

Louisiana Department of Environmental Quality



Risk Evaluation/ Corrective Action Program (RECAP)

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Louisiana Department of Environmental Quality

Corrective Action Group

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Preamble

The Louisiana Department of Environmental Quality (LDEQ) has developed a Risk Evaluation/Corrective Action Program (RECAP) to address risks to human health and the environment posed by the release of chemical constituents to the environment. This is LDEQ's primary statutory mandate for remediation activities. It is clear in Louisiana's Environmental Quality Act that risk to human health and the environment must be evaluated in the remedial decision-making process.

RECAP uses risk evaluation to: (1) determine if corrective action is necessary for the protection of human health and the environment, and (2) identify constituent levels in impacted media that do not pose unacceptable risks to human health or the environment, i.e., RECAP Standards.

RECAP consists of a tiered framework composed of a Screening Option and three Management Options. This tiered approach allows site evaluation and corrective action efforts to be tailored to site conditions and risks. As the Management Option level increases, the approach becomes more site-specific and, hence, the level of effort required to meet the objectives of the Option increases. Although the level of effort required for each Option varies, each Option achieves a common goal: protection of human health and the environment.

There are numerous reasons for establishing RECAP; chief among them is the necessity to ensure that risks are properly evaluated to protect human health and the environment. Absent the establishment of such a program, the Department will expend considerably more resources to ensure that risk is evaluated properly, the regulated community will not have a clear understanding of the Department's requirements, and the general public will be uncertain as to the criteria used by the Department for remedial decisions.

In addition, LDEQ finds it necessary to establish clear and consistent guidelines across media-based program lines for the remediation of releases to air, land, and water. RECAP will ensure that remediation standards are developed consistently, that all parties are treated equally, and that risk to human health and the environment is the primary consideration when remedial decisions are made.

RECAP is consistent with the Environmental Protection Agency's (EPA) guidance on risk assessment. However, RECAP establishes policy decisions for the State of Louisiana that are left open to interpretation in EPA guidance. These policy issues include appropriate risk level, exposure concentration, groundwater use, land use, points of exposure, and points of compliance. The written establishment of the Department's position on these issues will reduce transaction costs, not only for the regulated community, but also the Department. In addition, by clearly establishing the submittal requirements for a risk evaluation, LDEQ will be able to ensure that all documents received contain the information required for remedial decision making. The RECAP regulation serves as LDEQ's policy statement on the performance of risk evaluations to determine if corrective action is warranted and the level of remediation required.

Without the RECAP regulation, risk evaluation would not be performed consistently in Louisiana.

The Louisiana Legislature mandated in La. R.S. 30:2272 (Act 1092 of the 1995 Regular Session) that LDEQ develop Minimum Remediation Standards. The RECAP regulation is the Department's response to that mandate. RECAP's tiered approach to risk evaluation and corrective action establishes not only across the board numerical standards for most media, but also allows for the development of more site-specific numerical standards when warranted.

The difficulty in identifying appropriate remedial criteria has been an additional driving force behind the development of this program. Often, regardless of the resources spent, remediating to pristine conditions has been unachievable and risk is not reduced. The time and effort expended in making these sometimes futile efforts can be better spent on projects that provide greater reduction in risk to human health and the environment. RECAP regulation will assist the Department in prioritizing sites that require remediation. As a result, LDEQ remediation staff will better focus their efforts on sites posing the greatest risk.

The RECAP regulation was initially promulgated on December 20, 1998. The regulation was revised through rulemaking in June 2000 and October 2003. This is the fourth revision of RECAP. It is expected that the RECAP regulation will be revised through rulemaking on an as-needed basis to incorporate changes in the science of risk evaluation and revisions to toxicological data. Such revisions will also allow the Department to modify the regulation based on its work experience.

Additional regulations regarding issues such as scope and applicability of the RECAP regulation may be found in LAC 33:I.Chapter 13. We also encourage the use of our RECAP web site located at www.deq.state.la.us/technology/recap/ to assist you in the interpretation and application of the regulation. Technical questions regarding the RECAP regulation should be directed to LDEQ's Office of Environmental Compliance Underground Storage Tank and Remediation Division at (225) 219-3536 or may be directed to contact persons listed on our RECAP web site via email or telephone.

All requests for copies of this document should be directed to the Regulation Development Section (RDS) of the LDEQ. The RDS may be contacted as follows:

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The document is also available on the Internet on LDEQ's home page. Thank you for your interest in LDEQ's Risk Evaluation/Corrective Action Program.

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1.0 INTRODUCTION

This document presents the LDEQ Risk Evaluation/Corrective Action Program (RECAP) for addressing present and past uncontrolled constituent releases. It does not replace or supersede the Department's enforcement or permitting authority, notification requirements, or other applicable regulations. It does not replace or supersede the Hazardous and Solid Waste Amendments (HSWA) reporting requirements pertaining to newly discovered hazardous waste, hazardous constituents, or releases from Solid Waste Management Units at sites regulated under the Resource Conservation and Recovery Act (RCRA). It does not replace or supersede the Louisiana Department of Health and Hospitals, Office of Public Health's (LDHH/OPH) enforcement authority or evaluation of environmental situations where public health may be at risk. When warranted, the LDEQ, LDHH/OPH, and/or other appropriate state or federal agencies will work together to arrive at risk management decisions that are protective of human health and the environment. When warranted for the implementation of the Voluntary Cleanup Program, a partial remedial action plan may be approved in accordance with La.R.S.30:2286. This program does not preclude emergency response or interim measures necessary to protect human health and the environment and/or to prevent significant migration of constituents. It does not authorize any injury to private or public property (refer to Section 2.3.1.1) or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations, and does not authorize the migration of COC offsite to adjacent property. It is the responsibility of the Submitter to ensure that all exposure conditions and risks to human health and the environment are addressed and that decisions concerning management of the release site are protective of human health and the environment. The RECAP is designed for the management of typical chemical release sites. Variance from the requirements set forth in this program may be required/granted if deemed necessary by the LDEQ to prevent risks to human health or the environment posed by unique site conditions. The RECAP does not address constituents present in the environment due to the intended/labeled use of a product or material if the use of the product or material is still current (e.g., constituents associated with creosote, asphalt, pesticides, herbicides, etc). The RECAP regulation is revised through rulemaking on an as-needed basis to incorporate recent advances in environmental science and to improve the overall effectiveness of the program based on past implementation experiences of the Department and regulated community. It will be necessary for releases currently being regulated under RECAP (October 20, 2003) to transition to compliance with RECAP (2014). Unless otherwise approved by the Department, an Area of Concern (AOC) currently being regulated under RECAP (October 20, 2003) may continue to comply with RECAP (October 20, 2003) until the current task/phase of the assessment has been completed and approved by the Department. Further assessment of the AOC shall be conducted in accordance with the requirements set forth in RECAP (2014) unless otherwise approved by the Department to be conducted in accordance with a prior promulgated version of RECAP.

1.1 Overview of LDEQ's Risk Evaluation/Corrective Action Program

The LDEQ RECAP consists of a tiered framework comprised of a Screening Option (SO) and Management Option 1 (MO-1), Management Option 2 (MO-2), and Management

Option 3 (MO-3). The SO may be used to expeditiously determine if an AOC warrants further evaluation under the RECAP. The tiered Management Options allow site evaluation and corrective action efforts to be tailored to site conditions and risks. As the MO level increases, the approach becomes more site-specific and hence, the level of effort required to meet the objectives of the Option increases. Although the level of effort required for each Option varies, each Option achieves a common goal: protection of human health and the environment. The goal of RECAP is to reduce risks to human health and the environment associated with constituents present at or migrating from a current or historical uncontrolled release to acceptable levels (i.e., insignificant) as defined by EPA guidance.

The Submitter may choose which Option (SO, MO-1, MO-2, or MO-3) an AOC or an AOI is managed under as long as the conditions of the AOC or the AOI meet the criteria for the Option chosen. Non-contiguous AOI at a facility may be managed under different Options. For example, MO-1 may be used to manage areas of a facility that are minimally impacted while MO-2 or MO-3 may be used to manage the more heavily impacted areas. Different media within an AOI may also be managed under different Options. For example: (1) heavily impacted soils may be managed under MO-2 or MO-3, while minimally impacted groundwater may be managed under MO-1; and (2) surface soil may be managed under MO-1, while soil impacted with a volatile COC located beneath an enclosed structure may be managed under MO-2 or MO-3. Different COC within a medium may also be managed under different Options.

An overview of the LDEQ RECAP framework is illustrated in Figure 1. The methods for the development of the SS, MO-1 RS, MO-2 RS, and MO-3 RS are presented in Appendix A. The provisions of each Option are briefly described below and discussed in detail in Sections 3.0 to 6.0.

1.1.1 Screening Option

The Screening Option provides Department-derived Screening Standards (SS) for soil and groundwater for non-industrial (residential) and industrial land use scenarios. The SS were derived using the currently recommended EPA default exposure parameters and toxicity values and represent constituent concentrations in media that are protective of human health and the environment. The comparison of preliminary site investigation data against screening standards provides for an initial evaluation for the relative environmental concern for a site or set of environmental data. At sites where constituent concentrations fall below the screening levels, generally, no further action or study is needed. At sites where constituent concentrations exceed the screening levels, further study or investigation, but not necessarily cleanup, is warranted. Therefore, exceedance of a screening standard does not automatically trigger the need for response actions or define “unacceptable” levels of constituents in the environment, it simply means that further study or investigation is needed. Comparison of the SS with environmental data may be used to: (1) demonstrate an AOC does not pose a threat to human health or the environment and, hence, does not require further action at this time; (2) expeditiously manage an AOI defined by the presence of low constituent concentrations and standard

exposure conditions; and/or (3) identify areas of a facility, media, or COC that warrant further evaluation so that the scope of the Management Option 1 (MO-1), Management Option 2 (MO-2), or Management Option 3 (MO-3) evaluation can be limited to those areas/media/constituents most likely to pose risk.

1.1.2 Management Option 1

Management Option 1 (MO-1) provides Department-derived RECAP Standards (RS) for soil and groundwater. The MO-1 RS represent constituent concentrations in media that are protective of human health and the environment. The MO-1 RS were derived for non-industrial (residential) and industrial land use scenarios using currently recommended default exposure parameters and toxicity criteria issued by the EPA. This option allows for the default RS to be selected and/or adjusted to account for specified site-specific factors. Management Option 1 may be used to: (1) document that an AOI does not pose a threat to human health or the environment and hence, does not warrant further action at this time; (2) expeditiously manage an AOI defined by the presence of low constituent concentrations and standard exposure conditions; and/or (3) identify areas of a facility, media, or COC that warrant further evaluation so that the scope of the Management Option 2 (MO-2) or Management Option 3 (MO-3) evaluation can be limited to those areas/media/constituents most likely to pose risk.

1.1.3 Management Option 2

Management Option 2 provides for the development of soil and groundwater RS using site-specific data with specified analytical models to evaluate constituent fate and transport at the AOI. The results of this site-specific evaluation shall be used in conjunction with currently recommended default exposure assumptions and toxicity criteria to identify site-specific MO-2 RS. The MO-2 RS represent constituent concentrations in media that are protective of human health and the environment under site-specific conditions. Management Option 2 may be used to: (1) document that an AOI does not pose a threat to human health or the environment under site-specific conditions and hence, does not warrant further action at this time; (2) identify areas of a facility, media, or COC that warrant further evaluation under Management Option 3 (MO-3); or (3) identify areas of a facility, media, and/or COC that warrant remediation and identify site-specific remedial standards.

1.1.4 Management Option 3

Management Option 3 provides for the development of site-specific RS for all impacted media using site-specific exposure and environmental fate and transport data. The site-specific MO-3 limiting RS represent constituent concentrations in media that are protective of human health and the environment under site-specific conditions. Management Option 3 may be used to: (1) document that an AOI does not pose a threat to human health or the environment under site-specific conditions and hence, does not warrant further action at this time; or (2) identify areas of a facility, media, or COC that warrant remediation and derive site-specific remedial standards. In general, MO-3 requires additional site evaluation, a more extensive exposure assessment, and the

application of more sophisticated fate and transport models. However, it should be noted that the complexity and scope of MO-3 are dictated by the complexity of the AOI conditions and exposure scenarios.

1.2 Use of LDEQ's Risk Evaluation/Corrective Action Program

The LDEQ RECAP may be used by a Submitter as discussed in the following sections.

1.2.1 A Submitter Seeking a No Further Action At This Time Determination for an AOC or an AOI

Under the RECAP, a NFA-ATT determination may be granted at a site where: (1) the source of the release has been removed or mitigated; (2) it has been adequately demonstrated that the site does not pose a risk to human health or the environment, (i.e., AOIC and CC present at the site are less than or equal to the limiting SS, MO-1 RS, MO-2 RS, or MO-3 RS); (3) the property remains suitable for commerce and residual constituent concentrations are appropriate for the intended future use of the land; and (4) sufficient financial assurance and/or financial commitment is provided when deemed appropriate by the Department under MO-3.

1.2.2 A Submitter Seeking a Certification of Completion Under R.S. 30:2287.1 for an AOI

The Secretary shall certify completion of remedial actions taken under a voluntary remedial action plan, which has been approved under La. R.S. 30:2286 (and regulations promulgated pursuant thereto), when the Submitter has adequately demonstrated that the site does not pose a risk to human health or the environment for the proposed development/use of the land (i.e., constituent concentrations present at the AOI are less than or equal to the limiting SS, MO-1 RS, MO-2 RS, or MO-3 RS which constitute the minimum remediation standards under R.S. 30:2272.1).

1.2.3 A Submitter Seeking Approval of a Corrective Action Plan for an AOI

Where it is warranted that risks to human health and the environment be evaluated, a site seeking approval of a corrective action plan (CAP) may use the RECAP to demonstrate that the corrective measures proposed at the AOI: (1) are adequate to protect human health and the environment (i.e., constituent concentrations reaching potential receptors and receiving media are less than or equal to the limiting SS, MO-1 RS, MO-2 RS, or MO-3 RS); and (2) will achieve acceptable constituent concentrations in a timeframe that is acceptable to the Department. Financial assurance and/or financial commitment shall be provided by the Submitter as deemed appropriate by the Department under MO-3.

1.2.4 A Submitter Seeking Approval of a Closure Plan for a Waste Management Unit for an AOI

RECAP may be used to support a closure plan for a Waste Management Unit where: (1) all applicable regulations are being addressed in the closure plan; and (2) it is warranted

that risks to human health and the environment be evaluated. When deemed appropriate by the Department, a site seeking approval of a closure plan for a Waste Management Unit may use the RECAP in conjunction with applicable regulations to demonstrate that: (1) the proposed corrective measures are adequate to prevent a constituent from reaching potential receptors and/or receiving media at concentrations that are greater than the limiting SS, MO-1 RS, MO-2 RS, or MO-3 RS; and/or (2) residual constituent concentrations at or migrating from the site are less than or equal to the limiting SS, MO-1 RS, MO-2 RS, or MO-3 RS. Financial assurance and/or financial commitment shall be provided when deemed appropriate by the Department under MO-3. Clean closure of a Waste Management Unit (as defined in *Risk-Based Clean Closure*, EPA 1998) may be accomplished if: (1) all waste, waste residues, and containment system components have been removed from the Waste Management Unit; (2) the residual constituent concentrations in environmental media are less than or equal to the applicable SS, MO-1 RS, MO-2 RS, or MO-3 RS; and (3) the residual constituent concentrations in environmental media do not pose an unacceptable risk to ecological receptors.

1.3 Document Organization

Section 2.0, General Guidelines defines the terms used within the Program and provides guidance for key components of the Program including data requirements (data quality assurance/quality control requirements, data evaluation and data usability, data format, identification of the COC), exposure assessment (identification of the AOI and source area, estimation of the AOIC and groundwater CC, land use, groundwater/aquifer use classifications, point of exposure/point of compliance for groundwater); toxicity assessment (identification of toxicity values, risk characterization, target risk levels, descriptions of the Screening Standards and RECAP Standards, use of ARARS, identification of background concentrations); corrective action (demonstration of compliance with RS, corrective action study, corrective action plan, monitored natural attenuation, institutional controls); documentation of a “no further action at this time” determination; self-implementation of RECAP; and notification requirements. These guidelines apply to the management of sites under all of the Options.

Section 3.0, Screening Option provides direction on conducting the screening process including the criteria that must be met for soil and groundwater to be managed under the SO, and guidance on the identification and application of the limiting SS.

Section 4.0, Management Option 1 provides direction on conducting an MO-1 assessment including the criteria that must be met for soil and groundwater to be managed under MO-1, and guidance on the identification and application of the limiting MO-1 RS.

Section 5.0, Management Option 2 provides direction on conducting an MO-2 assessment including the criteria that must be met for management of soil and groundwater under MO-2, the use of site-specific environmental fate and transport data, and guidance on the identification and application of the MO-2 RS.

Section 6.0, Management Option 3 presents an overview of MO-3. It includes the criteria for management of an AOI under MO-3; guidance on the development of a workplan; guidance on conducting a site-specific exposure assessment for the development of MO-3 RS; and guidance on the application of MO-3 RS.

Section 7.0, Ecological Risk Assessment provides guidance on conducting ecological risk assessments under the RECAP.

Appendix A, Methods for the Development and Application of Screening Standards and MO-1, MO-2, and MO-3 RECAP Standards presents the methods and assumptions for the development of SS, MO-1 RS, MO-2 RS, MO-3 RS, Appendix G RS, and Appendix H MO-2 RS.

Appendix B, RECAP Site Investigation Requirements presents the site investigation requirements for the RECAP.

Appendix C, RECAP Forms contains the RECAP forms required to be included in the RECAP Assessment submittal.

Appendix D, Guidelines for Assessing Constituents with Special Considerations such as Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons, Lead, Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans, Nitrates/Nitrites/Ammonia, Mutagens, and Conventional Constituents and Parameters such as sodium chloride, sulfates, and pH.

Appendix E, North American Industry Classification System presents the North American Industry Classification codes used in defining industrial and non-industrial land use under the RECAP.

Appendix F, Aquifer Tests presents methods for measuring or estimating maximum sustainable yield for aquifers under investigation.

Appendix G, Vapor Intrusion Pathway, presents guidance for addressing the vapor intrusion pathway under the RECAP.

Appendix H, A Site-Specific RECAP Evaluation for Typical UST Sites and Other Small Petroleum Hydrocarbon Release Sites presents an MO-2 RECAP evaluation for UST and other small petroleum hydrocarbon release sites that meet the requirements for Appendix H evaluations. It includes discussions on the types of sites that qualify for management under Appendix H; the site-specific data needed for an Appendix H evaluation; and guidelines on the identification and application of Appendix H soil and groundwater RS.

2.0 GENERAL GUIDELINES

This section includes RECAP terminology and provides guidance for key components of the RECAP. This guidance is applicable to the management of sites under the Screening Option and RECAP Management Options 1, 2, and 3.

2.1 Program Terminology

This section includes descriptions of terms that are **specific** to the RECAP.

10^{-6} - 10^{-6} is a shorthand description for an incremental or excess lifetime cancer risk of 0.000001 in 1 (i.e., 1 chance in a 1,000,000).

10^{-5} - 10^{-5} is a shorthand description for an incremental or excess lifetime cancer risk of 0.00001 in 1 (i.e., 1 chance in a 100,000).

10^{-4} - 10^{-4} is a shorthand description for an incremental or excess lifetime cancer risk of 0.0001 in 1 (i.e., 1 chance in a 10,000).

95 percent upper confidence limit - the upper limit of a 95 percent confidence interval for the mean; there is only a 5 percent probability that the true mean is greater than this value.

95%UCL-AM – **95 percent upper confidence limit on the arithmetic mean.**

Acceptable risk - a total cumulative cancer risk less than or within the range of 10^{-6} to 10^{-4} ; a Total Hazard Index less than or equal to 1.0 for each critical health effect or target. (refer to Section 2.5.1 and 2.5.2).

Action standard - the concentration of a specific COC that is defined as acceptable; COC concentrations less than or equal to the action standard do not typically require further action, COC concentrations above the action standard typically warrant further evaluation.

Acute - refers to an exposure of short duration, often refers to a single exposure event.

ADAF - **age-dependent adjustment factors**, used in the assessment of mutagens; refer to Appendix D.

Additivity - the assumption that doses received from simultaneous exposure to several constituents from a variety of sources by more than one exposure pathway are additive. For carcinogens, simple dose additivity is assumed. For noncarcinogens, it is assumed that simultaneous subthreshold exposures to several constituents that elicit the same critical effect or affect the same target organ/system could result in an adverse health effect.

Air unit risk – upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of $1 \mu\text{g}/\text{m}^3$ in air.

AOC - **area of concern**.

AOI - **area of investigation**.

AOIC – **area of investigation concentration**.

Aliphatic fraction – mixture of aliphatic petroleum hydrocarbons; refer to Appendix D.

Applicable or Relevant and Appropriate Requirements (ARAR) - applicable requirements are those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site. Relevant and appropriate requirements are those clean-up standards which, while not applicable, at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well-suited to the particular site. ARAR can be action-specific, location-specific, or constituent-specific. Refer to Section 2.5.4 for additional information on the use of ARAR.

Aquifer - a geologic formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs (LAC 33:V.109).

ARAR - **Applicable or Relevant and Appropriate Requirements**.

Area of concern (AOC) - an area where constituents have been released to the environment or a waste management unit.

Area of investigation (AOI) - a zone contiguous to and including impacted media defined vertically and horizontally by the presence of one or more constituents in concentrations exceeding the limiting SS, MO-1 RS, or MO-2 RS (depending on the Option being implemented). For groundwater, the term AOI is synonymous with plume.

Area of investigation concentration (AOIC) – the COC concentration present in soil (or sediment) on and within the boundaries of the AOI; the AOIC is the soil concentrations compared to the RECAP Standard to determine compliance. The AOIC shall be determined in accordance with Section 2.3.1.3.

Background concentration - concentration of constituents present in the environment that are distinguishable from an identifiable source concentration (refer to Section 2.5.5).

Aromatic fraction – a mixture of aromatic petroleum hydrocarbons; refer to Appendix D.

BAPE – **Benzo[a]pyrene equivalent**; refer to polycyclic aromatic hydrocarbons in Appendix D.

BCF - **bioconcentration factor**.

bgs - **below ground surface**.

Bioconcentration factor (BCF) - a measure or an estimate of the extent of constituent partitioning at equilibrium between a biological medium such as fish tissue or plant tissue and an external medium such as water. The higher the BCF, the greater the accumulation of a constituent in living tissue is likely to be.

Biota - animals and plants likely to be consumed by humans.

