the mammal LD_{50} studies will also hold for the bird studies.

EFED has considered available information on all formulations of MCPA for toxicity, potential use areas, fate properties, and application methods in characterizing ecological risks related to labeled use. Upon review and synthesis of this information, EFED believes MCPA presents the greatest risks to birds and mammals through direct application to treated fields and to non-target plants through spray drift and runoff as compared to the other taxonomic groups evaluated in this assessment. Modeling results also indicate potential risks to endangered species including estuarine/marine invertebrates, freshwater vascular plants, birds, mammals, and terrestrial non-target plants. Based on the submitted toxicity studies, the potential for MCPA to have adverse effects on pollinators and other beneficial insects is low.

Based on the physical chemical properties of the ester formulation of MCPA and on evidence from the open literature there may be a concern for impacts to non-target organisms due to volatilization and off-site deposition of MCPA EHE. Currently, EFED includes an assessment of the effect of drift in both the aquatic and terrestrial risk assessments. However, EFED does not typically assess the impact of volatility, long-range transport and deposition as a route of exposure in its risk assessment process without evidence which indicates its likelihood. EFED has conducted a screening level assessment of the potential exposure of terrestrial organisms due to volatility of MCPA acid and MCPA EHE.

The findings discussed below are based on the assessment of the maximum label rate for all uses (i.e. pasture at 4 lbs ai/acre). Exceedances based on the maximum label rate for pasture are representative of those areas where MCPA is used on pasture but are not representative of the majority of MCPA use which is on wheat and small grains with a maximum label rate at least 2 times less than pasture. For terrestrial organisms this will result in a linear reduction in risk quotients and hence a reduction in or elimination of exceedances of levels of concern (LOC). However, it should be noted that there will still be exceedances of LOCs for non-target plants for the wheat and small grain label rates. Similarly, risk is further reduced when evaluating typical rates (see the BEAD report for details on these rates) relative to label rates which are typically less than 1 pound per application per year (lb/app/yr) for major crops while minor crops are typically less than 2 lb/app/yr. For both major and minor uses this will further reduce the risk, however, exceedances of LOCs still occur for both major and minor uses on **non-target plants and mammals**.

In this risk assessment, modeling results did not indicate potential concerns for freshwater and estuarine marine fish, and freshwater invertebrates.

Drinking Water Summary

The proposed surface water-derived drinking water concentrations presented in acid equivalents (ae) for use in the human health risk assessment are derived from modeling and are:

> **47.3 ug ae/l** for the 1 in 10 year annual peak concentration (acute)
> **1.9 ug ae/l** for the 1 in 10 year annual mean concentration (non-cancer chronic) and
> **1.2 ug ae/l** for the 30 year annual mean concentration (cancer chronic).

The PRZM/EXAMS model results are recommended for use in the human health risk assessment since monitoring data available for MCPA are not specific to areas of use of MCPA. The recommended concentrations in surface water were derived from the Pennsylvania pasture scenario which has the highest labeled application rate (4 lbs ae/acre) of the scenarios modeled. The predicted surface water-derived drinking water concentrations will vary depending on regional climate, soil, environmental characteristics, and watershed characteristics. These model estimates are approximately double the peak (acute) concentration of **18.58 ug ae/l** detected in the monitoring data and roughly equivalent to the maximum time weighted annual mean (TWM) concentration of **1.49 ug ae/l**.

MCPA concentrations in surface source drinking water impacted from rice production were estimated using an interim screening level model developed by EFED. A description of the screening level rice model may be found in the EFED policy memorandum dated October 29, 2002 attached to Appendix B. Model simulation of the maximum seasonal MCPA application rate of 1.25 pounds ae/A results in a screening level peak and chronic drinking water concentration of **1222 ug ae/l**. This value is expected to represent a bounding concentration for peak and annual average drinking water concentrations for MCPA because the model represents an edge of paddy concentration rather than an actual concentration at a drinking water utility.

The SCI-GROW model estimate of MCPA concentration in drinking water from shallow groundwater sources is **2.13 ug ae/l** using the pasture/rangeland application rate of 4 lbs ae per acre. MCPA was not detected in the NAWQA or STORET groundwater monitoring data evaluated for this assessment. The estimated concentration can be considered as both the acute and chronic value.

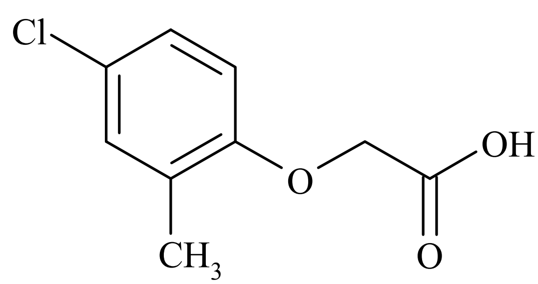
Several degradates were detected in the laboratory fate studies reviewed. The degradates detected were 4-chloro-o-cresol (4-CC), 5-chlorosalicylaldehyde, and $^{14}CO_2$. 4-chloro-2-methylanisole (4-MCA) was postulated by the registrant to be a potential degradate of MCPA but was not detected in any of the laboratory or field studies. The Metabolite Assessment Review Committee (MARC) has determined that none of these degradates are of toxicological concern, therefore, no degradates were included in the drinking water assessment.

II. Introduction

Physical and Chemical Properties

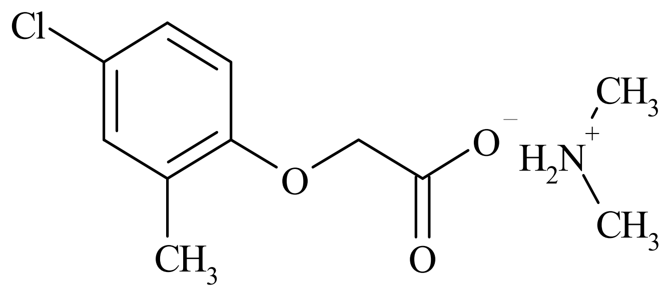
Common name:	MCPA acid
Chemical name:	2-methyl-4-chlorophenoxyacetic acid
Molecular formula:	$C_9H_9ClO_3$
CAS Number:	94-74-6
Molecular weight:	200.6
Physical state:	white to light brown solid, flake, or microcrystalline powder
Melting point:	114-119 C
Vapor pressure (20°C):	7.7×10^{-6} mbar at 20 C
Henry's Law:	5.08×10^{-9} atm-m^3/mol
Solubility:	practically insoluble in water (0.03 g/100 g at 20 C)
Log K_{ow}:	2.828

Chemical structure of MCPA:



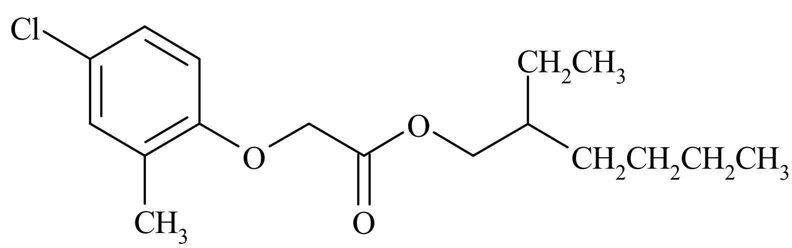
Common name:	MCPA dimethylamine salt (DMAS)
Chemical name:	diethylamine 2 -methyl
Molecular formula:	$C_{11}H_{16}ClNO_3$
CAS Number:	2039-46-5
Molecular weight:	245.7
Physical state:	pale yellow or yellowish-white liquid
Boiling point:	111 C
Vapor pressure:	Not reported (rapidly dissociates in water)
Henry's Law:	Not reported (rapidly dissociates in water)
Solubility:	Not reported (rapidly dissociates in water)
Log K_{ow}:	1.415 at 25 C

Chemical structure of MCPA DMAS:



Common name:	MCPA EHE
Chemical name:	2-ethylhexyl 2-methyl-4-chlorophenoxyacetate
Molecular formula:	$C_{17}H_{25}ClO_3$
CAS Number:	29450-45-1
Molecular weight:	312.5
Physical state:	amber to brown liquid
Boiling point:	260-265 C
Vapor pressure:	1.77×10^{-5} mbar at 20 C
Henry's Law:	5.47×10^{-6} atm-m^3/mol
Solubility:	slightly soluble in water (0.1%, w:w)
Log K_{ow}:	5.37

Chemical structure of MCPA EHE:



Mode of Action

MCPA is an herbicide in the phenoxy or phenoxyacetic acid family that is used postemergence for selective control of broadleaf weeds. MCPA, a synthetic auxin herbicides, causes disruption of plant hormone responses. Auxins are plant growth regulator hormones. These growth-regulating chemicals cause the disruption of multiple growth processes in susceptible plants by affecting proteins in the plasma membrane, interfering with RNA production, and changing the properties and integrity of the plasma membrane. The plant's vascular system becomes blocked due to excessive cell division and the resulting growth crushes the vascular transport system. The most susceptible tissues are those that are undergoing active cell division and growth (Gibson, 2003).

Plant injuries may include growth and reproduction abnormalities, especially on new growth. Stem and petiole twisting (epinasty), leaf malformations (parallel venation, leaf strapping, and cupping), undifferentiated cell masses and adventitious root formation on stems, and stunted root growth is experienced by broadleaf plants. Rolled leaves (onion leafing), fused brace roots, leaning stems, and stalk brittleness are observed on grass plants. Disruption of reproductive processes may occur resulting in sterile or multiple florets and nonviable seed production. Symptoms may appear on young growth almost immediately after application, but death may not occur for several weeks.

MCPA Formulations and Use Characterization

For this risk assessment, 2-methyl-4-chlorophenoxyacetic acid (MCPA) comes in multiple formulations and is found in numerous end use products intended for use in a wide range of use patterns. Formulation types registered include solids, soluble concentrate/solid, water dispersible granules (dry flowable), and wettable powder. Methods of application include controlled droplet applicator, high volume ground sprayer, low volume ground sprayer, hand held sprayer, aerial and ground broadcast, high volume spray (dilute), low volume spray (concentrate), and spot treatment. Timing of application includes dormant, early fall, early spring, fall, late spring postemergence, spring, and summer. Table 1 presents a summary of the registered MCPA use sites.

MCPA is an ingredient in several agricultural and home use products, as a sole active ingredient and in conjunction with other active ingredients. MCPA is formulated primarily as an amine in an aqueous solution or as an ester in an emulsifiable concentrate. Supported formulations are as MCPA acid (30501), MCPA DMAS (30516), MCPA EHE (30564), and MCPA Sodium (Na) salt (30502). Copies of all labels may be found at http://www.cdpr.ca.gov/docs/epa/m2.htm.

Based on available pesticide survey usage information for the years 1988 through 1998, an annual estimate of MCPA total domestic usage averaged approximately 4.6 million pounds active ingredient (a.i.) for almost 12 million acres treated. Most of the acreage is treated with one pound a.i. or less per application and one pound a.i. or less per year. MCPA is a broad spectrum herbicide with its largest markets in terms of total pounds active ingredient allocated to spring wheat at 56%, winter wheat and barley at 17% each, oats/rye at 4%, and rice at 2% (see the BEAD Quantitative Use Analysis). The remaining usage is primarily on seed crops, pasture, hay, lots/farmsteads, dry beans/peas, and flax. Crops with a high percentage of the total U.S. planted acres treated include spring wheat (33%), barley (28%), flax (23%), summer fallow (9%), oats/rye (8%), and green beans/peas (4%), while registered sites with little or no usage are the remaining crops in the usage profile. Most of the usage is in Michigan, California, Oregon, Idaho, North Carolina, Florida, Ohio, New York, Texas, Minnesota, North Dakota, and Washington (Figure 1).

Table 1. Registered MCPA Uses	
Crop Grouping	**Representative Crops**
Terrestrial food and feed crop	Barley, Barley-legume mixture, Flax, Oats, Oats-legume mixture, Peas (unspecified), Rice, Rye, Rye-legume mixture, Wheat, Wheat-legume mixture
Terrestrial feed crop	Alfalfa, Clover, Grass forage/fodder/hay, Lespedeza, Pastures, Rangeland, Trefoil, Vetch
Terrestrial non-food crop	Agricultural rights-of-way/fence rows/hedgerows, Agricultural uncultivated areas, Commercial/industrial lawns, Commercial/institutional/industrial, premises/equipment (outdoor), Golf course turf, Nonagricultural rights-of-way/fence rows/hedgerows, Nonagricultural uncultivated areas/soils, Ornamental sod farm (turf), Recreation area lawns, Recreational areas, Soil, pre-plant/outdoor
Terrestrial non-food and outdoor residential	Nonagricultural, rights-of-way/fence rows/hedgerows, Ornamental lawns and turf,
Outdoor residential	Household/domestic dwellings outdoor premises, Residential lawns

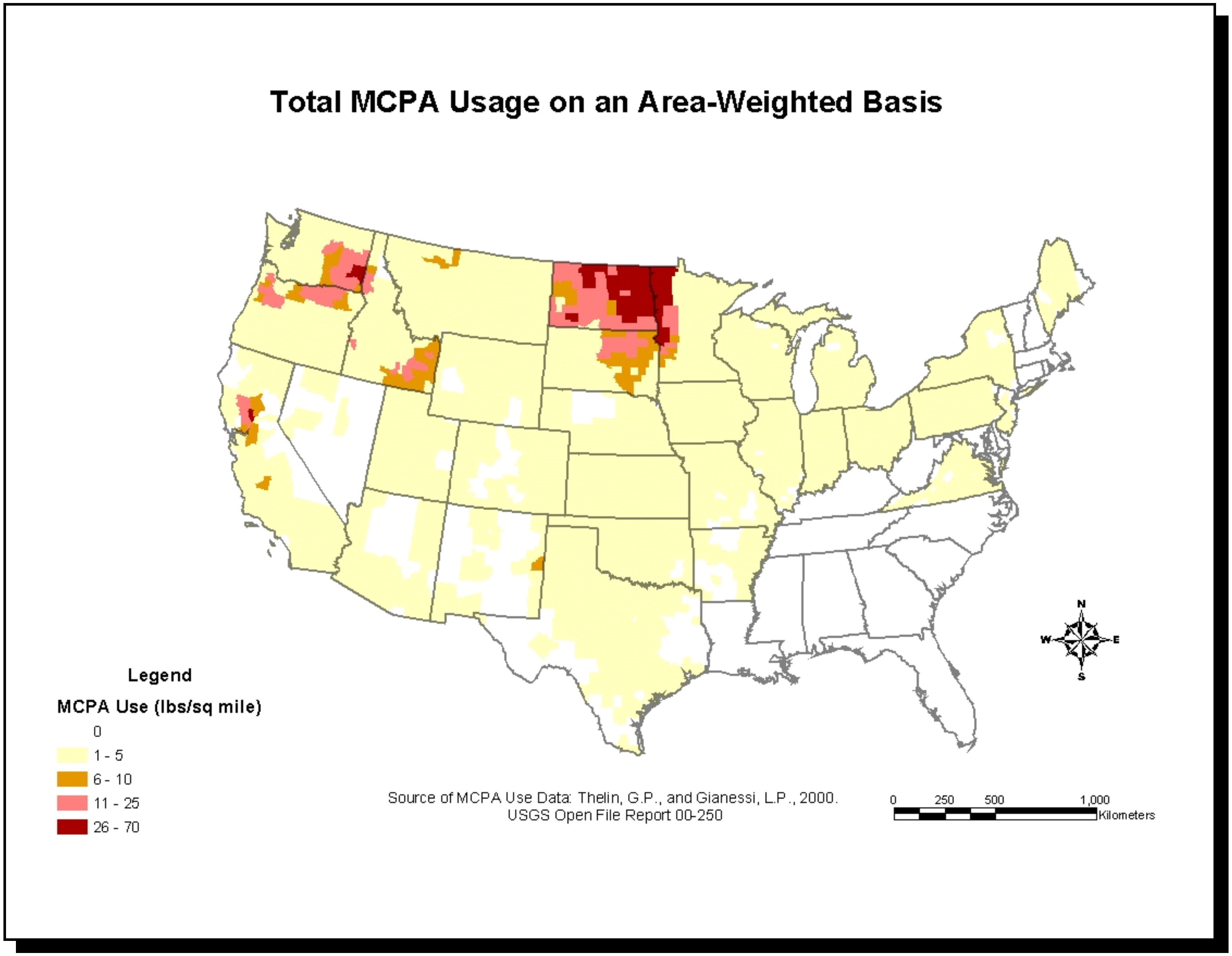


Figure 1. Estimated MCPA usage (lbs ai/square mile). The estimates are based on pesticide use rates from 1994 to 1998 compiled by the National Center for Food and Agricultural Policy (NCFAP) and modified by Thelin, G.P. and Gianessi, L.P., 2000 (USGS Open-File Report 00-250).

Risk Assessment Approach and Scenarios

This document includes an assessment of risks to aquatic and terrestrial organisms resulting from the use of MCPA and its various formulations. The risk assessment approach included an evaluation of available surface water and groundwater monitoring data as well as environmental modeling. The estimated environmental concentrations (EEC) used for the risk assessment are based on model predictions. EFED believes that the available monitoring data is non-targeted to MCPA use because it was not collected with the intention of capturing maximum acute and chronic MCPA concentrations. Targeted monitoring data should be collected with a sampling frequency specifically designed to capture peak runoff events coinciding with a specific pesticides use and with a duration designed to provide sufficient data to estimate long term exposures while being specifically tailored to the individual geography and crop uses of the target pesticide. The monitoring data used in this assessment, while of high quality, was not collected specifically with MCPA use in mind and is therefore considered to be non-targeted to MCPA use. The monitoring data evaluated in this assessment was used for comparison against model predictions. Specific uses chosen for modeling include pasture/rangeland, wheat, sorghum, peas, and turf (Table 2). Although these uses represent only a portion of the crops for which MCPA has a labeled use, crops with highest application rates and crops which have a large percentage of their total acreage treated with MCPA are among these uses. Some crops with large total acreage treated were also included as modeled scenarios. These crops were also chosen to represent a wide geographic area, thus encompassing a variety of environmental conditions. By encompassing crops with large percentages of acreage treated with MCPA and a large geographic area, some crops with lower maximum application rates were also covered by the set of scenarios. All application rates were adjusted to acid equivalents. Risks to aquatic organisms (i.e. fish, invertebrates, and plants) and terrestrial organisms (i.e. birds, mammals, and plants) are assessed based on modeled Estimated Environmental Concentrations (EECs). This document also includes a summary of the assessment of potential MCPA residues in drinking water.

Table 2. Exposure Scenarios for MCPA Risk Assessment

Crop (location)	Application Rate in acid equivalents (lbs ae/acre)	Application number/type	Application dates	Label Reference (Registration Number)
North Dakota wheat	1.5	1	June 1, 19xx	MCPA Amine 4 (2217-3632)
Oregon wheat	1.5	1	May 15, 19xx	MCPA Amine 4 (2217-3632)
California pasture	4.0	1	February 1, 19xx	Riverdale Veteran 2010 (228-296)
Pennsylvania pasture	4.0	1	June 1, 19xx	Riverdale Veteran 2010 (228-296)

Table 2. Exposure Scenarios for MCPA Risk Assessment				
Crop (location)	**Application Rate in acid equivalents (lbs ae/acre)**	**Application number/type**	**Application dates**	**Label Reference (Registration Number)**
Minnesota pasture	4.0	1	June 1, 19xx	Riverdale Veteran 2010 (228-296)
Kansas sorghum	0.75	1	June 15, 19xx	MCPA Na Salt (62719-58)
Oregon peas	0.375	1	May 15, 19xx	Gordon's MCPA Amine 4 (2217-3632)
Pennsylvania turf	2.0	1	June 1, 19xx	Gordon's MCPA Amine 4 (2217-3632)
Rice	1.25	1	NA	MCPA Sodium Salt (5905-510)

EFED established a fate strategy for bridging the fate data requirements for the MCPA EHE and MCPA DMAS to the MCPA acid. Bridging data were submitted to verify that MCPA DMAS and MCPA EHE will be rapidly converted to the free acid in the environment. The submitted studies confirmed that MCPA DMAS completely dissociated to MCPA acid and dimethylammonium ion within 1.5 minutes, that in sterile buffers the hydrolysis of MCPA EHE to MCPA acid was pH dependent (half-life ≤117 hours at pH 9 but there was no hydrolysis at pH 5 and 7), and that in a soil:$CaCl_2$ system at pH 5.6 and 6.8, MCPA-EHE adsorbed to the soil particles, but was available for degradation to MCPA with a half-life of ≤12 hours. Additional data submitted subsequent to establishment of the environmental fate bridging strategy support the strategy, including a terrestrial field dissipation study using MCPA EHE which indicates that greater than 80% of MCPA EHE converted to MCPA acid on the day of application and nearly all MCPA EHE was converted by day 3, a open literature study by Harrison, et al (1993) which indicate that application of esters of phenoxy herbicides (2,4-D and 2,4-D P) were not detected in runoff at the site, though acid was detected. Overall EFED believes this data supports the environmental fate bridging strategy and that studies conducted with the acid provide "surrogate data" for MCPA DMAS and MCPA EHE.

As noted above, abiotic hydrolysis of MCPA EHE to MCPA acid is pH dependent which raises the concern of the impact of the drift of MCPA EHE to acidic aquatic environments when spray applied. Runoff of MCPA EHE to aquatic systems was not considered in this scenario and it is noted that there is evidence that microbially active aquatic environments will temper the pH dependence of the hydrolysis of MCPA EHE. However, in order to account for the potential impact of the spray application of MCPA EHE to aquatic environments, EFED completed an estimation of the drift of MCPA EHE consistent with EFED standard assumptions for each scenario used in the standard aquatic ecological exposure assessment (see above for scenarios).

The estimation of drift of MCPA EHE to the standard aquatic pond was assumed for each scenario assuming 5% aerial spray drift for each scenario except turf with a ground spray drift of 1% (see EFED "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002.). The amount of loading for each scenario was estimated by converting the application rate of the respective ester product to the drift loading by multiplying the application amount (as an example 4.48 kilograms per hectare) by the drift (5% for aerial application). The resulting loading to the standard pond (0.22 kg to the 1 hectare pond) was converted to an acute concentration by dividing the loading to the standard pond by the volume of the pond (20,000,000 liters). The resulting concentration represents the maximum instantaneous concentration predicted by direct drift from the application to the pond. Only the peak (acute) EECs for MCPA EHE were estimated for each scenario. A chronic EEC was not provided in this scenario because it is felt that the hydrolysis soil slurry data indicate that dissipation in a non-sterile water body will occur at all pHs and therefore long-term exposures are unlikely.

There is evidence for the phenoxy esters as a class to suggest that the conversion of MCPA EHE to MCPA acid may not be rapid under all conditions. As evidence of this, Smith and Hayden noted that conversion did not occur immediately under dry condition at 15% field capacity. Additionally, an analysis of terrestrial field dissipation data collected for 2,4-D EHE indicates that the ester remains in the field with half lives between one and 14 days. It is important to note that these dry conditions will effect crop yield and it is likely that in a typical setting a farmer will irrigate to add moisture to the soil or abandon the crop. These facts, coupled with the increased toxicity to certain organisms for MCPA EHE, raises questions about whether a single terrestrial field dissipation study for MCPA EHE is sufficient to capture the behavior of MCPA EHE under a range of actual use conditions. **This uncertainty could be addressed through the submission of laboratory fate data for MCPA EHE which will allow for direct comparison of the fate behavior with MCPA acid.** In order to account for the potential for runoff during the time in which MCPA EHE may remain in the field, EFED conducted additional modeling with PRZM/EXAMS to assess the potential for aquatic organisms to be exposed to MCPA EHE when applied to the same terrestrial crops as modeled in the ester drift scenario.

Finally, based on the physical chemical properties of the ester formulation of MCPA and on evidence from the open literature there may be a concern for impacts to non-target organisms due to volatilization and off-site deposition of MCPA EHE. The state of Florida recently passed the Organo-Auxin Herbicide Rule which restricts the use of highly volatile esters based on concerns over volatility, however, these banned esters are high volatility esters and do not include MCPA EHE (email from Dale Dubberly, Florida Department of Agriculture and Consumer Services, dated August 12, 2003). Other states report incidences of off-site impact from the use of MCPA through a combination of drift and volatility and have banned, restricted or issued warnings on the use of phenoxy esters in warm or dry conditions. Currently, EFED includes an assessment of the effect of drift in both the aquatic and terrestrial risk assessments. However, EFED does not typically assess the impact of volatility, transport and deposition as a route of exposure in its risk assessment process unless there is evidence to suggest a potential for this route of exposure. EFED has conducted a screening level assessment of the potential exposure of terrestrial organisms due to volatility of MCPA acid and MCPA EHE. However, the effect of volatility of MCPA EHE on non-target organisms should be viewed as a source of uncertainty in this assessment.

III. Integrated Environmental Risk Characterization

EFED has considered available information on MCPA's toxicity, use areas, usage, fate properties, and application methods and formulations in characterizing ecological risks related to normal use. Upon review and synthesis of this information, EFED believes MCPA presents the greatest risks to: (1) non-target terrestrial plants and (2) mammals.

MCPA acid and salts are classified as practically non-toxic to moderately toxic, while the ester formulation of MCPA is classified as moderately toxic to highly toxic. MCPA may contaminate surface water through spray drift and runoff. MCPA has the potential to contaminate ground water because it is relatively mobile in the soil column; therefore, the likelihood of leaching is high.

EFED established a strategy for bridging the environmental fate data requirements for the MCPA ethylhexyl ester (EHE) and MCPA dimethylamine salt (DMAS) to the MCPA acid. Bridging data were submitted to verify that MCPA-amine salt and MCPA-EHE will be rapidly converted to the free acid in the environment. These studies confirmed that in a dissociation study, MCPA DMAS completely dissociated to MCPA and dimethylamine ion within 1.5 minutes. Two hydrolysis studies were included in this package for MCPA EHE which indicate that in sterile buffers at pH 5, 7, and 9, MCPA-EHE hydrolyzed to MCPA with a half-life $\leq$117 hours at pH 9 but there was no hydrolysis at pH 5 and 7. In the second hydrolysis study done in a soil:$CaCl_2$ system at pH 5.6 and 6.8, MCPA-EHE adsorbed to the soil particles, but was available for degradation to MCPA with a half-life of $\leq$12 hours. Therefore, EFED determined that studies conducted with the acid provide "surrogate data" for the MCPA-amine salt and MCPA-EHE compounds.

Data submitted subsequent to establishment of the environmental fate bridging strategy support the strategy. Data from a terrestrial field dissipation study using MCPA EHE indicate that greater than 80% of MCPA EHE converted to MCPA acid on the day of application and nearly all MCPA EHE was converted by day 3, while terrestrial field dissipation data submitted for MCPA iso-octyl ester (equivalent to EHE) report half lives of 9 and 23 days for MCPA iso-octyl ester. However, the analytical technique employed in the iso-octyl ester study reports total MCPA residues (ester and acid formulations) and therefore the half lives represent total MCPA residue half lives. Additionally, data by Harrison, et al (1993) indicate that for turfgrass sites applied with esters of phenoxy herbicides (2,4-D and 2,4-DP), no esters were detected in runoff water (though detection limits were relatively high at 20 ug/l for 2,4-D EHE), but 2,4-D acid was detected at concentrations as high as 312 ug/l in runoff. Open literature data indicate that carboxylic acid esters can be prone to both surface-catalyzed hydrolysis and microbial mediated hydrolysis. Microbial-mediated hydrolysis of carboxylic acid esters is an enzymatic controlled process (Schwarzenbach, et al.1993). Paris, et al (1981) found that the rate of microbial degradation of 2,4-D BEE in waters typical of natural conditions and at concentrations normally encountered in rivers had an estimated mean half life of 2.6 hours and that degradation kinetics could be described using second order kinetics. Available data indicate rapid degradation of 2,4-D esters in natural waters, although microbial mediated hydrolysis rates in soils may be dependent on clay mineralogy, organic carbon content, temperature, and moisture content (Wolfe, et al, 1989 and Wolfe, 1990).

Conversely, data from Smith and Hayden (1980) indicate that MCPA EHE which was surface applied to soils in Saskatchewan were rapidly converted to MCPA acid, however under dry conditions (15% of field capacity) the ester persisted for days with greater than 90% present after 48 hours. It is important to note that these dry conditions will effect crop yield and it is likely that in a typical setting a farmer will irrigate to add moisture to the soil or abandon the crop. Therefore, EFED believes the data reviewed supports the environmental fate bridging strategy for MCPA DMAS and MCPA EHE with the exception of dry field conditions where there is uncertainty as to the ultimate fate of the ester.

The exposure assessment relies on a combination of monitoring data and modeling. The EECs used for the risk assessment are based on model results due to the non-targeted nature of the available monitoring data for MCPA. Aquatic modeling was completed using the Tier I SciGrow model, a screening level model for acute aquatic exposure to the spray drift of the ester formulation, a screening level rice model, and the Tier II PRZM/EXAMS model to estimate exposure to MCPA and its various formulations in a variety of aquatic exposure scenarios. The screening level ester drift scenario was completed to evaluate the potential for acute exposure due to spray application of the ester formulation which is more toxic to aquatic organisms than the acid and amine salt formulations. Uses modeled using the Tier II model were rice, wheat in North Dakota and Oregon, peas in Oregon, sorghum in Kansas, and rangeland/pastureland in California, Pennsylvania, and Minnesota using EFED standard scenario for alfalfa in each state. For the uses of MCPA and its formulations the scenarios chosen for this assessment represent all available PRZM/EXAMS scenarios. Although these scenarios only represent a portion of the crops for which MCPA has a labeled use, it represents crops with higher application rates and crops which have a large percentage of their total acreage treated with MCPA. EFED has developed a suite of PRZM scenarios for specific crop state combinations. These scenarios are not limited to the particular county and soil series on which they were created but are in fact intended to be representative of a more regional use pattern for the particular crop modeled.

MCPA has been detected in monitoring data from several areas of the country. In particular, MCPA was detected along the North Dakota/Minnesota border, Washington and Oregon possibly associated with use on wheat, in the Central Valley of California and Mississippi possibly associated with rice, and scattered locations in Michigan, Texas, Georgia, and Virginia.

For birds and mammals, toxicant concentrations on food items, based on data from by Hoerger and Kenaga (1972) and Fletcher et al. (1994), are predicted using a first-order residue decline method. EFEDs “FATE5" model predicted maximum and mean EECs resulting from single or multiple applications. Acute and Chronic RQs are calculated using these EECs and appropriate toxicity data.

EFED's TerrPlant.xls model (Version 1.0) models pesticide exposure to terrestrial plants inhabiting dry and semi-aquatic through runoff and spray drift. The model incorporates water solubility, amount of pesticide present on the soil surface and top one inch of soil, and method of application. EECs are calculated for the following application methods: (1) unincorporated ground applications, (2) incorporated ground application, and (3) aerial, airblast, forced-air, and chemigation applications. Runoff from granular applications is similarly modeled.

For fish, invertebrates, and aquatic plants, data evaluating MCPA acid, sodium salt and DMAS have been bridged, while the data evaluating MCPA EHE was assessed separately. Most of the toxicity endpoints are within one order of magnitude when comparing the MCPA acid, sodium salt and DMAS. When compared to the acid and the salts, the toxicity of MCPA EHE tends to be two to three orders of magnitude greater for fish and invertebrates and one to two orders of magnitude greater for aquatic plants. For terrestrial toxicity assessments, data evaluating MCPA acid, sodium salt, DMAS, and EHE have been bridged. Within an organism group, the variation in the toxicity endpoints is less than two orders of magnitude, and for some groups, the variation is less than one order of magnitude. A limitation on these comparisons is that no studies have been submitted for birds using MCPA EHE. For this risk assessment, EFED assumed that the relationship among technical formulations of MCPA that was exhibited in the mammal LD_{50} studies will also hold for the bird studies.

Spray Drift Risks to Non-target Terrestrial Plants

The risk assessment suggests concern for non-target terrestrial plants across all use sites. The Acute Endangered Terrestrial Plant RQs and the Acute Non-Endangered Terrestrial Plant RQs exceeded the LOC for all the modeled scenarios at the highest labeled application rate (4 lbs ae/acre). At the highest labeled rate for wheat (1.5 lbs ae/acre), the Acute Endangered Species LOCs and Acute Non-endangered Species LOCs were exceeded for all except for drift to non-target non-endangered monocots from ground application. At the highest labeled rate for granular applications (1.09 lbs ae/acre), all Acute Endangered Species LOCs and all Acute Non-endangered Species LOCs were exceeded. Even at a more typical rate of 0.5 lbs ae/acre, all Acute Endangered Species LOCs and all Acute Non-endangered Species LOCs were exceeded except for drift from ground spray to all monocots and drift from aerial spray to non-endangered monocots.

The risk assessment for terrestrial plants was based on RQs calculated from toxicity studies using the technical grade of MCPA acid, salt, and esters instead of a typical end-use product (TEP). Often the TEPs include surfactants or adjuvants to increase the herbicide's adsorption into the plant, thereby increasing its efficacy. If the toxicity tests were conducted using a TEP of MCPA at the same rates as the technical grade, the toxicity endpoints are likely to be lower. In addition, the TEP testing may indicate differential toxicities among the formulations that was not observed with technical testing.

MCPA uptake is primarily through the foliage and it is translocated throughout the plant in the xylem and phloem. Uptake also occurs through the roots. Even if only a small surface area of the plant is exposed to MCPA, or a seedling is exposed to MCPA as it breaks through the soil surface, there is a possibility that the plant may be severely damaged or die as a result. The resulting damage, even if only minor, may be sufficient to prevent the plant from competing successfully with other plants for resources and water.

Plant material serves as a primary food source for many species of animals. If the available plant material (including seeds) are reduced due to the effects of MCPA, this may have negative effects throughout the food chain. Also, depending on the severity of impacts to the plant communities, habitats of other organisms may be altered due to reduced plant material (e.g., increased light penetration and temperatures in aquatic habitats due to reduced plant cover). Application timing should also be considered, as reproduction abnormalities are some of the plant injuries that can possibly occur due to MCPA exposure. Although the plant may survive, sterile florets or nonviable seed production can occur. If this does occur, there may be effects on the affected non-target plant populations in future years as they recover from the rapid population decline.

Effects on non-target terrestrial plants are most likely to occur as a result of spray drift from aerial and ground applications of the liquid formulation. Spray drift is an important factor in characterizing the risk of MCPA to non-target plants. There is as much as a 5-fold increase in the RQs when aerial application is used as opposed to ground application. MCPA applied according to label directions as a liquid spray for ground or aerial applications may impact non-target plants for some distance from the application site depending on droplet size, wind speed, and other factors. MCPA product labels do not specify a required or recommended droplet size for spray applications. MCPA applied as a fine or medium spray has the potential to damage off-target plants. Coarse sprays may also damage non-target plants through drift, but generally closer to the target site. The available terrestrial plant toxicity studies are expected to underestimate the toxicity of MCPA to plants because these toxicity studies were not conducted with formulated herbicide. Typically, herbicides are more toxic to plants when tests are conducted using a formulation. MCPA toxicity to plants would be expected to be greater in the presence of additives that improve its ability to penetrate into plants.

Spray drift exposure from ground application is assumed to be 1% of the application rate and the EECs and RQs were calculated using EFED's TerrPlant.xls model (Version 1.0). EFEDs TerrPlant model can be interpreted to represent exposure to non-target terrestrial plants as either drift from ground spray at a distance of 25 ft from the edge of the field, or as an average exposure across a swath 175 feet wide starting at the edge of the field. In both scenarios, exposures can be expected to be higher close to the edge of the field than at distances further from the field.

Based on the physical chemical properties of the ester formulation of MCPA and on evidence from the open literature there may be a concern for impacts to non-target organisms due to volatilization and off-site deposition of MCPA EHE. Currently, EFED includes an assessment of the effect of drift in both the aquatic and terrestrial risk assessments. However, EFED does not typically assess the impact of volatility, long-range transport and deposition as a route of exposure in its risk assessment process unless there is evidence to suggest a potential for this route of exposure. EFED has conducted a screening level assessment of the potential exposure of terrestrial organisms due to volatility of MCPA acid and MCPA EHE. However, the effect of volatility of MCPA EHE on non-target organisms should be viewed as a source of uncertainty in this assessment.

For MCPA, a total of 60 terrestrial plant studies were submitted using various formulations and species. Although a range of sensitivities to MCPA was observed in the studies, a majority of the tests indicated that all plant species are sensitive. For example, if the 75^{th} percentile of the definitive EC_{25}s (0.096 lbs ae/acre) is used as the toxicity endpoint to calculate non-endangered species non-granular RQs, all RQs (range from 2.50 to 21.25) exceeded an LOC of 1.0 for adjacent terrestrial and semi-aquatic non-target plants at an application rate of 4.0 lbs ae/acre. For lower application rates, the RQ would decrease linearly.

Risks to Birds and Mammals

Using the acute dietary bird toxicity studies, risks for acute lethal concerns to birds are low, as no mortality was observed at the highest dose. However, based on the gavage study and assuming maximum application rates and maximum predicted residue levels for spray applications, the Acute Risk LOC, Acute Restricted Use LOC, and the Endangered Species LOC were exceeded for all birds consuming short grasses and smaller birds (i.e., 20 and100 g) consuming tall grass, broadleaf forage, and/or small insects when using the acute gavage studies. The Acute Restricted Use LOC and the Endangered Species LOC were exceeded for large birds (i.e., 1000 g) consuming tall grass, broadleaf forage, and/or small insects and for small birds (i.e., 20 g) consuming fruit and large insects. The Endangered Species LOC was exceeded for medium birds (i.e., 100 g) consuming fruit and large insects. There were no LOC exceedances for birds consuming seeds and pods. Even at the 1.5 lbs ae/acre rate with maximum predicted residue levels, there were still exceedances of the Acute Risk LOC (20 and 100 g birds consuming short or tall grasses and 20 g birds consuming broadleaf forage or small insects) as well as exceedances of the Acute Restricted Use and Endangered Species LOCs. For granular applications, at a maximum application rate of 1.09 lbs ae/acre, EFED does not have concerns for acute bird toxicity, based on the LD_{50}-per-square-foot methodology.

Based on the acute toxicity studies submitted for birds, there is a large differential between the acute toxicity when MCPA is administered as a single gavage or when mixed in the feed. In the two gavage studies the calculated LD_{50}'s were 377 and 221 mg ae/kg-bird while in the two dietary studies, no mortalities were observed at the maximum treatment level of 4608 mg ae/kg-diet. Adverse effects were observed at lower doses including reduced feed consumption at 1460 mg ae/kg-diet in bobwhite quail and reduced body weight gain at 820 mg ae/kg-diet in mallard ducks. This disparity in mortality between the two studies suggests that the dietary matrix may have a lowering effect of the toxicity of MCPA.

Although no mortality was observed in the dietary studies conducted using MCPA DMAS, negative effects were observed. Using a 4 lb ae/acre application rate and predicted maximum residues, the highest modeled EEC (short grass, 960 mg ae/kg-diet) was higher than the NOAECs from both the bobwhite quail and the mallard duck study. At an application rate of 1.5 lbs ae/acre (maximum rate on wheat) with predicted maximum residues, the highest modeled EEC (short grass, 360 mg ae/kg-diet) was less than the NOAEC from either dietary study. Although there are no concerns for lethality from MCPA exposure to non-endangered birds, it is likely that the current maximum label rates could have adverse non-lethal effects on birds, especially those consuming short grasses. However, at maximum label rates for wheat (1.5 lbs ae/acre) there are no concerns for non-lethal effects to birds.

Risks to endangered bird species include sublethal effects and lethal effects exist due to the uncertainty in variability among species sensitivities. These risks would be greatest to short grass consumers, primarily smaller birds.

Based on the one chronic bird study submitted to the Agency and the predicted exposure levels, the risk of adverse chronic effects to birds is low.

As with birds, there were exceedances of the acute LOCs for mammals using predicted maximum residue levels and predicted mean residue levels at the maximum application rates. At the maximum application rate for wheat (1.5 lbs ae/acre) with predicted maximum residues, there will be no exceedances of the Acute Risk LOCs; however, there will still be exceedances of the Acute Restricted Use and Endangered Species LOCs for smaller mammals (i.e., 15-35 gms) that consume short or tall grasses. For granular applications, at a maximum application rate of 1.09 lbs ae/acre, EFED does not have concerns for acute mammal toxicity, based on the LD50-per-square-foot methodology.

The differential between the acute gavage studies and the subchronic dietary studies does not appear as large as the toxicity difference observed between the gavage and dietary studies for birds. The LD_{50}'s for the gavage studies ranged from 1383 to 3175 mg ae/kg-bwt. Treatment related mortality was only observed in one of the subchronic dietary studies. However, all the subchronic toxicity studies did have significant adverse effects and the NOAECs ranged between 6 and 900 mg ae/kg diet.

At the highest application rate (4.0 lbs ae/acre) of MCPA with either predicted maximum or mean residue levels on the foliage, the Chronic LOC was exceeded for mammals consuming short grass, broadleaf forage, and/or small insects; the Chronic LOC was also exceeded for mammals consuming tall grass when predicted maximum residues were assumed. At lower application rates, the RQs will be reduced; however, for all Chronic RQs to be less than the LOC of 1.0 with predicted maximum residue levels, the application rate can be no more than 0.6 lbs ae/acre. At 4 lbs ae/acre and assuming predicted maximum residues, the EEC exceeds the NOAEC for 2 to 3 months for grasses, broadleaf plants and small insects. At 1.5 lbs ae/acre and assuming predicted maximum residues, the EEC exceeds the NOAEC for 45 days for short grass, 5 days for tall grass, and 16 days for broadleaf plants and small insects. For those animals exposed to these treated fields, the window of exposure is fairly large.

The risk assessment and calculated RQs assume 100% of the diet is relegated to single food types foraged only from treated fields. The assumption of 100% diet from a single food type may be realistic for acute exposures, but diets are likely to be more variable over longer periods of time. However, even if there is variation in diet over time, when the Chronic LOCs are exceeded for multiple food categories, exposure will still be high enough to warrant concern. This assumption is likely to be conservative and will tend to overestimate potential risks for chronic exposure, especially for larger organisms that have larger home ranges. These large animals (e.g., deer and geese) will tend to forage from a variety of areas and move on and off of treated fields. Small animals (e.g., mice, voles, and small birds) may have home ranges smaller than the size of a treated field and will have little or no opportunity to obtain foodstuffs that have not been treated with MCPA. Even if their home range does cover areas outside the treated field, MCPA may have drifted to areas adjacent to the treated field.

Other exposure routes are possible for animals residing in or moving through treated areas. Ingestion of contaminated soils, dermal contact, and inhalation appear to be routes of low risk based on available toxicity data and screening methods. Consumption of drinking water would appear to be inconsequential if water concentrations were equivalent to the concentrations from PRZM/EXAMS; however, concentrations in puddled water sources on treated fields may be higher than concentrations in modeled ponds. Preening and grooming exposures, involving the oral ingestion of material from the feathers or fur remains an unquantified, but potentially important, exposure route.

<u>Risks to Terrestrial Non-Target Insects</u>

EFED currently does not quantify risks to terrestrial non-target insects. Risk quotients are therefore not calculated for these organisms. Since MCPA was practically non-toxic to honey bees (LD_{50} of >17 µg/bee), the potential for MCPA to have adverse effects on pollinators and other beneficial insects is low.

<u>Risks to Aquatic Organisms</u>

No fish or invertebrate Acute Risk LOCs were exceeded under any of the modeled scenarios: MCPA modeled as an acid (runoff/drift), or ester (runoff/drift and drift only). Except for the rice scenario, no invertebrate Endangered Species LOCs or Acute Restricted Use LOCs were exceeded under the scenarios in which MCPA was modeled as an acid. In general, there were exceedances of the Endangered Species LOC for estuarine/marine invertebrates when MCPA was modeled as an ester (runoff/drift and drift only) and for freshwater invertebrates when MCPA was modeled as an ester (runoff/drift).

Under all the scenarios modeled at the maximum labeled application rates, the only Acute Risk exceedances for aquatic plants was for the release of tailwater from MCPA-treated rice paddies for all plant tested plant groups. Several exceedances of the Endangered Species LOC (freshwater vascular plants only) occurred under the different modeling scenarios. Under the MCPA acid runoff/drift scenarios, the LOC for endangered freshwater vascular plants was exceeded for several scenarios: California pasture, Pennsylvania pasture, Minnesota pasture, Kansas sorghum, and rice. Under the EHE drift/runoff scenario, the LOC for freshwater vascular plants was exceeded for all scenarios except Oregon peas. Under the EHE drift only scenario, the LOC for endangered freshwater vascular plants was exceeded for all scenarios except Oregon peas and Pennsylvania turf.

For the rice scenario (applicable for MCPA sodium salt or MCPA DMAS) with the maximum application rate (1.25 lbs ae/acre), the LOC for Acute Restricted Use and Endangered Species was exceeded for estuarine/marine invertebrates; however, there are no federally listed endangered estuarine or marine invertebrates at this time. At a modeled application rate of 0.45 lbs ae/acre, the LOC for Acute Restricted Use for estuarine/marine invertebrates would not be exceeded, but it would be exceeded at the average application rate of 0.67 lbs ae/acre. At a modeled application rate of 0.13 lbs ae/acre, the Acute Risk LOCs for aquatic plants are no longer exceeded. This EEC in the rice scenario is the concentration predicted immediately after pesticide application by the screening level rice model represents a bounding concentration for acute and chronic exposures and both acute and chronic concentrations would be expected to be lower in aquatic environments away from the tailwater release point due to degradation, dilution, and dispersion.

The Endangered Species LOC for estuarine invertebrates in the California pasture and the Pennsylvania pasture scenarios was exceeded in the scenarios modeling MCPA EHE reaching the water body through drift only in the ester form. However, at this time there are no federally listed endangered estuarine or marine invertebrates.

However, for scenarios when MCPA EHE is applied and it is assumed that the substance reaches the water in the EHE form through both runoff and drift, there were several exceedances of the Endangered Species LOC for freshwater and estuarine invertebrates. There were also exceedances of the Endangered Species LOC for freshwater vascular plants. Since there are no federally listed endangered estuarine/marine invertebrates, EFED does not have concerns for these Endangered Species LOC exceedances at the present time. If MCPA EHE does reach waterbodies through both runoff and drift, EFED does have concerns since there were other LOC exceedances. However, for all those scenarios where there are exceedances of concern, when the average application rate is modeled, there are no longer any LOC exceedances.

Based on the available information for MCPA, chronic risks to freshwater fish and invertebrates are low, as there were no exceedances of the Chronic LOCs. EFED inferred that chronic risks to estuarine/marine fish and invertebrates are low under the assumption that the acute-to-chronic ratio of toxicity endpoints would hold constant across freshwater and estuarine/marine organisms.

Endangered Species Assessment

The preliminary risk assessment for endangered species indicates that MCPA exceeds the endangered species LOCs for the following combinations of analyzed uses and species:

- estuarine/marine invertebrates in the California pasture and the Pennsylvania pasture scenarios was exceeded in the scenarios modeling MCPA EHE reaching the water body through drift in the ester formulation, and in the rice use scenario. However, at this time there are no federally listed endangered estuarine or marine invertebrates.

- freshwater vascular plants under the MCPA acid runoff scenarios for California pasture, Pennsylvania pasture, Minnesota pasture, Kansas sorghum, and rice. Under the ester drift scenario for North Dakota wheat, Oregon wheat, California pasture, Pennsylvania pasture, and Minnesota pasture.

- small (i.e., 20 and 100 g) and large birds (i.e., 1000 g) feeding on short grass, tall grass, and broadleaf forage/small insects. Also smaller birds feeding on fruit and large insects.

- small (i.e., 15 and 35 g) and large (i.e., 1000 g) mammals feeding on short grass. Also smaller mammals feeding on tall grass and broadleaf forage/small insects.

- non-target terrestrial plants.

The Agency's LOC for endangered and threatened estuarine/marine invertebrates, freshwater vascular plants, birds, mammals, and non-target terrestrial plants is exceeded for the use of MCPA as outlined in previous sections. The Agency recognizes that there are no Federally listed estuarine/marine invertebrates at this time. The registrant must provide information on the proximity of Federally listed freshwater vascular plants, birds, mammals, and non-target terrestrial plants (there are no listed estuarine/marine invertebrates) to the MCPA 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.

Endocrine Disruption Assessment

The potential for endocrine disruptor related effects was observed in several mammalian toxicity studies submitted to the Agency. In the 2-generation reproduction study with rats (MRID 400417-01), ovary size was significantly increased in the high dose group (450 mg ae/kg-diet). Although there were no reported histological findings in the ovaries, reproductive organ effects were observed in several subchronic studies with MCPA EHE (MRID 435567-01 and 435568-01). These effects included testicular atrophy in rats and increased relative and absolute ovary and thyroid weights in dogs.

EPA is required under the FFDCA, as amended by 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 scientific bases 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 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, MCPA may be subjected to additional screening and/or testing to better characterize effects related to endocrine disruption.

Uncertainties in the Ecological Risk Assessment

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. First, this assessment accounts only for exposure of aquatic organisms to MCPA, but not to its degradates. Second, the risk assessment only considers the most sensitive species tested and only considers a subset of possible use scenarios. For the aquatic organism risk assessment, there are uncertainties associated with the PRZM/EXAMS model, input values, and scenarios including the use of surrogate scenarios such as using alfalfa to represent pasture, however these uncertainties cannot be quantified. Also, there may be environments where this bridging strategy is not applicable, such as dry soils which may limit the dissociation of the MCPA DMAS and acid environments which may limit the abiotic hydrolysis of the MCPA EHE. This assessment accounts only for exposure of non-target organisms to MCPA, but not to its degradates. The potential toxicity of degradates of MCPA is unknown. The risks presented in this assessment could be underestimated if degradates also exhibit toxicity under the conditions of use proposed on the label. The MARC of HED has determined that none of the degradates of MCPA are of toxicological concern. The potential impacts of these uncertainties are outlined in the Aquatic Exposure and Risk Assessment and the Terrestrial Exposure and Risk Assessment sections of this document.

IV. Environmental Fate Assessment

The MCPA Task Force is supporting terrestrial food and non-food uses for MCPA DMAS and the MCPA EHE. EFED adopted an environmental fate strategy for MCPA based on linking the dissociation of the dimethylamine salt of MCPA DMAS and the hydrolysis of the MCPA EHE to its free acid, MCPA. Bridging data were submitted to verify that MCPA DMAS and MCPA

EHE will be rapidly converted to the free acid in the environment. Therefore, studies conducted with MCPA acid provide "surrogate data" for the MCPA DMAS and MCPA EHE. In a dissociation study, MCPA DMAS completely dissociated to MCPA acid and dimethylammonium ion within 1.5 minutes of stirring in deionized water; therefore, fate studies with MCPA acid will provide data regarding the behavior of MCPA DMAS. Two hydrolysis studies were submitted for MCPA EHE. One study, an aqueous hydrolysis study indicated at pH 9, MCPA EHE hydrolyzed to MCPA with a half-life ≤117 hours and that MCPA acid did not degrade further and there was no hydrolysis of MCPA EHE at pH 5 and 7. The second hydrolysis study on a soil:$CaCl_2$ system at pH 5.6 and 6.8; the MCPA-EHE adsorbed to the soil particles, but was available for hydrolysis to MCPA with a half-life of ≤12 hours.

Data submitted subsequent to establishment of the environmental fate bridging strategy support the strategy. Data from a terrestrial field dissipation study using MCPA EHE indicate that greater than 80% of MCPA EHE converted to MCPA acid on the day of application and nearly all MCPA EHE was converted by day 3, while terrestrial field dissipation data submitted for MCPA iso-octyl ester (equivalent to EHE) report half lives of 9 and 23 days for MCPA iso-octyl ester. However, the analytical technique employed in the iso-octyl ester study reports total MCPA residues (ester and acid formulations) and therefore the half lives represent total MCPA residue half lives. Additionally, data by Harrison, et al (1993) indicate that for turfgrass sites applied with esters of phenoxy herbicides (2,4-D and 2,4-DP), no esters were detected in runoff water (though detection limits were relatively high @ 20 ug/l for 2,4-D EHE), but 2,4-D acid was detected at concentrations as high as 312 ug/l in runoff.

Open literature data indicate that carboxylic acid esters can be prone to both surface-catalyzed hydrolysis and microbial mediated hydrolysis (Schwarzenbach, et al.1993). Sediment and soils may promote heterogeneous hydrolysis through reactions with surface hydroxyl groups from transition metal oxide and hydroxide mineral coatings or through the enhance hydroxide concentrations in the diffuse double layer at the interface of sediment or soil surfaces.

Microbial-mediated hydrolysis of carboxylic acid esters is an enzymatic controlled process (Schwarzenbach, et al.1993). Paris, et al (1981) tested the rate of microbial degradation of 2,4-D BEE in natural waters from 31 sites with varying temperature and pH conditions (5.4 to 8.2). The authors found that in waters typical of natural conditions and at concentrations normally encountered in rivers and lakes, the rate constants from all sites were within a factor of eight and estimated a mean half life of 2.6 hours. Degradation kinetics could be described using second order kinetics. Paris, et al (1983) found 2,4-D n-alkyl esters had a range of microbial second order microbial-mediated hydrolysis rate from 5.9×10^{-10} liters/organism/hour to 3.5×10^{-8} liters/organism/hour for octyl ester. They developed a regression equation [$\log kb=(0.799\pm0.098)* \log Kow-(11.643\pm0.204)$] to estimated microbial-mediated hydrolysis for 2,4-D esters in natural waters. Although the available data indicate rapid degradation of 2,4-D esters in natural waters, microbial mediated hydrolysis rates in soils may be dependent on clay mineralogy, organic carbon content, temperature, and moisture content (Wolfe, et al, 1989 and Wolfe, 1990).

Conversely, data from Smith and Hayden (1980) indicate that MCPA EHE which was surface applied to soils in Saskatchewan were rapidly converted to MCPA acid, however under dry conditions (15% of field capacity) the ester persisted for days with greater than 90% present after 48 hours. It is important to note that these dry conditions will effect crop yield and it is likely that in a typical setting a farmer will irrigate to add moisture to the soil or abandon the crop.

In general, there may be environments where this bridging strategy is not applicable, such as dry soils which may limit the dissociation of the MCPA DMAS and acid environments which may limit the abiotic hydrolysis of the MCPA EHE. There is also evidence for the phenoxy esters as a class to suggest that the conversion of MCPA EHE to MCPA acid may not be rapid under all conditions. Therefore, EFED believes the data reviewed supports the environmental fate bridging strategy for MCPA DMAS and MCPA EHE with the exception of environmental conditions previously described.

MCPA acid does not hydrolyze in sterile, buffered solutions at pH's ranging from 5 to 7. MCPA acid photodegraded in sterile buffer at pH 5 when irradiated with natural sunlight with a half-life of approximately 25 days; one degradate, 4-chloro-o-cresol, comprised up to 12% of the radioactivity. MCPA acid photodegraded very slowly when applied to soil surfaces and irradiated with natural sunlight; the calculated half-life was 67 days. In the aerobic soil metabolism study MCPA acid degraded with a half-life of 24 days; no degradates were present $\geq$10% of the applied radioactivity. Under aerobic aquatic conditions MCPA acid degraded with a total system half life in a water-sandy clay loam sediment systems of >30 days, in water-loamy sand sediment system, half-life values of MCPA acid, based on first-order non-linear kinetics and linear regression, were 13/15 days. Half-life values for 4-CC were estimated following its formation in the water-loamy sand sediment systems at 44 days in both the total system and sediment. The observed total system degradation half life of MCPA acid in the water-light clay sediment systems was >100 days. An additional aerobic aquatic biodegradation study under review indicates that MCPA acid degrades in ditchwater/sediment with a whole system half life of 16.3 days and river water/sediment system with a whole system half life of 16.8 days. MCPA acid did not degrade anaerobically in either an anaerobic soil metabolism or an anaerobic aquatic metabolism study. Several degradates were detected in the laboratory fate studies reviewed. The degradates detected were 4-chloro-o-cresol (4-CC), 5-chlorosalicylaldehyde, and $^{14}CO_2$. 4-chloro-2-methylanisole (4-MCA) was postulated by the registrant to be a potential degradate of MCPA but was not detected in any of the laboratory or field studies. The Metabolite Assessment Review Committee (MARC) has determined that none of these degradates are of concern, therefore, no degradates were included in the drinking water assessment. A table presenting all environmental fate degradates detected is in Appendix A.

In laboratory batch equilibrium studies, MCPA acid was shown to be extremely mobile. MCPA acid is mobile in clay loam, silt loam, sandy loam soils, in a sandy loam aquatic sediment and in a beach sand with Freundlich K_{ads} values ranging from 0.45 to 1.20 mL/g and in clay, silt loam, sandy loam and loam soils with Freundlich K_{ads} values ranging from 0.0212 to 1.11 mL/g and corresponding K_{oc} values calculated from Freundlich K_{ads} values were 9.6-46. In a study on sand, sandy loam, loam and silty clay loam soil:solution slurries and sandy clay loam sediment:solution slurries Freundlich K_{ads} values were 0.21 for the sand soil, 0.26 for the sandy loam soil, 0.55 for the loam soil, 0.50 for the silty clay loam soil, and 0.36 for the sandy clay loam sediment with corresponding K_{oc} values of 52, 31, 59, 50, and 41 mL/g. In the same study 4-chloro-o-cresol (4-CC) was studied in sand soil:solution slurries and mobile in sandy loam, loam and silty clay loam soil:solution slurries and sandy clay loam sediment:solution slurries with Freundlich K_{ads} values of 0.81, 1.6, 3.1, 2.7, and 2.1 with corresponding K_{oc} values of 198, 199, 330, 266, and 238 mL/g. Finally, in this study 4-chloro-2-methylanisole (4-MCA) was studied in sand, sandy loam, loam and silty clay loam soil:solution slurries and sandy clay loam sediment:solution slurries with Freundlich K_{ads} values of 2.4, 4.8, 7.1, 6.2, and 5.5 with corresponding K_{oc} values were 588, 580, 755, 623, and 628 mL/g. No aged column leaching studies were submitted.

Three field dissipation studies were originally submitted which provided supplemental information on the dissipation of MCPA isooctyl ester and MCPA Na salt. In the studies conducted with MCPA iso-octyl ester (also known as MCPA EHE), the discussion of residues detected and half lives is focused on the formulation. However, re-review of the study indicates that the analytical extraction resulted in conversion of both MCPA iso-octyl ester and acid formulations to MCPA methyl ester which was then analyzed quantitatively. Therefore, the half lives discussed below for these two studies cannot distinguish between the MCPA ester and acid present and actually reflect the dissipation rate of total MCPA residues and not the iso-octyl ester as noted in the original DERs. It is likely, though not confirmed, that MCPA iso-octyl ester dissipates much more rapidly than presented below and that these half lives represent MCPA acid dissipation. MCPA-isooctyl ester dissipated with total MCPA residue field half-lives of 9 days from a loam soil in California and 23 days from a sandy loam soil in Montana. MCPA-Na salt dissipated with a MCPA acid equivalent field half-life of 15 days from a sandy loam soil in Washington. In the field studies, MCPA did not leach below the top 6-inch depth.

Three additional field studies were submitted for MCPA EHE and MCPA DMAS. In the first study conducted with MCPA EHE, MCPA EHE rapidly converted to MCPA acid at two sites with greater than 80% converted on day 0. MCPA acid dissipated at a Georgia site with reviewer-calculated half-lives of 6.2 days and 4.1 days on the bareground and wheat plots while at the Kansas site reviewer-calculated half-lives of MCPA acid were 8.9 days and 4.1 days on the bareground and wheat plots. In the second study conducted with MCPA DMAS, MCPA dissipated at a California site, with reviewer calculated half-lives of 8.5 days for grass and 10 days for thatch following the second application. MCPA dissipated at a Florida site with reviewer-calculated half-lives of 4.2 days for grass and 3.5 days for thatch. MCPA dissipated at a New York site with reviewer-calculated half-lives of 1.9 days for grass and 4.8 days for thatch. In the third study, MCPA acid dissipated at a California site with reviewer-calculated half-lives of 3.8 days on the bareground and 3.2 days on the wheat plot. MCPA acid dissipated at a Kansas site with reviewer-calculated half-lives of 5.6 days on the bareground and 6.6 days on the wheat plot; the observed half-lives occurred between 7 and 14 days posttreatment.

No Bioconcentration in Fish study (165-4) was submitted for MCPA acid.

A detailed assessment of MCPA's environmental fate is given in Appendix A.

Atmospheric Transport of MCPA

The process by which pesticides may be transported away from the target site include spray drift at the time of application and volatilization. Spray drift, the movement of pesticide droplets off-target during or shortly after application, has been well studied and is not dependent on the properties of the active ingredient Short range spray drift transport and resulting exposures to non-target organisms is quantified in EFED's risk assessments. Transport resulting from volatilization is highly dependent on the properties of the active ingredient (e.g vapor pressure) and as well as a number of environmental parameters. The magnitude and impact of potential transport of MCPA acid, salts and esters via volatilization or long range drift away from the target site is an uncertainty in this assessment. Reported evidence in the public domain suggests concern for impact to non-target organisms due to drift and volatilization of the ester formulations of the phenoxy herbicides. As an example, the state of Florida recently instituted the Organo-Auxin Herbicide Rule (see summary in Ducar, et al, 2003, or more specifically in Florida Pesticide Law and Rules 5E-2.033) which bans the use of phenoxy herbicide esters due to concerns of volatilization and off-site impact to non-target organisms. However, these banned esters are high volatility esters and do not include MCPA EHE (email from Dale Dubberly, Florida Department of Agriculture and Consumer Services, dated August 12, 2003). Other states have similarly banned or restricted the use of certain phenoxy herbicides including esters while other states have issued warnings on the use of phenoxy herbicides particularly under dry moisture conditions and warmer temperatures (Feitshans, T.A. 1999).

Data collected in the 1960s and 1970s, and summarized in Majewski and Capel (1995), indicate that compared to 2,4-D (which was detected in air and rain samples) MCPA was not widely detected in air or rainwater samples. More recent data reported by Anderson, et. al. (2002) on water and rainfall samples in a wetland environment in Alberta, Canada indicate that MCPA was one of the most frequently detected pesticides in rainfall samples with a frequency of detection of 53%, however concentrations did not exceed 1 ug/l. In a study conducted in southern Manitoba by Rawn et al (1999) MCPA was detected in rainfall at concentrations less than 1 ug/l and was detected in air as both vapor phase and on particle phase at a maximum concentration of 13000 pg/m$^{3.}$ Both rainfall and air detections were closely associated with local use, however the authors noted that the relative contribution of these compartments to surface water was low compared to runoff.

An important consideration resulting from this data is that any analysis of surface water monitoring data without corresponding air and rainfall data cannot distinguish between sources of contamination. In other words, the analysis of surface water concentrations discussed in this assessment cannot distinguish the source of the contaminant whether it be from runoff, drift, or deposition from rainfall. The reported value likely includes all sources of input into the surface water body and thus the effect of volatilization of MCPA in the aquatic exposure scenarios is likely captured. However, the impact of volatilization and the potential impact on off-site, non-target organisms in unknown and cannot be quantified in this assessment.

In order to attempt to assess the potential for MCPA to partition into various media, EFED performed an estimation of partitioning of MCPA acid and MCPA EHE with a simple fugacity model found in USEPA EpiSuite software. The fugacity model predicts that the relative percentage of MCPA acid that will partition into air is 0.04% while the relative percentage for MCPA EHE is 0.39%. The results of the fugacity model suggest that for MCPA acid and EHE that volatilization is not predicted to be a major route of exposure. Uncertainties associated with the use of a fugacity model are that partitioning of MCPA EHE to soil is estimated and that the effect of intercept and volatilization from plant surfaces is not accounted for. These facts could result in an underestimation of the amount partitioning to air.

It is noted that EFEDs current risk assessment does account for short range spray drift as a process effecting exposure through the use of PRZM/EXAMS and the drift component. However, longer-range transport coupled with volatility and ultimately deposition via rainfall is not accounted for in this assessment and lends additional uncertainty to the risk assessment.

V. Drinking Water Assessment Summary

Human exposure to MCPA through ingestion of drinking water was assessed through an evaluation of surface water and groundwater monitoring data and modeling. Existing MCPA monitoring data were evaluated for magnitude and frequency of MCPA occurrence. Annual maximum concentrations and frequency of detection data were determined from each data set. In addition, time weighted annual mean (TWM) concentrations were calculated for selected data. In order to augment this monitoring data, an additional set of drinking water exposure assessments were completed using Tier II model predictions.

Surface Water Monitoring Data for MCPA

Concentrations of 2-methyl-4-chlorophenoxyacetic acid (MCPA) to which humans potentially may be exposed through ingestion of drinking water are assessed through an evaluation of surface water and groundwater monitoring data. Existing monitoring data were compiled by the United States Geological Survey (USGS) National Water-Quality Assessment (NAWQA) Program, the United States Environmental Protection Agency (USEPA) STOrage and RETrieval System for Water and Biological Monitoring Data (STORET), and recently released data from the USGS Pilot Reservoir Monitoring Study. The data were evaluated for magnitude and frequency of MCPA occurrence. Annual maximum concentrations and frequency of detection data were determined from each data set. TWM concentrations were determined for the NAWQA and STORET data. The frequency of detection of MCPA from the USGS Pilot Reservoir Monitoring Study was not sufficient to calculate TWM concentrations from this data.

The highest annual maximum concentration of MCPA detected in surface water is **18.58 ug ae/l** from the NAWQA (station 4161820) study. The maximum TWM concentration of MCPA in surface water is **1.49 ug ae/l** from the NAWQA (station 4161820) study. The monitoring data were not targeted to MCPA use areas. The highest concentration of MCPA detected in groundwater was **5.3 ug ae/L** from the Pesticides in Groundwater Database.

In order to augment the existing monitoring data, an additional set of drinking water exposure assessments were completed using modeling predictions.

Surface Water Modeling of MCPA

A Tier II drinking water assessment for the use of MCPA was performed using the PRZM/EXAMS model with an index reservoir (IR) and a percent crop area (PCA) scenario. For a description of the IR/PCA scenarios and the uncertainties associated with them see the science policy document at the following URL : http://www.epa.gov/oppfead1/trac/science/reservoir.pdf. Eight different crop scenarios were modeled, including wheat in North Dakota and Oregon, peas in Oregon, sorghum in Kansas, and rangeland/pastureland in California, Pennsylvania, and Minnesota (Figure 2). The EFED standard scenario for alfalfa was used to represent rangeland/pastureland in California, Pennsylvania, and Minnesota. The alfalfa scenario was chosen because its hydrologic and agronomic practices closely match those of pasture/rangeland for which an approved scenario has not been developed. An additional non-crop scenario was run for turf in Pennsylvania. MCPA is a broad spectrum herbicide with its largest markets in terms of total pounds active ingredient allocated to spring wheat, winter wheat and barley, oats/rye, and rice. The remaining usage is primarily on seed crops, pasture, hay, lots/farmsteads, dry beans/peas, and flax. The PRZM/EXAMS scenarios selected for modeling represent all available EFED scenarios for registered MCPA uses. These scenarios were chosen to model the concentration of MCPA in surface drinking water over a geographically dispersed range of surface water concentrations in areas representative of heavy MCPA use (i.e. northern Great Plains and northwestern US). Tables 3 and 4 present the PRZM/EXAMS estimated exposure concentrations (EECs) of MCPA in surface drinking water for the eight different crop scenarios and the model input parameters.

PRZM 3.12/ EXAMS 2.98.04 modeling was performed with index reservoir (IR) scenarios and percent cropped area (PCA) adjustment factors. A default PCA factor of 0.87 was used for peas, sorghum, and rangeland/pastureland because a PCA factor for these crops was not available. A PCA factor of 0.56 was applied to wheat results. It should be noted that there may be instances where wheat co-occurs with other crops within a watershed. In these instances the default PCA (0.87) should be used. The EECs presented below for the wheat scenarios do not capture this co-occurrence and could underestimate concentrations that result from watersheds where other crops are present to which MCPA is applied. No PCA factor was applied to turf since this non-crop use was not considered when PCAs were developed. All application rates were adjusted to acid equivalents. It should also be noted that, for several of the scenarios, spray drift was the principal contributor to the acute exposures in up to half of the years modeled. However, the one in ten year EECs presented were the result of a combination of drift and runoff.

The PRZM/EXAMS model results were recommended for use in the human health risk assessment since monitoring data available for MCPA are not believed to be targeted to areas or timing of MCPA use. The recommended concentrations for surface water were derived from the Pennsylvania pasture scenario which has the highest labeled application rate (4 lbs ai/acre) of the scenarios modeled. The predicted surface water derived drinking water concentrations will vary depending on regional climate, soil, environmental characteristics, and watershed characteristics. These model predictions are approximately double the peak (acute) concentration of **18.58 ug ae/l** detected in monitoring data and roughly equivalent to the maximum TWM concentration of **1.49 ug ae/l**.

