OFF-GAS TREATMENT

OF POINT-SOURCE REMEDIAL AIR EMISSIONS

Policy #WSC-25-150

This Policy concerns air emissions that occur as a result of air stripping of contaminated groundwater, vacuum extraction of soil gases, or any other remedial activity conducted pursuant to MGL Chapter 21E that creates a point-source discharge of contaminants to air. The intent of this Policy is to articulate when off-gas treatment of point-source remedial air emissions may not be necessary to protect human health, safety, public welfare, and the environment.

This document updates and supersedes Policy #WSC-94-150.

7/28/2025

Date

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1.0 Background and Purpose

The Massachusetts Department of Environmental Protection (MassDEP) Bureau of Waste Site Cleanup (BWSC) regulates activities at sites contaminated by a release of oil or hazardous materials in accordance with the requirements and specifications contained in 310 CMR 40.0000, the Massachusetts Contingency Plan (MCP).

Remedial actions at such sites may involve the collection and treatment of groundwater and/or soil gases and the discharge of contaminated vapors to the ambient air. Emissions of this nature generally result from the operation of contaminated groundwater "air strippers" or soil vapor extraction (SVE) systems, designed to volatilize or "off-gas" contaminants from soil and/or groundwater to the atmosphere.

The purpose of this policy is to (1) describe the regulatory jurisdictions and procedures that govern emissions of this nature, (2) delineate and explain the required performance standards applicable to remedial emissions, (3) articulate details of the Response Action Performance Standard (RAPS) and (4) provide a simplified and conservative methodology for determining when off-gas controls may not be needed/may no longer be needed.

The information contained in this document is intended solely for guidance. This document does not create any substantive or procedural rights and is not enforceable by any party in any administrative proceeding with the Commonwealth. The regulations related to remedial air emissions contain both specific and general requirements. In addition to summarizing specific requirements, this document also provides guidance on what measures MassDEP considers acceptable for meeting the general requirements set forth in the regulations. Parties using this guidance should be aware that there may be acceptable alternatives to this guidance for achieving compliance with such general regulatory requirements.

2.0 Applicability

This policy applies to remedial actions being conducted at disposal sites subject to the performance and submittal requirements of 310 CMR 40.0049 of the MCP.

The guidance contained in this policy applies to any point-source remedial air emissions, such as, air discharges from packed-tower or diffused aeration air strippers, bioreactors, and SVE systems, except as described below.

This policy is neither designed nor intended to apply to the following:

(1) Well-head treatment systems at public water supply wells that are operated in conformance with applicable regulations and/or in conformance with requirements specified by MassDEP's Drinking Water Program.

(2) Active and Passive Exposure Pathway Mitigation Measures at residential dwellings, schools, or commercial buildings to prevent the migration of subsurface vapors into living/working spaces, provided the total air emission rate of all volatile contaminants is less than 100 pounds/year.

(3) Point-source remedial air emissions temporarily authorized by MassDEP to prevent or abate an imminent hazard to health, safety, public welfare, or the environment. In such cases, treatment devices, when necessary, must be installed as soon as possible.

Notwithstanding the above, MassDEP reserves the right to require off-gas controls on the above or any discharge should such emissions create odorous or adverse health, safety, or environmental conditions downwind of the discharges.

3.0 Regulatory Jurisdictions

While point-source remedial air emissions are regulated primarily by MassDEP/BWSC under MGL c.21E and 310 CMR 40.0000, remedial air emissions **that will exceed 1 ton/year** (with or without off-gas treatment/controls) may also be subject to the regulatory provisions specified by MassDEP Bureau of Air and Waste (BAW) under MGL c.111, section 142 A-K and 310 CMR 7.00, the "Massachusetts Air Pollution Control Regulations." Under these provisions, two options exist to satisfy BAW requirements:

(1) the person conducting remediation may file an appropriate permit/plan application, as specified in 310 CMR 7.02; or

(2) the person conducting remediation may, under the "permit by rule" provisions of 310 CMR 7.03, elect to apply off-gas control treatment (if not already required by BWSC requirements under 310 CMR 40.0049) for groundwater or soil venting systems that ensures 95% removal of volatile emissions, and implement specified monitoring and documentation procedures.

At most disposal sites remediated under MGL c 21E, remedial air emissions are less than 1 ton/year (even without treatment), and in most cases, will not require an air discharge permit or permit by rule from BAW. Regardless of emission levels, however, BAW has the authority to require a plan application or permit if such emissions create or contribute to a condition of air pollution.

