Response to Charge Question on

Public Health Committee – Perimeter Air Monitoring

Summary Report
of the NJDEP Science Advisory Board

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NJDEP-Science Advisory Board, Public Health Standing Committee, Report on the Perimeter Air Monitoring (PAM) Charge Questions.

Introduction

New Jersey Department of Environmental Protection (NJDEP) Commissioner, Bob Martin charged the Public Health Standing Committee (henceforth, "the Committee") of the NJDEP Science Advisory Board (NJDEP-SAB) with three broad categories of charge questions. The first of these, dealing with Acute Soil Exposure Criteria, was reported out to the full NJDEP-SAB which approved the recommendations of the Committee in March of 2012. The Committee subsequently began work on the second category of charge questions dealing with perimeter air monitoring (PAM) at hazardous site remediations. These charge questions were formulated by the NJDEP's Site Remediation Program (SRP) in order to assist them with ensuring that remedial operations at such sites did not adversely impact the off-site, surrounding community. Note that these charge questions do not deal with on-site exposure to workers

The Committee Chair, Dr. Mark Robson, appointed a PAM Workgroup (henceforth, "the Workgroup") to assess these charge questions. The Workgroup consisted of the following Committee members:

Dr. Mark Maddaloni (USEPA, Region 2), Workgroup Chair
Dr. Howard Kipen (UMDNJ/EOHSI)
Dr. Clifford Weisel (UMDNJ/EOHSI)
Jerry Kennedy (DuPont)

The following NJDEP staff assisted the Workgroup:

Dr. Alan Stern (Office of Science), liaison to the Committee
Dr. Terry Sugihara (SRP)
Allan Motter (SRP)

Workgroup meetings

The Workgroup held eight meetings, 4/24/12, 6/4/12, 8/14/12, 10/29/12, 11/8/12, 12/20/12, 1/31/13, and 3/6/13. The first two of these were face-to-face meetings at NJDEP and EOHSI, respectively. All other meetings were teleconferences.

Background to the Workgroup's Deliberations

SRP informed the Workgroup that the overarching scenario to be addressed under the Perimeter Air Monitoring (PAM) charge questions is the escape of contaminants from a site that is undergoing remediation. The contaminants can be soil-based or structure-based (i.e., generated from the demolition of a building). It was pointed out the that demolition of the Deutsche Bank building in lower Manhattan in conjunction with the World Trade Center collapse is an example of the latter scenario (http://www.epa.gov/wtc/demolish_deconstruct/130liberty.htm). SRP further clarified that PAM considerations relate to off-site air exposure and do not relate to on-site worker (occupational) exposure. Occupational exposure is addressed under OSHA regulations.

With respect to the actual implementation of the Workgroup's guidance relating to the charge questions below, the Workgroup recognizes that its role is advisory. The Workgroup also recognizes that the feasibility of implementing its recommendations depends on practical considerations that may be outside its purview.

Approval of the Workgroup Report by the Full Public Health Standing Committee

The Standing Public Health Committee of the NJDEP SAB met on 6/24/13 to consider the Workgroup's report having previously received the report for review. The following Committee members were present:

Dr. Mark Robson (Committee Chair)
Dr. Mark Maddaloni (Workgroup Chair)
Dr. Steven Marcus
Dr. Clifford Weisel
Dr. Judith Klotz
Dr. Judith Zelikoff
Dr. Howard Kippen

The Committee members considered the Workgroup's recommended responses to each of the charge questions separately and with minor editorial and clarifying changes, unanimously approved the report. The following reflects the changes requested by the Comnittee.

Charge Questions

Following the broad PAM charge question approved by Commissioner Martin, SRP, in consultation with the Office of Science, formulated 10 categories of specific questions. These questions are presented in detail with introductory material provided by SRP in

Appendix I to this report. These questions reflect the draft approach, as set forth in "PAM Guidance" previously developed by SRP. The draft PAM Guidance document is attached as Appendix II. In general, the Workgroup was asked to provide its opinion and guidance relative to the draft SRP approach rather than to formulate a PAM approach *de novo*.

Each charge question is presented below followed a summary of the discussion of the Workgroup relative to the question and the conclusion of the Workgroup. There was no significant disagreement among the Workgroup members on any of their responses to the charge questions. The conclusions and recommendations presented below thus represent the consensus of the Workgroup.

Conclusions and recommendations of the Workgroup are presented in bold type.

Charge Question #1

- **1a.** *Is limiting PAM to those projects of more than 30 days (with stated exceptions) defensible?*

In its draft guidance, SRP proposed that requirements for PAM should apply when exposure can occur for greater than 30 days, but less than 1 year. SRP explained that it considers exposures resulting from site remediation of less than 30 days to be of minimal impact and that the cumulative exposure potential for exposures of less than 30 days will, in general, not be of concern for health. However, in targeted cases exposures of less than 30 days may be addressed. Thus, for periods of less than 30 days it is assumed that acute exposure guidelines (e.g., USEPA Provisional Advisory Levels (PALS) (Adeshina et al, 2009), and Acute Exposure Guideline Levels (AEGLs) (http://www.epa.gov/oppt/aegl/) , would be used. SRP further clarified that the period encompassed by PAM corresponds to a period(s) of active remediation resulting in soil disturbance and active emission of contaminants. PAM would not apply to a quiescent site or a site prior to the commencement of remediation.

Workgroup members suggested that the *size* of the remediation effort may be more relevant for exposure impact than the *duration* of exposure. SRP responded that large size remediations generally correspond to remediations that occur over greater than 30 days. The Workgroup concluded that the potential exposure impact of a given site remediation depends on the time/duration of the work, the volume of material that is removed, the presence of sensitive receptors and the nature of the chemical contaminants involved.

The Workgroup agreed that for remediatons lasting less than 30 days, the need for PAM should not necessarily be excluded. However, the Workgroup recommended leaving this issue for further development by SRP including the development of a checklist for initiating PAM in remediations anticipated to last less than 30 days.

The Workgroup agreed that, with the exception of the less than 30 day duration checklist suggested above, the use of PAM for intermediate (i.e., greater than 30 and less than one year) duration remediations is appropriate.

- **1b.** *Is it appropriate to consider projects with durations of 30 days or more, but less than one year as non-chronic or short-term?*

The workgroup interpreted this question as specifically raising the issue of whether chronic exposure standards/guidelines (e.g, an EPA RfC (http://www.epa.gov/IRIS/) , or an ATSDR chronic MRL (http://www.atsdr.cdc.gov/toxprofiles/index.asp) should be applied to PAM at remediation operations of greater than 30 days, but less than one year when subchronic or intermediate exposure criteria/guidelines do not exist.

The Workgroup agreed that where subchronic or intermediate duration criteria exist, they can be applied for PAM. However, where no non-chronic criteria exist, the appropriate question that needs to be addressed is whether to apply a chronic value with duration adjustment (i.e.- In such cases, should a chronic exposure value be adjusted *upward* to allow for greater exposure than would be received during a chronic exposure?).

The Workgroup noted that for the Acute Soil Criteria SAB issue, the Public Health Committee decided not to adjust *sub-chronic* guidance upward to estimate the corresponding *acute* criterion. In the case of PAM, the relevant adjustment would be from *chronic to sub-chronic*. The Workgroup then discussed whether being at these different points on the continuum of exposure make such upward adjustments from a chronic to sub-chronic exposure more acceptable than the upward adjustment form sub-chronic to acute that the Public Health Committee recommended against.

It was noted that technically, "chronic" exposure is defined as occurring greater than10% of a lifetime (i.e., for humans, longer than 7 years) (http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do;jsessionid=DJXhSBbTpDGqvRdJGfnzM63pQvpX9v18XD6GHpdVdXshLsMXND44!-786806064?details=) . In practice, however, exposures of longer than 1year would generally trigger the application of chronic standards/guidelines by SRP. Thus, for an exposure of (e.g.) 2 months, it was suggested that the application of a chronic standard/guideline would be overly stringent.

The Workgroup recognized that some "chronic" risk-based standards/guidelines (e.g., developmental effects) are based on effects that can occur with relatively short time exposure. These effects are, however, used to define chronic values because the standards and guidelines protective of such effects are also protective of effects that occur with longer-term (truly chronic) duration exposures. In this context, it was pointed out that for such standards and guidelines, relatively short excursions above the chronic value - less than 1 year and possible as short as 1 day - could have effects. It was further noted that even if a chronic standard/guideline was based on a true chronic effect, a shorter-term endpoint could be the next-most sensitive effect such that a short exceedance of the chronic value could trigger the non-chronic effect. As an example of this, the Workgroup considered that for trichloroethylene, for example, a 10x upward adjustment of the chronic guidance to estimate an acceptable subchronic exposure level would result in exposure occurring in the range of a qualitatively different type of toxicity (developmental) than was addressed by the chronic exposure guidance.