Table 3. Tier II Concentration of MCPA in Surface Water Using IR/PCA PRZM/EXAMS Scenarios

Crop Scenario	Application Rate in acid equivalents (lbs ae/acre)	PCA Adjustment Factor	1/10 Peak Concentration (ug ae/l)	1/10 Yearly Annual Concentration (ug ae/l)	30 Year Annual Mean Concentration (ug ae/l)
North Dakota wheat	1.5	0.56	15.45	0.53	0.29
Oregon wheat	1.5	0.56	13.16	0.47	0.28
California pasture	4.0	0.87	37.25	1.60	1.17
Pennsylvania pasture*	4.0	0.87	**47.31**	**1.93**	**1.17**
Minnesota pasture	4.0	0.87	34.46	1.43	0.85
Kansas sorghum	0.75	0.87	31.28	0.92	0.44
Oregon beans	0.375	0.87	8.29	0.32	0.14
Pennsylvania turf	2.0	1.00	14.92	0.56	0.33

* - recommended for use in the drinking water component of the dietary risk assessment

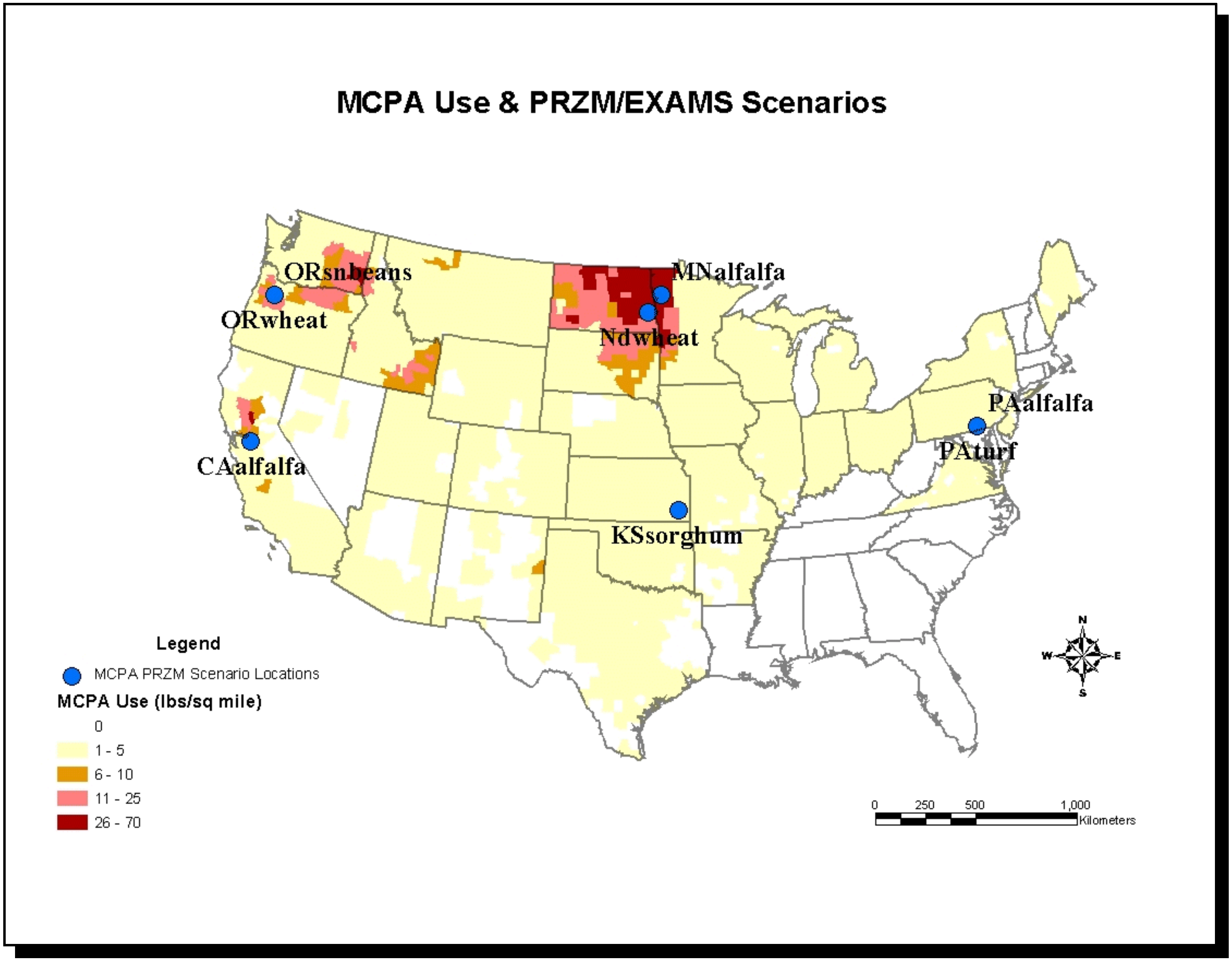


Figure 2. PRZM/EXAMS Scenarios versus MCPA Use Information (USGS Open File Report 00-250)

Table 4. PRZM/EXAMS Input Parameters for MCPA			
MODEL PARAMETER	**VALUE**	**COMMENTS**	**SOURCE**
Application Rate per Event	4 lbs ae/acre for pasture 1.5 lbs ae/acre for wheat 0.75 lbs ae/acre for sorghum 0.375 lbs ae/acre for peas 2.0 ae/acre for turf	applications to pasture, wheat, sorghum, and peas by aerial application application to turf by ground application	Label
Number of Applications per Crop Season	1 application per year for all scenarios; assumes one planting season per year		Label
Aerobic Soil Metabolism $t_{½}$	72 days [1]	estimated upper 90 th percentile	MRID 41586001
Anaerobic Soil Metabolism $t_{½}$	62 days [2]		MRID 41586001
Aerobic Aquatic Degradation $t_{½}$ (KBACW)	263 days [3]	estimated upper 90 th percentile	MRID 44732401A/44192701 MRID 44732401B
Anaerobic Aquatic Degradation $t_{½}$ (KBACS)	1122 days [4]	estimated upper 90 th percentile	MRID 40461901
Aqueous Photolysis $t_{½}$	25.4 days		MRID 42928101
Hydrolysis $t_{½}$	stable		MRID 42665301
Kd/Koc	0.60 ml/g [5]	Average Kd using all acceptable and supplemental Kd	MRID 42596903 MRID 40555801 MRID 44239601
Molecular Weight	200.6		Product Chemistry
Water Solubility	15,000 mg/l	10 x solubility	Product Chemistry
Vapor Pressure	3.12E-4 torr		Product Chemistry

1 - Upper 90th Percentile based on three times a single acceptable aerobic metabolism half life of 24 days.
2 - Upper 90th Percentile based on a single acceptable anaerobic metabolism half life of >62 days.
3 - Upper 90th Percentile based on half lives of 147 days, 15 days, and 247 days from whole system data.
4 - Upper 90th Percentile based on a single half life of 374 days.
5- From all acceptable and supplemental adsorption/desorption data including Kd values of 0.45, 1.16, 0.48, 1.20, and 0.82 from MRID 42596903; 0.73, 0.02, 1.11, and 0.58 from MRID 40555801; and 0.214, 0.257, 0.554, 0.502, and 0.357 from MRID 44239601.

Modeling of MCPA Use on Rice

The Special Review and Reregistration Division (SRRD) has determined that the rice use should be included in the Reregistration Eligibility Decision (RED) risk assessment for MCPA. Therefore, the Environmental Fate and Effects Division (EFED) prepared this assessment to predict MCPA concentrations in surface source drinking water impacted from rice tailwater releases.

MCPA concentrations in surface source drinking water impacted from rice production were estimated using an interim screening level model developed by EFED. A description of the screening level rice model may be found in the EFED policy memorandum dated October 29, 2002. Model simulation of the maximum seasonal MCPA (esters are not registered for use on rice) application rate of 1.25 pounds ae/A results in a screening level peak and chronic drinking water concentration of **1222 ug ae/l**. This value is expected to represent a bounding concentration immediately after pesticide application for peak and annual average drinking water concentrations for MCPA because the model represents an edge of paddy concentration rather than an actual concentration at a drinking water utility. Additionally, the model does not account for degradation, dilution, and dispersion of MCPA. Although, based on a Kd value or 0.6 ml/g, MCPA is expected to be highly mobile in tailwater from rice paddies, it is expected to degrade relatively rapidly in soil and be fairly persistent in aquatic environments. As expected, the estimated MCPA concentration from the interim model is higher than concentrations detected in the surface water monitoring data evaluated as part of this assessment. The highest concentration of MCPA detected in surface water was 18.58 ug/l from the NAWQA data.

Groundwater Modeling of MCPA

SCI-GROW modeling estimates the acute and chronic concentration of MCPA in shallow groundwater is **2.13 ug/L**. The highest concentration of MCPA detected in groundwater was **5.3 ug ae/l** from the Pesticides in Groundwater Database (PGWD), while MCPA was not detected in either the NAWQA or STORET databases. While the groundwater detection in the PGWD is higher than the SCI-GROW estimate, data from the PGWD are generally used qualitatively in EFED risk assessments due to a lack of characterization for the source of the data. The lack of MCPA detections in the NAWQA and STORET data is likely due to the fact that MCPA is not generally used in areas considered vulnerable to leaching and is moderately persistent and thus likely degrades in these areas prior to reaching groundwater. Input parameters for SCI-GROW are in Table 5.

Table 5. SCI-GROW Input Parameters			
Model Input Parameters	**Input Value**	**Comments**	**Source**
Aerobic Soil Metabolism $t_{1/2}$	24 days	Average value	MRID 41586001
K_{OC}	25 [1]	More than 3 fold variation. Use lowest value [2]	MRID 42596903 MRID 40555801 MRID 44239601
Application Rate	4 lbs ae/acre	Rangeland/Pasture	Label
Max. Number of Application Per Season	1 application	1	Label

1- From all acceptable and supplemental adsorption/desorption data including Koc values of 157, 60, 38, and 95 from MRID 42596903; 67, 25, 65, and 85 from MRID 40555801; and 52, 31, 59, 50, and 41 from MRID 44239601.
2- From (*"Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002.

A detailed discussion of available data and modeling for drinking water sources is in Appendix B.

VI. Aquatic Hazard, Exposure, and Risk Assessment

Hazard Summary

Toxicity to Freshwater Fish

Details of acute freshwater fish studies are summarized in Table D-1.

No studies were submitted to the Agency evaluating toxicity of MCPA acid to freshwater fish.

Toxicity studies were conducted using an end-use product for the sodium salt (Chiptox) and show MCPA sodium salt is 'slightly toxic' to freshwater fish under acute exposure with non-definitive LC_{50}'s ranging from >68 to >79 mg ae/L, where non-definitive estimates are those in which a precise estimate is not attained.

Toxicity studies conducted using the technical and an end-use product (Rhomene) for MCPA DMAS demonstrate it is 'slightly toxic' to 'practically non-toxic' to freshwater fish under acute exposure with definitive LC_{50}'s ranging from 96 to 251 mg ae/L and non-definitive LC_{50}'s ranging from >92 to >134 mg ae/L.

Toxicity tests show technical MCPA EHE is 'highly toxic' to 'moderately toxic' to freshwater fish exposed for short periods of time. The definitive LC_{50}'s for two species of freshwater fish range from 0.76 mg a.e./L to 1.10 mg a.e./L.

One fish early life-stage toxicity study was conducted for technical MCPA DMAS (Table D-5). The study on fathead minnows indicated a NOAEC of 12 mg ae/L and a LOAEC of 24 mg ae/L with the most sensitive parameters of length, wet weight, and dry weight.

Toxicity to Freshwater Invertebrates

Details of acute freshwater invertebrate studies are summarized in Table D-2.

No studies were submitted to the Agency evaluating toxicity of MCPA acid to freshwater invertebrates.

A toxicity study was conducted using an end-use product for the sodium salt (Chiptox) and shows MCPA sodium salt is 'practically non-toxic' to freshwater invertebrates under acute exposure with a non-definitive LC_{50} of >184 mg ae/L.

Toxicity studies conducted using the technical and an end-use product (Rhomene) for MCPA DMAS demonstrate it is 'slightly toxic' to 'practically non-toxic' to freshwater invertebrates under acute exposure with a definitive LC_{50} of 82 mg ae/L and a non-definitive LC_{50} of >187 mg ae/L.

Toxicity tests show technical MCPA EHE is 'highly toxic' to freshwater invertebrates exposed for short periods of time. The EC_{50} for daphnids was 0.18 mg a.e./L.

One invertebrate life–cycle toxicity study was conducted for MCPA DMAS (Table D-6). The study on daphnids indicated a NOAEC of 11 mg ae/L and a LOAEC of 22 mg ae/L with the most sensitive parameter of reproduction.

Toxicity to Estuarine/Marine Fish

Details of acute estuarine/marine fish studies are summarized in Table D-3.

A toxicity study conducted using the technical for MCPA acid demonstrates it is 'practically non-toxic' to estuarine/marine fish under acute exposure with a definitive LC_{50} of 179 mg ae/L.

A toxicity study conducted using an end-use product (Chiptox) for MCPA sodium salt demonstrate it is 'practically non-toxic' to estuarine/marine fish under acute exposure with a non-definitive LC_{50} of >100 mg ae/L.

Toxicity studies conducted using the technical and an end-use product (Rhomene) for MCPA DMAS demonstrate it is 'practically non-toxic' to estuarine/marine fish under acute exposure with a definitive LC_{50} of 520 mg ae/L and a non-definitive LC_{50} of >166 mg ae/L.

Toxicity tests show technical MCPA EHE is 'moderately toxic' to estuarine/marine fish exposed for short periods of time. The LC_{50} was >2.7 mg a.e./L.

No estuarine/marine fish chronic toxicity studies of MCPA acid, salts, or ester were submitted to the Agency.

Toxicity to Estuarine/Marine Invertebrates

Details of acute estuarine/marine invertebrate studies are summarized in Table D-4.

Toxicity studies conducted using the technical for MCPA acid demonstrate it is ‘practically non-toxic’ to estuarine/marine invertebrates under acute exposure with definitive EC_{50}'s /LC_{50}'s ranging from 150 to 236 mg ae/L.

Toxicity studies conducted using an end-use product (Chiptox) for MCPA sodium salt demonstrate it is ‘moderately toxic’ to ‘slightly toxic’ to estuarine/marine invertebrates under acute exposure with a definitive EC_{50} of 4.9 mg ae/L and a non-definitive LC_{50} of >86 mg ae/L.

Toxicity studies conducted using the technical and an end-use product (Rhomene) for MCPA DMAS demonstrate it is ‘moderately toxic’ to ‘practically non-toxic’ to estuarine/marine invertebrates under acute exposure with a definitive EC_{50}'s of 10.6 to 247 mg ae/L and a non-definitive EC_{50} of >58.7 mg ae/L.

Toxicity tests show technical MCPA EHE is ‘highly toxic’ to estuarine/marine invertebrates exposed for short periods of time. The LC_{50} was 0.13 mg a.e./L for the mysid.

No estuarine/marine invertebrate chronic toxicity studies of MCPA acid, salts, or ester were submitted to the Agency.

Toxicity to Aquatic Plants

Toxicity studies for technical MCPA acid, MCPA DMAS and MCPA EHE are summarized in Table D-5.

For MCPA acid, the EC_{50} for the *Lemna gibba* (freshwater vascular plant) was 0.17 mg ae/L and the NOAEC was <0.014 mg ae/L. For the three species of freshwater non-vascular plants (i.e., *Selenastrum capricornutum, Navicula pelliculosa,* and *Anabaena flos-aquae*), the EC_{50}'s ranged from 0.63 to 6.7 mg ae/L, and the NOAECs ranged from 0.0089 to 0.47 mg ae/L. For the estuarine/marine non-vascular plant (*Skeletonema costatum*), the EC_{50} was 0.30 mg ae/L and the NOAEC was 0.015 mg ae/L.

No aquatic plant studies were submitted to the Agency for MCPA sodium salt.

For MCPA DMAS, the EC_{50} for the *Lemna gibba* (freshwater vascular plant) was 0.21 mg ae/L and the NOAEC was <0.4 mg ae/L. For the three species of freshwater non-vascular plants (i.e., *Selenastrum capricornutum, Navicula pelliculosa,* and *Anabaena flos-aquae*), the EC_{50}'s ranged from 0.16 to 99 mg ae/L, and the NOAECs ranged from 0.005 to 10.4 mg ae/L. For the estuarine/marine non-vascular plant (*Skeletonema costatum*), the EC_{50} ranged from 1.2 to mg ae/L and the NOAEC ranged from 0.028 to 2.4 mg ae/L.

Toxicity studies were also conducted using the technical for MCPA EHE. For the *Lemna gibba* (freshwater vascular plant), the EC_{50} was 0.02 mg ae/L and the NOAEC was 0.004 mg ae/L. For the three species of freshwater non-vascular plants (i.e., *Selenastrum capricornutum, Navicula pelliculosa,* and *Anabaena flos-aquae*), Tier II toxicity tests were conducted. The EC_{50}'s ranged from 0.17 mg ae/L to 1.3 mg ae/L, and the definitive NOAECs ranged from 0.0035 to 0.021 mg ae/L. For the estuarine/marine non-vascular plant (*Skeletonema costatum*), the EC_{50} was 0.056 mg ae/L, and the NOAEC was <0.0019 mg ae/L.

<u>Comparison of Acute Toxicity Across Technical Formulations of MCPA</u>

For fish and invertebrates, most of the toxicity endpoints are within one order of magnitude when restricted to evaluating the MCPA acid, sodium salt and DMAS (Table 6). The toxicity of MCPA EHE tends to be two to three orders of magnitude greater than the toxicity of the acid and salts.

The relationships among toxicity endpoints for the aquatic plants are comparable to those for fish and aquatic invertebrates (Table 6). Most of the toxicity endpoints are within one order of magnitude for the acid and DMAS. No studies have been submitted for aquatic plants using MCPA sodium salt to confirm the toxicity relationship between the sodium salt and acid form of MCPA. For aquatic plants, the toxicity of MCPA EHE tends to be one to two orders of magnitude greater than the toxicity of the acid and DMAS.

EFED hypothesized that the primary reason for the differences in the levels of toxicity between the ester formulation relative to the salts and acid is because of the fact that esters have a greater affinity for uptake through cell wall membranes. The increased toxicity, coupled with the fact that MCPA EHE may be more stable in acidic aquatic environments is explanation for the inclusion of the ester drift scenario in the ecological risk assessment. EFED assumes that this scenario only applies to acute exposure because biotic processes should result in conversion of MCPA EHE to MCPA acid after an initial acute exposure.

Several other explanations are possible to rationalize the differences in the levels of toxicity; however, EFED does not believe they are as likely as the increased affinity for uptake through cell wall membranes. First, if MCPA EHE hydrolyzes in the test water, the hydrolysis products may be the cause of higher toxicity. The hydrolysis products are MCPA acid and a simple alcohol, and it is unlikely these products cause much excess toxicity. If the alcohol did exert additional toxicity, it would not be enough to explain the three orders of magnitude difference observed in some organism groups. Second, it is possible that the differences in observed toxicity are not the result of any chemical difference, but are the result of variation across laboratories and methods. Mayer and Ellerseck (1986) suggest that methodological differences may account for as much as a 50% difference in acute aquatic toxicity. It is unlikely that these large, systematic differences are due solely to differences in testing methodologies.

Table 6: Summary of endpoints (LC_{50} or EC_{50}, mg ae/L) for MCPA acute aquatic toxicity studies[a, b]				
ORGANISM GROUP	**MCPA ACID**	**MCPA SODIUM SALT**	**MCPA DMAS**	**MCPA EHE**
freshwater fish	no studies	>68, >79	**96**, 98, 251, >92, >134	**0.76**, 1.10
freshwater inverts	no studies	>184	**82**, >187	**0.18**
estuarine/marine fish	**179**	>100	520, >166	**>2.7**
estuarine/marine inverts	150, 236	**4.9**, >86	10.6, 25.3, 34, 247, >58.7	**0.13**
freshwater vascular plant	0.17	no studies	**0.13**, 0.21	**0.020**
freshwater non-vascular plant	0.63, 0.95, 6.7	no studies	**0.16**, 0.33, 0.38, 25, 30, 57, 99, 31	**0.17**, 0.7, 1.3
estuarine non-vascular plant	**0.30**	no studies	1.2, 29	**0.056**

[a] Details for each study are presented in Tables E-1, E-2, E-3, E-4, and E-7 and in earlier sections of this document. This table is intended simply for gross comparison among formulations.
[b] Bolded entries identify those toxicity endpoints used for calculation of RQs.

Reported Aquatic Incidences

No aquatic incidents have been reported to the Agency for MCPA as of June 6, 2003. The lack of reported incidents cannot be considered as evidence of lack of hazard. Incident reporting is a voluntary process. No attempt has been made to actively investigate if mortality of aquatic species is occurring near fields treated with MCPA, and there are many reasons why incidents would not get reported by growers who use MCPA. At the present time, the lack of mortality incidents in the Ecological Incident Information System (EIIS) database cannot be considered as evidence of a lack of hazard to aquatic organisms.

Aquatic Exposure

Aquatic EECs for the ecological exposure to MCPA acid were estimated using PRZM 3.12/EXAMS 2.98 employing the standard field pond scenario, a Tier 2 screening model designed to estimate pesticide concentrations found in water at the edge of a treated field. As such, it provides high-end values of the pesticide concentrations that might be found in ecologically sensitive environments following pesticide application. PRZM-EXAMS is a multi-year runoff model that also accounts for spray drift from multiple applications. In the ecological exposure assessment, PRZM-EXAMS simulates a 10 hectare (ha) field immediately adjacent to a 1 ha pond, 2 meters deep with no outlet. The location of the field is specific to the crop being simulated using site specific information on the soils, weather, cropping, and management factors associated with the scenario. The crop/location scenario is intended to represent a high-end vulnerable site on which the crop is normally grown. Based on historical rainfall patterns, the pond receives multiple runoff events during the years simulated.

Acute risk assessments are performed using peak EEC values for single and multiple applications. Chronic risk assessments for invertebrates and fish are performed using the average 21-day and 60-day EECs, respectively. Table 7 presents the input parameters used in the Tier II PRZM/EXAMS modeling for ecological assessment of MCPA acid for surface water sources. The model results are presented in Table 8. The PRZM/EXAMS output files from the ecological exposure assessment are presented in Appendix C.

EFED established a fate strategy for bridging the fate data requirements for the MCPA ethylhexyl ester (EHE) and MCPA dimethylamine salt (DMAS) to the MCPA acid. The fate strategy is based on linking the dissociation of the dimethylamine salt of MCPA DMAS and the abiotic and microbially mediated hydrolysis of the MCPA EHE to its free acid, MCPA. Bridging data were submitted which verified that MCPA DMAS and MCPA EHE will be rapidly converted to the free acid in the environment. Therefore, environmental fate studies conducted with the acid provide "surrogate data" for the MCPA-amine salt and MCPA-EHE compounds. Additional data submitted subsequent to establishment of the environmental fate bridging strategy support the strategy, including a terrestrial field dissipation study using MCPA EHE which indicates that greater than 80% of MCPA EHE converted to MCPA acid on the day of application and an open literature study by Harrison, et al (1993) which indicate that application of esters of phenoxy herbicides did not result in esters in runoff at the site. Finally, data from Smith and Hayden (1980) indicate that MCPA EHE which was surface applied to soils in Saskatchewan were rapidly converted to MCPA acid, however under dry conditions (15% of field capacity) the ester persisted for days with greater than 90% present after 48 hours, while data from terrestrial field dissipation studies conducted using 2,4-D EHE indicate that the ester formulation of this phenoxy herbicide persisted in the field under actual use conditions with half lives between 1 and 14 days**.** More details on the environmental fate bridging strategy may be found in Appendix A.

As noted above, the hydrolysis of MCPA EHE to MCPA acid is pH dependent which raises the concern of the impact of the drift of MCPA EHE to acidic aquatic environments when spray applied for the ecological assessment. Runoff of MCPA EHE to aquatic systems was not considered in this scenario given the laboratory data discussed above which indicates rapid conversion of the ester to the acid in moist soils and alkaline aquatic environments. In order to account for the potential impact of the spray application of MCPA EHE to aquatic environments, EFED completed an estimation of the drift of MCPA EHE for each scenario used in the standard aquatic ecological exposure assessment (see above for scenarios). The estimation of drift of MCPA EHE to the standard aquatic pond was assumed for each scenario assuming 5% aerial spray drift for each scenario except turf with a ground spray drift of 1% consistent with EFED policy (see EFED "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides*" dated February 28, 2002.). The amount of loading for each scenario was estimated by converting the application rate of the respective ester product to the drift loading by multiplying the application amount (as an example 4.48 kilograms per hectare for pasture) by the drift (5% for aerial application). The resulting loading to the standard pond (0.22 kg to the 1 hectare pond) was converted to an acute concentration by dividing the loading to the standard pond by the volume of the pond (20,000,000 liters). The resulting concentration represents the maximum instantaneous concentration predicted by direct drift from the application to the pond. Only the peak (acute) EECs for MCPA EHE were estimated for each scenario. A chronic EEC was not provided in this scenario because it is felt that the hydrolysis soil slurry data indicate that dissipation in a non-sterile water body will occur at all pHs and therefore long-term exposures are unlikely.

It was noted at the time of the establishment of the fate strategy that MCPA amines may be persistent under dry soil conditions and MCPA esters may persist under acidic aquatic conditions. A condition of the establishment of the bridging strategy was that terrestrial field dissipation studies should be conducted using MCPA DMAS and MCPA EHE. Review of the terrestrial field dissipation studies indicate that MCPA DMAS does convert rapidly to MCPA acid (reportedly conversion occurred in the tank mix). However, terrestrial field dissipation data conducted at 15 sites using 2,4-D EHE indicate that the ester form of this phenoxy herbicide may persist in the field for several days with half lives ranging between 1 and 14 days with a median half life of 2.9 days. In addition, the study by Smith and Hayden suggest that MCPA EHE persisted for days in the field when applied under dry field conditions at 15% of field capacity. These facts, coupled with the increased toxicity for MCPA EHE, raise concerns that a single terrestrial field dissipation study is sufficient to capture the behavior of MCPA EHE. In order to account for the potential for runoff during the time in which MCPA EHE may remain in the field, EFED conducted additional modeling with PRZM/EXAMS to assess the potential for aquatic organisms to be exposed to MCPA EHE. This scenario relied on the same terrestrial crop scenarios as was used in the ester drift scenario. Metabolism inputs for PRZM/EXAMS were assumed stable for metabolism and Koc and physical/chemical properties were estimated using the USEPA EpiSuite software. In general, the results of PRZM/EXAMS modeling for MCPA EHE increased the EECs by a factor of 3 to 5. Model inputs for modeling of MCPA EHE are listed in the Table 9 while the results for both the drift only and runoff scenarios are presented in Table 10. As with the previous scenario chronic EECs were not generated. Additional data on the behavior of MCPA EHE would be needed to refine these model predictions.

Table 7. PRZM/EXAMS Input Parameters for Ecological Assessment of MCPA Acid			
MODEL PARAMETER	**VALUE**	**COMMENTS**	**SOURCE**
Application Rate per Event	4 lbs ae/acre for pasture 1.5 lbs ae/acre for wheat 0.75 lbs ae/acre for sorghum 0.375 lbs ae/acre for peas 2.0 ae/acre for turf	applications to pasture, wheat, sorghum, and peas by aerial application application to turf by ground application	Label
Number of Applications per Crop Season	1 application per year for all scenarios; assumes one planting season per year		Label
Aerobic Soil Metabolism $t_{½}$	72 days [1]	estimated upper 90 th percentile	MRID 41586001
Anaerobic Soil Metabolism $t_{½}$	62 days [2]		MRID 41586001
Aerobic Aquatic Degradation $t_{½}$ (KBACW)	263 days [3]	estimated upper 90 th percentile	MRID 44732401A/44192701 MRID 44732401B
Anaerobic Aquatic Degradation $t_{½}$ (KBACS)	1122 days [4]	estimated upper 90 th percentile	MRID 40461901
Aqueous Photolysis $t_{½}$	25.4 days		MRID 42928101
Hydrolysis $t_{½}$	stable		MRID 42665301
Kd/Koc	0.60 ml/g [5]	Average Kd using all acceptable and supplemental Kd	MRID 42596903 MRID 40555801 MRID 44239601
Molecular Weight	200.6		Product Chemistry
Water Solubility	3000 mg/l	10 x solubility	Product Chemistry
Vapor Pressure	7.6E-9 atm		Product Chemistry

1 - Upper 90th Percentile based on three times a single acceptable aerobic metabolism half life of 24 days.
2 - Upper 90th Percentile based on a single acceptable anaerobic metabolism half life of >62 days.
3 - Upper 90th Percentile based on half lives of 147 days, 15 days, and 247 days from whole system data.
4 - Upper 90th Percentile based on a single half life of 374 days.
5- From all acceptable and supplemental adsorption/desorption data including Kd values of 0.45, 1.16, 0.48, 1.20, and 0.82 from MRID 42596903; 0.73, 0.02, 1.11, and 0.58 from MRID 40555801; and 0.214, 0.257, 0.554, 0.502, and 0.357 from MRID 44239601.

Table 8. Estimated Environmental Concentrations (: g a.e./L) of MCPA Acid in Surface Water (PRZM-EXAMS) from All Uses for Ecological Assessment.

Simulation Scenario		Concentration (: g ae/L)		
Crop and Location	**Application rate**	**1 in 10 year Peak**	**21 Day Average**	**60 Day Average**
North Dakota wheat	1.5 lbs ae/acre	11.68	5.38	2.72
Oregon wheat	1.5 lbs ae/acre	9.94	5.54	2.57
California pasture	4 lbs ae/acre	18.48	11.27	5.60
Pennsylvania pasture	4 lbs ae/acre	**23.02**	**13.69**	**6.69**
Minnesota pasture	4 lbs ae/acre	16.94	9.18	4.71
Kansas sorghum	0.75 lbs ae/acre	13.08	6.14	2.61
Oregon peas	0.375 lbs ae/acre	4.12	2.53	1.18
Pennsylvania turf	2.0 lbs ae/acre	5.69	2.88	1.36

Table 9. PRZM/EXAMS Input Parameters for MCPA EHE (combined runoff and drift scenarios)			
MODEL PARAMETER	**VALUE**	**COMMENTS**	**SOURCE**
Aerobic Soil Metabolism $t_{½}$	assumed stable	no data available	
Aerobic Aquatic Degradation $t_{½}$ (KBACW)	assumed stable	no data available	
Anaerobic Aquatic Degradation $t_{½}$ (KBACS)	assumed stable	no data available	
Aqueous Photolysis $t_{½}$	assumed stable	no data available	
Hydrolysis $t_{½}$	assumed stable	no data available	
Koc	10500 ml/g		Estimated by EpiSuite Software
Molecular Weight	312.84		Estimated by EpiSuite Software
Water Solubility	0.55 mg/l		Estimated by EpiSuite Software
Vapor Pressure	8.43 E-6 mm Hg		Estimated by EpiSuite Software
Henry's Law Constant	6.25 E-5 atm-m3/mole		Estimated by EpiSuite Software

Table 10. Acute Only Estimated Environmental Concentrations (ug acid equivalent/liter) of MCPA EHE Formulations Only in Surface Water (PRZM-EXAMS) Due to Runoff & Drift from All Applicable Uses for Ecological Assessment.				
Simulation Scenario			Peak Concentration (ug ae/L)	
Crop and Location	Scenario (Application Method)	Application Rate (Label #)	Drift and Runoff	Drift only
North Dakota wheat	MCPA EHE Drift into Standard Pond (Aerial Application)	1.5 lbs ae/acre (62719-59)	12.7	4.2
Oregon wheat	MCPA EHE Drift into Standard Pond (Aerial Application)	1.5 lbs ae/acre (62719-59)	9.7	4.2
California pasture	MCPA EHE Drift into Standard Pond (Aerial Application)	2.35 lbs ae/acre (62719-86)	6.6	6.6
Pennsylvania pasture	MCPA EHE Drift into Standard Pond (Aerial Application)	2.35 lbs ae/acre (62719-86)	11.6	6.6
Minnesota pasture	MCPA EHE Drift into Standard Pond (Aerial Application)	2.35 lbs ae/acre (62719-86)	9.0	6.6
Oregon peas	MCPA EHE Drift into Standard Pond (Aerial Application)	0.375 lbs ae/acre (62719-59)	2.2	1.1
Pennsylvania turf	MCPA EHE Drift into Standard Pond (Ground Application)	1.75 lbs ae/acre (2217-803)	5.6	1.0

1 - Three times (Upper 90th Percentile) based on single soil half life estimated from acceptable laboratory volatility study of 8 days.
2- From "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002.

MCPA concentrations in surface water impacted from rice production were estimated using an interim screening level model developed by EFED. A description of the screening level rice model may be found in the EFED policy memorandum dated October 29, 2002. Model simulation of the maximum seasonal MCPA (esters are not registered for use on rice) application rate of 1.25 pounds ae/A results in a screening level peak and chronic concentration of **1222 ug ae/l**. This value is expected to represent a bounding concentration for peak and annual average water concentrations for MCPA because the model represents an edge of paddy concentration rather than an actual concentration in a flowing water body. Additionally, the model does not account for degradation, dilution, and dispersion of MCPA. Although, based on a Kd value of 0.6 ml/g, MCPA is expected to be highly mobile in tailwater from rice paddies, it is expected to degrade relatively rapidly in soil and be fairly persistent in aquatic environments. As expected, the estimated MCPA concentration from the interim model is higher than concentrations detected in the surface water monitoring data evaluated as part of this assessment. The highest concentration of MCPA detected in surface water was 18.58 ug ae/l from the NAWQA data.

Risk Quotients

The general approach to risk quotient (RQ) calculation and detailed calculations are presented in Appendix E and in Tables F-1 to F-4.

Fish and Invertebrates

For all scenarios except rice, the aquatic Acute Risk, Acute Restricted Use, Endangered Species and chronic LOCs were not exceeded for fish and invertebrates when the assumption that all MCPA salt and ester has converted to the MCPA acid when it reaches the water body under consideration. For these scenarios, all Acute and Chronic RQs were < 0.01. For the rice scenario, the LOC for Acute Restricted Use and Endangered Species was exceeded for estuarine/marine invertebrates (RQ=0.25). There were no acute LOC exceedances for freshwater fish, freshwater invertebrates, or estuarine/marine fish. For the rice scenario, the chronic LOCs were not exceeded (RQ =0.10 for freshwater fish and RQ=0.11 for freshwater invertebrates).

For scenarios when MCPA EHE is applied and it is assumed that the substance reaches the water in the EHE form through runoff and drift, there were several exceedances of the Endangered Species LOC for freshwater and estuarine invertebrates (Table 11). For freshwater invertebrates, the Endangered Species LOC was exceeded for all scenarios except California pasture, Oregon peas and Pennsylvania turf. For estuarine invertebrates, the Endangered Species LOC was exceeded in Oregon wheat, California pasture, and Pennsylvania pasture.

For scenarios when MCPA EHE is applied and it is assumed that the substance reaches the water in the EHE form through drift, there were several exceedances of the Endangered Species LOC (Table 12). These exceedances were for estuarine invertebrates in the California pasture and the Pennsylvania pasture scenarios.

Table 11: Summarized Acute Aquatic Organism Risk Quotients for MCPA EHE runoff and drift component[a,b]				
Scenario	**Freshwater Fish**	**Freshwater Invert.**	**Estuarine Fish**	**Estuarine Invert.**
North Dakota wheat	0.02	0.07*	NA[c]	NA
Oregon wheat	0.01	0.05*	<0.01	0.07*
California pasture	0.01	0.04	<0.01	0.05*
Pennsylvania pasture	0.02	0.06*	<0.01	0.09*
Minnesota pasture	0.01	0.05*	NA	NA
Oregon peas	<0.01	0.01	<0.01	0.02
Pennsylvania turf	<0.01	0.03	<0.01	0.04

[a] * indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 0.05.
** indicates an exceedance of Acute Restricted Use LOC; RQ > 0.10.
*** indicates an exceedance of Acute Risk LOC; RQ > 0.50.

[b] Acute toxicity thresholds (LC50 or EC50) were 760, 180, >2700, and 130 µg ae/L for freshwater fish, freshwater invertebrates, estuarine/marine fish, and estuarine/marine invertebrates, respectively.

[c] Not applicable. For wheat, the Oregon scenario is more representative of the risks to estuarine/marine fish and invertebrates than the North Dakota scenario. For pasture, the California or Pennsylvania scenario is more representative of the risks to estuarine/marine fish and invertebrates than the Minnesota scenario.

Table 12: Summarized Acute Aquatic Organism Risk Quotients for MCPA EHE drift only component[a,b]				
Scenario	Freshwater Fish	Freshwater Invert.	Estuarine Fish	Estuarine Invert.
North Dakota wheat	<0.01	0.02	NA[c]	NA
Oregon wheat	<0.01	0.02	<0.01	0.03
California pasture	<0.01	0.04	<0.01	0.05*
Pennsylvania pasture	<0.01	0.04	<0.01	0.05*
Minnesota pasture	<0.01	0.04	NA	NA
Oregon peas	<0.01	<0.01	<0.01	<0.01
Pennsylvania turf	<0.01	<0.01	<0.01	<0.01

[a] * indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 0.05.
** indicates an exceedance of Acute Restricted Use LOC; RQ > 0.10.
*** indicates an exceedance of Acute Risk LOC; RQ > 0.50.
[b] Acute toxicity thresholds (LC50 or EC50) were 760, 180, >2700, and 130 μg ae/L for freshwater fish, freshwater invertebrates, estuarine/marine fish, and estuarine/marine invertebrates, respectively.
[c] Not applicable. For wheat, the Oregon scenario is more representative of the risks to estuarine/marine fish and invertebrates than the North Dakota scenario. For pasture, the California or Pennsylvania scenario is more representative of the risks to estuarine/marine fish and invertebrates than the Minnesota scenario.

Aquatic Plants

For MCPA acid runoff/drift, there were no exceedances of the non-endangered Acute Risk LOC for all scenarios that were modeled except for rice (Table 13). Non-endangered Acute Risk LOCs for all three classes of aquatic plants were exceeded for the rice scenario (RQs ranged from 4.07 to 9.40). The LOC for endangered freshwater vascular plants was exceeded for several scenarios: California pasture, Pennsylvania pasture, Minnesota pasture, Kansas sorghum, and rice (exceeding RQs ranged from 1.01 to 94.0).

Under the ester runoff and drift scenario, there were no exceedances of the non-endangered Acute Risk LOC. The LOC for endangered freshwater vascular plants was exceeded for all scenarios except Oregon peas (exceeding RQs ranged from 1.40 to 3.18).

Under the ester drift scenario, there were no exceedances of the non-endangered Acute Risk LOC for all scenarios that were modeled (Table 15). The LOC for endangered freshwater vascular plants was exceeded for several scenarios: North Dakota wheat, Oregon wheat, California pasture, Pennsylvania pasture, Minnesota pasture (exceeding RQs ranged from 1.05 to 1.65).

An assessment of endangered risks to non-vascular aquatic plants is not required since there are no listings of endangered non-vascular aquatic plants at this time.

Table 13: Summarized Acute Aquatic Plant Risk Quotients for acid runoff and drift [a,b,c]				
Scenario	**Endangered freshwater vascular**	**Non-endangered**		
		Freshwater vascular	**Freshwater non-vascular**	**Estuarine/marine non-vascular**
North Dakota wheat	0.90	0.09	0.07	NA[d]
Oregon wheat	0.76	0.08	0.06	0.03
California pasture	1.42*	0.14	0.12	0.06
Pennsylvania pasture	1.77*	0.18	0.14	0.08
Minnesota pasture	1.30*	0.13	0.11	NA
Kansas sorghum	1.01*	0.10	0.08	NA
Oregon peas	0.32	0.03	0.03	0.01
Pennsylvania turf	0.44	0.04	0.04	0.02
Rice	94.0*	9.40***	7.64***	4.07***

[a] * indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 1.0.
[b] *** indicates an exceedance of Acute Risk LOC, RQ > 1.0.
[c] Endangered acute toxicity threshold (NOAEC) was 13 µg/L for freshwater vascular; acute toxicity thresholds (EC_{50}) were 130, 160, and 300 µg ae/L for freshwater vascular, freshwater non-vascular, and estuarine/marine non-vascular, respectively.
[d] Not applicable. For wheat, the Oregon scenario is more representative of the risks to estuarine/marine plants than the North Dakota scenario. For pasture, the California or Pennsylvania scenario is more representative of the risks to estuarine/marine plants than the Minnesota scenario. For Kansas sorghum, the estuarine/marine RQ is not applicable.

Table 14: Summarized Acute Aquatic Plant Risk Quotients for ester runoff and drift [a,b,c]				
Scenario	Endangered freshwater vascular	Non-endangered		
		Freshwater vascular	Freshwater non-vascular	Estuarine/marine non-vascular
North Dakota wheat	3.18*	0.64	0.07	NA[d]
Oregon wheat	2.43*	0.49	0.06	0.17
California pasture	1.65*	0.33	0.04	0.12
Pennsylvania pasture	2.90*	0.58	0.07	0.21
Minnesota pasture	2.25*	0.45	0.05	NA
Oregon peas	0.55	0.11	0.01	0.04
Pennsylvania turf	1.40*	0.28	0.03	0.10

[a] * indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 1.0.
[b] *** indicates an exceedance of Acute Risk LOC, RQ > 1.0.
[c] Endangered acute toxicity threshold (NOAEC) was 4 µg/L for freshwater vascular; acute toxicity thresholds (EC_{50}) were 20, 170, and 56 µg ae/L for freshwater vascular, freshwater non-vascular, and estuarine/marine non-vascular, respectively.
[d] Not applicable. For wheat, the Oregon scenario is more representative of the risks to estuarine/marine plants than the North Dakota scenario. For pasture, the California or Pennsylvania scenario is more representative of the risks to estuarine/marine plants than the Minnesota scenario.

Table 15: Summarized Acute Aquatic Plant Risk Quotients for ester drift only [a,b,c]				
Scenario	Endangered freshwater vascular	Non-endangered		
		Freshwater vascular	Freshwater non-vascular	Estuarine/marine non-vascular
North Dakota wheat	1.05*	0.21	0.02	NA[d]
Oregon wheat	1.05*	0.21	0.02	0.08
California pasture	1.65*	0.33	0.04	0.12
Pennsylvania pasture	1.65*	0.33	0.04	0.12
Minnesota pasture	1.65*	0.33	0.04	NA
Oregon peas	0.25	0.06	<0.01	0.02
Pennsylvania turf	0.25	0.05	<0.01	0.02

[a] * indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 1.0.
[b] *** indicates an exceedance of Acute Risk LOC, RQ > 1.0.
[c] Endangered acute toxicity threshold (NOAEC) was 4 µg/L for freshwater vascular; acute toxicity thresholds (EC_{50}) were 20, 170, and 56 µg ae/L for freshwater vascular, freshwater non-vascular, and estuarine/marine non-vascular, respectively.
[d] Not applicable. For wheat, the Oregon scenario is more representative of the risks to estuarine/marine plants than the North Dakota scenario. For pasture, the California or Pennsylvania scenario is more representative of the risks to estuarine/marine plants than the Minnesota scenario.

Aquatic Organism Risk Characterization

The predicted peak MCPA acid concentrations based on the PRZM/EXAMS model for the ecological risk assessment are comparable to the highest annual maximum concentration of MCPA acid (18.58 µg ae/L) in the surface water monitoring data from NAWQA. The predicted PRZM/EXAMS chronic MCPA acid concentrations (21-day and 60-day average concentrations) are comparable to the maximum time-weighted mean concentration of MCPA acid (1.49 µg ae/L) of the surface water monitoring data from NAWQA. The predicted concentrations of MCPA acid for the rice scenario are approximately two orders of magnitude higher than the highest concentrations from the available monitoring data. Although the monitoring results support the modeling estimates, it is important to note that none of the monitoring data was targeted to MCPA usage and no degradates of MCPA are included in the data that were evaluated.

Risks to Fish and Invertebrates

Of the formulations for which toxicity data are available, the salts and acid form of MCPA ranged from 'practically non-toxic' to 'moderately' toxic to fish and invertebrates. MCPA EHE was 'moderately toxic' to 'highly toxic' to fish and invertebrates.

No Acute Risk LOCs were exceeded under any of the modeled scenarios: MCPA modeled as an acid (runoff/drift), or ester (runoff/drift and drift only). Except for the rice scenario, no Endangered Species LOCs or Acute Restricted Use LOCs were exceeded under the scenarios in which MCPA was modeled as an acid.

For the rice scenario (applicable for MCPA sodium salt or MCPA DMAS) with the maximum application rate (1.25 lbs ae/acre), the LOC for Acute Restricted Use and Endangered Species was exceeded for estuarine/marine invertebrates; however, there are no federally listed endangered estuarine or marine invertebrates at this time. If the RQs were calculated using an application rate of 0.45 lbs ae/acre and an assumption that the resulting EEC will be reduced linearly, the LOC for Acute Restricted Use for estuarine/marine invertebrates would not be exceeded (RQ=0.09 at application rate of 0.45 lbs ae/acre). BEAD reported that the average application rate was 0.67 lbs ae/acre, with an estimated 4% of the total rice acreage treated using MCPA. The EEC in the rice scenario is the concentration predicted immediately after pesticide application by the screening level rice model represents a bounding concentration for acute and chronic exposures and both acute and chronic concentrations would be expected to be lower in aquatic environments away from the tailwater release point due to degradation, dilution, and dispersion.

The Endangered Species LOC for estuarine invertebrates in the California pasture and the Pennsylvania pasture scenarios was exceeded in the scenarios modeling MCPA EHE reaching the water body through drift only in the ester form. However, at this time there are no federally listed endangered estuarine or marine invertebrates.

However, for scenarios when MCPA EHE is applied and it is assumed that the substance reaches the water in the EHE form through both runoff and drift, there were several exceedances of the Endangered Species LOC for freshwater and estuarine invertebrates. Since there are no federally listed endangered estuarine/marine invertebrates, EFED does not have concerns for these Endangered Species LOC exceedances at the present time. However, if MCPA EHE does reach waterbodies through both runoff and drift, EFED does have concerns since there were several Endangered Species LOC exceedances for freshwater invertebrates.

All the calculated RQs for EHE drift and runoff scenarios were based on maximum labeled application rates. The QUA from BEAD suggests that the average application rates for many crops are considerably less than the modeled maximum application rates.

For freshwater invertebrates, the highest RQ was attained for North Dakota wheat (RQ=0.07) based on a maximum application rate of 1.5 lbs ae/acre; however, the average application rate was only 0.37 lbs ae/acre/yr (BEAD QUA). If the modeled application rate was reduced to 0.37 lbs ae/acre for wheat, and there was an assumption that the resulting EEC will be reduced linearly, the RQs for all wheat scenarios would be less than the Endangered Species LOC for freshwater invertebrates. Similarly for pasture scenarios, at a average application rate of 0.39 lbs ae/acre, all RQs for the pasture scenarios would be less than the Endangered Species LOC for freshwater invertebrates.

Based on the available information for MCPA, chronic risks to freshwater fish and invertebrates are low, as there were no exceedances of the Chronic LOCs. EFED inferred that chronic risks to estuarine/marine fish and invertebrates would also be low under the assumption that the acute-to-chronic ratio of toxicity endpoints would hold constant across freshwater and estuarine/marine organisms.

Risks to Aquatic Plants

Under all the scenarios modeled at the maximum labeled application rates, there was only one Acute Risk exceedances for the release of tailwater from MCPA-treated rice paddies. This EEC is the concentration predicted immediately after pesticide application by the screening level rice model and represents a bounding concentration for acute and chronic exposures and both acute and chronic concentrations would be expected to be lower in aquatic environments away from the tailwater release point due to degradation, dilution, and dispersion.

Several exceedances of the Endangered Species LOC (freshwater vascular plants only) occurred under the different modeling scenarios. Under the MCPA acid runoff/drift scenarios, the LOC for endangered freshwater vascular plants was exceeded for several scenarios: California pasture, Pennsylvania pasture, Minnesota pasture, Kansas sorghum, and rice. Under the EHE drift/runoff scenario, the LOC for freshwater vascular plants was exceeded for all scenarios except Oregon peas. Under the EHE drift only scenario, the LOC for endangered freshwater vascular plants was exceeded for all scenarios except Oregon peas and Pennsylvania turf.

As with the invertebrates, these RQs were calculated using the maximum labeled application rates. However, for many crops, the average application rate is much lower than the maximum labeled rate. For the EHE drift/runoff modeling, the RQs for freshwater vascular endangered plants are below the Acute Endangered LOCs at an application rates of 0.47 lbs ae/acre/yr for wheat, 0.81 lbs ae/acre/yr for pasture, and 1.25 lbs ae/acre/yr for turf. The average application rates for wheat and pasture are 0.37 and 0.39 lbs ae/acre/yr (BEAD QUA). For the EHE drift only modeling, when the pasture and wheat application rates were modeled at 1.4 lbs ae/acre/yr the RQs for freshwater vascular aquatic plants were below the Endangered Species LOC.

All the toxicity endpoints on which the RQs were based were estimated from studies in which the technical form of MCPA was used. Often in many end-use products, surfactants and adjuvants are added to increase the effect of the active ingredient. If end-use products containing MCPA also contain these performance-enhancing inert ingredients and these inerts also reach the non-target aquatic plant species, this quantitative risk assessment may underestimate the risks.

Uncertainties in the Aquatic Assessment

There are a number of areas of uncertainty in the aquatic organism risk assessment that merit discussion. These include the following:

1. **This assessment accounts only for exposure of aquatic organisms to MCPA, but not to its degradates.** The potential toxicity of degradates of MCPA is unknown. The risks presented in this assessment could be underestimated if degradates also exhibit toxicity under the conditions of use proposed on the label. Since MCPA can only be applied to a field once per year, the acute aquatic assessment would not change if some or all degradates were assumed equipotent. For the chronic assessment, the risks would be higher if all degradates were assumed equipotent. A conservative scenario would be to compare the peak EECs to the chronic toxicity endpoints. With the exception of the rice scenario, the highest peak EEC is 0.023 mg ae/L. Using the freshwater fish NOAEC of 12 mg ae/L and the freshwater invertebrate NOAEC of 11 mg ae/L, both calculated RQs are <0.01. Therefore, if it is unlikely that adverse chronic effects would be of concern. The MARC of HED has determined that none of the degradates of MCPA are of toxicological concern.
2. **Some general uncertainties are associated with the use of PRZM/EXAMS standard runoff scenario (a 10 hectare field draining into a 1 hectare Georgia farm pond) with regional specific crop and pesticide management practices, weather, and soil types.** Although there are uncertainties with the use of a standard runoff scenario for a regional aquatic exposure assessment, it is designed to represent pesticide exposure from an agricultural watershed impacting a vulnerable aquatic environment. Extrapolating the risk conclusions from this standard pond scenario 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 phyiscochemical 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 farm pond represents a well mixed, static water body. Because the farm pond is a static water body (no flow through), it does not account for pesticide removal through flow through or accidental water releases. However, the lack of water flow in the farm pond provides an environmental condition for accumulation of persistent pesticides. The assumption of uniform mixing does not account for stratification due to thermoclines (e.g., seasonal stratification in deep water bodies). 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 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.

The EEC predicted by the screening level rice model represents a bounding concentration for acute and chronic exposures. The concentration represents a predicted concentration in rice paddy tailwater which would then be released immediately after pesticide application to aquatic environments where exposures typically occur. As such, the acute concentration predicted will represent an exposure estimate near the point of release from the paddy. Acute concentrations would be expected to decrease away from the release point due to degradation, dilution, and dispersion. Chronic EECs would also be expected to be lowered once released into an aquatic environment unless multiple releases occurred over time.

3. **The risk assessment only considers the most sensitive species tested**. Aquatic acute and chronic risks are based on toxicity data for the most sensitive fish, invertebrate, and plant species tested. Responses to a toxicant can be expected to be variable across species. Sensitivity differences between species can be considerable (even up to four orders of magnitude) for some chemicals (Mayer and Ellersieck 1986). The position of the tested species relative to the distribution of all species' sensitivities to MCPA is unknown. Extrapolating the risk conclusions from the most sensitive tested species to non-tested species may either underestimate or overestimate the potential risks to those

species.

4. **The risk assessment only considered a subset of possible use scenarios.** MCPA uses being considered under this re-registration assessment are for a variety of crops that are grown over a large geographic area. For this risk assessment, the scenarios were selected to represent a range of crops and geographic areas. Some of the labeled uses that were not modeled may have a greater risk to the environment than those included in this risk assessment. Other uses that may pose higher risks are those occurring in sensitive locations (close proximity to aquatic environments and high runoff potentials).
5. **The ester drift scenario relies on the assumption that the only route of exposure to the ester formulation is via drift and that only acute exposures to the ester formulation are likely.** The route of exposure assumption is supported by terrestrial field dissipation data which indicates that when applied in the field most MCPA EHE has converted to MCPA acid on day 0 and by published data which indicates that phenoxy esters applied to turfgrass were not detected in runoff. The assumption of acute only exposures is supported by the hydrolysis bridging study conducted on the soil slurry at approximately pH 6 which indicated rapid conversion in non-sterile water. It should be noted that the hydrolysis study conducted on sterile waters at pH 5, 7, and 9 did indicate that hydrolysis is pH dependent with rapid hydrolysis in alkaline water and no hydrolysis in acidic waters.
6. **Due to concern for the potential exposure to MCPA EHE, a runoff scenario was modeled for MCPA EHE using PRZM/EXAMS**. The modeling of MCPA EHE is characterized by uncertainty surrounding the selection of model inputs and the uncertainty of the environmental fate bridging strategy for the ester. The model inputs for MCPA EHE were selected by assuming stability when no data were available (i.e. metabolism rates) or by estimating with EpiSuite software (i.e. Koc and physical chemical properties). These assumptions are likely conservative but the effect on the predicted concentration cannot be quantified at this time.
7. **Volatilization, transport and deposition of MCPA in not addressed quantitatively as a route of exposure for aquatic organisms.** Based on the physical chemical properties of the ester formulation of MCPA and on evidence from the open literature there may be a concern for impacts to non-target organisms due to volatilization and off-site deposition of MCPA EHE. Currently, EFED includes an assessment of the effect of drift in both the aquatic and terrestrial risk assessments. However, EFED does not typically assess the impact of volatility, long-range transport and deposition as a route of exposure in its risk assessment process. EFED has conducted a screening level assessment of the potential exposure of terrestrial organisms due to volatility of MCPA acid and MCPA EHE. However, the effect of volatility of MCPA EHE on non-target organisms should be viewed as a source of uncertainty in this assessment.

VII. Terrestrial Hazard, Exposure and Risk Assessment

Hazard Summary

Toxicity to Birds

Acute toxicity tests indicate that MCPA technical is “moderately toxic” to “practically non-toxic” to birds exposed for short periods based on the submitted studies for MCPA acid and MCPA DMAS. No adverse effects were demonstrated in the avian reproduction toxicity study submitted based on the submitted study for MCPA acid.

The acute toxicity of technical grade MCPA to birds was established with the following guideline tests: two avian single-dose oral (LD_{50}) studies on the bobwhite quail using MCPA acid and MCPA DMAS and two sub-acute dietary studies (LC_{50}) on the mallard duck and the bobwhite quail using MCPA DMAS. No avian acute data were submitted for MCPA sodium salt or MCPA EHE.

Avian acute and subacute toxicity summary data for MCPA are presented in Tables D-8 and D-9. The LD_{50}s for bobwhite quail ranged from 221 to 377 mg ae/kg-bwt (MRIDs 400192-01 and 400192-02). For both studies, toxic effects (i.e., reduction in body weight and feed consumption, depression, wing droop) were noted in all dose groups. In the dietary studies, the LC_{50}s for bobwhite quail and mallard ducks were > 4608 mg ae/kg-diet (MRIDs 405558-03 and 405558-02). For both studies, no mortality was observed, but reduced feed consumption or reduced body weight gain were present in groups receiving doses greater than 820 mg ae/kg-diet (bobwhite quail) or 461 mg ae/kg-diet (mallard duck).

A single avian chronic exposure reproduction effects study was performed for MCPA using MCPA acid on bobwhite quail (Table D-10). In this quail study (MRID 449462-35), no negative effects were observed; therefore, the NOAEC = 1000 mg ae/kg-diet (the highest dose tested) and the LOAEC was >1000 mg ae/kg-diet. No avian chronic data were submitted for MCPA sodium salt, MCPA DMAS, or MCPA EHE.

Toxicity to Mammals

In general, toxicity tests indicate MCPA is “slightly toxic” to mammals exposed for short periods based on data submitted for MCPA acid, sodium salt, DMAS, and EHE. In addition, adverse effects were demonstrated in the mammalian sub-chronic, developmental, and 2-generation toxicity studies submitted.

In most cases, mammalian toxicity from the Agency's Health Effects Division (HED) are used to approximate toxicity to wild mammals. However, wild mammal toxicity tests may be required on a case-by-case basis, depending on the results of the lower tier studies such as acute and sub-acute testing, intended use pattern, and pertinent environmental fate characteristics. The registrant has not conducted toxicity testing on wild mammal species. For the purposes of this risk assessment, the available mammalian toxicity data on laboratory mammals was used in the absence of toxicity data on mammalian wildlife (Tables D-11, D-12, and D-13).

MCPA is "slightly toxic" to mammals when administered in an oral dose as a gavage with LD_{50}s ranging from 1383 to 3175 mg ae/kg-bwt (Acc. 21972, 256979, 256980, 156458). In contrast, subchronic toxic effects were observed in studies with dietary concentrations of MCPA as low as 30 mg ae/kg-diet (Acc. 164352) in a 1-year feeding study with dogs (NOAEC: 6 mg ae/kg-diet). Dogs in this study were observed to have treatment-related hepatotoxicity and nephrotoxicity. Other MCPA subchronic mammalian studies had treatment related effects with NOAELs ranging from 13 to 900 mg ae/kg-diet and LOAELs ranging from 51 to 2700 mg ae/kg-diet. In one range-finding study (28-day dog feeding), effects were observed at all doses (NOAEC < 160 mg ae/kg-diet, Acc. 61368). Effects observed in these studies are briefly described in Table D-12 and discussed in detail in the toxicology chapter provided by Health Effects Division of OPP. The most common effects observed in these studies were hepatotoxicity and nephrotoxicity.

Toxic effects of MCPA were observed in several pre-natal developmental toxicity studies with rats and rabbits. Of these studies, the lowest maternal NOAEC was 30 mg ae/kg-diet, based on decreased bodyweight gain and food consumption (MRID 427238-02). The lowest developmental NOAEC was 40 mg ae/kg-diet, based on litter resorptions, decreased fetal weight, and altered growth (MRID 449541-01). Chronic toxic effects of MCPA were observed in a 2-generation reproduction study with rats (MRID 400417-01) where the NOAEC was determined to be 150 mg ae/kg-diet, for both the parental and reproductive endpoints. The parental NOAEC was based on increased absolute and relative ovary weights, and the reproductive NOAEC was based on decreased pup weight gain during lactation. No toxic effects were observed in the offspring, so an offspring NOAEC of 450 mg ae/kg-diet was determined.

Toxicity to Non-Target Insects

Guideline toxicity tests show MCPA is "practically non-toxic" to honey bees (Table D-14). An acute contact toxicity study with MCPA DMAS yielded a 48-hr LD_{50} of >21 µg ae/bee, and an acute contact toxicity study with MCPA EHE yielded a 48-hr LD_{50} of >17 µg ae/bee (MRID 421503-01, 421978-01). No dietary honey bee studies were submitted to the Agency.

Toxicity to Terrestrial Plants

In general, toxicity tests demonstrate MCPA negatively impacts seedling emergence and vegetative vigor of terrestrial plants based on data submitted for MCPA acid, DMAS, and EHE. Results of Tier II toxicity testing on the technical materials are summarized in Tables D-15 and D-16.

MCPA acid adversely affects seedling emergence and vegetative vigor of both monocots and dicots (MRID 430832-05 and 430832-05). For seedling emergence, the most sensitive monocot was onion with an EC_{25} = 0.028 lbs ae/acre and NOAEC of 0.012 lbs ae/acre, and the most sensitive dicot was cabbage with an EC_{25} = 0.0080 lbs ae/acre and NOAEC = 0.0027 lbs ae/acre. For vegetative vigor, the most sensitive monocot was onion with an EC_{25} = 0.092 lbs ae/acre and NOAEC of 0.046 lbs ae/acre, and the most sensitive dicots were lettuce and turnip with an EC_{25} = 0.013 lbs ae/acre and NOAEC = 0.006 lbs ae/acre.

No terrestrial plant studies were submitted to the Agency for MCPA sodium salt.

MCPA DMAS adversely affects seedling emergence and vegetative vigor of both monocots and dicots (MRID 426987-01, 432579-01, 426693-04, and 437882-01). For seedling emergence, the most sensitive monocot was onion with an EC_{25} <0.005 lbs ae/acre and NOAEC <0.005 lbs ae/acre (MRID 426987-01), however, a second study with onion indicated no adverse effects at 0.0116 lbs ae/acre (MRID 4321579-01). The most sensitive monocot with a definitive EC_{25} and NOAEC was ryegrass with an EC_{25} = 0.012-0.024 lbs ae/acre and NOAEC = 0.012 lbs ae/acre. For seedling emergence, the most sensitive dicot was lettuce with an EC_{25} = 0.003 lbs ae/acre and NOAEC <0.006 lbs ae/acre (MRID 426987-01), however, a second study with lettuce indicated no adverse effects at 0.0116 lbs ae/acre (MRID 4321579-01). The most sensitive dicot with a definitive EC_{25} and NOAEC was cabbage with an EC_{25} = 0.005 lbs ae/acre and NOAEC = 0.006 lbs ae/acre. For vegetative vigor, the most sensitive moncot was onion with an EC_{25} = 0.043 lbs ae/acre and NOAEC of 0.024 lbs ae/acre, and the most sensitive dicot was radish with an EC_{25} = 0.004 lbs ae/acre and NOAEC = 0.003 lbs ae/acre.

MCPA EHE adversely affects seedling emergence and vegetative vigor of both monocots and dicots (MRID 426693-01 and 426693-02). For seedling emergence, the most sensitive monocot was oat with an EC_{25} = 0.010 lbs ae/acre and NOAEC of 0.006 lbs ae/acre, and the most sensitive dicot was cabbage with an EC_{25} = 0.010 lbs ae/acre and NOAEC = 0.006 lbs ae/acre. For vegetative vigor, the most sensitive moncot was onion with an EC_{25} = 0.038 lbs ae/acre and NOAEC of 0.013 lbs ae/acre, and the most sensitive dicots were lettuce and radish with an EC_{25} = 0.016 lbs ae/acre and NOAEC = 0.013 lbs ae/acre.

Comparison of Acute Toxicity Across Technical Formulations of MCPA

For terrestrial organisms, there does not appear to be differentiation in the toxicity levels among the acid, salts, and ester based on the available data (Table 16). Within an organism group (i.e., birds, mammals, honey bee, monocot plants, and dicot plants), the variation in the toxicity endpoints is less than two orders of magnitude, and for some groups, the variation is less than one order of magnitude. For those organism groups for which toxicity data were submitted to the Agency for MCPA EHE, there does not appear to be an increase in the toxicity relative to the acid and salts as was observed for the tested species.

A limitation on these comparisons was that there was only one study (rat) evaluating MCPA sodium salt toxicity to terrestrial organisms. Because MCPA sodium salt disassociates to the acid form very quickly, as does MCPA DMAS, and the terrestrial and aquatic toxicity values from the acid and the DMAS were similar, EFED assumed that the toxicity of MCPA sodium salt to terrestrial organisms was comparable to the toxicity of MCPA acid and MCPA DMAS to terrestrial organisms.

A second limitation on these comparisons is that no studies have been submitted for birds using MCPA EHE. EFED assumed that the relationship among technical formulations of MCPA that was exhibited in the mammal LD_{50} studies will also hold for the bird studies. However, EFED has less confidence in this assumption because of the differences in toxicity between the EHE form and the acid, sodium salt, and DMAS forms when testing aquatic organisms. An acute oral avian study conducted using MCPA EHE would be useful to confirm this assumption.

An additional limitation of these comparisons is that all terrestrial plant toxicity testing was conducted using the technical of the given MCPA formulation. Based on these studies, there appears to be little difference in toxicity to terrestrial plants among the three tested formulations. However, surfactants and adjuvants typically added to TEPs may alter the toxicity of each of the formulations by a different magnitude. Toxicity studies for terrestrial plants using TEPs for the different formulations of MCPA would be useful to confirm this assumption. These requested studies will enable EFED to better characterize the magnitude of potential effects of the MCPA formulations in conjunction with any added surfactants and adjuvants, as well as to determine if the toxicities of MCPA formulations are still similar when applied as the TEP.

Table 16: Summary of endpoints for MCPA acute terrestrial toxicity studies[a, b]				
ORGANISM GROUP	**MCPA ACID**	**MCPA SODIUM SALT**	**MCPA DMAS**	**MCPA EHE**
bird (oral dose), LD_{50}, mg ae/kg-bw	377	no studies	**221**	no studies
bird (dietary), LC_{50}, mg ae/kg-diet	no studies	no studies	>4608, >4608	no studies
mammal, LD_{50}, mg ae/kg-diet	**1383**	3175	1536	1433
honey bee, LD_{50}, µg ae/bee	no studies	no studies	>21	>17
terrestrial monocots emergence, EC_{25}, lbs ae/ac	0.028, 0.096, 0.16, 0.58	no studies	0.012-0.024, 0.094-0.118, 0.094-0.118, >0.0116	**0.010**, 0.018, 0.022, 0.077
terrestrial dicots emergence, EC_{25}, lbs ae/ac	0.0080, 0.0095, 0.027, 0.027, 0.055, 0.057	no studies	**0.005**, 0.012, 0.014, 0.016, 0.047-0.094, 0.094-0.118	0.010, 0.016, 0.020, 0.026, 0.038, 0.051
terrestrial monocots vegetative vigor, EC_{25}, lbs ae/ac	0.092, 0.050, 2.3, >3.0	no studies	0.043, 0.094, 0.20, 1.5-3.0	**0.038**, 0.28, 0.31, 0.60
terrestrial dicots vegetative vigor, EC_{25}, lbs ae/ac	0.013, 0.013, 0.027, 0.034, 0.040, 0.14	no studies	**0.004**, 0.006, 0.009, 0.017, 0.126, 0.570	0.016, 0.016, 0.025, 0.038, 0.12, 0.37

[a] Details for each study are presented in Tables E-8, E-9, E-11, E-14, E-15, and E-16 and in earlier sections of this document. This table is intended simply for gross comparison among formulations.
[b] Bolded entries identify those toxicity endpoints used for calculation of RQs.

Reported Incidents

There are several reported incidents in the Environmental Incident Information System (EIIS) database with a terrestrial organism effect, all were crop injury incidents. There are no reported incidents involving the use of MCPA alone, with the exception of the accidental misuse. All other reported incidents involve co-formulated products in which the damage may have been caused by MCPA and/or the other active ingredients in the products.

In North Dakota, Bronate Advanced, co-formulated with MCPA EHE, bromoxynil octanoate, and bromoxynil heptanoate, was reported to have damaged 880 acres of spring wheat when applied in 2002 (#I013430-023, I013430-024, I013103-029). In North Dakota, DAKOTA, co-formulated with MCPA EHE and fenoxaprop-p-ethyl, was reported to have damaged 150 acres of spring wheat when applied in 2000 (#I010472-093).

In Canada, Curtail, co-formulated with MCPA EHE and clopyralid, is alleged to have caused crop injury to 20,000 acres of peas, chick peas, and lentils planted in 2002. This was reported as a carry-over injury as Curtail had been applied to barley, oats, and wheat that were grown in those fields in 2001 (#I013636-008).

In Wisconsin, MCPA AMINE 4, formulated with MCPA DMAS, was reported to have killed 28.8 acres of alfalfa and oats when applied in excess of the labeled application rate in 2001 (#I012242-001).

The lack of reported incidents cannot be considered as evidence of lack of hazard. The major concerns for risks to birds and mammals are chronic effects. If MCPA is having a chronic impact to bird and mammal populations in the wild, observance of these effects is much less likely than if the risks of concern were acute effects (e.g., mortality). Also, incident reporting is a passive voluntary process. No attempt has been made to actively investigate if mortality of wildlife and non-target plants is occurring on fields treated with MCPA, and there are many reasons why incidents would not get reported by growers who use MCPA. Therefore, at the present time, the lack of wildlife mortality incidents in the EIIS database cannot be considered as evidence of a lack of hazard to terrestrial organisms.

Exposure

Birds and Mammals

Toxicant concentrations on terrestrial food items from spray applications are based on data from by Hoerger and Kenaga (1972) as modified by Fletcher et al. (1994) that determined residue levels on various terrestrial items immediately following toxicant application in the field. Specifically, for every 1 lb ai/acre of application, the resulting maximum concentration on short grass is 240 ppm, on tall grass is 110 ppm, on broad-leaved plants/small insects is 135 ppm, and on seeds/large insects is 15 ppm. For every 1 lb ai/acre of application, the resulting mean concentration on short grass is 85 ppm, on tall grass is 36 ppm, on broad-leaved plants/small insects is 45 ppm, and on seeds/large insects is 7 ppm. Toxicant concentrations on food items following multiple applications are predicted using a first-order residue decline method, EFED's “FATE5" model, which allows determination of residue dissipation over time incorporating degradation half-life.

Predicted maximum and mean EECs resulting from multiple applications are calculated from FATE5 program. FATE5 estimates the highest one-day residue, based on the maximum or mean initial EEC from the first application, the total number of applications, interval between applications, and a first-order degradation rate, consistent with EFED policy. Since no additional data were available as of September 3, 2003, and in accordance with EFED policy, the half-life used for MCPA was the default value of 35 days.

Birds and mammals may be exposed to granular pesticides when foraging for food or grit. They also may be exposed by other routes, such as by walking on exposed granules or drinking water contaminated by granules. The exposure to granules is estimated as the milligrams ae per square foot of treated ground using the maximum application rate of 0.124 lbs ae/5000 sq. ft (EPA Label # 228-203).

Terrestrial Plants

Terrestrial plants inhabiting dry and semi-aquatic areas may be exposed to pesticides from runoff, spray drift or volatilization. Semi-aquatic areas are those low-lying wet areas that may be dry at certain times of the year. EFED's runoff scenario is: (1) based on the water solubility of the pesticide and the amount of pesticide present on the soil surface and its top one inch, (2) characterized as "sheet runoff" (one treated acre to an adjacent acre) for dry areas, (3) characterized as "channelized runoff" (10 treated acres to a distant low-lying acre) for semi-aquatic areas, and (4) for water solubility of <10 mg/L the runoff value is 1% of the application rate, for water solubility of 10-100 mg/L the runoff value is 2% of the application rate, and for solubility of >100 mg/L the runoff value is 5% of the application rate. Since the water solubility of MCPA acid is 3000 mg/L, the runoff value is assumed to be 5% of the application rate. Spray drift exposure from ground application is assumed to be 1% of the application rate. Spray drift from aerial application is assumed to be 5% of the application rate. Runoff from granular applications is similarly modeled. EECs and RQs were calculated using EFED's TerrPlant.xls model (Version 1.0).

Risk Quotients

Birds

In the avian acute dietary studies that were submitted to the Agency, no mortalities were observed. Therefore, RQs based on these dietary studies were not calculated to evaluate the potential acute risks (i.e., Acute Endangered, Acute Restricted Use, and Acute Risk) to birds because of a high, unquantified LC_{50} (> 4608 mg ae/kg-diet). Negative effects were observed in the submitted studies (reduced feed consumption and body weight gain), and the NOAECs were established at 820 mg ae/kg-diet for the bobwhite quail and 461 mg ae/kg-diet for the mallard duck. Acute risk based on mortality in the dietary studies is low.

Since mortality was observed in the acute gavage studies, acute avian RQs were calculated using the acute gavage studies. The most sensitive LD_{50} was 221 mg ae/kg-bw (MCPA DMAS for bobwhite quail, MRID 400192-02). The RQ calculations for the maximum labeled application rate (4.0 lbs ae/acre) and the maximum labeled application rate for wheat (1.5 lbs ae/acre) are detailed in Table F-5 and are summarized in Table 17.

Assuming maximum application rates (4.0 lbs ae/acre) and maximum predicted residue levels, the Acute Risk LOC, Acute Restricted Use LOC, and the Endangered Species LOC were exceeded for all birds consuming short grasses and smaller birds (i.e., 20 and100 g) consuming tall grass, broadleaf forage, and/or small insects when using the acute gavage studies. The Acute Restricted Use LOC and the Endangered Species LOC were exceeded for large birds (i.e., 1000 g) consuming tall grass, broadleaf forage, and/or small insects and for small birds (i.e., 20 g) consuming fruit and large insects. The Endangered Species LOC was exceeded for medium birds (i.e., 100 g) consuming fruit and large insects. There were no LOC exceedances for birds consuming seeds and pods.