Of additional interest is the regulatory classification of spent activated carbon canisters and vessels associated with the treatment of remedial air emissions. Such materials are classified as "Containerized Waste" under the MCP, and as such are not considered Remediation Waste. They may however be classified as Hazardous Waste by listing or by characteristic; additional guidance is contained in MassDEP's *Policy on the Classification of Used Carbon Canisters*, BWP – 94-007,

4.0 Performance Standards for Determining When to Apply Off-Gas Controls

4.1 Background

Under the provisions of 310 CMR 40.0000, MassDEP/BWSC has established requirements and procedures for conducting remedial actions at contaminated sites. The Remedial Air Emissions provision of 310 CMR 40.0049(2) stipulates that point-source air emissions from remedial systems must be treated by control devices prior to their discharge to the ambient air, and in accordance with 40.0049(5), such control devices shall remove at least 95% of emitted contaminants. There are several possible exemptions to these requirements, including emissions that "*would be at or below a level of no significant risk to health, safety, public welfare, and the environment*". Exemptions from the need to apply controls and/or to achieve a 95% removal rate must be justified by a Licensed Site Professional (LSP) Opinion, based upon an evaluation of a number of factors, including "*the mass flux and toxicities of the oil and hazardous material being emitted*". Importantly, the option to forego treatment of remedial air emissions is not permitted where such controls are "*specifically required in writing by the Department*".

4.2 Mandatory Initial Treatment for Soil Vapor Extraction Systems

The mass flux of remedial air emission from SVE systems are unlike those of groundwater air stripping systems. In a typical SVE application, initial operations will generally produce very high contaminant concentrations and emission rates, followed by sharply reduced levels tailing off to an asymptotic steady-state condition, as the removal rate becomes limited by the slow diffusion of contaminant vapors from source-area soil pore spaces. Additionally, it is generally more difficult to predict the concentrations of contaminants that will be emitted from SVE systems, compared to groundwater treatment systems. For these reasons, and in accordance with 310 CMR 40.0049(3), as well as 40.0191, **it is MassDEP's position that SVE systems need to be initially fitted with off-gas control devices for the first 1500 hours of operation**. Following this initial period, an LSP Opinion to remove air emission control devices may be filed, if appropriate.

4.3 No Significant Risk

In order to achieve compliance with 310 CMR 40.0049, untreated remedial air emissions must be at or below a level of No Significant Risk to health, safety, public welfare, and the environment. In this context, "No Significant Risk" exists when all of the following conditions are met:

Human Health

A condition of No Significant Risk to human health would exist if the risk of harm to persons exposed to remedial air emissions meet the risk management criteria specified in 310 CMR 40.0900:

- using a cumulative risk approach, the risk associated with the remedial air emissions must be equal to or less than the Cumulative Cancer Risk Limit (an Excess Lifetime Cancer Risk of one-in-one hundred thousand), and the Cumulative Noncancer Risk Limit (a Hazard Index of 1.0); or
- using a chemical-specific approach, and consistent with the approach used to develop MCP Method 1 standards for soil and groundwater, the receptor concentration resulting from each oil or hazardous material emitted must be equal to or lower than the concentrations of that chemical which are associated with an Excess Lifetime Cancer Risk of one-in-one million and a Hazard Quotient of 0.2.

In accordance with the provisions of 310 CMR 40.0902(3), concentrations of oil and hazardous materials in ambient air at background concentrations need not be included in risk assessment and may be assumed to constitute a condition of No Significant Risk to human health

Safety

In accordance with the provisions of 310 CMR 40.0960, a condition of No Significant Risk to human safety would exist if:

- remedial air emissions do not result in the generation and/or accumulation of explosive vapors; and
- access to remedial treatment systems is restricted as needed to prevent physical harm or bodily injury.

Public Welfare

In accordance with the provisions of 310 CMR 40.0900 and 40.0994, a condition of No Significant Risk to public welfare would exist if:

- remedial air emissions do not result in nuisance odor conditions at downwind human receptors, and do not result in nuisance noise conditions. For the purpose of predicting the occurrence of such odor conditions, the 50th percentile odor recognition concentration for each chemical of interest should be utilized.
- Noise associated with the operation of the treatment systems shall conform to requirements of MassDEP regulations 310 CMR 7.00 and all local ordinances, by-laws, or rules.

Environment

In accordance with the provisions of 310 CMR 40.0995, a condition of No Significant Risk to the environment would exist if:

- remedial air emissions and/or fallout from remedial air emissions do not result in a deleterious impact to critical habitat, endangered species, or other ecological receptors.

4.4 Demonstrating No Significant Risk

In accordance with 310 CMR 40.0049(3) and 310 CMR 40.0049(7), an LSP Opinion must be submitted to MassDEP for any remedial air emission that will not be treated, or that will not be treated to the specified 95% removal standard. Such an opinion must include an evaluation of potential risks to Potentially Impacted Receptors, including:

(1) threshold (non-carcinogenic) and non-threshold (carcinogenic) health risks resulting from each oil and hazardous material emitted to the atmosphere, to evaluate risks to human health;

(2) potential odor and noise conditions resulting from such emissions, to evaluate risks to public welfare; and

(3) direct impacts of emissions on ecological receptors to evaluate risks to the environment.

Potential risks to human safety should also be considered when undertaking any remedial action at a disposal site.

To facilitate a demonstration of No Significant Risk, mathematical models may be used to predict increased ambient air concentrations at Potentially Impacted Receptors. Mathematical models typically calculate (increased) maximum hourly concentration values at a specified down-wind receptor.

