Update report: modified reassessment of methyl bromide

APP203660

MARCH 2021

Environmental Protection Authority
Te Mana Rauhī Taiao

New Zealand Government

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Executive Summary

Stakeholders in Methyl Bromide Reduction Incorporated ("STIMBR") applied for the reassessment of methyl bromide under section 63 of the Hazardous Substances and New Organisms Act ("the Act", or "the HSNO Act").

STIMBR sought a reassessment of the methyl bromide approval (HSR001635) in order to amend the recapture control and the associated buffer zone controls, such that the recapture control would change from (effectively) a 5 parts per million (ppm) end concentration to "a reduction of 80% in the amount of methyl bromide from the end of the fumigation phase". The applicant subsequently updated their request to a reduction of 30% in the amount of the methyl bromide.

The reassessment application was received on 9 April 2019, and the Environmental Protection Authority ("EPA") decided that the application would be progressed as a publicly notified, modified reassessment in accordance section 63A of the Act.

The hearing was held virtually between Tuesday 11 August 2020 and Monday 17 August 2020, where the Decision-making Committee (DMC) heard evidence from the applicant, the EPA, submitters, and the various expert witnesses called by all parties.

Following the adjournment of the hearing, the DMC requested additional modelling to assist with their deliberations. The applicant, as part of their feedback to that modelling, provided further modelling as well.

These modelling reports are summarised, along with the buffer zones and other controls proposed within them.

Modelling for the DMC indicates a range in downwind buffer zone from 45 m to 1,020 m depending on the fumigation rate, recapture rate, and whether the fumigation is of log stacks or ship holds.

The applicant's additional modelling refines several input parameters for selected scenarios so a 100 m buffer zone for log stacks could be achieved. Refinements to ship hold fumigations are also proposed in the associated modelling report.

In addition, the EPA's proposed changes to the HSNO classification scheme are due to commence on 30 April 2021. This change replaces the current system with one based on revision 7 of the United Nations' Globally Harmonised System of Classification and Labelling of Chemicals ("GHS"). A translation of the classifications proposed in the EPA's Staff Report is provided.

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1 Background

1.1 Methyl bromide is used as a fumigant to treat a number of products prior to their export to selected countries, and for quarantine applications in imported goods, collectively known as quarantine and pre-shipment (QPS) uses. It is also permitted to be used for the quarantine treatment of potato wart in New Zealand.

1.2 It was approved under the Act on 29 October 2004, via the Hazardous Substances (Fumigants) Transfer Notice 2004, and has the Hazardous Substances and New Organisms ("HSNO") Approval Number HSR001635.

1.3 Methyl bromide was previously reassessed in 2010 following an application by the Chief Executive of the Environmental Risk Management Authority ("ERMA", the EPA's predecessor). The 2010 DMC decision included controls relating to buffer zones, and the need to recapture methyl bromide (down to 5 parts per million, ppm) by October 2020.

1.4 STIMBR applied for grounds to reassess methyl bromide in 2017 (APP203435). Evidence was provided of a 50% increase in the use of methyl bromide between 2010 and 2016, along with reviews of recapture progress. These grounds were granted by a DMC on 5 April 2018.

1.5 STIMBR subsequently applied for a reassessment of methyl bromide (that is, this application, APP203660), which was formally received on 9 April 2019. They requested that the approval be changed to "clarify the current controls, specifically those relating to the performance target of recapture technology and feasibility of the controls" relating to recapture to:

- reduce the recapture target requirement to 80% of methyl bromide remaining at the end of fumigations
- extend the deadline by ten years for achieving recapture from ship hold fumigations
- make refinements to strengthen buffer zone requirements at the completion of the recapture.

1.6 The Chief Executive of the EPA considered the content of the application and decided to use the EPA's discretionary power in section 63A(1) of the Act to proceed with the application as a modified reassessment.

1.7 The Chief Executive decided to not use the EPA's discretionary power in section 63A(4) of the Act to process the application without public notification. The application was, therefore, publicly notified in accordance with section 53 of the Act.

1.8 A hearing into this reassessment commenced on Tuesday 11 August 2020. After hearing evidence from the applicant, the EPA, submitters, and the nominated expert witnesses of several parties, the DMC adjourned the hearing on Monday 17 August 2020.

2 Purpose of this report

2.1 During the course of the application, several air dispersion models have either been provided to or commissioned by the EPA and the DMC.

2.2 These models can be used to predict how far methyl bromide could travel if the assumptions in the models are correct, which can then be used to set protective buffer zones.

2.3 The EPA used several modelling reports and their specialist expert reviews to form the basis of our buffer zone recommendations presented at the hearing.

2.4 Following the adjournment of the hearing, the DMC directed that additional modelling be conducted to assist them with their deliberations – in Directions and Minute WGT023 and WGT024.

2.5 As part of their feedback on this additional modelling, the applicant provided two further air dispersion modelling reports.

2.6 The purpose of this report is to provide a summary of these post-adjournment modelling reports and any recommendations for appropriate buffer zones that the associated reports contain.

2.7 For context, a brief summary of the previous modelling presented at the hearing is provided also. For a full discussion, however, please refer to the EPA's Staff Report for this application (EPA, 2020a).

2.8 It is worth noting that although the models discussed are specific to the practices and environs at the Port of Tauranga, the modelling experts have previously agreed that they could be used qualitatively at the two other ports where methyl bromide fumigation of logs currently takes place. Should there be future fumigation activities at these ports, or any other location, then the requirements in the Health and Safety at Work (Hazardous Substances) Regulations would still apply. Regional Councils could also set larger buffer zones than any minimum buffer zone set in this application as part of their resource consenting process.

2.9 In addition, we have included a brief summary of the GHS-equivalent classifications to those previously proposed by the EPA.

Out of scope

2.10 The applicant's request for the recapture rate to be set at 80% of the methyl bromide available at the end of the fumigation phase, revised to 30% in the *'Opening Legal Submissions of Counsel for the Applicant'*, is outside the scope of this report. A recommendation as to an appropriate recapture rate is, therefore, not provided.

2.11 In their directions to conduct further modelling (WGT023 and WGT024), the DMC requested a range of recapture rates be modelled. To assist with the DMC's deliberations, any buffer zones relating to different recapture rates are discussed, without any recommendations from the EPA as to what recapture rate should be set as a control.

2.12 In addition, the timing of the introduction of any such recapture rate, including the ship-hold extension requested by the applicant, is outside the scope of this report.

3 Summary of existing modelling

3.1 In support of their application, STIMBR commissioned an “Air concentration dispersion modelling [sic] assessment of methyl bromide concentrations in Tauranga Port, New Zealand” from Sullivan Environmental Consultants Inc (SEC, 2018), and subsequent Addendum (SEC, 2019).

3.2 Following critical reviews of these reports by Todoroski Air Sciences Pty Ltd (TAS, 2019a) for the EPA and Atmospheric Science Global Ltd (ASG, 2019a) for the Bay of Plenty Regional Council (BOPRC; as part of their submission), the EPA commissioned its own modelling from TAS.

3.3 This modelling, using the same input parameters though the 100^{th} percentile results, considered that methyl bromide could reach as far as 1.9 km downwind from the port of Tauranga without any recapture technology, reducing to 1.1 km with 80% of the methyl bromide recaptured (TAS, 2019b).

3.4 Independent reviews by Pattle Delamore Partners Ltd (PDP, 2019) for the EPA and ASG (2019b) for BOPRC found that the TAS modelling under-estimated the amount of methyl bromide released. PDP recommended that any further work incorporate more port-specific fumigation data; an area acknowledged by TAS in their report.

3.5 The DMC considered there was a lack of information upon which they could make a decision because of the conflicting results from the SEC and TAS models. As such, they directed parties to the hearing to nominate experts and for expert conferencing to occur to address the issues raised with the modelling.

