GUIDELINES FOR ESTABLISHING REMEDIATION GOALS AT RCRA HAZARDOUS WASTE SITES

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North Carolina Department of Environmental Quality
Division of Waste Management
Hazardous Waste Section

NOTE: This document replaced the clean-up guidance
"Guidelines for Establishing Remediation Goals at RCRA Hazardous Waste Sites"
Revised December 11, 2013

CONTENTS

FIGURES, TABLES and APPENDICES

LIST OF ACRONYMS

ACL(s) – Alternate concentration level(s)
COPC(s) – Contaminant(s) of Potential Concern
DHHS – Department of Health and Human Services (North Carolina)
DQO(s) – Data quality objective(s)
DWM – Division of Waste Management
DWR – Division of Water Resources
EPA – Environmental Protection Agency, United States
ERA – Ecological risk assessment
HH&E – Human health and environment
HWS – Hazardous Waste Section
IMAC – Interim maximum allowable concentration
LOD – Limit of detection
LUR(s) – Land use restriction(s)
MDL – Method detection limit
MCLG – Maximum contaminant level goal
NC – North Carolina
NFA – No further action
OEEB – Occupational and Environmental Epidemiology Branch
OSWER - Office of Solid Waste and Emergency Response
PQL – Practical Quantitation Limit
PSRG(s) – Preliminary soil remediation goal(s)
Region 9 – US EPA Region IX
RCRA – Resource Conservation and Recovery Act
RSL – Regional Screening Levels
SCM – Site conceptual model
SLERA – Screening level ecological risk assessment
SLPOG – Screening level protective of groundwater
SPLP – Synthetic Precipitation Leaching Procedure
SQL – Sample quantitation level
SSL(s) – Soil screening level(s)
SWQ – Surface Water Quality
TCLP – Toxicity Characteristic Leaching Procedure
UST – Underground Storage Tank program
UTS – Universal Treatment Standards
USEPA – United States Environmental Protection Agency
2B–Classifications and Water Quality Standards Applicable to Surface Waters & Wetlands of NC
2L– Classifications and Water Quality Standards Applicable to the Groundwaters of NC

GUIDELINES FOR ESTABLISHING REMEDIATION GOALS AT RESOURCE CONSERVATION AND RECOVER ACT (RCRA) HAZARDOUS WASTE SITES

1.0 POLICY

If hazardous constituents are released into any environmental media, it is the policy of the Hazardous Waste Section (HWS) that the environmental media be restored to levels protective of human health and the environment.

2.0 PURPOSE & APPLICABILITY

The purpose of this document is to provide guidance and promote the consistent implementation of clean-up policies. These policies apply to locations under the jurisdiction of the HWS where releases of hazardous waste or hazardous waste constituents have contaminated environmental media. This document supersedes *Guidelines for Establishing Remediation Goals at RCRA Hazardous Waste Sites,* dated December 11, 2013, and all previous versions.

3.0 INTRODUCTION

Determining the risk to human health and the environment at contaminated sites involves the identification and characterization of site contaminants, migration pathways, exposure pathways and human and ecological receptors. Risk assessment can be approached in a multi-step process that starts out making conservative assumptions and then progresses to more site-specific assumptions. The first step is a preliminary screening assessment where site contaminants are compared to conservative, readily available risk-based concentrations derived from standardized equations that combine exposure information assumptions with toxicity data. Generally, when contaminant concentrations fall below appropriate preliminary screening values, no further action is necessary provided the exposure pathways at the site are fully accounted for in the screening value derivation. When contaminant concentrations exceed preliminary screening values, these values may be used as the remediation goal or site-specific screening values may be developed. Approved site-specific screening values may be used as the remediation goal or a site-specific risk assessment may be performed to determine appropriate remedial actions. This guidance document provides guidelines and preliminary screening values for evaluating contaminated environmental media once adequate site assessment has been performed.

3.1 Site Assessment

The nature and extent of contamination must be determined before human health and ecological risk can be adequately assessed. Site assessment activities generally include identification of the following: source(s) of contamination, characterization of the nature and extent of the contamination, evaluation of the environmental fate and transport properties of the contaminants, determination of the potential pathways of contaminant migration, and identification of potential human and environmental receptors.

Additional information on site assessment sampling is included in the HWS Generator Closure Guidelines available at the following weblink. http://deq.nc.gov/about/divisions/waste-management/waste-management-permit-guidance/hazardous-waste-section-technical-assistance-education-guidance In the Generator Closure Guidelines, Incremental Sampling Methodology (ISM) is included as an alternative to discrete sampling.

Incremental Sampling Methodology is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sample representativeness for a specified volume of soil under investigation. The online ISM guidance document is available on the Interstate Technology and Regulatory Council website at: http://www.itrcweb.org/Guidance

The HWS promotes the use of a site conceptual model (SCM) as a planning tool during the environmental site investigation. Establishing a SCM that represents links between contaminant sources, release mechanisms, exposure pathways and receptors based on historical information helps determine the applicability of the screening values and the need for additional information. Additional information on the development and use of the SCM is available in the Soil Screening Guidance: Users Guide (EPA, 1996) at: https://www.epa.gov/superfund/superfund-soil-screening-guidance
and the *Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration* (EPA, 1993) at https://www.epa.gov/nscep .

3.2 Data Collection and Evaluation

Analytical data must be of sufficient type, quantity and quality to assess risks to human health and ecological receptors from site contaminants. Guidance on designing a sampling and analysis plan and the data quality objectives process can be found at: https://www.epa.gov/quality/data-quality-objectives-process-hazardous-waste-site-investigations-epa-qag-4hw-january-2000 Method detection limits (MDLs) are also important pieces of data that must be evaluated before the sampling and analysis plan is completed. This is done to ensure that MDLs are below
levels of concern to human health and the environment. The ability to evaluate low-level data is critical when the MDL exceeds a health-based standard for a particular contaminant. EPA Region III *Guidance on Handling Chemical Concentration Data Near the Detection Limit in Risk Assessments* can be found at https://www.epa.gov/risk/epa-region-3-guidance-handling-chemical-concentration-data-near-detection-limit-risk . Method detection limits and practical quantitation limits must be defined and provided with the
data submitted to the HWS. See **Appendix 1** for HWS guidance on the minimum data reporting requirements.