This computed maximum hourly concentration should be:

(1) multiplied by 0.40, to obtain an estimate of the average (increased) daily receptor concentration value, in order to evaluate threshold health risks;

(2) multiplied by 0.08, to obtain an estimate of the average (increased) yearly receptor concentration, in order to evaluate non-threshold health risks; and

(3) remain unadjusted (maximum hourly concentrations), to evaluate potential receptor odor concerns.

The use of the above multiplying factors is consistent with standard statistical averaging practices, as used and recommended by MassDEP and the U.S. Environmental Protection Agency (EPA).[1]

To evaluate non-threshold and threshold health risks, available MassDEP risk assessment guidance and/or the agency's "Short Form" publications may be consulted. The use of a 50th percentile odor recognition concentration should be used to evaluate the potential for odor impacts at Potentially Impacted Receptors.

For chemicals with background concentrations in ambient air exceeding a condition of No Significant Risk or an odor threshold, the required evaluation of potential health and odor concerns should be made on the basis of increased ambient concentration values resulting from the proposed remedial emission. For the purpose of this policy, background concentrations of individual or collective VOCs should be determined by site-specific air sampling and analysis, and/or by citation of appropriate values from scientific literature.

4.5 Definition of and Distance to "Potentially Impacted Receptors"

In order to characterize the risk posed by oil and/or hazardous materials, human and environmental

[1] *Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised*, (EPA-454/R-92-019), October 1992(provides a more detailed discussion of multiplying factors.)

receptors must be identified in accordance with 310 CMR 40.0920. For the purposes of this policy, human receptors or "Potentially Impacted Receptors" are defined to include:

(1) residential properties, schools, daycare centers, or elder care facilities;

(2) parks, playgrounds, and recreation areas;

(3) off-property commercial areas where continuing exposure to a human receptor is likely; and/or

(4) on-property areas where continuing non-occupational exposure to a human receptor is likely (e.g., a former gasoline service station now being utilized as a restaurant).

In applying the Response Action Performance Standard (RAPS) and the "Simplified Remedial Emission Evaluation Methodology" (Section 7), distances should be measured from the base of emission stack(s) to the nearest "Potentially Impacted Receptor" as described below:

(1) the property boundary of the nearest residential dwelling;

(2) the property boundary of the nearest school, daycare center, elder-care facilities, park, playground, and recreation area; and/or

(3) any on or off-property point where continuing exposure (greater than 60 consecutive minutes) to a potentially impacted receptor is likely.

5.0 Performance Standards for the Operation and Monitoring of Off-Gas Control Systems

Except where an LSP Opinion is submitted as specified by 310 CMR 40.0049(7) stating that achievement of a 95% level of emission reduction is not feasible or necessary, or where treatment standards are specified in writing by MassDEP based upon its review of proposed or ongoing response actions, off-gas control systems (e.g., activated carbon, incineration, catalytic or thermal oxidation, or biotreatment units) must be designed, constructed, and operated in a manner that:

(1) as specified in 310 CMR 40.0049, ensures the continuous reduction of at least 95% of the total emitted oil and hazardous material, on a weight basis, or reduction to a background level (generally $\leq$ 1 ppmV as isobutylene on a photoionization detector (PID) meter), whichever concentration is higher;

(2) does not expose downwind receptors to concentrations exceeding a level of No Significant Risk; and

(3) does not expose downwind receptors to nuisance odors or any receptor to noise conditions.

The following are considered by MassDEP to be the minimum monitoring procedures for off- gas control systems necessary to ensure compliance with the 95% VOCs reduction performance standard. Proponents should continuously evaluate the need to expand on these minimum requirements during the operation of the treatment system.

a) Initially, the list of contaminants and their projected concentrations in the remedial air emissions must be established, to facilitate the design process and help ensure protective results:

- For air stripping systems treating contaminated groundwater, groundwater data may be used for this purpose, provided that the groundwater has been adequately characterized, including sufficient testing to rule out the presence of chlorinated hydrocarbons at petroleum contaminated sites. A conservate assumption would be to assume 100% contaminant mass transfer from groundwater to the vapor phase during air stripping operations.
- For soil vapor extraction systems, sufficient data should be obtained to characterize the

types and quantities of VOCs likely to be emitted during initial operations. At petroleum contaminated sites, sufficient testing must be performed to rule out the presence of chlorinated hydrocarbons.

b) In accordance with 310 CMR 40.0049(6), influent and effluent vapor samples must be obtained from the off-gas control system 1, 7, 14 and 28 days after system start-up, and monthly thereafter:

c) On day 1, after at least 4 hours of continuous system operation, vapor-phase samples must be obtained from the influent and effluent of the remedial air emission treatment system(s), for analysis by the MassDEP Air-phase Petroleum Hydrocarbon (APH) method for petroleum-only emissions, and EPA Method TO-15 for non-petroleum emissions. Both methods must be used at petroleum contaminated sites where the presence of chlorinated hydrocarbons has not been ruled out. These data may then be used to determine (i) the (untreated) remedial air emission flux rate and (ii) compliance with the 95% removal standard.

d) Additional influent/effluent analysis of remedial air emission to demonstrate compliance with the removal standard need not be by gas chromatography methods if (i) split-samples of the day 1 samples were analyzed by a photoionization detector (PID) or other screening instrument, and (ii) adequate correlation is established between TO-15 and/or APH method data and PID/screening instrument data. Absent unusual conditions, effluent PID readings of less than 1 ppmV as isobutylene may assumed to be a “background” condition.

e) All vapor samples should be obtained from "in-line" sampling ports in the vapor treatment system piping. Note that most PID and/or screening instruments will not be able to obtain samples from system piping under negative pressure without the use of an auxiliary pump.