3.6 Three rounds of expert conferencing were conducted. In the first two, the experts considered the model, inputs, and parameters to be used for six modelling scenarios. The third conference date was held to clarify an aspect of the second joint witness statement, regarding the incorporation of the meteorological dataset covering the years 2017-2019, in addition to the 2014-2016 dataset which was already available.

3.7 Following the second round of expert conferencing and the DMC’s Direction and Minute WGT008, the applicant commission SEC to undertake further air dispersion modelling.

3.8 SEC (2020a) used the CALPUFF model to represent the transport and dispersion conditions from a series of log fumigation activities. Modelling was performed on both a probabilistic basis to illustrate expected concentration distributions and a deterministic basis to illustrate the highest impact applications.

3.9 The report presented scenarios where fumigation of log stacks and ships were modelled concurrently, with no modelling of either fumigation type separately. Application rates were modelled in alignment with those currently required by China (maximum of 120 g/m3 at cool temperatures, but more typically 72-80 g/m3. An additional low application rate of 40 g/m3, yet to be accepted by trading partners, was also modelled.

3.10 SEC did not provide modelling results for three scenarios agreed at expert conferencing, including those with no recapture and the 80% recapture requested in the application form.

3.11 In their review of the updated modelling, TAS (2020a) noted that while the modelling information itself appeared accurate, they had identified an issue with the processing of the data that they considered to be a fatal error. (During the hearing, SEC (2020b) presented evidence in their favour as to why they considered that this was not an issue.) TAS also identified other issues, including that not all of the scenarios agreed at expert conferencing had been modelled.

3.12 During the course of the application, the EPA and DMC became aware of a number of existing air dispersion models for the Port of Tauranga (that is, Beca, 2015, and Golder, 2019). The EPA used some of the information from the Golder report (which had been externally reviewed by ASG, 2019c, for BOPRC) when forming our Staff Report recommendations.

3.13 During the period of time this application was being evaluated, WorkSafe New Zealand ("WorkSafe") commissioned their own independent monitoring and modelling programme. The interim results indicated that PDP (2020) were able to align the timing of their modelled peaks with the monitored results, though their modelling consistently under predicted the concentrations.

3.14 PDP (2020) also used a second model to understand the extent that methyl bromide would spread in an unintended release. The travel distances in this second model are more closely aligned with those identified in the TAS (2019b) and Golder (2019) reports.

3.15 More details are provided in 9.5Appendix D9.5Appendix D and the EPA's Staff Report (EPA, 2020a).

Previous buffer zones recommendations

3.16 The EPA recommended buffer zones, in the Staff Report (EPA, 2020) and at the hearing, based on our evaluation of the models discussed above.

3.17 In the absence of any modelling, and due to the lower amounts of methyl bromide used when compared to log fumigations, no changes to the buffer zones for container fumigations were proposed.

3.18 The buffer zones were based on the 100th percentile isopleths (that is, lines of equal concentration) when 120 g/m^3 of methyl bromide is used to fumigate log stacks and ship holds (although alternatives can be used for shipments to China, operators can currently use methyl bromide at this rate as well). The TAS (2020b) modelling was used for buffer zones without recapture, and the Golder (2019) modelling for recapture of 80% of the methyl bromide remaining at the end of the fumigation step.

3.19 The resulting down-wind buffer zones recommended at the hearing are summarised in Appendix D (Table 21).

3.20 Following the adjournment of the hearing, the DMC directed (in Direction and Minute WGT022) the EPA to update their buffer zone recommendations based on a variety of fumigation rates (those required by India, 72 g/m^3, and China, 120 g/m^3, as well as the lower rate being discussed with trading partners, 40 g/m^3) and a number of recapture scenarios (none, 30%, 50%, 60%, and 80%), and at the 99.9th percentile.

3.21 Our updated recommendations and how they were derived was provided in our memo to the DMC on 28 August 2020. These are summarised in 9.5Appendix D (Table 22).

4 Summary of recent modelling

DMC-commissioned modelling

4.1 Following the adjournment of the hearing, the DMC requested further modelling to help them with their deliberations.

4.2 In their Direction and Minute WGT023, the DMC instructed TAS to conduct deterministic modelling of the dispersion of methyl bromide from the Port of Tauranga using the CALPUFF model.

4.3 In response to clarification questions from TAS, the DMC confirmed, in Direction and Minute WGT024, the scenarios to be modelled, and that SEC and ASG were to conduct peer reviews of the modelling inputs and the resulting report. These were shown in Table 3-2 of TAS (2020), and are repeated in Table 1.

Table 1 DMC requested modelling scenarios

Scenario	Description	Log stack treatment rate (g/m^3)	Ship treatment rate (g/m^3)	Log stack recapture rate (%)	Ship recapture rate (%)	Fraction of log stacks recapture is applied to (%)	Number of log stacks	Buzzer zone (m)
1	Worst case logs & ships	120	120	30	0	50	6	900
2	Worst case logs only	120	-	30	-	50	6	375
3	Worst case ship only	-	120	-	0	-	-	1020
4	More likely high case log & ship	72	72	30	0	50	6	600
5	More likely high case log only	72	-	30	-	50	6	275
6a	More likely high case ship only	-	72	-	0	-	-	690
6b	Ship only	-	72	-	50	-	-	370
7a	Likely future high case log & ship	72	72	60	0	50	6	600
7b	Log & ship	72	72	60	50	50	6	320
8	Likely future high case log only	72	-	60	-	50	6	180

Scenario	Description	Log stack treatment rate (g/m³)	Ship treatment rate (g/m³)	Log stack recapture rate (%)	Ship recapture rate (%)	Fraction of log stacks recapture is applied to (%)	Number of log stacks	Buzzer zone (m)
9	Likely future high case ship only	-	72	-	0	-	-	660
10a	Likely future moderate case log & ship	72	72	60	0	75	5	600
10b	Log & ship	120	120	90	50	100	6	500
10c	Log & ship	72	72	90	50	100	6	320
10d	Log & ship	40	40	90	50	100	6	200
11a	Likely future moderate case log only	72	-	60	-	75	3	160
11b	Log only	120	-	90	-	100	6	150
11c	Log only	72	-	90	-	100	6	110
11d	Log only	40	-	90	-	100	6	45
12	Logs buffer worst case, 3 log stacks	120	-	30	-	50	3	250
13a	Logs buffer worst case, 1 log stack	120	-	30	-	50	1	125
13b *	0% recapture, Logs buffer worst case, 1 log stack	120	-	0	-	-	1	175
13c	Logs buffer worst case, 1 log stack	120	-	30	-	-	1	130
14	Ship only buffer low	-	40	-	0	-	-	400
15	0% recapture, worst case logs only	120	-	0	-	50	6	700

* Modelled following request by ASG as part of their review, rather than at request of DMC.

4.4 Following consultation with the operator at the Port of Tauranga, TAS identified that the port is restricted to operating hours between 7am and 7pm, which is when they modelled log stack fumigations.

4.5 Likewise, although the expert conferencing considered that ship holds would be vented at night (starting at 10pm), the operator confirmed to TAS that this would depend on the ships' and operator's schedules. As such, TAS modelled individual ship holds starting ventilation every hour.

4.6 A draft of the TAS modelling was shared with ASG and SEC. Their reviews (ASG, 2020; SEC, 2020c) identified that the original draft had not modelled the ship-hold ventilation at the correct height; which was corrected by TAS in their final report. The reviewers provided other comments: see ASG (2020) and SEC (2020c). TAS included a response to this feedback as Appendix D of their report (TAS, 2020).

4.7 As requested by the DMC, TAS provided approximate buffer zones for each of their modelled scenarios. TAS' proposed buffer zones ranged from 45 m (for log stacks fumigated with 40 g/m^3 where 90% of the methyl bromide at the end of the fumigation was recaptured) up to 1020 m (for ship holds fumigated at 120 g/m^3 with no methyl bromide recaptured). These were provided in Table 4-1 of the TAS report, and repeated in Table 1; they are discussed further in section 155.