3.3 Background Levels

When site contaminants are present above the risk-based screening values, a facility may conduct a background investigation to establish site-specific background levels for these contaminants. The number and kinds of samples collected to establish background should be appropriate for the site, the environmental media and the form of statistical test to be used. For a general overview of background sampling needs, refer to Section 4.4 of the *USEPA Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)* (December 1989) located at https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part. The EPA guidance for characterizing background
chemicals in soil Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites is available for download at:
https://www.epa.gov/nscep. For general RCRA groundwater background requirements, refer to 40 CFR 264.97 (g) and (h) as adopted in 15A NCAC .0109.

4.0 PRELIMINARY SITE SCREENING

The role of the preliminary site screening is to identify areas, contaminants, and conditions at the site that do not require further attention. It also identifies contaminants of potential concern (COPCs) that are most likely to contribute to an unacceptable risk to human and/or ecological receptors. The screening process presented in this document evaluates major pathways common at most contaminated sites (See Figure 2 on page 21). Due to the wide range of conditions

encountered at RCRA sites, the screening values provided may not address every conceivable exposure pathway. Evaluate each site to determine if the preliminary screening process and screening values in this document are adequate to ensure protection of human health and the environment. Screening values may need to be adjusted or a site-specific risk assessment may need to be performed if certain conditions exist. Site-specific screening values and risk assessments should evaluate all possible exposure pathways at a given site. Figures 2 and 3 on pages 22 and 23 illustrate potential exposure pathways, contaminated media and receptors that may need to be addressed. Conditions that may necessitate further evaluation at a site include but are not limited to the following:

- Multiple contaminants are present at the site and/or multiple routes of exposure are possible. Most screening values were developed for single contaminant exposure scenarios and are not appropriate to evaluate the compounded or synergistic effects of multiple contaminants. When multiple contaminants or routes of exposure exist, the effects of additivity must be considered. The total carcinogenic risk should be in the range of 10^{-4} to 10^{-6}. For non-carcinogens affecting the same target organ, the hazard index should not exceed one.
- Presence of oily soil and/or free phase hydrocarbon in groundwater.
- Potential for land uses other than those covered by the screening values.
- Other likely human exposure pathways exist at the site, that were not considered in development of the screening level (e.g., local fish consumption, human or livestock feed crops).
- Unusual site conditions exist (e.g., large areas of contamination, high fugitive dust levels, potential for indoor air contamination).

4.1 Screening Process Overview

The primary focus of these guidelines is soil and groundwater contamination. Guidance is also provided to evaluate and screen ecological risks and other contaminated media such as surface water, sediment and indoor air. The highest constituent concentration for each medium (soil, groundwater, surface water, sediment, etc.) within each area of concern is to be used for initial screening purposes. Constituent concentrations for each medium are compared to the appropriate HWS preliminary screening value or other applicable screening values (e.g., surface water, sediment, and indoor air). COPCs identified during the preliminary screening process are then carried through a more site-specific screening process or a risk assessment to determine appropriate remedial actions. See Figure 4 on page 23 for an overview of the HWS preliminary screening process.

4.2 Screening Values

The HWS preliminary screening values presented in these guidelines are the North Carolina groundwater standards (Classifications and Groundwater Standards Applicable to Groundwaters of North Carolina – 15A NCAC 2L .0202), health-based residential and industrial preliminary soil remediation goals (PSRGs) and soil screening levels (SSLs) protective of groundwater. The screening values are shown in the Preliminary Soil Remediation Goals (PSRG) Table at: http://deq.nc.gov/about/divisions/waste-management/waste-management-permit-guidance/inactive-hazardous-sites-guidance-documents
These remediation goals have been established using current U.S. EPA risk assessment guidance and are based on a lifetime excess cancer risk of 1 x 10-6 (carcinogens) and a hazard quotient of 0.2 (non-carcinogens). The hazard quotient of 0.2 is used to account for multiple (average of five) non-carcinogens in the same critical effect group. The branch will adjust these remediation goals at sites with less than five non-carcinogens in the same critical effect group. Where available, site-specific naturally occurring background levels may also be used in the screening process. If a screening value is not available for a constituent in a particular environmental media, a site-

specific screening value should be developed using current EPA and HWS guidance and available resources. Submit the proposed site-specific screening value(s) to the HWS for review.

4.3 Site-specific Risk Assessment Guidance

If a site-specific risk assessment is warranted, the HWS recommends using EPA risk assessment guidance to evaluate potential human health and ecological risk. EPA Superfund guidance for human health risk assessments and ecological risk assessments is at: https://www.epa.gov/risk/superfund-risk-assessment. For additional EPA risk assessment guidance and information, see the EPA National Center for Environmental Assessment Web page at http://www.epa.gov/ncea

5.0 SOIL AND GROUNDWATER SCREENING PROCESS

The HWS's goal is that RCRA facilities remediate all releases of hazardous waste or hazardous constituents to unrestricted use levels. For groundwater, the unrestricted use level is the North Carolina Division of Water Quality, 15A NCAC 2L groundwater standard (2L) or site-specific background concentration. For soil, the unrestricted use level is either the site-specific background concentration or the lowest of a soil screening level protective of groundwater and the health-based residential PSRG. Unrestricted use levels are the starting points for the HWS preliminary screening process. The HWS does recognize that, in some cases, it may be infeasible to remediate to unrestricted use levels.

5.1 Soil

5.1.1 Unrestricted Use Levels for Soil

Since no regulatory standards exist for contaminated soil, the HWS uses a risk-based approach to establish unrestricted use levels. This risk-based approach involves establishing unrestricted use levels that are protective of both human health and the environment. Two potential soil pathways are 1) direct contact to soil by residents, and 2) the leaching of a chemical from soil to groundwater. For unrestricted use, at a minimum, both of these standards must be met. If other exposure pathways exist or the exposure conditions at a site are greater in magnitude than the default values used to calculate the screening levels provided, additional steps are required. They must be addressed by developing site-specific screening levels or performing a site-specific risk assessment. For common exposure pathways for soil, see Figure 2 on page 21. For potential receptors, see Figure 3 on page 22.