Blank - analytical quality control samples analyzed in the same manner as site samples. They are used in the measurement of contamination that has been introduced into a sample either (1) in the field while the samples were being collected or transported to the laboratory or (2) in the laboratory during sample preparation or analysis. A rinsate/equipment blank is a sample of analyte free water poured over or through decontaminated field sampling equipment prior to the collection of environmental samples. The field blank is a sample of analyte-free water poured into the container in the field, preserved and shipped to the laboratory with field samples. The trip blank is a clean sample of analyte-free water that accompanies the empty sample bottles to the field as well as the samples returning to the laboratory for analysis; it is not opened until it is analyzed in the lab with the actual site samples.

Cancer risk - the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen.

CAP - Corrective Action Plan.

Carcinogen - a cancer-causing agent; see EPA's Weight-of-Evidence Classification System.

CC – compliance concentration.

Chronic - pertaining to an exposure duration of seven years to a lifetime (70 years).

Closure - the act of securing and rendering harmless a site that has been used to store, treat, or dispose of a hazardous or solid waste so that it will pose no significant threat to human health or the environment.

CLP - Contract Laboratory Program.

COC - Constituent(s) of Concern.

Compliance concentration (CC) - the COC concentration detected in groundwater at the point of compliance; for groundwater 3 zones, the upper confidence limit on the arithmetic mean COC concentration within the AOI may serve as the compliance concentration; the COC concentration that is compared to the groundwater RECAP standard.

Constituents of concern (COC) - solid waste and hazardous waste, as defined in LAC 33:V.109; industrial solid waste as defined in LAC 33:VII.115; hazardous substance, as defined in La. R.S. 30:2272; regulated substance, as defined in LAC 33:XI.103; pollutant

as defined in La. R.S. 30:2004; wastes as defined in La. R.S. 30:2073; and pollutant, priority pollutant, and toxic substances, as defined in LAC 33: IX.107.

Corrective action - activities conducted to protect human health and the environment.

Corrective action standard - term used within the meaning of the RECAP to prescribe concentrations of constituents in soil and groundwater above which remedial action shall take place or the concentrations to which impacted media shall be remedied.

Critical effect - the most sensitive health effect (the health effect observed at the Lowest Observable Adverse Effect Level) associated with exposure to the constituent of concern. The critical effect that serves as the basis of the RfD or RfC is the critical effect that should be identified for the purpose of adjusting RS to account for additive noncarcinogenic health effects.

Cumulative risks - total cancer risks associated with exposure to multiple constituents and/or via multiple exposure pathways/media.

DAF - **d**ilution and **a**ttenuation factor; applicable to monitored natural attenuation remedial actions.

DAF2 – a site-specific dilution and attenuation factor representative of the natural dilution and attenuation of constituent concentrations from the point of compliance to the point of exposure (nearest downgradient property boundary); applicable to monitored natural attenuation evaluations.

DAF3 – a site-specific dilution and attenuation factor representative of natural dilution and attenuation of constituent concentrations from the point of compliance to the point of exposure (nearest downgradient surface water body); applicable to monitored natural attenuation evaluations.

Data evaluation - the assessment of the effect of quality control issues on data usability for risk assessment purposes.

Data quality objectives (DQO) - qualitative and quantitative statements established prior to data collection which specify the quality of data required to support decisions during remedial response activities.

Data validation - the evaluation of data generated in accordance with EPA's Contract Laboratory Program Statement of Work for organics and inorganics. The evaluation is conducted in accordance with EPA's laboratory data validation functional guidelines for organic and inorganic analyses and includes the identification of deviations from the Statement Of Work (SOW), poor Quality Control (QC) results, matrix interferences, and other analytical problems that compromise the potential uses of the data. In the validation process, data may be flagged with qualifiers to alert data users of deviations from QC requirements.

Detection limit (DL) - the lowest amount of a constituent that can be seen above the normal noise of an analytical instrument or method.

DF - **d**ilution **f**actor.

DF2 - a dilution factor representative of natural dilution of constituent concentrations from the point of compliance to the point of exposure (nearest downgradient property boundary); applicable to Soil_{GW2} and GW₂.

DF3 - a dilution factor representative of natural dilution of constituent concentrations from the point of compliance to the point of exposure (nearest downgradient surface water body); applicable to Soil_{GW3} and GW₃.

Dilution and attenuation factor (DAF) - the site-specific ratio of the concentration of a constituent (dissolved in water or contained in soil) to the concentration of the same constituent after natural attenuation has occurred; applicable to monitored natural attenuation remediation evaluations.

Dilution factor (DF) - the ratio of the concentration of a COC dissolved in water to the concentration of the same constituent after mixing with constituent free water or less concentrated constituent laden water. The measurements of concentrations usually occur at two different spatial points (e.g., at the POC and at the POE).

Downgradient - in the direction of groundwater flow. Groundwater flow is from areas of high hydraulic head to areas of low hydraulic head.

DQO - **D**ata **Q**uality **O**bjectives.

EC – **E**lectrical **C**onductivity.

Ecological checklist – a checklist that is used to identify sites/releases that have the potential to pose risks to ecological receptors and/or their habitats.

Ecological risk assessment - an assessment that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors. It is a process for organizing and analyzing data, information, assumptions, and uncertainties to evaluate the likelihood of adverse ecological effects.

Electrical conductivity – a measure of the salinity of the solution phase; reported in decisiemens per meter (dS/m) or millimhos per centimeter (mmho/cm).

Enclosed structure – an enclosed structure for the evaluation of the vapor intrusion pathway is defined as 1) an occupied (or potentially occupied) structure [i.e., one or more receptors spend a significant portion of the day (or workday) within the enclosed structure]; 2) a structure that has a roof and walls on all sides which prevent the free exchange of indoor air with outdoor (ambient) air; and 3) a structure that is on a slab foundation or on piers with an enclosed crawl space that prevents the free exchange of crawl space air with outdoor air.

ESG_i – exterior soil gas standard which defines the acceptable constituent concentration in soil gas for the evaluation of the vapor intrusion pathway for industrial/commercial land use. For petroleum hydrocarbon components, the *ESG_i* was derived by applying an alpha (α) of 0.003 to the *IA_i*. For all other constituents, the *ESG_i* was derived by applying alpha of 0.03 to the *IA_i*.

ESG_{ni} – exterior soil gas standard which defines the acceptable constituent concentration in soil gas for the evaluation of the vapor intrusion pathway for non-industrial land use (residential). For petroleum hydrocarbon components, the *ESG_{ni}* was derived by applying an alpha (α) of 0.003 to the *IA_{ni}*. For all other constituents, the *ESG_{ni}* was derived by applying alpha of 0.03 to the *IA_{ni}*.

ESP – **Exchangable Sodium Percentage.**

Exchangable sodium percentage – the sodium fraction in the soil expressed as a percentage.

Exposure - contact of an organism with a COC (chemical, metal etc.).

Exposure assessment - an appraisal of the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures, and the pathways by which humans are potentially exposed.

Exposure medium - any environmental medium that may serve as a source of exposure to human or ecological receptors via current and/or future exposure pathways.

Exposure parameters - variables used in the calculation of intake (e.g., exposure duration, inhalation rate, body weight).

Exposure pathway - the course a constituent or physical agent takes from a source to an exposed organism. An exposure pathway describes a unique mechanism by which an individual or population is exposed to constituents or physical agents at or originating from a site. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, a transport/exposure medium (e.g., air) or media (in cases of intermedia transfer) also is included.

Exposure point - a location of actual or potential contact between an organism and a constituent or physical agent.

Exposure route - the way a constituent or physical agent comes in contact with an organism (e.g., by ingestion, inhalation, and/or dermal contact).

Facility - all contiguous land and structures, other appurtenances, and improvements on the land used for the processing, treating, storing, or disposing of COC. A facility may consist of one or more treatment, storage, disposal operational units (e.g., one or more landfills, surface impoundments, etc.), and areas of investigation or sites.

f_{oc} - **f**ractional **o**rganic **c**arbon in soil or sediment.

Groundwater - water located beneath the ground surface or below a surface water body in a saturated zone or stratum.

Groundwater Classification 1 - Groundwater within an aquifer or that has a direct hydraulic connection to an aquifer that currently supplies, or could potential supply, drinking water to a public water supply. The aquifer is sufficiently permeable to transmit water to a well at a maximum sustainable yield of greater than or equal to 4,800 gallons per day (gpd) **and** groundwater quality is such that the TDS concentration is less than or equal to 1,000 milligrams per liter (mg/l) (refer to Section 2.3.2.1).

Groundwater Classification 2 - Groundwater within an aquifer that currently supplies, or could potentially supply, water to a domestic water supply, agricultural supply, or any other supply. The aquifer is sufficiently permeable to transmit water to a well at a maximum sustainable yield of greater than or equal to 800 gpd **and** groundwater quality is such the TDS concentration is greater than 1,000 mg/l and less than or equal to 10,000 mg/l (refer to Section 2.3.2.1).

Groundwater Classification 3 - Groundwater within an aquifer that is sufficiently permeable to transmit water to a well at a maximum sustainable yield of less than 800 gpd or has a TDS concentration greater than 10,000 mg/l (refer to Section 2.3.2.1).

Groundwater plume - groundwater defined vertically and horizontally by the presence of a COC at concentrations greater than the limiting groundwater standard for the Option being implemented; equivalent to the groundwater AOI.

GW_1 - the RECAP standard for groundwater meeting the definition of **Groundwater Classification 1**.

GW_2 - the RECAP standard for groundwater meeting the definition of **Groundwater Classification 2**.

GW_3 - the RECAP standard for groundwater meeting the definition of **Groundwater Classification 3**.

GW_{3DW} - the RECAP standard for groundwater meeting the definition of **Groundwater Classification 3** that may potentially discharge to a downgradient surface water body (segment or subsegment) that is classified as a **d**rinking **w**ater source. The objective of the GW_{3DW} RECAP standard is to provide protection against the migration and discharge of a COC via groundwater to a surface water body. It is not the intent of this standard to allow the discharge of a COC to surface water.

GW_{3NDW} - the RECAP standard for groundwater meeting the definition of **Groundwater Classification 3** that may potentially discharge to a downgradient surface water body (segment or subsegment) that is classified as a **n**on-**d**rinking **w**ater source. The objective of the GW_{3NDW} RECAP standard is to provide protection against the migration and

discharge of a COC via groundwater to a surface water body. It is not the intent of this standard to allow the discharge of a COC to surface water.

GW_{SS} - is the RECAP screening standard for groundwater. The GW_{SS} is applicable to groundwater meeting the definitions of Groundwater Classifications 1, 2, and 3.

Hazard index (HI) - the sum of more than one hazard quotient for multiple noncarcinogens (that elicit the same critical effect or affect the same target organ/system) and/or multiple exposure pathways.

Hazard quotient (HQ) - the ratio of the AOIC for a single noncarcinogenic COC to the SS or RS for that COC.

Henry's Law Constant - provides a measure of the extent of constituent partitioning between air and water at equilibrium. The higher the Henry's Law constant, the more likely a constituent is to volatilize to air than to remain in the water.

HI - Hazard Index.

High fugitive dust emissions – the release of a high concentration of soil particulates to the ambient air due to the presence of dry soil (moisture content less than 8 percent), finely divided or dusty soils (high silt or clay content), high average annual wind speeds (greater than 5.3 m/sec), less than 50 percent vegetative cover, heavy traffic on unpaved roads, and/or soil intrusive activities.

HQ - Hazard Quotient.

Hydraulic conductivity - or “coefficient of permeability” is a measure of the capacity of a porous medium to transmit water. It is defined as the volume of water that will move in a unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow. The dimensions of hydraulic conductivity are length per time or velocity. Hydraulic conductivity is governed by the size and the shape of the pores, the effectiveness of the interconnection between pores, roughness of mineral particles, degree of soil saturation, and the physical properties of the fluid.

IA_i – acceptable constituent concentration in indoor air for the evaluation of vapor intrusion from a subsurface source to an enclosed structure, for industrial/commercial land use.

IA_{ni} – acceptable constituent concentration in indoor air for the evaluation of vapor intrusion to an enclosed structure for non-industrial land use.

Impact - the presence of a constituent at a concentration which exceeds the limiting standard applicable at the AOC or the AOI for the Option being implemented.

Industrial/commercial - any property not currently used for human habitation on a permanent or temporary/intermittent basis. Refer to Section 2.3.1.1.

Injury - a wrong or damage done to a person or his or her property or rights when caused by the wrongful act of another.

Institutional controls - actions taken or modifications to a site that prevent or minimize contact with impacted media.

Integrated Risk Information System (IRIS) - an EPA online database containing verified reference doses and cancer slope factors and up-to-date health risk and EPA regulatory information for numerous constituents. IRIS is the first tier of human health toxicity values.

IRIS - Integrated Risk Information System.

K_d - distribution coefficient defined by the product of the fraction of organic carbon in soil multiplied by the K_{oc} for the hydrophobic organic constituents. Although comparable algorithms are not available for estimating equilibrium partition coefficients for inorganic constituents, published values are available for metals (e.g., EPA 1996).

K_{oc} - organic carbon/water partition coefficient - provides a measure of the extent of constituent partitioning between organic carbon and water at equilibrium. The higher the K_{oc} , the more likely a constituent is to bind to carbon in soil or sediment than to remain in the water column.

K_{ow} - octanol/water partition coefficient - provides a measure of the extent of constituent partitioning between water and octanol at equilibrium. The greater the K_{ow} the more likely a constituent is to partition to octanol than to remain in water. Octanol is used as a surrogate for lipids (fat), and K_{ow} can be used to predict bioconcentration in aquatic organisms.

L - source length - refer to Section 2.3.1.4.

LDNR - Louisiana Department of Natural Resources.

Lifetime - the default average human lifetime which is assumed to be 70 years (EPA).

Limiting RECAP Standard (LRS) - the lowest standard of all the standards that are applicable to a given exposure or source medium.

LRS - Limiting RECAP Standard.

LSS - Limiting Screening Standard.

Limiting Screening Standard (LSS) - the lowest screening standard of all the standards that are applicable to a given medium.

Management Option 1 (MO-1) - provides Department-derived RECAP Standards (RS) for soil and groundwater that are protective of human health and the environment. MO-1 RS were derived for non-industrial (residential) and industrial exposure scenarios using

currently recommended default exposure parameters, fate and transport properties, and toxicity criteria.

Management Option 2 (MO-2) - provides the option of using site-specific data with specified analytical models to evaluate constituent fate and transport at the site. The results of this site-specific evaluation shall be used in conjunction with standard reasonable maximum exposure (RME) assumptions to identify site-specific MO-2 RS.

Management Option 3 (MO-3) - provides the option of using site-specific data for the evaluation of exposure and environmental fate and transport for the development of site-specific MO-3 RS.

Matrix Spike/Matrix Spike Duplicate – matrix spike samples are quality control samples employed to evaluate the effect a particular sample matrix has on the accuracy of a measurement. A matrix spike duplicate is theoretically equal to the corresponding matrix spike sample and provides a means of measuring method precision.

Maximum Contaminant Level (MCL) - the maximum permissible concentration of a contaminant in water which is delivered to any user of a public water system. The MCL is contained in the National Primary Drinking Water Regulations (40 CFR 141).

MCL - Maximum Contaminant Level.

Media of concern - any currently impacted media to which individuals may be exposed or through which constituents may be transported to potential receptors.

MO-1 - Management Option 1.

MO-2 - Management Option 2.

MO-3 - Management Option 3.

Monitored natural attenuation (MNA) - the monitored biodegradation, dispersion, dilution, sorption, volatilization, and/or chemical and biochemical transformation/stabilization of constituents to effectively reduce constituent concentration, toxicity, mobility, mass or volume to levels that are protective of human health and the ecosystem. Also referred to as intrinsic remediation or passive remediation.

Mutagen – a carcinogen that has a mutagenic mode of action; refer to Appendix D.

NAPL - non-aqueous phase liquid.

NFA-ATT - no further action at this time.

Non-Aqueous Phase Liquid (NAPL) - liquids that are immiscible with water through the vadose zone as well as below the water table. They may have densities that are greater than water (dense non-aqueous phase liquid) or densities that are less than water (light

non-aqueous phase liquid). They may be partially soluble in water, so that a dissolved phase as well as a non-aqueous phase may be present (*Contaminant Hydrogeology*, Second Edition, C.W. Fetter, 1999).

Noncarcinogen - an agent that is known not to cause cancer.

Non-detect - a constituent that is not detected in a particular sample above a certain limit, usually the quantitation limit for the constituent in that sample.

Non-industrial - any property that does not meet the exclusive definition of an industrial property (refer to Section 2.3.1.1). *Particulate emission factor (PEF)* - relates the COC concentration in soil with the concentration of respirable particles in the air due to fugitive dust emissions from impacted surface soils at sites.

PAH - polycyclic aromatic hydrocarbon.

PCDD – polychlorinated dibenzodioxins.

PCDF – polychlorinated dibenzofurans.

PEF - particulate emission factor.

Permanent structure - a well established building or similar structure located in an area of established, controlled land use that is not anticipated to change in the future or the planned development of a well established building or similar structure in an area of established, controlled land use under the Voluntary Cleanup Program.

POC - point of compliance.

POE - point of exposure.

Point of compliance (POC) - the point in groundwater where the RECAP standard must be met (refer to Section 2.3.2.2).

Point of exposure (POE) - a location of actual or potential contact between an organism and a chemical agent.

Post-remediation verification requirements - soil sampling and groundwater monitoring required to verify that remediated media meet the RS.

Post-closure requirements - monitoring, financial assurance, and/or institutional control requirements that shall be met after the closure of a site.

PPRTV – Provisional Peer-Reviewed Toxicity Values.

Preliminary evaluation - an initial investigation designed to determine if the release of a COC to the environment has occurred. This evaluation should include a review of any information available regarding the AOC, the results of an AOC inspection, and sample

results from any media potentially impacted by a release. Preliminary evaluations may be conducted by a responsible party, an interested party, or by a regulatory agency. Examples of preliminary evaluations include Phase II real estate evaluations, State Site Assessments (SSA I and II) conducted by LDEQ under the Inactive and Abandoned Sites guidelines, or RCRA facility assessments (RFAs) conducted by LDEQ for the RCRA corrective action program.

ProUCL – EPA software program for the statistical analysis of environmental data.

Provisional Peer-Reviewed Toxicity Values (PPRTV) – EPA online database of toxicity values; PPRTV represent the second tier of human health toxicity values.

QA/QC - **quality assurance/quality control.**

Quality assurance/quality control (QA/QC) - a system of procedures, checks, audits, and corrective actions used to ensure that field work and laboratory analysis meet certain established standards.

Reasonable maximum exposure (RME) - the highest exposure that could reasonably be expected to occur for a given exposure pathway at an AOI and is intended to account for both uncertainty in the COC concentration and variability in exposure parameters. Reasonable maximum exposure is estimated by combining a mean (95 percent UCL on the arithmetic mean) AOIC with protective exposure assumptions.

RECAP - Risk Evaluation/Corrective Action Program.

RECAP standard (RS) - a concentration of a constituent of concern in an environmental medium that defines an action standard or remediation standard depending on the Management Option and the application chosen.

Receptor - potentially exposed individual/population.

Reference concentration (RfC) - an estimate of a daily exposure level (i.e., COC concentration in air) for a human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime; expressed in units of mg/m³.

Reference dose (RfD) - an estimate of a daily exposure level for a human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime; expressed in units of mg/kg-day; EPA toxicity value for constituents that elicit noncarcinogenic health effects.

Regulated site - area of investigation that is subject to the requirements of this program.

Remediation - action or series of actions taken at a site to reduce, destroy, or otherwise mitigate the constituents present at the site.

Reporting limit (RL) - the lowest concentration at which a constituent can be accurately and reproducibly quantitated. Usually equal to the instrument detection limit multiplied by a factor of three to five, but varies for different constituents and different samples; a quantitation limit that takes into account adjustments in the preparation and analytical method for any given sample.

Residential - non-industrial land use generally characterized by an exposure frequency of 350 days/year and an exposure duration of 30 years.

RfC - **reference concentration**.

RfD - **reference dose**.

Risk assessment - is an analysis of the potential adverse health or environmental effects (current or future) associated with the presence of a constituent in an environmental medium.

Risk characterization - the description of the nature and the magnitude of human or ecological risk, including associated uncertainty.

RL – **analytical reporting limit**.

RME - **reasonable maximum exposure**.

RS - **RECAP Standard**.

Sampling bias - the condition in which a sample data set is comprised of an inordinate number of source, perimeter, or other samples such that the data set is not representative of true constituent distribution at the AOI.

SAR – **Sodium Adsorption Ratio**.

SAS - **special analytical services**.

Screening Option (SO) - provides Department-derived Screening Standards (SS) for soil and groundwater for non-industrial (residential) and industrial land use scenarios.

Screening Standard (SS) - a constituent concentration in medium used to: (1) determine if an AOC requires further evaluation; (2) identify the AOI; and (3) identify the COC for further evaluation under a MO.

S_d - the thickness of the impacted groundwater within the permeable zone.

Sediment - solid fragments of inorganic and/or organic material that come from the weathering of rock and are carried and deposited by wind, water, and ice and has come to rest on the earth's surface at, above, or below sea level.

Segment or subsegment of a surface water body - surface water bodies are identified by the drainage basin in which they are located. Each water body has an identification code. Refer to LAC 33:IX.1123.

Sensitive subpopulation - receptors at increased risk from chemical exposures due to increased sensitivity, behavior patterns that may result in high exposure, and/or current or past exposures from other sources. Subpopulations that may be more sensitive to chemical exposures include infants and children, elderly people, pregnant and nursing women, and people with chronic illness. Those potentially at higher risk due to behavior patterns include children, who are more likely to contact soil, and persons who may eat large amounts of locally caught fish or locally grown produce.

SF - slope factor.

Site - the physical location, including land area(s) and appurtenances, defined by the extent of migration of the COC, or any area where a COC has been or may have been deposited, stored, disposed of, placed, or otherwise come to be located.

Site investigation - an in-depth investigation for the purposes of defining site characteristics, determining the nature, horizontal and vertical extent of contamination, predicting fate and transport of contaminants, identifying potential exposure pathways and receptors, and determining the need for corrective action. A human health and/or ecological risk evaluation of the results of the remedial investigation will be required in all cases in accordance with RECAP.

Site location name - a location, including any appurtenances thereto, which encompasses one or more AOC or AOI.

Site-specific - activities, information, and data unique to a particular site.

Sodium adsorption ratio - the relationship between the soluble sodium and soluble divalent cations (calcium and magnesium) used to predict the exchangeable sodium fraction of soil.

Slope factor (SF) - a plausible upper-bound estimate of the probability of a carcinogenic response per unit intake of a constituent over a lifetime; EPA toxicity value for a constituent that elicits carcinogenic health effects via the oral route of exposure.

SO - Screening Option.

Soil_{GW1} - the RECAP Standard for the soil concentration protective of groundwater meeting the definition of **Groundwater Classification 1** (see Section 2.5.3.2); applicable to surface soil and subsurface soil.