If used, the state of calibration of the PID or other screening instruments must be confirmed every 20 analyses or daily, whichever is more frequent, by testing with a certified standard, with percent recoveries in the range of 80% to 120%. Such data should be included in relevant submittals to MassDEP.

6.0 Response Action Performance Standard

To meet the Response Action Performance Standard (RAPS) in 310 CMR 40.0191, remedial action alternatives must be designed and implemented in a manner which is protective of health, safety, public welfare, and the environment. In evaluating whether off-gas controls are necessary to meet a condition of No Significant Risk, there are certain conditions which cannot be adequately addressed via air dispersion modeling. Moreover, unless continuous emission/ambient air monitoring is conducted, all site-specific remedial emission monitoring programs are subject to significant spatial and temporal data limitations.

Because of these concerns, it is MassDEP’s position that evaluations of this nature must consider the following site and operational factors:

(1) **Gasoline Releases**

Gasoline releases represent a unique contamination profile due to the large and highly variable number of volatile aliphatic and aromatic hydrocarbon compounds, along with breakdown products, including methane. Of particular concern are the potential public welfare problems that may result from the discharge of odorous compounds such as alkenes or biological degradation products. These factors must be considered prior to any decision to allow the untreated emissions of such contaminants.

(2) **NonAqueous Phase Liquids (NAPL)**

Release conditions where mobile nonaqueous phase liquids, such as free-phase gasoline, are present represent a unique set of concerns. System failures could result in free-phase liquids entering air emission stacks. Globule/colloidal non- aqueous phase liquid entrainment into

aqueous flow systems or volatilization into SVE systems, could result in transient, but potentially significant fluctuations in emission levels. To address these concerns, at sites where the point of groundwater recovery or SVE is within 30 feet of a location where measurable (≥ 1/8 inch) NAPL exists, off-gas controls should be applied to protect against the impact of such potential system failures on ambient air quality.

(3) **Modeling Limitations**

Because of limitations inherent in most mathematical models, off-gas control devices should be applied on any remedial system where the discharge stack height (point of emission) is less than 15 feet (4.5 meters) above ground level, or where the distance to the nearest Potentially Impacted Receptor is less than 66 feet (20 meters) from any emission stack.

(4) **Untreated Air Stripping System Discharges**

In cases where remedial air emission controls were not installed on a newly installed groundwater air-stripping system (i.e., via the filing of an LSP Opinion), a sample of the (untreated) discharge should be obtained on Day 1, following at least 4 hours of continuous system operation, to confirm assumptions and calculations on the mass emission rate and lack of Significant Risk at downwind receptors. This is particularly important at sites with a past history of Light Non-Aqueous Phase Liquids (LNAPL), At petroleum contaminated sites, unless the presence of chlorinated hydrocarbons has been adequately ruled out at the site, the discharge sample should be analyzed by the APH and TO-15 methods.

7.0 Simplified Remedial Emission Evaluation Methodology

A simplified methodology has been developed by MassDEP for determining when the application of off-gas controls can be reasonably and safely eliminated from new groundwater air-stripping systems and/or removed from existing air-stripping or SVE systems, based upon the air emission rate and distance to Potentially Impacted Receptors. Specifically, a series of emission-distance graphs have been developed to evaluate risks to human health and public welfare, based upon air dispersion modeling.[2]

The default requirement in the MCP is to treat all remedial air emissions, absent justification to the contrary. The totality of conservative assumptions on air modeling and exposure assessments in the provided simplified methodology and emission-distance graphs are intended to demonstrate *de minimis* impacts from untreated emissions. As such, no modifications are permitted in the use of the simplified approach, such as the use of a Method 3 risk assessment process. Parties who believe the simplified approach is too conservative have the option to conduct a site-specific evaluation of emission flux and potential receptor impacts.

7.1 Modeling Assumptions/Results

The EPA "Screen" Model (EPA-450/4-88-010) was used to help predict potential ambient air concentration levels of common volatile organic compounds at varying distances from a point-source air discharge. Modeling inputs were designed to represent reasonably conservative, though not worst-case, site conditions and remedial system operational parameters. Modeling outputs were compared to designated "acceptable" increased ambient receptor concentrations. For the universe of targeted compounds, "acceptable" increased ambient receptor concentrations were defined as the lowest of the following three values: (1) A Hazard Quotient of 0.2, (2) an Excess Lifetime Cancer Risk (ELCR) value of 1 x 10-6, and (3) the 50th percentile odor recognition threshold.

[2] MassDEP "*Point-Source Air Emissions from 21E Remedial Systems*" discussion document, dated June 26, 1992, provides a more detailed description of the air dispersion modeling.