5.1.1.1 Unrestricted Use Levels Protective of Human Health

The HWS uses EPA Regional Screening Levels as a source of risk-based soil concentrations protective of human contact with soil through the *inhalation, dermal, and ingestion* pathways. EPA Regional Screening Levels address most common human health exposure pathways but do not consider all potential pathways or ecological concerns. See Figure 2 on page 21 for the exposure pathways considered in the calculation of the EPA Regional Screening Levels. The PSRGs were derived using equations and defaults from EPA guidance. They correspond to a fixed level of risk (i.e., either a one-in-a-million cancer risk or a non-carcinogenic hazard quotient of 0.2, whichever occurs at a lower concentration in soil, air, and water). In some cases, a PSRG is not risk-based but based on the soil saturation equation as indicated by a "Csat" in the PSRG table. In other cases, a non-risk-based "ceiling limit" concentration of 10^5 mg/kg

is used as indicated by a "max" in the PSRG table. The EPA Mid-Atlantic Risk Assessment User's Guide provides the equations and assumptions used to calculate PSRGs. For more information on how PSRGs are established, visit the EPA Region 9 Web site at http://www.epa.gov/region9/superfund/prg/index.html

5.1.1.2 Unrestricted Use Levels Protective of Groundwater (also referred to as Soil Screening Levels)

The methodology for calculating unrestricted use levels or soil screening levels (SSLs) for contaminant migration to groundwater was developed to identify chemical concentrations in soil with the potential to migrate and contaminate groundwater. SSLs protective of groundwater are back calculated from acceptable groundwater concentrations and take into consideration fate and transport parameters. The HWS has calculated and compiled a number of conservative SSLs for constituents using the current NC 2L groundwater standard or the 2L groundwater interim maximum allowable concentration (IMAC) as the target groundwater concentration. For the most up to date values please consult the NC DWQ website. The HWS SSLs were calculated using the equations and default parameters found in Figure 1 on page 19. The HWS SSLs are provided in. Remediating parties may use the HWS SSLs as the soil clean-up goal to protect groundwater or they may calculate site-specific SSLs using the approaches outlined below. Submit proposed site-specific soil screening levels to the HWS for review.

1. You may use the Preliminary Soil Remediation Goals in the Soil Remediation Goals Table located at: http://deq.nc.gov/about/divisions/waste-management/waste-management-permit-guidance/inactive-hazardous-sites-guidance-documents as the soil screening level protective of groundwater.
2. You may calculate a site-specific soil screening level with the equations in Figure 1 on page 19 and site-specific parameter values. In equation 1, the NC 2L groundwater standard, the NC 2L interim maximum allowable concentration, or an approved alternate concentration level (ACL) is the applicable groundwater target concentration (C_{gw}). NC 2L standards and IMACs can be found at:
   http://deq.nc.gov/about/divisions/water-resources/planning/classification-standards/groundwater-standards
   An alternate contaminant transport model that predicts soil concentrations protective of groundwater may be used in lieu of the transport model used in this document. If an alternate model is used, it must be approved by the HWS.
3. You may plot paired results for total soil contaminant concentration versus Toxicity Characteristic Leaching Procedure (TCLP) or the Synthetic Precipitation Leaching Procedure (SPLP) results for each sampling location for semi-volatile and inorganic constituents. These total constituent and leachability sampling results are graphed in a linear regression and compared to either the NC 2L standard, an IMAC or an approved ACL to extrapolate a leachability threshold concentration. The leachability threshold concentration may be used as a site specific soil screening level protective of groundwater. The Florida Department of Environmental Protection (FDEP) *Guidance for Determining Leachability by Analysis of SPLP Results* includes an example determining a site specific leachability threshold concentration for Lead in soil. The guidance can be found at:
   http://www.dep.state.fl.us/waste/quick_topics/publications/wc/GuidanceforDeterminingLeachabilitybySPLPAnalysisDraftVersion1-8.pdf

If another laboratory model is used, the remediating party must demonstrate its scientific validity and that its precision and accuracy are commensurate with its stated use. *TCLP/SPLP analyses are not appropriate for assessment purposes.*

5.1.2 Restricted Use Levels for Soil

Restricted use levels for soil are direct contact levels based on non-residential exposure scenarios (e.g., industrial use only with no child occupied facilities), or on restricting some specific site activity (e.g., no excavation below two feet depth allowed). Land use restrictions (LUR) are necessary when unrestricted use levels cannot be met, or clean-up levels for soil are based on exposures other than those considered in unrestricted use levels. LURs are legal mechanisms used to prevent unacceptable exposure to residual contamination. They may include the use of engineering controls. The HWS determines appropriate restricted use levels for sites on a case-by-case basis.

5.1.3 Preliminary Soil Screening Process

For preliminary screening, compare the maximum concentration of the constituent in soil to:

- Site-specific naturally occurring background, if available,
- Residential health-based PSRG Screening Levels protective of human health,
- HWS SSL or site-specific SSL (migration to groundwater pathway) Screenig Levels protective of groundwater (SLPOG), and
- Any other applicable screening level (e.g., soil-to-groundwater-to-surface water or soil-to-indoor air).

It may be helpful to prepare a table similar to Example Table 5-1 to aid in the screening process. If the maximum soil concentration is equal to or less than all of the appropriate and applicable screening values, that constituent can be dropped from further evaluation. If a screening value is exceeded, or isn't available for one or more constituents, site-specific screening levels may be developed. Submit site-specific screening level determinations to the HWS for review and concurrence.

Example Table 5-1 Selection of COPCs in Soil

Constituent	Maximum Concentration	MDL/ PQL	Site-specific Background	EPA Residential Health-Based PSRG	Soil Level Protective of Ground-water	*Other applicable screening levels	COPC (Y/N) basis
DDT	1.2	0.01 PQL	Not applicable	1.7	0.34	None	Y Max conc. > SLPOG

Concentrations in ppm
***For example, soil contaminant migration to indoor air.**

5.2 Groundwater

5.2.1 Unrestricted Use Levels for Groundwater

The unrestricted use level for groundwater is site-specific background or the NC DWR 2L groundwater standard or 2L interim maximum allowable concentration. The NC 2L Groundwater

standards and IMACs are listed in Appendix 3. They can also be found on the DWR Classification and Standards Unit's Web site at: http://deq.nc.gov/about/divisions/water-resources/planning/classification-standards/groundwater-standards

5.2.2 Restricted Use Levels for Groundwater

The NC 2L groundwater standards set the groundwater remediation goals. However, the HWS recognizes that, once groundwater is contaminated, it may be infeasible to remediate to the standard. A facility may apply to the HWS for a RCRA alternate concentration level per 40 CFR 264.94 (b) as adopted by 15A NCAC 13A .0109. However, the approval of an ACL by the HWS does not exempt the facility from complying with the NC 2L groundwater standard. Contact the NC Division of Water Resources at (919) 807-6300 for information on the groundwater quality rules and regulations.