Soil_{GW2} - the RECAP Standard for the soil concentration protective of groundwater meeting the definition of **Groundwater Classification 2** (see Section 2.5.3.2); applicable to surface soil and subsurface soil.

Soil_{GW3} - the RECAP Standard for the soil concentration protective of groundwater meeting the definition of **Groundwater Classification 3** (see Section 2.5.3.2); applicable to surface soil and subsurface soil.

Soil_{GW3DW} – the RECAP Standard for the soil concentration protective of groundwater meeting the definition of **Groundwater Classification 3** (see Section 2.5.3.2) that may potentially discharge to a downgradient surface water body (segment or subsegment) that is classified as a **drinking water source**; applicable to surface soil and subsurface soil.

Soil_{GW3NDW} – the RECAP Standard for the soil concentration protective of groundwater meeting the definition of **Groundwater Classification 3** (see Section 2.5.3.2) that may potentially discharge to a downgradient surface water body (segment or subsegment) that is classified as a **non-drinking water source**; applicable to surface soil and subsurface soil.

Soil_{LS} – the soil leachate standard is the RECAP standard that is compared to the leachate testing results for the evaluation of the soil to groundwater pathway.

Soil_{ni} - the RECAP Standard for the protection of human health; applicable to surface soil located in an area meeting the definition of **non-industrial land use**.

Soil_i - the RECAP Standard for the protection of human health; applicable to surface soil located in an area meeting the definition of **industrial land use**.

Soil re-use - the re-use of soil that meets, or has been treated to meet, applicable RS.

Soil_{sat} - soil **sat**uration concentration.

Soil saturation concentration (Soil_{sat}) - the concentration at which the pore spaces in the soil medium are saturated with a constituent of concern. *Soil_{sat}* is applicable to surface soil and subsurface soil. *Soil_{sat}* is applicable only for constituents that are liquid at ambient soil temperatures (i.e., those having a melting point less than or equal to 20°C).

Soil_{SSni} - is the risk-based soil screening standard based on the protection of human health for **non-industrial land use**. The *Soil_{SSni}* is applicable to surface soil.

Soil_{SSi} - is the risk-based soil screening standard based on the protection of human health for **industrial/commercial land use**. The *Soil_{SSi}* is applicable to surface soil.

Soil_{SSGW} - screening standard for the soil concentration protective of **groundwater** meeting the definitions of Groundwater Classifications 1, 2, and 3 (based on compliance with *GW_{SS}*). The *Soil_{SSGW}* is applicable to surface soil and subsurface soil.

Solubility - the amount of a substance that dissolves in a given amount of water to produce a saturated solution. Aqueous concentrations in excess of solubility may indicate sorption onto suspended solids/sediments, the presence of solubilizing constituents such as solvents, or the presence of a non-aqueous phase liquid (NAPL).

Source area, length (L) and width (S_w) – refer to Section 2.3.1.4.

Source medium - any environmental medium that is serving or may serve as a source for the transfer of constituents to another medium (e.g., soil that may leach constituents to groundwater).

Special analytical services - Non-standardized analyses conducted to meet requirements that cannot be met using routine analytical services such as shorter analytical turnaround time, lower detection limits, and analysis of non-standard matrices or non-standard constituents.

SPLP - **Synthetic Precipitation Leaching Procedure** (EPA SW846 Method 1312).

Standard industrial exposure scenario - a reasonable maximum exposure scenario for standard industrial land use based on an exposure time of 8 hours/day, an exposure frequency of 250 days/year, and an exposure duration of 25 years.

Standard residential (non-industrial) exposure scenario - a reasonable maximum exposure scenario for standard residential land use based on an exposure time of 24 hours/day, an exposure frequency of 350 days/year, and an exposure duration of 30 years.

SS - screening standard.

SSSG_i –sub-slab soil gas standard which defines the acceptable constituent concentration in soil gas for the evaluation of the vapor intrusion pathway for industrial/commercial land use. The SSSG_i was derived by applying an alpha (α) of 0.03 to the IA_i.

SSSG_{ni} – sub-slab soil gas standard which defines the acceptable constituent concentration in soil gas for the evaluation of the vapor intrusion pathway for non-industrial land use (residential). The SSSG_{ni} was derived by applying an alpha (α) of 0.03 to the IA_{ni}.

Submitter - an individual or group of individuals involved in the RECAP process including owners, operators, etc.

Subsurface soil - the soil interval present from 15 feet bgs to the depth of impact.

Surface soil - the soil interval present from ground surface to a depth of 15 feet bgs.

Surface water - all lakes, bays, rivers, streams, springs, ponds, impounding reservoirs, wetlands, swamps, marshes, water sources, drainage systems, and other surface waters, natural or artificial, public or private, within the state or under its jurisdiction that are not a part of the treatment system allowed by state law, regulation, or permit. Ditches that are part of a treatment system shall not be considered surface water provided that the treatment system is monitored downstream of the impacted area for the COC under the terms of an LPDES permit. It is not required that surface water in communication with groundwater be classified as groundwater for the purposes of determining yield and TDS for the selection of an aquifer classification.

S_w – source width - refer to Section 2.3.1.4.

Target hazard quotient (THQ) - an acceptable hazard quotient that is combined with exposure and toxicity information to calculate a corresponding acceptable constituent concentration in an environmental medium.

Target risk (TR) - an acceptable cancer risk level that is combined with exposure and toxicity information to calculate a corresponding acceptable constituent concentration in an environmental medium.

TDS - **T**otal **D**issolved **S**olids.

TEF – **T**oxicity **E**quivalent **F**actor; refer to dioxins in Appendix D.

TEQ – **T**oxicity **E**quivalent; refer to dioxins in Appendix D.

Tentatively identified compounds (TIC) - compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Threshold effects - refers to noncarcinogenic health effects. For many noncarcinogens there is a range of exposures that exists from zero to some finite value that can be tolerated by the organism with essentially no chance of expression of adverse effects. The exposure level must exceed the upper bound of this tolerance range before effects are observed.

TIC - **T**entatively **I**dentified **C**ompounds.

Total carcinogenic risk - the incremental individual lifetime cancer risk for simultaneous exposure to more than one carcinogen and/or for more than one exposure pathway contributing to exposure of the same receptor (refer to Section 2.5).

Total dissolved solids (TDS) - the total concentration of dissolved solids in water that is determined by evaporating a quantity of filtered water at a low temperature (measured in mg/L).

Total hazard index – the sum of hazard quotients to assess simultaneous exposure to more than one noncarcinogen that elicits the same critical effect or affects the same target organ/system and/or for exposure via multiple exposure pathways.

Total petroleum hydrocarbons (TPH) - an estimate of the total amount of petroleum hydrocarbons in a sample that may represent sums of concentrations of a limited number of compounds, groups of compounds, or the entire range of petroleum hydrocarbons. It may contain compounds that are not derived from petroleum.

Toxicity assessment - an appraisal of the evidence regarding the potential for particular COC to cause adverse effects in exposed individuals and/or organisms. Toxicity assessment is generally accomplished in two steps: hazard identification and dose-response assessment.

Toxicity value - a numerical expression of a substance's dose-response relationship that is used in risk assessments. The most common toxicity values used are reference doses (for noncarcinogenic effects) and slope factors (for carcinogenic effects).

TPH - **t**otal **p**etroleum **h**ydrocarbons.

TPH fraction - the aliphatic and aromatic petroleum hydrocarbon fractions defined by *Provisional Peer-Reviewed Toxicity Values for Complex Mixtures of Aliphatic and Aromatic Hydrocarbons* (EPA 2009) (refer to Appendix D).

UCL-AM - **u**pper confidence limit on the **a**rithmetic **m**ean.

Upper confidence limit - the upper limit of an interval which has a certain probability of including the population mean.

Volatile - referring to a constituent that evaporates readily at normal temperature and pressure.

Water_{sol} - water **s**olubility.

Weight-of-evidence classification - EPA's Weight-of-Evidence Classification System for carcinogenicity is a classification system for characterizing the extent to which the available data indicate that an agent is a human carcinogen. Under this system, Group A carcinogens are described as human carcinogens; Group B1 carcinogens are described as probable human carcinogens, limited human data are available; B2 carcinogens are described as probable human carcinogens, sufficient evidence in animal and inadequate or no evidence in humans; Group C carcinogens are described as possible human carcinogens; Group D carcinogens are described as not classifiable as to human carcinogenicity; and Group E carcinogens are described as having evidence of noncarcinogenicity for humans.

Yield - rate of groundwater transmitted to a well; expressed in units of gal/day.

2.2 Data Requirements

2.2.1 Site Investigation

The site investigation requirements for the RECAP are presented in Appendix B. Deviations from these requirements may be granted by the Department if justified based on site-specific conditions. Any Department-approved deviation from the requirements presented in Appendix B shall be outlined and summarized in the cover letter attached to the site investigation report. It is strongly recommended that a site investigation workplan be submitted to the Department for approval prior to the implementation of site investigation activities. Refer to Section B.2.2 of Appendix B for guidelines on developing a RECAP site investigation workplan.

Analyte List. The constituent list contained in Tables 1, 2, and 3 includes those constituents most frequently encountered at release sites, it does not represent a “RECAP” analyte or COC list. All constituents present at an AOI are potential COC under the RECAP. Therefore, the analyte list selected for the site investigation shall include, at a minimum, all constituents known or suspected to be present at the site due to current and historical activities at the site and any constituents that may occur as breakdown products of site-related constituents whether or not the constituents are listed in the RECAP Tables. For some type of releases, additional indicators (e.g., pH, EC, ESP, etc.) may be required for the assessment of environmental quality (refer to Appendix D).

2.2.2. Data Quality Assurance/Quality Control

Data Quality Assurance/Quality Control (QA/QC) is critical to the acquisition of reliable data for quantitative risk assessment. Data on which risk-based decisions are made must meet minimum analytical requirements and be of known quality to allow for an evaluation of uncertainty in the data and the resulting impact on estimated risks. Therefore, data used in the RECAP shall be obtained from a laboratory accredited by the State of Louisiana (or a laboratory exempt from accreditation) and shall meet the following requirements:

- (1) The data were generated using rigorous analytical methods such as an approved EPA method;
- (2) The data are analyte-specific and the identity and concentration are confirmed;
- (3) The method produced tangible raw data (e.g. chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files; and
- (4) QA/QC documentation includes:
 - (a) sample documentation,
 - (b) initial and continuing calibration,
 - (c) determination and documentation of detection limits,
 - (d) analyte identification and quantification,
 - (e) QC blanks (trip, method, rinsate),
 - (f) matrix spike recoveries,
 - (g) performance evaluation samples (external QA or laboratory control samples; performance evaluation samples are samples that are analyzed by the laboratory in which a known amount of chemical is present in the sample and

the results of the analysis are compared to the known amount of chemical to evaluate the performance of the analysis by the laboratory),

- (h) analytical error determination (measures precision of analytical method; analytical error can be determined with replicate samples), and
- (i) total measurement error determination [measures overall precision of measurement system from sample acquisition through analysis; total measurement error can be determined with field duplicate, matrix spike (MS), and matrix spike duplicate (MSD) samples].

Data meeting these requirements are referred to as definitive data [*Data Quality Objectives Process for Superfund, Interim Final Guidance* (EPA 540-R-93-071)]. Definitive data were formerly referred to as Level III Data (data generated in an offsite analytical laboratory using standard, documented procedures) and Level IV Data (Contract Laboratory Program routine analytical services) [*Data Quality Objectives for Remedial Response Activities, Development Process* (EPA/540/G-87/003)]. Definitive data meet the Data Quality Objectives for quantitative risk assessment and are considered acceptable for use in the RECAP. In general, data generated using an EPA 500 Series, 600 Series, SW-846 methods, or Contract Laboratory Program (CLP) Statement of Work (SOW) methods meet the definition of definitive data. CLP SOW methods are not required under the RECAP but may be used if additional QA/QC documentation is desired by the Submitter. Documentation for the QA/QC requirements listed above for definitive data should be requested from the laboratory at the time the sample(s) is submitted for analysis.

For routine sampling events, it is required that field QA/QC samples be collected and analyzed. The following is an example of an acceptable QA/QC set:

- 1 rinsate/equipment blank per 20 field samples,
- 1 field blank per day,
- 1 trip blank per ice chest of samples for VOA analysis,
- 1 field duplicate sample per 20 field samples, and
- 1 matrix spike/matrix spike duplicate from the site per 20 field samples.

The QA/QC submittal requirements shall include sample documentation; initial and continuing calibration data; documentation of detection limits; analyte identification and quantification; quality control blanks such as trip blanks, method blanks, and rinsate blanks; matrix spike recovery results; performance evaluation sample data; analytical error determination; and total measurement error determination.

2.2.3 Data Evaluation and Data Usability

Analytical results shall not be accepted at face value. All data shall be reviewed by the analytical laboratory to ensure technical compliance with the analytical method. The data review shall be conducted in accordance with standard EPA protocols. All data shall also be reviewed by the Submitter to ensure that any limitations or uncertainties associated

with the data are identified so that only data that are appropriate and reliable for use in quantitative risk assessment are carried through the RECAP process. Data shall be reviewed to identify reliable, accurate, and verifiable numbers that can be used to quantitate risks. Specifically, the data shall be evaluated to assess the effect of QC issues on data usability (*Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual, Part A*, EPA 540/1-89/002). Additional guidance is available in *Guidance on Environmental Data Verification and Data Validation EPA QA/G-8* (EPA/240/P-02/004).

Data shall be evaluated with respect to:

- (1) *Analytical Method* - In general, data generated using an EPA 500 Series, 600 Series, SW-846, or CLP SOW method will meet the definition of definitive data. Documentation for the aforementioned QA/QC requirements should be requested from the laboratory at the time the sample(s) is submitted for analysis. Analytical results that are: (a) not specific for a particular compound; (b) produced by insensitive analytical methods (e.g., analyses using portable field analytical instruments); or (c) associated with unknown, few, or no QA/QC procedures may be used qualitatively but may not be used quantitatively in determining the AOIC or the CC.
- (2) *Reporting Limits* - The reporting limit (RL) should be less than the limiting SS or RS for the Option being implemented at the AOI. Prior to sample analysis, the Submitter should identify the limiting SS or RS applicable to the Option being implemented and compare those constituent concentrations to the method detection limits (MDL) and the laboratory's practical quantitation limit (PQL) for the selected analytical method to ensure that the MDL and PQL are less than the applicable limiting standard. In the RECAP submittal, non-detected results shall be reported as less than the numerical value of the sample RL (e.g., < 5 ug/l) and a comparison of the RL to the limiting SS or RS shall be presented for all site-related (or potentially site-related) constituents reported as not detected to demonstrate that the SQL are less than or equal to the limiting SS or RS prior to eliminating a COC from further assessment. If the limiting SS or limiting RS is less than the laboratory's PQL, the Submitter shall select the most sensitive standard analytical method available (i.e., the analytical method with the lowest PQL) for the COC and the PQL shall serve as the limiting SS or limiting RS. A PQL selected by the Submitter to serve as the limiting standard is subject to Department approval. If a site-related COC is reported as not detected (< RL) and the RL for the constituent is greater than the limiting SS or RS for a significant number of samples for that medium, then the medium may require re-sampling. If a site-related COC is reported as not detected (< RL) for a key sampling location (e.g., drinking water well) and the RL for the constituent is greater than the limiting SS or RS, then the sample shall be reanalyzed. If the RL are elevated, the data may be considered acceptable by the Department if the following conditions are met: (a) the analytical method used is capable of achieving a PQL that is below the limiting standard; and (b) an analytical laboratory accredited by the State of Louisiana provides documentation to the Department that the PQL was not achievable due to site- or sample-specific considerations such as matrix interferences. Constituent concentrations detected below the PQL but above the MDL are flagged with a J

qualifier (organics) or a B qualifier (inorganics) which indicates the reported concentration is estimated because the concentration falls below the calibration range, i.e., the concentration detected is below the lowest concentration on the calibration curve (PQL). Under the RECAP, the results reported as J-qualified or B-qualified (concentration estimated) shall be evaluated as positive data since there is certainty as to the presence and identity of the constituent.

- (3) *Qualifiers and Codes* - Any anomalies in the data shall be noted in the laboratory report or by the data reviewer using qualifiers or codes to identify any potential problems in the data. Each qualifier or code shall be defined and include a statement on the useability of the data under the RECAP and the uncertainty in the data represented by the qualifier or code. All qualifiers and codes shall be addressed before the data are included in the RECAP process. For guidance on the use of qualified and coded data in quantitative risk assessment refer to *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual, Part A*, (EPA 1989) and *Guidance for Data Useability in Risk Assessment, Part A*, (EPA 1992, 9285.7-09A) and *Guidance on Environmental Data Verification and Data Validation EPA QA/G-8* (EPA/240/P-02/004). In general, all qualified data are considered suitable for inclusion in the quantitative risk assessment process with the exception of data flagged with the qualifier R (unusable organic and inorganic data). Results flagged with a J (organics) or a B (inorganics) (estimated concentration) qualifier shall be reported included as positive results in the RECAP assessment. If an estimated concentration drives or contributes significantly to the risk at the AOI, the uncertainty associated with the estimated concentration shall be clearly addressed in the data evaluation section of the submittal.
- (4) *Blank Samples* - Blank samples provide a measure of contamination that has been introduced into a sample set either: (a) in the field while the samples were being collected or transported to the laboratory, or (b) in the laboratory during sample preparation or analysis. To prevent the inclusion of non-site-related constituents in the risk assessment, the concentrations of constituents detected in blanks shall be evaluated in accordance with the most current versions of the USEPA Contract Laboratory Program *National Functional Guidelines for Superfund Organic Methods Data Review* and *National Functional Guidelines for Inorganic Superfund Data Review*.
- (5) *Tentatively Identified Compounds (TIC)* - An effort to classify TIC into compound classes should be conducted and a qualitative judgment of the potential toxicity, at the class level, without definitive identification of each compound, should be made. If the chemical class contains carcinogenic or otherwise toxic constituents, then confirmation of the identity of the TIC may be indicated. When only a few TIC are present and no historical or other site information indicates that a particular TIC may indeed be present at the site, the TIC are generally not included in the risk assessment. A TIC may be eliminated from the list of COC if: (a) the Department concurs that the TIC is not known or suspected to be present at an AOI (i.e., the TIC is not associated with current or historical operations at the AOI and the TIC is not a transformation product of constituents present at the AOI); (b) no toxicity values are

available for the TIC; and (c) the TIC is not the primary COC at the AOI in terms of distribution and concentration. However, when a TIC is known or suspected to be present at an AOC or an AOI, the identities of the TIC shall be confirmed using SAS and/or the methods presented in *Guidance for Data Useability in Risk Assessment (Part A), Final* (EPA 1992) and the TIC shall be included as a COC. In addition, a TIC that has an EPA toxicity value shall be identified as a COC and included in the RECAP process. Note: The identification of TIC is not required at sites impacted with petroleum hydrocarbons.

The results of the **data evaluation** shall be presented in the RECAP submittal and shall address: (1) the appropriateness of the analytical method used and the reporting limits; (2) the results of the blank analyses; (3) the TIC detected; (4) any calibration or matrix spike recoveries outside the acceptable range; (5) the results of the performance evaluation; and (6) the precision of the analyses. Based on the evaluation of the QA/QC data and the reported results, the Submitter shall make recommendations in the RECAP submittal concerning the usability of the data for RECAP purposes. Data determined not to be acceptable for RECAP shall be identified and justification for the determination shall be given. General guidelines on determining the usability of data for risk assessment purposes can be obtained in *Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Volume I, Part A* (EPA 1989). More detailed guidelines are available in *Guidance for Data Useability in Risk Assessment, Part A, Final* (EPA 1992).

If the Submitter opts to use EPA Contract Laboratory Program (CLP) Statement Of Work (SOW) methods, data validation shall be conducted in accordance with the the most current versions of *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* and *Laboratory Data Validation Functional Guidance for Inorganic Superfund Data Review; Guidance on Environmental Data Verification and Data Validation* (EPA 2002); and *Guidance for Data Useability in Risk Assessment, Part A* (EPA 1992). These guidelines may also be used to review non-CLP data where applicable.

The use of **historical data** in the RECAP process shall be in accordance with the following guidelines:

- (1) The quality of historical data shall be determined prior to their use in the RECAP. Historical data shall be compared to current data with respect to analytical methods, QA/QC, and reported concentrations. Historical data may be combined with current data to determine the AOIC if: (a) the methods used to analyze the samples are similar in terms of the types of analyses conducted and the QA/QC procedures followed; and (b) the constituents and concentrations detected in the historical data are consistent with the current data (i.e., the historical data are representative of current site conditions).
- (2) Historical data of **unknown** quality may be used qualitatively but may **not** be used in determining the AOIC.

- (3) Sampling techniques, analytical methods, QA/QC procedures, and quantitation limits for the historical data shall be documented in the RECAP submittal.
- (4) Historical data may **not** be combined with current data to determine the AOIC if:
 - (a) the methods used to analyze historical data are dissimilar to those used to collect the current data; or
 - (b) the methods and QA/QC are similar for the historical and current data sets, but the concentrations of a COC are significantly different for a defined AOI, i.e., data are not representative of current site conditions. For these situations, the most recent data set shall be used in determining the AOIC or CC.
- (5) If the methods and QA/QC are similar for the historical and current data sets, the historical data may be used for a quantitative analysis of changes in constituent concentrations over time.
- (6) The elimination of any data set shall be justified and fully described in the RECAP submittal (*Guidance for Data Useability in Risk Assessment*, EPA 1992; *Supplemental Region IV Risk Assessment Guidance*, EPA 1992).

2.2.4 Data Format

Data shall be submitted in a tabular format in accordance with the RECAP forms presented in Appendix C or similar format containing all the information contained in the Appendix C format. In addition, a summary table of data to be used in the RECAP assessment shall be provided in the submittal for each impacted medium and shall include the analyte, the number of samples, the frequency of detection, the reporting limits, the minimum concentration detected, the maximum concentration detected, and the mean (UCL-AM) concentration (if applicable) detected for each medium. The data shall be segregated by medium and source area (i.e., if multiple releases are under investigation, then the data shall be segregated by source/release site). The data shall be presented in units of mg/kg (soil, sediment, and biota), mg/l (water), or $\mu\text{g}/\text{m}^3$ (air). The QA/QC data (sample documentation, initial and continuing calibration data, determination and documentation of quantitation limits, analyte identification and quantitation, QC blanks, matrix spike recoveries, performance evaluation samples, analytical error determination, and total measurement error) shall be included in the RECAP submittal. The raw analytical data including chromatograms and additional QA/QC information may be requested by the Department on an “as-needed” basis and shall be retained by the Submitter for a period of at least three years.

