



# Department of Pesticide Regulation



Gray Davis  
Governor

Paul Helliiker  
Director

## MEMORANDUM

Winston H. Hickox  
Secretary, California  
Environmental  
Protection Agency

TO: Gary Patterson  
Supervising Toxicologist  
Medical Toxicology Branch

FROM: Lori O. Lim  
Staff Toxicologist  
(916) 324-3515

DATE: June 11, 2003

SUBJECT: Risk of methyl bromide exposure in Ventura and Monterey/Santa Cruz counties based on Alliance of the Methyl Bromide Industry monitoring in 2002 and update of risks for 8-week exposure from 2001 and 2000 data

---

In the past three years, four monitoring projects were completed:

- (1) Air Resources Board (ARB) monitoring in Monterey/Santa Cruz and Kern Counties in 2000,
- (2) ARB monitoring in Monterey/Santa Cruz and Kern Counties in 2001,
- (3) Alliance of the Methyl Bromide Industry (AMBI) monitoring in Oxnard and Santa Maria in 2001, and
- (4) AMBI monitoring in Monterey/Santa Cruz and Ventura Counties in 2002.

A complete chronological list of monitoring reports from AMBI and ARB, exposure estimates by Worker Health and Safety Branch, and risk calculations is in Appendix A. This memorandum contains the estimation of risk associated with methyl bromide air concentrations detected in Ventura and Monterey/Santa Cruz counties by the AMBI in 2002 (AMBI, 2003; Winegar, 2003). It also updates the risks estimated for the 8-week exposure estimates for the 2000 and 2001 monitoring projects because of a revision to the No-Observed-Effect Level (NOEL) for this exposure duration (DPR, 2003).

The risk to exposure is expressed as the margin of exposure (MOE), the ratio of the toxicity threshold NOEL to the exposure:

$$MOE = \frac{NOEL}{Exposure} \quad \text{(Equation 1)}$$

The current assessment uses the same critical NOELs from animal toxicity studies as used in the previous risk assessments (Lim, 2001, 2002 a, b; Reed, 2002) except for the NOEL for 8-week exposure (DPR, 2003). The critical NOELs are expressed as human equivalent NOELs by accounting for the differences in breathing rates and exposure durations between laboratory animals and humans. The human equivalent NOELs are: 21 ppm and 25 ppm, respectively, for adult and children acute exposures; 12 ppm and 7 ppm, respectively, for adult and children 1-week exposures; and 1.6 ppm and 0.9 ppm, respectively, for adult and children 6-week exposures.



## **Year 2002 Monitoring**

The air concentrations for three exposure scenarios were calculated by the Worker Health and Safety Branch (Powell, 2003) based on AMBI sampling taken in Ventura County in Summer 2002 and Monterey/Santa Cruz Counties in Fall 2002 (AMBI, 2003; Winegar, 2003). The MOEs were calculated for the 10 monitoring sites and the following durations: the 24-hour daily maximum and 95% tolerance limit, the maximum weekly average and 95% tolerance limit, and the 8-week average (Powell, 2003). The corresponding MOEs are presented in Table 1 for children and Table 2 for adults. A MOE of 100 is generally considered adequate for the protection of human health. This 100-fold factor takes into account the potential 10-fold higher sensitivity of humans than animals on a dose per body weight basis, and a 10-fold inter-individual variation in sensitivity among humans.

For the 2002 monitoring data for Ventura and Monterey/Santa Cruz Counties conducted by AMBI, the MOEs for both the 24-hour and the 1-week methyl bromide air concentrations from all sites exceeded the benchmark of 100 (Table 1 for children and Table 2 for adults). Based on the highest daily and the 95% tolerance limit of concentrations, the MOEs for a 24-hour exposure ranged from 1080 to 36232 for children (Table 1) and from 907 to 30,435 for adults (Table 2). Based on the highest weekly average and the 95% tolerance limit of concentrations, the MOEs for a 1-week exposure ranged from 643 to 20,000 for children and from 1,103 to 34,286 for adults. For the 8-week mean methyl bromide air concentrations, the children 8-week MOEs exceeded 100 (range 237 to 1552). The adults' 8-week MOEs exceeded the benchmark and ranged from 422 to 2,759. For these analyses, the uncertainties in the calculated exposure concentrations were discussed in Powell (2003) regarding the limited and unknown representativeness of the monitoring data. In addition, the monitoring duration was relatively short (8-week) and not all days in the week were monitored. The uncertainties in the toxicity data are primarily those associated with the extrapolating of data from experimental animals to humans (Lim, 2001; DPR, 2003).