4.8 To assist the DMC with their deliberations, TAS also investigated whether there were any wind conditions that were unsuitable for fumigation to occur. They considered that a "high degree of caution should be applied for log stack ventilation when wind speeds in any direction are below 2 m/s".

4.9 In addition, TAS indicated that "there may be value in the operator evaluating (with more precision than is possible in [TAS'] report) whether ventilation activities can be adjusted according to the weather conditions in order to minimise impacts."

4.10 We consider that this level of precision would be more suited to either a permission on the use of methyl bromide or, preferably, the resource consenting process under the Resource Management Act. It is conceivable that this could be incorporated in to, for example, the fumigation management plans required by the BOPRC for consented activities at the Port of Tauranga.

Applicant's additional modelling

4.11 As part of the applicant's feedback on the updated modelling by TAS, they provided further modelling by SEC (2021). This SEC modelling used AEROMOD. As the DMC had specifically directed the CALPUFF model to be used for this application, SEC (2021) is not considered further in this report. It is worth noting, though, that no buffer zones were proposed by SEC (2021).

4.12 In addition, the applicant also provided further modelling by Golder (2021), which built on some of the concepts developed by SEC (2021). Golder used the modelling scenarios set-up by TAS (2020) in CALPUFF to make refinements to the operating conditions in order to provide mitigation options to reduce the offsite effects of methyl bromide at the Port of Tauranga.

4.13 Unlike the other modelling reports reviewed by the EPA and available to the DMC, the latest reports by SEC (2021) and Golder (2021) have not been reviewed by an independent expert for the EPA or DMC.

Log stacks

4.14 Golder investigated the methyl bromide emission rates from log stacks required for the 1-hour TEL to be met 100 m from the fumigation activity, and whether the time of day of that release had any impact (based these calculations on TAS' scenario 2).

4.15 Golder concluded that an emission rate of venting of 32.6 g/s during the periods 7am – 9am and 3pm – 7pm or 51.0 g/s 9am – 3pm would allow this criteria to be met. These times are not dissimilar to an option proposed in TAS (2019b; Figure 4-6) which showed that fumigating in the middle of the day resulted in fewer impacts.

4.16 Golder consequently calculated the volume of log stacks that would be required to meet these emission rates. The different doses, recapture rates, and percentage of log stacks where recapture took place considered by Golder are provided in Table 2. They also calculated a methyl bromide dose required to meet these emission rates. The stacks sizes and dose rates are discussed further in Section 7.

Table 2 Refinements for log stack fumigations considered by Golder

Parameter	Values considered
Timing	7am – 9am 9am – 3pm 3pm – 7pm
Recapture rate	30% 50%
Stacks recaptured	50% 80% 99%

4.17 Golder indicate that their results are specific to Tauranga and although similar results would be expected at other locations, site specific modelling would be able to confirm this.

4.18 We consider that this level of precision would be more suited to either a permission on the use of methyl bromide or, preferably, the resource consenting process under the Resource Management Act. It is conceivable that this could be incorporated in to, for example, the fumigation management plans required by the BOPRC for consented activities at the Port of Tauranga.

Ship holds

4.19 Golder (2021) also looked into how varying the ship-hold fumigations could help mitigate the risks.

4.20 Although Golder (2021) identify that if the opening times of ship holds were restricted (see Table 3), the concentrations at the port boundary would comply with the guideline value, the results of this modelling are not presented in graphical form. As the configuration of the port and the dominant wind directions at Tauranga are not the same as other ports that fumigate ship holds with methyl bromide, the downwind distance considered to be within the port might be more helpful to understand a suitable buffer zone from this scenario.

Table 3 Ship-hold venting times proposed by Golder

Dose rate (g/m^3)	Earliest first hold opening time	Latest first hold opening time
40	12am	11pm
72	2am	5pm
120	5am	11am

From Golder 2021 Table 2, with holds opened every two hours

4.21 Golder amended TAS' scenario 3 to consider the effects of opening the ship holds one hour apart (rather than every two hours) with venting commencing at 8am, 9am or 10am every day with the each hold being vented an hour apart.

4.22 The resulting isopleths (that is, lines of equal air concentration) in Golder's figures 3, 4 and 5 show that the 1-hour TEL would be met within the port boundary, when the north-eastern corner of Sulphur Point is included. The distances extracted from these figures for the different opening times are provided in Table 4.

4.23 There are no figures or buffer zones presented for other fumigation or recapture rates, though Golder note that this "leads to around twice the emissions of Scenario 3, as two-hour release periods from each hold now overlap".

4.24 In order to explore these refinements for all the scenarios requested by the DMC, yet further modelling (in addition to the nine already reviewed for this application) would be required. Given the specificity to port and operator practices, it may be appropriate for this level of local detail to be part of a permission programme or the relevant resource consents. Such a resource consenting process would allow local iwi and hapū, and neighbouring residents, to have a voice on the emissions in their rohe and areas.

Table 4 Approximate distances to 1-hour TEL for ship holds at 120 $\mu g/m^3$ fumigation rate (from Golder, 2021)

Time ventilation starts	Approximate downwind distance to 3,900 $\mu g/m^3$ isopleth (m)	Downwind direction
8am	580	West-south-west (Sulphur Point)
9am	600	West-south-west (Sulphur Point)
10am	610	West-south-west (Sulphur Point)

Distance to 3,900 µg/m3 isopleth (that is, the 1-hour TEL) approximated from Figures 3 to 5 in Golder (2021)

5 Buffer zones – log stacks

5.1 As noted in Section 2, this report does not make any recommendations with regard to what methyl bromide recapture rate is appropriate.

5.2 The buffer zones proposed or presented in the recent modelling reports for log stacks alone are repeated here by the different recapture rates incorporated into the modelling: see Table 5 to Table 9.

5.3 As can be seen in the figures presented in the modelling reports and the tables below, the more methyl bromide that is released at the end of a fumigation, the larger the buffer zone needs to be.

5.4 With the natural air disbursement changes that happen through a typical day, releasing methyl bromide during the late morning and early afternoon will not travel as far as for releases in early morning and late afternoon. More methyl bromide can therefore be released around noon than at early morning/late afternoon for the same impacts to be seen at any particular distance.

5.5 The smaller buffer zones proposed by Golder (2021) would require the restrictions on ventilation time and maximum stack sizes discussed in Section 0 to be applied also. A combination of these constraints with recapture and fumigation rates are provided in 9.5Appendix C.

5.6 The buffer zones with respect to the fumigation of ship holds are presented in Section 0.

Table 5 Buffer zones – no recapture on log stacks

Treatment rate (g/m^3)	Stacks where recapture applied (%)	Constraints on venting time	Maximum stack size (m^3)	Downwind buffer zone (m)	Source
120	50	7am – 7pm	10,800	700	TAS (2020b)
	100	7am – 7pm	1,800	175	TAS (2020b)

Table 6 Buffer zones – 30% recapture on log stacks

Treatment rate (g/m^3)	Stacks where recapture applied (%)	Constraints on venting time	Maximum stack size (m^3)	Downwind buffer zone (m)	Source
40	50	See Table 12 to Table 15	6,800 – 10,800	100	Golder (2021)
	80	See Table 12 to Table 15	7,700 – 12,000	100	Golder (2021)
	99	See Table 12 to Table 15	8,300 – 13,000	100	Golder (2021)

