United States Environmental Protection Agency
Prevention, Pesticides and Toxic Substances (7508P)
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Amended Reregistration Eligibility Decision (RED) for Chloropicrin

Amended Reregistration Eligibility Decision (RED) for Chloropicrin

List [A]

Case No. 0040

Approved by: Richard P Keigwin, Jr

Richard Keigwin, Jr.
Director
Special Review and Reregistration Division

Date: 5/27/09

Glossary of Terms and Abbreviations

ai	Active Ingredient
ANLA	American Nursery and Landscape Association
APHIS	Animal and Plant Heath Inspection Service
APR	air-purifying respirator
ARS	Agricultural Research Service
ATV	all-terrain vehicle
BEAD	Biological and Economic Analysis Division
BrO	bromine monoxide
CDPR	California Department of Pesticide Regulation
CFC	chlorofluorocarbons
CFR	Code of Federal Regulations
ClO	chlorine monoxide
CMTF	Chloropicrin Manufacturers' Task Force
CSF	Confidential Statement of Formulation
CUE	Critical Use Exemption
CUN	Critical Use Nominations
DCI	Data Call-In
DNT	Developmental Neurotoxicity
EDSP	Endocrine Disruptor Screening Program
EDSTAC	Endocrine Disruptor Screening and Testing Advisory Committee
EEC	Estimated Environmental Concentration
EPA	Environmental Protection Agency
EUP	End-Use Product
FDMS	Federal Docket Management System
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FFDCA	Federal Food, Drug, and Cosmetic Act
FMP	Fumigant Management Plan
FQPA	Food Quality Protection Act
ft	feet
GAP	Good Agricultural Practices
GENEEC	GENeric Estimated Exposure Concentration model
GLN	Guideline Number
GPS	Global Positioning System
ha	hectare
HCFC	hydrochlorofluorocarbons
HDPE	High-density Polyethylene
HED	Health Effects Division
ISCST3	Industrial Source Complex Short Term model
KTS	Potassium Thiosulfate
lb	pound
LC_{50}	Median Lethal Concentration. A statistically derived concentration of a substance that can be expected to cause death in 50% of test animals. It is

	usually expressed as the weight of a substance per weight or volume of water, air, or feed, e.g., mg/l, mg/kg, or ppm.
LD_{50}	Median Lethal Dose. A statistically derived single dose that can be expected to cause death in 50% of the test animals when administered by the route indicated (oral, dermal, inhalation). It is expressed as a weight of substance per unit weight of animal, e.g., mg/kg.
LOC	Level of Concern
LOAEL	Lowest Observed Adverse Effect Level
MBAO	Methyl Bromide Alternatives Outreach
MBIP	Methyl Bromide Industry Panel
MBTOC	Methyl Bromide Technical Options Committee
MCFA	Minor Crop Farmer Alliance
mg/kg/day	Milligram Per Kilogram Per Day
mg/L	Milligram Per Liter
MITC	methyl isothiocyanate
MOE	Margin of Exposure
MRID	Master Record Identification Number. EPA's system for recording and tracking studies submitted.
MSHA	Mine Safety and Health Administration
MUP	Manufacturing-Use Product
NAM	National Association of Manufacturers
NIOSH	National Institute for Occupational Safety and Health
NOAEL	No Observed Adverse Effect Level
NPDES	National Pollutant Discharge Elimination System
OAR	Office of Air and Radiation
ODP	ozone depletion potential
OPP	EPA Office of Pesticide Programs
OPPTS	EPA Office of Prevention, Pesticides, and Toxic Substances
ORE	Occupational and Residential Exposure
OSHA	Occupational Safety and Health Administration
PC	Pesticide Chemical
PDCI	Product-specific Data Call-in
PERFUM	**P**robabilistic **E**xposure and **R**isk model for **Fum**igants
PLHCP	Physician or Other Licensed Health Care Professional
PPE	Personal Protective Equipment
ppm	Parts Per Million
PrG	Pressurized gas
PRZM/EXAMS	Pesticide Root Zone Model/Exposure Analysis Modeling System. A Tier II Surface Water Computer Model.
PSA	public service announcement
psi	pounds per square inch
PVC	Polyvinyl Chloride
QPS	Quarantine and Preshipment
RED	Reregistration Eligibility Decision
REI	Restricted Entry Interval
RQ	Risk Quotient

RUP	Restricted Use Pesticide
SAB	Science Advisory Board
SCBA	self-contained breathing apparatus
SLA	State Lead Agency
SRRD	Special Review and Reregistration Division
TEAP	Technical and Economic Assessment Panel
TRED	Tolerance Reassessment and Risk Management Decision
TWA	time weighted average
UNEP	United Nations Environment Programme
USC	United States Code
USDA	United States Department of Agriculture
UF	Uncertainty Factor
UV	Ultraviolet
VIF	Virtually Impermeable Film
WPS	Worker Protection Standard

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Abstract

This document presents the U.S. Environmental Protection Agency's (hereafter EPA or the Agency) amended decision regarding the reregistration eligibility of the registered uses of the active ingredient chloropicrin (trichloronitromethane). This follows the 105-day public comment period on the Reregistration Eligibility Decision provided for stakeholders to have the opportunity to review and provide comments on issues related to the implementation of the risk mitigation measures. The Agency's risk conclusions for chloropicrin have not changed. In addition, all measures established in the July 2008 RED to reduce risks to bystanders and workers will still be required. However, the Agency has determined that certain modifications in how and when some measures will be implemented are appropriate. Products containing chloropicrin are eligible for reregistration provided that: (1) current data gaps are addressed; (2) the risk mitigation measures identified in this document are adopted; and (3) labels are amended to implement these measures.

Concurrent to EPA's review of the soil fumigant uses of chloropicrin, EPA assessed the risks and developed risk management decisions for four other soil fumigants: dazomet, methyl bromide, metam sodium/potassium, and a new active ingredient, iodomethane. Risks of a fifth soil fumigant, 1,3-dichloropropene (1,3-D), were also analyzed along with the other soil fumigants for comparative purposes. The Reregistration Eligibility Document (RED) for 1,3-D was completed in 1998. The Agency evaluated these soil fumigants concurrently to ensure that human health risk assessment approaches are consistent, and that risk tradeoffs and economic outcomes were considered appropriately in reaching risk management decisions. This review is part of EPA's program to ensure that all pesticides meet current health and safety standards.

Chloropicrin acts as a nonselective soil fumigant with fungicidal, herbicidal, insecticidal, and nematicidal properties. The supported uses of chloropicrin include: (1) pre-plant soil fumigations (e.g., agricultural and commercial greenhouse); (2) empty grain bins and empty potato storage house/cellar fumigations; (3) residential uses (warning agent for sulfuryl fluoride); and (4) other specialized fumigations (e.g., spot tree replant sites and remedial wood treatments). Of the supported uses, chloropicrin is mainly used as an agricultural pre-plant soil fumigant. The Agency did not develop mitigation for the empty grain bin and empty potato storage/house cellar fumigations because the Agency received requests to voluntarily cancel these uses. A Federal Register notice was published on August 20, 2008 announcing the Agency's receipt of these voluntary requests. EPA did not receive any comments on this notice and these uses must be deleted from the labels when revised labels are submitted to the Agency in 2009.

Due to chloropicrin's volatility there is no reasonable expectation that finite residues will be incurred in/on any raw agricultural commodity when these products are applied according to label directions. Therefore, this fumigant does not require food tolerances and there is no expectation of risk from dietary exposure.

The Agency has identified potential human health risks associated with the above supported uses of chloropicrin. Due to chloropicrin's potential to move off-site, EPA is concerned with inhalation exposure to handlers, bystanders, and workers. To reduce inhalation

exposures and to address associated risks of concern for pre-plant soil fumigations, EPA is requiring a number of mitigation measures such as:

- buffer zones,
- buffer zone posting,
- respiratory protections,
- restrictions on the timing of tarp perforation and removal operations,
- entry restrictions,
- mandatory good agricultural practices (GAPs),
- fumigant management plans (FMPs),
- emergency preparedness and response,
- notice to state-lead agencies,
- training, and
- community outreach and education programs.

To address bystander and occupational risks for remedial wood treatments, the Agency is requiring a number of label statements and respiratory protection.

The Agency also has concerns regarding ecological and environmental risk when chloropicrin is used as a pre-plant soil fumigant. The Agency believes that many of the mitigation measures required above to address human health risk (e.g., buffer zones, timing of tarp perforation and removal, GAPs), will indirectly address ecological risk. The Agency is also requiring label statements to mitigate chloropicrin's potential to leach into ground and/or surface water.

Some chloropicrin end-use products are packaged as 100% chloropicrin, while other products contain mixtures of chloropicrin with methyl bromide, 1,3-D, and iodomethane. In these combination products the percent active ingredient for chloropicrin ranges from 20-67% when combined with methyl bromide, 15-60% when combined with 1,3-D, and 2-75% when combined with iodomethane. In addition, chloropicrin is used solely as a warning agent to indicate possible hazardous concentrations of methyl bromide[1] (chloropicrin is formulated at 2% or less by weight for pre-plant soil fumigations) and sulfuryl fluoride (chloropicrin is introduced into residential structures prior to the sulfuryl fluoride fumigation).

Separate RED documents have been completed for methyl bromide (July 2008, and an amendment will be published concurrently with chloropicrin), sulfuryl fluoride (1993), and 1,3-D (1998). Iodomethane was granted a one year time-limited registration in October 2007 while chloropicrin, methyl bromide, metam sodium/potassium, and dazomet were going through reregistration. In April 2009, EPA extended the registration of iodomethane maintaining appropriate provisions governing its use and maintaining the conditional registration with the same conditions but removing the time limitation on the registration. The conditions of registration were to ensure that the iodomethane registrant makes all changes to the iodomethane labels that are appropriate to ensure that all the fumigants are regulated in a consistent manner.

[1] Current labels reflect use of chloropicrin as a warning agent for methyl bromide during structural fumigations. The use of methyl bromide for structural fumigations is not eligible for reregistration. As a result, the warning agent use for chloropicrin formulations with methyl bromide for structural fumigations was not evaluated.

In accordance with Agency policy, if the required risk mitigation measures differ for two active ingredients in a product, the more stringent mitigation measure is required on product labels.

I. Introduction

This amends and supersedes the document, "Reregistration Eligibility Decision for Chloropicrin," published by the U.S. Environmental Protection Agency on July 16, 2008. That day EPA opened a 60-day public comment period on the implementation aspects of the risk mitigation measures that were required as conditions of reregistration eligibility under FIFRA. EPA received requests to extend the comment period from the Methyl Bromide Industry Panel (MBIP), California Specialty Crops Council, the Chloropicrin Manufacturers' Task Force (CMTF), the National Association of Manufacturers (NAM), the American Nursery and Landscape Association (ANLA), the California Strawberry Nurserymen's Association, the Agricultural Retailers Association, the American Forest and Paper Association, and McDermott, Will, and Emery LLP, on behalf of the Minor Crop Farmer Alliance (MCFA). In response to these requests, on August 29, 2008, EPA published a notice in the Federal Register extending the comment period for an additional 45 days. The comment period closed on October 30, 2008. EPA has completed its review of public comments as well as new scientific data and other information provided and determined that all measures established in the July 2008 RED to reduce risks to bystanders and workers will still be required. The Agency has determined that certain modifications in how and when some measures will be implemented are appropriate. The public comments and EPA's responses, as well as other supporting documents, may be found in the public docket for chloropicrin at www.regulations.gov, docket EPA-HQ-OPP-2007-0350. EPA has determined that the modifications described herein will achieve the same protection goals for persons potentially exposed to chloropicrin but with a greater likelihood of compliance, fewer impacts on the benefits of chloropicrin use, and with less uncertainty regarding the protectiveness of the required measures. Please see Table 1 for a summary of the modifications.

Table 1. Modifications from 2008 to 2009 Amended Chloropicrin RED

Mitigation	2008 REDs	2009 Amended REDs
Buffer Zones	**Buffer zones based on available data**	**New chloropicrin data support smaller buffers and increased confidence in safety**
Buffer Credits	**Credits allowed based on available data; capped at 50%**	**New data support additional credits and an increase in the cap to 80%**
Rights of Way	**Permission from local authorities must be granted if buffers extend onto rights of way**	**Permission from local authorities is only required when a sidewalk or permanent walkway is present**
Buffer Overlap	**Buffers may not overlap**	**Buffers may overlap; separate applications by 12 hours and increase emergency preparedness and response measures**
Structures within Buffer Zones	**Monitoring with devices before reentry**	**Monitor for sensory irritation before reentry**
Restrictions around difficult to evacuate	**¼ mile restriction around hard to evacuate areas including daycare**	**Maintain ¼ mile restriction but allow a reduced restricted area of ⅛ mile for**

Mitigation	2008 REDs	2009 Amended REDs
sites	**centers, nursing homes, and schools; was to be in effect for the duration of the buffer zone period**	**applications with smaller buffers (300 feet or less); is to be in effect during the application and for 36 hours following the application**
Posting	**Posting required at buffer zones points of entry, where people are likely to approach, and areas between these locations**	**The posting requirement is retained but no longer requires areas between the entry areas to be posted Information required on the signs has been simplified to encourage reuse of signs**
Handler Protection	**Described tasks that may only be performed by handlers and situations where 2 handlers were required to be present while in the buffer zone**	**Tasks that may only be performed by handlers have been updated and clarified The situations have been clarified requiring 2 handlers to be present based on the chemical properties of the different soil fumigants, and current label statements**
Respiratory Protection	**Required monitoring devices to trigger additional measures**	**Allow chloropicrin's sensory irritation properties to trigger additional measures Monitoring with devices is still required to remove respirators**
Tarp perforation and removal	**Perforating tarps restricted to mechanical means only**	**Perforating tarps by hand is allowed for areas less than 1 acre in size and for flood prevention activities**
Entry Prohibitions	**Entry for non-handlers is prohibited for the duration of the entry restricted period, until tarps have been removed, or if 14 days has passed**	**No major changes**
GAPs	**Certain GAPs required for all fumigant applications**	**Some clarifications and refinements have been made based on stakeholder comments**
FMPs	**FMPs required to be completed before fumigant application begins and post-application summary report required following the application**	**No major changes. Based on comments an example of an FMP has been included to illustrate how the required information may be presented effectively**
Emergency Response and Preparedness	**If neighbors are near buffers they must be provided with information or buffer zones must be monitored every 1-2 hours over 48 hours with monitoring devices**	**Same basic measures apply, however monitoring required only during peak emission times of the day; irritation detection acceptable for chloropicrin in lieu of devices**

Mitigation	2008 REDs	2009 Amended REDs
Notice to SLAs	**Applicators required to provide notice to the appropriate state/tribal lead agency before fumigating to facilitate compliance assistance and assurance**	**States may determine if they wish to receive this information** **All states required to include strategies for compliance assistance and assurance for soil fumigation in their cooperative agreements**
Applicator Training	**Certified applicators required to receive registrant soil-fumigant training every year**	**Certified applicators required to receive registrant soil-fumigant training every three years**
Community Outreach and Education	**Registrants required to develop and implement community outreach & education programs along with information for first responder in high fumigant use**	**Same basic requirement** **The Agency is providing information on where registrants are required to focus these efforts**

With regard to implementation timing, EPA has determined that most measures can be efficiently implemented via revised product labels by the 2010 use season. Other measures, in particular those related to buffer zones, will present greater compliance challenges and will require additional time for EPA to conduct the necessary outreach, and communication activities with states, tribes, other regulatory partners, fumigant users, and other stakeholders to facilitate transition. EPA has determined that these measures will be implemented via revised product labels by the 2011 use season. As a result, all measures described in this amended RED that are necessary for reregistration eligibility will appear on product labels by 2011. The table below shows the measures that will be implemented in 2010 and the additional measures that will be implemented in 2011.

Table 2. Implementation Schedule for Soil Fumigant Risk Mitigation Measures

Risk Mitigation Measure	Currently	2010	2011
Restricted Use	●	●	●
New Good Agricultural Practices		●	●
Rate reductions		●	●
Use site limitations		●	●
New handler protections		●	●
Tarp cutting and removal restrictions		●	●
Extended worker reentry restrictions		●	●
Training information for workers		●	●
Fumigant Management Plans		○	●
First responder and community outreach		○	●
Applicator training		○	●
Compliance assistance and assurance measures		○	●

Risk Mitigation Measure	Currently	2010	2011
Restrictions on applications near sensitive areas			●
Buffer zones around all occupied sites			●
Buffer credits for best practices			●
Buffer posting			●
Buffer overlap prohibitions			●
Emergency preparedness measures			●

○ = under development
● = adopt completely

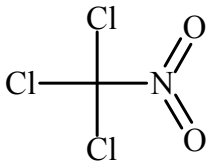
The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was amended in 1988 to accelerate the reregistration of products with active ingredients registered prior to November 1, 1984. The amended Act calls for the development and submission of data to support the reregistration of an active ingredient, as well as a review of all submitted data by the EPA. Reregistration involves a thorough review of the scientific database underlying a pesticide's registration. The purpose of the Agency's review is to reassess the potential risks arising from the currently registered uses of the pesticide, to determine the need for additional data on health and environmental effects, and to determine whether or not the pesticide meets the "no unreasonable adverse effects" criteria of FIFRA.

This document presents the Agency's amended reregistration eligibility decision for the supported soil (agricultural, greenhouse, and tree replant), warning agent, and antimicrobial wood preservative uses of chloropicrin. The document consists of five sections. Section I contains the regulatory framework for reregistration and a synopsis of modifications from the July 2008 RED. Section II provides chloropicrin's use and usage profile. Section III provides a general fumigant overview and also summarizes chloropicrin's human health and ecological risk assessments, as well as benefit and impact assessments. Section IV presents the Agency's amended reregistration eligibility and risk management decisions. Section V summarizes label changes necessary to implement the risk mitigation measures outlined in Section IV. The revised risk assessment documents and related addenda are not included in this document, but are available in the chloropicrin docket EPA-HQ-OPP-2007-0350 at https://www.regulations.gov. Unless otherwise noted, all Agency documents are available for review in the chloropicrin docket. Documents published during Phases 1-4 are available at https://www.regulations.gov, docket number EPA-HQ-OPP-2006-0661.

II. Chemical Overview

A. Chemical Identity

Chemical Structure:



Empirical Formula: CCl_3NO_2

Common Name: Chloropicrin

CAS Registry Number: 76-06-2

OPP Chemical Code: 081501

Case Number: 0040

Technical Registrants: Niklor Chemical Company, Inc., Arysta Life Sciences North America Corporation, ASHTA Chemicals, Inc., and Trinity Manufacturing, Inc. All 4 companies are part of the Chloropicrin Manufacturers' Task Force (CMTF).

B. Use and Usage Profile:

Pesticide Type: Chloropicrin is a broad spectrum fumigant with fungicidal, herbicidal, insecticidal, and nematicidal properties. Chloropicrin supported uses include: pre-plant soil fumigant use at agricultural sites, tree replant sites, and greenhouses; a warning agent use in residential structures before sulfuryl fluoride fumigations; and an antimicrobial remedial wood treatment use. Chloropicrin is currently labeled for use in empty grain bins and empty potato storage/house cellars, but these uses have been voluntarily cancelled and must be removed from labels.

Target Pests: When used as a pre-plant soil fumigant in agricultural settings and in greenhouses, chloropicrin is used to control weeds, nematodes, insects, and various soil borne pathogens.

In existing orchards chloropicrin is used to treat small areas to control weeds, nematodes, insects, and various soil borne pathogens.

Chloropicrin is also used to control internal wood decay caused by fungi and insects in wood poles, timbers, pilings, and glue-laminated beams.

Formulations:

Chloropicrin can be formulated as a soluble concentrate/liquid, pressurized gas, pressurized liquid, emulsifiable concentrate, and a ready-to-use product. All chloropicrin products are classified as restricted use pesticides (RUP). The "Restricted Use" classification restricts a product, or its uses, to use by certified pesticide applicators or those working under the direct supervision of a certified applicator.

Methods of Application:

As a pre-plant soil fumigant chloropicrin is either injected (e.g., by shank) into the soil or applied via drip irrigation. These applications can either be tarped or untarped.

Chloropicrin is used in existing orchards for tree replant purposes. Tree site applications take place in small treated areas (10' x 10') where chloropicrin is injected at least 18 inches into the soil using a replant wand.

When used as a warning agent prior to sulfuryl fluoride residential structure fumigations, a tent must first be put up around the structure. Chloropicrin is then placed in the center of the structure in either a shallow pan or onto absorbent material. A fan is then placed to direct the air stream over the pan or absorbent material to accelerate the chloropicrin's evaporation. Chloropicrin should be applied 5-10 minutes before sulfuryl fluoride is introduced into the structure.

For remedial wood treatment, chloropicrin is either poured/injected or applied with encapsulated vials into pre-drilled holes. For utility pole treatment, holes are drilled at a 45 degree angle and chloropicrin is poured/injected or applied with encapsulated vials into all of the holes. After the chloropicrin has been applied, the holes are immediately plugged.

Application Rates:

For pre-plant soil fumigation use the following are the supported maximum application rates:

- 350 lbs active ingredient (ai) per acre for tarped, shank injection applications;
- 175 lbs ai per acre for untarped, shank injection applications;
- 350 lb ai per acre for deep (at least 18 inches) untarped, shank injection applications;

- 300 lbs ai per acre for drip irrigation applications (including greenhouses);
- 500 lbs ai per acre for tree hole replant applications, this is equivalent to 1 lb of chloropicrin per 100 square feet.

When used as a warning agent prior to sulfuryl fluoride residential fumigations 1 fluid ounce ai of chloropicrin is used per 10,000-15,000 cubic feet.

Labels indicate that the amount of chloropicrin used for remedial wood treatment is based on the size of the pole. Pole applications range from 4 ounces ai up to 1 ¼ pints ai for larger poles.

Annual U.S. Usage: According to 2007 Agency use information, about 10 million pounds of chloropicrin are used annually for pre-plant soil fumigations. This amount may differ from what has been presented in the Agency's revised risk assessments since that data reflected usage data from 2002-2004.

C. Regulatory History

- First registered in the U.S. in 1975.
- A registration standard was issued in 1982.
- Data Call-In's (DCIs) issued in September 1990 and October 1995.
- Reregistration Eligibility Decision (RED) for Chloropicrin, July 2008.

III. Summary of Risk and Benefit Assessments and Links to Agency Documents

A. General Overview of Soil Fumigants

Soil fumigants are pesticides that form gasses when applied to soil. Once in the soil, the fumigants work by controlling pests that can disrupt plant growth and crop production. Soil fumigants play a very important role in agriculture, but they also have the potential to pose risk concerns to people involved in the application (handlers), workers who re-enter fumigated fields (workers), and people who may be near the treated area (bystanders).

B. Human Health Risk from Chloropicrin

The main risk of concern for handlers, workers, and bystanders associated with the soil uses of chloropicrin is from acute inhalation exposure as a result of fumigant off-gassing. The term *handler* refers to persons involved in the application of chloropicrin. For soil applications, handlers also include persons involved in tarp perforation and removal. The term *worker* in this document refers to persons performing non-handler tasks (e.g., planting) within the application block, after the fumigation process has been completed. The term *bystander* refers to any person who lives or works in the vicinity of a fumigation site.

In addition to the soil uses of chloropicrin, there are other uses that the Agency has assessed and included in the July 2008 RED. Chloropicrin's use as a warning agent was also evaluated in the Agency's revised human health risk assessment. Chloropicrin is also used as an antimicrobial to control internal wood decay in wood poles, timbers, pilings, and glue-laminated beams. These uses were assessed in a different document than the pre-plant soil and warning agent uses.

Estimating exposure to fumigants is different from non-fumigant pesticides due to fumigants' volatility, and thus, their increased ability to move off-site during and after application. For example, pesticide spray drift is the physical movement of pesticide particulate or droplets from the target site during the application and soon thereafter. In the case of soil fumigants, the pesticide moves as a gas (not as particulate or droplets) and movement off-site can occur for an extended period after application. Importantly, fumigants have a well-documented history of causing large-scale human exposure incidents up to several thousand feet from treated fields. Assessing fumigant exposure takes into account the size of the fumigated field, the amount of fumigant applied, and the rate at which the fumigant escapes from the treated field.

The term "flux rate" or "emission rate" defines the rate at which a fumigant off-gasses from a treated field. Many factors influence the emission rate from treated fields. Factors such as the application method, soil moisture, soil temperature, organic matter levels, water treatments, the use of tarps, biological activity in the soil, soil texture, weather conditions, soil compaction, and others influence the amount of fumigant that comes off the field and is available to move off-site to areas where bystanders may be located.

Chloropicrin can cause eye, nose, throat, and upper respiratory irritation. Results from a chloropicrin human sensory irritation study indicate that eye irritation is the most sensitive effect.

The Agency selected a reversible acute endpoint from the human study. EPA used this study to determine a bench mark concentration level ($BMCL_{10}$) of 0.073 parts per million (ppm). At this level EPA does not expect eye or nose irritation, or upper respiratory changes. Most of the study participants detected chloropicrin within 20-30 minutes at 0.15 ppm. This level corresponds to mild irritation without leading to more severe irritation and respiratory effects. In addition, the human study shows that persons exposed to 0.15 ppm of chloropicrin did not experience irritation effects 1 hour after the exposure ended, and also no irritation effects were seen the following day.

Based on the human study, a margin of exposure (MOE) of 1 defines the Agency's level of concern (LOC) for acute inhalation exposure. The uncertainty factors have been removed due to a) chloropicrin's mode of action (MOA) of sensory irritation,[2] and b) evaluation of the most sensitive human subpopulation to sensory irritants (young adults, average age 23).[3]

The Agency has high quality data that shows at 0.15 ppm (which corresponds to an MOE of 0.50) humans begin to sense chloropicrin without leading to more serious effects. While there are uncertainties about the effects of chloropicrin at higher concentrations and at exposure durations longer than 1 hour, data do suggest that effects would not become more severe unless the concentration of chloropicrin increases. Therefore, the Agency is confident that the human study provides high quality information regarding the dose-response in humans at the levels that lead to minor, reversible effects.

In assessing risks from chloropicrin, the Agency considered multiple lines of evidence, using the best available information from monitoring studies, modeling tools, and from incident reports.

- Monitoring: For the human health risk assessments completed for chloropicrin and the other soil fumigants within the group, several field-scale monitoring studies were considered, as well as monitoring of workers and handlers involved in various tasks. These studies quantify chloropicrin concentrations in and around fields at various times and distances during and after applications. Many of these data indicate that there can be risks of concern associated with chloropicrin use at a broad range of distances from treated fields. However, these data are limited in their utility because they provide results only for the specific conditions under which the study was conducted.

- Modeling: Models enable the use of data from monitoring studies to estimate concentrations and potential risks under a wide range of conditions and use patterns. EPA used Version 2.1.4 of the **P**robabilistic **E**xposure and **R**isk model for **Fum**igants (also called the PERFUM model), to evaluate potential risks at distances around treated fields. PERFUM incorporates actual weather data and flux distribution estimates, then accounts for changes and altering conditions. Analyses based on a variety of model

[2] For details on guidance documents and framework the Agency used to determine chloropicrin's see, EPA-HQ-OPP-2007-0350-0172. "MOA Mode of Action, Eye Irritation, and the Intra-Species Factor: Comparison of Chloropicrin and MITC." June 25, 2008. (DP Barcode 293356)

[3] For a more detailed explanation of the study see, "Chloropicrin: Third Revision of the HED Human Health Risk Assessment. April 30, 2009. (DP Barcode D348637)."

outputs were used to compare the potential risks at a range of distances. The PERFUM model and users manual are public domain and can be downloaded at http://www.exponent.com/perfum/.

- Bystander, handler and worker incident reports: Incidents for the soil fumigants generally occur at a low frequency relative to the total number of fumigant applications performed annually. However, when incidents occur, there are often many people involved. Incidents involving handlers and workers tend to occur more often than incidents with bystanders.

  Reconstructing incidents to examine the exact factors which led to the incident can be difficult, especially when bystanders are involved since all the factors that contributed to the incident may not have been documented. Some of the factors that have been linked to incidents in the past have included equipment failure, handler accidents, applicator failure to adhere to label recommendations and/or requirements, and temperature inversions. Bystander incidents have occurred both close to fumigated fields and up to two miles away from the fumigated field.

Based on these lines of evidence, and as described in more detail in the risk assessments, EPA has determined that chloropicrin risks to handlers, workers, and bystanders are of concern given current labels and use practices. The human health risk assessments indicate that inhalation exposures to bystanders who live and work near agricultural fields and greenhouses where chloropicrin fumigations occur have the potential to exceed the Agency's LOC without additional mitigation measures. There are also risks of concern for occupational handlers involved in chloropicrin applications and tarp perforation/removal activities, and for workers who may re-enter treated areas shortly after fumigation or tarp perforation has been completed.

The Agency does not have risk concerns for bystanders when chloropicrin is used prior to sulfuryl fluoride residential structure fumigations. When chloropicrin is used to treat wood decay, the Agency has identified potential acute inhalation risks to bystanders and handlers. The Agency's concern for acute inhalation exposure to bystanders and handlers is based on the same data described above. The Agency also does not have a risk concern for dietary exposure (including drinking water exposure).

For more information about the specific information in the Agency's human health risk analyses, refer to the documents listed below:

- Chloropicrin: Third Revision of the HED Human Health Risk Assessment. April 30, 2009 (DP Barcode 348637).
- Methyl Bromide (PC Code 053201), Chloropicrin (PC Code 081501), Dazomet (PC Code 035602), Metam Sodium and Potassium (PC Codes 039003 &039002), MITC (PC Code 068103), DP Barcode 362369, Updated Health Effects Division Recommendations for Good Agricultural Practices and Associated Buffer Credits. May 14, 2009.
- EPA-HQ-OPP-2007-0350-0172, MOA Mode of Action, Eye Irritation, and the Intra-Species Factor: Comparison of Chloropicrin and MITC. June 25, 2008. DP Barcode 293356.

- EPA-HQ-OPP-2007-0350-0173, Factors Which Impact Soil Fumigant Emissions - Evaluation For Use In Soil Fumigant Buffer Zone Credit Factor Approach. June 9, 2008. (DP Barcode 306857)
- EPA-HQ-OPP-2007-0350-0009, Review of Fumigants Group Incident Reports.
- EPA-HQ-OPP-2007-0350-0010, Summary Fumigants Group Incident Reports.
- EPA-HQ-OPP-2007-0350-0011, Summary Fumigants Group Incidents DP Barcode D326938.

For more information on the antimicrobial use of chloropicrin please see the following documents:

- EPA-HQ-OPP-2007-0350-0165, Revised Occupational and Residential/Bystander Assessment of the Antimicrobial Use (Remedial Wood Treatment) of Chloropicrin for the Reregistration Eligibility Decision (RED) Document (Phase 3 Comment Period). PC Code 081501, DP Barcode D314399. February 14, 2008.
- EPA-HQ-OPP-2007-0350-0167, Updated Label Language for the Antimicrobial Uses of Chloropicrin (PC Code 081501) for the Reregistration Eligibility Decision Document. May 13, 2008.

C. Environmental Fate and Ecological Risks

The Agency's environmental fate and ecological effects risk assessment indicates that there are some concerns for non-target organisms that may be exposed to fumigants.

Since chloropicrin is highly volatile and is a gas at room temperature and standard pressure, inhalation is the major exposure pathway for non-target terrestrial animals. For aquatic organisms, exposure in surface water could result from runoff with dissolved chloropicrin from fumigated fields.

The Agency evaluated the potential exposure of birds and mammals through inhalation exposure to chloropicrin using air monitoring data and values derived from exposure modeling. The Agency has not established LOCs for inhalation risk in animals; standard dietary LOCs were used. Comparison of modeled exposure concentrations to acute mammalian inhalation toxicity data did not exceed the endangered species LOC when exposure concentrations from PERFUM were used. Chronic exposure to chloropicrin from treatment of individual fields is not expected.

The potential for inhalation risk to birds was not quantified, because avian inhalation toxicity data were not available. The potential risk to non-target terrestrial plants was also not evaluated due to lack of toxicity data.

Exposure to aquatic animals and plants was simulated using the Pesticide Root Zone Model (PRZM) and Exposure Analysis Modeling System (EXAMS), although there is some uncertainty in their ability to fully account for the transport of chemicals as volatile as chloropicrin. Risk quotients exceeded the acute LOC for fish for two of six modeled scenarios (FL strawberry and FL tomato) and the endangered species LOC for all six scenarios modeled. The acute LOCs for aquatic invertebrates (endangered species and non-endangered species

LOCs) were exceeded for two of six scenarios (FL strawberry and FL tomato) although the lack of a definitive toxicity endpoint means that risk could not be completely discounted from the other four scenarios modeled. Chronic risk to aquatic animals was not evaluated due to lack of data, but volatilization of chloropicrin from surface water would greatly reduce residues of chloropicrin over time.

1. Hazard

Based on limited data, chloropicrin is considered very highly toxic to both fish (lowest LC50 = 5.14 ppb) and aquatic invertebrates (lowest LC50 < 71 ppb). Chloropicrin is also considered highly toxic to mammals. The acute mammal inhalation LD50 is 0.114 mg/L (male rats) and the developmental NOAEL in rabbits is 0.003 mg/L (LOAEL 0.008 mg/L, based on abortions and decreased fetal weights). The mammal acute oral LD50 value (used in a preliminary analysis) is 37.5 mg/kg (highly toxic). The Agency does not have avian inhalation, terrestrial/aquatic plant, or estuarine/marine aquatic life data.

2. Exposure

a. Environmental Fate

The high vapor pressure (23.8 mm @ 25°C), high Henry's Law Constant (2.05 X 10^{-3} atm M^3/mole), and low soil adsorption coefficient (K_{oc} 36.05 L kg^{-1}) of chloropicrin suggest that volatilization is the most important environmental route of dissipation. Direct photolytic degradation ($t_{1/2}$ <8 hrs) of chloropicrin is the primary route of dissipation in the atmosphere, which suggest it is not a significant threat to deplete stratosphere ozone layer. Due to the fact that volatilization is significant and occurs rapidly, the importance of other competing processes such as leaching, biotic and abiotic degradation, and adsorption to the soil particles will certainly depend on chloropicrin's emission rate from fumigated fields. This is because the emission rate determines the amount of chloropicrin left for other processes and its residence time in the soil system. However, if chloropicrin remains in soil, it also degrades with half-lives ranging from 3.7 to 4.5 days with CO_2 being the terminal breakdown product. Since chloropicrin is highly soluble in water and has low adsorption in soil, it can potentially leach into groundwater and to surface water through runoff under a flooded condition. The low octanol/water partition coefficient of chloropicrin also indicates that it is not likely to be bioconcentrated in tissues of aquatic organisms.

b. Terrestrial Exposure

The Industrial Source Complex Short Term Version 3 (ISCST3) model was used to calculate potential air concentrations to which terrestrial animals might be exposed via inhalation. Air concentrations at the field edge and at distances away from a 40-acre field edge were simulated, considering various application rates and methods, including if tarps were used. The highest air concentration of 0.019 mg/L was estimated. The values used for this assessment yield conservative air concentration estimates because considering a constant flux rate does not allow for diurnal/nocturnal changes that may occur, which when coupled with the appropriate wind speed and stability category, can result in lower concentrations. The meteorological inputs

also will provide a conservative estimate of exposure because the wind direction is considered to be perpendicular (pointed downwind) to the treated field for the entire 24 hours represented in the calculation. This is not a normal situation in the atmosphere for most locations.

PERFUM was used to refine the potential risks to terrestrial organisms. Twelve different application scenarios (e.g., broadcast, bedded, tarped, untarped, drip irrigation, Bakersfield/Ventura sites, application rates up to 350 lb ai/A) were modeled. The highest 90th percentile air residue across these scenarios is 0.004219 mg/ m^3, for 40 acres, broadcast, untarped, 0 – 5 meters radius from the field edge, 8 – 12 hours after application at 175 lb ai/A. This value is significantly less than the greatest value simulated using the ISCST3 model.

Available ambient monitoring data for chloropicrin indicates a maximum ambient air concentration of 0.000014 mg/L. Although it is possible that birds and mammals could be exposed to chloropicrin repeatedly by ranging between treated fields, the historical ambient air concentration was considered to determine the potential for chronic inhalation exposure.

c. Aquatic Exposure

Aquatic exposure was simulated using the combined PRZM and EXAMS surface water models. Estimated environmental concentrations (EECs) resulting from application of 350 lb ai/A and 175 lb ai/A were simulated for six crop scenarios (CA tomatoes, CA onions, FL tomatoes, FL strawberries, NC sweet potatoes, and NC tobacco). The calculated EECs were on the order of 1.0 µg/L or less for the California and North Carolina scenarios, but were on the order of 70 µg/L for the Florida scenarios.

There is an uncertainty in estimating chloropicrin exposure in water bodies due to post-application tarping of the treated area. If tarping is used to minimize the volatilization of chloropicrin, the loading of the chemical through runoff will be limited until the tarp is perforated or removed from the field. The present version of the PRZM model and the selected crop scenarios have limited capabilities in capturing the load of applied chemical under a post-application tarp scenario. Therefore, the estimated concentrations of chloropicrin in water bodies may be upper bound for tarped scenarios since the load of chloropicrin from runoff is considered in the PRZM/EXAMS simulation.

Because chloropicrin is highly soluble in water and has low adsorption in soil, residual chloropicrin in soil can potentially leach into groundwater under continuous irrigation and/or high rainfall events. However, consideration of the potential for groundwater contamination must take into account the fact that irrigation is applied with the intent of keeping chloropicrin within a small depth range around the root zone (and not below to groundwater). In addition, degradation of chloropicrin under a tarped field, and limited dissipation of material though a tarp would reduce the amount of residues which might be transported to groundwater by a potential heavy rainfall soon after the tarp is removed.

3. Risk

a. Terrestrial Risk

A risk quotient derived from the maximum EEC from the ISCST3 model and acute mammalian toxicity data was 0.17. Although the Agency has not set LOCs for inhalation risk to terrestrial animals, this value exceeds the standard endangered species LOC used in ecological dietary risk assessments. The maximum EEC from the refined PERFUM model, however, results in a maximum RQ below the endangered species LOC. Comparison of ambient chloropicrin concentrations in air from historical monitoring data to chronic rabbit inhalation toxicity data resulted in a RQ below the standard chronic LOC of 1.0.

Risk to birds from inhalation exposure to chloropicrin could not be assessed using the ISCST3 or PERFUM exposure estimates because avian inhalation toxicity data were not available. The potential for risk to non-target terrestrial plants was also not evaluated due to lack of toxicity data.

b. Aquatic Risk

Risk quotients exceeded the acute LOC for fish for two of six modeled scenarios (FL strawberry and FL tomato), and the endangered species LOC for all six scenarios. The acute LOCs for aquatic invertebrates (endangered species and non-endangered species) were exceeded for two of six scenarios (FL strawberry and FL tomato), although the lack of a definitive toxicity endpoint means that risk could not be completely discounted from the other four scenarios modeled. Chronic risk to aquatic animals was not evaluated due to a lack of data, but volatilization of chloropicrin from surface water would greatly reduce residues of chloropicrin over time.

For more information about the specific information in the Agency's assessment of environmental fate and ecological risks, refer to the following document:

- EPA-HQ-OPP-2007-0350-0175, Revised Screening Ecological Risk Assessment for the Reregistration of Chloropicrin. DP Barcode 348669. April 16, 2008.

D. Benefits

Soil fumigation can provide benefits to both food consumers and growers. For consumers it means more fresh fruits and vegetables can be cheaply produced domestically year-round because severe pest problems can be efficiently controlled. Growers benefit because crops grown in fumigated soil produce fewer blemished products, which translates into an increase in marketable yields. Fumigation can also provide benefits to growers by increasing crop management flexibility. This includes shorter crop rotational intervals (i.e., less time when fields are left fallow), improved ability to meet quarantine requirements (which are imposed when states or other jurisdictions require a pest-free harvested product), and consistent efficacy against critical pests. The magnitude of benefits depends on pest pressure, which varies over space and time, and the availability and costs associated with the use of alternatives.

Since chloropicrin is often used in combination with other fumigants, it is difficult to estimate an exact benefit for chloropicrin alone. Agency assessments (e.g., chloropicrin's use in

pepper production) indicate that if chloropicrin were no longer available, growers could experience large yield losses. These losses combined with increases in production costs that are higher than revenue could cause growers to stop pepper production.

Other benefits of chloropicrin include its use as a methyl bromide alternative and chloropicrin's role as a warning agent which makes people aware of potential exposures to other fumigants such as methyl bromide.

There are a number of benefit assessments that have been completed by the Agency to estimate the value of fumigants to various industries. Below is a list of the specific benefit assessments that include chloropicrin.

- EPA-HQ-OPP-2007-0350-0017, Summary of the Benefits of Soil Fumigation with Chloropicrin in Crop Production.
- EPA-HQ-OPP-2007-0350-0018, Assessment of the Benefits of Soil Fumigation with Chloropicrin, Methyl Bromide, and Metam Sodium in Cucurbit Production.
- EPA-HQ-OPP-2007-0350-0019, Assessment of the Benefits of Soil Fumigation with Chloropicrin, Methyl Bromide, and Metam Sodium in Eggplant Production
- EPA-HQ-OPP-2007-0350-0020, Assessment of the Benefits Soil Fumigants (Methyl Bromide, Chloropicrin, Metam-Sodium, Dazomet) Used by Forest Tree Seedling Nurseries.
- EPA-HQ-OPP-2007-0350-0021, Assessment of the Benefits of Soil Fumigation with Methyl Bromide, Chloropicrin, Dazomet, and Metam Sodium for Use in Raspberry Nurseries, Fruit and Nut Deciduous Tree Nurseries, and Rose Bush Nurseries in California.
- EPA-HQ-OPP-2007-0350-0022, Assessment of the Benefits of Soil Fumigation with Chloropicrin and Metam-sodium in Onion Production.
- EPA-HQ-OPP-2007-0350-0023, Assessment of the Benefits of Soil Fumigation with Methyl Bromide, Chloropicrin, and Metam Sodium in Grape Production.
- EPA-HQ-OPP-2007-0350-0024, Assessment of the Benefits of Soil Fumigation with Methyl Bromide, Chloropicrin and Metam Sodium in Tree Nut Production.
- EPA-HQ-OPP-2007-0350-0025, Assessment of the Benefits of Soil Fumigation with Chloropicrin and Metam Sodium in Pome Fruits Production.
- EPA-HQ-OPP-2007-0350-0026, Assessment of the Benefits of Soil Fumigation with Methyl Bromide, Chloropicrin, and Metam Sodium in Stone Fruit Production.
- EPA-HQ-OPP-2007-0350-0027, Assessment of the Benefits of Soil Fumigation with Chloropicrin, Methyl Bromide, and Metam Sodium in Bell Pepper Production.
- EPA-HQ-OPP-2007-0350-0028, Assessment of the Benefits of Soil Fumigation with Metam Sodium in Potato Production.
- EPA-HQ-OPP-2007-0350-0029, Assessment of Soil Fumigation with Chloropicrin, Methyl Bromide and Metam-sodium in Strawberry Production.
- EPA-HQ-OPP-2007-0350-0030, Assessment of the Benefits of Chloropicrin, Methyl Bromide, Metam-sodium and Dazomet Use In Strawberry Nursery Runner Production.
- EPA-HQ-OPP-2007-0350-0031, Assessment of the Benefits of Soil Fumigation with Chloropicrin, Methyl Bromide, and Metam-sodium on Sweet Potato Production.

- EPA-HQ-OPP-2007-0350-0032, Assessment of the Benefits of Soil Fumigation with Chloropicrin in Tobacco Production.
- EPA-HQ-OPP-2007-0350-0033, Assessment of the Benefits of Soil Fumigation with Chloropicrin, Methyl Bromide, and Metam Sodium in Tomato Production.
- EPA-HQ-OPP-2007-0350-0034, Assessment of the Benefits of Soil Fumigation with Metam-Sodium in Carrot Production.
- EPA-HQ-OPP-2007-0350-0035, Assessment of the Benefits of Soil Fumigation with Metam Sodium in Peanut Production.
- EPA-HQ-OPP-2007-0350-0036, Assessment of the Benefits of Soil Fumigation with Chloropicrin, Methyl Bromide, Metam Sodium and Dazomet in Ornamental Production.
- EPA-HQ-OPP-2007-0350-0037, BEAD's Planned Impact Assessments on Agricultural Sites with Significant Use of Soil Fumigants (Chloropicrin, Dazomet, Methyl Bromide, Metam Potassium, and Metam Sodium.

E. 2008 RED Mitigation Impacts

Requirements in the July 2008 RED

The July 2008 RED acknowledged that even with the use of credits, there could be significant economic impacts to some growers who may not be able to accommodate large buffers based on their current application practices. However, the Agency believed that the options provided in the scalable buffer approach in the fumigant REDs would allow growers the flexibility to modify their practices to achieve smaller buffers; for example, by treating smaller application blocks, switching to a lower emission application method, or by switching to an alternative fumigant that would require smaller buffers. In addition, EPA noted that pest control efficacy may be improved with high barrier tarps which may enable growers to use the buffer zone credits and utilize lower application rates resulting in further reductions of the buffer zone distances. Therefore, the Agency concluded that growers would be able to alter their fumigation applications, given the flexibility designed into the system, in a manner that would enable growers to minimize the impact on production. The Agency noted, however, that the buffers would significantly impact some growers by the use of more expensive high barrier film, delays in planting due to longer fumigation operations, additional planning, and more trips to the field for planting and other operations if fumigating in smaller blocks resulted in staggered operations. It was determined that some of these costs could be substantial in some production scenarios.

Comments on the July 2008 RED

The July 2008 RED requested commenters to submit a description of fumigation practices and provide maps of their property illustrating locations of fields, offices, residences, roads, and property lines so that the Agency could better understand the impacts of the mitigation plan. In response, various stakeholders, including several forest seedling nursery operations, submitted detailed information. From an analysis of the information submitted, including an analysis of a nursery and options they would have for compliance, the Agency concludes that it had overestimated the ease with which many growers and fumigators would be able to comply with the buffer requirements as presented in the July 2008 RED, and that potential impacts would be much greater than previously anticipated for some types of production; please see the

following Agency document for more details, "Analysis of Soil Fumigant Risk Management Requirements using Geographic Information Systems: Case Studies Based on a Forest Seedling Nursery (DP # 363546)" May 13, 2009. The analysis indicates that the buffer system identified in the July 2008 RED can be less flexible than expected for certain scenarios and the associated field topography, field infrastructure, and need for a consistent orientation in the application of a fumigant, which constrain how a field may be divided.

From the Agency's analysis, the primary driver of the impacts is the size of the buffer zones, which will require many growers to divide their fields into smaller fumigation blocks to achieve smaller buffer zone distances. Two other contributing factors are the prohibition on buffers overlapping in space and time and the duration of the buffer zone. Together, these requirements could result in the loss of part of a grower's field that can be effectively fumigated. Further, there may be substantial delays in completing fumigations and multiple trips to a field with fumigation equipment may often be necessary. Not only could there be delays in production activities in these instances, but it may also be difficult to maintain proper soil moisture over the period that multiple blocks would be fumigated. Soil moisture has been identified as a critical element in controlling emissions. Some growers will face numerous scheduling conflicts if they rely on commercial applicators, and the Agency estimates that growers would be more likely to conduct their own fumigations. In addition, repeated trips to the field to fumigate small blocks will increase costs, a further incentive for growers to conduct their own fumigations.