## **Year 2000 to 2002 Comparison**

Sites with multiple years of measures were compared; they included: three sites in Ventura (SHA1, PVW, and UWC) for 2002 and 2001, and one site (MAQ) in Monterey/Santa Cruz Counties, which was the same as the SAL sites monitored by ARB in 2001 and 2000. The MOEs for mean of weekly means calculated for the 2000 and 2001 data were adjusted with the revised 8-week NOEL. The year to year comparison of risk is expressed as the "2002/2001 or 2000" ratio of MOEs. A ratio of less than one indicated lower MOE for the year 2002, corresponding to higher methyl bromide air concentration. The comparison reflected the difference in air concentrations for the two year's monitoring, regardless whether the ratio was derived from the corresponding sets of children's or adults' MOEs. The "2002/2001 or 2000" ratio from children's MOEs are presented for the 24-exposure, 1-week exposure, and 8-week

Gary Patterson  
August 4, 2003  
Page 3

exposures (Table 3). For the Ventura sites, compared to the 2001 data, the “2002/2001” ratio varied from site to site, ranged from 0.26 to 1.01 for all durations (Table 3). This showed that the methyl bromide air concentrations measured in 2002 were generally higher (up to 4-fold, ratio of 0.26) than those detected in 2001. For example, the 2002/2001 ratios were 0.33 to 0.51 for the maximum 24-hour air concentrations of the three sites. The only exception was the ratio of 1.01 for the 1 week air levels for SHA1, indicated the similar air levels for both years.

For the Salinas site (MAQ, SAL), the air concentration remained relatively constant for the three years of monitoring. The MOE ratios were within a 2-fold difference (ratios from 0.93 to 2.35), which indicated that the air concentration were the same or reduced by 50% compared to previous years.

#### **Year 2000 to 2002 Revision of 8-week MOEs**

Table 4 showed the revised MOEs for previous monitoring data for the 8-week duration because of a revision to the NOEL. The MOEs for all sites were greater than 100, the benchmark for acceptable exposures.

#### **Conclusion:**

1. For all sites monitored in the last three years, methyl bromide exposures for all durations (daily, 1-week, and 8-week) estimated showed margins of exposures above 100, the benchmark for acceptable risk.
2. For three sites in Ventura, there were variations (ratios of 0.26 to 1.01) in methyl bromide air concentrations with the 2002 data showing the same or higher (up to 4-fold) concentrations than for 2001.
3. For one site in Monterey/Santa Cruz Counties, the variation was within a 2-fold difference (ratios of 0.93 to 2.35) when the 2002 data were compared with those for 2001 and 2000. The 2002 data showed the same or lower (50%) concentration compared to previous years.

cc. Keith Pfeifer  
Randy Segawa

**Table 1. Children MOEs for methyl bromide exposure in Ventura and Monterey/Santa Cruz Counties in 2002<sup>a</sup>**

Site <sup>a</sup>	Monitored days (N)	Daily		1-Week		8-Week
		Maximum 24-hr	95% tolerance limit	Maximum weekly mean	95% tolerance limit	Mean of weekly means
<b>Ventura</b>						
ABD	30	7267	5580	2593	2310	1184
SHA1	31	4333	4244	3070	2456	1552
PVW	32	2629	2787	1157	1009	556
UWC	26	1898	1761	879	768	405
<b>Monterey/Santa Cruz</b>						
MAQ	32	5519	3782	2672	2096	804
BBC	32	3981	1080	1308	1087	433
WAT	30	1526	1351	829	643	237
FRM	31	1786	1926	1054	813	344
CPW	30	2248	2697	1468	1146	437
SCF	7	36232	5319	20000	3684	NA

a/ Based on the air concentrations calculated from the AMBI monitoring in 2002 (Powell, 2003). The monitoring sites were described in the AMBI reports (AMBI, 2003; Winegar, 2003). The MOE was the ratio of the NOEL to the exposure. The human-equivalent NOELs of 25 ppm, 7 ppm, and 0.9 ppm were used for calculating the 24-hour, 1 week, and 8-week MOEs (Lim, 2001; DPR, 2003). NA=site monitored during only 2 nonconsecutive weeks. SHA1 denotes a different SHA site than that in the 2001 ARB monitoring.