Assuming maximum application rates on wheat (1.5 lbs ae/acre) and maximum predicted residue levels, the Acute Risk LOC, Acute Restricted Use LOC, and the Endangered Species LOC were exceeded for smaller birds (i.e., 20 and100 g) consuming short and tall grasses, and for the small birds (i.e., 20 g) consuming broadleaf forage and/or small insects when using the acute gavage studies. The Acute Restricted Use LOC and the Endangered Species LOC were exceeded for large birds (i.e., 1000 g) consuming short grass and for medium birds (i.e., 100 g) consuming broadleaf forage and/or small insects. The Endangered Species LOC was exceeded for large birds (i.e., 1000 g) consuming tall grasses or broadleaf forage and/or small insects and for small birds (i.e., 20 g) consuming fruit and/or large insects. There were no LOC exceedances for birds consuming seeds and pods at the 1.5 lbs ae/acre application rate.

Assuming maximum residue levels at the maximum application rate, no Chronic Risk LOCs were exceeded for short grass, tall grass, and broadleaf forage/small insects. The chronic risk quotients for MCPA are summarized in Table 17, and detailed calculations are provided in Table F-6.

Table 17: Avian Risk Quotient Summary (for application rates of 4 and 1.5 lbs ae/acre)[a,b,c]						
food type	weight class (g)	4 lbs ae/acre			1.5 lbs ae/acre	
		Acute RQ[d]		Chronic RQ (predicted max residues)[e]	Acute RQ[d]	
		predicted max residues	predicted mean residues		predicted max residues	predicted mean residues
short grass	20	6.57***	2.33***	0.96	2.46***	0.88***
	100	2.94***	1.04***		1.10***	0.39**
	1000	0.93***	0.33**		0.35**	0.12*
tall grass	20	3.01***	0.99***	0.44	1.13***	0.37**
	100	1.35***	0.44**		0.51***	0.17*
	1000	0.43**	0.14*		0.16*	0.05
broadleaf forage, small insects	20	2.68***	0.89***	0.54	1.01***	0.34**
	100	1.20***	0.40**		0.45**	0.15*
	1000	0.38**	0.13*		0.14*	0.05
fruit, large insects	20	0.28**	0.13*	0.06	0.11*	0.05
	100	0.12*	0.06		0.05	0.02
	1000	0.04	0.02		0.02	0.01
seeds, pods	20	0.10	0.04	0.06	0.04	0.02
	100	0.04	0.02		0.02	0.01
	1000	0.01	0.01		0.01	<0.01

[a] Acute toxicity threshold was LD_{50} = 221 mg ae/kg-bwt, chronic toxicity threshold was NOAEC = 1000 mg/kg-diet.
[b] Detailed calculations for Acute and Chronic RQs are provided in Tables F-5 and F-6, respectively.
[c] RQs in this table were calculated for the maximum labeled application rate of 4 lbs ae/acre and for the maximum labeled application rate for wheat of 1.5 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of 1 lb ae/acre, multiply the listed RQs for the 4 lbs ae/acre application rate by ¼ (since 1 lb ae/acre is ¼ the listed application rate of 4 lbs ae/acre).
[d] * indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 0.10.
** indicates an exceedance of Acute Restricted Use LOC; RQ > 0.20.
*** indicates an exceedance of Acute Risk LOC; RQ > 0.50.
[e] + indicates an exceedance of Chronic LOC.

Assuming maximum granular application rates (1.09 lbs ae/acre) there were no exceedances of the Acute Risk LOC, Acute Restricted Use LOC, or the Endangered Species LOC, as all calculated RQs were < 0.01 (Table 18). EFED does not currently assess chronic risks to birds from granular applications.

Table 18: Avian Acute Risk Quotients (for granular application rate of 1.09 lbs ae/acre)[a]				
LD_{50}	weight class (g)	adjusted LD_{50}[b]	EEC (mg ae/sq ft)	Acute RQ (LD_{50}/sq ft)[c]
221 mg ae/kg-bwt	20	158.43	10.9	0.003
	100	201.68		<0.001
	1000	284.89		<0.001

[a] The number of lethal doses (LD50s) that are available within one square foot immediately after application (LD50s/sq.ft) is used as the risk quotient for granular products.RQs in this table were calculated for the maximum labeled granular application rate of 1.09 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs.
[b] adjusted $LD_{50\ (XXgm\ bird)} = LD_{50\ (Test\ bird)}$ * ([XX(g) / [bwt of test bird(g)]) $^{(1.15\ -1)}$ where avg bwt of test birds was 184g and LD_{50} = 221 mg/kg-bwt (MRID 400192-02), Mineau et al 1996
[c] RQ calculated as EEC /(adjusted LD_{50} x bird weight)

* indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 0.10.
** indicates an exceedance of Acute Restricted Use LOC; RQ > 0.20.
*** indicates an exceedance of Acute Risk LOC; RQ > 1.0.

Mammals

To evaluate the acute risk to mammals, RQs were calculated using the minimum LD_{50} obtained from the acute oral studies (1383 mg ae/kg-bwt, MCPA acid, Acc. 21972) at the maximum labeled rate (4 lbs ae/acre) and the maximum labeled application rate for wheat (1.5 lbs ae/acre) . To evaluate the chronic risk to mammals, RQs were calculated using the NOAEC obtained from the 2-generation rat study with MCPA acid (NOAEC=150 mg ae/kg-diet, MRID 400417-01). The RQ calculations are detailed in Tables F-7 and F-8, and they are summarized in Table 18.

Assuming maximum residue levels at the maximum application rate (4.0 lbs ae/acre), the Acute Risk LOC was exceeded for small mammals (i.e., 15 g) consuming short grass (RQ = 0.63). Acute Restricted Use LOCs were exceeded for small mammals (i.e., 15 and 35 g) consuming grasses, broadleaf forage, and small insects. Endangered Species LOCs were also exceeded for these mammals, as well as for larger mammals consuming short grasses. There were no LOC exceedances for mammals consuming fruit, large insects, seeds, or pods.

Assuming maximum residue levels at the maximum application rate for wheat (1.5 lbs ae/acre), there were no exceedances of the Acute Risk LOC. The Acute Restricted Use LOC was exceeded for small mammals (i.e., 15 g) consuming short grasses. Endangered Species LOCs were also exceeded for these mammals, as well as for medium sized mammals (i.e., 35 g) consuming short grass and small mammals (i.e., 35 g) consuming tall grasses. There were no LOC exceedances for mammals consuming broadleaf forage, small insects, fruit, large insects, seeds, or pods.

Assuming the maximum labeled application rate (4.0 lbs ae/acre) for both maximum and mean residue levels, the Chronic LOC was exceeded for mammals consuming short grass, broadleaf forage, and small insects. The Chronic LOC also was exceeded for mammals consuming tall grasses when the maximum residue level was assumed.

Assuming the maximum labeled application rate for wheat (1.5 lbs ae/acre) for maximum residue levels, the Chronic LOC was exceeded for mammals consuming short grass, tall grass, broadleaf forage, and small insects. There were no exceedances of the Chronic LOC when the mean residue level was assumed.

Table 19: Mammalian Risk Quotient Summary (for rates of 4 and 1.5 lbs ae/acre)[a,b,c]									
food type	weight class (g)	4 lbs ae/acre				1.5 lbs ae/acre			
		Acute RQ[d]		Chronic RQ[e]		Acute RQ[d]		Chronic RQ[e]	
		max residues	mean residues	max residues	mean residues	max residues	mean residues	max residues	mean residues
short grass	15	0.63***	0.22**	6.40+	2.27+	0.24**	0.08	2.40+	0.85
	35	0.44**	0.15*			0.16*	0.06		
	1000	0.10*	0.04			0.04	0.01		
tall grass	15	0.29**	0.09	2.93+	0.96	0.11*	0.04	1.10+	0.36
	35	0.20**	0.07			0.07	0.02		
	1000	0.05	0.02			0.02	0.01		
broadleaf forage, small insects	15	0.26**	0.09	3.60+	1.20+	0.10	0.03	1.35+	0.45
	35	0.18**	0.06			0.07	0.02		
	1000	0.04	0.01			0.02	0.01		
fruit, large insects	15	0.03	0.01	0.40	0.19	0.01	<0.01	0.15	0.07
	35	0.02	0.01			<0.01	<0.01		
	1000	<0.01	<0.01			<0.01	<0.01		
seeds, pods	15	0.01	<0.01	0.40	0.19	<0.01	<0.01	0.15	0.07
	35	0.01	<0.01			<0.01	<0.01		
	1000	<0.01	<0.01			<0.01	<0.01		

[a] Acute toxicity threshold was LD_{50} = 1383 mg ae/kg-bwt, chronic toxicity threshold was NOAEC = 150 mg/kg-diet.
[b] Detailed calculations for Acute and Chronic RQs are provided in Tables F-7 and F-8, respectively.
[c] RQs in this table were calculated for the maximum labeled application rate of 4 lbs ae/acre and for the maximum labeled application rate for wheat of 1.5 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of 1 lb ae/acre, multiply the listed RQs for the 4 lbs ae/acre application rate by ¼ (since 1 lb ae/acre is ¼ the listed application rate of 4 lbs ae/acre).
[d] * indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 0.10.
** indicates an exceedance of Acute Restricted Use LOC; RQ > 0.20.
*** indicates an exceedance of Acute Risk LOC; RQ > 0.50.
[e] + indicates an exceedance of Chronic LOC.

Assuming maximum granular application rates (1.09 lbs ae/acre) there were no exceedances of the Acute Risk LOC, Acute Restricted Use LOC, or the Endangered Species LOC, as all calculated RQs were < 0.01 (Table 20). EFED does not currently assess chronic risks to mammals from granular applications.

Table 20: Mammalian Acute Risk Quotients (for granular application rate of 1.09 lbs ae/acre)[a]

LD_{50}	weight class (g)	EEC (mg ae/sq ft)	Acute RQ (LD_{50}/sq ft) [b]
	15		<0.001
1383 mg ae/kg-bwt	35	10.9	<0.001
	1000		<0.001

[a] The number of lethal doses (LD50s) that are available within one square foot immediately after application (LD50s/sq.ft) is used as the risk quotient for granular products.RQs in this table were calculated for the maximum labeled granular application rate of 1.09 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs.
[b] RQ calculated as EEC /(LD_{50} x mammal weight)
* indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 0.10.
** indicates an exceedance of Acute Restricted Use LOC; RQ > 0.20.
*** indicates an exceedance of Acute Risk LOC; RQ > 1.0.

Terrestrial Non-Target Insects

EFED currently does not quantify risks to terrestrial non-target insects; therefore, risk quotients are not calculated for these organisms. Risks are qualitatively discussed in the Terrestrial Organism Risk Characterization section of this document.

Terrestrial Plants

An analysis of the results indicates exceedance of the Acute Risk LOC and the Acute Endangered Species LOC for all modeled scenarios at the highest application rate (Table 19). At the highest labeled rate for wheat (1.5 lbs ae/acre), all Acute Endangered Species LOCs were exceeded, and all Acute Non-endangered Species LOCs were exceeded except for drift to non-target monocots from ground application. At the highest labeled rate for granular applications (1.09 lbs ae/acre), all Acute Endangered Species LOCs and all Acute Non-endangered Species LOCs were exceeded. Detailed calculations for risk quotients are presented in Appendix E and Tables F-9 through F-14.

Currently, EFED does not perform chronic risk assessments for terrestrial plants.

Table 21: Summarized Terrestrial Plant Risk Quotients [a, b, c, d]						
Scenario	Acute Non-endangered RQs			Acute Endangered RQs		
	adjacent to treated sites	semi-aquatic areas	drift	adjacent to treated sites	semi-aquatic areas	drift
Ground spray application (4.0 lbs ae/acre)						
Monocot	24.00***	204.00***	1.05***	40.00*	340.00*	3.08*
Dicot	48.00***	408.00***	10.00***	40.00*	340.00*	13.33*
Aerial or chemigation spray application (4.0 lbs ae/acre)						
Monocot	32.00***	140.00***	5.26***	53.33*	233.33*	15.38*
Dicot	64.00***	280.00***	50.00***	53.33*	233.33*	66.67*
Ground spray application (1.5 lbs ae/acre)						
Monocot	9.00***	76.50***	0.39	15.00*	127.50*	1.15*
Dicot	18.00***	153.00***	3.75***	15.00*	127.50*	5.00*
Aerial or chemigation spray application (1.5 lbs ae/acre)						
Monocot	12.00***	52.50***	1.97***	20.00*	87.50*	5.77*
Dicot	24.00***	105.00***	18.75***	20.00*	87.50*	25.00*
Granular ground application (1.09 lbs ae/acre)[e]						
Monocot	5.45***	54.50***	NA	9.08*	90.83*	NA
Dicot	10.90***	109.00***	NA	9.08*	90.83*	NA

[a] RQs for spray applications in this table were calculated for the maximum labeled application rate of 4 lbs ae/acre and for the maximum labeled application rate for wheat of 1.5 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of 1 lb ae/acre, multiply the listed RQs by ¼ (since 1 lb ae/acre is ¼ the listed application rate of 4 lbs ae/acre).
[b] Acute non-endangered toxicity thresholds (EC_{25}) were 0.010, 0.005, 0.038, and 0.004 lb ae/acre for seedling emergence monocot, seedling emergence dicot, vegetative vigor monocot, and vegetative vigor dicot, respectively.
[c] Acute endangered toxicity thresholds (NOAEC) were 0.006, 0.006, 0.013, and 0.003 lb ai/acre for seedling emergence monocot, seedling emergence dicot, vegetative vigor monocot, and vegetative vigor dicot, respectively.
[d] * indicates an exceedance of the Endangered Species Level of Concern (LOC).
*** indicates an exceedance of the Acute Risk LOC.
[e] RQs for ground granular applications in this table were calculated for the maximum labeled application rate of 1.09 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. Drift RQs are not applicable for granular applications.

Terrestrial Organism Risk Characterization

Risks to Birds and Mammals

Acute concerns to birds

Using the acute dietary bird toxicity studies, risks for acute lethal concerns to birds are low, as no mortality was observed at the highest dose. However, based on the acute toxicity studies submitted for birds, there is a large differential between the acute toxicity when MCPA is administered as a single gavage or when mixed in the feed. In the two gavage studies (MRID 400192-01 and 400192-02), the LD_{50}'s were 377 and 221 mg ae/kg-bird. In the two dietary studies (MRID 405558-03 and 405558-02), no mortalities were observed at the maximum treatment level of 4608 mg ae/kg-diet; however, adverse effects were observed at lower doses: reduced feed consumption at 1460 mg ae/kg-diet in bobwhite quail (MRID 405558-03, NOAEC = 820 mg ae/kg-diet) and reduced body weight gain at 820 mg ae/kg-diet in mallard ducks (MRID 405558-02, NOAEC = 461 mg ae/kg-diet). With no mortalities in the dietary studies at the highest dose, acute risks to birds are low. The gavage studies indicate acute risks are present due to the exceedance of the Acute Risk LOC at both 4.0 and 1.5 lbs ae/acre for small to medium birds of several feeding guilds. This disparity in mortality between the two studies suggests that the dietary matrix may have a lowering effect of the toxicity of MCPA.

In these two acute dietary studies, non-lethal toxic effects thresholds were defined by the NOAECs. Reduced feed consumption was observed at 1460 mg ae/kg-diet in bobwhite quail resulting in a NOAEC of 820 mg ae/kg-diet (MRID 405558-03), and reduced body weight gain was observed at 820 mg ae/kg-diet in mallard ducks resulting in a NOAEC of 461 mg ae/kg-diet (MRID 405558-02). Using a 4 lb ae/acre application rate and predicted maximum residues, the highest modeled EEC (short grass, 960 mg ae/kg-diet) was lower than the bobwhite quail LOAEC of 1460 mg ae/kg-diet but was higher than the NOAEC, 820 mg ae/kg-diet. With the 4 lb ae/acre application rate and predicted maximum residues on foodstuffs, the modeled EEC for short grass was higher than both the NOAEC and the LOAEC for the mallard duck study. At an application rate of 1.5 lbs ae/acre (maximum rate on wheat) with predicted maximum residues, the highest modeled EEC (short grass, 360 mg ae/kg-diet) was less than the NOAEC from either dietary study. Although the concerns for lethality of MCPA to non-endangered birds is minimal, it is likely that the current maximum label rates could have adverse non-lethal effects on birds, especially those consuming short grasses. However, at maximum label rates for wheat (1.5 lbs ae/acre), concerns for non-lethal effects on birds are minimal.

Risks to endangered bird species include sublethal effects and lethal effects still exist due to the uncertainty in variability among species sensitivities. These risks would be greatest short grass consumers, primarily smaller birds.

Acute concerns to mammals

As with birds, there were exceedances of the acute LOCs using predicted maximum residue levels and predicted mean residue levels at the maximum application rates. At the maximum application rate for wheat (1.5 lbs ae/acre) with predicted maximum residues, there will be no exceedances of the Acute Risk LOCs; however, there will still be exceedances of the Acute Restricted Use and Endangered Species LOCs for smaller mammals (i.e., 15-35 gms) that consume short or tall grasses.

The differential between the acute gavage studies and the subchronic dietary studies does not appear as large as the toxicity difference observed between the gavage and dietary studies for birds. The LD_{50}'s for the gavage studies ranged from 1383 to 3175 mg ae/kg-bwt. Treatment related mortality was only observed in one of the subchronic dietary studies. In a 90-day study on dogs (Acc. 106595), seven of eight test subjects died or were sacrificed moribund between weeks 5-8 at the 1198-1370 ppm dose (equivalent to 48.0 mg ae/kg-day). The other dietary studies had maximum doses less than 36 mg ae/kg-day except for one 28-day mouse study (Acc. 165470). In this study, the maximum dose was 2700 mg ae/kg-diet (equivalent to 453.7-820.1 mg ae/kg-bwt for males and 442.3-956.3 mg ae/kg-bwt for females), and no mortality was observed. However, all the subchronic toxicity studies did have significant adverse effects and the NOAECs ranged between 6 and 900 mg ae/kg diet.

Chronic concerns to birds

Based on the one chronic bird study submitted to the Agency and the predicted exposure levels, the risk of adverse chronic effects to birds is not expected.

Chronic concerns to mammals

At the highest application rate (4.0 lbs ae/acre) of MCPA with either predicted maximum or mean residue levels on the foliage, the Chronic LOC was exceeded for mammals consuming short grass, broadleaf forage, and/or small insects; the Chronic LOC was also exceeded for mammals consuming tall grass when predicted maximum residues were assumed. At lower application rates, the RQs will be reduced; however, for all Chronic RQs to be less than the LOC of 1.0 with predicted maximum residue levels, the application rate can be no more than 0.6 lbs ae/acre.

At 4 lbs ae/acre and assuming predicted maximum residues, the EEC exceeds the NOAEC for 94 days for short grass, 55 days for tall grass, and 65 days for broadleaf plants and small insects. At 1.5 lbs ae/acre and assuming predicted maximum residues, the EEC exceeds the NOAEC for 45 days for short grass, 5 days for tall grass, and 16 days for broadleaf plants and small insects. For those animals exposed to these treated fields, the window of exposure is fairly large.

In the 2-generation reproduction study (MRID 400417-01), there were no treatment-related mortalities. There were no treatment-related effects on mean live litter sizes, sex ratios at birth, or pup survival of either litter of the treated groups of either generation; however, offspring body weight gain for the postnatal day 4-21 interval decreased in all litters (group means ranged from 86-91% of control) of the high-dose group (450 mg ae/kg-diet). Most of these individuals were sacrificed at 21 days, so follow-up for potential recovery was not possible. However, some of these individuals were used for parenting the second generation in this study. For these rats, the reduced weight gains appeared to be transient as they had weights and weight gains similar to the control group when followed through gestation and lactation periods. In adult high-dose females, ovary size was significantly increased in the high dose group (450 mg ae/kg-diet). Although there were no reported histological findings in the ovaries, reproductive organ effects were observed in several subchronic studies with MCPA EHE (MRID 435567-01 and 435568-01). These effects included testicular atrophy in rats and increased relative and absolute ovary and thyroid weights in dogs. No reproductive effects were observed in the 2-generation reproduction study, resulting in a reproductive NOAEL of 450 mg ae/kg-diet and parental and offspring NOAELs of 150 mg ae/kg-diet.

Even if the risk assessment for chronic mammal concerns was conducted using the reproductive NOAEL of 450 mg ae/kg-diet, there would still be exceedances of the Chronic LOC. Using the maximum application rate of 4.0 lbs ae/acre and predicted maximum residue levels, the Chronic RQ for short grass was 2.13 and the Chronic RQ for broadleaf forage and small insects was 1.2. There were no exceedances of the Chronic LOC if predicted mean residue levels were used. This implies that even if the reduced weight gains of offspring between 4 and 21 days and increased ovary size in females were not considered significant adverse effects, EFED still has concerns for chronic effects to mammals from MCPA exposure.

The four pre-natal developmental studies had NOAECs ranging from 30 to 60 mg ae/kg-diet (MRIDs 427238-02, 427238-01, 449541-02, and 449541-01). Two of these studies were conducted using the acid form, one was conducted using the DMAS form, and one was conducted using the EHE form of MCPA. The NOAECs in these studies are considerably lower than in the 2-generation study. In all of the pre-natal studies, the chemical was administered as a gavage, not mixed in the feed as in the 2-generation reproduction study. EFED hypothesized that the differences in the NOAECs between the developmental studies and the 2-gen study are due to MCPA administration method. When the chemical is mixed in the feed, rate of intake into the body is slowed, and adsorption into the body through the stomach walls is slowed and possibly reduced.

Variation in diet composition

The risk assessment and calculated RQs assume 100% of the diet is relegated to single food types foraged only from treated fields. The assumption of 100% diet from a single food type may be realistic for acute exposures, but diets are likely to be more variable over longer periods of time. However, even if there is variation in diet over time, when the Chronic LOCs are exceeded for multiple food categories, exposure will still be high enough to warrant concern.

This assumption is likely to be conservative and will tend to overestimate potential risks for chronic exposure, especially for larger organisms that have larger home ranges. These large animals (e.g., deer and geese) will tend to forage from a variety of areas and move on and off of treated fields. Small animals (e.g., mice, voles, and small birds) may have home ranges smaller than the size of a treated field and will have little or no opportunity to obtain foodstuffs that have not been treated with MCPA. Even if their home range does cover area outside the treated field, MCPA may have drifted to areas adjacent to the treated field.

Exposure routes other than dietary

Other exposure routes are possible for animals residing in or moving through treated areas. These routes include ingestion of contaminated drinking water, ingestion of contaminated soils, preening/grooming, and dermal contact. Consumption of drinking water would appear to be inconsequential if water concentrations were equivalent to the concentrations from PRZM/EXAMS; however, concentrations in puddled water sources on treated fields may be higher than concentrations in modeled ponds. Preening exposures, involving the oral ingestion of material from the feathers remains an unquantified, but potentially important, exposure route. Toxicity due to dermal contact is likely to be of moderate importance because mammal testing revealed MCPA EHE was a dermal sensitizer; however, MCPA acid, sodium salt, and DMAS were not dermal sensitizers (MRID430628-06, 403520-01, 416130-03). Neither MCPA acid or EHE demonstrated any dermal effects, but MCPA DMAS and MCPA sodium salt did demonstrate slight dermal irritation (Acc. 250090, 156456, 256980, 256979). However, the potential for MCPA to be percutaneously absorbed into the body and to cause systemic toxic effects remains unqualified. If toxicity is expected through any of these other routes of exposure, then the risks of a toxic response to MCPA is underestimated in this risk assessment.

Because MCPA acid does not volatilize appreciably (v.p. 7.60×10^{-9} atmospheres at 20°C), inhalation of gas phase MCPA acid does not appear to be a significant contributor to overall exposure. Since the salts (sodium salt and DMAS) disassociate to the acid very quickly, they are also not of concern for inhalation exposure. MCPA EHE is slightly volatile (v.p. 5.47×10^{-6} atmospheres at 20°C); however, it also has a strong tendency to bind to the organic matter in soil (K_{oc} = 9576). It is not likely to volatilize off of the soil after binding; therefore, the likelihood of high exposure to animals through inhalation is minimal. For birds, this risk of effect due to inhalation exposure was also evaluated more qualitatively in the screen detailed below.

The pore air concentration of the chemical is determined based on the following formula:

$$C_a(z=0,t) = C_{bulk}(z=0,t) / [(p_s K_d/K_H)+(2_w/K_H)+N_g]$$

where:

$C_a(z=0,t)$ = pore air concentration at the soil:air interface as a function of time (g/cm^3)
$C_{bulk}(z=0,t)$ = concentration in soil to 2.5 cm depth (g/g-soil)
p_s = bulk density of soil (g/cm^3)
K_d = soil/water equilibrium constant
K_H = Henry's Law constant, dimensionless

2_w = volumetric fraction of pore space in water
N_g = volumetric air fraction in soil pore space.

C_{bulk}(z=0,t) is a function of the labeled application rate of the chemical;, K_d and K_H are chemical specific properties; and p_s, 2_w and N_g are soil properties based on the selected PRZM/EXAMS standard scenario. K_d was calculated from $\log K_{oc}$ [K_d = fraction organic carbon in soil * $10^{\log Koc}$]; $\log K_{oc}$ values were obtained from the EpiSuite 3.10 software (Estimation Programs Interface (EPI) Suite, US EPA & Syracuse Research Corporation, 2000).

The maximum 1-hour inhalation dose, assuming a 50 g non-passerine bird, is calculated as:

$$ID = [\text{pore air concentration} * (1000\text{mg}/1\text{g})] * IR / [\text{birdwt(g)} * (1\text{kg}/1000\text{g})]$$

where:

ID = inhalation dose (mg ai/kg-hr)
IR = inhalation rate (cm^3/hr) = 284* $[\text{birdwt(g)}*(1\text{kg}/1000\text{g})]^{0.77}$ *60 minutes *3
from EPA (1993) adjusted by a factor of 3 for field metabolic rates.

Assuming toxicity through the inhalation pathway is the same as the toxicity through the oral pathway, the estimated inhalation dose is compared to the LD_{50}s obtained from the acute avian toxicity studies. If this dose is close to or greater than the LD_{50}, there is a potential for adverse acute effects due to inhalation of the test chemical. If the inhalation dose is much smaller than the LD_{50}, then it is unlikely that sufficient quantities of the test material would be inhaled to trigger adverse effects.

For MCPA, two scenarios were evaluated; both used the soil properties of the North Dakota wheat scenario; one represented the maximum labeled rate for the MCPA acid/salts (4.0 lbs ae/acre) and the second represented the maximum labeled rate for MCPA EHE (2.35 lbs ae/acre) (Table 20). This analysis assumes that complete disassociation from the salts to the acid has occurred and that no hydrolysis from the ester to the acid has occurred. The analysis also assumes that the structural activity model predicts proper partitioning coefficients and volatilization of MCPA from plant material is negligible. The concentration in air was estimated to be 6.1×10^{-14} g ae/cm^3 for MCPA acid and 1.8×10^{-16} g ae/cm^3 for MCPA EHE. The estimated inhalation doses were 6.1×10^{-6} mg ae/kg-hr for MCPA acid and 1.8×10^{-8} mg ae/kg-hr for MCPA EHE. These inhalation doses were less than 0.1% of the minimum LD_{50} for both scenarios which indicated that exposure was not likely significant for adverse inhalation effects.

Table 22: Input Parameters for Volatilization and Inhalation Model		
Parameter	**MCPA acid/salts**	**MCPA EHE**
maximum application rate (lbs ae/acre)	4.0	2.35
C_{bulk}(z=0,t) = concentration in soil to 2.5 cm depth (g/g-soil)	$1.49x10^{-5}$	$8.78x10^{-6}$
p_s = bulk density of soil (g/cm^3)	1.2	1.2
K_d = soil/water equilibrium constant	0.683	222
K_H = Henry's Law constant, dimensionless	$5.08x10^{-9}$	$5.47x10^{-9}$
2_w = volumetric fraction of pore space in water	0.432	0.432
N_g = volumetric air fraction in soil pore space	0.568	0.568

Risks to Non-Target Insects

EFED currently does not quantify risks to terrestrial non-target insects. Risk quotients are therefore not calculated for these organisms. Since MCPA was practically non-toxic to honey bees (LD_{50} of >17 µg/bee), the potential for MCPA to have adverse effects on pollinators and other beneficial insects is low.

Risks to Terrestrial Plants

The risk quotient calculations suggest concern for non-target terrestrial plants across all use sites at the highest application rate (4.0 lbs ae/acre); the Acute Endangered Terrestrial Plant RQs and the Acute Non-Endangered Terrestrial Plant RQs exceeded the LOC for all the modeled scenarios. At the highest labeled rate for wheat (1.5 lbs ae/acre), the Acute Endangered LOCs and Acute Non-endangered LOCs were exceeded for all except for drift to non-target non-endangered monocots from ground application.

For MCPA, a total of 60 terrestrial plant studies were submitted using various formulations and species. Typically, EFED evaluates risk to non-target terrestrial plants using the EC_{25}s for the most sensitive species tested from the seedling emergence studies and from the vegetative vigor studies. In order to test the conservativeness of this approach, EFED evaluated the full range of EC_{25} results. Of the 52 definitive EC_{25}s obtained in all the terrestrial plant studies, the highest was 2.3 lbs ae/acre (oat vegetative vigor with MCPA acid, MRID 430832-05) and the lowest was 0.004 lbs ae/acre (radish vegetative vigor with MCPA DMAS, MRID 437882-01). The median was 0.28 lbs ae/acre and the 75th percentile was 0.096 lbs ae/acre. Several EC_{25}s were reported as ranges (due to limitations from the study design and data analysis), and several EC_{25}s were undefined (EC_{25} was greater than the highest dose tested).

If the 75th percentile of the definitive EC_{25}s (0.096 lbs ae/acre) is used as the toxicity endpoint, to calculate non-endangered non-granular RQs, all RQs (range from 2.50 to 21.25) exceeded an

LOC of 1.0 for adjacent terrestrial and semi-aquatic non-target plants at an application rate of 4.0 lbs ae/acre. For drift from ground spray, the RQ for non-target plants was 0.42 and for drift from aerial application, the RQ for non-target plants was 2.08. This indicates that although there is a range of plant sensitivities to MCPA, a majority of the tested species have a high sensitivity to MCPA; therefore, this assessment for terrestrial plants is not overly conservative.

MCPA uptake is primarily through the foliage and it is translocated throughout the plant in the xylem and phloem. Uptake also occurs through the roots. Even if only a small surface area of the plant is exposed to MCPA, or a seedling is exposed to MCPA as it breaks through the soil surface, there is a possibility that the plant may be severely damaged or die as a result. The resulting damage, even if only minor, may be sufficient to prevent the plant from competing successfully with other plants for resources and water.

Plant material serves as a primary food source for many species of animals. If the available plant material (including seeds) are reduced due to the effects of MCPA, this may have negative effects throughout the food chain. Application timing should also be considered, as reproduction abnormalities are some of the plant injuries that can possibly occur due to MCPA exposure. Although the plant may survive, sterile florets or nonviable seed production can occur. If this does occur, there may be effects on the affected non-target plant populations in future years as they recover from the rapid population decline.

Spray drift is also an important factor in characterizing the risk of MCPA to non-target plants. There is as much as a 5-fold increase in the RQs when aerial application is used as opposed to ground application. Spray drift exposure from ground application is assumed to be 1% of the application rate and the EECs and RQs were calculated using EFED's TerrPlant.xls model (Version 1.0). The AgDrift Tier 1 model (ground application, fine to medium coarse nozzle, and low boom height) was used to determine what conditions are represented by a 1% spray drift exposure from ground application. AgDrift provided both the 50^{th} and 90^{th} percentiles estimates based on the distribution of field measurements at different distances from the edge of field and averaged over a swath of given width from the edge of the field. The 50^{th} and 90^{th} percentile drift estimates from AgDrift were 0.8 and 1.3% of applied at a distance 25 ft from the edge of the field. The 50^{th} and 90^{th} percentile drift estimates were 1.0 and 1.3% averaged over a swath 175 feet from the edge of the field. Therefore, EFED's TerrPlant model can be interpreted to represent exposure to non-target terrestrial plants in either of two ways. First, TerrPlant models the exposure to drift from ground spray at a distance of 25 ft from the edge of the field. Distances closer to the field than 25 ft would have an exposure higher than modeled by TerrPlant and distances farther from the field than 25 ft would have an exposure lower than modeled. A second interpretation is that TerrPlant models the average exposure across a swath 175 feet wide starting at the edge of the field. Within this swath, the exposure is higher close to the edge of the field than it is at distances further from the field.

Concerns have also been raised regarding the higher volatility of the phenoxy esters, relative to the phenoxy amine salts, as this may increase off-target damage to plants through volatilization and subsequent drift. The vapor pressure of MCPA EHE is 5.47×10^{-6} atmospheres at 20°C.

Based on the chemical properties of MCPA EHE, the fugacity model predicts that 0.39% of the applied material may volatilize using EpiSuite 3.10 software (Estimation Programs Interface (EPI) Suite, US EPA & Syracuse Research Corporation, 2000). Assuming this rate of volatilization at the maximum MCPA EHE application rate (2.35 lbs ae/acre), as much as 0.009 lbs ae/acre will be predicted by the fugacity model to volatilize from the treated fields. Only four of the EC_{25}s and 13 of the NOAECs from the 60 available plant (seedling and vegetative vigor) studies for all formulations of MCPA were less than 0.009 lbs ae/acre, indicating volatilization alone is not a major factor in non-target plant exposure to MCPA EHE.

The risk assessment for terrestrial plants was based on RQs calculated from toxicity studies using the technical grade of MCPA acid, salt, and esters instead of TEPs (typical end-use product). Often the TEPs include surfactants or adjuvants to increase the herbicide's adsorption into the plant, thereby increasing its efficacy. If the toxicity tests were conducted using a TEP of MCPA at the same rates as the technical grade, the toxicity endpoints are likely to be much lower. Furthermore, if the toxicity endpoints were reduced in studies using the TEP, the RQs and the risks would be higher than currently estimated. In addition, surfactants and adjuvants typically added to TEPs may alter the toxicity of each of the formulations by a different magnitude. Toxicity studies for terrestrial plants using TEPs for the different formulations of MCPA would be useful to confirm this assumption. These studies will enable EFED to better characterize the magnitude of potential effects of the MCPA formulations in conjunction with any added surfactants and adjuvants, as well as to determine if the toxicities of MCPA formulations are still similar when applied as the TEP.

Uncertainties in the Terrestrial Assessment

There are a number of general areas of uncertainty in the terrestrial risk assessment including:

1. **This assessment accounts only for exposure of terrestrial organisms to MCPA, but not to its degradates.** The potential toxicity of degradates of MCPA is unknown. The risks presented in this assessment could be underestimated if degradates also exhibit toxicity under the conditions of use proposed on the label. Since MCPA can only be applied to a field once per year, the acute terrestrial assessment would not change if some or all degradates were assumed equipotent. For the chronic assessment, the risks would be higher if all degradates were assumed equipotent. Although the EECs used for calculating the RQs would be the same (since there is only one application per year), the length of exposure in exceedance of the toxicological endpoints would be longer. The concentration of the parent material would decline according to the estimated half-live, but as the parent material degrades, the concentration of the degradates would increase. The MARC of HED has determined that none of the degradates of MCPA are of toxicological concern.
2. **The risk assessment only considers the most sensitive species tested.** Terrestrial acute and chronic risks are based on toxicity data for the most sensitive bird, mammal, and plant species tested. Responses to a toxicant can be expected to be variable across species. In the case of MCPA, only two bird, three mammalian, one beneficial insect, and

10 agricultural plant species were tested. Sensitivity differences between species can be considerable (even up to two orders of magnitude) for some chemicals (ECOFRAM 1999). The position of the tested species relative to the distribution of all species' sensitivities to MCPA is unknown. In addition, the toxicity of MCPA to wild (non-laboratory) species relative to laboratory species is unknown. Extrapolating the risk conclusions from the most sensitive species tested to non-tested species may either underestimate or overestimate the potential risks to those species.

3. **The risk assessment only considered a subset of possible use scenarios.** For this risk assessment, the scenarios were selected to represent a range of application rates, crops, and geographic areas. An attempt was made to examine scenarios that are expected to cause the greatest risks based on geographic and application-related factors. It is possible, however, that some of the labeled uses (crop-geographic region combinations) that were not modeled will have a greater risk to the environment than those included in this risk assessment. These uses that may exhibit a greater risk to the environment would include those occurring in or near sensitive environments (e.g., close proximity to habitat that supports or has the potential to support endangered or threatened terrestrial species).
4. **Based on the physical chemical properties of the ester formulation of MCPA and on evidence from the open literature there may be a concern for impacts to non-target organisms due to volatilization and off-site deposition of MCPA EHE**. Currently, EFED includes an assessment of the effect of drift in both the aquatic and terrestrial risk assessments. However, EFED does not typically assess the impact of volatility, long-range transport and deposition as a route of exposure in its risk assessment process. EFED has conducted a screening level assessment of the potential exposure of terrestrial organisms due to volatility of MCPA acid and MCPA EHE. However, the effect of volatility of MCPA EHE on non-target organisms should be viewed as a source of uncertainty in this assessment.

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APPENDIX A: Environmental Fate Assessment

Environmental Fate Assessment

I. Environmental Fate Summary

The environmental fate data base is adequate to perform a fate assessment for MCPA.

Bridging data were submitted to verify that MCPA dimethylamine salt (DMAS) and MCPA ethylhexyl ester (EHE) will be rapidly converted to the free acid in the environment. Therefore, studies conducted with the acid provide "surrogate data" for the MCPA DMAS and MCPA EHE.

In a dissociation study, MCPA DMAS completely dissociated to MCPA and dimethylammonium ion within 1.5 minutes of stirring in deionized water; therefore, fate studies with MCPA acid will provide data regarding the behavior of MCPA DMAS. Two hydrolysis studies were included in this package for MCPA EHE. One study was a standard hydrolysis study in sterile buffers at pH 5, 7, and 9. At pH 9, MCPA EHE hydrolyzed to MCPA acid with a half-life $\leq$117 hours; the MCPA acid did not degrade further and there was no hydrolysis of MCPA EHE at pH 5 and 7. The second hydrolysis study was done in a soil:$CaCl_2$ system at pH 5.6 and 6.8; the MCPA EHE adsorbed to the soil particles, but was available for hydrolysis to MCPA acid with a half-life of $\leq$12 hours.

Data submitted subsequent to establishment of the environmental fate bridging strategy support the rationale and add context to the strategy. Data from a terrestrial field dissipation study using MCPA EHE indicate that greater than 80% of MCPA EHE converted to MCPA acid on the day of application and nearly all MCPA EHE was converted by day 3, while terrestrial field dissipation data submitted for MCPA iso-octyl ester (equivalent to EHE) report half lives of 9 and 23 days for MCPA iso-octyl ester. However, the analytical technique employed in the iso-octyl ester study reports total MCPA residues (ester and acid formulations) and therefore the half lives represent total MCPA residue half lives. Additionally, data by Harrison, et al (1993) indicate that for turfgrass sites where esters of phenoxy herbicides (2,4-D and 2,4-DP) were applied, no esters were detected in runoff water (detection limits were 20 ug/l for 2,4-D EHE), but 2,4-D acid was detected at concentrations as high as 312 ug/l in runoff water. Terrestrial field dissipation data collected for 2,4-D EHE indicate that this phenoxy ester remained in the field with half lives between 1 and 14 days.

Open literature data indicate that carboxylic acid esters can be prone to both surface-catalyzed hydrolysis and microbial mediated hydrolysis (Schwarzenbach, et al.1993). Sediment and soils may promote heterogeneous hydrolysis through reactions with surface hydroxyl groups from transition metal oxide and hydroxide mineral coatings or through enhance hydroxide concentrations in the diffuse double layer at the interface of sediment or soil surfaces.

Microbial-mediated hydrolysis of carboxylic acid esters is an enzymatic controlled process (Schwarzenbach, et al.1993). Paris, et al (1981) tested the rate of microbial degradation of 2,4-D BEE in natural waters from 31 sites with varying temperature and pH conditions (5.4 to 8.2). The authors found that in waters typical of natural conditions and at concentrations normally encountered in rivers and lakes, the rate constants from all sites were within a factor of eight and estimated a mean half life of 2.6 hours. Degradation kinetics could be described using second order kinetics. Paris, et al (1983) found 2,4-D n-alkyl esters had a range of second order microbial-mediated hydrolysis rate from 5.9 x 10^{-10} liters/organism/hour to 3.5 x 10^{-8} liters/organism/hour for octyl ester. They developed a regression equation [log kb=(0.799±0.098)* log Kow-(11.643±0.204)] to estimated microbial-mediated hydrolysis for 2,4-D esters in natural waters. Although the available data indicate rapid degradation of 2,4-D esters in natural waters, microbial mediated hydrolysis rates in soils may be dependent on clay mineralogy, organic carbon content, temperature, and moisture content (Wolf and Metwally and Wolf). The open literature data suggest that under normal environmental conditions MCPA EHE will be expected to rapidly convert to MCPA acid.

Finally, data from Smith and Hayden (1980) indicate that MCPA EHE which was surface applied to soils in Saskatchewan were rapidly converted to MCPA acid, however under dry conditions (15% of field capacity) the ester persisted for days with greater than 90% present after 48 hours. It is important to note that these dry conditions will effect crop yield and it is likely that in a typical setting a farmer will irrigate to add moisture to the soil or abandon the crop.

The dissociation of MCPA is expected to be influenced by numerous conditions controlling a dynamic equilibrium with dissociated MCPA acid, undissociated MCPA acid, and dimethylammoium. Under environmental conditions, this equilibrium process is expected to be controlled by chemical concentrations, soil moisture environments, pH, microbial degradation of DMA and MCPA acid. Because MCPA and the DMA are not persistent in soils, equilibrium conditions favor complete dissociation of MCPA. The rapid dissociation of the MCPA-DMAS is not expected to alter microbial degradation kinetics and transport processes of MCPA.

In general, EFED believes the data reviewed supports the environmental fate bridging strategy for MCPA DMAS and MCPA EHE. However, there may be environments where this bridging strategy is not applicable, such as dry soils which may limit the conversion MCPA DMAS and MCPA EHE, and acid environments which may limit the abiotic hydrolysis of the MCPA EHE. However, these situations are not expected to be typical for MCPA.

MCPA acid does not hydrolyze in sterile, buffered solutions at pH's ranging from 5 to 9. MCPA acid photodegraded in sterile buffer at pH 5 when irradiated with natural sunlight with a half-life of approximately 25 days; one degradate, 4-chloro-o-cresol, comprised up to 12% of the radioactivity. MCPA acid photodegraded slowly when applied to soil surfaces and irradiated with natural sunlight; the calculated half-life was 67 days. In the aerobic soil metabolism study MCPA acid degraded with a half-life of 24 days; no degradates were present $\geq$10% of the applied radioactivity. After 209 days of aerobic incubation, $^{14}CO_2$ accounted for 64% of the initial applied radioactivity. Under aerobic aquatic conditions MCPA acid degraded with an observed degradation half life in a water-sandy clay loam sediment system of >30 days in the total system, and in water-loamy sand sediment system, half-life values of MCPA acid, based on first-order kinetics and linear regression, were 13/15 days. Half-life values for 4-CC were estimated following its formation in the water-loamy sand sediment system at 44 days in both the total system ($r^2 = 0.783$) and sediment ($r^2 = 0.742$). The observed degradation half-lives of MCPA acid in the water-light clay sediment system was >100 days in the total system. An additional aerobic aquatic biodegradation study was recently submitted and is under review which indicates that MCPA acid degrades in a ditchwater/sediment system with a whole system half life of 16.3 days and in a river water/sediment system with whole system half life of 16.8 days, respectively. MCPA acid did not degrade anaerobically in either an anaerobic soil metabolism or an anaerobic aquatic metabolism study.

In laboratory batch equilibrium studies, MCPA acid was shown to be mobile. Three separate studies were reviewed. In MRID 42596903, MCPA acid is mobile in clay loam, silt loam, sandy loam soils, in a sandy loam aquatic sediment and in a beach sand with Freundlich K_{ads} values ranging from 0.45 to 1.20 mL/g. In MRID 40555801, MCPA acid is mobile in clay, silt loam, sandy loam and loam soils with Freundlich K_{ads} values ranging from 0.0212 to 1.11 mL/g. K_{oc} values calculated from Freundlich K_{ads} values were 9.6-46. In MRID 44239601, uniformly phenyl ring-labeled [^{14}C]MCPA acid was studied in sand, sandy loam, loam and silty clay loam soil:solution slurries and sandy clay loam sediment:solution slurries with Freundlich K_{ads} values of 0.21 for the sand soil (0.7% o.m.), 0.26 for the sandy loam soil, 0.55 for the loam soil, 0.50 for the silty clay loam soil, and 0.36 for the sandy clay loam sediment (1.7% o.m.). Corresponding K_{oc} values were 52, 31, 59, 50, and 41 mL/g. The reviewer-calculated coefficient of determination (r^2) values for the relationships K_{ads} *vs*. organic matter is 0.44, K_{ads} *vs*. pH is 0.38, and K_{ads} *vs*. clay content is 0.22. These coefficients suggest that adsorption cannot be correlated with these soil parameters. Also in MRID 44239601, uniformly phenyl ring-labeled [^{14}C]4-CC was studied in sand soil:solution slurries and mobile in sandy loam, loam and silty clay loam soil:solution slurries and sandy clay loam sediment:solution slurries with Freundlich K_{ads} values of 0.81 for the sand soil (0.7% o.m.), 1.6 for the sandy loam soil, 3.1 for the loam soil, 2.7 for the silty clay loam soil, and 2.1 for the sandy clay loam sediment (1.7% o.m.). Corresponding K_{oc} values were 198, 199, 330, 266, and 238 mL/g. The reviewer-calculated coefficient of determination (r^2) values for the relationships K_{ads} *vs*. organic matter is 0.66, K_{ads} *vs*. pH is 0.42, and K_{ads} *vs*. clay content is 0.22. These coefficients suggest that adsorption cannot be correlated with these soil parameters. Finally, in MRID 44239601, uniformly phenyl ring-labeled [^{14}C]4-MCA was studied in sand, sandy loam, loam and silty clay loam soil:solution slurries and sandy clay loam sediment:solution slurries with Freundlich K_{ads} values of 2.4 for the sand soil (0.7% o.m.), 4.8 for the sandy loam soil, 7.1 for the loam soil, 6.2 for the silty clay loam soil, and 5.5 for the sandy clay loam sediment (1.7% o.m.). Corresponding K_{oc} values were 588, 580, 755, 623, and 628 mL/g. The reviewer-calculated coefficient of determination (r^2) values for the relationships K_{ads} *vs*. organic matter is 0.80, K_{ads} *vs*. pH is 0.43, and K_{ads} *vs*. clay content is 0.23. These coefficients suggest that adsorption may be slightly correlated with these soil organic matter content.

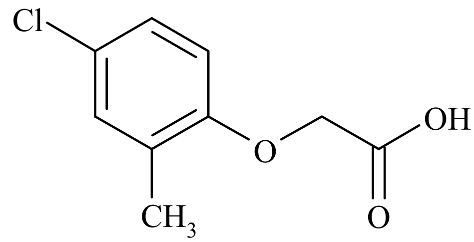
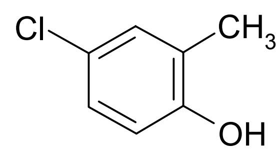
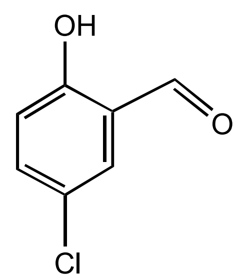
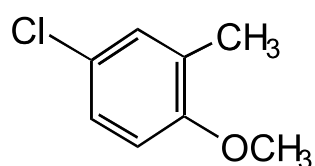
No aged column leaching studies or bioconcentration in fish studies were submitted.

Three field dissipation studies were originally submitted which provided supplemental information on the dissipation of MCPA isooctyl ester and MCPA Na salt. In the studies conducted with MCPA iso-octyl ester (also known as MCPA EHE), the discussion of residues detected and half lives is focused on the formulation. However, re-review of the study indicates that the analytical extraction resulted in conversion of both MCPA iso-octyl ester and acid formulations to MCPA methyl ester which was then analyzed quantitatively. Therefore, the half lives discussed below for these two studies cannot distinguish between the MCPA ester and acid present and actually reflect the dissipation rate of total MCPA residues and not the iso-octyl ester as noted in the original DERs. It is likely, though not confirmed, that MCPA iso-octyl ester dissipates much more rapidly than presented below and that these half lives represent MCPA acid dissipation. MCPA-isooctyl ester dissipated with total MCPA residue field half-lives of 9 days from a loam soil in California and 23 days from a sandy loam soil in Montana. MCPA-Na salt dissipated with a MCPA acid equivalent field half-life of 15 days from a sandy loam soil in Washington. In the field studies, MCPA did not leach below the top 6-inch depth.

Three additional field studies were submitted which provided supplemental information on the dissipation of MCPA EHE and MCPA DMAS. MCPA EHE rapidly converted to MCPA acid at both sites with greater than 80% converted on day 0. MCPA acid dissipated at a Georgia site with registrant-calculated half-lives of 5.6 days (r^2 = 0.99) and 5.9 days (r^2 = 0.92) based on total MCPA residues (as MCPA equivalents). The observed half-life of MCPA EHE occurred prior to 1 day posttreatment (both plots); the acid equivalent MCPA dissipated in the soil with reviewer-calculated half-lives of 6.2 days (r^2 = 0.92) on the bareground plot and 4.1 days (r^2 = 0.90; 0-14 day data) on the wheat plots. MCPA acid dissipated at a Kansas site with registrant-calculated half-lives of 9.0 days (r^2 = 0.94) and 4.1 days (r^2 = 0.98); the registrant-calculated half-lives are based on total MCPA residues (as MCPA equivalents). The reviewer-calculated half-life the acid equivalent MCPA dissipated in the soil with reviewer-calculated half-lives of 8.9 days (r^2 = 0.82) on the bareground plot and 4.1 days (r^2 = 0.88; 0-14 day data) on the wheat plots. MCPA acid dissipated at a California site, with registrant-calculated half-lives of 3.9 days (r^2 = 0.95; 0-14 day data) and 5.6 days (r^2 = 0.55; 0-14 day data) following the second application; the registrant-calculated half-lives are based on total MCPA residues (as MCPA equivalents). Total MCPA residues dissipated in the grass and thatch with registrant-calculated half-lives of 8.5 days (r^2 = 0.73; 0-31 day data) in the grass and 10 days (r^2 = 0.77; 0-31 day data) in thatch following the second application; the observed first half-lives occurred prior to 1 day posttreatment for grass and prior to 3 days posttreatment for thatch. MCPA acid dissipated at a Florida site with registrant-calculated half-lives of 3.5 days (r^2 = 0.91; 0-14 day data) and 5.3 days (r^2 = 0.22; 0-14 day data) following the second application; the registrant-calculated half-lives are based on total MCPA residues (as MCPA equivalents). Total MCPA residues dissipated in the grass and thatch with registrant-calculated half-lives of 15.5 days (r^2 = 0.63; 0-30 day data) in the grass and 9.6 days (r^2 = 0.70; 0-30 day data) in thatch following the second application; reviewer-calculated half-lives were 4.2 days (r^2 = 0.55; 0-7 day data) for grass and 3.5 days (r^2 = 0.72; 0-7 day data) for thatch. MCPA dissipated at a New York site with registrant-calculated half-lives of 10.4 days (r^2 = 0.77; 0-14 day data) and 3.3 days (r^2 = 0.86; 0-14 day data) following the second application; the observed first half-life was approximately 3 days posttreatment for the bareground plot. The registrant-calculated half-lives are based on total MCPA residues (as MCPA equivalents). Total MCPA residues dissipated in the grass and thatch with registrant-calculated half-lives of 10.4 days (r^2 = 0.85; 0-28 day data) in the grass and 11.0 days (r^2 = 0.77; 0-28 day data) in thatch following the second application; reviewer-calculated half-lives were 1.9 days (r^2 = 0.77; 0-7 day data) for grass and 4.8 days (r^2 = 0.63; 0-7 day data) for thatch.

MCPA acid dissipated at a California site with registrant-calculated half-lives of 5 days (r^2 = 0.97) and 3 days (r^2 = 0.98); the registrant-calculated half-lives are based on total MCPA residues (as MCPA equivalents). MCPA dissipated in the soil with reviewer-calculated half-lives of 3.8 days (r^2 = 0.56) on the bareground and 3.2 days (r^2 = 0.82) on the wheat plot. MCPA acid dissipated at a Kansas site with registrant-calculated half-lives of 6 days (r^2 = 0.92) and 7 days (r^2 = 0.95); the registrant-calculated half-lives are based on total MCPA residues (as MCPA equivalents). MCPA dissipated in the soil with reviewer-calculated half-lives of 5.6 days (r^2 = 0.89) on the bareground and 6.6 days (r^2 = 0.87) on the wheat plot; the observed half-lives occurred between 7 and 14 days posttreatment.

Several degradates were detected in the laboratory fate studies reviewed. The degradates detected were 4-chloro-o-cresol (4-CC), 5-chlorosalicylaldehyde, and $^{14}CO_2$. 4-chloro-2-methylanisole (4-MCA) was postulated by the registrant to be a potential degradate of MCPA but was not detected in any of the laboratory or field studies. The Metabolite Assessment Review Committee (MARC) has determined that none of the degradates are of concern, therefore, no degradates were included in the drinking water assessment.

Table A-1. Environmental Degradates of MCPA		
Confirmed Degradate	**Lab Results Max %AR[1] (Study)**	**Chemical Structure**
2-methyl-4-chlorophenoxyacetic acid (MCPA)	Parent	
4-chloro-o-cresol (4-CC)	11.6% (aq photolysis) 5.6% (soil photolysis) 16.7% (aerobic aquatic)	
5-chlorosalicylaldehyde	1.2% (aq photolysis)	
4-chloro-2-methylanisole (4-MCA)	Analyzed For But Not Detected	
$^{14}CO_2$	2.2% (aq photolysis 10.5% (aerobic soil) 50.3% (aerobic aquatic)	

[1] %AR =% of applied radioactivity.

II. Physical and Chemical Properties

Common name:	MCPA
Chemical name:	2-methyl-4-chlorophenoxyacetic acid, 2-ethylhexyl 2-methyl-4-chlorophenoxyacetate, and diethylamine 2 -methyl
Molecular formula:	$C_9H_9ClO_3$
CAS Number:	94-74-6
Molecular weight:	200.6
Physical state:	colorless crystals
Melting point:	120 ºC
Vapor pressure (20°C):	0.000312 mm Hg @ 25ºC
Henry's Law:	0.0000549 atm-m^3/mol
Solubility (25°C):	1500 ppm @ 20ºC
Log K_{ow}:	2.828

III. Environmental Fate and Transport Studies

Environmental Fate Studies:

1. Degradation

Dissociation Study

In MRID 42457101 MCPA-DMAS completely dissociated into MCPA and the dimethylammonium ion when stirred in deionized water. Dissociation had occurred by the time the first measurement was taken at 1.5 minutes. Registration information on MCPA can substituted for information on MCPA-DMA because of the complete and rapid dissociation of MCPA-DMA to MCPA and the dimethylammonium ion.

Hydrolysis (161-1)

An acceptable hydrolysis study (MRID 42693901) was reviewed to demonstrate the hydrolysis of MCPA-EHE. MCPA-EHE degraded with hydrolytic half-lives of 75-117 hours in pH 9 buffered solution and 76 days in pH 7 buffered solution. MCPA-EHE did not hydrolyze in pH 5 buffered solution. The only hydrolysis product was MCPA-acid which does not hydrolyze.

A supplemental hydrolysis study (MRID 42671501) was reviewed to demonstrate the hydrolysis of MCPA-EHE. This study provides supplemental information on the hydrolysis of 2-methyl-4-chlorophenoxy acetic acid-2-ethylhexyl ester (MCPA-EHE). In soil:0.01 M $CaCl_2$ (1:5) systems, MCPA-EHE initially adsorbed to the soil surfaces and was then available for hydrolysis to MCPA-acid.

After 12 hours of incubation, MCPA-acid accounted for an average of 83.9% of the applied radioactivity for the silt loam soil system and 71.5% of the applied in the sandy loam soil system. This study along with Study 2 (MRID 42693901; Lai, I. 1993. Hydrolysis of [^{14}C]-MCPA-2-EHE in Buffered Aqueous Solutions.) provide acceptable bridging data to allow data submitted for MCPA to be acceptable as "surrogate data" towards the reregistration of MCPA-EHE.

An acceptable MCPA hydrolysis study (MRID 42665301) was reviewed in this data package. MCPA did not hydrolyze in aqueous buffered solutions of pH 5, 7, and 9 when incubated at 25 C for 30 days. After 30 days, MCPA comprised 88-102.5% of the applied radioactivity with no pattern of degradation. No other compounds were detected by HPLC or TLC.

Photodegradation in water (161-2)

An acceptable aqueous photolysis study (MRID 42928101) was reviewed in this data package. Uniformly phenyl-ring-labeled [^{14}C]MCPA photodegraded with a calculated half-life of 25.4 days in aqueous pH 5 buffer when irradiated with natural sunlight for up to 30 days. One main degradate, **4-chloro-o-cresol**, comprised approximately 12% of the applied radioactivity and a second minor degradate was identified as 5-chlorosalicylaldehyde at 1% of applied. Several other minor degradates were isolated but were not identified.

Photodegradation on soil (161-3)

An acceptable soil photolysis study (MRID 43225801) was reviewed in this data package. Uniformly phenyl-ring-labeled [^{14}C]MCPA degraded with calculated half-lives of 67.3 days on sandy loam soil irradiated with natural sunlight for 30 days and 121.6 days on sandy loam soil incubated in the dark for 30 days. Photodegradation on soil is not a major route of environmental dissipation for MCPA.

Aerobic soil metabolism (162-1)

This study (MRID 41586001) provides acceptable data for the aerobic soil metabolism data requirement, but does not address a aerobic degradative pathway. [^{14}C]MCPA at 9.9 ug/g sandy loam soil incubated aerobically at 25 C degraded with a registrant calculated half-life of 24 days. No degradates were identified as present. $^{14}CO_2$ accounted for 10.5% of the applied radioactivity 19 and 28 days (the sampling intervals closest to the half-life); at 209 days posttreatment 64.3% of the radioactivity was recovered as $^{14}CO_2$. One unknown degradate was present at up to 0.9% of the applied. From 2.0 to 6.0% of the extracted radioactivity was not accounted for.

Anaerobic soil metabolism (162-2)

This study (MRID 41586001) provides acceptable data for the anaerobic soil metabolism data requirement. [^{14}C]MCPA does not degrade anaerobically when incubated for 62 days following a 28 day aerobic incubation period. One unknown degradate which was not found in the aerobic samples was present at up to 1.2% of the applied radioactivity in the soil extracts.

Anaerobic aquatic metabolism (162-3)

This study (MRID 40461901) provides acceptable data for the anaerobic aquatic metabolism data requirement. [^{14}C]MCPA did not degrade when incubated anaerobically in a flooded sediment system for 374 days. MCPA accounted for 79.1-108.1% of the applied radioactivity throughout the study with no pattern of degradation. This MRID was previously reviewed in July, 1988.

Aerobic aquatic metabolism (162-4)

Two aerobic aquatic metabolism studies were submitted.

An acceptable aerobic aquatic metabolism study (MRID 44732401A/44192701) for [phenyl-U-^{14}C]-labeled 4-chloro-2-methylphenoxyacetic acid dimethylamine salt (MCPA DMAS) was reviewed in this data package. The aerobic biotransformation of MCPA DMAS was studied in a water-sandy clay loam sediment system from a California rice plot for 30 days in darkness at 25 ± 1°C. [^{14}C]MCPA DMA was applied at the rate of 1.1 mg a.i./L (1.0 mg a.i./kg water-sediment). MCPA DMAS dissociated to MCPA upon introduction to aqueous system and thus all half lives are reported for MCPA acid.

Aerobic conditions were maintained throughout the study. The observed degradation half-lives of MCPA acid in the water-sandy clay loam sediment systems was >30 days in the total system (half life estimated at 236 days by extrapolation beyond the end of the study), water layer and sediment. No major transformation products of [phenyl-U-^{14}C]MCPA acid were detected in the water-sediment systems. One minor transformation product, 4-chloro-*o*-cresol (4-CC), was detected at a maximum 1.9% of the applied at 30 days in sediment extract, but was not detected (detection limit not specified) in the water layer at any sampling interval.

An acceptable aerobic aquatic metabolism study (MRID 44732401B) for [phenyl-U-^{14}C]-labeled 4-chloro-2-methylphenoxyacetic acid dimethylamine salt (MCPA DMAS) was reviewed in this data package. The aerobic biotransformation of MCPA DMAS was studied in a water-loamy sand sediment system and a water-light clay sediment system for 100 days in darkness at 20 ± 2°C. [^{14}C]MCPA

DMAS was applied at a nominal rate of 0.65 mg a.i./L (0.5 mg a.i./kg water-sediment). Aerobic conditions were maintained throughout the study. MCPA DMAS dissociated to MCPA upon introduction to aqueous system and thus all half lives are reported for MCPA acid.

In both water-sediment systems, $^{14}CO_2$ and **4-chloro-*o*-cresol (4-CC)** were the major transformation products of [phenyl-U-^{14}C]MCPA acid. For water-loamy sand sediment systems, half-life values of MCPA acid, based on first-order kinetics and linear regression, were 13/15 days in both the total system (r^2 = 0.9562/0.994) and water layer (r^2 = 0.9576/0.997) and were 7 days (r^2 = 0.946, 7- to 45-day data) in the sediment. Half-life values for 4-CC following its formation in the water-loamy sand sediment systems were 44 days in both the total system (r^2 = 0.783) and sediment (r^2 = 0.742); DT_{50} and DT_{90} values for 4-CC in the total system were 13 and 44 days, respectively. The observed degradation half-lives of MCPA acid in the water-light clay sediment systems was >100 days in the total system, water layer and sediment.

2. Mobility

<u>Leaching, adsorption/desorption (163-1)</u>

This study (MRID 42596903) provides acceptable data on the unaged mobility in soil data requirement by presenting Freundlich $K_{ads/des}$ values for MCPA on four soils and a sediment. MCPA is mobile in clay loam, silt loam, sandy loam soils, in a sandy loam aquatic sediment and in a beach sand with Freundlich K_{ads} values ranging from 0.45 to 1.20 mL/g.

A second study (MRID 40555801) providing supplemental information on the mobility in soil of unaged MCPA was reviewed and confirmed that MCPA is mobile in clay, silt loam, sandy loam and loam soils with Freundlich K_{ads} values ranging from 0.0212 to 1.11 mL/g. K_{oc} values calculated from Freundlich K_{ads} values were 9.6-46 mL/g.

A third study (MRID 44239601) provides useful information on the soil mobility (batch equilibrium) of MCPA and its degradates **4-CC** and **4-MCA** in four soils and one sediment. However, complete data were not provided to demonstrate that the test compounds were stable in the soil:solution slurries throughout the adsorption and desorption phases of the. Uniformly phenyl ring-labeled [^{14}C]MCPA was studied in sand, sandy loam, loam and silty clay loam soil:solution slurries and sandy clay loam sediment:solution slurries that were equilibrated for 24 hours at 25 ± 1 ºC. Freundlich K_{ads} values were 0.21 for the sand soil (0.7% o.m.), 0.26 for the sandy loam soil, 0.55 for the loam soil, 0.50 for the silty clay loam soil, and 0.36 for the sandy clay loam sediment (1.7% o.m.); corresponding K_{oc} values were 52, 31, 59, 50, and 41 mL/g. Respective 1/N values were 0.82, 0.87, 0.87, 0.82, and 0.88 for adsorption. Freundlich K_{des} values determined following a 24-hour equilibration period were 1.3 for the sand soil, 0.45 for the sandy loam soil, 1.3 for the loam soil, 0.71 for the silty clay loam soil, and 1.5 for the sandy clay loam sediment; corresponding K_{oc} values were 305, 55, 137, 71, and 172 mL/g. Respective 1/N values were 1.0, 0.61, 1.0, 0.42, and 0.94 for desorption. The reviewer-calculated coefficient of determination (r^2) values for the relationships K_{ads} *vs*. organic matter, K_{ads} *vs*. pH and K_{ads} *vs*. clay content were 0.44, 0.38 and 0.22, respectively. These coefficients suggest that adsorption cannot be correlated with these soil parameters.

Uniformly phenyl ring-labeled **[^{14}C]4-CC** was studied in sand soil:solution slurries and mobile in sandy loam, loam and silty clay loam soil:solution slurries and sandy clay loam sediment:solution slurries that were equilibrated for 8 hours at 25 ± 1 ºC. Freundlich K_{ads} values were 0.81 for the sand soil (0.7% o.m.), 1.6 for the sandy loam soil, 3.1 for the loam soil, 2.7 for the silty clay loam soil, and 2.1 for the sandy clay loam sediment (1.7% o.m.); corresponding K_{oc} values were 198, 199, 330, 266, and 238 mL/g. Respective 1/N values were 0.71, 0.83, 0.80, 0.84, and 0.87 for adsorption. Freundlich K_{des} values determined following an 8-hour equilibration period were 0.87 for the sand soil, 2.6 for the sandy loam soil, 5.1 for the loam soil, 4.2 for the silty clay loam soil, and 2.7 for the sandy clay loam sediment; corresponding K_{oc} values were 212, 311, 543, 418, and 302 mL/g. Respective 1/N values were 0.54, 0.81, 0.72, 0.77, and 0.80 for desorption. The reviewer-calculated coefficient of determination (r^2) values for the relationships K_{ads} *vs*. organic matter, K_{ads} *vs*. pH and K_{ads} *vs*. clay content were 0.66, 0.42 and 0.22, respectively. These coefficients suggest that adsorption cannot be correlated with these soil parameters.

Uniformly phenyl ring-labeled **[^{14}C]4-MCA** was studied in sand, sandy loam, loam and silty clay loam soil:solution slurries and sandy clay loam sediment:solution slurries that were equilibrated for 24 hours at 25 ± 1 ºC. Freundlich K_{ads} values were 2.4 for the sand soil (0.7% o.m.), 4.8 for the sandy loam soil, 7.1 for the loam soil, 6.2 for the silty clay loam soil, and 5.5 for the sandy clay loam sediment (1.7% o.m.); corresponding K_{oc} values were 588, 580, 755, 623, and 628 mL/g. Respective 1/N values were 0.84, 0.92, 0.88, 0.83, and 0.91 for adsorption. Freundlich K_{des} values determined following a 24-hour equilibration period were 1.4 for the sand soil, 6.0 for the sandy loam soil, 8.5 for the loam soil, 8.4 for the silty clay loam soil, and 7.6 for the sandy clay loam sediment; corresponding K_{oc} values were 346, 730, 904, 841, and 865 mL/g. Respective 1/N values were 0.54, 0.90, 0.73, 0.78, and 0.92 for desorption. The reviewer-calculated coefficient of determination (r^2) values for the relationships K_{ads} *vs*. organic matter, K_{ads} *vs*. pH and K_{ads} *vs*. clay content were 0.80, 0.43 and 0.23, respectively. These coefficients suggest that adsorption may be slightly correlated with these soil organic matter content.

Laboratory volatility 163-2

One scientifically unacceptable study (MRID 4078000) was submitted. From information in this study, volatility does not appear to be a major route of dissipation for MCPA isooctyl ester. Only volatile traps were analyzed in this study; in most cases the compound detected in the trap was below detection limits. However, since no material balance was attempted, it is possible that the compound volatilized from the soil, but was not contained in the trap.

3. Accumulation

No studies were submitted.

4. Field Dissipation

Terrestrial field dissipation (164-1)

Four studies for four separate sites were originally submitted. In the studies conducted with MCPA iso-octyl ester, the discussion of residues detected and half lives is focused on the formulation applied. However, the study indicates that the analytical extraction resulted in conversion of both MCPA iso-octyl ester and acid formulations to MCPA methyl ester which was then quantitated analytically. Therefore, the half lives discussed below cannot distinguish between the formulation and MCPA acid and actually reflect the dissipation rate of total MCPA residues and not the iso-octyl ester. It is likely, though not confirmed, that MCPA iso-octyl ester dissipates much more rapidly than presented below and that these half lives represent MCPA acid dissipation.

A study was submitted (MRID 42133901) providing supplemental information regarding the terrestrial field dissipation of MCPA-Na salt. MCPA-Na salt dissipated with a calculated half-life of 14.64 days from the top 6 inches of a sandy loam soil in Othello, Washington. No MCPA residues were recovered below the 6-inch depth. The compound was applied as an emulsifiable concentrate at a nominal rate of 3 lb ai/A to barley.

A study was submitted (MRID 42134001) providing supplemental information regarding the terrestrial field dissipation of total MCPA residues (reported as MCPA-isooctyl ester). Total MCPA residues dissipated with a calculated half-life of 9.08 days from the top 6 inches of a loam soil in California. The compound was applied as an emulsifiable concentrate at a nominal rate of 3 lb ae/A to barley. No detectable MCPA residues leached below the 6-inch depth; there were three 1-inch irrigation events within the first 30 days after application.

A study was submitted (MRID 42134101) providing supplemental information regarding the terrestrial field dissipation of total MCPA residues. MCPA residues dissipated with a calculated half-life of 23 days from the top 6 inches of a sandy loam soil in Montana when applied to bareground. The compound was applied as an emulsifiable concentrate formulation at a nominal rate of 3 lb ae/A. No detectable MCPA residues leached below the 6-inch depth; there were no precipitation events resulting in greater than 0.1 inch rainfall and no irrigation with the first 40 days after application.

A study was submitted (MRID 42134201) which provided unacceptable information regarding the terrestrial field dissipation of MCPA-DMAS. It was not possible to determine a dissipation pattern for MCPA-DMAS from the data presented in this study. MCPA residues were recovered only from one plot at 3 days posttreatment from the soil of a dense bermudagrass pasture in GA which was treated at 2 lb ai/A. Although the registrant assumed that all of the MCPA was retained by the grass and that MCPA degraded prior to reaching the soil, no plant samples were taken to confirm this assumption.