The Agency does agree that compliance with buffer zones requirements as outlined in the July 2008 RED would be a significant challenge for applicators and growers. However, field flux studies, monitoring data, modeling analyses, and information from incidents involving fumigants continue to support a conclusion that chloropicrin off-gasses and moves away from treated fields at concentrations that have the potential to cause adverse effects. Therefore, the Agency still believes that buffer zones that exclude bystanders are a critical aspect of mitigating risks from the use of chloropicrin.

In addition to these impacts, if emergency preparedness and response requirements were triggered due to proximity of neighbors, for example, the requirement in the July 2008 RED to monitor the buffer zone for its 48-hour duration was estimated to impose the highest direct costs. The Agency estimates that the cost of sampling tubes alone could range from $1000 to over $3000 for a field or enterprise, not including the cost of labor. These costs would fall disproportionately on growers with small acreage. As an alternative, growers could notify their neighbors of their intent to fumigate. However, the Agency understands and appreciates the many comments indicating that notification may not be an attractive option due to the potential for neighbors to attempt to impede or block fumigant applications.

Finally, the Agency concludes that the development and implementation of workable fumigation strategies, considering buffer and other requirements, will require substantial new information and management skills on the part of growers and applicators. While the Agency's risk management approach provides flexibility to the grower, providing a reasonable period of time for growers to adapt would reduce impacts.

Based on this new information and EPA's analyses, the Agency has identified modifications to the mitigation which will maintain the important protections necessary for the health and safety of workers and bystanders, but will increase the ability of fumigant users to comply by reducing impacts associated with the mitigation. This includes allowing buffer zone overlap and changes in monitoring requirements. In addition, due to new data that have been submitted to the Agency, buffer zones distances for some scenarios have been refined for chloropicrin and additional buffer zone credits have been provided. Although many aspects of the RED mitigation will appear on labels in 2010, the Agency will not require buffers until the 2011 growing season.

IV. Risk Management and Reregistration Decision

A. Determination of Reregistration Eligibility

Section 4(g)(2)(A) of FIFRA calls for the Agency to determine, after submission of relevant data concerning an active ingredient, whether pesticides containing the active ingredient are eligible for reregistration. The Agency has previously identified and required the submission of the generic (i.e., active ingredient specific) data required to support reregistration of products containing chloropicrin.

The Agency has completed its assessment of the dietary (including drinking water), residential, occupational, and ecological risks associated with the use of pesticides containing the active ingredient chloropicrin. Dietary (food) risks were not quantitatively assessed because there are no food/feed uses of chloropicrin. In addition to the risk assessments, the Agency completed benefit assessments on crops with significant chloropicrin usage.[4]

In Phase 5, the Agency published a risk mitigation options paper.[5] This document detailed potential mitigation options and sought public comment on these options. The following is the list of mitigation options discussed in the Agency's paper:

- Buffer zones,
- Sealing methods,
- Timing of applications,
- Application block size limitations,
- Respiratory protection,
- Tarp cutting/removal procedures,
- Entry-restricted period,
- Application method/practice restrictions,
- Fumigant management plans (FMPs),
- FMP certification,
- Responsible parties,
- Record keeping/reporting/tracking,
- Restricted Use Pesticide Classification (this option does not apply to chloropicrin, since it is already a RUP),
- Notification and posting,
- Good agricultural practices (GAPs),
- Fumigant manuals, and
- Stewardship programs.

The July 2008 RED determined based on a review of the chloropicrin data and public comments on the Agency's assessments for the active ingredient chloropicrin, that the Agency had sufficient information on the human health and ecological effects as well as the benefits of

[4] EPA-HQ-OPP-2007-0350-0037, BEAD's Planned Impact Assessments on Agricultural Site with Significant Use of Soil Fumigants

[5] EPA-HQ-OPP-2007-0350-0003, Risk Mitigation Options to Address Bystander and Occupational Exposures from Soil Fumigant Applications

chloropicrin to make a decision as part of the reregistration process under FIFRA. The Agency determined that the supported uses of chloropicrin would not pose unreasonable risks or adverse effects to humans or the environment provided that the risk mitigation measures and label changes outlined in the RED were implemented. This remains the case for the amended RED document.

Based on its evaluation of chloropicrin, the Agency has determined that chloropicrin products, unless labeled and used as specified in this document, would present risks inconsistent with FIFRA. Accordingly, should a registrant fail to implement any of the risk mitigation measures identified in this document, the Agency may take regulatory action to address the risk concerns from the use of chloropicrin. If all changes outlined in this document are incorporated into the product labels, then current risks for chloropicrin will be adequately mitigated for the purposes of this determination under FIFRA.

A substantial amount of research is currently underway or is expected to begin in the near term to (1) address current data gaps, and (2) refine understanding of factors that affect fumigant emissions. Additionally, a number of new methods and technologies for fumigation are emerging. EPA plans to move the soil fumigants forward in Registration Review, from 2017 to 2013, which will allow EPA to consider new data and information relatively soon, to determine whether the mitigation included in this decision is effectively addressing the risks as EPA believes it will, and to include other soil fumigants which are not part of the current fumigant group review.

The Registration Review process for chloropicrin and the other soil fumigants will also include a comprehensive endangered species assessment. Once that endangered species assessment is completed, further changes to chloropicrin labels may be necessary.

B. Public Comments and Responses

The Phase 3 public comment period on the preliminary risk assessments and related documents commenced November 29, 2006 and ended on February 28, 2007. The Agency documents and comments can be found in the chloropicrin docket, EPA-HQ-OPP-2006-0661. The Agency's responses to comments received are available in the new chloropicrin docket, EPA-HQ-OPP-2007-0350. Both dockets can be found at www.regulations.gov.

After the Phase 3 comment period, the Agency revised the human health risk assessment, completed benefit assessments, and developed risk mitigation options. These documents were put out for public comment on May 2, 2007 and the comment period ended on November 3, 2007. Comments on issues which were significant to many stakeholders and directly influenced EPA's decisions were highlighted in the July 2008 RED. The following documents include the EPA's responses to comments. These documents are located in the chloropicrin docket, EPA-HQ-OPP-2007-0350.

- EPA-HQ-OPP-2007-0350-0170, RESPONSE TO PUBLIC COMMENTS. The Health Effects Division's Response to Comments on the Agency's April 12, 2007 document,

Chloropicrin: Revised HED Human Health Risk Assessment for Phase 5 (Docket EPA-HQ-OPP-2007-0350). June 18, 2008. DP Barcode 348676.

- EPA-HQ-OPP-2007-0350-0174, Response to Phase 5 Public Comments on the Phase 4 Chloropicrin Reregistration Risk Assessment. April 16, 2008. DP Barcode 348669.
- EPA-HQ-OPP-2007-0350-0168, Review of Stakeholder Submitted Impact Assessments of Proposed Fumigant Buffers, Comments on Initial Buffer Zone Proposal, and Case Studies of the Impact of a Flexible Buffer System for Managing By-Stander Risks of Fumigants. June 25, 2008. DP Barcode 353940.
- EPA-HQ-OPP-2007-0350-0169, Response to Phase 5 BEAD Related Public Comments Received on the Reregistration of Chloropicrin, Dazomet, Metam Potassium, Metam Sodium, and Methyl Bromide. June 25, 2008. DP Barcode 353940.
- EPA-HQ-OPP-2007-0350-1066, Phase 6 Response to Substantive Public Comments on Antimicrobials Division's Occupational and Residential Assessments for the Reregistration Eligibility Decision (RED) Documents for the following chemicals: Methylisothiocyanate (MITC), Metam Sodium, Dazomet, and Chloropicrin. February, 14, 2008.
- EPA-HQ-OPP-2007-0350-1077, SRRD's Response to Phase 5 Public Comments for the Soil Fumigants, July 2008.

The Agency opened a 60-day public comment period following the publication of the chloropicrin RED on July 16, 2008. The Agency received requests to extend the comment period, so in response to these requests, on August 29, 2008, EPA published a notice in the Federal Register extending the comment period for an additional 45 days. The comment period closed on October 30, 2008. The Agency has reviewed these public comments as well as new scientific data and other information provided and determined that all measures established in the July 2008 RED to reduce risks to bystanders and workers will still be required. The Agency has determined that certain modifications in how and when some measures will be implemented are appropriate. The following documents include EPA's responses to comments on the July 2008 chloropicrin RED which may be found in the chloropicrin docket:

- Further Response to Public Comments on the 7/9/08 Completed Chloropicrin RED. (March 3, 2009)
- Evaluation of "Probabilistic Modeling of Chloropicrin Exposure to Aquatic Nontarget Organisms" (March 3, 2009).
- Response to Comments from Dow Agrochemicals Regarding EPA's Review of the Chain-2D Model (March 3, 2009).
- Methyl Bromide, 1,3-Dichloropropene, Chloropicrin, Dazomet, Metam Sodium/Potassium, MITC: Health Effects Division (HED) Component of Agency Response To Comments On 2008 Reregistration Eligibility Documents (May 14, 2009)
- Response to BEAD Related Public Comments Received on the Reregistration Eligibility Decision for Chloropicrin, Dazomet, Metam Potassium, Metam Sodium, and Methyl Bromide (DP# 363545) May 14, 2009.
- Analysis of Soil Fumigant Risk Management Requirements using Geographic Information Systems: Case Studies based on a Forest Seedling Nursery (DP#363546). May 13, 2009.

- SRRD's Response to Post-RED Comments for the Soil Fumigants (May 27, 2009).

C. Regulatory Position

1. Regulatory Rationale

The Agency has determined that the supported uses of chloropicrin are eligible for reregistration provided the risk mitigation measures outlined in this document are adopted and label amendments are made to reflect these measures.

a. Chloropicrin Pre-Plant Soil Uses

As summarized in Section III, there are risks of concern to humans and the environment resulting from chloropicrin use. Understanding these risks, and also the benefits of chloropicrin (also outlined in Section III), the Agency's goal for this decision is to be protective, especially of severe and irreversible effects, encourage best practices, and to reduce the potential impacts on benefits. To reach this goal, EPA considered a range of factors including:

- exposure characteristics of bystander and other populations exposed to chloropicrin;
- hazard characteristics of chloropicrin (the chloropicrin endpoint is based on a minor and reversible effect, eye irritation);
- hazard characteristics of other fumigants that are combined with chloropicrin;
- available information on levels of exposure, feasibility, cost, and effectiveness of various risk mitigation options;
- bystander, handler and worker incident reports;
- potential impacts of mitigation on growers' ability to produce crops;
- uncertainties and assumptions underlying the risk and benefit assessments; and
- public comments.

Considering these factors, EPA has determined that the modifications to the measures outlined in the July 2008 RED, described herein, will achieve the same protection goals for persons potentially exposed to chloropicrin but with a greater likelihood of compliance, fewer impacts on the benefits of chloropicrin use, and with less uncertainty regarding the protectiveness of the required measures. The following is a summary of the rationale for managing risks associated with chloropicrin use. Where labeling revisions are warranted, specific language is set forth in the summary label table in Section V of this document.

The following is a summary of the rationale for managing risks associated with the supported uses of chloropicrin.

i. Human Health Risk Management

The human health risk assessment indicates that inhalation exposures to bystanders, handlers, and workers who live and work near agricultural fields and greenhouses where chloropicrin fumigations occur have the potential to exceed the Agency's level of concern without additional mitigation measures. To reduce the potential for chloropicrin exposure to

bystanders, handlers, and workers and to address associated risks of concern, EPA is requiring a number of mitigation measures which include:

- buffer zones,
- buffer zone posting,
- respiratory protections,
- restrictions on the timing of tarp perforation and removal operations,
- entry restrictions,
- mandatory good agricultural practices (GAPs),
- fumigant management plans (FMPs),
- emergency preparedness and response, and
- notice to state-lead agencies.

The Agency also believes that registrant developed and implemented training and community outreach and education programs, will help reduce risk. Additionally, EPA will continue to work with registrants to identify additional measures that could be implemented as part of product stewardship. These additional measures should include efforts to assist users' transition to the new label requirements.

Some of the required mitigation measures only address one group of potentially exposed individuals (i.e., bystanders, handlers, or workers), while other measures will help reduce risk to more than one group. All mitigation measures are designed to work together to reduce exposures, enhance safety, and facilitate compliance and enforcement. The Agency has based its risk mitigation decision on a flexible approach which EPA believes will be protective and allow users to make site-specific choices to reduce potential impacts on benefits of the use. While some of these measures, buffer zones for example, can be used to estimate MOEs, others such as emergency preparedness and response and community outreach and education will contribute to bystander safety, but are difficult to express in terms of changes to quantitative risk estimates such as MOEs. However, EPA has determined that these measures, working together, will prevent unreasonable adverse effects on human health.

1. Bystander Risk Mitigation

Bystanders are persons who live and/or work near fumigated fields and could be potentially exposed to fumigant emissions that travel off-site. In some cases the bystanders are workers performing agricultural tasks in nearby fields. If they are employed by the grower who has control of the fumigated field, they are more likely to be aware that a fumigant application has occurred.

Bystander risks for people that live near treated fields differ from other human health risks evaluated under FIFRA, for example residential and worker reentry risks. Unlike residential exposures resulting from use of products to control pests in and around the home, non-occupational bystanders receive no direct benefit from the pesticide which was applied elsewhere. These bystanders have not made a decision to purchase a pest control product or service, and as a result they have little access to information about the product (e.g., hazards, safety information, first aid, etc.) or symptoms of exposure. Additionally, non-occupational bystander exposures to fumigants are largely involuntary and unanticipated. In this regard non-

occupational bystander exposure is similar to dietary exposure in that people consuming foods or drinking water expect to be safe from possible adverse effects associated with pesticide residues that could be present in their food and drinking water.

Unlike workers, non-occupational bystanders typically receive no safety information or training related to the pesticide to which they may be exposed. Whereas workers are generally expected to play an active role in protecting themselves from pesticide risk, no such expectation exists for non-occupational bystanders. Workers who experience symptoms of pesticide exposure are also more likely to link their symptoms to the pesticide and take steps to receive appropriate treatment. Conversely, bystanders are much less likely to attribute adverse effects to pesticide exposures or to have access to information needed to take appropriate steps to mitigate the effects of the exposure. Thus, EPA's mitigation includes elements of emergency preparedness and response, notice to state lead agencies, training, and community outreach and education as well as labeling changes.

a. Buffer Zones

The human health risk assessments indicate bystanders may be exposed to chloropicrin air concentrations that exceed the Agency's level of concern based on current label requirements. In general, the risk from inhalation exposures decreases as the distance from the field where bystanders are located increases. Because of this relationship, the Agency has determined that a buffer zone must be established around the perimeter of each application block where chloropicrin is applied. The Agency acknowledges that buffer zones alone will not mitigate all risks or eliminate incidents caused by equipment failure, human error, adverse weather (e.g., temperature inversions), or other events. The Agency however does believe that buffer zones along with other mitigation measures required by this decision described below will mitigate risks so that bystanders will not experience unreasonable adverse effects.

i. General Buffer Zone Requirements

General Requirements in the July 2008 RED

The 2008 chloropicrin RED described general buffer zone requirements for chloropicrin and other soil fumigants. This included the definition of a buffer zone, the requirement to exclude non-handlers from the buffer zone during the buffer-zone period, and the definition of the application block.

The RED also did not allow buffer zones to overlap and fumigations were prohibited within ¼ mile of difficult to evacuate sites such as schools, state licensed daycare centers, nursing homes, and hospitals, if occupied during the buffer zone period. Exemptions for vehicular and bicycle traffic were allowed on roadways through the buffer zone. However, bus stops or other locations where persons wait for public transit were not permitted within the buffer zone. Structures within the buffer zone were also not allowed to be occupied during the buffer zone period and air samples were required before bystanders could enter the structure following expiration of the buffer-zone period. In addition, before a buffer zone could extend onto adjacent private or public property, the applicator needed to obtain written permission from the

owner/operator or local authority to allow the buffer zone to extend onto the property. This was to ensure that non-handlers would not enter the buffer zone and that buffer zones did not overlap.

Comments on the July 2008 RED

During the post-RED comment period, the Agency received many comments from stakeholders concerning the buffer zone requirements. Many comments stated that the large buffer zone distances would make fumigation infeasible and the mitigation options were not flexible enough to allow some fumigations to occur; however, other comments expressed concern that buffers EPA specified would not be large enough to protect bystanders.

The Agency also received numerous comments that buffer zone duration will present severe hardship for growers. Many commenters expressed concern that the buffer zone overlap restriction would have the unintended consequence of forcing some applications to occur during less-than-optimal weather and soil conditions, because the restriction could preclude nearby application blocks from being treated when weather and soil conditions would be optimal for reducing emissions. Hence, subsequent fumigations in adjacent fields would have an increased chance of occurring when weather and soil conditions are more conducive to off-gassing. Examples cited by commenters where this situation could occur include the Southeast and Pacific Northwest where optimal soil moisture conditions occur during a limited time period. The commenters felt that while the buffer zone is in effect, properly trained and equipped handlers should be allowed to enter adjacent application blocks to make applications. Several commenters felt that providing an exception to this prohibition would make buffers more workable, reduce delays, allow a more efficient use of equipment and labor, allow growers additional flexibility to achieve compliance with buffer requirements, and potentially reduce risk if applications could be made under more favorable soil and weather conditions. In addition, some commenters suggested that allowing adjacent application blocks to be treated would not increase risk to bystanders since the Agency's mitigation measures encourage users to split application blocks into smaller treatment areas which result in less fumigant being applied, less exposure, and less potential risk.

Some commenters also asked for clarification on various aspects of the buffer zone requirements, and some asked that EPA provide additional increments for acreages and application rates for buffer zone tables. In addition, many commenters stated that buffer zone credits should be greater for the use of tarps and for certain environmental conditions. A number of comments indicated that obtaining written permission from local authorities for buffers to extend over roads and rights-of-way would be extremely difficult, and that neighbors may not provide permission. EPA also received additional field emissions (flux) data for chloropicrin, as well as additional information regarding factors that affect fumigant emissions.

Based on EPA's review of the comments, and new data and information, the Agency has determined that certain amendments to the buffer zone requirements are appropriate. EPA believes these amendments will maintain the important protections for bystanders but will increase the feasibility of compliance with buffers and will reduce potential impacts of buffers on the beneficial uses of soil fumigants. The Agency does agree that compliance with buffer zone requirements as outlined in the July 2008 RED would be a significant challenge for applicators

and growers. However, field flux studies, monitoring data, modeling analyses, and information from incidents involving fumigants continue to support a conclusion that chloropicrin off-gasses and moves away from treated fields at concentrations that have the potential to cause adverse effects. Therefore, the Agency still believes that buffer zones that exclude bystanders are a critical aspect of mitigating risks from the use of chloropicrin. The Agency believes the modifications to the buffer requirements, specified below, will increase compliance feasibility and encourage further adoption of emission reduction application techniques, while still protecting human health and the environment.

Amended RED Requirements

EPA has determined that no changes to several aspects of the general buffer zone requirements from the 2008 RED are appropriate. This includes:

- the definition and duration of a buffer zone;
- the requirement to exclude field workers, nearby residents, pedestrians, and other bystanders from the buffer zone during the buffer zone period;
- the exemption for transit through buffer zones;
- the definition of the application block;
- the minimum buffer of 25 feet and maximum buffer of ½ mile;
- the requirement limiting entry into buffer zones to handlers who have been properly trained and equipped according to EPA's Worker Protection Standard;
- the prohibition on including in buffer zones bus stops or other locations where persons wait for public transit;
- the prohibition against including in buffer zones buildings under the control of the owner/operator of the application block used for storage such as sheds, barns, garages, etc., unless the storage buildings are not occupied during the buffer zone period, and the storage buildings do not share a common wall with an occupied structure;
- the prohibition against including in buffer zones residential areas that are not under the control of the owner/operator unless occupants agree in writing that they will voluntarily vacate the buffer zone until the buffer zone period expires;
- the prohibition against including in buffer zones agricultural areas that are not under the control of the owner/operator unless the owner/operator of the other area provides written agreement that they, their employees, and other persons will not enter the buffer zone; and
- the prohibition against including in buffer zones publicly owned and/or operated areas such as parks, sidewalks, walking paths, playgrounds, and athletic fields without first obtaining written permission from local authorities.

EPA has determined that amendments to the July 2008 RED requirements are appropriate; these are discussed in greater detail below. The amended buffer zone requirements are summarized at the end of this section.

<u>Buffer Zone Proximity - Exception to Allow Buffer Zone Overlap</u>

The Agency is concerned that emissions from multiple fields located close to one another could be higher than air concentrations from individually treated fields. As a result, bystanders outside of buffers for individual application blocks could be exposed to concentrations of concern particularly if peak concentrations from multiple application blocks in proximity to each other coincide. To reduce the potential for off-site movement of fumigant emissions beyond buffer zones for multiple fumigated fields, the July 2008 RED prohibited buffer zones from multiple application blocks from overlapping, including application blocks fumigated by other property operators.

EPA has considered the comments submitted and has determined that allowing an exception to the buffer zone overlap prohibition, under the conditions specified below, is reasonable and will not demonstrably alter the protection goals provided to bystanders in the July 2008 RED. EPA has determined that buffer zones from nearby application blocks may overlap one another provided at least 12 hours have elapsed from the end of one application until the start of the next application. By separating the application times by at least 12 hours the fumigant emission peaks are less likely to occur at the same time which would sufficiently reduce potential exposure outside buffer zones and meets the Agency's protection goals.

The Agency is maintaining the requirement for buffer zones around each application block to be in effect for 48 hours and that only properly trained and equipped handlers are allowed to enter into buffers zones.

To clarify, below are conditions when buffer zones may or may not overlap:

- A buffer zone may NOT overlap buffer zones from other application blocks that are already in effect UNLESS a minimum of 12 hours has elapsed from the time the first application ends until the second application begins.

EPA has determined that when fumigators exercise the exception to allow buffers to overlap, the emergency preparedness and response measures described on page 114 of this document must be implemented if there are homes, businesses, or property not within the control of the fumigator within 300 feet of the buffer zone.

To ensure handlers are aware that they are working in an existing buffer from an overlapping buffer zone area, the labels will require the certified applicator, before beginning the application, to determine whether the application block or its resulting buffer will overlap with a buffer that is already in effect. If so, the certified applicator must inform handlers of this, the health effects, early signs of exposure, and respiratory protection and PPE requirements for products applied in both the application block in which they are working and the other application block. The Agency is requiring that all treatment areas and buffers be clearly posted with proper signage to ensure handlers entering a treatment area are aware of previous treatments and the existence of buffers. In addition, certified applicators must obtain permission from other landowners when buffers extend onto other lands, which provides an additional mechanism to ensure handlers are aware when they are working in a buffer zone and that they have the necessary information regarding health effects, warning properties, and respiratory/PPE requirements for all products to which they may be exposed.

Areas not under the control of owner/operator of the application block

For areas not under the control of the owner/operator of the application block, the requirements remain unchanged except (1) air samples do not need to be taken to allow occupants to reenter buildings or homes after the buffer zone period has expired, and (2) buffer zones may include publicly owned and/or operated roads, including rights of ways, without first obtaining written permission from local authorities; however, if a sidewalk or permanent walking path is associated with the road or right-of-way, written permission must be given by the appropriate state and/or local authorities.

In summary, areas of a buffer zone not under the control of the owner/operator of the application block may not include residential areas (including employee housing, private property, buildings, commercial, industrial, and other areas that people may occupy or outdoor residential areas, such as lawns, gardens, or play areas) unless the occupants provide written agreement that they will voluntarily vacate the buffer zone during the entire buffer zone period. Air samples for chloropicrin do not need to be taken before the occupants can re-enter a building, home, or outdoor area that was vacated in order to permit the fumigation to occur. The Agency determined that the concentrations of the fumigants 48 hours after completion of the application were likely to be below the Agency's level of concern, and that the warning properties of chloropicrin would alert persons reentering these sites if concentrations were of concern. Therefore, monitoring of buildings and outdoor areas after termination of the buffer zone is not necessary and will no longer be required.

Buffer zones may still not include agricultural areas owned/operated by persons other than the owner/operator of the application block unless the owner/operator of the application block can ensure that the buffer zone will not overlap with a buffer zone from any adjacent property owners, taking into account the amended requirements for overlapping buffers. In addition, the applicator must still receive written permission from the owner/operator of areas that are not under the control of the applicator stating that the owner, their employees, and other persons other than handlers, consistent with buffer overlap provisions, will stay out of the buffer zone during the entire buffer zone period. The goal of this agreement is to ensure that a property owner of an agricultural field adjacent to an area that will be treated with a fumigant is aware when the fumigation will occur. This will allow the applicator to post on the adjacent property and take other required safety measures to ensure that persons on the property will not be exposed to a fumigant at levels above the Agency's level of concern. Informing the property owner of the adjacent field will enable them to take any appropriate safety measures they deem necessary. The Agency believes that requiring the applicator to obtain written permission will be an enforceable measure that will meet the goal of protecting workers and bystanders on adjacent properties that fall within a buffer zone.

In addition, buffer zones still may include publicly owned and/or operated areas such as parks, sidewalks, walking paths, playgrounds, and athletic fields only if the area is not occupied during the buffer zone period and entry by non-handlers is prohibited during the buffer zone period. Written permission from the appropriate state and/or local authorities to include these public areas in the buffer zone is also still required.

However, for roads and rights-of-ways, EPA has determined that these may be included in buffers, subject to local laws and regulations, as long as it is posted according to the requirements of this amended RED. If, as discussed above, the road or right-of-way has an associated sidewalk or permanent walking path, then written permission would also be required to include the area in the buffer zone. The Agency believes that if a town or county has invested resources into building a sidewalk or establishing a walking path, it is reasonable to anticipate pedestrian traffic at that location. In such circumstances, EPA believes a local authority would be best positioned to make a determination about the practicality of preventing non-handlers from entering the buffer zone. EPA acknowledges that laws and regulations vary from jurisdiction to jurisdiction and that the requirement to post points of entry into buffer zones may necessitate additional steps on the part of fumigant applicators before a road or right-of-way can be included in a buffer.

Buffer zone distances - Requirements in the July 2008 RED

Based on several factors including the severity and reversibility of the effect and also the quality of the hazard database, the goal of the buffer zone distances in the July 2008 RED was to reach an air concentration of 0.073 ppm which equates to an MOE of 1. In the July 2008 RED if the target MOE was not reached, at minimum half of the target (MOE 0.5), which corresponds to minor, reversible effects, was achieved at high percentiles of the PERFUM model Version 2.1.4. PERFUM is one of the resources EPA used to help inform decisions regarding buffer zone distances.

As discussed in the July 2008 RED, the buffer zones distances were not based on the selection of a specific percentile or distribution from the PERFUM modeling results. Rather, EPA used a weight of evidence approach to set the buffers, which included consideration of the hazard profile of chloropicrin, information from incident reports, monitoring data, stakeholder comments, along with comprehensive analysis of results from PERFUM modeling and consideration of results using other models (e.g., Industrial Source Complex Model[6]). The analysis of PERFUM results considered distances at various percentiles of the whole field and maximum distance distributions, and predicted MOEs for various distances. The risk assessment characterizes additional types of analysis that were performed. EPA's goal for risk management was to achieve buffer distances where associated risks were at or above target concentration levels at high percentiles of exposure. EPA also believed that the 2008 RED buffer zone distances would be manageable for most growers using existing cultural practices because of the flexibility and options provided to modify buffers by altering certain aspects of fumigation practices.

For the July 2008 RED, the Agency developed buffer zone distances that were scaled based on application method, application rate, and application block size. For each of the outdoor pre-plant soil emission profiles for the July 2008 RED, distances were determined for the maximum supported rates as well as increments less than the maximum rate with application block sizes of 1, 5, 10, 20, 30, 40, 50, 60, 80, 100, and 120 acres. It should be noted that the

[6] http://www.epa.gov/scram001/dispersion_alt.htm#isc3

distances in the lookup tables are not model outputs, although as described above the model outputs were used to inform the selection of buffer zone distances.

The risks associated with the July 2008 RED buffer zone distances are characterized as follows:

- Buffer zone distances are based on a reversible endpoint.
- The buffer zone distances selected for agricultural field and greenhouse pre-plant soil fumigations generally reach the target MOE of 1 at high percentiles (>90%).
- Buffers are protective of more severe effects. The MOEs at high percentiles (99^{th}) of the whole field reach half of the target MOE. This MOE corresponds to the 0.15 ppm concentration of chloropicrin that can cause irritation without leading to more serious respiratory effects.
- It was assumed that chloropicrin air concentrations inside homes and other occupied structures are equal to outside concentrations. These structures could act as a barrier which in some cases may reduce potential inside air concentrations. However, there is insufficient data to quantify differences between indoor and outdoor concentrations.
- The use of GAPs, FMPs, and other mitigation measures required by this decision will contribute to an additional decrease in risk (see *GAP* section on page 98 and *FMP* section on page 107).

Minimum and Maximum Distances

A minimum buffer zone of 25 feet was required in the July 2008 RED regardless of site-specific application parameters. In some instances the PERFUM model predicts that the risks reach the target at the edge of the field. While modeling may support no buffer zone in some cases, a minimum buffer was required because of variability in the emission rates over a field and other factors not accounted for in the modeling; as such the Agency determined that a 25 foot minimum buffer zone was a good agricultural practice. Also, in the 2008 RED, application scenarios requiring buffer zone distances of more than ½ mile (2,640 feet) were prohibited. EPA believes that for areas where chloropicrin is used, buffers greater than ½ mile are not practical and difficult to enforce. These requirements have not changed since the July 2008 RED.

"Greenhouse" Uses

In the July 2008 RED the Agency developed buffer zones for the different size structures (up to 50,000 ft^2) for greenhouse pre-plant soil fumigations. The Agency limited the maximum size of a greenhouse that can be fumigated to 50,000 ft^2. In addition the 2008 RED stated that all pre-plant greenhouse fumigations must be tarped. These requirements have not changed since the July 2008 RED.

The "greenhouse" industry sector is extremely varied because of the breadth of the facilities that are used across the country and because of the nature of the products that are produced. As a result, some clarification is required to interpret the buffer zone distances for "greenhouses." In common "greenhouse" operations, many types of containerized ornamental plants and vegetable starter sets are produced in either closed structures that will be referred to as "greenhouses" or in other related nursery operations such as small fields, or in what are

commonly known as "shade" houses (i.e., essentially fields with an overhead sunblock, typically a semi-translucent black shade cloth). In the latter type of operation, cultural practices related to chloropicrin use are essentially identical to the pre-plant field uses except they typically occur on a smaller scale (e.g., 1 acre applications or less). As a result, the minimum buffer zone distances for these types of use patterns must be determined from the applicable outdoor lookup tables. The Agency has not changed the buffer zones for the "greenhouse" use since the July 2008 RED. The appropriate buffer zone table for this use is Table 17.

Distances for Combination Products

As mentioned previously, products containing chloropicrin often include other active ingredients, for example methyl bromide, 1,3-D, and iodomethane. Buffer distances have also been developed for these fumigants. In accordance with Agency policy, when a pesticide product contains more than one active ingredient, the product shall bear labeling for the active ingredient with the more restrictive measures. When chloropicrin is formulated with methyl bromide, the buffers generally are based on the fumigant with the greater amount of active ingredient in the product; for example for products with 67% methyl bromide and 33% chloropicrin, the buffer zone is driven by the amount of methyl bromide.

The July 2008 RED also provided detailed descriptions of the PERFUM model inputs and outputs. Most of these descriptions have not changed and are included in this Amended RED in Appendix D. As detailed below in the *New Emission (Flux) Study* section on page 44, the Agency received several new emission studies for the pre-plant soil uses. This information will be discussed in detail in the section below and not included in Appendix D. One additional change is that PERFUM outputs were calculated for up to 80 acres. In the July 2008 RED the outputs were calculated for up to 120 acres.

Comments on the July 2008 RED Buffer Distances and Amended RED Determinations

Additional Acreage and Rate Increments

During the post-RED comment period, the Agency received comments requesting buffer zone distances for additional acreage increments for small fields and additional application rate increments. In response, the Agency determined buffer distances for smaller block sizes (1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 acres) as well as more application rates for all of the agricultural field use scenarios. EPA believes this will help to better refine the buffer distances for these use scenarios, and will provide additional options for growers to achieve more workable buffers.

Although the Agency added additional acreage and rate increments, not all increments may be captured in the revised buffer zone tables. If the tables do not capture a specific acreage or rate, round up to the nearest acre or rate. For example, when applying to a 9.5 acre field, round up to 10 acres.

New Flux (Emissions) Studies

The Agency's Phase 5 risk assessment "Chloropicrin: Revised HED Human Health Risk Assessment for Phase 5; DP Barcode: D305336, PC Code 081501" (April 12, 2007) modeled the following emission studies in Table 3 for chloropicrin's pre-plant agricultural field soil use.

Table 3. Emission Studies Modeled in Phase 5

MRID	Location	Application Method	Weather Data Modeled
441492-01	Phoenix, AZ*	Shank, bed, untarp	• Ventura, CA • Bakersfield, CA • Yakima, WA • Flint, MI • Tallahassee, FL • Bradenton, FL*
		Shank, bed, tarp	• Ventura, CA • Bakersfield, CA • Yakima, WA • Flint, MI • Tallahassee, FL • Bradenton, FL
		Shank, broadcast, untarp	• Ventura, CA* • Bakersfield, CA • Yakima, WA • Flint, MI • Tallahassee, FL • Bradenton, FL
		Shank, broadcast, tarp	• Ventura, CA* • Bakersfield, CA • Flint, MI
	Yakima, WA	Shank, broadcast, tarp	• Yakima, WA • Flint, MI
	Bradenton, FL	Shank, broadcast, tarp	• Flint, MI • Tallahassee, FL • Bradenton, FL
451129-01	Salinas, CA*	Drip irrigation, bed, ploy tarp	• Ventura, CA • Bakersfield, CA • Yakima, WA* • Flint, MI • Tallahassee, FL • Bradenton, FL
	Salinas, CA	Drip irrigation, bed, VIF tarp	• Ventura, CA • Bakersfield, CA • Yakima, WA • Flint, MI • Tallahassee, FL • Bradenton, FL
451129-02	Douglas, GA	Drip irrigation, bed, tarp	• Yakima, WA • Flint, MI • Tallahassee, FL • Bradenton, FL

The asterisks (*) in Table 3 represent the emission studies and weather data that were used in the July 2008 RED to frame the buffer zone distances. At the time of the 2008 RED the emissions studies used were those that provided high-end emission and buffer estimates based on the Agency's risk assessment, which used all of the valid and available emissions studies for chloropicrin, as well as weather data that are representative of regions of the country where chloropicrin is commonly used. The model used five years of weather data (i.e., 1825 potential application days) for each location.

In the July 2008 RED the Agency did not use the Salinas, CA drip irrigation with the VIF tarp; the Phoenix, AZ shank bed tarp; the Yakima, WA shank broadcast tarp; or the Bradenton, FL shank broadcast tarp emission studies as baselines for the buffers zones for those application methods. Although the human health risk assessment shows that PERFUM outputs are the largest for the Salinas, CA study with the VIF tarp, the Salinas, CA poly tarp study was used as the baseline instead. This is because poly tarps are much more commonly used; also, the VIF study was conducted in 2000, and the Agency does not believe that the study reflects current high barrier film technology. The Agency also did not use the Phoenix, AZ shank bed tarp study in the July 2008 RED because of the late start time of the study. Based on comments from CMTF, EPA did not believe that nighttime applications were typical. The Agency did not want to restrict chloropicrin applications to the daylight hours, and as a result the Agency did not use the study as the baseline. Instead the Agency required that the buffer zones for the shank bed tarp application increase 25% if the applications were made between one hour before sunset and one hour after sunrise. EPA did not use the Yakima, WA or the Bradenton, FL shank broadcast tarp studies in the July 2008 RED because as noted above the Agency used the most conservative study as the baseline for the buffers and this was the Phoenix, AZ study. The Agency understands that emission studies vary regionally and that more regionally representative emissions data would reduce uncertainty in determining buffer zone distances for different areas. However for the July 2008 RED, EPA did not use a site-specific approach because of data gaps for many of the application methods, the variation among regions, and the complexity of implementing and enforcing site-specific buffer zones. Instead, EPA addressed regional differences with buffer credits. Also in the July 2008 RED the Agency determined buffer zones for a deep (at least 18 inches) untarp broadcast application method using surrogate data from the Phoenix, AZ broadcast untarp emission study.

During the post-RED comment period EPA received numerous comments on the flux studies used to determine the buffer zones in the July 2008 RED. Specifically commenters indicated that: the Phoenix, AZ flux studies should not be used as the baseline because those studies did not reflect the July 2008 RED GAPs; the use of the surrogate study for the deep (at least 18 inches) shank untarped broadcast application was inappropriate because of the difference in application depth; and buffers for combination chloropicrin and 1,3-D products should be based on flux studies for those products. Commenters also expressed confusion regarding the 25% buffer zone increase for the shank bed tarp buffers.

Regarding the request that EPA should use product specific flux data to determine the buffer zones, the Agency is willing to review the studies and take them into consideration.

Since the July 2008 RED EPA has received and reviewed additional flux studies, please see the Agency's document, "Chloropicrin: Third Revision of the HED Human Health Risk Assessment" (April 30, 2009) for detailed analysis. Table 4 lists all of the emission studies currently reviewed by the Agency. The **bolded** studies indicate the studies EPA has received and reviewed since the July 2008 RED. The asterisks indicate the emissions studies and weather data used as the baseline in the amended RED buffer zone tables.

Table 4. Emission Studies Reviewed by EPA as of May 2009

MRID	Location	Application Method	Weather Data Modeled
441492-01	Phoenix, AZ	Shank, bed, untarp	• Ventura, CA • Bakersfield, CA • Yakima, WA • Flint, MI • Tallahassee, FL • Bradenton, FL
		Shank, bed, tarp	• Ventura, CA • Bakersfield, CA • Yakima, WA • Flint, MI • Tallahassee, FL • Bradenton, FL
		Shank, broadcast, untarp	• Ventura, CA • Bakersfield, CA • Yakima, WA • Flint, MI • Tallahassee, FL • Bradenton, FL
		Shank, broadcast, tarp	• Ventura, CA • Bakersfield, CA • Flint, MI
	Yakima, WA	Shank, broadcast, tarp	• Yakima, WA • Flint, MI
	Bradenton, FL	Shank, broadcast, tarp	• Flint, MI • Tallahassee, FL • Bradenton, FL
451129-01	Salinas, CA*	Drip irrigation, bed, ploy tarp	• Ventura, CA • Bakersfield, CA • Yakima, WA* • Flint, MI • Tallahassee, FL • Bradenton, FL
	Salinas, CA	Drip irrigation, bed, VIF tarp	• Ventura, CA • Bakersfield, CA • Yakima, WA

MRID	Location	Application Method	Weather Data Modeled
			• Flint, MI • Tallahassee, FL • Bradenton, FL
451129-02	Douglas, GA	Drip irrigation, bed, tarp	• Yakima, WA • Flint, MI • Tallahassee, FL • Bradenton, FL
472952-03	**Bainbridge, GA**	**Shank, bed, Hytiblock tarp**	• **Ventura, CA** • **Bakersfield, CA** • **Yakima, WA** • **Flint, MI** • **Tallahassee, FL** • **Bradenton, FL**
472952-02	**Dover, FL**	**Shank, bed, Metallized tarp**	• **Ventura, CA** • **Bakersfield, CA** • **Yakima, WA** • **Flint, MI** • **Tallahassee, FL** • **Bradenton, FL**
472952-04	**Hart, MI**	**Shank, bed, Blockade tarp**	• **Ventura, CA** • **Bakersfield, CA** • **Yakima, WA** • **Flint, MI** • **Tallahassee, FL** • **Bradenton, FL**
474560-01	**Yuma, AZ**	**Drip irrigation (buried 10 inches), bed, tarp**	• **Ventura, CA** • **Bakersfield, CA** • **Flint, MI** • **Tallahassee, FL** • **Bradenton, FL**
474560-01	**Yuma, AZ**	**Drip irrigation (buried 10 inches), bed, untarp**	• **Ventura, CA** • **Bakersfield, CA** • **Flint, MI** • **Tallahassee, FL** • **Bradenton, FL**
476793-01	**Yuma, AZ***	**Drip irrigation (buried 6 inches), bed, untarp**	• **Ventura, CA** • **Bakersfield, CA** • **Flint, MI** • **Tallahassee, FL** • **Bradenton, FL***
475769-01	**Wasco, CA***	**Shank, broadcast, tarp**	• **Ventura, CA** • **Bakersfield, CA**

MRID	Location	Application Method	Weather Data Modeled
			• **Yakima, WA** • **Flint, MI** • **Tallahassee, FL** • **Bradenton, FL***
475769-01	**Wasco, CA***	**Shank, strip, tarp**	• **Ventura, CA** • **Bakersfield, CA** • **Yakima, WA** • **Flint, MI** • **Tallahassee, FL** • **Bradenton, FL***
475769-01	**Wasco, CA***	**Shank, broadcast, untarp**	• **Ventura, CA** • **Bakersfield, CA** • **Yakima, WA** • **Flint, MI** • **Tallahassee, FL** • **Bradenton, FL***
475769-01	**Wasco, CA***	**Shank, deep (18") broadcast untarp**	• **Ventura, CA** • **Bakersfield, CA** • **Yakima, WA** • **Flint, MI** • **Tallahassee, FL** • **Bradenton, FL***

Taking the new data and stakeholder comments into consideration, EPA has revised the buffer zones that were presented in the July 2008 RED. The revised buffer zone tables are presented in Tables 5-16. The Agency believes the Wasco, CA studies are more representative of current shank application practices than the older Phoenix, AZ studies that were used as the baseline in the July 2008 RED because the new studies included the GAPs required by the July 2008 RED. New buffer zone tables based on the Wasco, CA flux studies (Tables 5, 7, 8 and 9) for shank strip tarp, shank bed tarp[7], shank broadcast tarp, shank broadcast untarp, and shank deep (18") broadcast untarp represent application blocks when soil moisture is measured at ≥ 70% with an instrument (e.g., tensiometer) or if soil moisture is determined to be ≥ 75% using the USDA Feel and Appearance Method. Please see the *GAP* section on page 97 for details on the USDA method. If the soil moisture is measured to be between 50-69% with a meter or falls into the USDA Feel and Appearance Method category of 50-75%, then the buffer zones are based on Tables 12, 14, 15 and 16, which represents a 3x increase from the Wasco, CA baseline. The Agency believes that the different tables are warranted based on the suite of emission studies available to the Agency that indicate a significant difference in emissions depending on the percent soil moisture. EPA considered increasing the GAP for soil moisture to 70% field capacity, but determined that larger buffers as provided in Tables 12, 14, 15, and 16 would adequately address risks resulting from the increased emissions associated with lower moisture.

[7] For the shank bed tarp application the Agency believes the Wasco, CA shank strip tarp study is a reliable and appropriate surrogate because of the similarities in the application method.

Since the July 2008 RED, it has come to the Agency's attention that the Phoenix, AZ shank bed tarp application did not start at 7 pm. Due to this error, and also the revision of the buffer zones based on the new emission study, the Agency is no longer requiring a 25% increase to the shank bed tarp buffers if applications are made between one hour before sunset and one hour after sunrise.

Although the Agency did not receive a new emission study for the shank bed untarp application method, EPA has included an additional buffer zone table for this scenario provided the soil moisture is measured to be ≥ 70% with an instrument or is determined to be ≥ 75% using the USDA Feel and Appearance Method. The revisions are based information from the Wasco, CA studies regarding the impact of soil moisture on emissions. Additional information presented to the Agency by Dr. Chad Hutchison of the University of Florida[8] indicates that the recent adoption of increased moisture and compaction of beds for potato production have allowed growers to increase the efficacy of chloropicrin. EPA believes that although an increase in efficacy does not directly correlate to emission reduction, that these practices do reduce chloropicrin emissions. The Agency believes that these important factors may not be reflected in the Phoenix, AZ emission study, and has developed the supplemental buffer table taking these factors into account. Since the Agency does not have an emission study specifically for the shank, bed, untarp application method, EPA is calling in this study as part of the DCI to confirm the buffer zones in Table 6. Buffer zone tables based on the Phoenix, AZ study are presented in Table 13.

Since the July 2008 RED EPA did receive an additional tarp drip irrigation study. However since the drip tape was buried 10 inches and the Agency understands that this is not a typical practice; this study was not used in the determination of the buffer zones for this application method. Therefore, the Agency is still using the Salinas, CA flux study with the poly tarp as the baseline for this scenario. Although EPA is still using the same study as the baseline, the buffers have increased slightly since the July 2008 RED. This is due to the percentage of organic matter in the soil. As detailed in the Agency's May 14, 2009 updated factors memo, the Agency has determined that organic content of the soil has a significant impact on fumigant emissions and that the July 2008 RED credit for organic content can be refined to allow a credit at lower percentiles of organic matter. The July 2008 RED only gave a credit if organic matter was ≥ 3%. In the amended RED, credit is given if the organic matter is > 1%. Since the organic matter in the Salinas, CA study is greater than 1%, the buffer zone table had to be revised to ensure that this credit was not already taken into account in the baseline buffer table. The revised buffers are presented in Table 10.

In the July 2008 RED the Agency stated that it did not have adequate data to evaluate the drip buried untarp application method, and that this application method would be prohibited unless data were submitted that allowed EPA to develop appropriate mitigation. The Agency has since received and reviewed two untarp buried (6" and 10") drip irrigation emission studies. The Agency used the buried 6" flux study as the baseline for the buffers for this application method, and this use is now eligible for reregistration with the mitigation specified for this scenario. Buffers for this application method are presented below in Table 11.

[8] www.regulations.gov, EPA-HQ-2007-0350-0155.

In addition, new fumigant data submitted during the post-RED comment period has also allowed the Agency to refine and update buffer zone credits for tarps, certain application techniques, and environmental conditions. As a result, buffers for growers who use emission-reducing tarps or application methods, or have site conditions that qualify for credits will have smaller buffers than those specified in the 2008 RED. Available data indicate that for some crops and regions, pest control efficacy may be improved with high barrier tarps that may enable growers to use the buffer zone credits and utilize lower application rates, resulting in further reductions of the buffer zone distances. Some growers in the Southeast are commonly using high barrier tarps and lower rates. The amended credits are discussed in detail below in the *Buffer Zone Reduction Credits* section on page 67.

Chloropicrin agricultural field use buffer distances, amended as noted above, are specified in Tables 5-16 below. Distances in the buffer zone tables are listed in feet. Distances greater than ½ mile (2,640 feet) are listed in the buffer zone tables. However, no buffer zone, including a buffer zone that has been determined by applying credits, may exceed a distance of ½ mile (2,640 feet).

Like the July 2008 RED, it should be noted that the distances in the lookup tables are not model outputs, although as described above the model outputs were used to inform the selection of buffer zone distances. The greenhouse buffer zone table (Table 17) remains unchanged from the July 2008 RED.

The risks associated with the amended RED buffer zone distances are characterized as follows:

- Buffer zone distances are based on a reversible endpoint.
- The buffer zone distances selected for agricultural field and greenhouse pre-plant soil fumigations reach the target MOE of 1 at high percentiles (95%).
- Buffers are protective of more severe effects. The MOEs at high percentiles (99^{th}) of the whole field reach half of the target MOE. This MOE corresponds to the 0.15 ppm concentration of chloropicrin that can cause irritation without leading to more serious respiratory effects.
- The use of GAPs, FMPs, and other mitigation measures required by this decision will contribute to an additional decrease in risk (see *GAP* section on page 98 and *FMP* section on page 107).