Land Use Restrictions are necessary when unrestricted use levels cannot be met for groundwater. LURs may include the use of engineering controls to prevent public exposure and additional environmental damage. Monitoring may also be required to confirm that receptors are being protected. Appropriate restricted use levels for a site will be determined by the HWS on a case-by-case basis.

5.2.3 Preliminary Groundwater Screening Process

For preliminary screening, compare the maximum concentration of the constituent in groundwater to:

- Site-specific naturally occurring background, if available,
- The NC 2L groundwater standard or IMAC[1],
- The MDL/PQL as appropriate[2], and
- Other applicable and appropriate screening levels (such as groundwater-to-indoor air, groundwater-to-surface water).

Preparing a table similar to Example Table 5-2 below may aid in the screening process. If the maximum groundwater concentration is equal to or less than all of the appropriate and applicable screening values, that constituent can be dropped from further evaluation. If a screening value is exceeded or isn't available for one or more constituents, site specific screening levels may be developed. Submit site-specific screening level determinations to the HWS for review and concurrence.

[1] T15A 02L .0202 (c) states that "…substances which are not naturally occurring and for which no standard is specified shall not be permitted by in concentrations at or above the practical quantitation limit in Class GA or Class GSA groundwaters. Any person may petition the Director to establish an interim maximum allowable concentration for a substance for which a standard has not been established under this Rule. The petitioner shall submit relevant toxicological and epidemiological data, study results, and calculations necessary to establish a standard in accordance with Paragraph (d) of this Rule." Contact the DWR Classification and Standards Unit at (919) 807-6300-for procedural information regarding requests for IMACs.

[2] T15A 02L .0202 (b)(1) states that "Where the standard for a substance is less than the practical quantitation limit, the detection of that substance at or above the practical quantitation limit constitutes a violation of the standard."

Example Table 5-2 Selection of COPCs in Groundwater

Constituent	Maximum Concentration	MDL/ PQL	Site-Specific Back-ground	NC 2L Ground-water Standard or IMAC	*EPA Regional Tap Water PRG	^Other applicable Screening levels	COPC (Y/N) basis
Benzene	5.0	1.0 PQL	Not Applicable	1.0	0.39	14 indoor air	Y Max Conc. > 2L

Concentrations in ppb

***To assess risk to human health from consumption of contaminated groundwater, EPA Regional risk-based tap water PRGs may be used to screen and evaluate contaminated groundwater when a 2L standard is not available. http://www.epa.gov/region9/superfund//prg/index.html**

^For example, groundwater contaminant migration to indoor air or to surface water.

6.0 ECOLOGICAL SCREENING PROCESS

The role of an ecological risk assessment (ERA) is to estimate the likelihood that adverse ecological effects (e.g., mortality, reproductive failure) will occur as a result of a release of a hazardous constituent. While an ERA should be conducted at all sites, the scope of the assessment will depend upon a number of site-specific factors. The physical characteristics of the site, the toxicity and fate of the contaminants, the proximity to ecological receptors and likelihood of exposure, and the ecosystem types potentially at risk should be considered when planning the ERA. Perform an initial screening-level ecological risk assessment to evaluate the available data, identify data gaps and screen contaminants of potential concern (COPCs) to determine if a more detailed ERA is warranted.

6.1 Preliminary Ecological Screening Process

For preliminary screening, the HWS advocates the use of either the EPA Region 4 ecological screening process and screening values found in the *Region 4 Ecological Risk Assessment Supplemental Guidance* or the N.C. DWM's *Guidelines for Performing Screening Level Ecological Risk Assessments Within the North Carolina Division of Waste Management*. Ecological screening values are contaminant levels with a low probability of unacceptable risks to ecological receptors. They are based on conservative endpoints and sensitive ecological effects data. They can be used as a preliminary screening of site contaminant levels to determine if there is a need to conduct further site investigation. When values exceed ecological screening values further evaluation may be needed to determine the site's potential ecological risk. The frequency, magnitude and pattern of any exceedances (acute or chronic) should be weighed to determine if further evaluation is necessary. EPA and DWM Guidance for the screening level ecological risk assessment can be found in the following locations.

- *USEPA Region 4's Ecological Risk Assessment Supplemental Guidance*. Provides regional direction for implementation of EPA's ERA Guidance for Superfund and contains a limited number of surface water (fresh and salt water), sediment and soil ecological screening values. https://www.epa.gov/risk/region-4-ecological-risk-assessment-supplemental-guidance

- *Guidelines for Performing Screening Level Ecological Risk Assessments Within the North Carolina Division of Waste Management*. October 2003. Provides guidelines for conducting a screening level ecological risk assessment (SLERA) for sites under the authority of the N.C. DWM. https://ncdenr.s3.amazonaws.com/s3fs-public/document-library/SLERA.pdf

- *Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs)* November 2005. Provides a set of risk-based soil screening levels for many soil contaminants that are frequently of ecological concern for terrestrial plants and animals at hazardous waste sites. It also describes the process used to derive these levels and guidance for their use.https://www.epa.gov/risk/ecological-soil-screening-level-eco-ssl-guidance-and-documents.
- *The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments.* June 2001 [ECO Update, Intermittent Bulletin]. Outlines the components of a screening-level assessment and a Baseline ERA. https://www.epa.gov/risk/risk-assessment-guidelines.

Here are other sources of ecological benchmarks.

- USEPA ECOTOX Thresholds. Media specific benchmark values for surface water, sediment and soil to determine if additional work for ecological protection is required. Calculate ECOTOX values for site-specific conditions (water hardness, pH, etc.) http://www.epa.gov/ecotox/ .
- *National Oceanic and Atmospheric Administration (NOAA). 1999. Screening Quick Reference Tables.* http://response.restoration.noaa.gov/sites/default/files/SQuiRTs.pdf

- Suter and Tsao. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biotas: 1996. http://www.esd.ornl.gov/programs/ecorisk/documents/tm96r2.pdf .

6.2 Detailed Ecological Risk Assessment Guidance

A more in-depth ecological risk assessment may be necessary if contaminants of potential concern are identified in the SLERA or other site-specific factors indicate the potential of adverse impacts to ecological receptors from exposure to site related contaminants. In these cases, use the following USEPA guidance to evaluate ecological risk.

- USEPA Ecological *Risk Assessment for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* Interim Final. Office of Solid Waste and Emergency Response, EPA 540-R-97-006. June 1997.