Treatment rate (g/m³)	Stacks where recapture applied (%)	Constraints on venting time	Maximum stack size (m³)	Downwind buffer zone (m)	Source
72	50	7am – 7pm	10,800	275	TAS (2020b)
		See Table 12 to Table 15	3,800 – 6,000	100	Golder (2021)
	80	See Table 12 to Table 15	4,200 – 6,700	100	Golder (2021)
	99	See Table 12 to Table 15	4,600 – 7,200	100	Golder (2021)
120	50	7am – 7pm	5,400	250	TAS (2020b)
		7am – 7pm	10,800	375	TAS (2020b)
		See Table 12 to Table 15	2,200 – 3,600	100	Golder (2021)
	80	See Table 12 to Table 15	2,500 – 4,000	100	Golder (2021)
	99	See Table 12 to Table 15	2,700 – 4,300	100	Golder (2021)
	100	7am – 7pm	1,800	130	TAS (2020b)

Table 7 Buffer zones – 50% recapture on log stacks

Treatment rate (g/m³)	Stacks where recapture applied (%)	Constraints on venting time	Maximum stack size (m³)	Downwind buffer zone (m)	Source
40	50	See Table 12 to Table 15	7,800 – 12,200	100	Golder (2021)
	80	See Table 12 to Table 15	9,700 – 15,300	100	Golder (2021)
	99	See Table 12 to Table 15	11,600 – 18,100	100	Golder (2021)
72	50	See Table 12 to Table 15	4,300 – 6,800	100	Golder (2021)
	80	See Table 12 to Table 15	5,400 – 8,500	100	Golder (2021)
	99	See Table 12 to Table 15	6,400 – 10,000	100	Golder (2021)
120	50	See Table 12 to Table 15	2,600 – 4,000	100	Golder (2021)
	80	See Table 12 to Table 15	3,200 – 5,100	100	Golder (2021)
	99	See Table 12 to Table 15	3,800 – 6,000	100	Golder (2021)

Table 8 Buffer zones – 60% recapture on log stacks

Treatment rate (g/m^3)	Stacks where recapture applied (%)	Constraints on venting time	Maximum stack size (m^3)	Downwind buffer zone (m)	Source
72	50	None	10,800	180	TAS (2020b)
	75	None	5,400	160	TAS (2020b)

Table 9 Buffer zones – 90% recapture on log stacks

Treatment rate (g/m^3)	Stacks where recapture applied (%)	Constraints on venting time	Maximum stack size (m^3)	Downwind buffer zone (m)	Source
40	100	None	10,800	45	TAS (2020b)
72	100	None	10,800	110	TAS (2020b)
120	100	None	10,800	150	TAS (2020b)

6 Buffer zones – ship holds

6.1 As noted in Section 2, this report does not make any recommendations with regard to what methyl bromide recapture rate is appropriate.

6.2 The buffer zones proposed or presented in the recent modelling reports are repeated here by the different recapture rates incorporated into the modelling: see Table 10 and Table 11.

6.3 The buffer zones with respect to the fumigation of log stacks are presented in Section 5.

Table 10 Buffer zones – 0% recapture on ship holds

Treatment rate (g/m^3)	Constraints on first hold vented	Minimum gap between each hold venting (hours)	Downwind buffer zone (m)	Source
40	None	2	400	TAS (2020b)
72	None	2	690	TAS (2020b)
120	None	2	1020	TAS (2020b)
	8am – 10am	1	610	Golder (2021)

Table 11 Buffer zones – 50% recapture on ship holds

Treatment rate (g/m^3)	Constraints on first hold vented	Minimum gap between each hold venting (hours)	Downwind buffer zone (m)	Source
72	None	2	370	TAS (2020b)

7 Other controls proposed in modelling reports

Weather

7.1 Golder (2021) noted that modelling is less reliable at wind speeds less than 0.5 m/s.

7.2 TAS (2020b) considered that ventilation of methyl bromide should not take place below wind speeds of 2 m/s due to the poor dispersion and instability in wind directions.

7.3 As the DMC explicitly asked TAS for advice relating to adverse conditions to avoid, it would be appropriate to phrase TAS' recommendation of a 2 m/s minimum wind speed as a control.

7.4 The reporting requirements would need to include records of wind speeds during ventilation so that any such minimum wind speed control can be monitored for compliance.

7.5 TAS (2020b) also proposes a risk matrix of wind speeds specific to Tauranga to reduce the impact of methyl bromide from its venting. They note that their matrix is specific to the Port of Tauranga and advises each operator to prepare their own. As such, if the DMC so desired to incorporate the risk as a mitigation measure, this would fit better with a permission control or as a resource consent condition.

Emission rate

7.6 If the 100 m buffer zone proposed by Golder (2021) for log stacks were to be selected by the DMC, then the associated modelling parameters that allowed for this smaller buffer zone would also need to be set as controls.

7.7 One option would be to set a limit on the emission rate during ventilation.

7.8 Golder calculated the maximum emission rates as repeated in Table 12.

Table 12 Maximum emission rate (from Golder, 2021)

Time of emission	Maximum emission rate (μg/m^3)
7 am – 9am 3pm – 7pm	32.6
9am – 3pm	51.0

7.9 Such a control would address issues raised at the hearing regarding flexibility should the operators and the Ministry for Primary Industries be able to negotiate trading partners to accept effective fumigation rates rather than starting fumigation concentrations.

7.10 Similar to the wind speed control, the reporting requirements would need to include records of the emission rates so that any such control can be monitored for compliance.

7.11 However, operators and compliance, monitoring and enforcement (CME) agencies may find it difficult to measure this emission rate in order to either comply with or monitor/enforce any such control. BOPRC requested clearer and more enforceable controls in their written submissions and presentations to the hearing.

Stack size

7.12 A second option to ensuring that the 100 m buffer zone proposed by Golder (2021) can be met is to limit the size of the log stacks.

7.13 The stack sizes proposed by Golder are provided in Table 13 and Table 14.

Table 13 Maximum volume of log stacks from Golder (2021) – 30% recapture

Dose rate	Time of ventilation	Maximum volume of log stacks (m^3)		
		50% stacks recaptured	80% stacks recaptured	99% stacks recaptured
40	7 am – 9am 3pm – 7pm	6,800	7,700	8,300
	9am – 3pm	10,800	12,000	13,000
72	7 am – 9am 3pm – 7pm	3,800	4,200	4,600
	9am – 3pm	6,000	6,700	7,200
120	7 am – 9am 3pm – 7pm	2,200	2,500	2,700
	9am – 3pm	3,600	4,000	4,300

Table 14 Maximum volume of log stacks from Golder (2021) – 50% recapture

Dose rate	Time of ventilation	Maximum volume of log stacks (m^3)		
		50% stacks recaptured	80% stacks recaptured	99% stacks recaptured
40	7 am – 9am 3pm – 7pm	7,800	9,700	11,600
	9am – 3pm	12,200	15,300	18,100
72	7 am – 9am 3pm – 7pm	4,300	5,400	6,400
	9am – 3pm	6,800	8,500	10,000
120	7 am – 9am 3pm – 7pm	2,600	3,200	3,800
	9am – 3pm	4,000	5,100	6,000

7.14 The buffer zones proposed by TAS also have an associated maximum log size associated with the values used in the modelling: these are included in Table 5 to Table 9.

7.15 Similar to the wind speed control, the reporting requirements would need to include records of log stack dimensions and volume so that any such maximum stack size control can be monitored for compliance.

Maximum dose

7.16 An alternative to setting an emission rate limit or maximum log stack size would be to set a maximum dosing rate.

7.17 Golder (2021) provided the dosing rates required to meet their proposed emission rate such that their proposed 100m buffer zone would be met: see Table 15.

Table 15 Maximum dose (from Golder, 2021)

Recapture rate (%)	Time of ventilation	Maximum dose of methyl bromide (kg)		
		50% stacks recaptured	80% stacks recaptured	99% stacks recaptured
30	7 am – 9am 3pm – 7pm	276	308	333
	9am – 3pm	432	483	522
50	7 am – 9am 3pm – 7pm	313	391	464
	9am – 3pm	490	612	727

7.18 Similar to the other controls above, the reporting requirements would need to include records of the dosage rates so that any such control can be monitored for compliance.