**Table 2. Adults MOEs for methyl bromide exposure in Oxnard/Camarillo and Santa Maria areas in 2001<sup>a</sup>**

Site <sup>a</sup>	Monitored days (N)	Daily		1-Week		8-Week
		Maximum 24-hr	95% tolerance limit	Maximum weekly mean	95% tolerance limit	Mean of weekly means
<b>Ventura</b>						
ABD	30	6105	4688	4444	3960	2105
SHA1	31	3640	3565	5263	4211	2759
PVW	32	2208	2341	1983	1729	988
UWC	26	1595	1479	1508	1316	721
<b>Monterey/Santa Cruz</b>						
MAQ	32	4636	3177	4580	3593	1429
BBC	32	3344	907	2243	1863	769
WAT	30	1282	1135	1422	1103	422
FRM	31	1500	1618	1807	1394	611
CPW	30	1888	2265	2516	1964	777
SCF	7	30435	4468	34286	6316	NA

a/ Based on the air concentrations calculated from the AMBI monitoring in 2002 (Powell, 2003). The monitoring sites were described in the AMBI reports (AMBI, 2003; Winegar, 2003). The MOE was the ratio of the NOEL to the exposure. The human-equivalent NOELs of 21 ppm, 12 ppm, and 1.6 ppm were used for calculating the 24-hour, 1 week, and 8-week MOEs (Lim, 2001; DPR, 2003). SHA1 denotes a different SHA site than that in the 2001 ARB monitoring.

**Table 3. Comparison of the MOEs for year 2001 and 2002.<sup>a</sup>**

Sites	Maximum 24 hours	95% Upper limit	Maximum weekly mean	95% Upper limit	Mean of weekly means
<b>2002/2001 ratios</b>					
SHA1	0.51	0.41	1.01	0.89	0.86
PVW	0.33	0.29	0.33	0.37	0.35
UWC	0.33	0.62	0.26	0.38	0.37
<b>2002/2001 and 2002/2000 ratios</b>					
MAQ-2002 or SAL-2001 and 2000	<b>2002/2001:</b> 2.04	<b>2002/2001:</b> 1.15	<b>2002/2001:</b> 2.35	<b>2002/2001:</b> 2.07	<b>2002/2001:</b> 1.23
	<b>2002/2000:</b> 1.74	<b>2002/2000:</b> 0.93	<b>2002/2000:</b> 1.15	<b>2002/2000:</b> 0.94	<b>2002/2000:</b> 0.93

<sup>a/</sup> The MOEs were taken from Table 1 and previous assessments (Lim, 2001; Lim, 2002a; Reed, 2002). Values represented the MOEs for children. The ratios would be the same when adult MOEs were compared.

**Table 4. Adults and children margins of exposure for 8 week methyl bromide air concentrations for year 2000 to 2002 monitoring.<sup>a</sup>**

Sites	2002 AMBI		2001 ARB		2001 AMBI		2000 ARB	
	Adult	Child	Adult	Child	Adult	Child	Adult	Child
<b>Ventura/Oxnard</b>								
ABD	2105	1184	NA		NA	NA	NA	
SHA1	2759	1552			3200	1800		
PVW	988	556			2857	1607		
UWC	702	405			1951	1098		
ABC	NA	NA			8889	5000		
<b>Monterey/Santa Cruz</b>								
MAQ	1429	804	NA		NA		NA	
BBC	769	433						
WAT	422	237						
FRM	611	344						
CPW	777	437						
SCF	NA							
CHU			2857	1607			2484	1398
LJE			567	319			422	237
MES			290	163			NA	NA
PMS			535	301			208	117
SAL			1159	652			1240	698
SES			1311	738			615	346
OAS			NA	NA			4134	2326
<b>Kern</b>								
ARB	NA		13333	7500	NA		8466	4762
ARV			20000	11250			NA	NA
CRS			576	324			741	417
MET			22857	12857			10948	10714
MVS			20000	11250			17391	9783
VSD			20000	11250			16162	9091
SHA2			NA	NA			2020	1136
<b>Santa Maria</b>								
BLO	NA		NA		2192	1233	NA	
AGCCRS					5714	3214		
EDW					1212	682		
PNT					1720	968		

a/ MOEs from Tables 1 and 2 for 2002, and previous assessments (Lim, 2002a; Lim, 2002b; Reed, 2002, and Lim, 2001). NA=sites not monitored.