Model output data for air plume "wake" areas were used to formulate a series of emission-rate vs. distance-to-receptor graphs. The targeted contaminants were grouped into 5 categories, based upon commonality of "acceptable" receptor concentration values.

Modeling results indicate the possibility of deleterious air plume "cavity effects" within 66 feet (20 meters) of the emission point. Accordingly, off-gas controls should always be applied for all emission stacks located less than 66 feet (20 meters) from a "potentially impacted receptor."

7.2 Calculating Air Emission Rate (Emission Flux)

For contaminated groundwater air stripping systems, the remedial air emission rate should be calculated as follows:

(1) Unless a pilot study has been undertaken to determine steady-state influent groundwater concentrations, the highest aqueous concentration value for each contaminant from within the projected recovery area should be the designated influent concentration level.

(2) The air emission rate (µg/s) is calculated for each influent contaminant assuming 100% mass-transfer from the aqueous phase, according to the relationship:

$$E = [C_w * Q_w] / 15.84$$

where:

E = air emission rate, µg/s
C_w = aqueous concentration, µg/L
Q_w = influent aqueous flow rate, gal/min

For Soil Vapor Extraction (SVE) Systems, after the initial 1500 hours of off-gas controls, the remedial air emission rate should be calculated as follows:

(1) Stack concentrations should be measured directly from a sampling port in the stack by obtaining a vapor sample for analysis by EPA Method TO-15 and/or MassDEP APH.

(2) The air emission rate (µg/s) is determined for each contaminant, according to the following relationship:

$$E = [C_a * Q_a] / 2118$$

where:

E = air emission rate, µg/s
C_a = air (stack) concentration, µg/m^3
Q_a = air (stack) discharge rate, CFM

Air emission rates (µg/s) from other remedial systems should be determined by the most appropriate method(s).

7.3 Using Emission-Distance Graphs

Five emission-distance graphs are provided.

(1) The emission-distance graphs (Figures 1 through 5) should, in most cases, address potential impacts to human health and public welfare; project proponents must still satisfy the

safety and environmental performance standards specified in Section 4. Note that contaminant groupings in these graphs are different from the previous iteration of this guidance document (WSC-94-150) and recommendations provided in #WSC-02-411 (VPH/EPH Implementation guidance). Note also the change in units of the "x" axis from meters to feet.

(2) For each **individual** site contaminant, select the appropriate graph and plot the calculated air emission rate ("x" axis) against the distance to nearest "potentially impacted receptor" ("y" axis). If **any** coordinate point for **any** individual contaminant is below the designated line (i.e., in shaded area, then, under this approach, off-gas controls may NOT be eliminated.

(3) For sites contaminated by releases of petroleum fuel products, use the graphs for target analytes Benzene, Toluene, Ethylbenzene, Xylenes, MtBE, C_5-C_8 Aliphatic Hydrocarbons, C_9-C_{12} Aliphatic Hydrocarbons, and C_9-C_{10} Aromatic Hydrocarbons.

Due to the inherent degree of uncertainty in predicting downwind ambient air concentrations, MassDEP reserves the right to require off-gas treatment at locations where health concerns and/odors are present, regardless of the need for such treatment as determined using this simplified graphical approach.

8.0 Licensed Site Professional Opinions

All LSP Opinions, as described in this policy and 310 CMR 40.0049, must be accompanied by the appropriate level of documentation to support the particular Opinion. Specifically:

(1) an LSP Opinion submitted to MassDEP prior to the commencement of the remedial action stating that untreated remedial air emissions from an air stripping system will present No Significant Risk must be supported by information and reasoning which addresses all of the criteria outlined in 40.0049. As this provision requires the LSP to consider "all relevant policies issued by the Department", i.e., this Policy, the LSP Opinion should address why it is not necessary to apply off-gas controls to meet the conditions outlined in Section 4.0 of this Policy in order to achieve the No Significant Risk standard;

(2) an LSP Opinion submitted stating that off-gas controls are no longer necessary in order to achieve the No Significant Risk standard, based on the absence of all of the conditions outlined in Section 4.0 of this policy must be supported by an adequate description of why those conditions no longer apply; and

(3) an LSP Opinion submitted stating that 95% reduction in level of emissions is not feasible or necessary, as described in 310 CMR 40.0049(7), must be supported by the information and reasoning used to reach this conclusion.

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Figure 1
Emission Rate vs. Distance: Group 1

[Concentrations at receptor above shaded area projected to be < 0.4 µg/m^3]

