Iodomethane Registration Decision Options
Revised 4-15-10

Pre-decisional Document -
Internal Discussion Only

ISSUE

Whether to register the iodomethane technical product and four end-use products requested by Arysta LifeScience North America Corporation (Arysta). The products include Iodomethane Technical (U.S. EPA Registration Number 66330-44), Midas 98:2 (U.S. EPA Registration Number 66330-43), Midas 50:50 (U.S. EPA Registration Number 66330-57), Midas 33:67 (U.S. EPA Registration Number 66330-59) Midas EC Gold (U.S. EPA Registration Number 66330-60). On February 3, 2010, Arysta informed DPR that that it chose not to maintain the federal registration for Midas 25:75 (U.S. EPA Registration Number 66330-42), and decided not to pursue the registration of Midas EC Bronze (U.S. EPA Registration Number 66330-58) in California.

BACKGROUND

In October 2007, the United States Environmental Protection Agency (U.S. EPA) granted a 1-year time-limited registration for iodomethane (Midas®) as a pesticide after the completion of the risk assessment process. In the risk assessment, U.S. EPA concluded that acute exposure, compared to repeated exposures, was of primary concern. The toxicity endpoints were developmental toxicity (fetal loss), port-of-entry toxicity (nasal lesions), and neurotoxicity. For the finding of thyroid tumors in rats, iodomethane was classified as "Not likely to be carcinogenic to humans at doses that do not alter rat thyroid hormone homeostasis." U.S. EPA considered iodomethane a non-food use chemical and thus food tolerances were not needed. The rationale for the non-food use determination included iodomethane rapid metabolism, low iodide level produced and its incorporation into natural plant constituents, and difficulty associated with enforcement of a tolerance on iodide, which is also a natural element in the environment. U.S. EPA concluded that Midas products could be registered as a restricted use pesticide with the requirement of buffer zones, recording keeping, training and stewardship programs, entry restricted period, and respirators for some workers (tarp monitors, shovelers, tractor drivers and co-pilots). On September 29, 2008, U.S. EPA granted conditional registration for all MeI products without time limitations. U.S. EPA registered Midas for use as a pre-plant fumigant on a limited number of crops and field-grown ornamentals, including peppers, strawberries, tomatoes, turf, nurseries (strawberry plants, and stone fruit, tree nut and conifer trees), stone fruit, tree nut, and vine (table, raisin and wine grapes) replants.

In 2002, the Department of Pesticide Regulation (DPR) received several applications from Arysta requesting registration of products. In addition to the proposed labels, Arysta submitted several studies that included air monitoring data of application methods and worker exposure. Midas is a Restricted Use Pesticide due to acute inhalation toxicity. Midas would be used only by certified applicators or under their direct supervision (requires the person on-site). Iodomethane is not listed in regulation as a California restricted material, and therefore would not require a restricted materials permit by the county agricultural commissioner prior to use. Federally Restricted Use pesticides are exempt from a restricted materials permit pursuant to

California Code of Regulations section 6414 (b), "No permit shall be required for restricted materials in subsection (a) of section 6400 (federally restricted use) when possessed or used by or under the supervision of a certified private or certified commercial applicator unless otherwise required by the commissioner."

PROBLEMS IDENTIFIED DURING REGISTRATION EVALUATIONS
The Registration Branch received several registration (e.g., label) evaluation reports that recommended denial of the Midas products. The Registration Branch also received several registration (e.g., label) evaluation reports that recommended conditional registration of the Midas products. The basis for these recommended denials and conditional registrations, and our responses are summarized below. Note: All other Branches that conducted registration evaluations recommended registration of this product and do not require any action.

Staff Recommendations for Denial

Medical Toxicology Branch
On June 26, 2002 through September 12, 2005, the Medical Toxicology scientists conducted an evaluation of several toxicology studies. The data reviewed was found to be adequate for a complete toxicological evaluation.

The Medical Toxicology scientists recommended a denial of registration until a risk assessment has been completed and finalized for iodomethane.

Response: DPR completed its risk assessment and developed mitigation measures to address unacceptable margins of exposure, including specific buffer zones for bystanders (workers and residents), work restrictions, limited treatment of acreage, and other restrictions (see mitigation options).

On September 7, 2005, the Medical Toxicology scientists conducted an evaluation of Midas product label based on the evaluation of several acute toxicology studies. The proposed product label identifies the potential acute toxicity hazards indicated by the data reviewed. The first aid statements are adequate, however, the personal protective equipment (PPE) requirements are not adequate for the Category I dermal irritation hazard presented by the exposure to the subject product. Registration is not recommended until the deficiencies noted are addressed.

Response: Require Arysta to revise its label(s) to address this PPE deficiency.

Environmental Monitoring Branch: (Review Area- Off-site Air Concentration Mitigation)
On February 6, 2003, and March 3, 2003, and April 8, 2005 the Environmental Monitoring Branch scientists evaluated the labels and data from two monitoring studies (volatility of iodomethane; and environmental monitoring and direct /indirect flux) for Midas products and prepared recommendations (memorandum attached) to the Registration Branch. **(Note- old labels reviewed before EPA registration)** Environmental Monitoring scientists identified the following label issues as its basis for recommending that "Data/Information Do Not Support Registration" of Midas products:

1. The proposed label does not have any buffer zones included on the label. Buffer zones will need to be developed and included on the label.
2. The Pre-plant Soil Fumigation Table contains application rates in conflict with other statements on the labels. The conversion of bed application rates to the equivalent broadcast rates should be illustrated since buffer zones for off-site exposure will be expressed on the broadcast acre basis. The label statements related to broadcast versus bed fumigation need to be clarified.
3. Tarpaulin/Shallow/Broadcast and Bed application rates of 235 lbs of iodomethane is substantially more than the 165 lbs iodomethane/treated acreage in the Table.
4. The limitation of application block to 40 acres or less is not supported by field studies. This limitation will need to be developed as the buffer zone development process proceeds.
5. California does not currently have any tarpaulins (VIF) approved.
6. The term "outer buffer zone" is undefined.

Response: Mitigation options were developed (see mitigation options) to include specific buffer zones. Labels related to broadcast versus bed fumigation will be clarified to ensure consistency and that bed fumigations contain adjusted maximum rates. Recommend Arysta submit additional flux studies of larger field sites for each application method (20 acres treated) to address the small field sizes used to calculate off-site movement. Recommend Arysta submit additional flux studies of fumigations using VIF tarps as a condition of registration.

Worker Health and Safety Branch
On January 14, 2005 and September 19, 2006, the Worker Health and Safety Branch scientists evaluated the labels and worker exposure data for Midas products (98:2 and 50:50) and prepared recommendations (memorandum attached) to the Registration Branch.

Worker Health and Safety scientists found these labels to be unacceptable because a 4 ppm threshold level for chloropicrin (before requiring supplied air or self contained breathing apparatus) is inadequate. The labels should state a 2 ppm level, consistent with the NIOSH Immediately Dangerous to Life or Health Concentration (1994).

Response: Require Arysta to revise its label(s) to address this label deficiency.

Staff Recommendations for Conditional Registration

Registration Branch
On August 10 and 13, 2009, the Registration Branch (Pest and Disease Protection Station) scientists evaluated the labels and efficacy data for Midas products and prepared recommendations (memoranda attached). Registration scientists identified the following efficacy issue, and recommended additional data as part of a conditional registration:

1. The data submitted demonstrated that the products were effective against soil-borne diseases and nematodes. The registrant did not submit data to support claimed efficacy of the Midas products against soil-borne insect pests (e.g., wireworms, cutworms, grubs, rootworms,

garden symphylans, ants, and termites). A conditional registration is requested for two years to allow Arysta to submit efficacy data for these soil-borne insect pests.

Response: Recommend requiring the data as part of a conditional registration.

On November 14, 2007, the Registration Branch (Product Chemistry Station) scientists evaluated the labels and product chemistry data for Midas products and prepared recommendations (memoranda attached). Registration scientists identified the following chemistry issue, and recommended additional data as part of a conditional registration:

1. These data were evaluated and all studies were determined to adequately comply with 40 CFR 158.150-190 product chemistry data requirements except storage stability and corrosion characteristics. A conditional registration is recommended to allow Arysta to submit a one-year Storage and Stability and Corrosion Characteristics Study for Midas products.

Response: In February 2010, Registration scientists completed the evaluation of data and found it to be acceptable. No further action is warranted.

Environmental Monitoring Branch

On January 11, 2010, the Environmental Monitoring Branch (Ground Water Program) scientists evaluated the labels and terrestrial field dissipation data for Midas products and prepared recommendations (memorandum attached) to the Registration Branch. Environmental Monitoring scientists identified the following ground water contaminant issue and its basis for recommending additional data as part of a conditional registration:

The potential for iodomethane contamination of well water is low because of high volatility and relatively fast hydrolysis when compared to long travel times of surface water to drinking water wells. However, there is a large amount of uncertainty with respect to iodide's environmental fate, which was reflected in the disparity of soil mass between actual measurements and the potential amount determined from a mass balance approach calculated from iodomethane recovery in air and soil. Based on this uncertainty, additional data are recommended to determine the environmental fate of iodomethane:

1. Conduct soil sampling after field applications of iodomethane at course-textured soil sites in California that are vulnerable to leaching of residues to ground water. The objective is to provide the concentration distribution in the soil profile of iodide and its other chemical forms.
2. Apply exiting methods or develop additional chemical analytical techniques that are capable of measuring iodide and its other chemical forms in soil. For example, the predominant oxidized form in soil could be iodide. Snyder et al. (2005) report on a method to measure trace concentration of iodide in water using LC-MS/MS.
3. Explain why the lapse in time from the start of each study until the measurement of iodide using the specific ion electrode was nearly identical for both studies. Although the studies were conducted six months apart, both were subject to the same analytical problems with

respect to iodide measurement in soil. Were the samples from both studies analyzed at the same time?

Response: Recommend requiring the data as part of a conditional registration.

CRITICAL NO OBSERVABLE EFFECT LEVELS (NOEL) AND TARGET LEVELS (REFERENCE CONCENTRATIONS) FOR CONSIDERATION

The DPR RCD was reviewed by OEHHA, USEPA, Arysta, several public reviewers, and the Scientific Review Committee (SRC) convened by Dr. John Froines. This document summarizes aspects of the RCD and considers the various perspectives of all the reviewers.

Background

The toxicity database for MeI consists of both laboratory studies in animals and human case reports. Laboratory studies in animals are considered an appropriate surrogate of human exposure. From a review of all the laboratory animal studies, a critical No Observed Effect Level (NOEL) is identified to address the toxicity endpoint of concern for each exposure duration (acute, subchronic, chronic and lifetime); *more than one endpoint may be identified for an exposure duration.* When data are suitable to use in benchmark dose modeling software, a "benchmark dose" (BMD) may be used in lieu of the critical NOEL; benchmark dose values include some statistical considerations reflecting the quality of the data. This methodology is preferred in contemporary risk assessments as a better indicator of the toxicity response. Either approach provides a dose termed the Point of Departure (POD) to characterize the toxicity. The POD also means the "starting point" from which to derive a reference dose. Since the POD values (NOEL or BMD) are derived from animal studies, they are converted to a Human Equivalent Concentration (HEC) to account for differences between animals and humans in intake, exposure duration, absorption, distribution, metabolism and elimination by the body. This process is also termed pharmacokinetics.

The registrant developed a Physiologically Based Pharmocodynamic (PBPK) model to calculate the HECs. This modeling uses the principles of computational toxicology and is used widely in the pharmaceutical industry. This model was accepted and used by USEPA in its risk calculations for all toxicity endpoints. PBPK is a mathematical modeling technique for predicting the absorption, distribution, metabolism and excretion of compounds in humans and other animal species. DPR authors also used the model to calculate HECs for the acute toxicity endpoints but refined some of the parameters that reflected a more appropriate use of the model from a biological and toxicological viewpoint. The SRC rejected the use of the model because of concerns about model limitations and uncertainties, thus the final RCD reflects revisions of HEC calculations based on DPR's default methodology and benchmark dose calculations.

Critical Toxicity Endpoints

Acute Inhalation Toxicity: The critical endpoints selected and presented by DPR's RCD for the acute inhalation exposure, as identified in animal studies were: rabbit fetal loss, nasal effects causing degeneration of the nasal epithelium in rats, and neurotoxicity in adult rats. The lowest No Observable Effect Level (NOEL) dose was observed for the fetal loss endpoint at 2 ppm and was therefore selected to be the most critical endpoint. The endpoint selection was also consistent with the study author's conclusion who published his report in a scientific journal. U.S. EPA and Arysta, selected a NOEL of 10 ppm and based their selection on the lack of statistical significance of fetal death at 10 ppm when data are expressed as percentage of fetal

resorptions per litter. U.S. EPA scientists also reviewed data from the Mid-Atlantic Reproductive Toxicology Association (MARTA) Database and their evaluation concluded that their selection of 10 ppm NOEL is consistent with conclusions from various studies in that database. In discussions with DPR scientists regarding the MARTA database, DPR scientists believe that in evaluating specific animal studies, the NOEL selection should be based on the study itself and not on a database of studies because when multiple studies are reviewed and evaluated, the data results vary widely and therefore cannot and should not be compared or applied to a specific study. Additionally, DPR's RCD states that toxicity determination should not rely solely on statistical significance on a subset of the data but should consider the biological significance of the data set when treated as a whole. OEHHA agreed with DPR's NOEL selection for the fetal loss endpoint and the SRC initially agreed with the NOEL selection as well. However, the SRC ultimately suggested using the benchmark dose calculations with a 1% level of response which resulted in a lower HEC in DPR's final document in February 2010. DPR scientists expressed their reservations in using the lower HEC in the final document and stated the uncertainties when using those numbers as an endpoint for the risk assessment.