  EPA's 1989 Risk Assessment Guidance for Superfund, Volume 2, Environmental Evaluation Manual. http://rais.ornl.gov/documents/RASUPEV.pdf .
- USEPA *Guidelines for Ecological Risk Assessment.* (EPA/630/R-95/002F) at https://www.epa.gov/risk/risk-assessment-guidelines.
- Additional ecological risk assessment tools and guidelines can be found at https://www.epa.gov/risk/superfund-risk-assessment.

7.0 OTHER SCREENING CONSIDERATIONS

This guidance document primarily addresses contaminated soil and groundwater. However, a release of hazardous waste may contaminate other environmental media. Impacts to any environmental media must be investigated and evaluated to determine the risk posed to human health and the environment.

7.1 Indoor Air

Concerns have been raised about the potential for sub-surface contamination in either soil or groundwater to adversely impact indoor air quality. For example, exposures may occur as the result of subsurface soil gas entering indoors (e.g., basements, crawl spaces, elevator shafts). At

sites where volatile or semi-volatile contaminants are present in the soil or groundwater, an evaluation of the current or potential impact to indoor air and the likelihood of exposure is generally required. To aid in the evaluation of this pathway, EPA has developed a draft *Vapor Intrusion Guidance* document that includes a screening strategy and screening levels for soil gas, groundwater and indoor air concentrations. The guidance is located at: https://www.epa.gov/vaporintrusion. A series of models for estimating indoor air concentrations and associated health risks from subsurface vapor intrusion into buildings have also been developed. These models, based on the analytical solutions of Johnson and Ettinger (1991, with updated EPA OSWER values Nov 2002) for contaminant partitioning and subsurface vapor transport into buildings, can be found at: http://www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm.

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7.2 Surface Water

At sites where there is current or potential movement of contaminants to surface water, use the 15A NCAC 2B Classifications and Water Quality Standards Applicable to Surface Waters of NC for protection of human health and/or aquatic life to screen measured or modeled contaminant concentrations. Classifications and Water Quality Standards can be found on the Internet at: http://deq.nc.gov/about/divisions/water-resources/planning/classification-standards/surface-water-standards

(Water Quality Rules Subchapter 2B, Section .0200). Contact the Division of Water Resources at (919) 807-6300 for information on surface water classifications and standards. Be prepared to send a site map of the property to determine the proper stream classification and standard. The site map may be submitted by fax to the DWR at 919-807-6492.

Surface water quality standards are established to protect human health and aquatic life based on the classification of use of the surface water. If it is determined, through monitoring or modeling, that surface water is impacted or may be impacted, the remediation goal is the NC 2B Surface Water Quality standard (SWQ). Where there is not a SWQ standard, a provisional standard provided by the NC Division of Water Resources may be used.

Example Table 7-1 Selection of COPCs in Surface Water

Constituent	Maximum Concentration	MDL/ PQL	Upstream Back-ground	NC DWQ 2B Surface Water Classification	NC DWQ 2B Water Quality Standard	Other Applicable screening levels	COPC (Y/N) basis
Selenium	Not detected	1 PQL	Not determined	C	5	None	N PQL < WQS

Concentrations in ppb.

7.3 Sediment

Sediment can be impacted by site constituents through surface runoff and/or groundwater influx. To protect *human health*, use EPA Regional Screening Level residential soil PRGs to screen the maximum detected concentrations in sediment. Since most sediment is covered by water for all or most of the year, this approach will be overly conservative as far as human health risk. If sediment becomes a risk driver under this scenario, a more site-specific exposure evaluation should be undertaken. For protection of *ecological receptors*, sediments should be initially screened using EPA Region 4 sediment screening values. Region 4 sediment screening values can be found at: https://www.epa.gov/risk/region-4-ecological-risk-assessment-supplemental-guidance

. If a Region 4 sediment screening level is not available for a COPC, then one may be proposed for the site.

Example Table 7-2 Selection of COPCs in Sediment

Constituent	Maximum Concentration	MDL/ PQL	Back-ground	EPA Regional Screening Levels residential soil	EPA Sediment Screening value	Other Applicable screening values	COPC (y/n) basis
Mercury	0.10	0.02 PQL	NA	23	0.13 EPA	None	N 0.10 < 23 and 0.13

Concentrations in ppm.
NA = not available.

7.4 Indirect Risk

An indirect risk assessment may be necessary to estimate exposures and health risks that can result from the transfer of contaminants to plants and/or animals consumed by humans. An indirect risk assessment may be necessary if either of the following conditions exist. The site characterization indicates the presence of contaminants that are persistent and have the potential to bioaccumulate, and contaminant fate and transport assessment indicates one or more of the following situations exist at the site:

- A contaminant release to groundwater that is used or could be used for irrigation or watering livestock.
- A contaminant release to surface water which supports a commercial or sport fish population.
- A contaminant release to the atmosphere through volatilization and/or fugitive dust/contaminated particles that could potentially reach agricultural, hunting or fishing areas.

8.0 CONTACTS

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9.0 GLOSSARY

1. **Alternate Concentration Level** (ACL) – A groundwater concentration for a hazardous constituent, established under 40 CFR Part 264.94, that will not pose a substantial present or potential hazard to human health or the environment.

2. **Background** – The concentrations of chemicals that are consistently present in the environment at and in the vicinity of the site because they are naturally occurring (attributable to natural conditions) or anthropogenic (due to man-made, non-site sources). Background samples should be taken from a geologically similar area having similar biological, physical and chemical characteristics as the contaminated site. Background samples are not influenced by site activities or releases.

3. **Contaminant of Potential Concern (COPC) –** Contaminants identified at a site based on their potential to pose an increased risk or hazard via one or more direct or indirect exposure pathways.

4. **Data Quality Objectives (DQOs)-** In data collection activities, DQOs are qualitative and quantitative statements that clarify study objectives, define the appropriate type of data and specify tolerable levels of decision error.

5. **IMAC** – The interim maximum allowable concentration determined per 15A NCAC 2L .0200, if no groundwater quality standard is available for a contaminant.

6. **2L Standards** (2L) – These are water quality standards for the protection of the groundwater of NC as specified in 15A NCAC 2L .0200, Classifications and Water Quality Standards Applicable to the Groundwaters of North Carolina. They are maximum allowable concentrations resulting from any discharge of contaminants to the land or waters of the state, which may be tolerated without creating a threat to human health or which would otherwise render the groundwater unsuitable for its intended best usage.

7. **2L Variance** – 15A NCAC 2L .0113 outlines the requirements and procedures for requesting a variance (or exception) from the 2L groundwater standards.