The Workgroup agreed that when there is no sub-chronic inhalation guidance and there is sufficient information to conduct a thorough literature review to ascertain that no short-term health effect, or adverse effect other than the critical effect would be triggered by the upward adjustment, such an adjustment could be appropriate.

The Workgroup then considered what the appropriate magnitude of such an upward adjustment should be. The Workgroup discussed that the current draft USEPA Removal Management Level guidance that addresses exposures during time-critical removal activities recommends using a 3x upward adjustment of chronic exposure guidance to address subchronic exposure.

A question was raised regarding whether any upward adjustment was appropriate when the "chronic" exposure guidance is based on developmental effects. In such cases, although the guidance is intended to apply to chronic exposure duration, the true duration of exposure over which adverse effects could occur would be less than 1 year and possible as short as 1 day.

The Workgroup agreed that there should be a chemical specific review to support an upward adjustment with particular emphasis on adverse effects that could occur with a relatively short duration exposure (e.g., developmental effects), but that as a starting point, a default adjustment of 3x from a chronic exposure guidance value was appropriate.

- **1c.** *Is one year an appropriate cut-off beyond which to consider health effects only on a long-term or chronic basis?*

SRP explained that 225 days represents the default exposure duration assumption for a working year (taking weekends and vacation into account). For exposures of greater than one year, a site-specific PAM plan addressing the entire site (contaminant and remediation equipment) would be developed. However, such a plan would not be have a strict regulatory status such as would be the case for an Air Permit.

On this basis, the Workgroup agreed that a one-year cut-off is appropriate for implementation of PAM

- **1d.** *Does the SAB identify time frames applicable to PAM which it considers more appropriate than the ones proposed?*

As above, the Workgroup considered the timeframe initially proposed by SRP to be appropriate for implementation of PAM.

Charge Question #2

- **2a.** *Are the RfC and URF equations used in the Draft PAM Document the most appropriate?*

The Workgroup agreed that the equations as presented by SRP are standard and appropriate for application *per se* in PAM guidance.

- **2b.** *Is the preference for using non-carcinogenic endpoints for short term exposure valid?*

The Workgroup observed that the URF (cancer unit risk factor for inhalation exposures) assumes a lifetime (i.e., 70 year) exposure (http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=IRIS%20Glossary) . The Workgroup discussed the fact that cancer risk from animal studies is based on animal lifetime exposures and that cancer risk from epidemiological studies is generally calculated from a cohort with a range of exposure durations, but nonetheless extending over decades. Given this, the Workgroup noted the lack of knowledge in how, if at all, it is appropriate to scale cancer risk based on observation from long-term exposures to exposures of less than one year. The Workgroup further noted that despite the ability to *mathematically* scale a lifetime exposure to a one-year exposure, such an adjustment had little or no biological basis.

The Workgroup therefore concluded that when appropriate non-cancer guidance is available for a carcinogenic chemical, it should be used in preference to the URF.

- **2c.** *When there is no non-carcinogenic reference value is adjusting the acceptable ambient air concentration based on the carcinogenic value upward to reflect a short term exposure valid?*

It was noted that such an upward adjustment based on cancer risk would not be an adjustment to the underlying cancer potency (the Unit Cancer Risk, UCR), but to the exposure duration parameter of 70 years.

The Workgroup acknowledged that there is little or no scientific basis for estimating the less than 1 year cancer risk relative to the lifetime (i.e., 70 year) cancer risk. Nonetheless, the Workgroup acknowledged that a policy-driven adjustment of the exposure corresponding to the 1×10^{-6} cancer risk by multiplying the 70-year risk by 70 to extrapolate from 70 year exposure to 1 year exposure is not contradicted by the available science. It was also pointed out that multiplying a 1×10^{-6} risk by 70 would still result in concentration with a risk of less than 1×10^{-4} from a full 70 years of exposure. Lifetime exposure to such a level would thus be less than the upper limit of the range of cancer risk considered acceptable in various NJDEP and USEPA applications.

The Workgroup recommended that in the absence of an appropriate non-cancer guideline, the exposure corresponding to a lifetime cancer of 1×10^{-6} could be multiplied by 70 to address exposure of one year or less, but that a rreview of the available toxicity data should be undertaken (notwithstanding the absence of an appropriate non-cancer guideline) to provide confidence that the resulting exposure would not likely result in significant non-cancer risk.

The Workgroup also considered whether, if, for a given chemical, there is no RfC (or inhalation MRL), but an (ingestion) RfD (or ingestion-based MRL) is available, route-to-route extrapolation could be carried out to estimate the corresponding RfC providing that the chemical had the appropriate characteristics (see the "U.S. EPA. 1994. Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry (http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=71993). Under such an approach, the resulting estimated RfC could then be adjusted to address subchronic exposure as discussed above.

A Workgroup member noted that the USEPA, in its Risk Assessment Guidance for Superfund (RAGS), part-F (http://www.epa.gov/oswer/riskassessment/ragsf/) is currently de-emphasizing the use of route-to-route extrapolation. The Workgroup member stated, however, that this is not an agency-wide policy. It was also noted that in

its list of IRIS guidance documents, the USEPA continues to reference the above-cited 1994 Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry document that specifically addresses route-to-route extrapolation.

The Workgroup concurred that barring portal of entry effects or marked difference in absorption; distribution; metabolism; or excretion (ADME) between the ingestion and inhalation routes, it is preferable to derive a (non-cancer) RfC from an RfD rather than extrapolate the cancer risk upward from a 70-year exposure to a one-year exposure. If, however, there are marked differences in ADME between the inhalation and ingestion routes of exposure, the Workgroup endorsed the upward adjustment of the exposure corresponding to the 70-year, 1 x 10^{-6} cancer risk by multiplying that exposure by 70.

In light of this conclusion, the Workgroup considered what the appropriate procedure should be if an (ingestion) RfD is being used to estimate an (inhalation) RfC by route-to-route extrapolation and the starting-point RfD incorporated an uncertainty factor (UF) adjustment to estimate the chronic NOAEL from a sub-chronic NOAEL. The uncertainty factor for estimating a chronic NOAEL from a subchronic NOAEL is usually a downward adjustment of the subchronic value by a factor of 3 or 10. However, the RfC that would be derived by route-to-route extrapolation is intended to be used in a subchronic (or shorter) exposure context. Thus, should the subchronic-to-chronic uncertainty factor adjustment be removed in the route-to-route extrapolation for PAM purposes? Removal of this UF would result in a larger permissible exposure.

The Workgroup members agreed that in the interest of clarity and ease of application, existing sub-chronic-to-chronic adjustments should not be removed in route-to-route extrapolations for PAM.

- **2d.** *For the above case* [i.e., applying UCR cancer risk values as the basis for PAM guidance]*, is applying a factor of 10 to address the uncertainty of adjusting carcinogenic values to short-term values justifiable?*

The Workgroup concurred that its recommendation (with the abovementioned caveats) to extrapolate the cancer risk for a one year exposure from the lifetime cancer risk by multiplying the permissible lifetime exposure by 70, obviates the possible utility of dividing the UCR cancer risk by a factor of 10 to estimate the risk from short-term exposure to carcinogens.

- **2e.** *Is it appropriate to calculate both volatile and particulate values for all contaminants and choose the most conservative? If not, on what basis should contaminants be considered to be volatiles or particulates for the purposes of the PAM plan?*

SRP clarified that this question is intended to specifically apply to semi-volatile chemicals. The question does not apply to chemicals that are strictly volatile or strictly particulate in nature.

The Workgroup agreed that for comparison between volatiles and particulates, concentrations values should be expressed as mass/volume (e.g., µg/m^3) where the mass (whether on particulate or in vapor form) refers to the pure chemical and not to carrier particulates. Thus mass should reflect total mass/vol. including the mass of the chemical found in all forms in air. With this approach, it would not be necessary to choose between measurement of volatiles and particulates.

Charge Question #3

- **3a.** *Is assuming the upper 95% confidence interval on the mean on-site soil concentration of the target contaminant(s) for the contaminant(s) concentration in the particulates justifiable? If not, is there an alternative course of action?*

It was clarified that this approach assumes that particulates in air arise from the on-site soil and that the concentration on the airborne particulates is the same as that in the soil. Thus, under this approach, measurement of the particulate (not chemical) mass can provide an estimate of the chemical concentration in air.

SRP noted that they planned to eventually move toward direct measurement of contaminant concentration in air rather than measured as generic particulate concentration, and that this question thus, reflected guidance for operations in the near-term.

For the measurement of particulate concentration in air (given SRP's present approach), the Workgroup concurred with approach of estimating the chemical concentration in airborne particulates on the basis of the upper 95% confidence interval on the mean chemical concentration in the on-site soil.