Table 5. Shank Bed Tarp/Strip Tarp Buffer Zones Based on Wasco, CA Flux Study

Broadcast Equivalent Application Rate (lbs ai/arce)	Application Block Size (Acres)																			
	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	50	60	70	80
90	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
95	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
100	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
105	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
110	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	27	29
115	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	29	32
120	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	30	36
125	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	32	39
130	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	34	43
135	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	36	46
140	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	38	50
145	25	25	25	25	25	25	25	25	25	25	25	25	26	26	29	31	36	41	54	66
150	25	25	25	25	25	25	25	25	25	25	25	25	26	28	32	36	46	56	70	83
155	25	25	25	25	25	25	25	25	25	25	25	25	27	29	36	42	57	72	86	99
160	25	25	25	25	25	25	25	25	25	25	25	25	28	31	39	48	68	88	102	116
165	25	25	25	25	25	25	25	25	25	25	25	25	29	32	43	54	79	104	118	132
170	25	25	25	25	25	25	25	25	25	25	25	25	29	34	46	59	89	119	134	149
175	25	25	25	25	25	25	25	25	25	25	25	25	30	35	50	65	100	135	150	165
180	25	25	25	25	25	25	25	25	25	25	29	33	41	50	65	79	114	149	166	184
185	25	25	25	25	25	25	25	25	25	25	33	41	53	65	79	94	128	162	182	202
190	25	25	25	25	25	25	25	25	25	25	37	49	64	80	94	108	142	176	198	221
195	25	25	25	25	25	25	25	25	25	25	41	56	76	95	109	122	156	189	214	239
200	25	25	25	25	25	25	25	25	25	25	45	64	87	110	123	136	170	203	230	258
205	25	25	25	25	25	25	25	25	25	25	49	72	99	125	138	151	184	216	246	276
210	25	25	25	25	25	25	25	25	25	25	53	80	110	140	153	165	198	230	263	295
215	25	25	25	25	25	26	26	27	28	29	59	90	119	149	161	174	208	241	271	301
220	25	25	25	25	25	26	28	29	31	32	66	100	129	157	170	184	218	253	280	306
225	25	25	25	25	25	27	29	31	34	36	73	110	138	166	179	193	229	264	288	312
230	25	25	25	25	25	28	31	34	36	39	80	120	147	174	188	202	239	276	297	318
235	25	25	25	25	25	29	32	36	39	43	86	130	156	183	197	211	249	287	305	324
240	25	25	25	25	25	29	34	38	42	46	93	140	166	191	206	221	260	299	314	329
245	25	25	25	25	25	30	35	40	45	50	100	150	175	200	215	230	270	310	323	335
250	25	25	25	25	25	31	38	44	51	57	106	154	182	209	224	239	281	322	340	358
255	25	25	25	25	25	33	41	49	56	64	111	159	189	219	234	249	291	334	358	381
260	25	25	25	25	25	34	44	53	62	71	117	163	195	228	243	258	302	346	375	404
265	25	25	25	25	25	36	46	57	68	79	123	167	202	237	252	267	313	359	393	426
270	25	25	25	25	25	37	49	61	74	86	129	171	209	246	261	276	324	371	410	449
275	25	25	25	25	25	39	52	66	79	93	134	176	216	256	271	286	334	383	428	472
280	25	25	25	25	25	40	55	70	85	100	140	180	223	265	280	295	345	395	445	495
285	25	26	28	29	31	46	61	77	92	107	147	187	230	274	290	307	358	409	460	510
290	25	28	31	34	36	52	68	83	99	114	154	194	238	282	301	319	371	424	474	525
295	25	29	34	38	42	58	74	90	106	121	161	201	246	291	311	331	385	438	489	540
300	25	31	36	42	48	64	80	96	112	129	169	209	254	299	321	344	398	452	504	555
305	25	32	39	46	54	70	86	103	119	136	176	216	262	308	332	356	411	466	518	570
310	25	34	42	51	59	76	93	109	126	143	183	223	270	316	342	368	424	481	533	585
315	25	35	45	55	65	82	99	116	133	150	190	230	278	325	353	380	438	495	548	600
320	25	36	46	57	68	85	102	118	135	152	194	235	283	330	360	389	448	506	561	615
325	25	36	48	59	71	87	104	121	138	154	197	240	288	335	367	399	458	518	574	630
330	25	37	49	61	74	90	107	123	140	156	201	245	293	340	374	408	469	529	587	645
335	25	38	51	64	76	93	109	126	142	159	204	250	298	345	381	417	479	541	600	660
340	25	39	52	66	79	96	112	128	144	161	208	255	303	350	388	426	489	552	614	675
345	25	39	54	68	82	98	114	131	147	163	211	260	308	355	395	436	500	564	627	690
350	25	40	55	70	85	101	117	133	149	165	215	265	313	360	403	445	510	575	640	705

Table 6. Shank Bed Untarp Based on Wasco, CA Flux Study

Broadcast Equivalent Application Rate (lbs ai/arce)	Application Block Size (Acres)																				
	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	50	60	70	80
15	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
20	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	38	53	64	75
25	25	25	25	25	25	25	25	25	52	25	25	25	25	25	31	38	63	88	106	125
30	25	25	25	25	25	25	25	25	25	25	29	40	51	63	78	94	119	144	166	188
35	25	25	25	25	25	25	25	25	25	25	44	63	81	100	125	150	175	200	225	250
40	25	25	25	25	25	35	45	55	65	75	106	138	156	175	200	225	275	325	356	388
45	25	25	28	33	38	48	58	68	78	88	125	163	194	225	250	275	319	369	406	444
50	25	31	38	44	50	60	70	80	90	100	144	188	231	275	300	325	363	413	456	500
55	38	45	53	61	69	80	91	103	114	125	172	219	263	306	334	363	413	463	509	556
60	50	59	69	78	88	100	113	125	138	150	200	250	294	338	369	400	463	513	563	613
65	56	67	78	89	100	114	128	141	155	169	222	275	322	369	406	444	506	569	622	675
70	63	75	88	100	113	128	143	158	173	188	244	300	350	400	444	488	550	625	681	738
75	69	83	97	111	125	141	158	174	190	206	269	331	381	431	475	519	594	681	747	813
80	75	91	106	122	138	155	173	190	208	225	294	363	413	463	506	550	638	738	813	888
85	81	98	116	133	150	170	190	210	230	250	319	388	441	494	544	594	688	788	869	950
90	88	106	125	144	163	185	208	230	253	275	344	413	469	525	581	638	738	838	925	1013
95	88	113	138	163	188	210	233	255	278	300	381	463	525	588	650	713	813	938	1088	1238
100	94	119	144	169	194	218	241	265	289	313	397	481	550	619	684	750	850	969	1113	1256
105	100	125	150	175	200	225	250	275	300	325	413	500	575	650	719	788	888	1000	1138	1275
110	108	135	163	190	217	242	267	292	317	342	435	529	604	679	750	821	938	1063	1190	1317
115	117	146	175	204	233	258	283	308	333	358	458	558	633	708	781	854	988	1125	1242	1358
120	125	156	188	219	250	275	300	325	350	375	481	588	663	738	813	888	1038	1188	1294	1400
125	131	163	194	225	256	284	311	339	366	394	484	575	675	775	856	938	1075	1238	1331	1425
130	138	169	200	231	263	293	323	353	383	413	488	563	688	813	900	988	1113	1288	1369	1450
135	144	177	209	242	275	305	335	365	395	425	522	619	725	831	934	1038	1150	1338	1431	1525
140	150	184	219	253	288	318	348	378	408	438	556	675	763	850	969	1088	1188	1388	1494	1600
145	154	190	225	260	296	328	361	393	426	458	577	696	792	888	1002	1117	1250	1438	1565	1692
150	158	195	231	268	304	339	374	409	444	479	598	717	821	925	1035	1146	1313	1488	1635	1783
155	163	200	238	275	313	350	388	425	463	500	619	738	850	963	1069	1175	1375	1538	1706	1875
160	166	205	244	283	322	360	398	436	474	513	636	759	877	994	1097	1200	1406	1597	1773	1950
165	169	209	250	291	331	370	409	448	486	525	653	781	903	1025	1125	1225	1438	1656	1841	2025
170	172	214	256	298	341	380	419	459	498	538	670	803	930	1056	1153	1250	1469	1716	1908	2100
175	175	219	263	306	350	390	430	470	510	550	688	825	956	1088	1181	1275	1500	1775	1975	2175

Table 7. Shank Broadcast Tarp Buffer Zones Based on Wasco, CA Flux Study

Broadcast Equivalent Application Rate (lbs ai/arce)	Application Block Size (Acres)																				
	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	50	60	70	80
70	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
80	25	25	25	25	25	25	25	25	25	25	25	25	25	25	26	27	32	37	40	43
90	25	25	25	25	25	25	25	25	25	25	25	25	25	25	27	29	39	49	55	61
95	25	25	25	25	25	25	25	25	25	25	25	25	25	25	28	31	46	61	70	79
100	25	25	25	25	25	25	25	25	25	25	25	25	25	25	29	33	53	73	85	97
105	25	25	25	25	25	25	25	25	25	25	25	25	25	25	30	35	60	85	100	115
110	25	25	25	25	25	25	25	25	25	25	29	34	36	38	45	51	78	104	120	136
115	25	25	25	25	25	25	25	25	25	25	34	42	46	51	59	68	95	122	140	158
120	25	25	25	25	25	25	25	25	25	25	38	51	57	64	74	84	113	141	160	179
125	25	25	25	25	25	25	25	25	25	25	42	59	68	76	89	101	130	159	180	201
130	25	25	25	25	25	25	25	25	25	25	46	68	79	89	103	117	148	178	200	222
135	25	25	25	25	25	25	25	25	25	25	51	76	89	102	118	134	165	196	220	244
140	25	25	25	25	25	25	25	25	25	25	55	85	100	115	133	150	183	215	240	265
145	25	25	25	25	25	27	28	30	32	34	64	94	112	129	147	164	198	231	259	286
150	25	25	25	25	25	28	32	35	39	42	73	104	124	144	161	179	213	248	277	306
155	25	25	25	25	25	30	35	40	46	51	82	113	135	158	175	193	229	264	296	327
160	25	25	25	25	25	32	39	46	52	59	91	122	147	172	190	207	244	281	314	348
165	25	25	25	25	25	34	42	51	59	68	100	131	159	186	204	221	259	297	333	369
170	25	25	25	25	25	35	46	56	66	76	109	141	171	201	218	236	275	314	351	389
175	25	25	25	25	25	37	49	61	73	85	118	150	183	215	233	250	290	330	370	410
180	25	27	29	30	32	45	58	70	83	96	129	161	194	226	249	271	312	353	394	434
185	25	29	32	36	39	53	66	80	93	106	140	173	205	238	265	291	334	376	417	459
190	25	30	36	41	46	61	75	89	103	117	151	184	217	249	281	312	355	399	441	483
195	25	32	39	46	54	68	83	98	113	128	162	196	228	261	297	333	377	421	464	507
200	25	34	43	52	61	76	92	107	123	139	173	207	240	272	313	354	399	444	488	531
205	25	36	46	57	68	84	100	117	133	149	184	219	251	284	329	374	421	467	511	556
210	25	38	50	63	75	92	109	126	143	160	195	230	263	295	345	395	443	490	535	580
215	25	39	54	68	82	99	116	132	149	166	203	239	274	309	359	409	456	504	549	594
220	25	41	57	73	89	106	122	139	155	171	210	249	286	324	373	422	470	519	564	609
225	25	43	61	79	96	113	129	145	161	177	218	258	298	338	387	436	484	533	578	623
230	25	45	64	84	104	119	135	151	167	183	225	267	310	352	401	449	498	547	592	637
235	25	46	68	89	111	126	142	157	173	189	233	276	321	366	415	463	512	561	606	651
240	25	48	71	95	118	133	148	164	179	194	240	286	333	381	429	476	526	576	621	666
245	25	50	75	100	125	140	155	170	185	200	248	295	345	395	443	490	540	590	635	680
250	25	51	77	103	129	144	159	174	189	204	254	303	355	407	453	499	551	604	656	708
255	25	52	79	105	132	147	163	178	193	209	260	311	365	419	463	507	563	619	677	736
260	25	53	80	108	136	151	167	182	197	213	266	319	375	431	474	516	574	633	698	764
265	25	54	82	111	139	155	170	186	202	217	272	326	385	444	484	524	586	647	719	791
270	25	54	84	113	143	159	174	190	206	221	278	334	395	456	494	533	597	661	740	819
275	25	55	86	116	146	162	178	194	210	226	284	342	405	468	505	541	609	676	761	847
280	25	56	87.5	119	150	166	182	198	214	230	290	350	415	480	515	550	620	690	783	875
285	25	57	89	122	154	171	188	205	222	239	300	361	423	484	526	569	642	715	798	881
290	25	58	91.3	124	158	176	194	212	230	248	310	373	430	488	538	588	664	740	814	888
295	25	59	93.1	127	161	180	199	218	237	256	320	384	438	491	549	606	686	765	829	894
300	25	60	95	130	165	185	205	225	245	265	330	395	445	495	560	625	708	790	845	900
305	28	64	100	136	172	192	212	233	253	273	341	408	460	512	573	633	718	803	862	920
310	32	68	105	142	178	199	220	240	261	282	352	422	475	528	585	642	729	817	878	940
315	35	73	110	148	185	206	227	248	269	290	363	435	490	545	598	650	740	830	895	960
320	37	75	113	151	189	210	231	252	273	294	367	441	498	554	608	661	752	843	906	969
325	39	78	116	155	194	214	235	256	276	297	372	446	505	564	618	671	764	856	916	977
330	41	81	120	159	198	218	239	260	280	301	376	452	513	573	628	682	775	869	927	986
335	44	83	123	163	202	223	243	263	284	304	381	458	520	582	638	693	787	881	938	994
340	46	86	126	166	206	227	247	267	288	308	386	464	528	591	648	704	799	894	949	1003
345	48	89	129	170	211	231	251	271	291	311	390	469	535	601	658	714	811	907	959	1011
350	50	91	133	174	215	235	255	275	295	315	395	475	543	610	668	725	823	920	970	1020

Table 8. Shank Broadcast Untarp Buffer Zones Based on Wasco, CA Flux Study

Broadcast Equivalent Application Rate (lbs ai/arce)	Application Block Size (Acres)																				
	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	50	60	70	80
30	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
35	25	25	25	25	25	25	25	25	25	25	25	25	25	25	30	35	43	50	63	75
40	25	25	25	25	25	25	25	25	25	25	25	25	25	25	38	50	80	110	137.5	165
45	25	25	25	25	25	25	25	25	25	25	25	25	41	58	76	95	133	170	201	233
50	25	25	25	25	25	25	25	25	25	25	25	25	57.5	90	115	140	185	230	265	300
55	25	25	25	25	25	25	25	25	25	25	46	68	100	133	161	190	238	285	325	365
60	25	25	25	25	25	25	25	25	25	25	68	110	143	175	208	240	290	340	385	430
65	25	25	25	25	25	29	33	37	41	45	95	145	183	220	253	285	343	400	448	495
70	25	25	25	25	25	33	41	49	57	65	123	180	223	265	298	330	395	460	510	560
75	25	26	27	28	28	42.3	56	70	84	98	158	218	263	307	343	380	452	523	578	633
80	25	27	28	30	32	51.7	72	92	112	132	194	257	303	348	389	430	508	587	647	707
85	25	28	30	33	35	61	87	113	139	165	230	295	343	390	435	480	565	650	715	780
90	25	34	43	52	61	86.3	111	136	161	186	248	309	366	423	473	523	616	709	794	879
95	25	41	56	72	88	112	136	160	184	208	265	323	389	455	510	565	666	768	873	978
100	25	47	69	92	114	137	160	183	206	229	283	336	412	488	548	608	717	826	951	1076
105	25	54	83	111	140	162	184	206	228	250	300	350	435	520	585	650	768	885	1030	1175
110	25	56	88	119	150	173	196	218	241	264	325	386	473	559	628	696	817	938	1079	1220
115	25	59	93	126	160	184	207	231	254	278	350	422	510	598	670	742	867	991	1128	1265
120	25	61	98	134	170	194	219	243	268	292	375	458	548	637	713	788	916	1044	1177	1310
125	25	64	103	141	180	205	230	256	281	306	400	494	585	676	755	834	966	1097	1226	1355
130	25	66	108	149	190	216	242	268	294	320	425	530	623	715	798	880	1015	1150	1275	1400
135	25	71	118	164	210	238	265	293	320	348	450	553	651	750	833	915	1040	1165	1314	1463
140	25	76	128	179	230	259	288	317	346	375	475	575	680	785	868	950	1065	1180	1353	1525
145	25	78	130	183	235	268	301	334	367	400	500	600	706	811	903	994	1108	1223	1402	1581
150	25	79	133	186	240	277	314	351	388	425	525	625	731	838	938	1038	1151	1265	1451	1638
155	25	80	135	190	245	286	327	368	409	450	550	650	757	864	973	1081	1194	1308	1501	1694
160	25	81	138	194	250	295	340	385	430	475	575	675	783	890	1008	1125	1238	1350	1550	1750
165	25	85	146	206	267	310	353	397	440	483	595	707	817	927	1038	1150	1283	1417	1600	1783
170	25	90	154	219	283	325	367	408	450	492	615	738	851	963	1069	1175	1329	1483	1650	1817
175	25	94	163	231	300	340	380	420	460	500	635	770	885	1000	1100	1200	1375	1550	1700	1850

Table 9. Shank Broadcast Deep (18 inches) Untarp Buffer Zones Based on Wasco, CA Flux Study

Broadcast Equivalent Application Rate (lbs ai/arce)	Application Block Size (Acres)																			
	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	50	60	70	80
30	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
40	25	25	25	25	25	25	25	25	25	25	30	35	40	46	51	57	63	70	77	84
50	25	25	25	25	25	25	25	25	25	25	35	45	56	67	78	88	102	115	129	143
60	25	25	25	25	25	25	25	25	25	25	45	65	87	108	130	152	178	205	233	262
70	25	25	25	25	25	25	25	25	25	25	55	85	118	150	183	215	255	295	338	380
80	25	25	25	25	25	33	39	45	51	55	99	143	179	215	249	283	334	385	431	478
90	25	25	25	25	25	42	53	65	76	85	143	200	240	280	315	350	413	475	525	575
100	25	26	28	29	30	50	67	84	102	118	179	240	285	330	368	405	478	550	608	665
105	25	28	30	33	35	58	81	104	127	150	215	280	330	380	420	460	543	625	690	755
110	25	32	38	45	51	74	97	120	143	166	234	301	355	408	450	493	579	665	735	804
115	25	36	46	57	68	91	114	137	160	183	253	323	379	436	481	526	615	705	779	854
120	25	40	55	69	84	107	130	153	176	199	272	344	404	464	511	559	652	745	824	903
125	25	44	63	82	101	124	147	170	193	216	291	366	429	491	541	591	688	785	869	952
130	25	48	71	94	117	140	163	186	209	232	310	387	453	519	572	624	725	825	913	1001
135	25	52	79	106	134	157	180	203	226	249	329	409	478	547	602	657	761	865	958	1051
140	25	56	88	119	150	173	196	219	242	265	348	430	503	575	633	690	798	905	1003	1100
145	25	59	92	126	159	183	207	231	255	279	365	451	527	603	664	725	841	956	1061	1166
150	25	61	97	133	169	193	218	243	267	292	382	471	551	631	695	760	884	1008	1120	1231
155	25	63	101	140	178	203	229	255	280	306	399	492	575	659	727	795	927	1059	1178	1297
160	25	66	106	147	187	214	240	266	293	319	416	513	600	686	758	830	970	1111	1237	1363
165	25	68	111	154	196	224	251	278	306	333	433	534	624	714	790	865	1014	1162	1295	1429
170	25	70	115	161	206	234	262	290	318	346	450	554	648	742	821	900	1057	1214	1354	1494
175	25	73	120	168	215	244	273	302	331	360	468	575	673	770	853	935	1100	1265	1413	1560
180	25	75	126	176	226	257	287	317	347	377	491	605	704	803	886	969	1139	1309	1452	1594
185	25	78	131	185	238	269	300	332	363	394	515	635	735	836	920	1004	1179	1354	1491	1629
190	25	81	137	193	249	282	314	347	379	411	538	665	767	869	953	1038	1218	1398	1530	1663
195	25	84	143	202	261	294	328	361	395	429	562	695	798	901	987	1072	1257	1442	1570	1697
200	25	87	149	210	272	307	342	376	411	446	585	725	830	934	1020	1106	1296	1486	1609	1731
205	25	90	154	219	284	319	355	391	427	463	609	755	861	967	1054	1141	1336	1531	1648	1766
210	25	93	160	228	295	332	369	406	443	480	633	785	893	1000	1088	1175	1375	1575	1688	1800
215	32	101	170	238	307	345	383	420	458	496	650	805	913	1021	1111	1201	1409	1617	1721	1825
220	39	109	179	249	319	358	396	435	473	511	668	825	934	1043	1135	1228	1444	1659	1755	1850
225	46	118	189	260	331	371	410	449	488	527	686	845	955	1064	1159	1254	1478	1701	1788	1875
230	54	126	199	271	344	383	423	463	503	543	704	865	975	1086	1183	1281	1512	1744	1822	1900
235	61	134	208	282	356	396	437	477	518	559	722	885	996	1107	1207	1307	1546	1786	1855	1925
240	68	143	218	293	368	409	450	492	533	574	740	905	1017	1129	1231	1334	1581	1828	1889	1950
245	75	151	228	304	380	422	464	506	548	590	758	925	1038	1150	1255	1360	1615	1870	1923	1975
250	82	159	235	312	389	431	474	516	559	601	769	936	1057	1179	1283	1387	1641	1896	1962	2029
255	89	166	243	320	397	440	483	527	570	613	780	946	1077	1207	1311	1414	1668	1921	2002	2082
260	96	174	251	328	406	449	493	537	581	624	791	957	1096	1236	1339	1441	1694	1947	2041	2136
265	104	181	259	337	414	459	503	547	591	636	802	968	1116	1264	1366	1469	1721	1973	2081	2189
270	111	189	267	345	423	468	513	557	602	647	813	979	1136	1293	1394	1496	1747	1999	2121	2243
275	118	196	275	353	431	477	522	568	613	659	824	989	1155	1321	1422	1523	1774	2024	2160	2296
280	125	204	283	361	440	486	532	578	624	670	835	1000	1175	1350	1450	1550	1800	2050	2200	2350
285	129	208	287	366	446	493	541	588	635	683	853	1023	1201	1379	1479	1579	1836	2093	2243	2393
290	132	212	292	372	451	500	549	598	647	696	871	1046	1226	1407	1507	1607	1871	2136	2286	2436
295	136	216	296	377	457	507	558	608	658	709	889	1069	1252	1436	1536	1636	1907	2179	2329	2479
300	139	220	301	382	463	515	566	618	670	721	906	1091	1278	1464	1564	1664	1943	2221	2371	2521
305	143	224	306	387	469	522	575	628	681	734	924	1114	1304	1493	1593	1693	1979	2264	2414	2564
310	146	228	310	392	474	529	583	638	693	747	942	1137	1329	1521	1621	1721	2014	2307	2457	2607
315	150	233	315	398	480	536	592	648	704	760	960	1160	1355	1550	1650	1750	2050	2350	2500	2650
320	151	235	319	403	486	543	599	656	712	769	973	1177	1371	1566	1675	1784	2085	2385	2559	2734
325	153	238	323	408	493	550	607	663	720	777	986	1194	1388	1581	1700	1819	2119	2420	2619	2817
330	154	241	327	413	499	557	614	671	728	786	999	1211	1404	1597	1725	1853	2154	2455	2678	2901
335	156	243	331	418	506	563	621	679	737	794	1011	1229	1421	1613	1750	1887	2189	2490	2737	2984
340	157	246	335	423	512	570	628	687	745	803	1024	1246	1437	1629	1775	1921	2223	2525	2796	3068
345	159	249	339	429	519	577	636	694	753	811	1037	1263	1454	1644	1800	1956	2258	2560	2856	3151
350	160	251	343	434	525	584	643	702	761	820	1050	1280	1470	1660	1825	1990	2293	2595	2915	3235

Table 10. Drip Tarp Buffer Zones

Broadcast Equivalent Application Rate (lbs ai/a)	Application Block Size (Acres)																			
	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	50	60	70	80
120	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
125	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	35	40
130	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	40	50
135	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	45	60
140	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	45	60
145	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	45	60
150	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	45	60
155	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	38	45	53	60
160	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	38	45	53	60
165	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	40	60	60	60
170	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	40	50	60	60	60
175	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	40	50	60	60	60
180	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	40	60	60	60	60
185	30	30	30	30	30	30	30	30	30	30	30	32	34	36	38	40	60	60	62	64
190	30	30	30	30	30	30	30	30	30	30	30	32	34	36	38	40	60	60	64	68
195	30	30	30	30	30	30	30	30	30	30	30	32	34	36	38	40	60	60	66	73
200	30	30	30	30	30	30	30	30	30	30	30	32	34	36	38	40	60	60	68	77
205	30	30	30	30	30	30	30	30	30	30	30	32	34	36	38	40	60	60	70	81
210	30	30	30	30	30	30	30	30	30	30	30	32	34	36	38	40	60	60	73	85
215	30	30	30	30	30	30	30	30	30	30	30	33	37	40	43	47	68	77	90	103
220	30	30	30	30	30	30	30	30	30	30	30	35	39	44	49	53	77	93	108	122
225	30	30	30	30	30	30	30	30	30	30	30	40	50	60	60	60	85	110	125	140
230	30	30	30	30	30	30	30	30	30	30	39	48	56	65	67	68	103	120	134	148
235	30	30	30	30	30	30	30	30	30	30	40	50	60	70	73	77	122	130	143	157
240	30	30	30	30	30	30	30	30	30	30	45	60	68	75	80	85	140	140	153	165
245	30	30	30	30	30	30	30	30	30	30	46	63	70	78	86	94	143	150	165	179
250	30	30	30	30	30	30	30	30	30	30	48	65	73	82	93	103	147	160	177	193
255	30	30	30	30	30	30	30	30	30	30	49	68	76	85	99	113	150	170	189	208
260	30	30	30	30	30	30	30	30	30	30	50	70	79	88	105	122	153	180	201	222
265	30	30	30	30	30	30	30	30	30	30	51	73	82	92	111	131	157	190	213	236
270	30	30	30	30	30	30	30	30	30	30	53	75	85	95	118	140	160	200	225	250
275	30	30	30	30	30	32	33	35	36	38	61	84	95	108	131	153	176	215	241	267
280	30	30	30	30	30	33	36	39	42	45	69	93	105	122	145	167	192	230	257	283
285	30	30	30	30	30	35	39	44	48	53	78	103	115	135	159	180	208	245	273	300
290	30	30	30	30	30	36	42	48	54	60	86	112	125	148	173	193	223	260	288	317
295	30	30	30	30	30	38	45	53	60	68	94	121	135	162	186	207	239	275	304	333
300	30	30	30	30	30	39	48	57	66	75	110	130	145	175	200	220	255	290	320	350

Table 11. Drip Untarp Buried (6") Buffer Zones

Broadcast Equivalent Application Rate (lbs ai/arce)	Application Block Size (Acres)																			
	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	50	60	70	80
90	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
95	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	42	53	64	75
100	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	53	77	98	120
105	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	65	100	133	165
110	30	30	30	30	30	30	30	30	30	30	30	30	33	37	45	53	93	133	165	197
115	30	30	30	30	30	30	30	30	30	30	30	30	37	43	60	77	122	167	198	228
120	30	30	30	30	30	30	30	30	30	30	30	30	40	50	75	100	150	200	230	260
125	30	30	30	30	30	30	30	30	30	30	33	37	54	72	103	133	182	230	257	283
130	30	30	30	30	30	30	30	30	30	30	37	43	68	93	130	167	213	260	283	307
135	30	30	30	30	30	30	30	30	30	30	40	50	83	115	158	200	245	290	310	330
140	30	30	30	30	30	30	30	30	30	30	48	67	105	143	182	220	273	327	350	373
145	30	30	30	30	30	30	30	30	30	30	57	83	128	172	206	240	302	363	390	417
150	30	30	30	30	30	30	30	30	30	30	65	100	150	200	230	260	330	400	430	460
155	30	30	30	30	30	31	33	34	35	37	78	120	170	220	252	283	349	415	457	498
160	30	30	30	30	30	33	35	38	41	43	92	140	190	240	273	307	368	430	483	537
165	30	30	30	30	30	34	38	42	46	50	105	160	210	260	295	330	388	445	510	575
170	30	30	30	30	30	36	42	48	54	60	118	177	228	278	315	352	413	473	543	613
175	30	30	30	30	30	38	46	54	62	70	132	193	245	297	335	373	438	502	577	652
180	30	30	30	30	30	40	50	60	70	80	145	210	263	315	355	395	463	530	610	690
185	30	30	30	30	30	43	56	69	82	95	162	228	281	333	376	418	488	558	636	713
190	30	30	30	30	30	46	62	78	94	110	178	247	299	352	397	442	514	587	662	737
195	30	30	30	30	30	49	68	87	106	125	195	265	318	370	418	465	540	615	688	760
200	30	30	30	30	30	51	71	92	113	133	208	282	334	387	437	487	565	643	713	783
205	30	30	30	30	30	52	75	97	119	142	220	298	351	403	456	508	590	672	739	807
210	30	30	30	30	30	54	78	102	126	150	233	315	368	420	475	530	615	700	765	830
215	30	30	30	30	30	56	82	108	134	160	242	323	378	433	485	537	627	717	786	855
220	30	30	30	30	30	58	86	114	142	170	251	332	389	447	495	543	638	733	807	880
225	30	30	30	30	30	60	90	120	150	180	260	340	400	460	505	550	650	750	828	905
230	30	33	37	40	43	75	106	137	169	200	278	357	420	483	533	583	680	777	868	958
235	30	37	43	50	57	89	122	155	187	220	297	373	440	507	562	617	710	803	908	1012
240	30	40	50	60	70	104	138	172	206	240	315	390	460	530	590	650	740	830	948	1065
245	30	42	54	66	78	112	146	179	213	247	325	403	472	540	602	663	753	843	964	1085
250	30	44	58	73	87	120	153	187	220	253	335	417	483	550	613	677	767	857	981	1105
255	30	46	63	79	95	128	161	194	227	260	345	430	495	560	625	690	780	870	998	1125
260	30	48	67	85	103	136	168	200	233	265	355	445	508	570	638	705	800	895	1020	1145
265	30	50	71	91	112	143	175	207	238	270	365	460	520	580	650	720	820	920	1043	1165
270	30	53	75	98	120	151	182	213	244	275	375	475	533	590	663	735	840	945	1065	1185
275	30	53	77	100	123	155	187	219	251	283	383	482	544	607	681	755	862	968	1089	1210
280	30	54	78	103	127	160	193	226	259	292	390	488	556	623	699	775	883	992	1113	1235
285	30	55	80	105	130	164	198	232	266	300	398	495	568	640	718	795	905	1015	1138	1260
290	30	56	82	108	133	168	203	237	272	307	404	502	579	657	732	807	923	1040	1160	1280
295	30	57	83	110	137	172	207	243	278	313	411	508	591	673	746	818	942	1065	1183	1300
300	30	58	85	113	140	176	212	248	284	320	418	515	603	690	760	830	960	1090	1205	1320

Table 12. ***Increased*** Shank Bed Tarp/Strip Tarp Buffer Zones

Broadcast Equivalent Application Rate (lbs ai/arce)	Application Block Size (Acres)																			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**50**	**60**	**70**	**80**
90	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
95	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
100	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
105	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
110	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	80	86
115	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	86	96
120	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	91	107
125	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	96	118
130	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	102	129
135	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	107	139
140	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	113	150
145	75	75	75	75	75	75	75	75	75	75	75	75	77	79	86	92	107	122	161	199
150	75	75	75	75	75	75	75	75	75	75	75	75	79	84	96	109	139	169	209	249
155	75	75	75	75	75	75	75	75	75	75	75	75	81	88	107	126	171	216	257	298
160	75	75	75	75	75	75	75	75	75	75	75	75	84	92	118	144	204	264	305	347
165	75	75	75	75	75	75	75	75	75	75	75	75	86	96	129	161	236	311	354	396
170	75	75	75	75	75	75	75	75	75	75	75	75	88	101	139	178	268	358	402	446
175	75	75	75	75	75	75	75	75	75	75	75	75	90	105	150	195	300	405	450	495
180	75	75	75	75	75	75	75	75	75	75	87	99	124	150	194	238	342	446	498	551
185	75	75	75	75	75	75	75	75	75	75	99	122	159	195	238	281	384	486	546	606
190	75	75	75	75	75	75	75	75	75	75	110	146	193	240	282	324	425	527	595	662
195	75	75	75	75	75	75	75	75	75	75	122	169	227	285	326	366	467	568	643	718
200	75	75	75	75	75	75	75	75	75	75	134	193	261	330	370	409	509	609	691	774
205	75	75	75	75	75	75	75	75	75	75	146	216	296	375	414	452	551	649	739	829
210	75	75	75	75	75	75	75	75	75	75	158	240	330	420	458	495	593	690	788	885
215	75	75	75	75	75	77	79	81	84	86	178	270	358	446	484	523	624	724	813	902
220	75	75	75	75	75	79	84	88	92	96	198	300	386	471	511	551	655	759	839	919
225	75	75	75	75	75	81	88	94	101	107	219	330	414	497	538	579	686	793	865	936
230	75	75	75	75	75	84	92	101	109	118	239	360	441	523	565	606	717	827	890	954
235	75	75	75	75	75	86	96	107	118	129	259	390	469	549	591	634	748	861	916	971
240	75	75	75	75	75	88	101	114	126	139	280	420	497	574	618	662	779	896	942	988
245	75	75	75	75	75	90	105	120	135	150	300	450	525	600	645	690	810	930	968	1005
250	75	75	75	75	75	94	114	133	152	171	317	463	545	628	673	718	842	966	1020	1074
255	75	75	75	75	75	99	122	146	169	193	334	476	566	656	701	746	874	1003	1073	1142
260	75	75	75	75	75	103	131	159	186	214	351	489	586	684	729	774	906	1039	1125	1211
265	75	75	75	75	75	107	139	171	204	236	369	501	606	711	756	801	939	1076	1178	1279
270	75	75	75	75	75	111	148	184	221	257	386	514	627	739	784	829	971	1112	1230	1348
275	75	75	75	75	75	116	156	197	238	279	403	527	647	767	812	857	1003	1149	1283	1416
280	75	75	75	75	75	120	165	210	255	300	420	540	668	795	840	885	1035	1185	1335	1485
285	75	79	84	88	92	138	184	230	276	321	441	561	691	821	871	921	1075	1228	1379	1530
290	75	84	92	101	109	156	203	249	296	343	463	583	715	846	902	958	1114	1271	1423	1575
295	75	88	101	114	126	174	222	269	317	364	484	604	738	872	933	994	1154	1314	1467	1620
300	75	92	109	126	144	192	240	289	337	386	506	626	762	898	964	1031	1194	1356	1511	1665
305	75	96	118	139	161	210	259	309	358	407	527	647	785	924	995	1067	1233	1399	1555	1710
310	75	101	126	152	178	228	278	328	378	429	549	669	809	949	1026	1104	1273	1442	1599	1755
315	75	105	135	165	195	246	297	348	399	450	570	690	833	975	1058	1140	1313	1485	1643	1800
320	75	107	139	171	204	254	305	355	406	456	581	705	848	990	1079	1168	1344	1519	1682	1845
325	75	109	144	178	212	262	312	363	413	463	591	720	863	1005	1100	1196	1375	1554	1722	1890
330	75	111	148	184	221	270	320	370	420	469	602	735	878	1020	1122	1224	1406	1588	1761	1935
335	75	114	152	191	229	279	328	377	426	476	613	750	893	1035	1143	1251	1437	1622	1801	1980
340	75	116	156	197	238	287	336	384	433	482	624	765	908	1050	1165	1279	1468	1656	1841	2025
345	75	118	161	204	246	295	343	392	440	489	634	780	923	1065	1186	1307	1499	1691	1880	2070
350	75	120	165	210	255	303	351	399	447	495	645	795	938	1080	1208	1335	1530	1725	1920	2115

Table 13. Shank Bed Untarp Based on Phoenix, AZ Flux Study

Broadcast Equivalent Application Rate (lbs ai/arce)	Application Block Size (Acres)																				
	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	50	60	70	80
15	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	35	43	50
20	25	25	25	25	25	25	25	25	25	25	28	30	34	38	44	50	75	105	128	150
25	25	25	25	25	25	25	25	25	25	25	30	35	43	50	63	75	125	175	213	250
30	25	25	25	25	25	28	30	33	35	38	59	80	103	125	156	188	238	288	331	375
35	25	25	25	25	25	30	35	40	45	50	88	125	163	200	250	300	350	400	450	500
40	25	31	38	44	50	70	90	110	130	150	213	275	313	350	400	450	550	650	713	775
45	38	47	56	66	75	95	115	135	155	175	250	325	388	450	500	550	638	738	813	888
50	50	63	75	88	100	120	140	160	180	200	288	375	463	550	600	650	725	825	913	1000
55	75	91	106	122	138	160	183	205	228	250	344	438	525	613	669	725	825	925	1019	1113
60	100	119	138	156	175	200	225	250	275	300	400	500	588	675	738	800	925	1025	1125	1225
65	113	134	156	178	200	228	255	283	310	338	444	550	644	738	813	888	1013	1138	1244	1350
70	125	150	175	200	225	255	285	315	345	375	488	600	700	800	888	975	1100	1250	1363	1475
75	138	166	194	222	250	283	315	348	380	413	538	663	763	863	950	1038	1188	1363	1494	1625
80	150	181	213	244	275	310	345	380	415	450	588	725	825	925	1013	1100	1275	1475	1625	1775
85	163	197	231	266	300	340	380	420	460	500	638	775	881	988	1088	1188	1375	1575	1738	1900
90	175	213	250	288	325	370	415	460	505	550	688	825	938	1050	1163	1275	1475	1675	1850	2025
95	175	225	275	325	375	420	465	510	555	600	763	925	1050	1175	1300	1425	1625	1875	2175	2475
100	188	238	288	338	388	435	483	530	578	625	794	963	1100	1238	1369	1500	1700	1938	2225	2513
105	200	250	300	350	400	450	500	550	600	650	825	1000	1150	1300	1438	1575	1775	2000	2275	2550
110	217	271	325	379	433	483	533	583	633	683	871	1058	1208	1358	1500	1642	1875	2125	2379	2633
115	233	292	350	408	467	517	567	617	667	717	917	1117	1267	1417	1563	1708	1975	2250	2483	2717
120	250	313	375	438	500	550	600	650	700	750	963	1175	1325	1475	1625	1775	2075	2375	2588	2800
125	263	325	388	450	513	568	623	678	733	788	969	1150	1350	1550	1713	1875	2150	2475	2663	2850
130	275	338	400	463	525	585	645	705	765	825	975	1125	1375	1625	1800	1975	2225	2575	2738	2900
135	288	353	419	484	550	610	670	730	790	850	1044	1238	1450	1663	1869	2075	2300	2675	2863	3050
140	300	369	437.5	506	575	635	695	755	815	875	1113	1350	1525	1700	1938	2175	2375	2775	2988	3200
145	308	379	450	521	592	657	722	787	852	917	1154	1392	1583	1775	2004	2233	2500	2875	3129	3383
150	317	390	463	535	608	678	748	818	888	958	1196	1433	1642	1850	2071	2292	2625	2975	3271	3567
155	325	400	475	550	625	700	775	850	925	1000	1238	1475	1700	1925	2138	2350	2750	3075	3413	3750
160	331	409	488	566	644	720	796	873	949	1025	1272	1519	1753	1988	2194	2400	2813	3194	3547	3900
165	338	419	500	581	663	740	818	895	973	1050	1306	1563	1806	2050	2250	2450	2875	3313	3681	4050
170	344	428	513	597	681	760	839	918	996	1075	1341	1606	1859	2113	2306	2500	2938	3431	3816	4200
175	350	438	525	613	700	780	860	940	1020	1100	1375	1650	1913	2175	2363	2550	3000	3550	3950	4350

Table 14. ***Increased*** Shank Broadcast Tarp Buffer Zones

Broadcast Equivalent Application Rate (lbs ai/arce)	Application Block Size (Acres)																				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**50**	**60**	**70**	**80**
70	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
80	75	75	75	75	75	75	75	75	75	75	75	75	75	75	78	81	96	111	120	129
90	75	75	75	75	75	75	75	75	75	75	75	75	75	75	81	87	117	147	165	183
95	75	75	75	75	75	75	75	75	75	75	75	75	75	75	84	93	138	183	210	237
100	75	75	75	75	75	75	75	75	75	75	75	75	75	75	87	99	159	219	255	291
105	75	75	75	75	75	75	75	75	75	75	75	75	75	75	90	105	180	255	300	345
110	75	75	75	75	75	75	75	75	75	75	88	101	107	114	134	154	233	311	360	409
115	75	75	75	75	75	75	75	75	75	75	101	126	139	152	178	204	285	366	420	474
120	75	75	75	75	75	75	75	75	75	75	114	152	171	191	222	253	338	422	480	538
125	75	75	75	75	75	75	75	75	75	75	126	178	204	229	266	302	390	478	540	602
130	75	75	75	75	75	75	75	75	75	75	139	204	236	268	310	351	443	534	600	666
135	75	75	75	75	75	75	75	75	75	75	152	229	268	306	354	401	495	589	660	731
140	75	75	75	75	75	75	75	75	75	75	165	255	300	345	398	450	548	645	720	795
145	75	75	75	75	75	80	85	90	96	101	192	283	335	388	440	493	594	694	776	857
150	75	75	75	75	75	85	96	106	116	126	219	311	371	431	483	536	640	744	831	919
155	75	75	75	75	75	90	106	121	137	152	245	339	406	474	526	579	686	793	887	981
160	75	75	75	75	75	96	116	137	157	178	272	366	441	516	569	621	732	842	943	1044
165	75	75	75	75	75	101	126	152	178	204	299	394	477	559	612	664	778	891	999	1106
170	75	75	75	75	75	106	137	168	198	229	326	422	512	602	655	707	824	941	1054	1168
175	75	75	75	75	75	111	147	183	219	255	353	450	548	645	698	750	870	990	1110	1230
180	75	80	86	91	96	135	173	211	249	287	386	484	582	679	746	812	935	1059	1181	1303
185	75	86	96	107	118	158	198	239	279	319	419	519	616	714	794	874	1001	1127	1251	1376
190	75	91	107	123	139	182	224	267	309	351	452	553	650	748	842	936	1066	1196	1322	1449
195	75	96	118	139	161	205	250	294	339	384	485	587	685	782	890	999	1131	1264	1393	1521
200	75	102	129	155	182	229	276	322	369	416	519	621	719	816	939	1061	1197	1333	1464	1594
205	75	107	139	171	204	252	301	350	399	448	552	656	753	851	987	1123	1262	1401	1534	1667
210	75	113	150	188	225	276	327	378	429	480	585	690	788	885	1035	1185	1328	1470	1605	1740
215	75	118	161	204	246	297	347	397	447	497	608	718	823	928	1077	1226	1369	1513	1648	1783
220	75	123	171	220	268	317	366	416	465	514	630	746	858	971	1119	1266	1411	1556	1691	1826
225	75	129	182	236	289	338	386	435	483	531	653	774	894	1014	1160	1307	1453	1599	1734	1869
230	75	134	193	252	311	358	406	453	501	549	675	801	929	1056	1202	1348	1495	1641	1776	1911
235	75	139	204	268	332	379	426	472	519	566	698	829	964	1099	1244	1389	1536	1684	1819	1954
240	75	145	214	284	354	399	445	491	537	583	720	857	1000	1142	1286	1429	1578	1727	1862	1997
245	75	150	225	300	375	420	465	510	555	600	743	885	1035	1185	1328	1470	1620	1770	1905	2040
250	75	153	230	308	386	431	477	522	567	613	761	909	1065	1221	1359	1496	1654	1813	1968	2124
255	75	155	236	316	396	442	488	534	580	626	779	932	1095	1258	1390	1521	1689	1856	2031	2207
260	75	158	241	324	407	453	500	546	592	639	797	956	1125	1294	1421	1547	1723	1899	2095	2291
265	75	161	246	332	418	465	511	558	605	651	815	979	1155	1331	1452	1573	1757	1941	2158	2374
270	75	163	252	340	429	476	523	570	617	664	834	1003	1185	1367	1483	1599	1791	1984	2221	2458
275	75	166	257	348	439	487	534	582	630	677	852	1026	1215	1404	1514	1624	1826	2027	2284	2541
280	75	169	263	356	450	498	546	594	642	690	870	1050	1245	1440	1545	1650	1860	2070	2348	2625
285	75	172	268	365	461	512	563	614	665	716	900	1084	1268	1451	1579	1706	1926	2145	2394	2644
290	75	174	274	373	473	527	581	635	689	743	930	1118	1290	1463	1613	1763	1991	2220	2441	2663
295	75	177	279	382	484	541	598	655	712	769	960	1151	1313	1474	1646	1819	2057	2295	2488	2681
300	75	180	285	390	495	555	615	675	735	795	990	1185	1335	1485	1680	1875	2123	2370	2535	2700
305	85	193	300	408	515	576	637	698	759	820	1023	1225	1380	1535	1718	1900	2155	2410	2585	2760
310	95	205	315	425	535	597	659	721	783	845	1055	1265	1425	1585	1755	1925	2188	2450	2635	2820
315	105	218	330	443	555	618	681	744	807	870	1088	1305	1470	1635	1793	1950	2220	2490	2685	2880
320	111	226	340	454	568	630	693	756	818	881	1101	1322	1493	1663	1823	1982	2255	2529	2717	2906
325	118	234	349	465	581	643	705	767	829	891	1115	1339	1515	1691	1853	2014	2291	2567	2749	2931
330	124	242	359	476	594	655	717	779	840	902	1129	1356	1538	1719	1883	2046	2326	2606	2781	2957
335	131	250	369	488	606	668	729	790	852	913	1143	1374	1560	1746	1913	2079	2361	2644	2814	2983
340	137	258	378	499	619	680	741	802	863	924	1157	1391	1583	1774	1943	2111	2397	2683	2846	3009
345	144	266	388	510	632	693	753	813	874	934	1171	1408	1605	1802	1973	2143	2432	2721	2878	3034
350	150	274	398	521	645	705	765	825	885	945	1185	1425	1628	1830	2003	2175	2468	2760	2910	3060