**References:**

- AMBI, 2003. Alliance of the Methyl Bromide Industry Methyl Bromide Air Monitoring: Ventura, Santa Cruz, and Monterey Counties July-October, 2002. Final Report dated April 15. Applied Measurement Science, Fair Oaks, CA.
- DPR, 2003. Addendum to the Methyl Bromide Risk Characterization Document for Inhalation Exposure. Medical Toxicology Branch, Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA.
- Lim, L., 2001. Evaluation of ambient air concentration of methyl bromide in Monterey, Santa Cruz, and Kern counties. Memorandum to G. Patterson dated February 15, 2001. Medical Toxicology Branch, Department of Pesticide Regulation, California Environmental Protection Agency.
- Lim, L., 2002a. Risk of methyl bromide exposure in Oxnard/Camarillo and Santa Maria based on the Alliance of the Methyl Bromide Industry monitoring in Fall 2001. Memorandum to G. Patterson dated April 11, 2002. Medical Toxicology Branch, Department of Pesticide Regulation, California Environmental Protection Agency.
- Lim, L., 2002b. Risk of methyl bromide exposure in Kern county based on the Air Resources Board monitoring in Summer 2001. Memorandum to G. Patterson dated June 25, 2002. Medical Toxicology Branch, Department of Pesticide Regulation, California Environmental Protection Agency.
- Powell, S., 2003. Exposures to methyl bromide in Monterey/Santa Cruz and Ventura counties based on the 2002 monitoring by the alliance of the Methyl Bromide Industry (HSM-03014). Memorandum to J. Frank dated June 5, 2003. Worker Health and Safety Branch, Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA.
- Reed, N.-M., 2002. Risk of methyl bromide exposure in Monterey and Santa Cruz counties based on the California Air Resources Board monitoring in Fall 2001. Memorandum to G. Patterson dated April 11, 2002. Medical Toxicology Branch, Department of Pesticide Regulation, California Environmental Protection Agency.
- Winegar, E., 2003. Response to DPR Comments on AMBI 2001 and 2002 Reports. Memorandum to Randy Segawa, DPR, dated June 2 [the memo is incorrectly dated June 2, 2002]. Applied Measurement Science, Fair Oaks, CA.



**Appendix A - List of memoranda for year 2000 to 2002 monitoring of methyl bromide**

**2002 AMBI Monitoring (Ventura, Monterey/Santa Cruz)**

AMBI, 2003. Alliance of the Methyl Bromide Industry Methyl Bromide Air Monitoring: Ventura, Santa Cruz, and Monterey Counties July-October, 2002. Final Report dated April 15. Applied Measurement Science, Fair Oaks, CA.

Winegar, E., 2003. Response to DPR Comments on AMBI 2001 and 2002 Reports. Memorandum to Randy Segawa, DPR, dated June 2 [the memo is incorrectly dated June 2, 2002]. Applied Measurement Science, Fair Oaks, CA.

Powell, S., 2003. Exposures to methyl bromide in Monterey/Santa Cruz and Ventura counties based on the 2002 monitoring by the alliance of the Methyl Bromide Industry (HSM-03014). Memorandum to J. Frank dated June 5, 2003. Worker Health and Safety Branch, Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA.

Lim, 2003. (current memorandum)

**2001 AMBI Monitoring (Oxnard/Santa Maria)**

AMBI, 2002. Draft preliminary report: Methyl bromide ambient air monitoring in Oxnard/Camarillo and Santa Maria, August-October, 2001. Draft dated Feb. 15. Alliance of the Methyl Bromide Industry, Sacramento, CA.

AMBI, 2002. Final report: Methyl bromide ambient air monitoring in Oxnard/Camarillo and Santa Maria, August-October, 2001. Report dated April 4. Alliance of the Methyl Bromide Industry, Sacramento, CA.