8. **Land Use Restriction** (LUR)– A type of institutional control, which restricts the use or disturbance of the soil, surface water or underground water at property and/or restricts activities at a property.

9. **Limit of Quantitation (LOQ)** – Level above which quantitative results may be obtained with a specified degree of confidence. The LOQ is mathematically defined as equal to 10 times the standard deviation of the results for a series of replicates used to determine a justifiable limit of detection or detection limit. LOQs are matrix, method and analyte specific.

10. **Method Detection Limit (MDL) -** The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. It is determined from the analysis of a sample in a given matrix type that contains the analyte (per 40 CFR 136 Appendix B).

11. **Practical Quantitation Limit (PQL) -** The lowest concentration at which analytical measurements can be "trusted". The quantitation limit is the lowest concentration of a given analyte in soil, water or other matrix, at which measurements can be reliably achieved within

specified limits of precision and accuracy by a given analytical method during routine laboratory analysis. To determine a PQL, a method detection limit must be determined per 40 CFR 136 Appendix B or the SW-846 methodology. The MDL and a multiplier (usually two to five times the MDL) are then used to establish the PQL.

12. **Synthetic Precipitation Leaching Procedure (SPLP)** – SW-846 Method 1312 as designed to determine the mobility of both organic and inorganic analytes present in liquids, soil and wastes.

13. **Toxicity Characteristic Leaching Procedure (TCLP)** - SW-846 Method 1311 as designed to determine the mobility of both organic and inorganic analytes present in liquids, solids and multiphase wastes.

14. **Unrestricted Use Level** – The maximum concentration of a chemical or chemicals that may be present in environmental media and not cause an adverse impact on human health or the environment. Cleanup or remediation to unrestricted use levels means that the property is restored to a condition such that the property and any use made of it does not pose a danger or risk to public health, the environment, or users of the property that is greater than was posed by the use of the property before its contamination.

10.0 REFERENCES USEFUL WEBSITES

1. DEQ Home Page http://deq.nc.gov/
2. N.C. Division of Water Resources (DWR) Home Page http://deq.nc.gov/about/divisions/water-resources
3. N.C. DWR Water Quality Programs Home Page (Rules and 2L standards) http://deq.nc.gov/about/divisions/water-resources/water-resources-rules/nc-administrative-code-statutes
4. N.C. Division of Waste Management Home Page https://deq.nc.gov/about/divisions/waste-management/
5. N.C. DWM Hazardous Waste Section Guidance Documents https://deq.nc.gov/about/divisions/waste-management/waste-management-permit-guidance/hazardous-waste-section-technical-assistance-education-guidance
6. USEPA Home Page http://www.epa.gov/
7. USEPA Region 4 Home Page http://www.epa.gov/region4/index.html
8. USEPA Region 4 Human Health Risk Assessment Supplemental Guidance https://www.epa.gov/risk/region-4-human-health-risk-assessment-supplemental-guidance
9. USEPA Region 4 Ecological Risk Assessment Supplemental Guidance https://www.epa.gov/risk/region-4-ecological-risk-assessment-supplemental-guidance
10. USEPA Region 9 Solid and Hazardous Waste http://www.epa.gov/region09/waste/
11. USEPA Regional Screening Levels https://www.epa.gov/risk/regional-screening-levels-rsls
12. USEPA RCRA Corrective Action https://www.epa.gov/hw/learn-about-corrective-action
13. USEPA National Center for Environmental Assessment (NCEA) http://cfpub2.epa.gov/ncea/

RULES & REGULATIONS

14. 15A NCAC 13A N.C. Hazardous Waste Management Rules http://reports.oah.state.nc.us/ncac.asp?folderName=\Title 15A - Environmental Quality\Chapter 13 - Solid Waste Management
15. 15A NCAC 2L Classifications and Water Quality Standards Applicable to the Groundwaters of North Carolina http://deq.nc.gov/about/divisions/water-resources/planning/classification-standards/groundwater-standards
16. 15A NCAC 2B Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina http://deq.nc.gov/about/divisions/water-resources/planning/classification-standards/surface-water-standards

GUIDANCE DOCUMENTS

17. RCRA Facility Investigation (RFI) Guidance. EPA 530/SW-89-031.
18. RCRA Groundwater Monitoring Draft Technical Guidance. EPA 530-R-93-001.
19. Subsurface Vapor Intrusion into Buildings. Johnson and Ettinger Model (1991). http://www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm
20. USEPA Soil Screening Guidance: Technical Background Document. EPA/540/R-95/128. http://www.epa.gov/superfund/resources/soil/index.htm.
21. USEPA Soil Screening Guidance: User's Guide. EPA/540/R-96/018. http://www.epa.gov/superfund/health/conmedia/soil/index.htm .
22. USEPA RCRA Corrective Action Guidance https://www.epa.gov/hw/learn-about-corrective-action23. USEPA Data Quality Objectives (DQOs) Guidancehttps://www.epa.gov/quality/data-quality-objectives-process-hazardous-waste-site-investigations-epa-qag-4hw-january-2000.
24. USEPA Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites https://www.epa.gov/nscep25. USEPA Region III Guidance on Handling Chemical Concentrations Data Near the Detection Limit in Risk Assessments. https://www.epa.gov/risk/epa-region-3-guidance-handling-chemical-concentration-data-near-detection-limit-risk.
26. USEPA Superfund Risk Assessment Guidance.https://www.epa.gov/risk/superfund-risk-assessment
27. USEPA Vapor Intrusion Guidance https://www.epa.gov/vaporintrusion

FIGURE 1

Transport Model for Calculation of Soil Screening Levels

Equation 1 - General Formula for Soil Concentrations Protective of Groundwater

$$C_{soil} = C_{gw}\left[k_s + \frac{(\theta_w + \theta_a H')}{P_b}\right] Df$$

	Parameters	Default Values	Units
C_{soil}	Calculated Source Concentration for soil	Not applicable	mg/kg - soil
C_{gw}	Applicable Groundwater Target Concentration (NC GW Std)	Chemical-specific	mg/L - water
Df	Dilution factor (see equation 2)	20 (0.5 acre source size)+*	Unitless
k_s	Soil-water partition coefficient For organic constituents $k_s = k_{oc}f_{oc}$ For inorganic constituents ks = k_d	Chemical-specific	L/kg
k_{oc}	Soil organic carbon-water partition coefficient	Chemical-specific	L/kg
f_{oc}	Fraction of organic carbon in subsurface vadose soil	0.001 (0.1%)+	Kg/kg
k_d	Soil-water partition coefficient for inorganics	Chemical-specific (pH=5.5)	L/kg
θ_w	Water-filled soil porosity-vadose soil	0.3	L_{water}/L_{soil}
θ_a	Air-filled soil porosity-vadose soil	0.13	L_{air}/L_{soil}
P_b	Dry bulk density	1.5	Kg/L
H'	Henry's Law constant-dimensionless Where: H' = Henry's Law constant (atm-m^3/mole) x conversion factor of 41	Chemical-specific	Unitless