- **3b.** *Should dust be monitored as PM_{10} or $PM_{2.5}$?*

The Workgroup noted that $PM_{2.5}$ better reflects the portion of the particulates that can be absorbed in the respiratory tract (Costa, 2008). However, in terms of the total particulate available for inhalation, confining particulate measurement to $PM_{2.5}$ would underestimate the available particulate concentration. Conversely, PM_{10} measurements would reflect a less biologically relevant particulate fraction, but would reflect an overall higher concentration. Also, PM_{10} would reflect those particulates that might be absorbed and/or interact with tissue in the upper airways.

The Workgroup recommended that for PAM, particulate measurements should be made for PM_{10} as being more protective and reflective of possible respiratory irritation and upper respiratory tract absorption.

Charge Question #4

The following explanatory material is provided from Appendix 2 to clarify the context of this question.

A 24 Hour National Ambient Air Quality Standard (NAAQS) adjusted for work day length and New Jersey background levels is also used [under the SRP draft PAM guidance] *in combination* [with perimeter air sampling for particulates] *for particulates. For an 8 hour day, the maximum level of PM_{10} allowed for a site is calculated* [based on adjustments for work day length and New Jersey background] *as 338 $\mu g/m^3$. At no time can 338 ug/m^3 plus upwind background be exceeded. (PAM Guidance, Section VI. MONITORING* –Appendix 2*)*

- *Is it defensible to employ the 24 Hour NAAQS adjusted only for work day length (8 hours) which would be 450 ug/m^3? This value is derived by using the NAAQS without subtracting the worst-case measured background levels associated with the State monitoring data (i.e. Newark data).*

SRP clarified that a visible dust criterion would be used in parallel with the NAAQS-derived value.

The Workgroup noted that although the NAAQS standard for particulates (http://www.epa.gov/burnwise/workshop2011/PM-NAAQS-Hassett-Sipple.pdf) is largely based on studies of exposure to generic particulates, urban particulates arise largely from combustion processes (including vehicle exhaust). One Workgroup member expressed the opinion that the endpoints for which the NAAQS particulate standard is designed to be protective may not be relevant to off-site exposures resulting from site remediation because the particulates of concern from remediation are not largely combustion particulates, and it is not clear how remediation particulates compare to

combustion particulates in terms of toxicity. The member added, however, that he was not aware of a reasonable alternative to the use of the NAAQS value as a particulate criterion in this context.

SRP explained that it is proposing to use its modified version of the NAAQS particulate standard (338 $\mu g/m^3$ PM_{10} adjusted to 8-hr workday and correcting for background conditions) as a ceiling for particulate concentration even if all chemical-specific standards are met. SRP presented the basis for this value as:

(150 $\mu g/m^3$ – 37.3 $\mu g/m^3$) x (24 hr/8 hr) = 338 $\mu g/m^3$

Where 150 $\mu g/m^3$ is the NAAQS 24-hr PM_{10} standard; 37.3 $\mu g/m^3$ is SRP's estimate of the generic New Jersey background PM_{10} concentration; and 8 hr is the default work day length corresponding to the off-site exposure period.

SRP clarified that a visible dust criterion would be used in parallel with the NAAQS-derived value.

The Workgroup entertained a suggestion that instead of a value based on the NAAQS, a PM_{10} criterion could be based on a statistical factor – e.g., the mean background PM_{10} x 2 SD. A further clarification of this suggestion was proposed such that the mean generic background assumption could be specific to urban, suburban and rural settings. However, on further discussion, the Workgroup concluded that such an approach was essentially arbitrary and, while potentially protective, it would be more defensible to apply the NAAQS criterion even if the particulates emitted from a site had a different etiology from those commonly found in ambient air (i.e., a combustion etiology). Furthermore, the Workgroup concluded that the role of the specific particle types in the causation of the health effects underlying the NAAQS criterion was not well understood. **Therefore, the Workgroup considered that it was appropriate to apply the NAAQS criterion to perimeter air monitoring despite the conceptual difficulty presented by the potentially different sources of site-generated and ambient particulate.**

The Workgroup noted that adjustment of the NAAQS concentration to account for background PM at the remediation site would lower the permissible concentration of PM that was specifically emitted from the site. That is, that adjustment of the NAAQS value to account for background would result in more stringent site criteria.

The Workgroup, nonetheless, agreed that the PM concentration corresponding to the NAAQS standard concentration should not be adjusted for background since the NAAQS concentration addressed total PM levels regardless of their source.

In considering adjustment of the NAAQS concentration to account for an anticipated 8-hr remediation site workday (and thus, an anticipated 8 hr duration of off-site exposure), the

Workgroup noted that while the NAAQS PM standard, itself, is defined as a 24-hr average concentration, the PM-associated adverse health effects underlying the NAAQS standard were not strictly defined over a given time period. Thus, there was no way to know the risk of exposure to 8 hrs of a PM concentration that exceeds the 24-hr average concentration.

The Workgroup therefore concluded that the NAAQS 24-hr average PM concentration should be applied to PAM without adjustment for an 8-hr workday.

SRP stated that this would result in PAM site measurements being calculated on a 24 hr basis with 16 hr of those measurements reflecting non-remedial (background) activities. The Workgroup noted this, but agreed that given the nature of the NAAQS criterion, it was appropriate to average background PM concentrations with PM concentrations measured during site work.

In considering whether the appropriate NAAQS PM standard to apply to PAM is the PM_{10} or the $PM_{2.5}$ standard, the Workgroup noted that the NAAQS standards for both PM_{10} and $PM_{2.5}$ were potentially applicable for PAM. The PM_{10} standard would be most applicable to entrainment of soil particles due soil disturbance during remediation work (e.g., digging, truck traffic), while the $PM_{2.5}$ standard would be most applicable to vehicle and stationary combustion (e.g., generator) emissions.

The Workgroup agreed that the PM_{10} would be most appropriate and useful given that soil disturbance would likely constitute the largest part of total PM emissions. This conclusion is consistent with the Workgroup's previous determination that PM measurements for PAM should be made as PM_{10}.

Charge Question #5

- **5a.** *Is it appropriate to allow screening of volatile contaminants as total volatiles? Should it be mandatory to employ an instrument which can speciate the contaminants (i.e. field GC)?*

Underlying this question are alternate air sampling strategies that are available for PAM. One strategy uses direct reading sampling devices (i.e., photo-ionization/flame ionization detectors, PID/FID) that employ a common property of many volatile organic compounds – their relatively low energy ionizability in air and the ability to measure relatively low concentrations of the resulting ions (http://www.ert.org/products/2008.PDF) . This approach has the advantage of providing an essentially real-time measure of airborne concentration of gases and vapors. However, this approach also has the disadvantage of measuring a non-chemical specific property of volatile organics. It therefore cannot

distinguish the components of a mixture of volatile organics or identify an unknown volatile organic that may be emitted during a remediation.

A second strategy uses a field gas chromatograph (GC) (http://www.ert.org/products/2008.PDF). While not technically a real-time measurement device, a field-GC can provide quantitative measurements and tentative identification of a range of specific airborne chemicals within minutes to approximately one hour of sampling. This instrument is able to provide chemical-specific quantitative information when the chemical of interest is known and the instrument is calibrated to that chemical. The instrument is less useful for identification of unknown chemicals in the field, although tentative identification of unknowns based on retention time on the column is possible. A limitation of field GCs is that for some chemicals, the detection limit may exceed the PAM action level.

A third strategy is to collect air samples over the course of a day's site work (or some fraction of a full day's work) and to analyze those samples in an off-site laboratory using sensitive and chemical-specific analytical methods. While this approach has the advantages of sensitivity and specificity, it has the disadvantage of delaying conclusions about exposure and health risk and associated decisions about the continuation of site-work for approximately 24 hours.

The Workgroup discussed the use of PID/FID instruments versus field GC for the PAM. SRP noted that PID/FID instruments provide a read-out in terms of ppm benzene (i.e., the concentration of benzene that would produce the observed degree of ionization). SRP noted that PID/FID instruments can be calibrated for individual chemicals, but that the default setting for benzene reflects the fact that the acceptable air concentration for benzene is lower than for most (but not all) common volatiles. SRP stated that it was proposing to use PID/FID instruments (calibrated to benzene) under the assumption that the total volatile concentration expressed by the instrument as a benzene-equivalent concentration would be equal to or greater than the contribution of the most restrictive on-site chemical without chemical-specific adjustment. SRP also noted that the alternative use of a field GC would be more costly given that its use would be predicated on chemical-specific calibration.

The Workgroup recommended that PID/FID be used with calibration for the most sensitive on-site chemical. If the action limit for that chemical is exceeded using PID/FID, grab samples should be taken and sent for laboratory analysis. The Workgroup further recommended that given that laboratory results would not be received the same day as the sample was collected, it would not *a priori* be necessary to stop work based on a PID/FID exceedance, but that such a decision should be made using a graded approach. That is, work should be stopped if repeated exceedances of the PID/FID-based action limit are obtained over the course of a

given day and work should not continue until laboratory results are received. The Workgroup noted that this is a protective approach because the PID/FID is non-specific and the most sensitive chemical may be a minor component on-site. Thus, PID/FID exceedances of the action limit, even with calibration for the most sensitive chemical, would not necessarily imply an exceedance of the limit for that chemical.