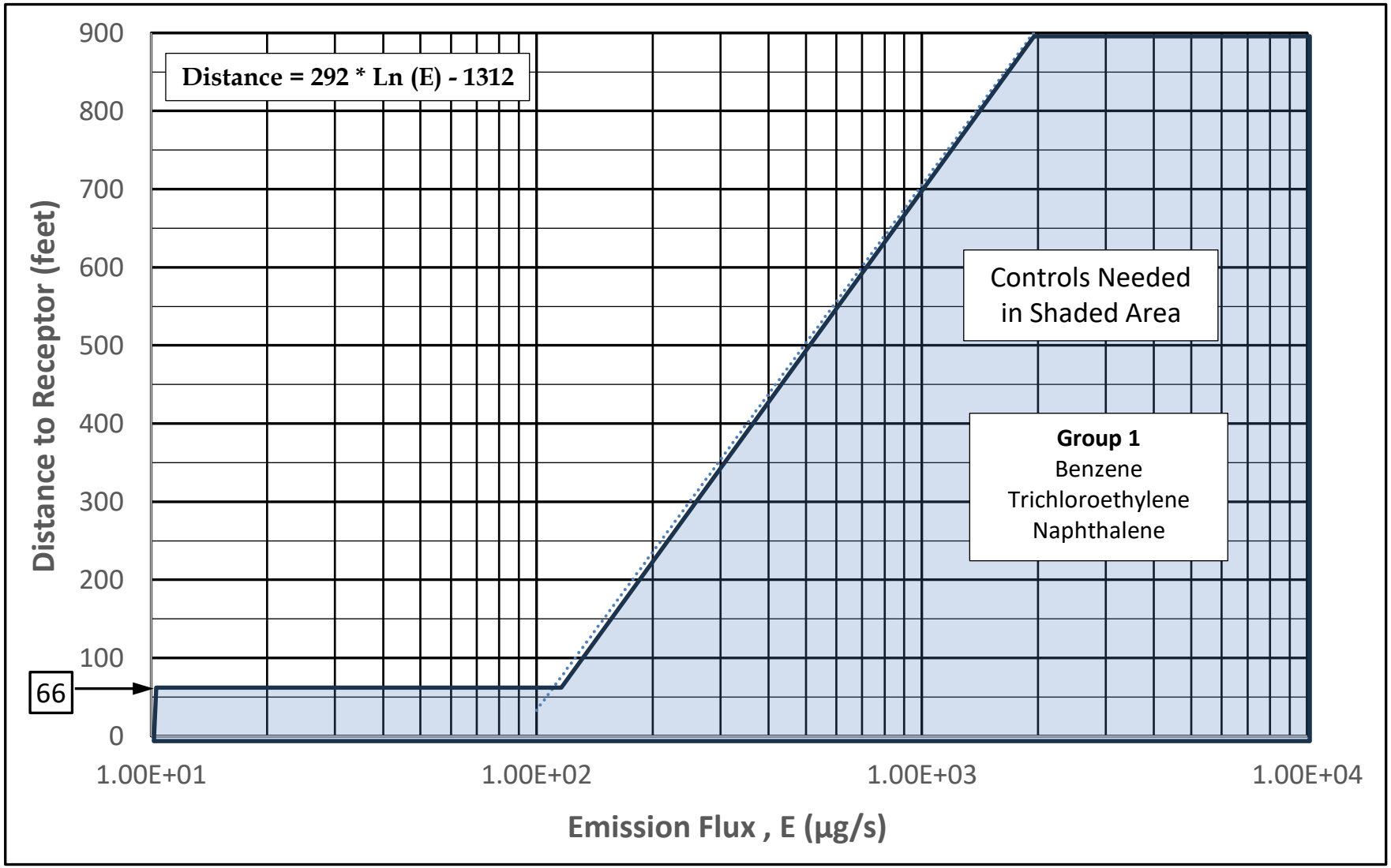

Figure 2
Emission Rate vs. Distance: Group 2

[Concentrations at receptor above shaded area projected to be < 1 µg/m^3]