Table 15. ***Increased*** Shank Broadcast Untarp Buffer Zones

Broadcast Equivalent Application Rate (lbs ai/arce)	Application Block Size (Acres)																				
	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	50	60	70	80
30	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
35	75	75	75	75	75	75	75	75	75	75	75	75	75	75	90	105	128	150	188	225
40	75	75	75	75	75	75	75	75	75	75	75	75	75	75	113	150	240	330	413	495
45	75	75	75	75	75	75	75	75	75	75	75	75	124	173	229	285	398	510	604	698
50	75	75	75	75	75	75	75	75	75	75	75	75	173	270	345	420	555	690	795	900
55	75	75	75	75	75	75	75	75	75	75	139	203	300	398	484	570	713	855	975	1095
60	75	75	75	75	75	75	75	75	75	75	203	330	428	525	623	720	870	1020	1155	1290
65	75	75	75	75	75	87	99	111	123	135	285	435	548	660	758	855	1028	1200	1343	1485
70	75	75	75	75	75	99	123	147	171	195	368	540	668	795	893	990	1185	1380	1530	1680
75	75	78	80	83	85	127	169	211	253	295	475	655	788	920	1030	1140	1355	1570	1735	1900
80	75	80	85	90	95	155	215	275	335	395	583	770	908	1045	1168	1290	1525	1760	1940	2120
85	75	83	90	98	105	183	261	339	417	495	690	885	1028	1170	1305	1440	1695	1950	2145	2340
90	75	102	129	157	184	259	334	409	484	559	743	926	1097	1268	1418	1568	1847	2126	2381	2636
95	75	122	169	216	263	335	407	479	551	623	795	968	1166	1365	1530	1695	1999	2303	2618	2933
100	75	142	208	275	341	410	479	548	617	686	848	1009	1236	1463	1643	1823	2151	2479	2854	3229
105	75	161	248	334	420	486	552	618	684	750	900	1050	1305	1560	1755	1950	2303	2655	3090	3525
110	75	169	263	356	450	518	587	655	724	792	975	1158	1418	1677	1883	2088	2451	2814	3237	3660
115	75	176	278	379	480	551	622	692	763	834	1050	1266	1530	1794	2010	2226	2600	2973	3384	3795
120	75	184	293	401	510	583	656	730	803	876	1125	1374	1643	1911	2138	2364	2748	3132	3531	3930
125	75	191	308	424	540	616	691	767	842	918	1200	1482	1755	2028	2265	2502	2897	3291	3678	4065
130	75	199	323	446	570	648	726	804	882	960	1275	1590	1868	2145	2393	2640	3045	3450	3825	4200
135	75	214	353	491	630	713	795	878	960	1043	1350	1658	1954	2250	2498	2745	3120	3495	3941	4388
140	75	229	383	536	690	777	864	951	1038	1125	1425	1725	2040	2355	2603	2850	3195	3540	4058	4575
145	75	233	390	548	705	804	903	1002	1101	1200	1500	1800	2117	2434	2708	2981	3324	3668	4206	4744
150	75	236	398	559	720	831	942	1053	1164	1275	1575	1875	2194	2513	2813	3113	3454	3795	4354	4913
155	75	240	405	570	735	858	981	1104	1227	1350	1650	1950	2271	2591	2918	3244	3583	3923	4502	5081
160	75	244	413	581	750	885	1020	1155	1290	1425	1725	2025	2348	2670	3023	3375	3713	4050	4650	5250
165	75	256	438	619	800	930	1060	1190	1320	1450	1785	2120	2450	2780	3115	3450	3850	4250	4800	5350
170	75	269	463	656	850	975	1100	1225	1350	1475	1845	2215	2553	2890	3208	3525	3988	4450	4950	5450
175	75	281	488	694	900	1020	1140	1260	1380	1500	1905	2310	2655	3000	3300	3600	4125	4650	5100	5550

Table 16. ***Increased*** Shank Broadcast Deep (18 inches) Untarp Buffer Zones

Broadcast Equivalent Application Rate (lbs ai/arce)	Application Block Size (Acres)																				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**50**	**60**	**70**	**80**
30	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
40	75	75	75	75	75	75	75	75	75	75	90	105	121.3	138	153.8	170	190	210	231.3	252.5
50	75	75	75	75	75	75	75	75	75	75	105	135	167.5	200	232.5	265	305	345	387.5	430
60	75	75	75	75	75	75	75	75	75	75	135	195	260	325	390	455	535	615	700	785
70	75	75	75	75	75	75	75	75	75	75	165	255	353	450	548	645	765	885	1013	1140
80	75	75	75	75	75	100	117	134	152	165	296	428	536	645	746	848	1001	1155	1294	1433
90	75	75	75	75	75	125	159	194	228	255	428	600	720	840	945	1050	1238	1425	1575	1725
100	75	79	83	86	90	149	201	253	305	353	536	720	855	990	1103	1215	1433	1650	1823	1995
105	75	83	90	98	105	174	243	312	381	450	645	840	990	1140	1260	1380	1628	1875	2070	2265
110	75	95	115	134	154	223	292	361	430	499	702	904	1064	1224	1351	1479	1737	1995	2204	2413
115	75	107	139	171	204	273	342	411	480	549	759	969	1138	1307	1442	1577	1846	2115	2338	2561
120	75	119	164	208	253	322	391	460	529	598	815	1033	1212	1391	1533	1676	1955	2235	2472	2709
125	75	132	189	245	302	371	440	509	578	647	872	1097	1286	1474	1624	1774	2065	2355	2606	2856
130	75	144	213	282	351	420	489	558	627	696	929	1161	1360	1558	1715	1873	2174	2475	2740	3004
135	75	156	238	319	401	470	539	608	677	746	986	1226	1434	1641	1806	1971	2283	2595	2874	3152
140	75	169	263	356	450	519	588	657	726	795	1043	1290	1508	1725	1898	2070	2393	2715	3008	3300
145	75	176	276	377	478	549	621	693	764	836	1094	1352	1580	1809	1992	2175	2522	2869	3183	3497
150	75	183	290	398	506	580	654	728	802	876	1145	1414	1653	1892	2086	2280	2652	3024	3359	3694
155	75	190	304	419	534	610	687	764	840	917	1197	1476	1726	1976	2180	2385	2781	3178	3535	3891
160	75	197	318	440	561	641	720	799	879	958	1248	1539	1799	2059	2275	2490	2911	3332	3710	4089
165	75	204	332	461	589	671	753	835	917	999	1300	1601	1872	2143	2369	2595	3041	3486	3886	4286
170	75	211	346	482	617	702	786	870	955	1039	1351	1663	1945	2226	2463	2700	3170	3641	4062	4483
175	75	218	360	503	645	732	819	906	993	1080	1403	1725	2018	2310	2558	2805	3300	3795	4238	4680
180	75	226	377	528	679	770	860	951	1041	1131	1473	1815	2112	2409	2658	2908	3418	3928	4355	4783
185	75	235	394	554	714	807	901	995	1089	1183	1544	1905	2206	2507	2759	3011	3536	4061	4473	4886
190	75	243	411	580	748	845	942	1040	1137	1234	1615	1995	2300	2606	2860	3114	3654	4194	4591	4989
195	75	252	429	605	782	883	984	1084	1185	1286	1685	2085	2395	2704	2960	3216	3771	4326	4709	5091
200	75	260	446	631	816	921	1025	1129	1233	1337	1756	2175	2489	2803	3061	3319	3889	4459	4827	5194
205	75	269	463	657	851	958	1066	1173	1281	1389	1827	2265	2583	2901	3162	3422	4007	4592	4945	5297
210	75	278	480	683	885	996	1107	1218	1329	1440	1898	2355	2678	3000	3263	3525	4125	4725	5063	5400
215	96	303	509	715	921	1035	1148	1261	1374	1487	1951	2415	2740	3064	3334	3604	4228	4851	5163	5475
220	118	328	538	748	958	1073	1188	1304	1419	1534	2005	2475	2802	3129	3406	3684	4331	4978	5264	5550
225	139	353	567	781	994	1112	1229	1347	1464	1581	2058	2535	2864	3193	3478	3763	4434	5104	5365	5625
230	161	378	596	813	1031	1150	1270	1389	1509	1629	2112	2595	2926	3257	3550	3842	4536	5231	5465	5700
235	182	403	625	846	1067	1189	1311	1432	1554	1676	2165	2655	2988	3321	3621	3921	4639	5357	5566	5775
240	204	429	654	879	1104	1227	1351	1475	1599	1723	2219	2715	3050	3386	3693	4001	4742	5484	5667	5850
245	225	454	683	911	1140	1266	1392	1518	1644	1770	2273	2775	3113	3450	3765	4080	4845	5610	5768	5925
250	246	476	706	936	1166	1293	1421	1549	1677	1804	2306	2807	3171	3536	3849	4161	4924	5687	5886	6086
255	268	499	730	961	1191	1321	1450	1580	1709	1839	2339	2839	3230	3621	3932	4243	5004	5764	6005	6246
260	289	521	753	985	1217	1348	1479	1611	1742	1873	2372	2871	3289	3707	4016	4324	5083	5841	6124	6407
265	311	544	777	1010	1243	1376	1509	1641	1774	1907	2405	2904	3348	3793	4099	4406	5162	5919	6243	6568
270	332	566	800	1034	1269	1403	1538	1672	1807	1941	2439	2936	3407	3879	4183	4487	5241	5996	6362	6729
275	354	589	824	1059	1294	1431	1567	1703	1839	1976	2472	2968	3466	3964	4266	4569	5321	6073	6481	6889
280	375	611	848	1084	1320	1458	1596	1734	1872	2010	2505	3000	3525	4050	4350	4650	5400	6150	6600	7050
285	386	624	861	1099	1337	1479	1622	1764	1906	2049	2559	3069	3602	4136	4436	4736	5507	6279	6729	7179
290	396	636	875	1115	1354	1501	1647	1794	1941	2087	2612	3137	3679	4221	4521	4821	5614	6407	6857	7307
295	407	648	889	1130	1371	1522	1673	1824	1975	2126	2666	3206	3756	4307	4607	4907	5721	6536	6986	7436
300	418	661	903	1146	1389	1544	1699	1854	2009	2164	2719	3274	3834	4393	4693	4993	5829	6664	7114	7564
305	429	673	917	1161	1406	1565	1725	1884	2043	2203	2773	3343	3911	4479	4779	5079	5936	6793	7243	7693
310	439	685	931	1177	1423	1587	1750	1914	2078	2241	2826	3411	3988	4564	4864	5164	6043	6921	7371	7821
315	450	698	945	1193	1440	1608	1776	1944	2112	2280	2880	3480	4065	4650	4950	5250	6150	7050	7500	7950
320	454	706	957	1208	1459	1629	1798	1967	2136	2306	2919	3531	4114	4697	5025	5353	6254	7155	7678	8201
325	459	714	969	1224	1479	1649	1820	1990	2161	2331	2957	3583	4164	4744	5100	5456	6358	7260	7856	8451
330	463	722	980	1239	1498	1670	1842	2013	2185	2357	2996	3634	4213	4791	5175	5559	6462	7365	8034	8702
335	467	730	992	1255	1517	1690	1863	2037	2210	2383	3034	3686	4262	4839	5250	5661	6566	7470	8211	8953
340	471	738	1004	1270	1536	1711	1885	2060	2234	2409	3073	3737	4311	4886	5325	5764	6670	7575	8389	9204
345	476	746	1016	1286	1556	1731	1907	2083	2259	2434	3111	3789	4361	4933	5400	5867	6774	7680	8567	9454
350	480	754	1028	1301	1575	1752	1929	2106	2283	2460	3150	3840	4410	4980	5475	5970	6878	7785	8745	9705

Table 17. Buffer Zones for Pre-Plant Greenhouse Tarped Soil Fumigations

Structure Size	Buffer Zone
≤ 25,000 square feet	25 feet
> 25,000 square feet and ≤ 30,000 square feet	50 feet
> 30,000 square feet and ≤ 35,000 square feet	75 feet
> 35,000 square feet and ≤ 40,000 square feet	100 feet
> 40,000 square feet and ≤ 45,000 square feet	115 feet
> 45,000 square feet and up to 50,000 square feet	130 feet

Table 9, from the July 2008 RED, summarized the required buffer zone distances and corresponding PERFUM modeling results for the pre-plant soil uses assessed by the Agency during Phase 5 of the reregistration process. It also showed the percentile for the whole and maximum field distributions for each buffer distance, as well as the MOE at the 95th and 99th percentile air concentration of PERFUM. (See Appendix D for more details on the PERFUM model inputs and outputs).

The Agency has revised Table 9 from the July 2008 RED based on the new Wasco, CA data. As noted above the Wasco emission data did not include a study for the untarp bed application method, and therefore the numbers for the scenarios have not changed since the July 2008 RED. These scenarios are italicized in the table. Since the Agency believes that the Wasco studies are more representative of current practices, the results characterized below represent information from the Wasco studies. Table 18 contains the new information.

In Table 18 the buffer zones reach the target MOE of 1 at high percentiles, i.e., at least at 95% whole field and all maximum percentiles range from 50 to above 99 percent. Furthermore the numbers also reach half of the target at the 99th percentile air concentration in PERFUM runs. This concentration corresponds to minor, reversible irritation effects observed in the human study. Even though the new buffer zones are smaller, the new distances reach the Agency's target at higher percentiles. As such, the Agency is confident that the buffer zones are still protective against severe health effects while also reducing the impacts to users.

Focusing on the forest seedling nursery in the Southeast as an example, the buffer zone for a 10 acre plot at a rate of 300 lbs ai/A is 265 feet. At 265 feet, the PERFUM model predicts the 95th percentile for the whole field distribution and the 55th percentile for the maximum field distribution. The risk level corresponding to this buffer zone distance at the 95th percentile whole field distribution is equivalent to saying a person at any location on the perimeter of the buffer zone during the 24 hour period following the fumigation of a specific field during a 5-year period would have at least a 95 percent chance of having of an exposure below the level of concern (i.e., MOE of 1or higher). The risk level corresponding to the buffer zone distances at the 55th percentile maximum distribution is equivalent to saying a person at the location on the perimeter of the buffer zone where the maximum concentration occurs during the worst case 24 hour period following the fumigation of a specific field during a 5-year period would have a 55 percent chance of having of an exposure below the level of concern (i.e., MOE of 1 or higher).

The Agency believes that the buffer zone distances described above, combined with other risk mitigations described herein, will provide protection against unreasonable adverse effects.

Table 18. Projected Buffer Zone Distances for Crops with Significant Chloropicrin Usage

Crop	Region	Application Method	Rate (lb ai/A)	Block Size (acres)	Buffer zone Distances without credits	Whole and Maximum Field Percentiles (MOE = 1)		MOE at 95th and 99th Percentile of PERFUM 2	
						Whole	Max	95th	99th
Cucurbits	CA & Southeast	Tarp Broadcast	50	10	25	99	90	>1	1
				40	25	99	90	>1	1
	CA & Southeast	Tarp Bed	50	10	25	99	99	>1	1
				40	25	99	99	>1	1
	Michigan	Tarp Broadcast	70	10	25	99	90	>1	1
				40	25	99	90	>1	1
	Michigan	Tarp Bed	70	10	25	99	99	>1	1
				40	25	99	99	>1	1
Eggplant	CA & Southeast	Tarp Bed	75	10	25	99	99	>1	1
				40	25	99	99	>1	1
Forest Seedling	Southeast	Tarp Broadcast	300	10	265	95	55	1	0.6
				20	395	95	50	1	0.6
	West	Tarp Broadcast	116	10	25	99	80	>1	1
				20	51	99	80	>1	1
Orchard Replant-Stone	CA	Deep Tarp Bed	43	20	25	99	99	>1	1
				30	25	99	99	>1	1
Pepper	CA & MI	Tarp Bed	100	10	25	99	99	>1	1
				40	25	99	95	>1	1
	Southeast	Tarp Bed	75	10	25	99	99	>1	1
				40	25	99	99	>1	1
Strawberry	CA	Tarp Bed	117	10	25	99	99	>1	1
				20	25	99	95	>1	1
	FL	Tarp Bed	143	10	25	97	90	>1	1
				20	25	95	80	1	1
Strawberry Nursery	CA & Southeast	Tarp Broadcast	200	10	139	99	55	>1	1
				40	354	95	50	1	1
Sweet Potato	Texas	Tarp Bed	10	10	25	99	99	>1	1
				40	25	99	99	>1	1
Tobacco	All States	Tarp Bed	80	10	25	99	99	>1	1
				40	25	99	95	>1	1
Tomato	CA & FL	Tarp Bed	133	10	25	99	97	>1	1
				40	25	95	80	1	1
	MI	Tarp Bed	114	10	25	99	99	>1	1
				40	25	97	80	>1	1
Carrot	*CA*	*Bed*	*18*	*80*	*50*	*90*	*65*	*0.9*	*0.5*
Onion	*Oregon*	*Bed Compaction*	*34*	*40*	*300*	*90*	*50*	*0.9*	*0.5*
	Washington	*Bed Compaction*	*22*	*40*	*100*	*97*	*80*	*0.9*	*0.6*
Orchard Replant-Grape & Nut	*CA*	*Deep Bed Compaction*	*12*	*20*	*25*	*97*	*85*	*>1*	*1*
				30	*25*	*95*	*75*	*>1*	*1*
Orchard Replant-Pome	*Pacific NW*	*Deep Bed Compaction*	*50*	*5*	*100*	*90*	*50*	*0.9*	*0.5*
Orchard Replant-Stone	*Pacific NW*	*Deep Bed Compaction*	*68*	*5*	*225*	*90*	*50*	*0.9*	*0.5*

Amended Buffer Zone Requirements

The following describes the general buffer zone requirements, as amended, for chloropicrin:

- "Buffer zone" is an area established around the perimeter of each application block or greenhouse where a soil fumigant is applied. The buffer zone must extend from the edge of the application block or greenhouse perimeter equally in all directions.
- All non-handlers including field workers, nearby residents, pedestrians, and other bystanders, must be excluded from the buffer zone during the buffer zone period except for transit (see exemptions section).
- The "buffer zone period" starts at the moment when any fumigant is delivered/dispensed to the soil within the application block and lasts for a minimum of 48 hours after the fumigant has stopped being delivered/dispensed to the soil.
- An "application block" is a field or portion of a field treated with a fumigant in any 24-hour period. See exception provided in the "Buffer zone proximity" section below. (See Figures 8 and 9 in Appendix D on page 153 for further explanation.)

Buffer zone proximity

- To reduce the potential for off-site movement from multiple fumigated fields, buffer zones from multiple chloropicrin application blocks may not overlap UNLESS:
    - A minimum of 12 hours have elapsed from the time the earlier application(s) for which a buffer is in place end(s) until the latter application begins, and
    - Emergency preparedness and response measures specified later in this document have been implemented if there are any homes, businesses, or property not within the control of the fumigator within 300 feet of each buffer zone.

Buffer zone distances

- Buffer zone distances must be based on look-up tables on product labels. Twenty-five feet is the minimum buffer distance regardless of site-specific application parameters.
- For selective replant fumigation in an orchard using hand held application methods (e.g., deep injection auger probes), the minimum buffer zone will be 25 feet measured from the center of each injection site (i.e., tree hole).

Authorized entry to buffer zones

- Only authorized handlers who have been properly trained and equipped according to EPA's Worker Protection Standard (WPS) and label requirements may be in the buffer zone during the buffer zone period.

Exemptions for transit through buffer zones

- Vehicular and bicycle traffic on public and private roadways through the buffer zone is permitted. "Roadway" means that portion of a street or highway improved, designed or ordinarily used for vehicular travel, exclusive of the sidewalk or shoulder even if such sidewalk or shoulder is used by persons riding bicycles. In the event a highway includes two or more separated roadways, the term "roadway" shall refer to any such roadway separately. (This definition is based on the definition of roadway in the Uniform Vehicle Code prepared

by the National Committee on Uniform Traffic Laws and Ordinances. See http://www.ncutlo.org/ for more details)

- Bus stops or other locations where persons wait for public transit are not permitted within the buffer zone.
- See the Posting Section of this document for additional requirements that may apply.

Structures under the control of owner/operator of the application block

- Buffer zones may not include buildings used for storage such as sheds, barns, garages, etc., **UNLESS,**
  1. The storage buildings are not occupied during the buffer zone period, and
  2. The storage buildings do not share a common wall with an occupied structure.
- See the Posting Section of this document for additional requirements that may apply.

Areas not under the control of owner/operator of the application block

- Buffer zones may not include residential areas (including employee housing, private property, buildings, commercial, industrial, and other areas that people may occupy or outdoor residential areas, such as lawns, gardens, or play areas) **UNLESS,**
  1. The occupants provide written agreement that they will voluntarily vacate the buffer zone during the entire buffer zone period, and
  2. Reentry by occupants and other non-handlers must not occur until,
     - The buffer zone period has ended, and
     - Sensory irritation is not experienced.
- Buffer zones may not include agricultural areas owned/operated by persons other than the owner/operator of the application block, **UNLESS,**
  1. The owner/operator of the application block can ensure that the buffer zone will not overlap with a buffer zone from any adjacent property owners, except as provided for above, and
  2. The owner/operator of the adjacent areas (i.e., areas that are not under the control of the owner/operator of the application block) provides written agreement to the applicator that they, their employees, and other persons will stay out of the buffer zone during the entire buffer zone period.
- Buffer zones must not include roads and rights of way **UNLESS,**
  1. The area is not occupied during the buffer zone period, and
  2. Entry by non-handlers is prohibited during the buffer zone period.
  3. Applicators must comply with all local laws and regulations.
- For all other publicly owned and/or operated areas such as parks, side walks, walking paths, playgrounds, and athletic fields, buffer zones must not include these areas **UNLESS,**
  1. The area is not occupied during the buffer zone period,
  2. Entry by non-handlers is prohibited during the buffer zone period, and
  3. Written permission to include the public area in the buffer zone is granted by the appropriate state and/or local authorities responsible for management and operation of the area.
  4. Applicators must comply with all local laws and regulations.
- See the *Posting* Section of this document for additional requirements that may apply.

ii. Buffer Zone Reduction Credits

Requirements in the July 2008 RED

In preparing for the July 2008 RED, the Agency undertook a significant effort to evaluate available empirical data results, modeling, and scientific studies reported in the literature regarding the factors and control methods that may reduce emissions from soil fumigants. For details on the Agency's analysis, please see the June 9, 2008 memo, "Factors Which Impact Soil Fumigant Emissions - Evaluation for Use in Soil Fumigant Buffer Zone Credit Factor Approach,"[9] in the chloropicrin docket. The Agency also coordinated and led fora to discuss this issue at the 2006 and 2007 Methyl Bromide Alternatives Outreach (MBAO) Conferences with leading researchers and other stakeholders. A general description of the MBAO sessions can be found at http://mbao.org.

Based on the Agency's analysis of the data, the 2008 chloropicrin RED gave buffer zone reduction credits for: high barrier tarps (40%), high barrier tarps used in combination with the Symmetry™ application system (50%), potassium thiosulfate (KTS) applied over tarped fields (5%), soils with high organic matter (10%), and soils with high clay content (10%). The July 2008 RED stated that the buffer zone credits were additive, but that the total credit could not exceed 50 percent. EPA noted that changing current use practices or site conditions to utilize these credits may be a challenge, but that the Agency believed that in addition to reducing bystander risk and the size of buffer zones, the credits for high barrier tarps, Symmetry™ application system, and KTS had the potential to increase efficacy, and also that the use of high barrier tarps could reduce application rates.

Comments on the July 2008 RED

Data were submitted since the July 2008 RED was issued that show greater reductions in emissions from the use of tarps and environmental conditions than what was determined in the July 2008 RED. In addition, the information submitted during the comment period indicated an additive effect in reducing emissions when multiple factors were combined. As a result, EPA has updated the buffer reduction credits and determined that the 50% credit cap should be increased to 80%. The new credits for individual factors and the cap on credits are detailed below. For details on the Agency's analysis please see the May 14, 2009 memo; "Methyl Bromide (PC Code 053201), Chloropicrin (PC Code 081501), Dazomet (PC Code 035602), Metam Sodium and Potassium (PC Codes 039003 & 039002), MITC (PC Code 068103), DP Barcode D362369, Updated Health Effects Division Recommendations For Good Agricultural Practices and Associated Buffer Credits," in the chloropicrin docket.

- High Barrier Tarps

Credits in the July 2008 RED

[9] EPA-HQ-OPP-2007-0350-0173. Factors Which Impact Soil Fumigant Emissions - Evaluation for Use in Soil Fumigant Buffer Zone Credit Factor Approach, June 9, 2008, DP Barcode: 306857

The July 2008 RED determined that a 40% buffer credit for chloropicrin was appropriate for the following high barrier tarps: Bromostop® (1.38 mil), IPM Clear VIF (1.38 mil), Eval/Mitsui (1.38 mil), Hytiblock 7 Black (0.00125"), XL Black Blockade (0.00125"), and Hytibar (1.5 mil). The Agency believed that the actual reduction for tarps could be higher for certain conditions but that a 40% credit was appropriate based on uncertainties in the available data.

Comments on the July 2008 RED

Since the RED was published, data have been submitted by the United States Department of Agriculture- Agricultural Research Service (USDA-ARS) and other organizations that have shown a greater reduction in emissions for a larger number of tarps.

Credits for the Amended RED

From these data, the Agency has increased the credit for certain tarps and increased the number of tarps that are given credits. The Agency has determined that the tarps tested can be divided into two groups based on results in the emissions tests mentioned above. The first group includes the Canslit Heatstrip Silver and Canslit Metalized high-barrier tarps, which will be given a buffer credit of 30%. The second group includes the Olefinas Embossed VIF, Klerks VIF, Pliant Blockade, Bromostop® (1.38 mil), Eval/Mitsui TIF (1.38 mil), Hytiblock 7 Black (0.00125"), XL Black Blockade (0.00125"), Hytibar (1.5 mil), and IPM Clear VIF (1.38 mil) high barrier tarps, which will be given a buffer credit of 60%.

It is important to note, however, that when considering the credits selected for high barrier tarps for each fumigant, a number of issues must be taken into account, including: different tarp and fumigant combinations result in different degrees of emission control; difficulty in determining the exact impact that high barrier tarps have on emissions in a full field flux study unless a co-located field is also monitored in the same vicinity using a standard tarp; and the lack of a standard fumigant tarp testing procedure.

The Agency is currently validating a standard fumigant tarp testing procedure, developed at USDA that measures the mass transfer coefficients of tarps. The purpose of this research is to develop a standardized method of testing and rating permeability of tarps based on mass transfer coefficients. From these results a permeability database and a standardized method for testing tarp permeability will be developed. The database will allow the Agency to evaluate potential buffer zone credits for additional tarps. In addition, the method can be used by other laboratories or tarp manufacturers to test the permeability of their tarps which could augment the number of tarps that receive buffer credits. For more details on USDA's research, please refer to the Agency's May 14, 2009 memo; "Methyl Bromide (PC Code 053201), Chloropicrin (PC Code 081501), Dazomet (PC Code 035602), Metam Sodium and Potassium (PC Codes 039003 & 039002), MITC (PC Code 068103), DP Barcode D362369, Updated Health Effects Division Recommendations For Good Agricultural Practices and Associated Buffer Credits."

The Agency has also co-funded a grant with USDA-ARS to conduct several flux studies in the southeastern U.S. These studies will provide field data on the emission reduction potential

of certain barrier films to further enhance EPA's understanding of the emission reduction value of various agricultural films, and possibly support additional buffer reduction credits and an affordable and reliable hybrid field/lab test to evaluate the many barrier films available to growers.

- High Barrier Tarps with Symmetry™ Application System

Credits in the July 2008 RED

In the July 2008 RED, the Agency gave a 50% credit when the Symmetry™ application system was used with approved high barrier tarps (tarps listed in the July 2008 RED) and the application rate was less than 100 lbs ai/A. The 50% credit was based on the 40% credit for the high barrier tarps and a 10% credit for the Symmetry™ application method. This credit was based on studies sponsored by Arysta Life Sciences North America Corporation.[10, 11] EPA stated in the 2008 RED that due to limited information regarding how the application system reduced emissions without high barrier tarps or at higher application rates, the Agency believed the credit, while conservative, is appropriate.

Credits for the Amended RED

The Agency did not receive any comments or additional data on this credit in particular. However since the credits for the high barrier tarps have changed the Agency is increasing the credit to 70% when the Symmetry™ application system is used with the following high barrier tarps: Olefinas Embossed VIF, Klerks VIF, Pliant Blockade, Bromostop® (1.38 mil), Eval/Mitsui TIF (1.38 mil), Hytiblock 7 Black (0.00125"), XL Black Blockade (0.00125"), Hytibar (1.5 mil), and IPM Clear VIF (1.38 mil), provided the application rate is less than 100 lbs ai/A. The 70% credit is based on the 60% credit for the tarp and a 10% credit for the Symmetry™ application method. In addition to the increase, the Agency is giving a 40% credit when the Symmetry™ application system is used with Canslit Heatstrip Silver and Canslit Metalized high-barrier tarps, provided the application rate is less than 100 lbs ai/A. The 40% credit was based on the 30% credit for the high barrier tarps and a 10% credit for the Symmetry™ application method.

- Potassium Thiosulfate (KTS) and Tarps

Credits in the July 2008 RED

[10] EPA MRID 472952-03 Baker, F.: Arndt, T. (2007) Direct and Indirect Flux Determination of Iodomethane and Chloropicrin Under Field Conditions Following Tarped/Raised Bed/Shallow Shank Injection of Midas 50:50 in Bainbridge, GA. Project Number: 1619W, 1619W/1. Unpublished study prepared by PTRL West, Inc, Paragon Research Services, Pacific Ag Group. 590 p. [Black Hytiblock]

[11] EPA MRID 472952-04; Baker F.; Arndt, T. (2007) Direct and Indirect Flux Determination of Iodomethane and Chloropicrin Under Field Conditions Following Tarped/Raised Bed/Shallow Shank Injection of Midas 50:50 in Hart, Michigan. Project Number: 1646W, 1646W/1. Unpublished study prepared by PTRL West, Inc, Paragon Research Services, Pacific Ag Group, 590 p. [Black Blockade]

EPA gave a 5% credit for applications of KTS. The KTS credit was based on a field study conducted by Dr. Husein Ajwa[12] that indicated reductions in chloropicrin emissions when KTS is applied to the top of tarps after the fumigation. In the 2008 RED the Agency stated that the KTS credit could be added to the high barrier tarp credit, e.g., the buffer zone could be reduced by 45%. However, only a 5% credit would apply if KTS was used with any other tarp.

Comments on the July 2008 RED

The Agency received comments that buffer zone credits should be greater than 5% for KTS. In addition, results from Ajwa's 2007 and 2008 research published by the California Strawberry Commission, titled: "Reduce Fumigant Emissions Using Impermeable Film and Water Seal in Strawberry Raised Beds. California Strawberry Commission Annual Production Research Report 2007-2008," show that applying a water seal/KTS combination over the bedded tarped field resulted in a reduction in the peak flux of chloropicrin and the total mass of chloropicrin lost. The water seal/KTS combination resulted in an approximate reduction of peak flux of 36% and total mass loss was reduced by approximately 20% at Salinas when compared to the standard tarp water seal scenario. The water seal/KTS combination resulted in an approximate reduction of peak flux of 32% and total mass loss was reduced by approximately 10% at the Oxnard site when compared to the standard tarp scenario.

Credits for the Amended RED

Based on the data, the Agency determined that a conservative credit of 15% is appropriate for KTS when applied with ¼ to ½ inch of water over a tarp. When used with one of the high-barrier tarps listed above, the 15% credit will be added to the tarp credit. For example if KTS is applied over Bromostop® (1.38 mil) which qualifies for a 60% credit, the total credit would be 75%. If KTS is used with any other tarp not currently listed in the amended RED, the credit is 15%.

- Water Seals

Credits in the July 2008 RED

The July 2008 RED did not give credits for the application of water seals.

Comments on the July 2008 RED

The Agency received comments that buffer zone credits should be considered for water seals. In addition, results from Ajwa's 2008 research study published by the California Strawberry Commission, titled: "Reduce Fumigant Emissions Using Impermeable Film and Water Seal in Strawberry Raised Beds. California Strawberry Commission Annual Production Research Report 2007-2008," show that applying a water seal over the bedded tarped field resulted in a reduction in the peak flux of chloropicrin and the total mass of chloropicrin lost.

[12] Ajwa, H. Fumigant Emission Reductions by Using Low Permeability Film and Thiosulfate Water Seal. 2007 Methyl Bromide Alternatives Outreach Conference. http://mbao.org/2007/PDF/Preplant/PP1/Ajwa(6).pdf.

The water seal resulted in an approximate reduction of peak flux of 30% and total mass loss was reduced by approximately 39% at Salinas when compared to the standard tarp scenario.

Credits for the Amended RED

Based on the data, the Agency determined that a conservative credit of 15% is appropriate when ¼ to ½ inch of water is applied over a tarp. When used with one of the high-barrier tarps listed above, the 15% credit will be added to the tarp credit. For example when a water seal is applied over Bromostop® (1.38 mil) which qualifies for a 60% credit, the total credit would be 75%. If a water seal is used with any other tarp not currently listed in the amended RED, the credit is 15%.

- Soil Conditions

Credits in the July 2008 RED

Like high barrier tarps, inherent soil conditions (e.g., organic matter and soil type) do have an impact on fumigant emissions. However, while the use of high barrier tarp is a choice an applicator can make, soil conditions are factors essentially beyond a grower's ability to change. Although a grower may not be able to manipulate organic matter or soil type, the Agency's June 2008 factors document indicates that soil conditions can reduce fumigant emissions, and is offering credits for these conditions where they exist.

In the July 2008 RED, the Agency determined that a 10 percent buffer zone credit was appropriate if the application block contains soil with organic matter of greater than 3 percent and/or for clay content of at least 27 percent. This was based on the review of literature available before the July 2008 RED and modeling with the CHAIN_2D model.

Comments on the July 2008 RED

Since the July 2008 RED, information from the CMTF has been submitted that has allowed the Agency to reevaluate credits for soil organic matter. Analysis of peak emissions of chloropicrin in five studies with very similar soil factors, except for organic matter, concluded that peak flux was reduced by approximately 50% for soils that were composed of approximately 1.5% organic matter compared to soils that were composed of approximately 0.5% organic matter.

Credits for the Amended RED

From these studies the Agency has determined that the organic matter credit can be revised. A 10% credit will be given if chloropicrin is applied in soils with an organic matter range of >1% - 2%; a 20% credit for soils with an organic matter range of >2% - 3%; and a 30% credit for soils with an organic matter range of >3%. No credit will be given for soils with less than 1% organic matter.

The Agency has not received any new data that would result in changes to the credit for soil type. Therefore, the credit for clay content of greater than 27% will remain at 10%.

- Soil Moisture

Credits in the July 2008 RED

The Agency's document, "Factors Which Impact Soil Fumigant Emissions - Evaluation For Use In Soil Fumigant Buffer Zone Credit Factor Approach. DP Barcode D306857 (6/9/08)," reviewed data which examined the effects of proper soil moisture levels prior to application on fumigant emissions. Through review of these data it was determined that soil moisture is a critical parameter to reduce emissions for certain fumigants. However, in the July 2008 RED, the Agency did not provide a credit for soil moisture because the Agency could not justify credits based on the available data. The Agency established mandatory GAPs for soil moisture conditions.

Comments on the July 2008 RED

The Agency received comments that buffer zone credits should be considered for soil moisture. For chloropicrin in particular, this fact was further supported by a chloropicrin field flux study (performed in Wasco, CA) recently submitted to the Agency by CMTF. This study was conducted with soil moisture field capacities in the 70-75% range. When this study was compared to previous studies done with the same application methods at much lower field capacities, in the 35-55% range, and all other factors being relatively equal, a 3-4 fold reduction in emissions was observed.

Credits for the Amended RED

The amended RED is not going to provide credits for soil moisture. However, based on the Wasco, CA emission studies the Agency has developed buffer tables based on different soil moisture percentiles.

- Soil Temperature

July 2008 RED

EPA did not give a credit for soil temperature in the July 2008 RED. Instead the Agency required a maximum temperature as part of the mandatory GAPs.

Comments on the July 2008 RED

Stakeholders commented that chloropicrin should receive a credit for lower soil temperatures.

Credits for the Amended RED

Most of the emission studies occurred at reasonable temperatures, with the average day/night air temperature around 70°F. Data presented in the Agency's June 2008 factors document indicate that increased soil temperatures correspond to increase fumigant emissions. Based on this information and the GAP for soil temperature, a 10% emission credit is being provided to reduce the buffers for applications in soils with temperatures of 50°F or less when measured at a soil depth of 3 inches.

- Buffer Zone Credit Cap

Credits in the July 2008 RED

The Agency determined, in the July 2008 RED, that the buffer zone credits were additive. This meant, for example, that a 40% credit for a high barrier tarp could be added to a 10 % credit for organic matter to achieve a total credit of 50%. The Agency placed a limit, or "credit cap," of 50% on the total size of the credit allowed for chloropicrin.

Comments on the July 2008 RED

During the comment period, the Agency received new data concerning a number of factors that impact fumigant emissions as well as a number of comments indicating that there should not be a cap on credits or that the cap should be raised. Some suggested that the 50% cap would be a disincentive to growers considering whether to adopt emission-reducing application methods.

Credits for the Amended RED

Upon review of the new data and public comments, the Agency has decided to raise the credits cap to 80%. The Agency has reviewed the new studies to evaluate the extent to which the various factors that reduce emissions act independently, and has reconsidered the earlier studies. As a result of this evaluation, the Agency concludes that credits be additive up to a cap of 80% for chloropicrin. This revised credit cap is based on studies that show a greater-than-50% reduction in emissions when two or more factors are combined. Further, EPA believes that increasing the credit cap to 80% will encourage adoption of emission reduction techniques, result in lower off-site fumigant concentrations, and will allow for reduced application rates for various tarps.

- Buffer Zone Credit Example

Focusing on forest seedling nurseries in the Southeast as an example, the buffer zone distance for a 10 acre application block at a rate of 300 lbs ai/A is 265 feet without any credits (see Table 7). If the grower uses Bromostop® (1.38 mil) high barrier tarp, the buffer zone can be reduced by 60%. The resulting buffer zone distance for this case is 106 feet. If the organic matter in the application block is two percent and Bromostop® (1.38 mil) high barrier tarp is used, the total credit would be 80% (60% for the tarp and 20% for organic content), and the resulting buffer zone distance would be 53 feet.

- Other Buffer Zone Credits Considered

The Agency's revised document; "Methyl Bromide (PC Code 053201), Chloropicrin (PC Code 081501), Dazomet (PC Code 035602), Metam Sodium and Potassium (PC Codes 039003 & 039002), MITC (PC Code 068103), DP Barcode: D362369, Updated Health Effects Division Recommendations for Good Agricultural Practices and Associated Buffer Credits (5/14/09)," reviewed several other factors such as field preparation and compaction. The Agency determined that those factors could not be used to justify credits based on the available data. However, EPA has established mandatory GAPs for these conditions. See the *GAP* Section of this document for further discussion.

The Agency has used the best available data to estimate potential chloropicrin bystander risks and has both quantitatively and qualitatively evaluated the impact of potential emission control measures on bystander risk. The Agency recognizes that there is substantial research being conducted by stakeholders to further quantify emission reductions. The Agency will consider such data in future decisions if new data become available. Such data may also support the Agency's decisions on additional emission credits in the future.

b. Restriction for Schools and Other Difficult to Evacuate Sites

Certain types of sites are difficult to evacuate should an incident occur. EPA determined that additional measures to reduce the potential need to evacuate these types of sites were necessary to reduce risk of exposure to occupants and address potential challenges associated with an accident. There were many comments on this measure including: requests to delete this requirement; suggestions to reduce the size of the restricted area; a proposal to use a scalable approach to calculate the distance; requests to define and refine the places included on this list so that facilities such as research universities were excluded; suggestions to shorten the duration of the requirement so applicators may be able to take advantage of weekends to fumigate; questions about how to determine where these sites are located, and other suggestions to change the required measures.

Based on a review of the comments, the Agency has retained this mitigation measure to ensure the protection goals are still achieved and encourage lower-emission application methods. This mitigation measure has been refined such that compliance is more effective in achieving the protection goal. Modifications to this requirement include: shortening the duration of the restriction so weekends may be used to fumigate near schools and daycare centers; clarifying the types of schools that are covered by this requirement; removing the term "elder care facilities" from the list since many of the same facilities are included in the phrase, "assisted living facilities, nursing homes, and in-patient clinics;" and reducing the restricted area from ¼ mile to ⅛ mile for application blocks with less than 300 foot buffers. The ⅛ mile (660 feet) distance is more than twice the required buffer distance and remains protective of people who may be difficult to evacuate while reducing the potential challenges of complying with the restrictions for some users who may be fumigating in close proximity to these types of institutions. EPA has determined that these modifications achieve the same protection goals as the 2008 RED but provide additional clarity and flexibility that will enhance users' ability to practically and

effectively comply with the requirements. EPA also believes that reducing the restricted area for blocks with buffers less than 300 feet will provide an incentive for some users to adopt lower-emission application methods or practices. The revised measures are summarized below.

- "Difficult-to-evacuate" sites include schools (preschool to grade 12), state licensed daycare centers, nursing homes, assisted living facilities, hospitals, in-patient clinics, and prisons.
- No fumigant application with a buffer zone greater than 300 feet is permitted within ¼ mile (1320 feet) of the sites listed above unless the site is not occupied during the application and the 36-hour period following the application.
- No fumigant application with a buffer zone of 300 feet or less is permitted within ⅛ mile (660 feet) of the sites listed above unless the site is not occupied during the application and the 36-hour period following the start of application.

c. Posting

Posting is an effective means of informing workers and bystanders about areas where certain hazards and restrictions exist. Current soil fumigant labels require treated areas to be posted and handlers are required to wear specific PPE when they are in a treated area. For buffer zones to be effective risk mitigation, bystanders, including agricultural workers in nearby areas, need to be informed of the location and timing of the buffer zone to ensure they do not enter designated areas.

In addition to alerting bystanders, posting a buffer zone will help handlers determine where and when they are required to use PPE. As described in the *Handler* section on page 78 handlers working in treated areas or buffers during the buffer zone period must use label-specified PPE and meet other requirements under the WPS. Therefore, EPA has determined that to ensure the protectiveness of buffer zones for bystanders and handlers, the perimeter of the fumigant buffer zones must be posted.

Comments received in response to the July 2008 RED recommended some changes to the posting requirements to make them easier to understand and implement. Based on EPA's review and consideration of these comments, EPA has slightly revised the posting requirements and provided additional clarification as described below.

EPA had included two exceptions for the buffer zone posting requirement. The first exception did not require posting in situations where the land 300 feet from the edge of the buffer was under the control of the property operator. Based on comments that this measure was too complicated and confusing this exception has been removed. There were also comments that the examples provided in the description of a physical barrier may lead to misinterpretation of the requirement. EPA agrees and believes that a performance standard is a more effective means of communicating the requirement. Therefore, to reduce the potential for confusion, the examples have been removed.

In the 2008 RED, signs were required to be posted at usual points of entry and likely routes of approach to buffer zones. If there were no usual points of entry or likely routes of approach, then posting was required in the corners of buffer zones, and between the corners, so

signs could be viewed from one another. Many comments expressed concern over the burden and potential confusion with the number of signs that may need to be posted and how many signs may need to be posted depending on the configuration of the field. EPA agrees that signs posted in areas where there is low likelihood of workers or others approaching or accessing the buffer provide little risk reduction, but can add substantially to the challenges of compliance. As a result, the Agency has revised the criteria for location of signs since the areas that are of most concern are those where people are most likely to enter (e.g., roads, footpaths, etc.), and at likely routes of approach such as the perimeter of a buffer that faces a housing development.

Comments also indicated that the requirement to include certain application-specific information on the posted signs would make reuse of the signs more difficult and would also substantially increase the amount of time needed to prepare signs before posting. These comments stated that the primary purpose of signs is to communicate to bystanders the buffer zone locations. EPA generally agrees with these comments; therefore certain application-specific details on the posted signs, like the date and time of the fumigation and buffer zone restrictions, have also been reduced to allow the signs to be reused more easily.

Comments also stated that the posting example included in the 2008 RED was confusing. Since the posting restrictions have been simplified by removing the distance criteria, the example has been removed from this document. There were no substantive comments suggesting a change to the exception for posting multiple contiguous blocks and no changes have been made in this amended RED.

The revised posting requirements are listed below and have been included in the revised label table.

Requirements

- Posting of a **buffer zone** is required unless there is a physical barrier that prevents bystander access to the buffer zone.

- Buffer zone posting signs must:
  - Be placed at all usual points of entry and along likely routes of approach from areas where people not under the land operator's control may approach the buffer zone.
  - Some examples of points of entry include, but are not limited to, roadways, sidewalks, paths, and bike trails.
  - Some examples of likely routes of approach are the area between a buffer zone and a roadway, or the area between a buffer zone and a housing development.

- Buffer zone posted signs must meet the following criteria:
  - The printed side of the sign must face away from the treated area toward areas from which people could approach.
  - Signs must remain legible during entire posting period and must meet the general standards outlined in the WPS for text size and legibility (see 40 CFR §170.120).
  - Signs must be posted before the application begins and remain posted until the buffer zone period has expired.

- Signs must be removed within 3 days after the end of the buffer zone period.
- Registrants must provide generic buffer zone posting signs which meet the criteria above at points of sale for applicators to use. The Agency is requiring registrants to submit proposals for these materials through the data call-ins that will accompany this RED.

Exception: If multiple contiguous blocks are fumigated within a 14-day period, the entire periphery of the contiguous blocks' buffer zones may be posted. The signs must remain posted until the last buffer zone period expires and signs may remain posted up to 3-days after the buffer zone period for the last block has expired.

Additional requirements for treated-area posting:

- The treated area posted signs must remain posted for no less than the duration of the *entry restricted period* after treatment.
- Treated area signs must be removed within 3 days after the end of the entry-restricted period.
- Signs must meet the general standards in the WPS for placement, text size, and location (40 CFR §170.120).

Contents of Signs

The treated area **sign (currently required for fumigants) must state the following:**	**The** buffer zone **sign must include the following:**
-- Skull and crossbones symbol  **-- "DANGER/PELIGRO,"** **-- "Area under fumigation, DO NOT ENTER/NO ENTRE,"** **-- "Chloropicrin Fumigant in USE,"** **-- the date and time of fumigation,** **-- the date and time entry prohibition is lifted,** **-- Name of this product, and** **-- name, address, and telephone number of the certified applicator in charge of the fumigation.**	**-- Do not walk sign**  **-- "DO NOT ENTER/NO ENTRE,"** **-- "Chloropicrin OR [Name of product] Fumigant BUFFER ZONE,"** **-- contact information for the certified applicator in charge of the fumigation**

d. Use Prohibitions

In the July 2008 RED the Agency prohibited the drip untarp buried application method because it did not have adequate data to determine the appropriate mitigation. As described in

the *Buffer Zone* section on page 36, EPA has reviewed emission studies for the drip irrigation buried untarp application method, and this use is now eligible for reregistration.

2. Occupational Mitigation

a. Handler Definition

Based on stakeholder comments provided during the Phase 5 comment period, the July 2008 RED clarified fumigation tasks that meet EPA's definition of *handler* activities, as currently defined in the WPS and on fumigant labels. During the post-RED comment period the Agency received some comments from stakeholders who were concerned that the Agency was redefining *handlers*. It was not the Agency's intention to change the current definition. As a result, the Agency has slightly changed the language from the July 2008 RED so it is clear that the Agency is just clarifying the existing definition and not writing a new definition. Below is the revised language.