- **5b.** *If an action level is lower than a real-time instrument can measure, is it appropriate to default to the real-time instrument method detection limit (MDL) for the action level or, instead, use a laboratory method with a lower MDL. This means the results will be available 24 hours later?*

SRP noted that in many (perhaps most) situations involving PAM, there are multiple volatile contaminants, all of which will contribute to a single PID/FID reading. Thus, even if there is a "driver" chemical for which the action level is below the limit of its detection using PID/FID, a "detect" reading on the PID/FID would not necessarily imply an exceedance of the action level for the "driver" chemical. **The Workgroup agreed that this would trigger the graded approach described above.**

The Workgroup recognized, however, the possible, and less ambiguous, scenario in which there is a unique or predominant volatile contaminant on a site for which the action level is below the PID/FID detection limit for that chemical. The Workgroup understands that for such a case, it is not possible to *a priori* describe a generic response for a stop-work order as opposed to continuing work pending receipt of laboratory results. Rather, the Workgroup recommended that the response in such a case should depend on several factors, including: the ratio of the detection level to the action level; the toxicological basis of the action level (e.g., acute vs. chronic); the persistence of the PID\/FID detectable excursion; and the actual magnitude of the PID/FID readings. The Workgroup recommended that these factors be taken into account in considering a graded response.

- **5c.** *Should the measured background levels for a given contaminant be added to the generic action levels to derive specific action levels for the site? If not, what is the appropriate way to handle background levels, particularly when background levels exceed generic action levels?*

The Workgroup members agreed that an upper-bound estimate of generic background rather than the measured background should be included in the criterion defining acceptable PM_{10} concentration because acceptable PM levels are risk-based and "receptors don't care about the source of the particulates." The Workgroup agreed that PM emissions from remediation operation should not exceed the NAAQS concentration. Thus, if the background is not greater than or

equal to the health-based criterion, the criterion value should be used. However, the Workgroup also agreed that NAAQS value could be adjusted on an *ad hoc* basis in those cases where the background PM level exceeded the NAAQS concentration.

Charge Quesiton #6

- *Is it appropriate to apply a dispersion factor to the action levels based on distance to the receptor?*

SRP draft PAM guidance proposes that health-based measurements be conducted at the fence line even if no receptors are located at the fence line and that levels measured at the fence line would then be adjusted for the modeled concentration at the nearest receptor. SRP further clarified that the nearest receptor need not be a residence or school, but could be a location where exposure could (but not necessarily will) occur such as a roadway or street).

One of the Workgroup members expressed the opinion that the estimation of the dispersion required to reduce the measured concentration at the fence line to below the action at the nearest receptor is less appropriate if the action level is based on acute effects than if the action level is based on chronic effects. This is because with acute effects, an underestimation of the off-site concentration due to unusual conditions or incorrect assumptions in the modeling could lead to adverse health effects.

A question was raised regarding the use of meteorological data in the dispersion modeling. Would site-specific meteorological factors (e.g., average wind speed and direction and site/receptor elevation) be used, or would worst-case assumptions be employed? SRP clarified that historical meteorological data would be used to characterize the mean wind speed and direction and the mean number of days with at least 0.01 inches of precipitation for the area in question.

A Workgroup member inquired whether it would be feasible to incorporate on-site monitoring data to increase the reliability of the off-site modeling. SRP pointed out, however, that remediation work would not necessarily occur site-wide and could occur on different parts of the site at different times. Thus, there may be no specific on-site location that gives representative monitoring data. Given this, fence-line monitoring data (as envisioned in SRP's approach) should be sufficiently informative.

The Workgroup members agreed that off-site modeling was an appropriate option providing that the nearest off-site receptor was identified and that the modeling addressed that receptor. The Workgroup also endorsed the use of historical meteorological data as described by SRP for use in the modeling.

Charge Question #7

- **7a.** *Should dust suppression and other best management practices be employed at all sites?*

The Workgroup noted that the charge question, itself, assumes that best management practices will be employed in any case. The Workgroup accepts this assumption.

The Workgroup noted, however, that the more pertinent question is posed below (7b).

- **7b.** *It has been suggested for short term exposures that rather than perform PAM, only best management practices are required to address the concerns of off-site migration. Is this position supportable?*

The Workgroup noted that best management practices such as dust suppression are not appropriate for volatiles. They further noted that even for PM, best management practices are not adequate because monitoring would still be necessary to ascertain the efficacy of the management practices.

Charge Question #8

- **8a.** *Should the draft PAM Guidance allow for exceedences of the action levels as the short-term impacts can be justified based on the long-term benefits (i.e. short term risk may be increased; however, lifetime exposure will be eliminated once the remediation is completed)?*

- ***8b.*** *Is there a technical basis for allowing short-term exposure above calculated action levels based on long-term risk reductions?*

The Workgroup considered 8a and 8b to be closely linked questions and thus, considered them together. The Workgroup noted that the balancing of short-term exceedances in exposure against the long-term benefits to be derived from the remediation relates to risk management rather than risk assessment. The acceptability of such exceedances depends on the nature of the exposure and the specific risk. One Workgroup member suggested that in the case of ongoing or persistent exceedances, the remediation operation could be shut down until the nature of such trade-offs is adequately evaluated. SRP noted that this would likely require a 24-hour lag given the nature of data collection and analysis.

The Workgroup members concluded that as a general rule, short-term exceedances should not be permitted as a trade-off for longer-term benefits, but the decision in

each case should be based on the specific criteria/health endpoints involved as well as on the nature of the exposure.

Charge Question #9

- **9a.** *Should the trigger for monitoring air for asbestos be 1% asbestos in soil or some other level?*
- **9b**. *Should the analytical method for monitoring asbestos in air be PCM analysis with an action level of less than or equal to 0.01 fibers per cc of air, or should the analytical method and action level be taken from the recent EPA guidance document Framework For Investigating Asbestos-Contaminated Superfund Sites (OSWER Directive #9200.0-68, September 2008)?*

The Workgroup provided a joint response to these two questions. Information provided by a member of the USEPA Technical Review Workgtoup (TRW) Asbestos Committee stated that due to the many variables that mediate between asbestos fibers in soil and their entrainment into the breathing zone, the USEPA does not feel confident in setting a direct health-based soil asbestos level as a surrogate for airborne asbestos levels that could result from disturbance of that soil. Instead, the USEPA in its most recent guidance (http://epa.gov/superfund/health/contaminants/asbestos/pdfs/framework_asbestos_guidance.pdf) recommends air monitoring. SRP noted that USEPA refers to a 1% soil value for asbestos and inquired what the significance of that value is. The Workgroup member acquainted with USEPA asbestos policy stated that this value was essentially an informal screening value for decisions about remedial action, but is superceded by the aforementioned guidance. However, an asbestos concentration in soil below 1% does not imply that air concentration resulting from disturbance of that soil would not be significant. The USEPA does not have a definitive soil asbestos concentration that can be used to determine the acceptability of potential asbestos fiber entrainment in a remediation operation.

The Workgroup agreed that operationally, if it is known or can reasonably be expected (based on site use or history) that asbestos contamination is present on site, air monitoring should be required. However, if the asbestos contamination is discrete (e.g. a single piece of asbestos pipe covering) that material could be removed *a priori.* Decisions about the necessity for air monitoring should be based on weight of evidence.

With respect to the acceptable air concentration of asbestos for PAM and how that concentration should be measured and interpreted, the Workgroup agreed that SRP

should refer to the USEPA guidance (see link above) . The Workgroup noted that the guidance level of 0.01 fibers/cc is not referenced in the most recent USEPA guidance. However, it is referenced in AHERA (school asbestos remediation) (http://www.gpo.gov/fdsys/pkg/CFR-2011-title40-vol31/pdf/CFR-2011-title40-vol31-part763-subpartE.pdf) and can be used with professional judgment for PAM (e.g., 0.01 fibers/cc would not necessarily be appropriate in a case where a residence was located at the fence-line). The use of this value (as appropriate) is bolstered by the short-term nature of the remediation-related exposure.

Charge Question #10

- *Is it appropriate to measure PCBs as particulates based on 95% of the UCL of the mean concentration of contamination present in the soil and to measure PM_{10} as a surrogate for the purpose of PAM?*

The Workgroup noted that PCBs can be present in both the vapor and particulate phases (ATSDR, 2000) and pointed out that both phases were found to be significant in NYC school PCB contamination cases (http://www.epa.gov/pcbsincaulk/pdf/pcb_EPA600R12051_final.pdf). SRP stated that this charge question largely reflects its early policy and that it recognizes that both phases are potentially significant and that both phases need to be measured.