2.2.5 Identification of the Constituents of Concern

Constituents of Concern (COC) are the constituents that are site-related and the focus of the RECAP assessment. A COC list shall be developed for each impacted medium. Constituent speciation should be identified where appropriate, e.g., chromium, mercury, barium, etc. All constituents detected shall be identified as COC until it has been adequately demonstrated that reported concentrations are less than or equal to the applicable limiting SS or RS. A reduced COC list may be approved by the Department

for environmental fate and transport modeling under MO-3 when sophisticated, three-dimensional groundwater models are being used to predict future CC. The COC on the reduced list shall be identified based on migration potential, frequency of detection, concentration, and toxicity. The RECAP submittal should present all constituents detected at the AOI, the COC identified for each medium, and the rationale for eliminating constituents from the COC list(s). Additional guidelines for petroleum hydrocarbons, carcinogenic PAHs, produced water, sodium chloride, dioxins/furans, PCB, nitrogenous constituents (ammonia, nitrate, nitrite), acids and caustics are presented in Appendix D.

Any variance from these requirements is subject to Department approval prior to submission of the RECAP evaluation.

2.3 Exposure Assessment

The exposure assessment shall include: (1) characterization of the exposure setting including current and future land use at and in the vicinity of the AOI; identification of current and future on-site and off-site receptor populations and sensitive subpopulations; identification of all potential current and future exposure pathways including an evaluation of constituent sources (primary, secondary, etc.), receiving media, fate and transport in release media, potential exposure points (within a one-mile radius of the AOI), and exposure routes; (2) quantification of the AOIC for impacted soil and sediment the CC for groundwater, vapor concentration in indoor air, and exposure concentration for biota; and (3) application of standard default reasonable maximum exposure (RME) assumptions under the SO, MO-1, and MO-2 (refer to Appendix A) or identification and documentation of site-specific exposure data representative of a RME scenario under MO-3 (in the absence of site-specific exposure data, default RME assumptions shall be used). When a standard default exposure parameter is revised by the EPA, the revised value may only be used under MO-3. Under the SO, MO-1, and MO-2, the default exposure parameters in Appendix A shall be applied. The exposure assessment shall be conducted in accordance with the current EPA risk assessment guidance.

Constituent sources shall be identified based on site history and/or site investigation results. Migration pathways for the COC shall consider, where applicable, volatilization, fugitive dust generation/deposition, surface runoff, episodic overland flow, leaching, groundwater seepage, and biota uptake. Exposure media shall include currently impacted media to which receptors are being exposed or may be exposed or through which COC may be transported to potential receptors, and currently unimpacted media that may become impacted in the future due to COC transport. Source media shall include currently impacted media that may result in the transfer of constituents to another medium. Exposure points and potential exposure points shall be identified by determining if and where the known or potential receptors may come in contact with an exposure medium. All current or potential points of contact between a receptor and an exposure medium shall be identified as exposure points. The exposure pathways and potential exposure pathways shall be identified based on the anticipated receptor activities at the exposure point(s). The identification of receptors and potential receptors shall consider current and future land use at the AOI.

All current and potential exposure pathways shall be included in the assessment unless it is adequately demonstrated that an exposure pathway(s) is incomplete and the Department concurs with the finding. Exposure pathways that are determined to be incomplete shall be documented as incomplete. Where applicable, documentation shall include monitoring and/or modeling data.

Documentation that a groundwater exposure pathway is incomplete shall include, but may not be limited to: (1) characterization of site geology/hydrology; (2) identification of potential exposure points for a COC present in or migrating with groundwater, e.g., surface discharge point such as surface water body, a water supply well [a LDNR listing within a one-mile radius (unless otherwise warranted) obtained within the last 12 months] or an enclosed structure subject to vapor intrusion; and (3) demonstration that constituent concentrations will not exceed acceptable concentrations at identified exposure points. For the identification of future POE (via a detailed site-specific groundwater environmental fate and transport analysis), constituent migration shall be simulated until the maximum concentration is predicted at the point of compliance (POC) and the simulation period shall not be less than 70 years unless otherwise approved by the Department.

Documentation that a soil exposure pathway is incomplete shall include, but may not be limited to, demonstration that: (1) a receptor will not come in direct contact with COC due to the presence of a permanent structure (i.e., a well established building or similar structure located in an area of established, controlled land use that is not anticipated to change in the future or the planned development of a well established building or similar structure in an area of established, controlled land use); and (2) receptors will not be exposed to COC migrating from the soil to other media such as air, groundwater, or surface water at unacceptable concentrations. If it is adequately demonstrated that exposure to constituents present in soil will not occur, the Department may allow the soil to be evaluated as a source medium only. It should be noted that: (1) if a permanent structure is removed, then the exposure pathways for soil shall be considered complete, and exposure to COC present in the soil shall be evaluated under RECAP based on the future use of the land; and (2) for most land use scenarios, fences and concrete (or asphalt) coverings shall not be considered permanent structures and shall not serve as adequate justification that soil exposure pathways are incomplete. Soil (0-15 ft bgs) containing constituent concentrations above the applicable RS shall not remain in place unless: (1) Department approval is granted based on site-specific conditions; (2) there is sufficient financial assurance/commitment to ensure that the property will remain usable and in commerce; and (3) institutional controls are employed to ensure that unacceptable exposure does not occur (refer to Section 2.6.4).

2.3.1 Soil

2.3.1.1 Land Use

Current and future land use shall be determined in order to characterize the activities and activity patterns of the potentially exposed population. Current land use shall be

determined for the assessment of cross-media transfer, resource aesthetics, and beneficial uses of the land at the site. The current and/or future land use category assigned to the AOI is subject to Department approval. The following land use categories shall be used for the RECAP:

Industrial/Commercial

Industrial/Commercial land use refers to any property not currently used for human habitation on a permanent or temporary/intermittent basis having the following North American Industry Classification System (NAICS) major group numbers 11-56; 61 (except 61111); 62 (except 623, 62411, 62422, and 62441); 71; 72 (except 721191, 721211, and 72131); 81 (except 81411); and 92 (except 92214). The NAICS codes are defined in Appendix E. Industrial/Commercial property shall include any block(s) or lot(s) of land controlled by the same owner or operator that are vacant land(s) found within or beside developed land(s). For leased lands, industrial/commercial property includes the leasehold and any containers, vessels, tanks, or any other contrivances or units that provide for the management of COC to or from the leasehold.

If the Submitter proposes to manage the AOC or AOI under an industrial/commercial land use scenario, the AOC or AOI shall meet the following additional criteria: the facility is zoned for industrial use (areas not zoned shall be considered as industrial if the property is currently used for industrial purposes and the use falls under one or more of the NAICS codes) and future use of the property remains industrial. A conveyance notification shall be placed on all industrial properties having residual constituent concentrations in soil that are greater than the risk-based RS for non-industrial land use (i.e., the AOIC is greater than the $Soil_{ni}$ or constituent concentrations in soil have been demonstrated to produce indoor air concentrations greater than the IA_{ni}) refer to Section 2.6.4 for additional information on institutional controls.

If a residential dwelling is located within the AOI (e.g., house trailer on industrial property), the land use shall be considered residential for the purpose of management of the AOI under the RECAP. In some cases, an industrial facility may house a day care center within the boundaries of the facility or a person or persons reside at the facility in a designated housing unit. The Submitter, in order to retain and use the industrial scenario, shall demonstrate to the Department that acceptable exposure levels (RS) for a non-industrial scenario will not be exceeded at the day care center or housing unit.

If constituent migration from an industrial site has impacted an adjacent residential area, an industrial AOI and a residential AOI shall be identified. It should be noted that industrial dumping on rural land does not constitute industrial land use.

If land use at an AOI managed under the RECAP changes (or is likely to change) from industrial/commercial to non-industrial, the Submitter/responsible party is required to notify the Department within 30 days.

Non-industrial

Non-industrial land use refers to any property that does not meet the exclusive definition of an industrial property. Such properties may be residential, recreational, or undeveloped lands that are not included in the industrial property description. Areas of residential housing located on industrial/commercial properties such as colleges, universities, and professional schools (NAICS 61121 and 61131) shall be addressed using a residential scenario. For the SO, MO-1, and MO-2, a non-industrial land use scenario shall be represented by a default RME residential scenario.

If future land use is unknown at the AOI, a future non-industrial scenario shall be assumed for the assessment of exposure unless there is a strong reason to assume otherwise. Justification/documentation for not considering a non-industrial scenario shall be included in the RECAP submittal.

For further guidance on land use issues refer to *Land Use in the CERCLA Remedy Selection Process* (EPA 1995).

2.3.1.2 Identification of the Area of Investigation for Soil

Surface soil is defined as the soil interval present from ground surface to a depth of 15 feet bgs. If the depth of impact is less than 15 feet bgs, then the surface soil shall be defined as the interval present between ground surface and the depth of impact. Soil present from ground surface to a depth of 15 feet bgs is considered potentially accessible and thus, a potential source of exposure, based on the fact that future intrusive soil activities at the site may result in deeper soils being brought to the surface. A depth of 15 feet was selected based on considerations of technical practicability for routine activities requiring the movement of soil. If the Department determines that it is warranted based on site-specific conditions or if the Submitter elects, the 0-15 feet bgs interval may be divided into two AOI for the assessment of direct contact exposure: (1) 0-3 feet bgs; and (2) 3 feet bgs to depth of impact (up to 15 feet bgs).

Subsurface soil is defined as the soil interval present from 15 feet bgs to the depth of impact.

The **Area of Investigation (AOI)** is the zone contiguous to, and including, impacted soil defined vertically and horizontally by the presence of one or more constituents in concentrations that exceed the limiting screening or RECAP standard. The AOI shall be delineated using the limiting standard from a lower tier of assessment or the limiting standard for the option currently being implemented. Delineation of the AOI is subject to Department approval.

The soil AOI shall be delineated by comparing the constituent concentration detected at each sampling location with the appropriate limiting soil standard for the Option being implemented. All sampling locations having a constituent concentration that exceeds the limiting soil standard shall be identified for inclusion in the AOI. Based on these identified sampling locations, the horizontal and vertical boundaries of the AOI shall be delineated. The soil AOI shall be a three-dimensional space which contains all data

points with constituent concentrations above the limiting soil SS or the limiting soil RS and all points contained **within** that space whether the concentrations are less than, equal to, or greater than the limiting soil SS or the limiting soil RS. Sampling locations **outside** the delineated AOI with reported constituent concentrations less than the limiting soil SS or the limiting soil RS shall be eliminated from further consideration.

If the depth of impact is greater than 15 ft bgs, then two soil AOI shall be identified: (1) a surface soil AOI for the evaluation of exposure (the soil interval extending from ground surface to a depth of 15 feet bgs); and (2) a soil AOI extending from ground surface to the depth of impact for the evaluation of cross-media transfer and aesthetics.

For an AOC with site characteristics (e.g., land use, exposure pathways, COC distribution, multiple releases, or other unusual site conditions) that require special consideration when identifying the soil AOI, refer to the guidelines presented below.

(1) To determine if more than one AOI should be identified at an AOC, site-specific conditions such as the release history, constituent type(s) and distribution, land use, receptor activity patterns, and exposure pathways at the AOC shall be taken into consideration. The identification of multiple AOI within an AOC is subject to Department approval. Multiple AOI within an AOC shall be identified as follows:

(a) If the AOC contains impacted areas (i.e., areas characterized by constituent concentrations above the limiting SS or RS) that are distinctly separated by non-impacted areas (i.e., areas characterized by constituent concentrations less than or equal to the limiting SS or RS), then multiple AOI shall be identified. In general, a limited area defined by one or two non-detect sampling locations will not be considered adequate to divide an AOC into two AOI unless the impacted areas are characterized by different constituents indicating the presence of two separate releases.

(b) If an AOC is comprised of multiple releases characterized by different constituents and distinct areas of impact can be delineated for each release, then an AOI shall be identified for each release.

(c) If multiple constituents are present at the AOC, the Submitter may: (i) identify one AOI that includes all of the COC (i.e., the boundaries of the AOI shall be defined by all sampling locations that have at least one constituent present at a concentration that exceeds the limiting standard for the Option being implemented); or (ii) identify an AOI for each constituent present within the AOC (i.e., the boundaries of an AOI for one constituent shall be defined by the sampling locations that have concentrations that exceed the limiting standard for that particular constituent). Note: Multiple AOI identified for each constituent will be superimposed on one another.

(d) If land use varies within the AOC (e.g., constituents have migrated from an industrial site to a residential area), then an AOI shall be identified for each type of land use within the AOC (refer to Figure 2). Where appropriate, site-specific

factors such as property boundaries and receptor activity patterns shall be taken into consideration when delineating the boundaries of the AOI.

(e) The Submitter may elect to divide the soil AOI for surface soil into two AOI: 1) ground surface to 3 feet bgs; and 2) 3 feet to 15 feet bgs. If warranted based on site-specific conditions, the Department may require that two AOI be identified for surface soil (ground surface to 3 ft bgs and 3-15 ft bgs).

(2) If only 1 or 2 sampling locations have a constituent concentration that exceeds the limiting SS or RS, it is not possible to identify an AOI as presented above. Therefore, the Submitter may: (a) evaluate the constituent under a higher tier; (b) conduct further site investigation to confirm the AOIC; (c) conduct further investigation to obtain additional data to evaluate a specific pathway of concern (e.g., SPLP data for the soil to groundwater pathway); or (d) remediate the area exceeding the limiting SS or RS.

Any variance from these requirements is subject to Department approval prior to submission of the RECAP evaluation.

2.3.1.3 Identification of the Area of Investigation Concentration for Soil

The **AOI concentration (AOIC)** is defined as: 1) the concentration of the COC in the soil to which the receptor is exposed or may be exposed in the future; and/or 2) the concentration of the COC in soil that may serve as a source for constituent transport and/or transfer to another medium of concern. The AOIC is the concentration of the COC in the soil that is compared to the limiting SS or the MO-1, MO-2, or MO-3 limiting RS to determine if the constituent concentrations present in the medium are acceptable (less than or equal to the limiting standard) or unacceptable (greater than the limiting standard) for the Option being implemented. The AOIC shall be presented in unit of parts per million (ppm) (mg/kg).

For the SO, the maximum detected constituent concentration in soil shall be used as the AOIC. The maximum concentration used in the screening process shall be representative of the most heavily impacted area(s) known or suspected to be present within the AOC. Identification of the most heavily impacted area(s) is subject to concurrence by the Department.

For MO-1, MO-2, and MO-3, the AOIC for soil shall be represented by an upper confidence limit on the arithmetic mean (**UCL-AM**) (e.g., 95%UCL-AM) constituent concentration determined to be statistically appropriate for the distribution of the site data. **All** data points (including data points with constituent concentrations less than, equal to, or greater than the limiting standard) located **on** or **within** the boundaries of the AOI shall be included in the calculation of the AOIC. It is the Department's preference that the UCL-AM concentration be calculated using the most current version of EPA's ProUCL software or a comparable statistical software program. The UCL value recommended by ProUCL shall be used as the soil AOIC unless it is determined by the Department that an alternate measure of the AOIC is more appropriate based on site-

specific conditions. Software input and output files shall be included in the RECAP submittal for each COC.

If the UCL-AM constituent concentration recommended by ProUCL is greater than the maximum detected concentration, or the dataset is too small to calculate a UCL-AM, then the maximum constituent concentration shall be identified as the AOIC.

An UCL-AM constituent concentration is used to represent the AOIC because: (1) carcinogenic and chronic noncarcinogenic toxicity criteria are based on a lifetime average exposure; (2) the average concentration is most representative of the concentration that would be contacted over time; and (3) there is uncertainty associated with estimating the true average concentration at an AOI. (The UCL provides reasonable confidence that the true AOI average will not be underestimated. The UCL-AM is defined as a value that, when calculated repeatedly for randomly drawn subsets of data, equals or exceeds the true mean 95 to 99 percent of the time.) The UCL-AM concentration is considered appropriate to represent the AOIC regardless of the pattern of daily exposures over time or the type of statistical distribution that might best describe the sampling data.

In the event the COC distribution at an AOI is such that standard statistical methods are not applicable or appropriate for the estimation of an upper bound mean constituent concentration, the Department may require that the limiting RS be met throughout the AOI. This approach serves to: (1) eliminate the uncertainty that may be associated with estimating an upper bound mean concentration at an AOI characterized by a unique COC distribution; and (2) ensure that the COC concentrations remaining at the AOI do not pose an unacceptable risk to human health or the environment.

When evaluating site data to determine whether or not a COC is site-related or background, the **arithmetic mean** (not the UCL-AM) concentration within the AOI shall be compared to the background concentration.

2.3.1.4 Identification of the Soil Source Area

The soil source area is defined as the area of impacted soil that is serving or may serve as a source for the transfer of constituents of concern (COC) from one medium to another (e.g., soil that may release volatile emissions to air and/or leach constituents to groundwater). Residual constituent concentrations in an environmental medium may serve as a source of constituent transport and/or transfer to another environmental medium. However, it should be noted that RECAP is applicable to sites that are in a declining condition (i.e., the primary source/original source of the contaminant release has been removed or mitigated and the constituent mass is not increasing). RECAP was not designed, or intended to be used to address sludges or other non-media sources. The objective of RECAP is to identify residual constituent levels in impacted media that do not pose unacceptable risk to human health or the environment.

For the identification of applicable RECAP standards and dilution factors, the soil source area is defined as the contiguous area of impacted soil within the vadose zone having COC concentrations that exceed the limiting standard applicable for the Option being

implemented. The source length (L) is defined as the longest length of the soil source area parallel to groundwater flow and source width (S_w) is defined as the longest length of the soil source area perpendicular to groundwater flow (refer to Figure 3). For LNAPL impacted sites, the soil source area should not include the impacted soil within the zone of groundwater fluctuation or smear zone present at the soil-groundwater interface (refer to Figure 4).

For sites where the vertical extent of contamination encompasses multiple soil intervals and potentially impacts deeper groundwater zones (eg., DNAPL impacted sites), the soil source area is defined as the contiguous area of impacted soil bounded by the shallow groundwater zone above and the deeper groundwater zone of interest below having COC concentrations that exceed the limiting standard applicable for the Option being implemented (refer to Figure 5). For groundwater classifications 2 and 3, a DF shall be identified for each impacted groundwater zone based on the soil source area, S_d , distance to the POE, and other relevant site conditions.

For sites with historical releases and where significant COC migration has already occurred, the soil source area may be based on the areal extent of the original source (e.g. pit or pond) and on site-specific conditions, if determine to be appropriate by the Department.

It should be noted that RECAP is applicable to sites that are in a declining condition, i.e., the original source of contaminant release has been removed or mitigated and the constituent mass is not increasing. For sites with NAPL present, a RECAP evaluation may be conducted for the development of corrective action standards; however, in no circumstance will an NFA be granted with NAPL present.

2.3.2 Groundwater

For the purpose of implementing the RECAP, groundwater shall be classified into Groundwater Classification 1, 2, or 3, as determined by current or potential use, maximum sustainable yield, and/or Total Dissolved Solids (TDS) concentration. Alternate means of groundwater classification may be considered by the Department in the final determination. Current groundwater use shall be determined for the assessment of cross-media transfer, resource aesthetics, and beneficial uses of groundwater at the site. The Groundwater Classification assigned to the aquifer(s) of concern by the Submitter is subject to Department approval. The information required to classify the groundwater zone(s) of concern at the AOI shall be collected during the site investigation and shall include: (1) the current use of the aquifer determined by identifying all existing water wells and usage within one-mile radius of the AOI property boundaries (at a minimum, a LDNR well survey obtained within the past 12 months and a 500-foot radius walking receptor survey shall be performed); (2) the maximum sustainable yield determined by well yield estimation methods or by direct measurements which are outlined in Appendix F; and/or (3) the site-specific total dissolved solids (TDS) concentration representative of the background conditions of the aquifer of concern determined by EPA Method 2540C. Note: Well yield measurements obtained from an

aquifer that is hydraulically connected to a nearby surface water body may be influenced by the surface water body and not representative of the aquifer storativity. Therefore, the aquifer may be classified as a Groundwater Classification 3 zone after an adequate demonstration is made to the Department that the well yield measurements are influenced by pumpage from the surface water body.

In order to take advantage of the groundwater information gathered from hundreds of sites across the State and to aid in expediting the remediation process, groundwater may be classified at a site using information from a nearby site if it can be demonstrated that the geological and hydrogeological conditions are similar between the sites. Review of boring logs, well completion diagrams, hydrological and hydrogeological data, including aquifer test data and potentiometric surface maps, should be reviewed to make the demonstration. Consideration should also be given to the existence of nearby pumping centers, perched water zones, nearby water bodies, faults, etc. Approval of a site groundwater classification using data from other area sites will be at the discretion of the Department and prior approval is REQUIRED.

All impacted underground waters of the state shall be evaluated using one of the groundwater classifications defined under RECAP.

2.3.2.1 Groundwater Classifications

The identifying criteria for the three Groundwater Classifications are defined as follows:

Groundwater Classification 1

Class 1A: Groundwater within an aquifer or that has a direct hydraulic connection to an aquifer that currently supplies drinking water to a public water supply. A public water supply is defined as a water supply which provides water to the public and has a minimum of 15 service connections or regularly serves a minimum of 25 individuals daily at least 60 days out of the year (State of Louisiana Sanitary Code);

or

Class 1B: Groundwater within an aquifer that could potentially supply drinking water to a public water supply. The aquifer should be sufficiently permeable to transmit water to a well at a maximum sustainable yield of greater than or equal to 4,800 gallons per day (gpd) (6 households x 4 persons per household x 100 gpd x peaking factor of 2); **and**

Groundwater quality is such that it has a TDS concentration less than or equal to 1,000 milligrams per liter (mg/l).

NOTE:

- (1) An aquifer meeting the Groundwater Classification 1 criteria is considered an underground source of drinking water and shall be protected or restored to its maximum beneficial use (residential use).

- (2) A water supply that serves greater than six households is considered to be a public water supply as it is assumed that the average household has four occupants. Each person in the household is considered to use 100 gallons of water per day (Louisiana Department of Health and Hospitals). To ensure that water is available on an as-needed basis, a peaking factor of two has been applied to the daily water consumption rate. Therefore, a value of 4,800 gpd has been established as the minimum sustainable yield for a public water supply.

Groundwater Classification 2

Class 2A: Groundwater within an aquifer that currently supplies water to a domestic water supply, agricultural supply or any other supply. A domestic water supply is defined as one which provides water to an individual household or households but is not considered to be a public water supply as defined in Groundwater Classification 1;

or

Class 2B: Groundwater within an aquifer that could potentially supply drinking water to a domestic water supply. The aquifer should be sufficiently permeable to transmit water to a well at a maximum sustainable yield of greater than or equal to 800 gpd and less than 4,800 gpd (4 persons per household x 100 gpd x peaking factor of 2); **and**

Groundwater quality is such that it has a TDS concentration less than or equal to 1,000 mg/l;

or

Class 2C: Groundwater within an aquifer that could potentially supply drinking water to a domestic water supply. The aquifer should be sufficiently permeable to transmit water to a well at a maximum sustainable yield of greater than or equal to 800 gpd; **and**

Groundwater quality is such that it has a TDS concentration greater than 1,000 mg/l and less than or equal to 10,000 mg/l.