Three additional studies for seven separate sites subsequently submitted:

A study was submitted (MRID 43815701) which provided supplemental information regarding the terrestrial field dissipation of MCPA EHE. This study is scientifically valid and provides useful information on the terrestrial field dissipation of MCPA EHE on bareground and wheat plots of loamy sand soil in Georgia and loam soil in Kansas. However, this study does not meet Subdivision N Guidelines for the partial fulfillment of EPA data requirements on terrestrial field dissipation for the following reasons. First, the analytical method, specifically sample storage, was inadequate for the determination of the pattern of formation and decline of the degradates **4-MCA and 4-CC**; second, frozen storage stability data were inadequate; and third, wheat plants were not analyzed for the parent and its degradates. In all the sites conducted with MCPA EHE, greater than 80% of the ester formulation converted to MCPA acid on day 0. All reported half lives for the studies conducted with MCPA EHE discussed below are for MCPA acid. Similarly, for the studies conducted with MCPA DMAS, the parent compound converted to the acid equivalent (a.e.), MCPA, during preparation of the application mixture, therefore all half lives reported below are for MCPA acid.

At the Georgia site, MCPA EHE broadcast applied once as a spray at a nominal application rate of 1.6 lb acid equivalents per acre (lbs ae/acre) to bareground and wheat plots of Tifton loamy sand soil, dissipated in the soil with registrant-calculated half-lives of 5.6 days ($r^2 = 0.99$) on the bareground plot and 5.9 days ($r^2 = 0.92$) on the wheat plot based on total MCPA residues (as MCPA equivalents). The observed half-life of MCPA EHE occurred prior to 1 day posttreatment (both plots); the acid equivalent MCPA dissipated in the soil with reviewer-calculated half-lives of 6.2 days (r^2 = 0.92) on the bareground plot and 4.1 days (r^2 = 0.90; 0-14 day data) on the wheat plot. The degradates 4-CC and 4-MCA were not detected above the LOQ at any sampling interval. The wheat plants were not analyzed for the parent or its degradates.

At the Kansas site, MCPA EHE broadcast applied once as a spray at a nominal application rate of 1.6 lb a.e./A to bareground and wheat plots of Osage loam soil, dissipated in the soil with registrant-calculated half-lives of 9.0 days (r^2 = 0.94) on the bareground plot and 4.1 days (r^2 = 0.98) on the wheat plot; the registrant-calculated half-lives are based on total MCPA residues (as MCPA equivalents). The reviewer-calculated half-life of the acid equivalent MCPA dissipated in the soil with reviewer-calculated half-lives of 8.9 days (r^2 = 0.82) on the bareground plot and 4.1 days (r^2 = 0.88; 0-14 day data) on the wheat plot. The degradates **4-CC and 4-MCA** were not detected above the LOQ at any sampling The wheat plants were not analyzed for the parent or its degradates.

A study was submitted (MRID 43883001) which provided supplemental information regarding the terrestrial field dissipation of MCPA DMAS. This study is scientifically valid and provides useful information on the terrestrial field dissipation of MCPA DMAS on bareground and turf plots in California, Florida, and New York. However, this study does not meet Subdivision N Guidelines for the fulfillment of EPA data requirements on terrestrial field dissipation for the following reasons. First, the analytical method, specifically sample transport and storage, may have been inadequate for the determination of the patterns of formation and decline of the degradates **4-MCA and 4-CC**; and second, frozen storage stability data were inadequate.

At the California site, MCPA DMAS broadcast applied twice (21-day interval) as a spray at a nominal application rate of 1.6 lb a.e./A/application to bareground and turf plots of sandy loam soil, dissipated in the soil with registrant-calculated half-lives of 3.9 days (r^2 = 0.95; 0-14 day data) on the bareground plot and 5.6 days (r^2 = 0.55; 0-14 day data) on the grass plot following the second application; the registrant-calculated half-lives are based on total MCPA residues (as MCPA equivalents). Total MCPA residues dissipated in the grass and thatch with registrant-calculated half-lives of 8.5 days (r^2 = 0.73; 0-31 day data) on grass and 10 days (r^2 = 0.77; 0-31 day data) on thatch following the second application; the observed first half-lives occurred prior to 1 day posttreatment for grass and prior to 3 days posttreatment for thatch. The parent compound converted to the acid equivalent (a.e.), MCPA, during preparation of the application mixture. The degradates **4-CC and 4-MCA** were not detected above the LOQ following the second application**.**

At the Florida site, MCPA DMAS broadcast applied twice (21-day interval) as a spray at a nominal application rate of 1.6 lb a.e./A/application to bareground and turf plots of sandy loam soil, dissipated in the soil with registrant-calculated half-lives of 3.5 days (r^2 = 0.91; 0-14 day data) on bareground and 5.3 days (r^2 = 0.22; 0-14 day data) on grass following the second application; the registrant-calculated half-lives are based on total MCPA residues (as MCPA equivalents). Total MCPA residues dissipated in the grass and thatch with registrant-calculated half-lives of 15.5 days (r^2 = 0.63; 0-30 day data) for grass and 9.6 days (r^2 = 0.70; 0-30 day data) for thatch following the second application; reviewer-calculated half-lives were 4.2 days (r^2 = 0.55; 0-7 day data) for grass and 3.5 days (r^2 = 0.72; 0-7 day data) for thatch. The parent compound converted to the acid equivalent (a.e.), MCPA, during preparation of the application mixture. The degradates **4-CC and 4-MCA** were not detected above the LOQ following the second application**.**

At the New York site, MCPA DMAS broadcast applied twice (21-day interval) as a spray at a nominal application rate of 1.6 lb a.e./A/application to bareground and turf plots of sandy loam soil, dissipated in the soil with registrant-calculated half-lives of 10.4 days (r^2 = 0.77; 0-14 day data) on bareground and 3.3 days (r^2 = 0.86; 0-14 day data) for grass following the second application; the observed first half-life was approximately 3 days posttreatment for the bareground plot. The registrant-calculated half-lives are based on total MCPA residues (as MCPA equivalents). Total MCPA residues dissipated in the grass and thatch with registrant-calculated half-lives of 10.4 days (r^2 = 0.85; 0-28 day data) for grass and 11.0 days (r^2 = 0.77; 0-28 day data) for thatch following the second application; reviewer-calculated half-lives were 1.9 days (r^2 = 0.77; 0-7 day data) for grass and 4.8 days (r^2 = 0.63; 0-7 day data) for thatch. The parent compound converted to the acid equivalent (a.e.), MCPA, during preparation of the application mixture. . The degradate **4-CC** was detected twice in the 0- to 6-inch depth, at 0.010-0.012 ppm (1 of 3 replicates each) from 0 to 1 day posttreatment, and was not detected below the 0- to 6-inch depth. The degradate **4-MCA** was not detected above the LOQ following the second application.

A study was submitted (MRID 43697501) which provided supplemental information regarding the terrestrial field dissipation of MCPA DMAS. This study is scientifically valid and provides useful information on the terrestrial field dissipation of MCPA DMAS on bareground and wheat plots of loamy sand soil in California and loam soil in Kansas. However, this study does not meet Subdivision N Guidelines for the partial fulfillment of EPA data requirements on terrestrial field dissipation for the following reasons. First, frozen storage stability data were inadequate, second, the analytical method, specifically sample transport and storage, may have been inadequate for the determination of the pattern of formation and decline of the degradate **4-CC**; and third, wheat plants were not analyzed for the parent and its degradates.

At the California site, MCPA DMAS broadcast applied once as a spray at a nominal application rate of 1.6 lb a.e./A to bareground and wheat plots of Cajon loamy sand soil, dissipated in the soil with registrant-calculated half-lives of 5 days (r^2 = 0.97) on the bareground plot and 3 days (r^2 = 0.98)on the wheat plot; the registrant-calculated half-lives are based on total MCPA residues (as MCPA equivalents). MCPA dissipated in the soil with reviewer-calculated half-lives of 3.8 days (r^2 = 0.56) for bareground and 3.2 days (r^2 = 0.82) on the wheat plot. The parent compound converted to the acid equivalent (a.e.), MCPA, during preparation of the application mixture. The degradates **4-CC and 4-MCA** were not detected above the LOQ at any sampling interval or depth. The wheat plants were not analyzed for the parent or its degradates.

At the Kansas site, MCPA DMAS broadcast applied once as a spray at a nominal application rate of 1.6 lb a.e./A to bareground and wheat plots of Osage loam soil, dissipated with registrant-calculated half-lives of 6 days (r^2 = 0.92) for bareground and 7 days (r^2 = 0.95) for the wheat plot; the registrant-calculated half-lives are based on total MCPA residues (as MCPA equivalents). MCPA dissipated in the soil with reviewer-calculated half-lives of 5.6 days (r^2 = 0.89) for the bareground plot and 6.6 days (r^2 = 0.87) on the wheat plot; the observed half-lives occurred between 7 and 14 days posttreatment. The parent compound converted to the acid equivalent (a.e.), MCPA, during preparation of the application mixture. The degradate **4-CC** was detected once in the 0- to 6-inch depth, at 0.010 ppm (1 of 3 replicates) at 28 days posttreatment, and was not detected above the LOQ below that depth. The degradate **4-MCA** was not detected above the LOQ at any sampling interval or depth. The wheat plants were not analyzed for the parent or its degradates.

Aquatic field dissipation (164-1)

No studies were submitted.

5. Spray Drift

Not applicable.

Recommendations:

i. The fate database is essentially complete. All Terrestrial Field Dissipation studies reviewed have been classified as supplemental but upgradable. Submission of the additional data requested may result in acceptance of these studies. A rice use is currently registered for MCPA. Typically a rice use triggers the need for an aquatic field dissipation study. No aquatic field dissipation study have been submitted. This data is needed to assess the behavior of MCPA under the actual use conditions in the field for this use. No other outstanding fate issues have been identified.

IV. **Bibliography**:

Hydrolysis (161-1)

Lai, I. 1993. Hydrolysis of [^{14}C]-MCPA Acid in Buffered Aqueous Solutions. Unpublished study performed by Battelle Columbus Operations, Columbus, OH for Industry Task Force II on MCPA Research Data. STUDY 4/MRID 42665301/DP Barcode D189438.

Photodegradation in Water (161-2)

Concha, M., and K. Shepler. 1993. Sunlight photodegradation of [^{14}C]-MCPA in a buffered aqueous solution at pH 5 by natural sunlight. Unpublished study performed by PTRL West, Richmond, CA for Industry Task Force II on MCPA Research Data. STUDY 5/MRID 42928101/DP Barcode D195361

Photodegradation on Soil (161-3)

Concha, M., and K. Shepler. 1994. Photodegradation of [^{14}C]-MCPA in/on soil by natural sunlight. Unpublished study performed by PTRL West, Richmond, CA for Industry Task Force II on MCPA Research Data (c/o Rhone-Poulenc Ag Co.). STUDY 6/MRID 43225801/DP Barcode D203302.

Aerobic Soil Metabolism (162-1)

Matt, F.J. 1990. Aerobic and aerobic/anaerobic soil metabolism of [^{14}C]-MCPA. Laboratory ID #: HLA 6237-107. Unpublished study performed by Hazleton Laboratories America, Inc., Madison, WI for Industry Task Force on MCPA Research Data c/o Dowelanco, Indianapolis, IN. STUDY 7/MRID 41586001/DP Barcode D165007.

Anaerobic Soil Metabolism (162-2)

Matt, F.J. 1990. Aerobic and aerobic/anaerobic soil metabolism of [^{14}C]-MCPA. Laboratory ID #: HLA 6237-107. Unpublished study performed by Hazleton Laboratories America, Inc., Madison, WI for Industry Task Force on MCPA Research Data c/o Dowelanco, Indianapolis, IN. STUDY 7/MRID 41586001/DP Barcode D165007.

Anaerobic aquatic metabolism (162-3)

Obrist, J.J. 1987. Anaerobic aquatic metabolism of MCPA. Laboratory ID #: HLA 6015-325. Unpublished study performed by Hazleton Laboratories America, Inc., Madison, WI for Industry Task Force on MCPA Research Data c/o Dowelanco, Indianapolis, IN.

Aerobic aquatic metabolism (162-4)

Bashir, M. 1998. Aerobic aquatic metabolism of ^{14}C-4-chloro-2-methylphenoxyacetic acid dimethylamine salt. Unpublished study performed by Covance Laboratories, Inc., Madison, WI and sponsored by MCPA Task Force Three, Raleigh, NC. Laboratory Project ID. Covance 6698-106. Study initiated November 25, 1996 and completed December 18, 1998 (p. 12).

Bashir, M. 1998. Aerobic aquatic metabolism of ^{14}C-4-chloro-2-methylphenoxyacetic acid dimethylamine salt. Unpublished study performed by Covance Laboratories, Inc., Madison, WI and sponsored by MCPA Task Force Three, Raleigh, NC. Laboratory Project ID. Covance 6698-106. Study initiated November 25, 1996 and completed December 18, 1998 (p. 12).

Leaching, adsorption/desorption (163-1)

Fernando, T.R. 1992. Sorption/desorption of [^{14}C]-MCPA Acid on soils by the batch equilibrium method. Battelle Study No. SC910081. Unpublished study performed by Battelle Columbus Operations, Columbus, OH for Industry Task Force II on MCPA Research Data. STUDY 8/MRID 42596903/DP Barcode D186654.

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Laboratory Volatility (163-2)

Macdonald, I.A. and V.J. Battle. 1988. Determination of the volatility of MCPA-ester from soil under laboratory conditions. Unpublished study performed by Huntingdon Research Centre Ltd. Cambridgeshire, UK for Industry Task Force on MCPA Research Data. STUDY 14/MRID 40780001/DP Barcode D167984.

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Silvoy, J.J. 1991. MCPA - dimethylamine salt field dissipation - terrestrial study on pasture grass in Donalsonville, GA. Unpublished study performed by Southern Agricultural Research, Inc., Donalsonville, GA; Hazleton Laboratories America, Inc., Madison, WI; and Landis International, Inc., Valdosta, GA for Industry Task Force on MCPA Research Data c/o Dowelanco, Indianapolis, IN. STUDY 11/MRID 42134201/DP Barcode D172969.

Silvoy, J.J. 1991. LX143-04 (MCP-ester) field dissipation - terrestrial on small grains in California. Unpublished study performed by Northwest Agricultural Research, Inc., Pullman, WA and Hazleton Laboratories America, Inc., Madison, WI for Industry Task Force on MCPA Research Data c/o Dowelanco, Indianapolis, IN. STUDY 12/MRID 42134001/DP Barcode D172967.

Silvoy, J.J. 1991. LX143-04 (MCP-ester) field dissipation - terrestrial on bareground in Montana. Unpublished study performed by Northwest Agricultural Research, Inc., Pullman, WA and Hazleton Laboratories America, Inc., Madison, WI for Industry Task Force on MCPA Research Data c/o Dowelanco, Indianapolis, IN. STUDY 13/MRID 42134101/DP Barcode D172967.

Silvoy, J.J. 1991. MCPA-Na salt formulation field dissipation - terrestrial study on small grains in Washington. Unpublished study performed by Northwest Agricultural Research, Inc., Pullman, WA and Hazleton Laboratories America, Inc., Madison, WI for Industry Task Force on MCPA Research Data. STUDY 10/MRID 42133901/DP Barcode D172970.

Hatfield, M. W. 1995. Terrestrial field dissipation of MCPA 2-ethylhexyl ester following ground application to wheat and bareground. American Agricultural Services Laboratory Project ID: AA940508. Hazleton Wisconsin Laboratory Project ID: 6576-100B. Unpublished study performed by American Agricultural Services, Inc., Cary, NC (study director); Hickey's Agri-Services Laboratory, Camilla, GA (in-life phase); Beason Research Services, Elk City, KS (in-life phase); AGVISE Laboratories, Northwood, ND (processing phase); Minnesota Valley Testing Laboratories, New Ulm, MN (analytical phase); and Hazleton Wisconsin, Inc., Madison, WI (analytical phase); and submitted by the MCPA Task Force Three, Raleigh, NC.

Singer, G. M. 1995. Terrestrial field dissipation of MCPA dimethylamine salt following ground application to wheat and bareground. American Agricultural Services Laboratory Project ID: AA940507. Hazleton Wisconsin Laboratory Project ID: 6576-100A. Unpublished study performed by American Agricultural Services, Inc., Cary, NC (study director); Research For Hire, Porterville, CA (in-life phase); Beason Research Service, Elk City, KS (in-life phase); AGVISE Laboratories, Inc., Northwood, ND (processing phase); and Hazleton Wisconsin, Inc., Madison, WI (analytical phase); and submitted by the MCPA Task Force Three, Raleigh, NC.

Hatfield, M. W. 1995. Terrestrial field dissipation of MCPA dimethylamine salt following ground application to turfgrass and bareground. AASI Study No.: AA940509. HWI Project No.: 6576-100D. MVTL Project No.: 12-9406. Unpublished study performed by American Agricultural Services, Inc., Cary, NC (study director); Research For Hire, Porterville, CA (in-life phase); Hickey's Agri-Services Laboratory, Camilla, GA (in-life phase); A.C.D.S. Research, Inc., Lyons, NY (in-life phase); AGVISE Laboratories, Northwood, ND (processing phase); Minnesota Valley Testing Laboratories, Inc., New Ulm, MN (analytical phase); and Corning Hazleton, Inc., Madison, WI (analytical phase); and submitted by the MCPA Task Force Three, Raleigh, NC.

Fleming, P. 1996. Freezer storage stability for MCPA EHE, MCPA, and major metabolites in soil. MVTL Study No.: 12-9410. Unpublished study performed by Minnesota Valley Testing Laboratories, Inc., New Ulm, MN; and submitted by the MCPA Task Force Three, Raleigh, NC.

Bridging data (no guideline numbers)

Chang, J.S.C. 1992. Special study: dissociation of MCPA DMAS in water. Unpublished study performed by Battelle Columbus Operations, Columbus, OH for Industry Task Force II on MCPA Research Data. STUDY 1/MRID 42457101/DP Barcode D182938.

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Fernando, T.R. and R. Kok. 1993. Hydrolysis of [^{14}C]-MCPA-2-EHE to MCPA-acid in a soil/water system. Unpublished study performed by Battelle Columbus Operations, Columbus, OH for Industry Task Force II on MCPA Research Data. STUDY 3/MRID 42671501/DP Barcode D189442.

APPENDIX B: Detailed Drinking Water Assessment Memo

NOTE: This appendix is a reproduction of the body of the Drinking Water Assessment submitted to the Health Effects Division (HED) and the Special Review and Reregistration Division (SRRD). The complete input and output data files for the PRZM/EXAMS model runs can be found in the original drinking water memo. This memo was addressed from Mark Corbin (EFED) to Felicia Fort (HED) and Demson Fuller (SRRD), dated on April 9, 2003, with the DP Barcode D286079. The Appendix also includes the Addendum to the April 9, 2003 drinking water memorandum dated June 24, 2003 which presented exposure estimates for use of MCPA on rice.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Date: April 9, 2003
Chemical: MCPA
PC Code: 030501, 030502, 030516, 030564
DP Barcode: D286079

Subject: **MCPA – Drinking Water Assessment for the Health Effects Division (HED) Reregistration Eligibility Decision Document**

To: Felicia Fort
Reregistration Branch I
Health Effects Division (7509C)

Demson Fuller, Chemical Review Manager
Reregistration Branch I
Special Review and Reregistration Division (7508C)

From: Mark Corbin, Environmental Scientist
James Hetrick, Ph.D., Senior Physical Scientist
Environmental Risk Branch 1
Environmental Fate and Effects Division (7507C)

Approved By: Pat Jennings, Risk Assessment Process Leader (RAPL)
Sid Abel, Branch Chief
Environmental Risk Branch I
Environmental Fate and Effects Division (7507C)

Summary

Concentrations of 2-methyl-4-chlorophenoxyacetic acid (MCPA) to which humans potentially may be exposed through ingestion of drinking water are assessed through an evaluation of surface water and groundwater monitoring data and modeling. MCPA, a broad spectrum herbicide proposed for reregistration, is used (in terms of pounds of active ingredient) primarily on spring wheat, winter wheat and barley, oats/rye, and rice with the remaining minor usage on seed crops, pasture, hay, lots/farmsteads, dry beans/peas, and flax. The MCPA Task Force is supporting terrestrial food and non-food uses for the dimethylamine salt of MCPA (MCPA DMAS) and the 2-ethylhexyl ester of MCPA (MCPA EHE). EFED adopted an environmental fate strategy for MCPA based on linking the dissociation of the salts of MCPA and the hydrolysis of the MCPA EHE to its free acid, MCPA. In a dissociation study, MCPA-dimethylamine salt completely dissociated to MCPA and dimethylamine ion within 1.5 minutes of stirring in deionized water; therefore, fate studies with MCPA will provide data regarding the behavior of MCPA-dimethylamine salt. Two hydrolysis studies were included in this package for MCPA-ethylhexyl ester (EHE). One study was a standard Subdivision N hydrolysis study in sterile buffers at pH 5, 7, and 9. At

pH 9, MCPA-EHE hydrolyzed to MCPA with a half-life ≤117 hours; the MCPA did not degrade further and there was no hydrolysis at pH 5 and 7. The second study was done in a soil:water system at pH 5.6 and 6.8. Under these conditions MCPA-EHE degraded to MCPA with a half-life of less than 12 hours.

Existing MCPA monitoring data evaluated in this exposure assessment were available from the United States Geological Survey (USGS) National Water-Quality Assessment (NAWQA) Program, the United States Environmental Protection Agency (USEPA) STOrage and RETrieval System for Water and Biological Monitoring Data (STORET), and recently released data from the USGS Pilot Reservoir Monitoring Study. The data were evaluated for magnitude and frequency of MCPA occurrence. Annual maximum concentrations and frequency of detection were determined from each data set. Time weighted annual mean (TWM) concentrations were determined for the NAWQA and STORET data. The frequency of detection of MCPA from the USGS Pilot Reservoir Monitoring Study was not sufficient to calculate TWM concentrations from these data. The highest annual maximum concentration of MCPA detected in surface water is **18.58 ug/l** from the NAWQA (station 4161820) study. The maximum TWM concentration of MCPA in surface water is **1.49 ug/l** from the NAWQA (station 4161820) study. The monitoring data were not targeted to MCPA use areas.

Modeling was completed to augment the monitoring data. Surface water concentrations were modeled using the Tier II PRZM version 3.12/ EXAMS version 2.98.04 model and the EFED graphical interface (PE4.pl dated January 9, 2003). Ground water concentrations were modeled using the Tier I SCIGROW version 2.2 model. Eight different crop scenarios were modeled to represent all registered uses and included wheat in North Dakota and Oregon, peas in Oregon, sorghum in Kansas, and rangeland/pastureland in California, Pennsylvania, and Minnesota. The EFED standard scenario for alfalfa was used as a surrogate for rangeland/pastureland in California, Pennsylvania, and Minnesota because its hydrologic and agronomic practices closely match those of pasture/rangeland and EFED does not have a currently approved pasture/rangeland scenario. The PRZM/EXAMS scenarios selected for modeling represent all available EFED scenarios for registered MCPA uses.

Based on modeling results, the estimated surface water-derived drinking water concentrations for the use of MCPA are:

47.3 ug/l for the 1 in 10 year annual peak concentration (acute)
1.9 ug/l for the 1 in 10 year annual mean concentration (non-cancer chronic) and
1.2 ug/l for the 36 year annual mean concentration (cancer chronic).

The PRZM/EXAMS model results are recommended for use in the human health risk assessment since monitoring data available for MCPA is not specific to areas of use of MCPA. The recommended concentrations in surface water were derived from the Pennsylvania pasture scenario which has the highest labeled application rate (4 lbs ai/acre) of the scenarios modeled. The predicted surface water-derived drinking water concentrations will vary depending on regional climate, soil, environmental characteristics, and watershed characteristics. These model estimates are approximately double the peak (acute) concentration of **18.58 ug/l** detected in the monitoring data and roughly equivalent to the maximum TWM concentration of **1.49 ug/l**.

The SCI-GROW model estimate of MCPA concentration in drinking water from shallow groundwater sources is **2.13 ug/l** using the pasture/rangeland application rate of 4 lbs. ai per acre. MCPA was not detected in the NAWQA or STORET groundwater monitoring data evaluated for this assessment. The estimated concentration can be considered as both the acute and chronic value.

VULNERABILITY ASSESSMENT

As a first step in determining the potential for MCPA to occur in drinking water, a vulnerability assessment of MCPA was completed as part of this drinking water assessment. MCPA county level use data (Thelin and Gianessi, 2000) was compared against community water system (CWS) location information, runoff vulnerability and leaching potential (Kellogg, et al, 1998), sampling locations from monitoring data evaluated in this assessment, and the location of PRZM/EXAMS scenarios. Quantitative analysis was conducted by comparing sources of potential exposure (CWS intakes and NAWQA sample locations) against MCPA county level use data greater than one pound active ingredient per square mile (lb ai/sq mile) representing areas of high MCPA use. Results of each analysis are presented below.

Community Water System (CWS) Intakes

Figure 1 illustrates the location of surface water intakes for CWS relative to MCPA use areas. The analysis indicates that, while much of the MCPA use area does not correlate with CWS intakes, there are a number of exceptions. In particular, the MCPA use area corresponds with CWS intakes in the mid-Atlantic and northern Ohio, the Missouri River Valley of the northern Great Plains, western Oregon, and the Central Valley of California. This type of analysis indicates that the majority of surface water CWS intakes are not in areas of use of MCPA at rates greater than one lb ai/sq mile. A more quantitative evaluation of the analysis indicates that 13% (i.e. 826 out of a total of 6361 CWS intakes) are located in areas where MCPA is used at greater than one lb ai/sq mile. The total population served by these CWS intakes is approximately 10,500,000 out of a total population served of approximately 116,000,000. These estimates are approximations from available data and it should be noted that more than one intake may be associated with a public water system. The frequency of occurrence of CWS intakes in areas of MCPA use is approximately 10%. The average population served for CWS intakes in areas of MCPA use area is approximately 18,000 and the median population is approximately 2,600. Figure 2 illustrates where the CWS intakes and MCPA use area overlap.

Runoff and Leaching Vulnerability

Figure 3 illustrates the location of counties with greater than one lb ai/sq mile of MCPA use relative to the surface water runoff vulnerability index of Kellogg, et al, 1998. This analysis indicates that the areas of highest runoff vulnerability are in the southern states stretching from eastern Texas across to Florida. As with the analysis of CWS intakes, most of the MCPA use area lies outside this high vulnerability area. There are however, some limited areas of moderate runoff vulnerability that do correlate with MCPA use areas. Included in these are Pennsylvania, Ohio, southern Minnesota, central Kansas and Oklahoma, eastern Oregon, and the northern Central Valley of California. These areas correspond closely with the PRZM/EXAMS scenario locations discussed below.

Figure 4 illustrates the location of counties with greater than one lb ai/sq. mile of MCPA use relative to the leaching potential index of Kellogg, et al, 1998. This analysis indicates that the areas of highest leaching potential are in the Mississippi River Valley, southeastern Coastal Plain, central Great Plains, and the southern portion of the Central Valley of California. As with runoff vulnerability, most of the MCPA use area lies outside these high leaching potential areas. However, MCPA is used in the central Great Plains and southern Central Valley of California suggesting a potential for MCPA migration to groundwater in these areas.

Surface Water and Groundwater Monitoring Sites

Figure 5 illustrates an analysis of the location of all NAWQA surface water sample sites relative to MCPA use areas. This analysis indicates that, while some of the NAWQA surface water sites are within high MCPA use areas, the majority of NAWQA sites are not. Therefore, caution should be exercised when evaluating NAWQA surface water samples for MCPA because these data may not reflect the complete range of MCPA occurrence in surface water. Quantitative evaluation of the analysis indicates that 22% (i.e. 886 NAWQA surface water sites out of a total of 4101 sites) are located within the main MCPA use area. Figure 6 illustrates where the NAWQA surface water locations and MCPA use areas overlap.

Figure 7 illustrates the location of the 12 reservoirs in the USGS Pilot Reservoir Monitoring study relative to MCPA use areas. This analysis indicates that none of the Pilot Reservoir sites are within the high MCPA use area (although the South Dakota reservoir is on the edge of the high use area in the upper Great Plains region). Therefore, caution should be exercised when evaluating data from the Pilot Reservoir surface water samples for MCPA because these data may not reflect the complete range of MCPA occurrence in surface water.

Figure 8 illustrates an analysis of the location of all NAWQA groundwater sample sites relative to MCPA use areas. As with the analysis of NAWQA surface water sites, only some of the NAWQA groundwater sites are within high MCPA use areas. The majority of NAWQA sites are not and therefore caution should be exercised when evaluating NAWQA groundwater samples for MCPA because these data may not reflect the complete range of MCPA occurrence in the nations groundwater. Quantitative evaluation of the analysis indicates that 24% (i.e.1622 NAWQA groundwater sites out of a total of 6804 sites) are located within the main MCPA use area. Figure 9 illustrates where the NAWQA groundwater locations and MCPA use areas overlap.

PRZM/EXAMS Scenarios

Figure 10 illustrates the location of all PRZM/EXAMS scenarios used in this assessment relative to MCPA use data in order to evaluate the correspondence of the results of modeling to the MCPA use pattern. The analysis indicates that the scenarios selected provide reasonable coverage of the MCPA use pattern with an emphasis on the mid-Atlantic, Great Plains, northwest, and Central Valley of California.

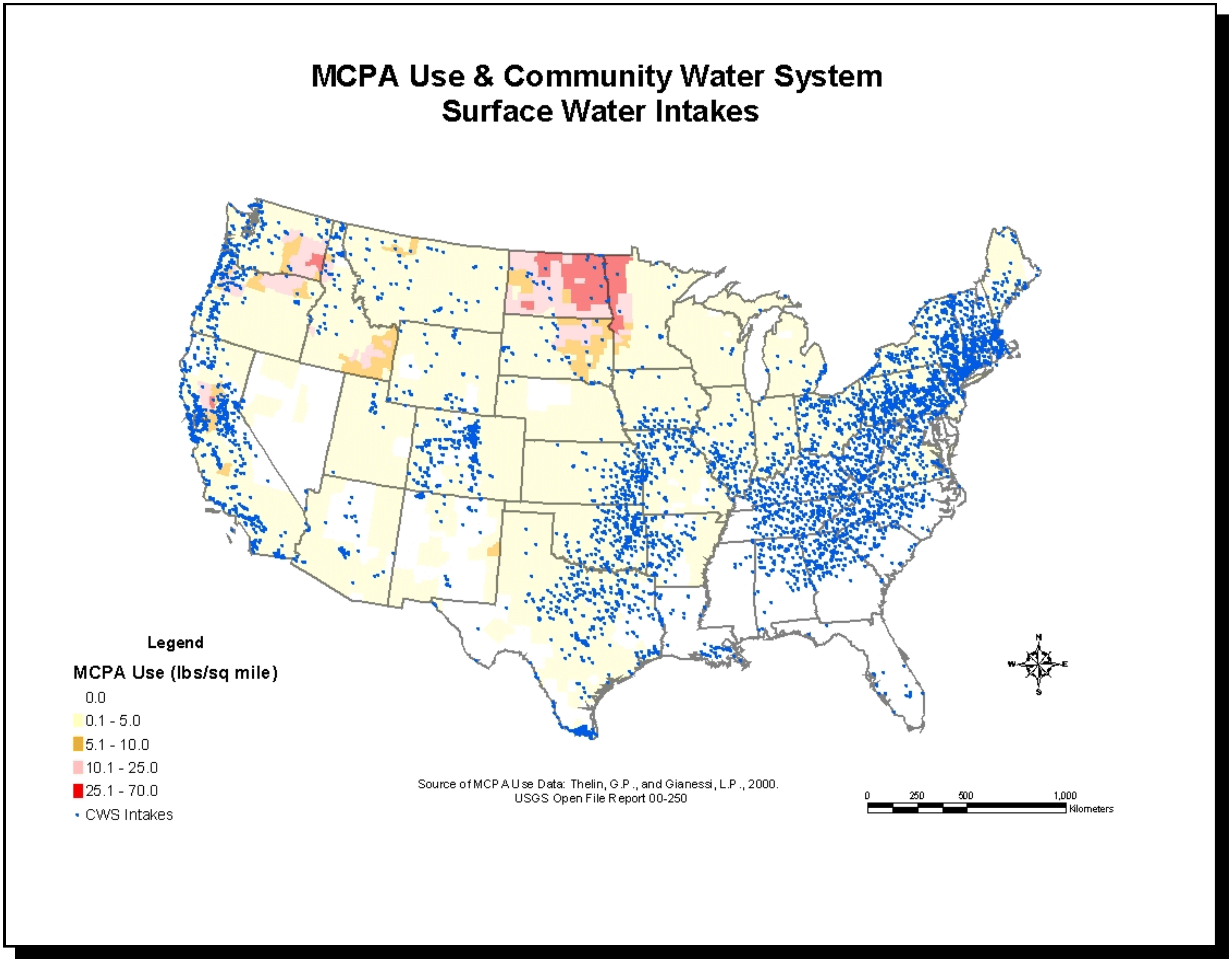

Figure 1. Community Water System (CWS) Intakes from surface water versus MCPA County Level Use Information (USGS Open File Report 00-250)

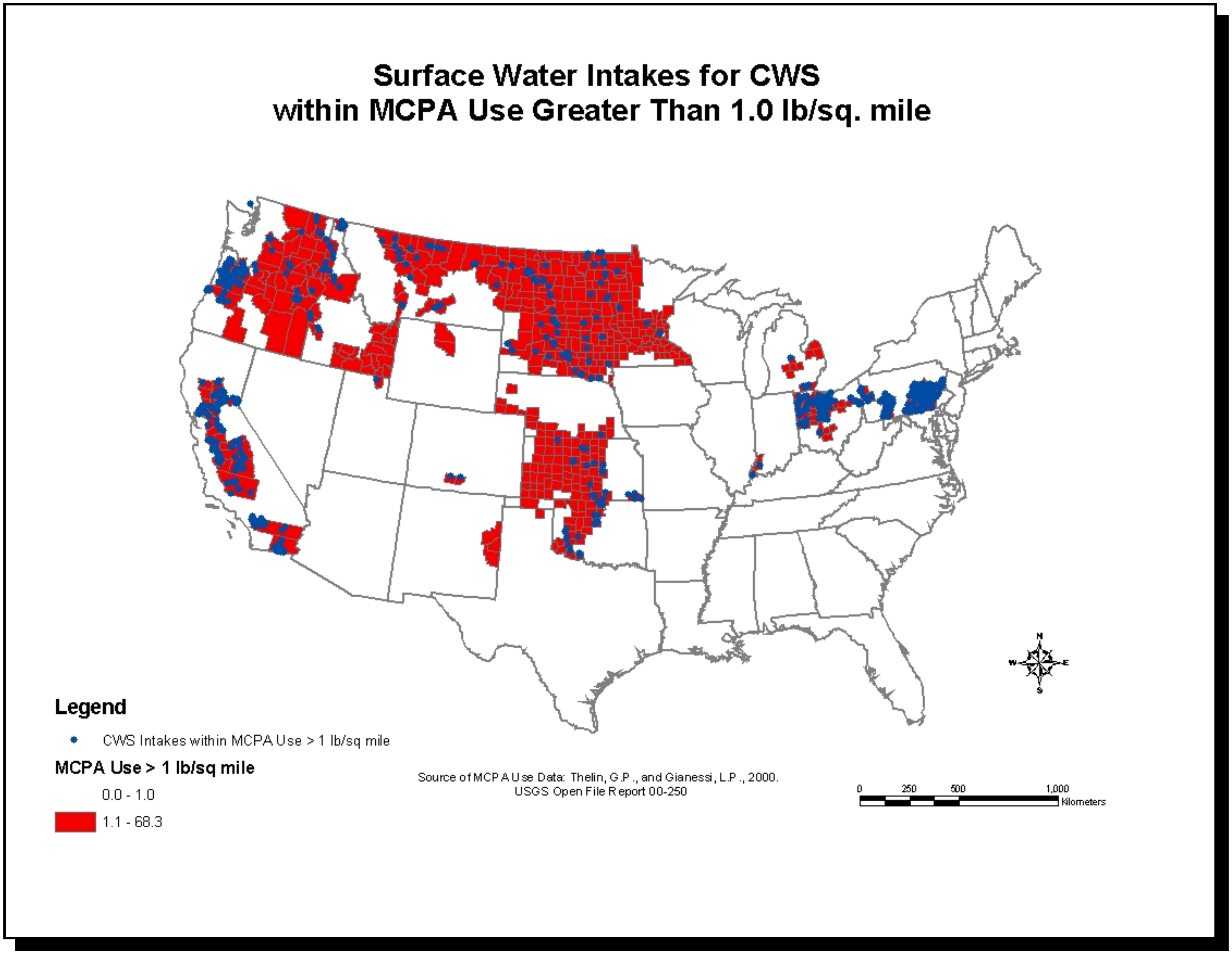

Figure 2. Community Water System (CWS) Intakes from Surface Water within Areas of MCPA County Level Use Greater Than One lb/sq. mile (USGS Open File Report 00-250)

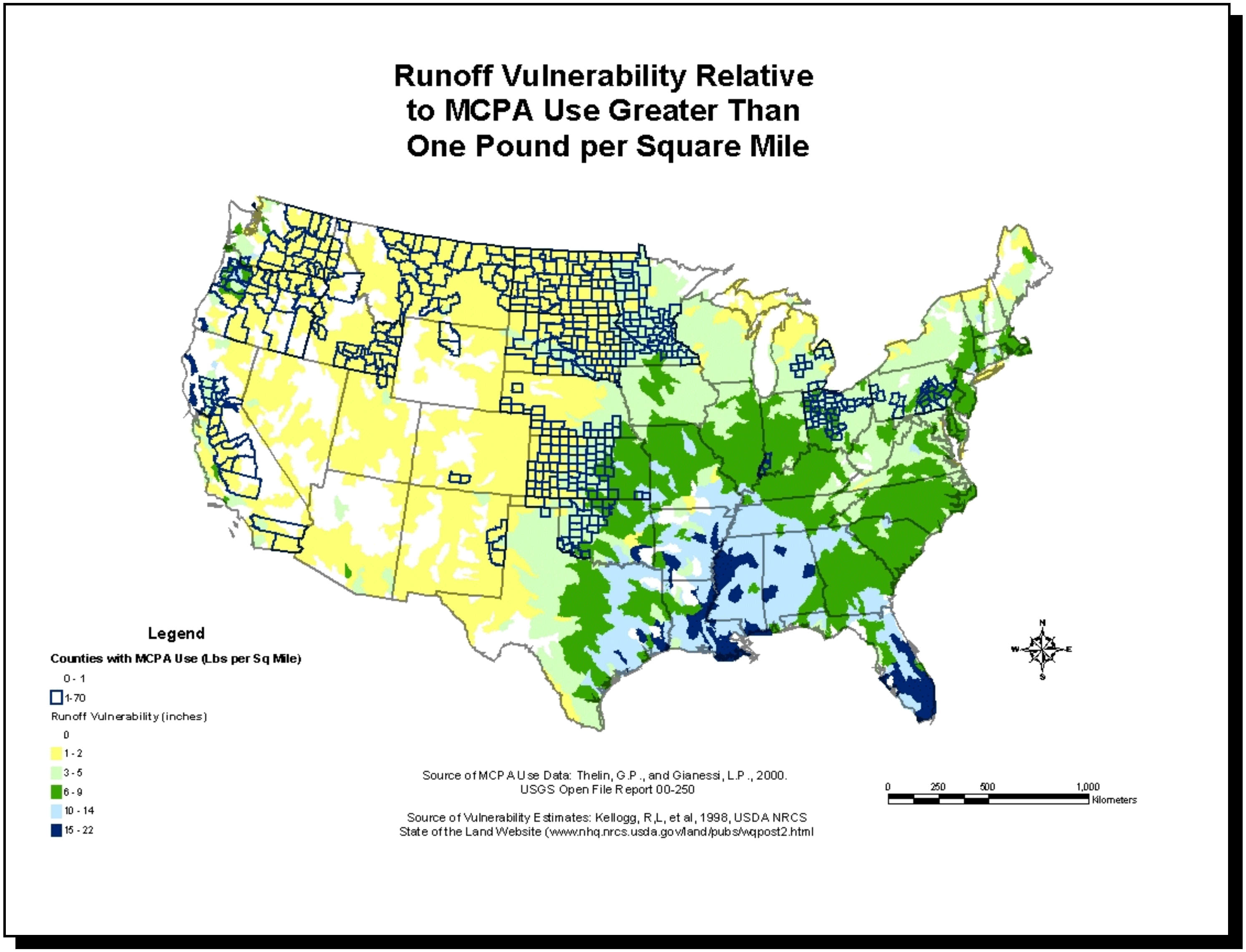

Figure 3. Runoff Vulnerability Index (Kellogg, et al, 1997) versus MCPA County Level Use (USGS Open File Report 00-250)

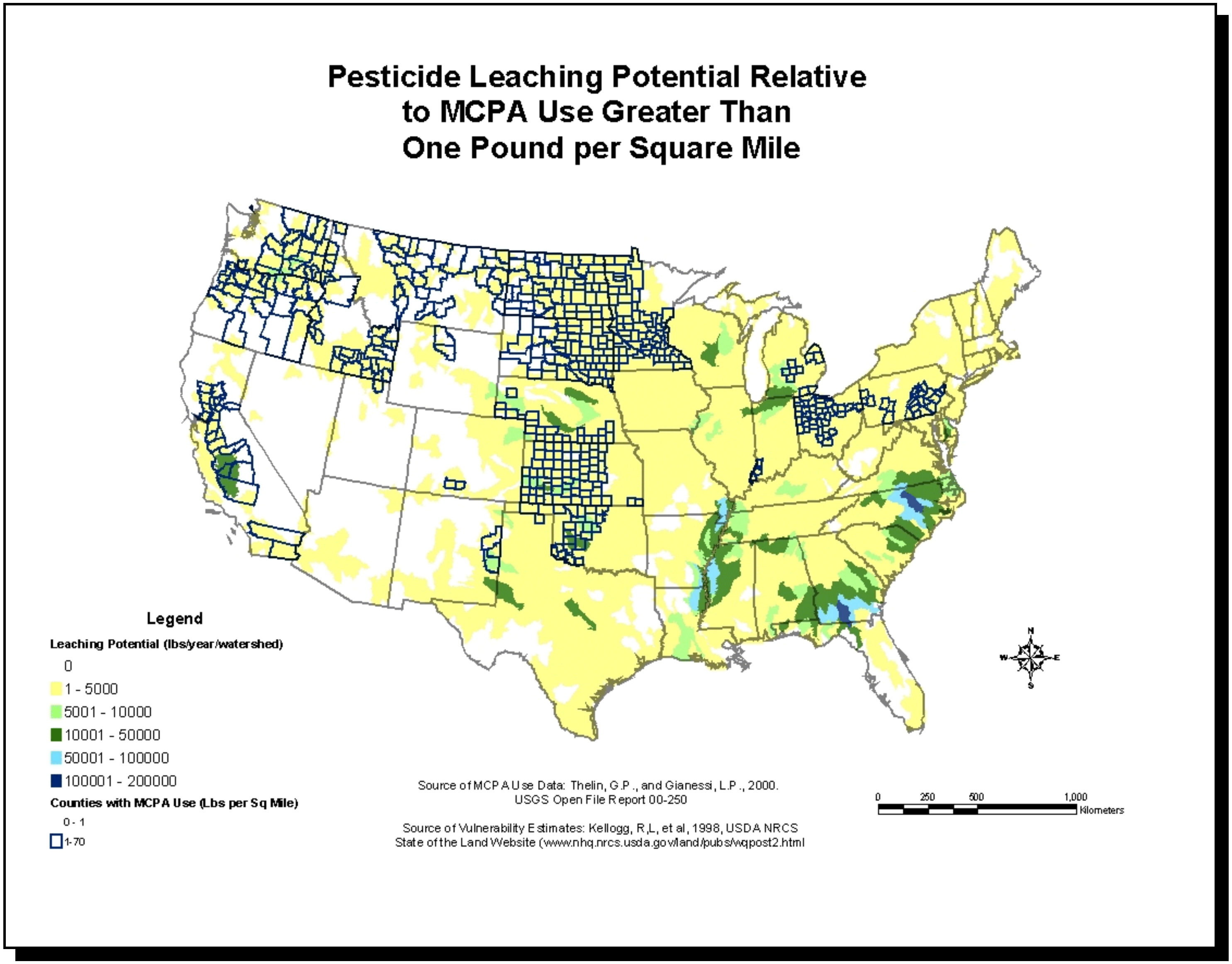

Figure 4. Pesticide Leaching Potential (Kellogg, et al, 1997) versus MCPA County Level Use Greater Than One Lb/Sq Mile (USGS Open File Report 00-250)

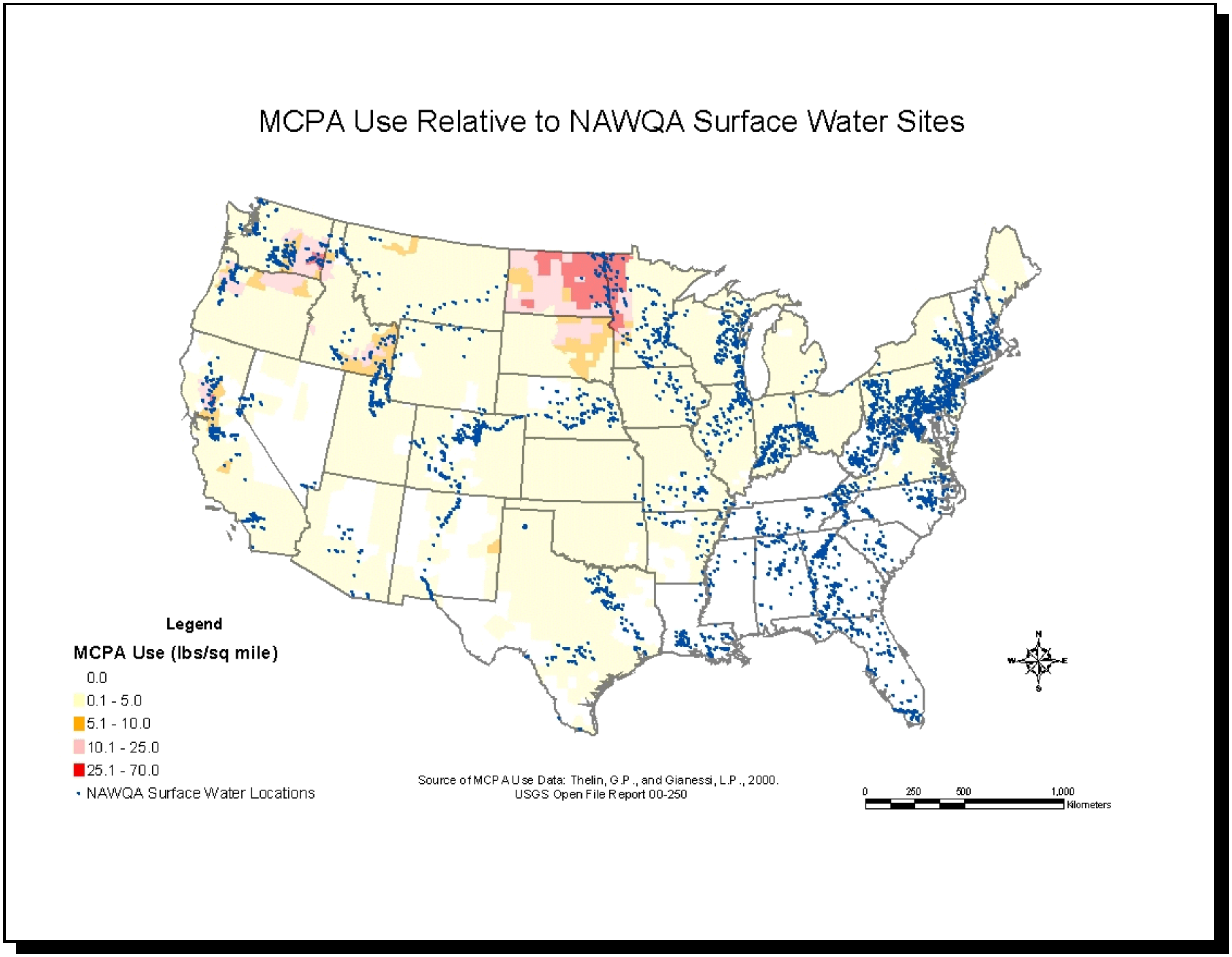

Figure 5. NAWQA Surface Water Locations versus MCPA County Level Use Information (USGS Open File Report 00-250)

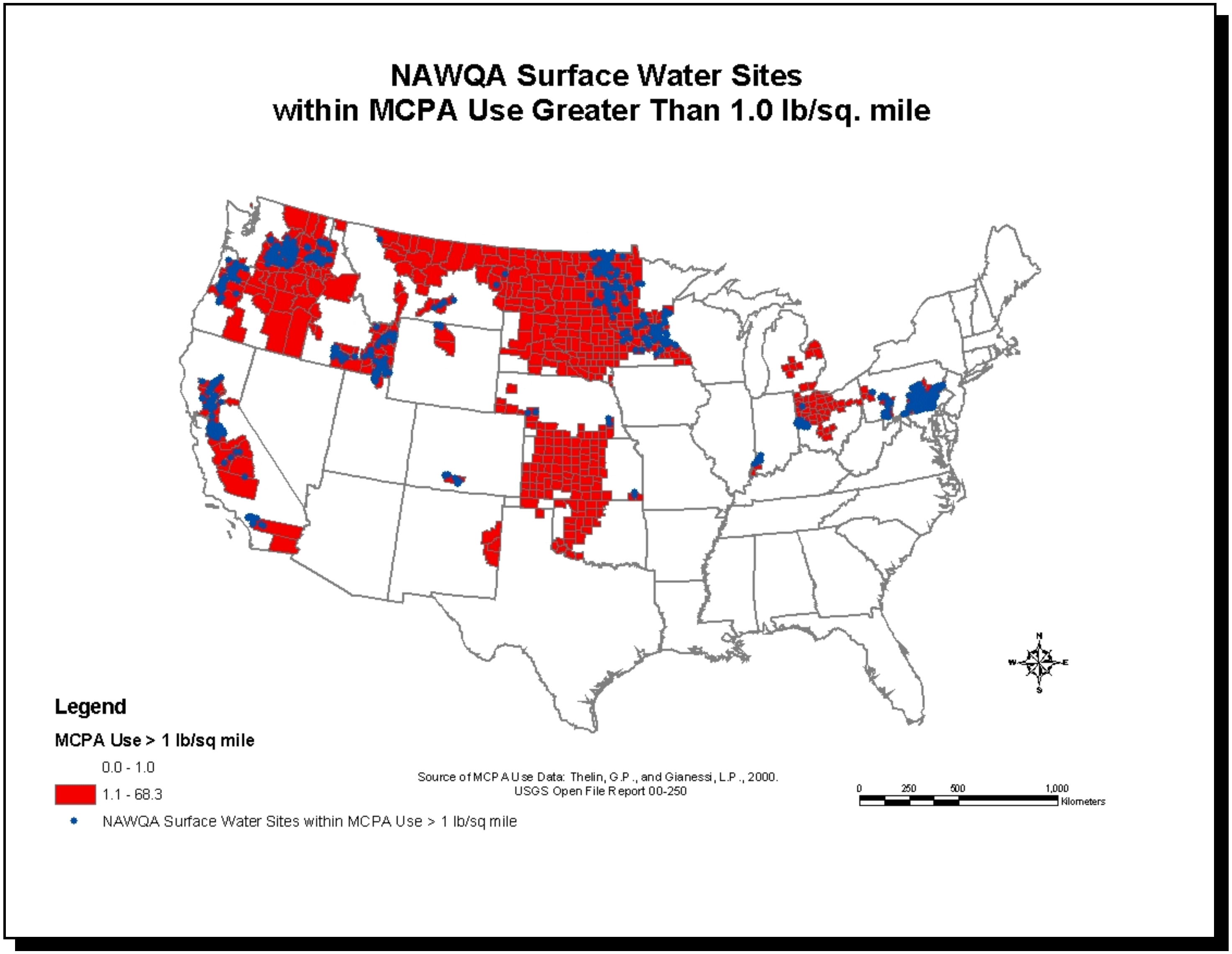

Figure 6. NAWQA Surface Water Locations within Areas of MCPA County Level Use Greater than One lb/sq. mile (USGS Open File Report 00-250)

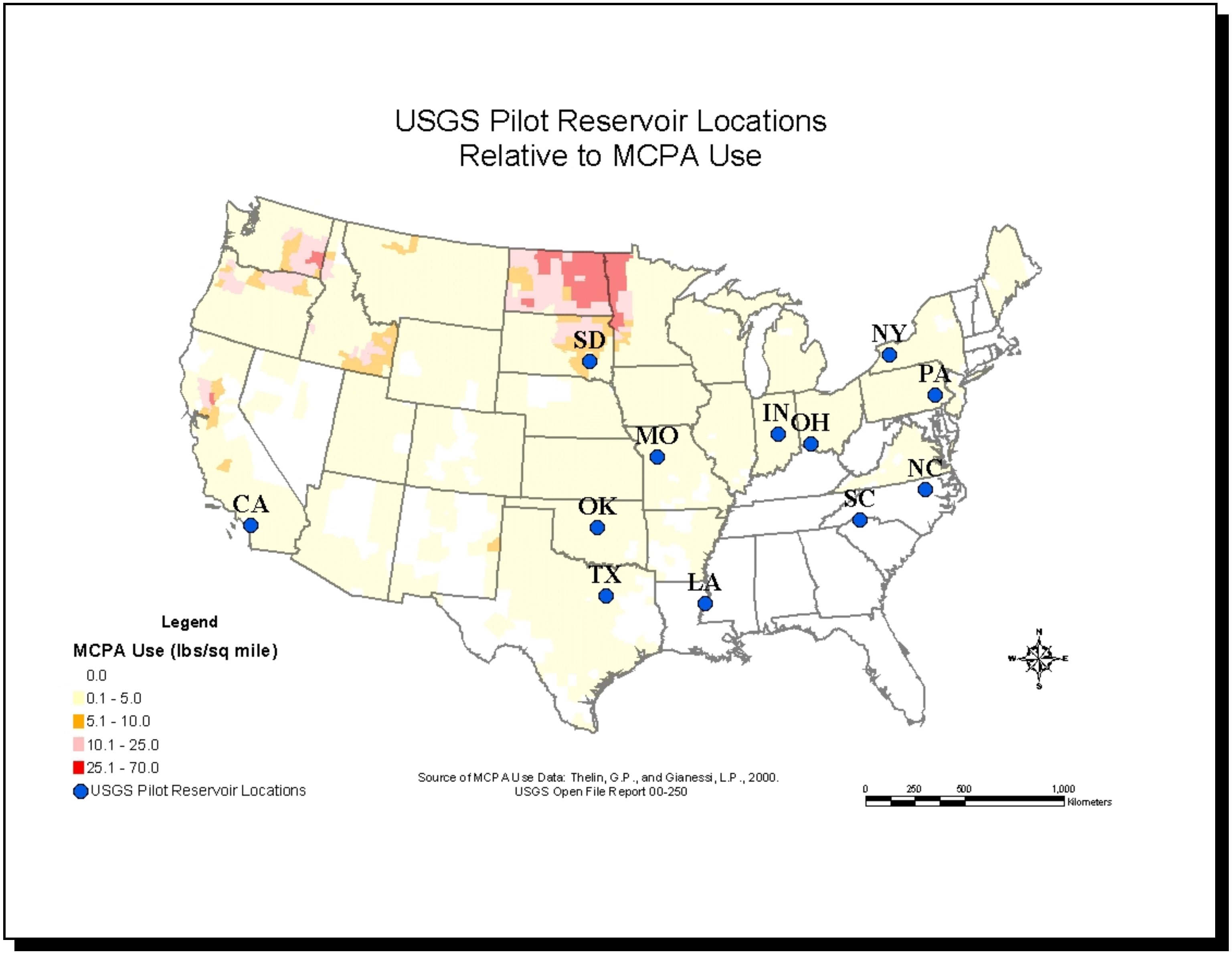

Figure 7. MCPA County Level Use Relative to USGS Pilot Reservoir Locations (USGS Open-File Report 01-456)

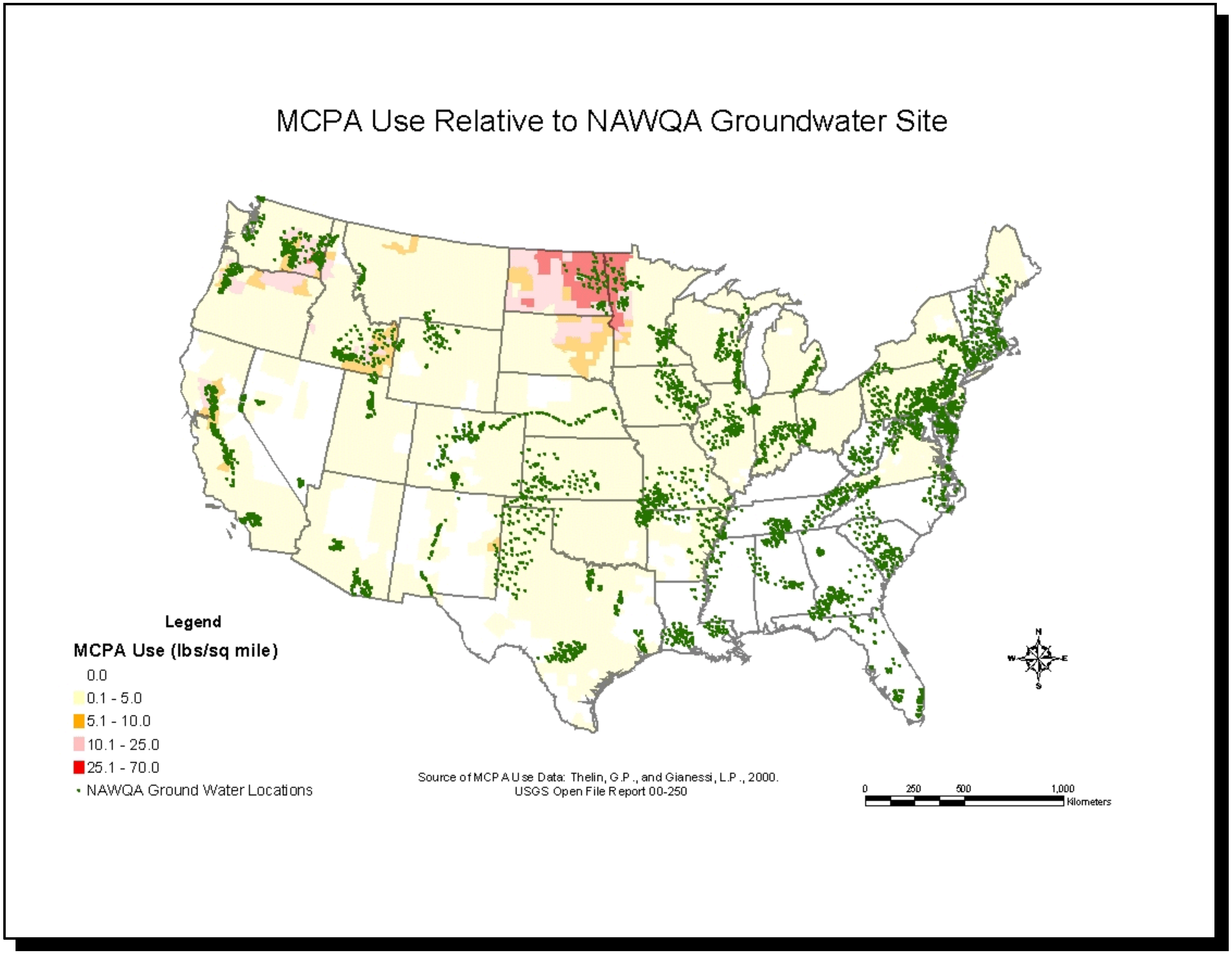

Figure 8. NAWQA Groundwater Locations versus MCPA County Level Use Information (USGS Open File Report 00-250)

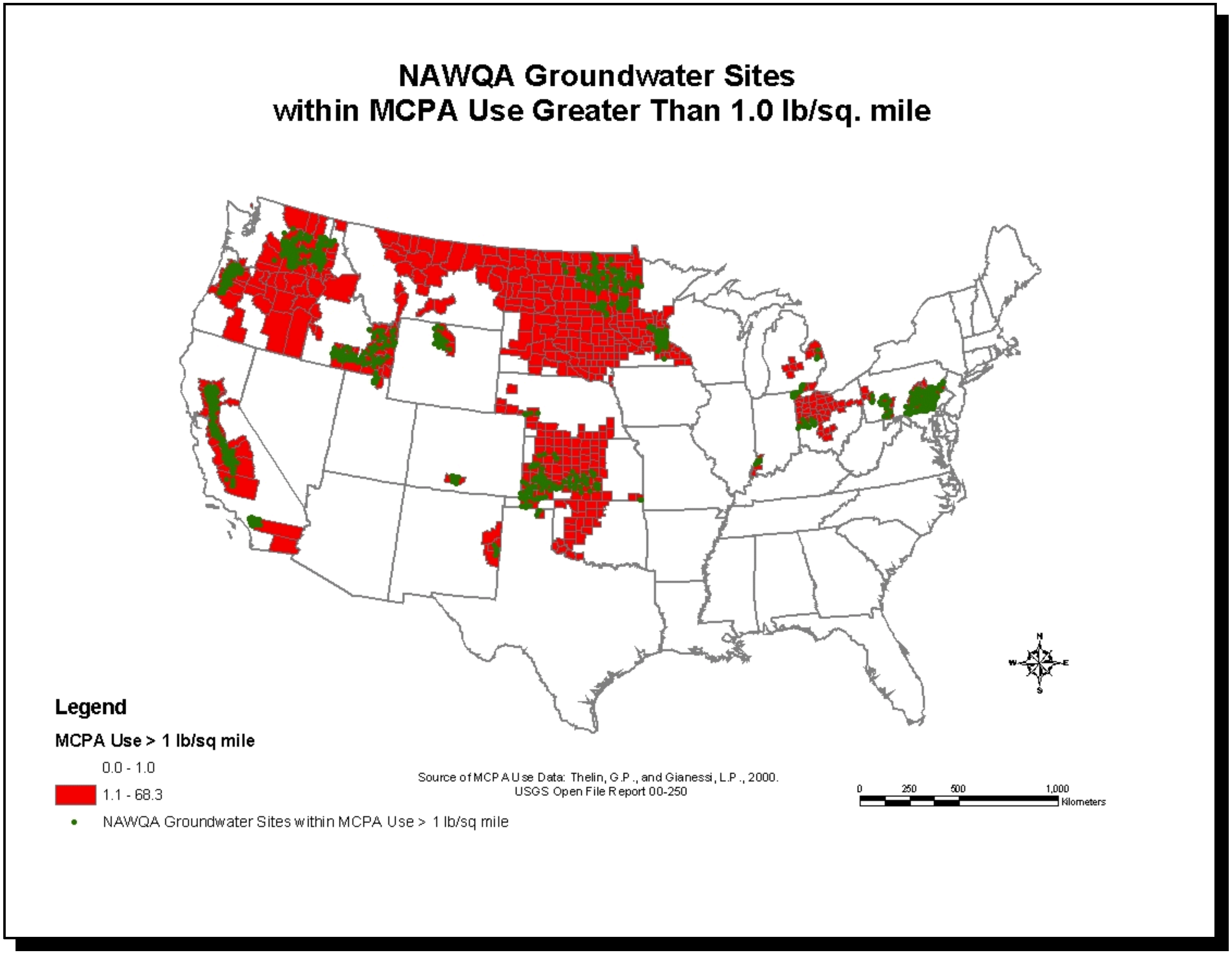

Figure 9. NAWQA Groundwater Locations versus MCPA County Level Use Information (USGS Open File Report 00-250)

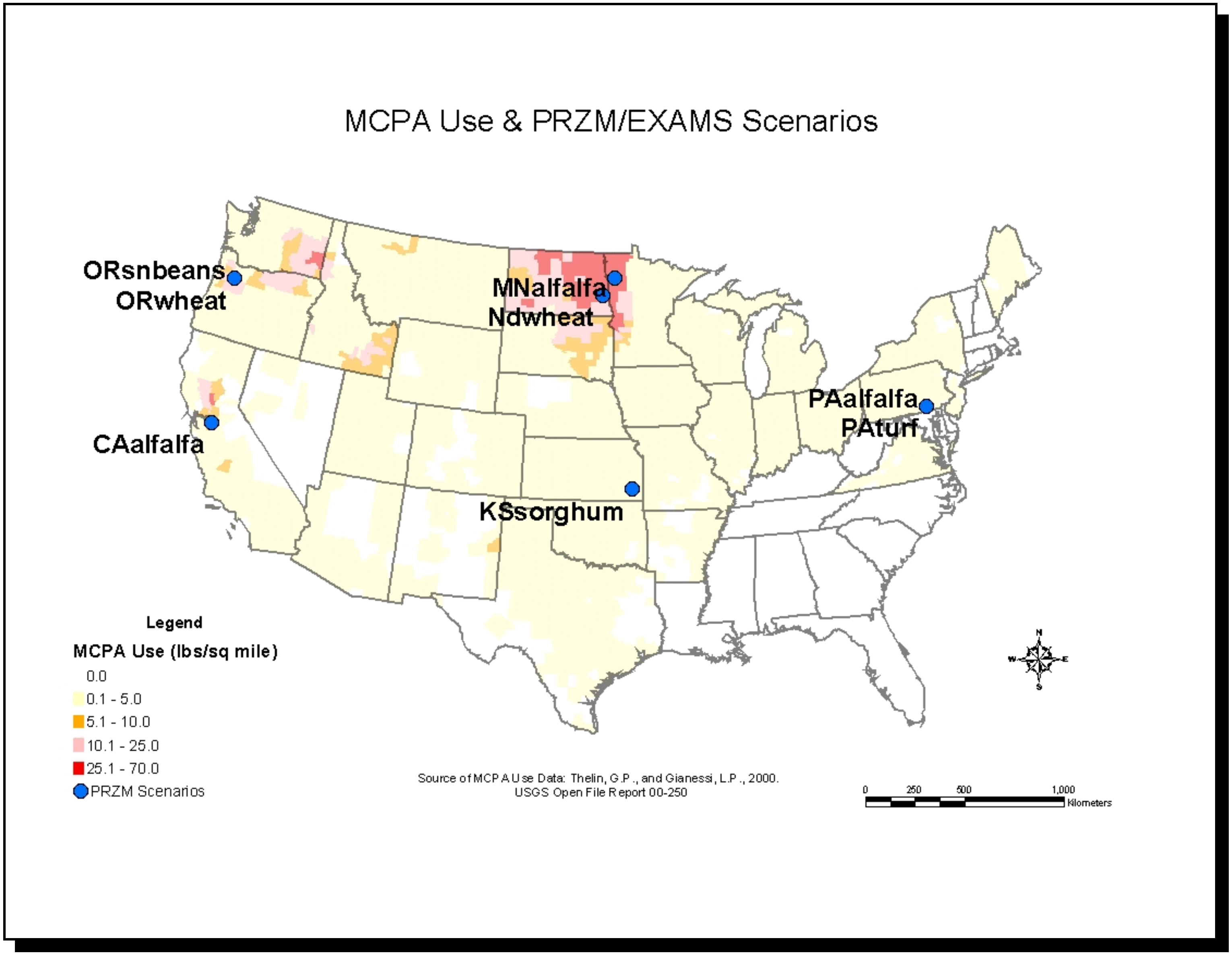

Figure 10. PRZM/EXAMS Scenarios versus MCPA County Level Use Information (USGS Open File Report 00-250)

SURFACE WATER MONITORING DATA ASSESSMENT

Existing MCPA monitoring data evaluated in this exposure assessment were from the United States Geological Survey (USGS) National Water-Quality Assessment (NAWQA) Program, the United States Environmental Protection Agency (USEPA) STOrage and RETrieval System for Water and Biological Monitoring Data (STORET), and data from the USGS Pilot Reservoir Monitoring Study. The data were evaluated for magnitude and frequency of MCPA occurrence. Each surface water data set was separated by location and year of sampling and an analysis conducted to tabulate the annual maximum concentration and to estimate the time weighted annual mean (TWM) concentration from each set. The minimum criterion for calculating TWM concentration for each sampling station was at least 4 samples in a single year. The equation used for calculating the time weighted annual mean is as follows:

$$[((T_{0+1}-T_0) + ((T_{0+2}-T_{0+1})/2))*C\ t_{0+1})] + (((T_{i+1}-T_{i-1})/2)*C_i) + [((T_{end}-T_{end-1}) + ((T_{end-1}-T_{end-2})/2)*C_{Tend-1})]/365$$

where: Ci=Concentration of pesticide at sampling time (Ti)
Ti= Julian time of sample with concentration Ci
T_0 =Julian time at start of year=0
T_{end} =Julian time at end of year=365

The annual maximum and TWM concentrations from the NAWQA, STORET, and USGS Pilot Reservoir studies were ranked and percentiles generated for each distribution for each data set. The frequency of detection of MCPA from the USGS Pilot Reservoir Monitoring Study was not sufficient to calculate TWM concentrations from this data. Data from the individual studies were not analyzed together and the results from each data set are presented separately.

The highest maximum concentration of MCPA detected in any of the surface water monitoring data analyzed was **18.58 ug/l** from the NAWQA program. The maximum annual TWM concentration detected from the surface water monitoring data is **1.49 ug/l** from the NAWQA program. None of the monitoring data were targeted specifically to MCPA use and no degradates of MCPA are included in any of the data evaluated. Annual maximum and TWM concentrations were ranked and percentiles generated for the distribution for each data source. Annual maximum concentrations for all data evaluated are presented in Table 1. TWM concentrations for all data evaluated are presented in Table 2.

Table 1 Summary of Percentiles of Maximum MCPA Concentrations in Surface Water			
Percentile	National NAWQA Data (ug/l)	STORET Data (ug/l)	USGS Pilot Reservoir Data (ug/l)
Maximum	**18.58**	1.3	0.121
99.9%	18.027	1.18	0.0947
99%	13.0504	0.61	0.0585
95%	1.084	0.29	0.0585
90%	0.882	0.1	0.0585
75%	0.42	0.05	0.0585
50%	0.21	0.05	0.0585

Table 2 Summary of Percentiles of TWM MCPA Concentrations in Surface Water		
Percentile	National NAWQA Data (ug/l)	STORET Data (ug/l)
Maximum	**1.4928**	0.11
99.9%	1.4512	0.11
99%	1.0771	0.09
95%	0.1827	0.06
90%	0.1731	0.06
75%	0.0713	0.05
50%	0.0585	0.05

National NAWQA Data

The United States Geological Survey (USGS) began collecting surface and groundwater data from selected watersheds in order to catalog the quality of water resources in the United States. The National Water Quality Assessment (NAWQA) program began in 1991 and consists of chemical, biological and physical water quality data from 59 study units across the United States. The NAWQA method (2001) had a median MCPA recovery of 72% with a standard deviation of 18.6%. The method detection limit (MDL) for MCPA was 0.0032 ug/l in groundwater and 0.011 ug/l in surface water. The limit of quantitation

(LOQ) was 0.05 ug/l. More details on the QA/QC of MCPA in the NAWQA data may be found in Furlong, E.T., et al, 2001 (USGS WRI-Report 01-4134).