7.19 However, CME agencies may find it difficult to measure this dosage rate independently of an operator. This might present difficulties for such agencies to monitor compliance with this control, and consequently to enforce it.

Timing constraints

7.20 The log stack modelling by TAS (2020b) took into account expert and operator feedback that operations are limited on the Port of Tauranga to between 7am and 7pm.

7.21 To achieve a 100 m buffer zone, Golder (2021) incorporated three time periods with associated other constraints to limit the amount of methyl bromide released. These times (7am – 9am, 9am – 3pm, and 3pm – 7pm) are incorporated into Table 6 – Table 7 and Table 12 – Table 15.

7.22 For ship holds, TAS (2020b) considered that a minimum of two hours would pass between consecutive holds being ventilated.

7.23 Golder (2021) suggested constraints on the timing of ship hold ventilations, with two hour gaps between consecutive holds being ventilated (see Table 3), though the downwind distance buffer zone that should be associated with it to ensure the safety of the public is not clear.

7.24 Golder also considered venting ship holds one hour apart, with the venting of the first hold starting between the hours of 8am and 10am. The associated buffer zone is included in Table 10.

7.25 As such, a control (or controls) to ensure that timing of ventilation of methyl bromide from log stacks and ship holds matched the constraints used in the relevant modelling are appropriate for when fumigation and ventilation occurs at any port.

8 Adoption of GHS classifications

8.1 The EPA is currently updating its classification system to adopt the 7th revision of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS).

8.2 Approved hazardous substances will be either reissued (under schedule 7 of the Act) or the subject of a modified reassessment (under section 63C of the Act) during 2021 to ensure that the new GHS classifications apply.

8.3 The approval for methyl bromide was reissued on 19 July 2019 (as amended on 19 November 2019) in order to adopt the 2017 EPA Notices and Health and Safety at Work (Hazardous Substances) Regulations. This was done early in the process to provide clarity on the controls that would be subject to the reassessment.

8.4 At that time, it was envisioned that the methyl bromide reassessment would be completed prior to the adoption of the new classification scheme. We, therefore, originally planned for methyl bromide to be included in the general process to adopt GHS 7 classifications.

8.5 Given the current progress with the methyl bromide reassessment, this general process will be completed alongside or before a decision on this application is published. Therefore, it is appropriate for this DMC to consider the changes to the classification scheme for this particular approval, rather than the separate DMC who are dealing with the general process. This aspect of the reassessment is under section 63C of the Act and a decision on the classification under that section can be made alongside the decision under section 63A.

8.6 Table 16 shows the classifications proposed by the EPA (2020a, 2020b), with their GHS equivalents.

8.7 More details of the translations can be found Schedule 3 of the EPA (Hazardous Substances (Hazard Classification) Notice 2020.

Table 16 Proposed GHS classifications

Hazard	Current HSNO classification	**EPA's** proposed HSNO classification	GHS equivalent **of EPA's proposed classification**
Flammable gas	2.1.1B	2.1.1B	Flammable gas Category 2
Acute toxicity (oral)	6.1B	6.1C	Acute oral toxicity Category 3
Acute toxicity (inhalation)	6.1C	6.1C	Acute inhalation toxicity Category 3
Respiratory irritant	No	6.1E	Specific target organ toxicity – single exposure Category 3 respiratory tract irritation
Skin irritant/corrosion	8.2C	8.2C	Skin corrosion Category 1C
Eye irritant/corrosion	8.3A	8.3A	Serious eye damage Category 1
Mutagenicity	6.6B	6.6B	Germ cell mutagenicity Category 1
Reproductive/ developmental toxicity	6.8B	6.8B	Reproductive toxicity Category 2
Specific target organ toxicity	6.9A	6.9A	Specific target organ toxicity (repeated exposure) Category 1
Aquatic ecotoxicity	9.1A	9.1A	Hazardous to the aquatic environment acute Category 1
			Hazardous to the aquatic environment chronic Category 1
Soil organism ecotoxicity	9.2A	9.2A	Hazardous to soil organisms
Terrestrial vertebrate ecotoxicity	9.3B	9.3B	Hazardous to terrestrial vertebrates
Terrestrial invertebrate ecotoxicity	9.4A	9.4A	Hazardous to terrestrial invertebrates

9 Conclusions

9.1 In response to the DMC’s direction for additional modelling, the TAS report identifies several potential buffer zones for log stack and ship hold fumigations based on several potential recapture rates.

9.2 Further modelling by Golder on behalf of the applicant identified several refinements for some of these scenarios to reduce the buffer zone size. If these smaller buffer zones were to be set, then additional controls would be required to ensure that operational practice matched the risk conclusions of the modelling.

9.3 As confirming these refinements for all of the scenarios requested, and possibly at other fumigation locations, would require more air dispersion modelling (noting that nine modelling reports have been reviewed in this application to date), we consider that these refinements would fit better within a permission control or as a resource consent condition.

9.4 TAS proposed that venting should not take place at wind speeds less than 2 m/s.

9.5 The EPA has also taken this opportunity to advise on upcoming changes to the hazardous substance classification regime, including a translation of our proposed classifications under the new GHS-based system (that is, Flammable gas Category 2, Acute oral toxicity Category 3, Acute inhalation toxicity Category 3, Specific target organ toxicity – single exposure Category 3 respiratory tract irritation, Skin corrosion Category 1C, Serious eye damage Category 1, Germ cell mutagenicity Category 1, Reproductive toxicity Category 2, Specific target organ toxicity (repeated exposure) Category 1, Hazardous to the aquatic environment acute Category 1, Hazardous to the aquatic environment chronic Category 1, Hazardous to soil organisms, Hazardous to terrestrial vertebrates, Hazardous to terrestrial invertebrates.)

Appendix A Acronyms

Table 17 Acronyms

Acronym	Meaning
µg/m^3	Microgram per cubic metre
ASG	Atmospheric Science Global
BOPRC	Bay of Plenty Regional Council
CME	Compliance, monitoring and enforcement
DMC	Decision-making Committee
EPA	Environmental Protection Authority
ERMA	Environmental Risk Management Authority
g/m^3	Gram per cubic metre
HSNO	Hazardous Substances and New Organisms [Act 1996]
kg	Kilogram
m	Metre
m^3	Cubic metre
PID	Photoionisation detector
PDP	Pattle Delamore Partners Limited
QPS	Quarantine and pre-shipment
RMA	Resource Management Act 1991
SEC	Sullivan Environmental Consultants Inc
STIMBR	Stakeholders in Methyl Bromide Reduction Incorporated
TAPM	The Air Pollution Model
TAS	Todoroski Air Sciences Proprietary Limited
TEL	Tolerable exposure limit
TVOC	Total volatile organic compounds

Appendix B Reports relied upon in this report

There are a number of standalone reports that have been used in preparing this report. Instead of including all of these as appendices to the report, please find a links to these reports in Table 18.