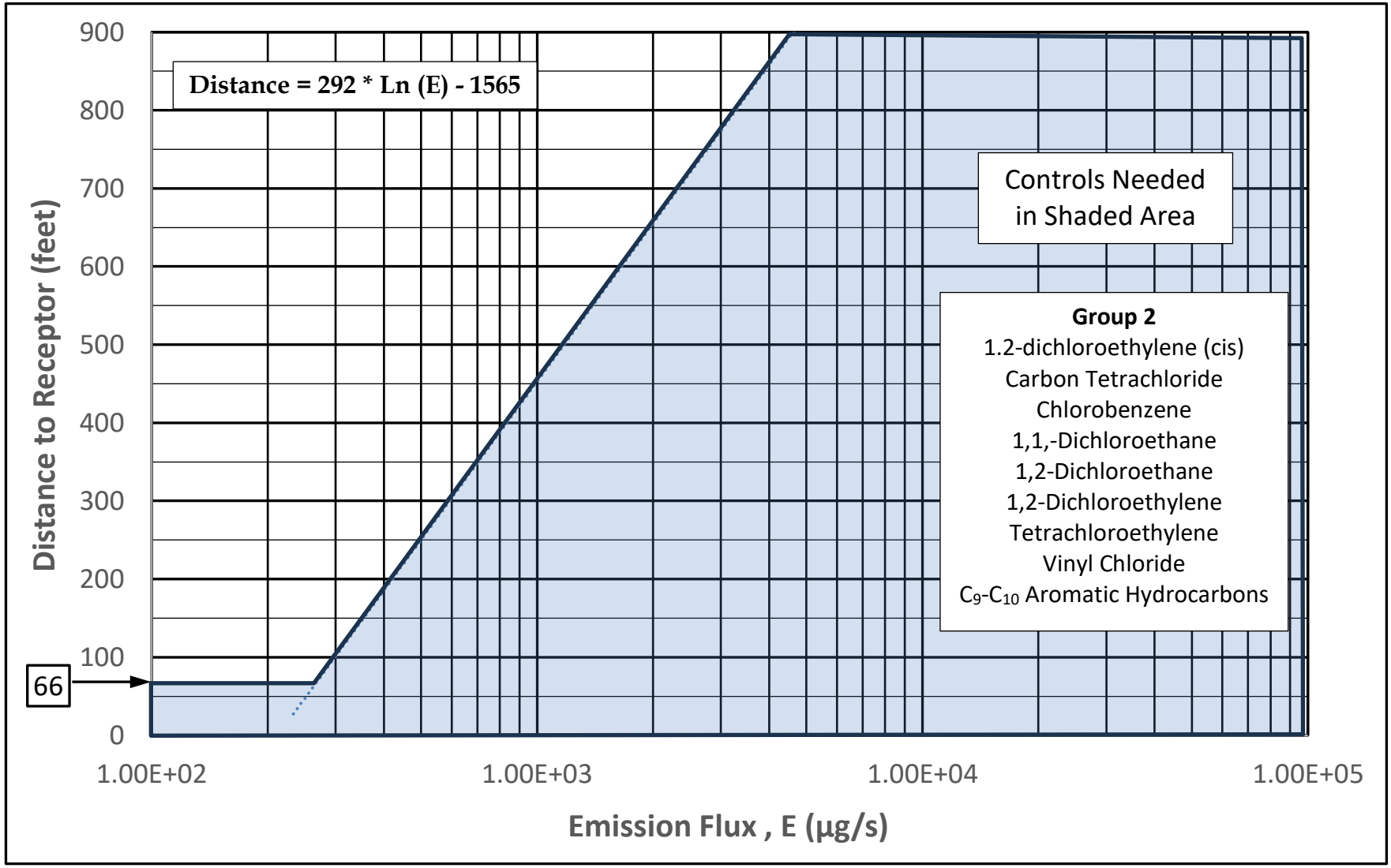

Figure 3
Emission Rate vs. Distance: Group 3

[Concentrations at receptor above shaded area projected to be < 13 µg/m^3]