EFED evaluated the occurrence of MCPA in surface water from the national data. MCPA was detected in surface water from locations in 14 states. MCPA was detected in 1.85% of samples (i.e. 90 samples from a total national data set of 4378 samples). EFED analyzed the occurrence of MCPA in surface water from each sampling location within each state on an annual basis. For the purposes of this assessment only the upper bound TWM concentration from the NAWQA data is presented. The upper bound TWM concentration was estimated by setting detections at or below the detection limit at the value of the detection limit.

The annual maximum concentrations of MCPA ranged from 0.05 ug/l to 18.58 ug/l (the highest concentration was detected at the Clinton River location at Sterling Heights, Michigan). The next five maximum concentrations were widely dispersed geographically with detections in Virginia, Georgia, California, North Dakota, and Tennessee. Figure 11 presents the maximum concentration of MCPA in surface water from NAWQA. Table 3 includes the maximum concentration data presented graphically in Figure 11. The upper bound TWM concentrations ranged from 0.05 ug/l to a maximum of 1.49 ug/l (same site as maximum). No MCPA degradate data were available for this analysis.

Table 3. NAWQA Surface Water Locations with Maximum Concentrations > 0.25 ug/l				
Latitude	**Longitude**	**Maximum Conc. (ug/l)**	**Station ID**	**Location**
42.6	-83	18.58	4161820	CLINTON RIVER AT STERLING HEIGHTS MI
38.8	-77.20	1.3	1654000	"ACCOTINK C NEAR ANNANDALE, VA"
33.50	-84.90	1.120	2338000	"CHATTAHOOCHEE RIVER NEAR WHITESBURG, GA."
38.80	-121.80	0.940	11390890	COLUSA BASIN DR A RD 99E NR KNIGHTS LANDING CA
47.90	-97.50	0.920	5082625	"TURTLE R AT TURTLE R STATE PARK NR ARVILLA, ND"
35.20	-89.90	0.78	7031692	FLETCHER CREEK AT SYCAMORE VIEW ROAD AT MEMPHIS
32.00	-106.60	0.73	8363840	
48.40	-97.10	0.68	5086500	
45.20	-122.80	0.63	14202000	"PUDDING RIVER AT AURORA, OREG."
37.40	-121.00	0.54	11273500	MERCED R A RIVER ROAD BRIDGE NR NEWMAN CA
45.10	-122.80	0.52	14201300	"ZOLLNER CREEK NEAR MT ANGEL, OR"
32.90	-97.10	0.51	325147097040599	
34.00	-84.40	0.42	23358694	SOPE CREEK AT INDIAN HILLS RD NEAR MARIETTA
29.7	-94.60	0.42	294349094345999	
46.80	-118.10	0.38	13351000	"PALOUSE RIVER AT HOOPER, WA"
34.00	-84.40	0.37	2335870	"SOPE CREEK (S ROSWELL RD) NR MARIETTA, GA."
48.20	-97.10	0.34	5083100	
29.80	-94.60	0.29	295001094384699	
32.7	-97.30	0.28	8048542	
47.30	-96.20	0.25	5062500	

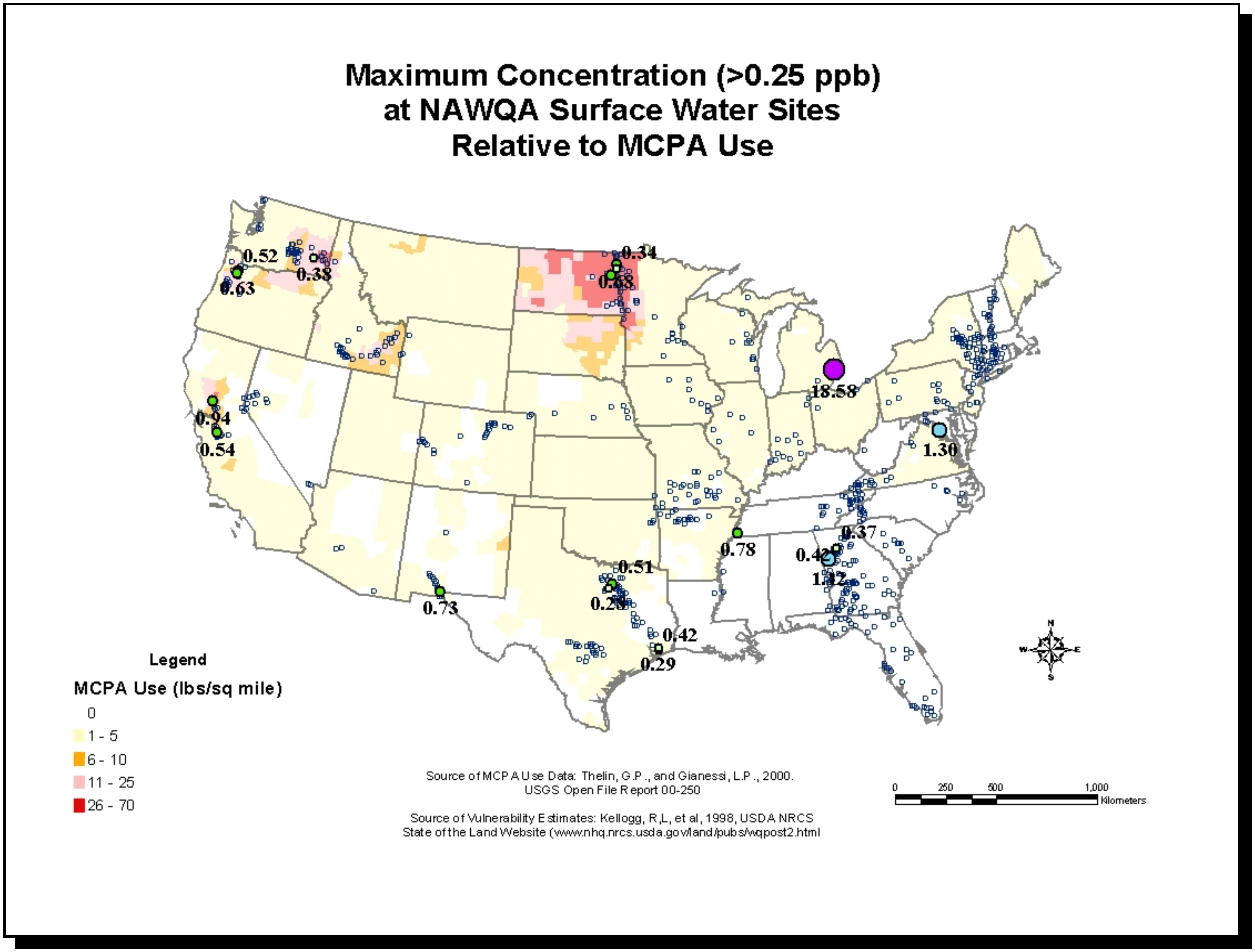

Figure 11. NAWQA Surface Water Locations with Maximum Concentrations Greater Than 0.25 ppb versus MCPA Use Information (USGS Open File Report 00-250)

STORET Data

STORET is a database of surface water detections compiled and maintained by the USEPA Office of Water. EFED uses STORET data with caution due to inherent limitations in STORET. Issues of concern for STORET include the nature of study objectives from which data were generated is variable, the data are generally not targeted to areas of specific pesticide or chemical use, information on QA/QC of the data is inadequate, and ancillary data are not available for more detailed analysis.

MCPA was present above the LOQ (reported as 0.05 ug/l) in 352 samples from a total national data set of 3430 samples. Of monitoring data in STORET, the detection frequency of MCPA was 10.3%. No QA/QC data are available for the MCPA monitoring data reported in STORET. The maximum concentrations ranged from 0.05 ug/l to 1.30 ug/l and the TWM concentrations ranged from 0.05 ug/l to 0.11 ug/l. No degradate data in surface water were available from STORET in this analysis.

USGS Reservoir and Finished Water - Pilot Monitoring Study, 1999-2000

The USGS recently issued data from a cooperative study between the USGS and USEPA for "Pesticides in Water-supply Reservoirs and Finished Drinking Water - A Pilot Monitoring Program" by Blomquist, J.D., et al, 2001 (USGS Open-File Report 01-456). The study consists of the analysis of raw and finished water (i.e. treated drinking water) samples from 12 drinking water reservoirs. The analytical method LOQ was 0.0585 ug/l and the median recovery for all QA/QC samples (for both raw and finished water) was 76% with a standard deviation of 11% (personal communication with Joel Blomquist January 22, 2003).

The detection frequency of MCPA was 1.48% (i.e. 9 detections out of a total of 608 samples). The highest peak concentration of MCPA was 0.121 ug/l in the raw water from the Eagle Creek Reservoir, Indiana. Due to the low detection frequency from this data set, no TWM concentrations were estimated. The annual maximum concentrations of MCPA ranged from 0.0585 ug/l to 0.121 ug/l.

GROUNDWATER MONITORING DATA ASSESSMENT

NAWQA Data

The United States Geological Survey (USGS) began collecting groundwater data from selected watersheds in order to catalog the quality of water resources in the United States. The National Water Quality Assessment (NAWQA) program began in 1991 and consists of chemical, biological and physical water quality data from 59 study units across the United States. EFED evaluated the occurrence of MCPA in groundwater from the national data. MCPA was not detected above the LOQ in any of a total of 4351 samples. The LOQ was reported to range between 0.05 ug/l and 1.28 ug/l. A discussion of the QA/QC data for MCPA in the NAWQA data is summarized in the surface water section of this assessment. Figure 12 presents the maximum concentration of MCPA in groundwater from NAWQA. In this case, these values correspond with the samples with an elevated LOQ of 1.28 ug/l.

STORET Data

MCPA was not detected above the LOQ from 2351 samples. However, the detection limits reported in the data ranged from 0 ug/l to1 ug/l with most samples reporting detection limits of 0.05 ug/l. No degradate data in groundwater samples from STORET were found.

Pesticides in Groundwater Database - 1992 Report, National Summary

The Pesticides in Groundwater Database (PGWD) was created by the Agency to provide a more complete picture of the occurrence of pesticides in groundwater at the time of publication of the report in 1992. The PGWD is a collection of groundwater monitoring studies conducted by federal, state, and local governments as well as industry and private institutions. The data represent groundwater data collected between 1971 and 1991, providing an overview of the pesticide monitoring in groundwater efforts as of the date of the summary. MCPA was present in wells from 3 out of 8 states where MCPA was analyzed. MCPA was detected in 0.33% of samples (i.e. 5 detections from a total of 1,524 analysis) with 2 detections greater than the Lifetime Health Advisory Level (HAL) of 4 ug/l. Concentrations range between 0.13 ug/l and 5.3 ug/l. There is limited QA/QC information on these data and LOQs were not reported.

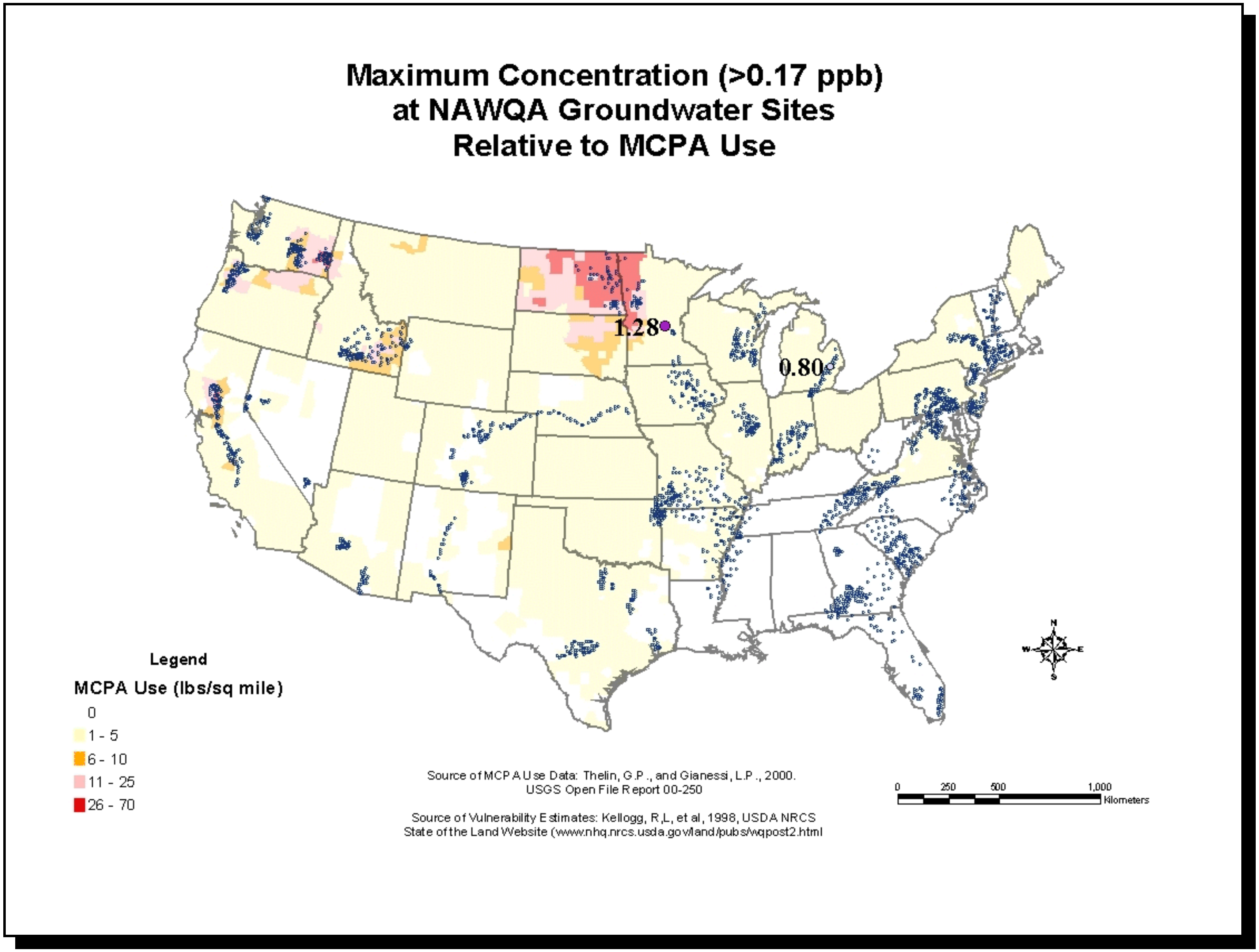

Figure 12. NAWQA Groundwater Locations with Maximum Concentrations Greater Than 0.17 ppb versus MCPA Use Information (USGS Open File Report 00-250)

MODELING ASSESSMENT

Several surface water and groundwater monitoring data sets (NAWQA, STORET, USGS Pilot Reservoir Monitoring Study) were available for analysis as part of this assessment. To augment these monitoring data, drinking water concentrations were estimated using model predictions.

Surface Water Modeling of MCPA

A Tier II drinking water assessment for the use of MCPA was performed using the PRZM/EXAMS model with an index reservoir (IR) and a percent crop area (PCA) scenario. For a description of the IR/PCA scenarios and the uncertainties associated with them see the science policy document at the following URL : http://www.epa.gov/oppfead1/trac/science/reservoir.pdf. Eight different crop scenarios were modeled, including wheat in North Dakota and Oregon, peas in Oregon, sorghum in Kansas, and rangeland/pastureland in California, Pennsylvania, and Minnesota. The EFED standard scenario for alfalfa was used to represent rangeland/pastureland in California, Pennsylvania, and Minnesota. The alfalfa scenario was chosen because its hydrologic and agronomic practices closely match those of pasture/rangeland for which an approved scenario has not been developed. An additional non-crop scenario was run for turf in Pennsylvania. MCPA is a broad spectrum herbicide with its largest markets in terms of total pounds active ingredient allocated to spring wheat, winter wheat and barley, oats/rye, and rice. The remaining usage is primarily on seed crops, pasture, hay, lots/farmsteads, dry beans/peas, and flax. The PRZM/EXAMS scenarios selected for modeling represent all available EFED scenarios for registered MCPA uses. These scenarios were chosen to model the concentration of MCPA in surface drinking water over a geographically dispersed range of surface water concentrations in areas representative of heavy MCPA use (i.e. northern Great Plains and northwestern US). A summary of the application conditions modeled for these exposure scenarios is presented in Table 4. Figure 10 presents the location of the eight scenarios relative to MCPA use information obtained from Thelin and Gianessi, 2000 (USGS Open File Report 00-250).

Table 4: Exposure Scenarios for MCPA Risk Assessment				
Crop (location)	**Application Rate in acid equivalents (lbs ai/acre)**	**Application number/type**	**Application dates**	**Label Reference (Registration Number)**
North Dakota wheat	1.5	1	June 1, 19xx	MCPA Amine 4 (2217-362)
Oregon wheat	1.5	1	May 15, 19xx	MCPA Amine 4 (2217-362)
California pasture	4	1	February 1, 19xx	Riverdale Veteran 2010 (228-296)
Pennsylvania pasture	4	1	June 1, 19xx	Riverdale Veteran 2010 (228-296)
Minnesota pasture	4	1	June 1, 19xx	Riverdale Veteran 2010 (228-296)
Kansas sorghum	0.75	1	June 15, 19xx	MCPA Na Salt (5905-510)
Oregon peas	0.375	1	May 15, 19xx	Gordon's MCPA Amine 4 (2217-362)
Pennsylvania turf	2	1	June 1, 19xx	Gordon's MCPA Amine 4 (2217-362)

PRZM 3.12/ EXAMS 2.98.04 modeling was performed with index reservoir (IR) scenarios and percent cropped area (PCA) adjustment factors. A default PCA factor of 0.87 was used for peas, sorghum, and rangeland/pastureland because a PCA factor for these crops was not available. A PCA factor of 0.56 was applied to wheat results. It should be noted that there may be instances where wheat co-occurs with other crops within a watershed. In these instances the default PCA (0.87) should be used. The EECs presented below for the wheat scenarios do not capture this co-occurrence and could underestimate concentrations that result from watersheds where other crops are present to which MCPA is applied. No PCA factor was applied to turf since this non-crop use was not considered when PCAs were developed. All application rates were adjusted to acid equivalents. It should also be noted that, for several of the scenarios, spray drift was the principal contributor to the acute exposures in up to half of the years modeled. However, the one in ten year EECs presented were the result of a combination of drift and runoff. Table 5 presents a summary of the results of PRZM/EXAMS modeling. Table 6 summarizes the PRZM/EXAMS model inputs. Copies of the PRZM input files are presented in Appendix A. Copies of the PRZM/EXAMS output files are presented in Appendix B. Copies of the Metadata files for each individual model scenario are located at http://www.epa.gov/oppefed1/models/water/metadata.htm.

TABLE 5. Tier II Concentrations of MCPA in Surface Water Using IR/PCA PRZM/EXAMS Scenarios				
Crop Scenario	**PCA Adjustment Factor**	**1/10 Peak Concentration (ug/l)**	**1/10 Yearly Annual Concentration (ug/l)**	**36 Year Annual Mean Concentration (ug/l)**
North Dakota wheat	0.56	15.45	0.53	0.29
Oregon wheat	0.56	13.16	0.47	0.28
California pasture	0.87	37.25	1.6	1.17
Pennsylvania pasture*	0.87	**47.31**	**1.93**	**1.17**
Minnesota pasture	0.87	34.46	1.43	0.85
Kansas sorghum	0.87	31.28	0.92	0.44
Oregon peas	0.87	8.29	0.32	0.14
Pennsylvania turf	1	14.92	0.56	0.33

* Recommended for use in the human health risk assessment.

Table 6. PRZM/EXAMS Input Parameters for MCPA			
Model Parameter	**Value**	**Comments**	**Source**
Application Rate per Event	4 lbs ae/acre for pasture 1.5 lbs ae/acre for wheat 0.75 lbs ae/acre for sorghum 0.375 lbs ae/acre for peas 2.0 ae/acre for turf	applications to pasture, wheat, sorghum, and peas by aerial application application to turf by ground application	Label
Number of Applications per Crop Season	1 application per year for all scenarios; assumes one planting season per year		Label
Aerobic Soil Metabolism $t_{1/2}$	72 days [1]	estimated upper 90 th percentile	MRID 41586001
Anaerobic Soil Metabolism $t_{1/2}$	62 days [2]		MRID 41586001
Aerobic Aquatic Degradation $t_{1/2}$ (KBACW)	263 days [3]	estimated upper 90 th percentile	MRID 44732401A/44192701 MRID 44732401B
Anaerobic Aquatic Degradation $t_{1/2}$ (KBACS)	1122 days [4]	estimated upper 90 th percentile	MRID 40461901
Aqueous Photolysis $t_{1/2}$	25.4 days		MRID 42928101
Hydrolysis $t_{1/2}$	stable		MRID 42665301
Kd/Koc	0.60 ml/g [5]	Average Kd using all acceptable and supplemental Kd	MRID 42596903 MRID 40555801 MRID 44239601
Molecular Weight	200.6		Product Chemistry
Water Solubility	15,000 mg/l	10 x solubility	Product Chemistry
Vapor Pressure	3.12E-4 torr		Product Chemistry

1 - Upper 90th Percentile based on three times a single acceptable aerobic metabolism half life of 24 days.
2 - Upper 90th Percentile based on a single acceptable anaerobic metabolism half life of >62 days.
3 - Upper 90th Percentile based on half lives of 147 days, 15 days, and 247 days from whole system data.
4 - Upper 90th Percentile based on a single half life of 374 days.
5- From all acceptable and supplemental adsorption/desorption data including Kd values of 0.45, 1.16, 0.48, 1.20, and 0.82 from MRID 42596903; 0.73, 0.02, 1.11, and 0.58 from MRID 40555801; and 0.214, 0.257, 0.554, 0.502, and 0.357 from MRID 44239601.

Groundwater Modeling of Parent MCPA

Based on SCI-GROW modeling the acute and chronic concentration of MCPA in shallow groundwater is estimated to be **2.13 ug/l**. Input parameters for SCI-GROW are presented in Table 7.

Table 7. SCI-GROW Input Parameters

Model Input Parameters	Input Value	Comments	Source
Aerobic Soil Metabolism $t_{1/2}$	24 days	Average value	MRID 41586001
K_{OC}	25 [1]	More than 3 fold variation. Use lowest value [2]	MRID 42596903 MRID 40555801 MRID 44239601
Application Rate	4 lbs ae/acre	Rangeland/Pasture	Label
Max. Number of Application Per Season	1 application	1	Label

1- From all acceptable and supplemental adsorption/desorption data including Koc values of 157, 60, 38, and 95 from MRID 42596903; 67, 25, 65, and 85 from MRID 40555801; and 52, 31, 59, 50, and 41 from MRID 44239601.
2- From ("*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002.

Uncertainty

The drinking water assessment for MCPA relied on both an analysis of monitoring data and modeling to predict potential concentrations to which humans may be exposed. There are uncertainties in this assessment for both types of analysis.

Modeling relies on estimated fate parameters and assumed agricultural practices to predict exposure to MCPA. In this instance, the environmental fate database of studies is essentially complete. Although terrestrial field dissipation studies were deemed supplemental, they are upgradable. Sufficient information was available to estimate all fate parameters required as model inputs for both PRZM/EXAMS and SCIGROW. However, the data set is limited to those studies submitted and therefore to insure that an EEC which is protective of all populations is predicted, many of the model inputs used in this assessment were estimated at the upper 90^{th} percentile in accordance with EFED guidance. In the case of MCPA, the model inputs for aerobic soil metabolism, anaerobic soil metabolism, and anaerobic aquatic metabolism were all based on a single value. This limitation on the number of data with which to estimate model inputs lends uncertainty to the EECs modeled.

PRZM/EXAMS requires information on agricultural practices as inputs. In the case of PRZM/EXAMS, the model requires a specific application date and rate to be applied for a number of scenarios. In reality, application dates and rates actually applied across the United States will vary depending on geography, pest pressure, climatic factors, and changes in agricultural cropping patterns. EFED attempts to capture some of this variability by modeling as many representative scenarios as possible and by using meteorological data which covers a time span sufficient to capture climatic variations which are likely to occur. However, the model is limited in its ability to capture all of the natural variation which occurs for any pesticide application and this adds uncertainty to the exposure assessment.

Finally, no degradates have been included in this assessment at this time. No environmental fate data or monitoring data are currently available for any of the degradates of MCPA that were identified.

No surface water or groundwater monitoring studies which specifically targeted MCPA use were available for analysis as part of this assessment. EFED has also relied on an evaluation of monitoring data for MCPA collected by others. Each monitoring data set evaluated in this drinking water assessment was collected with a different study objective. The NAWQA data represents surface-water and groundwater concentrations collected on a national basis with an emphasis on high agricultural use areas. Typically, STORET data represent a compilation of several studies, each with different objectives and quality of data, both of which add uncertainty to the use of these data. The USGS/EPA Reservoir Pilot Monitoring study represents raw and treated water from twelve different states but is not targeted to MCPA use. Analysis of MCPA by community water systems (CWS) is not required and therefore no data from the National Contaminant Occurrence Database (NCOD) is available for this assessment.

MCPA, a herbicide used on multiple crop and non-crop uses over a wide geographic range, has been frequently detected in surface water and groundwater. However, as noted in the vulnerability assessment, many of the sample locations from the monitoring data evaluated were not targeted to areas of highest MCPA use. Consequently, extrapolation of concentrations of MCPA in groundwater and surface water from these data may not be representative of concentrations in all areas of highest MCPA use.

The frequency of sampling from the monitoring data evaluated also adds uncertainty to this assessment. Estimates from monitoring data of acute exposure have varying sample frequencies and it is unclear what affect this has on peak estimates from monitoring data. Therefore, it is likely that the monitoring data has not captured the maximum peak concentration from the locations sampled. This fact, coupled with the fact that monitoring data are not targeted to MCPA use areas, adds uncertainty to the estimation of EECs from the monitoring data.

The runoff and leaching vulnerability schemes used in this assessment were adapted from a vulnerability scheme developed by the USDA (Kellogg et al, 1998). USDA identified several caveats to be considered when using this vulnerability scheme which could contribute to the uncertainty associated with this assessment. Among these are that estimates of runoff and leaching vulnerability are estimated through the use of algorithms (i.e. they represent estimates of vulnerability and not actual field measurements), fate and transport processes (i.e. dilution and recharge) are not included, farm management practices are not considered, and some watershed estimates are based on major crops only. The effect of these factors on the vulnerability assessment is unknown.

The use of MCPA is not the only source of MCPA in the environment. Another source is the phenoxy herbicide, MCPB, which degrades to MCPA. An analysis of the use patterns (Figure 13) from the data collected by Thelin and Gianessi (USGS Open-File Report 00-250) indicates that while MCPB is not used in the highest MCPA use areas, there is geographic overlap between the two uses. It is likely that some percentage of the MCPA detected in surface water and groundwater monitoring data may result from degradation of MCPB to MCPA. There are insufficient data to determine what impact the degradation of MCPB to MCPA has on an evaluation of monitoring data, adding more uncertainty to this assessment.

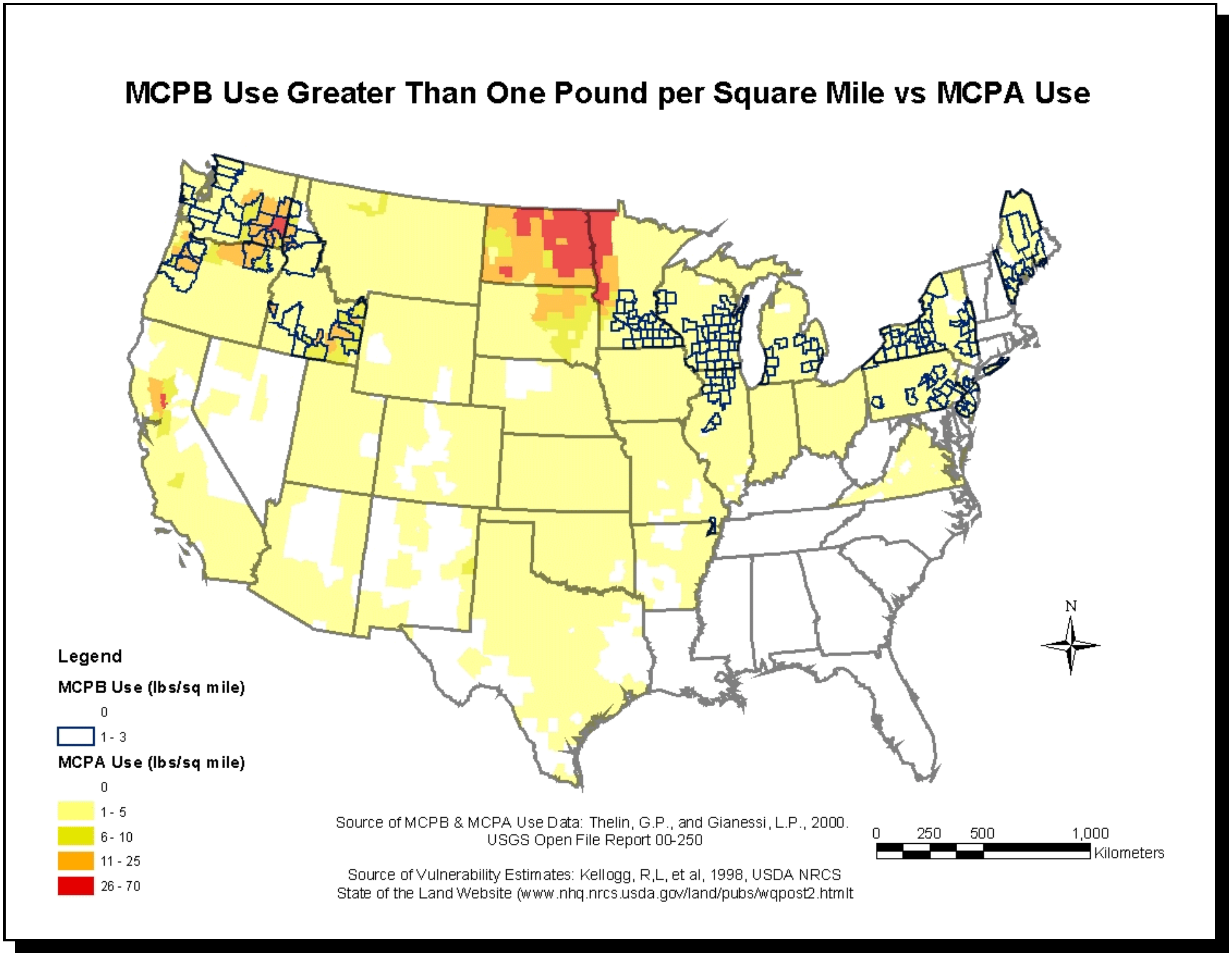

Figure 13. Analysis of MCPB versus MCPA use patterns using County Level Use Data from Thelin and Gianessi, 2000

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Date: June 24, 2003
Chemical: MCPA
PC Code: 030501, 030502, 0303516, 030564
DP Barcode: D286079

Subject: **Addendum to the Drinking Water Assessment for MCPA Transmitted to the Health Effects Division (HED) to Account for Use on Rice**

To: Felicia Fort
Reregistration Branch I
Health Effects Division (7509C)

Demson Fuller, Chemical Review Manager
Reregistration Branch I
Special Review and Reregistration Division (7508C)

From: Mark Corbin, Environmental Scientist
James Hetrick, Ph.D., Senior Physical Scientist
Environmental Risk Branch 1
Environmental Fate and Effects Division (7507C)

Approved By: Pat Jennings, Risk Assessment Process Leader (RAPL)
Sid Abel, Branch Chief
Environmental Risk Branch I
Environmental Fate and Effects Division (7507C)

Summary

This memorandum is an addendum to the Drinking Water Assessment issued April 9, 2003 (D286079) for use of 2-methyl-4-chlorophenoxyacetic acid (MCPA) on terrestrial crops and incorporates the use of MCPA on rice. Although the MCPA Task Force has indicated that the rice use of MCPA will not be supported, an end use product is currently registered for rice and the Special Review and Reregistration Division (SRRD) has determined that the rice use should be included in the Reregistration Eligibility Decision (RED) risk assessment for MCPA. Therefore, the Environmental Fate and Effects Division (EFED) prepared this assessment to predict MCPA concentrations in surface source drinking water impacted from rice tailwater releases.

MCPA concentrations in surface source drinking water impacted from rice production were estimated using an interim screening level model developed by EFED. A description of the screening level rice model may be found in the EFED policy memorandum dated October 29, 2002 (Appendix A). Model simulation of the maximum seasonal MCPA application rate of 1.25 pounds ae/A results in a screening

level peak and chronic drinking water concentration of **1222 ug/l**. This value is expected to represent a bounding concentration for peak and annual average drinking water concentrations for MCPA because the model represents an edge of paddy concentration rather than an actual concentration at a drinking water utility. Additionally, the model does not account for degradation, dilution, and dispersion of MCPA. Although, based on a Kd value or 0.6 ml/g, MCPA is expected to be highly mobile in tailwater from rice paddies, it is expected to degrade relatively rapidly in soil and be fairly persistent in aquatic environments. As expected, the estimated MCPA concentration from the interim model is higher than concentrations detected in the surface water monitoring data evaluated as part of this assessment. The highest concentration of MCPA detected in surface water was 18.58 ug/l from the NAWQA data.

To assess the likelihood of exposures to MCPA in surface water, an analysis of the use pattern and rice acreage relative to sources of drinking water supplied by surface water was conducted. Not that, of the states where rice is grown (i.e. Arkansas, Mississippi, Missouri, Louisiana, Texas, and California) direct evidence of potential exposures of humans from ingestion of drinking water from facilities located downstream of where MCPA is used on rice is available only for California. Figure 1 presents the total extent of the use of MCPA using data from Thelin and Gianessi, 2000. This figure indicates that the highest areas of MCPA use are in the upper Great Plains, eastern Washington state, and the northern San Joaquin Valley. Figure 2 presents the location of rice acreage taken from the U.S. Department of Agriculture (USDA) 1997 Census of Agriculture (Ag Census) relative to surface water intakes for community water systems (CWS). The data presented in figure 2 indicate that rice is grown primarily in Arkansas, Mississippi, Missouri, Louisiana, Texas, and California.

There are an undetermined number of people served by drinking water facilities which are within and downstream from rice growing areas, including certain basins in California and southeast Texas. The area with highest potential for exposure to pesticides applied to rice is in the San Joaquin Valley in California with several intakes located downstream near Sacramento. There is also substantial rice culture in Louisiana, Arkansas, Mississippi, and Missouri, but there are few surface water source drinking water facilities identified downstream from rice cultural areas in these states.

In order to complete a more detailed analysis, EFED reviewed the "Summary of Pesticide Use Report Data 2001 Indexed by Commodity" prepared by the California Department of Pesticide Regulation (CDPR) dated October 2002. The CDPR report indicates that a total of 12,660 pounds of MCPA was used on 45,766 acres of rice statewide. Figure 3 presents CDPR county level use data for MCPA on rice and indicates that MCPA rice use was centered on the counties of Butte, Glenn, and Sutter with lesser amounts in Colusa, Merced, Stanislaus, Placer, and Yuba counties. MCPA was detected in surface water from NAWQA in several locations within and downstream of these counties with a maximum concentration of **0.94 ug/l**. A time weighted annual mean (TWM) concentration of **0.18 ug/l** was calculated for this site (station # 11390890 at Colusa Basin Dr A Rd 99E Near Knights Landing, California) for 1997. However, this analysis also indicates that there are several CWS surface water intakes in the high use counties of Butte, Glenn, and Sutter which may be closer to the MCPA rice use and therefore have a higher potential for human exposure to MCPA from ingestion of drinking water from facilities located downstream of where MCPA is used on rice. An important point to note about rice use in California is that the state requires that tailwater be held for 24 hours prior to release although this may not be significant for MCPA given its relatively persistent nature in aquatic environments.

Unlike California, there are no data indicating how much of the MCPA used in Arkansas, Mississippi, Missouri, Louisiana, and Texas is applied to rice. Figure 4 shows where MCPA is used relative to rice acreage and indicates that there may be some rice use of MCPA in these areas. This analysis also indicates that the potential for exposure of humans from ingestion of MCPA in drinking water from use on rice in these areas is low due to the fact that there are no CWS surface water intakes in the high rice acreage areas of eastern Arkansas and southwest Louisiana. There are a few CWS intakes in central Arkansas and southeast Texas, however there is less MCPA used in general in these areas.

Figure 5 presents the location of all rice acreage relative to NAWQA surface water sites. The data presented suggests that there are NAWQA surface water locations in areas of high rice acreage. The maximum detected concentration of MCPA in NAWQA surface water data, 18.58 ug/l, was at the Clinton River location at Sterling Heights, Michigan. Figure 6 presents the maximum concentration of MCPA in surface water from NAWQA. This suggests that there are detections occurring in areas of rice acreage which may correlate with MCPA use. However, more data are needed to confirm this correlation between MCPA use, rice acreage and detections of MCPA in surface water analyzed from NAWQA surface water sites.

Ultimately, there is insufficient information to assess what the potential maximum exposure of humans from ingestion of MCPA in drinking water in the rice growing regions of California, Arkansas, Mississippi, Louisiana, and Texas might be.

SCI-GROW modeling estimates the acute and chronic concentration of MCPA in shallow groundwater from use on rice at a rate of 1.25 lbs ae/acre is **0.59 ug/L**.

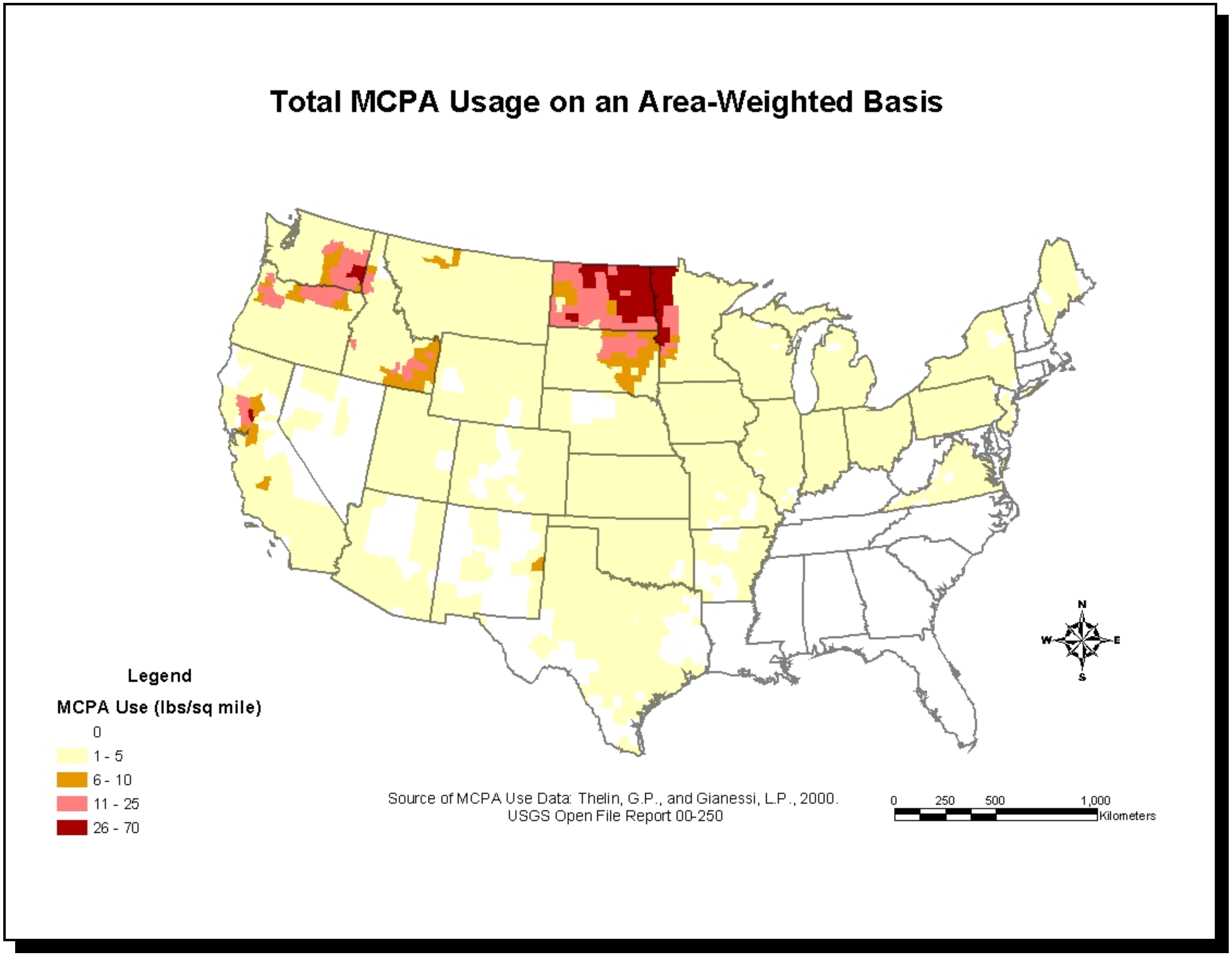

Figure 1. Total MCPA Use from Thelin and Giannesi, 2000 (USGS Open File Report 00-250)

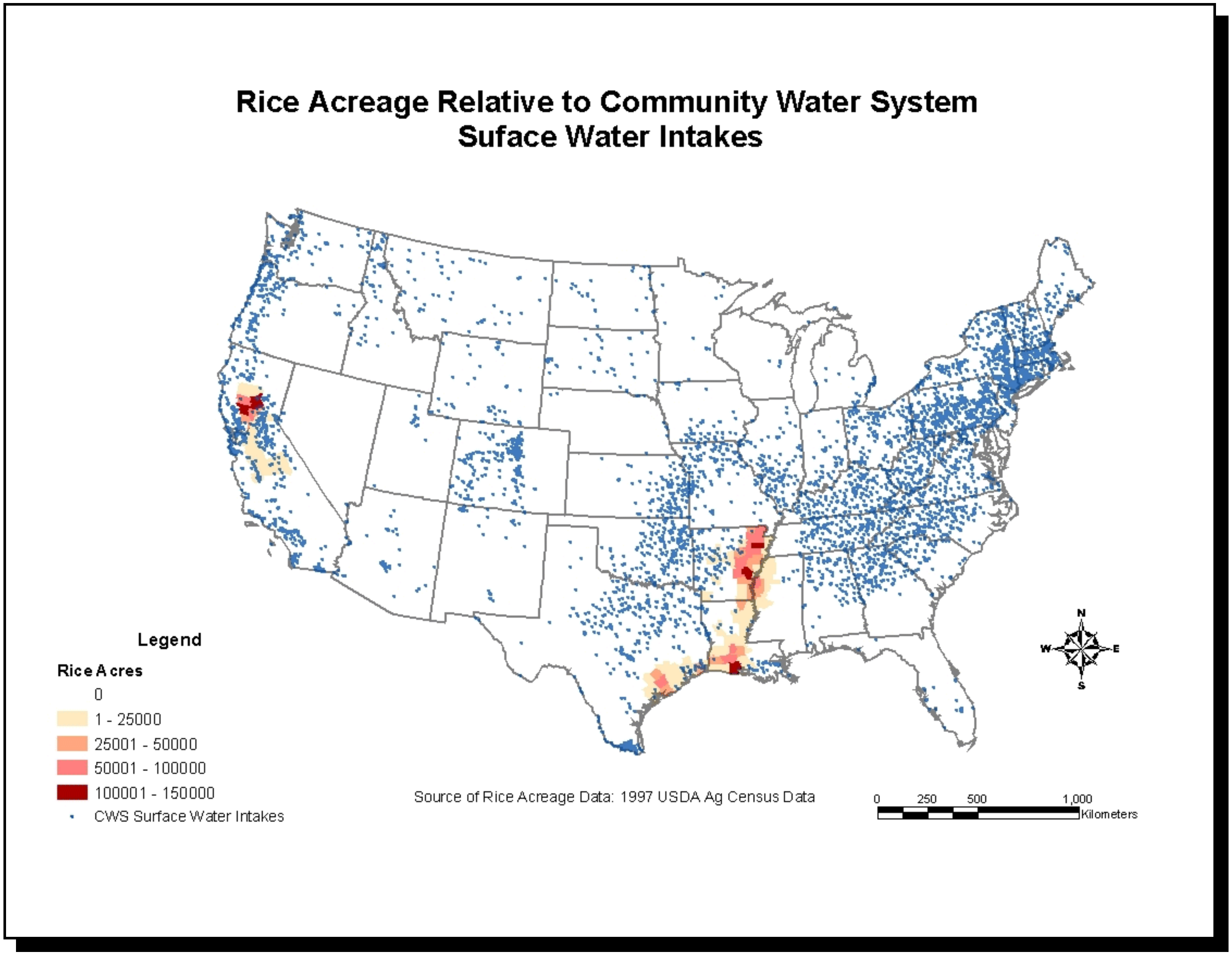

Figure 2. Total Rice Acreage Taken from USDA 1997 Agricultural Census Data Relative to Community Water System (CWS) Surface Water Intakes.

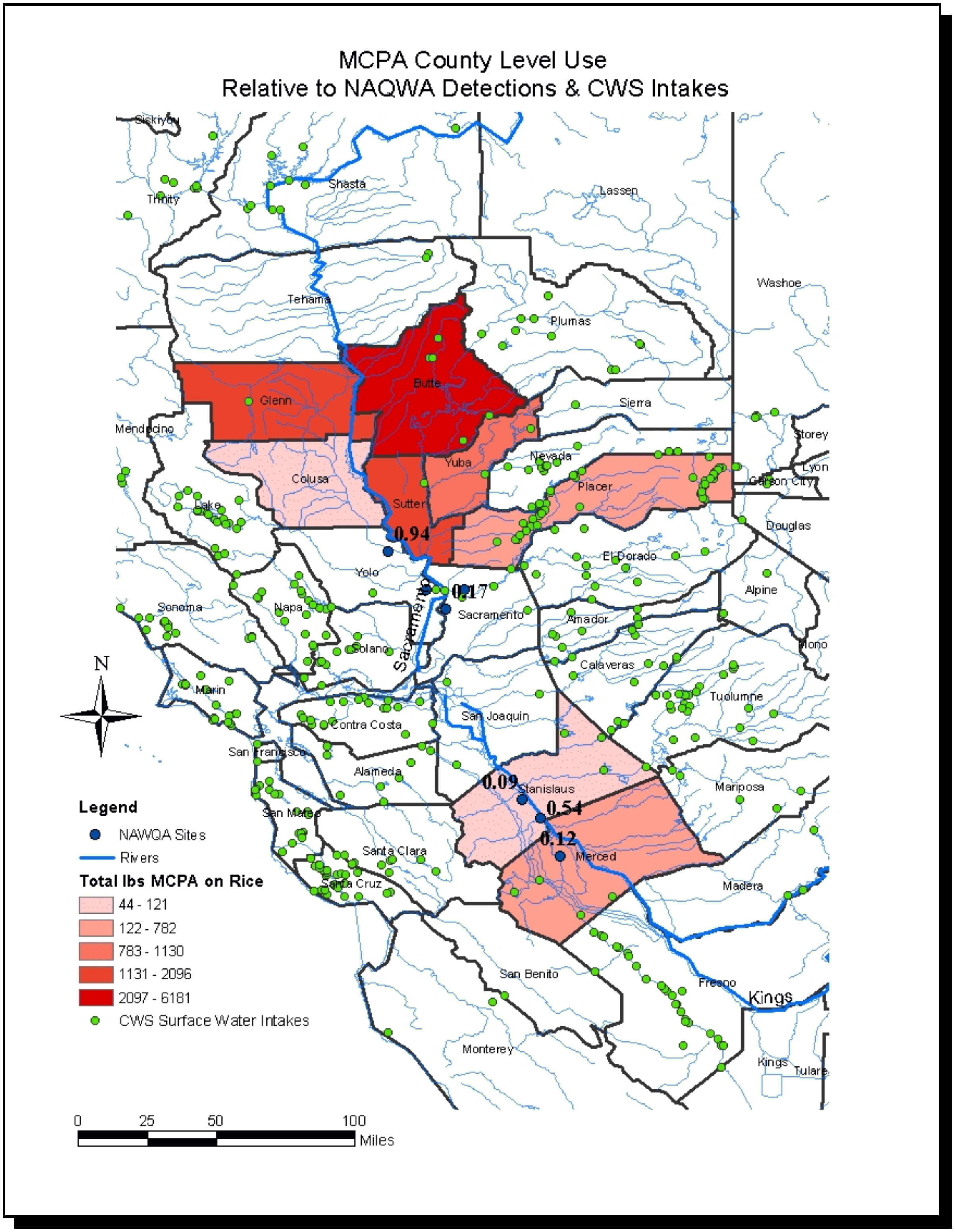

Figure 3. Total Pounds of MCPA Use on Rice by County from 2001 (CDPR, 2002) Relative to Maximum Concentrations at NAWQA Surface Water Sites.

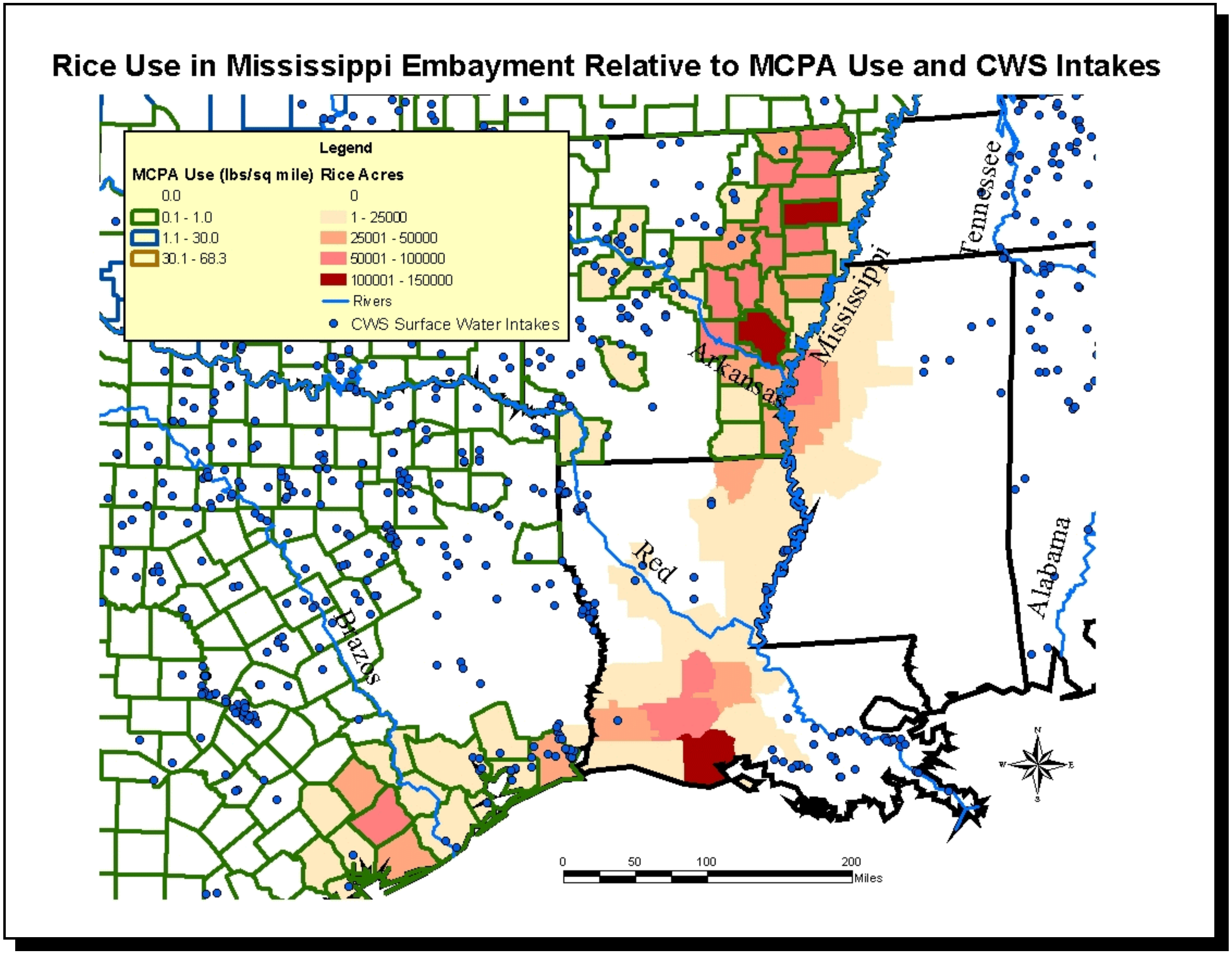

Figure 4. MCPA Use Relative to Rice Acreage and CWS Surface Water Intakes

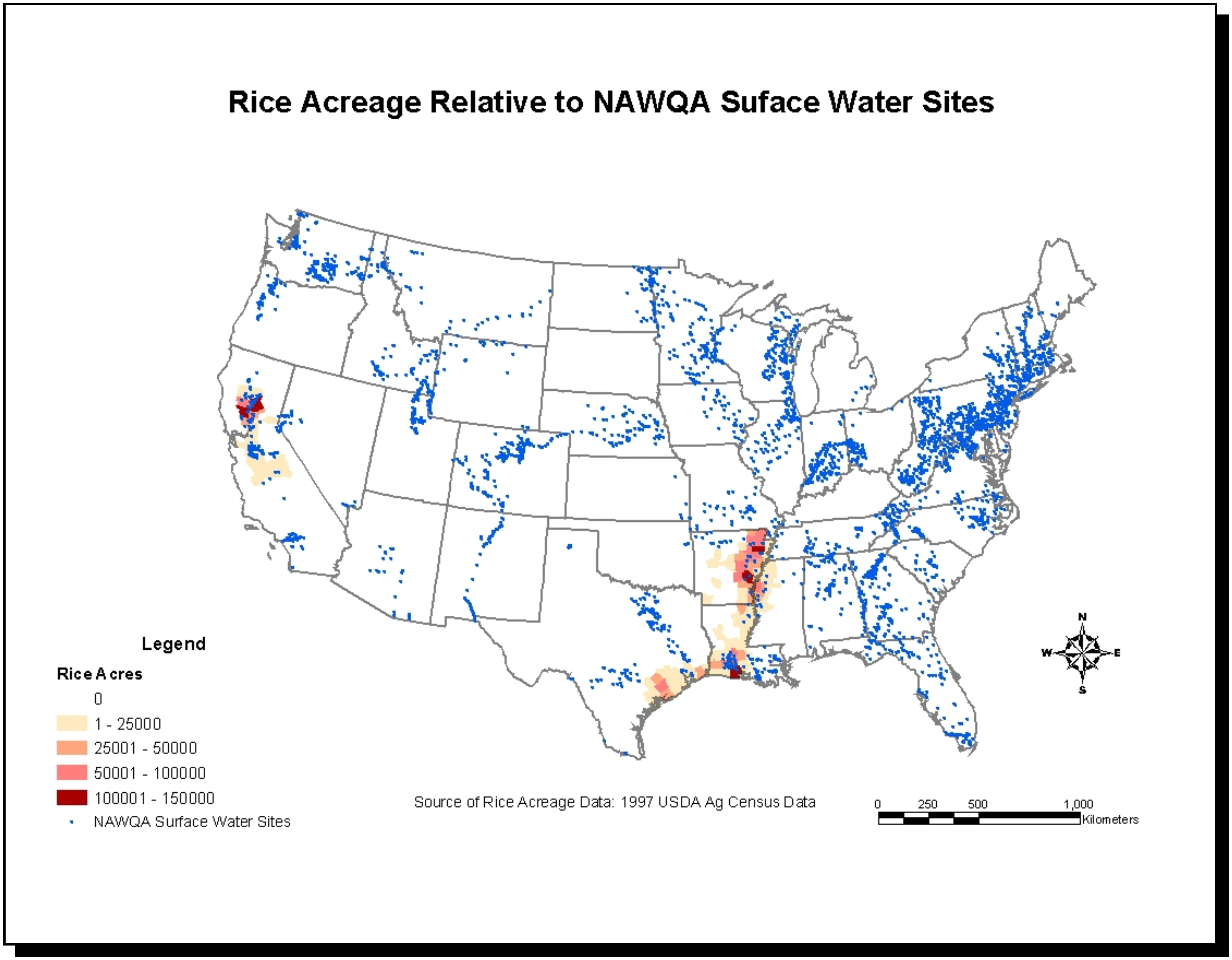

Figure 5. Total Rice Acreage Taken (USDA 1997 Ag Census) Relative to NAWQA Surface Water Sites.

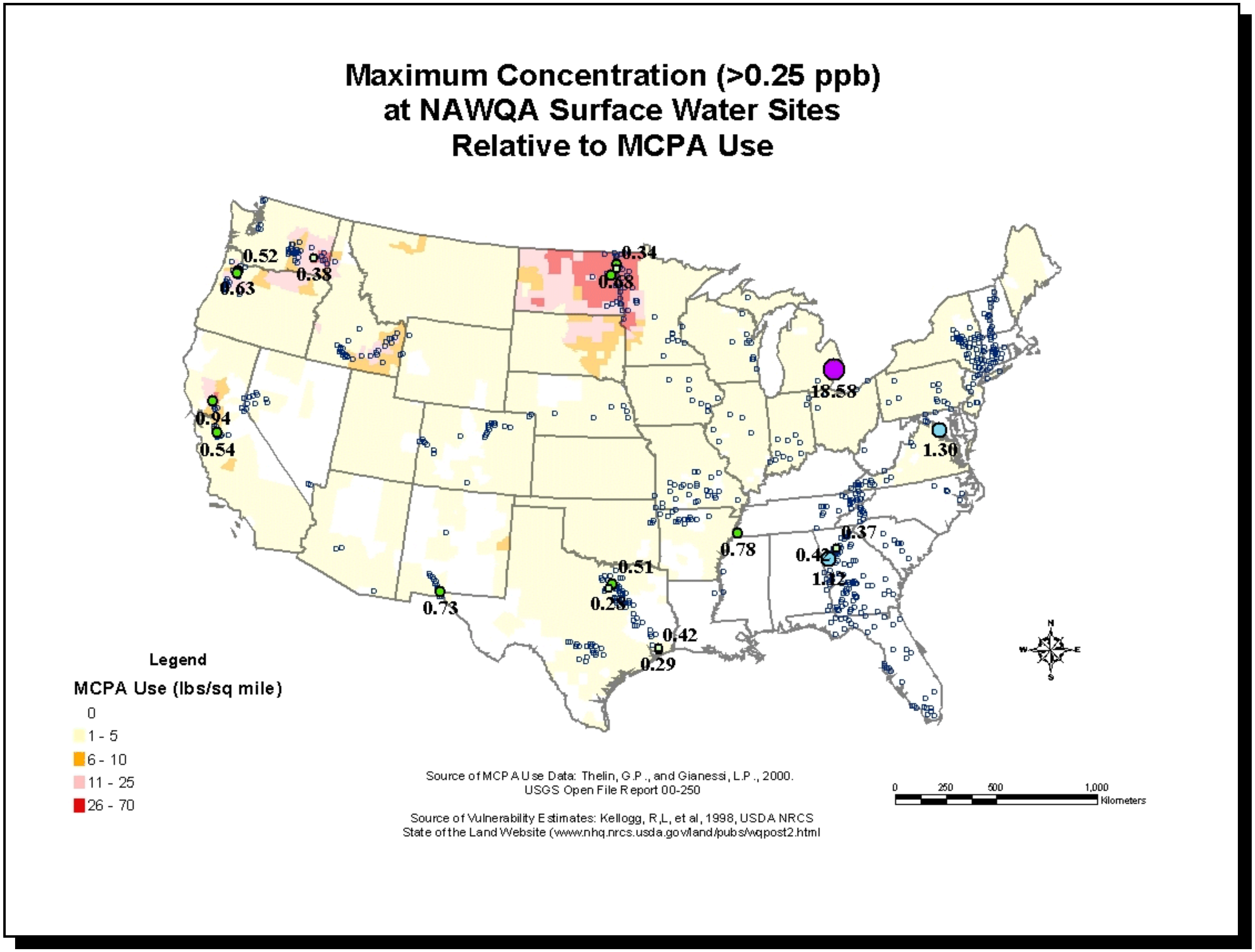

Figure 6. NAWQA Surface Water Locations with Maximum Concentrations Greater Than 0.25 ppb versus MCPA Use Information (USGS Open File Report 00-250)

APPENDIX A: EFED Policy Memorandum:
Policy for Estimating Aqueous Concentrations from Pesticides Labeled for Use on Rice Dated October 29, 2002

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

EFED POLICY MEMORANDUM October 29, 2002

SUBJECT: Policy for Estimating Aqueous Concentrations from Pesticides Labeled for Use on Rice

FROM: Steven Bradbury, Acting Director
Environmental Fate and Effects Division 7507C
Office of Pesticide Programs

TO: Environmental Fate and Effects Division
Office of Pesticide Programs

A number of pesticides used in rice agriculture require ecological and human health risk assessments. A method to estimate the concentrations of these pesticide in water is necessary to support these assessments for new pesticides, new uses for pesticides that are already registered and reregistration decisions. The policy and method described in the attachment provides an approach to estimate these concentrations for screening level assessments.

This method is a first effort to estimate aqueous concentrations from rice culture until more refined methods can be implemented at both the Tier 1 and Tier 2 levels. The attached policy represents a reasonable interim approach to ensure consistent estimates in Division risk assessments and I ask that this methodology be implemented immediately. As advances are developed and reviewed, updates will be released and implemented.

Attachment: Calculation for Estimating Pesticide Concentrations in Water From Pesticide Application to Rice Paddies

Calculation for Estimating Pesticide Concentrations in Water From Pesticide Application to Rice Paddies

October 29, 2002

This policy establishes a method for calculating estimated environmental concentrations (EEC's) for the use of pesticides in rice paddies. This is intended to be an interim measure until a more complete rice modeling method becomes available. EEC's are estimated by applying the total annual application to the paddy and partitioning the pesticide between the water and the paddy sediment according to a linear or K_d partitioning model. The EEC (μg. L^{-1}) represents the dissolved concentration occurring in the water column and the concentration in water released from the paddy. Movement of pesticide on suspended sediment is not considered. The equation to use for this calculation is:

$$EEC = \frac{10^9 M_T}{V_T + m_{sed} K_d}$$

where M_T is the total mass of pesticide in kg applied per ha of paddy, V_T is 1.067 x10^6 L ha^{-1} which is the volume of water in a paddy 4 inches (10.16 cm) deep, and includes the pore space in a 1 cm sediment interaction zone. The mass of sediment, m_{sed}, is the amount found in the top 1 cm interaction zone and is 130,000 kg ha^{-1} when the sediment bulk density was assumed to be 1.3 kg L^{-1}, a standard assumption for the bulk density of surface horizons of mineral soils (Brady, 1984; Hillel, 1982). The 10^9 constant converts the units of mass from kg to μg. For chemicals that have a valid K_{oc}, the K_d can be calculated using a sediment carbon content of 2% (K_{oc}*0.02). An organic carbon content of 2% represents a typical value for a high clay soil that might be used to grow rice in the Mississippi Valley or gulf coast regions. Both K_d and K_{oc} should be estimated according to the methods recommended for other surface water models in EFED's Input Parameter Guidance (USEPA, 2002).

The EEC's estimated should be used for both acute and chronic EEC's as well as for both aquatic ecological risk assessments and for drinking water exposure in human health risk assessments. The EEC's calculated by this method are screening estimates and as such are expected to exceed the true values found in the environment the great majority of the time. Based on preliminary assessment of rice monitoring data, predicted pesticide concentrations as derived above (assuming a 1 cm sediment interaction zone) exceed the observed peak pesticide concentrations (Figures 1 and 2). These EEC's are expected to exceed the concentrations measured in the paddy, because degradation processes and dilution with uncontaminated water outside the paddy is not considered.

It is worth emphasizing that the result of this calculation does not represent a concentration that we would expect to find in drinking water, as it represents paddy discharge water. Rather, it represents an upper bound on the drinking water concentrations, and is therefore suitable for use in screening assessments. The concentrations found at drinking water facilities impacted by rice culture would be expected to be less than this value (in some cases much less) because of the aforementioned degradation processes, dilution by water from areas in the basin not in rice culture, and the fact that in most cases less than 100% of the rice paddies in a specific area will be treated with the pesticide.

When the level of concern in a risk assessment is not exceeded using an EEC calculated by this

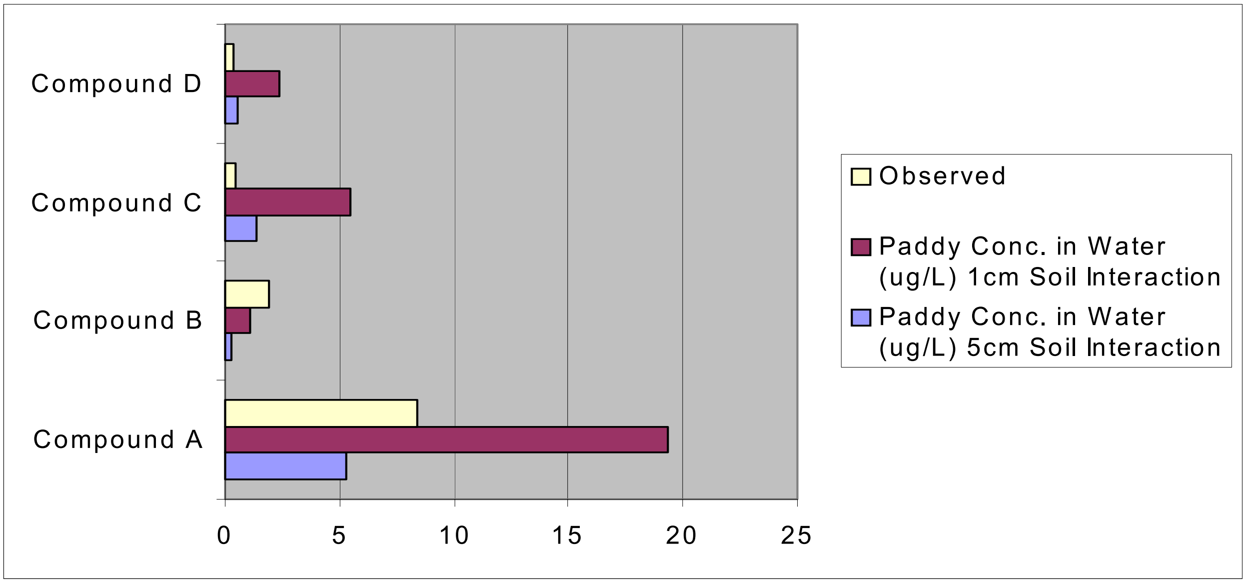

Figure 1. Comparison of Predicted and Observed Water Concentrations for A Rice Pesticide and Its Degradation Products

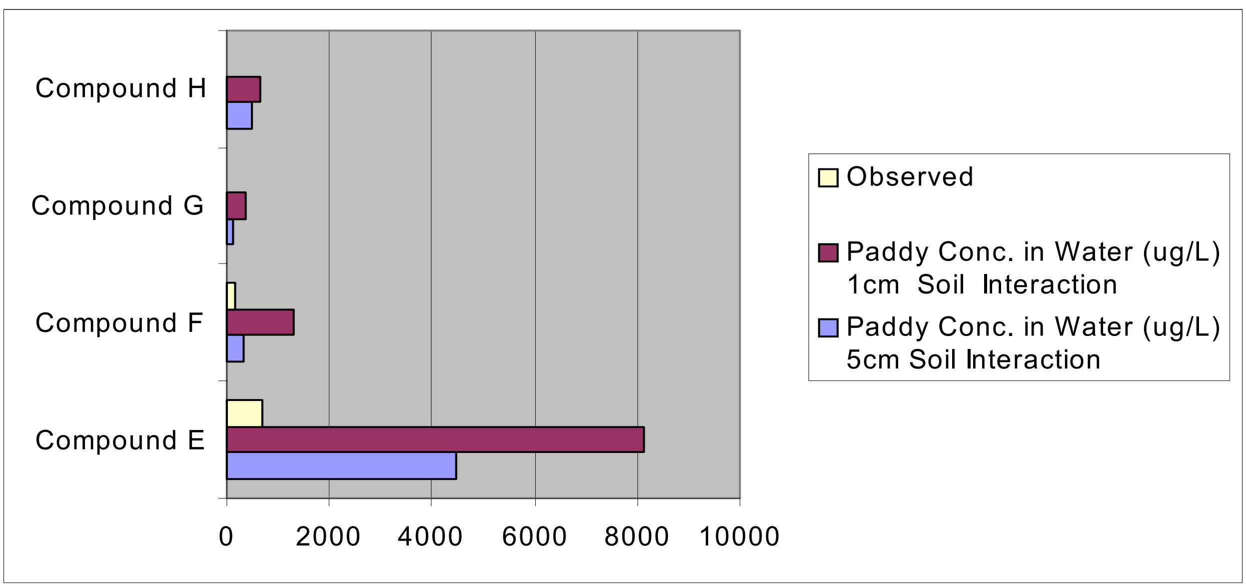

Figure 2. Comparison of Predicted and Observed Water Concentrations for Rice Pesticides

screening method, there is high confidence that there will be little or no risk above the level of concern from exposure through water resources. However, because of the uncertainties associated with this method, when a level of concern is exceeded it cannot be determined whether the exceedance will in fact occur or whether this method has overestimated the exposure. While this method is conservative it does represent the exposure experience by aquatic organisms whose habitat lies close to the discharge from the paddies during and shortly after discharge.

The size of the area and length of time for which the estimate is reasonable depends upon how fast the pesticide degrades, the rate of removal onto uncontaminated bed sediments, and the nature of the local stream network.. EFED is working to develop more refined methods for drinking water estimation for rice pesticides. To further characterize the nature of the risk for a particular chemical, it is necessary to have information on the specific agronomic practices for that use, dissipation rates in the environment (degradation, volatilization, dilution), and site specific pesticide usage data. For drinking water, there are a undetermined number of people on drinking water facilities which are downstream from rice growing areas. These areas would includes certain basins in California, Texas, and Louisiana. There is also substantial rice culture in Arkansas, Mississippi, and Missouri, but there are no identified surface water source drinking water facilities downstream from rice cultural areas in these states.

Literature Cited

Brady, Nyle C. 1984. **The Nature and Properties of Soils, Ninth Edition.** Macmillan Publishing Company, New York.

Hillel, Daniel. 1982. **Introduction to Soil Physics.** Academic Press. Orlando, Florida.

United States Environmental Protection Agency. 2002. **Water Models; Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides. Version II. February 28, 2002**. http://www.epa.gov/oppefed1/models/water/input_guidance2_28_02.htm.