The Workgroup endorsed the current SRP approach of measuring both particulate and vapor phases.

The Workgroup also suggested that as appropriate, the PCB guidance could apply to related compounds (e.g., dioxins, PCDFs).

References

ATSDR (Agency for Toxic Substances and Diesease Registry) (2000). Toxicological Profile for Polychlorinated Biphenyls (PCBs).

Adeshina F, Sonich-Mullin C, Ross RH, Wood CS (2009). Health-based Provisional Advisory Levels (PALs) for homeland security. Inhal Toxicol. 2009 Dec;21 Suppl 3:12-6. doi: 10.3109/08958370903202788.

Costa DL (2008). "Air Pollution" in *Caserett & Doull's Toxicology*, 7th edition, Klaussen CD ed., McGraw Hill Medical, New York.

Appendix I

Detailed Perimeter Air Monitoring Charge Questions Supplied by NJDEP-SRP

Each charge question (or set of charge questions) is preceded by an introduction provided by SRP that provides background places the charge question in the context of SRP's concerns for perimeter air monitoring.

1) The draft PAM Guidance applies to situations where there is disturbance of contaminated soils for more than 30 work days, but less than one year. Provided best management practices are employed, exposures of 30 days or less are deemed to have minimal impact and PAM will not be required. An exposure of one year or more would constitute a chronic exposure and would require the need for a PAM plan with a different conceptual basis than this guidance. (PAM Guidance, Section III. SITE APPLICABILITY)

   - *Is limiting PAM to those projects of more than 30 days (with stated exceptions) defensible?*
   - *Is it appropriate to consider projects with durations of 30 days or more, but less than one year as non-chronic or short-term?*
   - *Is one year an appropriate cut-off beyond which to consider health effects only on a long-term or chronic basis?*
   - *Does the SAB identify time frames applicable to PAM which it considers more appropriate than the ones proposed?*

2) The draft PAM Guidance utilizes both RfC (non-cancer) and URF (cancer) equations for both particulate and volatile forms of contaminants. SRP contends that non-carcinogenic-based toxicity factors better reflect the non-chronic duration covered by this guidance. Consequently, non-carcinogenic based toxicity factors are used in these equations even if both carcinogenic and non-carcinogenic toxicity data are available. When a non-carcinogenic based toxicity factor is not available, the carcinogenic value is used and adjusted to reflect the short term exposure. For this later case, SRP is further considering increasing the action levels by applying (i.e., multiplying by) a factor of 10 to address the uncertainty of using lifetime chronic toxicity factors to develop short-term values. SRP is also considering evaluating contaminants as both volatiles and particulates with the most conservative value of

the two chosen as the action level for that contaminant. (PAM Guidance, Section V. CALCULATING ACTION LEVELS)

- *Are the RfC and URF equations used in the Draft PAM Document the most appropriate?*
- *Is the preference for using non-carcinogenic endpoints for short term exposure valid?*
- *When there is no non-carcinogenic reference value is adjusting the acceptable ambient air concentration based on the carcinogenic value upward to reflect a short term exposure valid?*
- *For the above case, is applying a factor of 10 to address the uncertainty of adjusting carcinogenic values to short-term values justifiable?*
- *Is it appropriate to calculate both volatile and particulate values for all contaminants and choose the most conservative? If not, on what basis should contaminants be considered to be volatiles or particulates for the purposes of the PAM plan?*

3) The draft PAM Guidance ideally requires monitoring both upwind and downwind conditions using real-time instrumentation with readings taken every fifteen minutes when contaminated material is being disturbed. For particulates, only monitors that provide measurement of generic particulate concentration are available for real-time measurement. Therefore, the dust as PM_{10} is assumed to contain the target contaminant(s) at a concentration equal to the upper 95% confidence interval on the mean concentration of that contaminant(s) in the on-site soil. (PAM Guidance, Section VI. MONITORING)

    - *Is assuming the upper 95% confidence interval on the mean on-site soil concentration of the target contaminant(s) for the contaminant(s) concentration in the particulates justifiable? If not, is there an alternative course of action?*
    - *Should dust be monitored as PM_{10} or $PM_{2.5}$?*

4) In addition, a 24 Hour National Ambient Air Quality Standard (NAAQS) adjusted for work day length and New Jersey background levels is also used in combination for particulates. For an 8 hour day, the maximum level of PM_{10} allowed for a site is calculated as 338 $\mu g/m^3$. At no time can 338 ug/m^3 plus upwind background be exceeded. (PAM Guidance, Section VI. MONITORING)

- *Is it more defensible to employ the 24 Hour NAAQS adjusted only for work day length (8 hours) which would be 450 ug/m^3? This value is derived by using the NAAQS without subtracting the worst-case measured background levels associated with the State monitoring data (i.e. Newark data).*

5) Volatile compounds may be measured as total volatiles with a PID/FID unit, assuming that 100% of the measured value is the contaminant with the most conservative action level. Alternatively, volatile compounds may also be measured using field gas chromatographic equipment on a compound specific basis. The use of a field GC could be cost prohibitive for some remediation projects. (PAM Guidance, Section VI. MONITORING)

    - *Is it appropriate to allow screening of volatile contaminants as total volatiles? Should it be mandatory to employ an instrument which can speciate the contaminants (i.e. field GC)?*

    - *If an action level is lower than a real-time instrument can measure, is it appropriate to default to the real-time instrument method detection limit (MDL) for the action level or instead use a laboratory method with a lower MDL. This means the results will be available 24 hours later?*

    - *Should the measured background levels for a given contaminant be added to the generic action levels to derive specific action levels for the site? If not, what is the appropriate way to handle background levels, particularly when background levels exceed generic action levels?*

6) SRP is also considering the use of a dispersal factor for both volatile and particulate contaminants. Given that contaminants disperse in air, the SRP is considering allowing the application of an attenuation factor to the action level (which is applicable to the fence line or border of the property) based on the distance from the monitoring point to the sensitive receptor. In this case, an action level monitored at the site would be allowed to be increased by the dispersion factor (i.e. multiplied) based on the distance to the closest receptor. (PAM Guidance, Section VI. MONITORING)

    - *Is it appropriate to apply a dispersion factor to the action levels based on distance to the receptor?*

7) The draft PAM Guidance requires that visible dust be abated at all sites and that best management practices (i.e. dust suppression, etc.) be employed at all sites. (PAM Guidance, Section VII. SPECIAL MONITORING CONSIDERATIONS)

- *Should dust suppression and other best management practices be employed at all sites?*

- *It has been suggested for short term exposures that rather than perform PAM, only best management practices are required to address the concerns of off-site migration. Is position supportable?*

8) The action levels may not be able to be achieved at all sites even with employing best management practices based on contaminant levels in the soil and distance to receptors. (GENERAL QUESTION)

   - *Should the draft PAM Guidance allow for exceedences of the action levels as the short-term impacts can be justified based on the long-term benefits (i.e. short term risk may be increased; however, lifetime exposure will be eliminated once the remediation is completed)?*

   - *Is there a technical basis for allowing short-term exposure above calculated action levels based on long-term risk reductions?*

9) The draft PAM Guidance currently requires that asbestos be monitored if soil exhibits 1% or more asbestos and that an air action level of less than or equal to 0.01 fibers per cc of air via phase-contrast microscopy (PCM) analysis (this is not a real-time analysis) be achieved based on a value derived from 40 CFR 763.80, Subpart E. After several days of data are collected for both PM_{10} and asbestos, it may be possible to use a correlation of the results to discontinue the asbestos monitoring if it can be demonstrated that the PM_{10} level is protective of the 0.01 fibers per cc of air level. (PAM Guidance, Section VII. SPECIAL MONITORING CONSIDERATIONS) However, the asbestos section may be removed and RESERVED as SRP evaluates how to integrate the latest USEPA guidance .

   - *Should the trigger for monitoring air for asbestos be 1% asbestos in soil or some other level?*

   - *Should the analytical method for monitoring asbestos in air be PCM analysis with an action level of less than or equal to 0.01 fibers per cc of air, or should the analytical method and action level be taken from the recent EPA guidance document Framework For Investigating Asbestos-Contaminated Superfund Sites (OSWER Directive #9200.0-68, September 2008)?*

10) The Draft PAM Guidance requires that polychlorinated biphenyls (PCBs) be measured as a particulates based on 95% of the UCL of the mean concentration of contamination present in the soil and measures PM_{10} as a surrogate for the

contaminant. (PAM Guidance, Section VII. SPECIAL MONITORING CONSIDERATIONS)

- *Is it appropriate to measure PCBs as particulates based on 95% of the UCL of the mean concentration of contamination present in the soil and to measure PM_{10} as a surrogate for the purpose of PAM?*

Appendix II

NJDEP-SRP Draft PAM Guidance

PERIMETER AIR MONITORING GUIDANCE FOR SITES UNDERGOING REMEDIAL ACTION

October 7, 2010 Draft

I. INTRODUCTION

This document contains guidance for those who are remediating sites under the New Jersey Department of Environmental Protection (Department) Site Remediation Program (SRP) and are required to monitor and prevent unacceptable exposure from the inhalation of airborne contaminants by off-site receptors. Air monitoring is to be conducted in a way that allows actions to be taken in real time during an emission event, by reducing contaminants to acceptable levels or eliminating any off-site dispersion. The regulatory authority for this guidance is pursuant to the Technical Requirements for Site Remediation (N.J.A.C. 7:26E –6.2(a)10 and 5.1(c)1.iv and v). This document is subject to change without notice and may vary from decisions made on a site-specific basis. Use of commercial or copyrighted names in this guidance document does not constitute endorsement of that product by the Department.