The NOEL or BMD on the fetal loss endpoint defines the significant difference between U.S. EPA and DPR's Human Equivalent Concentration calculations. The table below summarizes the key differences (LED = lower bound of effective dose, this term is used in BMD calculations. The values differ according to the severity of the endpoint, the lower the number, the more severe the endpoint, in this case fetal loss).

	DPR	U.S. EPA	Reason for difference
NOEL or $LED_{.01}$ *	0.5 ppm	10 ppm	At the recommendation of the SRC, DPR considered this BMD, with reservations. This number is reflected in DPR's final document in February 2010.
NOEL or $LED_{.04}$	2 ppm	10 ppm	This NOEL was DPR's original position before SRC's review. DPR selected this NOEL consistent with the study author's selection. U.S. EPA selected 10 ppm and cited the lack of statistical significance of fetal death at this dose. DPR maintains that with such a severe endpoint, biological effects should also be considered.
PBPK dose metric	Maternal iodide	Fetal iodide	DPR refined the PBPK model input parameters that reflected a more appropriate use of the model from a biological and toxicological viewpoint. The key difference is identifying the Mode of Action that causes fetal loss. Both the study author and DPR believe that the maternal iodide dose metric carries less uncertainty than the fetal iodide dose metric.
Uncertainty Factors (UF)	300	30	DPR considered an additional 10x UF because of the serious and irreversible nature of neurodevelopmental effects that have not been studied; the post-natal mortality from excess iodide that needs further study in the context of MeI exposure; and the level of excess iodide in MeI being added to background iodide intake. Since U.S. EPA's assessment selected the NOEL for the nasal toxicity endpoint instead of the fetal death, a neurodevelopmental study was not deemed necessary and therefore an additional UF was not needed. More importantly, USEPA concluded that MeI is a direct thyroid toxicant based on the review of the Middle Atlantic Reproductive Toxicity Database and therefore a developmental neurotoxicity study is not needed and there was NO data gap identified.

* This LED using the benchmark dose approach was recommended by the SRC and is reflected in DPR's final RCD although the authors did not completely agree citing wide data variability for the endpoint which therefore carries uncertainty of being within the normal range.

Furthermore, DPR identified that data is not available for evaluating the potential neurodevelopmental effects, especially since there was evidence of iodomethane effects in the maternal and fetal thyroid functions in the submitted animal studies. Maternal thyroid hormone is critical for fetal brain development before the onset of fetal thyroid functions. Unlike adults suffering from thyroid effects, the effects on the developing fetus can be permanent, but not detectable until after birth, especially in laboratory animals. Thyroid-related effects on the fetal brain are specific in the timing and region of the developing brain. Excess iodide may also result in neurological damage. DPR authors describe animal studies conducted with potassium iodide, which also has iodide as a metabolite, where offspring of dams were treated before mating, during gestation and lactation, and offspring treated post-weaning. While fetal loss was not reported, several measures of neurological deficiency were measured. Overall, there is a need for a more thorough investigation of developmental neurotoxicity in pre- and postnatal exposures to MeI because the existing data do not address these exposures.

The USEPA risk assessment also identified fetal loss as one of three endpoints in the acute toxicity category but selected the NOEL of 21 ppm for the nasal epithelium or nasal toxicity effects as a POD instead. In evaluating the acute toxicity endpoints, U.S. EPA initially selecting the POD of 10 ppm for the fetal loss endpoint and used the parameters for the fetal iodide dose metric in the PBPK modeling. The U.S. EPA HEC for the fetal loss endpoint resulted in a higher value (7.4 ppm) than the nasal toxicity HEC (4.5 ppm). Therefore the reference concentration calculated with an UF of 30 was 150 ppb for residential bystanders based on the HEC of 4.5 ppm for the nasal toxicity endpoint.

Subchronic Toxicity Endpoints. Two endpoints were identified for subchronic exposure: reproductive effects in rat (lowered mean pup body weight and delayed development) and systemic effects (increased relative liver weight and decreased body weight gain; increased cholesterol was also consistently found). In the August 2009 draft DPR RCD, HEC values were calculated using DPR default calculations based on the submitted inhalation studies in rats. However, because of SRC concerns about potential for neurotoxicity from repeated exposures, the revised RCD presents a calculation of a POD for subchronic neurotoxicity using the acute critical dose for neurotoxicity and a default modifying factor of 3. The resulting values were considered because of the uncertainties on the rat neurotoxicity studies. U.S. EPA on the other hand, used the NOEL from the rat studies only from one endpoint (↓ Pup weight, delayed development in rats) and used the PBPK modeling approach to derive the HEC calculations. The table below illustrates the differences in POD and HEC calculations based on the rat inhalation studies and the extrapolated values in the current DPR RCD and U.S. EPA's risk assessment.

Subchronic Toxicity	DPR August 2009 RCD	DPR February 2010 RCD	U.S. EPA
↓ Pup weight, delayed development in rats	5 ppm (NOEL) HEC: 1.4 and 4.1 ppm	3 ppm (LED_{36}) HEC: 0.39 and 0.51 ppm	5 ppm (NOEL) HEC: 1.25 and 3.75 ppm
↑ Relative liver weight, ↓ body weight gain in rats	21 ppm (NOEL) HEC 1.9 and 2.5 ppm	4.3 ppm (MF = 3 from acute 12.8 ppm) HEC 0.5, 0.7, 1.2 and 3.5 ppm	N/A

Chronic Toxicity. For chronic toxicity, the most critical endpoint was mandibular salivary gland metaplasia in rats after inhalation exposure for 2 years. Thyroid toxicity is a common finding for several laboratory animal species exposed repeatedly to MeI by either inhalation or oral route. As with subchronic exposure, the potential for MeI-induced neurotoxicity from chronic exposure needs to be considered. DPR authors initially calculated the HEC using DPR's default parameters from the NOEL of 5 ppm in the rat neurotoxicity studies. However, after extensive discussions with the SRC on the inadequacy of the rat neurotoxicity studies and the uncertainties from the conclusions of those studies, DPR authors calculated the chronic exposure HEC by using the acute critical dose of 12.8 ppm and a default modifying factor of 10. This resulted in a lower HEC as shown in the table below.

Chronic Toxicity	DPR August 2009 RCD	DPR February 2010 RCD	U.S. EPA
Salivary gland Metaplasia in rats	5 ppm (NOEL) HEC 2.9, 1.0, 0.6 and 0.5 ppm	3.4 ppm ($LED_{.05}$) HEC 2.0, 0.66, 0.41 and 0.31 ppm	5 ppm (NOEL) HEC 3.75 and 0.89 ppm
Neurotoxicity in Rats (extrapolated)	Not considered an endpoint	1.28 ppm (MF = 10 from acute 12.8 ppm) HEC 1.0, 0.35, 0.22, and 0.16 ppm	Not considered an endpoint

Lifetime Exposure. Thyroid tumors in rats was selected as the critical endpoint. From the weight of evidence from the animal studies designed for studying oncogenicity, MeI is considered an oncogen. Other associated findings were thyroid hyperplasia, astrocytomas in the brains of male mice, and cervical/uterine fibromas in female mice. DPR authors discuss the possible modes of action for the thyroid tumors because they influence how cancer risk is quantified. One possible mode of action is thyroid perturbation as the result of excess iodide (resulting from the metabolism of MeI); this would be considered a "threshold" response and an HEC is calculated to describe the risk. The second possible mode of action is MeI inducing genetic mutation; this would be considered a "nonthreshold" mode of action and cancer risk is calculated from a model and presented as a probability. DPR authors received extensive comments from the SRC regarding the possible MeI modes of action with regards to cancer. During the last meeting with the panel, the SRC agreed to include both threshold and non-threshold MOA but emphasized that genotoxicity is a more plausible MOA. DPR authors maintain that both MOA are plausible and discusses both MOA extensively in the document.

DPR authors however, do not agree with U.S. EPA's determination that the finding of thyroid tumor in rat was not relevant to humans, and provides a discussion of other studies that suggest otherwise and the need for additional studies to clarify the issue. The HECs for both MOA are shown in the table below.

Lifetime Exposure	DPR RCD August 2009	DPR RCD February 2010	U.S. EPA
Thyroid tumors in rats, thyroid perturbation MOA	20 ppm NOEL HEC 11.6 and 3.9 ppm	2 ppm $LED_{.01}$ HEC 1.2 ppm and 0.39 ppm	Not considered an endpoint
Thyroid tumors in rats, genotoxicity MOA	1.6×10^{-2} mg/kg/day HEC 6×10^{-6}, 2.5×10^{-5}	1.6×10^{-2} mg/kg/day HEC 6×10^{-6}, 2.5×10^{-5}	Not considered an endpoint

Reference Concentration (RfC) Calculations and Options:

For the calculation of Reference Concentrations (RfC), DPR authors also recommend the use of an additional uncertainty factor of 10 for young children. The default risk assessment approach for taking into account data gaps, especially a lack of information on pre- and post-natal developmental toxicity with evidence of neurodevelopmental effects, is to apply an uncertainty factor to the final RfC calculation. The magnitude of the uncertainty factor considers the weight of evidence for the concern, data availability and adversity of effects of concern, and may range from 3 to 10. Selection of the factor of 10 is related to the potential for serious and irreversible neurodevelopmental effects that have not been studied, post-natal mortality from excess iodide, and excess iodide from MeI being added to the background.

Although DPR's current document dismisses the use of the PBPK modeling approach in calculating the HEC's, it is important to note that new technologies in computational toxicology are available and acceptable. U.S. EPA used the PBPK modeling introduced by Arysta and DPR used the model as well using different factors and approaches. DPR authors believe that the PBPK modeling approach is reasonable and considered it in their August 2009 document. However, after the SRC rejected the model, DPR authors used the benchmark dose approach instead but discussed the inherent uncertainties in that approach as well.

Reference Concentrations Based on DPR's Risk Assessment Calculations

Using DPR's RCD as the baseline for calculating the RfC, the following are the different options for calculating the reference concentrations for the *acute toxicity endpoint of fetal loss.*

Residential Bystander: (24 hour exposure)

a. 0.3 ppb RfC. This reference concentration (RfC) was calculated based on DPR's current RCD, reviewed by the SRC. This calculation is based on a benchmark dose calculation and used a 1% lowest effective dose ($LED_{.01}$) 0.5 ppm. Although the authors believed there is a lot of uncertainty on using the 1% response, this number is reflected in

the document based on SRC's comments. This also uses an UF of 300 instead of 30, used by U.S. EPA. The additional 10 UF differs from USEPA's RfC. Since U.S. EPA believes that excess iodide in the fetus is the mode of action for the fetal death, they believe additional developmental neurotoxicity studies are not necessary. However, DPR authors believe that an additional "safety factor" of 10 is needed to take the post-natal neurotoxic effects in consideration since the rabbit studies delivered some live pups at the end of gestation but no neurotoxicity studies were conducted.

b. 3 ppb RfC This RfC does not consider the additional 10 safety or uncertainty factor but is still based on DPR's current calculations (HEC= 0.081 ppm, HEC basis of 0.5 ppm $-LED_{.01}$). The use of this RfC may not be justified based on DPR's evaluation of the lack of developmental neurotoxicity studies. However, U.S. EPA deemed that since the developmental neurotoxicity was not necessary, it could be possible that the additional UF not be used based on the following USEPA's justification for that reasoning: 1) a developmental neurotoxicity (DNT) study is performed in a species that is less responsive to iodomethane (rats) than the species that exhibited developmental toxicity (rabbits); 2) The behavioral and physical measures used in the DNT are less sensitive than the biochemical measures available that characterize changes in thyroid hormone homeostasis; 3) thyroid hormone perturbations are the most sensitive systemic effect caused by iodomethane, and protection against these effects will protect against other systemic effects, including developmental neurotoxicty. DPR authors agree with the first two, but disagree with the third reasoning that thyroid hormone perturbations are the most sensitive effect caused by iodomethane and maintain that further investigation is necessary to evaluate iodomethane effects.

c. 10 ppb RfC. This RfC is based on DPR's 2.0 ppm NOEL calculations (HEC = 0.32, HEC basis of 2.0 ppm NOEL). This calculation is based on DPR's default calculations of HEC and does not use the PBPK modeling laid out in the August 2009 document. At that time, DPR considered using the maternal iodide dose metric and used the PBPK modeling to calculate the HEC. This calculation is also consistent with the benchmark dose approach with a LED of 4%. However, at 10 ppb RfC, the additional 10x uncertainty factor is not applied. If the additional uncertainty factor is calculated, the RfC will be **1.0 ppb.** When RCD authors consulted with OEHHA to calculate an RfC concentration using their method of relative exposure levels (REL), their RfC calculation was 1.0 ppb.

d. 32 ppb RfC. This RfC is based on a variation of DPR's HEC calculations. This calculation uses an HEC of 0.965 ppm from a NOEL of 2 ppm but removes the 3X uncertainty factor on the pharmacokinetic interspecies variation that DPR normally uses for calculating reference concentrations. U.S. EPA adopted this policy in their methods for derivation of inhalation reference concentrations since 1994 citing the uptake of gas at the cell level in the lungs as it reaches an equilibrium with the blood fairly rapidly. So the ratio of chemical concentration in the blood to the chemical in the gas phase is constant (Regional Gas Dose Ratio, RGDR). Arysta submitted a laboratory study to DPR in 2004 on the iodomethane blood:gas partition coefficient to illustrate the differences between rats, rabbits and humans. According to the in-vitro study, for a given external exposure,

the rabbit and human will receive an internal dose that is approximately equal, due to the similarity of their blood:air partition coefficients. It also points out that iodomethane is distributed to the body primarily via blood flow which does not differ appreciably among species.