NOTE:

- (1) If a public water supply well is located within one mile of the AOI property boundaries and is screened in the same stratum as the aquifer of concern or has a direct hydraulic connection, then the aquifer shall be classified as a Groundwater Classification 1 aquifer.

- (2) It is assumed that the average household has four occupants and that each person in the household uses 100 gallons of water per day (Louisiana Department of Health and Hospitals). To ensure that water is available on an as needed basis, a peaking factor of two has been applied to the daily water consumption rate. Therefore, a value of 800 gpd has been established as the minimum yield for a potential domestic water supply.
- (3) A yield of 800 gpd is approximately the median yield for an underground source of drinking water as defined by EPA (150-1440 gpd) (*Assistance on Compliance of 40 CFR Part 191 with Groundwater Protection Standards*, Memorandum, EPA, Office of Water, June 1993).
- (4) If the limiting RS for the protection of an aquifer meeting the definition of Groundwater Classification 2 is less than the limiting RS for the protection of an aquifer meeting the definition of Groundwater Classification 1, then the aquifer shall be managed as a Groundwater Classification 1 aquifer.

Groundwater Classification 3

Class 3A: Groundwater within an aquifer that is sufficiently permeable to transmit water to a well at a maximum sustainable yield of less than 800 gpd;

or

Class 3B: Groundwater quality is such that it has a TDS concentration greater than 10,000 mg/l.

NOTE:

- (1) If a domestic or agricultural water supply well is located within one mile of the AOI property boundaries and is screened in the same stratum as the aquifer of concern or has a direct hydraulic connection, then the aquifer shall be classified as a Groundwater Classification 2 aquifer.
- (2) If the limiting RS for the protection of an aquifer meeting the definition of Groundwater Classification 3 is less than the limiting RS for the protection of an aquifer meeting the definition of Groundwater Classification 2, then the aquifer shall be managed as a Groundwater Classification 2 aquifer.

The Groundwater Classifications are illustrated in Figure 6.

2.3.2.2 Point of Exposure and Point of Compliance

The **point of exposure (POE)** for groundwater shall be the point in the aquifer where exposure to groundwater is occurring or may reasonably be expected to occur. The **point of compliance (POC)** for groundwater shall be the point in the aquifer where the groundwater RS is enforced and where groundwater monitoring takes place. A sampling location positioned as near to the source as feasible without causing an adverse impact to

groundwater at which reproducible and representative samples can be withdrawn shall serve as the POC.

Based on site-specific conditions, the identification of more than one POC, POE, and/or RS may be warranted (e.g., GW₂ zone potentially discharging to a surface water body that is also the property boundary).

The POE and POC for GW₁ (and GW_{SS}), GW₂, and GW₃ are illustrated in Figure 7. The assumed points of exposure and the points of compliance for the groundwater classifications defined in Section 2.3.2.1 are as follows.

Groundwater Classification 1

The **POE** for an underground drinking water source meeting the criteria for Groundwater Classification 1 shall be assumed to be throughout the aquifer to be protected/restored.

The **POC** for the application of the groundwater SS (GW_{SS}) or limiting RS shall be a sampling location placed as near to the source as feasible without causing an adverse impact to groundwater at which reproducible and representative samples can be withdrawn. The groundwater SS or limiting RS shall be met throughout the aquifer to be protected/restored.

Groundwater Classification 2

In the absence of an on-site exposure point, the **POE** for an underground drinking water source meeting the criteria for Groundwater Classification 2 shall be assumed to be at the facility's property boundary (nearest to the source and/or downgradient of the source) or the nearest downgradient point off-site that could reasonably be considered for installation of a drinking water well within the aquifer to be protected/restored.

The **POC** for the application of the groundwater SS or limiting RS shall be a sampling location placed as near to the source as feasible without causing an adverse impact to groundwater at which reproducible and representative samples can be withdrawn. Appropriate and protective estimates of COC attenuation from the POC to the POE may be applied to the GW₂ RS prior to application at the POC. It should be noted that RECAP does not authorize the migration of COC offsite to adjacent property (but rather serves to evaluate the acceptability of constituent concentrations with respect to human health and the environment).

Groundwater Classification 3

The **POE** for a groundwater source meeting the criteria for Groundwater Classification 3 shall be assumed to be at the potential point of discharge to the nearest downgradient surface water body **within** the aquifer to be protected/restored i.e., a point within the aquifer that is located proximal to the point of groundwater discharge to surface water.

The **POC** for the application of the groundwater SS or limiting RS shall be a sampling location placed as near to the source as feasible without causing an adverse impact to

groundwater at which reproducible and representative samples can be withdrawn. Appropriate and protective estimates of COC attenuation from the POC to the POE may be applied to the GW₃ RS prior to application at the POC. It should be noted that RECAP does not authorize the migration of COC offsite to adjacent property nor the discharge of a COC to surface water (but rather serves to evaluate the acceptability of constituent concentrations with respect to human health and the environment). In lieu of demonstrating compliance at a single POC, the AOI UCL-AM concentration may be used for GW₃ zones under MO-1, MO-2, and MO-3.

2.3.2.3 Identification of the Area of Investigation

The groundwater plume (AOI) shall be delineated by comparing the constituent concentration detected at each sampling location with the appropriate limiting groundwater standard. All sampling locations having constituent concentrations that exceed the limiting groundwater standard shall be identified. Based on these identified sampling locations, the horizontal and vertical boundaries of the groundwater plume shall be delineated. The delineated groundwater plume shall be a three-dimensional space which contains all data points with constituent concentrations above the groundwater SS or the limiting groundwater RS and all points contained **within** that space whether the concentrations are less than, equal to, or greater than the groundwater limiting groundwater standard. Sampling locations **outside** the delineated plume with reported constituent concentrations less than the limiting groundwater standard shall be eliminated from further consideration.

2.3.2.4 Identification of the Compliance Concentration

The Compliance Concentration (CC) is the constituent concentration in groundwater that is compared to the groundwater SS or limiting RECAP Standard to determine if the constituent concentrations present in the groundwater are acceptable (less than or equal to the limiting RS) or unacceptable (greater than the limiting RS) for the Option being implemented.

Groundwater Classifications 1 and 2

The CC for groundwater classifications 1 and 2 shall be the COC concentration detected at the POC, i.e., the CC shall be representative of the maximum COC concentration in groundwater within the source area. The maximum detected concentration shall be used as the CC for the SO, MO-1, MO-2, and MO-3. The CC shall be determined at all POC for groundwater meeting the definition of Groundwater Classification 1 or 2 and shall be presented in units of mg/l. If an actual POE (e.g., a public or domestic well) is present within the AOC or the AOI, then the COC concentration detected at this POE shall also be used to demonstrate compliance with the limiting RS. Facilities with multiple groundwater plumes or multiple POC shall determine the CC for each plume and/or POC. The CC shall be compared to the SS or the limiting MO-1, MO-2, or MO-3 groundwater RS.

Groundwater Classification 3

For the SO, the maximum detected constituent concentration shall be used as the CC. The maximum concentration used in the screening process shall be representative of the most heavily impacted area(s) known or suspected to be present within the AOC. Identification of the most heavily impacted area(s) is subject to concurrence by the Department.

For MO-1, MO-2, and MO-3, the CC for a groundwater 3 zone may be represented by an upper confidence limit on the arithmetic mean (**UCL-AM**) constituent concentration determined to be statistically appropriate for the distribution of the groundwater data. The UCL-AM shall be based on **all** data points (including data points with constituent concentrations less than, equal to, or greater than the limiting standard) located **on** or **within** the boundaries of the groundwater AOI (i.e., plume). Groundwater concentrations are known to vary naturally over time, therefore, the UCL-AM shall be based on the most current groundwater monitoring data. The UCL-AM concentration shall be representative of the spatial distribution of the COC within the aquifer. It is not the intent that a UCL-AM be calculated for data collected over time from single location, e.g., a monitoring well(s). It is recommended that the UCL-AM concentration be calculated using EPA's ProUCL software or a comparable statistical software program. The UCL value recommended by ProUCL shall be used as the groundwater CC. Software input and output files shall be included in the RECAP submittal for each COC. If the UCL-AM constituent concentration recommended by ProUCL is greater than the maximum detected concentration, or if the groundwater dataset is inadequate to calculate a UCL-AM, then the maximum constituent concentration shall be identified as the CC.

Groundwater Source Area

For the identification of MO-1 and MO-2 dilution factors for groundwater classifications 2 and 3, the soil and groundwater source areas are assumed to have the same source width and source length. The source length (L) is defined as the longest length of the soil source area parallel to groundwater flow and source width (S_w) is defined as the longest length of the soil source area perpendicular to groundwater flow (refer to Section 2.3.1.4 and Figures 3 and 4).

For sites where the vertical extent of contamination encompasses multiple soil intervals and potentially impacts deeper groundwater zones (e.g., DNAPL impacted sites), the soil source area is defined as the contiguous area of impacted soil bounded by the shallow groundwater zone above and the deeper groundwater zone of interest below having COC concentrations that exceed the limiting standard applicable for the Option being implemented (refer to Figure 5). For groundwater classifications 2 and 3, a DF shall be identified for each impacted groundwater zone based on the soil source area, S_d , distance to the POE, and other relevant site conditions.

Groundwater Modeling

For the prediction of future constituent concentrations at the POC or potentially reaching a POE, the lower of the UCL-AM constituent concentration and the maximum detected concentration may be used as the baseline source concentration for groundwater environmental fate and transport models. **All** data points (including data points with constituent concentrations less than, equal to, or greater than the SS) located **on** or **within** the boundaries of the groundwater plume shall be included in the calculation of the UCL-AM concentration unless skewed due to sample bias. For an environmental fate and transport model which allows for the input of multiple constituent concentrations, the constituent concentrations detected at individual sampling locations shall be used. Facilities with multiple groundwater plumes shall model separate CC for each plume. For the evaluation of future exposure/risk under MO-3, the highest concentration predicted (via modeling) to reach the POE(s) shall be used to demonstrate compliance with the limiting RECAP standard over time. Constituent migration shall be simulated until the maximum concentration is predicted at the POE and the simulation period shall not be less than 70 years unless otherwise approved by the Department.

2.3.3 Sediment

The AOI for sediment shall be delineated by comparing the constituent concentration detected at each sampling location with a site-specific sediment screening standard based on: 1) a Department-approved analytical reporting limit, 2) a Department-approved background concentration (refer to Section 2.5.3.9), or 3) other Department-approved sediment quality criterion or benchmark. All sampling locations having a constituent concentration that exceeds the site-specific Department-approved screening standard shall be identified. Based on these identified sampling locations, the horizontal and vertical boundaries of the AOI shall be delineated. The sediment AOI shall be a three dimensional space which contains all data points with constituent concentrations above the site-specific Department-approved screening standard and all points contained **within** that space whether the concentrations are less than, equal to, or greater than the screening concentration. Depending on the pathways of concern, the Department may require the identification of an AOI representative of the biological active interval (top 10-15 cm). Sampling locations **outside** the defined AOI with reported constituent concentrations less than the site-specific Department-approved screening standard shall be eliminated from further consideration. Any variance from these requirements is subject to Department approval.

The AOIC for sediment shall be determined using the method(s) deemed most appropriate for the environmental fate and transport and/or exposure pathways identified for evaluation at the AOI (e.g., recreational direct contact exposure, bioaccumulation, toxicity to benthic fauna, etc.). The AOIC shall be based on an upper bound estimate of the average COC concentration within the AOI. The methods used to determine the sediment AOIC are dependent on the pathway(s) of concern and are subject to Department approval.

2.3.4 Biota

The exposure concentration for biota shall be based on the arithmetic mean constituent concentration for the edible portion(s) of the samples collected. A tissue residue concentration shall be established for each target species or group of species as appropriate based on species-specific and site-specific considerations. For the evaluation of fish and shellfish tissue residues, refer to *Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish* (LDHH, LDEQ, LDAF, and LDWF 2012) for further guidance on calculating tissue concentrations. Tissue concentrations shall be presented in units of mg/kg.

2.3.5 Indoor Air (Vapor Intrusion Pathway)

Vapor intrusion is the migration of hazardous vapors from a subsurface source through the vadose zone and into indoor air. Subsurface sources of vapors generally include soil and/or groundwater that are impacted with a constituent that has sufficient volatility and toxicity and is present at sufficient concentrations to pose a possible inhalation risk within overlying buildings. The approach(es) used to measure/estimate COC concentrations in indoor air due to vapor intrusion is dependent upon the type(s) of sampling conducted at the AOI (e.g., indoor air, sub-slab soil gas, etc). Refer to Appendix G for guidance on addressing the vapor intrusion pathway.

2.4 Toxicity Assessment

2.4.1 Toxicity Values

The toxicity values used to assess noncarcinogenic health effects under the RECAP include chronic oral reference doses (RfD_o) and chronic inhalation reference concentrations (RfC). The critical effect(s) identified as the basis for the development of the RfD and/or RfC (or equivalent toxicity value) shall be identified for the assessment of potential additive health effects when multiple COC are under evaluation.

The toxicity values used to assess carcinogenic health effects include oral slope factors (SF) and air unit risk values. The weight-of-evidence classification accompanying the oral slope factor and air unit risk value shall be identified for each carcinogenic COC.

EPA Directive 9285.7-53 presents the current technical and policy recommendations regarding the sources of toxicity information to be used in performing human health risk assessments. The recommended hierarchy of toxicological information provided in this directive includes:

- Tier 1 EPA's Integrated Risk Information System (IRIS)
- Tier 2 EPA's Provisional Peer Reviewed Toxicity Values (PPRTV) derived by EPA's Superfund Health Risk Technical Support Center for the EPA Superfund Program

- Tier 3 Other Toxicity Values including EPA and non-EPA sources of toxicity information. Priority should be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed.

The RECAP SS, MO-1, MO-2 Standards contained within the regulation (i.e., Tables 1-3, Appendix G, Appendix H) were derived using toxicity values obtained from EPA's IRIS database. If a toxicity value was not available in IRIS, then an EPA PPRTV was used. Refer to Appendix A Table A-1 and Appendix D Table D-4 for the toxicity values that were used in the development of the SS, MO-1, Appendix G and Appendix H RS. Tier 3 toxicity values were not used in the development of the SO SS (Soil_{SSni}, Soil_{SSi}), MO-1 RS (Soil_{ni}, Soil_i, Soil_{GW1}, Soil_{GW2}, GW_{SS}, GW₁, GW₂), IA_{ni}, IA_i, ESG_{ni}, ESG_i, SSSG_{ni}, SSSG_i, or the Appendix H MO-2 RS (Soil_{ni}, Soil_i, Soil_{GW1}, Soil_{GW2}, GW_{SS}, GW₁, GW₂). In the absence of a Tier 1 or Tier 2 toxicity value, a Tier 3 toxicity value was used for MO-1 and Appendix H MO-2 GW_{3DW}, GW_{3NDW}, Soil_{GW3DW}, Soil_{GW3NDW} since these are environmental fate and transport RS as opposed to risk-based RS.

For COC not listed in RECAP (Tables 1-3, Appendix G, and Appendix H) and site-specific RECAP Standards developed under MO-2 and MO-3, toxicity values shall be obtained from EPA's IRIS or PPRTV databases. In the event a toxicity value is not available in the IRIS or PPRTV databases, then Tier 3 toxicity values may be used if approved by the Department. Tier 3 values typically include Agency for Toxic Substances and Disease Registry (ATSDR) Chronic Minimum Risk Levels (MRL); California Environmental Protection Agency Office of Environmental Health Hazard Assessment's Chronic Reference Exposure Levels (REL) and Cancer Potency Values; and EPA's Superfund Program's Health Effects Assessment Summary (HEAST) (EPA 2012). The Department will determine if the Tier 3 toxicity values selected are appropriate for site-specific conditions and comply with the criteria set forth in Directive 9285.7-53. Due to the potential uncertainty in the quality of the underlying toxicity data, PPRTV Appendix screening values are intended for use in limited circumstances when no Tier 1, 2 or 3 values are available. These values are not considered to be suitable for the development of regulatory levels that are applied at a wide variety of sites (i.e., SS, MO-1 RS, Appendix G indoor air standards, and Appendix H MO-2 standards). However, these values may be considered acceptable on a site-specific basis.

Screening standards and MO-1 RS for COC not listed in RECAP (Tables 1-3, Appendix G, and Appendix H) and site-specific MO-2 and MO-3 RS shall be developed using the most current toxicity values available. SS and MO-1 RS in Tables 1, 2 and 3, Appendix H MO-2 RS, and Appendix G IA values are regulatory standards and cannot be re-calculated using revised toxicity values. These standards can only be revised through formal regulatory procedures.

If the toxicity of a COC is dependent on the speciation/isomer present and the speciation of the COC cannot be determined based on the nature of the release and speciation/isomer data are not available, then it shall be assumed that the most toxic speciation/isomer of the COC is present at the AOI.

2.4.2 Constituents or Exposure Routes Without Toxicity Values

If a toxicity value for a COC is not available from a Tier 1, 2, or 3 source, then the following options may be considered: 1) a screening value developed in the Appendix of a PPRTV; or 2) a surrogate approach using a tier 1, 2 or 3 toxicity value for a constituent with similar physical/chemical properties, critical effects, mechanism of action, and/or toxicokinetics. Screening values are intended for use in limited circumstances when no Tier 1, 2, or 3 values are available. A screening value or surrogate toxicity value identified by the Submitter shall receive approval from the Department **prior** to the use of the value in a RECAP assessment. To receive approval, supporting documentation for the selection of the surrogate toxicity value shall be included in the assessment. References for toxicity values and toxicological data cited shall be included in the report.

EPA toxicity values for the dermal route of exposure are not available. The oral toxicity values adjusted for gastrointestinal absorption shall be used for the evaluation of the dermal route of exposure in accordance with *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual*, EPA 1989; *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E Supplemental Guidance for Dermal Risk Assessment) Final* (EPA 2004).

The generic route-to-route extrapolation of toxicity values (e.g., oral to inhalation and inhalation to oral) is not recommended. Chemical-specific route-to-route extrapolation may be used if it is determined to be appropriate after consideration of chemical-specific factors that affect toxicity (e.g. port-of-entry, first-pass, and or other route-specific effects) (EPA Mid-Atlantic Regional Screening Levels Frequently Asked Questions May 2012).

2.4.3 Toxicity Values for Constituents with Special Considerations

Refer to Appendix D for the toxicity values/approaches for addressing mutagens, total petroleum hydrocarbons, polycyclic aromatic hydrocarbons, lead, polychlorinated dibenzodioxins/polychlorinated dibenzofurans, polychlorinated biphenyls, nitrate/nitrite/ammonia, and nontraditional parameters such as chlorides, sulfate, pH, etc.

For some constituents, for example benzene, IRIS presents a cancer slope range rather than a single slope factor estimate. The set of risk estimates falling within this interval reflects both the inherent uncertainties in the risk assessment of the constituent, limitations of the epidemiological studies in determining dose-response and exposure data, and the lack of a scientific basis for choosing a single result from various model estimates. EPA considers any value within the range scientifically defensible but recommends the use of the upper limit value (EPA IRIS). Therefore, for a COC that has been assigned a range of slope factors or air unit risk values, the risk estimate representing the upper bound of the range shall be used to develop SO SS, MO-1 RS, IA, and Appendix H MO-2 RS. Alternate values within the slope factor or air unit risk range may be used under MO-2 or MO-3 if approved by the Department with the exception of MO-3 RS that are based on an alternate target cancer risk.

2.5 Risk Characterization

Acceptable risk levels for site management decisions under the SO, MO-1, MO-2, and MO-3 shall be determined in accordance with the following guidelines.

If there are public health concerns associated with exposure to constituents present at or migrating from the AOI, further evaluation and/or recommendations from LDHH/OPH may need to be incorporated into the decision-making process.

2.5.1 Target Risk Levels for Carcinogens

Screening Standards and RECAP Standards for carcinogens shall be based on a target cancer risk of 10^{-6} in accordance with EPA guidelines and policy (*Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual Part B Development of Risk-Based Preliminary Remediation Goals*, EPA 1991; *Soil Screening Guidance*, EPA 1996; *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*, EPA 2001; *Role of Baseline Risk Assessment in Superfund Remedy Selection Decisions*, EPA 1991; NCP 40 CFR 300.430(e)(2); and *Regional Screening Table User's Guide*, Mid-Atlantic Risk Assessment USEPA Regions 3, 6, and 9). For carcinogens, it is generally assumed that setting a 10^{-6} target risk level for individual constituents and pathways will result in a total cumulative cancer risk that is within the acceptable risk range of 10^{-6} to 10^{-4} (*Soil Screening Guidance*, EPA 1996). Therefore, since a target risk level of 10^{-6} is used in the development of SS and RS, it is generally not necessary to adjust RS when there is exposure to multiple carcinogens or exposure via multiple media. The SS, MO-1, Appendix G, and Appendix H RS based on carcinogenic health effects are footnoted with "C".

The Department has a preference for site management decisions that meet the more protective end of the target risk range (i.e., 10^{-6}). However, an alternate target risk level may be approved by the Department for the development of site-specific MO-3 RS when it has been adequately demonstrated to be appropriate for site-specific conditions under current and future land use and sufficient site-specific data have been provided to support the decision. In general, the better site conditions have been characterized, the less uncertainty there is associated with the site and thus the more likely the Department is to approve site management decision based on a higher target risk level. Factors taken into consideration by the Department in the selection of a MO-3 site-specific target cancer risk level include the level of certainty in the nature and extent of impact; the reasonableness of site-specific exposure data under current and future land use and the adequacy of supporting documentation; the potential for cross-media impacts and the ability to monitor and control movement of COC at the site; level of certainty in future site use; the reliability of remedial alternatives; technical limitations to remediation; financial assurance/commitment; the use of ARARs, background concentrations, and quantitation limits as remedial standards; potential impacts to ecological receptors; the potential for noncarcinogenic health effects; and adequate documentation that the total cumulative cancer risk is less than or within the target range of 10^{-6} to 10^{-4} .

If the total cumulative cancer risk estimate exceeds the target risk, then typically, further evaluation or corrective action shall be warranted. Carcinogenic COC, exposure pathways, and media screened out under previously completed Options shall not be included in the calculation of the total cumulative cancer risk for the Option currently being implemented at the AOI. It should be noted that corrective action may be warranted even if the cancer risk is within the target range if: (a) a chemical-specific standard that defines acceptable risk (ARAR) is exceeded; (b) the potential for noncarcinogenic adverse health effects is unacceptable ($HI > 1.0$); (c) an adverse environmental impact has occurred or may occur; and/or (d) ecological risks are unacceptable.