II. PURPOSE

The purpose of the Department's Perimeter Air Monitoring (PAM) Guidance is to standardize the approach used to evaluate and address potential off-site human exposure to contaminants released to the air from a site undergoing remediation. The intended audience includes case teams, project managers, the regulated community, interested parties, and other personnel providing oversight of the remediation. The goal is to assist the user in determining whether an action is required to protect off-site receptors from the dispersion of contaminants caused by remediation activities. This guidance is not intended for worker protection, which is covered by the site health and safety plan. Secondary standards such as odors are not addressed by this guidance.

This guidance addresses those sites where the remedial action that is generating emissions will be longer than 30 working days but less than one year, and where a human receptor is present within 500 feet of the remediation work. At the Department's discretion, exceptions to this guidance may be made, but only with Department review and approval.

The procedure described here requires real-time assessment of both volatile organic contaminants (VOCs) and particulate contaminants (particulates) that are of concern during the remedial investigation. Measurements collected during the perimeter air monitoring will be compared to calculated short-term VOC criteria and/or short-term particulate criteria (action levels). The Department has determined that reference concentrations (RfCs), non-cancer toxicity values for the inhalation pathway (adjusted for the shorter exposure time and site-specific conditions), are the most appropriate to use with this guidance (see Section V below). Unit risk factors (URFs) for carcinogenicity, also adjusted for the shorter exposure time and site-specific conditions, may be used if RfCs are not available for specific contaminants. Asbestos is an exception and is regulated on a fiber concentration derived from 40 CFR 763.80, Subpart E.

This guidance incorporates both chemical-specific and non-specific methodologies. Action levels for both VOC and particulates must be determined if there is a possibility of such emissions. VOC measurements can be conducted on a contaminant-specific basis as well as in a non-specific manner. Direct-measuring real-time instrumentation, such as a field gas chromatograph (GC), is available for VOCs and can be used if an appropriate detection level for specific contaminants can be achieved. Contaminant non-specific instruments such as photo ionization detectors (PID) or flame ionization detectors (FID) may also be used. If non-specific instruments are used, the presumption must be made that whatever VOC concentration is detected consists entirely of the most toxic VOC present.

There is currently no instrumentation that can measure chemical-specific particulate concentrations on a real-time basis. Consequently, portable real-time particulate measuring devices, such as the DataRAM, are used to measure PM_{10} as a surrogate for contaminant-specific particulate data. Although data from these devices cannot be used to determine compliance with the National Ambient Air Quality Standards (NAAQS) for fine particulates ($PM_{2.5}$) or inhalable particulates (PM_{10}), the 24-hour average NAAQS for PM_{10} of 150 $\mu g/m^3$ must not be exceeded during remediation. Direct Use of the 24-hour average NAAQS for PM_{10} of 150 $\mu g/m^3$ is not appropriate because the equipment proposed for use in this document is not suitable (i.e. not reference grade) and because the long term compliance period of the NAAQS is inconsistent with the short term approach of this guidance document. Nevertheless, the Department has opted to modify the conceptual approach of the 24-hour average NAAQS for PM_{10} of 150 $\mu g/m^3$ and use it for short term protection from particulates. The process is described under V. C. (Particulate Contaminant Adjustments). The 24-hour PM_{10} standard is established to protect public health, including the health of sensitive populations, such as asthmatics, children and the elderly; it is not to be exceeded more than once per year on average over a period of 3 years. However, a higher short-term one-hour average PM_{10} action level can be set based on overall background particulate concentrations at the remediation site, the duration of excavation, and the length of remedial activity per day.

Best management dust and vapor control procedures must be instituted at all remediation sites. Examples of best management controls include water and foam spray, physical barriers, and/or chemical barriers.

III. SITE APPLICABILITY

Sites where PAM is required include those where remediation activities potentially generate emissions for a period of time exceeding 30 working days, and where an off-site receptor exists within 500 feet. In those situations where emissions-generating activities will last 30 days or less, a PAM program is not required. However, the Department reserves the right at its own discretion to require PAM at a site. Some reasons for doing so may include contaminant-specific concerns, the presence of sensitive receptors, community concerns, the presence of free product, or the established historical need for monitoring. For remediation activity that will exceed 1 year, consultation with the Department's Division of Air Quality, Bureau of Technical Services, is required to determine the appropriate PAM plan to be employed.

The Department may determine that PAM is required for other types of remediation activities (i.e. soil vapor extraction), or sites including but not limited to remediation of lagoons, ponds, streams, etc. In addition, any responsible party (RP) may voluntarily develop and implement PAM for any given site. The Department also solely reserves the right to determine that PAM is not required.

IV. DETERMINING CONTAMINANTS OF INTEREST

The major contaminants of concern that trigger the proposed remedial activity are the presumed candidates for PAM. However, all contaminants present at a site should be considered as possible candidates, since toxicity via the inhalation pathway can vary considerably, and a contaminant's adverse effects may be disproportionate to its observed concentration.

Most PAHs, metals and pesticides will be adsorbed onto soil particles and should be monitored as particulates (i.e. PM_{10}). VOCs will be monitored as organic vapors, either as individual compounds (i.e. by means of a GC) or as total organic vapors (i.e. by means of a PID or FID). When individual VOCs will be monitored, the chemical-specific allowable VOC concentration for each compound will be the action value. When monitored as total VOCs, the lowest allowable VOC concentration for the compounds detected in site soils will be the action value for total VOCs.

V. CALCULATING ACTION LEVELS

The method for establishing a site-specific action level for the protection of off-site receptors with respect to air monitoring will be based on the following:

1. The exposure being evaluated is short-term or subchronic inhalation. However, there is a lack of this type of toxicity data for many of the potential contaminants encountered. The Department is currently reviewing the implications of using acute exposure data, but has not determined a final course of action regarding its use. In the interim, the Department will use adjusted long-term toxicity values as a default. The order of preference for the selection of chemical-specific toxicity data will be RfCs (non-carcinogenic) values, when available, and URFs (carcinogenic) when RfCs are not available.

2. Inhalation toxicity data can be found at www.nj.gov/aqpp/risk.html. Click on "Reference Concentrations for Inhalation" and "Unit Risk Factors for Inhalation."

3. Long-term toxicity data (RfCs and URFs) must be adjusted to reflect the shorter-term exposure period (less than or equal to 1 year). For particulates, an adjustment must also be made for the contaminant concentration present in the soil. The default concentration to use is the 95% upper confidence level of the mean of the contaminant concentration present in the area of disturbance.

4. If the timeframe for soil excavation and soil disturbance will exceed one year the potential health impact becomes more chronic in nature. In such cases, an action level based on a chronic toxicity value must be compared to the chemical-specific air

concentration averaged over a period of time (i.e. a month or longer), rather than being used in a short or instantaneous timeframe. However, consultation with the Department's Bureau of Technical Services is required in these situations.

5. For action levels derived from long-term toxicity data, the calculated action level is added to the existing background level to establish the value used to trigger action responses. Background level in this case refers to the current upwind air concentration, which is to be measured simultaneously with perimeter air concentrations.

6. For particulates, there is an upper-limit action level derived from the 24-hour NAAQS for PM_{10} of 150 ug/m^3. For an 8-hour period, and correcting for a New Jersey annual ambient PM_{10} background concentrations, an action level of 338 micrograms of PM_{10} per cubic meter of air has been established. This value, when added to the site-specific background, is to be used as the trigger for an action response, and is an absolute maximum. In no instance can this action level be increased for an 8-hour work period under normal circumstances.