APPENDIX C: PRZM/EXAMS Input & Output Files for Ecological Assessment

Input/Output Files for PRZM/EXAMS Scenarios - Acid Equivalents

```
CAalfalf.txt – California central valley alfalfa 14Aug2001
"Central valley of California MLRA17, Metfile: W93193.dvf (old: Met18.met or Met17.met), San Joaquin county"
*** Record 3:
   0.73    0.45       0      15       1       1
*** Record 6 -- ERFLAG
      4
*** Record 7:
    0.2    0.19       1      10              1       2     354
*** Record 8
      1
*** Record 9
      1    0.25      60     100       1  90  88  89       0      45
*** Record 9a-d
      1      24
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108 1608
.068 .076 .092 .099 .147 .175 .193 .212 .221 .217 .208 .197 .180 .163 .155 .154
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
0109 1609 0110 1610 0111 1611 0112 1612
.161 .170 .180 .188 .046 .051 .056 .061
.023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
     30
*** Record 11
  100161  281261  311261       1
  100162  281262  311262       1
  100163  281263  311263       1
  100164  281264  311264       1
  100165  281265  311265       1
  100166  281266  311266       1
  100167  281267  311267       1
  100168  281268  311268       1
  100169  281269  311269       1
  100170  281270  311270       1
  100171  281271  311271       1
  100172  281272  311272       1
  100173  281273  311273       1
  100174  281274  311274       1
  100175  281275  311275       1
  100176  281276  311276       1
  100177  281277  311277       1
  100178  281278  311278       1
  100179  281279  311279       1
  100180  281280  311280       1
  100181  281281  311281       1
  100182  281282  311282       1
  100183  281283  311283       1
  100184  281284  311284       1
  100185  281285  311285       1
  100186  281286  311286       1
  100187  281287  311287       1
  100188  281288  311288       1
  100189  281289  311289       1
  100190  281290  311290       1
```

```
*** Record 12 -- PTITLE
MCPA - 1 applications @ 4.48 kg/ha
*** Record 13
     30       1       0       0
*** Record 15 -- PSTNAM
MCPA
*** Record 16
  010261  0 2  0.0  4.48 0.95 0.05
  010262  0 2  0.0  4.48 0.95 0.05
  010263  0 2  0.0  4.48 0.95 0.05
  010264  0 2  0.0  4.48 0.95 0.05
  010265  0 2  0.0  4.48 0.95 0.05
  010266  0 2  0.0  4.48 0.95 0.05
  010267  0 2  0.0  4.48 0.95 0.05
  010268  0 2  0.0  4.48 0.95 0.05
  010269  0 2  0.0  4.48 0.95 0.05
  010270  0 2  0.0  4.48 0.95 0.05
  010271  0 2  0.0  4.48 0.95 0.05
  010272  0 2  0.0  4.48 0.95 0.05
  010273  0 2  0.0  4.48 0.95 0.05
  010274  0 2  0.0  4.48 0.95 0.05
  010275  0 2  0.0  4.48 0.95 0.05
  010276  0 2  0.0  4.48 0.95 0.05
  010277  0 2  0.0  4.48 0.95 0.05
  010278  0 2  0.0  4.48 0.95 0.05
  010279  0 2  0.0  4.48 0.95 0.05
  010280  0 2  0.0  4.48 0.95 0.05
  010281  0 2  0.0  4.48 0.95 0.05
  010282  0 2  0.0  4.48 0.95 0.05
  010283  0 2  0.0  4.48 0.95 0.05
  010284  0 2  0.0  4.48 0.95 0.05
  010285  0 2  0.0  4.48 0.95 0.05
  010286  0 2  0.0  4.48 0.95 0.05
  010287  0 2  0.0  4.48 0.95 0.05
  010288  0 2  0.0  4.48 0.95 0.05
  010289  0 2  0.0  4.48 0.95 0.05
  010290  0 2  0.0  4.48 0.95 0.05
*** Record 17
      0       1       0
*** Record 18
      0       0     0.5
*** Record 19 -- STITLE
"Sacramento clay, Hyd grp D"
*** Record 20
    176           0   0   0   0   0   2   0   0   0
*** Record 26
      0       0       0
*** Record 27 -- irrigation
      1     0.1    0.55     0.4
*** Record 33
      4
      1      10    1.43    0.42       0       0       0
       0.0096270.009627       0
```

```
        0.1    0.42    0.36    1.77     0.6
    2       8    1.43    0.42       0       0       0
     0.0096270.009627       0
          4    0.42    0.36    1.77     0.6
    3     157    1.29    0.44       0       0       0
     0.0096270.009627       0
       15.7    0.44    0.36    0.84     0.6
    3       1    1.48    0.39       0       0       0
     0.0096270.009627       0
          1    0.39     0.3    0.84     0.6
***Record 40
    0
       YEAR      10           YEAR      10           YEAR      10   1
    1
    1  -----
    7    YEAR
  PRCP    TCUM   0   0
  RUNF    TCUM   0   0
  INFL    TCUM   1   1
  ESLS    TCUM   0   0  1.0E3
  RFLX    TCUM   0   0  1.0E5
  EFLX    TCUM   0   0  1.0E5
  RZFX    TCUM   0   0  1.0E5
```

KSSorghum; 10/09/02
Osage County in MLRA 112; County nearest weather station Topeka (W13996) and still in MLRA 112 (East Central KS); Metfile: W13996.dvf, (old metfile: Met112.met)

```
*** Record 3:
   0.73     0.3       0      17       1       3
*** Record 6 -- ERFLAG
      4
*** Record 7:
   0.43   0.264       1      10              3       4     354
*** Record 8
      1
*** Record 9
      1     0.1     120     100       3  89  86  87       0     120
*** Record 9a-d
      1      26
0101 1601 0102 1602 0103 1603 0104 1604 0105 0505 1605 2005 0106 1606 0107 1607
.161 .163 .165 .168 .174 .185 .199 .217 .231 .372 .425 .449 .448 .385 .224 .117
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.076 .076 .078 .186 .194 .171 .162 .171 .175 .178
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
     30
*** Record 11
  200561  200961  011061       1
  200562  200962  011062       1
  200563  200963  011063       1
  200564  200964  011064       1
  200565  200965  011065       1
  200566  200966  011066       1
  200567  200967  011067       1
  200568  200968  011068       1
  200569  200969  011069       1
  200570  200970  011070       1
  200571  200971  011071       1
  200572  200972  011072       1
  200573  200973  011073       1
  200574  200974  011074       1
  200575  200975  011075       1
  200576  200976  011076       1
  200577  200977  011077       1
  200578  200978  011078       1
  200579  200979  011079       1
  200580  200980  011080       1
  200581  200981  011081       1
  200582  200982  011082       1
  200583  200983  011083       1
  200584  200984  011084       1
  200585  200985  011085       1
  200586  200986  011086       1
  200587  200987  011087       1
  200588  200988  011088       1
  200589  200989  011089       1
```

```
  200590  200990  011090       1
*** Record 12 -- PTITLE
MCPA - 1 applications @ 0.84 kg/ha
*** Record 13
     30       1       0       0
*** Record 15 -- PSTNAM
MCPA
*** Record 16
  150661  0 2  0.0  0.84 0.95 0.05
  150662  0 2  0.0  0.84 0.95 0.05
  150663  0 2  0.0  0.84 0.95 0.05
  150664  0 2  0.0  0.84 0.95 0.05
  150665  0 2  0.0  0.84 0.95 0.05
  150666  0 2  0.0  0.84 0.95 0.05
  150667  0 2  0.0  0.84 0.95 0.05
  150668  0 2  0.0  0.84 0.95 0.05
  150669  0 2  0.0  0.84 0.95 0.05
  150670  0 2  0.0  0.84 0.95 0.05
  150671  0 2  0.0  0.84 0.95 0.05
  150672  0 2  0.0  0.84 0.95 0.05
  150673  0 2  0.0  0.84 0.95 0.05
  150674  0 2  0.0  0.84 0.95 0.05
  150675  0 2  0.0  0.84 0.95 0.05
  150676  0 2  0.0  0.84 0.95 0.05
  150677  0 2  0.0  0.84 0.95 0.05
  150678  0 2  0.0  0.84 0.95 0.05
  150679  0 2  0.0  0.84 0.95 0.05
  150680  0 2  0.0  0.84 0.95 0.05
  150681  0 2  0.0  0.84 0.95 0.05
  150682  0 2  0.0  0.84 0.95 0.05
  150683  0 2  0.0  0.84 0.95 0.05
  150684  0 2  0.0  0.84 0.95 0.05
  150685  0 2  0.0  0.84 0.95 0.05
  150686  0 2  0.0  0.84 0.95 0.05
  150687  0 2  0.0  0.84 0.95 0.05
  150688  0 2  0.0  0.84 0.95 0.05
  150689  0 2  0.0  0.84 0.95 0.05
  150690  0 2  0.0  0.84 0.95 0.05
*** Record 17
      0       1       0
*** Record 18
      0       0     0.5
*** Record 19 -- STITLE
Dennis Silt Loam; Benchmark Soil, Hydrologic Group C
*** Record 20
    120           0   0   0   0   0   0   0   0   0
*** Record 26
      0       0       0
*** Record 33
      4
      1      10    1.55   0.247       0       0       0
       0.0096270.009627       0
            0.1   0.247   0.097    1.74     0.6
```

```
    2    24   1.55   0.247     0     0     0
     0.0096270.009627     0
         2   0.247   0.097   1.74    0.6
    3    10    1.6   0.316     0     0     0
     0.0096270.009627     0
         5   0.316   0.166   0.174    0.6
    4    76    1.6   0.348     0     0     0
     0.0096270.009627     0
         2   0.348   0.198   0.116    0.6
***Record 40
    0
       YEAR     10          YEAR     10          YEAR     10   1
    1
    1  -----
    7   YEAR
  PRCP   TCUM   0   0
  RUNF   TCUM   0   0
  INFL   TCUM   1   1
  ESLS   TCUM   0   0  1.0E3
  RFLX   TCUM   0   0  1.0E5
  EFLX   TCUM   0   0  1.0E5
  RZFX   TCUM   0   0  1.0E5
```

```
MN Alfalfa; 8/16/2001
"Red River Valley; Polk County, MN; MLRA: 56, Metfile: W14914.dvf (old: Met 56.met),
*** Record 3:
   0.75     0.5       0      12       1       1
*** Record 6 -- ERFLAG
      4
*** Record 7:
   0.28    0.17     0.5      10              3     1.5     354
*** Record 8
      1
*** Record 9
      1    0.25     100     100       3  85  81  83       0      50
*** Record 9a-d
      1      26
0101 1601 0102 1602 0103 1503 1603 0104 1604 0105 1605 0106 1506 1606 0107 1607
.009 .009 .009 .009 .009 .010 .007 .003 .001 .005 .002 .001 .005 .004 .002 .001
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.004 .002 .002 .003 .006 .008 .008 .008 .008 .008
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110
*** Record 10 -- NCPDS, the number of cropping periods
     30
*** Record 11
  270561  250861  300861       1
  270562  250862  300862       1
  270563  250863  300863       1
  270564  250864  300864       1
  270565  250865  300865       1
  270566  250866  300866       1
  270567  250867  300867       1
  270568  250868  300868       1
  270569  250869  300869       1
  270570  250870  300870       1
  270571  250871  300871       1
  270572  250872  300872       1
  270573  250873  300873       1
  270574  250874  300874       1
  270575  250875  300875       1
  270576  250876  300876       1
  270577  250877  300877       1
  270578  250878  300878       1
  270579  250879  300879       1
  270580  250880  300880       1
  270581  250881  300881       1
  270582  250882  300882       1
  270583  250883  300883       1
  270584  250884  300884       1
  270585  250885  300885       1
  270586  250886  300886       1
  270587  250887  300887       1
  270588  250888  300888       1
  270589  250889  300889       1
  270590  250890  300890       1
```

```
*** Record 12 -- PTITLE
MCPA - 1 applications @ 4.48 kg/ha
*** Record 13
     30       1       0       0
*** Record 15 -- PSTNAM
MCPA
*** Record 16
  010661  0 2  0.0  4.48 0.95 0.05
  010662  0 2  0.0  4.48 0.95 0.05
  010663  0 2  0.0  4.48 0.95 0.05
  010664  0 2  0.0  4.48 0.95 0.05
  010665  0 2  0.0  4.48 0.95 0.05
  010666  0 2  0.0  4.48 0.95 0.05
  010667  0 2  0.0  4.48 0.95 0.05
  010668  0 2  0.0  4.48 0.95 0.05
  010669  0 2  0.0  4.48 0.95 0.05
  010670  0 2  0.0  4.48 0.95 0.05
  010671  0 2  0.0  4.48 0.95 0.05
  010672  0 2  0.0  4.48 0.95 0.05
  010673  0 2  0.0  4.48 0.95 0.05
  010674  0 2  0.0  4.48 0.95 0.05
  010675  0 2  0.0  4.48 0.95 0.05
  010676  0 2  0.0  4.48 0.95 0.05
  010677  0 2  0.0  4.48 0.95 0.05
  010678  0 2  0.0  4.48 0.95 0.05
  010679  0 2  0.0  4.48 0.95 0.05
  010680  0 2  0.0  4.48 0.95 0.05
  010681  0 2  0.0  4.48 0.95 0.05
  010682  0 2  0.0  4.48 0.95 0.05
  010683  0 2  0.0  4.48 0.95 0.05
  010684  0 2  0.0  4.48 0.95 0.05
  010685  0 2  0.0  4.48 0.95 0.05
  010686  0 2  0.0  4.48 0.95 0.05
  010687  0 2  0.0  4.48 0.95 0.05
  010688  0 2  0.0  4.48 0.95 0.05
  010689  0 2  0.0  4.48 0.95 0.05
  010690  0 2  0.0  4.48 0.95 0.05
*** Record 17
      0       1       0
*** Record 18
      0       0     0.5
*** Record 19 -- STITLE
Bearden silty clay loam; HTDG: C
*** Record 20
    100           0   0   0   0   0   0   0   0   0
*** Record 26
      0       0       0
*** Record 33
      4
      1      10     1.4   0.377       0       0       0
       0.0096270.009627       0
          0.1   0.377   0.207    1.74     0.6
      2       8     1.4   0.377       0       0       0
```

```
      0.0096270.009627      0
         0.1   0.377   0.207    1.74     0.6
     3     54     1.5   0.292      0      0      0
      0.0096270.009627      0
           1   0.292   0.132   0.116     0.6
     4     28     1.8   0.285      0      0      0
      0.0096270.009627      0
           2   0.285   0.125   0.058     0.6
***Record 40
     0
        YEAR      10           YEAR      10           YEAR      10   1
     1
     1  -----
     7   YEAR
   PRCP    TCUM   0   0
   RUNF    TCUM   0   0
   INFL    TCUM   1   1
   ESLS    TCUM   0   0  1.0E3
   RFLX    TCUM   0   0  1.0E5
   EFLX    TCUM   0   0  1.0E5
   RZFX    TCUM   0   0  1.0E5
```

North Dakota Spring Wheat MLRA F56 Cass County Bearden silty clay loam
"Red River Valley of the North MLRA 56 MN, ND, SD 1948-1983; Metfile: W14914.dvf (old: Met56.met),

```
*** Record 3:
   0.75     0.5       0      12       1       1
*** Record 6 -- ERFLAG
      4
*** Record 7:
   0.28    0.17       1      10              3     1.5     354
*** Record 8
      1
*** Record 9
      1     0.1      22     100       1  91  85  87       0     100
*** Record 9a-d
      1      28
0101 1601 0102 1602 0103 1603 0104 1604 2004 0105 0505 1605 0106 1606 0107 1607
.583 .581 .579 .577 .574 .574 .575 .575 .611 .617 .610 .562 .468 .268 .092 .064
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
0108 0508 1008 1608 0109 1609 0110 1610 0111 1611 0112 1612
.065 .036 .098 .110 .126 .139 .152 .162 .168 .170 .171 .171
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
     30
*** Record 11
  150561  250761  050861       1
  150562  250762  050862       1
  150563  250763  050863       1
  150564  250764  050864       1
  150565  250765  050865       1
  150566  250766  050866       1
  150567  250767  050867       1
  150568  250768  050868       1
  150569  250769  050869       1
  150570  250770  050870       1
  150571  250771  050871       1
  150572  250772  050872       1
  150573  250773  050873       1
  150574  250774  050874       1
  150575  250775  050875       1
  150576  250776  050876       1
  150577  250777  050877       1
  150578  250778  050878       1
  150579  250779  050879       1
  150580  250780  050880       1
  150581  250781  050881       1
  150582  250782  050882       1
  150583  250783  050883       1
  150584  250784  050884       1
  150585  250785  050885       1
  150586  250786  050886       1
  150587  250787  050887       1
  150588  250788  050888       1
  150589  250789  050889       1
  150590  250790  050890       1
```

```
*** Record 12 -- PTITLE
MCPA - 1 applications @ 1.68 kg/ha
*** Record 13
    30      1      0      0
*** Record 15 -- PSTNAM
MCPA
*** Record 16
  010661  0 2  0.0  1.68 0.95 0.05
  010662  0 2  0.0  1.68 0.95 0.05
  010663  0 2  0.0  1.68 0.95 0.05
  010664  0 2  0.0  1.68 0.95 0.05
  010665  0 2  0.0  1.68 0.95 0.05
  010666  0 2  0.0  1.68 0.95 0.05
  010667  0 2  0.0  1.68 0.95 0.05
  010668  0 2  0.0  1.68 0.95 0.05
  010669  0 2  0.0  1.68 0.95 0.05
  010670  0 2  0.0  1.68 0.95 0.05
  010671  0 2  0.0  1.68 0.95 0.05
  010672  0 2  0.0  1.68 0.95 0.05
  010673  0 2  0.0  1.68 0.95 0.05
  010674  0 2  0.0  1.68 0.95 0.05
  010675  0 2  0.0  1.68 0.95 0.05
  010676  0 2  0.0  1.68 0.95 0.05
  010677  0 2  0.0  1.68 0.95 0.05
  010678  0 2  0.0  1.68 0.95 0.05
  010679  0 2  0.0  1.68 0.95 0.05
  010680  0 2  0.0  1.68 0.95 0.05
  010681  0 2  0.0  1.68 0.95 0.05
  010682  0 2  0.0  1.68 0.95 0.05
  010683  0 2  0.0  1.68 0.95 0.05
  010684  0 2  0.0  1.68 0.95 0.05
  010685  0 2  0.0  1.68 0.95 0.05
  010686  0 2  0.0  1.68 0.95 0.05
  010687  0 2  0.0  1.68 0.95 0.05
  010688  0 2  0.0  1.68 0.95 0.05
  010689  0 2  0.0  1.68 0.95 0.05
  010690  0 2  0.0  1.68 0.95 0.05
*** Record 17
     0      1      0
*** Record 18
     0      0    0.5
*** Record 19 -- STITLE
Bearden silty clay loam; HTDG: C
*** Record 20
   100          0   0   0   0   0   0   0   0   0
*** Record 26
     0      0      0
*** Record 33
     3
     1     10     1.4   0.377      0      0      0
      0.0096270.009627      0
          0.1   0.377   0.207    1.74     0.6
     2     52     1.5   0.292      0      0      0
```

```
      0.0096270.009627       0
            1   0.292   0.132   0.116     0.6
     3      38     1.8   0.285       0       0       0
      0.0096270.009627       0
            2   0.285   0.125   0.058     0.6
***Record 40
     0
        YEAR      10           YEAR      10           YEAR      10   1
     1
     1  -----
     7    YEAR
   PRCP    TCUM   0   0
   RUNF    TCUM   0   0
   INFL    TCUM   1   1
   ESLS    TCUM   0   0  1.0E3
   RFLX    TCUM   0   0  1.0E5
   EFLX    TCUM   0   0  1.0E5
   RZFX    TCUM   0   0  1.0E5
```

OR Snapbeans
OR/WA Snap Beans; MLRA 2; Metfile: W24232.dvf (old: Met2.met),

```
*** Record 3:
   0.74    0.15       0      17       1       1
*** Record 6 -- ERFLAG
      4
*** Record 7:
   0.43   0.173       1      10              2       1     354
*** Record 8
      1
*** Record 9
      1     0.1      18      80       1  92  89  90       0      50
*** Record 9a-d
      1      27
0101 1601 0102 1602 0103 1603 0104 1604 0105 1505 1605 2505 0106 1606 0107 1607
.547 .567 .588 .610 .635 .664 .694 .720 .742 .769 .775 .884 .796 .542 .268 .166
.011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011
0108 1008 1608 0109 1609 0110 1610 0111 1611 0112 1612
.152 .186 .204 .233 .269 .318 .373 .424 .464 .497 .525
.011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011
*** Record 10 -- NCPDS, the number of cropping periods
     30
*** Record 11
  110661  180861  020961       1
  110662  180862  020962       1
  110663  180863  020963       1
  110664  180864  020964       1
  110665  180865  020965       1
  110666  180866  020966       1
  110667  180867  020967       1
  110668  180868  020968       1
  110669  180869  020969       1
  110670  180870  020970       1
  110671  180871  020971       1
  110672  180872  020972       1
  110673  180873  020973       1
  110674  180874  020974       1
  110675  180875  020975       1
  110676  180876  020976       1
  110677  180877  020977       1
  110678  180878  020978       1
  110679  180879  020979       1
  110680  180880  020980       1
  110681  180881  020981       1
  110682  180882  020982       1
  110683  180883  020983       1
  110684  180884  020984       1
  110685  180885  020985       1
  110686  180886  020986       1
  110687  180887  020987       1
  110688  180888  020988       1
  110689  180889  020989       1
  110690  180890  020990       1
```

```
*** Record 12 -- PTITLE
MCPA - 1 applications @ 0.42 kg/ha
*** Record 13
     30       1       0       0
*** Record 15 -- PSTNAM
MCPA
*** Record 16
  150561  0 2  0.0  0.42 0.95 0.05
  150562  0 2  0.0  0.42 0.95 0.05
  150563  0 2  0.0  0.42 0.95 0.05
  150564  0 2  0.0  0.42 0.95 0.05
  150565  0 2  0.0  0.42 0.95 0.05
  150566  0 2  0.0  0.42 0.95 0.05
  150567  0 2  0.0  0.42 0.95 0.05
  150568  0 2  0.0  0.42 0.95 0.05
  150569  0 2  0.0  0.42 0.95 0.05
  150570  0 2  0.0  0.42 0.95 0.05
  150571  0 2  0.0  0.42 0.95 0.05
  150572  0 2  0.0  0.42 0.95 0.05
  150573  0 2  0.0  0.42 0.95 0.05
  150574  0 2  0.0  0.42 0.95 0.05
  150575  0 2  0.0  0.42 0.95 0.05
  150576  0 2  0.0  0.42 0.95 0.05
  150577  0 2  0.0  0.42 0.95 0.05
  150578  0 2  0.0  0.42 0.95 0.05
  150579  0 2  0.0  0.42 0.95 0.05
  150580  0 2  0.0  0.42 0.95 0.05
  150581  0 2  0.0  0.42 0.95 0.05
  150582  0 2  0.0  0.42 0.95 0.05
  150583  0 2  0.0  0.42 0.95 0.05
  150584  0 2  0.0  0.42 0.95 0.05
  150585  0 2  0.0  0.42 0.95 0.05
  150586  0 2  0.0  0.42 0.95 0.05
  150587  0 2  0.0  0.42 0.95 0.05
  150588  0 2  0.0  0.42 0.95 0.05
  150589  0 2  0.0  0.42 0.95 0.05
  150590  0 2  0.0  0.42 0.95 0.05
*** Record 17
      0       1       0
*** Record 18
      0       0     0.5
*** Record 19 -- STITLE
Dayton; HYDG: D
*** Record 20
    100           0   0   0   0   0   0   0   0   0
*** Record 26
      0       0       0
*** Record 33
      3
      1      10     1.4   0.312       0       0       0
       0.0096270.009627       0
           0.1   0.312   0.132    2.32     0.6
      2       8     1.4   0.312       0       0       0
```

```
 0.0096270.009627       0
        2   0.312   0.132    2.32     0.6
    3      82     1.4   0.266      0       0       0
 0.0096270.009627       0
        2   0.266   0.236    0.29     0.6
***Record 40
    0
      YEAR      10            YEAR      10            YEAR      10   1
    1
    1  -----
    7    YEAR
  PRCP    TCUM   0   0
  RUNF    TCUM   0   0
  INFL    TCUM   1   1
  ESLS    TCUM   0   0  1.0E3
  RFLX    TCUM   0   0  1.0E5
  EFLX    TCUM   0   0  1.0E5
  RZFX    TCUM   0   0  1.0E5
```

```
OR Wheat; 8/07/2001
Willamette Valley; MLRA 2; Metfile: W24232.dvf (old: Met2.met),
*** Record 3:
   0.74    0.36       0      17       1       1
*** Record 6 -- ERFLAG
      4
*** Record 7:
   0.13    1.34       1      10              2       6     354
*** Record 8
      1
*** Record 9
      1     0.1      23     100       1  92  86  87       0     100
*** Record 9a-d
      1      27
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1507 1607 0108
.226 .240 .254 .259 .265 .262 .224 .154 .101 .089 .091 .092 .092 .017 .017 .051
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
1008 1508 1608 0109 1609 0110 1610 0111 1611 0112 1612
.154 .223 .228 .231 .220 .210 .230 .267 .302 .323 .336
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
     30
*** Record 11
  010961  100361  010761       1
  010962  100362  010762       1
  010963  100363  010763       1
  010964  100364  010764       1
  010965  100365  010765       1
  010966  100366  010766       1
  010967  100367  010767       1
  010968  100368  010768       1
  010969  100369  010769       1
  010970  100370  010770       1
  010971  100371  010771       1
  010972  100372  010772       1
  010973  100373  010773       1
  010974  100374  010774       1
  010975  100375  010775       1
  010976  100376  010776       1
  010977  100377  010777       1
  010978  100378  010778       1
  010979  100379  010779       1
  010980  100380  010780       1
  010981  100381  010781       1
  010982  100382  010782       1
  010983  100383  010783       1
  010984  100384  010784       1
  010985  100385  010785       1
  010986  100386  010786       1
  010987  100387  010787       1
  010988  100388  010788       1
  010989  100389  010789       1
  010990  100390  010790       1
```

```
*** Record 12 -- PTITLE
MCPA - 1 applications @ 1.68 kg/ha
*** Record 13
     30       1       0       0
*** Record 15 -- PSTNAM
MCPA
*** Record 16
  150561  0 2  0.0  1.68 0.95 0.05
  150562  0 2  0.0  1.68 0.95 0.05
  150563  0 2  0.0  1.68 0.95 0.05
  150564  0 2  0.0  1.68 0.95 0.05
  150565  0 2  0.0  1.68 0.95 0.05
  150566  0 2  0.0  1.68 0.95 0.05
  150567  0 2  0.0  1.68 0.95 0.05
  150568  0 2  0.0  1.68 0.95 0.05
  150569  0 2  0.0  1.68 0.95 0.05
  150570  0 2  0.0  1.68 0.95 0.05
  150571  0 2  0.0  1.68 0.95 0.05
  150572  0 2  0.0  1.68 0.95 0.05
  150573  0 2  0.0  1.68 0.95 0.05
  150574  0 2  0.0  1.68 0.95 0.05
  150575  0 2  0.0  1.68 0.95 0.05
  150576  0 2  0.0  1.68 0.95 0.05
  150577  0 2  0.0  1.68 0.95 0.05
  150578  0 2  0.0  1.68 0.95 0.05
  150579  0 2  0.0  1.68 0.95 0.05
  150580  0 2  0.0  1.68 0.95 0.05
  150581  0 2  0.0  1.68 0.95 0.05
  150582  0 2  0.0  1.68 0.95 0.05
  150583  0 2  0.0  1.68 0.95 0.05
  150584  0 2  0.0  1.68 0.95 0.05
  150585  0 2  0.0  1.68 0.95 0.05
  150586  0 2  0.0  1.68 0.95 0.05
  150587  0 2  0.0  1.68 0.95 0.05
  150588  0 2  0.0  1.68 0.95 0.05
  150589  0 2  0.0  1.68 0.95 0.05
  150590  0 2  0.0  1.68 0.95 0.05
*** Record 17
      0       1       0
*** Record 18
      0       0     0.5
*** Record 19 -- STITLE
Bashaw Clay; HYDG: D
*** Record 20
    100           0   0   0   0   0   0   0   0   0
*** Record 26
      0       0       0
*** Record 33
      3
      1      10     1.3   0.487       0       0       0
       0.0096270.009627       0
           0.1   0.487   0.347    4.64     0.6
      2      26     1.3   0.487       0       0       0
```

```
  0.0096270.009627      0
         2   0.487   0.347    4.64     0.6
    3      64     1.3   0.441       0       0       0
  0.0096270.009627      0
         2   0.441   0.301    0.29     0.6
***Record 40
    0
       YEAR      10            YEAR      10            YEAR      10   1
    1
    1  -----
    7   YEAR
  PRCP    TCUM   0   0
  RUNF    TCUM   0   0
  INFL    TCUM   1   1
  ESLS    TCUM   0   0  1.0E3
  RFLX    TCUM   0   0  1.0E5
  EFLX    TCUM   0   0  1.0E5
  RZFX    TCUM   0   0  1.0E5
```

```
PA Alfalfa; 8/14/01
"York Co, MLRA 148; Metfile: W14737.dvf (old: Met148.met),
*** Record 3:
   0.76     0.3       0    12.5       1       1
*** Record 6 -- ERFLAG
     4
*** Record 7:
   0.33   0.123     0.6      10              3      12     354
*** Record 8
     1
*** Record 9
     1    0.25     120     100       1  87  83  86       0      61
*** Record 9a-d
     1      26
0101 1601 0102 1602 0103 1503 1603 0104 1604 0105 1605 0106 1506 1606 0107 1607
.015 .015 .015 .015 .015 .017 .012 .006 .002 .007 .004 .002 .007 .005 .003 .001
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.005 .003 .003 .005 .009 .013 .013 .014 .014 .015
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110
*** Record 10 -- NCPDS, the number of cropping periods
    30
*** Record 11
  150461  311061  311061       1
  150462  311062  311062       1
  150463  311063  311063       1
  150464  311064  311064       1
  150465  311065  311065       1
  150466  311066  311066       1
  150467  311067  311067       1
  150468  311068  311068       1
  150469  311069  311069       1
  150470  311070  311070       1
  150471  311071  311071       1
  150472  311072  311072       1
  150473  311073  311073       1
  150474  311074  311074       1
  150475  311075  311075       1
  150476  311076  311076       1
  150477  311077  311077       1
  150478  311078  311078       1
  150479  311079  311079       1
  150480  311080  311080       1
  150481  311081  311081       1
  150482  311082  311082       1
  150483  311083  311083       1
  150484  311084  311084       1
  150485  311085  311085       1
  150486  311086  311086       1
  150487  311087  311087       1
  150488  311088  311088       1
  150489  311089  311089       1
  150490  311090  311090       1
```

```
*** Record 12 -- PTITLE
MCPA - 1 applications @ 4.48 kg/ha
*** Record 13
     30       1       0       0
*** Record 15 -- PSTNAM
MCPA
*** Record 16
  010661  0 2  0.0  4.48 0.95 0.05
  010662  0 2  0.0  4.48 0.95 0.05
  010663  0 2  0.0  4.48 0.95 0.05
  010664  0 2  0.0  4.48 0.95 0.05
  010665  0 2  0.0  4.48 0.95 0.05
  010666  0 2  0.0  4.48 0.95 0.05
  010667  0 2  0.0  4.48 0.95 0.05
  010668  0 2  0.0  4.48 0.95 0.05
  010669  0 2  0.0  4.48 0.95 0.05
  010670  0 2  0.0  4.48 0.95 0.05
  010671  0 2  0.0  4.48 0.95 0.05
  010672  0 2  0.0  4.48 0.95 0.05
  010673  0 2  0.0  4.48 0.95 0.05
  010674  0 2  0.0  4.48 0.95 0.05
  010675  0 2  0.0  4.48 0.95 0.05
  010676  0 2  0.0  4.48 0.95 0.05
  010677  0 2  0.0  4.48 0.95 0.05
  010678  0 2  0.0  4.48 0.95 0.05
  010679  0 2  0.0  4.48 0.95 0.05
  010680  0 2  0.0  4.48 0.95 0.05
  010681  0 2  0.0  4.48 0.95 0.05
  010682  0 2  0.0  4.48 0.95 0.05
  010683  0 2  0.0  4.48 0.95 0.05
  010684  0 2  0.0  4.48 0.95 0.05
  010685  0 2  0.0  4.48 0.95 0.05
  010686  0 2  0.0  4.48 0.95 0.05
  010687  0 2  0.0  4.48 0.95 0.05
  010688  0 2  0.0  4.48 0.95 0.05
  010689  0 2  0.0  4.48 0.95 0.05
  010690  0 2  0.0  4.48 0.95 0.05
*** Record 17
      0       1       0
*** Record 18
      0       0     0.5
*** Record 19 -- STITLE
"Glenville, Silt Loam, HYDG: C"
*** Record 20
    120           0   0   0   0   0   0   0   0   0
*** Record 26
      0       0       0
*** Record 33
      3
      1      10     1.4   0.254       0       0       0
       0.0096270.009627       0
            0.1   0.254   0.094    1.74     0.6
      2      12     1.4   0.254       0       0       0
```

```
   0.0096270.009627       0
          2   0.254   0.094    1.74     0.6
     3      98     1.8   0.201       0       0       0
   0.0096270.009627       0
          2   0.201   0.121   0.174     0.6
***Record 40
     0
        YEAR      10           YEAR      10           YEAR      10   1
     1
     1  -----
     7    YEAR
   PRCP    TCUM   0   0
   RUNF    TCUM   0   0
   INFL    TCUM   1   1
   ESLS    TCUM   0   0  1.0E3
   RFLX    TCUM   0   0  1.0E5
   EFLX    TCUM   0   0  1.0E5
   RZFX    TCUM   0   0  1.0E5
```

```
PA TURF; 8/08/2001
Lancaster County; MLRA 148; Metfile: Met148.met
*** Record 3:
   0.76     0.3      0    12.5       1       3
*** Record 6 -- ERFLAG
     4
*** Record 7:
   0.33   0.123      1      10             3      12     354
*** Record 8
     1
*** Record 9
     1     0.1      10     100       3  74  74  74       0       5
*** Record 9a-d
     1      26
0101 1601 0102 1602 0103 1503 1603 0104 1604 0105 1605 0106 1506 1606 0107 1607
.015 .015 .015 .015 .015 .017 .012 .006 .002 .007 .004 .002 .007 .005 .003 .001
.010 .010 .010 .010 .010 .010 .010 .010 .010 .010 .010 .010 .010 .010 .010 .010
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.005 .003 .003 .005 .009 .013 .013 .014 .014 .015
.010 .010 .010 .010 .010 .010 .010 .010 .010 .010
*** Record 10 -- NCPDS, the number of cropping periods
    36
*** Record 11
 010448  150448  011148       1
 010449  150449  011149       1
 010450  150450  011150       1
 010451  150451  011151       1
 010452  150452  011152       1
 010453  150453  011153       1
 010454  150454  011154       1
 010455  150455  011155       1
 010456  150456  011156       1
 010457  150457  011157       1
 010458  150458  011158       1
 010459  150459  011159       1
 010460  150460  011160       1
 010461  150461  011161       1
 010462  150462  011162       1
 010463  150463  011163       1
 010464  150464  011164       1
 010465  150465  011165       1
 010466  150466  011166       1
 010467  150467  011167       1
 010468  150468  011168       1
 010469  150469  011169       1
 010470  150470  011170       1
 010471  150471  011171       1
 010472  150472  011172       1
 010473  150473  011173       1
 010474  150474  011174       1
 010475  150475  011175       1
 010476  150476  011176       1
 010477  150477  011177       1
```

```
 010478  150478  011178       1
 010479  150479  011179       1
 010480  150480  011180       1
 010481  150481  011181       1
 010482  150482  011182       1
 010483  150483  011183       1
*** Record 12 -- PTITLE
MCPA - 1 applications @ 2.24 kg/ha
*** Record 13
     36       1       0       0
*** Record 15 -- PSTNAM
MCPA
*** Record 16
 010648  0 2  0.0  2.24 0.99 0.01
 010649  0 2  0.0  2.24 0.99 0.01
 010650  0 2  0.0  2.24 0.99 0.01
 010651  0 2  0.0  2.24 0.99 0.01
 010652  0 2  0.0  2.24 0.99 0.01
 010653  0 2  0.0  2.24 0.99 0.01
 010654  0 2  0.0  2.24 0.99 0.01
 010655  0 2  0.0  2.24 0.99 0.01
 010656  0 2  0.0  2.24 0.99 0.01
 010657  0 2  0.0  2.24 0.99 0.01
 010658  0 2  0.0  2.24 0.99 0.01
 010659  0 2  0.0  2.24 0.99 0.01
 010660  0 2  0.0  2.24 0.99 0.01
 010661  0 2  0.0  2.24 0.99 0.01
 010662  0 2  0.0  2.24 0.99 0.01
 010663  0 2  0.0  2.24 0.99 0.01
 010664  0 2  0.0  2.24 0.99 0.01
 010665  0 2  0.0  2.24 0.99 0.01
 010666  0 2  0.0  2.24 0.99 0.01
 010667  0 2  0.0  2.24 0.99 0.01
 010668  0 2  0.0  2.24 0.99 0.01
 010669  0 2  0.0  2.24 0.99 0.01
 010670  0 2  0.0  2.24 0.99 0.01
 010671  0 2  0.0  2.24 0.99 0.01
 010672  0 2  0.0  2.24 0.99 0.01
 010673  0 2  0.0  2.24 0.99 0.01
 010674  0 2  0.0  2.24 0.99 0.01
 010675  0 2  0.0  2.24 0.99 0.01
 010676  0 2  0.0  2.24 0.99 0.01
 010677  0 2  0.0  2.24 0.99 0.01
 010678  0 2  0.0  2.24 0.99 0.01
 010679  0 2  0.0  2.24 0.99 0.01
 010680  0 2  0.0  2.24 0.99 0.01
 010681  0 2  0.0  2.24 0.99 0.01
 010682  0 2  0.0  2.24 0.99 0.01
 010683  0 2  0.0  2.24 0.99 0.01
*** Record 17
      0       1       0
*** Record 18
      0       0     0.5
```

```
*** Record 19 -- STITLE
"Glenville, Silt Loam; HYDG: C"
*** Record 20
   102          0   0   0   0   0   0   0   0   0
*** Record 26
     0       0       0
*** Record 33
     4
     1       2    0.37    0.47      0       0       0
      0.0096270.009627       0
          0.1    0.47    0.27     7.5     0.6
     2      10     1.4   0.254      0       0       0
      0.0096270.009627       0
          0.1   0.254   0.094    1.74     0.6
     3      12     1.4   0.254      0       0       0
      0.0096270.009627       0
            2   0.254   0.094    1.74     0.6
     4      78     1.8   0.201      0       0       0
      0.0096270.009627       0
            2   0.201     121   0.174     0.6
***Record 40
     0
        YEAR      10           YEAR      10           YEAR      10   1
     1
     1  -----
     7    YEAR
   PRCP    TCUM   0   0
   RUNF    TCUM   0   0
   INFL    TCUM   1   1
   ESLS    TCUM   0   0  1.0E3
   RFLX    TCUM   0   0  1.0E5
   EFLX    TCUM   0   0  1.0E5
   RZFX    TCUM   0   0  1.0E5
```

stored as NDwhteco.out
Chemical: MCPA
PRZM environment: NDwheatC.txt modified Satday, 12 October 2002 at 17:15:08
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 15:33:29
Metfile: w14914.dvf modified Wedday, 3 July 2002 at 08:05:52
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	4.2	3.41	1.802	0.8978	0.6485	0.1629
1962	7.694	6.764	4.837	2.74	1.881	0.468
1963	4.2	3.495	1.959	0.7995	0.6273	0.162
1964	6.159	5.164	2.774	1.742	1.18	0.2924
1965	6.471	5.418	3.053	1.28	0.8594	0.2149
1966	4.2	3.463	2.256	0.931	0.6269	0.1565
1967	5.868	4.943	3.198	1.372	0.9196	0.2289
1968	4.739	4.215	2.892	1.223	0.8199	0.2034
1969	4.61	3.857	2.039	1.338	0.9326	0.2326
1970	6.403	5.29	3.043	1.642	1.105	0.2801
1971	5.714	4.871	3.133	1.399	0.9391	0.2347
1972	4.2	3.468	1.764	0.8567	0.6763	0.1707
1973	4.2	3.374	1.592	0.6795	0.4614	0.1153
1974	4.2	3.427	1.686	0.9342	0.6877	0.1717
1975	11.84	9.746	4.956	2.502	1.683	0.4181
1976	4.2	3.368	1.582	0.6111	0.4084	0.1042
1977	5.4	4.399	2.155	1.463	1.011	0.2519
1978	13.97	11.61	6.016	2.946	1.984	0.4933
1979	6.871	5.694	3.358	2.006	1.376	0.3448
1980	4.2	3.493	1.982	0.8221	0.56	0.1423
1981	4.2	3.548	2.211	1.004	0.679	0.1684
1982	4.2	3.537	2.127	1.014	0.6905	0.1717
1983	4.2	3.466	1.801	0.9945	0.678	0.1692
1984	10.32	9.129	5.43	2.428	1.631	0.4038
1985	4.2	3.56	2.498	1.319	0.9396	0.2355
1986	5.299	4.419	2.977	1.635	1.103	0.2751
1987	4.2	3.478	1.782	0.9075	0.6933	0.1757
1988	4.2	3.378	1.885	0.7869	0.6516	0.172
1989	4.2	3.472	1.772	0.8823	0.7739	0.2018
1990	20.33	16.8	8.591	3.468	2.322	0.577

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly

0.032258	20.33	16.8	8.591	3.468	2.322	0.577
0.064516	13.97	11.61	6.016	2.946	1.984	0.4933
0.096774	11.84	9.746	5.43	2.74	1.881	0.468
0.129032	10.32	9.129	4.956	2.502	1.683	0.4181
0.16129	7.694	6.764	4.837	2.428	1.631	0.4038
0.193548	6.871	5.694	3.358	2.006	1.376	0.3448
0.225806	6.471	5.418	3.198	1.742	1.18	0.2924
0.258065	6.403	5.29	3.133	1.642	1.105	0.2801
0.290323	6.159	5.164	3.053	1.635	1.103	0.2751
0.322581	5.868	4.943	3.043	1.463	1.011	0.2519
0.354839	5.714	4.871	2.977	1.399	0.9396	0.2355
0.387097	5.4	4.419	2.892	1.372	0.9391	0.2347
0.419355	5.299	4.399	2.774	1.338	0.9326	0.2326
0.451613	4.739	4.215	2.498	1.319	0.9196	0.2289
0.483871	4.61	3.857	2.256	1.28	0.8594	0.2149
0.516129	4.2	3.56	2.211	1.223	0.8199	0.2034
0.548387	4.2	3.548	2.155	1.014	0.7739	0.2018
0.580645	4.2	3.537	2.127	1.004	0.6933	0.1757
0.612903	4.2	3.495	2.039	0.9945	0.6905	0.172
0.645161	4.2	3.493	1.982	0.9342	0.6877	0.1717
0.677419	4.2	3.478	1.959	0.931	0.679	0.1717
0.709677	4.2	3.472	1.885	0.9075	0.678	0.1707
0.741935	4.2	3.468	1.802	0.8978	0.6763	0.1692
0.774194	4.2	3.466	1.801	0.8823	0.6516	0.1684
0.806452	4.2	3.463	1.782	0.8567	0.6485	0.1629
0.83871	4.2	3.427	1.772	0.8221	0.6273	0.162
0.870968	4.2	3.41	1.764	0.7995	0.6269	0.1565
0.903226	4.2	3.378	1.686	0.7869	0.56	0.1423
0.935484	4.2	3.374	1.592	0.6795	0.4614	0.1153
0.967742	4.2	3.368	1.582	0.6111	0.4084	0.1042
0.1	11.688	9.6843	5.3826	2.7162	1.8612	0.46301
					Average of yearly averages:	0.24663

Inputs generaged by pe4.pl - 8-January-2003

stored as ORwhteco.out
Chemical: MCPA
PRZM environment: ORwheatC.txt modified Satday, 12 October 2002 at 17:22:28
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 15:33:29
Metfile: w24232.dvf modified Wedday, 3 July 2002 at 08:06:10
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	6.025	5.307	4.154	2.269	1.664	0.4186
1962	4.2	3.699	2.295	1.044	0.7076	0.1754
1963	4.2	3.696	2.281	1.031	0.6977	0.1729
1964	4.2	3.681	2.301	1.299	0.8849	0.2189
1965	4.2	3.66	2.19	1.113	0.7607	0.1888
1966	4.2	3.647	2.157	0.9455	0.6375	0.1578
1967	4.2	3.694	2.348	1.105	0.75	0.1858
1968	11.32	10.49	6.891	3.474	2.363	0.584
1969	4.2	3.651	2.168	1.051	0.7251	0.1803
1970	4.2	3.676	2.231	1.026	0.6941	0.172
1971	4.535	3.983	2.466	1.169	0.7986	0.1982
1972	31.07	27.8	17.64	8.107	5.486	1.356
1973	4.25	3.738	2.994	1.451	0.9861	0.245
1974	4.2	3.677	2.232	0.9927	0.6713	0.1665
1975	4.2	3.71	2.318	1.068	0.7269	0.1803
1976	4.2	3.728	2.37	1.118	0.7615	0.1887
1977	10.37	9.148	5.695	2.602	1.764	0.4374
1978	4.2	3.703	2.301	1.054	0.7215	0.1794
1979	4.2	3.679	2.237	1.202	0.8265	0.2054
1980	4.2	3.803	2.874	1.477	1.007	0.2493
1981	4.807	4.256	3.021	1.413	0.9583	0.2377
1982	4.2	3.719	2.346	1.136	0.7754	0.1924
1983	4.2	3.713	2.325	1.19	0.8135	0.202
1984	4.2	3.697	2.696	1.323	0.8997	0.2226
1985	4.2	3.7	2.292	1.6	1.098	0.2726
1986	4.2	3.625	2.104	0.9373	0.6436	0.1598
1987	4.417	3.828	2.842	1.591	1.087	0.2698
1988	4.2	3.702	2.272	1.091	0.7376	0.1822
1989	4.2	3.658	2.182	0.9458	0.6364	0.1576
1990	4.2	3.668	2.372	1.069	0.7219	0.1787

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly

0.032258	31.07	27.8	17.64	8.107	5.486	1.356
0.064516	11.32	10.49	6.891	3.474	2.363	0.584
0.096774	10.37	9.148	5.695	2.602	1.764	0.4374
0.129032	6.025	5.307	4.154	2.269	1.664	0.4186
0.16129	4.807	4.256	3.021	1.6	1.098	0.2726
0.193548	4.535	3.983	2.994	1.591	1.087	0.2698
0.225806	4.417	3.828	2.874	1.477	1.007	0.2493
0.258065	4.25	3.803	2.842	1.451	0.9861	0.245
0.290323	4.2	3.738	2.696	1.413	0.9583	0.2377
0.322581	4.2	3.728	2.466	1.323	0.8997	0.2226
0.354839	4.2	3.719	2.372	1.299	0.8849	0.2189
0.387097	4.2	3.713	2.37	1.202	0.8265	0.2054
0.419355	4.2	3.71	2.348	1.19	0.8135	0.202
0.451613	4.2	3.703	2.346	1.169	0.7986	0.1982
0.483871	4.2	3.702	2.325	1.136	0.7754	0.1924
0.516129	4.2	3.7	2.318	1.118	0.7615	0.1888
0.548387	4.2	3.699	2.301	1.113	0.7607	0.1887
0.580645	4.2	3.697	2.301	1.105	0.75	0.1858
0.612903	4.2	3.696	2.295	1.091	0.7376	0.1822
0.645161	4.2	3.694	2.292	1.069	0.7269	0.1803
0.677419	4.2	3.681	2.281	1.068	0.7251	0.1803
0.709677	4.2	3.679	2.272	1.054	0.7219	0.1794
0.741935	4.2	3.677	2.237	1.051	0.7215	0.1787
0.774194	4.2	3.676	2.232	1.044	0.7076	0.1754
0.806452	4.2	3.668	2.231	1.031	0.6977	0.1729
0.83871	4.2	3.66	2.19	1.026	0.6941	0.172
0.870968	4.2	3.658	2.182	0.9927	0.6713	0.1665
0.903226	4.2	3.651	2.168	0.9458	0.6436	0.1598
0.935484	4.2	3.647	2.157	0.9455	0.6375	0.1578
0.967742	4.2	3.625	2.104	0.9373	0.6364	0.1576
0.1	9.9355	8.7639	5.5409	2.5687	1.754	0.43552
					Average of yearly averages:	0.264537

Inputs generaged by pe4.pl - 8-January-2003

stored as CApaseco.out
Chemical: MCPA
PRZM environment: CAalfalfaC.txt modified Satday, 12 October 2002 at 16:27:56
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 15:33:29
Metfile: w93193.dvf modified Wedday, 3 July 2002 at 08:04:24
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	11.2	9.855	6.444	3.096	2.109	0.5285
1962	25.07	22.82	16.13	8.864	6.099	1.514
1963	11.76	10.44	8.53	4.313	2.944	0.7298
1964	11.2	10.09	6.75	3.293	2.241	0.5572
1965	11.2	10.03	6.571	3.712	2.614	0.6494
1966	11.2	10.05	6.636	3.195	2.17	0.5482
1967	11.21	10.28	7.322	3.862	2.668	0.6648
1968	11.2	10.15	7.025	3.581	2.451	0.6073
1969	11.2	9.854	6.376	3.146	2.144	0.531
1970	11.2	9.969	6.396	3.251	2.22	0.5516
1971	11.2	9.877	6.143	2.821	1.959	0.4908
1972	17.3	15.45	10.84	5.385	3.659	0.9148
1973	11.2	10.02	7.673	3.887	2.648	0.6564
1974	11.2	9.989	6.451	3.09	2.109	0.5234
1975	11.2	9.965	6.382	3.027	2.064	0.5121
1976	29.67	27.14	19.71	10.23	7.008	1.734
1977	11.2	9.972	6.402	3.044	2.071	0.5163
1978	11.21	9.962	7.454	3.646	2.479	0.6156
1979	12.07	10.75	6.965	3.356	2.275	0.5628
1980	11.2	9.83	6.572	3.488	2.371	0.5854
1981	11.2	10.04	6.932	3.373	2.293	0.5676
1982	11.2	10.09	6.737	3.342	2.287	0.5667
1983	11.7	10.37	7.869	3.725	2.525	0.6249
1984	11.2	10.08	7.022	3.458	2.349	0.5811
1985	11.2	10.28	8.462	4.551	3.123	0.7756
1986	11.2	9.77	7.741	3.944	2.689	0.6662
1987	11.2	9.968	6.658	3.277	2.234	0.5541
1988	11.2	10.22	7.137	3.75	2.633	0.6597
1989	11.9	10.82	8.3	4.236	2.886	0.7149
1990	18.61	16.59	11.32	5.629	3.851	0.9573

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly

0.032258	29.67	27.14	19.71	10.23	7.008	1.734
0.064516	25.07	22.82	16.13	8.864	6.099	1.514
0.096774	18.61	16.59	11.32	5.629	3.851	0.9573
0.129032	17.3	15.45	10.84	5.385	3.659	0.9148
0.16129	12.07	10.82	8.53	4.551	3.123	0.7756
0.193548	11.9	10.75	8.462	4.313	2.944	0.7298
0.225806	11.76	10.44	8.3	4.236	2.886	0.7149
0.258065	11.7	10.37	7.869	3.944	2.689	0.6662
0.290323	11.21	10.28	7.741	3.887	2.668	0.6648
0.322581	11.21	10.28	7.673	3.862	2.648	0.6597
0.354839	11.2	10.22	7.454	3.75	2.633	0.6564
0.387097	11.2	10.15	7.322	3.725	2.614	0.6494
0.419355	11.2	10.09	7.137	3.712	2.525	0.6249
0.451613	11.2	10.09	7.025	3.646	2.479	0.6156
0.483871	11.2	10.08	7.022	3.581	2.451	0.6073
0.516129	11.2	10.05	6.965	3.488	2.371	0.5854
0.548387	11.2	10.04	6.932	3.458	2.349	0.5811
0.580645	11.2	10.03	6.75	3.373	2.293	0.5676
0.612903	11.2	10.02	6.737	3.356	2.287	0.5667
0.645161	11.2	9.989	6.658	3.342	2.275	0.5628
0.677419	11.2	9.972	6.636	3.293	2.241	0.5572
0.709677	11.2	9.969	6.572	3.277	2.234	0.5541
0.741935	11.2	9.968	6.571	3.251	2.22	0.5516
0.774194	11.2	9.965	6.451	3.195	2.17	0.5482
0.806452	11.2	9.962	6.444	3.146	2.144	0.531
0.83871	11.2	9.877	6.402	3.096	2.109	0.5285
0.870968	11.2	9.855	6.396	3.09	2.109	0.5234
0.903226	11.2	9.854	6.382	3.044	2.071	0.5163
0.935484	11.2	9.83	6.376	3.027	2.064	0.5121
0.967742	11.2	9.77	6.143	2.821	1.959	0.4908
0.1	18.479	16.476	11.272	5.6046	3.8318	0.95305
					Average of yearly averages:	0.688717

Inputs generaged by pe4.pl - 8-January-2003

stored as PApaseco.out
Chemical: MCPA

PRZM environment: PAalfalfaC.txt	modified Satday, 12 October 2002 at 17:24:04
EXAMS environment: pond298.exv	modified Thuday, 29 August 2002 at 15:33:29
Metfile: w14737.dvf	modified Wedday, 3 July 2002 at 08:06:12

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	11.2	9.446	5.356	2.835	2.016	0.5029
1962	11.34	9.852	7.673	4.145	2.818	0.7002
1963	11.2	9.695	5.678	2.524	1.723	0.4296
1964	11.2	9.708	6.725	3.108	2.102	0.5199
1965	13.82	11.94	7.134	3.095	2.093	0.5195
1966	11.2	9.557	5.354	2.365	1.68	0.4232
1967	82.66	70.3	39.59	18.54	12.81	3.181
1968	12.34	10.96	6.864	3.067	2.073	0.5169
1969	11.2	9.618	5.819	2.647	1.795	0.446
1970	11.2	9.607	5.628	2.569	1.738	0.4315
1971	12.98	11.38	8.067	3.613	2.442	0.6054
1972	13.47	11.41	7.287	4.655	3.17	0.7838
1973	11.22	9.531	5.402	4.134	2.872	0.7145
1974	17.57	15.08	8.93	5.421	3.698	0.9183
1975	29.93	26.02	16.23	7.363	4.975	1.232
1976	11.2	9.409	5.781	2.698	1.82	0.4502
1977	13.05	10.98	7.823	3.529	2.383	0.5909
1978	11.2	9.632	5.56	2.652	1.801	0.448
1979	11.2	9.695	5.678	2.748	1.921	0.4773
1980	14.81	12.56	7.679	3.268	2.196	0.5424
1981	11.59	10.38	6.473	2.922	1.966	0.4872
1982	23.46	20.02	14.07	6.833	4.624	1.146
1983	11.2	9.743	5.921	2.912	1.971	0.4888
1984	11.2	9.509	5.957	3.635	2.479	0.6135
1985	15.46	13.1	8.641	3.821	2.575	0.6377
1986	11.2	9.384	6.57	2.856	1.926	0.4779
1987	11.2	9.462	5.155	2.582	1.753	0.4346
1988	11.37	9.51	5.017	2.241	1.557	0.3859
1989	19.01	16.18	10.34	4.948	3.343	0.8278
1990	11.2	9.435	6.204	2.709	1.828	0.4529

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly

0.032258	82.66	70.3	39.59	18.54	12.81	3.181
0.064516	29.93	26.02	16.23	7.363	4.975	1.232
0.096774	23.46	20.02	14.07	6.833	4.624	1.146
0.129032	19.01	16.18	10.34	5.421	3.698	0.9183
0.16129	17.57	15.08	8.93	4.948	3.343	0.8278
0.193548	15.46	13.1	8.641	4.655	3.17	0.7838
0.225806	14.81	12.56	8.067	4.145	2.872	0.7145
0.258065	13.82	11.94	7.823	4.134	2.818	0.7002
0.290323	13.47	11.41	7.679	3.821	2.575	0.6377
0.322581	13.05	11.38	7.673	3.635	2.479	0.6135
0.354839	12.98	10.98	7.287	3.613	2.442	0.6054
0.387097	12.34	10.96	7.134	3.529	2.383	0.5909
0.419355	11.59	10.38	6.864	3.268	2.196	0.5424
0.451613	11.37	9.852	6.725	3.108	2.102	0.5199
0.483871	11.34	9.743	6.57	3.095	2.093	0.5195
0.516129	11.22	9.708	6.473	3.067	2.073	0.5169
0.548387	11.2	9.695	6.204	2.922	2.016	0.5029
0.580645	11.2	9.695	5.957	2.912	1.971	0.4888
0.612903	11.2	9.632	5.921	2.856	1.966	0.4872
0.645161	11.2	9.618	5.819	2.835	1.926	0.4779
0.677419	11.2	9.607	5.781	2.748	1.921	0.4773
0.709677	11.2	9.557	5.678	2.709	1.828	0.4529
0.741935	11.2	9.531	5.678	2.698	1.82	0.4502
0.774194	11.2	9.51	5.628	2.652	1.801	0.448
0.806452	11.2	9.509	5.56	2.647	1.795	0.446
0.83871	11.2	9.462	5.402	2.582	1.753	0.4346
0.870968	11.2	9.446	5.356	2.569	1.738	0.4315
0.903226	11.2	9.435	5.354	2.524	1.723	0.4296
0.935484	11.2	9.409	5.155	2.365	1.68	0.4232
0.967742	11.2	9.384	5.017	2.241	1.557	0.3859
0.1	23.015	19.636	13.697	6.6918	4.5314	1.12323
					Average of yearly averages:	0.679527

Inputs generaged by pe4.pl - 8-January-2003

EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 15:33:29
Metfile: w14914.dvf modified Wedday, 3 July 2002 at 08:05:52
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	11.2	9.202	4.858	2.132	1.466	0.364
1962	13.76	12.1	9.207	4.756	3.247	0.8072
1963	11.2	9.32	4.847	1.96	1.349	0.3387
1964	11.2	9.39	5.91	3.098	2.089	0.5171
1965	12.3	10.76	5.873	2.415	1.619	0.404
1966	11.2	9.234	4.869	1.949	1.306	0.3255
1967	11.2	9.433	6.259	2.625	1.758	0.4366
1968	11.2	9.344	5.469	2.241	1.5	0.3717
1969	11.2	9.372	4.953	2.516	1.719	0.428
1970	11.2	9.212	6.12	2.931	1.966	0.4914
1971	11.2	10.02	6.225	2.648	1.775	0.4425
1972	11.2	9.249	4.705	2.076	1.488	0.3715
1973	11.2	8.997	4.246	1.683	1.129	0.281
1974	11.2	9.139	4.497	1.979	1.381	0.3438
1975	17.16	14.12	7.143	4.312	2.898	0.7192
1976	11.2	8.982	4.22	1.629	1.089	0.2731
1977	11.2	9.189	4.59	2.794	1.909	0.4748
1978	21.42	17.8	9.312	5.126	3.449	0.8568
1979	11.2	9.28	5.741	3.559	2.417	0.6042
1980	11.2	9.26	4.83	1.952	1.31	0.3274
1981	11.2	9.462	5.224	2.2	1.478	0.3662
1982	11.2	9.433	5.146	2.223	1.498	0.3722
1983	11.2	9.242	4.693	2.102	1.417	0.3529
1984	14.99	13.42	8.907	3.883	2.607	0.6455
1985	11.2	9.493	5.595	2.565	1.767	0.4408
1986	11.2	9.34	5.795	2.801	1.885	0.4694
1987	11.2	9.273	4.753	2.129	1.515	0.3793
1988	11.2	9.007	4.383	1.718	1.192	0.2997
1989	11.2	9.259	4.726	2.027	1.428	0.3588
1990	37.27	30.8	15.72	6.314	4.226	1.048

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258	37.27	30.8	15.72	6.314	4.226	1.048
0.064516	21.42	17.8	9.312	5.126	3.449	0.8568
0.096774	17.16	14.12	9.207	4.756	3.247	0.8072
0.129032	14.99	13.42	8.907	4.312	2.898	0.7192
0.16129	13.76	12.1	7.143	3.883	2.607	0.6455
0.193548	12.3	10.76	6.259	3.559	2.417	0.6042
0.225806	11.2	10.02	6.225	3.098	2.089	0.5171

0.258065	11.2	9.493	6.12	2.931	1.966	0.4914
0.290323	11.2	9.462	5.91	2.801	1.909	0.4748
0.322581	11.2	9.433	5.873	2.794	1.885	0.4694
0.354839	11.2	9.433	5.795	2.648	1.775	0.4425
0.387097	11.2	9.39	5.741	2.625	1.767	0.4408
0.419355	11.2	9.372	5.595	2.565	1.758	0.4366
0.451613	11.2	9.344	5.469	2.516	1.719	0.428
0.483871	11.2	9.34	5.224	2.415	1.619	0.404
0.516129	11.2	9.32	5.146	2.241	1.515	0.3793
0.548387	11.2	9.28	4.953	2.223	1.5	0.3722
0.580645	11.2	9.273	4.869	2.2	1.498	0.3717
0.612903	11.2	9.26	4.858	2.132	1.488	0.3715
0.645161	11.2	9.259	4.847	2.129	1.478	0.3662
0.677419	11.2	9.249	4.83	2.102	1.466	0.364
0.709677	11.2	9.242	4.753	2.076	1.428	0.3588
0.741935	11.2	9.234	4.726	2.027	1.417	0.3529
0.774194	11.2	9.212	4.705	1.979	1.381	0.3438
0.806452	11.2	9.202	4.693	1.96	1.349	0.3387
0.83871	11.2	9.189	4.59	1.952	1.31	0.3274
0.870968	11.2	9.139	4.497	1.949	1.306	0.3255
0.903226	11.2	9.007	4.383	1.718	1.192	0.2997
0.935484	11.2	8.997	4.246	1.683	1.129	0.281
0.967742	11.2	8.982	4.22	1.629	1.089	0.2731
0.1	16.943	14.05	9.177	4.7116	3.2121	0.7984
					Average of yearly averages:	0.46371

Inputs generaged by pe4.pl - 8-January-2003

stored as KSsoreco.out
Chemical: MCPA
PRZM environment: KSsorghumC.txt modified Satday, 12 October 2002 at 15:57:56
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 15:33:29
Metfile: w13996.dvf modified Wedday, 3 July 2002 at 08:04:44
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	2.766	2.305	1.27	0.8425	0.5816	0.1441
1962	6.962	5.893	3.637	1.606	1.079	0.2671
1963	6.301	5.174	2.594	1.193	0.8035	0.1993
1964	4.491	3.714	2.451	1.045	0.7037	0.1738
1965	4.761	4.353	2.487	1.27	0.8576	0.2127
1966	5.685	4.749	2.511	1.263	0.857	0.2127
1967	9.422	8.379	5.015	2.346	1.59	0.3943
1968	11.11	9.204	4.739	2.394	1.628	0.403
1969	11.99	10.04	6.04	2.622	1.765	0.4381
1970	2.1	1.73	0.8976	0.4242	0.3001	0.0766
1971	2.1	1.754	1.003	0.541	0.3668	0.09088
1972	3.681	3.074	1.699	1.015	0.695	0.1718
1973	6.159	5.221	3.002	1.574	1.075	0.2668
1974	2.26	1.903	1.183	0.9073	0.6451	0.1615
1975	2.1	1.756	1.224	0.543	0.3737	0.09371
1976	2.454	2.038	1.429	0.7456	0.5068	0.1254
1977	13.2	11.65	6.251	2.519	1.685	0.4168
1978	16.61	14.24	7.492	3.223	2.171	0.5392
1979	4.805	4.1	2.472	1.378	0.9369	0.2344
1980	2.1	1.717	0.85	0.4958	0.3988	0.09994
1981	4.068	3.36	2.402	1.053	0.7092	0.1756
1982	3.565	3.225	2.212	0.9813	0.6604	0.164
1983	3.06	2.6	1.983	0.9177	0.6167	0.1526
1984	7.767	6.447	3.765	1.696	1.142	0.2819
1985	4.183	3.554	2.121	0.9705	0.6565	0.1629
1986	5.619	4.784	2.885	1.363	0.919	0.2276
1987	5.515	4.744	2.773	1.306	0.8789	0.2177
1988	11.84	10.45	6.147	2.91	1.986	0.4907
1989	5.347	4.764	2.96	1.47	0.9937	0.2466
1990	15.72	12.54	5.941	2.353	1.578	0.3907

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly

0.032258	16.61	14.24	7.492	3.223	2.171	0.5392
0.064516	15.72	12.54	6.251	2.91	1.986	0.4907
0.096774	13.2	11.65	6.147	2.622	1.765	0.4381
0.129032	11.99	10.45	6.04	2.519	1.685	0.4168
0.16129	11.84	10.04	5.941	2.394	1.628	0.403
0.193548	11.11	9.204	5.015	2.353	1.59	0.3943
0.225806	9.422	8.379	4.739	2.346	1.578	0.3907
0.258065	7.767	6.447	3.765	1.696	1.142	0.2819
0.290323	6.962	5.893	3.637	1.606	1.079	0.2671
0.322581	6.301	5.221	3.002	1.574	1.075	0.2668
0.354839	6.159	5.174	2.96	1.47	0.9937	0.2466
0.387097	5.685	4.784	2.885	1.378	0.9369	0.2344
0.419355	5.619	4.764	2.773	1.363	0.919	0.2276
0.451613	5.515	4.749	2.594	1.306	0.8789	0.2177
0.483871	5.347	4.744	2.511	1.27	0.8576	0.2127
0.516129	4.805	4.353	2.487	1.263	0.857	0.2127
0.548387	4.761	4.1	2.472	1.193	0.8035	0.1993
0.580645	4.491	3.714	2.451	1.053	0.7092	0.1756
0.612903	4.183	3.554	2.402	1.045	0.7037	0.1738
0.645161	4.068	3.36	2.212	1.015	0.695	0.1718
0.677419	3.681	3.225	2.121	0.9813	0.6604	0.164
0.709677	3.565	3.074	1.983	0.9705	0.6565	0.1629
0.741935	3.06	2.6	1.699	0.9177	0.6451	0.1615
0.774194	2.766	2.305	1.429	0.9073	0.6167	0.1526
0.806452	2.454	2.038	1.27	0.8425	0.5816	0.1441
0.83871	2.26	1.903	1.224	0.7456	0.5068	0.1254
0.870968	2.1	1.756	1.183	0.543	0.3988	0.09994
0.903226	2.1	1.754	1.003	0.541	0.3737	0.09371
0.935484	2.1	1.73	0.8976	0.4958	0.3668	0.09088
0.967742	2.1	1.717	0.85	0.4242	0.3001	0.0766
0.1	13.079	11.53	6.1363	2.6117	1.757	0.43597
					Average of yearly averages:	0.241081

Inputs generaged by pe4.pl - 8-January-2003

stored as ORpeaeco.out
Chemical: MCPA
PRZM environment: ORsnbeansC.txt modified Satday, 12 October 2002 at 17:20:58
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 15:33:29
Metfile: w24232.dvf modified Wedday, 3 July 2002 at 08:06:10
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	1.097	0.9665	0.7846	0.403	0.287	0.07187
1962	1.05	0.9248	0.6286	0.3093	0.2103	0.05257
1963	1.05	0.9241	0.5703	0.2579	0.1747	0.04343
1964	1.097	1.037	0.6543	0.4726	0.3249	0.08051
1965	1.05	0.915	0.6098	0.3489	0.2406	0.05998
1966	1.05	0.9118	0.5392	0.2364	0.1594	0.03958
1967	1.05	0.9234	0.6714	0.3578	0.244	0.0609
1968	4.148	3.748	2.592	1.284	0.8742	0.2161
1969	1.05	0.9128	0.542	0.3202	0.2306	0.05777
1970	1.05	0.9191	0.5577	0.2584	0.1749	0.04879
1971	1.801	1.583	1.043	0.5127	0.3512	0.08722
1972	6.848	6.335	4.068	1.876	1.27	0.3139
1973	1.689	1.514	1.04	0.542	0.37	0.09204
1974	1.05	0.9193	0.5579	0.2494	0.1704	0.04237
1975	1.05	0.9274	0.5796	0.267	0.1817	0.04516
1976	1.05	0.932	0.5927	0.2845	0.1957	0.04858
1977	4.617	4.074	2.567	1.187	0.8052	0.1997
1978	1.05	0.9258	0.5752	0.2636	0.1975	0.05048
1979	1.05	0.9198	0.5592	0.2887	0.1978	0.0541
1980	1.395	1.263	0.989	0.5727	0.3927	0.09731
1981	1.875	1.66	1.11	0.5465	0.3716	0.09224
1982	1.05	0.9302	0.5868	0.2891	0.1981	0.04958
1983	1.05	0.9282	0.5868	0.3962	0.2757	0.06865
1984	1.645	1.448	1.077	0.6081	0.4164	0.1031
1985	3.818	3.5	2.154	1.117	0.7808	0.1944
1986	1.05	0.9063	0.526	0.26	0.1917	0.04853
1987	2.046	1.779	1.039	0.6028	0.4689	0.1188
1988	1.896	1.644	1.1	0.6069	0.412	0.1019
1989	1.05	0.9146	0.6013	0.2682	0.181	0.04488
1990	1.248	1.09	0.8317	0.3992	0.2702	0.06691

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly

0.032258	6.848	6.335	4.068	1.876	1.27	0.3139
0.064516	4.617	4.074	2.592	1.284	0.8742	0.2161
0.096774	4.148	3.748	2.567	1.187	0.8052	0.1997
0.129032	3.818	3.5	2.154	1.117	0.7808	0.1944
0.16129	2.046	1.779	1.11	0.6081	0.4689	0.1188
0.193548	1.896	1.66	1.1	0.6069	0.4164	0.1031
0.225806	1.875	1.644	1.077	0.6028	0.412	0.1019
0.258065	1.801	1.583	1.043	0.5727	0.3927	0.09731
0.290323	1.689	1.514	1.04	0.5465	0.3716	0.09224
0.322581	1.645	1.448	1.039	0.542	0.37	0.09204
0.354839	1.395	1.263	0.989	0.5127	0.3512	0.08722
0.387097	1.248	1.09	0.8317	0.4726	0.3249	0.08051
0.419355	1.097	1.037	0.7846	0.403	0.287	0.07187
0.451613	1.097	0.9665	0.6714	0.3992	0.2757	0.06865
0.483871	1.05	0.932	0.6543	0.3962	0.2702	0.06691
0.516129	1.05	0.9302	0.6286	0.3578	0.244	0.0609
0.548387	1.05	0.9282	0.6098	0.3489	0.2406	0.05998
0.580645	1.05	0.9274	0.6013	0.3202	0.2306	0.05777
0.612903	1.05	0.9258	0.5927	0.3093	0.2103	0.0541
0.645161	1.05	0.9248	0.5868	0.2891	0.1981	0.05257
0.677419	1.05	0.9241	0.5868	0.2887	0.1978	0.05048
0.709677	1.05	0.9234	0.5796	0.2845	0.1975	0.04958
0.741935	1.05	0.9198	0.5752	0.2682	0.1957	0.04879
0.774194	1.05	0.9193	0.5703	0.267	0.1917	0.04858
0.806452	1.05	0.9191	0.5592	0.2636	0.1817	0.04853
0.83871	1.05	0.915	0.5579	0.26	0.181	0.04516
0.870968	1.05	0.9146	0.5577	0.2584	0.1749	0.04488
0.903226	1.05	0.9128	0.542	0.2579	0.1747	0.04343
0.935484	1.05	0.9118	0.5392	0.2494	0.1704	0.04237
0.967742	1.05	0.9063	0.526	0.2364	0.1594	0.03958
0.1	4.115	3.7232	2.5257	1.18	0.80276	0.19917
					Average of yearly averages:	0.088378