2.5.2 Target Hazard Index for Noncarcinogens

RECAP Screening Standards shall be based on a target hazard quotient of 0.1 and therefore generally do not require adjustment for additive health effects when multiple COC or impacted media are present.

RECAP MO-1, MO-2, and MO-3 Standards shall be based on a target hazard quotient of 1.0 in accordance with EPA guidelines (*Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual, Part B - Development of Risk-Based Preliminary Remediation Goals*, EPA 1991; *Soil Screening Guidance*, EPA 1996; *Regional Screening Table User's Guide*, Mid-Atlantic Risk Assessment USEPA Regions 3, 6, and 9). A target hazard quotient of 1.0 corresponds to an acceptable exposure level for exposure to a single constituent via a single medium. Therefore, a RECAP Standard based on a target hazard quotient of 1.0 represents an acceptable exposure concentration for exposure to a single constituent via a single medium. If multiple COC are present and/or exposure is occurring to more than one impacted media (e.g., direct contact with soil and household use of groundwater), the RECAP standards based on noncarcinogenic health effects must be evaluated for potential additive health effects and if warranted, the target hazard quotient or RS shall be adjusted so that the total hazard index for each critical health effect/target organ is less than or equal to 1.0. In general, RECAP Standards based on noncarcinogenic health effects shall be adjusted to account for additive health effects associated with: 1) exposure to more than one constituent that has the same critical effect or target organ as defined by the RfD and/or RfC; and 2) exposure to more than one environmental medium that contains the same COC. The SS, MO-1 RS, Appendix G IA RS, and Appendix H RS based on noncarcinogenic health effects are footnoted with "N".

The risk-based RECAP Standards requiring adjustment include: (1) Soil_{ni}; (2) Soil_i; (3) IA based on a risk-based standard; (4) GW₁ based on a risk-based standard; and (5) GW₂ based on a risk-based standard. The RS that do not require modification to account for additivity include: (1) Soil_{GW}; (2) Soil_{sat}; (3) GW₃; (4) Water_{sol}; (5) ESG_{ni}; (6) ESG_i; (7) SSSG_{ni}; (8) SSSG_i; (9) Soil_{LS}; (10) 1E+05 ceiling limit based on aesthetics; (11) a RS based on an approved reporting limit; (12) a RS based on an approved site-specific or Department background concentration; (13) risk-based standard based on carcinogenic health effects; (14) a RS for lead; and (15) a RS based on a state standard such as the Louisiana Toxic Air Pollutant Ambient Air Standard or federal regulatory standard such as a groundwater RS based on an SDWA MCL. To identify the risk-based RS requiring

modification for additive health effects, the noncarcinogenic COC for the Option currently being implemented shall be grouped according to the critical effect. If more than one noncarcinogenic COC has the same critical effect, the risk-based RS for those COC shall be adjusted for additive health effects by: (1) equal apportionment of the Target Hazard Index between the COC (i.e., dividing the RS by the number of COC affecting the same target or critical effect (*Soil Screening Guidance: User's Guide*, EPA 1996); or (2) site-specific apportionment of the Target Hazard Index based on a site-specific conditions. The adjustment of MO-1 RS or Appendix G or H RS shall be based on the critical effects/target organs listed in the Table 4. The adjustment of MO-2 and MO-3 RS shall be based on the critical effects/target organs identified for development of the RfD and/or RfC (or equivalent values) used to calculate the RS.

2.5.3 Screening Standards and RECAP Standards

The methodologies and exposure assumptions used for the development of the SS and RS are consistent with current EPA guidelines [*Risk Assessment Guidance for Superfund, Volume I Human Health Evaluation Manual, Part A (RAGS-A)* (EPA 1989); *Risk Assessment Guidance for Superfund, Volume I Human Health Evaluation Manual, Part B Development of Risk-Based Preliminary Remediation Goals (RAGS-B)* (EPA 1991); *Soil Screening Guidance (SSG)* (EPA 1996); *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Part E Supplemental Guidance Dermal Risk Assessment* Final (EPA 2004); *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (EPA 2001); and *EPA Mid-Atlantic Risk Assessment Regional Screening Table User's Guide*]. For the development of the SS and MO-1 RS, toxicity values shall be obtained using the hierarchy of references presented in Section 2.4.1. For Appendix H RS, toxicity values and physical/chemical parameters for the petroleum components shall be obtained from Appendix D. Default exposure assumptions representative of a RME scenario shall be applied under the SO, MO-1, and MO-2. Site-specific exposure data representative of a RME scenario and approved by the Department may be used under MO-3. If applicable, a risk-based standard shall be developed for both carcinogenic and noncarcinogenic health effects, and the lower of the two values shall be selected as the SS or RS. Under MO-2 and MO-3, site-specific environmental fate and transport data may be used in the development of RS. Sections 3.0 through 6.0 provide detailed guidance on the identification and application of the limiting SS and RS for each option. Appendix A provides the calculation methods and input values that shall be used in the development of the SS and RS. Figures 8 and 9 illustrate how to identify applicable soil standards for surface soil and subsurface soil, respectively.

The toxicity values and physical/chemical properties used in the development of the SO, MO-1 RS, and IA values are presented in Appendix A Section A7.0. The toxicity values and physical/chemical properties used in the development of the RS for the petroleum components are presented in Appendix D.

2.5.3.1 Soil Screening Standards for the SO

Soil_{SSni} The Soil_{SSni} represents a constituent concentration in soil that is protective of human health for non-industrial land use. The exposure pathways addressed by the Soil_{SSni} include the ingestion of soil, the inhalation of volatile emissions and particulates released from soil to the ambient air, and dermal contact with soil. The Soil_{SSni} is applicable to surface soil.

Soil_{SSi} The Soil_{SSi} represents a constituent concentration in soil that is protective of human health for industrial/commercial land use. The exposure pathways addressed by the Soil_{SSi} include the ingestion of soil, the inhalation of volatile emissions and particulates released from soil to the ambient air, and dermal contact with soil. The Soil_{SSi} is applicable surface soil.

Soil_{SSGW} The Soil_{SSGW} represents a constituent concentration in soil that is not expected to result in the leaching of an unacceptable constituent concentration from soil to groundwater. The Soil_{SSGW} serves to protect groundwater meeting the definition of Groundwater Classification 1 and is applicable to groundwater meeting the definition of Groundwater Classifications 1, 2, and 3. As an alternative to applying the Soil_{SSGW} at the AOI, the soil to groundwater pathway may be evaluated using a leachate test. The soil to groundwater pathway shall be evaluated for surface soil and subsurface soil.

Soil_{LSS} The Soil Leachate Screening Standard (Soil_{LSS}) is the SS that is compared to the leachate test result for the evaluation of the soil to groundwater pathway. The Soil_{LSS} shall be protective of groundwater meeting the definition of Groundwater Classification 1 and is applicable to groundwater meeting the definition of Groundwater Classifications 1, 2, and 3. The soil leachate concentration shall be representative of the most heavily impacted soils within the AOI.

The Screening Standards are presented in Table 1. For the compilation of Table 1: (1) the noncarcinogenic Soil_{SSi} and Soil_{SSni} are based on a target hazard quotient of 0.1 and the carcinogenic Soil_{SSi} and Soil_{SSni} are based on a target risk level of 10^{-6} , the lower of the two values was entered as the SS in Table 1; (2) the Soil_{SSni}, Soil_{SSi}, and Soil_{SSGW} were compared to the soil saturation concentration (Soil_{sat}) [for constituents that are in the liquid state at ambient temperature, i.e., those having a melting point less than or equal to 20°C (with the exception of the TPH fractions and mixtures)] and the lower of the two values was entered as the SS in Table 1. Therefore, Soil_{sat} is not listed in Table 1 as a separate SS; (3) if the Soil_{SSni}, Soil_{SSi}, or Soil_{SSGW} was less than the analytical quantitation limit, the quantitation limit was entered in Table 1 as the SS; and (4) if the Soil_{ni}, Soil_i, or Soil_{GW} was less than the background level, the background level was entered in Table 1 as the RS. Soil_{LSS} is not included in Table 1; it shall be calculated as needed on a site-specific basis.

2.5.3.2 Soil RECAP Standards for MO-1, MO-2, and MO-3

Soil_{ni} The Soil_{ni} represents a constituent concentration in soil that is protective of human health for non-industrial land use. The exposure pathways addressed by the Soil_{ni} include the ingestion of soil, the inhalation of volatile emissions and particulates released from soil to the ambient air, and dermal contact with soil. The Soil_{ni} is applicable to surface soil.

Soil_i The Soil_i represents a constituent concentration in soil that is protective of human health for industrial/commercial land use. The exposure pathways addressed by the Soil_i include the ingestion of soil, the inhalation of volatile emissions and particulates released from soil to the ambient air, and dermal contact with soil. The Soil_i is applicable to surface soil.

Soil_{GW} The Soil_{GW} represents a constituent concentration in soil that does not result in the leaching of an unacceptable constituent concentration from soil to groundwater. The Soil_{GW} shall be based on the classification of the groundwater to be protected: **Soil_{GW1}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 1 (the Soil_{GW1} shall not result in a groundwater concentration that exceeds the GW₁); **Soil_{GW2}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 2 (the Soil_{GW2} shall not result in a groundwater concentration that exceeds the GW₂ at the POE); **Soil_{GW3DW}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 3 that may potentially discharge to a surface water body designated as a drinking water source (the Soil_{GW3DW} shall not result in a groundwater concentration that exceeds the GW_{3DW} at the POE); and **Soil_{GW3NDW}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 3 that may potentially discharge to a surface water body designated as a non-drinking water source (the Soil_{GW3NDW} shall not result in a groundwater concentration that exceeds the GW_{3NDW} at the POE). The soil to groundwater pathway shall be evaluated for surface soil and subsurface soil.

Soil_{LS} The Soil_{LS} is the soil RECAP standard that is compared to the soil leachate test result for the evaluation of the soil to groundwater pathway. **Soil_{LS1}** shall not result in a groundwater concentration that exceeds the GW₁; **Soil_{LS2}** shall not result in a groundwater concentration that exceeds the GW₂ at the POE; **Soil_{LS3DW}** shall not result in a groundwater concentration that exceeds the GW_{3DW} at the POE; and **Soil_{LS3NDW}** shall not result in a groundwater concentration that exceeds the GW_{3NDW} at the POE. The soil leachate concentration shall be representative of the most heavily impacted soils within the AOI.

Soil_{sat} The Soil_{sat} concentration represents a chemical-physical limit where saturation of the soil occurs. A constituent concentration in soil at or above the Soil_{sat} indicates the potential for NAPL to be present in the soil. If the Soil_{sat} is exceeded, the potential for NAPL to be present may be evaluated using an alternate approach.

This approach shall address the most heavily impacted soils within the AOI and is subject to Department approval. The Soil_{sat} is applicable to surface soil and subsurface soil.

Soil_{LS} The Soil Leachate Standard (Soil_{LS}) is the constituent concentration (mg/l) in leachate (as determined by SPLP analysis) that is not expected to result in an unacceptable constituent concentration in groundwater. The soil leachate concentration shall be representative of the most heavily impacted soils within the AOI. The soil leachate standard is based on the groundwater RS multiplied by the applicable dilution factor(s).

The MO-1 Soil RECAP Standards are presented in Table 2. For the compilation of Table 2: (1) the noncarcinogenic Soil_i and Soil_{ni} are based on a target hazard quotient of 1.0 and the carcinogenic Soil_i and Soil_{ni} are based on a target risk level of 10^{-6} , the lower of the two values was identified as the RS in Table 2; (2) if the Soil_{ni} , Soil_i , or Soil_{GW} was less than the analytical quantitation limit, the quantitation limit was entered in Table 2 as the RS; and (3) if the Soil_{ni} , Soil_i , or Soil_{GW} was less than the background level, the background level was entered in Table 2 as the RS. The Soil_{LS} is site-specific and therefore not included in Table 2.

2.5.3.3 Groundwater Screening Standard for the SO

GW_{SS} The GW_{SS} serves to protect groundwater meeting the definition of Groundwater Classifications 1, 2, and 3. The GW_{SS} represents a constituent concentration in groundwater that is protective of human health. The exposure pathways addressed by the GW_{SS} include the ingestion of groundwater, dermal contact with groundwater, and the inhalation of volatile emissions associated with indoor groundwater use. The GW_{SS} is applicable to groundwater meeting the definitions of Groundwater Classifications 1, 2, and 3.

The GW_{SS} is present in Table 1. For the compilation of Table 1, the GW_{SS} was compared to the water solubility ($\text{Water}_{\text{sol}}$) and the lower of the two values was entered in Table 1 as the GW_{SS} . Therefore, $\text{Water}_{\text{sol}}$ is not listed as a separate SS in Table 1. If the GW_{SS} was less than the analytical quantitation limit, the quantitation limit was entered in Table 1 as the GW_{SS} .

2.5.3.4 Groundwater RECAP Standards for MO-1, MO-2, and MO-3

GW₁ The GW_1 serves to protect groundwater meeting the definition of Groundwater Classification 1. The GW_1 represents a constituent concentration in groundwater that is protective of human health. The exposure pathways addressed by the GW_1 include the ingestion of groundwater and the inhalation of volatile emissions associated with indoor groundwater use. The GW_1 RS is applicable to groundwater meeting the definition of Groundwater Classification 1.

- GW₂** The GW₂ serves to protect groundwater meeting the definition of Groundwater Classification 2. The GW₂ represents a constituent concentration that is protective of human health. The exposure pathways addressed by the risk-based GW₂ include the ingestion of groundwater, dermal contact with groundwater, and the inhalation of volatile emissions associated with indoor groundwater use. The GW₂ RS is applicable to groundwater meeting the definition of Groundwater Classification 2.
- GW₃** The GW₃ serves to protect groundwater meeting the definition of Groundwater Classification 3. The GW₃ represents a constituent concentration in groundwater that will not result in the cross-media transfer of a constituent from groundwater to a downgradient surface water body. The **GW₃DW** shall be based on the protection of a downgradient surface water that is classified as a drinking water source. The **GW₃NDW** shall be based on the protection of a downgradient surface water that is classified as a non-drinking water source. The GW₃ RS is applicable to groundwater meeting the definition of Groundwater Classification 3.
- Water_{sol}** The Water_{sol} represents a chemical-physical limit where saturation of the water occurs. Constituent concentrations in water at or above the water solubility limit indicate a potential for NAPL to be present.

The Groundwater RECAP Standards are presented in Table 3. For the compilation of Table 3, (1) the SDWA MCL was used as the GW₁ and GW₂. If an MCL was not available, then a risk-based value was developed in accordance with Appendix A; (2) for GW₃, the surface water criterion for the protection of human health was identified based on the use classifications for surface water bodies (LAC 33:IX.1113). If a surface water criterion was not available, the GW₃ was calculated in accordance with Appendix A; (3) the noncarcinogenic GW₁, GW₂, or GW₃ were based on a target hazard quotient of 1.0 and the carcinogenic GW₁, GW₂, or GW₃ were based on a target risk level of 10⁻⁶; and (2) if the GW₁, GW₂, or GW₃ was less than the analytical quantitation limit, the quantitation limit was entered in Table 3 as the RS.

2.5.3.5 Indoor Air Standards

- IA_{ni}** The IA_{ni} represents a constituent concentration in indoor air that is protective of human health for non-industrial land use (residential). The exposure pathway addressed by the IA_{ni} is the inhalation of volatile emissions. The IA_{ni} is applicable to the evaluation of the vapor intrusion pathway.
- IA_i** The IA_i represents a constituent concentration in indoor air that is protective of human health for industrial/commercial land use. The exposure pathway addressed by the IA_i is the inhalation of volatile emissions. The IA_i is applicable to the evaluation of the vapor intrusion pathway.

The IA standards are presented in Appendix G Table G-1. For the compilation of Table G-1, the IA is represented by: (1) the Louisiana Toxic Air Pollutant Ambient Air Standards from Table 51.2 of LAC 33:III.5112; if the COC is a noncarcinogen, the 8-hour average ambient air standard was selected as the IA; if the COC is a carcinogen, the annual average ambient air standard was selected as the IA; or (2) if a COC was not listed in Table 51.2, a risk-based IA was calculated in accordance with Appendix A for the appropriate land use scenario (Note: a risk-based IA shall not be calculated using the methods for standard development under LAC 33:III.5112).

2.5.3.6 Soil Gas Standards

ESG_i – The exterior soil gas standard defines the acceptable constituent concentration in soil gas for the evaluation of the vapor intrusion pathway for industrial/commercial land use. For petroleum hydrocarbon components, the ESG_i was derived by applying an alpha (α) of 0.003 to the IA_i. For all other constituents, the ESG_i was derived by applying alpha of 0.03 to the IA_i. The ESG_i is applicable to soil gas collected exterior to the enclosed structure.

ESG_{ni} – The exterior soil gas standard defines the acceptable constituent concentration in soil gas for the evaluation of the vapor intrusion pathway for non-industrial land use (residential). For petroleum hydrocarbon components, the ESG_{ni} was derived by applying an alpha (α) of 0.003 to the IA_{ni}. For all other constituents, the ESG_{ni} was derived by applying alpha of 0.03 to the IA_{ni}. The ESG_{ni} is applicable to soil gas collected exterior to the enclosed structure.

SSSG_i – The sub-slab soil gas standard defines the acceptable constituent concentration in soil gas for the evaluation of the vapor intrusion pathway for industrial/commercial land use. The SSSG_i was derived by applying an alpha (α) of 0.03 to the IA_i. The SSSG_i is applicable to soil gas collected beneath the slab of the enclosed structure.

SSSG_{ni} The sub-slab soil gas standard defines the acceptable constituent concentration in soil gas for the evaluation of the vapor intrusion pathway for non-industrial land use (residential). The SSSG_{ni} was derived by applying an alpha (α) of 0.03 to the IA_{ni}. The SSSG_{ni} is applicable to soil gas collected beneath the slab of the enclosed structure.

The alpha (α) represents the attenuation of the vapor concentrations associated with migration of vapors from the source to indoor air. The external soil gas standards and the sub-slab soil gas standards are listed in Appendix G Table G-2 and Table G-3, respectively.

2.5.3.7 MO-3 RECAP Standards for Other Media and/or Exposure Pathways

Site-specific RS shall be developed for other media (air, surface water, sediments, biota, etc.) and/or exposure pathways as warranted by site conditions. The development of RS for chemical residues in fish and shellfish shall be consistent with the approach presented in *Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish* and *Tissue Screening Level Guidelines for Issuance of Public Health Advisories for Select Contaminants* (LDHH, LDEQ, LDAF, and LDWF 2012).

2.5.3.8 Applicable or Relevant and Appropriate Requirements

The Applicable or Relevant and Appropriate Requirements (ARAR) that are included in the identification of the limiting RECAP are the Louisiana Water Quality Standards (LAC 33:IX.1113 Table 1 and LAC 33:IX.1123 Table 3); Louisiana Toxic Air Pollutant Ambient Air Standards (LAC 33:III.5112 Table 51.2); and Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs), action levels, and taste/odor thresholds. Other state and federal standards may be considered acceptable for use under the RECAP. The use of other ARAR under the RECAP is subject to Department approval.

When an ARAR for a specific constituent defines an acceptable level of exposure, compliance with the ARAR shall generally be considered protective even if it is outside the risk range (*Memorandum: Role of Baseline Risk Assessment in Superfund Remedy Selection Decision*, EPA 1991). In general, a GW₁ or GW₂ RS based on a MCL (SDWA) and an IA RS based on a Louisiana Toxic Air Pollutant Ambient Air Standard shall not be adjusted to account for additivity. If it is determined by the Department that an ARAR serving as a SS or MO-1 RS is not adequately protective based on site-specific conditions or new toxicity data, an appropriate risk-based standard shall be developed or a risk-based guideline or recommendation shall be identified to serve as the RS under MO-2 or MO-3.

2.5.3.9 Background Concentrations

If the soil or groundwater limiting SS or RS is less than the background concentration, then the background concentration shall be identified as described in this section and shall serve as the limiting RS. The background concentration shall not be multiplied by a DF. Background concentrations for other media (e.g., sediment, biota, air, etc.) may be considered in the selection of the limiting RS. A site-specific background concentration used as a SS or RS is subject to Department approval.

A background concentration is defined as the concentration of a constituent (or the measurement of a parameter such as pH) present in an environmental medium that is distinguishable from an identifiable source concentration. An evaluation of the background conditions at an AOI is warranted when a COC that is found to pose a risk to human health or the environment is thought to be attributable to naturally-occurring or

ubiquitous anthropogenic background concentrations of the COC. The background concentration may be used: (1) to distinguish site-related constituent concentrations from naturally-occurring or ubiquitous anthropogenic constituent concentrations, i.e., in the identification of site-related COC; and (2) as a default SS or RS when the limiting SS or RS is less than the naturally-occurring background concentration. The background concentration applied at an AOC or an AOI for these purposes shall be: (1) a State-specific concentration established by the Department; (2) a site-specific concentration based on sample collection/analysis by the Submitter and approved by the Department; or (3) Department approved background concentration derived from the literature. State-specific background concentrations may be developed for frequently encountered constituents pursuant to this regulation. The State-specific background concentrations shall serve as SO SS and MO-1 RS and shall be listed in Tables 1-3.

In the absence of a Department-derived, State-specific, background concentration, the site-specific background concentration shall be established via the collection and analysis of background samples obtained from an area within the vicinity of the AOC or the AOI that has not been impacted by site activities (or other contaminant source) and that shares the same basic characteristics as the medium of concern. Background samples shall be collected for each medium of concern. The need, and required level of effort, for background characterization shall be determined on a site-specific basis.

Sampling considerations for establishing background include the natural variability, operational practices, source characteristics, constituent mobility, soil type, groundwater zone characteristics, sample number, and sample locations. Soil background samples shall be collected from similar depths and soil types as those found within the AOI. Groundwater background samples shall be collected from the same zone of concern as the AOI and shall consider groundwater flow direction, seasonal variability, and other potential influences such as nearby surface water bodies, water wells, and other sources of potential impact to groundwater. Sediment background samples shall be collected from depths and sediment types similar to those of the AOI. Biota samples shall be collected for the species of concern and shall be obtained from a waterbody (or area) with characteristics similar to those of the AOI.

An insufficient number of background samples, inappropriate background sample locations, unknown or suspect data quality, alterations in the land (excavation, addition of fill material, soil movement, new sources, etc.) since data collection, and gaps in the available data will result in the need for further background characterization. The use of state, regional, or local background data from published sources is subject to Department approval. If a COC is not naturally-occurring or the COC concentrations present at the AOI are not suspected to be greater than background concentrations, characterization of background conditions is not warranted.