Table 18 Reports relied upon

Author (in alphabetical order)	Date	Title	Link
Atmospheric Science Global	2019a	Review of air concentration dispersion modelling assessment of methyl bromide concentrations in Tauranga Port, New Zealand	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/SUBMISSION127599_Bay-of-Plenty-Regional-Council.pdf
Atmospheric Science Global	2019b	Review of TAS Air Sciences modelling assessment of methyl bromide at Port of Tauranga	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/Final-ASG-review-of-Todoroski-Air-Sciences-Modelling-of-MB-at-Port-of-Ta.pdf
Atmospheric Science Global	2019c	Review of (Beca, latest Golder modelling (Oct19) and ESR) Genera air assessment for fumigant release at the Port of Tauranga	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/Final-ASG-Review-of-Beca-Golder-ESR-Air-Assessment-October2019-on-behalf-of-Genera-December-2019.pdf
Atmospheric Science Global	2020	Review of TAS Modelling Report for Methyl Bromide Exposures for Timber Fumigation at the Port of Tauranga, Mount Maunganui Area (TMMA).	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/APP203660_ASGs-review-of-TASs-2020-modelling.pdf
Beca	2015	Assessment of effects – Discharges to air from methyl bromide fumigation	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/Dec19_a_Assessment-of-Effects.pdf
Environmental Protection Authority	2020a	Staff Report	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/APP203660_Final_Staff-Report_July-2020.pdf
Environmental Protection Authority	2020b	Addendum to Staff Report (in response to Direction and Minute WGT022)	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/APP203660_Memo-Updated-Buffer-Zones-Response-To-WGT022.pdf

Author (in alphabetical order)	Date	Title	Link
Golder Associates (NZ)	2019	Technical air quality assessment	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/Dec19_g_Air-Discharge-Consent_Appendix-D.PDF
Golder Associates (NZ)	2021	Fumigation Mitigation Options Investigation	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/WGT029response009.2_25th-Memorandum-of-Counsel-for-the-Applicant-29.1.21-Attachment-2-Golder-Report.pdf
Pattle Delamore Partners	2019	Review of air dispersion modelling of methyl bromide fumigation events	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/APP203660_NZ_EPA_Methylbromide_-Pattle_Delamore_Partners_Limited_-Review_of_Todoroski_Air_Sciences-Air_Dispersion_Modelling.pdf
Pattle Delamore Partners	2020	Methyl bromide modelling study – Port of Tauranga (Draft)	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/APP203660_UPDATED_W02347800R001_Draft_WorkSafe_Air_Dispersion_Monitoring_Report_watermark.pdf
Sullivan Environmental Consulting	2018	Air concentration dispersion modeling [sic] assessment of methyl bromide concentrations in Tauranga port, New Zealand	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/54ae837cca/Appendix-07A-Air-dispersion-Modeling-Report.pdf
Sullivan Environmental Consulting	2019	Addendum to Air concentration dispersion modeling [sic] assessment of methyl bromide concentrations in Tauranga port, New Zealand	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/e2eac1c256/Appendix-07B-Air-dispersion-Modeling-Report-addendum.pdf

Author (in alphabetical order)	Date	Title	Link
Sullivan Environmental Consulting	2020a	Modelling report for methyl bromide exposures for timber fumigation at the Port of Tauranga, New Zealand	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/APP203660_Modeling-Report-for-Methyl-Bromide-Exposures-for-Log-Fumigation-at-the-Port-of-Tauranga.pdf
Sullivan Environmental Consulting	2020b	STIMBR Hearing August 17, 2020: Sullivan Environmental Consulting, Inc. (SEC) Air Quality Modeling [sic]	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/Presentation_-from-David-Sullivan-17082020.pdf
Sullivan Environmental Consulting	2020c	Review Comments on the Report: Draft Air Dispersion Modeling [sic] of Methyl Bromide for Decision-Making Committee Produced by Todoroski Air Sciences, 2 November 2020	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/APP203660_SECs-review-of-TASs-2020-modelling.pdf
Sullivan Environmental Consulting	2021	Normalized Methyl Bromide Dispersion Modeling [sic] Report for Ship and Log Stack Fumigation at the Port of Tauranga, NZ	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/WGT029response009.1_25th-Memorandum-of-Counsel-for-the-Applicant-29.1.21-Attachment-1-SEC-Report.pdf
Todoroski Air Sciences	2019a	Air quality review: dispersion modelling assessment of methyl bromide	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/APP203660_NZ_EPA_Methylbromide_-Todoroski_Air_Sciences_Review_of_Sullivan_Air-_dispersion_-Modelling_Report.pdf
Todoroski Air Sciences	2019b	Air dispersion modelling: methyl bromide	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/APP203660_NZ_EPA_Methylbromide_Air-Dispersion-Modelling_-Todoroski_Air_Sciences.pdf
Todoroski Air Sciences	2020a	Air quality review: Dispersion modelling assessment of methyl bromide	APP203660_Todoroski_Air_Sciences_Review-of_Updated_Air_Dispersion_Modelling_July2020.pdf

Author (in alphabetical order)	Date	Title	Link
Todoroski Air Sciences	2020b	Air dispersion modelling of methyl bromide for decision-making committee	https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/APP203660_TASs-2020-air-dispersion-modelling.pdf

Appendix C Buffer zone tables in full

The buffer zones presented in Table 5 to Table 11, and the combined buffer zones presented in TAS (2020), are combined with the restrictions in Table 12 to Table 15, to give the full combinations of constraints. The buffer zones where log stacks are fumigated are presented in Table 19, and those incorporating ship hold fumigations are presented in Table 20

Table 19 Combined constraints and buffer zones – log stacks

Log stack recapture rate (%)	Log stack treatment rate (g/m3)	Stacks where recapture applied (%)	Stack size (m3)	Ship recapture rate (%)	Ship treatment rate (g/m3)	Time between holds venting (hours)	Time constraints	Approximate buffer distance (m)
0	120	50	10,800	-	-	-	7am – 7pm	700
0	120	100	1,800	-	-	-	7am – 7pm	175
30	40	99	13,000	-	-	-	9am – 3pm	100
30	40	80	12,000	-	-	-	9am – 3pm	100
30	40	50	10,800	-	-	-	9am – 3pm	100
30	40	99	8,300	-	-	-	3pm – 7pm	100
30	40	99	8,300	-	-	-	7am – 9am	100
30	40	80	7,700	-	-	-	3pm – 7pm	100
30	40	80	7,700	-	-	-	7am – 9am	100
30	40	50	6,800	-	-	-	3pm – 7pm	100
30	40	50	6,800	-	-	-	7am – 9am	100
30	72	50	10,800	-	-	-	7am – 7pm	275
30	72	50	10,800	0	72	2	7am – 7pm	600
30	72	99	7,200	-	-	-	9am – 3pm	100
30	72	80	6,700	-	-	-	9am – 3pm	100
30	72	50	6,000	-	-	-	9am – 3pm	100
30	72	99	4,600	-	-	-	3pm – 7pm	100
30	72	99	4,600	-	-	-	7am – 9am	100

Log stack recapture rate (%)	Log stack treatment rate (g/m3)	Stacks where recapture applied (%)	Stack size (m3)	Ship recapture rate (%)	Ship treatment rate (g/m3)	Time between holds venting (hours)	Time constraints	Approximate buffer distance (m)
30	72	80	4,200	-	-	-	3pm – 7pm	100
30	72	80	4,200	-	-	-	7am – 9am	100
30	72	50	3,800	-	-	-	3pm – 7pm	100
30	72	50	3,800	-	-	-	7am – 9am	100
30	120	50	10,800	-	-	-	7am – 7pm	375
30	120	50	10,800	0	120	2	7am – 7pm	900
30	120	50	5,400	-	-	-	7am – 7pm	250
30	120	99	4,300	-	-	-	9am – 3pm	100
30	120	80	4,000	-	-	-	9am – 3pm	100
30	120	50	3,600	-	-	-	9am – 3pm	100
30	120	99	2,700	-	-	-	3pm – 7pm	100
30	120	99	2,700	-	-	-	7am – 9am	100
30	120	80	2,500	-	-	-	3pm – 7pm	100
30	120	80	2,500	-	-	-	7am – 9am	100
30	120	50	2,200	-	-	-	3pm – 7pm	100
30	120	50	2,200	-	-	-	7am – 9am	100
30	120	50	1,800	-	-	-	7am – 7pm	125
30	120	100	1,800	-	-	-	7am – 7pm	130
50	40	99	18,100	-	-	-	9am – 3pm	100
50	40	80	15,300	-	-	-	9am – 3pm	100
50	40	50	12,200	-	-	-	9am – 3pm	100
50	40	99	11,600	-	-	-	3pm – 7pm	100
50	40	99	11,600	-	-	-	7am – 9am	100