Continued on next page

***FIGURE 1** continued*

Equation 2 - Derivation of Dilution Factor:

$$Df = 1 + \frac{Kid}{IL}$$

	Parameters	**Units**
Df	Dilution factor	unitless
K	Aquifer hydraulic conductivity+	m/yr
i	Hydraulic gradient+	m/m
I	Infiltration rate of water through soil +	m/yr
d	Mixing zone depth (see equation 3)+	m
L	Source length parallel to groundwater flow+	m

Equation 3 - Estimation of Mixing Zone Depth:

$$d = (0.0112L^2)^{0.5} + d_a\left[1 - e^{\left(\frac{-LI}{Kid_a}\right)}\right]$$

	Parameters	**Units**
d	Mixing zone depth	m
L	Source length parallel to groundwater flow+	m
I	Infiltration rate of water through soil+	m/yr
K	Aquifer hydraulic conductivity+	m/yr
i	Hydraulic gradient+	m/m
d_a	Aquifer thickness+	m

+Site-specific values for these parameters may be used.

*Facility Management Branch default value from Soil Screening Guidance: User's Guide (April 1996).

FIGURE 2

Potential Human Health Exposure Pathways

Medium	Residential Land Use	Industrial Land Use
Ground Water		
	Ingestion from drinking[a]	Ingestion from drinking
	Inhalation of volatiles[a]	Inhalation of volatiles
	Dermal absorption from bathing	Dermal absorption
Surface Water		
	Ingestion from drinking[a]	Ingestion from drinking
	Inhalation of volatiles[a]	Inhalation of volatiles
	Dermal absorption from bathing	Dermal absorption
	Ingestion during swimming	
	Ingestion of contaminated fish	
Soil		
	Ingestion[a]	***Ingestion***[a]
	Inhalation of particulates[a]	***Inhalation of particulates***[a]
	Inhalation of volatiles[a]	***Inhalation of volatiles***[a]
	Exposure to indoor air from soil gas	Exposure to indoor air from soil gas
	Exposure to ground water[b] contaminated by soil leachate	Exposure to ground water contaminated by soil leachate
	Ingestion via plant, meat, or dairy products	Inhalation of particulates from trucks and heavy equipment
	Dermal absorption[a]	***Dermal absorption***[a]
Ambient Air		
	Inhalation[a]	

Footnotes

[a]**Exposure pathways considered in the EPA Regional PRG calculations are indicated in boldface italics**

[b]Exposure pathway considered in the HWS SSLs protective of groundwater used as a residential drinking water source.

FIGURE 3

Contaminated Media/Receptor Evaluation Table

	RECEPTORS								
CONTAMINATED MEDIUM	Residents	Workers	Day Care	Construction	Trespassers	Recreation	Food*	Ecological	Other
Groundwater									
Air (outdoor)									
Air (indoor)									
Surface Soil (< 2 ft)									
Subsurface Soil									
Surface Water									
Sediment									
Other									

*Food chain indirect pathway (e.g., ingestion of contaminated vegetables, fruits, crops, meat and dairy products, fish and shellfish).

FIGURE 4

HWS Preliminary Site Screening Process

Step 1 Ensure Applicability of HWS Screening Values

- Ensure relevant exposure pathways at the site are accounted for in the HWS screening values. To help make this determination, refer to Section 4, Preliminary Site Screening; Figure 2, Potential Human Exposure Pathways; Figure 3, Media/Receptor Evaluation; and Section 7.0, Other Screening Considerations. For example, the indoor air pathway is not accounted for in the soil or groundwater screening values. Therefore, at sites where volatile or semi-volatile contaminants are present in the soil or groundwater, an evaluation of the current or potential impact to indoor air will also be necessary.
- Where HWS screening values are applicable to site exposure conditions, proceed to Step 2.
- Where relevant exposure pathways are not accounted for, proceed to Step 3 or Step 4.

Step 2 Perform Preliminary Screening

- Compare maximum contaminant concentrations at the site to the appropriate HWS screening values.
- For each media, identify site constituents that exceed the appropriate HWS screening values.
- If a HWS screening value is not available for a site constituent, proceed to Step 3.
- If one or more site contaminants exceed the HWS screening values, proceed to step 3 or 4 or use the HWS screening value as the remediation goal or clean-up level.
- If all relevant exposure pathways are accounted for and maximum concentrations of all site constituents are equal to or less than the appropriate HWS screening values, then no further action is necessary.

Step 3 Develop Site-Specific Screening Values

- Calculate site-specific screening values as needed using HWS and EPA guidance or other approved or relevant guidance. Submit site-specific screening values to HWS for review and concurrence.
- Screen maximum concentration of site constituents or COPCs identified in Step 2 to site-specific screening values.
- If one or more site contaminants exceed established site-specific screening values remediate, if feasible, to the site-specific screening value or proceed to Step 4.
- If all relevant exposure pathways are accounted for, and maximum concentrations of all site constituents are equal to or less than the site-specific screening values, then no further action is necessary.
- Where necessary, institute engineering controls or land use restrictions to protect human health and the environment (e.g., where restricted use levels are used as the remediation goal).

Step 4 Perform a Site-Specific Risk Assessment

- Perform a site-specific risk assessment using current EPA guidance. Submit to the HWS for review and concurrence of results.
- Upon HWS concurrence with risk assessment results, remediate to levels determined to be protective of human health and the environment or take actions necessary to control exposure.
- Where necessary, institute engineering controls or land use restrictions to protect HH&E.

APPENDIX 1

N.C. Hazardous Waste Section Analytical Reporting Requirements

A. Minimum Data Reporting Requirements

The goal of the HWS is to ensure that all decisions are based on data of known quality. To evaluate the quality of analytical data, the following information must be submitted:

1. General information

- Facility Name and EPA ID Number (if applicable);
- Laboratory contact and phone number;
- NC Laboratory certification number (if applicable);
- Date of report preparation.