A minimum dataset consisting of 4 discrete samples shall be required to establish a site-specific background concentration. For a dataset consisting of 7 or fewer discrete samples, the arithmetic mean constituent concentration (unless skewed due to sample bias) shall be used to define the background concentration at the AOC or the AOI. For a dataset consisting of 8 or more discrete samples, the arithmetic mean constituent

concentration (unless skewed due to sample bias) plus one standard deviation shall be used to define the background concentration at the AOC or AOI as presented below. (Note: the mean concentration plus one standard deviation shall be used to estimate background concentrations only and shall not be used for the estimation of the AOIC.)

1. Calculate the mean background concentration (BG_{μ}):

$$BG_{\mu} = (BG_1 + BG_2 + BG_3 \dots BG_n)/n$$

2. Calculate the background variance (BG_s^2) by taking the sum of the squares of each reading minus the mean and dividing by the degrees of freedom (the total number of background samples minus 1):

$$BG_s^2 = [(BG_1 - BG_{\mu})^2 + (BG_2 - BG_{\mu})^2 + \dots (BG_n - BG_{\mu})^2]/n-1$$

3. Calculate the background standard deviation (BG_{σ}) by taking the square root of the variance:

$$BG_{\sigma} = (BG_s^2)^{1/2}$$

4. Evaluate the distribution of the background data using the Coefficient of Variation Test (CV) where:

$$CV = BG_{\sigma}/BG_{\mu}$$

The CV should not exceed 1. If the data distribution exceeds a CV of 1, then the data should be evaluated to determine the source of the variability. If the data evaluation indicates that a data point does not accurately represent background concentrations, the outlier data point may be excluded or additional background data points may be collected to ensure the dataset used to estimate the background concentration is truly representative of background conditions.

5. Calculate the upper limit of the background data as follows:

$$BG = BG_{\mu} + BG_{\sigma}$$

The site-specific background concentration (BG) is subject to Department approval prior to application at the AOI. A BG value based on a background data set characterized by high variability or skewed due to one or more outlier values shall not be approved by the Department if it is questionable that the data are truly representative of background conditions. Alternate statistical approaches utilizing ProUCL may be approved by the Department on a site-specific basis. Statistical methods used to establish background concentrations are subject to Department approval.

To determine if a constituent is site-related or attributable to natural background, compare the BG calculated in Step 5 to the arithmetic mean constituent concentration

(not the UCL-AM constituent concentration) detected within the AOI. If the AOI arithmetic mean constituent concentration is less than or equal to the BG, then the presence of the constituent at the AOI shall be considered to be attributable to background and shall not be identified as a COC. If the AOI arithmetic mean constituent concentration is greater than the BG, then the constituent shall be identified as a COC and included in the RECAP assessment.

In the event a limiting SS or limiting RS is less than the background concentration, the background concentration (determined as described above or by a similar approach approved by the Department) shall be used as the default limiting SS or RS. A background concentration used as a default SS or RS shall receive Department approval prior to application at the AOC or the AOI. If deemed appropriate by the Department based on current and future land use, compliance with a Department-approved background level shall be considered to be acceptable even if the associated risk is outside the target cancer risk range or if the hazard index is greater than 1.0 for that COC. However, in the event the Department determines that the background concentration for a COC poses an unacceptable acute or chronic risk to human health or the environment for current or future land use, then the background concentration shall not be used as a SS or RS. The background concentration shall not be subtracted from the reported concentration(s) at the AOI. A RS based on a background concentration shall not be adjusted to account for additive health effects.

2.5.3.10 Reporting Limits

In the event a limiting SS or RS is less than the analytical reporting limit, the reporting limit shall be used as the default limiting SS or RS. The reporting limit identified for application as a SS or RS shall be the lowest reporting limit available by routine analysis and shall be approved by the Department. If deemed appropriate by the Department based on current and future land use, compliance with a Department-approved analytical reporting limit shall be considered to be acceptable even if the associated risk is outside the target cancer risk range or if the hazard index is greater than 1.0 for that COC. A RS based on reporting limit shall not be adjusted to account for additive health effects. The RL used in the identification of SS and MO-1 RS are listed in Appendix A Table A-3.

2.5.3.11 Other Considerations in the Selection of the Limiting Screening or RECAP Standard

It should be noted that the Department-derived SS and RS are not available for all possible chemical forms of a constituent. In some site-specific situations, a constituent may exist in a particular chemical form such that the toxicity and/or fate and transport of the constituent is significantly different from that assumed for the development of the SS and RS, thus making the application of the SS and/or RS inappropriate under site-specific conditions. If an EPA toxicity value is available for a specific chemical form of a constituent, then a SS and/or RS may be developed by the Submitter.

RECAP Standards are not available for all soil and groundwater pathways or all environmental media. If there is potential for exposure to constituents present in, or

released from, soil and/or groundwater via pathways not considered in the selection of the limiting SO, MO-1 RS or MO-2 RS, then these pathways shall be addressed on a site-specific basis (e.g., vapor intrusion pathway).

A limiting GW_3 RS shall not result in an unacceptable constituent concentration in deeper groundwater zones meeting the definition of Groundwater Classifications 1 or 2. If there is concern that a limiting GW_3 may result in unacceptable constituent concentrations in a deeper Groundwater 1 or 2 Zone, the potential for constituent migration from the Groundwater 3 Zone to a Groundwater 1 or 2 Zone shall be addressed under MO-3. Criteria for this determination shall include constituent mobility, constituent concentration, vertical distance from Groundwater 3 Zone to a Groundwater 1 or 2 Zone, and probability of public/domestic well installation at or in the vicinity of the AOI.

The GW_2 RECAP standard does not authorize the migration of COC offsite to adjacent property but rather serves to evaluate the acceptability of constituent concentrations with respect to human health and the environment.

The GW_3 RECAP standard serves to provide protection against the migration and discharge of a COC via groundwater to a surface water body. It is **not** the intent of this standard to allow the discharge of a COC to surface water. This standard does not authorize the migration of COC offsite to adjacent property but rather serves to evaluate the acceptability of constituent concentrations with respect to human health and the environment.

If a POE (e.g., domestic or public water supply) is present within the AOI for a Groundwater Classification 1 or 2 aquifer, the limiting RS shall be applied at the POE (Note: A DAF shall **not** be applied to a RS applied at the POE).

If the GW_{3DW} or GW_{3NDW} (after multiplying by the DF3) is less than the GW_2 , then the GW_2 shall be identified as the standard. A DF2 (not a DF3) shall be applied to the GW_2 if the GW_2 is applicable. If the GW_2 (after multiplying by the DF2) for a COC is less than the GW_1 , then the GW_1 shall be identified as the standard. A DF shall not be applied to the GW_1 .

If the $Soil_{GW3DW}$ or $Soil_{GW3NDW}$ (after multiplying by the DF3) for a COC is less than the $Soil_{GW2}$ then the $Soil_{GW2}$ shall serve as the standard. A DF2 (not a DF3) shall be applied to the $Soil_{GW2}$ if applicable. If the $Soil_{GW2}$ (after multiplying by the DF2) for a COC is less than the $Soil_{GW1}$, then the $Soil_{GW1}$ shall serve as the standard. A DF shall not be applied to the $Soil_{GW1}$.

The soil and groundwater SS and RS are based on the protection of human health and environmental resources, they do not address ecological risks. A screening level ecological risk assessment shall be required if the ecological checklist (Appendix C, RECAP Form 11) indicates that ecological risks may be of concern.

The petroleum hydrocarbon concentration in soil shall not exceed: 1) a total of 6,000 mg/kg for aliphatics C_6-C_{10} and aromatics $C_{>8}-C_{10}$; 2) a total of 13,000 mg/kg for

aliphatics C_{>10}-C₁₆ and aromatics C_{>10}-C₁₆; and 3) a total of 30,000 mg/kg for aliphatics C_{>16}-C₃₅ (and higher) and aromatics C_{>21}-C₃₅ without Department approval.

Soil screening standards or RECAP standards shall not exceed 1.0E+05 mg/kg. The ceiling limit of 1.0E+05 mg/kg is equivalent to a chemical representing 10% by weight of the soil sample. At this constituent concentration (and higher), the exposure and environmental fate and transport assumptions used in the development of the SS and RS may not be valid due to the presence of the chemical itself (EPA 2013).

Application of RS shall not result in soil or groundwater that exhibits hazardous waste characteristics of ignitability, corrosivity or reactivity as defined in the Hazardous Waste Regulations (LAC 33:V).

2.5.4 Target Hazard Quotient for Ecological Risks

In general, a hazard quotient of less than or equal to 1.0 shall define acceptable exposure for the assessment of ecological risks. If unacceptable environmental/ecological risks are determined to be associated with constituent concentrations at an AOI (refer to Section 7.0), corrective action shall be warranted even if there is no significant risk to human health.

2.6 Corrective Action

If a medium of concern (e.g. soil, groundwater, sediment, etc.) contains one or more COC at concentrations that exceed the limiting RS and further assessment under a higher option of assessment is not feasible, then corrective action shall be implemented such that the residual COC concentrations in the medium comply with the limiting RS.

2.6.1 Corrective Action Study

When deemed appropriate by the Department based on site-specific conditions, a Corrective Action Study (CAS) shall be required to support remedial decisions. The development and evaluation of alternatives in the CAS shall reflect the scope and complexity of the site problems being addressed.

The CAS shall identify the limiting RS and demonstrate that one or more remedial alternatives will meet the limiting RS. Alternatively, the submitter may demonstrate in the CAS that compliance with the limiting RS is technically impracticable and/or economically infeasible and may propose an alternative remedial approach. A determination of technical impracticability and/or economic infeasibility is subject to Department concurrence.

The CAS shall include the development of the appropriate remedial alternatives for achieving the limiting RS and include a provision of performance and cost data for use in

evaluating these alternatives and selecting a remedy. The CAS shall include where warranted:

- (1) Identification of remedial alternatives and remedial standard(s);
- (2) Screening of remedial alternatives; the remedial alternatives screening shall be based on the following criteria:
 - (a) Effectiveness. This criterion examines the effectiveness of the alternatives to achieve the Limiting RS. Alternatives that have been proven to be successful in past use and are capable of achieving the RS shall be retained for evaluation. Alternatives that are innovative technologies may be retained if it is successfully demonstrated to the Department through treatability studies that the alternatives will achieve the RS. Alternatives that have demonstrated the capability of achieving the RS shall be preferred to those only achieving partial clean-ups, unless other mitigating factors exist. Alternatives that have been proven incapable of achieving the RS may be used if it has been successfully proven to the Department that no known alternatives can achieve the RS;
 - (b) Implementability. This criterion examines the technical and administrative application of the alternatives. Factors such as use and readiness of equipment, processes, and services, and the obtaining of any required permits and waivers shall be considered;
 - (c) Infeasible Alternatives. Alternatives that may ultimately prove to be technically or administratively infeasible to implement shall be eliminated from further consideration;
 - (d) Relative Cost. Alternatives that offer technical and administrative applicability and implementability similar to that of other alternatives but at grossly higher construction, operation, and maintenance costs shall be identified and eliminated if lower-cost alternatives are available that can meet the limiting RS; and
 - (e) Regulatory requirements. This criterion determines whether or not the alternatives will meet all state and federal ARAR for the location or remedy.

(3) Performance of treatability studies

Treatability studies may be conducted to produce performance and cost data needed to evaluate and select remedial alternatives and to determine if an alternative can meet the limiting RS.

(4) Evaluation of alternatives

Evaluation of the alternatives shall consist of a detailed assessment of the individual alternatives using the evaluation criteria listed below. Quantitative

analytical data shall be included in the treatability study to gauge effectiveness in meeting the limiting RS. An analysis of the remedial alternatives shall present a detailed comparison of the relative performance of each alternative using:

- (a) Ability of the alternative to achieve the RS;
- (b) Long-term effectiveness and permanence of the alternative considering the magnitude of the residual risk after implementation of the remedy, adequacy and reliability of the engineering and institutional controls and degree to which treatment is irreversible;
- (c) Reduction in toxicity, mobility, and/or volume through treatment considering: the treatment process used and materials treated; the amount of COC destroyed or treated; the degree of expected reductions in toxicity, mobility, and volume; and the type and quantity of residuals remaining after treatment;
- (d) Short-term effects, including protection to the community and workers during the implementation of the alternative, the environmental impacts during implementation of the alternative, and time required to achieve limiting RS;
- (e) Implementability of the alternative which considering the ability to construct and operate the technology at the site; the reliability of the technology; the cost of undertaking additional remedial actions (if necessary); ability to monitor effectiveness of the remedy; the ability to obtain approvals from other agencies; coordination with other agencies; availability of necessary equipment, specialists, services and materials; the availability of off-site treatment, storage and disposal services and capacity for disposal of residuals;
- (f) Cost effectiveness considering capital costs and operating and maintenance costs.

2.6.1.1 Selection of Final Remedy

Corrective actions and closures shall be protective of human health and the environment. The Submitter shall have the responsibility of demonstrating to the Department that the final remedial actions and/or control measures proposed or used effectively abate present and future threats to human health and the environment, to the maximum extent practical. The final remedy shall comply with the limiting RS. An alternative that does not meet the limiting RS may be selected under the following circumstances: 1) the alternative is an interim measure and will become part of a total remedial action that will attain the LRS; 2) compliance with the LRS is technically impracticable or economically infeasible; and/or 3) the alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard through the use of another method or approach. Remedies which incorporate the use of engineering or institutional controls shall be accompanied by post-closure care and financial assurance (in accordance with LDEQ guidelines).

2.6.1.2 Removal Actions

If a removal action is performed at the AOI and the residual COC comply with the limiting RS, then the removal action may be considered a final remedy and the department may determine that no further action at this time is required.

2.6.1.3 Remedial Actions Other Than Removal

For a final remedy other than a removal action, the department shall:

Assess the remedial alternatives described in the CAS considering the goals, objectives and regulatory requirements; the current and expected uses of the property; the effectiveness of the remedy in significantly reducing the volume, toxicity, or mobility of the COC at the site ; the effectiveness of the remedy in permanently reducing the volume, toxicity, or mobility of the COC at the site; the reliability of the remedial alternatives and the potential for future remedial costs if an alternative does not achieve the limiting RS; the ability to monitor remedial performance; the cost effectiveness of a final remedy; and other factors determined appropriate by the department.

Any variation in the CAS requirements are subject to Departmental approval.

2.6.2 Corrective Action Plan

When deemed appropriate by the Department based on site-specific conditions, a Corrective Action Plan (CAP) shall be required to support implementation of the final remedy. The scope of the CAP shall reflect the scope and complexity of site conditions and the final remedy. The CAP shall include all tasks, specifications, and subplans necessary for the implementation of the final remedy. The CAP shall include a workplan, a sampling and analysis plan, a quality assurance/quality control plan; a site-specific health and safety plan; a project implementation schedule; and other information requested by the department. The CAP shall be approved by the department prior to implementation of the final remedy. Any variation in the CAP requirements are subject to Departmental approval.

2.6.3 Demonstration of Compliance Post-Corrective Action

Post-corrective action sampling shall be conducted for all media requiring corrective action. The number of data points to be collected shall be determined utilizing the methods presented in *SW846 Test Methods for Evaluating Solid Waste* (EPA) or other methods deemed appropriate by the Department for site-specific conditions. The QA/QC associated with the confirmatory data shall meet the requirements set forth in Section 2.2.

For soil, the area requiring corrective action shall be delineated using the limiting RS for the option being implemented (e.g. if corrective action is conducted under MO-2, then the MO-2 limiting RS shall be used to identify the boundaries of the area requiring

remediation). To demonstrate compliance with the corrective action standards, the residual COC concentration remaining in the soil following corrective action shall be represented by the lower of the UCL-AM constituent concentration and the maximum detected concentration remaining within the boundaries of the AOI. Based on site-specific considerations such as the method of remediation and the characteristics of the confirmatory data set (e.g., number and distribution of datapoints, the proportion of nondetect results, and the occurrence of outlier values), the use of alternate statistical methods to demonstrate compliance with the LRS may be approved by the Department.

All confirmatory data points obtained within the boundaries of the AOI shall be used in the calculation of the residual COC concentration (unless skewed due to sample bias). In the calculation of the UCL-AM constituent concentration, all positively detected results (including estimated values flagged with a J qualifier) as well as non-detected results within the boundaries of the AOI shall be considered. Refer to Section 2.3.1.3 for further guidance on calculating the UCL-AM constituent concentration. Compliance shall be demonstrated when: 1) the residual constituent concentration(s) is less than or equal to the corrective action standard; or 2) the COC concentration detected at each confirmatory sampling location is less than or equal to the corrective action standard.

For groundwater, compliance shall be demonstrated when the COC concentration detected at the POC(s) is less than or equal to the corrective action standard for a monitoring frequency and period to be determined by the Department based on site-specific conditions. If the groundwater corrective action standard is exceeded during the post-closure period, further corrective action may be required. Refer to Section 2.3.2.4 for determining the groundwater compliance concentration.

Post-corrective action compliance for sediment shall be demonstrated using the method(s) deemed most appropriate for the environmental fate and transport and/or exposure pathways identified for evaluation at the AOI (e.g., recreational direct contact exposure, bioaccumulation, toxicity to benthic fauna, etc.). The post-corrective action AOIC shall be based on an upper bound estimate of the average COC concentration within the AOI unless otherwise approved by the Department based on site-specific conditions. The methods used to determine the sediment AOIC are subject to Department approval.

For impacted biota, compliance shall be demonstrated when the mean concentration detected for the edible portion of the samples collected is less than or equal to limiting RS (or complies with the requirements in *Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish* (LDHH, LDEQ, LDAF, and LDWF). When modeling of the bioaccumulation pathway is deemed to be appropriate by the Department, the upper bound predicted tissue concentration shall be less than or equal to the limiting RS.

The corrective action standard used to demonstrate compliance shall be the limiting RS identified for the medium of concern for the highest RECAP Option completed at the AOI. If it is adequately demonstrated that the residual constituent concentrations at the AOI or in the medium of concern are less than or equal to the corrective action standard,

then no further corrective action at this time shall typically be required. Post-corrective action monitoring requirements shall be determined by the Department on a site-specific basis.

2.6.4 Institutional Controls

It is the Department's preference that the RECAP objectives of protection of human health [target risk range of 10^{-6} to 10^{-4} (or less) and/or hazard index less than or equal 1.0], prevention of cross-media transfer, and the protection of resource aesthetics be met without the use of institutional controls. However, under site-specific conditions or when it is **not** technically or economically feasible (as determined by a corrective study) to attain these objectives, institutional controls may be used to supplement treatment and/or containment-based remedial action provided that Department approval is obtained. For an AOI with residual constituent concentrations that: (1) exceed the cumulative cancer risk level of 10^{-4} ; (2) exceed a total hazard index of 1.0; (3) result in the exceedance of a limiting RS based on cross-media transfer; and/or (4) exceed a limiting RS based on the protection of resource aesthetics, institutional controls and/or financial assurance shall be required (as deemed appropriate by the Department). Institutional controls shall not be used in such a manner that a property or portion of a property is rendered unsuitable for commerce.

Institutional controls may be used by the Submitter to supplement treatment and/or containment-based remedial action provided that Department approval is obtained. Institutional Controls may not be used as stand-alone remedial measures to address the contamination present at the site. The post-closure care associated with institutional controls will require the Submitter to notify the Department of any situation which may result if the institutional control becomes non-effective and corrective actions have to be taken.

Conveyance Notification. Institutional controls will usually require a legal instrument to be recorded in the parish conveyance records for the subject property. This legal instrument shall clearly state the notice or restriction imposed on the site; the description of the site; and a scaled site map showing the affected soil and groundwater zones. **The conveyance notice shall receive Department approval prior to filing.** A conveyance notification shall be required under the following site conditions:

- (1) A conveyance notification shall be placed on all properties having residual constituent concentrations in soil that are greater than the acceptable exposure concentration defined for non-industrial (residential) land use [i.e., constituent concentrations greater than the $Soil_{ni}$ or constituent concentrations in soil corresponding to indoor air concentrations greater than the IA_{ni} , if applicable]. Note: If land use at the AOI is industrial and the limiting soil RS applied at the AOI is a non-risk-based RS ($Soil_{GW}$, $Soil_{sat}$, quantitation limit, or background level) that is lower than the $Soil_{ni}$, then a conveyance notification shall not be required.

- (2) A Groundwater 2 Zone shall be required to have a conveyance notification on that portion of the plume within property boundaries that contains a residual constituent concentration that exceeds the GW₂ RS (without the application of a dilution and attenuation factor).

However, other legal controls may be implemented at the site such as a zoning ordinance by a local government which prevents the installation of groundwater wells and use of existing wells for potable or other purposes. If such a local ordinance is developed, the following must be submitted to the Department: (1) a copy of the ordinance restricting the stated actions at the site; and (2) a scaled map showing the horizontal and vertical extent of contamination of soils or groundwater and the legal boundaries of all properties on which soils or groundwater exceed the RECAP standard. If for any reason the ordinance that is being used as an institutional control changes, the Department reserves the right to evaluate the use of the changed ordinance as an institutional control. Changes or variances to the ordinance must be submitted by the owner/operator/responsible person of the affected site to the Department at least 30 days prior to the scheduled action date.

2.6.5 Monitored Natural Attenuation

Monitored natural attenuation is defined as the biodegradation, dispersion, dilution, sorption, volatilization, and/or chemical and biochemical transformation/stabilization of constituents to effectively reduce constituent concentration, toxicity, mobility, mass, or volume to levels that are protective of human health and the ecosystem (USEPA ORD, OSWER). Monitored natural attenuation may be applied as a stand alone remedial process or included as a unit operation of a remedial process under MO-3. It should be evaluated and compared to other remedial processes to determine which is the most appropriate process for a site. As with any remedial process, monitored natural attenuation should be selected only where it can meet all of the remedial goals for the site and where it can obtain those goals in an appropriate timeframe. An appropriate timeframe is one that is reasonably compared to that offered by other remedial methods. To ensure that the timeframe estimates are comparable, the assumptions used in each treatment proposal evaluated are to be consistent [*Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*] (OSWER Directive Number 9200.4-17P)]. Unless otherwise approved by the Department, the criteria presented in Sections 2.6.4.1, 2.6.4.2, and 2.6.4.3 should be followed for monitored natural attenuation plans submitted to the Department.