A. Using a Reference Concentration to Derive an Action Level

Equation 1. Particulate Action Level Derived from an RfC

$$ActionLevel = \frac{RfC * AT}{SoilConcentration * \frac{1kg}{10^6 mg} * ET * EF * ED}$$

Where

RfC = Reference Concentration = Contaminant-specific ($\mu g/m^3$)
AT = Averaging Time = 1 year
Soil Concentration = 95% upper confidence limit of the mean of the contaminant in the Area of Concern (mg/kg)
ET = Exposure Time = Work shift length (hours/24 hours)
EF = Exposure Frequency = Length of actual excavation (days/365 days)
ED = Exposure Duration = 1 year

Equation 2. VOC Action Level Derived from an RfC

$$ActionLevel = \frac{RfC * AT}{ET * EF * ED}$$

Where

RfC = Reference Concentration = Contaminant-specific ($\mu g/m^3$)
AT = Averaging Time = 1 year

ET = Exposure Time = Work shift length (hours/24 hours)
EF = Exposure Frequency = Length of actual excavation (days/365 days)
ED = Exposure Duration = 1 year

B. Using a Unit Risk Factor to Derive an Action Level

If an RfC is not available for a contaminant, but a URF (for carcinogenicity) is available, the URF may be used to develop an action level.

Equation 3. Particulate Action Level Derived from a URF

$$ActionLevel = \frac{TR * AT}{SoilConcentration * \frac{1kg}{10^6 mg} * URF * ET * EF * ED}$$

Where

TR = Target Risk = 1×10^{-6}
AT = Averaging Time = 70 years
Soil Concentration = 95% upper confidence limit of the mean of the contaminant in the Area of Concern (mg/kg)
URF = Unit Risk Factor = Contaminant-specific but in terms of $(\mu g/m^3)^{-1}$
ET = Exposure Time = Work shift length (hours/24 hours)
EF = Exposure Frequency = Length of actual excavation (days/365 days)
ED = Exposure Duration = 1 year

Equation 4. VOC Action Level Derived from a URF

$$ActionLevel = \frac{TR * AT}{URF * ET * EF * ED}$$

Where

TR = Target Risk = 1×10^{-6}
AT = Averaging Time = 70 years
URF = Unit Risk Factor = Contaminant-specific but in terms of $(\mu g/m^3)^{-1}$
ET = Exposure Time = Work shift length (hours/24 hours)
EF = Exposure Frequency = Length of actual excavation (days/365 days)
ED = Exposure Duration = 1 year

C. Particulate Contaminant Adjustments

An additional criterion will apply for particulates. This criterion is the 24-hour NAAQS adjusted for workday duration and New Jersey background. For an 8-hour workday this value is 338 micrograms of PM_{10} dust per cubic meter of air (μg PM_{10} dust/m^3). Note

that for 10 and 12-hour workdays, the adjusted criterion is 270 and 225 μg PM_{10} dust/m^3, respectively. For most sites, this PM_{10} criterion will be protective for the individual constituents of the dust.

$$MaxPM10\,ActionLevel = \frac{(NAAQS - BackgroundCorrection) * (24hr)}{Workday(hr)}$$

Even at extremely high concentrations for specific particulates, the PM_{10} concentration allowed by an adjusted NAAQS will be protective in many cases. Appendix A lists contaminant-specific soil concentrations in milligrams of contaminant per kilogram of dry weight soil (mg/kg) below which there is no need to calculate a contaminant-specific particulate action level because the adjusted NAAQS is protective. Note that values in Appendix A should be compared to the 95% upper confidence limit of the soil concentration of the area where emissions are generated.

D. VOC Contaminant Adjustments

If VOC monitoring is conducted using an instrument that can only measure total VOCs, it must be assumed that the measured concentration consists entirely of the most toxic VOC chemical of concern. Therefore, the action level for total VOCs is the action level for the most toxic contaminant.

VI. MONITORING

Real-time monitoring is required, with few exceptions, for PAM, and this monitoring can be conducted either by using contaminant-non-specific or contaminant-specific equipment. In either case, the selected equipment must have detection limits that can measure the relevant action levels.

The minimum detection limit must be able to accurately determine if an action level is exceeded. Instruments must be audibly alarmed, with a monitoring period of 15-minute intervals.

A. Monitoring Locations

Monitoring should be conducted in two general areas: at the site perimeter, and immediately downwind of the work zone. Site perimeter monitors will be located on all four sides of the area of remediation. Locations are subject to the approval of the Department. The downwind work zone measurements will provide advance warning of potential concerns at the perimeter, and can also provide worker safety information. Immediate downwind work zone measurements present a worst case scenario with respect to emissions. The perimeter is where the need for action will be determined. Because the action levels are based on a short-term approach, the allowed duration of an action level exceedance will necessarily be short, no more than 1-hour actual elapsed time. Consequently, the health risk from such an exposure is well within the safety margin of the calculated action level. Placement of data loggers at the site perimeter will also document the conditions potentially impacting off-site receptors. Additional

perimeter monitors may be required to address sensitive receptors. The location of additional monitors may also require adjustment for the same reason.

B. Monitoring Equipment and Methodology

There are numerous instruments available to provide real-time air measurements. Instruments that provide chemical-specific concentrations are preferred.

1. Volatile Organic Contaminants

If contaminant non-specific equipment (i.e. PID or FID), is used, it must be assumed that the total VOC concentration is comprised entirely of the highest-risk VOC contaminant present. Sorbent tubes can be used to assess the actual absence or presence of this worst-case contaminant in the air sample. If action level exceedances are determined by this non-specific equipment and confirmed by sorbent tube analysis, one option is to switch to monitoring using contaminant-specific equipment such as a field GC.

Contaminant-specific monitors include field GCs for VOCs. The contaminant concentration can be measured directly and there is no need to assume a worst-case contaminant-presence scenario. The U.S. Environmental Protection Agency (USEPA), 1999, Compendium of Methods for Toxic Air Pollutants, Second Edition, Method TO-15 (TO-15) is also contaminant-specific. However, because it is not a real-time methodology, TO-15 is typically used for documentation or verification at a perimeter location.

2. Particulates

Particle-measuring equipment must be able to detect the PM_{10} fraction of particulate at the appropriate concentration (i.e. DataRAM). The selected equipment must be properly set up for outdoor use, and a workplan describing the exact set-up and accessories for the aerosol monitor must be submitted for approval prior to monitoring. Standard operating procedures (SOPs) may be required, since the instrument instructions may not sufficiently describe how the instruments will be operated on daily basis. Specifically, the environmental enclosure and omnidirectional inlet must be used. A description of how humidity will be managed must be provided (i.e., humidity data correction, inlet heater, or water vapor trap). The workplan must also include a section describing whether a visible and audible latching alarm will be used, or how exceedances of the calculated action levels will be monitored and determined from the central computer.

C. Monitoring Schedule

Real-time monitoring must be conducted 24 hours per day for the first three days of active remediation. An evaluation can then be made whether real-time monitoring is only required during remediation activity, or whether to continue monitoring 24 hours per day. The 24-hour per day real-time monitoring will not be required if dust suppression

methods (i.e. application of foam or tarps) are used during non-activity periods The purpose of the 24-hour monitoring is to verify the validity of the assumption that emissions are largely restricted to the periods of active soil disturbance.

Air monitoring data requiring laboratory analysis (i.e. TO-15, dust monitoring for GC or GC/MS analysis) over the entire active work period for a workday on a periodic basis will more accurately assess and document the actual exposure. Given that the laboratory analytical data results will be received after the workday activities are completed, no immediate actions (i.e. stop work, dust suppression) can be taken based on the laboratory data; however, it can be used to determine if future work needs to be conducted under more or less stringent criteria, or if different response actions should be employed. The frequency of the air monitoring for laboratory analysis is a site-specific decision. As a default recommendation, air monitoring for laboratory analysis may be conducted once per week during the active remediation, when the highest levels of contamination are being remediated.

The default sampling scheme involves a local meteorological station to measure wind speed and direction. This station must have data logging capabilities. There should also be instrumentation appropriate for site-specific contaminant detection at fixed locations around the perimeter of the site (i.e. on the fence line), with the positions biased towards receptor locations (i.e., adjacent residential community, commercial office building, retail area, industrial area, etc.). Additional equipment may be required to document the potential impact on receptors deemed to be particularly sensitive. For the immediate downwind work zone monitoring locations, portable equipment is acceptable and will allow location flexibility.

D. Perimeter Air Monitoring Start-Up

1. Baseline Conditions

Prior to the start of a project, it may be beneficial to establish baseline conditions at the site. This step involves conducting short-term air monitoring before any emissions-generating activities begin. The air monitoring must be conducted in the exact manner described in the PAM workplan. This step allows any unanticipated difficulties to be addressed prior to commencement of full-scale remedial activities.

2. Background Contributions

Similarly, before the start of daily remediation operations, background ambient air levels and upwind conditions need to be established. Existing ambient concentrations can sometimes confound the interpretation of measurements collected during remediation activities; however, ongoing statewide air monitoring conducted by the Department Division of Air Quality indicates this will not be a frequent occurrence. New Jersey ambient air data can be accessed at www.state.nj.us/dep/airmon.