Powell, S., 2002. Exposures to methyl bromide based on the draft report on the 2001 monitoring in Oxnard/Camarillo and Santa Maria by the Alliance of the Methyl Bromide Industry. Memorandum to J. Frank dated March 8, 2002 (HSM-02007). Worker Health and Safety Branch, Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA.

Powell, S., 2002. Revised exposures to methyl bromide based on the final report on the 2001 monitoring in Oxnard/Camarillo and Santa Maria by the Alliance of the Methyl Bromide Industry. Memorandum to J. Frank dated April 9, 2002 (HSM-02012). Worker Health and Safety Branch, Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA.

Lim, L., 2002. Risk of methyl bromide exposure in Oxnard/Camarillo and Santa Maria based on the Alliance of the Methyl Bromide Industry monitoring in Fall 2001. Memorandum to G. Patterson dated April 11, 2002. Medical Toxicology Branch, Department of Pesticide Regulation, California Environmental Protection Agency.

**2001 ARB Monitoring (Monterey/Santa Cruz, Kern)**

ARB, 2002. Ambient air monitoring for methyl bromide and 1,3-dichloropropene in Monterey and Santa Cruz Counties, Fall 2001. Report dated Mar. 29, Project No. P-01-004. Quality Management Branch, Monitoring and Laboratory Division, Air Resources Board, California Environmental Protection Agency, Sacramento, CA.

ARB, 2002. Ambient air monitoring for methyl bromide and 1,3-dichloropropene in Kern County - Summer 2001. Final report dated June 18, 2002, Project No. P-01-004. Quality Management Branch, Monitoring and Laboratory Division, Air Resources Board, California Environmental Protection Agency, Sacramento, CA.

Powell, S., 2002. Exposures to methyl bromide in Kern /county based on the report on the summer 2001 monitoring by the California Air Resources Board. Memorandum to J. Frank (HSM-02016). Worker Health and Safety Branch, Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA.

Powell, S., 2002. Exposures to methyl bromide in Monterey and Santa Cruz Counties based on the fall 2001 monitoring by the California Air Resources Board. Memorandum to J. Frank dated April 2, 2002 (HSM-02008). Worker Health and Safety Branch, Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA.

Lim, L., 2002. Risk of methyl bromide exposure in Kern county based on the Air Resources Board monitoring in Summer 2001. Memorandum to G. Patterson dated June 25, 2002. Medical Toxicology Branch, Department of Pesticide Regulation, California Environmental Protection Agency.

Reed, N.-M., 2002. Risk of methyl bromide exposure in Monterey and Santa Cruz counties based on the California Air Resources Board monitoring in Fall 2001. Memorandum to G. Patterson dated April 11, 2002. Medical Toxicology Branch, Department of Pesticide Regulation, California Environmental Protection Agency.

**2000 ARB Monitoring (Monterey/Santa Cruz, Kern)**

Gary Patterson  
August 4, 2003  
Page 11

ARB, 2000. Final Report for the 2000 Methyl Bromide and 1,3-Dichloropropene Air Monitoring in Kern County. Air Resources Board, California Environmental Protection Agency, Sacramento, CA.

ARB, 2001. Final Report for the 2000 Methyl Bromide and 1,3-Dichloropropene Air Monitoring in Monterey and Santa Cruz Counties. Air Resources Board, California Environmental Protection Agency, Sacramento, CA.

Powell, 2001. Exposures to methyl bromide based on ARB 2000 monitoring in Monterey/Santa Cruz and Kern Counties. Memorandum to Joe Frank dated February 9, 2001. Worker Health and Safety Branch, Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA.

Lim, L., 2001. Evaluation of ambient air concentration of methyl bromide in Monterey, Santa Cruz, and Kern counties. Memorandum to G. Patterson dated February 15, 2001. Medical Toxicology Branch, Department of Pesticide Regulation, California Environmental Protection Agency.

#### **Toxicology- No-Observed-Effect Levels**

DPR, 2002. Methyl Bromide Risk Characterization Document Inhalation Exposure Volume I (August, 2002; RCD 2002-03). Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA.

DPR, 2003. Addendum to the Methyl Bromide Risk Characterization Document for Inhalation Exposure. Medical Toxicology Branch, Department of Pesticide Regulation, California Environmental Protection Agency, Sacramento, CA.