Log stack recapture rate (%)	Log stack treatment rate (g/m3)	Stacks where recapture applied (%)	Stack size (m3)	Ship recapture rate (%)	Ship treatment rate (g/m3)	Time between holds venting (hours)	Time constraints	Approximate buffer distance (m)
50	40	80	9,700	-	-	-	3pm – 7pm	100
50	40	80	9,700	-	-	-	7am – 9am	100
50	40	50	7,800	-	-	-	3pm – 7pm	100
50	40	50	7,800	-	-	-	7am – 9am	100
50	72	99	10,000	-	-	-	9am – 3pm	100
50	72	80	8,500	-	-	-	9am – 3pm	100
50	72	50	6,800	-	-	-	9am – 3pm	100
50	72	99	6,400	-	-	-	3pm – 7pm	100
50	72	99	6,400	-	-	-	7am – 9am	100
50	72	80	5,400	-	-	-	3pm – 7pm	100
50	72	80	5,400	-	-	-	7am – 9am	100
50	72	50	4,300	-	-	-	3pm – 7pm	100
50	72	50	4,300	-	-	-	7am – 9am	100
50	120	99	6,000	-	-	-	9am – 3pm	100
50	120	80	5,100	-	-	-	9am – 3pm	100
50	120	50	4,000	-	-	-	9am – 3pm	100
50	120	99	3,800	-	-	-	3pm – 7pm	100
50	120	99	3,800	-	-	-	7am – 9am	100
50	120	80	3,200	-	-	-	3pm – 7pm	100
50	120	80	3,200	-	-	-	7am – 9am	100
50	120	50	2,600	-	-	-	3pm – 7pm	100
50	120	50	2,600	-	-	-	7am – 9am	100
60	72	50	10,800	-	-	-	7am – 7pm	180

Log stack recapture rate (%)	Log stack treatment rate (g/m3)	Stacks where recapture applied (%)	Stack size (m3)	Ship recapture rate (%)	Ship treatment rate (g/m3)	Time between holds venting (hours)	Time constraints	Approximate buffer distance (m)
60	72	50	10,800	0	72	2	7am – 7pm	600
60	72	50	10,800	50	72	2	7am – 7pm	320
60	72	75	9,000	0	72	2	7am – 7pm	600
60	72	75	5,400	-	-	-	7am – 7pm	160
90	40	100	10,800	-	-	-	7am – 7pm	45
90	40	100	10,800	50	40	2	7am – 7pm	200
90	72	100	10,800	-	-	-	7am – 7pm	110
90	72	100	10,800	50	72	2	7am – 7pm	320
90	120	100	10,800	-	-	-	7am – 7pm	150
90	120	100	10,800	50	120	2	7am – 7pm	500

Table 20 Combined constraints and buffer zones – ship holds

Ship recapture rate (%)	Ship treatment rate (g/m3)	Time between holds venting (hours)	Log stack recapture rate (%)	Log stack treatment rate (g/m3)	Stacks where recapture applied (%)	Stack size (m3)	Time constraints	Approximate buffer distance (m)
0	40	2	-	-	-	-	None	400
0	72	2	30	72	50	10,800	None	600
0	72	2	60	72	50	10,800	None	600
0	72	2	60	72	75	9,000	None	600
0	72	2	-	-	-	-	None	690
0	120	1	-	-	-	-	8am – 10am	610
0	120	2	30	120	50	10,800	None	900
0	120	2	-	-	-	-	None	1020
50	40	2	90	40	100	10,800	None	200
50	72	2	60	72	50	10,800	None	320
50	72	2	90	72	100	10,800	None	320
50	72	2	-	-	-	-	None	370
50	120	2	90	120	100	10,800	None	500

Appendix D Summary of existing modelling

Applicant's original modelling (SEC 2018)

STIMBR commissioned an "Air concentration dispersion modelling [sic] assessment of methyl bromide concentrations in Tauranga Port, New Zealand" from Sullivan Environmental Consultants Inc (SEC, 2018), and subsequent Addendum (SEC, 2019). These were provided with the application (as Appendices 7A and 7B, respectively).

These SEC reports used the AERMOD model to represent the transport and dispersion conditions from a series of log fumigation activities, including log stacks and ship holds fumigated separately and in combination. Smaller fumigation activities, such as from shipping containers were not modelled.

An independent review by Todoroski Air Sciences Pty Ltd (TAS) for the EPA found that there was "*a critical error … that renders the … conclusions invalid as there would be a significant underestimation of potential impacts*" (TAS, 2019a).

As part of the Bay of Plenty Regional Council's (BOPRC's) submission on the application, the BOPRC included an independent review of the SEC reports by Atmospheric Science Global Ltd (ASG). ASG (2019a) found that the SEC reports were *"not robust and that there is a clear pattern that the methods used in the study are not representative of methyl bromide fumigation and ventilation at the port [of Tauranga]."*

EPA-commissioned modelling (TAS 2019)

As a result of the critical review from TAS, the EPA commissioned TAS to prepare a specialist air dispersion report.

TAS undertook modelling using the CALPUFF Modelling System and The Air Pollution Model (TAPM). CALPUFF is a transport and dispersion model that simulates the movement of material and substances, including dispersion processes. TAPM is used to simulate the upper air data that goes into CALPUFF.

They modelled the amount of methyl bromide that would be released from three log stacks and a ship hold at the Port of Tauranga under a number of scenarios; including the applicant's proposed 80% recapture definition, and a range of initial treatment concentrations.

TAS compared the results of their model (at the, 100th percentile) with monitoring information provided in the ASG report submitted as part of the BOPRC submission. They considered that their model results for the 120 g/m^3 initial treatment rate demonstrates close agreement to those monitoring results provided by ASG, and so the model reasonably represents the actual fumigation case in reality at Port of Tauranga. These results are for ventilation under the worst meteorological conditions for air dispersion and do not represent overall average conditions, with each hour modelled independently.

This modelling considered that methyl bromide could reach as far as 1.9 km downwind without any recapture technology, reducing to 1.1 km with 80% of the methyl bromide recaptured.

Independent reviews by Pattle Delamore Partners Ltd (PDP, 2019) for the EPA and ASG (2019b) for BOPRC found that the TAS modelling under-estimated the amount of methyl bromide released.

PDP recommended that any further work incorporates more port-specific fumigation data; an area acknowledged by TAS in their report.

Expert Conferencing

The DMC considered there was a lack of information upon which they could make a decision because of the conflicting results from the SEC and TAS models. As such, they directed parties to the hearing to nominate experts and for expert conferencing to occur to address the issues raised with the modelling.

Three rounds of expert conferencing were conducted. In the first two, the experts considered the model, inputs, and parameters to be used for six modelling scenarios. The third conference date was held to clarify an aspect of the second joint witness statement, regarding the incorporation of the meteorological dataset covering the years 2017-2019, in addition to the 2014-2016 dataset which was already available.

Applicant's revised modelling (SEC 2020)

Following the second round of expert conferencing and the DMC's Direction and Minute WGT008, the applicant commission SEC to undertake further air dispersion modelling.

SEC (2020a) used the CALPUFF model to represent the transport and dispersion conditions from a series of log fumigation activities. Modelling was performed on both a probabilistic basis to illustrate expected concentration distributions and a deterministic basis to illustrate the highest impact applications.

The report presented scenarios where fumigation of log stacks and ships were modelled concurrently, with no modelling of either fumigation type separately.

Application rates were modelled in alignment with those currently required by China (maximum of 120 g/m3 at cool temperatures, but more typically 72-80 g/m3. An additional low application rate of 40 g/m3, yet to be accepted by trading partners, was also modelled.

SEC did not provide modelling results for three scenarios agreed at expert conferencing, including those with no recapture and the 80% recapture requested in the application form.