3. Confirmatory Sampling

Confirmatory sampling may be needed and/or useful if non-specific instrumentation is employed. Contaminant-specific measurements may be necessary to confirm assumptions regarding contaminant concentrations. Another potential function of contaminant-specific measurements is to verify and/or adjust the calculated criteria.

The calculated values are conservative and if justification can be provided that the criteria are overly restrictive, the calculated values may be revised accordingly.

VII. SPECIAL MONITORING CONSIDERATIONS

A. Visible Dust

The observation of visible dust leaving the site from contaminated portions of the site (i.e. not from certified clean fill or clean zones) should be evaluated in the same manner as the downwind work zone instrument readings. Visible dust is an early warning of a problem, such as inadequate dust control or an excessive rate of disturbance. Visible dust generated at the immediate work area which settles out of the air within close proximity to the work area should not be treated in the same manner as visible dust leaving the site.

B. Meteorological Station and Features

The main purpose of the meteorological station is to determine wind direction impacts on air monitors. This is important because action levels are based on the sum of the site-specific contribution and the existing upwind contribution. The downwind direction must be determined for proper placement of the downwind monitors, as well as to allow the assessment of off-site contaminant movement. The meteorological station must be located so that the data collected will appropriately reflect off-site receptor exposures, with emphasis on the receptor breathing zone. Wind direction and wind speed may vary over time, and buildings, other structures, and site topography can create complex wind patterns. Supplemental instrumentation (i.e. wind vanes) or devices (i.e. windsocks) may be needed to properly evaluate the data being collected.

C. Central Monitoring Station Option

The size and complexity of the site may warrant the use of a central monitoring station. Hardwire or wireless connections allow the routing of data from the various instruments to a monitoring station where an operator can evaluate several data streams simultaneously. While not a mandated requirement, the central monitoring station option may be a cost-effective choice that results in more efficient management of the site.

D. Excavation of Hot Spots

The option to calculate work-area-specific action levels is available. Under this option, an action level is developed for a subset of the site that is being remediated for a specified timeframe. The calculated criterion applies only for that defined portion of the remediation site (i.e. free product encountered, adjacent to sensitive receptor, etc.). Note that the use of this option requires Department pre-approval.

E. Asbestos in Soils

This section pertains to sites undergoing remediation that contain soil contaminated with more than 1% asbestos or other site-specific concentration determined for remedial actions. When buildings are contaminated with asbestos, remediation of those buildings will be covered under the National Emissions Standard for Hazardous Air Pollutants (NESHAPS) found in 40 CFR Part 61, subpart M.

The PAM program to be implemented during the remediation of a site with soils containing more than 1% asbestos or other site-specific concentration determined for remedial actions must include asbestos monitoring using an acceptable level of less than or equal to 0.01 fibers per cc of air via phase-contrast microscopy (PCM) analysis. Given that there are currently no real-time monitors specific to asbestos fibers, the asbestos sampling will be done on a daily basis, in addition to particulate monitoring to demonstrate compliance with the site-specific PM_{10} action level. While it is anticipated that compliance with the site-specific PM_{10} action level will most likely be protective for asbestos, the PM_{10} and asbestos data must be evaluated to ensure that use of the site-specific PM_{10} level remains protective for asbestos. After several days of data are collected for both PM_{10} and asbestos, it may be possible to use a correlation of the results to discontinue the asbestos monitoring if it can be demonstrated that the PM_{10} level is protective of the 0.01 fibers per cc of air level. The 0.01 fibers per cc of air level comes from the NJ Uniform construction code N.J.A.C. 5:23-8.21 that is based on the federal criteria for asbestos abatement in schools found in 40 CFR 763.80, Subpart E. ATSDR has previously concurred with the use of the above asbestos level as a perimeter action level protective of community residents during building demolition. The NJDEP has also used the asbestos level of 0.01 fibers per cc of air in other remediation projects involving asbestos (See Section VI MONITORING, A. Monitoring Locations for location of monitoring stations).

Best management practices must be used to minimize the generation and/or dispersion of asbestos containing dust during site activities. This should include at a minimum, wetting down areas subject to dust generation and adequate vehicle/equipment cleaning to avoid the spread of asbestos beyond the site.

F. PCBs in Soils

This section pertains to sites undergoing remediation that contain soil contaminated with polychlorinated biphenyls (PCBs). PCBs are currently regulated by SRP as a volatile; however, subsequent experience in monitoring for PCBs for the purpose of PAM has shown that it is more appropriate to monitor PCBs as a particulate. Therefore, PCBs will be monitored by using the 95% upper confidence limit of the soil concentration inserted into the applicable equation to calculate a corresponding acceptable PM_{10} level. This calculated PM_{10} level is not to exceed 338 $\mu g/m^3$ plus site-specific background for an 8 hour work day.

VIII. RESPONSES TO ACTION LEVEL EXCEEDANCES

A. Locations Immediately Downwind of Work Zones

1. The primary function of this station is to provide early warning of adverse conditions, before they can affect the perimeter.

2. Any potentially adverse change in emission conditions is to be investigated and/or evaluated.

3. Any increase in particulate and/or VOC concentrations due to remedial activities is to be investigated and/or evaluated.

4. Proactive steps are to be taken to ensure an alarm condition caused by remedial action does not occur at the perimeter.

B. Site Perimeter Actions

1. For an initial alarm condition at the perimeter (period of exceedance not to be greater than 15 minutes), the cause of the alarm must be investigated.

2. If conditions cause the alarm at the perimeter to persist into the next 15-minute period, and are the result of emissions-generating remediation activity, vapor and dust control corrective actions must be implemented. These would include the application of water and/or foam, as well as the reduction in the rate of vapor- and/or particulate-generating activities.

3. If the alarm condition at the perimeter still persists into the following 15-minute period, is attributable to the same cause, and is due to emissions- generating remedial activity, all activity with the potential to generate vapors or particulates must cease.

4. If the alarm condition at the downwind perimeter station occurs and receptors could be potentially impacted, either the maximization of vapor and dust controls or the cessation of work must be initiated immediately. If the use of controls is the selected option and levels are not acceptable within 15 minutes, all work must cease.

5. Following a shutdown, if upon re-start the action levels are again exceeded as in Steps 1, 2, and 3 above, and operations are again precluded, the use of an enclosure should be considered where feasible. Similarly, if work cessation occurs as in Step 4 above, an enclosure should be considered.

C. Exceedances Caused by Conditions Not Related to Remedial Activities

Short-term exceedences caused by activities not directly resulting from the remedial activity will occasionally occur. When these exceedences occur and can be documented as not being related, the project manager or designee should reset the monitoring station, record the reason for the exceedance and proceed with site activities. Appropriate action should be taken to eliminate the cause of the short-term exceedance when possible (i.e.,

having an idling vehicle moved away from the vicinity of the monitoring station). In the event the exceedance is caused by equipment malfunction, the equipment must be immediately re-set, repaired, or replaced as appropriate. If the exceedence is caused from off-site sources, NJDEP Enforcement should be notified, at 1-877-WARN DEP. Note that exceedences are for the action level added to background; however, high or unexpected background levels may cause equipment to alarm. If the same type of short-term exceedances occur repeatedly, corrective actions must be taken (i.e. posting "no parking" signs, adjusting the location of monitoring stations, changing work practices, relocating equipment, etc.) For record keeping purposes, the action level exceedance and an explanation of any action taken must be recorded in the final report to NJDEP.

Typical reasons for exceedances of the action levels not related to remediation activities include, but are not limited to the following:

1. Vehicle or equipment start-up or idling adjacent to a monitoring station;

2. Off-site sources causing the release of VOC contaminants or particulates, (NJDEP Enforcement should be notified, at 1-877-WARN DEP); or

3. Equipment malfunction.

IX. PAM APPROVAL AND SUBMITTAL

A. Workplan

A PAM workplan must be submitted to the designated representative of the Department for review and approval prior to the initiation of remedial activities. The following items must be included.

1. Name of site
2. Organization of personnel
3. Site map showing:
   a. Proposed number and location of monitors
   b. Distance to and location of receptors
4. Duration of remediation and sampling
5. Contaminants and meteorological parameters to be monitored
6. Frequency of monitoring
7. Monitoring procedures (as discussed in V. MONITORING)
8. Samplers and equipment selected and detection limits for that equipment
9. Name of NJ certified laboratory, if applicable
10. RfC and URF used to develop action levels
11. Proposed action levels (including calculations)
12. Proposed corrective actions

PAM **progress reports** may be required by the Department. Typically this would be for projects of extended length or complexity.

B. Final Report

A PAM report must be provided following completion of the remedial activities. The report must contain:

1. Contaminants monitored
2. Action levels and their basis,
3. All exceedances/alarms with appropriate explanation of how they were resolved
4. Daily data evaluation, including downwind stations, and overall results summaries. Problems should also be noted.
5. A site map showing actual monitoring locations and receptors
6. All data deliverables, including data logging files from the meteorological and monitoring stations, and daily wind roses.