Although U.S. EPA's and Arysta's explanation is reasonable, DPR scientists believe that the interspecies pharmacokinetic variation cannot be fully explained by the study. First of all, the study did not use live animals. Secondly, even if the iodomethane is primarily distributed throughout the body via blood flow, it does not account for all the aspects of pharmacokinetic principles such as metabolism and excretion. Additionally, DPR has not adopted a policy that removes the 3X interspecies uncertainty factor for inhalation toxicity. If this RfC is chosen, this will be the first active ingredient DPR will have considered for this policy. On the other hand, this concept has been used by other international regulatory agencies including the World Health Organization.

Occupational (Worker 8-hour exposure)

a. 0.8 ppb RfC This RfC is based on DPR's current RCD reviewed by the SRC. This HEC is based on a benchmark dose calculation (HEC= 0.23 ppm, HEC basis of 0.5 ppm at $LED_{.01}$) and considers an additional 10x UF. Although the authors believed there is a lot of uncertainty on using the 1% response, this number is reflected in the document based on SRC's comments.

b. 8 ppb RfC This RfC is based on the same calculations as above but does not apply the additional 10x uncertainty factor to the RfC calculation.

c. 30 ppb RfC. This RfC is based on DPR's 2.0 ppm NOEL calculations (HEC = 0.92, HEC basis of 2.0 ppm NOEL). This calculation is based on DPR's default calculations of HEC and does not use the PBPK modeling laid out in the August 2009 document. At that time, DPR considered using the maternal iodide dose metric and used the PBPK modeling to calculate the HEC. This calculation is also consistent with the benchmark dose approach with a LED of 4%. However, at 30 ppb RfC, the background or 16-hour bystander exposures were not added to the occupational exposures. Also, the additional 10x uncertainty factor is not applied. If the additional uncertainty factor is calculated, the RfC will be **3.0 ppb.** When RCD authors consulted with OEHHA to calculate an RfC concentration using their method of relative exposure levels (REL), their RfC calculation was 4.0 ppb.

d. 96 ppb RfC. This RfC. This RfC is based on a variation of DPR's HEC calculations. This calculation uses an HEC of 2.9 ppm and a NOEL of 2 ppm but removes the 3X uncertainty factor on the pharmacokinetic interspecies variation that DPR normally uses for calculating reference concentrations. (See previous page for the explanation on this variation).

Reference Concentrations Based on U.S. EPA's Risk Assessment Calculations

Other options to consider in calculating the RfC's would be to use U.S. EPA's NOEL of 10 ppm. Although this approach is inconsistent with DPR authors, it is listed and evaluated here for consideration as well.

Residential Bystander (24-hour exposure)

a. 5 ppb RfC This RfC is based on a NOEL of 10 ppm, using DPR's default calculations of breathing rate, time of exposure, pharmacokinetic factor and an additional UF of 10x. The HEC is 0.52 ppm.

b. 17 ppb Rfc This RfC is based on a NOEL of 10 ppm, also using DPR's default calculations as stated above. However, this calculation considers an additional uncertainty factor of 3x instead of 10x. Uncertainty factors are determined based on various factors in toxicology. Most UF considered are between 1 and 10, depending on the severity of the endpoint. For a fetal death endpoint, an additional UF of 3 may be unjustified. The HEC is also 0.52 ppm.

Occupational (Worker 8-hour Exposure)

a. 15 ppb RfC This RfC is based on a NOEL of 10 ppm, using DPR's default calculations as described above, but using worker exposure defaults and an additional UF of 10x. The HEC is 4.6 ppm

b. 51 ppb RfC This RfC is based on a NOEL of 10 ppm, using DPR's default calculations as described above. However, this calculation considers an additional uncertainty factor of 3x instead of 10x. The HEC is also 4.6 ppm.

Other Factors to Consider in Selecting Reference Concentrations:
Adding to the complexity of the calculations is the consideration to evaluate reference concentrations as a whole (i.e. selecting RfC based on one critical endpoint might overlook the RfC calculations for other critical endpoints). The table below summarizes the RfC presented above for the acute toxicity endpoint and how it relates to the RfC for the subchronic, chronic and lifetime toxicity endpoints, from the February 2010 DPR RCD and the August 2009 DPR RCD. The RfC presented here are the lowest for each critical endpoint.

Residential Bystander (24-hour exposure)				
Acute Toxicity RfC	Subchronic RfC	Chronic RfC	Lifetime RfC	Comments
0.3 ppb (UF 300)	2 ppb (UF 300)	0.5 ppb (UF 300)	1 ppb (UF 300)	In the February 2010 DPR document, the RfC for all the critical endpoints considered an additional UF of 10 upon the recommendation of the SRC.
3 ppb (UF 30)	2 ppb (UF 300) *13 ppb (UF 30)*	0.5 ppb (UF 300) *5 ppb (UF 30)*	1 ppb (UF 300) *13 ppb (UF30)*	The italicized values are the RfC if there is not additional 10x UF. The values in red show that if this RfC is selected, it may not be protective enough for the other critical endpoints.
10 ppb (UF 30)	2 ppb (UF 300) *13 ppb (UF 30)* *45 ppb (UF 30)*	0.5 ppb (UF 300) *5 ppb (UF 30)* *15 ppb (UF 30)*	1 ppb (UF 300) *13 ppb (UF30)* *13 ppb (UF 30)*	This RfC calculation for the acute toxicity endpoint is based on a NOEL of 2 ppm using the BMD approach with a 4% LED. An additional 10x UF is not used. It may be helpful to note that the chronic RfC may not be addressed if the 10 ppb is selected. However, the last line considers the RfC presented in the Aug. 2009 DPR RCD.
32 ppb (UF 30)	2 ppb (UF 300) *13 ppb (UF 30)* *45 ppb (UF 30)*	0.5 ppb (UF 300) *5 ppb (UF 30)* *15 ppb (UF 30)*	1 ppb (UF 300) *13 ppb (UF30)* *13 ppb (UF 30)*	This RfC calculation is based on a variation of DPR's HEC calculations. This is based on a 3X UF for pharmacodynamic variations but NOT pharmacokinetic variation.
5 ppb (UF 300) NOEL = 10 ppm	2 ppb (UF 300) *13 ppb (UF 30)*	0.5 ppb (UF 300) *5 ppb (UF 30)*	1 ppb (UF 300) *13 ppb (UF30)*	The italicized values are the RfC if there is not additional 10x UF. The values in red show that if this RfC is selected, it may not be protective enough for the other critical endpoints.
17 ppb (UF 90 NOEL = 10 ppm	2 ppb (UF 300) *13 ppb (UF 30)*	0.5 ppb (UF 300) *5 ppb (UF 30)*	1 ppb (UF 300) *13 ppb (UF30)*	If this RfC is selected, it will not be protective of the other critical endpoints.

Occupational (8-hour worker exposure)				
Acute Toxicity RfC	Subchronic RfC	Chronic RfC	Lifetime RfC	Comments
0.8 ppb (UF 300)	12 ppb (UF 300)	4 ppb (UF 300)	4 ppb (UF 300)	In the February 2010 DPR document, the RfC for all the critical endpoints considered an additional UF of 10 upon the recommendation of the SRC.
8 ppb (UF 30)	12 ppb (UF 300) *120 ppb (UF 30)*	4 ppb (UF 300) *40 ppb (UF 30)*	4 ppb (UF 300) *10 ppb (UF 30)*	The italicized values are the RfC if there is no additional 10x UF.
30 ppb (UF 30)	12 ppb (UF 300) *120 ppb (UF 30)* *136 ppb (UF 30)*	4 ppb (UF 300) *40 ppb (UF*	4 ppb (UF 300) *40 ppb (UF*	This RfC calculation for the acute toxicity endpoint is based on a NOEL of 2 ppm using the BMD approach with a 4% LED. An additional 10x UF is not used. The last line considers the RfC

Occupational (8-hour worker exposure)				
Acute Toxicity RfC	Subchronic RfC	Chronic RfC	Lifetime RfC	Comments
		30) *97 ppb (UF 30)*	*30)* *39 ppb (UF 300)*	presented in the Aug. 2009 DPR RCD.
96 ppb (UF 30)	12 ppb (UF 300) *120 ppb (UF 30)* *136 ppb (UF 30)*	4 ppb (UF 300) *40 ppb (UF 30)* *97 ppb (UF 30)*	4 ppb (UF 300) *40 ppb (UF 30)* *39 ppb (UF 300)*	This RfC calculation is a variation from DPR's HEC calculation. It only considers the pharmacodynamic variation between species and NOT the pharmacokinetic variation, resulting in an UF of 30 instead of 100.
15 ppb (UF 300) NOEL = 10 ppm	12 ppb (UF 300) *120 ppb (UF 30)*	4 ppb (UF 300) *40 ppb (UF 30)*	4 ppb (UF 300) *10 ppb (UF 30)*	This acute toxicity endpoint RfC calculation is based on U.S. EPA's NOEL of 10 ppm instead of 2 ppm. All the other values (subchronic, chronic and lifetime) are from DPR's RCD. The italicized values are the RfC if there is no additional 10x UF.
51 ppb (UF 90) NOEL = 10 ppm	12 ppb (UF 300) *120 ppb (UF 30)* *136 ppb (UF 30)*	4 ppb (UF 300) *40 ppb (UF 30)* *97 ppb (UF 30)*	4 ppb (UF 300) *40 ppb (UF 30)* *39 ppb (UF 300)*	This acute toxicity endpoint RfC calculation is based on U.S. EPA's NOEL of 10 ppm instead of 2 ppm. All the other values (subchronic, chronic and lifetime) are from DPR's RCD. The last line considers the RfC presented in the Aug. 2009 DPR RCD.

When looking at U.S. EPA's reference concentration selection of the critical endpoints they regulated to, it is helpful to note that the 150 ppb they selected for nasal toxicity does not consider the reference concentrations they selected for their subchronic (42 ppb) and chronic (30 ppb) toxicity endpoints.

Additional Information from Arysta

On February 16, 2010, DPR received a memo from Arysta presenting other options in calculating reference concentrations. In the memo, they discussed the inherent conservative approach in our calculations of the human equivalent concentration (HEC). They pointed out four scenarios to consider in recalculating the HEC.

A. They pointed out that the PK factor of 3.16 used in the calculation is unnecessary because of the certainty of the pharmacokinetics and mode of action (MOA) of methyl iodide. The following is the calculation for HEC using DPR's default without the PK factor:

HEC = NOEL x (Animal breathing rate/ Human breathing rate) x (Animal Exposure hours per day/ Human Exposure hours per day) x (Animal Exposure Days/ Human Exposure days)

If we calculate the HEC for the bystander exposures using the 2 ppm NOEL, the calculation will be:

= 2 ppm x (0.54/0.28) x (6/24) x (7/7)
= 0.965 ppm

Using DPR's default calculations for pharmacodynamic and pharmacokinetic variations between human and animals and variations of toxicity between humans, the RfC calculations will be:

RfC = HEC ÷ PK (10) ÷ PD (10) x 1000
= 0.965 ppm ÷ 10 ÷ 10 x 1000
= 9.65 ppb approximately 10 ppb

In their discussion of the issue, they pointed out the certainty of the pharmacokinetics of iodide therefore the PK variation of 10 in the calculation of the reference concentration should only be 3. They also stated that since the metabolism and distribution of MeI is very well understood based on the behavior of the Iodide, the PK UF should only be 3 instead of 10. However, according to the metabolism and distribution studies evaluated in the RCD, there are still uncertainties during the absorption and distribution of the MeI. Therefore, the PK variation of 10 is necessary.