Inputs generaged by pe4.pl - 8-January-2003

stored as PAtrfeco.out
Chemical: MCPA
PRZM environment: PATurf.txt modified Monday, 17 June 2002 at 10:10:16
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 15:33:29
Metfile: met148.met modified Friday, 22 March 1991 at 15:28:18
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1948	1.12	0.9621	0.7144	0.3201	0.2163	0.05342
1949	1.881	1.711	1	0.513	0.4357	0.1109
1950	1.12	0.962	0.5499	0.2673	0.1834	0.04563
1951	1.21	1.046	0.6858	0.4804	0.3298	0.08194
1952	2.068	1.785	1.036	0.6093	0.4603	0.1154
1953	1.12	0.9601	0.5454	0.2374	0.1621	0.04025
1954	1.12	0.9608	0.6241	0.2853	0.1941	0.04829
1955	1.883	1.651	1.051	0.5374	0.3754	0.0942
1956	6.165	5.289	3.07	1.537	1.077	0.2676
1957	3.719	3.183	1.827	0.9523	0.6669	0.1662
1958	1.12	0.9659	0.5592	0.2434	0.1644	0.04097
1959	4.309	3.693	2.108	0.9268	0.6308	0.1564
1960	1.12	0.9742	0.5742	0.2515	0.1702	0.04219
1961	1.425	1.232	0.7256	0.4535	0.3628	0.09179
1962	3.725	3.193	1.817	0.9328	0.6404	0.1594
1963	1.12	0.961	0.5475	0.2385	0.1633	0.04115
1964	1.12	0.9617	0.6055	0.282	0.1907	0.0472
1965	1.12	0.9622	0.5504	0.2379	0.161	0.04002
1966	1.12	0.9593	0.5437	0.2332	0.1785	0.04753
1967	28.28	24.24	13.86	6.072	4.199	1.044
1968	1.12	0.9636	0.5532	0.2395	0.1615	0.04157
1969	1.12	0.9605	0.5849	0.2688	0.1837	0.04567
1970	1.12	0.963	0.5522	0.2436	0.1666	0.04144
1971	1.12	0.9603	0.5459	0.2351	0.1626	0.04049
1972	3.23	2.781	1.927	1.01	0.6962	0.1724
1973	6.54	5.61	3.255	1.514	1.089	0.272
1974	3.607	3.104	1.792	0.9308	0.6389	0.159
1975	5.484	4.74	2.797	1.289	0.8728	0.2164
1976	1.12	0.9534	0.6033	0.2899	0.1982	0.04924
1977	2.379	2.024	1.211	0.5851	0.3962	0.09826
1978	1.12	0.9607	0.5481	0.275	0.1892	0.04728
1979	1.12	0.9702	0.5695	0.3145	0.2311	0.05779
1980	1.12	0.9667	0.5355	0.2237	0.1502	0.03714
1981	1.12	0.9629	0.7319	0.3808	0.2589	0.06423

1982	4.103	3.518	2.344	1.198	0.8196	0.2035
1983	1.191	1.038	0.6647	0.4571	0.3125	0.07774

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.027027	28.28	24.24	13.86	6.072	4.199	1.044
0.054054	6.54	5.61	3.255	1.537	1.089	0.272
0.081081	6.165	5.289	3.07	1.514	1.077	0.2676
0.108108	5.484	4.74	2.797	1.289	0.8728	0.2164
0.135135	4.309	3.693	2.344	1.198	0.8196	0.2035
0.162162	4.103	3.518	2.108	1.01	0.6962	0.1724
0.189189	3.725	3.193	1.927	0.9523	0.6669	0.1662
0.216216	3.719	3.183	1.827	0.9328	0.6404	0.1594
0.243243	3.607	3.104	1.817	0.9308	0.6389	0.159
0.27027	3.23	2.781	1.792	0.9268	0.6308	0.1564
0.297297	2.379	2.024	1.211	0.6093	0.4603	0.1154
0.324324	2.068	1.785	1.051	0.5851	0.4357	0.1109
0.351351	1.883	1.711	1.036	0.5374	0.3962	0.09826
0.378378	1.881	1.651	1	0.513	0.3754	0.0942
0.405405	1.425	1.232	0.7319	0.4804	0.3628	0.09179
0.432432	1.21	1.046	0.7256	0.4571	0.3298	0.08194
0.459459	1.191	1.038	0.7144	0.4535	0.3125	0.07774
0.486486	1.12	0.9742	0.6858	0.3808	0.2589	0.06423
0.513514	1.12	0.9702	0.6647	0.3201	0.2311	0.05779
0.540541	1.12	0.9667	0.6241	0.3145	0.2163	0.05342
0.567568	1.12	0.9659	0.6055	0.2899	0.1982	0.04924
0.594595	1.12	0.9636	0.6033	0.2853	0.1941	0.04829
0.621622	1.12	0.963	0.5849	0.282	0.1907	0.04753
0.648649	1.12	0.9629	0.5742	0.275	0.1892	0.04728
0.675676	1.12	0.9622	0.5695	0.2688	0.1837	0.0472
0.702703	1.12	0.9621	0.5592	0.2673	0.1834	0.04567
0.72973	1.12	0.962	0.5532	0.2515	0.1785	0.04563
0.756757	1.12	0.9617	0.5522	0.2436	0.1702	0.04219
0.783784	1.12	0.961	0.5504	0.2434	0.1666	0.04157
0.810811	1.12	0.9608	0.5499	0.2395	0.1644	0.04144
0.837838	1.12	0.9607	0.5481	0.2385	0.1633	0.04115
0.864865	1.12	0.9605	0.5475	0.2379	0.1626	0.04097
0.891892	1.12	0.9603	0.5459	0.2374	0.1621	0.04049
0.918919	1.12	0.9601	0.5454	0.2351	0.1615	0.04025
0.945946	1.12	0.9593	0.5437	0.2332	0.161	0.04002
0.972973	1.12	0.9534	0.5355	0.2237	0.1502	0.03714
0.1	5.6883	4.9047	2.8789	1.3565	0.93406	0.23176
					Average of yearly averages:	0.121073

Inputs generaged by pe4.pl - 8-January-2003

Input/Output Files for PRZM/EXAMS Scenarios - Ester Only

```
set mode = 3
set outfil(4) to Y
set outfil(2) to N
READ ENV C:\models\INPUTS\EXAMSenv\pond298.exv
READ MET C:\models\INPUTS\Metfiles\w14914.dvf
SET YEAR1 = 1961
recall chem 1
chemical name is MCPA EHE
set MWT(1) = 312.84
set HENRY(1) = 6.25E-5
set VAPR(1) = 8.43E-6
set SOL(1,1) = 0.55
set KOC(1) = 10500
set QTBAS(*,1,1) = 2
set QTBAW(*,1,1) = 2
READ PRZM P2E-C1.D61
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
RUN
READ PRZM P2E-C1.D62
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D63
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D64
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D65
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D66
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
```

```
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D67
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D68
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D69
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D70
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D71
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D72
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D73
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
```

```
READ PRZM P2E-C1.D74
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D75
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D76
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D77
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D78
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D79
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D80
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D81
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
```

```
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D82
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D83
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D84
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D85
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D86
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D87
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D88
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D89
```

```
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
READ PRZM P2E-C1.D90
set STFLO(1,*) = 0.0
set EVAP(*,*) = 0.0
set NPSFL(*,*)=0.0
set NPSED(*,*)=0.0
set RAIN(*) = 0.0
CONTINUE
QUIT
```

North Dakota Spring Wheat MLRA F56 Cass County Bearden silty clay loam
"Red River Valley of the North MLRA 56 MN, ND, SD 1948-1983; Metfile: W14914.dvf (old: Met56.met),

```
*** Record 3:
   0.75     0.5      0      12       1       1
*** Record 6 -- ERFLAG
      4
*** Record 7:
   0.28    0.17      1      10             3     1.5     354
*** Record 8
      1
*** Record 9
      1     0.1      22     100      1  91  85  87       0     100
*** Record 9a-d
      1      28
0101 1601 0102 1602 0103 1603 0104 1604 2004 0105 0505 1605 0106 1606 0107 1607
.583 .581 .579 .577 .574 .574 .575 .575 .611 .617 .610 .562 .468 .268 .092 .064
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
0108 0508 1008 1608 0109 1609 0110 1610 0111 1611 0112 1612
.065 .036 .098 .110 .126 .139 .152 .162 .168 .170 .171 .171
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
     30
*** Record 11
  150561  250761  050861       1
  150562  250762  050862       1
  150563  250763  050863       1
  150564  250764  050864       1
  150565  250765  050865       1
  150566  250766  050866       1
  150567  250767  050867       1
  150568  250768  050868       1
  150569  250769  050869       1
  150570  250770  050870       1
  150571  250771  050871       1
  150572  250772  050872       1
  150573  250773  050873       1
  150574  250774  050874       1
  150575  250775  050875       1
  150576  250776  050876       1
  150577  250777  050877       1
  150578  250778  050878       1
  150579  250779  050879       1
  150580  250780  050880       1
  150581  250781  050881       1
  150582  250782  050882       1
  150583  250783  050883       1
  150584  250784  050884       1
  150585  250785  050885       1
  150586  250786  050886       1
  150587  250787  050887       1
  150588  250788  050888       1
  150589  250789  050889       1
  150590  250790  050890       1
```

```
*** Record 12 -- PTITLE
MCPA EHE - 1 applications @ 1.68 kg/ha
*** Record 13
     30       1       0       0
*** Record 15 -- PSTNAM
MCPA EHE
*** Record 16
  010661  0 2  0.0  1.68 0.95 0.05
  010662  0 2  0.0  1.68 0.95 0.05
  010663  0 2  0.0  1.68 0.95 0.05
  010664  0 2  0.0  1.68 0.95 0.05
  010665  0 2  0.0  1.68 0.95 0.05
  010666  0 2  0.0  1.68 0.95 0.05
  010667  0 2  0.0  1.68 0.95 0.05
  010668  0 2  0.0  1.68 0.95 0.05
  010669  0 2  0.0  1.68 0.95 0.05
  010670  0 2  0.0  1.68 0.95 0.05
  010671  0 2  0.0  1.68 0.95 0.05
  010672  0 2  0.0  1.68 0.95 0.05
  010673  0 2  0.0  1.68 0.95 0.05
  010674  0 2  0.0  1.68 0.95 0.05
  010675  0 2  0.0  1.68 0.95 0.05
  010676  0 2  0.0  1.68 0.95 0.05
  010677  0 2  0.0  1.68 0.95 0.05
  010678  0 2  0.0  1.68 0.95 0.05
  010679  0 2  0.0  1.68 0.95 0.05
  010680  0 2  0.0  1.68 0.95 0.05
  010681  0 2  0.0  1.68 0.95 0.05
  010682  0 2  0.0  1.68 0.95 0.05
  010683  0 2  0.0  1.68 0.95 0.05
  010684  0 2  0.0  1.68 0.95 0.05
  010685  0 2  0.0  1.68 0.95 0.05
  010686  0 2  0.0  1.68 0.95 0.05
  010687  0 2  0.0  1.68 0.95 0.05
  010688  0 2  0.0  1.68 0.95 0.05
  010689  0 2  0.0  1.68 0.95 0.05
  010690  0 2  0.0  1.68 0.95 0.05
*** Record 17
      0       1       0
*** Record 18
      0       0     0.5
*** Record 19 -- STITLE
Bearden silty clay loam; HTDG: C
*** Record 20
    100           0   0   1   0   0   0   0   0   0
*** Record 26
      0       0       0
*** Record 30
      4   10500
*** Record 33
      3
      1      10     1.4   0.377       0       0       0
              0       0       0
```

```
        0.1   0.377   0.207    1.74      0
    2     52     1.5   0.292      0      0      0
          0      0      0
          1   0.292   0.132   0.116      0
    3     38     1.8   0.285      0      0      0
          0      0      0
          2   0.285   0.125   0.058      0
***Record 40
    0
        YEAR      10           YEAR      10           YEAR      10   1
    1
    1  -----
    7    YEAR
  PRCP    TCUM   0   0
  RUNF    TCUM   0   0
  INFL    TCUM   1   1
  ESLS    TCUM   0   0  1.0E3
  RFLX    TCUM   0   0  1.0E5
  EFLX    TCUM   0   0  1.0E5
  RZFX    TCUM   0   0  1.0E5
```

```
OR Wheat; 8/07/2001
"Willamette Valley; MLRA 2; Metfile: W24232.dvf (old: Met2.met),"
*** Record 3:
    0.74    0.36       0      17       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.13    1.34       1      10               2       6     354
*** Record 8
       1
*** Record 9
       1     0.1      23     100       1  92  86  87       0     100
*** Record 9a-d
       1      27
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1507 1607
0108
.226 .240 .254 .259 .265 .262 .224 .154 .101 .089 .091 .092 .092 .017 .017
.051
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
.023
1008 1508 1608 0109 1609 0110 1610 0111 1611 0112 1612
.154 .223 .228 .231 .220 .210 .230 .267 .302 .323 .336
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  010961  100361  010761       1
  010962  100362  010762       1
  010963  100363  010763       1
  010964  100364  010764       1
  010965  100365  010765       1
  010966  100366  010766       1
  010967  100367  010767       1
  010968  100368  010768       1
  010969  100369  010769       1
  010970  100370  010770       1
  010971  100371  010771       1
  010972  100372  010772       1
  010973  100373  010773       1
  010974  100374  010774       1
  010975  100375  010775       1
  010976  100376  010776       1
  010977  100377  010777       1
  010978  100378  010778       1
  010979  100379  010779       1
  010980  100380  010780       1
  010981  100381  010781       1
  010982  100382  010782       1
  010983  100383  010783       1
  010984  100384  010784       1
  010985  100385  010785       1
  010986  100386  010786       1
  010987  100387  010787       1
  010988  100388  010788       1
  010989  100389  010789       1
  010990  100390  010790       1
*** Record 12 -- PTITLE
MCPA EHE - 1 applications @ 1.68 kg/ha
```

```
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
MCPA EHE
*** Record 16
  150561  0 2  0.0  1.68 0.95 0.05
  150562  0 2  0.0  1.68 0.95 0.05
  150563  0 2  0.0  1.68 0.95 0.05
  150564  0 2  0.0  1.68 0.95 0.05
  150565  0 2  0.0  1.68 0.95 0.05
  150566  0 2  0.0  1.68 0.95 0.05
  150567  0 2  0.0  1.68 0.95 0.05
  150568  0 2  0.0  1.68 0.95 0.05
  150569  0 2  0.0  1.68 0.95 0.05
  150570  0 2  0.0  1.68 0.95 0.05
  150571  0 2  0.0  1.68 0.95 0.05
  150572  0 2  0.0  1.68 0.95 0.05
  150573  0 2  0.0  1.68 0.95 0.05
  150574  0 2  0.0  1.68 0.95 0.05
  150575  0 2  0.0  1.68 0.95 0.05
  150576  0 2  0.0  1.68 0.95 0.05
  150577  0 2  0.0  1.68 0.95 0.05
  150578  0 2  0.0  1.68 0.95 0.05
  150579  0 2  0.0  1.68 0.95 0.05
  150580  0 2  0.0  1.68 0.95 0.05
  150581  0 2  0.0  1.68 0.95 0.05
  150582  0 2  0.0  1.68 0.95 0.05
  150583  0 2  0.0  1.68 0.95 0.05
  150584  0 2  0.0  1.68 0.95 0.05
  150585  0 2  0.0  1.68 0.95 0.05
  150586  0 2  0.0  1.68 0.95 0.05
  150587  0 2  0.0  1.68 0.95 0.05
  150588  0 2  0.0  1.68 0.95 0.05
  150589  0 2  0.0  1.68 0.95 0.05
  150590  0 2  0.0  1.68 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
Bashaw Clay; HYDG: D
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10500
*** Record 33
       3
       1      10     1.3   0.487       0       0       0
               0       0       0
             0.1   0.487   0.347    4.64       0
       2      26     1.3   0.487       0       0       0
               0       0       0
               2   0.487   0.347    4.64       0
       3      64     1.3   0.441       0       0       0
               0       0       0
               2   0.441   0.301    0.29       0
```

```
***Record 40
      0
          YEAR      10            YEAR      10            YEAR      10   1
      1
      1  -----
      7   YEAR
   PRCP   TCUM   0   0
   RUNF   TCUM   0   0
   INFL   TCUM   1   1
   ESLS   TCUM   0   0  1.0E3
   RFLX   TCUM   0   0  1.0E5
   EFLX   TCUM   0   0  1.0E5
   RZFX   TCUM   0   0  1.0E5
```

```
CAalfalf.txt – California central valley alfalfa 14Aug2001
"Central valley of California MLRA17, Metfile: W93193.dvf (old: Met18.met or
Met17.met), San Joaquin county"
*** Record 3:
    0.73    0.45       0      15       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
     0.2    0.19       1      10               1       2     354
*** Record 8
       1
*** Record 9
       1    0.25      60     100       1  90  88  89       0      45
*** Record 9a-d
       1      24
0101 1601 0102 1602 0103 1603 0104 1604 0105 1605 0106 1606 0107 1607 0108
1608
.068 .076 .092 .099 .147 .175 .193 .212 .221 .217 .208 .197 .180 .163 .155
.154
.023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023 .023
.023
0109 1609 0110 1610 0111 1611 0112 1612
.161 .170 .180 .188 .046 .051 .056 .061
.023 .023 .023 .023 .023 .023 .023 .023
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  100161  281261  311261       1
  100162  281262  311262       1
  100163  281263  311263       1
  100164  281264  311264       1
  100165  281265  311265       1
  100166  281266  311266       1
  100167  281267  311267       1
  100168  281268  311268       1
  100169  281269  311269       1
  100170  281270  311270       1
  100171  281271  311271       1
  100172  281272  311272       1
  100173  281273  311273       1
  100174  281274  311274       1
  100175  281275  311275       1
  100176  281276  311276       1
  100177  281277  311277       1
  100178  281278  311278       1
  100179  281279  311279       1
  100180  281280  311280       1
  100181  281281  311281       1
  100182  281282  311282       1
  100183  281283  311283       1
  100184  281284  311284       1
  100185  281285  311285       1
  100186  281286  311286       1
  100187  281287  311287       1
  100188  281288  311288       1
  100189  281289  311289       1
  100190  281290  311290       1
*** Record 12 -- PTITLE
```

```
MCPA EHE - 1 applications @ 2.63 kg/ha
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
MCPA EHE
*** Record 16
  010261  0 2  0.0  2.63 0.95 0.05
  010262  0 2  0.0  2.63 0.95 0.05
  010263  0 2  0.0  2.63 0.95 0.05
  010264  0 2  0.0  2.63 0.95 0.05
  010265  0 2  0.0  2.63 0.95 0.05
  010266  0 2  0.0  2.63 0.95 0.05
  010267  0 2  0.0  2.63 0.95 0.05
  010268  0 2  0.0  2.63 0.95 0.05
  010269  0 2  0.0  2.63 0.95 0.05
  010270  0 2  0.0  2.63 0.95 0.05
  010271  0 2  0.0  2.63 0.95 0.05
  010272  0 2  0.0  2.63 0.95 0.05
  010273  0 2  0.0  2.63 0.95 0.05
  010274  0 2  0.0  2.63 0.95 0.05
  010275  0 2  0.0  2.63 0.95 0.05
  010276  0 2  0.0  2.63 0.95 0.05
  010277  0 2  0.0  2.63 0.95 0.05
  010278  0 2  0.0  2.63 0.95 0.05
  010279  0 2  0.0  2.63 0.95 0.05
  010280  0 2  0.0  2.63 0.95 0.05
  010281  0 2  0.0  2.63 0.95 0.05
  010282  0 2  0.0  2.63 0.95 0.05
  010283  0 2  0.0  2.63 0.95 0.05
  010284  0 2  0.0  2.63 0.95 0.05
  010285  0 2  0.0  2.63 0.95 0.05
  010286  0 2  0.0  2.63 0.95 0.05
  010287  0 2  0.0  2.63 0.95 0.05
  010288  0 2  0.0  2.63 0.95 0.05
  010289  0 2  0.0  2.63 0.95 0.05
  010290  0 2  0.0  2.63 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
"Sacramento clay, Hyd grp D"
*** Record 20
     176           0   0   1   0   0   2   0   0   0
*** Record 26
       0       0       0
*** Record 27 -- irrigation
       1     0.1    0.55     0.4
*** Record 30
       4   10500
*** Record 33
       4
       1      10    1.43    0.42       0       0       0
               0       0       0
             0.1    0.42    0.36    1.77       0
       2       8    1.43    0.42       0       0       0
               0       0       0
               4    0.42    0.36    1.77       0
```

```
       3      157     1.29     0.44        0        0        0
                0        0        0
             15.7     0.44     0.36     0.84        0
       3        1     1.48     0.39        0        0        0
                0        0        0
                1     0.39      0.3     0.84        0
***Record 40
       0
             YEAR       10              YEAR       10              YEAR       10   1
       1
       1  -----
       7     YEAR
    PRCP     TCUM   0   0
    RUNF     TCUM   0   0
    INFL     TCUM   1   1
    ESLS     TCUM   0   0  1.0E3
    RFLX     TCUM   0   0  1.0E5
    EFLX     TCUM   0   0  1.0E5
    RZFX     TCUM   0   0  1.0E5
```

```
PA Alfalfa; 8/14/01
"York Co, MLRA 148; Metfile: W14737.dvf (old: Met148.met),
*** Record 3:
    0.76     0.3       0    12.5       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.33   0.123     0.6      10               3      12     354
*** Record 8
       1
*** Record 9
       1    0.25     120     100       1  87  83  86       0      61
*** Record 9a-d
       1      26
0101 1601 0102 1602 0103 1503 1603 0104 1604 0105 1605 0106 1506 1606 0107
1607
.015 .015 .015 .015 .015 .017 .012 .006 .002 .007 .004 .002 .007 .005 .003
.001
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110
.110
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.005 .003 .003 .005 .009 .013 .013 .014 .014 .015
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  150461  311061  311061       1
  150462  311062  311062       1
  150463  311063  311063       1
  150464  311064  311064       1
  150465  311065  311065       1
  150466  311066  311066       1
  150467  311067  311067       1
  150468  311068  311068       1
  150469  311069  311069       1
  150470  311070  311070       1
  150471  311071  311071       1
  150472  311072  311072       1
  150473  311073  311073       1
  150474  311074  311074       1
  150475  311075  311075       1
  150476  311076  311076       1
  150477  311077  311077       1
  150478  311078  311078       1
  150479  311079  311079       1
  150480  311080  311080       1
  150481  311081  311081       1
  150482  311082  311082       1
  150483  311083  311083       1
  150484  311084  311084       1
  150485  311085  311085       1
  150486  311086  311086       1
  150487  311087  311087       1
  150488  311088  311088       1
  150489  311089  311089       1
  150490  311090  311090       1
*** Record 12 -- PTITLE
MCPA EHE - 1 applications @ 2.63 kg/ha
```

```
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
MCPA EHE
*** Record 16
  010661  0 2  0.0  2.63 0.95 0.05
  010662  0 2  0.0  2.63 0.95 0.05
  010663  0 2  0.0  2.63 0.95 0.05
  010664  0 2  0.0  2.63 0.95 0.05
  010665  0 2  0.0  2.63 0.95 0.05
  010666  0 2  0.0  2.63 0.95 0.05
  010667  0 2  0.0  2.63 0.95 0.05
  010668  0 2  0.0  2.63 0.95 0.05
  010669  0 2  0.0  2.63 0.95 0.05
  010670  0 2  0.0  2.63 0.95 0.05
  010671  0 2  0.0  2.63 0.95 0.05
  010672  0 2  0.0  2.63 0.95 0.05
  010673  0 2  0.0  2.63 0.95 0.05
  010674  0 2  0.0  2.63 0.95 0.05
  010675  0 2  0.0  2.63 0.95 0.05
  010676  0 2  0.0  2.63 0.95 0.05
  010677  0 2  0.0  2.63 0.95 0.05
  010678  0 2  0.0  2.63 0.95 0.05
  010679  0 2  0.0  2.63 0.95 0.05
  010680  0 2  0.0  2.63 0.95 0.05
  010681  0 2  0.0  2.63 0.95 0.05
  010682  0 2  0.0  2.63 0.95 0.05
  010683  0 2  0.0  2.63 0.95 0.05
  010684  0 2  0.0  2.63 0.95 0.05
  010685  0 2  0.0  2.63 0.95 0.05
  010686  0 2  0.0  2.63 0.95 0.05
  010687  0 2  0.0  2.63 0.95 0.05
  010688  0 2  0.0  2.63 0.95 0.05
  010689  0 2  0.0  2.63 0.95 0.05
  010690  0 2  0.0  2.63 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
"Glenville, Silt Loam, HYDG: C"
*** Record 20
     120           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10500
*** Record 33
       3
       1      10     1.4   0.254       0       0       0
               0       0       0
             0.1   0.254   0.094    1.74       0
       2      12     1.4   0.254       0       0       0
               0       0       0
               2   0.254   0.094    1.74       0
       3      98     1.8   0.201       0       0       0
               0       0       0
               2   0.201   0.121   0.174       0
```

```
***Record 40
      0
        YEAR      10           YEAR      10           YEAR      10   1
      1
      1  -----
      7    YEAR
   PRCP    TCUM   0   0
   RUNF    TCUM   0   0
   INFL    TCUM   1   1
   ESLS    TCUM   0   0  1.0E3
   RFLX    TCUM   0   0  1.0E5
   EFLX    TCUM   0   0  1.0E5
   RZFX    TCUM   0   0  1.0E5
```

```
MN Alfalfa; 8/16/2001
"Red River Valley; Polk County, MN; MLRA: 56, Metfile: W14914.dvf (old: Met
56.met),
*** Record 3:
    0.75     0.5       0      12       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.28    0.17     0.5      10               3     1.5     354
*** Record 8
       1
*** Record 9
       1    0.25     100     100       3  85  81  83       0      50
*** Record 9a-d
       1      26
0101 1601 0102 1602 0103 1503 1603 0104 1604 0105 1605 0106 1506 1606 0107
1607
.009 .009 .009 .009 .009 .010 .007 .003 .001 .005 .002 .001 .005 .004 .002
.001
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110
.110
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.004 .002 .002 .003 .006 .008 .008 .008 .008 .008
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  270561  250861  300861       1
  270562  250862  300862       1
  270563  250863  300863       1
  270564  250864  300864       1
  270565  250865  300865       1
  270566  250866  300866       1
  270567  250867  300867       1
  270568  250868  300868       1
  270569  250869  300869       1
  270570  250870  300870       1
  270571  250871  300871       1
  270572  250872  300872       1
  270573  250873  300873       1
  270574  250874  300874       1
  270575  250875  300875       1
  270576  250876  300876       1
  270577  250877  300877       1
  270578  250878  300878       1
  270579  250879  300879       1
  270580  250880  300880       1
  270581  250881  300881       1
  270582  250882  300882       1
  270583  250883  300883       1
  270584  250884  300884       1
  270585  250885  300885       1
  270586  250886  300886       1
  270587  250887  300887       1
  270588  250888  300888       1
  270589  250889  300889       1
  270590  250890  300890       1
*** Record 12 -- PTITLE
```

```
MCPA EHE - 1 applications @ 2.63 kg/ha
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
MCPA EHE
*** Record 16
  010661  0 2  0.0  2.63 0.95 0.05
  010662  0 2  0.0  2.63 0.95 0.05
  010663  0 2  0.0  2.63 0.95 0.05
  010664  0 2  0.0  2.63 0.95 0.05
  010665  0 2  0.0  2.63 0.95 0.05
  010666  0 2  0.0  2.63 0.95 0.05
  010667  0 2  0.0  2.63 0.95 0.05
  010668  0 2  0.0  2.63 0.95 0.05
  010669  0 2  0.0  2.63 0.95 0.05
  010670  0 2  0.0  2.63 0.95 0.05
  010671  0 2  0.0  2.63 0.95 0.05
  010672  0 2  0.0  2.63 0.95 0.05
  010673  0 2  0.0  2.63 0.95 0.05
  010674  0 2  0.0  2.63 0.95 0.05
  010675  0 2  0.0  2.63 0.95 0.05
  010676  0 2  0.0  2.63 0.95 0.05
  010677  0 2  0.0  2.63 0.95 0.05
  010678  0 2  0.0  2.63 0.95 0.05
  010679  0 2  0.0  2.63 0.95 0.05
  010680  0 2  0.0  2.63 0.95 0.05
  010681  0 2  0.0  2.63 0.95 0.05
  010682  0 2  0.0  2.63 0.95 0.05
  010683  0 2  0.0  2.63 0.95 0.05
  010684  0 2  0.0  2.63 0.95 0.05
  010685  0 2  0.0  2.63 0.95 0.05
  010686  0 2  0.0  2.63 0.95 0.05
  010687  0 2  0.0  2.63 0.95 0.05
  010688  0 2  0.0  2.63 0.95 0.05
  010689  0 2  0.0  2.63 0.95 0.05
  010690  0 2  0.0  2.63 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
Bearden silty clay loam; HTDG: C
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10500
*** Record 33
       4
       1      10     1.4   0.377       0       0       0
               0       0       0
             0.1   0.377   0.207    1.74       0
       2       8     1.4   0.377       0       0       0
               0       0       0
             0.1   0.377   0.207    1.74       0
       3      54     1.5   0.292       0       0       0
               0       0       0
```

```
             1   0.292   0.132   0.116        0
     4      28     1.8   0.285       0        0        0
             0       0       0
             2   0.285   0.125   0.058        0
***Record 40
     0
          YEAR      10            YEAR      10            YEAR      10   1
     1
     1  -----
     7    YEAR
   PRCP    TCUM   0   0
   RUNF    TCUM   0   0
   INFL    TCUM   1   1
   ESLS    TCUM   0   0  1.0E3
   RFLX    TCUM   0   0  1.0E5
   EFLX    TCUM   0   0  1.0E5
   RZFX    TCUM   0   0  1.0E5
```

```
OR Snapbeans
"OR/WA Snap Beans; MLRA 2; Metfile: W24232.dvf (old: Met2.met),"
*** Record 3:
    0.74    0.15       0      17       1       1
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.43   0.173       1      10               2       1     354
*** Record 8
       1
*** Record 9
       1     0.1      18      80       1  92  89  90       0      50
*** Record 9a-d
       1      27
0101 1601 0102 1602 0103 1603 0104 1604 0105 1505 1605 2505 0106 1606 0107
1607
.547 .567 .588 .610 .635 .664 .694 .720 .742 .769 .775 .884 .796 .542 .268
.166
.011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011
.011
0108 1008 1608 0109 1609 0110 1610 0111 1611 0112 1612
.152 .186 .204 .233 .269 .318 .373 .424 .464 .497 .525
.011 .011 .011 .011 .011 .011 .011 .011 .011 .011 .011
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  110661  180861  020961       1
  110662  180862  020962       1
  110663  180863  020963       1
  110664  180864  020964       1
  110665  180865  020965       1
  110666  180866  020966       1
  110667  180867  020967       1
  110668  180868  020968       1
  110669  180869  020969       1
  110670  180870  020970       1
  110671  180871  020971       1
  110672  180872  020972       1
  110673  180873  020973       1
  110674  180874  020974       1
  110675  180875  020975       1
  110676  180876  020976       1
  110677  180877  020977       1
  110678  180878  020978       1
  110679  180879  020979       1
  110680  180880  020980       1
  110681  180881  020981       1
  110682  180882  020982       1
  110683  180883  020983       1
  110684  180884  020984       1
  110685  180885  020985       1
  110686  180886  020986       1
  110687  180887  020987       1
  110688  180888  020988       1
  110689  180889  020989       1
  110690  180890  020990       1
*** Record 12 -- PTITLE
MCPA EHE - 1 applications @ 0.42 kg/ha
```

```
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
MCPA EHE
*** Record 16
  150561  0 2  0.0  0.42 0.95 0.05
  150562  0 2  0.0  0.42 0.95 0.05
  150563  0 2  0.0  0.42 0.95 0.05
  150564  0 2  0.0  0.42 0.95 0.05
  150565  0 2  0.0  0.42 0.95 0.05
  150566  0 2  0.0  0.42 0.95 0.05
  150567  0 2  0.0  0.42 0.95 0.05
  150568  0 2  0.0  0.42 0.95 0.05
  150569  0 2  0.0  0.42 0.95 0.05
  150570  0 2  0.0  0.42 0.95 0.05
  150571  0 2  0.0  0.42 0.95 0.05
  150572  0 2  0.0  0.42 0.95 0.05
  150573  0 2  0.0  0.42 0.95 0.05
  150574  0 2  0.0  0.42 0.95 0.05
  150575  0 2  0.0  0.42 0.95 0.05
  150576  0 2  0.0  0.42 0.95 0.05
  150577  0 2  0.0  0.42 0.95 0.05
  150578  0 2  0.0  0.42 0.95 0.05
  150579  0 2  0.0  0.42 0.95 0.05
  150580  0 2  0.0  0.42 0.95 0.05
  150581  0 2  0.0  0.42 0.95 0.05
  150582  0 2  0.0  0.42 0.95 0.05
  150583  0 2  0.0  0.42 0.95 0.05
  150584  0 2  0.0  0.42 0.95 0.05
  150585  0 2  0.0  0.42 0.95 0.05
  150586  0 2  0.0  0.42 0.95 0.05
  150587  0 2  0.0  0.42 0.95 0.05
  150588  0 2  0.0  0.42 0.95 0.05
  150589  0 2  0.0  0.42 0.95 0.05
  150590  0 2  0.0  0.42 0.95 0.05
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
Dayton; HYDG: D
*** Record 20
     100           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10500
*** Record 33
       3
       1      10     1.4   0.312       0       0       0
               0       0       0
             0.1   0.312   0.132    2.32       0
       2       8     1.4   0.312       0       0       0
               0       0       0
               2   0.312   0.132    2.32       0
       3      82     1.4   0.266       0       0       0
               0       0       0
               2   0.266   0.236    0.29       0
```

```
***Record 40
      0
         YEAR      10             YEAR      10             YEAR      10   1
      1
      1  -----
      7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
```

```
PA Turf; 9/28/01
"York Co, MLRA 148; Metfile: W14737.dvf (old: Met148.met),
*** Record 3:
    0.76     0.3       0    12.5       1       3
*** Record 6 -- ERFLAG
       4
*** Record 7:
    0.33   0.123       1      10               3      12     354
*** Record 8
       1
*** Record 9
       1     0.1      10     100       3  74  74  74       0       5
*** Record 9a-d
       1      26
0101 1601 0102 1602 0103 1503 1603 0104 1604 0105 1605 0106 1506 1606 0107
1607
.015 .015 .015 .015 .015 .017 .012 .006 .002 .007 .004 .002 .007 .005 .003
.001
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110
.110
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.005 .003 .003 .005 .009 .013 .013 .014 .014 .015
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110
*** Record 10 -- NCPDS, the number of cropping periods
      30
*** Record 11
  010461  150461  011161       1
  010462  150462  011162       1
  010463  150463  011163       1
  010464  150464  011164       1
  010465  150465  011165       1
  010466  150466  011166       1
  010467  150467  011167       1
  010468  150468  011168       1
  010469  150469  011169       1
  010470  150470  011170       1
  010471  150471  011171       1
  010472  150472  011172       1
  010473  150473  011173       1
  010474  150474  011174       1
  010475  150475  011175       1
  010476  150476  011176       1
  010477  150477  011177       1
  010478  150478  011178       1
  010479  150479  011179       1
  010480  150480  011180       1
  010481  150481  011181       1
  010482  150482  011182       1
  010483  150483  011183       1
  010484  150484  011184       1
  010485  150485  011185       1
  010486  150486  011186       1
  010487  150487  011187       1
  010488  150488  011188       1
  010489  150489  011189       1
  010490  150490  011190       1
*** Record 12 -- PTITLE
MCPA EHE - 1 applications @ 1.96 kg/ha
```

```
*** Record 13
      30       1       0       0
*** Record 15 -- PSTNAM
MCPA EHE
*** Record 16
  150561  0 2  0.0  1.96 0.99 0.01
  150562  0 2  0.0  1.96 0.99 0.01
  150563  0 2  0.0  1.96 0.99 0.01
  150564  0 2  0.0  1.96 0.99 0.01
  150565  0 2  0.0  1.96 0.99 0.01
  150566  0 2  0.0  1.96 0.99 0.01
  150567  0 2  0.0  1.96 0.99 0.01
  150568  0 2  0.0  1.96 0.99 0.01
  150569  0 2  0.0  1.96 0.99 0.01
  150570  0 2  0.0  1.96 0.99 0.01
  150571  0 2  0.0  1.96 0.99 0.01
  150572  0 2  0.0  1.96 0.99 0.01
  150573  0 2  0.0  1.96 0.99 0.01
  150574  0 2  0.0  1.96 0.99 0.01
  150575  0 2  0.0  1.96 0.99 0.01
  150576  0 2  0.0  1.96 0.99 0.01
  150577  0 2  0.0  1.96 0.99 0.01
  150578  0 2  0.0  1.96 0.99 0.01
  150579  0 2  0.0  1.96 0.99 0.01
  150580  0 2  0.0  1.96 0.99 0.01
  150581  0 2  0.0  1.96 0.99 0.01
  150582  0 2  0.0  1.96 0.99 0.01
  150583  0 2  0.0  1.96 0.99 0.01
  150584  0 2  0.0  1.96 0.99 0.01
  150585  0 2  0.0  1.96 0.99 0.01
  150586  0 2  0.0  1.96 0.99 0.01
  150587  0 2  0.0  1.96 0.99 0.01
  150588  0 2  0.0  1.96 0.99 0.01
  150589  0 2  0.0  1.96 0.99 0.01
  150590  0 2  0.0  1.96 0.99 0.01
*** Record 17
       0       1       0
*** Record 18
       0       0     0.5
*** Record 19 -- STITLE
"Glenville, Silt Loam, HYDG: C"
*** Record 20
     102           0   0   1   0   0   0   0   0   0
*** Record 26
       0       0       0
*** Record 30
       4   10500
*** Record 33
       4
       1       2    0.37    0.47       0       0       0
               0       0       0
             0.1    0.47    0.27     7.5       0
       2      10     1.4   0.254       0       0       0
               0       0       0
             0.1   0.254   0.094    1.74       0
       3      12     1.4   0.254       0       0       0
               0       0       0
               2   0.254   0.094    1.74       0
```

```
       4       78      1.8   0.201       0       0       0
                0        0       0
                2    0.201   0.121   0.174       0
***Record 40
       0
          YEAR       10             YEAR       10             YEAR       10   1
       1
       1  -----
       7    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    INFL    TCUM   1   1
    ESLS    TCUM   0   0  1.0E3
    RFLX    TCUM   0   0  1.0E5
    EFLX    TCUM   0   0  1.0E5
    RZFX    TCUM   0   0  1.0E5
```

stored as eheNDwht.out
Chemical: MCPA EHE
PRZM environment: NDwheatC.txt modified Satday, 12 October 2002 at 17:15:08
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14914.dvf modified Wedday, 3 July 2002 at 09:05:52
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	4.095	2.586	0.8665	0.5689	0.5363	0.2622
1962	4.566	3.145	1.541	1.227	1.18	0.7568
1963	5.204	3.561	1.655	1.065	1.027	0.8169
1964	7.437	5.041	2.216	1.576	1.494	1.04
1965	4.938	3.603	1.811	1.384	1.356	1.152
1966	4.832	3.314	1.786	1.346	1.265	1.111
1967	4.84	3.362	1.666	1.22	1.197	0.8816
1968	4.573	3.084	1.421	0.9696	0.8836	0.6717
1969	7.68	5.176	2.933	1.777	1.563	1.086
1970	9.42	6.306	2.645	1.708	1.607	1.279
1971	6.966	4.763	2.151	1.959	1.91	1.453
1972	5.396	3.856	2.617	2.032	1.966	1.582
1973	7.895	5.448	2.689	2.185	1.966	1.388
1974	12.93	8.674	3.917	2.902	2.505	1.985
1975	9.686	7.775	4.722	3.064	2.72	2.223
1976	5.359	3.753	2.414	2.281	2.218	1.421
1977	14.27	9.069	3.463	2.398	2.489	1.83
1978	7.167	5.088	3.063	2.373	2.28	1.926
1979	5.892	4.444	2.729	2.384	2.196	1.826
1980	7.051	4.906	2.627	2.273	1.982	1.64
1981	5.493	3.885	2.438	1.702	1.526	1.247
1982	14.59	9.733	4.156	2.545	2.273	1.335
1983	5.109	3.603	2.113	1.919	1.874	1.558
1984	10.64	7.562	3.91	2.644	2.341	1.772
1985	6.269	4.496	2.505	2.114	1.957	1.657
1986	5.793	4.159	2.624	2.054	1.96	1.695
1987	5.181	3.637	1.883	1.689	1.686	1.321
1988	6.215	4.701	2.073	1.446	1.317	1.088
1989	9.446	7.002	3.459	2.353	2.056	1.56
1990	8.582	5.823	2.987	2.049	1.846	1.539

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	14.59	9.733	4.722	3.064	2.72	2.223
0.0645161290322581	14.27	9.069	4.156	2.902	2.505	1.985
0.0967741935483871	12.93	8.674	3.917	2.644	2.489	1.926

0.129032258064516	10.64	7.775	3.91	2.545	2.341	1.83
0.161290322580645	9.686	7.562	3.463	2.398	2.28	1.826
0.193548387096774	9.446	7.002	3.459	2.384	2.273	1.772
0.225806451612903	9.42	6.306	3.063	2.373	2.218	1.695
0.258064516129032	8.582	5.823	2.987	2.353	2.196	1.657
0.290322580645161	7.895	5.448	2.933	2.281	2.056	1.64
0.32258064516129	7.68	5.176	2.729	2.273	1.982	1.582
0.354838709677419	7.437	5.088	2.689	2.185	1.966	1.56
0.387096774193548	7.167	5.041	2.645	2.114	1.966	1.558
0.419354838709677	7.051	4.906	2.627	2.054	1.96	1.539
0.451612903225806	6.966	4.763	2.624	2.049	1.957	1.453
0.483870967741936	6.269	4.701	2.617	2.032	1.91	1.421
0.516129032258065	6.215	4.496	2.505	1.959	1.874	1.388
0.548387096774194	5.892	4.444	2.438	1.919	1.846	1.335
0.580645161290323	5.793	4.159	2.414	1.777	1.686	1.321
0.612903225806452	5.493	3.885	2.216	1.708	1.607	1.279
0.645161290322581	5.396	3.856	2.151	1.702	1.563	1.247
0.67741935483871	5.359	3.753	2.113	1.689	1.526	1.152
0.709677419354839	5.204	3.637	2.073	1.576	1.494	1.111
0.741935483870968	5.181	3.603	1.883	1.446	1.356	1.088
0.774193548387097	5.109	3.603	1.811	1.384	1.317	1.086
0.806451612903226	4.938	3.561	1.786	1.346	1.265	1.04
0.838709677419355	4.84	3.362	1.666	1.227	1.197	0.8816
0.870967741935484	4.832	3.314	1.655	1.22	1.18	0.8169
0.903225806451613	4.573	3.145	1.541	1.065	1.027	0.7568
0.935483870967742	4.566	3.084	1.421	0.9696	0.8836	0.6717
0.967741935483871	4.095	2.586	0.8665	0.5689	0.5363	0.2622

0.1 12.701 8.5841 3.9163 2.6341 2.4742 1.9164

Average of yearly averages: 1.37010666666667

Inputs generaged by pe4.pl - 14-May-2003

stored as MCPA EHE.out
Chemical: MCPA EHE
PRZM environment: ORwheatC.txt modified Satday, 12 October 2002 at 17:22:28
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w24232.dvf modified Wedday, 3 July 2002 at 09:06:10
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	4.095	2.682	0.9583	0.47	0.3752	0.1757
1962	4.332	2.94	1.328	0.8742	0.7818	0.4688
1963	4.973	3.548	1.775	1.321	1.187	0.9263
1964	8.712	6.732	2.878	1.687	1.335	1.061
1965	5.69	4.337	2.359	1.838	1.701	1.399
1966	5.291	3.935	2.441	1.789	1.794	1.41
1967	5.641	4.144	2.24	1.634	1.478	1.225
1968	5.361	4.144	2.998	2.202	2.105	1.705
1969	6.005	4.535	3.092	2.503	2.208	1.82
1970	7.053	4.607	3.22	2.86	2.588	1.944
1971	5.617	4.21	2.725	2.146	2.044	1.837
1972	8.827	6.298	3.297	2.398	2.177	1.725
1973	9.494	6.708	4.095	3.062	2.354	1.593
1974	9.787	7.794	4.405	3.14	2.924	2.134
1975	5.43	4.035	2.244	1.886	1.809	1.523
1976	5.33	3.948	2.167	1.765	1.737	1.309
1977	5.11	4.032	2.421	1.677	1.342	0.9155
1978	6.035	4.323	2.215	1.523	1.414	1.244
1979	5.144	3.732	2.352	2.013	1.817	1.421
1980	9.292	7.17	3.572	2.75	2.193	1.793
1981	6.269	4.711	3.248	2.779	2.566	2.054
1982	5.774	4.385	2.735	2.481	2.313	1.855
1983	5.797	4.394	2.936	2.47	2.279	1.876
1984	6.509	4.701	2.787	2.313	1.946	1.589
1985	5.271	3.875	2.147	1.892	1.688	1.448
1986	5.105	3.716	2.155	1.551	1.457	1.211
1987	9.982	7.36	4.461	2.329	1.861	1.455
1988	5.551	4.087	2.819	2.172	2.008	1.556
1989	9.694	6.937	3.268	1.968	1.642	1.288
1990	5.441	4.025	2.518	2.19	2.009	1.584

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	9.982	7.794	4.461	3.14	2.924	2.134
0.0645161290322581	9.787	7.36	4.405	3.062	2.588	2.054
0.0967741935483871	9.694	7.17	4.095	2.86	2.566	1.944

0.129032258064516	9.494	6.937	3.572	2.779	2.354	1.876
0.161290322580645	9.292	6.732	3.297	2.75	2.313	1.855
0.193548387096774	8.827	6.708	3.268	2.503	2.279	1.837
0.225806451612903	8.712	6.298	3.248	2.481	2.208	1.82
0.258064516129032	7.053	4.711	3.22	2.47	2.193	1.793
0.290322580645161	6.509	4.701	3.092	2.398	2.177	1.725
0.32258064516129	6.269	4.607	2.998	2.329	2.105	1.705
0.354838709677419	6.035	4.535	2.936	2.313	2.044	1.593
0.387096774193548	6.005	4.394	2.878	2.202	2.009	1.589
0.419354838709677	5.797	4.385	2.819	2.19	2.008	1.584
0.451612903225806	5.774	4.337	2.787	2.172	1.946	1.556
0.483870967741936	5.69	4.323	2.735	2.146	1.861	1.523
0.516129032258065	5.641	4.21	2.725	2.013	1.817	1.455
0.548387096774194	5.617	4.144	2.518	1.968	1.809	1.448
0.580645161290323	5.551	4.144	2.441	1.892	1.794	1.421
0.612903225806452	5.441	4.087	2.421	1.886	1.737	1.41
0.645161290322581	5.43	4.035	2.359	1.838	1.701	1.399
0.67741935483871	5.361	4.032	2.352	1.789	1.688	1.309
0.709677419354839	5.33	4.025	2.244	1.765	1.642	1.288
0.741935483870968	5.291	3.948	2.24	1.687	1.478	1.244
0.774193548387097	5.271	3.935	2.215	1.677	1.457	1.225
0.806451612903226	5.144	3.875	2.167	1.634	1.414	1.211
0.838709677419355	5.11	3.732	2.155	1.551	1.342	1.061
0.870967741935484	5.105	3.716	2.147	1.523	1.335	0.9263
0.903225806451613	4.973	3.548	1.775	1.321	1.187	0.9155
0.935483870967742	4.332	2.94	1.328	0.8742	0.7818	0.4688
0.967741935483871	4.095	2.682	0.9583	0.47	0.3752	0.1757

0.1 9.674 7.1467 4.0427 2.8519 2.5448 1.9372

Average of yearly averages: 1.45151

Inputs generaged by pe4.pl - 14-May-2003

stored as MCPA EHE.out
Chemical: MCPA EHE
PRZM environment: CAalfalfaC.txt modified Satday, 12 October 2002 at 16:27:56
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w93193.dvf modified Wedday, 3 July 2002 at 09:04:24
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	6.41	4.257	1.53	0.7171	0.5595	0.2436
1962	6.526	4.398	1.997	1.013	0.8105	0.382
1963	6.612	4.447	1.81	0.9488	0.7966	0.3921
1964	6.595	4.487	1.735	0.8952	0.7233	0.3502
1965	6.563	4.437	1.687	0.924	0.7482	0.3616
1966	6.584	4.462	1.709	0.8734	0.7034	0.344
1967	6.579	4.524	1.773	0.9237	0.7771	0.3873
1968	6.598	4.509	1.768	0.9282	0.7577	0.372
1969	6.628	4.435	1.696	1.034	0.8582	0.4295
1970	6.617	4.471	1.719	0.9445	0.7658	0.3859
1971	6.587	4.412	1.662	0.8488	0.6911	0.3347
1972	6.558	4.424	1.693	0.8562	0.6853	0.3293
1973	6.554	4.424	1.785	0.9298	0.7472	0.3649
1974	6.581	4.442	1.691	0.8725	0.7061	0.3473
1975	6.575	4.426	1.674	0.8572	0.6949	0.3494
1976	6.589	4.489	2.067	1.061	0.8581	0.4177
1977	6.607	4.461	1.709	0.8858	0.7145	0.3504
1978	6.564	4.415	1.924	1.019	0.8465	0.4083
1979	6.6	4.456	1.716	0.8967	0.7204	0.3489
1980	6.562	4.374	1.753	0.9536	0.7664	0.3639
1981	6.586	4.457	1.713	0.8861	0.7152	0.3377
1982	6.558	4.449	1.699	0.8913	0.7265	0.351
1983	6.615	4.422	1.755	0.9427	0.7702	0.3819
1984	6.592	4.479	1.748	0.8974	0.7205	0.3446
1985	6.576	4.524	1.79	0.92	0.74	0.359
1986	6.6	4.384	1.827	0.981	0.792	0.3936
1987	6.597	4.451	1.723	0.9116	0.7381	0.3718
1988	6.582	4.514	1.766	0.918	0.7606	0.3805
1989	6.604	4.529	1.776	0.9538	0.7701	0.3764
1990	6.593	4.473	1.721	0.8894	0.7234	0.3622

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	6.628	4.529	2.067	1.061	0.8582	0.4295
0.0645161290322581	6.617	4.524	1.997	1.034	0.8581	0.4177
0.0967741935483871	6.615	4.524	1.924	1.019	0.8465	0.4083

0.129032258064516	6.612	4.514	1.827	1.013	0.8105	0.3936
0.161290322580645	6.607	4.509	1.81	0.981	0.7966	0.3921
0.193548387096774	6.604	4.489	1.79	0.9538	0.792	0.3873
0.225806451612903	6.6	4.487	1.785	0.9536	0.7771	0.3859
0.258064516129032	6.6	4.479	1.776	0.9488	0.7702	0.382
0.290322580645161	6.598	4.473	1.773	0.9445	0.7701	0.3819
0.32258064516129	6.597	4.471	1.768	0.9427	0.7664	0.3805
0.354838709677419	6.595	4.462	1.766	0.9298	0.7658	0.3764
0.387096774193548	6.593	4.461	1.755	0.9282	0.7606	0.372
0.419354838709677	6.592	4.457	1.753	0.924	0.7577	0.3718
0.451612903225806	6.589	4.456	1.748	0.9237	0.7482	0.3649
0.483870967741936	6.587	4.451	1.735	0.92	0.7472	0.3639
0.516129032258065	6.586	4.449	1.723	0.918	0.74	0.3622
0.548387096774194	6.584	4.447	1.721	0.9116	0.7381	0.3616
0.580645161290323	6.582	4.442	1.719	0.8974	0.7265	0.359
0.612903225806452	6.581	4.437	1.716	0.8967	0.7234	0.351
0.645161290322581	6.579	4.435	1.713	0.8952	0.7233	0.3504
0.67741935483871	6.576	4.426	1.709	0.8913	0.7205	0.3502
0.709677419354839	6.575	4.424	1.709	0.8894	0.7204	0.3494
0.741935483870968	6.564	4.424	1.699	0.8861	0.7152	0.3489
0.774193548387097	6.563	4.422	1.696	0.8858	0.7145	0.3473
0.806451612903226	6.562	4.415	1.693	0.8734	0.7061	0.3446
0.838709677419355	6.558	4.412	1.691	0.8725	0.7034	0.344
0.870967741935484	6.558	4.398	1.687	0.8572	0.6949	0.3377
0.903225806451613	6.554	4.384	1.674	0.8562	0.6911	0.3347
0.935483870967742	6.526	4.374	1.662	0.8488	0.6853	0.3293
0.967741935483871	6.41	4.257	1.53	0.7171	0.5595	0.2436

0.1 6.6147 4.523 1.9143 1.0184 0.8429 0.40683

Average of yearly averages: 0.364056666666667

Inputs generaged by pe4.pl - 14-May-2003

stored as MCPA EHE.out
Chemical: MCPA EHE
PRZM environment: PAalfalfaC.txt modified Satday, 12 October 2002 at 17:24:04
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14737.dvf modified Wedday, 3 July 2002 at 09:06:12
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	6.41	4.126	1.41	0.8155	0.6602	0.2725
1962	6.722	4.508	1.984	1.088	0.9844	0.6825
1963	6.877	4.651	1.902	1.209	1.166	0.9014
1964	7.221	5.001	2.37	1.576	1.402	1.143
1965	7.118	4.938	2.141	1.441	1.303	1.07
1966	7.192	4.916	2.688	1.627	1.439	1.205
1967	7.396	5.112	3.014	2.194	1.968	1.554
1968	9.345	6.468	3.173	1.988	1.789	1.445
1969	11.85	8.087	3.895	2.313	2.048	1.44
1970	7.535	5.279	2.534	1.965	1.876	1.633
1971	7.953	5.607	3.299	2.331	2.168	1.899
1972	9.636	6.584	3.7	2.882	2.475	1.987
1973	8.149	5.703	2.928	2.454	2.222	1.903
1974	7.555	5.294	2.651	2.09	1.945	1.705
1975	7.543	5.228	2.783	2.008	1.767	1.558
1976	7.286	4.966	2.489	1.774	1.604	1.404
1977	7.387	5.066	2.444	1.804	1.646	1.477
1978	7.665	5.399	2.897	2.014	2.067	1.702
1979	7.879	5.579	2.931	2.531	2.27	1.793
1980	7.33	5.11	2.313	1.493	1.472	1.16
1981	7.075	4.796	2.178	1.407	1.213	0.9086
1982	11.26	8.45	3.733	2.226	2.277	1.431
1983	7.366	5.147	3.119	2.044	1.745	1.442
1984	9.325	6.42	3.264	2.58	2.284	1.676
1985	15.07	10.13	4.167	2.712	2.527	1.586
1986	7.764	5.413	2.65	2.396	2.221	1.692
1987	11.67	8.061	3.754	2.5	2.175	1.602
1988	7.727	5.306	2.979	1.897	1.802	1.514
1989	7.581	5.202	2.605	1.808	1.646	1.318
1990	8.133	5.458	2.482	1.584	1.612	1.196

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	15.07	10.13	4.167	2.882	2.527	1.987
0.0645161290322581	11.85	8.45	3.895	2.712	2.475	1.903
0.0967741935483871	11.67	8.087	3.754	2.58	2.284	1.899

0.129032258064516	11.26	8.061	3.733	2.531	2.277	1.793
0.161290322580645	9.636	6.584	3.7	2.5	2.27	1.705
0.193548387096774	9.345	6.468	3.299	2.454	2.222	1.702
0.225806451612903	9.325	6.42	3.264	2.396	2.221	1.692
0.258064516129032	8.149	5.703	3.173	2.331	2.175	1.676
0.290322580645161	8.133	5.607	3.119	2.313	2.168	1.633
0.32258064516129	7.953	5.579	3.014	2.226	2.067	1.602
0.354838709677419	7.879	5.458	2.979	2.194	2.048	1.586
0.387096774193548	7.764	5.413	2.931	2.09	1.968	1.558
0.419354838709677	7.727	5.399	2.928	2.044	1.945	1.554
0.451612903225806	7.665	5.306	2.897	2.014	1.876	1.514
0.483870967741936	7.581	5.294	2.783	2.008	1.802	1.477
0.516129032258065	7.555	5.279	2.688	1.988	1.789	1.445
0.548387096774194	7.543	5.228	2.651	1.965	1.767	1.442
0.580645161290323	7.535	5.202	2.65	1.897	1.745	1.44
0.612903225806452	7.396	5.147	2.605	1.808	1.646	1.431
0.645161290322581	7.387	5.112	2.534	1.804	1.646	1.404
0.67741935483871	7.366	5.11	2.489	1.774	1.612	1.318
0.709677419354839	7.33	5.066	2.482	1.627	1.604	1.205
0.741935483870968	7.286	5.001	2.444	1.584	1.472	1.196
0.774193548387097	7.221	4.966	2.37	1.576	1.439	1.16
0.806451612903226	7.192	4.938	2.313	1.493	1.402	1.143
0.838709677419355	7.118	4.916	2.178	1.441	1.303	1.07
0.870967741935484	7.075	4.796	2.141	1.407	1.213	0.9086
0.903225806451613	6.877	4.651	1.984	1.209	1.166	0.9014
0.935483870967742	6.722	4.508	1.902	1.088	0.9844	0.6825
0.967741935483871	6.41	4.126	1.41	0.8155	0.6602	0.2725

0.1 11.629 8.0844 3.7519 2.5751 2.2833 1.8884

Average of yearly averages: 1.41

Inputs generaged by pe4.pl - 14-May-2003

stored as MCPA EHE.out
Chemical: MCPA EHE
PRZM environment: MNalfalfaC.txt modified Satday, 12 October 2002 at 17:04:22
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14914.dvf modified Wedday, 3 July 2002 at 09:05:52
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	6.41	4.056	1.351	0.6274	0.4903	0.1976
1962	6.66	4.456	1.737	0.9967	0.8346	0.4304
1963	6.763	4.384	1.613	0.8462	0.7891	0.4807
1964	6.666	4.347	2.138	1.234	1.041	0.5948
1965	6.794	4.534	1.766	1.036	0.8911	0.6436
1966	6.778	4.407	1.681	0.935	0.9121	0.6369
1967	6.777	4.468	1.752	0.9581	0.7904	0.553
1968	6.657	4.324	1.615	0.853	0.6923	0.4484
1969	6.937	4.541	2.245	1.548	1.287	0.7478
1970	7.133	4.664	1.965	1.124	1.039	0.8478
1971	7.086	4.79	2.056	1.23	1.114	0.9311
1972	7.14	4.759	2.004	1.339	1.282	0.937
1973	6.805	4.351	1.704	1.167	1.051	0.7942
1974	9.013	5.953	2.533	1.891	1.694	1.155
1975	8.403	6.564	3.544	2.348	1.97	1.337
1976	7.12	4.648	1.904	1.263	1.247	0.8968
1977	11.29	7.073	2.512	1.905	1.911	1.173
1978	7.146	4.794	2.687	1.68	1.532	1.149
1979	7.147	4.784	2.083	1.525	1.363	1.12
1980	7.053	4.685	1.966	1.18	1.124	0.9711
1981	7.326	4.897	2.386	1.408	1.177	0.7546
1982	12.53	8.163	3.234	1.854	1.607	0.8957
1983	7.048	4.686	1.955	1.442	1.243	1.001
1984	7.799	5.523	3.218	1.718	1.404	1.072
1985	7.902	5.347	2.363	1.565	1.433	1.026
1986	7.071	4.727	2.321	1.509	1.306	1.014
1987	7.05	4.662	1.891	1.217	1.078	0.7986
1988	6.71	4.279	1.582	0.8583	0.749	0.6334
1989	6.906	4.536	1.869	1.144	1.031	0.8465
1990	8.88	5.778	2.429	1.405	1.155	0.8061

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	12.53	8.163	3.544	2.348	1.97	1.337
0.0645161290322581	11.29	7.073	3.234	1.905	1.911	1.173
0.0967741935483871	9.013	6.564	3.218	1.891	1.694	1.155

0.129032258064516	8.88	5.953	2.687	1.854	1.607	1.149
0.161290322580645	8.403	5.778	2.533	1.718	1.532	1.12
0.193548387096774	7.902	5.523	2.512	1.68	1.433	1.072
0.225806451612903	7.799	5.347	2.429	1.565	1.404	1.026
0.258064516129032	7.326	4.897	2.386	1.548	1.363	1.014
0.290322580645161	7.147	4.794	2.363	1.525	1.306	1.001
0.32258064516129	7.146	4.79	2.321	1.509	1.287	0.9711
0.354838709677419	7.14	4.784	2.245	1.442	1.282	0.937
0.387096774193548	7.133	4.759	2.138	1.408	1.247	0.9311
0.419354838709677	7.12	4.727	2.083	1.405	1.243	0.8968
0.451612903225806	7.086	4.686	2.056	1.339	1.177	0.8957
0.483870967741936	7.071	4.685	2.004	1.263	1.155	0.8478
0.516129032258065	7.053	4.664	1.966	1.234	1.124	0.8465
0.548387096774194	7.05	4.662	1.965	1.23	1.114	0.8061
0.580645161290323	7.048	4.648	1.955	1.217	1.078	0.7986
0.612903225806452	6.937	4.541	1.904	1.18	1.051	0.7942
0.645161290322581	6.906	4.536	1.891	1.167	1.041	0.7546
0.67741935483871	6.805	4.534	1.869	1.144	1.039	0.7478
0.709677419354839	6.794	4.468	1.766	1.124	1.031	0.6436
0.741935483870968	6.778	4.456	1.752	1.036	0.9121	0.6369
0.774193548387097	6.777	4.407	1.737	0.9967	0.8911	0.6334
0.806451612903226	6.763	4.384	1.704	0.9581	0.8346	0.5948
0.838709677419355	6.71	4.351	1.681	0.935	0.7904	0.553
0.870967741935484	6.666	4.347	1.615	0.8583	0.7891	0.4807
0.903225806451613	6.66	4.324	1.613	0.853	0.749	0.4484
0.935483870967742	6.657	4.279	1.582	0.8462	0.6923	0.4304
0.967741935483871	6.41	4.056	1.351	0.6274	0.4903	0.1976

0.1 8.9997 6.5029 3.1649 1.8873 1.6853 1.1544

Average of yearly averages: 0.82977

Inputs generaged by pe4.pl - 14-May-2003

stored as eheORpea.out
Chemical: MCPA EHE
PRZM environment: ORsnbeansC.txt modified Satday, 12 October 2002 at 17:20:58
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w24232.dvf modified Wedday, 3 July 2002 at 09:06:10
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	1.024	0.6689	0.2414	0.1619	0.1353	0.06166
1962	1.151	0.801	0.4312	0.3444	0.3221	0.1977
1963	1.31	0.9501	0.5204	0.4055	0.3623	0.3078
1964	1.995	1.603	0.8011	0.5629	0.442	0.3397
1965	1.54	1.236	0.6258	0.5369	0.4762	0.4041
1966	1.392	1.137	0.7258	0.5614	0.5322	0.4232
1967	1.36	1.115	0.6676	0.4915	0.4507	0.3853
1968	1.413	1.126	0.8513	0.685	0.654	0.5367
1969	1.427	1.146	0.9001	0.7116	0.6536	0.5459
1970	1.635	1.236	0.9982	0.8279	0.7461	0.5684
1971	1.512	1.15	0.7793	0.6505	0.6333	0.5589
1972	1.843	1.471	0.8291	0.6524	0.6112	0.5139
1973	2.308	1.733	1.195	0.9144	0.7228	0.5047
1974	2.053	1.719	1.05	0.8129	0.774	0.5934
1975	1.439	1.089	0.6673	0.5995	0.5595	0.4765
1976	1.41	1.064	0.6379	0.5618	0.5369	0.4087
1977	1.638	1.317	0.8316	0.6059	0.4858	0.3272
1978	1.69	1.237	0.6811	0.5477	0.5068	0.4357
1979	1.407	1.101	0.7965	0.6885	0.6226	0.4828
1980	2.215	1.727	0.9558	0.8041	0.658	0.5729
1981	1.777	1.35	0.9643	0.8508	0.7943	0.618
1982	1.535	1.187	0.8823	0.7595	0.7065	0.5736
1983	1.566	1.211	0.9115	0.7824	0.7304	0.6
1984	1.647	1.243	0.8487	0.7144	0.623	0.525
1985	1.422	1.18	0.6836	0.5776	0.5256	0.4659
1986	1.358	1.018	0.6961	0.5343	0.4964	0.4093
1987	2.389	1.819	1.171	0.6716	0.5511	0.4646
1988	1.565	1.182	0.8197	0.6234	0.5777	0.466
1989	1.975	1.456	0.7517	0.5471	0.4711	0.3979
1990	1.396	1.041	0.7268	0.6177	0.5665	0.4592

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	2.389	1.819	1.195	0.9144	0.7943	0.618
0.0645161290322581	2.308	1.733	1.171	0.8508	0.774	0.6
0.0967741935483871	2.215	1.727	1.05	0.8279	0.7461	0.5934

0.129032258064516	2.053	1.719	0.9982	0.8129	0.7304	0.5736
0.161290322580645	1.995	1.603	0.9643	0.8041	0.7228	0.5729
0.193548387096774	1.975	1.471	0.9558	0.7824	0.7065	0.5684
0.225806451612903	1.843	1.456	0.9115	0.7595	0.658	0.5589
0.258064516129032	1.777	1.35	0.9001	0.7144	0.654	0.5459
0.290322580645161	1.69	1.317	0.8823	0.7116	0.6536	0.5367
0.32258064516129	1.647	1.243	0.8513	0.6885	0.6333	0.525
0.354838709677419	1.638	1.237	0.8487	0.685	0.623	0.5139
0.387096774193548	1.635	1.236	0.8316	0.6716	0.6226	0.5047
0.419354838709677	1.566	1.236	0.8291	0.6524	0.6112	0.4828
0.451612903225806	1.565	1.211	0.8197	0.6505	0.5777	0.4765
0.483870967741936	1.54	1.187	0.8011	0.6234	0.5665	0.466
0.516129032258065	1.535	1.182	0.7965	0.6177	0.5595	0.4659
0.548387096774194	1.512	1.18	0.7793	0.6059	0.5511	0.4646
0.580645161290323	1.439	1.15	0.7517	0.5995	0.5369	0.4592
0.612903225806452	1.427	1.146	0.7268	0.5776	0.5322	0.4357
0.645161290322581	1.422	1.137	0.7258	0.5629	0.5256	0.4232
0.67741935483871	1.413	1.126	0.6961	0.5618	0.5068	0.4093
0.709677419354839	1.41	1.115	0.6836	0.5614	0.4964	0.4087
0.741935483870968	1.407	1.101	0.6811	0.5477	0.4858	0.4041
0.774193548387097	1.396	1.089	0.6676	0.5471	0.4762	0.3979
0.806451612903226	1.392	1.064	0.6673	0.5369	0.4711	0.3853
0.838709677419355	1.36	1.041	0.6379	0.5343	0.4507	0.3397
0.870967741935484	1.358	1.018	0.6258	0.4915	0.442	0.3272
0.903225806451613	1.31	0.9501	0.5204	0.4055	0.3623	0.3078
0.935483870967742	1.151	0.801	0.4312	0.3444	0.3221	0.1977
0.967741935483871	1.024	0.6689	0.2414	0.1619	0.1353	0.06166

0.1 2.1988 1.7262 1.04482 0.8264 0.74453 0.59142

Average of yearly averages: 0.454155333333333

Inputs generaged by pe4.pl - 14-May-2003

stored as MCPA EHE.out
Chemical: MCPA EHE
PRZM environment: PAturfC.txt modified Satday, 12 October 2002 at 17:27:02
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w14737.dvf modified Wedday, 3 July 2002 at 09:06:12
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.9554	0.6081	0.2597	0.1426	0.1321	0.06273
1962	1.031	0.6956	0.2857	0.2204	0.2012	0.1471
1963	1.429	0.9778	0.4519	0.3056	0.2834	0.1829
1964	1.134	0.7937	0.4248	0.3334	0.2947	0.219
1965	1.151	0.9097	0.4914	0.3064	0.2717	0.197
1966	2.075	1.543	0.7361	0.3937	0.3224	0.2509
1967	2.971	1.998	0.9161	0.557	0.4881	0.3577
1968	2.048	1.436	0.777	0.5494	0.4779	0.3486
1969	5.661	3.771	1.587	0.8352	0.6833	0.3844
1970	2.201	1.536	0.7236	0.5679	0.5377	0.4293
1971	2.384	1.848	0.9995	0.7777	0.6836	0.5034
1972	4.422	2.985	1.38	0.9461	0.8166	0.6104
1973	3.027	2.1	0.9866	0.7506	0.6768	0.5855
1974	1.607	1.167	0.6364	0.5565	0.5074	0.4295
1975	2.168	1.506	0.6941	0.532	0.455	0.3608
1976	2.502	1.747	0.7415	0.5174	0.4729	0.3713
1977	1.368	0.9694	0.5389	0.4478	0.4276	0.3409
1978	2.203	1.573	0.9039	0.552	0.4751	0.3803
1979	1.896	1.348	0.8101	0.6288	0.5558	0.4492
1980	1.208	0.8632	0.4418	0.3723	0.36	0.2669
1981	1.36	0.9225	0.4301	0.2752	0.2341	0.1754
1982	4.773	3.506	1.446	0.796	0.6762	0.3956
1983	1.679	1.338	0.8019	0.4746	0.411	0.3531
1984	3.359	2.27	1.052	0.7802	0.6976	0.4571
1985	8.377	5.532	2.075	1.184	1.026	0.5016
1986	1.407	1.059	0.8063	0.7704	0.7112	0.4884
1987	6.517	4.388	1.75	0.9925	0.8351	0.4673
1988	4.002	2.738	1.267	0.7296	0.6527	0.4942
1989	1.608	1.13	0.6199	0.4614	0.4159	0.3648
1990	2.517	1.725	0.7597	0.4988	0.4799	0.3485

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	8.377	5.532	2.075	1.184	1.026	0.6104
0.0645161290322581	6.517	4.388	1.75	0.9925	0.8351	0.5855
0.0967741935483871	5.661	3.771	1.587	0.9461	0.8166	0.5034

0.129032258064516	4.773	3.506	1.446	0.8352	0.7112	0.5016
0.161290322580645	4.422	2.985	1.38	0.796	0.6976	0.4942
0.193548387096774	4.002	2.738	1.267	0.7802	0.6836	0.4884
0.225806451612903	3.359	2.27	1.052	0.7777	0.6833	0.4673
0.258064516129032	3.027	2.1	0.9995	0.7704	0.6768	0.4571
0.290322580645161	2.971	1.998	0.9866	0.7506	0.6762	0.4492
0.32258064516129	2.517	1.848	0.9161	0.7296	0.6527	0.4295
0.354838709677419	2.502	1.747	0.9039	0.6288	0.5558	0.4293
0.387096774193548	2.384	1.725	0.8101	0.5679	0.5377	0.3956
0.419354838709677	2.203	1.573	0.8063	0.557	0.5074	0.3844
0.451612903225806	2.201	1.543	0.8019	0.5565	0.4881	0.3803
0.483870967741936	2.168	1.536	0.777	0.552	0.4799	0.3713
0.516129032258065	2.075	1.506	0.7597	0.5494	0.4779	0.3648
0.548387096774194	2.048	1.436	0.7415	0.532	0.4751	0.3608
0.580645161290323	1.896	1.348	0.7361	0.5174	0.4729	0.3577
0.612903225806452	1.679	1.338	0.7236	0.4988	0.455	0.3531
0.645161290322581	1.608	1.167	0.6941	0.4746	0.4276	0.3486
0.67741935483871	1.607	1.13	0.6364	0.4614	0.4159	0.3485
0.709677419354839	1.429	1.059	0.6199	0.4478	0.411	0.3409
0.741935483870968	1.407	0.9778	0.5389	0.3937	0.36	0.2669
0.774193548387097	1.368	0.9694	0.4914	0.3723	0.3224	0.2509
0.806451612903226	1.36	0.9225	0.4519	0.3334	0.2947	0.219
0.838709677419355	1.208	0.9097	0.4418	0.3064	0.2834	0.197
0.870967741935484	1.151	0.8632	0.4301	0.3056	0.2717	0.1829
0.903225806451613	1.134	0.7937	0.4248	0.2752	0.2341	0.1754
0.935483870967742	1.031	0.6956	0.2857	0.2204	0.2012	0.1471
0.967741935483871	0.9554	0.6081	0.2597	0.1426	0.1321	0.06273

0.1 5.5722 3.7445 1.5729 0.93501 0.80606 0.50322

Average of yearly averages: 0.364127666666667

Inputs generaged by pe4.pl - 14-May-2003

APPENDIX D: Ecological Hazard Data

Table D-1: Acute Toxicity of MCPA to Freshwater Fish									
Species	% a.i.	96-hr LC_{50}, mg/L (confid. int.)		NOEC (mg/L)		Study Properties[b]	Toxicity Classification (based on a.e.)	MRID (year of citation)	Status
		a.i.	a.e.[a]	a.i.	a.e.				
030501 - MCPA Acid									
no studies									
030502 - MCPA Sodium Salt									
Bluegill sunfish	24.57 (Chiptox)	> 88	> 79	88	79	M, F-T	slightly toxic	418009-01 (1990)	core [c]
Rainbow trout	24.57 (Chiptox)	>76	> 68	44	40	M, F-T	slightly toxic	418009-02 (1990)	core [c]
030516 - MCPA DMA Salt									
Bluegill sunfish	56.4	306 (270, 362)	251 (221, 297)	245	200	M, S[d]	practically non-toxic	400620-04 (1986)	core
Bluegill sunfish	74.7	> 112	> 92	112	92	M, S[d]	slightly toxic	426244-02 (1992)	core
Bluegill sunfish	52.8 (Rhomene)	>164	> 134	79	65	M, F-T	practically non-toxic	418009-04 (1990)	core [c]
Rainbow trout	56.4	117 (81, 148)	96 (66, 121)	89	80	M, S	slightly toxic	400620-05 (1986)	core
Rainbow trout	52.8 (Rhomene)	119 (84, 169)	98 (69, 139)	19	16	M, F-T	slightly toxic	418009-05 (1990)	core [c]
030564 - MCPA EHE									
Bluegill sunfish	93.9	1.66 (1.46, 3.38)	1.10 (0.96, 2.23)	1.46	0.96	M, S[e]	moderately toxic	426244-03 (1992)	core
Rainbow trout	93.9	1.15 (0.98, 2.36)	0.76 (0.65,1.56)	0.916	0.605	M, S[e]	highly toxic	426244-04 (1992)	core

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.
[a] M=mean-measured chemical concentrations, N=nominal chemical concentrations; F-T=flow-through; S=static.