The following activities are prohibited from being performed in the fumigant application block or surrounding buffer zone during the buffer zone period by anyone other than persons who have been appropriately trained and equipped as handlers in accordance with the requirements in the WPS (40 CFR Part 170), from the start of the application until the entry-restricted period ends. Those activities include those persons:

- Participating in the application as supervisors, loaders, drivers, tractor co-pilots, shovelers, cross ditchers, or as other direct application participants (note: the application starts when the fumigant is first introduced into the soil and ends after the fumigant has stopped being delivered/dispensed to the soil);
- Using devices to take air samples to monitor fumigant air concentrations;
- Persons cleaning up fumigant spills (this does not include emergency personnel not associated with the fumigation application);
- Handling or disposing of fumigant containers;
- Cleaning, handling, adjusting, or repairing the parts of fumigation equipment that may contain fumigant residues;
- Installing, repairing, or operating irrigation equipment in the fumigant application block or surrounding buffer zone during the buffer zone period;
- Entering the application site or surrounding buffer zone during the buffer zone period to perform scouting or crop advising tasks;
- Installing, perforating (cutting, punching, slicing, poking), removing, repairing, or monitoring tarps:
    - until 14 days after application is complete if tarps are not perforated and removed during those 14 days; or
    - until tarp removal is complete if tarps are **both** perforated **and** removed less than 14 days after application; or
    - until 48 hours after tarp perforation is complete if they will not be removed within 14 days after application.

In addition to the above, persons outside the perimeter of the buffer zone who monitor fumigant air concentrations must also be trained and equipped as handlers in accordance with the requirements in the WPS (40 CFR Part 170).

b. Handler Requirements

Currently, chloropicrin labels require that all handlers involved in a chloropicrin application must be under the supervision of a certified applicator who may not necessarily be on-site. Since many incidents are caused by human error and equipment failure, EPA believes the presence of on-site trained personnel will help to reduce these risks. Therefore, to address these risks, the July 2008 RED required that a certified applicator maintain visual contact with any fumigant handler while the fumigant is being incorporated into the soil. The Agency also stated that the certified applicator supervising the fumigation may also perform fumigant handler tasks.

During the post-RED comment period the Agency received many comments that stressed the difficulty of implementing a requirement that mandates certified applicators to maintain visual contact with handlers. The commenters also indicated that for longer applications this requirement would be a significant burden. Other stakeholders stated that the Agency should modify the requirement to ensure that the certified applicator is on-site, while others commented that EPA should require that all handlers are certified applicators, which would eliminate the need for direct handler supervision.

The Agency has considered the comments and has determined that the revisions outlined below accomplish the same handler-protection goals as the July 2008 RED mitigation while somewhat reducing the burden on users. The revised language is:

- For all applications, except water run, (e.g., shank) from the start of the application until the fumigant has stopped being delivered/dispensed into the soil, i.e., after the soil is sealed, the certified applicator must be at the fumigation site and must directly supervise all persons performing handling activities.
- For water-run applications (e.g., drip), the certified applicator must be at the fumigation site to start the application including set-up, calibration, and initiation of the application. The certified applicator may leave the site but must return every two hours to visually inspect the equipment to ensure proper functioning and must directly supervise all WPS-trained handlers on-site until the fumigation has stopped being delivered/dispersed into the soil. WPS-trained handlers may perform the monitoring functions in place of the certified applicator but must be under the supervision of the certified applicator and be able to communicate with the certified applicator at all times during monitoring activities via cell phone or other means. The results of monitoring activities must be captured in the FMP's post-application summary report.
- For fumigant handling activities that take place after the fumigant has been delivered/dispensed into the soil until the entry restricted period expires, the certified applicator does not have to be on-site, but must have communicated in writing to the site owner/operator and handlers the information necessary to comply with the label and procedures described in the FMP (e.g., emergency response plans and procedures).

The July 2008 RED also required that certified applicators complete a registrant administered chloropicrin training program within the preceding 12 months before they apply a chloropicrin product. The Agency is still requiring that certified applicators complete the registrant training; however, the Agency is now requiring that certified applicators successfully complete the training every 36 months. Please see *Soil Fumigation Training for Applicators and Other Handlers* section on page 121 for further details.

In addition to the certified applicator supervision requirement, the Agency also required in the July 2008 RED that a minimum of two WPS trained handlers were on site during all fumigation handling activities. This mitigation measure addresses the concern that handlers could be overcome with fumigant vapors and be unable to leave the area while they are performing handler tasks. The Agency did receive some comments offering suggestions and others asking clarifying questions. The Agency has modified the language of the requirement for clarity; however, the mitigation measure itself is not changing. Comments related to this requirement are more fully addressed in the following document, "SRRD's Response to Post-RED Comments for the Soil Fumigants" May, 27, 2009. The revised language for this mitigation measure is as follows:

- For all fumigant handling tasks at least two handlers trained under the provisions of the WPS 40 CFR 170.230 must be present.

c. Respiratory Protection

The Agency's human health risk assessment indicates that inhalation risks exceed the Agency's level of concern for many handler activities. The human study which served as the basis for the occupational risk assessment indicates that transient eye and nose irritation associated with acute chloropicrin exposure do not carryover day to day, and therefore the Agency is most concerned about protecting handlers and workers from acute inhalation exposure.

To address the acute inhalation risks the July 2008 Chloropicrin RED required air monitoring with colorimetric tubes or other real-time monitoring devices every two hours as a means of determining when respirators may be needed. The tubes were required to have a sensitivity of at least 0.15 ppm for chloropicrin, which is the level that corresponds to early signs of exposure. If air samples indicated chloropicrin levels were above the Agency's LOC (0.15 ppm) or if any handler experienced sensory irritation indicative of chloropicrin exposure, then handlers were required to wear air-purifying respirators.

The Agency's decision to require respiratory protection only if certain triggers were reached took into consideration current label requirements,[13] the identified risks, and stakeholder comments that respirators are not necessary because (1) chloropicrin's warning properties are sufficient to alert handlers if there are unsafe concentrations; (2) respirators inhibit

[13] Current chloropicrin labels state that the acceptable air concentration level is 0.1 ppm, and require air-purifying respirators when the air concentration of chloropicrin exceeds 0.1 ppm, and SCBA when the air concentration exceeds 4 ppm. The labels, however, do not require monitoring to determine whether the acceptable air concentration as been exceeded. The 4 ppm level was formerly NIOSH's IDLH (immediately dangerous to life and health) level. This level has since been revised to 2 ppm. (http://www.cdc.gov/Niosh/idlh/76062.html)

communication which could increase the risk of an accident; and (3) in warm weather respirators can cause heat stress and other ailments.

During the post-RED comment period, the Agency received several comments on the *Respiratory Protection* section. For chloropicrin, comments focused on the feasibility, reliability, and protectiveness of using colorimetric tubes due to the current sensitivity and accuracy of the tubes, the cost of the tubes, and the Agency's action level of 0.15 ppm (some commenters claim that 0.15 ppm is overly protective, while others state the level should not have been changed from 0.1 ppm). Other comments stated that handlers should have the option of ceasing the application until air concentrations of chloropicrin are less than the action level. Comments also suggested that tractor drivers do not need to be monitored if occupants are in an enclosed cab that meets certain specifications.

After reviewing the comments, the Agency is adding a stop work option where handlers can leave the field and surrounding buffer zone in lieu of putting on a respirator. If handlers remain in the field, EPA has determined that respiratory protection requirements are still needed to mitigate risks if concentrations reach a certain level. However, EPA is revising the required procedures for determining when respirators must be used due to technological limitations of the monitoring devices that are currently available for field use. The Agency is aware of several commercial systems for monitoring chloropicrin including colorimetric tubes from manufacturers including: Matheson/Kitagawa, Sensidyne, and Dräger. While these tubes have detection limits that are less than the Agency's action level of 0.15 ppm, the Agency has opted not to require monitoring with colorimetric tubes or other devices as a trigger to put on respiratory protection because EPA believes that these devices are not consistently reliable at fumigant concentrations at or just below 0.15 ppm. EPA's action level is typically at the lower end of the range for which the devices are rated, in fact; some of these action levels are at or near the device's detection limits. Additionally, colorimetric devices provide snapshot measurements of the environment in which individuals are working. In conditions that are likely to be more static (e.g., monitoring an indoor fumigation such as a grain mill or warehouse) it is likely that minute to minute changes in conditions would not be as great as those anticipated for the more dynamic conditions characteristic of outdoor field fumigation where exposure concentrations could shift because of weather changes or stratification in soil conditions across a single treated field. Furthermore, commenters' experience indicates that handlers will likely experience early sensory irritation before the air samples show concentrations at or above the action level. As such, the Agency does not believe that initial monitoring with available devices would significantly reduce handler risks. In addition, EPA is aware that monitoring with these devices adds significant costs to fumigations, please see the following document for more details, "Analysis of Soil Fumigant Risk Management Requirements using Geographic Information Systems: Case Studies Based on a Forest Seedling Nursery (DP # 363546)" May 13, 2009. EPA is also concerned that monitoring with devices that are not reliable could cause handlers to believe that concentrations are below the action level despite other indications such as eye irritation. As a result, the Agency is removing the initial monitoring requirement.

EPA does believe, however, that monitoring devices that are currently available will generally be reliable at higher concentrations of chloropicrin and that there is high value in air monitoring using currently available devices in certain situations. As a result, EPA is

maintaining the monitoring requirement once use of respirators has been triggered and respirators are being worn. This will enable handlers to detect concentrations that would exceed the upper working limit of the respirator. Additionally monitoring will still be required to help enable handlers to determine if concentrations have decreased and whether it is safe to either remove respirators or to resume the application if the fumigator has opted to cease the application rather than have handlers wear respirators.

The Agency is modifying the procedures for respiratory protection because of technological limitations of currently available devices that are practical and reliable for field use at action-level concentrations. However, the Agency does believe that quantitative air monitoring would enhance worker safety if the appropriate technology were available. Some equipment manufacturers have indicated interest in developing devices that would be more functional and reliable for field fumigation applications (e.g., badge-type monitors). EPA encourages such efforts and plans to stay abreast of developments and improvements in monitoring devices and will consider this issue again in Registration Review or sooner should such monitors become available in the short term.

Although the Agency has removed the initial monitoring requirement, EPA is keeping the action level for chloropicrin at 0.15 ppm. The Agency does not believe that this level is overly conservative because 0.15 ppm corresponds to approximately two times the $BMCL_{10}$ of 0.073 ppm. While 0.15 ppm is greater than the $BMCL_{10}$, EPA is keeping this action level because this is the level at which participants in the human study began to experience eye irritation that was mild and reversible and effects did not carry over. Since effects are non-severe and reversible the Agency believes that this level is effective as a warning for handlers of when concentrations are reaching the point where steps are needed to protect fumigant handlers.

In addition to the comments on the monitoring devices, EPA received a comment requesting that tractor drivers should be exempt from monitoring when operating tractors with enclosed cabs that meet one of the following specifications:

- ANSI/ASAE S525-1.1 May 1998 Sections 7.1.5., 7.1.7, 7.2.3, and 9, or
- The requirements listed in the WPS for agricultural pesticides- 40 CFR170.240(d)(5). The cab must be equipped with a vapor adsorptive filter containing a minimum of 1000g of activated charcoal. The filter must be changed after no more than 50 hours of application time.

The commenter requests that EPA add this language to chloropicrin labels since the language is currently on 1,3-D labels. Since the Agency is now relying on sensory irritation as the trigger for when respiratory protection is needed, every handler must either put on a respirator or stop work regardless of the handler's task. Therefore drivers in any enclosed cab would be subject to the same requirements.

Even if EPA still had the initial monitoring requirement the Agency does not currently support adding this language to chloropicrin labels because ANSI/ASAE has withdrawn this standard due to problems with verifying protective factors.

i. Respiratory Requirements

Based on the Agency's review of the comments as described above in the *Respiratory Protection* section on page 80, EPA has amended the requirements that trigger the need for respiratory protection. In addition to the revised respiratory protection requirements below, the Agency believes that GAPs, FMPs, and other mitigation measures will reduce inhalation risks to concentrations below the EPA's level of concern. When chloropicrin is used in combination with other fumigants such as methyl bromide, iodomethane, and 1,3-D, the mitigation may differ somewhat due to the risks associated with the other fumigant; the most stringent mitigation must be followed. The following procedures must be followed for all agricultural field and greenhouse pre-plant soil applications of chloropicrin:

- If at any time any handler experiences sensory irritation (tearing, burning of the eyes or nose) then either:
    - An air-purifying respirator (APR) must be worn by all handlers who remain in the application block and surrounding buffer zone, or
    - Operations must cease and handlers not wearing respiratory protection must leave the application block and surrounding buffer zone.
- Handlers can remove respirators or resume operations if two consecutive breathing-zone samples taken at the handling site at least 15 minutes apart show that levels of chloropicrin have decreased to less than 0.15 ppm, provided that handlers do not experience sensory irritation. Samples must be taken where the irritation is first experienced.
- When respirators are worn, then air monitoring samples must be collected at least every 2 hours in the breathing zone of a handler performing a representative handling task.
- If at any time: (1) a handler experiences any sensory irritation when wearing a respirator, or (2) an air sample is greater than or equal to 1.5 ppm, then all handler activities must cease and handlers must be removed from the application block and surrounding buffer zone. If operations cease the emergency plan detailed in the FMP must be implemented.
- Handlers can resume work activities without respiratory protection if two consecutive breathing-zone samples taken at the handling site at least 15 minutes apart show levels of chloropicrin have decreased to less than 0.15 ppm, provided that handlers do not experience sensory irritation.
    - During the collection of air samples an air-purifying respirator must be worn by the handler taking the air samples. Samples must be taken where the irritation is first experienced.
- Work activities may resume if the following conditions exist provided that the appropriate respiratory protection is worn:
    - Two consecutive breathing zone samples for chloropicrin taken at the handling site at least 15 minutes apart must be less than 1.5 ppm but greater than 0.15 ppm,
    - Handlers do not experience sensory irritation while wearing the APR, and
    - Cartridges have been changed.
    - During the collection of air samples an air-purifying respirator must be worn by the handler taking the air samples. Samples must be taken where the irritation is first experienced.

Figure 1 provides an illustration of the requirements when handlers cease operations.

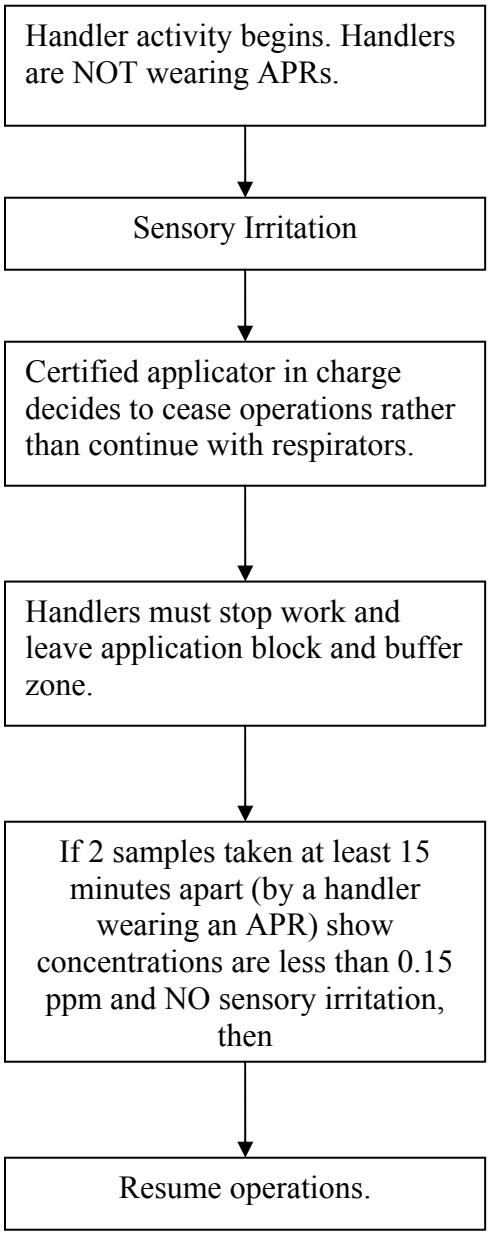
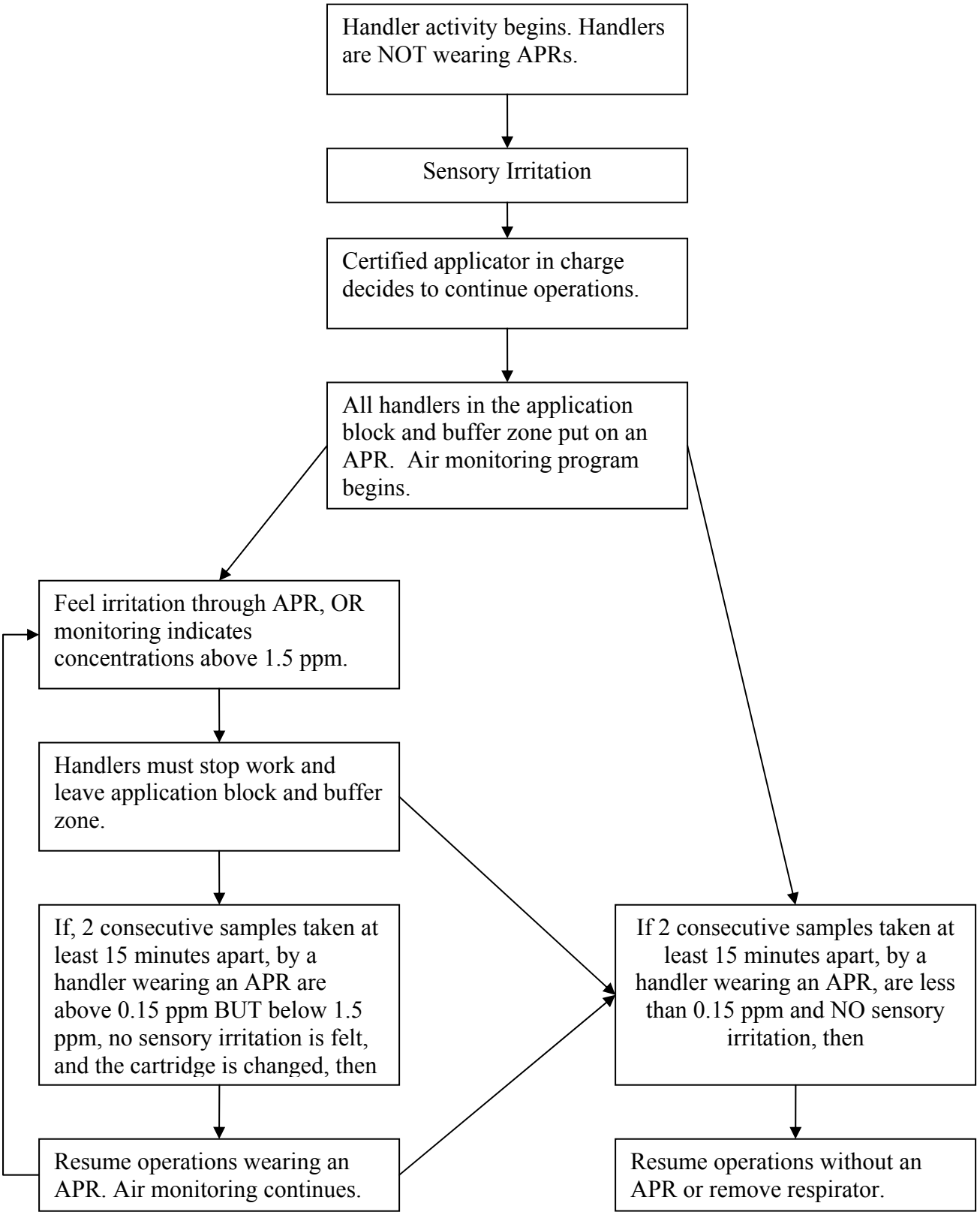


Figure 2 provides an illustration of the requirements when handlers put on a respirator.



- Respiratory Protection Equipment Requirement

The purpose of this section in the July 2008 RED was to establish general conditions and requirements for respiratory protection equipment. Below is a summary of what was included in the July 2008 RED.

- The Agency required half-face respirators with organic vapor cartridges when respirators are necessary. In the RED EPA noted that although currently there are no APR cartridges certified by the Mine Safety and Health Administration-National Institute for Occupational Safety and Health (MSHA-NIOSH) for protection against chloropicrin specifically, NIOSH/OSHA does recommend respirators with organic vapor cartridges for chloropicrin use. EPA also stated that it would consider other APR-cartridge combinations, provided written certification of their efficacy against chloropicrin is submitted to the Agency.
- EPA assumes half-face respirators have a protection factor of 10, therefore these respirators are protective up to chloropicrin concentrations of 1.5 ppm; and if concentrations exceed 1.5 ppm operations must cease.
- SCBA has a protection factor of 1,000, but, due to practical limitations, SCBA should only be used for short durations.

EPA is making revisions to the requirements above taking into consideration the comments and the revisions to the *Respiratory Requirements* section on page 82. Since the Agency is relying on the warning properties of chloropicrin to indicate when an APR must be worn, the Agency does not believe that a half-face respirator would be appropriate because the handler would still experience eye irritation if a half-face respirator is worn. Therefore, EPA has determined that when handlers opt to continue operations when the action level for respiratory protection is triggered (i.e., sensory irritation is recognized), handlers must wear a full-face respirator. Note that while EPA assumes that a full-face respirator has a protection factor of 50, the Agency is keeping the cease-work action level at 1.5 ppm because respirators have not been tested for effectiveness against chloropicrin specifically and EPA does not believe handlers should continue fumigant operations, even if using respiratory protection, if chloropicrin concentrations resulting from the application are near the IDLH of 2 ppm.

The Agency received additional comments regarding the cartridge recommendations, SCBA use, and the respirator protection factor. EPA is providing a clarification to address the concerns brought up in the comments. Comments suggested that the Agency require organic-vapor cartridges. This was the Agency's intention in the July 2008 RED. Others remarked that use of goggles should be prohibited. The Agency agrees with the comments regarding goggles and notes that current chloropicrin labels do not permit the use of closed goggles, and it was not EPA's intention to imply a change in current label language with regard to closed goggles in the July 2008 RED. For more detailed responses on the above comments please see the following document, "Methyl Bromide, 1,3-Dichloropropene, Chloropicrin, Dazomet, Metam Sodium/Potassium, MITC: Health Effects Division (HED) Component of Agency Response To Comments On 2008 Reregistration Eligibility Documents" May 14, 2009.

As a result of the changes discussed above the amended requirements are listed below:

- The Agency is requiring full-face respirators with organic-vapor cartridges when respirators are necessary. EPA will also consider other APR-cartridge combinations, provided written certification of their efficacy against chloropicrin is submitted to the Agency.
- If chloropicrin concentrations exceed 1.5 ppm operations must cease.

    - Tarp Repair

The July 2008 RED required handlers to wear APRs if they perform tarp repair operations before the entry-restricted period has ended. The requirements were different from other handling activities because the duration of tarp repair activities was believed to be shorter than other handling tasks and therefore tarp repair activities would not trigger the initial monitoring requirement. Upon consideration of comments the Agency received on this requirement, which are addressed in detail in the following document, "Methyl Bromide, 1,3-Dichloropropene, Chloropicrin, Dazomet, Metam Sodium/Potassium, MITC: Health Effects Division (HED) Component of Agency Response To Comments On 2008 Reregistration Eligibility Documents" May 14, 2009, EPA has determined that respiratory protection for tarp repair activities should be handled consistently with other handler activities, i.e., handlers repairing tarps are not required to wear respirators unless sensory irritation is experienced. Additionally, the Agency believes that tarp repair like other handling activities described above would benefit from the development of sensitive monitoring devices to reliably inform handlers if and when concentrations are above the action level for respiratory protection. EPA will reevaluate this measure during Registration Review or sooner if such devices are available in the short term.

    - Respirator fit testing, medical qualification, and training

To ensure that respirators are mitigating inhalation risk, the July 2008 RED respirator requirements included fit testing, respirator training, and an annual medical evaluation. Without these requirements, it is unclear whether the reduction in inhalation exposure that is assumed by the use of respirators will be achieved.

During the comment period the Agency received a variety of comments ranging from full support of the requirement, to comments about the cost and time burden associated with fit-testing, training, and medical exams. The Agency also received several comments regarding the details of this requirement, for example, some commenters questioned who conducts the fit-testing and medical exam and what the medical exam entails. Detailed responses to these comments are included in the following document, "SRRD's Response to Post-RED Comments on the Soil Fumigants" May 27, 2009.

While EPA recognizes that there is a cost associated with the fit-testing, training, and medical exam requirements, the Agency still believes these are necessary to ensure respirators perform as intended. Also note that, in response to suggestions from several fumigators, EPA is now allowing fumigators the option to *cease operations* and have handlers leave the application block and surrounding buffer zone in lieu of wearing a respirator and continuing fumigation

activities. Only handlers who will wear a respirator must be fit-tested, trained, and medically examined. For fumigators who exercise the *cease operations* option, the Agency believes that this revision will reduce the cost associated with the respirator requirement, while maintaining the same level of protection for the handlers that wear respirators. The following revised language takes into account the new *cease operations* option and must be added to product labels:

"Employers must also ensure that any handler who uses a respirator is:

- Fit-tested and fit-checked using a program that conforms to OSHA's requirements (see 29CFR Part 1910.134)
- Trained using a program that confirms to OSHA's requirements (see 29CFR Part 1910.134)
- Examined by a qualified medical practitioner to ensure physical ability to safely wear the style of respirator to be worn. A qualified medical practitioner is a physician or other licensed health care professional (PLHCP) who will evaluate the ability of a worker to wear a respirator. The initial evaluation consists of a questionnaire that asks about medical conditions (such as a heart condition) that would be problematic for respirator use. If concerns are identified, then additional evaluations, such as a physical exam, might be necessary. The initial evaluation must be done before respirator use begins. Handlers must be reexamined by a qualified medical practitioner at least annually or if their health status or respirator style or use-conditions change."

    - Respirator availability

The July 2008 RED required that every handler had the appropriate respiratory protection equipment available. This requirement has been slightly modified as a result of the *cease operations* option. The new language requires that the handler's employer must confirm and document in the FMP that an air-purifying respirator and cartridge is immediately available for each handler who will wear one. The Agency is requiring that at minimum two handlers have the appropriate respirator and cartridges available and that these handlers are fit-tested, trained, and medically examined.

    - Air-Rescue Device Availability

EPA slightly altered the air-rescue device availability language from the July 2008 RED to include that the device is not only on-site, but also ready to use. This change was made to clarify the Agency's previous requirement, and the following language must be added to product labels:

> "The fumigation handler employer must confirm and document in the FMP that at least one air rescue device (e.g., SCBA) is on-site and is ready for use in case of an emergency."

d. Tarp Perforation and Removal

The Agency's risk assessment indicates that there is a risk concern for handlers during the perforation (cutting, poking, punching, or slicing) and removal of tarps, and notes potential

for increased risk when high barrier tarps are used. To address these risks EPA required the following mitigation in the July 2008 RED:

- Tarps cannot be perforated until a minimum of 5 days (120 hours) after fumigation was complete.
- Tarps cannot be removed until 24 hours after tarp perforation is complete.
- If tarps are not removed after perforation, planting cannot start until 48 hours after perforation is complete.
- If tarps are left intact for at least 14 days after the fumigation is complete then planting can take place as tarps are being perforated.
- Broadcast tarps could be removed before 5 days if adverse weather compromised the integrity of the tarp provided that at least 48 hours had passed since the fumigation was completed, the buffer zone was extended until 24 hours after the tarp removal was complete, and untreated areas in the application block are not treated for at least 24 hours after tarp removal is complete.
- Tarp perforation must be done using mechanical methods.
- Each broadcast tarp panel must be perforated using a lengthwise cut.

During the post-RED comment period the Agency received comments on the tarp perforation and removal requirements. In particular the Agency received comments on: the adequacy of the 5 day requirement for high barrier tarps to protect workers; the feasibility of leaving tarps down for 5 days in areas that use seepage irrigation for flood prevention; the difficulty implementing the 24 hour period between tarp perforation and removal; and concerns regarding the weather condition exceptions, mechanical perforation, and broadcast panel perforation.

There is some uncertainty regarding potential risks if high barrier tarps are perforated after 5 days. This is because worker exposure data used in the risk assessments are generally based on what has been the industry standard tarping technology, i.e., low or high density polyethylene tarps, typically with higher application rates and no significant emphasis on using the GAPs as defined in the RED. Data indicate that high barrier tarps are effective measures to reduce fumigant emissions. While this reduction decreases the risk to bystanders, it could increase the risk to handlers perforating or removing tarps because more fumigant could be trapped between the soil surface and the tarp—currently California Department of Pesticide Regulation (CDPR) prohibits the use of methyl bromide with certain high barrier tarps due to worker concerns.

Based on CDPR's prohibition and stakeholder's comments, EPA considered requiring a longer interval such as 10 days before allowing high barrier tarps to be perforated. However, EPA was concerned that adding such a requirement could discourage fumigators from using high barrier tarps which potentially allow for lower application rates and reduce bystander risk associated with off-gassing. New studies currently underway which involve use of high barrier tarps may enable EPA to refine estimates of handler risk in the future. EPA will consider these data during Registration Review, or sooner as the information becomes available.

Since the Agency has designed the mitigation measures to work together and believes that measures to address handler risks are likely to protect these handlers when the reduced rates

are considered in conjunction with other measures such as respiratory protection, GAPs, FMPs, and training, EPA is not increasing the number of days before high barrier tarps can be perforated.

In the comment period EPA learned from stakeholders that leaving the tarps on for 5 days would pose problems for current flood prevention activities. According to the comment, for flood prevention, fields must be properly drained. In order to ensure proper drainage, tarps must be manually cut, soil removed, and then tarps retucked. The Agency understands that the 5 day requirement before tarps can be perforated and the restriction on manual tarp perforation would be difficult for this situation and the Agency has added language to address this situation.

During earlier comment periods EPA heard from various stakeholders that windy conditions sometimes caused tarps to blow off fields and create other hazards, e.g., to motorists on nearby roadways. As a result, in the July 2008 RED the Agency provided an exception to allow tarps to be removed after 48 hours under adverse weather conditions. During the post-RED comment period EPA received comments that this exception did not fully address the issue since the mitigation required waiting a minimum of 48 hours after fumigation but tarps could blow of fields sooner than that. Commenters also said waiting 24 hours between tarp perforation and removal and the requirement to cut every broadcast tarp panel added to the potential for tarps to blow off fields and create other hazards: once tarps are cut they are prone to blowing off when windy conditions occur. To decrease the potential of tarps blowing off commenters also suggested that the Agency add flexibility to the 24 hour requirement by giving tarp removers the option to remove tarps 2 hours after tarp perforation if monitoring indicated levels below the Agency's LOC. Commenters also suggested that every 1-3 tarp panels should be cut based on the professional judgment of the handler.

Upon review of the comments the Agency agrees that the mitigation should be revised somewhat to allow for tarp removal at any time if the tarp is no longer performing its intended function and it is creating other types of risk. Therefore, EPA is revising the exception outlined in the RED to address these comments. EPA notes that handlers undertaking these tasks must follow the respiratory protection procedures detailed in the *Respiratory Requirements* section on page 82; this change still provides handler protection while reducing the unintended consequences of tarps creating other hazards.

The Agency believes cutting every panel allows the fumigant trapped beneath each panel to off-gas before the tarp is removed. If each panel is not cut, it is not likely that necessary off-gassing can take place to reduce risks to handlers removing tarps. The Agency understands that the main concern for not cutting every panel is due to the potential for tarps to blow off and has determined that this concern is best addressed by modifying the 24-hour wait period. Tarps may be removed 2 hours after tarp perforation is complete provided that tarp removers follow the procedures set forth in the *Respiratory Requirements* section on page 82; therefore the risk to handlers will not increase as a result of this modification. EPA considered the suggestion to monitor before tarp removal begins; however, because of technical limitations with current technology the Agency did not include monitoring as part of the mitigation. As with the respiratory protection section, the Agency sees the value in a monitoring program if reliable and

accurate devices are available and will consider monitoring during Registration Review or sooner if information becomes available.

The Agency received comments supporting the requirement for mechanical tarp perforation, though other commenters stated that for some situations mechanical cutting is not feasible. Examples cited included at the start of a row when a mechanical device such as an ATV will be used to cut the tarps on the field, during flood prevention activities, and for small fields. Based on comments, EPA believes these are necessary and short-duration activities. Provided the respiratory protection procedures for handlers are followed, these activities would not increase the risk to handlers. With regard to small fields where mechanical cutting is not feasible, the Agency considered the duration of the activity and the respiratory protection considerations and will permit manual perforation only for application blocks that are 1 acre or less in size.

As a result of the Agency's review and consideration of comments, the following summarizes the revised mitigation measures to address inhalation risks from tarp perforation and removal activities:

- As described in the *Handler Definition* section on page 78, tarp perforators and removers are considered handlers for a specified duration and every handler must adhere to the respiratory protection procedures outlined in the *Respiratory Requirements* section on page 82.
- Tarps must not be perforated until a minimum of 5 days (120 hours) have elapsed after the fumigant injection into the soil is complete (e.g., after injection of the fumigant product and tarps have been laid or after drip lines have been purged and tarps have been laid), unless a weather condition exists which necessitates the need for early perforation or removal. (See *Early Tarp Removal for Broadcast Applications Only* and *Early Tarp Perforation for Flood Prevention Activities* sections below).
- If tarps will be removed before planting, tarp removal must not begin until at least 2 hours after tarp perforation is complete.
- If tarps will not be removed before planting, planting or transplanting must not begin until at least 48 hours after the tarp perforation is complete.
- If tarps are left intact for a minimum of 14 days after fumigant injection into the soil is complete, planting or transplanting may take place while the tarps are being perforated.
- Each tarp panel used for broadcast fumigation must be perforated.
- Tarps used for fumigations may be perforated manually ONLY for the following situations:
    - At the beginning of each row when a coulter blade (or other device which performs similarly) is used on a motorized vehicle such as an ATV.
    - In fields that are 1 acre or less.
    - During flood prevention activities
- In all other instances tarps must be perforated (cut, punched, poked, or sliced) only by mechanical methods.
- Tarp perforation for broadcast fumigations must be completed before noon.
- For broadcast fumigations tarps must not be perforated if rainfall is expected within 12 hours.
- Early Tarp Removal for Broadcast Applications Only:

    - Tarps may be removed before the required 5 days (120 hours) if adverse weather conditions have compromised the integrity of the tarp, provided that the compromised tarp poses a safety hazard. *Adverse weather* includes high wind, hail, or storms that blow tarps off the field and create a hazard, e.g., tarps blowing into power lines and onto roads. A *compromised tarp* is a tarp that due to an adverse weather condition is no longer performing its intended function and is creating a hazard.
    - If tarps are removed before the required 5 days have elapsed due to adverse weather, the events must be documented in the post fumigation summary section of the FMP.
- Early Tarp Perforation for Flood Prevention Activities
    - Tarp perforation is allowed before the 5 days (120 hours) have elapsed.
    - Tarps must be immediately retucked and packed after soil removal.

e. Entry Restricted Period

Most of the current chloropicrin labels allow reentry to the treated field by workers 48 hours after application. When chloropicrin is used in combination with 1,3-D the labels permit worker reentry into the treated field 5 days after application. The risk assessment indicates that risks exceed EPA's LOC for workers entering fields after 48 hours. However, the risk assessment indicates that extending this period decreases workers' risks. In addition, stakeholder comments prior to the July 2008 RED indicated that non-handler entry to perform post-application (i.e., non-handler) tasks is generally not needed for at least 10 to 14 days following the completion of the application.

Due to the volatile nature of chloropicrin and the potential for worker exposure, in the July 2008 RED the Agency restricted entry into the treated area by anyone other than a properly trained and protected handler. This restriction differs from Restricted Entry Intervals (REIs) that are currently required for most conventional pesticides where dermal exposure is the primary pathway of exposure. Under the WPS, exceptions allow certain tasks to take place before the REI has expired as long as dermal contact with treated surfaces will be limited; however for fumigants where inhalation exposure is the primary risk concern, entry to a treated area is further restricted.

During the post-RED comment period the Agency received some comments that expressed concern that extending the entry-restricted period for fumigants could prevent certain important activities from taking place, contrary to the comments received during earlier comment periods. Based on discussions with stakeholders, EPA's review of public comments, and the risks identified in EPA's risk assessment, EPA does not believe any change to the entry-restricted period is warranted. EPA's review of comments indicates that extending the entry-restricted period to protect workers will not have a substantial impact on agricultural operations. Therefore, the Agency is not making any changes to this section of the July 2008 RED. The mitigation is listed below.

EPA believes that risks will not exceed the Agency's LOC provided entry (including early entry that would otherwise be permitted under the WPS) by any person – other than a

correctly trained and PPE-equipped handler who is performing a handling task – is prohibited from the start of the application until:

- 5 days (120 hours) after application has ended for untarped applications, see Figure 3, or
- After tarps are perforated and removed if tarp removal is completed less than 14 days after application, see Figure 4, or
- 48 hours after tarps are perforated if they will not be removed prior to planting, see Figure 5, or
- 5 days (120 hours) after application is complete if tarps are not perforated and removed until 14 days after the application is complete, see Figure 6.

Figures 3, 4, 5, and 6 provide illustrations of tarp perforation/removal and entry prohibition mitigation required for various chloropicrin applications. The intervals depicted are the minimum that must be followed.

Figure 3. Untarped Applications

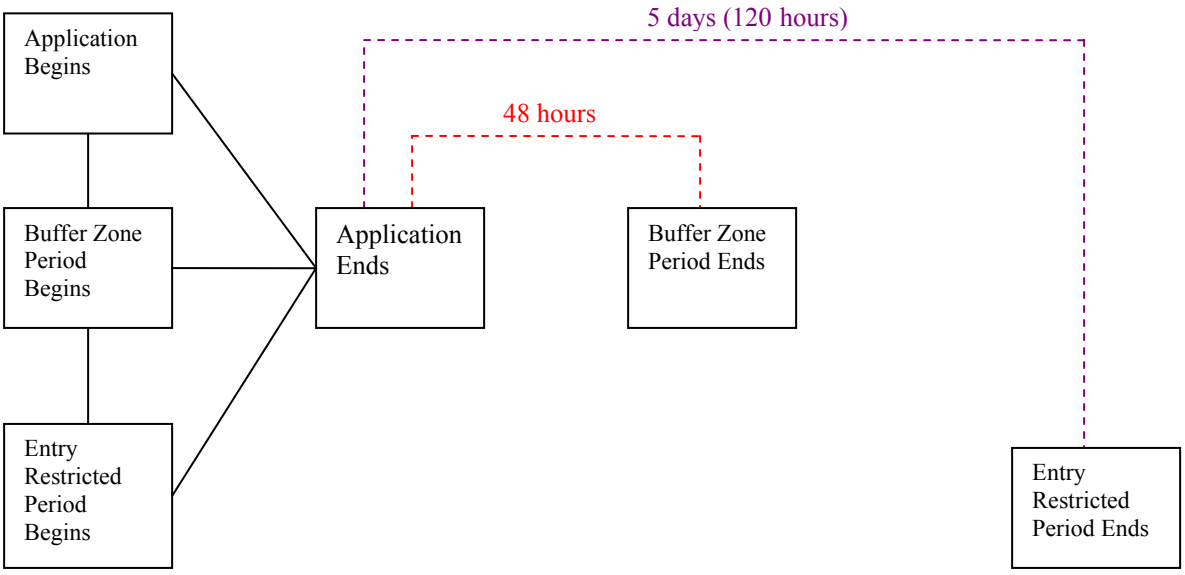


Figure 4. Tarp Broadcast Applications (tarps removed before planting)

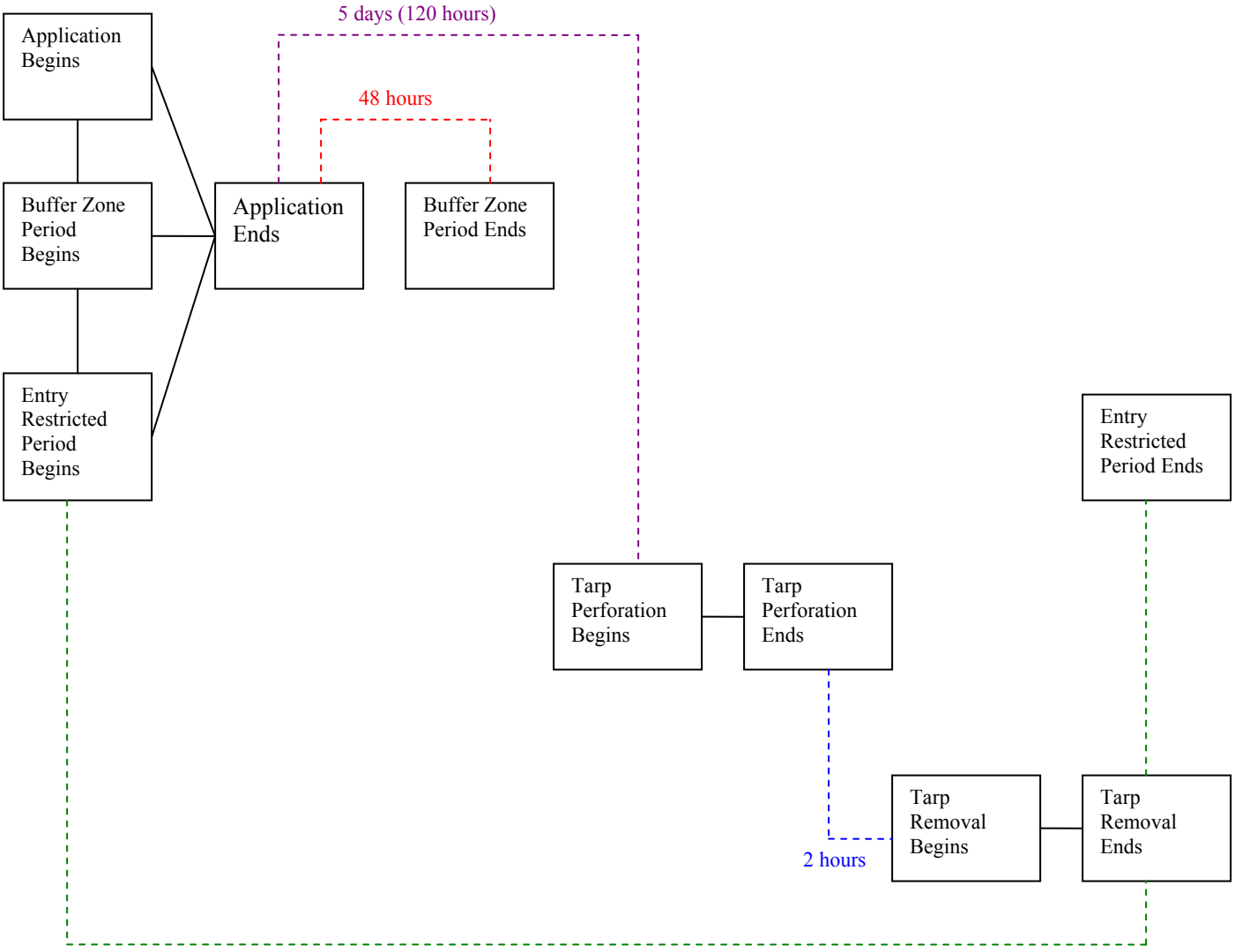


Figure 5. Tarp Bed Applications (Tarps not removed before planting)

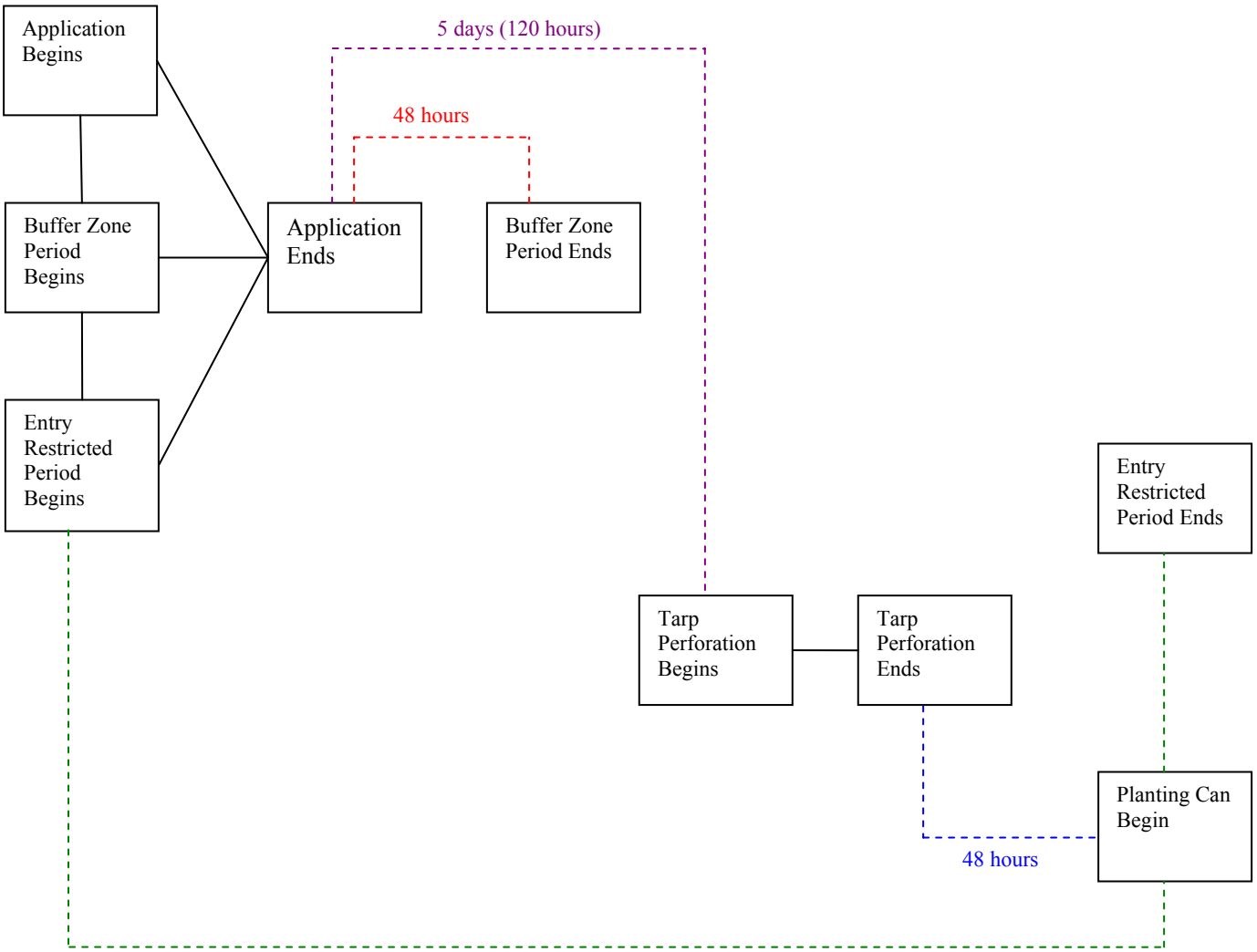
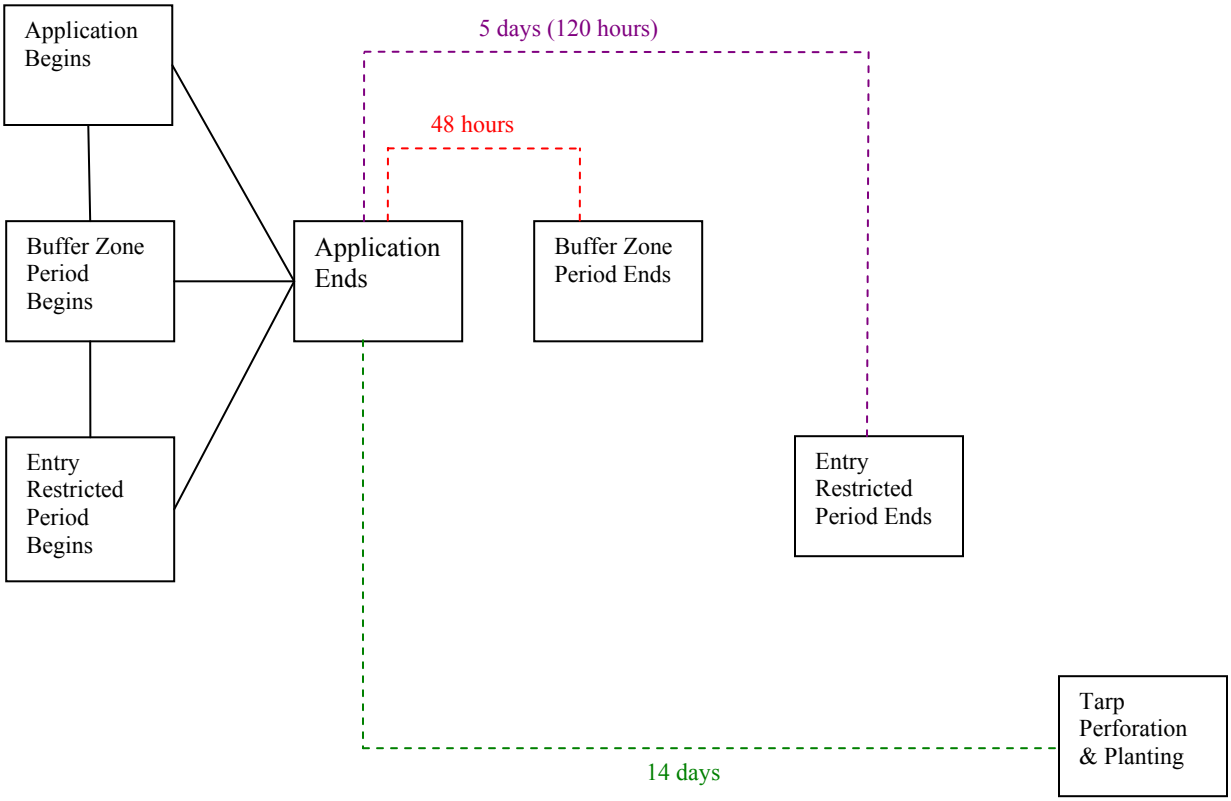


Figure 6. Tarp Bed/Broadcast Applications (Tarps are not perforated until 14 days after application)



ii. Other Mitigation

Below are requirements for FMPs, GAPs, emergency preparedness and response, notice to state-lead agencies, training, and community outreach and education that the Agency concludes are needed to mitigate risks and the likelihood of incidents caused by human error, equipment failure, and weather events such as temperature inversions.