B. A second option was to use U.S. EPA's approach; therefore the RfC will be 193 and 150 ppb for workers and bystanders respectively. DPR disagrees with this approach and has discussed this with Arysta and U.S. EPA from the beginning.

C. The third option was to use the PBPK model using the fetal iodide dose metric with a NOEL of 2 ppm and the resulting HEC of 1.8 ppm and 1.3 ppm for worker and bystander respectively. The RfC calculations for bystanders with these HEC are:

> RfC = 1.3 ppm ÷ 30 x 1000 = 43 ppb. Since this RfC uses the fetal iodide dose metric for the PBPK model, this is not consistent with DPR's scientific evaluation of the data, because other MOA may be involved in causing the endpoint of fetal death or resorption.

D. The fourth option was to use the bench mark dose response of 5% or 2.3 ppm instead of 2.0 ppm at the 4% response. Although the option is reasonable, using the 2.3 ppm POD cannot be justified by any of the studies submitted on the endpoint. The SRC also recommended a 1% response at 0.5 ppm instead of the NOEL of 2 ppm. Additionally, using the 2.3 ppm using DPR's default RfC calculations will result in 11 ppb for bystanders and 33 ppb for workers.

MITIGATION OPTIONS BASED ON A RANGE OF ACUTE TARGET LEVELS

Scenario I

Target Level of 0.3 parts per billion (Bystander 24-hour Exposure)
This target level (RfC) was recommended by scientists based on the risk assessment, and supported by the peer review panel (see write-up on critical NOEL and Reference Concentrations). DPR evaluated the buffer zones and found them to be in the range of several hundred feet to several miles. We found these buffer zones to be excessive and difficult to enforce unless very limited use was allowed. The registrant may find these buffer zones unacceptable due to its economic viability.

Target Level of 0.8 parts per billion (Worker 8-hour Exposure)
This target level (RfC) was recommended by scientists based on the risk assessment, and supported by the peer review panel (see write-up on critical NOEL and Reference Concentrations). DPR evaluated the worker buffer zones and found them to be in the range of several hundred feet to several miles. We found these buffer zones to be excessive and difficult to enforce unless very limited use was allowed. The registrant may find these buffer zones unacceptable due to its economic viability.

Target Level of 0.8 parts per billion (Handler 8-hour Exposure)
This target level (RfC) was recommended by scientists based on the risk assessment, and supported by the peer review panel (see write-up on critical NOEL and Reference Concentrations). DPR evaluated the worker tasks and personal protective equipment (respiratory protection) to determine if mitigation is feasible. We found the PPE requirements to be excessive (see below). The registrant may find these mitigation measures unacceptable.

Acute Exposure Estimates (PPB) for Workers – Pre-plant Drip Irrigation (tarped)

Tasks	Unadjusted	Half-Face Respirator (90%)	SCBA (99.99%)
Applicator		3	insignificant
Hole Puncher	15	1.5	insignificant
Planter	4	0.4	insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds, and 8-hour exposure duration

The mitigation options available for handlers and post-application workers (planters) for the drip application method include SCBA for applicators and hole-punchers, and a half-face respirator for planters. Applicators are required to wear a half-face respirator according to the label. The mitigation option of SCBA is not recommended due to other potential impacts (heat stress, difficulty performing the tasks). DPR should consider extending the time for hole-punchers and planters as an option to respiratory protection; however, no specific worker monitoring data is available to estimate this time. DPR may be able to develop a time period based on other field flux data. If this scenario is chosen,

we recommend assigning staff to evaluate whether work hour adjustments can be calculated.

Acute Exposure Estimates (PPB) for Workers – Shank Injection (tarped, broadcast and bedded combined)

Tasks	Unadjusted	Half-Face Respirator (90%)	Fan + Half-Face Respirator (60% adj)	SCBA (99.99%)
Applicator	2700	270	108	insignificant
Shoveler	800	80	Not Applicable	insignificant
Tarp Monitor	3000	300	Not Applicable	insignificant
Tarp hole puncher, cutter, remover	80	8	Not Applicable	insignificant
Planter	6	0.6	Not Applicable	insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds, and 8-hour exposure duration

The mitigation options for handlers and post-application workers (planters) for the shank application methods (broadcast and bed) may include: (1) SCBA for applicators, shovelers, tarp monitors, and tarp punchers and cutters/removers. (Note: Applicators and other handlers [shoveler, tarp monitor] are required to wear a half-face respirator according to the label); and (2) Planters would need to wear a half-face respirator to reduce exposures to an acceptable level. These mitigations options are not recommended due to other potential impacts (heat stress, difficulty performing the tasks). Arysta informed DPR that the tarp monitor activity could be eliminated (prohibited), therefore mitigation is not needed. DPR should consider extending the time for hole-punchers and planters as an option to respiratory protection; however, no specific worker monitoring data is available to estimate this time. DPR may be able to develop a time period based on other field flux data. If this scenario is chosen, we recommend assigning staff to evaluate whether work hour adjustments can be calculated.

The exposure estimates listed above may be an underestimate of exposure due to tasks added (i.e., weighing cylinders at various times) to the study protocol that are not normally conducted. These tasks added significant time (~8-hours to fumigate 2.5 acres) to the handler tasks with unknown exposure consequences. Applicators can typically complete between 2-5 acres per hour (16-40 acres in an 8-hour period) for shank-bedded applications. Worker Health and Safety Branch scientists evaluated exposure values derived from the studies and determined that adjustments may be necessary (270 ppb adjusted to 400 ppb for applicators; 80 ppb adjusted to 130 ppb for shovelers; and 300 ppb to 480 ppb for tarp monitors).

Scenario II

Target Level of 3.0 parts per billion (Bystander 24-hour Exposure)
This target level (RfC) eliminates a 10-fold uncertainty/safety factor based on additional protection for neurotoxicity. DPR evaluated the buffer zones for (1) drip (standard and VIF tarp), (2) bedded-shank application (standard tarp), and (3) broadcast-shank application (standard tarp).

Bystander (24-hour) Buffer Zones (Feet) for 10 Acre Field Treated with Midas Products

Pounds Mel per Acre	Drip Standard	Drip VIF Tarp 30% reduction	Drip VIF Tarp 50% reduction	Shank-bedded Standard Tarp	Shank-bedded VIF Tarp 30% red.	Shank-broadcast Standard Tarp	Shank-broadcast VIF Tarp 30% red.
50	4,188	3,597	2,925	5,214		3,597	
75							
100	6,508	5,214	4,188	7,618		6,101	
125							
175				10,599		8,288	

ISCST3 (C stability): Drip 50%; Shank-bedded 67%; Shank-broadcast 44% amount applied

There is no data available for drip applications with VIF tarps. These buffer zones were extrapolated using a conservative approach (30% adjustment) based on professional judgment from shank-bedded VIF tarp data, and other data (maximum concentrations available). DPR completed its evaluation of the VIF studies, and found them to be unacceptable due quality control data, storage stability problems, and sample tube break-through. We recommend requesting additional flux studies for VIF tarp applications for the three methods to refine the mitigation measures. Buffer zones should be maintained for 48 hours consistent with the flux profile and U.S. EPA's label requirements. The maximum application rates for drip (standard) and shank-bedded (standard) is anticipated to be 130 lbs Mel per acre; drip (VIF) and shank-bedded (VIF) is anticipated to be 75 lbs Mel per acre; shank broadcast (standard) is anticipated to be 175 lbs Mel per acre; shank broadcast (VIF) is anticipated to be 100 lbs Mel per acre for strawberries, and 125 lbs Mel per acre for nursery, tree and vine; replant tree and vine method (standard; 60% of field treated) is 105 lbs Mel per acre; and replant tree and vine method (VIF; 60% of field treated) is 75 lbs Mel per acre.

Target Level of 8.0 parts per billion (Worker 8-hour Exposure)
This target level (RfC) eliminates a 10-fold uncertainty/safety factor based on additional protection for neurotoxicity. DPR evaluated the buffer zones for (1) drip (standard tarp and VIF tarp), (2) bedded-shank application (Standard, and VIF tarp), and (3) broadcast-shank application (standard and VIF tarp).

Worker (8-hour) Buffer Zones for 10 Acre Field Treated with Midas Products

Pounds Mel per Acre	Drip Standard	Drip VIF Tarp 30% reduction	Drip VIF Tarp 50% reduction	Shank-bedded Standard Tarp	Shank-bedded VIF Tarp 30% red.	Shank-broadcast Standard Tarp	Shank-broadcast VIF Tarp 30% red.
50	2,224	1,331	1,092	2,925		1,755	
75							
100	3,610	2,972	2,129	4,188		2,925	
125							
175	5,176	4,179	2,925	6,101		4,722	

ISCST3 (C stability): Drip 50%; Shank-bedded 67%; Shank-broadcast 44% amount applied

There is no data available for drip applications with VIF tarps. These buffer zones were extrapolated using a conservative approach (30% adjustment) based on professional judgment from shank-bedded VIF tarp data, and other data (maximum concentrations available). DPR completed its evaluation of the VIF studies, and found them to be unacceptable due quality control data, storage stability problems, and sample tube break-through. We recommend requesting additional flux studies for VIF tarp applications for the three methods to refine the mitigation measures. Buffer zones should be maintained for 48 hours consistent with the flux profile and U.S. EPA's label requirements. The typical application for drip (standard) and shank-bedded (standard) is anticipated to be 50-100 lbs MeI/acre; drip (VIF) shank-bedded (VIF) is anticipated to be 30-75 lbs MeI/acre; shank broadcast (standard) is anticipated to be 100-175 lbs MeI/acre; and shank broadcast (VIF) is anticipated to be 75-125 lbs MeI/acre.

Target Level of 8.0 parts per billion (Handler 8-hour Exposure)

This target level (RfC) eliminates a 10-fold uncertainty/safety factor based on additional protection for neurotoxicity. DPR evaluated the worker tasks and personal protective equipment (respiratory protection) to determine if mitigation is feasible. We found the PPE requirements to be acceptable (see below). However, the registrant may find these mitigation measures unacceptable.

Acute Exposure Estimates (PPB) for Workers – Pre-plant Drip Irrigation (tarped)

Tasks	Unadjusted	Half-Face Respirator (90%)	SCBA (99.99%)
Applicator		3	Insignificant
Hole Puncher	15	1.5	Insignificant
Planter	4	0.4	Insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds, and 8-hour exposure duration

The mitigation options for handlers and post-application workers (hole puncher) for the drip application method include a half-face respirator. Applicators are required to wear a half-face respirator according to the label. No other mitigation is necessary for the planter. The mitigation option of half-face respirator for the hole puncher is acceptable,

but does result in other potential impacts (compliance concerns due to the difficulty performing the task). DPR should consider extending the time for hole-punchers as an option to respiratory protection, however, no specific worker monitoring data is available to estimate this time. DPR may be able to develop a time period based on other field flux data. If this scenario is chosen, we recommend assigning staff to evaluate whether work hour adjustments can be calculated.

Acute Exposure Estimates (PPB) for Workers – Shank Injection (tarped, broadcast and bedded combined)

Tasks	Unadjusted	Half-Face Respirator (90%)	Fan + Half-Face Respirator (60% adj)	SCBA (99.99%)
Applicator	2700	270	108	insignificant
Shoveler	800	80	Not Applicable	insignificant
Tarp Monitor	3000	300	Not Applicable	insignificant
Tarp hole puncher, cutter, remover	80	8	Not Applicable	insignificant
Planter	6	0.6	Not Applicable	insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds, and 8-hour exposure duration

The mitigation options for handlers (applicators, shovelers, tarp monitors) for the shank application methods (broadcast and bed) include SCBA. Applicators and other handlers (shoveler, tarp monitor) are required to wear a half-face respirator according to the label. Tarp punchers and cutters/removers would need to wear a half-face respirator. Planters would not need additional mitigation. The mitigation option of half-face respirator for the tarp punchers and cutters/removers is acceptable, but does result in other potential impacts (compliance concerns due to the difficulty performing the task). This mitigation option to wear SCBA is not recommended due to other potential impacts (heat stress, difficulty performing the tasks). Arysta informed DPR that the tarp monitor activity could be eliminated (prohibited), therefore mitigation is not needed. DPR should consider extending the time for hole-punchers, cutters/removers as an option to respiratory protection, however, no specific worker monitoring data is available to estimate this time. DPR may be able to develop a time period based on other field flux data. If this scenario is chosen, we recommend assigning staff to evaluate whether work hour adjustments can be calculated.

The exposure estimates listed above may be an underestimate of exposure due to tasks added (i.e., weighing cylinders at various times) to the study protocol that are not normally conducted. These tasks added significant time (~8-hours to fumigate 2.5 acres) to the handler tasks with unknown exposure consequences. Worker Health and Safety Branch scientists evaluated exposure values derived from the studies and determined that adjustments may be necessary (270 ppb adjusted to 400 ppb for applicators; 80 ppb adjusted to 130 ppb for shovelers; and 300 ppb to 480 ppb for tarp monitors).