In their review of the updated modelling, TAS (2020a) noted that while the modelling information itself appeared accurate, a critical error had been made in the processing of modelling results. This error was in the way the FORTRAN program has functioned. Although apparently intended to extract the value from the modelling data, this was not occurring and in many instances a significantly lower value had been extracted. This had flow on effects in underestimating the other percentiles determined using the FORTRAN program. The error was noted to affect all the results and was not limited to any single scenario or averaging period. As a consequence, TAS considered that none of the modelling results presented were correct or valid, and could not be used to draw any risk or regulatory conclusions. (During the hearing, SEC (2020b) presented evidence in their favour as to why they considered that this was not an issue.)

In addition, TAS noted several other issues relating to the SEC modelling.

Third-party modelling

During the course of the application, the EPA and DMC became aware of a number of existing air dispersion models for the Port of Tauranga.

A BECA (2015) report in support of a resource consent was not considered further as it related to the use of forced ventilation, which was not proposed in the application.

In support of another resource consent, Golder (2019) used the CALPUFF model to estimate the air concentration of methyl bromide near the port. They presented results at the 99.9th and 100th percentiles. Although they concluded that the one hour tolerable exposure level (1-hour TEL) would be met at the port boundary at the 99.9th percentiles, their report also showed exceedances of the TEL out to 1.1km at the 100th percentile.

Golder also noted monitored exceedances of the 1-hour TEL up to 300m downwind of fumigations.

A review by ASG for BOPRC, the relevant resource consenting authority, considered that the 100th percentile approach was more suitable, especially given these exceedances. ASG had issues with some other parameters also. (ASG, 2019c)

During the period of time this application was being evaluated, WorkSafe New Zealand ("WorkSafe") commissioned their own independent monitoring and modelling programme. Their contractor, PDP, used CALPUFF to assess the transport of methyl bromide. The interim results indicated that PDP were able to align the timing of their modelled peaks with the monitored results, though their modelling consistently under predicted the concentrations. PDP considered this underestimation is likely due to the volume of headspace used in the log stacks in their model. (PDP, 2020)

PDP (2020) also used a second model to understand the extent that methyl bromide would spread in an unintended release; using three scenarios representing a small slow release, a medium release, and a large immediate release. The travel distances in this second model are more closely aligned with those identified by the TAS (2019b) and Golder (2019) reports.

Buffer zones recommended at the hearing

The EPA recommended buffer zones, in our Staff Report (EPA, 2020) and at the hearing, based on our evaluation of the models discussed above.

In the absence of any modelling, and due to the lower amounts of methyl bromide used when compared to log fumigations, no changes to the buffer zones for container fumigations were proposed.

With two experts proposing that the 100th percentile was the appropriate modelling result to use (TAS, 2019a, 2019b; ASG, 2019c), the EPA used the 100th percentiles from the available modelling reports.

Although it is common practice to currently fumigate ship holds bound to China with phosphine, it is still possible for companies (or even China) to request that methyl bromide is used. For this reason, a fumigation rate of 120 g/m^3 was used to recommend buffer zones.

Due to the critical errors identified in reviews of the updated SEC modelling, this report was not relied upon by the EPA to recommend appropriate buffer zones.

Only one available modelling report considered the 'no recapture' scenario – TAS (2019b). As a result, the buffer zones derived from this report were recommended to the hearing by the EPA.

Noting the comments from TAS (2019b) and PDP (2019) that more port-specific parameter values should be used in any future modelling, and that the Golder (2019) report used such values, the 100th percentile information in Golder (2019) was used to derive the recommended buffer zones for the 80% recapture scenario.

The resulting down-wind buffer zones recommended at the hearing are summarised in Table 21**Error! Reference source not found.**.

Table 21 Buffer zones recommended at the hearing

Recapture scenario	Use	Minimum buffer zone (m)	Source model
No recapture	Containers (total volume less than 77 m^2 in any 60-minute period)	10	2010 reassessment decision
	Containers (total volume of 77 m^2 or more in any 60-minute period)	25	2010 reassessment decision
	Fumigation under sheets	625	TAS, log stacks, 100th percentile, 120g/m^3
	Ship holds	1,900	TAS, ship holds, 100th percentile, 120g/m^3
80% recapture	Containers (total volume less than 77 m^2 in any 60-minute period)	10	2010 reassessment decision
	Containers (total volume of 77 m^2 or more in any 60-minute period)	25	2010 reassessment decision
	Fumigation under sheets	300	Golder, log stacks, 100th percentile
	Ship holds	1,000	Golder, ship holds, 100th percentile

Revised buffer zones (immediately post-adjournment)

During the hearing for the reassessment of methyl bromide, the air dispersion experts discussed whether the right approach was to use the 80th, 99.9th or the 100th percentile of the modelling results. Although the applicant's expert (SEC) maintained that the 80th percentile from their modelling was appropriate, the EPA'S expert agreed that the 99.9th percentile would provide dispersion distances appropriate to set downwind buzzer zone distances.

Following the adjournment of the hearing, the DMC directed (in Direction and Minute WGT022) the EPA to update their buffer zone recommendations based on a variety of fumigation rates (those required by India, 72 g/m^3, and China, 120 g/m^3, as well as the lower rate being discussed with trading partners, 40 g/m^3) and a number of recapture scenarios (none, 30%, 50%, 60%, and 80%).

Our response, summarised below, was provided in our memo to the DMC on 28 August 2020.

We maintained our recommendation for shipping container fumigations, to be dependent on their size (highlighted light blue in Table 22).

During the hearing, the Ministry of Primary Industries requested that more variable buffer zones be considered in order to give more certainty to the importers and exporters of fresh produce, and other (non-log) QPS uses. We therefore recommended that the buffer zone for fumigations in fresh produce dedicated facilities and containers under sheets be the same as that for large containers (highlighted dark blue in Table 22).

For log fumigations, as Golder (2019) had presented information related to the 99.9th percentile modelling result with 80% of the methyl bromide recaptured, this report was used to derive updated buffer zones (highlighted yellow in Table 22).

The TAS (2019b) report had presented figures for the dispersion of methyl bromide for a number of fumigation rates and recapture rates. Where these fumigation and recapture rates aligned with the information requested by the DMC, these were used to derive the updated buffer zones (highlighted light orange in Table 22).

For the requested recapture rates not covered by the TAS modelling, the EPA used the fact that there is a linear relationship between the amount of methyl bromide released and the distance it will travel. As such, the buffer zones derived directly from the TAS modelling were plotted at the different recapture rates for each fumigation rate. The linear relationship was then used to extract the updated buffer zones for the remaining recapture rates (highlighted dark orange in Table 22).

Table 22 Buffer zones recommendations as updated soon after hearing adjournment

Use		**Minimum buffer zone (m)**				
Main	Details	No recapture	30% recapture	50% recapture	60% recapture	80% recapture
Containers	Total volume less than 77 m^2 in any 60-minute period	10	10	10	10	10
	Total volume of 77 m^2 or more in any 60-minute period	25	25	25	25	25
	Single shipping container under sheet	25	25	25	25	25
	Dedicated fresh produce fumigation enclosure	25	25	25	25	25
Log stacks under sheets	When methyl bromide used ≤40 g/m^3	300	220	160	140	100
	When methyl bromide used >40 - ≤72 g/m^3	500	380	300	250	100
	When methyl bromide used >72 g/m3	625	530	460	410	100
Ship holds	When methyl bromide used ≤40 g/m^3	1200	1000	850	775	540
	When methyl bromide used >40 - ≤72 g/m^3	1650	1400	1225	1150	540
	When methyl bromide used >72 g/m3	1900	1700	1600	1500	540

Light blue shading: as 2010 reassessment decision
Dark blue shading: expanded sub-uses based on 2010 reassessment decision
Yellow shading: At 99.9th percentile in Golder (2019) report (no differentiation between rates in report)
Light orange shading: At 100^{th} percentile in Todoroski Air Sciences (TAS, 2019b) report
Dark orange shading: Extrapolated from distances extracted from TAS (2019b) report

Further information

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