1. Good Agricultural Practices (GAPs)

Since the application methods and work practices of fumigators have direct impacts on the amount of fumigant applied and emitted, the Agency determined that labeling should require proven practices that will reduce risks to handlers, bystanders, and the environment. Registrants, applicators, growers, and other stakeholders have consistently reported to the Agency that GAPs are a key mitigation measure to reduce the amount of fumigants applied and fumigant emissions.

The purpose of this section in the July 2008 RED was to specify GAPs that were required for soil applications of chloropicrin. The practices specified contribute to reducing emissions and thereby are expected to reduce potential for worker and bystander exposures.

The Agency received comments regarding the GAPs outlined in the July 2008 RED. These comments addressed a range of topics:

- making the GAPs voluntary rather than mandatory label requirements,
- buffer zone credits associated with GAP implementation,
- wind speed requirements and the description of inversion conditions,
- crop residue requirements,
- application equipment requirements,
- soil moisture and temperature requirements,
- flexibility in the event that new GAPs are developed,
- enforceability of GAPs, and
- university research exemptions.

These comments are addressed in detail in the following document, "SRRD's Response to Post-RED Comments on the Soil Fumigants" May 27, 2009. Based on the comments, the Agency has revised some of the GAPs.

The GAPs outlined in the July 2008 RED and this RED amendment have been shown to reduce emissions and bystander exposures and will continue to be mandatory label requirements. Buffer zone credits have been reanalyzed and additional credits have been calculated for various GAPs depending on the soil fumigant used (see *Buffer Zone Reduction Credit* section on page 67).

The Agency has clarified the language regarding inversions and wind speed requirements. The Agency agrees that erosion control is an important consideration. However, removing the crop residue prior to fumigation is important to limit the natural "chimneys" that will occur in the soil when crop residue is present. These "chimneys" allow the soil fumigants to move through the soil quickly and escape into the atmosphere. This may create potentially

harmful conditions for workers and bystanders and will limit the efficacy of the fumigant. To accommodate both of these important considerations (erosion control and human health protection), the Agency encourages that the field be cleared of crop residue as close to the timing of the fumigation as possible to limit the length of time that the soil would be exposed to potentially erosive weather conditions.

Requirements for soil temperature monitoring have been revised from "air temperatures have been above 100 degrees F for more than three hours in any of the three days prior to application" to "air temperatures have been above 100 degrees F in any of the three days prior to application."

The GAPs outlined below must be followed during all fumigant applications. Registrants may develop additional optional GAPs to include on product labels provided they do not conflict with the required practices. All measurements and other documentation necessary to ensure that the mandatory GAPs are achieved must be recorded in the FMP and/or the post-application summary report as described in the FMP section.

Tarps (when tarps are used in chloropicrin applications)

- A written tarp plan must be developed and included in the FMP that includes:
  - schedule and procedures for checking tarps for damage, tears, and other problems
  - plans for determining when and how repairs to tarps will be made, and by whom
  - minimum time following injection that tarp will be repaired
  - minimum size of tarp damage that will be repaired
  - other factors used to determine when tarp repair will be conducted
  - schedule, equipment, and methods used to perforate tarps
  - aeration plans and procedures following perforation of tarp, but prior to tarp removal or planting/transplanting
  - schedule, equipment, and procedures for tarp removal

The written tarp plan must be included in the site specific FMP as described in the *FMP* section on page 106. This section of the GAPs has not changed from the July 2008 RED.

Weather Conditions

The Agency is concerned with off-gassing occurring during temperature inversion. In many reported incidents, a temperature inversion is often given as a potential contributing factor. To address this concern in the 2008 RED, the Agency prohibited applications during periods of temperature inversion, or when the wind speed is less than 2 mph, which can sometimes be an indication an inversion is occurring. In addition, the Agency provided additional information on the label as guidance to applicators in determining if an inversion exists.

The Agency received many comments related to the inversion label language including: concern that some of the characteristics of inversion conditions (like misty conditions or clear skies at night) do not always indicate the presence of an inversion, relying on a weather forecast to predict inversions is unreliable and not enforceable, and that prohibiting application during inversions does not address concerns of inversions during the off-gassing period.

Based on these comments the Agency has revised the *weather conditions* section of the GAPs that relates to temperature inversions to clarify that parts of the weather conditions that are requirements and those that are included to help guide the applicator to identify temperature inversions. The measures have also been updated to prohibit application only if temperature inversion conditions are forecasted to persist for more than 18 of the 48 hours after the start of the application since this will filter out conditions when diurnal temperature inversions may occur, though even diurnal temperature inversions could contribute to exposures to fumigant concentrations outside buffers. As such, EPA believes that the measures described below in the *Emergency Preparedness and Response* section of this document are important to address potential risks associated with shorter-term diurnal inversions. The Agency is also changing the wind speed requirement so winds may either be 2 mph at the start of application or be forecasted to reach 5 mph during the application. These changes are designed to prevent applications when inversion conditions are predicted to occur after the application has begun, since this is the time when the peak off-gassing is expected to occur. In summary, EPA has determined that applicators must (1) check the weather forecast and make a decision whether to proceed with a planned fumigation, based on conditions that are predicted, (2) only begin a fumigant application if wind speed is a minimum of 2 mph at the start of the application or forecasted to reach at least 5 mph during the application, and (3) not fumigate if there will be a persistent low-level local inversion or an air stagnation advisory is in effect. EPA believes advisory language providing more detailed information on how to identify inversions and adverse weather conditions will increase the likelihood that applicators will proceed with applications only when weather conditions are or are forecast to be favorable for safe fumigations. See the revised language below and the label table in Section V of this document for label statements.

Stakeholders also questioned where the inversion conditions must exist and to what extent the temperature inversion must exist that would prevent an application. The Agency has provided additional temperature inversion details and has added a prohibition for application during an air-stagnation advisory. Air-stagnation advisories are issued through the National Weather Service and usually capture long periods of air stillness that may remain in an area from one to several days. EPA has determined that these modifications achieve the same goals as the 2008 RED since they provide additional clarity that will enhance users' ability to practically comply with the requirements. The revised statements are stated below.

- Prior to fumigation the weather forecast for the day of the application and the 48-hour period following the fumigation *must* be checked to determine if unfavorable weather conditions exist or are predicted and whether fumigation should proceed.
- Wind speed at the application site must be a minimum of 2 mph at the start of the application or forecasted to reach at least 5 mph during the application.
- Do not apply if a shallow, compressed (low-level) temperature inversion is forecast to persist for more than 18 consecutive hours for the 48-hour period after the start of application, or if there is an air-stagnation advisory in effect for the area in which the fumigation is planned.
- Detailed local forecasts for weather conditions, wind speed, and air stagnation advisories may be obtained on-line at: http://www.nws.noaa.gov. For further guidance, contact your local National Weather Service Forecasting Office.

Unfavorable Weather Conditions

Unfavorable weather conditions block upward movement of air, which results in trapping fumigant vapors near the ground. The resulting air mass can move off-site in unpredictable directions and cause injury to humans, animals or property. These conditions typically exist prior to sunset and continue past sunrise and persist as late as noontime. Unfavorable conditions are common on nights with limited cloud cover and light to no wind and their presence can be indicated by ground fog or smog and can also be identified by smoke from a ground source that flattens out below a ceiling layer and moves laterally in a concentrated cloud.

Soil Temperature and Soil Moisture

In the July 2008 RED the Agency required the soil temperature and soil moisture GAPs for all chloropicrin applications, i.e., both shank and drip. After discussions with CMTF, the Agency is no longer requiring these GAPs for drip applications. Soil temperature has been removed because once the water is applied the soil temperature is cooled by evaporative cooling. The soil moisture GAP was removed from drip applications because the soil needs to be below field capacity before the application to prevent the potential for the beds to become oversaturated during the application, which could potentially cause chloropicrin to leak into the furrows or could cause the beds to collapse. Since water is a part of the drip application, the soil moisture is brought up to field capacity during the application. As a result soil temperature and soil moisture GAPs have been moved to the *Chloropicrin Bedded and Broadcast Shank Applications: Additional GAPs* section on page 101.

Soil Preparation

- Soil shall be properly prepared and at the surface generally be free of clods that are golf ball size or larger. The area to be fumigated shall be tilled to a depth of 5 to 8 inches.
- Field trash must be properly managed. Residue from a previous crop must be worked into the soil to allow for decomposition prior to fumigation. Little or no crop residue shall be present on the soil surface. Crop residue that is present must not interfere with the soil seal. Removing the crop residue prior to fumigation is important to limit the natural "chimneys" that will occur in the soil when crop residue is present. These "chimneys" allow the soil fumigants to move through the soil quickly and escape into the atmosphere. This may create potentially harmful conditions for workers and bystanders and will limit the efficacy of the fumigant. However, crop residue on the field serves to prevent soil erosion from both wind and water and is an important consideration. To accommodate erosion control, fumigant efficacy, and human health protection, clear fields of crop residue as close to the timing of the fumigation as possible to limit the length of time that the soil would be exposed to potentially erosive weather conditions.

Soil Sealing

- *For Broadcast Untarped Applications:* Use a disc or similar equipment to uniformly mix the soil to at least a depth of 3 to 4 inches to eliminate the chisel or plow traces. Following elimination of the chisel trace, the soil surface must be compacted with a cultipacker, ring roller, and roller in combination with tillage equipment.

- *For Bedded Applications*: Performed beds shall be sealed by disruption of the chisel trace using press sealers, bed shapers, cultipackers, or by re-shaping (relisting, lifting and replacing, etc.) the beds immediately following injection. Beds formed at the time of application shall be sealed by disrupting the chisel trace using press sealers, or bed shapers.
- *Soil Sealing for Tarped Applications*: The use of a tarp does not eliminate the need to minimize chisel traces prior to application of the tarp, such as by using a nobel plow or other injection shank that disrupts the chisel traces.

Chloropicrin Bedded and Broadcast Shank Applications: Additional GAPs

In addition to the GAPs required for all chloropicrin soil fumigation applications, the following GAPs apply for injection applications:

Tarps (when tarps are used in chloropicrin applications)
- Tarps must be installed immediately after the fumigant is applied to the soil.

Soil Preparation
- Trash pulled by the shanks to the ends of the field must be covered with tarp, or soil, depending on the application method before making the turn for the next pass.

Soil Temperature
- The maximum soil temperature at the depth of injection shall not exceed 90 degrees F at the beginning of the application.
  - If air temperatures have been above 100 degrees F in any of the three days prior to application, then soil temperature shall be measured and recorded in the FMP.

Soil Moisture
- The soil must be moist 9 inches below the surface. Soil moisture must be determined by one of the following methods:
  - The USDA Feel and Appearance Method for testing (see below). Surface soil generally dries rapidly and must not be considered in this determination, or
  - An instrument, such as a tensiometer.
- If there is insufficient moisture 9 inches below the surface, the soil moisture must be adjusted. If irrigation is not available and there is adequate soil moisture below 9 inches, soil moisture can be adjusted by discing or plowing before fumigant injection. To conserve existing soil moisture, pretreatment irrigation or pretreatment tillage should be done as close to the time of application as possible.
- Measure soil moisture at a depth of 9 inches at either end of the field, no more than 48 hours prior to application.

Soil moisture determination

To use the buffers zones tables based on the Wasco, CA data (Tables 5-9), the soil shall contain at the time of application enough moisture at 9 inches below the surface. Soil moisture must either be measured at ≥ 70% with an instrument (e.g., tensiometer), or meet the following criteria

defined in the USDA Feel and Appearance method for estimating soil moisture as appropriate for the soil texture.

- For **coarse** textured soils (fine sand and loamy fine sand) there must be enough moisture (75-100 percent available soil water moisture) so that the soil is wet, forms a weak ball, loose and aggregated sand grains remain on fingers, darkened color, heavy water staining on fingers, will not ribbon.
- For **moderately coarse** textured soils (sandy loam and fine sandy loam) there must be enough moisture (75-100 percent available soil water moisture) so that the soil is wet, forms a ball with a wet outline left on hand, light to medium staining on fingers, makes a weak ribbon between the thumb and forefinger.
- For **medium** textured soils **(**sandy clay loam, loam, and silt loam) there must be enough moisture (75-100 percent available soil water moisture) so that the soil is wet, forms a ball with well-defined finger marks, light to heavy soil/water coating on fingers, ribbons between thumb and forefinger.
- For **fine** textured soils (clay, clay loam, and silty clay loam) there must be enough moisture 75-100 percent available soil water moisture)) so that the soil is wet, forms a ball, uneven medium to heavy soil/water coating on fingers, ribbons easily between thumb and forefinger.
- For **fields with more than one soil texture**, soil moisture content in the lightest textured (most sandy) areas must comply with this soil moisture requirement. Whenever possible, the field should be divided into areas of similar soil texture and the soil moisture of each area should be adjusted as needed. Coarser textured soils can be fumigated under conditions of higher soil moisture than finer textured soils; however, if the soil moisture is too high, fumigant movement will be retarded and effectiveness of the treatment will be reduced. Previous and/or local experience with the soil to be treated or the crop to be planted can often serve as a guide to conditions that will be acceptable. If there is uncertainty in determining the soil moisture content of the area to be treated, a local extension service or soil conservation service specialist or pest control advisor (agriculture consultant) should be consulted for assistance.

If the field capacity is measured to be between 50-69% with a meter or falls into the USDA Feel and Appearance Method category of 50-75% then the buffer zones are based on Tables 12-16.

- For **coarse** textured soils (fine sand and loamy fine sand) there must be enough moisture (50 to 75 percent available soil water moisture) so the soil is moist, forms a weak ball with loose and clustered sand grains on fingers, darkened color, moderate water staining on fingers, will not ribbon.
- For **moderately coarse** textured soils (sandy loam and fine sandy loam) there must be enough moisture (50 to 75 percent available soil water moisture) so the soil is moist, forms a ball with defined finger marks, very light soil/water staining on fingers, darkened color will not stick.
- For **medium** textured soils (sandy clay loam, loam, and silt loam) there must be enough moisture (50 to 75 percent available soil water moisture) so the soil is moist, forms a ball, very light staining on fingers, darkened color, pliable, and forms a weak ribbon between the thumb and forefinger.
- For **fine** textured soils (clay, clay loam, and silty clay loam) there must be enough moisture (50 to 75 percent available soil water moisture) so the soil is moist, forms a

smooth ball with defined finger marks, light soil/water staining on fingers, ribbons between thumb and forefinger.

- For **fields with more than one soil texture**, soil moisture content in the lightest textured (most sandy) areas must comply with this soil moisture requirement. Whenever possible, the field should be divided into areas of similar soil texture and the soil moisture of each area should be adjusted as needed. Coarser textured soils can be fumigated under conditions of higher soil moisture than finer textured soils; however, if the soil moisture is too high, fumigant movement will be retarded and effectiveness of the treatment will be reduced. Previous and/or local experience with the soil to be treated or the crop to be planted can often serve as a guide to conditions that will be acceptable. If there is uncertainty in determining the soil moisture content of the area to be treated, a local extension service or soil conservation service specialist or pest control advisor (agriculture consultant) should be consulted for assistance.

Application Depth

- *For Tarped-Broadcast and Tarped-Bedded Applications:* The injection point shall be a minimum of 8 inches from the nearest final soil/air interface.
- *For Untarped-Bedded Applications*: The injection point shall be a minimum of 12 inches from the nearest final soil/air interface.
- *For Untarped-Broadcast Applications*: The injection point shall be a minimum of 10 inches from the nearest final soil/air interface.

Prevention of End Row Spillage

- Do not apply or allow fumigant to drain onto the soil surface. For each injection line either have a check valve located as close as possible to the final injection point, or drain/purge the line of any remaining fumigant prior to lifting injection shanks from the ground.
- Do not lift injection shanks from the soil until the shut-off valve has been closed and the fumigant has been depressurized (passively drained) or purged (actively forced out via air compressor) from the system.

Calibration, Set-up, Repair, and Maintenance for Application Rigs

- Brass, carbon steel or stainless steel fittings must be used throughout. Polyethylene tubing, polypropylene tubing, Teflon® tubing or Teflon® -lined steel braided tubing must be used for all low pressure lines, drain lines, and compressed gas or air pressure lines. All other tubing must be Teflon® -lined steel braided.
- Galvanized, PVC, nylon or aluminum pipe fittings must not be used.
- All rigs must include a filter to remove any particulates from the fumigant, and a check valve to prevent backflow of the fumigant into the pressurizing cylinder or the compressed air system.
- Rigs must include a flowmeter or a constant pressure system with orifice plates to insure the proper amount of fumigant is applied.
- To prevent the backflow of fumigant into the compressed gas cylinder (e.g. nitrogen, other inert gas or compressed air), if used, applicators must:
    - Ensure that positive pressure is maintained in the cylinder at not less than 200 psi during the entire time it is connected to the application rig, if a compressed gas cylinder is used. (*This is not required for a compressed air system that is part of*

the application rig because if the compressor system fails the application rig will not be operable).
    - Ensure that application rigs are equipped with properly functioning check valves between the compressed gas cylinder or compressed air system and the fumigant cylinder. The check valve is best placed on the outlet side of the pressure regulator, and is oriented to only allow compressed gas to flow out of the cylinder or compressed air out of the compressed air system.
    - Always pressurize the system with compressed gas or by use of a compressed air system before opening the fumigant cylinder valve.
- Before using a fumigation rig for the first time, or when preparing it for use after storage, the operator must check the following items carefully:
    - Check the filter, and clean or replace the filter element as required.
    - Check all tubes and chisels to make sure they are free of debris and obstructions.
    - Check and clean the orifice plates and screen checks, if installed.
    - Pressurize the system with compressed gas or compressed air, and check all fittings, valves, and connections for leaks using soap solution.
- Install the fumigant cylinder, and connect and secure all tubing. Slowly open the compressed gas or compressed air valve, and increase the pressure to the desired level. Slowly open the fumigant cylinder valve, always watching for leaks.
- When the application is complete, close the fumigant cylinder valve and blow residual fumigant out of the fumigant lines into the soil using compressed gas or compressed air. At the end of the application, disconnect all fumigant cylinders from the application rig. At the end of the season, seal all tubing openings with tape to prevent the entry of insects and dirt.

Application equipment must be calibrated and all control systems must be working properly. Proper calibration is essential for application equipment to deliver the correct amount of fumigant uniformly to the soil. Refer to the manufacturer's instructions on how to calibrate your equipment, usually the equipment manufacturer, fumigant dealer, or Cooperative Extension Service can provide assistance.

Chloropicrin Drip Applications: Additional GAPs

The Agency has made one minor change to the additional GAPs for chloropicrin drip applications from the July 2008 RED. This change is in the soil sealing section. The July 2008 RED required that every drip application was tarped. Since the Agency has received and reviewed drip untarp emission studies, EPA has deleted this requirement.

In addition to the GAPs required for all chloropicrin soil fumigation applications, the following GAPs apply for drip applications:

Soil Preparation

- Till fields with known plowpans because they can lead to puddling of the fumigant due to inadequate soil drainage.

Product and Dosage

- Plan the application by calculating the amount of fumigant required at the appropriate rate for the crop, acreage and target pest. Fumigant must be metered into the water supply line and then passed through a mixing device, such as a centrifugal pump or static mixer, to assure proper agitation.

System Controls and Integrity

- The irrigation system (main lines, headers, drip tape) must be thoroughly checked for leaks before the start of application. Leak detection requires that the irrigation system be at full operating pressure. The amount of time needed at full operating pressure will vary by irrigation system design. Look for puddling along major pipes (holes in pipes or leaky joints), at the top and ends of rows (leaky connection, open drip tape), and on the bed surface (damaged drip tape, malfunctioning emitters). Any leaks discovered during the pre-application check must be repaired prior to fumigant application.
- To inject fumigant, use a metering system (such as a positive pressure system, positive displacement injection pump, diaphragm pump, or a Venturi system) effectively designed and constructed of materials that are compatible with the fumigant and capable of being fitted with system interlocking controls. Do not use containers pumps or other equipment made of aluminum, magnesium or their alloys as chloropicrin can be corrosive to such metals.
- The system must contain:
    - A functional check valve and low-pressure drain appropriately located on the irrigation pipeline to prevent water source contamination and backflow;
    - A functional, automatic, quick-closing check valve to prevent the flow of fluids back toward the fumigant container;
    - A functional, normally closed valve located on the intake side of the injection point and connected to the system interlock to prevent the fumigant from being withdrawn from the supply tank when the irrigation system is either automatically or manually shut down;
    - Functional interlocking controls to automatically shut off the fumigant injection when the irrigation water flow stops or decreases to the point where fumigant distribution is adversely affected.

Site of Injection and Irrigation System Layout

- Site of injection must be as close as practical to the area being treated (such as direct injection of fumigant into the header pipe/manifold or into an aboveground delivery pipe attached to the header). If the fumigant is injected into a main line, make sure the irrigation pipe is able to be cleared of all fumigant as the fumigant may pool in low sections of the pipe. Also make sure that valves on lateral lines of the main line are closed, if these lateral lines lead to areas not being fumigation at the time of the application.

System Flush

- After application of the fumigant, continue to drip-irrigate the area with water to flush the irrigation system. Do not allow the fumigant to remain in the irrigation system after the application is complete. The total volume of water, including the amount used for flushing the irrigation system, must be adequate to completely remove the fumigant from

the lines, but should be less than the amount that could over-saturate the beds (bed collapse can occur from over-saturation). If common lines are used for both the fumigant application and water seal (if a water seal is applied) these lines must be adequately flushed before starting the water seal and/or normal irrigation practices.

Soil Sealing (change, no longer requiring tarps if the drip tape is buried)

- If tarps are used they must be put in place before the fumigation begins.
- Tarp edges must be buried along the furrow and at the ends of rows.

Chloropicrin Tree Replant Application: GAPs

This section has not changed from the July 2008 RED.

This application method is used when chloropicrin is applied to individual tree sites in an existing orchard where shank or drip application are not possible.

In addition to the GAPs required for all chloropicrin soil fumigation applications, the following GAPs apply for chloropicrin tree replant applications:

Site Preparation

- Each individual tree-site must remove the tree stump and primary root system with a back-hoe or other similar equipment, for example an auger.
- The hole must be backfilled with soil before application.

Application Depth

- The fumigant must be injected at least 18 inches into the soil.

System Flush

- Before removing the application wand from the soil the wand must be cleared using nitrogen or compressed air.

Soil Sealing

- After the wand is cleared and removed from the soil, the injection hole must be either covered with soil and tamp or the soil must be compacted over the injection hole.

2. Fumigant Management Plans (FMPs)

As noted elsewhere in this document, soil fumigation is a complex site-specific activity. Failure to adhere to label requirements and procedures for safe use has led to accidents affecting workers involved in fumigations as well as bystanders. Information from various sources shows that health and safety plans, FMPs in this context, typically reduce workplace injuries and accidents by prescribing a series of operational requirements and criteria. In fact, plans like these are widely implemented in a variety of industries and are recommended as standard approaches for occupational health and safety management by groups such as American

Industrial Hygiene Association[14] (i.e., through "Administrative" and "Workplace" controls). The Centers for Disease Control provides guidance for developing health and safety plans in agricultural settings.[15] The effectiveness of similar plans has also been evaluated in the literature. Examples include "lookback" reviews conducted by the Occupational Safety and Health Administration (OSHA) which essentially implemented standards in various industries then reviewed their effectiveness in this process as they are required to determine whether the standards should be maintained without change, rescinded or modified. OSHA is required by Section 610 of the Regulatory Flexibility Act (5 U.S.C. 610) and Executive Order 12866 to conduct the "lookback" reviews. These reviews are conducted to make the subject final standards more effective or less burdensome in achieving their objectives, to bring them into better alignment with the objectives of Executive Order 12866, and to make them consistent with the objectives of the Regulatory Flexibility Act. Two examples of "lookback" reviews that support the use of FMPs for soil fumigant health and safety management include: ethylene oxide use as a fumigant/sterilant, and grain handling facilities requirements.[16]

In the July 2008 RED, EPA required FMPs to be completed before a fumigant application occurs. EPA concluded that FMPs will reduce potential risks to bystanders as well as handlers by requiring that applicators have carefully planned, in writing, each major element of the fumigation. In this context, an FMP is a set of performance criteria for each application, including how the fumigator intends to comply with label requirements. As added benefits, the Agency determined that FMPs would ensure directions on the product labels were followed and that the conditions under which fumigation occurred were documented. EPA also concluded that FMPs would help ensure an appropriate response by the applicator or others involved in the application should an incident occur since a proper and prompt response would reduce the potential risk to bystanders from potential high exposure situations (e.g., readily available first responder contact information could reduce response times to impacted bystanders and carefully thought out emergency response plans can help ensure appropriate actions are taken in case of unforeseen events).

The July 2008 RED provided a list of each major element FMPs would need to address. These included general site and applicator information, application procedures, and a description of how the fumigator planned to comply with label requirements for GAPs, buffer zones, monitoring, worker protection, posting, and providing notification to the state or tribal lead agency. FMPs also were required to include plans for communication between the applicator and others involved in the fumigation, documentation, and handling emergency situation. Additionally, EPA required that applicators complete a post-fumigation summary that described any deviations from the FMP, measurements taken to comply with GAPs, and information about any problems such as complaints or incidents that occurred as a result of the fumigation. The

[14] Ignacio and Bullock (2006) A Strategy For Assessing and Managing Occupational Exposures (Third Edition), American Industrial Hygiene Association, AIHA Press 2700 Prosperity Avenue, Suite 250 Fairfax VA 22031 (ISBN 1-931504-69-5)

[15] Karsky (2002) Developing a Safety and Health Program to Reduce Injuries and Accident Losses, Centers For Disease Control National Ag Safety Database, available at http://www.cdc.gov/nasd/docs/d001501-d001600/d001571/d001571.html

[16] United States Department of Labor, Occupational Safety and Health Administration (2008) Lookback Reviews available at http://www.osha.gov/dea/lookback.html

RED also specified requirements for record keeping and that FMPs must be provided, upon request, to enforcement officials and handlers involved in the fumigation.

According to stakeholder comments in earlier comment periods, much of the information required for the site-specific FMP was already being documented by users, and most industry stakeholders supported mandatory FMPs provided they are not too restrictive or complex and do not result in an excessive administrative burden.

During the post-RED comment period, EPA received several comments regarding FMPs. Several comments from industry and user stakeholders expressed concern that FMP requirements would increase paperwork burden without providing significant risk reduction, though others supported FMPs provided they did not result in an excessive administrative burden. A number of comments suggested that the level of detail EPA had required was too great and could result in voluminous, resource-intensive plans. Some of these comments suggested that a checklist format would be more efficient and far less burdensome. Some comments expressed reservations about the ability of FMPs to enhance compliance with label requirements. Some commenters were concerned about the feasibility of providing a copy of the FMP to on-site handlers or enforcement personnel, though others said that copies of the FMP should be provided to workers in areas adjacent to the application block.

Following EPA's review of the post-RED comments, the Agency still believes that FMPs will reduce potential risks to bystanders as well as handlers and are a key component of the package of measures to reduce risks. EPA believes that FMPs will also enhance compliance by requiring that applicators verify and document compliance with the label requirements during and after application events are completed. In cases where errors may have occurred, a post-application summary may also prevent similar problems from occurring during future applications. However, in response to comments, the Agency has somewhat modified the list of elements that must be addressed in the FMP (as described below) to make it more streamlined and thus less burdensome to applicators and growers. In addition, the Agency has developed a sample template in which many of the elements are covered in checklist format, which fumigators have the option of downloading and modifying to meet the needs of their specific fumigation situations. See http://www.epa.gov/pesticides/reregistration/soil_fumigants/. EPA will also continue to work with stakeholders to refine the FMP template and potentially develop others so it is a more useful tool for ensuring the safe application of chloropicrin.

The Agency estimates that, if a certified applicator decides not to use the FMP template and decides to prepare a narrative FMP, a carefully designed FMP could take several days to develop the first time. Subsequent FMPs should require substantially less time to develop because much of the information can be reused from the initial plan. In addition, an enterprise fumigating multiple application blocks as part of a larger fumigation may format their FMP in a manner whereby all of the information that is common to all the application blocks is captured once, and any information unique to a particular application block or blocks is captured in subsequent, separate sections.

Amended FMP Requirements

Consistent with the July 2008 RED, the Agency is not requiring FMPs to be submitted to state or local agencies. They must, however be maintained by the applicator and grower (if the grower is not the applicator) for a period of 2 years.

The Agency agrees with comments that having both the applicator and the owner/operator provide copies of the FMP to handlers is unnecessarily duplicative and that providing each worker with a hardcopy of the FMP wastes paper. The Agency also agrees that it is not necessary for the FMP to be provided to the workers in areas adjacent to the application block. Workers in adjacent areas will be notified of the fumigation by buffer posting requirements and, in the case of neighbors whose land is part of a buffer zone, the adjoining neighbor has responsibility for workers in areas adjacent to the application for which permission was granted to use as part of a fumigation buffer. The Agency has revised the following requirement that was included in the 2008 RED, "Once the application begins, the certified applicator and owner/operator of the application block must provide a copy of the FMP to handlers involved in the fumigation, workers in adjacent areas to the application block, and federal/state/local enforcement personnel, upon request." The RED Amendment requires the certified applicator to make a copy of the FMP available for viewing by handlers involved in the fumigation. The certified applicator or the owner/operator of the application block must provide a copy of the FMP to any federal, state, tribal, or local enforcement personnel who request the FMP. In the case of an emergency, the FMP must be made available when requested by federal/state/local emergency response and enforcement personnel.

The Agency agrees with comments that the term "etc." complicates enforcement activities and has removed that term from the label tables.

Each site-specific FMP must contain the following elements:

- Applicator information (name, phone number, license number, employer name, employer address, date of completing registrant chloropicrin training program)
- General site information
  - Application block location, address or global positioning system (GPS) coordinates
  - Name, address, and, phone number of owner/operator of the application block
  - Map, aerial photo, or detailed sketch showing field location, dimensions, buffer zones, property lines, roads, rights-of-ways, sidewalks, permanent walking paths, bus stops, water bodies, wells, nearby application blocks, surrounding structures (occupied and non-occupied), locations of posted signs for buffers, and sites requiring ¼ or ⅛ mile buffer zones (schools, state licensed daycare centers, nursing homes, assisted living facilities, hospitals, in-patient clinics, and prisons) with distances from the application site labeled
- General application information (target application date/window, brand name of fumigant, EPA registration number)
- Tarp information and procedures for repair, perforation, and removal (if tarp is used)
  - Brand name, lot number, thickness
  - Name and phone number of person responsible for repairing tarps
  - Schedule for checking tarps for damage, tears, and other problems

- Maximum time following notification of damage that the person(s) responsible for tarp repair will respond
- Minimum time following application that tarp will be repaired
- Minimum size of damage that will be repaired
- Other factors used to determine when tarp repair will be conducted
- Name and phone number of person responsible for cutting and/or removing tarps (if other than certified applicator)
- Equipment/methods used to cut tarps
- Schedule and target dates for cutting tarps
- Schedule and target dates for removing tarps

- Soil conditions (description of soil texture in application block, method used to determine soil moisture)
- Weather conditions (summary of forecasted conditions for the day of the application and the 48-hour period following the fumigant application)
  - Wind speed
  - Inversion conditions (e.g., shallow, compressed (low-level) temperature inversion)
  - Air stagnation advisory
- Buffer zones
  - Application method
  - Application rate from lookup table on label (lbs ai/acre)
  - Application block size from lookup table on label (acres)
  - Credits applied
  - Buffer zone distance
  - Description of areas in the buffer zone that are not under the control of the owner/operator of the application block
- Respirators and other personal protective equipment (PPE) for handlers (handler task, protective clothing, respirator type, respirator cartridge type, respirator cartridge replacement schedule, eye protection, gloves, other PPE)
- Emergency procedures (evacuation routes, locations of telephones, contact information for first responders, local/state/federal contacts, key personnel and emergency procedures/responsibilities in case of an incident, equipment/tarp/seal failure, complaints or elevated air concentration levels outside buffer zone suggesting potential problems, or other emergencies).
- Posting procedures (person(s) who will post signs, location of posting signs, procedures for sign removal)
- Site-specific response and management (if applicable)
  - Fumigant site monitoring
    - Description of who, when, where, and procedures for monitoring buffer zone perimeter
  - Response information for neighbors
    - List of residences, businesses, and neighboring property owners informed
    - Name and phone number of person doing notification
    - Method of providing the information
- State and tribal lead agency notification (If state and/or tribal lead agency requires notice, provide a list of contacts that were notified and date notified).

- ❖ Plan describing how communication will take place between applicator, land owner/operator, and other on-site handlers (e.g., tarp perforators/removers, irrigators) for complying with label requirements (e.g., buffer zone location, buffer zone start/stop times, timing of tarp cutting and removal, PPE).
  - ➢ Name and phone number of persons contacted
  - ➢ Date contacted
- ❖ Authorized on-site personnel
  - ➢ Names, addresses and phone numbers of all handlers
  - ➢ Employer name, addresses, and phone numbers for all handlers
  - ➢ Tasks that each handler is authorized and trained to perform
  - ➢ Date of PPE training for each handler
  - ➢ For handlers designated to wear respirators, respiratory protection is required (minimum of 2 handlers), date of medical qualification to wear a respirator and date of fit testing for respirator.
- ❖ Air monitoring plan
  - ➢ For buffer zone monitoring:
    - ▪ Name, address, and, phone number of handler to perform monitoring activities
    - ▪ Location and timing of monitoring for the buffer zone
  - ➢ For handlers without respiratory protection:
    - ▪ If sensory irritation is experienced, indicate whether operations will be ceased or operations will continue with respiratory protection
    - ▪ If intend to cease operations when sensory irritation is experienced, provide the name, address, and phone number of the handler that will perform monitoring activities prior to operations resuming
  - ➢ For handlers with respiratory protection:
    - ▪ Representative handler tasks to be monitored
    - ▪ Monitoring equipment to be used and timing of monitoring
- ❖ Good Agricultural Practices (GAPs)
  - ➢ Description of applicable mandatory GAPs (registrants may also include optional GAPs)
  - ➢ Measurements and documentation to ensure GAPs are achieved (e.g., measurement of soil and other site conditions)
- ❖ Description of hazard communication. (The buffer zone around the application block has been posted in accordance with the label. Pesticide product labels and material safety data sheets are on-site and readily available for employees to review.)
- ❖ Record-keeping procedures (the owner/operator of the application block as well as the certified applicator must keep a signed copy of the site-specific FMP and the post application summary for 2 years from the date of application)

For situations where an initial FMP is developed and certain elements do not change for multiple fumigation sites (e.g., applicator information, authorized on-site personnel, record keeping procedures, emergency procedures) only elements that have changed need to be updated in the site-specific FMP provided the following:

- The certified applicator supervising the application has verified that those elements are current and applicable to the application block before it is fumigated and has documented the verification in the site-specific FMP.

- Recordkeeping requirements are followed for the entire FMP (including elements that do not change).

Once the application begins, the certified applicator must make a copy of the FMP available for viewing by handlers involved in the fumigation. The certified applicator or the owner/operator of the application block must provide a copy of the FMP to any federal, state, tribal, or local enforcement personnel who request the FMP. In the case of an emergency, the FMP must be made available when requested by federal/state/local emergency response and enforcement personnel.

Within 30 days of completing the application portion of the fumigation process, the certified applicator supervising the application must complete a post fumigation application summary that describes any deviations from the FMP that have occurred, measurements taken to comply with GAPs as well as any complaints and/or incidents that have been reported to him/her.

Specifically the Post-Application Summary must contain the following elements:

- Actual date of the application, application rate, and size of application block fumigated
- Summary of weather conditions on the day of the application and during the 48-hour period following the fumigant application
- Soil temperature measurement (if air temperatures were above 100 degrees F in any of the 3 days prior to the application)
- Tarp damage and repair information (if applicable)
  - Location and size of tarp damage
  - Description of tarp/tarp seal/tarp equipment failure
  - Date and time of tarp repair
- Tarp removal details (if applicable)
  - Description of tarp removal (if different than in the FMP)
  - Date tarps were cut
  - Date tarps were removed
- Complaint details (if applicable)
  - Person filing complaint (e.g., on-site handler, person off-site)
  - If off-site person, name, address, and phone number of person filing complaint
  - Description of control measures or emergency procedures followed after complaint
- Description of incidents, equipment failure, or other emergency and emergency procedures followed (if applicable)
- Details of elevated air concentrations monitored on-site (if applicable)
  - Location of elevated air concentration levels
  - Description of control measures or emergency procedures followed
  - Air monitoring results
    - When sensory irritation experienced:
      - Date and time of sensory irritation
      - Handler task/activity
      - Handler location where irritation was observed

        - Resulting action (e.g., cease operations, continue operations with respiratory protection)
    - When using a direct read instrument:
        - Sample date and time
        - Handler task/activity
        - Handler location
        - Air concentration
        - Sampling method
- Date of sign removal
- Any deviations from the FMP

In addition to recordkeeping requirements from 7 CFR part 110 "Recordkeeping Requirements for Certified Applicators of Federally Restricted Use Pesticides," this decision requires that both the applicator and owner/operator of the application block keep a signed copy of the site-specific FMPs and the post-application summary record for 2 years from the date of application.

Applicators and other stakeholders have the flexibility to use EPA's template (Appendix E), prepare their own FMPs templates, or use other commercially available software with certain elements listed above in check-list and/or fill in the blank format. Below are examples of other FMP templates available on the internet for structural fumigations that may be useful to users when developing FMPs for methyl bromide soil applications:

- http://www.cardinalproproducts.com/Misc/FMP%20Version%203.pdf
- http://www.pestcon.com/techlibrary/fum_mgmt_plan.doc
- http://www.agr.state.ne.us/division/bpi/pes/fumigation_plan.pdf
- http://www.agr.state.ne.us/division/bpi/pes/fumigation_plan2.pdf
- http://nmdaweb.nmsu.edu/pesticides/Management%20Plans%20Required%20for%20Fumigations.html

The Agency has provided a template in Appendix E on page 156. This template is specific for methyl bromide. A chloropicrin template will be provided at a later date.

3. Site Specific Management and Response

EPA believes measures for ensuring preparedness for situations when accidents or emergencies occur are an important part of the suite of measures necessary to address risks posed by fumigants. Therefore, EPA is requiring such measures at the community level in the form of educational materials for first responders, and measures for specific sites to ensure early detection and quick and appropriate response to situations as they arise.

Although EPA believes buffers and other mitigation will prevent many future incidents, it is likely that some incidents will still occur due to accidents, errors, and/or unforeseen weather conditions such as diurnal inversions. Early detection and appropriate response to accidental chemical releases is an effective means of reducing risk, as well as addressing the source of the release. Reducing risks associated with incidents that may occur in the future is a key part of

EPA's soil fumigant decisions. By combining buffers with GAPs, FMPs, and effective emergency response, EPA is able to reach a "no unreasonable adverse effects" finding under FIFRA.

To ensure that appropriate response mechanisms are in place in the event of a fumigant exposure incident, EPA is requiring that registrants provide training information, in the context of their community outreach and education programs (see the *Community Outreach and Education Programs* section on page 126) to first responders in high-fumigant use areas and areas with significant interface between communities and fumigated fields. In addition, for situations in which people, homes, or other structures are in proximity to buffer zones, applicators must either monitor buffer zone perimeters or, alternatively, provide emergency response information directly to neighbors. Each element is discussed in more detail below.

a. First Responder Education

EPA is requiring registrants through their community outreach and education programs see *Community Outreach and Education Programs* section on page 126, to ensure that emergency responders have the training and information that they need to effectively identify and respond to fumigant exposure incidents. EPA believes this will help ensure, in the case of a fumigant accident or incident that first responders recognize the exposure as fumigant related and respond appropriately.

b. Emergency Preparedness and Response

Emergency Preparedness and Response Considerations for the 2008 RED

Prior to the 2008 RED EPA received comments from many stakeholders about the Agency's emergency preparedness and response option. Users have commented that notification is burdensome and that it is unnecessary if buffer zones are also required. However, community groups have commented on the importance of bystanders being informed when fumigations are occurring, since this group of pesticides, compared to other pesticides, has a greater potential to move off-site and affect people not involved in the application. State regulators have different views on this requirement. Some support the sharing of information with neighbors, and some states have notification requirements for fumigations with certain products or for certain application methods. In addition, some states require notification to chemically sensitive individuals in proximity to pesticide applications. Others also had concerns about the enforceability of this type of measure and the possible burden on the states to enforce a notification requirement.

California currently requires notification of persons within 300 feet of a methyl bromide buffer zone. California strawberry growers consider the 300 foot notification area for methyl bromide applications to be an extension of the buffer zone. In areas where a large number of people would need to be notified about a planned methyl bromide application, strawberry growers indicated that they would rather not use methyl bromide because some communities could mobilize to prevent the fumigation from taking place. Some stakeholders also commented that it would be protective and less burdensome if EPA required the user to monitor fumigant air

concentrations at the edge of the buffer for 24 hours after the application to ensure the fumigant does not move beyond the buffer at concentrations that exceed EPA's level of concern. If concentrations of concern were detected, the user would be required to implement the emergency response measures specified in the fumigant management plan.

EPA has concluded that bystanders could take steps to protect themselves if they had basic information about fumigations and the appropriate steps to take if they experienced symptoms of exposure. In a number of fumigant incidents that have occurred, the magnitude and severity of the incident could have been significantly reduced if people had such information. Similarly, having on-site monitoring will enable site managers to take remedial action (i.e., activate the control plan in the FMP) to lower emissions sooner, also resulting in fewer and less severe exposures. And, if necessary, site managers would activate the emergency response elements of the FMP.

Providing communities with information about local chemical releases is an important part of emergency preparedness programs and is recognized as an effective means of addressing risk at the local level. Some states, like Florida and Wisconsin, have requirements for providing information to chemically-sensitive individuals about chemicals used nearby so they can take steps to protect themselves from potentially harmful exposures (see http://edis.ifas.ufl.edu/pi004 and http://www.legis.state.wi.us/rsb/code/atcp/atcp029.pdf). The requirements in Florida do not apply to agricultural chemical applications. Wisconsin also requires fumigators applying metam sodium products through chemigation to provide written notice to the county public health agency and to every individual or household within ¼ miles of the chemigation application site (see http://www.legis.state.wi.us/rsb/code/atcp/atcp030.pdf). EPA agrees that information about how to recognize and address exposures can help citizens reduce potential risk.

EPA understands that difficult challenges exist when agricultural land borders urban or suburban communities. While EPA's decisions for the fumigants will not alleviate challenges that already exist, EPA is allowing options for ensuring emergency preparedness in an effort to lessen potential impact on growers, while maintaining the Agency's protection goals.

EPA is not requiring a specific method of providing the information to neighbors, but rather that it be done in a way that effectively communicates, in a manner the recipients will understand. Some methods may not result in documentation that would be retained. To address concerns about enforcement, EPA is requiring that information on how and when the emergency response information was delivered, and to whom, be included in the FMP.

Emergency Preparedness and Response Revisions

To reduce risks to people who may be near a buffer zone (e.g., at their home or working in a nearby field) in the July 2008 RED EPA required applicators to either monitor buffer zone perimeters or, alternatively, provide emergency response information directly to neighbors. This measure is intended to ensure protection in places people may be found. Whether measures are required depends on the size of the buffer zone and how close land, e.g., residential properties and businesses, not under the control of the owner/operator of the application block may be to the buffer zone.

The Agency received many comments about the Emergency Preparedness and Response requirements that suggested the requirements were too complex and confusing. To address these concerns, EPA has revised the structure and content of the requirements in the amended RED to improve clarity. As was outlined in the 2008 RED, it is important to note that site-specific Emergency Preparedness and Response measures are only required if there are people, homes, or businesses within a certain specified distance from the edge of the buffer zone.

Some comments were received that questioned the rationale behind scaling the Emergency Preparedness and Response measures. EPA believes that scaling the size of the Emergency Preparedness and Response area will be protective. Generally the larger the buffer distance, the higher the application rate or the size of the treated area, which translates to a greater total amount of fumigant being applied and potentially higher exposure in the area surrounding the application block. The buffer distances for triggering the Emergency Preparedness and Response requirements are scaled to allow the amount of fumigant used (a surrogate for potential exposure) to determine the applicable distance for implementing this requirement. When the area is scaled to the size of the buffer, small buffers which generally result from applications to small areas, at low application rates, and/or using low-emission application techniques, will have small or no areas to monitor or inform, while larger applications will have larger areas to monitor or inform. In addition, to create additional incentive to achieve the smallest buffer possible, the EPA has included an exception for application blocks so fields with the smallest required buffer (25 feet) would not be subject to this requirement, since they are most likely using lower application rates, applying to smaller areas, and/or using lower-emission application methods. Based on changes to the buffer zone section regarding overlapping buffer zones, any buffer zone that overlaps with another buffer zone must use the maximum distance in the Emergency Preparedness and Response measures to determine if monitoring or providing information to neighbors is needed. None of the other distances have changed.