Scenario III

Target Level of 5.0 parts per billion (Bystander 24-hour Exposure)
This target level (RfC) is based on a NOEL of 10 ppm, using DPR's default calculations of breathing rate, time of exposure, pharmacokinetic factor and an additional UF of 10 based on additional protection for neurotoxicity. DPR evaluated the buffer zones for (1) drip (standard tarp and VIF tarp), (2) bedded-shank application (Standard, and with Symmetry and VIF tarp), and (3) broadcast-shank application (standard and VIF tarp).

Bystander (24-hour) Buffer Zones (Feet) for 10 Acre Field Treated with Midas Products

Pounds MeI per Acre	Drip Standard	Drip VIF Tarp 30% reduction	Drip VIF Tarp 50% reduction	Shank-bedded Standard Tarp	Shank-bedded VIF Tarp 30% red.	Shank-broadcast Standard Tarp	Shank-broadcast VIF Tarp 30% red.
50	2,925	2,129	1,755	3,597		2,925	
75							
100	4,722	3,597	2,925	5,672		4,188	
125							
175	6,894	5,672	4,188	7,959		6,101	

ISCST3 (C stability): Drip 50%; Shank-bedded 67%; Shank-broadcast 44% amount applied

There is no data available for drip applications with VIF tarps. These buffer zones were extrapolated using a conservative approach (30% adjustment) based on professional judgment from shank-bedded VIF tarp data, and other data (maximum concentrations available). DPR completed its evaluation of the VIF studies, and found them to be unacceptable due quality control data, storage stability problems, and sample tube break-through. We recommend requesting additional flux studies for VIF tarp applications for the three methods to refine the mitigation measures. Buffer zones should be maintained for 48 hours consistent with the flux profile and U.S. EPA's label requirements. The maximum application rates for drip (standard) and shank-bedded (standard) is anticipated to be 130 lbs MeI per acre; drip (VIF) and shank-bedded (VIF) is anticipated to be 75 lbs MeI per acre; shank broadcast (standard) is anticipated to be 175 lbs MeI per acre; shank broadcast (VIF) is anticipated to be 100 lbs MeI per acre for strawberries, and 125 lbs MeI per acre for nursery, tree and vine; replant tree and vine (standard; 60% of field treated) is 105 lbs MeI per acre; and replant tree and vine (VIF; 60% of field treated) is 75 lbs MeI per acre.

Target Level of 15.0 parts per billion (Worker 8-hour Exposure)
This target level (RfC) is based on a NOEL of 10 ppm, using DPR's default calculations of breathing rate, time of exposure, pharmacokinetic factor and an additional UF of 10 based on additional protection for neurotoxicity. DPR evaluated the buffer zones for (1) drip (standard tarp and VIF tarp), (2) bedded-shank application (Standard, and with Symmetry and VIF tarp), and (3) broadcast-shank application (standard and VIF tarp).

Worker (8-hour) Buffer Zones for 10 Acre Field Treated with Midas Products

Pounds MeI per Acre	Drip Standard	Drip VIF Tarp 30% reduction	Drip VIF Tarp 50% reduction	Shank-bedded Standard Tarp	Shank-bedded VIF Tarp 30% red.	Shank-broadcast Standard Tarp	Shank-broadcast VIF Tarp 30% red.
50	1,174	749	453	1,331		1,009	
75							
100	2,224	1,877	1,174	2,925		1,755	
125							
175	3,610	2,972	2,129	4,188		2,925	

ISCST3 (C stability): Drip 50%; Shank-bedded 67%; Shank-broadcast 44% amount applied

There is no data available for drip applications with VIF tarps. These buffer zones were extrapolated using a conservative approach (30% adjustment) based on professional judgment from shank-bedded VIF tarp data, and other data (maximum concentrations available). DPR completed its evaluation of the VIF studies, and found them to be unacceptable due quality control data, storage stability problems, and sample tube break-through. We recommend requesting additional flux studies for VIF tarp applications for the three methods to refine the mitigation measures. Buffer zones should be maintained for 48 hours consistent with the flux profile and U.S. EPA's label requirements. The typical application for drip (standard) and shank-bedded (standard) is anticipated to be 50-100 lbs MeI/acre; drip (VIF) shank-bedded (VIF) is anticipated to be 30-50 lbs MeI/acre; and shank broadcast (standard) is anticipated to be 100-175 lbs MeI/acre.

Target Level of 15.0 parts per billion (Handler 8-hour Exposure)

This target level (RfC) is based on a NOEL of 10 ppm, using DPR's default calculations of breathing rate, time of exposure, pharmacokinetic factor and an additional UF of 10 based on additional protection for neurotoxicity. DPR evaluated the worker tasks and personal protective equipment (respiratory protection) to determine if mitigation is feasible. We found the PPE requirements to be acceptable (see below). However, the registrant may find these mitigation measures unacceptable.

Acute Exposure Estimates (PPB) for Workers – Pre-plant Drip Irrigation (tarped)

Tasks	Unadjusted	Half-Face Respirator (90%)	SCBA (99.99%)
Applicator		3	insignificant
Hole Puncher	15	1.5	insignificant
Planter	4	0.4	insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds, and 8-hour exposure duration

Additional mitigation is not needed for the drip application method applicator activity. Applicators are required to wear a half-face respirator according to the label. No other mitigation is necessary for the hole puncher or planter.

Acute Exposure Estimates (PPB) for Workers – Shank Injection (tarped, broadcast and bedded combined)

Tasks	Unadjusted	Half-Face Respirator (90%)	Fan + Half-Face Respirator (60% adj)	SCBA (99.99%)
Applicator	2700	270	108	insignificant
Shoveler	800	80	Not Applicable	insignificant
Tarp Monitor	3000	300	Not Applicable	insignificant
Tarp hole puncher, cutter, remover	80	8	Not Applicable	insignificant
Planter	6	0.6	Not Applicable	insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds, and 8-hour exposure duration

The mitigation options for handlers (applicators, shovelers, tarp monitors) for the shank application methods (broadcast and bed) include SCBA. These handlers are required by the label to wear a half-faced respirator. Tarp punchers and cutters/removers would need to wear a half-face respirator. Planters would not need additional mitigation. The mitigation option of half-face respirator for the tarp punchers and cutters/removers is acceptable, but does result in other potential impacts (compliance concerns due to the difficulty performing the task). This mitigation option to wear SCBA is not recommended due to other potential impacts (heat stress, difficulty performing the tasks). Arysta informed DPR that the tarp monitor activity could be eliminated (prohibited), therefore mitigation is not needed. DPR should consider extending the time for hole-punchers, cutters/removers as an option to respiratory protection, however, no specific worker monitoring data is available to estimate this time. DPR may be able to develop a time period based on other field flux data. If this scenario is chosen, we recommend assigning staff to evaluate whether work hour adjustments can be calculated.

The exposure estimates listed above may be an underestimate of exposure due to tasks added (i.e., weighing cylinders at various times) to the study protocol that are not normally conducted. These tasks added significant time (~8-hours to fumigate 2.5 acres) to the handler tasks with unknown exposure consequences. Worker Health and Safety Branch scientists evaluated exposure values derived from the studies and determined that adjustments may be necessary (270 ppb adjusted to 400 ppb for applicators; 80 ppb adjusted to 130 ppb for shovelers; and 300 ppb to 480 ppb for tarp monitors).

Scenario IV

Target Level of 10.0 parts per billion (Bystander 24-hour Exposure)
This target level (RfC) is based on a NOEL of 2.0 ppm, using DPR's benchmark dose approach with a LED of 4%. This target level eliminates a 10-fold uncertainty/safety factor based on additional protection for neurotoxicity. DPR evaluated the buffer zones for (1) drip (standard tarp and VIF tarp), (2) bedded-shank application (Standard, and

with Symmetry and VIF tarp), and (3) broadcast-shank application (standard and VIF tarp).

Bystander (24-hour) Buffer Zones (Feet) for 10 Acre Field Treated with Midas Products

Pounds MeI per Acre	Drip Standard	Drip VIF Tarp 30% reduction	Drip VIF Tarp 50% reduction	Shank-bedded Standard Tarp	Shank-bedded VIF Tarp 30% red.	Shank-broadcast Standard Tarp	Shank-broadcast VIF Tarp 30% red.
50	1,755	1,174	837	2,129		1,331	
75							
100	2,925	2,129	1,755	3,597		2,925	
125							
175	4,188	3,597	2,925	5,214		4,188	

ISCST3 (C stability): Drip 50%; Shank-bedded 67%; Shank-broadcast 44% amount applied

There is no data available for drip applications with VIF tarps. These buffer zones were extrapolated using a conservative approach (30% adjustment) based on professional judgment from shank-bedded VIF tarp data, and other data (maximum concentrations available). DPR completed its evaluation of the VIF studies, and found them to be unacceptable due quality control data, storage stability problems, and sample tube break-through. We recommend requesting additional flux studies for VIF tarp applications for the three methods to refine the mitigation measures. Buffer zones should be maintained for 48 hours consistent with the flux profile and U.S. EPA's label requirements. The maximum application rates for drip (standard) and shank-bedded (standard) is anticipated to be 130 lbs MeI per acre; drip (VIF) and shank-bedded (VIF) is anticipated to be 75 lbs MeI per acre; shank broadcast (standard) is anticipated to be 175 lbs MeI per acre; shank broadcast (VIF) is anticipated to be 100 lbs MeI per acre for strawberries, and 125 lbs MeI per acre for nursery, tree and vine; replant tree and vine (standard; 60% of field treated) is 105 lbs MeI per acre; and replant tree and vine (VIF; 60% of field treated) is 75 lbs MeI per acre.

Target Level of 30 parts per billion (Worker 8-hour Exposure)

This target level (RfC) is based on a NOEL of 2.0 ppm, using DPR's benchmark dose approach with a LED of 4%. This target level eliminates a 10-fold uncertainty/safety factor based on additional protection for neurotoxicity. DPR evaluated the buffer zones for (1) drip (standard tarp and VIF tarp), (2) bedded-shank application (Standard, and with Symmetry and VIF tarp), and (3) broadcast-shank application (standard and VIF tarp).

Worker (8-hour) Buffer Zones for 10 Acre Field Treated with Midas Products

Pounds Mel per Acre	Drip Standard	Drip VIF Tarp 30% reduction	Drip VIF Tarp 50% reduction	Shank-bedded Standard Tarp	Shank-bedded VIF Tarp 30% red.	Shank-broadcast Standard Tarp	Shank-broadcast VIF Tarp 30% red.
50	453	254	129	720		366	
75							
100	1,174	749	453	1,331		1,009	
125							
175	2,224	1,487	1,009	2,129		1,755	

ISCST3 (C stability): Drip 50%; Shank-bedded 67%; Shank-broadcast 44% amount applied

There is no data available for drip applications with VIF tarps. These buffer zones were extrapolated using a conservative approach (30% adjustment) based on professional judgment from shank-bedded VIF tarp data, and other data (maximum concentrations available). DPR completed its evaluation of the VIF studies, and found them to be unacceptable due quality control data, storage stability problems, and sample tube break-through. We recommend requesting additional flux studies for VIF tarp applications for the three methods to refine the mitigation measures. Buffer zones should be maintained for 48 hours consistent with the flux profile and U.S. EPA's label requirements. The typical application for drip (standard) and shank-bedded (standard) is anticipated to be 50-100 lbs Mel/acre; drip (VIF) shank-bedded (VIF) is anticipated to be 30-50 lbs Mel/acre; and shank broadcast (standard) is anticipated to be 100-175 lbs Mel/acre.

Target Level of 30 parts per billion (Handler 8-hour Exposure)

This target level (RfC) is based on a NOEL of 2.0 ppm, using DPR's benchmark dose approach with a LED of 4%. This target level eliminates a 10-fold uncertainty/safety factor based on additional protection for neurotoxicity. DPR evaluated the worker tasks and personal protective equipment (respiratory protection) to determine if mitigation is necessary and feasible. We found that no additional PPE requirements are necessary (see below) for the drip application method. However, mitigation measures would be necessary for the other application methods (shank-broadcast and bedded). The registrant may find these mitigation measures unacceptable.

Acute Exposure Estimates (PPB) for Workers – Pre-plant Drip Irrigation (tarped)

Tasks	Unadjusted	Half-Face Respirator (90%)	SCBA (99.99%)
Applicator		3	insignificant
Hole Puncher	15	1.5	insignificant
Planter	4	0.4	insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds, and 8-hour exposure duration

Applicators are required to wear a half-face respirator according to the label. No other mitigation is necessary for the applicator, hole-puncher or planter.