[c] For formulated product.
[d] Aeration after 72-hrs.
[e] Slight aeration was used.

Table D-2: Acute Toxicity of MCPA to Freshwater Invertebrates									
Species	% a.i.	48-hr EC_{50}, mg/L (confid. int.)		NOAEC (mg/L)		Study Properties[b]	Toxicity Classification (based on a.e.)	MRID (year of citation)	Status
		a.i.	a.e.[a]	a.i.	a.e.				
030501 - MCPA Acid									
no studies									
030502 - MCPA Sodium Salt									
Daphnid	24.57 (Chiptox)	> 204	> 184	204	184	M, F-T	practically non-toxic	418009-03 (1990)	core[c]
030516 - MCPA DMA Salt									
Daphnid	63.4	> 230	> 187	38	31	M, F-T	practically non-toxic	424122-01 (1992)	core
Daphnid	52.8 (Rhomene)	100 (CI undetermined)	82 (CI undetermined)	63	56	M, F-T	slightly toxic	418009-06 (1990)	core[c]
030564 - MCPA EHE									
Daphnid	93.9	0.28 (0.21, 0.43)	0.18 (0.14, 0.28)	0.077	0.051	M, F-T	highly toxic	426136-01 (1992)	core

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.
[b] M=mean-measured chemical concentrations, N=nominal chemical concentrations; F-T=flow-through; S=static.
[c] For formulated product.

Table D-3: Acute Toxicity of MCPA to Estuarine Fish									
Species	% a.i.	96-hr LC_{50}, mg/L (confid. int.)		NOAEC (mg/L)		Study Properties[b]	Toxicity Classification (based on a.e.)	MRID (year of citation)	Status
		a.i.	a.e.[a]	a.i.	a.e.				
030501 - MCPA Acid									
Atlantic silverside	96.4	179 (138, 291)	179 (138, 291)	78	78	M, S	practically non-toxic	400620-02 (1986)	core
030502 - MCPA Sodium Salt									
Sheepshead minnow	24.57 (Chiptox)	> 111	> 100	111	100	M, F-T	practically non-toxic	419395-04 (1991)	core [c]
030516 - MCPA DMA Salt									
Sheepshead minnow	77	630 (550, 870)	520 (450, 710)	359	280	M, F-T	practically non-toxic	430832-10 (1993)	core
Sheepshead minnow	52.8 (Rhomene)	>202	> 166	202	166	M, F-T	practically non-toxic	419395-01 (1991)	core [c]
030564 - MCPA EHE									
Sheepshead minnow	93.5	> 4.1[d]	>2.7	4.1	2.7	M, F-T	moderately toxic	430865-01 (1993)	core

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.
[b] M=mean-measured chemical concentrations, N=nominal chemical concentrations; F-T=flow-through; S=static.
[c] For formulated product.
[d] Limit of solubility.

Table D-4: Acute Toxicity of MCPA to Estuarine/Marine Invertebrates									
Species	% a.i.	Toxicity endpoint, mg/L		NOAEC (mg/L)		Study Properties[b]	Toxicity Classification (based on a.e.)	MRID (year of citation)	Status
		a.i.	a.e.[a]	a.i.	a.e.				
030501 - MCPA Acid									
Eastern oyster-larvae/embryo	94.6	48-hr EC_{50} = 150 (142, 160)	48-hr EC_{50} = 150 (142, 160)	115	115	M, S	practically non-toxic	400620-03 (1986)	core
Pink shrimp	94.6	96-hr LC_{50} = 236 (199, 291)	96-hr LC_{50} = 236 (199, 291)	162	162	M, S	practically non-toxic	400620-01 (1986)	core
030502 - MCPA Sodium Salt									
Eastern oyster - shell deposition	24.5 (Chiptox)	96-hr EC_{50} = 5.4 (2.6, 8.7)	96-hr EC_{50} = 4.9 (2.3, 7.8)	< 1.25	< 1.13	M, F-T	moderately toxic	419395-06 (1991)	core[c]
Mysid	24.57 (Chiptox)	96-hr LC_{50} >95	96-hr LC_{50} >86	56.2	50.6	M, F-T	slightly toxic	419395-05 (1991)	core[c]
030516 - MCPA DMA Salt									
Eastern oyster - shell deposition	77	96-hr EC_{50} = 30.8 (22.0, 46.9)	96-hr EC_{50} = 25.3 (18.0, 38.5)	7.9	6.5	M, F-T	moderately toxic	430832-09 (1993)	core
Eastern oyster - shell deposition	53 (Rhomene)	96-hr EC_{50} = 42 (27, 55)	96-hr EC_{50} = 34 (22, 45)	6.9	5.3	M, F-T	moderately toxic	432521-01 (1994)	core[c]
Eastern oyster - shell deposition	52.8 (Rhomene)	96-hr EC_{50} = 12.9 (6.7, 40.1)	96-hr EC_{50} = 10.6 (5.5, 32.9)	< 1.2	< 1.0	M, F-T	moderately toxic	419395-03 (1991)	supplemental[c]
Mysid	52.8 (Rhomene)	96-hr EC_{50} >71.6	96-hr EC_{50} >58.7	19.9	16.3	M, F-T	moderately toxic	419395-02 (1991)	core[c]
Pink Shrimp	56.4	96-hr EC_{50} = 301 (247, 354)	96-hr EC_{50} = 247 (203, 290)	<186	<152	M, S	practically non-toxic	400620-06 (1996)	core

Table D-4: Acute Toxicity of MCPA to Estuarine/Marine Invertebrates									
Species	% a.i.	Toxicity endpoint, mg/L		NOAEC (mg/L)		Study Properties[b]	Toxicity Classification (based on a.e.)	MRID (year of citation)	Status
		a.i.	a.e.[a]	a.i.	a.e.				
030564 - MCPA EHE									
Mysid	93.5	96-hr LC_{50} = 0.20 (0.16, 0.28)	96-hr LC_{50} = 0.13 (0.11, 0.18)	0.040	0.026	M, F-T	highly toxic	430865-02 (1993)	core

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.
[b] M=mean-measured chemical concentrations, N=nominal chemical concentrations; F-T=flow-through; S=static.
[c] For formulated product.

Table D-5: Chronic (Early-life) Toxicity of MCPA to Fish								
Species	% a.i.	NOAEC (mg/L)		LOAEC (mg/L)		Study Properties[b]	Most sensitive parameter	MRID (year of citation)	Status
		a.i.	a.e.[a]	a.i.	a.e.				
030516 - MCPA DMA Salt									
Fathead minnow	80.2	15	12	29	24	M, F-T	Length, dry weight, wet weight.	444072-02 (1997)	core

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.
[b] M=mean-measured chemical concentrations, N=nominal chemical concentrations; F-T=flow-through; S=static.

Table D-6: Chronic (Life-cycle) Toxicity of MCPA to Invertebrates									
Species	% a.i.	NOAEC (mg/L)		LOAEC (mg/L)		Study Properties[b]	Most sensitive parameter	MRID (year of citation)	Status
		a.i.	a.e.[a]	a.i.	a.e.				
030516 - MCPA DMA Salt									
Daphnia	80.2	13	11	27	22	M, F-T	Reproduction.	444072-01 (1997)	core

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.
[b] M=mean-measured chemical concentrations, N=nominal chemical concentrations; F-T=flow-through; S=static.

Table D-7: Acute Toxicity of MCPA to Aquatic Plants										
Species	**%a.i.**	**EC_{50}, mg/L (confidence interval)**		**NOAEC (mg/L)**		**Most sensitive parameter**	**Initial/mean measured concentrations**	**MRID (year of citation)**	**Status**
		a.i.	**a.e.[a]**	**a.i.**	**a.e.**				
030501 - MCPA Acid									
Lemna gibba	94.2	0.17 (0.05, 0.57)	0.17 (0.05, 0.57)	<0.014	<0.014	frond number	initial	431265-01 (1994)	supplemental
Selenastrum capricornutum	94.2	0.95 (0.22, 4.5)	0.95 (0.22, 4.5)	0.009	0.009	cell density	mean	430832-03 (1993)	core
Navicula pelliculosa	94.2	0.63 (0.28, 1.5)	0.63 (0.28, 1.5)	0.009	0.009	cell density	mean	430832-02 (1993)	core
Anabaena flos-aquae	94.2	6.7 (0.37, 540)	6.7 (0.37, 540)	0.47	0.47	cell density	mean	430832-04 (1993)	core
Skeletonema costatum	94.2	0.30 (0.12, 0.77)	0.30 (0.12, 0.77)	0.015	0.015	cell density	mean	430832-01 (1993)	core
030502 - MCPA Sodium Salt									
no studies									
030516 - MCPA DMA Salt									
Lemna gibba	77.7	0.25 (0.074, 0.81)	0.21 (0.061, 0.66)	<0.05	<0.04	frond number	mean	431265-02 (1994)	supplemental
Lemna gibba	83.3	0.155 (0.12, 0.200)	0.13 (0.101, 0.168)	0.016	0.013	frond number	initial	449035-01 (1999)	core
Selenastrum capricornutum	63.42	0.19 (0.029, 1.2)	0.16 (0.024, 0.98)	<0.033	<0.027	cell density	mean	424613-01 (1992)	core
Selenastrum capricornutum	83.3	70 (49, 99)	57 (40, 81)	12.7	10.4	Cell density	initial	449035-02 (1999)	core

Table D-7: Acute Toxicity of MCPA to Aquatic Plants									
Species	%a.i.	EC_{50}, mg/L (confidence interval)		NOAEC (mg/L)		Most sensitive parameter	Initial/mean measured concentrations	MRID (year of citation)	Status
		a.i.	a.e.[a]	a.i.	a.e.				
Selenastrum capricornutum	86.8	122 (87-156)	99 (71, 127)	8.7	7.1	area under growth curve	nominal	453131-01 (2000)	supplemental
Selenastrum capricornutum	86.8	38 (27, 54)	31 (22, 44)	<2.85	<2.33	cell density	mean	455544-03 (2000)	supplemental
Navicula pelliculosa	77.7	0.46 (0.12, 1.8)	0.38 (0.10, 1.5)	0.022	0.018	cell density	mean	430832-07 (1993)	core
Navicula pelliculosa	83.3	30 (27, 34)	25 (22,28)	<9.6	<7.8	area under growth curve	initial	449035-04 (1999)	supplemental
Anabaena flos-aquae	77.7	0.40 (0.078, 2.2)	0.33 (0.064, 1.8)	0.006	0.005	cell density	mean	430832-08 (1993)	core
Anabaena flos-aquae	83.3	37 (29, 47)	30 (24, 38)	5.38	4.40	cell density	initial	449035-03 (1999)	core
Skeletonema costatum	77.7	1.5 (0.32, 7.7)	1.2 (0.26, 6.3)	0.034	0.028	cell density	mean	430832-06 (1993)	core
Skeletonema costatum	83.3	35 (31, 41)	29 (25, 33)	2.9	2.4	cell density	initial	449035-05 (1999)	core
030564 - MCPA EHE									
Lemna gibba	93.5	0.031 (0.0029, 53)	0.020 (0.0020, 34)	0.007	0.004	biomass	initial	430832-14 (1993)	core
Selenastrum capricornutum	93.9	0.25 (0.082, 0.78)	0.17 (0.054, 0.51)	0.032	0.021	cell density	initial	424612-01 (1992)	core
Navicula pelliculosa	93.5	1.2 (0.19, 10.0)	0.7 (0.13, 6.6)	0.008	0.0051	cell density	initial	430832-11 (1993)	core

Table D-7: Acute Toxicity of MCPA to Aquatic Plants									
Species	%a.i.	EC_{50}, mg/L (confidence interval)		NOAEC (mg/L)		Most sensitive parameter	Initial/mean measured concentrations	MRID (year of citation)	Status
		a.i.	a.e.[a]	a.i.	a.e.				
Anabaena flos-aquae	93.5	2.0 (0.023, 777)	1.3 (0.012, 520)	0.005	0.0035	cell density	initial	430832-13 (1993)	core
Skeletonema costatum	93.5	0.085 (0.014, 0.52)	0.056 (0.009, .034)	<0.0029	<0.0019	cell density	initial	430832-12 (1993)	core

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.

Table D-8: Acute Toxicity to MCPA to Birds (oral administration)									
Species	% a.i.	LD_{50}, mg/kg-bw (conf. interval)		NOAEC, mg/kg-bw		Effects	Toxicity Classification (based on a.e.)	MRID (year of citation)	Status
		a.i.	a.e.[a]	a.i.	a.e.				
030501 - MCPA Acid									
Bobwhite quail	94.6	377 (314, 452)	377 (314, 452)	< 292	< 292	Reduction in body wt, feed consumption. Depression, wing droop, etc.	moderately toxic	400192-01 (1986)	core
030502 - MCPA Sodium Salt									
no studies									
030516 - MCPA DMA Salt									
Bobwhite quail	56.4	270 (173, 480)	221 (142, 394)	<104	< 85	Lethargy, reduced reaction to stimuli, wing droop, etc.	moderately toxic	400192-02 (1986)	core
030564 - MCPA EHE									
no studies									

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.

Table D-9: Acute Toxicity to MCPA to Birds (dietary administration)

Species	% a.i.	LC_{50}, mg/kg-diet (conf. interval)		NOAEC, mg/kg-diet		Effects	Toxicity Classification (based on a.e.)	MRID (year of citation)	Status
		a.i.	a.e.[a]	a.i.	a.e.				
030501 - MCPA Acid									
no studies									
030502 - MCPA Sodium Salt									
no studies									
030516 - MCPA DMA Salt									
Bobwhite quail	56.4	>5620	>4608	1000	820	No mortality. Reduced feed consumption.	practically non-toxic	405558-03 (1988)	core
Mallard duck	56.4	>5620	>4608	562	461	No mortality. Reduced body weight gain.	practically non-toxic	405558-02 (1988)	core
030564 - MCPA EHE									
no studies									

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.

Table D-10: Chronic Toxicity to MCPA to Birds								
Species	% a.i.	NOAEC (mg/kg-diet)		LOAEC (mg/kg-diet)		Effects	MRID (year of citation)	Status
		a.i.	a.e.[a]	a.i.	a.e.			
030501 - MCPA Acid								
Bobwhite quail	94.22	1000	1000	>1000	>1000	None	435052-01 (1994)	core

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.

Table D-11: Mammalian Acute Oral Toxicity to MCPA						
Species	**% a.i.**	**LD_{50} (mg/kg-bwt)**		**Toxicity Classification (based on a.e.)**	**MRID (year of citation)**	**Status[b]**
		a.i.	**a.e.[a]**			
030501 - MCPA Acid						
Rat	approx 93%	1383	1383	slightly toxic	Acc. 21972 (1979)	acceptable
030502 - MCPA sodium salt						
Rat	approx 23.5%	3500	3175	slightly toxic	Acc.256979 (1982)	acceptable
030516 - MCPA DMA salt						
Rat	approx 52%	1876	1536	slightly toxic	Acc. 256980 (1982)	acceptable
030564 - MCPA EHE						
Rat	approx 45%	2235	1433	slightly toxic	Acc. 156458 (1985)	acceptable

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.
[b] Status (acceptability) based on HEDs guidelines.

Table D-12: Mammalian Subchronic Toxicity to MCPA								
Test Type	% a.i.	NOAEC (mg/kg-diet)		LOAEC (mg/kg-diet)		Effects	MRID (year of citation)	Status[b]
		a.i.	a.e.[a]	a.i.	a.e.			
030501 - MCPA Acid								
28-day feeding (mouse)	94.8	female: 300 male: 900	female: 300 male: 900	female: 900 male: 2700	female: 900 male: 2700	**females:** cloudy swelling in liver **males**: clinical signs consistent with general motor disturbances, body weight loss, decreased adrenal weight, cachexia, hepatotoxicity, involution of the spleen due to lymphocytic depletion, and testicular atrophy.	Acc. 165470 (1985)	acceptable (non-guideline)
90-day oral-feeding (rats)	94.8	150	150	450	450	increased absolute and relative kidney weights, increased clotting time, increased creatinine levels, and presence of crystalluria (oxalate, calcium phosphate, and urate).	Acc. 165471 (1985)	acceptable
28-day range-finding (dog)	98.4	<160	<160	160 (lowest dose tested)	160 (lowest dose tested)	based on changes in clinical chemistry	Acc. 61368 (1978)	acceptable (non-guideline)
90-day oral-feeding (dog)	94.8	25	25	300-342	300-342	based on renal toxicity as evidenced by increased phenol red dye retention (males only)	Acc. 106595 (1980)	acceptable
1-year feeding (dog)	94.8	6	6	30	30	hepatotoxicity and nephrotoxicity	Acc. 164352 (1986)	acceptable
030502 - MCPA sodium salt								
no studies								
030516 - MCPA DMA salt								

Table D-12: Mammalian Subchronic Toxicity to MCPA								
Test Type	**% a.i.**	**NOAEC (mg/kg-diet)**		**LOAEC (mg/kg-diet)**		**Effects**	**MRID (year of citation)**	**Status[b]**
		a.i.	**a.e.[a]**	**a.i.**	**a.e.**			
90-day oral-feeding (dog)	99.9	20	16	80	65	Changes in histopathology, hematology, and clinical chemistry	435568-02 (1995)	acceptable
030564 - MCPA EHE								
90-day oral feeding (dog)	93.5	20	13	80	51	Increased creatinine and urea in both sexes and alanine aminotransferase. At 7.1 m/k/d, increased absolute and relative wts (ovary and thyroid) in both sexes.	435568-01 (1995)	acceptable

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.
[b] Status (acceptability) based on HEDs guidelines.

Table D-13: Mammalian Developmental and Chronic Toxicity to MCPA								
Test Type	% a.i.	NOAEC (mg/kg-diet)		LOAEC (mg/kg-diet)		Effects	MRID	Status[b]
		a.i.	a.e.[a]	a.i.	a.e.			
030501 - MCPA Acid								
pre-natal developmental toxicity (rabbits)	94.22	maternal = 30 develop = 60	maternal = 30 develop = 60	maternal = 60 develop >60	maternal = 60 develop >60	**Maternal:** decreases in body weight and food consumption **Developmental**: none observed.	427238-02 (1993)	acceptable
pre-natal developmental toxicity (rats)	94.22	maternal = 60 develop = 60	maternal = 60 develop = 60	maternal = 120 develop = 120	maternal = 120 develop = 120	**Maternal**: decreases in body weight gain and food consumption during treatment **Developmental:** decreased placental and fetal body weights and an increase in the number of fetuses with skeletal retardation	427238-01 (1993)	acceptable
2-generation reproductive (rats)	94.8	parental=150 repro=150 offspring=450	parental=150 repro=150 offspring=450	parental=450 repro=450 offspring>450	parental=450 repro=450 offspring>450	**Parental:** Increased absolute and relative ovary wts ($p<0.05$; 23-25% greater than controls) **Repro:** decreased pup weight gain during lactation **Offspring:** none observed	400417-01 (1986)	acceptable
030502 - MCPA sodium salt								
no studies								
030516 - MCPA DMA salt								

Table D-13: Mammalian Developmental and Chronic Toxicity to MCPA								
Test Type	% a.i.	NOAEC (mg/kg-diet)		LOAEC (mg/kg-diet)		Effects	MRID	Status[b]
		a.i.	a.e.[a]	a.i.	a.e.			
pre-natal developmental toxicity (rats)	78.2	maternal = 62 develop = 62	maternal = 50 develop = 50	maternal = 185 develop = 185	maternal = 150 develop = 150	**Maternal**: mortality and clinical signs (rocking, lurching, or swaying, hunched appearance, dried yellow matting/staining on the urogenital area) **Developmental:** increased resorptions, decreased fetal body weight, and external and skeletal malformations/variations	449541-02 (1999)	acceptable
030564 - MCPA EHE								
pre-natal developmental toxicity (rats)	99.9	maternal = 62.7 develop = 62.7	maternal = 40 develop = 40	maternal = 188 develop = 188	maternal = 120 develop = 120	**Maternal**: reduced and body weight gains **Developmental**: total litter resorptions, decreased fetal weight, and altered growth	449541-01 (1999)	acceptable

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.
[b] Status (acceptability) based on HEDs guidelines.

Table D-14: Acute Contact Toxicity of MCPA to Non-target Insects						
Species	% a.i.	Toxicity endpoint		Toxicity classification (based on a.e.)	MRID	Status
		a.i.	a.e.[a]			
030501 - MCPA Acid						
no studies						
030502 - MCPA Sodium Salt						
no studies						
030516 - MCPA DMA Salt						
Honey bee	63.42	LD_{50} > 25 :g/bee	LD_{50} > 21 :g/bee	practically non-toxic	421503-01 (1991)	core
030564 - MCPA EHE						
Honey bee	93.9	LD_{50} > 25 :g/bee	LD_{50} > 17 :g/bee	practically non-toxic	421978-01(1992)	core

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.

Table D-15: Toxicity of MCPA to Terrestrial Plants (emergence)								
Species	**% a.i.**	**EC_{25}, (lbs/acre)**		**NOAEC (lbs/acre)**		**Most sensitive parameter**	**MRID**	**Status**
		a.i.	**a.e.[a]**	**a.i.**	**a.e.**			
030501 - MCPA Acid								
Monocot - onion	94.2	0.028	0.028	0.012	0.012	shoot length	430832-05 (1993)	core
corn	94.2	0.58	0.58	0.38	0.38	shoot length		
oat	94.2	0.096	0.096	0.023	0.023	shoot length		
perr. ryegrass	94.2	0.16	0.16	<0.10	<0.10	shoot length		
Dicot - cabbage	94.2	0.0080	0.0080	0.0027	0.0027	shoot length		
cucumber	94.2	0.059	0.059	0.025	0.025	shoot length		
lettuce	94.2	0.027	0.027	0.0056	0.0056	percent emerge		
soybean	94.2	0.055	0.055	<0.0065	<0.0065	shoot length		
tomato	94.2	0.027	0.027	0.012	0.012	shoot length		
turnip	94.2	0.0095	0.0095	0.0032	0.0032	shoot length		
030502 - MCPA Sodium Salt								
no studies								

Table D-15: Toxicity of MCPA to Terrestrial Plants (emergence)								
Species	% a.i.	EC_{25}, (lbs/acre)		NOAEC (lbs/acre)		Most sensitive parameter	MRID	Status
		a.i.	a.e.[a]	a.i.	a.e.			
030516 - MCPA DMA Salt								
Monocot - onion	63.42	<0.006	<0.005	<0.006	<0.005	dry weight	426987-01 (1993)	core [b]
corn	63.42	0.115-0.230[d]	0.094-0.188	0.029	0.024	height		
oats	63.42	0.115-0.230	0.094-0.188	0.058	0.047	dry weight		
ryegrass	63.42	0.015-0.029	0.012-0.024	0.015	0.012	dry weight		
Dicot - lettuce	63.42	0.004	0.003	<0.007	<0.006	height and dry weight		
soybean	63.42	0.058-0.115	0.047-0.094	0.058	0.047	height and dry weight		
radish	63.42	0.020	0.016	0.015	0.012	dry weight		
tomato	63.42	0.017	0.014	0.015	0.012	dry weight		
corn	63.42	0.115-0.230	0.094-0.188	0.029	0.024	height		
cucumber	63.42	0.015	0.012	0.029	0.024	dry weight		
cabbage	63.42	0.006	0.005	0.007	0.006	dry weight		
Monocot - onion	77.7	>0.0142	>0.0116	0.0142	0.0116	no adverse effects	432579-01 (1994)	core [c]
Dicot - lettuce	77.7	>0.0142	>0.0116	0.0142	0.0116	no adverse effects		

Table D-15: Toxicity of MCPA to Terrestrial Plants (emergence)								
Species	**% a.i.**	**EC_{25}, (lbs/acre)**		**NOAEC (lbs/acre)**		**Most sensitive parameter**	**MRID**	**Status**
		a.i.	**a.e.[a]**	**a.i.**	**a.e.**			
030564 - MCPA EHE								
Monocot - onion	93.9	0.027	0.018	0.019	0.013	dry weight	426693-01 (1993)	core
oat	93.9	0.016	0.010	0.009	0.006	dry weight		
ryegrass	93.9	0.12	0.077	0.074	0.047	dry weight		
corn	93.9	0.034	0.022	0.019	0.012	height and dry weight		
Dicot - cabbage	93.9	0.016	0.010	0.009	0.006	dry weight		
soybean	93.9	0.080	0.051	0.037	0.024	dry weight		
lettuce	93.9	0.040	0.026	0.019	0.012	dry weight		
radish	93.9	0.025	0.016	0.019	0.012	dry weight		
tomato	93.9	0.060	0.038	0.037	0.024	dry weight		
cucumber	93.9	0.035	0.022	0.019	0.012	dry weight		

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.
[b] Core for all species tested except onion and lettuce. These two species must be retested since a NOAEC was not established.
[c] Core for onion and lettuce (only two species tested).
[d] Data available for this species were not suitable for regression analysis; therefore, a range of values is presented which brackets the projected value (note in the submitted study report).

Table D-16: Toxicity of MCPA to Terrestrial Plants (vegetative vigor)								
Species	% a.i.	EC_{25}, (lbs /acre)		NOAEC (lbs /acre)		Most sensitive parameter	MRID	Status
		a.i.	a.e.[a]	a.i.	a.e.			
030501 - MCPA Acid								
Monocot - onion	94.2	0.092	0.092	0.046	0.046	shoot length	430832-05 (1993)	core
oat	94.2	2.3	2.3	0.37	0.37	shoot length		
corn	94.2	0.50	0.50	0.19	0.19	shoot length		
perr. ryegrass	94.2	>3.0	>3.0	3.0	3.0	shoot length		
Dicot - lettuce	94.2	0.013	0.013	0.006	0.006	shoot length		
cabbage	94.2	0.034	0.034	0.012	0.012	shoot length		
cucumber	94.2	0.14	0.14	0.048	0.048	shoot length		
soybean	94.2	0.040	0.040	<0.022	<0.022	shoot weight		
tomato	94.2	0.027	0.027	0.012	0.012	shoot length		
turnip	94.2	0.013	0.013	0.006	0.006	shoot length		
030502 - MCPA Sodium Salt								
no studies								

Table D-16: Toxicity of MCPA to Terrestrial Plants (vegetative vigor)								
Species	% a.i.	EC_{25}, (lbs /acre)		NOAEC (lbs /acre)		Most sensitive parameter	MRID	Status
		a.i.	a.e.[a]	a.i.	a.e.			
030516 - MCPA DMA Salt								
Monocot - onion	63.42	0.057	0.043	0.029	0.024	dry weight	426693-04 (1993)	supplemental[b]
oat	63.42	1.8-3.7	1.5-3.0	0.115	0.094	height		
ryegrass	63.42	0.115	0.094	0.115	0.094	dry weight		
Dicot - lettuce	63.42	0.007	0.006	0.004	0.003	dry weight		
soybean	63.42	0.698	0.570	0.058	0.047	dry weight		
Monocot - corn	82.7	0.24	0.20	0.03	0.02	shoot weight	437882-01 (1995)	supplemental[c]
Dicot - radish	82.7	0.005	0.004	0.004	0.003	root weight		
cabbage	82.7	0.011	0.009	0.008	0.007	root weight		
cucumber	82.7	0.154	0.126	0.068	0.056	shoot weight		
tomato	82.7	0.021	0.017	0.008	0.007	root weight		

Table D-16: Toxicity of MCPA to Terrestrial Plants (vegetative vigor)								
Species	% a.i.	EC_{25}, (lbs /acre)		NOAEC (lbs /acre)		Most sensitive parameter	MRID	Status
		a.i.	a.e.[a]	a.i.	a.e.			
030564 - MCPA EHE								
Monocot - onion	93.9	0.058	0.038	0.020	0.013	dry weight	426693-02 (1993)	core
oat	93.9	0.44	0.28	0.15	0.10	dry weight		
ryegrass	93.9	0.94	0.60	0.29	0.19	dry weight		
corn	93.9	0.48	0.31	0.29	0.19	dry weight		
Dicot - lettuce	93.9	0.025	0.016	0.020	0.013	dry weight		
soybean	93.9	0.058	0.37	0.020	0.013	dry weight		
radish	93.9	0.025	0.016	0.020	0.013	dry weight		
tomato	93.9	0.060	0.038	0.037	0.024	dry weight		
cucumber	93.9	0.19	0.12	0.037	0.024	dry weight		
cabbage	93.9	0.039	0.025	0.020	0.013	dry weight		

[a] Acid equivalency calculated as: 90.3% for MCPA sodium salt, 81.7% for MCPA DMAS, and 64.1% for MCPA EHE.
[b] CORE for five species (soybean, lettuce, onion, ryegrass, oat). Data for the other five species tested (corn, cucumber, cabbage, radish, tomato) were INVALID because test seeds were pretreated with pesticides.
[c] Core for five species (cabbage, cucumber, radish, tomato, corn).

APPENDIX E: The Risk Quotient Method

The Risk Quotient Method is the means used by EFED to integrate the results of exposure and ecotoxicity data. For this method, risk quotients (RQs) are calculated by dividing exposure estimates by ecotoxicity values (i.e., RQ = EXPOSURE/TOXICITY), both acute and chronic. These RQs are then compared to OPP's levels of concern (LOCs). These LOCs are criteria used by OPP to indicate potential risk to non-target organisms and the need to consider regulatory action. EFED has defined LOCs for acute risk, potential restricted use classification, and for endangered species.

The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on nontarget organisms. LOCs currently address the following risk presumption categories:

(1) acute - there is a potential for acute risk; 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.

The ecotoxicity test values (i.e., measurement endpoints) used in the acute and chronic risk quotients are derived from required studies. Examples of ecotoxicity values derived from short-term laboratory studies that assess acute effects are: (1) LC_{50} (fish and birds), (2) LD_{50} (birds and mammals), (3) EC_{50} (aquatic plants and aquatic invertebrates), and (4) EC_{25} (terrestrial plants). Examples of toxicity test effect levels derived from the results of long-term laboratory studies that assess chronic effects are: (1) LOEL (birds, fish, and aquatic invertebrates), and (2) NOEL (birds, fish and aquatic invertebrates). The NOEL is generally used as the ecotoxicity test value in assessing chronic effects.

Risk presumptions, along with the corresponding RQs and LOCs are summarized in Table D1.

Table E-1: Risk Presumptions and LOCs		
Risk Presumption	**RQ**	**LOC**
Birds[1]		
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/NOEC	1
Wild Mammals[1]		
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/NOEC	1
Aquatic Animals[2]		
Acute Risk	EEC/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/NOEC	1
Terrestrial and Semi-Aquatic Plants		
Acute Risk	EEC/EC_{25}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1
Aquatic Plants[2]		
Acute Risk	EEC/EC_{50}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1

[1] LD_{50}/sqft = (mg/sqft) / (LD_{50} * wt. of animal)
LD_{50}/day = (mg of toxicant consumed/day) / (LD_{50} * wt. of animal)

[2] EEC = (ppm or ug/L) in water

APPENDIX F: Detailed Risk Quotients

Table F-1: Aquatic Organism Risk Quotient Calculations (acid drift and runoff)							
Scenario	Acute Toxicity Threshold, LC_{50} or EC_{50} (: g a.e. /L)	Chronic Toxicity Threshold, NOAEC (: g a.e. /L)	Water Concentration (: g a.e./L)			Acute RQ	Chronic RQ
			peak	21-day	60-day		
North Dakota wheat							
Freshwater Fish	96x10^{3}	12x10^{3}	11.7		2.7	<0.01	<0.01
Freshwater Invert.	82x10^{3}	11x10^{3}	11.7	5.4		<0.01	<0.01
Estuarine Fish	179x10^{3}	no data	11.7			<0.01	
Estuarine Invert.	4.9x10^{3}	no data	11.7			<0.01	
Oregon wheat							
Freshwater Fish	96x10^{3}	12x10^{3}	9.9		2.6	<0.01	<0.01
Freshwater Invert.	82x10^{3}	11x10^{3}	9.9	5.5		<0.01	<0.01
Estuarine Fish	179x10^{3}	no data	9.9			<0.01	
Estuarine Invert.	4.9x10^{3}	no data	9.9			<0.01	
California pasture							
Freshwater Fish	96x10^{3}	12x10^{3}	18.5		5.6	<0.01	<0.01
Freshwater Invert.	82x10^{3}	11x10^{3}	18.5	11.3		<0.01	<0.01
Estuarine Fish	179x10^{3}	no data	18.5			<0.01	
Estuarine Invert.	4.9x10^{3}	no data	18.5			<0.01	
Pennsylvania pasture							

Table F-1: Aquatic Organism Risk Quotient Calculations (acid drift and runoff)							
Scenario	Acute Toxicity Threshold, LC_{50} or EC_{50} (µg a.e. /L)	Chronic Toxicity Threshold, NOAEC (µg a.e. /L)	Water Concentration (µg a.e./L)			Acute RQ	Chronic RQ
			peak	21-day	60-day		
Freshwater Fish	96x10^3	12x10^3	23.0		6.7	<0.01	<0.01
Freshwater Invert.	82x10^3	11x10^3	23.0	13.7		<0.01	<0.01
Estuarine Fish	179x10^3	no data	23.0			<0.01	
Estuarine Invert.	4.9x10^3	no data	23.0			<0.01	
Minnesota pasture							
Freshwater Fish	96x10^3	12x10^3	16.9		4.7	<0.01	<0.01
Freshwater Invert.	82x10^3	11x10^3	16.9	9.2		<0.01	<0.01
Estuarine Fish	179x10^3	no data	16.9			<0.01	
Estuarine Invert.	4.9x10^3	no data	16.9			<0.01	
Kansas sorghum							
Freshwater Fish	96x10^3	12x10^3	13.1		2.6	<0.01	<0.01
Freshwater Invert.	82x10^3	11x10^3	13.1	6.1		<0.01	<0.01
Estuarine Fish	179x10^3	no data	13.1			<0.01	
Estuarine Invert.	4.9x10^3	no data	13.1			<0.01	
Oregon peas							
Freshwater Fish	96x10^3	12x10^3	4.1		1.2	<0.01	<0.01

Table F-1: Aquatic Organism Risk Quotient Calculations (acid drift and runoff)							
Scenario	Acute Toxicity Threshold, LC_{50} or EC_{50} (:g a.e. /L)	Chronic Toxicity Threshold, NOAEC (:g a.e. /L)	Water Concentration (:g a.e./L)			Acute RQ	Chronic RQ
			peak	21-day	60-day		
Freshwater Invert.	$82x10^3$	$11x10^3$	4.1	2.5		<0.01	<0.01
Estuarine Fish	$179x10^3$	no data	4.1			<0.01	
Estuarine Invert.	$4.9x10^3$	no data	4.1			<0.01	
Pennsylvania turf							
Freshwater Fish	$96x10^3$	$12x10^3$	5.7		1.4	<0.01	<0.01
Freshwater Invert.	$82x10^3$	$11x10^3$	5.7	2.9		<0.01	<0.01
Estuarine Fish	$179x10^3$	no data	5.7			<0.01	
Estuarine Invert.	$4.9x10^3$	no data	5.7			<0.01	
Rice							
Freshwater Fish	$96x10^3$	$12x10^3$	1222		1222	0.01	0.10
Freshwater Invert.	$82x10^3$	$11x10^3$	1222	1222		0.01	0.11
Estuarine Fish	$179x10^3$	no data	1222			<0.01	
Estuarine Invert.	$4.9x10^3$	no data	1222			0.25**	

[a] * indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 0.05.
** indicates an exceedance of Acute Restricted Use LOC; RQ > 0.10.
*** indicates an exceedance of Acute Risk LOC; RQ > 0.50.

[b] + indicates an exceedance of Chronic LOC.

Table F-2: Acute Aquatic Organism Risk Quotient Calculations for (1) ester runoff and drift and (2) ester drift only					
		EHE runoff and drift		EHE drift only	
Scenario	Acute Toxicity Threshold, LC_{50} or EC_{50} (μg a.e. /L)	Peak Water Concentration (μg a.e./L)	Acute RQ[a]	Peak Water Concentration (μg a.e./L)	Acute RQ[a]
North Dakota wheat					
Freshwater Fish	760	12.7	0.02	4.2	<0.01
Freshwater Invert.	180	12.7	0.07*	4.2	0.02
Estuarine Fish	>2700	12.7	<0.01	4.2	<0.01
Estuarine Invert.	130	12.7	0.10**	4.2	0.03
Oregon wheat					
Freshwater Fish	760	9.7	0.01	4.2	<0.01
Freshwater Invert.	180	9.7	0.05*	4.2	0.02
Estuarine Fish	>2700	9.7	<0.01	4.2	<0.01
Estuarine Invert.	130	9.7	0.07*	4.2	0.03
California pasture					
Freshwater Fish	760	6.6	0.01	6.6	<0.01
Freshwater Invert.	180	6.6	0.04	6.6	0.04
Estuarine Fish	>2700	6.6	<0.01	6.6	<0.01
Estuarine Invert.	130	6.6	0.05*	6.6	0.05*
Pennsylvania pasture					

Table F-2: Acute Aquatic Organism Risk Quotient Calculations for (1) ester runoff and drift and (2) ester drift only					
Scenario	**Acute Toxicity Threshold, LC_{50} or EC_{50} (: g a.e. /L)**	**EHE runoff and drift**		**EHE drift only**	
		Peak Water Concentration (: g a.e./L)	**Acute RQ[a]**	**Peak Water Concentration (: g a.e./L)**	**Acute RQ[a]**
Freshwater Fish	760	11.6	0.02	6.6	<0.01
Freshwater Invert.	180	11.6	0.06*	6.6	0.04
Estuarine Fish	>2700	11.6	<0.01	6.6	<0.01
Estuarine Invert.	130	11.6	0.09*	6.6	0.05*
Minnesota pasture					
Freshwater Fish	760	9	0.01	6.6	<0.01
Freshwater Invert.	180	9	0.05*	6.6	0.04
Estuarine Fish	>2700	9	<0.01	6.6	<0.01
Estuarine Invert.	130	9	0.07*	6.6	0.05*
Oregon peas					
Freshwater Fish	760	2.2	<0.01	1.1	<0.01
Freshwater Invert.	180	2.2	0.01	1.1	<0.01
Estuarine Fish	>2700	2.2	<0.01	1.1	<0.01
Estuarine Invert.	130	2.2	0.02	1.1	<0.01
Pennsylvania turf					
Freshwater Fish	760	5.6	<0.01	1.0	<0.01

Table F-2: Acute Aquatic Organism Risk Quotient Calculations for (1) ester runoff and drift and (2) ester drift only					
Scenario	Acute Toxicity Threshold, LC_{50} or EC_{50} (μg a.e. /L)	EHE runoff and drift		EHE drift only	
		Peak Water Concentration (μg a.e./L)	Acute RQ[a]	Peak Water Concentration (μg a.e./L)	Acute RQ[a]
Freshwater Invert.	180	5.6	0.03	1.0	<0.01
Estuarine Fish	>2700	5.6	<0.01	1.0	<0.01
Estuarine Invert.	130	5.6	0.04	1.0	<0.01

[a] * indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 0.05.
** indicates an exceedance of Acute Restricted Use LOC; RQ > 0.10.
*** indicates an exceedance of Acute Risk LOC; RQ > 0.50.

Table F-3: Aquatic Plant Acute Risk Quotient Calculations (acid drift and runoff)					
Scenario	EC_{50} (µg a.e./L)	NOAEC (µg a.e./L)	Peak Water Concentration (µg a.e./L)	Acute Risk RQ	
				Non-endangered[a]	Endangered[b]
North Dakota wheat					
Freshwater vascular	130	13	11.7	0.09	0.90
Freshwater non-vascular	160	<0.027	11.7	0.07	NA
Estuarine non-vascular	300	15	11.7	0.04	NA
Oregon wheat					
Freshwater vascular	130	13	9.9	0.08	0.76
Freshwater non-vascular	160	<0.027	9.9	0.06	NA
Estuarine non-vascular	300	15	9.9	0.03	NA
California pasture					
Freshwater vascular	130	13	18.5	0.14	1.42*
Freshwater non-vascular	160	<0.027	18.5	0.12	NA
Estuarine non-vascular	300	15	18.5	0.06	NA
Pennsylvania pasture					
Freshwater vascular	130	13	23.0	0.18	1.77*
Freshwater non-vascular	160	<0.027	23.0	0.14	NA
Estuarine non-vascular	300	15	23.0	0.08	NA
Minnesota pasture					

Table F-3: Aquatic Plant Acute Risk Quotient Calculations (acid drift and runoff)					
Scenario	EC_{50} (µg a.e./L)	NOAEC (µg a.e./L)	Peak Water Concentration (µg a.e./L)	Acute Risk RQ	
				Non-endangered[a]	Endangered[b]
Freshwater vascular	130	13	16.9	0.13	1.30*
Freshwater non-vascular	160	<0.027	16.9	0.11	NA
Estuarine non-vascular	300	15	16.9	0.06	NA
Kansas sorghum					
Freshwater vascular	130	13	13.1	0.10	1.01*
Freshwater non-vascular	160	<0.027	13.1	0.08	NA
Estuarine non-vascular	300	15	13.1	0.04	NA
Oregon peas					
Freshwater vascular	130	13	4.1	0.03	0.32
Freshwater non-vascular	160	<0.027	4.1	0.03	NA
Estuarine non-vascular	300	15	4.1	0.01	NA
Pennsylvania turf					
Freshwater vascular	130	13	5.7	0.04	0.44
Freshwater non-vascular	160	<0.027	5.7	0.04	NA
Estuarine non-vascular	300	15	5.7	0.02	NA
Rice					
Freshwater vascular	130	13	1222	9.40***	94.0*

Table F-3: Aquatic Plant Acute Risk Quotient Calculations (acid drift and runoff)					
Scenario	**EC_{50} (µg a.e./L)**	**NOAEC (µg a.e./L)**	**Peak Water Concentration (µg a.e./L)**	**Acute Risk RQ**	
				Non-endangered[a]	**Endangered[b]**
Freshwater non-vascular	160	<0.027	1222	7.64***	NA
Estuarine non-vascular	300	15	1222	4.07***	NA

[a] *** indicates an exceedance of Acute Risk LOC; RQ > 1.0.
[b] * indicates an exceedance of Endangered Species LOC; RQ > 1.0.

Table F-4: Aquatic Plant Acute Risk Quotient Calculations for (1) ester runoff and drift and (2) ester drift only								
Scenario	EC_{50} (µg ae/L)	NOAEC (µg ae/L)	EHE runoff and drift			EHE drift only		
			Peak Water Concentration (µg ae/L)	Acute Risk RQ		Peak Water Concentration (µg ae/L)	Acute Risk RQ	
				Non-endangered[a]	Endangered[a]		Non-endangered[a]	Endangered[a]
North Dakota wheat								
Freshwater vascular	20	4	12.7	0.64	3.18*	4.2	0.21	1.05*
Freshwater non-vascular	170	21	12.7	0.07	NA	4.2	0.02	NA
Estuarine non-vascular	56	<1.9	12.7	0.23	NA	4.2	0.08	NA
Oregon wheat								
Freshwater vascular	20	4	9.7	0.49	2.43*	4.2	0.21	1.05*
Freshwater non-vascular	170	21	9.7	0.06	NA	4.2	0.02	NA
Estuarine non-vascular	56	<1.9	9.7	0.17	NA	4.2	0.08	NA
California pasture								
Freshwater vascular	20	4	6.6	0.33	1.65*	6.6	0.33	1.65*
Freshwater non-vascular	170	21	6.6	0.04	NA	6.6	0.04	NA
Estuarine non-vascular	56	<1.9	6.6	0.12	NA	6.6	0.12	NA
Pennsylvania pasture								
Freshwater vascular	20	4	11.6	0.58	2.90*	6.6	0.33	1.65*
Freshwater non-vascular	170	21	11.6	0.07	NA	6.6	0.04	NA
Estuarine non-vascular	56	<1.9	11.6	0.21	NA	6.6	0.12	NA
Minnesota pasture								

Table F-4: Aquatic Plant Acute Risk Quotient Calculations for (1) ester runoff and drift and (2) ester drift only								
Scenario	EC_{50} (µg ae/L)	NOAEC (µg ae/L)	EHE runoff and drift			EHE drift only		
			Peak Water Concentration (µg ae/L)	Acute Risk RQ		Peak Water Concentration (µg ae/L)	Acute Risk RQ	
				Non-endangered[a]	Endangered[a]		Non-endangered[a]	Endangered[a]
Freshwater vascular	20	4	9	0.45	2.25*	6.6	0.33	1.65*
Freshwater non-vascular	170	21	9	0.05	NA	6.6	0.04	NA
Estuarine non-vascular	56	<1.9	9	0.16	NA	6.6	0.12	NA
Oregon peas								
Freshwater vascular	20	4	2.2	0.11	0.55	1.1	0.06	0.25
Freshwater non-vascular	170	21	2.2	0.01	NA	1.1	<0.01	NA
Estuarine non-vascular	56	<1.9	2.2	0.04	NA	1.1	0.02	NA
Pennsylvania turf								
Freshwater vascular	20	4	5.6	0.28	1.40***	1.0	0.05	0.25
Freshwater non-vascular	170	21	5.6	0.03	NA	1.0	<0.01	NA
Estuarine non-vascular	56	<1.9	5.6	0.1	NA	1.0	0.02	NA

[a] *** indicates an exceedance of Acute Risk LOC; RQ > 1.0.
[b] * indicates an exceedance of Endangered Species LOC; RQ > 1.0.

Table F-5: Avian Acute Risk Quotient Calculations (for application rate of 4 lbs ae/acre)[a]											
						Predicted Max residues			Predicted Mean residues		
food type	LD_{50} (mg ae/kg-bwt)	weight class	adjusted LD_{50}[b]	water fraction[c]	food intake(g)[d]	EEC (mg/kg-diet)[e]	exposure (mg/kg-bwt)[f]	acute RQ[g]	EEC (mg/kg-diet)	exposure (mg/kg-bwt)	acute RQ[g]
short grass	221	20	158.43	0.79	21.69	960	1041.28	6.57***	340	368.79	2.33***
		100	201.68		61.85		593.78	2.94***		210.30	1.04***
		1000	284.89		276.92		265.84	0.93***		94.15	0.33**
tall grass	221	20	158.43	0.79	21.69	440	477.25	3.01***	144	156.19	0.99***
		100	201.68		61.85		272.15	1.35***		89.07	0.44**
		1000	284.89		276.92		121.85	0.43**		39.88	0.14*
broadleaf forage, small insects	221	20	158.43	0.71	15.71	540	424.14	2.68***	180	141.38	0.89***
		100	201.68		44.79		241.86	1.20***		80.62	0.40**
		1000	284.89		200.53		108.29	0.38**		36.10	0.13*
fruit, large insects	221	20	158.43	0.69	14.70	60	44.09	0.28**	28	20.57	0.13*
		100	201.68		41.9		25.14	0.12*		11.73	0.06
		1000	284.89		187.59		11.26	0.04		5.25	0.02
seeds, pods	221	20	158.43	0.1	5.06	60	15.19	0.1	28	7.09	0.04
		100	201.68		14.43		8.66	0.04		4.04	0.02
		1000	284.89		64.61		3.88	0.01		1.81	0.01

[a] RQs in this table were calculated for the maximum labeled application rate of 4 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of 1 lb ae/acre, multiply the listed RQs by ¼ (since 1 lb ae/acre is ¼ the listed application rate of 4 lbs ae/acre).

[b] adjusted $LD_{50\ (XXgm\ bird)} = LD_{50\ (Test\ bird)} * ([XX(g) / [bwt\ of\ test\ bird(g)])^{(1.15-1)}$ where avg bwt of test birds was 184g and LD_{50} = 221 mg/kg-bwt (MRID 400192-

02), Mineau et al 1996
[c] water fraction as determined from Exposure Factors Handbook
[d] food intake (g-diet/day) = (0.648 * BW $^{0.651}$) / (1-water fraction in food), from Nagy's (1987) allometric equations, adjusted for percentage of water contained in the food source
[e] EEC calculated from FATE5
[f] exposure (mg/kg-bwt) = food intake (g-diet/day) x EEC (mg/kg-diet) / BW (g-bwt) x (1000g-bwt/1kg-bwt) x (1kg-diet/1000g-diet)
[g] * indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 0.10.
** indicates an exceedance of Acute Restricted Use LOC; RQ > 0.20.
*** indicates an exceedance of Acute Risk LOC; RQ > 1.0.

Table F-6: Avian Chronic Risk Quotient Calculations (for application rate of 4 lbs ae/acre)[a]

Food Source	Chronic Toxicity Threshold (mg/kg-diet)	Predicted Maximum Residue Levels	
		EEC (mg/kg-diet)	Chronic RQ[b]
Short grass	1000	960	0.96
Tall grass	1000	440	0.44
Broadleaf forage, small insects	1000	540	0.54
Fruit, pods, seeds, large insects	1000	60	0.06

[a] RQs in this table were calculated for the maximum labeled application rate of 4 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of 1 lb ae/acre, multiply the listed RQs by ¼ (since 1 lb ae/acre is ¼ the listed application rate of 4 lbs ae/acre).
[b] + indicates an exceedance of Chronic Risk LOC; RQ > 1.0.

Table F-7: Mammalian Acute Risk Quotient Calculations (for application rate of 4 lbs ae/acre)[a]										
					Predicted Max residues			Predicted Mean residues		
food type	acute tox LD50	weight class (g)	water fraction[b]	food intake(g)[c]	EEC (mg/kg-diet)[d]	exposure (mg/kg-bwt)[e]	acute RQ[f]	EEC (mg/kg-diet)	exposure (mg/kg-bwt)	acute RQ[f]
short grass	1383	15	0.79	13.62	960	871.7	0.63***	340	308.73	0.22**
		35		21.96		602.46	0.44**		213.37	0.15*
		1000		145.50		139.68	0.10*		49.47	0.04
tall grass	1383	15	0.79	13.62	440	399.53	0.29**	144	130.76	0.09
		35		21.96		276.13	0.20**		90.37	0.07
		1000		145.50		64.02	0.05		20.95	0.02
broadleaf forage, small insects	1383	15	0.71	9.86	540	355.07	0.26**	180	118.36	0.09
		35		15.91		245.4	0.18**		81.8	0.06
		1000		105.36		56.90	0.04		18.97	0.01
fruit, large insects	1383	15	0.69	9.23	60	36.91	0.03	28	17.22	0.01
		35		14.88		25.51	0.02		11.9	0.01
		1000		98.57		5.91	<0.01		2.76	<0.01
seeds, pods	1383	15	0.1	3.18	60	12.71	0.01	28	5.93	<0.01
		35		5.13		8.79	0.01		4.10	<0.01
		1000		33.95		2.04	<0.01		0.95	<0.01

[a] RQs in this table were calculated for the maximum labeled application rate of 4 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of 1 lb ae/acre, multiply the listed RQs by ¼ (since 1 lb ae/acre is ¼ the listed application rate of 4 lbs ae/acre).
[b] water fraction as determined from Exposure Factors Handbook

[c] food intake (g-diet/day) =(0.621 * BW $^{0.564}$) / (1-water fraction in food), from Nagy's (1987) allometric equations, adjusted for percentage of water contained in the food source
[d] EEC calculated from FATE5
[e] exposure (mg/kg-bwt) = food intake (g-diet/day) x EEC (mg/kg-diet) / BW (g-bwt) x (1000g-bwt/1kg-bwt) x (1kg-diet/1000g-diet)
[f] * indicates an exceedance of Endangered Species Level of Concern (LOC); RQ > 0.10.
** indicates an exceedance of Acute Restricted Use LOC; RQ > 0.20.
*** indicates an exceedance of Acute Risk LOC; RQ > 1.0.

Table F-8: Mammalian Chronic Risk Quotient Calculations (for application rate of 4 lbs ae/acre)[a]

Food Source	Chronic Toxicity Threshold (mg/kg-diet)	Predicted Maximum Residue Levels		Predicted Mean Residue Levels	
		EEC (mg/kg-diet)	Chronic RQ [b]	EEC (mg/kg-diet)	Chronic RQ [b]
Short grass	150	960	6.40+	340	2.27+
Tall grass	150	440	2.93+	144	0.96
Broadleaf forage, small insects	150	540	3.60+	180	1.20+
Fruit, pods, seeds, large insects	150	60	0.40	28	0.19

[a] RQs in this table were calculated for the maximum labeled application rate of 4 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of 1 lb ae/acre, multiply the listed RQs by ¼ (since 1 lb ae/acre is ¼ the listed application rate of 4 lbs ae/acre).
[b] + indicates an exceedance of Chronic Risk LOC; RQ > 1.0.

Table F-9: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations (for application rate of 4 lbs ae/acre)[a]

Terrestrial Plant EECs and Acute Non Endangered RQs (8/8/01; version 1.0)) **Chemical: MCPA**

Input Values

Application Rate (lb a.i./acre)	4
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)	0
Seed Emerg Monocot EC25 (lb a.i./acre)	0.01
Seed Emerg Dicot EC25 (lb a.i./acre)	0.005
Veg Vigor Monocot EC25 (lb a.i./acre)	0.038
Veg Vigor Dicot EC25 (lb a.i./acre)	0.004

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.	0.24	2.0400	0.04
Aerial, Airblast, Spray Chemigation	0.3200	1.4000	0.2

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
24	48	204	408	1.05	10.00
32	64	140	280	5.26	50.00

[a] RQs in this table were calculated for the maximum labeled application rate of 4 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of 1 lb ae/acre, multiply the listed RQs by ¼ (since 1 lb ae/acre is ¼ the listed application rate of 4 lbs ae/acre).

Table F-10: Acute Endangered Terrestrial Plant Risk Quotient Calculations (for application rate of 4 lbs ae/acre)[a]

Terrestrial Plant EECs and Acute Endangered RQs (8/8/01; version 1.0) **Chemical: MCPA**

Input Values

Application Rate (lb a.i./acre)	4
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)	0
Seed Emerg Monocot EC05 or NOAEC (lb a.i./acre)	0.006
Seed Emerg Dicot EC05 or NOAEC (lb a.i./acre)	0.006
Veg Vigor Monocot EC05 or NOAEC (lbs a.i./acre)	0.013
Veg Vigor Dicot EC05 or NOAEC (lb a.i./acre)	0.003

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.	0.2400	2.0400	0.04
Aerial, Airblast, Spray Chemigation	0.3200	1.4000	0.2

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
40	40	340	340	3.08	13.33
53.33	53.33	233.33	233.33	15.38	66.67

[a] RQs in this table were calculated for the maximum labeled application rate of 4 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of 1 lb ae/acre, multiply the listed RQs by ¼ (since 1 lb ae/acre is ¼ the listed application rate of 4 lbs ae/acre).

Table F-11: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations (for application rate of 1.5 lbs ae/acre)[a]

Terrestrial Plant EECs and Acute Non Endangered RQs (8/8/01; version 1.0)) **Chemical: MCPA**

Input Values

Input	Value
Application Rate (lb a.i./acre)	1.5
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)	0
Seed Emerg Monocot EC25 (lb a.i./acre)	0.01
Seed Emerg Dicot EC25 (lb a.i./acre)	0.005
Veg Vigor Monocot EC25 (lb a.i./acre)	0.038
Veg Vigor Dicot EC25 (lb a.i./acre)	0.004

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.	0.0900	0.7650	0.0150
Aerial, Airblast, Spray Chemigation	0.1200	0.5250	0.0750

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
9.00	18.00	76.50	153.00	0.39	3.79
12.00	24.00	52.50	105.00	1.97	18.75

[a] RQs in this table were calculated for the labeled application rate of 1.5 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of 1 lb ae/acre, multiply the listed RQs by ⅔ (since 1 lb ae/acre is ⅔ the listed application rate of 1.5 lbs ae/acre).

Table F-12: Acute Endangered Terrestrial Plant Risk Quotient Calculations (for application rate of 1.5 lbs ae/acre)[a]

Terrestrial Plant EECs and Acute Endangered RQs (8/8/01; version 1.0) **Chemical: MCPA**

Input Values

Application Rate (lb a.i./acre)	1.5
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)	0
Seed Emerg Monocot EC05 or NOAEC (lb a.i./acre)	0.006
Seed Emerg Dicot EC05 or NOAEC (lb a.i./acre)	0.006
Veg Vigor Monocot EC05 or NOAEC (lbs a.i./acre)	0.013
Veg Vigor Dicot EC05 or NOAEC (lb a.i./acre)	0.003

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.	0.0900	0.7650	0.0150
Aerial, Airblast, Spray Chemigation	0.1200	0.5250	0.0750

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
15.00	15.00	127.50	127.50	1.15	5.00
20.00	20.00	87.50	87.50	5.77	25.00

[a] RQs in this table were calculated for the labeled application rate of 1.5 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of 1 lb ae/acre, multiply the listed RQs by ⅔ (since 1 lb ae/acre is ⅔ the listed application rate of 1.5 lbs ae/acre).

Table F-13: Acute Non-Endangered Terrestrial Plant Risk Quotient Calculations (for granular application rate of 1.09 lbs ae/acre) [a]

Terrestrial Plant EECs and Acute Non Endangered RQs (8/8/01; version 1.0)) Chemical: MCPA

Input Values

Input	Value
Application Rate (lb a.i./acre)	1.09
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)	0
Seed Emerg Monocot EC25 (lb a.i./acre)	0.01
Seed Emerg Dicot EC25 (lb a.i./acre)	0.005
Veg Vigor Monocot EC25 (lb a.i./acre)	0.038
Veg Vigor Dicot EC25 (lb a.i./acre)	0.004

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.	0.0545	0.5450

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
5.45	10.90	54.50	109.00

[a] RQs in this table were calculated for the maximum labeled granular application rate of 1.09 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of .55 lb ae/acre, multiply the listed RQs by ½ (since 0.55 lb ae/acre is ½ the listed application rate of 1.09 lbs ae/acre).

Table F-14: Acute Endangered Terrestrial Plant Risk Quotient Calculations (for granular application rate of 1.09 lbs ae/acre) [a]

Terrestrial Plant EECs and Acute Endangered RQs (8/8/01; version 1.0)) **Chemical: MCPA**

Input Values

Application Rate (lb a.i./acre)	1.09
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)	0
Seed Emerg Monocot NOAEC (lb a.i./acre)	0.006
Seed Emerg Dicot NOAEC (lb a.i./acre)	0.006
Veg Vigor Monocot NOAEC (lb a.i./acre)	0.013
Veg Vigor Dicot NOAEC (lb a.i./acre)	0.003

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.	0.0545	0.5450

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
9.08	9.08	90.83	90.83

[a] RQs in this table were calculated for the maximum labeled granular application rate of 1.09 lbs ae/acre. RQs for other application rates are a linear function of the listed RQs. For example to calculate an RQ for a rate of .55 lb ae/acre, multiply the listed RQs by ½ (since 0.55 lb ae/acre is ½ the listed application rate of 1.09 lbs ae/acre).

APPENDIX G: Status of Fate and Ecological Effects Data Requirements for MCPA

Table G-1: Environmental Fate Data Requirements for MCPA				
Guideline #		Data Requirement	MRID #'s	Study Classification
		Dissociation	42571-01	Acceptable
161-1	835.212	Hydrolysis	426939-01A 426715-01 426653-01A	Acceptable Supplemental Acceptable
161-2	835.224	Photodegradation in Water	429281-01	Acceptable
161-3	835.241	Photodegradation on Soil	432258-01	Acceptable
161-4	835.237	Photodegradation in Air		Reserved
162-1	835.41	Aerobic Soil Metabolism	415860-01	Acceptable
162-2	835.42	Anaerobic Soil Metabolism	415860-01	Acceptable
162-3	835.44	Anaerobic Aquatic Metabolism	404619-01	Acceptable
162-4	835.43	Aerobic Aquatic Metabolism	447324-01 441927-01 447324-01B	Acceptable Acceptable Acceptable
163-1	835.1240 835.1230	Leaching-Adsorption/Desorption	425969-03 405558-01 442386-01	Acceptable Supplemental Supplemental
163-2	835.141	Laboratory Volatility	40780-00	Unacceptable
163-3	835.81	Field Volatility		Reserved
164-1	835.61	Terrestrial Field Dissipation	421339-01 421340-01 421341-01 421342-01 438157-01 438830-01 436975-01	Supplemental Supplemental Supplemental Supplemental Supplemental Supplemental Supplemental
164-2	835.62	Aquatic Field Dissipation		Reserved
164-3	835.63	Forestry Dissipation		Reserved
164-4	835.64	Combination Products and Tank Mixes Dissipation		Reserved
165-4	850.173	Accumulation in Fish		Reserved
165-5	850.195	Accumulation- aquatic non-target		Reserved
166-1	835.71	Ground Water- small prospective		Reserved
201-1	840.11	Droplet Size Spectrum		a
202-1	840.12	Drift Field Evaluation		a

[a] Member of Spray-Drift Task Force.

Table G-2: Ecological Effects Data Requirements for MCPA										
Guideline #		Data Requirement	030501		030502		030516		030564	
			MRID	Study Classification	MRID	Study Classification	MRID	Study Classification	MRID	Study Classification
71-1	850.21	Avian Oral LD_{50}	bobwhite 400192-01	core			bobwhite 400192-01	core		
71-2	850.22	Avian Dietary LC_{50}					bobwhite 405558-03 mallard 405558-02	core core		
71-4	850.23	Avian Reproduction	bobwhite 435052-01	core						
72-1	850.1075	Freshwater Fish LC_{50}			bluegill 418009-01 rainbow 418009-02	core TEP core TEP	bluegill 400620-04 bluegill 426244-02 bluegill 418009-04 rainbow 400620-05 rainbow 418009-05	core core core TEP core core TEP	bluegill 426244-03 rainbow 426244-04	core core
72-2	850.101	Freshwater Invertebrate Acute LC_{50}			daphnid 418009-03	core TEP	daphnid 424122-01 daphnid 418009-06	core core TEP	daphnid 426136-01	core
72-3(a)	850.1075	Estuarine/Marine Fish LC_{50}	Atlantic silverside 400620-02	core	sheepshead 419395-04	core TEP	sheepshead 430832-10 sheepshead 419395-01	core core TEP	sheepshead 430865-01	core

Table G-2: Ecological Effects Data Requirements for MCPA										
Guideline #		Data Requirement	030501		030502		030516		030564	
			MRID	Study Classification	MRID	Study Classification	MRID	Study Classification	MRID	Study Classification
72-3(b)	850.1025	Estuarine/Marine Mollusk EC_{50}	Eastern oyster larvae 400620-03	core	Eastern oyster shell 419395-06	core TEP	Eastern oyster shell 430932-09 Eastern oyster shell 432521-01 Eastern oyster shell 419395-03	core core TEP supp TEP (no definitive NOAEC)		
72-3(c)	850.1035 850.1045	Estuarine/Marine Shrimp EC_{50}	pink shrimp 400620-01	core	mysid 419395-05	core TEP	mysid 419395-02 pink shrimp 400620-06	core TEP core	mysid 430965-02	core
72-4(a)	850.14	Freshwater Fish Early Life-Stage					fathead minnow 444072-02	core		
72-4(b)	850.1300 850.1350	Aquatic Invertebrate Life-Cycle					daphnid 444072-01	core		
72-5	850.15	Freshwater Fish Full Life-Cycle								
122-1(a)	850.41	Seed Germ./Seedling Emergence								
122-1(b)	850.415	Vegetative Vigor								
122-2	850.44	Aquatic Plant Growth								

Table G-2: Ecological Effects Data Requirements for MCPA										
Guideline #		Data Requirement	030501		030502		030516		030564	
			MRID	Study Classification	MRID	Study Classification	MRID	Study Classification	MRID	Study Classification
123-1(a)	850.4225	Seed Germ./Seedling Emergence	430832-05 (ten species)	core			426987-08 (eight species) 432579-01 (two species)	Together, these two studies contain core data for ten species.	426693-01 (ten species)	core
123-1(b)	850.425	Vegetative Vigor	430832-05 (ten species)	core			426693-04 (five species) 437882-01 (five species)	Together, these two studies contain core data for ten species.	426693-02 (ten species)	core

Table G-2: Ecological Effects Data Requirements for MCPA

Guideline #		Data Requirement	030501		030502		030516		030564	
			MRID	Study Classification	MRID	Study Classification	MRID	Study Classification	MRID	Study Classification
123-2	850.44	Aquatic Plant Growth	*Lemna gibba* 431265-01 *Selan. capricornitum* 430632-03 *Navic. pelliculosa* 430932-02 *Ana. flos-aquae* 430832-04 *Skel. costatum* 430832-01	supp (no definitive NOAEC) core core core core			*Lemna gibba* 431265-02 *Lemna gibba* 449035-01 *Selan. capricornitum* 424613-01 *Selan. capricornitum* 449035-02 *Selan. capricornitum* 453131-01 *Selan. capricornitum* 455544-03 *Navic. pelliculosa* 430832-07 *Navic. pelliculosa* 449035-04 *Ana. flos-aquae* 430832-08 *Ana. flos-aquae* 449035-03 *Skel. costatum* 430832-06 *Skel. costatum* 449035-05	supp (no definitive NOAEC) core core core supp (insufficient replicates) supp (no definitive NOAEC) core supp (no definitive NOAEC) core core core core	*Lemna gibba* 430832-14 *Selan. capricornitum* 424612-01 *Navic. pelliculosa* 430832-11 *Ana. flos-aquae* 430832-13 *Skel. costatum* 430832-12	core core core core core
141-1	850.302	Honey Bee Acute Contact LD_{50}					honey bee 421503-01	core	honeybee 421978-01	core

Table G-2: Ecological Effects Data Requirements for MCPA										
Guideline #		Data Requirement	030501		030502		030516		030564	
			MRID	Study Classification	MRID	Study Classification	MRID	Study Classification	MRID	Study Classification
141-2	850.303	Honey Bee Residue on Foliage								