Many stakeholders also expressed concern over the potential burden the 2008 RED requirements may have on applicators and growers. Specifically, the frequency and cost of monitoring using sampling devices such as colorimetric tubes were of concern. Several of these comments noted concerns with the reliability of such devices at low concentrations. Stakeholders felt the inherent warning properties of chloropicrin and MITC (i.e., eye irritation) were better indicators of exposure than available devices. Additionally, several stakeholders indicated that monitoring is most appropriate and effective at dawn and dusk, the times of day when off-site movement of concentrations is most likely. Based on these comments, the Agency has revised the requirement so monitoring is required during those periods when risk of high concentrations of fumigant moving beyond buffers is greatest (i.e., at dawn and dusk). As a precaution, monitoring is also required once during the night and during the day.

Additionally, as noted in the respiratory protection section of this document, due to limitations on currently available technology for monitoring, use of sampling devices such as colorimetric tubes will not be required at this time. EPA believes that currently available devices are likely to be more reliable at fumigant concentrations which exceed EPA's action level concentrations. In fact, some of these action levels are at or near the detection limits for the

devices available for some fumigants. Additionally, colorimetric devices provide snapshot measurements. In conditions that are likely to be more static (e.g., monitoring an indoor fumigation such as a grain mill or warehouse) it is likely that minute to minute changes in conditions would not be as great as those anticipated for the more dynamic conditions characteristic of outdoor field fumigation where exposure concentrations could shift because of weather changes or stratification in soil conditions across a single field.

While the Agency is modifying the procedures for monitoring buffer zones because of technological limitations of currently available devices for chloropicrin that are not practical or reliable for field use, the Agency does believe that quantitative air monitoring would enhance safety if the appropriate technology were available as it is for methyl bromide. Some equipment manufacturers have indicated interest in developing devices that would be more functional and reliable for field fumigation applications (e.g., badge-type monitors). EPA encourages such efforts and plans to stay abreast of developments and improvements in monitoring devices and will consider this issue again in Registration Review or sooner should such monitors become available in the short term. In the interim, buffer monitoring for chloropicrin will rely on sensory indicators (e.g., eye and/or nasal irritation) to trigger a response instead of using tubes.

Finally some comments provided suggestions to increase flexibility in how a grower may comply with these measures as well as the effectiveness of the option to provide information to neighbors. EPA agrees with the importance of users being able to comply with these measures and has modified some aspects of the requirements for this option to reduce the number of notices an applicator may need to provide to a given neighbor. Also, to enhance the effectiveness of the information neighbors would receive, EPA is requiring that the information is provided close to when the application is planned to take place and early enough for neighbors to make use of the information. EPA believes these modifications will enhance compliance and effectiveness of the information if the emergency response criteria are met and applicators exercise this option.

Emergency Preparedness and Response Requirements

When are Emergency Preparedness and Response Measures Needed?

If the buffer zone is:	AND	There is land (e.g. residential properties and businesses) NOT in the control of the property operator within this distance from the edge of the buffer zone:
25 feet < Buffer ≤ 100 feet		**50 feet**
100 feet < Buffer ≤ 200 feet		**100 feet**
200 feet < Buffer ≤ 300 feet		**200 feet**
Buffer > 300 feet or buffer zones overlap		**300 feet**

Then either monitoring of the buffer zone perimeter or providing emergency response information to neighbors is required.

If the buffer zone is 25 feet, the minimum buffer zone size, then the Emergency Preparedness and Response requirements are not applicable. Also, if all of the land within 300 feet of the edge of the buffer zone is under the control of the property operator, then no site monitoring or informing neighbors would be required regardless of the size of the buffer zone.

Fumigation Site Monitoring

EPA has determined that monitoring of the buffer zone perimeter for fumigants moving beyond buffers is an effective approach to protecting bystanders. Under this approach, if the person monitoring the buffer perimeter experiences eye or nasal irritation, an early sign of exposure to concentrations that exceed the Agency's action level, then the emergency response plan specified in the FMP must be implemented. If other problems occur, such as a tarp coming loose, then the appropriate control plan must be activated. Because data indicate that peak concentrations sometimes occur on the second day following applications, and the greatest potential for concentrations outside buffers may be observed at dawn and dusk, EPA has decided that this monitoring must be done at least three times per day during the full buffer zone period at dawn, dusk, and once during the night and during the day, to ensure concentrations do not exceed the action level which will be specified on product labels.

Specific requirements include:

- Monitoring must take place beginning on the day the application begins until the buffer zone period expires.
- Monitoring must be conducted by a certified applicator or someone under his/her supervision.
- Monitoring for air concentrations above the action level for the fumigant, as determined by sensory irritation, must take place in areas between the buffer zone perimeter and residences or other occupied areas that trigger this requirement.
- The person(s) monitoring for perceptible levels must start monitoring approximately 1 hour before sunset of the day the application begins and continue once during the night, once at 1 hour after sunrise, and once during the day until the end of the buffer zone period.
- If at any time the person(s) monitoring the air concentrations experiences sensory irritation, then the emergency response plan stated in the FMP must be immediately implemented.
- If other problems occur, such as a tarp coming loose, then the appropriate control plan must be activated.
- The location and any results of the air monitoring must be recorded in the FMP.

While protective, this site monitoring might be burdensome for users fumigating in areas with few people. Therefore, EPA is allowing users the alternative option of providing emergency response information directly to neighbors.

Response Information for Neighbors

As an alternative to on-site monitoring, the certified applicator supervising the fumigation (or someone under his/her direct supervision) would need to ensure that residences, businesses, or other sites that meet the criteria outlined below have been provided the required information below at least one week prior to the fumigant application in a specified field. If after four weeks, the fumigation has not yet taken place, the information must be delivered again.

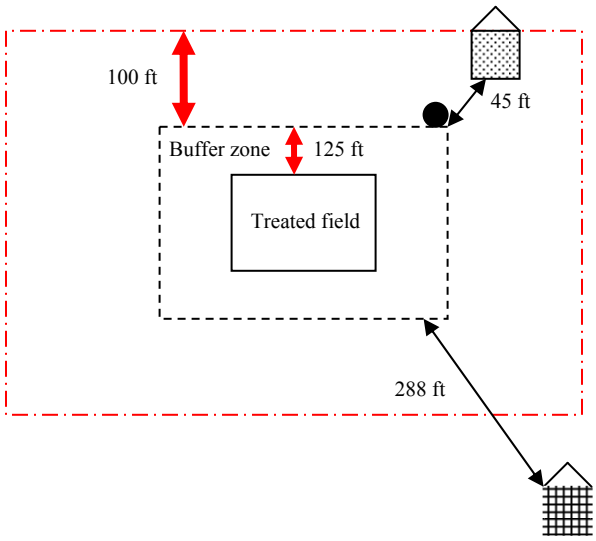
- Information that must be provided includes:
  - The general location of the application block,
  - Fumigant(s) applied including the active ingredient, name of the fumigant products(s), and the EPA Registration number,
  - Contact information for the applicator and property owner/operator,
  - Time period in which the fumigation is planned to take place (must not range more than 4 weeks),
  - Early signs and symptoms of exposure to the fumigant(s) applied, what to do, and what emergency responder phone number to call who to call if you believe you are being exposed (911 in most cases), and
  - How to find additional information about fumigants.

The method for distributing information to neighbors must be described in the FMP and may be accomplished through mail, telephone, door hangers, or through other methods that can be reasonably expected to effectively inform people at residences and businesses within the required distance from the edge of the buffer zone.

To clarify this measure, the following example is provided:

- IF the buffer zone is **125 feet**, then these requirements apply to residences within 100 feet of the buffer zone. Either the applicator must monitor the area between the dotted house and the buffer zone or residents of the dotted house must be provided emergency response information.
- The location of the cross-hatched house would not prompt any action.

Figure 7. Example Site Map for Informing Neighbors



If there are no residences or other occupied structures within 300 feet of the edge of the buffer zone, or if the buffer distance is the minimum of 25 feet, neither site monitoring nor providing information to neighbors is required.

4. Notice to State Lead Agencies

Ensuring fumigant users understand and comply with the new label requirements is an important component of the fumigant risk mitigation package since these requirements are designed to mitigate risks of concern for bystanders, handlers, and workers. Knowledge of the location and timing of fumigant applications allows enforcement officials to focus their compliance assistance and inspection efforts around periods when, and places where, fumigations are expected to occur. Therefore, in the July 2008 RED, the Agency required written notification of the appropriate state or tribal lead agency prior to fumigant applications.

Following publication of the July 2008 REDs, the Agency received feedback from some states that were interested in receiving the notice because it would enhance their ability to provide technical assistance and assure compliance. However, the Agency also received comments from states that were concerned about the notification requirement largely due to resource constraints. Some states also indicated that they are already well-informed about when and where fumigations take place, and receiving specific notice of applications would create a paperwork burden rather than aid their compliance assistance and assurance programs. Some states recommended that, in lieu of receiving notice of fumigations, states could modify their cooperative agreements with EPA to incorporate specific strategies for assuring compliance with the new fumigant labels. States also suggested that rather than providing notice directly to states, fumigators could enter application information into a registrant-developed and maintained

database. They suggested this would be an appropriate mechanism because it would standardize and streamline the process for applicators to provide the required information, and states could access and utilize information more quickly, with greater ease, and using fewer state resources.

Based on consideration of public comments, the Agency still believes that compliance assistance and assurance is a critical component of the soil fumigant mitigation. EPA agrees that some states already have mechanisms in place to provide them with information needed to assist and assure compliance with new fumigant requirements, but other states are in need of additional information to accomplish this objective. The Agency also believes that all states in which fumigants are used will need to modify their cooperative agreements, to some extent, to incorporate strategies for compliance assistance and assurance to aid the transition from current labels to labels that reflect the new mitigation.

While the Agency will continue to work with all state and tribal lead agencies on efficient ways to obtain the information needed to plan and implement compliance assistance and assurance activities, the Agency is currently retaining the notification requirement only for state and tribal lead agencies that choose to be notified of fumigant applications. The Agency plans to provide a website listing these state and tribal lead agencies, and also how and when these agencies want applicators to provide to them the following information:

- Applicator and property owner/operator contact information (name, telephone number, and applicator license number)
- Location of the application block(s)
- Name of fumigant(s) products(s) applied including EPA Registration number
- Time period in which fumigation may occur

The Agency will work with all states to amend their cooperative agreements to include strategies for compliance assistance and assurance, which will be particularly important over the next several years as the new mitigation measures are implemented. For states that do not choose to be notified of fumigant applications, modification of their cooperative agreements must include the methods these agencies will use to survey fumigation application periods and locations.

5. Soil Fumigation Training for Applicators and Other Handlers

Soil fumigation is an inherently complex activity involving specialized equipment and application techniques. Additionally, the mitigation measures required as part of these decisions will introduce new requirements in the form of more detailed instructions and restrictions on soil fumigations. Failure to adequately manage fumigant applications increases risks to handlers involved in the fumigation, nearby workers, and other bystanders. Incident data show that a number of fumigant incidents are the result of misapplications, failure to follow label requirements and other safety precautions, and other errors on the part of fumigant applicators. Although states have certification programs, some of which include a specific category or subcategory for soil fumigation, there currently is not a consistent standard across states and regions where soil fumigation is done. Additionally, the federal certification program currently

has no category for soil fumigation, and while EPA is considering the development of a category for soil fumigation, the potential changes to the federal certification program and worker safety regulations to include a soil fumigation category are not anticipated in the near future.

EPA believes that training is an effective way to increase applicators' skill and knowledge so they are better prepared to effectively manage the complexities and risks associated with soil fumigation. Further, training is a means of ensuring fumigators are able to understand and comply with revised fumigant labeling. Therefore, EPA determined that training designed to establish a national baseline for safe fumigant use, developed and implemented by registrants, will help enhance fumigators' ability to adequately manage the complexities of soil fumigation and enhance compliance with fumigant product labeling. EPA also determined that providing additional safety information to other fumigant handlers will help them understand and adhere to practices that will help handlers protect themselves from risks of exposure.

Soil Fumigation Training Considerations

In comments on fumigant risk management options, stakeholders were broadly supportive of additional training for applicators and handlers. During the Phase 5 and post-RED comment periods, the majority of stakeholders, including growers, community groups, farm workers, states, and registrants expressed strong support for increased training for applicators and other handlers. Several comments noted that fumigant incidents affecting both fumigant workers and bystanders could have been prevented or mitigated if applicators had better training about correct practices and procedures.

The Agency agrees that additional training for fumigant applicators and handlers will help educate and inform these workers, thus decreasing the likelihood of both incidents and noncompliance. EPA believes fumigant-specific training for applicators and additional training information for handlers also will help reduce the magnitude and frequency of exposure incidents and coupled with the other mitigation measures described in this decision, training will address risks of unreasonable adverse effects from the use of soil fumigants.

It is important to note that training developed and provided by registrants as required by this RED is separate and distinct from state certification programs. EPA encourages registrants, in developing their training proposals, to work with states where their products are used to identify opportunities to build on and complement state programs. However, the training programs required as part of this decision are intended to be separate from the state certification process and will be developed and administered by registrants. Individual state regulatory agencies have the option of working with registrants on these activities, but are not required to do so. It is important to note that some fumigant registrants have already developed soil fumigant training programs that will serve as a good basis for this expanded effort.

As noted above, several states have high-quality certification programs for fumigators that include exams to test the competency of fumigators. EPA recognized that for applicators to become certified in those states, they must acquire the knowledge and skill necessary to pass the exam. But several stakeholders commented that training opportunities are varied across the country, and the scope and detail of information provided in available training is not consistent.

EPA is also concerned that information in existing programs will need to be substantially updated as a result of new requirements associated with this decision and the label changes which will implement it. Although EPA is considering revisions to the federal certification and training program in the future to include a soil fumigation category/subcategory, EPA believes that registrants have access to resources and materials to best develop and deliver training in the interim.

EPA stresses that registrant training programs will be separate from the state certification process and will be developed and administered by registrants in coordination with EPA. EPA will, however, work with state organizations and training experts to explore opportunities for the registrant programs to supplement any existing state programs to provide additional training resources for fumigators working in those states. EPA will also work with state lead agencies and extension programs to review training program proposals, the content for the programs and materials, and proposed vehicles for delivery.

During the post-RED comment period, the Agency received comments from several states asking that the applicator training requirements be coordinated with existing state certification and training programs. The Agency agrees that for states that have existing soil fumigation certification programs that address the same training elements required of the registrant soil fumigant training programs, as outlined in this section of the RED addendum, applicators should be able to complete the state certification program in lieu of completing the registrant soil fumigation training. For the state soil fumigation certification program to qualify, both EPA and the state must agree that the program satisfies the applicator training elements required in the RED.

Pesticide labels will state that "Before applying the product, the certified applicator supervising that application must successfully complete, within the last 36 months, a chloropicrin training program made available by the registrant. The FMP (see details elsewhere on this label) must document when and where the training program was completed. This requirement for registrant-provided applicator training does not supersede or fulfill state requirements, unless the state has expressly acknowledged that the registrant training may substitute for state requirements."

a. Training for Applicators Supervising Fumigations

The July 2008 RED required registrants to develop and implement training programs for applicators in charge of soil fumigations on the proper use of and best management practices for soil fumigants. During the public comment period on the proposed mitigation measures and the post-RED comment period, stakeholders were broadly supportive of additional training for fumigators, but concerns were raised with regard to implementation of the training. The Agency also received comments from state representatives and pesticide applicator training organizations, such as the Association of American Pesticide Control Operators, American Association of Pesticide Safety Educators, and Certification & Training Assessment Group, expressing concern over EPA's decision to implement the training via labeling and raising questions over compliance and state enforcement of such a requirement and the potential for

conflict or redundancy with state certification and training programs. Various stakeholders recommended that, rather than a label-mandated training requirement, the Agency, instead, should require registrants to develop and implement training for soil fumigant applicators as a condition of registration.

The Agency's goal in requiring soil fumigation training for applicators is to ensure that all applicators in charge of soil fumigations understand the safe use of soil fumigants and in how to apply products in compliance with new product labeling, including provision required by the RED. Given the unique properties of soil fumigants and their application and safety procedures compared with other agricultural and non-agricultural pest control practices, the inherent complexities involved in soil fumigant applications, and the additional complexities that will arise with the implementation of the REDs, the Agency feels that additional training, beyond that available currently, will be needed. The states that currently have certification programs that include soil fumigation categories will not have requirements pertaining to the new mitigation and their programs will need to be modified. EPA agrees that making the required training programs a condition of registration is an important means of ensuring that such training is ultimately developed and implemented. However, it would not ensure that all individuals in charge of soil fumigant applications avail themselves of the training. The Agency believes that making successful completion of the training a condition of use is also important to achieve this goal. Therefore, EPA has decided that development and delivery of training will be included in the DCI that accompanies this amended RED and successful completion of the training will remain a condition of use.

Each registrant must develop and implement training programs for applicators in charge of soil fumigations on the proper use of and best practices for soil fumigants. In addition, registrants will be required to submit proposals for these programs as data requirements that will accompany this RED. EPA will review each program and determine whether it adequately addresses the requirements specified in the DCI. The proposal must address, among other elements, both the content and the format for delivering training. The Agency acknowledges the value of hands-on training in the field, but recognizes that may not be feasible in all instances. The Agency welcomes and is actively seeking participation from state lead agencies and extension programs in the evaluation of the registrant training proposals and materials that are submitted.

The training programs must address, at a minimum, the following elements: (1) how to correctly apply the fumigant, including how to comply with new label requirements; (2) how to protect handlers and bystanders; (3) how to determine buffer zone distances; (4) how to develop a FMP and complete the post-fumigation application summary; (5) how to determine when weather and other site-specific factors are not favorable for fumigant application; and (6) how to comply with required GAPs and how to document compliance with GAPs in the FMP. In addition, based on comments received during the post-RED comment period, the Agency is adding a seventh training element—training programs must also include information on how to develop and implement emergency response plans—to ensure that applicators are prepared in the event that a problem develops during or shortly after the fumigant application. EPA is also requiring registrants to incorporate a mechanism for evaluating the effectiveness of their training

programs at conveying the required information to participants and for determining whether participants have successfully completed the training program.

To assist states in enforcing these training requirements, the registrants will be required to (1) develop a database to track which certified applicators have successfully completed the training, (2) make this database available to state and/or federal enforcement entities upon request, and (3) provide documentation (e.g., a card) to each training participant who successfully completes the training. This documentation shall include the applicator's name, address, license number, and the date of completion. Applicators must provide to federal, state, or local enforcement personnel, upon request, this documentation that verifies successful completion of the appropriate training program(s).

In the July 2008 RED, the Agency required applicators supervising fumigations to complete the training annually. During the post-RED public comment period, the Agency received comments from various stakeholders indicating that the substance and content of training would not change significantly from year to year, and that an annual training requirement for applicators would be excessive and burdensome to both applicators and registrants and was unnecessary. As a result of these comments, the Agency has decided to require applicators supervising fumigations to have successfully completed the program within the preceding 36 months and to document when and where the training program was completed in their FMPs. This may be accomplished, for example, by simply attaching a copy of the training documentation provided by the registrant to the FMP. The registrant also must be able to provide to federal, state, or local enforcement personnel, upon request, the names, addresses, and certified applicator license numbers of persons who successfully completed the training program, as well as the date of completion.

Based on questions received during the post-RED comment period, the Agency is clarifying that the applicator training requirements are active ingredient-specific rather than product-specific. That is, applicators who apply more than one of the soil fumigant active ingredients (i.e., methyl bromide, chloropicrin, metam sodium/potassium, or dazomet) will be required to complete training for each soil fumigant active ingredient they apply, but not for each different product containing the same active ingredient(s). Further, EPA encourages the soil fumigant registrants to jointly develop programs to reduce the redundancy of this training requirement. For example, a substantial portion of the required training is universal to all soil fumigants. Therefore modules addressing the information common to all could be generic and each fumigator would participate in those modules, while separate modules addressing active ingredient-specific content could be provided to those fumigators supervising applications with those active ingredients only. Documentation provided to trainees could indicate the active ingredient modules completed. While EPA sees efficiencies in such an approach, it will be the registrants' choice as to how they will comply with the requirement to develop and implement training programs.

b. Training Materials for Handlers

EPA is requiring registrants to prepare and disseminate training information and materials for other fumigant handlers, i.e., those working under the supervision of the certified

applicator in charge of fumigations. The Agency is requiring registrants to submit proposals for these materials through the data call-ins that will accompany this RED. EPA will review these materials to determine whether they adequately address the requirements specified in the DCI. The Agency welcomes and is actively seeking participation from state lead agencies and extension programs in the evaluation of these handler training materials.

The training materials must address, at minimum, the following elements: (1) what fumigants are and how they work, (2) safe application and handling of soil fumigants, (3) air monitoring and respiratory protection requirements for handlers, (4) early signs and symptoms of exposure, (5) appropriate steps to take to mitigate exposures, (6) what to do in case of an emergency, and (7) how to report incidents. Registrants must provide this training information through channels open to the public (e.g., via a website). Pesticide labels will require that applicators supervising fumigations provide this training information to handlers under their supervision before they perform any fumigant handling task, or they must ensure that handlers have been provided the required information within the preceding 12 months. The label will also require that the training information be provided in a manner that the handler can understand. Applicators supervising fumigations must ensure the FMP includes how and when the required training information was provided to the handlers under their supervision. The following language must be added to labels.

> "The certified applicator must provide fumigant safe handling information to each handler involved in the application in a manner that they can understand prior to performing any fumigant handling task or confirm that each handler participating in the application has received fumigant safe handling information in the past 12 months."

During the post-RED comment period, no substantive comments were received that resulted in changes to the RED requirements for training materials for handlers, as a result, these requirements are identical to those published in the July 2008 RED. However, during the comment period, the Agency received comments indicating that there was some confusion about whether fumigant handlers working under the supervision of the certified applicator would be required to be trained, i.e., participate in a training program developed by the soil fumigant registrant(s), or whether handlers would need only to be provided with training information and materials. The Agency wishes to clarify that handler participation in a registrant training program, per se, is not required. As noted above, applicators supervising a soil fumigation will be required to provide the registrant-developed, EPA-approved training information to handlers in a manner that they can understand prior to performing any fumigant handling task, or applicators must ensure that the handler has been provided the required information within the proceeding 12 months.

6. Community Outreach and Education Programs

EPA understands from public comments, site visits, and stakeholder meetings, conducted as part of the soil fumigant review, that there is often a fundamental lack of information and communication within communities where soil fumigation occurs, which has raised health and safety concerns among community members. This lack of information and communication has led to inappropriate responses in cases where fumigants have moved off-site and into

communities. This also has led in some cases to unwarranted concern and anxiety among communities about the risks associated with the use of fumigants. The Agency believes that outreach and education to communities where soil fumigation occurs is an important component of the overall package of measures to address bystander risk. This outreach and education will address the risk of acute bystander exposure by educating community members in high-use areas about buffer zones and their characteristics and purpose; the importance of not entering these zones; how to recognize early signs of fumigant exposure, and how to respond appropriately in case of an incident. The first responder education discussed in the *First Responder Education* section on page 114 is a significant part of this program.

In the July 2008 RED, the Agency required registrants to develop and implement community outreach and education programs to address these needs. At a minimum, these programs were to include the following elements: (1) what soil fumigants are and how they work, (2) what buffer zones are, (3) early signs and symptoms of exposure, (4) appropriate steps to take to mitigate exposures, (5) what to do in case of an emergency, and (6) how to report an incident as well as a plan for evaluating the effectiveness of these programs. Few details on how the programs would be implemented were provided in the RED. Rather, during the post-RED comment period, the Agency sought feedback from the registrants and other stakeholders on how best to design and target programs to community members in high-use areas. The Agency encouraged the registrants to work with existing community resources, such as community health networks, for disseminating information and implementing community outreach programs.

During the post-RED comment period, the Agency received some comments from stakeholders that suggested that having registrants develop and implement a community outreach and education program is unnecessary and likely to needlessly raise heath and safety concerns among community members, and such a requirement could draw scarce resources from other registrant stewardship efforts. As noted previously, the Agency believes that providing basic information about soil fumigants and buffer zones as well as information on what to do in the event that an incident occurs to communities in high fumigant use areas is an important component of the overall package of risk mitigation measures to address bystander risk. EPA's community outreach requirements do not preclude other voluntary stewardship programs or activities targeted to community members or the applicator/grower community, but rather are meant to help ensure that community members in high fumigant usage areas are informed about soil fumigant safety and better able to respond appropriately if an incident were to occur.

Few recommendations and no specific proposals for these programs were received during the post-RED comment period. Therefore, the Agency is identifying minimum requirements that each registrant must fulfill when developing its community outreach programs in response to a DCI that will be issued. The Agency remains open to considering additional registrant outreach program elements that address the same needs and goals as the program requirements described below in their response to the DCI. EPA notes that registrants have suggested that programs focusing on specific target audiences, such as staff and managers of migrant healthcare and daycare facilities, prison officials, and school nurses and principals, may be more effective in providing useful information in a meaningful way than broadcast messages to entire communities. Registrants have indicated that they will provide proposals for such programs in

late May 2009. EPA looks forward to these proposals and will consider the extent to which they contribute to meeting the goals of the community outreach programs required by the RED.

In the absence of acceptable alternative proposals, registrants will be required to provide information to communities in the form of monthly public service announcements (PSAs) distributed via local radio stations or newspapers in high-use fumigant areas during the fumigation season(s) in those areas. As per the requirements included in the July 2008 RED, at a minimum, registrants must include the following information in their community outreach messages: (1) what soil fumigants are and how they work, (2) what buffer zones are, (3) early signs and symptoms of exposure to chloropicrin, (4) appropriate steps to take to mitigate exposures to chloropicrin, (5) what to do in case of an emergency, and (6) how to report an incident as well as a plan for evaluating the effectiveness of these programs. Based on comments, EPA has decided that information on the meaning of posted warning signs is also important to help ensure the signs convey the needed information about the importance of staying out of buffer zones and treated areas.

The Agency is requiring registrants to implement their outreach programs in communities located in areas where there is high soil fumigant use. For the purposes of the RED amendment, high-use areas are considered at the county level. To identify these areas, the Agency is proposing a process for identifying high-use areas in the subsection following the section on information for first responders. However, the Agency is willing to consider alternative proposals for identifying high soil fumigant-use areas, based on additional data sources and alternate approaches identified by the registrant(s) and other stakeholders.

Information for First Responders

In the July 2008 RED, the Agency required registrants to ensure that first responders in areas with high fumigant usage have the training and information that they need to effectively identify and respond to fumigant exposure incidents. Specifically, the registrants were required to provide information and/or training to first responders, which at a minimum, included the following elements: (1) how to recognize the early signs and symptoms of fumigant exposure, (2) how to treat fumigant exposures, and (3) how fumigant exposure differs from other pesticide exposure. In addition, the registrants were required to provide material safety data sheets to first responders for both the fumigant applied. Few details on how the education programs would be implemented were provided in the RED. Rather, during the post-RED comment period, the Agency sought feedback from the registrants and other stakeholders on how best to design and target programs to first responders in high-use areas. The Agency encouraged the registrants to work with state and local emergency response coordinators to identify needs and opportunities to supplement any information already included in state and local training for first responders about soil fumigants specifically.

During the post-RED comment period, the Agency received comments from several registrants indicating that rather than requiring registrants to implement face-to-face training programs, the Agency should consider allowing the required first responder training information to be conveyed via written materials to state and local emergency response agencies, which would provide these agencies the ability to incorporate this information into their existing

training programs. Other comments indicated that even if training programs were developed, it would be difficult to ensure participation of first responders. The Agency's goal for the first responder training program is to ensure that first responders in high use fumigant areas have access to the information that they need to be able to quickly and effectively identify an exposure that is fumigant related and respond appropriately. The Agency agrees that this goal can be met by requiring the soil fumigant registrants to develop informational materials on the soil fumigants and distribute this information to first responders (i.e., police, fire, rescue, emergency medical services, and others who respond to "911" calls) in high soil fumigant-use areas. This would then provide the first responder entities the ability to incorporate this information into their existing first responder training programs as they best see fit. This recommendation has been incorporated into the RED amendments for the soil fumigants.

The Agency is willing to consider additional registrant proposals so long as they address the same needs and achieve the same goals as the program requirements described below. At a minimum, registrants will be required to develop and disseminate chemical-specific soil fumigant training materials to first responders i.e., police, fire, rescue, emergency medical services, and others who respond to "911" calls) operating in high fumigant-use areas. As a data requirement in the DCIs that will accompany the REDs, registrants must submit proposals detailing how they will (1) identify the first responder entities in high soil fumigant-use areas to which they will disseminate the training materials, and (2) provide materials to the first responders in these areas. Additionally registrants must provide draft copies of the training materials for EPA review and approval. As per the requirements included in the July 2008 RED, at a minimum, the materials must convey the following information to first responders: (1) how to recognize the early signs and symptoms of chloropicrin fumigant exposure, (2) how to treat chloropicrin fumigant exposures, and (3) how chloropicrin fumigant exposures differ from other pesticide exposures as well as (4) copies of material safety data sheet(s) for the fumigant applied. Training materials can take a number of forms, including: brochures, fact sheets, CDs, videos, web-based training materials, etc., as long as these materials incorporate, at a minimum, the information requirements identified above.

The Agency is requiring registrants to target their first responder training information to those communities located in high soil fumigant-use areas. For the purposes of the RED, high-use areas are considered at the county level. To identify these areas, the Agency is proposing the process described below. However, the Agency is willing to consider alternative proposals in the registrants' response to the DCIs for identifying and targeting high-use soil fumigant areas, based on additional data sources and alternate approaches identified by the registrant(s).

Process for Identifying High-Use Fumigant Areas:

Identifying high-use areas for chloropicrin is a two-step process because reliable fumigant use data is not available at the county level from either publicly available data sources or EPA proprietary data sources. First, the states with high use of chloropicrin have been identified by the Agency using EPA proprietary data. [Although state-level data are available from USDA's National Agricultural Statistics Service (NASS), EPA proprietary data are more robust.] Second, the high-use counties for chloropicrin within those states must be identified.

The second step, identifying high-use counties, will be the registrant's responsibility, using the process defined below.

Step 1: Identifying States with High Use of Chloropicrin: The Agency is defining states with high usage of chloropicrin as those states where, on average, more than 100,000 lbs of chloropicrin or methyl bromide. (Since chloropicrin is often used with methyl bromide for pre-plant soil uses, the states with greater than 100,000 lb of methyl bromide applied annually are also included in the list.) To determine those states where, on average, more than 100,000 lbs of chloropicrin or methyl bromide have been applied annually, the Agency obtained data on the average number of pounds of both chloropicrin and methyl bromide applied in all states across a ten–year period (1999-2008) using EPA proprietary data. To view the Agency's analysis of this data, please see the following memo, "Process for Defining High-Use Fumigation Areas at the State and County Levels (DP# 364647)" May 14, 2009 and supporting documentation located in the chloropicrin docket. The states identified for chloropicrin and methyl bromide are Washington, Oregon, Idaho, South Carolina, Georgia, North Carolina, California, Florida, and Michigan.

Step 2: Identifying Counties with High Use of Chloropicrin: For each of the high-use states that the Agency identified in Step 1, the registrants will be required to identify the counties where use of chloropicrin may be high. Because county-level fumigant usage data is not publicly available and EPA proprietary data are not appropriate for this level of specificity, crop acreage should be used as a surrogate indicator for fumigant usage. Crop acreage can be obtained for major use sites of chloropicrin from the publicly available 2007 USDA Census of Agriculture. Crop acreages for each of the major use sites for chloropicrin should be obtained for each the major use sites for chloropicrin and then summed by county. All counties making up at least the top 90% of acreage in a state are considered high-use areas. Registrants will be required to target each of these high-use counties for community outreach programs.

For the purposes of this analysis, the Agency defines a "major use site" as any crop that has more than 5% crop treated annually or more than 1,000,000 lb of chloropicrin applied annually. The crops identified for chloropicrin are cantaloupes, peppers, squash, strawberries, sugar beets, tobacco, tomatoes, and watermelons.

Example Identifying High-Use Fumigant Areas for Metam Sodium in California:

To help explain the process for identifying high-use fumigant areas for chloropicrin the Agency is providing the following example, which identifies the high-use counties for the soil fumigant, metam sodium, usage in California.

- Step 1: Identify States with High Use of Metam Sodium:
    - Based on its analysis of proprietary data, the Agency has identified the following high-use states for metam sodium: California, Washington, Idaho, Oregon, Wisconsin, Michigan, Florida, Minnesota, North Carolina, Virginia, Arizona, Nevada, Georgia, Colorado, and North Dakota. This example will focus only on identifying the counties in California with high use of metam sodium. The same process would be applied to other high-use states.

- Step 2: Identify the Counties in California with High Use of Metam Sodium:
    - EPA has identified the following as the major use sites of metam sodium/potassium: artichokes, cabbage, cantaloupes, carrots, onions, peanuts, peppers, potatoes, spinach, squash, tomatoes, and watermelons.
    - Using the 2007 USDA Census of Agriculture, registrants will need to obtain harvested crop acreage data for each of the 12 major use sites for metam sodium identified above for each county in California. An example of this analysis is provided as a supporting document to the Agency's memo "Process for Defining High-Use Fumigation Areas at the State and County Levels (DP# 364647)" May 14, 2009, which is located in the chloropicrin at docket.
    - Registrants will then need to sum the total number of combined crop acres for these major use sites for each county in California and then select all the counties that make up at least the top 90% of acreage in the county. An example of this analysis is also provided as a supporting document to the Agency's memo "Process for Defining High-Use Fumigation Areas at the State and County Levels (DP# 364647)" May 14, 2009, which is located in the chloropicrin at docket.

As with the training for fumigant applicators and handlers and the community outreach program that the Agency is requiring, the first responder training requirements are intended to be part of the registrants' long-term product stewardship. The Agency encourages registrants to work with appropriate state emergency response entities in these areas to ensure that the appropriate first responder entities are being targeted and that the information being provided to first responders is both useful and presented appropriately.

iii. Environmental Risk Mitigation

In the July 2008 RED, EPA addressed the concerns for both aquatic and terrestrial risks which are mentioned in Section III.C on page 24. The July 2008 RED also stated that EPA believed that mitigation measures detailed in the Human Health Risk Mitigation Section would also reduce ecological risks. The Agency stated that although buffer zones and GAPs do not directly reduce the potential risk to ecological organisms, these mitigation measures do provide an incentive to reduce fumigant application rates and individual treatment areas which in turn will contribute to lower exposure and risks for non-target organisms.

The July 2008 RED discussed EPA's concern regarding chloropicrin's potential to leach into ground and surface water. Since chloropicrin has been detected in ground water, the Label Review Manual indicates that the following language should be added to chloropicrin labels, "Chloropicrin is known to leach through soil into ground water under certain conditions as a result of label use. This chemical may leach into ground water if used in areas where soils are permeable, particularly where the water table is shallow." In the July 2008 RED, EPA deviated from the Label Review Manual language because dissipation of chloropicrin in aquatic environments is predominately dependent on volatilization and to a lesser extent on leaching and degradation. In addition, as discussed in the *Human Health Risk Mitigation* section managing soil moisture is an important factor that may be used to reduce peak emissions. Due to the importance of adequate soil moisture as described in the *GAP* section and the knowledge that

volatilization is chloropicrin's most important route of dissipation, EPA required the following language in the July 2008 RED taking these factors into consideration, "While chloropicrin has certain properties and characteristics in common with chemicals that have been detected in groundwater (chloropicrin is highly soluble in water and has low adsorption to soil), volatilization is this chemical's most important route of dissipation."

The Agency still believes that a deviation from the recommended language in the Label Review Manual is necessary due to the importance of soil moisture and chloropicrin's volatility. While the Agency believes that volatilization is this chemical's most important route of dissipation, it is being removed from the ground water statement because volatilization is addressed in other areas of the mitigation package. The new language will state, "Chloropicrin has certain properties and characteristics in common with chemicals that have been detected in groundwater (chloropicrin is highly soluble in water and has low adsorption to soil)."

EPA also discussed, in the July 2008 RED, the potential for chloropicrin to leach into ground water when tarps are used in broadcast applications. Falling temperatures typically found in the late afternoon and evening would not promote dissipation of remaining chloropicrin under the perforated tarp and rainfall may cause remaining chloropicrin under the perforated tarp to leach into ground water. For raised bed applications, rainfall is not a factor since planting occurs with the tarp in place and perforation and/or tarp removal occurs after chloropicrin has dissipated. In the 2008 RED, EPA required that tarps for broadcast applications must be perforated before noon and only when rainfall is not expected within 12 hours. The Agency is keeping this requirement in the amended RED. The language is included in the *Tarp Perforation and Removal* section of this document on page 88.

The July 2008 RED also discussed the potential for chloropicrin to leach into ground water and surface water if a rainfall event occurs after an untarped application. Chloropicrin may impact surface water quality due to runoff of rain water. This is more likely for poorly draining soils and soils with shallow ground water. Chloropicrin triggers the following language according to the Label Review Manual,

> "Chloropicrin is known to leach through soil into ground water under certain conditions as a result of label use. This chemical may leach into ground water if used in areas where soils are permeable, particularly where the water table is shallow. Chloropicrin may also impact surface water quality due to runoff of rain water. This is especially true for poorly draining soils and soils with shallow ground water. This chemical is classified as having high potential for reaching surface water via runoff several days after application. Leaching and runoff of this product will be reduced by avoiding applications when rainfall is forecasted to occur within 48 hours."

The Agency modified this language in the July 2008 RED due to the importance of soil moisture and chloropicrin's volatility. The Agency required the following language in the July 2008 RED, "For untarped applications of chloropicrin, potential leaching into ground water and runoff into surface water can be reduced by avoiding applications when heavy rainfall is forecasted to occur within 24 hours."

During the post-RED comment period commenters stated that the above July 2008 RED language was not clear or enforceable. EPA would like to clarify that the statement was meant to

be advisory and not mandatory. However in an effort to clarify the requirement the Agency has revised the July 2008 RED language as follows, "For untarped applications, leaching, and runoff may occur if there is heavy rainfall after soil fumigation." This is more likely in areas with poorly draining soils. The revised statement is based on information presented in a 2007 article by Zhang and Wang.[17]

EPA received also comments from the CMTF during the post-RED comment period. The comments have been addressed in the following documents: "Further Response to Public Comments on the 7/9/08 Completed Chloropicrin RED" (March 3, 2009) and "Evaluation of, 'Probabilistic Modeling of Chloropicrin Exposure to Aquatic Nontarget Organisms'" (March 3, 2009).

In addition to the changes above, EPA is requiring several ecological fate and effect studies to address data gaps identified in the ecological risk assessment. See Section V of this document for the revised label statements and for details on the studies.

b. Residential Structure Warning Agent Use Mitigation

Details on chloropicrin's use as a warning agent prior to sulfuryl fluoride applications are included in the Agency's revised human health risk assessment as listed in Section III.B of this document.

The Agency reviewed monitoring studies completed by the California Air Resources Board (CARB) of the California Environmental Protection Agency. These studies directly monitored chloropicrin. The results of these studies are below the Agency's level of concern for bystanders.

i. Occupational Risk Mitigation

1. Respiratory Requirements

When chloropicrin is used as a warning agent prior to sulfuryl fluoride fumigations the July 2008 RED required that handlers wear respiratory protection, and that each handler was were fit tested, trained, and medically examined. The July 2008 RED, did not require monitoring because the Agency did not anticipate that the level of chloropicrin would exceed 1.5 ppm based on conservative estimates of labeled use rates.

The Agency received comments requesting that this use be reviewed during the Registration Review of sulfuryl fluoride, and also that additional mitigation for chloropicrin was not necessary for this use. Other commenters asked EPA to clarify the type of respiratory protection needed for this use.

Based on current data EPA is not changing the mitigation required in the July 2008 RED. Respiratory protection is still required and handlers must be fit-tested, trained and medically

[17] Zhang, Y. and Wang, D .2007. Emission, distribution, and leaching of methyl isothiocyanate and chloropicrin under different surface containments. Chemosphere, 2007 Jun; 68(3): 445-454.

examined. The Agency has listed acceptable respiratory protection devices and cartridges in the label table in Section V of this document.

c. Chloropicrin Antimicrobial Use Mitigation

For details on the chloropicrin human health risk assessment for antimicrobial uses, please refer to the revised occupational and residential/bystander assessment described in Section III.B of this document.

The July 2008 RED required that the antimicrobial uses of chloropicrin are subject only to the mitigation listed below. The Agency is only making one change to the *Air Concentration* section below to make the concentration level consistent with the 0.15 ppm level discussed in the *Respiratory Requirements* section on page 82. The rest of the mitigation remains the same as the July 2008 RED.

i. Bystander Risk Mitigation

The revised risk assessment indicates the potential for acute bystander exposure to chloropicrin when it is used for remedial wood treatment. The Agency believes that requiring the following will reduce this potential below the Agency's level of concern:

- Plug the pre-drilled holes immediately after chloropicrin applications;
- Do not treat structures/beams indoors; and
- Do not drill an application hole through seasoning checks to apply product. If the hole intersects a check, plug the hole and drill another. If more than 2 treatment holes intersect an internal void or rot pocket, redrill the holes farther up the pole into relatively solid wood.

ii. Occupational Risk Mitigation

The Agency's revised risk assessment indicates the potential for handler inhalation during the transfer of chloropicrin into vials and during the pouring/injection of chloropicrin into pre-drilled holes. To mitigate these risks, the Agency is requiring that applicators and handlers wear a full face tight-fitting or loose-fitting helmet or hood style NIOSH/MSHA approved respirator at all times when handling chloropicrin during the transfer of the product into vials and during the pouring/injecting of chloropicrin into pre-drilled holes. However, use of a respirator is not being proposed for application of the vials once they are filled.

1. Air Concentration

If a spill or leak were to occur, some of the current labels require respiratory protection if air concentrations of chloropicrin exceed 0.3 ppm at any time, while others require respiratory protection if the air concentrations exceed 0.1 ppm. To rectify these differences, the Agency is requiring that unprotected persons not be permitted entry into a spill area or clean-up area until the concentration of chloropicrin is measured with a device to be less than 0.15 ppm.

2. Respiratory Requirements

Applicators and handlers that directly pour or inject chloropicrin into timbers or fill vials must wear a full-face tight-fitting, or loose-fitting helmet or hood style NIOSH/MSHA approved respirator when handling chloropicrin. Since the Agency is requiring a full-face respirator and eyes are covered, and not a half-face respirator, all references to wearing goggles and/or full face shields for this application use must be removed from the labels.

Applicators and handlers that are involved in the vial application method are not required to wear a respirator (as the vials are already filled and capped). However, at least one air rescue device (e.g., SCBA) and air-purifying respirators and cartridges for each handler must be immediately available on-site in case of a spill or an emergency.

In order to ensure that the respiratory protection EPA is assuming is being achieved for this use, respiratory requirements for chloropicrin will include fit testing, respirator training, and annual medical evaluation. These requirements are the same as detailed in the respiratory protection section for pre-plant soil fumigation on page 87.

2. Endocrine Disruptor Effects

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 were scientific bases for including, as part of the program, 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. When the appropriate screening and/or testing protocols being considered under the Agency's Endocrine Disrupter Screening Program (EDSP) have been developed and vetted, chloropicrin may be subjected to additional screening and/or testing to better characterize effects related to endocrine disruption.

3. Endangered Species Considerations

The Agency has completed an endangered species risk assessment of the potential effects of chloropicrin on the Federally-listed threatened California red-legged frog. After completing the analysis of the effects of chloropicrin on the California red-legged frog, the Agency concluded that chloropicrin is "likely to adversely effect" this species.[18] Following a Biological Opinion by the U.S. Fish and Wildlife Service, the Agency may require additional mitigation.

D. Conclusions

The Agency has determined that products containing chloropicrin are eligible for reregistration provided the risk mitigation measures outlined above are adopted and label amendments are made to reflect these measures. Where labeling revisions are warranted, specific language is set forth in the label table in Section V of this document.

[18] http://www.epa.gov/espp/litstatus/effects/redleg-frog/index.html#chloropicrin

V. What Registrants Need to Do

EPA recognizes that the extent of the mitigation needed for chloropicrin and the other soil fumigants will require continued coordination among state regulatory agencies, EPA, registrants, growers and other stakeholders to ensure that all provisions of the RED are understood, that data are developed and evaluated expeditiously, and that bystander and worker protection measures are implemented as soon as practicable.

When the soil fumigant REDs were issued in July, 2008, EPA specifically requested comment on the mechanisms and timing of implementing the provisions of the REDs. After considering stakeholder comments largely focused on the challenges of implementing many new measures simultaneously, EPA has developed the following schedule:

July 2008	Chloropicrin RED issued
October 2008	Comment period closed
May 2009	EPA responds to comments, amends RED as appropriate
Mid 2009	EPA issues product and generic DCIs
September 1, 2009	**Registrants must submit revised labels to EPA**, reflecting phase one of the mitigation measures as outlined in Table 2: GAPs, rate reductions, limitations on use sites, new handler protection measures, tarp cutting and removal restrictions, extended worker re-entry restrictions, training information for workers, and relevant portions of the FMP requirements.
December, 2009	EPA reviews/approves new labeling for 2010 use season
During 2009-10	EPA works with registrants, states and stakeholders to develop and begin implementation of first responder and community outreach, applicator training, and compliance assistance and assurance measures.
September 1, 2010	Registrants must submit revised labels to EPA reflecting all remaining mitigation measures outlined in Table 2 including: applicator training, restrictions on applications near sensitive sites, buffer zones, buffer credits, buffer zone posting and buffer overlap prohibitions and exceptions, and the full FMP requirements.
2009-2012	Registrants develop data per DCIs
2013	EPA begins Registration Review for chloropicrin and other fumigants

<u>Labeling</u>

Registrants must submit labeling reflecting phase one mitigation measures by September 1, 2009. All measures will need to be reflected on labels submitted to EPA by September 1, 2010. Because of the relatively large amounts of product shipped under a single label, e.g., 50 gallon drums and railroad tank cars, changes to fumigant labeling can be adopted relatively quickly. Therefore, the Agency anticipates that labeling approved late in 2009 would begin to appear on products used for the 2010 fumigation season.

A. Manufacturing Use Products

1. Additional Generic Data Requirements

The generic data base supporting the reregistration of chloropicrin has been reviewed and determined to be substantially complete. However, the data listed below are necessary to confirm the reregistration eligibility decision documented in this RED.

a. Data Requirements for Chloropicrin Soil Uses

i. Human Health

1. Toxicity

There are no data requirements.

2. Residue Chemistry

There are no data requirements.

3. Occupational and Residential Exposure

See chart below.

OPPTS Guideline Number	Data Requirement	Study type
835.8100	Field volatility from soil, to determine flux for modeling purposes for applications using water seals	ORE
835.8100	Field volatility from soil, to determine flux for modeling purposes for untarp bed shank applications.	ORE

835.8100 - Field volatility from soil

Volatility studies are required for chloropicrin's soil uses to determine flux for modeling purposes. These studies will allow the Agency determine appropriate buffer zones when water seals are used. Data for the untarp bed shank application will enable a more refined inhalation risk assessment to be completed for buffer zone determinations.

ii. Environmental Fate and Ecological Effects

1. Environmental Fate

There are no data requirements.