Acute Exposure Estimates (PPB) for Workers – Shank Injection (tarped, broadcast and bedded combined)

Tasks	Unadjusted	Half-Face Respirator (90%)	Fan + Half-Face Respirator (60% adj)	SCBA (99.99%)
Applicator	2700	270	108	insignificant
Shoveler	800	80	Not Applicable	insignificant
Tarp Monitor	3000	300	Not Applicable	insignificant
Tarp hole puncher, cutter, remover	80	8	Not Applicable	insignificant
Planter	6	0.6	Not Applicable	insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds, and 8-hour exposure duration

The mitigation options for handlers (applicators, shovelers, tarp monitors) for the shank application methods (broadcast and bed) include SCBA. Applicators and other handlers (shoveler, tarp monitor) are required to wear a half-face respirator according to the label. Tarp punchers and cutters/removers would need to wear a half-face respirator. Planters would not need additional mitigation. The mitigation option of half-face respirator for the tarp punchers and cutters/removers is acceptable, but does result in other potential impacts (compliance concerns due to the difficulty performing the task). This mitigation option to wear SCBA is not recommended due to other potential impacts (heat stress, difficulty performing the tasks). Arysta informed DPR that the tarp monitor activity could be eliminated (prohibited), therefore mitigation is not needed. DPR should consider extending the time for hole-punchers, cutters/removers as an option to respiratory protection, however, no specific worker monitoring data is available to estimate this time. DPR may be able to develop a time period based on other field flux data. If this scenario is chosen, we recommend assigning staff to evaluate whether work hour adjustments can be calculated.

The exposure estimates listed above may be an underestimate of exposure due to tasks added (i.e., weighing cylinders at various times) to the study protocol that are not normally conducted. These tasks added significant time (~8-hours to fumigate 2.5 acres) to the handler tasks with unknown exposure consequences. Worker Health and Safety Branch scientists evaluated exposure values derived from the studies and determined that adjustments may be necessary (270 ppb adjusted to 400 ppb for applicators; 80 ppb adjusted to 130 ppb for shovelers; and 300 ppb to 480 ppb for tarp monitors).

Scenario V

Target Level of 17 parts per billion (Bystander 24-hour Exposure)
This target level (RfC) is based on a NOEL of 10 ppm, using DPR's default calculations of breathing rate, time of exposure, pharmacokinetic factor. However, this calculation considers an additional uncertainty factor of 3x instead of 10x. Uncertainty factors are determined based on various factors in toxicology. Most UF considered are between 1 and 10, depending on the severity of the endpoint. For a fetal death endpoint, an additional UF of 3 may be unjustified. DPR evaluated the buffer zones for (1) drip (standard tarp and VIF tarp), (2) bedded-shank application (Standard, and with Symmetry and VIF tarp), and (3) broadcast-shank application (standard and VIF tarp).

Bystander (24-hour) Buffer Zones (Feet) for 10 Acre Field Treated with Midas Products

Pounds MeI per Acre	Drip Standard	Drip VIF Tarp 30% reduction	Drip VIF Tarp 50% reduction	Shank-bedded Standard Tarp	Shank-bedded VIF Tarp 30% red.	Shank-broadcast Standard Tarp	Shank-broadcast VIF Tarp 30% red.
50	1,009	631	366	1,331		866	
75							
100	2,129	1,331	1,009	2,129		1,755	
125							
175	2,925	2,129	1,755	3,597		2,925	

ISCST3 (C stability): Drip 50%; Shank-bedded 67%; Shank-broadcast 44% amount applied

There is no data available for drip applications with VIF tarps. These buffer zones were extrapolated using a conservative approach (30% adjustment) based on professional judgment from shank-bedded VIF tarp data, and other data (maximum concentrations available). DPR completed its evaluation of the VIF studies, and found them to be unacceptable due quality control data, storage stability problems, and sample tube break-through. We recommend requesting additional flux studies for VIF tarp applications for the three methods to refine the mitigation measures. Buffer zones should be maintained for 48 hours consistent with the flux profile and U.S. EPA's label requirements. The maximum application rates for drip (standard) and shank-bedded (standard) is anticipated to be 130 lbs MeI per acre; drip (VIF) and shank-bedded (VIF) is anticipated to be 75 lbs MeI per acre; shank broadcast (standard) is anticipated to be 175 lbs MeI per acre; shank broadcast (VIF) is anticipated to be 100 lbs MeI per acre for strawberries, and 125 lbs MeI per acre for nursery, tree and vine; replant tree and vine (standard; 60% of field treated) is 105 lbs MeI per acre; and replant tree and vine (VIF; 60% of field treated) is 75 lbs MeI per acre.

Target Level of 51 parts per billion (Worker 8-hour Exposure)
This target level (RfC) is based on a NOEL of 10 ppm, using DPR's default calculations of breathing rate, time of exposure, pharmacokinetic factor. However, this calculation considers an additional uncertainty factor of 3x instead of 10x. Uncertainty factors are determined based on various factors in toxicology. Most UF considered are between 1

and 10, depending on the severity of the endpoint. For a fetal death endpoint, an additional UF of 3 may be unjustified. DPR evaluated the buffer zones for (1) drip (standard tarp and VIF tarp), (2) bedded-shank application (Standard, and with Symmetry and VIF tarp), and (3) broadcast-shank application (standard and VIF tarp).

Worker (8-hour) Buffer Zones for 10 Acre Field Treated with Midas Products

Pounds MeI per Acre	Drip Standard	Drip VIF Tarp 30% reduction	Drip VIF Tarp 50% reduction	Shank-bedded Standard Tarp	Shank-bedded VIF Tarp 30% red.	Shank-broadcast Standard Tarp	Shank-broadcast VIF Tarp 30% red.
50	176	68	25	309		129	
75							
100	572	337	176	866		483	
125							
175	1,174	779	483	1,331		1,037	

ISCST3 (C stability): Drip 50%; Shank-bedded 67%; Shank-broadcast 44% amount applied

There is no data available for drip applications with VIF tarps. These buffer zones were extrapolated using a conservative approach (30% adjustment) based on professional judgment from shank-bedded VIF tarp data, and other data (maximum concentrations available). DPR completed its evaluation of the VIF studies, and found them to be unacceptable due quality control data, storage stability problems, and sample tube break-through. We recommend requesting additional flux studies for VIF tarp applications for the three methods to refine the mitigation measures. Buffer zones should be maintained for 48 hours consistent with the flux profile and U.S. EPA's label requirements. The maximum application rates for drip (standard) and shank-bedded (standard) is anticipated to be 130 lbs MeI per acre; drip (VIF) and shank-bedded (VIF) is anticipated to be 75 lbs MeI per acre; shank broadcast (standard) is anticipated to be 175 lbs MeI per acre; shank broadcast (VIF) is anticipated to be 100 lbs MeI per acre for strawberries, and 125 lbs MeI per acre for nursery, tree and vine; replant tree and vine (standard; 60% of field treated) is 105 lbs MeI per acre; and replant tree and vine (VIF; 60% of field treated) is 75 lbs MeI per acre.

Target Level of 51 parts per billion (Handler 8-hour Exposure)

This target level (RfC) is based on a NOEL of 10 ppm, using DPR's default calculations of breathing rate, time of exposure, pharmacokinetic factor. However, this calculation considers an additional uncertainty factor of 3x instead of 10x. Uncertainty factors are determined based on various factors in toxicology. Most UF considered are between 1 and 10, depending on the severity of the endpoint. For a fetal death endpoint, an additional UF of 3 may be unjustified. DPR evaluated the worker tasks and personal protective equipment (respiratory protection) to determine if mitigation is necessary and feasible. We found that no additional PPE requirements are necessary (see below) for the drip application method. However, mitigation measures would be necessary for the other application methods (shank-broadcast and bedded). The registrant may find these mitigation measures unacceptable.

Acute Exposure Estimates (PPB) for Workers – Pre-plant Drip Irrigation (tarped)

Tasks	Unadjusted	Half-Face Respirator (90%)	SCBA (99.99%)
Applicator		3	Insignificant
Hole Puncher	15	1.5	Insignificant
Planter	4	0.4	Insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds, and 8-hour exposure duration

Applicators are required to wear a half-face respirator according to the label. No other mitigation is necessary for the applicator, hole puncher or planter.

Acute Exposure Estimates (PPB) for Workers – Shank Injection (tarped, broadcast and bedded combined)

Tasks	Unadjusted	Half-Face Respirator (90%)	Fan + Half-Face Respirator (60% adj)	SCBA (99.99%)
Applicator	2700	270	108	insignificant
Shoveler	800	80	Not Applicable	insignificant
Tarp Monitor	3000	300	Not Applicable	insignificant
Tarp hole puncher, cutter, remover	80	8	Not Applicable	insignificant
Planter	6	0.6	Not Applicable	Insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds, and 8-hour exposure duration

The mitigation options for handlers (applicators, shovelers, tarp monitors) for the shank application methods (broadcast and bed) include SCBA. Applicators and other handlers (shoveler, tarp monitor) are required to wear a half-face respirator according to the label. Tarp punchers and cutters/removers would need to wear a half-face respirator. Planters would not need additional mitigation. The mitigation option of half-face respirator for the tarp punchers and cutters/removers is acceptable, but does result in other potential impacts (compliance concerns due to the difficulty performing the task). This mitigation option to wear SCBA is not recommended due to other potential impacts (heat stress, difficulty performing the tasks). Arysta informed DPR that the tarp monitor activity could be eliminated (prohibited), therefore mitigation is not needed. DPR should consider extending the time for hole-punchers, cutters/removers as an option to respiratory protection, however, no specific worker monitoring data is available to estimate this time. DPR may be able to develop a time period based on other field flux data. If this scenario is chosen, we recommend assigning staff to evaluate whether work hour adjustments can be calculated.

The exposure estimates listed above may be an underestimate of exposure due to tasks added (i.e., weighing cylinders at various times) to the study protocol that are not normally conducted. These tasks added significant time (~8-hours to fumigate 2.5 acres) to the handler tasks with unknown exposure consequences. Worker Health and Safety Branch scientists evaluated exposure values derived from the studies and determined that

adjustments may be necessary (270 ppb adjusted to 400 ppb for applicators; 80 ppb adjusted to 130 ppb for shovelers; and 300 ppb to 480 ppb for tarp monitors).

Scenario VI

Target Level of 32 parts per billion (Bystander 24-hour Exposure)
This RfC is based on a variation of DPR's HEC calculations. This calculation uses an HEC of 0.965 ppm and a NOEL of 2 ppm but removes the 3X uncertainty factor on the pharmacokinetic interspecies variation that DPR normally uses for calculating reference concentrations. DPR evaluated the buffer zones only for (1) drip (standard tarp and VIF tarp using the PERFUM model.

Bystander (24-hour) Buffer Zones (Feet) for 10 Acre Field Treated with Midas Products

Pounds MeI per Acre	Drip Standard	Drip VIF Tarp 30% reduction	Drip VIF Tarp 50% reduction	Shank-bedded Standard Tarp	Shank-bedded VIF Tarp 30% red.	Shank-broadcast Standard Tarp	Shank-broadcast VIF Tarp 30% red.
50	410	213	66	869	558	541	295
75	679	410	213	1,214	870	859	541
100	968	640	410	1,722	1,230	1,246	836
125	1,200	853	456	2,050	1,525	1,508	1,082
175	1,656	1,181	853	2,903	2,050	2,198	1,509

PERFUM (Ventura weather data)

There is no data available for drip applications with VIF tarps. These buffer zones were extrapolated using a conservative approach (30% adjustment) based on professional judgment from shank-bedded VIF tarp data, and other data (maximum concentrations available). DPR completed its evaluation of the VIF studies, and found them to be unacceptable due quality control data, storage stability problems, and sample tube break-through. We recommend requesting additional flux studies for VIF tarp applications for the three methods to refine the mitigation measures. Buffer zones should be maintained for 48 hours consistent with the flux profile and U.S. EPA's label requirements. The maximum application rates for drip (standard) and shank-bedded (standard) is anticipated to be 130 lbs MeI per acre; drip (VIF) and shank-bedded (VIF) is anticipated to be 75 lbs MeI per acre; shank broadcast (standard) is anticipated to be 175 lbs MeI per acre; shank broadcast (VIF) is anticipated to be 100 lbs MeI per acre for strawberries, and 125 lbs MeI per acre for nursery, tree and vine; replant tree and vine (standard; 60% of field treated) is 105 lbs MeI per acre; and replant tree and vine (VIF; 60% of field treated) is 75 lbs MeI per acre.

Target Level of 96 parts per billion (Worker 8-hour Exposure)
This RfC is based on a variation of DPR's HEC calculations. This calculation uses an HEC of 0.965 ppm and a NOEL of 2 ppm but removes the 3X uncertainty factor on the pharmacokinetic interspecies variation that DPR normally uses for calculating reference

concentrations. DPR evaluated the buffer zones only for (1) drip (standard tarp and VIF tarp) using the PERFUM model.