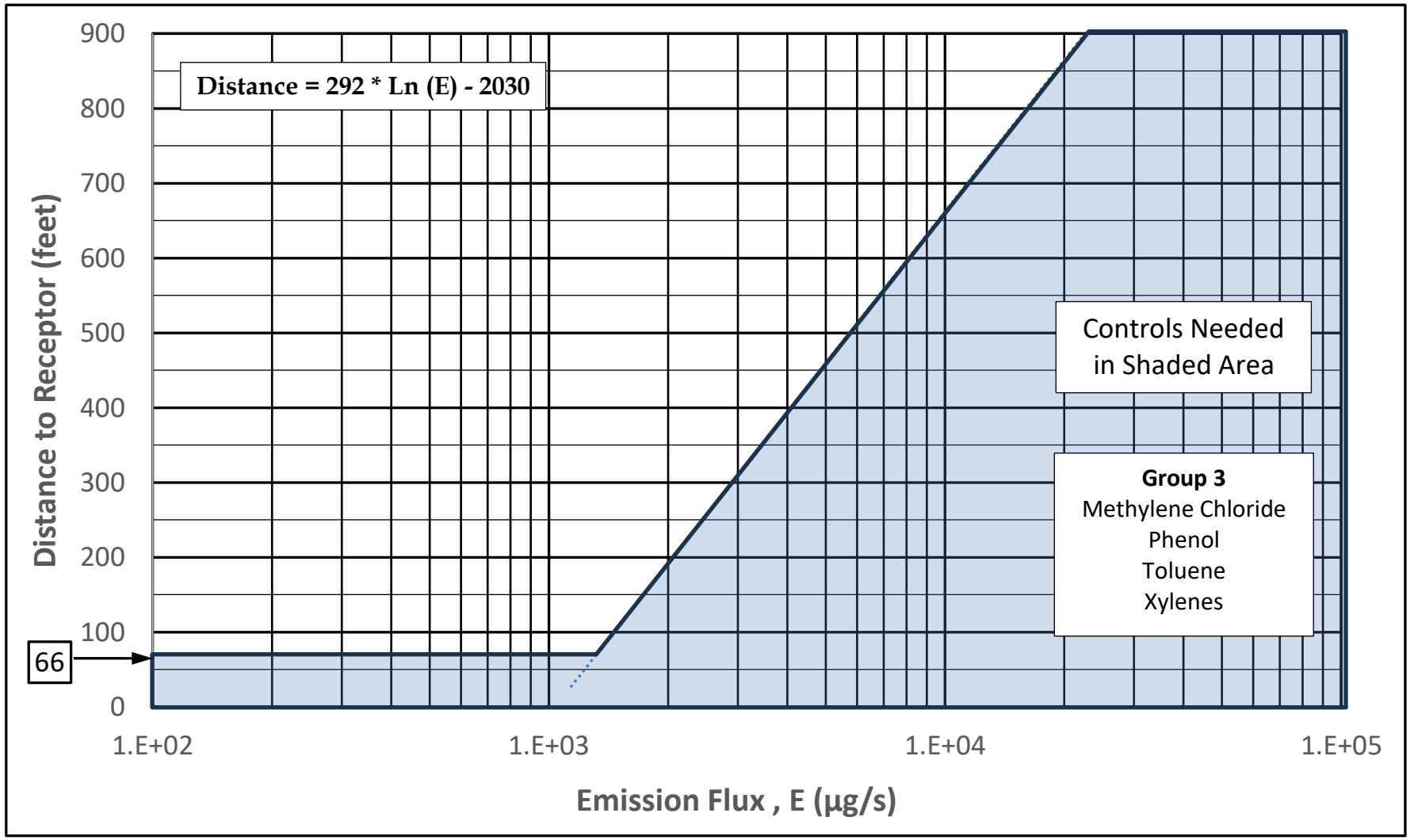

Figure 4
Emission Rate vs. Distance: Group 4

[Concentrations at receptor above shaded area projected to be < 32 µg/m^3]

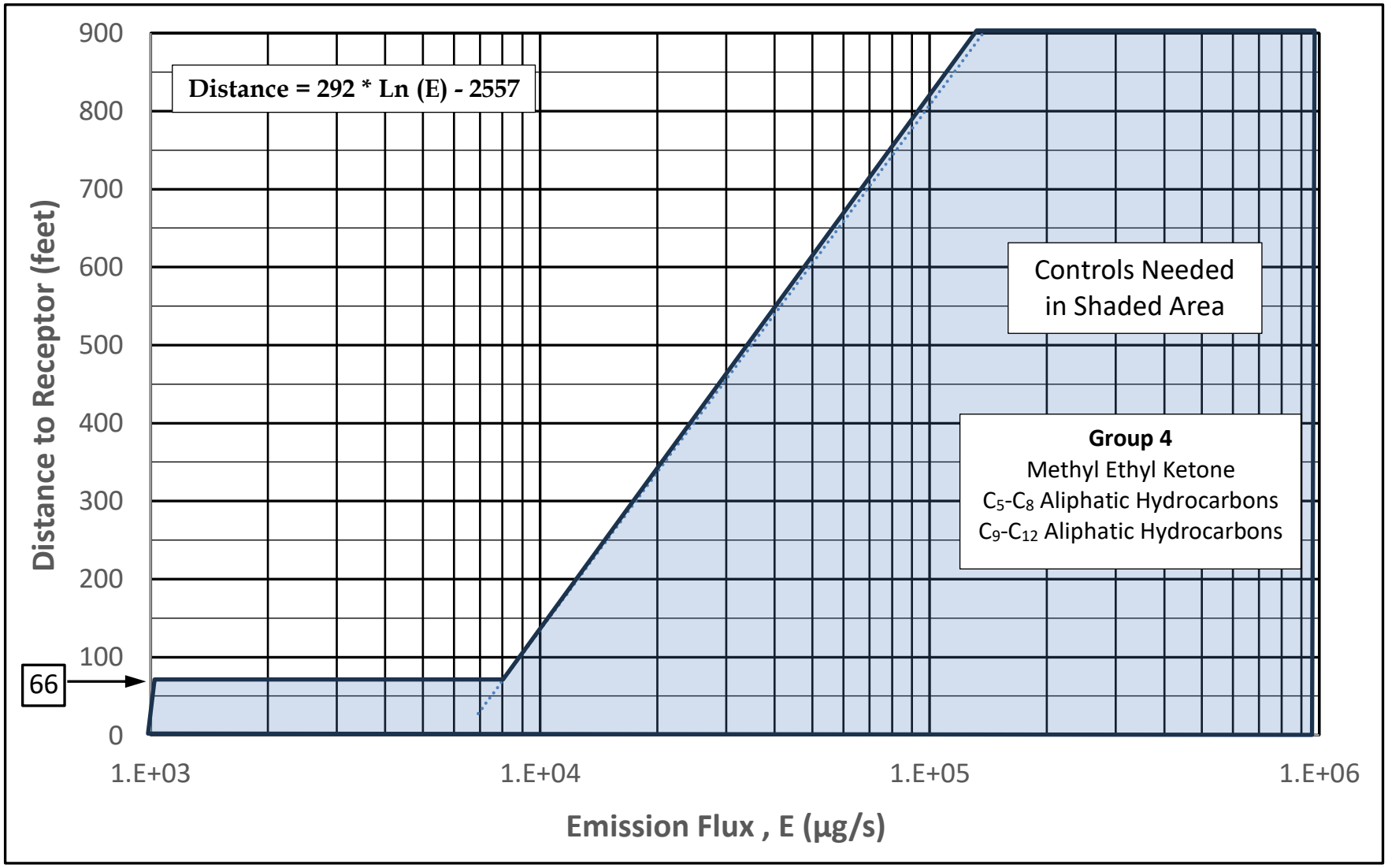

Figure 5
Emission Rate vs. Distance: Group 5

[Concentrations at receptor above shaded area projected to be < 118 µg/m^3]