2. Case Narrative

The case narrative must be written on laboratory letterhead and the release of data authorized by the laboratory manager or his/her designee. The case narrative must consist of the following information:

- Whether the holding times were met or exceeded;
- Whether the samples were received in good condition and at the required temperature/ preservation;
- Discussion of possible reasons for any quality control criteria outside acceptance limits;
- Justification for any deviation from the methods, additional sample preparation, sample dilution, and analytical problems not rectified;
- Observations regarding any occurrences that may affect sample integrity or data quality.

3. **Legible Chain-of-Custody Forms including:**

- A description of each sample (including QA/QC samples) and the number of containers (sample location and identification);
- Signature of the sampler;
- The date and time of sample collection;
- The analytical method to be performed;
- The sample type (i.e., water or soil);
- Signatures of all persons relinquishing and receiving custody of the samples, and dates and times of custody transfers.

4. **Summary of Analytical Results including:**

- Client's sample identification and the corresponding laboratory identification;
- Analytical methodology used; when applicable, cite EPA method numbers;
- Sample matrix (soil, water, waste, etc.);
- Date of sample extraction/digestion, as applicable;
- Date and time of analysis;
- Identification of the instrument type used for analysis;
- Weight or volume of sample used for analysis/extraction/digestion;
- Dilution or concentration factor for the samples;
- Percent moisture in the soil samples;
- Method detection limits and practical quantitation limits. Define the MDLs and PQLs which are reported (i.e., how they were derived).

- Estimated values where the constituent was detected at or above the MDL but below the PQL;
- Definitions of any data qualifiers used;
- Analytical results and units of measure. Report all results on a dry weight basis.

5. Summary of QA/QC Results including:

- Method/Preparation Blank Analysis. List the environmental samples and QC analysis associated with each method blank (e.g., run logs). Report the concentration of any analyte found in the method blanks;
- Field, equipment, trip or any other blank analysis results if applicable;
- Surrogate Standard Recovery. Report the name and concentration of each surrogate compound added. List the percent recoveries of all surrogates in the samples, method blanks, matrix spike/matrix spike duplicates and other QC analyses. Include the acceptable recovery criteria and indicate when criteria are not met;
- Matrix spike/matrix spike duplicate analysis. Report the name and concentration of each spiking compound. Samples are to be spiked with all specified compounds of interest. List the sample results, spiked sample results, percent recovery and the relative percent difference. Include the acceptable recovery criteria and indicate when criteria are not met.
- Matrix duplicate analysis, as applicable. Report the relative percent difference between duplicate analyses. Include the acceptable criteria and indicate when criteria are not met.
- Laboratory QC check sample or control sample analysis. Report the percent recovery for each analyte in the laboratory QC sample. List the acceptable control limits and indicate when criteria are not met.

6. Results of other QC Criteria as Applicable

For example, ICP interference check sample, post digest spike, method of standard additions, trip blanks, field blanks, equipment blanks, etc.

7. Additional Reporting Requirements for Non-certified Laboratories

- A copy of the laboratory's Quality Assurance Plan**.**
- Results from the laboratory's Precision and Accuracy study for each method run for the sampling results submitted.
- Results from the laboratory's MDL studies.
- Results from the laboratory's annual Performance Evaluation study. If the laboratory does not participate in a performance evaluation study, then the HWS may require the laboratory to analyze a performance evaluation sample to check the performance of the laboratory before accepting data.

8. Field Screening Data Requirements

Each sampling day the following must be recorded and reported. If field conditions change during field monitoring, the changes must be noted.

For Flame Ionization Detectors (and similar instruments) report:

- The temperature;
- The relative humidity;
- Calibration gas;
- Results in ppm associated with each confirmation sample collected.

For Photo Ionization Detectors (and similar instruments) report:

- The temperature;

- The relative humidity;
- Calibration gas;
- The lamp eV;
- Results in ppm associated with each confirmation sample collected.

B. Document Retention Criteria

Additional information may be required if questions about the data come up when the data is reviewed (e.g., tuning results, chromatograms, response factors, etc.). Laboratories or facilities should retain the following items in files for five years after analyses are performed. The document can be submitted with the data, but they are not required. However, they must be made available to the HWS upon request.

1. Copies of all sample gas chromatogram traces with the attached integration report; copies of the reconstructed ion chromatograms (RICs) must be provided if performing the analysis by mass spectroscopy. Chromatograms must be provided for all samples, method blanks and daily calibration standards. Chromatograms must be identified with a sample identification and the time and date of analysis.

2. Documentation with the date and time for the initial calibration and the standards used to verify instrument settings for the data reported. Include the composition and concentration range of standards used to establish and verify instrument maintenance calibration.

3. Documentation that explains laboratory quality control samples used for the data reported and results obtained. Include information concerning surrogates, standards, column performance, matrix spike and matrix spike duplicate samples, blank data and reference samples.

4. Documentation supporting laboratory reporting limits (i.e. Limit of Quantitation, Practical Quantitation Limit) and method detection limits.

C. Blank Evaluation Criteria

The purpose of laboratory or field blank analysis is to determine the existence and magnitude of contamination resulting from laboratory or field activities. The criteria used to evaluate blanks applies to any blank associated with the samples (e.g., method blanks, instrument blanks, storage blanks, trip blanks, and equipment blanks). If problems exist with any blank, evaluate all associated data to determine if the data is inherently variable or if the problem is an isolated occurrence that does not affect other data.

Action regarding positive blank results depends on the blank's circumstances and origin. For common laboratory contaminants (i.e., volatiles such as methylene chloride, acetone, and 2-butanone and semi-volatiles such as common phthalates), report positive sample results unless either of two situations exist. In one case, the compound's concentration in the sample is less than or equal to 10 times (10x) the amount in any blank for the common laboratory contaminants. The second case is where the compound's concentration sample is five times (5x) the amount for other target compounds. Case narratives should explain possible laboratory contamination sources for the affected blanks(s) (e.g., method, instrument or storage).

Where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank that has the highest contaminant concentration. Reviewer should note that blanks may not involve the same weights, volumes or dilution factors as the associated samples. These factors must be considered when applying the "5x" and "10x"

criteria to ensure that a comparison of the total amount of contamination occurs. Results must not be corrected by subtracting any blank values, unless this practice is specified as an option in the method. Results must be identified as being generated by an analytical method with a significant performance-based modification.