Worker (8-hour) Buffer Zones for 10 Acre Field Treated with Midas Products

Pounds MeI per Acre	Drip Standard	Drip VIF Tarp 30% reduction	Drip VIF Tarp 50% reduction	Shank-bedded Standard Tarp	Shank-bedded VIF Tarp 30% red.	Shank-broadcast Standard Tarp	Shank-broadcast VIF Tarp 30% red.
50	82	17	17				
75							
100	328	180	82				
125							
175	722	443	262				

PREFUM (Ventura weather data)

There is no data available for drip applications with VIF tarps. These buffer zones were extrapolated using a conservative approach (30% adjustment) based on professional judgment from shank-bedded VIF tarp data, and other data (maximum concentrations available). DPR completed its evaluation of the VIF studies, and found them to be unacceptable due quality control data, storage stability problems, and sample tube break-through. We recommend requesting additional flux studies for VIF tarp applications for the three methods to refine the mitigation measures. Buffer zones should be maintained for 48 hours consistent with the flux profile and U.S. EPA's label requirements. The typical application for drip (standard) and shank-bedded (standard) is anticipated to be 50-100 lbs MeI/acre; drip (VIF) shank-bedded (VIF) is anticipated to be 30-50 lbs MeI/acre; and shank broadcast (standard) is anticipated to be 100-175 lbs MeI/acre.

Target Level of 96 parts per billion (Handler 8-hour Exposure)

This RfC is based on a variation of DPR's HEC calculations. This calculation uses an HEC of 0.965 ppm and a NOEL of 2 ppm but removes the 3X uncertainty factor on the pharmacokinetic interspecies variation that DPR normally uses for calculating reference concentrations. DPR evaluated the worker tasks and personal protective equipment (respiratory protection) to determine if mitigation is necessary and feasible. We found that no additional PPE requirements are necessary (see below) for the drip application method. However, mitigation measures would be necessary for the other application methods (shank-broadcast and bedded). The registrant may find these mitigation measures unacceptable.

Acute Exposure Estimates (PPB) for Workers – Pre-plant Drip Irrigation (tarped)

Tasks	Unadjusted	Half-Face Respirator (90%)	SCBA (99.99%)
Applicator		3	insignificant
Hole Puncher	15	1.5	insignificant
Planter	4	0.4	insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds, and 8-hour exposure duration

Applicators are required to wear a half-face respirator according to the label. No other mitigation is necessary for the applicator, hole puncher or planter.

Acute Exposure Estimates (PPB) for Workers – Shank Injection (tarped, broadcast and bedded combined)

Tasks	Unadjusted	Half-Face Respirator (90%)	Fan + Half-Face Respirator (60% adj)	SCBA (99.99%)
Applicator	2700	270	108	insignificant
Shoveler	800	80	Not Applicable	insignificant
Tarp Monitor	3000	300	Not Applicable	insignificant
Tarp hole puncher, cutter, remover	80	8	Not Applicable	insignificant
Planter	6	0.6	Not Applicable	insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds, and 8-hour exposure duration

The mitigation options for applicators and tarp monitors for the shank application methods (broadcast and bed) include SCBA. As an option, the applicator activity could be mitigated with a half-face respirator with a forced-air fan, and limited work hours. Applicators and the handlers (shoveler, tarp monitor) are required to wear a half-face respirator according to the label. Tarp punchers and cutters/removers would need to wear a half-face respirator. Planters would not need additional mitigation. The mitigation option of half-face respirator for the tarp punchers and cutters/removers is acceptable, but does result in other potential impacts (compliance concerns due to the difficulty performing the task). This mitigation option to wear SCBA is not recommended due to other potential impacts (heat stress, difficulty performing the tasks). Arysta informed DPR that the tarp monitor activity could be eliminated (prohibited), therefore mitigation is not needed. DPR should consider extending the time for hole-punchers, cutters/removers as an option to respiratory protection, however, no specific worker monitoring data is available to estimate this time. DPR may be able to develop a time period based on other field flux data. If this scenario is chosen, we recommend assigning staff to evaluate whether work hour adjustments can be calculated.

The exposure estimates listed above may be an underestimate of exposure due to tasks added (i.e., weighing cylinders at various times) to the study protocol that are not normally conducted. These tasks added significant time (~8-hours to fumigate 2.5 acres) to the handler tasks with unknown exposure consequences. Worker Health and Safety Branch scientists evaluated exposure values derived from the studies and determined that adjustments may be necessary (270 ppb adjusted to 400 ppb for applicators; 80 ppb adjusted to 130 ppb for shovelers; and 300 ppb to 480 ppb for tarp monitors).

Comparison: U.S. EPA Target Levels

Target Level of 150 parts per billion (Bystander 24-hour Exposure)
This target level (RfC) is based on nasal toxicity with a 30-fold uncertainty factor. DPR evaluated the buffer zones for (1) drip (standard tarp and VIF tarp), (2) bedded-shank application (Standard, and with Symmetry and VIF tarp), and (3) broadcast-shank application (standard and VIF tarp).

Bystander (24-hour) Buffer Zones for 10 Acre Field Treated with Midas Products

Pounds MeI per Acre	Drip Standard	Drip VIF Tarp 50% reduction	Shank-bedded Standard Tarp	Shank-bedded VIF Tarp/Sym	Shank-broadcast Standard Tarp	Shank-broadcast VIF Tarp
50	8	0	25	0	8	NA
100	68	8	129	0	52	NA
175	254	52	394	0	176	NA

ISCST3 (C stability)

Target Level of 193 parts per billion (Worker 8-hour Exposure)
This target level (RfC) is based on nasal toxicity with a 30-fold uncertainty factor. DPR evaluated the buffer zones for (1) drip (standard tarp and VIF tarp), (2) bedded-shank application (Standard, and with Symmetry and VIF tarp), and (3) broadcast-shank application (standard and VIF tarp).

Worker (8-hour) Buffer Zones for 10 Acre Field Treated with Midas Products

Pounds MeI per Acre	Drip Standard	Drip VIF Tarp 50% reduction	Shank-bedded Standard Tarp	Shank-bedded VIF Tarp/Sym	Shank-broadcast Standard Tarp	Shank-broadcast VIF Tarp
50	8	0	8	0	0	NA
100	37	8	68	0	25	NA
175	152	25	254	0	107	NA

ISCST3 (C stability)

Target Level of 193 parts per billion (Handler 8-hour Exposure)

DPR did not evaluate EPA's handler (8-hour) exposure scenarios.

MITIGATION RECOMMENDATIONS

Bystander Exposure: 10 parts per billion Target Level

Drip and Shank (bed and broadcast) Application Methods

Bystander (24-hour) Buffer Zones for 10 Acre Field Treated with Midas Products

Pounds MeI per Acre	Drip Standard	Drip VIF Tarp 30% Reduction	Drip VIF Tarp 40% Reduction	Drip VIF Tarp 50% Reduction	Shank Bed Std Tarp	Shank Bed VIF Tarp 30%	Shank Bed VIF Tarp 40%	Shank Broadcast Std Tarp	Shank Brdcst VIF Tarp 30%	Shank Brdcst VIF Tarp 40%
50	1,541	1,082		754	2,657	1,902		2000	1394	
75	2,007	1,542		1,082	3,615	2,657		2900	2000	
100	2,804	2,066		1,542	>4723	3,690		>4723	4592	
125	3,113				>4723			>4723	>4723	
175	4,526				>4723			>4723	>4723	

PERFUM (Ventura weather data)

Mitigation measures for standard tarp applications are unacceptable. The buffer zones for this scenario are enforceable for drip fumigations using VIF tarps, but could have a significant impact on use. Acreage treated would be limited and prohibited in some areas due to the length of buffer zones (1,082 to 1,542 feet for drip). Shank (bed and broadcast) buffer zones are greater than ½ mile; therefore impractical for growers since the use would be so limited.

Pre-plant Deep Injection Auger-Probe Application Method

The application rate for this method is 2 pounds per injection site of 100 square feet (1 injection site every 10 feet in a standard grid pattern); the label restricts the number of trees per day to 230 trees per acre per day. This is equivalent to 53 sites per acre or 106 pounds per acre. (Note: the label is confusing and should be clarified to limit the acreage or pounds per day.)

Buffer zones required on the U.S. EPA label include:
25 feet for application rates less than 50 pounds MeI/acre
50 feet for application rates of 50 to 124 pounds MeI/acre
100 feet for application rates of 125 to 175 pounds MeI/acre

These buffer zones are considered adequate. (Check with EM)

Handler Exposure: 30 parts per billion Target Level

Drip Application Method

Acute Exposure Estimates (PPB) for Workers – Pre-plant Drip Irrigation (tarped)

Tasks	Unadjusted	Half-Face Respirator (90%)	SCBA (99.99%)
Applicator		3	Insignificant
Hole Puncher	15	1.5	Insignificant
Planter	4	0.4	Insignificant

Based on 95% interval, adjusted for maximum rate of 175 pounds and 8-hour exposure duration

The mitigation options recommended below for the drip application method are acceptable and practical. Applicators are required to wear a half-face respirator according to the label. No other PPE mitigation is necessary for the applicator, hole-puncher or planter. Due to the lack of worker exposure data for VIF tarps, we recommend prohibiting tarp punching or cutting for 14-21 days after the application. Current label allows re-entry and signs to be removed after the treated field is monitored for chloropicrin and levels measured to be less than 0.1 parts per million at the edge of the treated area, and no sooner than 5 days after the application. Tarp cutting cannot occur until these conditions have been met. The label also requires the treated soil to be left undisturbed for at least 10 days after application, and a planting and aeration restriction of 14-21 days after application. (Note: The Midas Gold EC label contains unclear language [no provision for VIF tarps] regarding the re-entry and planting time period after application and should be corrected.)

DPR should consider requiring additional worker exposure data to confirm our conservative assumptions are correct, and refine the mitigation measures.

Shank (bed and broadcast) Application Method

Acute Exposure Estimates (Parts Per Billion) for Workers – Shank Injection (tarped, broadcast and bedded combined adjusted for VIF Tarp Application Rates)

Tasks	Unadjusted (Corrected for Work Time)	Half-Face Respirator (90%) (Corrected for Work Time)	Full-Face Respirator 95%) (Corrected for Work Time)	Fan + Half-Face Respirator (60%) (Corrected for Work Time)	SCBA (99.99%) (Corrected: Work Time)
Drivers	684	68	34	27	insignificant
Shovelers	474	47	24	Not Applicable	insignificant
Tarp Monitors	460	46	23	Not Applicable	insignificant
Tarp hole puncher, cutter, remover	80	8		Not Applicable	insignificant
Planter	6	0.6		Not Applicable	insignificant

Based on 95% interval, adjusted for maximum rates for Std. and VIF Tarps, adjusted for actual work time during study, and 8-hour exposure duration

Mitigation measures for standard tarp applications are unacceptable. Applicators and other handlers (shoveler, tarp monitor) are required to wear a half-face respirator according to the label. The mitigation option for applicators (shank application methods: broadcast and bed) using VIF tarps include a forced-air fan and half-face respirator. The mitigation options for shovelers and tarp monitors include a full-face respirator. Tarp punchers and cutters/removers would need to wear a half-face respirator. Planters would not need additional mitigation. The mitigation option of half-face respirator for the tarp punchers and cutters/removers is acceptable, but does result in other potential impacts (compliance concerns due to the difficulty performing the task). DPR should consider extending the time for hole-punchers, cutters/removers as an option to respiratory protection; however, no specific worker monitoring data is available to estimate this time.

The exposure estimates listed above were adjusted due to tasks added (i.e., weighing cylinders at various times) during the study that are not normally conducted during routine applications. These tasks added significant time (~8-hours to fumigate 2.5 acres) to the handler tasks. Worker Health and Safety Branch scientists were also concerned about the limited number of acreage treated during the exposure period. This may result in an underestimate of exposure.

Due to the lack of worker exposure data for VIF tarps, we recommend prohibiting tarp punching or cutting for 14-21 days after the application. Current label allows re-entry and signs to be removed after the treated field is monitored for chloropicrin and levels

measured to be less than 0.1 parts per million at the edge of the treated area, and no sooner than 5 days (10-days for VIF tarps) after the application. Tarp cutting cannot occur until these conditions have been met. The label also requires a planting and aeration restriction of 14-21 days after application.

DPR should consider requiring additional worker exposure data to confirm our conservative assumptions are correct, and refine the mitigation measures.

Pre-plant Deep Injection Auger-Probe Application Method

The handler exposure level (112 ppb) estimated in the risk assessment was based on surrogate data (chloropicrin monitory data). Applicators are required to wear a half-face respirator according to the label. Applicator exposure level with a half-faced respirator was 11.2 ppb, and found to be acceptable at this regulatory target level.