2. Ecological Effects

See chart below.

OPPTS Guideline Number	Data Requirement	Study type
Special Study	Avian Acute Inhalation	ECO
870.1300	Acute Inhalation Toxicity Test-Rat	TOX
850.1075	Acute Fish Toxicity-bluegill and rainbow trout	ECO
850.1010	Acute Aquatic Invertebrate Toxicity	ECO
850.1075	Acute Marine/Estuarine Fish	ECO
850.1025	Acute Marine/Estuarine Mollusk	ECO
850.1035	Acute Marine/Estuarine Shrimp	ECO
850.4225	Seed Germination/Seedling Emergence – Tier II.	ECO
850.4250	Vegetative Vigor – Tier II.	ECO
850.4400	Aquatic Plant Growth – Tier II	ECO
850.3020	Honeybee Acute contact.	ECO

Special Study—Avian acute inhalation.

The current estimate of avian risk is based largely on the mammal assessment. This study will enable an inhalation risk assessment specific to birds. Since the risk assessment for terrestrial wildlife is focused on inhalation and this study will provide actual inhalation data rather than an estimation based on acute oral data, it is of even higher priority than the acute oral study.

870.1300—Acute inhalation toxicity test – rat.

The existing study (MRID 45117902) is classified by HED as Acceptable/Non-guideline. The 7/25/00 DER and 1/31/05 Revised HED Human Health Risk Assessment state: "The LC50 calculated for the study should not be considered to be a true LC50 for chloropicrin. Due to the sacrifice of all live animals at day 3 of the study instead of day 14, and too large of exposure particle sizes, the true LC50 could be lower." Thus, a new study will enable an improved wild mammal risk assessment with reduced uncertainty.

850.1075—Acute Fish Toxicity – bluegill and rainbow trout.

The risk assessment is currently relying on supplemental data. Flow-through studies with measured concentrations will greatly reduce uncertainty.

850.1010—Acute aquatic invertebrate toxicity.

The risk assessment is currently relying on supplemental data. Flow-through studies with measured concentrations will greatly reduce uncertainty.

850.1075—Acute Marine/Estuarine Fish.

Given the use patterns of chloropicrin, marine/estuarine species could be exposed. This study will enable a risk assessment specific for marine/estuarine species exposure.

850.1025—Acute Marine/Estuarine Mollusk.

Given the use patterns of chloropicrin, marine/estuarine species could be exposed. This study will enable a risk assessment specific for marine/estuarine species exposure. It will also improve certainty with the endangered species risk assessment, as this test species may be more representative of endangered freshwater mussels than the freshwater *Daphnia*.

850.1035—Acute Marine/Estuarine Shrimp.

Given the use patterns of chloropicrin, marine/estuarine species could be exposed. This study will enable a risk assessment specific for marine/estuarine species exposure. One toxicity value is available from a study published in the scientific literature, but it is from a static study without measured concentrations.

850.4225—Seed Germination/Seedling Emergence – Tier II.

Chloropicrin is used in part due to its phytotoxicity at the application site, and a wide range of open literature and other non-guideline studies indicate the potential for plant damage. This study will enable the assessment of risk to non-target terrestrial plants off-site.

850.4250—Vegetative Vigor – Tier II.

Chloropicrin has at least some phytotoxicity on the treatment site, based on label and open literature information. This study will enable the assessment of risk to non-target terrestrial plants off-site.

850.4400—Aquatic Plant Growth – Tier II.

Chloropicrin has at least some phytotoxicity on the treatment site, based on label and open literature information. This study will enable the assessment of risk to non-target aquatic plants off-site.

850.3020—Honeybee Acute contact.

This basic study is now being requested for virtually all outdoor uses, and will help determine the need for, and specifics of, bee hazard labeling.

iii. Other

OPPTS Guideline Number	Data Requirement	Study type
Special	Community Outreach and Education Programs	Special
Special	Training for Applicators Supervising Fumigations	Special
Special	Training Materials for Handlers	Special
Special	Buffer Zone Posting Signs	Special

Special Study - Community Outreach and Education Programs

The Agency is requiring registrants to develop and implement community outreach and education programs, including programs for first responders, to address these needs. Community outreach and education programs must include the following elements, at minimum: (1) what soil fumigants are and how they work, (2) what buffer zones are, (3) early signs and symptoms of exposure, (4) appropriate steps to take to mitigate exposures, (5) what to do in case of an emergency, (6) how to report an incident, and (7) how to develop and implement emergency response plans to ensure that applicators are prepared in the event that a problem develops during or shortly after the fumigant application. EPA is also requiring registrants to incorporate a mechanism for evaluating the effectiveness of their training programs at conveying the required information to participants and for determining whether participants have successfully completed the training program. EPA expects registrants' proposals for the first responder programs described in Section IV will also be designed to integrate with existing local first-response and emergency preparedness networks.

Special Study - Training for Applicators Supervising Fumigations

EPA has determined that training, developed and implemented by registrants to foster product stewardship, will help reduce potential risks associated with failure to adequately manage the complexities of fumigation, and failure to comply with fumigant product labeling. Additionally, EPA believes that providing safety information to other fumigant handlers will help them understand and adhere to practices that will help handlers protect themselves from risks of exposure.

Registrants are required to develop and implement training programs for applicators in charge of soil fumigations on the proper use of and GAPs for soil fumigants. EPA is requiring

registrants to submit proposals for these programs. The training programs must address, at minimum, the following elements: how to correctly apply the fumigant; how to protect handlers and bystanders; how to determine buffer zone distances; how to develop a FMP and complete the post-fumigation application summary; how to determine when weather and other site-specific factors are not favorable for fumigant application; how to comply with required GAPs and document compliance in the FMP. The training program must be made available to applicators at least annually. The registrant shall provide documentation, such as a card or certificate, to each applicator who successfully completes the training. This documentation shall include the applicator's name, address, license number, and the date of completion. The registrant must be able to provide to federal, state, or local enforcement personnel, upon request, the names, addresses, and certified applicator license numbers of persons who successfully completed the training program, as well as the date of completion. Applicators supervising fumigations must have successfully completed the program within the preceding 36 months and must document when and where the training program was completed in the FMP. The registrants will be required to (1) develop a database to track which certified applicators have successfully completed the training and (2) make this database available to state and/or federal enforcement entities upon request. In addition, the applicator must provide to federal, state, or local enforcement personnel, upon request, documentation that verifies completion of the appropriate training program(s).

Special Study - Training Materials for Handlers

EPA has determined that registrants must prepare and disseminate training information and materials for other fumigant handlers, i.e., those working under the supervision of the certified applicator in charge of fumigations. The training materials must address, at minimum, the following elements: (1) what fumigants are and how they work, (2) safe application and handling of soil fumigants, (3) air monitoring and respiratory protection requirements for handlers, (4) early signs and symptoms of exposure, (5) appropriate steps to take to mitigate exposures, (6) what to do in case of an emergency, and (7) how to report incidents. Registrants must provide this training information through channels open to the public (e.g., via a website). Pesticide labels will require that applicators supervising fumigations provide this training information to handlers under their supervision before they perform any fumigant handling task, or they must ensure that handlers have been provided the required information within the preceding 12 months. The label will also require that the training information be provided in a manner that the handler can understand. Applicators supervising fumigations must ensure the FMP includes how and when the required training information was provided to the handlers under their supervision.

Special Study – Buffer Zone Posting Signs

EPA has determined that registrants must prepare and disseminate generic buffer zone posting signs which meet the following criteria: (1) signs must remain legible during the entire posting period (2) signs must meet the general standards outlined in the WPS for text size and legibility (see 40 CFR §170.120). The requirements for the contents of the sign are as follows:

The **treated area** sign (currently required for fumigants) must state the following: -- Skull and crossbones symbol  -- "DANGER/PELIGRO," -- "Area under fumigation, DO NOT ENTER/NO ENTRE," -- "Chloropicrin fumigant in USE," -- the date and time of fumigation, -- the date and time entry prohibition is lifted -- Name of this product, and -- name, address, and telephone number of the certified applicator in charge of the fumigation.	The **buffer zone** sign must include the following: -- Do not walk sign  -- "DO NOT ENTER/NO ENTRE," -- "Chloropicrin OR [Name of product] Fumigant BUFFER ZONE," -- contact information for the certified applicator in charge of the fumigation

Registrants must capture all of the information above, excluding the contact information for the certified applicator in charge of fumigating. However, registrants must provide appropriate space on the sign, and the sign must be made of material appropriate for applicators to write in this information on the buffer zone posting signs. Registrants must provide buffer zone posting signs at the point of sale for applicators to use. EPA is requiring registrants to submit proposals that must address their strategy for development and dissemination of the buffer zone posting signs.

b. Chloropicrin Warning Agent Uses

There are no data requirements.

c. Antimicrobial Uses

There are no data requirements.

2. Labeling for Manufacturing-Use Products

To ensure compliance with FIFRA, manufacturing use product (MUP) labeling must be revised to comply with all current EPA regulations, PR Notices, and applicable policies.

B. End-Use Products

1. Additional Product-Specific Data Requirements

Section 4(g)(2)(B) of FIFRA calls for the Agency to obtain any needed product-specific data regarding the pesticide after a determination of eligibility has been made. The Registrant must review previous data submissions to ensure that they meet current EPA acceptance criteria

and if not, commit to conduct new studies. If a registrant believes that previously submitted data meet current testing standards, then the study MRID numbers must be cited according to the instructions in the Requirement Status and Registrants Response Form provided for each product. The Agency intends to issue a separate product-specific data call-in (PDCI), outlining specific data requirements.

2. Labeling for End-Use Products

In order to be eligible for reregistration, amend all product labels to incorporate the risk mitigation measures outlined in Section IV.

Appendix A

Chloropicrin PC Code 081501 Uses Eligible for Reregistration

Use Site	Formulation	Application Method	Maximum Application Rate/Number of Applications	Use Limitations
Pre-Plant Soil				
Agricultural Crops **<u>Berries</u>:** **caneberries, blackberries, boysenberries, dewberries, loganberries, raspberries, youngberries, blueberries, cranberries, gooseberries, huckleberries.** **<u>Small fruits</u>:** **strawberries, currants, grapes, kumquat, bananas, figs, persimmons, pineapple, pomegranates, tree fruits (all), vine fruits (all).** **<u>Citrus fruits</u>:** **Grapefruit, lemon, limes, oranges, tangelos, tangerines.** **<u>Nut crops</u>:** **almonds, cashews, chestnuts, filberts, hickory nuts, pecans, walnuts, pistachios.** **<u>Pome and stone fruits</u>:** **apples, pears, quinces,**	**soluble concentrate/liquid, pressurized gas, pressurized liquid, emulsifiable concentrate, and a ready-to-use product**	**1. Shank injection tarped**** **2. Shank injection untarped** **3. Shank injection deep (at least 18 inches) untarped** **4. Drip Irrigation Tarp** **5. Tree hole replant**	**1. 350 lbs ai/A** **2. 175 lbs ai/A** **3. 350 lbs ai/A** **4. 300 lbs ai/A** **5. 500 lbs ai/A (1 lb/100 ft^2)**	**See applicable GAPS from the label table.**

Use Site	Formulation	Application Method	Maximum Application Rate/Number of Applications	Use Limitations
apricots, cherries, nectarines, peaches, plums, prunes, dates. **<u>Cucurbits</u>: Melons (all), cantaloupes, casaba melons, crenshaw melons, honeydew, muskmelons, persian melons, watermelon, cucumbers, pumpkins, squash (summer and winter), mango melons.** **<u>Vegetables</u>: asparagus, eggplant, peppers, pimentos, tomatoes, cole crops, broccoli, brussels sprouts, cabbage, cauliflower, collards, kale, kohlrabi, endive, lettuce (all), mustard, spinach, Swiss chard, carrots, garlic, leeks, okra, onions, parsnips, potatoes, radishes, rutabagas, salsify, shallots, sweet potato, yams, popcorn, garden beets, celery, turnips, vegetables (all).** **<u>Field crops</u>: beans (all), peas (all), kenaf, forage-fodder grasses (all), pastures, alfalfa, clover, lespedeza, vetch,**				

Use Site	Formulation	Application Method	Maximum Application Rate/Number of Applications	Use Limitations
birdsfoot trefoil, barley, corn, oats, rye, sorghum, wheat, sugarcane, buckwheat, tobacco, safflower, cotton, flax, peanuts, soybeans, millet. **<u>Ornamentals</u>: golf course turf, ornamental turf, forest trees (all), herbaceous plants (all), woody plants (all), flowering plants (all).** **<u>Miscellaneous</u>: hops, horseradish, mint, olives, greenhouse soils, mushroom house soils.**				
Warning Agent Prior to Sulfuryl Fluoride Residential Fumigations				
Residential Structures	**Ready-to-Use**	**Chloropicrin is then placed in the center of the structure in either a shallow pan or onto absorbent material. A fan is then placed to direct the air stream over the pan or absorbent material to accelerate the chloropicrin's evaporation.**	**1 fluid ounce ai of chloropicrin is used per 10,000-15,000 cubic feet.**	
Remedial Wood Treatment				
Wood poles, timbers,	**Ready to use**	**There are two**	**<u>Pole</u>**	**Do not treat**

Use Site	Formulation	Application Method	Maximum Application Rate/Number of Applications	Use Limitations
pilings, and glue-laminated beams.		**methods for application of chloropicrin for remedial wood treatment. One method involves using encapsulated vials. Applicators pour liquid chloropicrin into vials and cap them. After the applicator has reached the area to be treated, the cap is removed and the vial inserted into the holes that have been pre-drilled into the timber. The hole is then capped. The other method involves pouring/injecting liquid chloropicrin into holes that have been pre-drilled. The hole is then capped.**	**<u>Circumference in inches and amount of solution to be applied</u> :** **22-29in, use ¼ pint** **30-38in, use ½ pint** **39-56in, use 1.0 pint** **57-65in, use 1 ¼ pint**	**structures/beams indoors.** **Do not drill an application hole through seasoning checks to apply product. If the hole intersects a check, plug the hole and drill another. If more than 2 treatment holes intersect an internal void or rot pocket, re-drill the holes farther up the pole into relatively solid wood.**

**The application method matches up with the same number for the maximum application rate. For example, the maximum application rate for shank bedded tarped applications is 350 lbs ai/A.

Appendix B
Table of Generic Data Requirements and Studies Used to Make the Reregistration Decision

This section is currently not available.

Appendix C.

Technical Support Documents

Additional support of this RED is maintained in the OPP docket EPA-HQ-OPP-2007-0350. This docket may be accessed in the OPP docket room located at S-4900, One Potomac Yard 2777 S. Crystal Drive, Arlington, VA. It is open Monday through Friday, excluding federal holidays, from 8:30-4:00 pm. All documents may be view in the OPP docket room or downloaded or viewed via the internet at http://www.regulations.gov.

Health Effects Support Documents

- Methyl Bromide, 1,3-Dichloropropene, Chloropicrin, Dazomet, Metam Sodium/Potassium, MITC: Health Effects Division (HED) Component of Agency Response To Comments On 2008 Reregistration Eligibility Documents (Date May 14, 2009)
- Chloropicrin: Third Revision of the HED Human Health Risk Assessment. April 30, 2009 (DP Barcode 348637).
- EPA-HQ-OPP-2007-0350-0170, RESPONSE TO PUBLIC COMMENTS. The Health Effects Division's Response to Comments on the Agency's April 12, 2007 document, Chloropicrin: Revised HED Human Health Risk Assessment for Phase 5 (Docket EPA-HQ-OPP-2007-0350). DP Barcode 348676.
- EPA-HQ-OPP-2007-0350-0172, MOA Mode of Action, Eye Irritation, and the Intra-Species Factor: Comparison of Chloropicrin and MITC. June 25, 2008. DP Barcode 293356.
- EPA-HQ-OPP-2007-0350-0173, Factors Which Impact Soil Fumigant Emissions - Evaluation For Use In Soil Fumigant Buffer Zone Credit Factor Approach. June 9, 2008. (DP Barcode 306857)

Environmental Fate and Ecological Effects Support Documents

- Further Response to Public Comments on the 7/9/08 Completed Chloropicrin RED. (March 3, 2009)
- Evaluation of "Probabilistic Modeling of Chloropicrin Exposure to Aquatic Nontarget Organisms" (March 3, 2009).
- Response to Comments from Dow Agrochemicals Regarding EPA's Review of the Chain-2D Model (March 3, 2009).
- EPA-HQ-OPP-2007-0350-0174, Response to Phase 5 Public Comments on the Phase 4 Chloropicrin Reregistration Risk Assessment. April 16, 2008. DP Barcode 348669.
- EPA-HQ-OPP-2007-0350-0175, Revised Screening Ecological Risk Assessment for the Reregistration of Chloropicrin. DP Barcode 348669. April 16, 2008.

Biological and Economical Analysis Support Documents

- Response to BEAD Related Public Comments Received on the Reregistration Eligibility Decision for Chloropicrin, Dazomet, Metam Potassium, Metam Sodium, and Methyl Bromide (DP# 363545) May 14, 2009.

- Analysis of Soil Fumigant Risk Management Requirements using Geographic Information Systems: Case Studies based on a Forest Seedling Nursery (DP#363546). May 13, 2009.
- Process for Defining High-Use Fumigation Areas at the State and County Levels (DP#364647) May 14, 2009.
- EPA-HQ-OPP-2007-0350-0168, Review of Stakeholder Submitted Impact Assessments of Proposed Fumigant Buffers, Comments on Initial Buffer Zone Proposal, and Case Studies of the Impact of a Flexible Buffer System for Managing By-Stander Risks of Fumigants. June 25, 2008. DP Barcode 353940.
- EPA-HQ-OPP-2007-0350-0169, Response to Phase 5 BEAD Related Public Comments Received on the Reregistration of Chloropicrin, Dazomet, Metam Potassium, Metam Sodium, and Methyl Bromide. June 25, 2008. DP Barcode 353940.
- EPA-HQ-OPP-2007-0350-0017, Summary of the Benefits of Soil Fumigation with Chloropicrin in Crop Production.
- EPA-HQ-OPP-2007-0350-0018, Assessment of the Benefits of Soil Fumigation with Chloropicrin, Methyl Bromide, and Metam Sodium in Cucurbit Production.
- EPA-HQ-OPP-2007-0350-0019, Assessment of the Benefits of Soil Fumigation with Chloropicrin, Methyl Bromide, and Metam Sodium in Eggplant Production
- EPA-HQ-OPP-2007-0350-0020, Assessment of the Benefits Soil Fumigants (Methyl Bromide, Chloropicrin, Metam-Sodium, Dazomet) Used by Forest Tree Seedling Nurseries.
- EPA-HQ-OPP-2007-0350-0021, Assessment of the Benefits of Soil Fumigation with Methyl Bromide, Chloropicrin, Dazomet, and Metam Sodium for Use in Raspberry Nurseries, Fruit and Nut Deciduous Tree Nurseries, and Rose Bush Nurseries in California.
- EPA-HQ-OPP-2007-0350-0022, Assessment of the Benefits of Soil Fumigation with Chloropicrin and Metam-sodium in Onion Production.
- EPA-HQ-OPP-2007-0350-0023, Assessment of the Benefits of Soil Fumigation with Methyl Bromide, Chloropicrin, and Metam Sodium in Grape Production.
- EPA-HQ-OPP-2007-0350-0024, Assessment of the Benefits of Soil Fumigation with Methyl Bromide, Chloropicrin and Metam Sodium in Tree Nut Production.
- EPA-HQ-OPP-2007-0350-0025, Assessment of the Benefits of Soil Fumigation with Chloropicrin and Metam Sodium in Pome Fruits Production.
- EPA-HQ-OPP-2007-0350-0026, Assessment of the Benefits of Soil Fumigation with Methyl Bromide, Chloropicrin, and Metam Sodium in Stone Fruit Production.
- EPA-HQ-OPP-2007-0350-0027, Assessment of the Benefits of Soil Fumigation with Chloropicrin, Methyl Bromide, and Metam Sodium in Bell Pepper Production.
- EPA-HQ-OPP-2007-0350-0028, Assessment of the Benefits of Soil Fumigation with Metam Sodium in Potato Production.
- EPA-HQ-OPP-2007-0350-0029, Assessment of Soil Fumigation with Chloropicrin, Methyl Bromide and Metam-sodium in Strawberry Production.
- EPA-HQ-OPP-2007-0350-0030, Assessment of the Benefits of Chloropicrin, Methyl Bromide, Metam-sodium and Dazomet Use In Strawberry Nursery Runner Production.
- EPA-HQ-OPP-2007-0350-0031, Assessment of the Benefits of Soil Fumigation with Chloropicrin, Methyl Bromide, and Metam-sodium on Sweet Potato Production.

- EPA-HQ-OPP-2007-0350-0032, Assessment of the Benefits of Soil Fumigation with Chloropicrin in Tobacco Production.
- EPA-HQ-OPP-2007-0350-0033, Assessment of the Benefits of Soil Fumigation with Chloropicrin, Methyl Bromide, and Metam Sodium in Tomato Production.
- EPA-HQ-OPP-2007-0350-0034, Assessment of the Benefits of Soil Fumigation with Metam-Sodium in Carrot Production.
- EPA-HQ-OPP-2007-0350-0035, Assessment of the Benefits of Soil Fumigation with Metam Sodium in Peanut Production.
- EPA-HQ-OPP-2007-0350-0036, Assessment of the Benefits of Soil Fumigation with Chloropicrin, Methyl Bromide, Metam Sodium and Dazomet in Ornamental Production.
- EPA-HQ-OPP-2007-0350-0037, BEAD's Planned Impact Assessments on Agricultural Sites with Significant Use of Soil Fumigants (Chloropicrin, Dazomet, Methyl Bromide, Metam Potassium, and Metam Sodium.

Antimicrobial Assessment Support Documents

- EPA-HQ-OPP-2007-0350-1065, Revised Occupation and Residential/Bystander Assessment of the Antimicrobial Use (Remedial Wood Treatment) of Chloropicrin for the Reregistration Eligibility Decision (RED) Document. (Phase 3 Comment). PC Code 081501, DP Barcode 314399.
- EPA-HQ-OPP-2007-0350-1066, Phase 6 Response to Substantive Public Comments on Antimicrobials Division's Occupational and Residential Assessments for the Reregistration Eligibility Decision (RED) Documents for the following chemicals: Methylisothiocyanate (MITC), Metam Sodium, Dazomet, and Chloropicrin.
- EPA-HQ-OPP-2007-0350-1067, Updated Label Language for the Antimicrobial Uses of Chloropicrin (PC Code 081501) for the Reregistration Eligibility Decision Document.

Buffer Zone Credits Support Document

- Methyl Bromide (PC Code 053201), Chloropicrin (PC Code 081501), Dazomet (PC Code 035602), Metam Sodium and Potassium (PC Codes 039003 &039002), MITC (PC Code 068103), DP Barcode 362369, Updated Health Effects Division Recommendations for Good Agricultural Practices and Associated Buffer Credits. May 14, 2009
- EPA-HQ-OPP-2007-0350-1073, Factors Which Impact Soil Fumigant Emissions - Evaluation for Use in Soil Fumigant Buffer Zone Credit Factor Approach. Dawson, J. and Smith, C.; D306857; June 9, 2008..
- EPA-HQ-OPP-2007-0350-1078, Health Effects Division Recommendations for Fumigant Data to Refine Exposure Assessments. DP Barcode 353724.

Risk Management Support Documents

- EPA-HQ-OPP-2007-0350-1077, SRRD's Response to Phase 5 Public Comments for the Soil Fumigants. Rice, M. and McNally, R.; July 2008.
- EPA-HQ-OPP-2007-0350-0003, Risk Mitigation Options to Address Bystander and Occupational Exposures from Soil Fumigant Applications.
- SRRD's Response to Post-RED Comments for the Soil Fumigants. May 27, 2009.

Appendix D
PERFUM Model Inputs and Outputs

Version 2.1.4 of the **P**robabilistic **E**xposure and **R**isk model for **Fum**igants (also called the PERFUM model) combined with monitoring data and incident data were used to characterize the risk for specific buffer zone distances corresponding to the range of application scenarios anticipated. A CD containing all of the PERFUM input/output files and files with the PERFUM MOE/air concentration analysis that were considered for this decision are available upon request at the OPP Docket Office. Additional information on the PERFUM inputs and outputs can be found in the Agency's risk assessment[3], in a June 2006 a peer-reviewed article describing the model (http://www.sciencedirect.com/science/journal/13522310), and/or the PERFUM user's guide which can be download from the internet (http://www.exponent.com/perfum/)

The major input parameters for the PERFUM model were: application rates, application block sizes, application method emission studies, weather conditions, and target air concentration (based on acute inhalation endpoint and uncertainty factors). The following summarizes the key points for each of these input parameters.

- Rates
    - Agricultural Field

Although labels currently allow higher rates, the Agency modeled the maximum rates supported by the CMTF. These rates are listed in Section II B on page 18. Buffer zones were determined for the maximum rates as well as increments less than the maximum application rate. This was done to allow flexibility in the buffer approach while taking into consideration current typical use patterns. According to 2007 Agency proprietary data about 93% of chloropicrin usage is at rates less than 125 lbs ai/A. The Agency completed a series of benefit assessments by crop and region that include a more detailed analysis of use rates.

    - Greenhouse

The maximum application rate for greenhouse drip applications is 300 lbs ai/A. This is the same rate used in outdoor agricultural field drip applications.

Rates for bedded or strip applications (lb ai per treated area) were converted to broadcast equivalent application rate to determine the minimum buffer zone distance. In Figures 8 and 9 (shown below), the dashed line represents the perimeter of the field, the shaded area is the portion of the field that is treated, and the un-shaded area is the untreated portion of the field. Assuming both fields are 10 acres, and only 50% of field in Figure 9 is fumigated, the *rate per treated acre* is 400 lbs ai/A for both Figure 8 and 9. The *broadcast rate* for Figure 8 is 400 lb ai/A but the *effective broadcast equivalent rate* for Figure 9 is 200 lbs ai/A.

Labels may express rates as lbs per treated acre under the application instructions but they must identify buffer zone distances based on the broadcast or effective broadcast equivalent rates.

Figure 8. Broadcast Application

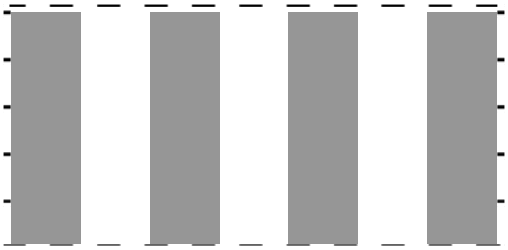


Figure 9. Bedded Application

- Block Size
    - Agricultural Field

The Agency has limited information regarding the size of the application blocks typically treated in a given day, but estimates that each crew or application rig treats less than 40 acres for most scenarios. However several commercial applicators have indicated that they sometimes use multiple rigs and crews to treat blocks greater than 80 acres per day.

Buffer zone distances were determined for 1, 5, 10, 20, 30, 40, 50, 60, and 80 acres.

The application block size pertains to size of the field and not the size of the area treated. The area inside the dashed lines in both Figures 8 and 9 is the application block. In this example the application block size for both figures is 10 acres. For both figures, 10 acres would be used to determine the buffer zone distance.

- Greenhouse

Greenhouse soil fumigations can take place in a wide range of structure sizes. The Agency modeled the following 5,000; 10,000; 15,000; 20,000; 25,000; 30,000; 35,000; 40;000; 45,000; and 50,000 ft^2.

- Emission Studies and Weather Data
    - Agricultural Field

This section has been updated and is presented in the *New Flux (Emission) Studies* section on page 44.

- Greenhouse

A flux study was not used. Instead a 24-hour continuous single emission was used in the modeling runs. This is based upon current California permit conditions. Ventura, CA weather data was used.

- Target Air Concentration

- Agricultural Field and Greenhouse

Based on several factors including the severity and reversibility of the effect, and the quality of the hazard database, the buffer zone distance target is to reach an air concentration of 0.073 ppm which equates to an MOE of 1. At minimum, if the target MOE was not reached, half of the target (MOE 0.5), which corresponds to minor, reversible effects, was achieved with the buffer zone distance selected.

PERFUM Model Outputs

The PEFRUM model outputs are presented in percentiles for "whole field" and the "maximum distance" distributions. The model also provides outputs as distributions of air concentrations from which MOEs can be estimated. The following summarizes the key points for each of these *output* parameters.

The maximum distance distribution is a compilation of the farthest predicted distances (i.e., the farthest downwind points) over 5 years of weather. The whole field distribution differs because it includes all points around the perimeter of the application block for the same period. Another way to consider the difference between the distributions is that maximum distance results are a subset of the whole field results and that maximum distances allow for more resolution at the upper percentiles of this distribution. Version 2.1.4 of PERFUM also allows for direct consideration of air concentrations at various distances around treated fields. These air concentrations and MOEs were also considered in the decision making process.

An analysis based on a variety of PERFUM outputs was used in the buffer distance determinations. This involved consideration of the typical maximum and whole-field results, which are predictions of the distances where a target concentration of concern is achieved at varying percentiles of exposure. In addition, a complementary approach, which determined the percentiles of exposure for maximum and whole-field buffers at predetermined buffer distances, was employed. Air concentration data were also used to calculate risk estimates (i.e., MOEs) at predefined buffer distances and varied percentiles of exposure.

This overall approach allowed the Agency to utilize more of the information available from PERFUM so that a more comprehensive view of the risks could be considered. Buffer distances indicated by this type of analysis along with information from monitoring studies and incidents were valuable in determining buffer distances to manage potential risks from chloropicrin use when coupled with other mitigation measures.

Appendix E
Sample FMP for Soil Applications

(Please note that this example is tailored to methyl bromide and will be refined for chloropicrin at a later date).

FUMIGANT MANAGEMENT PLAN

Certified Applicator Supervising the Fumigation		
Name and phone number:	License number:	☐ Commercial applicator ☐ Private applicator
Employer name and address:		Date of completing registrant training program:

General Site Information
Application block location, address, or global positioning system (GPS) coordinates:
Name, address, and phone number of owner/operator of application block:

General Application Information		
Target application date/window:	Brand name of fumigant:	EPA Registration Number:

Tarps (check here if section is not applicable ☐)		
Brand name:	Lot #:	Thickness:
Name and phone number of contact person responsible for repairing tarps:		
Schedule for checking tarps for damage, tears, and other problems:		
Maximum time following notification of damage that the person(s) responsible for tarp repair will respond:		
Minimum time following application that tarp will be repaired:	Minimum size of damage that will be repaired:	
Other factors used to determine when tarp repair will be conducted:		
Name and phone number of contact person responsible for cutting and/or removing tarps (if other than certified applicator):	Equipment/methods used to cut tarps:	
Schedule and target dates for cutting tarps:	Schedule and target dates for removing tarps:	

Soil Conditions	
Description of soil texture and moisture in application block:	Description of method used to determine soil moisture level:

Weather Conditions

Summary of the weather forecast for the day of the application and the 48-hour period following the fumigant application (may attach a copy of printed forecast to FMP):

Buffer Zones

Application method:	Rate from lookup table on label (lb ai/A):	Block size from lookup table on label (acres):	Credits applied:	Buffer zone distance:
☐ Bedded ☐ Broadcast ☐ Hot gas - outdoor ☐ Hot gas - greenhouse ☐ Hand held probes			☐ high barrier film _____ % ☐ organic content _____ % ☐ clay content _____ % ☐ other: _____ % Total credits _____ %	_____ ft

List and describe areas in the buffer zone that are not under the control of owner/operator of the application block:

Personal Protective Equipment for Handlers

Handler Task	Clothing	Respirator Type, Filter Cartridge Type and Change-out Schedule	Eye Protection	Gloves	Other

Emergency Response Plan

Description of evacuation routes:

Locations of telephones:

Contact information for first responders:	Local/state/federal contacts:	Other contact information for emergencies:

Emergency procedures/responsibilities in case of an incident, equipment/tarp/seal failure, complaints or elevated air concentration levels outside buffer zone suggesting potential problems, or other emergencies).

Posting Signs

Name and phone number of person that is doing posting:

Location of posting signs:

Procedures for posting and sign removal:

Site Specific Response and Management ☐ Fumigation Site Monitoring or ☐Response Information for Neighbors

If **Response Information for Neighbors** has been selected, completed the following:

If buffer zone is 25-100 ft:	☐ Neighbors within 50 ft of buffer zone	☐ No neighbors within 50 ft of buffer zone
If buffer zone is 100-200 ft:	☐ Neighbors within 100 ft of buffer zone	☐ No neighbors within 100 ft of buffer zone
If buffer zone is 200-300 ft:	☐ Neighbors within 200 ft of buffer zone	☐ No neighbors within 200 ft of buffer zone
If buffer zone is > 300 ft:	☐ Neighbors within 300 ft of buffer zone	☐ No neighbors within 300 ft of buffer zone
If buffer zones overlap	☐ Neighbors within 300 ft of buffer zone	☐ No neighbors within 300 ft of buffer zone

List of residences and businesses informed (neighboring property owners):

Name, address, and phone number of person providing information:

Method used to provide information:

Notice to State Lead Tribal Agencies

If your state and/or tribal lead agency requires notice, list contacts that were notified:	Date notified:

Communication Between Applicator, Land Owner/Operator, and Other On-site Handlers

Plan for communicating to the land owner/operator and all on-site handlers (e.g., tarp cutters/removers, irrigators) requirements to comply with label including location and start/stop times of buffer zones; timing of tarp cutting/removal, and PPE:

Names and phone numbers of persons contacted:	Date contacted:

Comments/notes:

Site Map

Location of application block: _____

Map Legend

Application block
Buffer zone
Property lines
Roads
Right-of-way
Walkway, sidewalk, path
B Bus stop
WB Water body
DC Daycare facility
Sch School
NAB Nearby application block
IPC Inpatient clinic
P Prison
Well
NH Nursing home
ALF Assisted living facility

Handler Information

Handler Name, Address, and Phone Number	Employer Name, Address, and Phone Number	Tasks They are Trained and Authorized to Perform	Date of PPE Training	Date of Medical Qualification to Wear a Respirator	Date of Fit Testing for Respirator

Air Monitoring Plan

For Buffer Zone Monitoring: (check here if section is not applicable ☐)

Name of handler performing monitoring activities	Handler address	Handler phone number	Location of monitoring	Timing

For Handlers without Respiratory Protection: (check here if section is not applicable ☐)

If sensory irritation is experienced: ☐ **Intend to cease operations** ☐ **Intend to continue operations with respiratory protection**
If intend to continue operations with respiratory protection, complete section for Handlers with Respiratory Protection below.

If intend to cease operations - Name, address, and phone number of handler to perform monitoring activities prior to operations resuming:	Monitoring equipment:

For Handlers with Respiratory Protection: (check here if section is not applicable ☐)

Representative Handler Tasks to be Monitored	Monitoring Equipment	Timing

Air Monitoring Plan for Methyl Bromide Formulation with < 20% Chloropicrin

For Buffer Zone Monitoring: (check here if section is not applicable ☐)

Name, address, and phone number of person(s) to perform sampling:

Area or Structure to be Monitored Before Reentry is Permitted	Monitoring Equipment	Timing

For Handlers with Respiratory Protection:

Representative Handler Tasks to be Monitored	Monitoring Equipment	Timing

Methyl Bromide FMP Check List

General Site Information	
A map, aerial photo, or detailed sketch is attached to this FMP that shows each of the following with distances from the application site labeled: field location, application block dimensions, buffer zones, property lines, roads, bus stops, water bodies, wells, rights-of-ways, nearby application blocks, surrounding structures, and sites requiring ⅛ and ¼ mile buffer zones.	☐
Supervision of Handlers	
An on site certified applicator will directly supervise the handlers participating in the application starting when the fumigant is first introduced into the soil and ending after the fumigant has stopped being delivered/dispensed to the soil and the soil is sealed.	☐
After the application is complete, and before leaving the application block, the certified applicator has provided the owner/operator and handlers with written information necessary to comply with the label and procedures outlined in the FMP.	☐
Fumigant safe handling information has been provided to each handler involved in the application or confirm that each handler participating in the application has received fumigant safe handling information in the past 12 months.	☐
For all fumigation handling tasks, at least 2 WPS-trained handlers must be present.	☐
Weather Conditions	
Wind speed at the application site is a minimum of 2 mph at the start of the application or forecasted to reach at least 5 mph during the application.	☐
A shallow, compressed (low-level) temperature inversion is not forecast to persist for more than 18 consecutive hours during the 48-hour period after the application.	☐
An air-stagnation advisory is not in effect for the area where the application site is located.	☐
If air temperatures have been above 100 degrees F in any of the 3 days prior to application, then soil temperature will be measured and recorded in the post application summary report.	☐
Soil Conditions	
The soil has been properly prepared and the surface has been checked to ensure that it is free of clods that are golf ball size or larger.	☐
The area to be fumigated has been tilled to a depth of 5 to 8 inches.	☐
Field trash has been properly managed (e.g., residue from a previous crop has been worked into the soil to allow for decomposition prior to fumigation, little or no crop residue is present on the soil surface, and crop residue that is present does not interfere with the soil seal).	☐
The soil temperature at the depth of injection ≤ 90 degrees F at the beginning of the application.	☐
The soil moisture at 9 inches below the surface is sufficient (field capacity is 50 to 80 percent).	☐
Trash pulled by the shanks to the ends of the field will be covered with tarp or soil before making the turn for the next pass.	☐
Shank Applications (check here if section is not applicable ☐)	
For tarped-broadcast and -bedded applications, injection points will be at least 8 inches from the nearest final soil/air interface.	☐
For tarped-bedded applications, the injection depth will not be as deep as the lowest point of the tarp (i.e., the lowest point of the tuck).	☐
For untarped-bedded applications, the injection points will be at least 12 inches from the nearest final soil/air interface.	☐
For untarped-broadcast applications, the injection points will be at least 18 inches from the nearest final soil/air interface.	☐
For broadcast untarped applications, a disc or similar equipment will be used to uniformly mix the soil to at least a depth of 3 to 4 inches to eliminate the chisel or plow traces and will following elimination of the chisel trace, the soil surface will be compacted with a cultipacker, ring roller, and roller in combination with tillage equipment.	☐
For performed bed applications, the soil will be sealed by disruption of the chisel trace using press sealers, bed shapers, cultipackers, or by re-shaping (e.g., relisting, lifting, replacing) the beds immediately following injection.	☐
For beds formed at the time of application, the soil will be sealed by disrupting the chisel trace using press sealers, or bed shapers.	☐
For shanked bedded and broadcast applications, tarps will be installed immediately after fumigant is injected into the soil.	☐
Applicators have been trained and instructed not to apply or allow fumigant to drain onto the soil surface.	☐
For each injection line a check valve been located as close as possible to the final injection point, or applicators will drain/purge the line of any remaining fumigant prior to lifting injection shanks from the ground.	☐
Applicators have been trained and instructed not to lift injection shanks from the soil until the shut-off valve has been closed and the fumigant has been depressurized (passively drained) or purged (actively forced out via air compressor) from the system.	☐
Brass, carbon steel, or stainless steel fittings must be used throughout application rigs.	☐
Polyethylene tubing, polypropylene tubing, Teflon® tubing or Teflon® -lined steel braided tubing have been used for all low pressure lines, drain lines, and compressed gas or air pressure lines and is all other tubing Teflon® -lined steel braided.	☐
Application equipment been inspected to ensure that application rigs do not contain galvanized, PVC, nylon, or aluminum pipe fittings.	☐
All rigs include a filter to remove any particulates from the fumigant, and a check valve to prevent backflow of the fumigant into the pressurizing cylinder or the compressed air system.	☐
All rigs include a flowmeter or a constant pressure system with orifice plates to insure the proper amount of fumigant is applied.	☐
Applicators have been trained and instructed to ensure that positive pressure is maintained in the cylinder at not less than 200 psi during the entire time it is connected to the application rig, if a compressed gas cylinder is used. (This is not required for a compressed air system that is part of the application rig because if the compressor system fails the application rig will not be operable).	☐
Application rigs are equipped with properly functioning check valves between the compressed gas cylinder or compressed air system and the fumigant cylinder.	☐
Applicators have been trained and instructed to always pressurize the system with compressed gas or by use of a compressed air system before opening the fumigant cylinder valve.	☐

Before using a fumigation rig for the first time, or when preparing it for use after storage, applicators have been trained and instructed to: ° Check the filter, and clean or replace the filter element as required. ° Check all tubes and chisels to make sure they are free of debris and obstructions. ° Check and clean the orifice plates and screen checks, if installed. ° Pressurize the system with compressed gas or compressed air, and check all fittings, valves, and connections for leaks using soap solution.	☐
Applicators have been trained and instructed to: ° Install the fumigant cylinder, and connect and secure all tubing. Slowly open the compressed gas or compressed air valve, and increase the pressure to the desired level. Slowly open the fumigant cylinder valve, always watching for leaks. ° When the application is complete, close the fumigant cylinder valve and blow residual fumigant out of the fumigant lines into the soil using compressed gas or compressed air. At the end of the application, disconnect all fumigant cylinders from the application rig. At the end of the season, seal all tubing openings with tape to prevent the entry of insects and dirt. ° Calibrate all application equipment and ensure that all control systems must be working properly.	☐
Hot Gas Applications (check here if section is not applicable ☐)	
Tarps have been installed prior to starting the application.	☐
All delivery tubes have been placed under the tarp in such a way that they do not move during the application of methyl bromide.	☐
The fumigant will be introduced from outside of the greenhouse.	☐
All fittings, connections, and valves have been checked for leaks prior to fumigation and if cylinders are replaced during the fumigation process, the connections and valves were checked for leaks prior to continuing the job.	☐
Tree Replant (non-shank) Application (check here if section is not applicable ☐)	
For each individual tree-site, the tree stump and primary root system have been removed and the tree hole has been backfilled with soil before application.	☐
The fumigant will be injected at a depth of at least 18 inches into the soil.	☐
The wand will be cleared using nitrogen or compressed air before removing it from the soil and after the wand is cleared and removed from the soil, the injection hole will be covered with soil and tamp or the soil will be compacted over the injection hole.	☐
Buffer Zones	
There are no difficult to evacuate sites within ¼ (or ⅛) miles of the application block that will be occupied during the buffer zone period.	☐
There are no bus stops or other locations where persons wait for public transit within the buffer zone.	☐
There are no buildings used for storage such as sheds, barns, garages, within the buffer zone that are occupied or that share a common wall with an occupied structure.	☐
For areas in the buffer zone that are not under the control of owner/operator of the application block, written agreement has been obtained from occupants that they will voluntarily vacate the buffer zone during the entire buffer zone period.	☐
For nearby agricultural areas that are in the buffer zone the owner/operator of that property provided written agreement that they, their employees, or other persons will stay out of the buffer zone during the entire buffer zone period.	☐
For publicly owned and/or operated areas (e.g., parks, rights of way, side walks, walking paths, playgrounds, athletic fields) written permission has been given to include the public area in the buffer zone from the appropriate local and/or state officials.	
Buffer Zones Overlap (check here if section is not applicable ☐)	☐
A minimum of 12 hours has elapsed from the time the 1st application ends until the 2nd application begins.	☐
If a structure exists within 300 feet of the buffer zone, appropriate emergency preparedness and response procedures are followed.	☐
Certified applicator has informed handlers of the overlapping buffers and associated health protection requirements.	☐
Personal Protective Equipment for Handlers	
At least 1 air rescue device (e.g., SCBA) is on-site in case of an emergency.	☐
All of the handler's PPE has been cleaned and maintained as required by the WPS for Agricultural Pesticides.	☐
Hazard Communication	
The application area buffer zone has been posted in accordance with the label.	☐
Pesticide product labels and material safety data sheets are on-site and readily available for employees to review.	☐
Recordkeeping	
The owner/operator of the application block has been informed that he/she as well as the certified applicator must keep a signed copy of the site-specific FMPs and the post-application summary record for 2 years from the date of application.	☐

I have verified that this site-specific FMP reflects current site conditions and product label directions before beginning the fumigation.

_____ _____

Signature of certified applicator supervising the fumigation **Date**

Post-Application Summary

General Application Information		
Application date and time:	Application rate:	Size of application block:

Weather Conditions

Summary of the weather on the day of the application:

Summary of the weather during the 48-hour period following the fumigant application:

Soil Conditions (check here if section is not applicable ☐)

Soil temperature if air temperatures were above 100 degrees F in any of the 3 days prior to the application:

Tarp Damage and Repair (check here if section is not applicable ☐)

Location and size of tarp damage:

Description of tarp/tarp seal/tarp equipment failure:

Date and time of tarp repair:

Additional comments or other deviations from FMP (if applicable):

Tarp Removal (check here if section is not applicable ☐)

Description of tarp removal (if different than in the FMP):

Date tarps were cut:	Date tarps were removed:

Complaints (check here if section is not applicable ☐)

Person filing complaint: ☐ On-site handler ☐ Person off-site	If off-site person, name, address, and phone number of person filing complaints:

Description of control measures or emergency procedures followed after complaint:

Additional comments:

Description of Incidents (check here if section is not applicable ☐)	
Description of incident, equipment failure, or other emergency:	Date and time:
Description of emergency procedures followed:	
Additional comments:	

Elevated Air Concentration Levels (check here if section is not applicable ☐)		
☐ On-site ☐ Outside buffer zone	Location of elevated air concentration levels:	Date and time:
Description of elevated air concentration levels: (provide air monitoring results on next page)		
Description of control measures or emergency procedures followed:		
Description of deviations from FMP (if applicable):		

Posting Signs
Date of sign removal:
Description of deviations from FMP (if applicable):

Other
Additional comments/notes:

Air Monitoring Results

When Respiratory Protection is Not in Use – Sensory Irritation Experienced (check here if section is not applicable ☐)				
Date and Time	**Handler Task/Activity**	**Handler Location Where Irritation Was Observed**	**Resulting Action**	**Comments**
			☐ Cease operations ☐ Respiratory protection	
			☐ Cease operations ☐ Respiratory protection	
			☐ Cease operations ☐ Respiratory protection	
			☐ Cease operations ☐ Respiratory protection	
			☐ Cease operations ☐ Respiratory protection	

When Respiratory Protection is in Use – Direct Read Instrument Air Monitoring (check here if section is not applicable ☐)							
Sample Type	**Sample Number**	**Sample Date/Time**	**Handler Task/Activity (not applicable for structural monitoring)**	**Handler Location/ Structure Location**	**Air Concentration**	**Sampling Method**	**Comments (e.g., sensory irritation experienced while wearing respirator)**
☐Area ☐Breathing Zone ☐Structure							
☐Area ☐Breathing Zone ☐Structure							
☐Area ☐Breathing Zone ☐Structure							
☐Area ☐Breathing Zone ☐Structure							
☐Area ☐Breathing Zone ☐Structure							
☐Area ☐Breathing Zone ☐Structure							
☐Area ☐Breathing Zone ☐Structure							
☐Area ☐Breathing Zone ☐Structure							
☐Area ☐Breathing Zone ☐Structure							
☐Area ☐Breathing Zone ☐Structure							

I have verified that this post application summary reflects the actual site conditions during the fumigation and an accurate description of deviations from the FMP (if applicable).

______________________________________ ____________________________

Signature of certified applicator supervising the fumigation **Date**