Bystander Exposure: 32 parts per billion Target Level

Drip and Shank (bed and broadcast) Application Methods

Calculated with PERFUM using Ventura weather data
32 ppb 24-hr target concentration
Drip flux is average of Camarillo, La Selva, and Guadalupe studies (54% of applied amount)
Bed-shank flux is average of Guadalupe and Oxnard studies (57% of applied amount)
Broadcast-shank flux is average of Manteca and Watsonville studies (43% of applied amount)

Bystander (24-hour) Buffer Zones for **1 Acre Field** Treated with Midas Products

Pounds MeI per Acre	Drip Std	Drip VIF Tarp 30%	Drip VIF Tarp 40%	Drip VIF Tarp 50%	Shank Bed Std Tarp	Shank Bed VIF Tarp 30%	Shank Bed VIF Tarp 40%	Shank Brdcast Std Tarp	Shank Brdcst VIF Tarp 30%	Shank Brdcst VIF Tarp 40%
50	47	9	8	7	157	81	76	67	14	13
75	116	65	49	46	300	198	168	162	92	70
100	170	119	92	86	417	308	261	236	166	129
125	230	163	152	129	538	401	357	319	227	211
175	334	248	230	192	754	579	538	462	343	319

Bystander (24-hour) Buffer Zones for **5 Acre Field** Treated with Midas Products

Pounds MeI per Acre	Drip Std	Drip VIF Tarp 30%	Drip VIF Tarp 40%	Drip VIF Tarp 50%	Shank Bed Std Tarp	Shank Bed VIF Tarp 30%	Shank Bed VIF Tarp 40%	Shank Brdcast Std Tarp	Shank Brdcst VIF Tarp 30%	Shank Brdcst VIF Tarp 40%
50	175	79	74	29	588	397	369	296	162	150
75	346	221	184	171	951	698	630	532	360	310
100	486	355	295	276	1,275	976	884	734	546	470
125	634	467	434	384	1,575	1,224	1,133	937	705	656
175	896	682	634	538	2,140	1,696	1,575	1,306	1,009	937

Bystander (24-hour) Buffer Zones for **10 Acre Field** Treated with Midas Products

Pounds MeI per Acre	Drip Std	Drip VIF Tarp 30%	Drip VIF Tarp 40%	Drip VIF Tarp 50%	Shank Bed Std Tarp	Shank Bed VIF Tarp 30%	Shank Bed VIF Tarp 40%	Shank Brdcast Std Tarp	Shank Brdcst VIF Tarp 30%	Shank Brdcst VIF Tarp 40%
50	340	198	184	127	965	684	636	480	274	255
75	588	408	356	332	1,502	1,132	1,034	841	578	503
100	805	603	528	492	1,993	1,541	1,419	1,154	863	750
125	1,018	773	719	654	2,432	1,913	1,788	1,464	1,108	1,031
175	1,409	1,097	1,018	875	3,274	2,619	2,432	2,031	1,577	1,464

Bystander (24-hour) Buffer Zones for **20 Acre Field** Treated with Midas Products

Pounds MeI per Acre	Drip Std	Drip VIF Tarp 30%	Drip VIF Tarp 40%	Drip VIF Tarp 50%	Shank Bed Std Tarp	Shank Bed VIF Tarp 30%	Shank Bed VIF Tarp 40%	Shank Brdcast Std Tarp	Shank Brdcst VIF Tarp 30%	Shank Brdcst VIF Tarp 40%
50	530	311	289	202	1,507	1,145	1,065	793	489	455
75	911	634	555	518	2,198	1,731	1,614	1,318	937	830
100	1,245	934	819	764	2,865	2,254	2,134	1,788	1,352	1,201
125	1,572	1,195	1,112	1,012	3,422	2,751	2,617	2,239	1,717	1,597
175	2,174	1,693	1,572	1,351	4,528	3,685	3,422	3,075	2,411	2,239

Bystander (24-hour) Buffer Zones for **30 Acre Field** Treated with Midas Products

Pounds MeI per Acre	Drip Std	Drip VIF Tarp 30%	Drip VIF Tarp 40%	Drip VIF Tarp 50%	Shank Bed Std Tarp	Shank Bed VIF Tarp 30%	Shank Bed VIF Tarp 40%	Shank Brdcast Std Tarp	Shank Brdcst VIF Tarp 30%	Shank Brdcst VIF Tarp 40%
50	707	437	406	305	2,273	1,728	1,607	1,034	666	619
75	1,173	834	740	690	3,315	2,611	2,435	1,665	1,207	1,082
100	1,591	1,203	1,069	998	4,321	3,400	3,219	2,241	1,707	1,535
125	1,991	1,527	1,420	1,304	5,160	4,148	3,946	2,782	2,151	2,001
175	2,734	2,144	1,991	1,717	6,827	5,557	5,160	3,795	2,995	2,782

Bystander (24-hour) Buffer Zones for **40 Acre Field** Treated with Midas Products

Pounds MeI per Acre	Drip Std	Drip VIF Tarp 30%	Drip VIF Tarp 40%	Drip VIF Tarp 50%	Shank Bed Std Tarp	Shank Bed VIF Tarp 30%	Shank Bed VIF Tarp 40%	Shank Brdcast Std Tarp	Shank Brdcst VIF Tarp 30%	Shank Brdcst VIF Tarp 40%
50	878	546	508	384	2,418	1,839	1,710	1,269	811	754
75	1,451	1,035	919	858	3,527	2,778	2,591	2,055	1,485	1,328
100	1,966	1,488	1,325	1,236	4,597	3,617	3,425	2,770	2,107	1,891
125	2,457	1,887	1,755	1,612	5,489	4,413	4,198	3,443	2,659	2,473
175	3,371	2,646	2,457	2,120	7,262	5,911	5,489	4,704	3,708	3,443

Mitigation measures for standard tarp applications are unacceptable (Buffer zones range from 1,820 to 3,510 feet for a 20 acre field). Therefore, we do not recommend allowing the use of standard tarps for these application methods. The buffer zones are enforceable for drip and shank fumigations using VIF tarps, but could have some impact on use depending on the adjustment given (30%, 40% or 50%). Acreage treated would be limited in some areas due to the length of buffer zones (164 to 1,673 feet for a 20 acre field). Shank (bed and broadcast) buffer zones are greater than ¼ mile; therefore may be impractical for growers since the use would be so limited. (Note: The Midas Gold label has different buffer zone management requirements than other Midas product labels. Recommend correcting these label requirements for consistency.)

Pre-plant Deep Injection Auger-Probe Application Method

The application rate for this method is 2 pounds per injection site of 100 square feet (1 injection site every 10 feet in a standard grid pattern); the label restricts the number of trees per day to 230 trees per acre per day. This is equivalent to 53 sites per acre or 106 pounds per acre. (Note: the label is confusing and should be clarified to limit the acreage or pounds per day.)

Buffer zones required on the U.S. EPA label include:

- 25 feet for application rates less than 50 pounds MeI/acre
- 50 feet for application rates of 50 to 124 pounds MeI/acre
- 100 feet for application rates of 125 to 175 pounds MeI/acre

These buffer zones are considered adequate. (Check with EM)

Handler Exposure: 96 parts per billion Target Level

Drip Application Method

Acute Exposure Estimates (PPB) for Workers – Pre-plant Drip Irrigation (tarped)

Tasks	Unadjusted	Half-Face Respirator (90%)	SCBA (99.99%)
Applicator		3	insignificant
Hole Puncher	15	1.5	insignificant
Planter	4	0.4	insignificant

The mitigation options recommended below for the drip application method are acceptable and practical. Applicators are required to wear a half-face respirator according to the label. No other mitigation is necessary for the applicator, hole-puncher or planter. Due to the lack of worker exposure data for VIF tarps, we recommend prohibiting tarp punching or cutting for 14-21 days after the application. Current label allows re-entry and signs to be removed after the treated field is monitored for chloropicrin and levels measured to be less than 0.1 parts per million at the edge of the treated area, and no sooner than 5 days after the application. Tarp cutting cannot occur until these conditions have been met. The label also requires the treated soil to be left undisturbed for at least 10 days after application, and a planting and aeration restriction of 14-21 days after application. (Note: The Midas Gold EC label contains unclear language [no provision for VIF tarps] regarding the re-entry and planting time period after application and should be corrected.)

DPR should consider requiring additional worker exposure data to confirm our conservative assumptions are correct, and refine the mitigation measures.

Shank (bed and broadcast) Application Method

Acute Exposure Estimates (Parts Per Billion) for Workers – Shank Injection (tarped, broadcast and bedded combined adjusted for VIF Tarp Application Rates)

Tasks	Unadjusted (Corrected for Work Time)	Half-Face Respirator (90%) (Corrected for Work Time)	Fan + Half-Face Respirator (60%) (Corrected for Work Time)	Full-Face Respirator (95%) (Corrected for Work Time)	SCBA (99.99%) (Corrected: Work Time)
Applicator	684	68	34	27	insignificant
Shoveler	474	47	24	Not Applicable	insignificant
Tarp Monitor	460	46	23	Not Applicable	insignificant
Tarp hole puncher, cutter, remover	80	8		Not Applicable	insignificant
Planter	6	0.6		Not Applicable	insignificant

Based on 95% interval, adjusted for maximum rates for Std. and VIF Tarps, adjusted for actual work time during study, and 8-hour exposure duration

Mitigation measures for standard tarp applications are acceptable; however, the buffer zones are unacceptable for these scenarios. Therefore, standard tarp applications are not recommended. Applicators and other handlers (shoveler, tarp monitor) are required to wear a half-face respirator according to the label. The exposure levels for applicators and shovelers (shank application methods: broadcast and bed) using VIF tarps are acceptable with label restrictions in place. Tarp punchers and cutters/removers exposure levels are also acceptable and therefore do not need additional mitigation measures. Planters also do not need additional mitigation.

The exposure estimates listed above were adjusted due to tasks added (i.e., weighing cylinders at various times) during the study that are not normally conducted during routine applications. These tasks added significant time (~8-hours to fumigate 2.5 acres) to complete the application. Worker Health and Safety Branch scientists were also concerned about the limited number of acreage treated during the exposure period. This may result in an underestimate of exposure.

Due to the lack of worker exposure data for VIF tarps, we recommend prohibiting tarp punching or cutting for 14-21 days after the application. Current label allows re-entry and signs to be removed after the treated field is monitored for chloropicrin and levels measured to be less than 0.1 parts per million at the edge of the treated area, and no sooner than 5 days (10-days for VIF tarps) after the application. The label also requires a planting and aeration restriction of 14-21 days after application.

DPR should consider requiring additional worker exposure data to confirm our conservative assumptions are correct, and refine the mitigation measures.

Pre-plant Deep Injection Auger-Probe Application Method

The handler exposure levels (112 ppb) estimated in the risk assessment were based on surrogate data (chloropicrin monitory data). Applicators are required to wear a half-face respirator according to the label. Applicator exposure level with a half-faced respirator was 11.2 ppb, and found to be acceptable at this regulatory target level.

DPR will adopt a regulation making MeI a restricted material that requires a permit issued by the County Agricultural Commissioner. This will add an additional level of compliance oversight and protection to assure safe use under specific local conditions for each application site. In addition, DPR will also require extensive mitigation measures to reduce exposures to levels that meet the regulatory target levels above. These measures would be established through label changes

Additional Mitigation Strategies

Several mitigation strategies will be required to ensure that the target levels are met. DPR plans to work with the registrant to adopt these mitigation measures through label changes specific for California conditions.

a. Require a minimum buffer zone of a half mile from the edge of the field for sites around sensitive sites such as schools and day care centers. USEPA requires buffer zones of ¼ mile from sensitive sites.
b. Require a restriction to prohibit buffer zones from over-lapping during the buffer zone duration; as an option require a field separation of 1,000-1,300 feet. USEPA also prohibits buffer zones from over-lapping.
c. Require applicators to either provide on-site monitoring of the buffer zone perimeter in areas where residences and other occupied structures are within a specific distance, or, as an alternative to on-site monitoring, provide emergency response information directly to neighbors.
d. Require ground water restrictions such as buffer zones around wellheads, application restrictions in sensitive areas (ground water protection zones), and application restrictions whenever rain events are predicted.
e. Limit acreage treated to a maximum of 30 acres per site for drip applications and 20 acres for shank applications. USEPA established a 40 acres maximum regardless of application method.
f. Prohibit standard tarps for all application methods. All application methods will require VIF tarps, regardless of application rates and field size. A list of acceptable VIF tarps will be defined. USEPA allows both standard and VIF tarps.
g. Prohibit applications at night or define the start time of applications on the label. USEPA does not have restrictions in this area.
h. Establish maximum rates of iodomethane: 75 pounds MeI per acre (broadcast equivalent) for the drip and shank (bedded) application methods; 100 pounds MeI per acre (broadcast equivalent) for the shank (broadcast) application method for

strawberries, peppers, tomatoes, field-grown ornamentals, and turf; 125 pounds Mel per acre (broadcast equivalent) for the shank (broadcast) application method for stone fruits, tree nuts, vines, and nurseries (strawberries, stone fruits, tree nuts, and conifer trees). USEPA has a maximum rate of 175 pounds Mel per acre.

i. Require a minimum of 14 days before workers can re-enter the field for other activities such as tarp-cutting, tarp removal or planting. U.S. EPA requires a minimum of 5-10 days before re-entry.
j. For the deep injection Auger-probe application method restrictions, require applications to be limited to 25 sites per acre. U.S. EPA currently allows 50 sites per acre for this application method.
k. Require fumigation equipment to be operated in a manner that eliminates pesticide drip by clearing the fumigant from the injection device before it is lifted or removed from the soil.

MITIGATION OPTIONS FOR SUBCHRONIC AND CHRONIC TARGET LEVELS

The mitigation options for acute exposures will provide adequate protection for subchronic (seasonal) and chronic (annual) target levels, provided the same assumptions are used for uncertainty factors.