2.6.5.1 Evidence to Support Monitored Natural Attenuation

Monitored natural attenuation of COC impacting soil and/or groundwater may be allowed as a remedial alternative under MO-3 when it has been demonstrated to the Department that the COC, under site-specific conditions, will naturally attenuate to the appropriate RS without causing adverse impacts. Department requirements for a monitored natural attenuation program shall include adequate evidence to support a determination that:

- 1) All sources of COC have been controlled and NAPL has been removed/controlled to the extent of technical practicability;
- 2) The plume has reached declining conditions and the area of constituent concentrations above SS is not expanding;
- 3) Constituents are susceptible to natural degradation processes;
- 4) Constituent concentrations reaching human or ecological receptors do not result in unacceptable risks (refer to Section 2.5); and
- 5) Conditions are favorable for degradation and/or natural attenuation of the COC (This shall include documentation of the constituent(s)' degradability and/or attenuation capacity and identification and discussion of site-specific characteristics which support natural attenuation. Monitoring results shall be submitted which demonstrate that site-specific conditions are conducive to the natural processes of degradability and/or attenuation).

2.6.5.2 Contingency Plan

A contingency remedial plan shall be included with the *Evidence to Support Monitored Natural Attenuation* in the event that the natural attenuation remedy fails to achieve the remedial goals. The contingency plan may be further assessment of the AOI or actions that will be taken to develop and implement an active remediation program.

If the Department, at any time, determines that: (1) a COC being monitored under a natural attenuation compliance program has the potential to migrate to a human or ecological receptor above the applicable RS; (2) COC concentrations are not decreasing; (3) applicable RS will not be reached within a reasonable timeframe; or (4) in any way fails to achieve the remedial goals of the program within a reasonable timeframe, then the contingency plan shall be implemented. The Department may require the use of institutional controls as a condition to the approval of a natural attenuation compliance program when necessary to protect current or future use.

2.6.5.3 Documentation of the Effectiveness of Monitored Natural Attenuation

A plan to evaluate the progress of the remedy shall be included. This plan must provide specifics on sampling points, sampling methods, sampling frequency, analytical parameters, analytical methods, and Quality Assurance/Quality Control procedures.

The following specific requirements for groundwater are to be addressed in the plan:

- 1) The establishment of a sentinel monitoring well system for impacted groundwater designed to detect a COC in groundwater prior to reaching any potential human or ecological receptor. This system shall be located between the

impacted plume and the human or ecological receptor at a point at least 2-years travel time upgradient of the exposure point(s) unless otherwise approved by the Department;

- 2) A POC monitoring well network sufficient to document reduction of contaminant concentrations at the source and for confirmation of attainment of RECAP standards at the POC; and
- 3) A network of monitoring wells extending from the source area down-gradient to the leading edge of the plume. These wells should be located near the mid-line of the plume in order to evaluate spatial and temporal variation of the plume and obtain geochemical data documenting that NA is occurring and to document specific processes occurring.

The plan is to state when reports shall be issued addressing the following items as deemed to be appropriate for site-specific conditions:

- 1) The treatment pathways and processes including potential byproducts of the COC;
- 2) The rate of treatment for each COC and for any byproducts;
- 3) The usage rate of electron acceptors and any related geochemical parameters that contribute to the natural attenuation process;
- 4) The treatment mass balance for each COC, any byproducts, and related electron acceptors;
- 5) Isopleths for each COC, electron acceptors, and byproducts; and
- 6) In some cases, microbiological laboratory data supporting degradation and decay rates.

2.6.5.4 Determination of the Biodegradation Rate and Retardation Factor for the Calculation of a Site-Specific Dilution and Attenuation Factor(s)

The biodegradation rate and retardation factor used in the Domenico model or other fate and transport modeling must be derived from site-specific monitored natural attenuation data for each COC. It is not the intent of this sub-section to outline a step-by-step procedure of how to derive these parameters, but to provide a general overview of the type of basic information required to justify these parameters. Additional information on how to confirm and quantify biodegradation may be obtained from the “*Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*,” EPA/600/R-98/128 or “*Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in*

Groundwater,” Air Force Center for Environmental Excellence Technology Transfer Division, 03/08/99.

The biodegradation rate can be derived using isopleths developed from site monitoring data. The isopleths are to include the COC, tracer, electron acceptors, and metabolic byproducts. The tracer is a chemical that is unaffected by biodegradation and may be inherent to the site. The contaminant concentration is to be normalized for advection, dispersion, dilution, and sorption. (Microcosms can be used to determine that biodegradation is occurring at a site but cannot be substituted for field data.)

The retardation factor by definition is the advective velocity of the groundwater divided by the advective velocity of the contaminant. The advective velocity of the groundwater can be derived from properties collected from pumping tests or slug tests and soil physical data obtained from the borehole. The advective velocity of the contaminant can be derived using contaminant iso-concentration drawings developed from site monitoring data. This method of deriving the retardation assumes that biodegradation is not occurring. If retardation and biodegradation are both occurring, then the retardation factor will have to be corrected to remove the biodegradation component.

Dilution and attenuation factors developed for MNA programs shall be supported by site-specific biodegradation and retardation data and the submittal shall include a presentation of the methods used to derive the biodegradation rate(s) and retardation factor(s). All calculations shall be presented. Dilution and attenuation factors with inadequate documentation shall not be approved by the Department.

Dilution and attenuation factors based on site-specific biodegradation and retardation data can only be used for the evaluation of potential COC migration for monitored natural attenuation plans, they cannot be used to support a NFA-ATT determination.

2.7 No Further Action At This Time (NFA-ATT)

Under the RECAP, a NFA-ATT determination may be granted at a site where: (1) the source of the release has been removed or mitigated; (2) it has been adequately demonstrated that the site does not pose a risk to human health or the environment, (i.e., the COC concentrations present at the site are less than or equal to the limiting SS, MO-1 RS, MO-2 RS, or MO-3 RS and if applicable, the post-corrective action monitoring requirements have been met); (3) the property remains suitable for commerce and residual constituent concentrations are appropriate for the intended future use of the land; (4) the need for institutional controls has been addressed in accordance with Section 2.6.3; and (5) sufficient financial assurance and/or financial commitment is provided when deemed appropriate by the Department under MO-3.

Requests to the Department for a NFA-ATT determination shall demonstrate that: (1) the AOI meets the criteria for management under option implemented; (2) current site conditions meet the limiting RS; (3) the RS have been modified to account for additive effects due to exposure to multiple constituents that elicit noncarcinogenic effects on the same target organ/system **and/or** exposure to more than one impacted medium by the

same receptor; and (4) the RL for non-detected site-related constituents are less than the limiting RS. If a NFA-ATT is requested, RECAP Form 12 shall be included in the submittal.

2.8 Self-Implementation of the RECAP

In some instances, the Submitter may wish to expeditiously remediate an impacted area that is discovered during routine operations or construction activities or that may be due to spill events. This type of activity is implemented by the Submitter without prior LDEQ approval in an effort to prevent migration of COC and/or impact to receptors. Although these actions are often termed interim measures, they are sometimes of sufficient scope and magnitude such that additional corrective action is not warranted. **Self-implementation of the RECAP shall be allowed for these types of activities provided that the following conditions are adhered to:**

- (1) All reporting requirements to the Department shall be met;
- (2) The Department shall be notified prior to samples being collected:
 - (a) Within five working days for planned sample events (e.g., a scheduled remediation event); or within two working days when non-time critical (non-emergency) events impact a remediation (e.g., severe rainfall event, unexpected changes to a planned remediation); or as soon as possible but prior to completion of remediation for time critical/unexpected events (e.g., real time spill remediation); and
 - (b) The sampling notification may be made in person, by telephone or, preferably, in writing to the appropriate LDEQ personnel. The sampling notification requirement has been satisfied if the appropriate LDEQ representative is present on-site during the sampling event and provided an opportunity to collect split samples or if a written waiver of the sampling notification requirement has been provided to the Submitter by the LDEQ prior to the sampling event. Written documentation of all personal and telephone sampling notifications required by this section shall be made to the Department within five (5) working days after the sampling notification. In the event that the five-day written sampling notification was not made, the Submitter shall provide, in the written documentation, a justification as to why such sampling notification was not made;
- (3) Reimbursement shall not be sought from the state for remedial action costs that were not part of an emergency response action; and
- (4) Engineering or institutional controls shall not be used as part of the final remedy unless installed during an emergency response.

For more extensive site characterization and/or remediation activities, the LDEQ recommends that the LDEQ and the Submitter reach an agreement about site management objectives and site characterization strategy prior to the Submitter

expending extensive effort and resources on site activities. Performance of such activities without prior Department approval shall be conducted at the risk of the Submitter.

Investigation Self-Implementation. Preliminary evaluation investigations are conducted for the purpose of determining if a release of COC to the environment has occurred, i.e., screening of the site under the SO (refer to Section 3.0). Typically, these investigations (e.g. Phase II property transfer investigations) are of limited scope and are not sufficient to obtain a NFA-ATT decision from the Department if COC are detected. Site investigations may be self-implemented as preliminary evaluation tools to determine if a release has occurred provided that all laws, regulations, and permit conditions are followed. **Note: If COC are detected at an AOC, applicable LDEQ notification requirements shall be met.**

Self-implemented site investigations that are performed in accordance with Appendix B of this regulation may be considered as part of a more detailed RECAP submittal that includes additional investigation data provided that a sufficient number of samples have been collected and the areas most likely to have been impacted are sampled.

A workplan for a more detailed site investigation should be approved by the Department prior to being implemented. Self-implemented site investigations are performed at the risk of the Submitter. LDEQ may require confirmation sampling for any self-implemented site investigations where no further action is requested.

LDEQ may waive the requirement to submit a Site Investigation Workplan provided that all requirements of Appendix B are followed. The Submitter shall contact the LDEQ to establish the necessity of a Workplan. The requirement for a site investigation Workplan for a MO-1 or MO-2 evaluation shall be made by the Department based on site-specific conditions. A site investigation Workplan shall be submitted for Department approval for all MO-3 evaluations.

The Department may waive the requirement to submit a Site Investigation Workplan at sites determined to be eligible to participate in the Louisiana Motor Fuels Underground Storage Tank Trust Fund. The request for a waiver shall be submitted **prior** to the initiation of field activities and shall include a statement declaring that the investigation will be conducted in accordance with Appendix B. The request for a waiver shall also include a cost estimate to complete the proposed site investigation. The cost estimate shall include all costs related to the completion of the investigation and shall address unit costs should it become necessary to expand the proposed scope of the investigation (horizontally or vertically). Additionally, in order to ensure maximum potential eligibility under the Trust Fund, all site activities shall be conducted in accordance with the latest version of the Louisiana Motor Fuels *Underground Storage Tank Trust Fund Cost Control Guidance Document* and overseen or performed by a Response Action Contractor. Failure to follow these guidelines could result in some or all costs being ruled ineligible for Trust Fund reimbursements.

2.9 Identification of Landowners, Lessees, and Servitude Holders

The Submitter shall identify the name and mailing address (to the extent reasonably known and available) of all other landowners, lessees, and servitude holders whose property is within an AOI (reasonably known, for the purpose of this section, means the property interest holder of record as identified on the official parish tax assessor's records). This requirement shall not apply to landowners, lessees, and servitude holders that are owned or controlled by, or under common control of, the Submitter, such as parent and subsidiary corporations and partnerships. Where more than one responsible party exists, this duty is satisfied if any one of the responsible parties submits the information. This submission is due with any report required under RECAP that identifies one or more AOI. It must be updated in any subsequent report required under RECAP if there is any material change in information. A material change includes identification of a new AOI or a change in the boundaries of the AOI which affects a new landowner, new lessee, or new servitude holder not previously identified. A map depicting the AOI and identifying the property owners, lessees, and servitude holders within the AOI shall also be submitted.

This section applies only to RECAP submittals made after October 20, 2003.

3.0 SCREENING OPTION

The Screening Option provides Department-derived Screening Standards (SS) for soil and groundwater for non-industrial (residential) and industrial land use scenarios. The SS represent constituent concentrations in media that are protective of human health and the environment. The comparison of preliminary site investigation data against screening standards provides for an initial evaluation for the relative environmental concern for a site or set of environmental data. At sites where constituent concentrations fall below the screening levels, generally, no further action or study is needed. At sites where constituent concentrations exceed the screening levels, further study or investigation, but not necessarily cleanup, is warranted. Therefore, exceedance of a screening standard does not trigger the need for response actions or define “unacceptable” levels of constituents in the environment, it simply means that further study or investigation is needed. Comparison of the SS with environmental data may be used to: (1) demonstrate an AOC does not pose a threat to human health or the environment and, hence, does not require further action at this time; (2) identify the AOI and COC for management of an AOC under the SO; or (3) determine if an AOC warrants further evaluation under RECAP, and if further evaluation is warranted, to identify the AOI and COC for the next tier of assessment.

3.1 Criteria for the Management of Soil and Groundwater Under the Screening Option

In order to develop the Department-derived soil and groundwater SS, assumptions were made with regard to: (1) exposure potential at the AOC (receptors, exposure pathways, exposure frequency and duration, intake rates, cumulative exposures); and (2) site characteristics that influence constituent fate and transport (site size, soil characteristics, hydrogeological conditions, etc.). The application of risk-based and cross-media transfer standards is protective only if the AOI shares the same (or reasonably similar) characteristics as those assumed in the development of the standards. Therefore, the soil and groundwater SS presented in Table 1 (or calculated using the guidelines in Appendix A) are only applicable at an AOC or AOI that meets the management criteria listed below. The Submitter shall demonstrate to the Department that these requirements have been met if Department-derived SS are applied at the AOC.

Application of the SO SS at an AOC that does meet all of the criteria presented below is subject to Department approval prior to submission of the SO assessment. Screening Option management criteria include:

- (1) A non-industrial or industrial exposure scenario is applicable at the AOC.
- (2) All likely human exposure pathways associated with soil and groundwater at or adjacent to the AOC are addressed by the SS.
- (3) The impacted soil and/or groundwater under investigation is in declining conditions, i.e., the constituent mass is not increasing, the source of the release has been mitigated, and the area of constituent concentrations above the SS is not expanding.

[The environmental fate and transport models used to develop the cross-media transfer SS assume steady-state concentrations over the AOC.]

- (4) NAPL is not present (i.e., If NAPL was present at the site but has been, or will be, removed to the extent practicable, the adsorbed concentrations in soil and/or the dissolved concentrations in groundwater may be addressed in the SO evaluation). [Note: The environmental fate and transport models used to develop the cross-media transfer SS assume that NAPL is not present.] The SO may be applied at a AOC or AOI where NAPL is present, if approved by the Department for the purpose of demonstrating that a CAP (refer to Section 1.2.3) is protective of human health and the environment (i.e., constituent concentrations at or reaching current or potential exposure points or cross-media transfer points are less than or equal to the SS).
- (5) The area of impacted soil under investigation is approximately 0.5 acre or less [The Q/C parameter for the calculation of the volatilization factor (VF) and particulate emission factor (PEF) for Soil_{SSi} and Soil_{SSni} values presented in Table 1 are based upon an area of impacted soil that is 0.5 acre in size.]

Exceptions to this criterion:

- (a) The limiting SS for a COC is based on a quantitation limit, the soil saturation concentration, the ceiling concentration of 100,000 ppm, or an approved background concentration.
- (b) If the area of impacted soil is greater than 0.5 acre **and** all other criteria for management under the SO are met, a site-specific Soil_{SSi} or Soil_{SSni} may be calculated using the site-specific area of impacted soil and the guidelines in Appendix A. The only site-specific input that may be incorporated into the development of the site-specific Soil_{SSi} or Soil_{SSni} is the Q/C value used in the calculation of a site-specific VF. If the area of impacted soil is not known, site-specific SS based on estimated areas of impacted soil shall be calculated and applied at the AOC in a re-iterative manner until the boundaries of the AOI have been defined.

Note: If a COC is discharging via groundwater to a surface water body, then surface water, sediment, and/or biota shall be addressed under MO-3.

3.2 Screening Standards

3.2.1 Soil Screening Standards

Soil_{SSni} The Soil_{SSni} represents a constituent concentration in soil that is protective of human health for non-industrial land use. The exposure pathways addressed by the Soil_{SSni} include the ingestion of soil, the inhalation of volatile emissions and particulates released from soil to the ambient air, and dermal contact with soil. The Soil_{SSni} is applicable to surface soil.

Soil_{SSi} The Soil_{SSi} represents a constituent concentration in soil that is protective of human health for industrial/commercial land use. The exposure pathways addressed by the Soil_{SSi} include the ingestion of soil, the inhalation of volatile emissions and particulates released from soil to the ambient air, and dermal contact with soil. The Soil_{SSi} is applicable surface soil.

Soil_{SSGW} The Soil_{SSGW} represents a constituent concentration in soil that is not expected to result in the leaching of an unacceptable constituent concentration from soil to groundwater. The Soil_{SSGW} serves to protect groundwater meeting the definition of Groundwater Classification 1 and is applicable to groundwater meeting the definition of Groundwater Classifications 1, 2, and 3. Thus, the Soil_{SSGW} represents the constituent concentration in soil that will not result in a groundwater concentration that exceeds the GW_{SS}. As an alternative to applying the Soil_{SSGW} at the AOI, the soil to groundwater pathway may be evaluated using a leachate test. The soil to groundwater pathway shall be evaluated for surface soil and subsurface soil.

Soil_{LSS} The Soil Leachate Screening Standard (Soil_{LSS}) is the SS that is compared to the leachate test result for the evaluation of the soil to groundwater pathway. The Soil_{LSS} shall be protective of groundwater meeting the definition of Groundwater Classification 1 and is applicable to groundwater meeting the definition of Groundwater Classifications 1, 2, and 3.

The Soil_{SSni}, Soil_{SSi}, and Soil_{SSGW} shall be obtained from Table 1. For a constituent not listed in Table 1, soil SS shall be calculated in accordance with Appendix A.

The **Soil Limiting Screening Standard (LSS)** for soil shall be identified as the lower of: 1) Soil_{SSni} or Soil_{SSi} and 2) Soil_{SSGW}. If leachate testing is used in lieu of Soil_{SSGW}, then the Soil_{SSni} or Soil_{SSi} and the Soil_{LSS} shall be applied at the AOI.

3.2.2 Groundwater Screening Standard

GW_{SS} The GW_{SS} serves to protect groundwater meeting the definition of Groundwater Classifications 1, 2, and 3. The GW_{SS} represents a constituent concentration in groundwater that is protective of human health. The exposure pathways addressed by the GW_{SS} include the ingestion of groundwater, dermal exposure to groundwater, and the inhalation of volatile emissions associated with indoor groundwater use. The GW_{SS} is applicable to groundwater meeting the definitions of Groundwater Classifications 1, 2, and 3. A dilution and attenuation factor shall **not** be applied to the GW_{SS}.

The GW_{SS} shall be obtained from Table 1. For a constituent not listed in Table 1, the Safe Drinking Water Act (SWDA) Maximum Contaminant Level (MCL) shall be identified as the GW_{SS}. If an MCL is not available, then a risk-based standard shall be developed in accordance with Appendix A.

The **Groundwater Limiting Screening Standard** is the GW_{SS}.

3.2.3 Other Considerations in the Selection of the Limiting SS

Refer to Section 2.5.3 for other factors that require consideration in the identification of the limiting SS.

3.3 Screening Option Soil and Groundwater Assessment

To determine if the soil warrants further evaluation under RECAP, the Limiting Soil SS shall be compared to the maximum constituent concentration (AOIC) detected in soil. To determine if the groundwater warrants further evaluation, the GW_{SS} shall be compared to the maximum constituent concentration (CC) detected in groundwater. The maximum constituent concentration used in the screening process shall be representative of the most heavily impacted area(s) known or suspected to be present within the AOC. Identification of the most heavily impacted area(s) is subject to concurrence by the Department.

If the maximum concentration of a COC exceeds the limiting SS, then the COC shall be evaluated under a Management Option or managed under the SO.

If the maximum concentration of a COC is less than or equal to the limiting SS, then the COC does not require further evaluation (i.e., the COC is screened out under the SO).

If the maximum concentrations of all COC in soil and groundwater are less than or equal to their respective limiting SS, then typically soil and groundwater do not require further evaluation and the SO shall serve to expeditiously document that the AOC does not pose a risk to human health or the environment.

If leachate testing is used in lieu of the $Soil_{SSGW}$ to evaluate the soil to groundwater pathway, then the soil leachate testing shall be conducted in the area of the most heavily impacted soil. The $Soil_{LS}$ shall be determined by multiplying the GW_1 RS (Table 3) by the default Summers DF of 20. If the leachate results are less than or equal to the $Soil_{LSS}$, then no further evaluation of the soil to groundwater pathway is warranted. If the leachate test results are greater than the $Soil_{LSS}$, then further evaluation of the soil to groundwater pathway is required under MO-1 or a higher option.

3.4 Screening Option Submittal Requirements

A SO Submittal Report shall be submitted to the Department for approval. This report shall, at a minimum, meet the submittal requirements listed in Table 5. Any variance from these requirements is subject to Department approval prior to submission of the SO report. Refer to Appendix C for the RECAP Forms.

4.0 MANAGEMENT OPTION 1

Management Option 1 (MO-1) provides Department-derived RECAP Standards (RS) for the evaluation of soil and groundwater meeting the criteria presented in Section 4.1. The MO-1 RS represent constituent concentrations in soil and groundwater that are protective of human health and the environment. The comparison of the MO-1 RS with the soil AOIC and/or groundwater CC serves to provide predictable, consistent guidance regarding when further evaluation and/or corrective action is warranted at a site. The MO-1 RS were developed for non-industrial (residential) and industrial exposure scenarios using protective assumptions with regard to the protection of human health and the prevention of cross-media transfer. The MO-1 RS comply with ARAR and consider the protection of resource aesthetics. Management Option 1 may be used to: (1) document that an AOI does not pose a threat to human health or the environment and hence, does not warrant further action at this time; (2) expeditiously manage an AOI defined by the presence of low constituent concentrations and standard exposure conditions; and/or (3) identify areas of a facility, media, or COC that warrant further evaluation so that the scope of the Management Option 2 (MO-2) or Management Option 3 (MO-3) evaluation can be limited to those areas/media/constituents most likely to pose risk.

4.1 Criteria for the Management of Soil and Groundwater Under MO-1

In order to develop MO-1 soil and groundwater RS, assumptions were made with regard to: (1) exposure potential at the AOC or the AOI (receptors, exposure pathways, exposure frequency and duration, intake rates, and cumulative exposures); and (2) site characteristics that influence constituent fate and transport (site size, soil characteristics, hydrogeological conditions, etc.). The application of risk-based and cross-media transfer standards are protective only if the AOI shares the same (or reasonably similar) characteristics as those assumed in the development of the standards. Therefore, MO-1 RS are only applicable at an AOI that meets the management criteria listed below. Application of the MO-1 RS at an AOC or an AOI that does not meet all of the criteria for management under MO-1 shall receive Department approval prior to submission of the MO-1 assessment. Management Option 1 criteria include:

- (1) A non-industrial or industrial exposure scenario is applicable at the AOC/AOI.
- (2) All likely human exposure pathways associated with soil and groundwater at or adjacent to the AOC/AOI are addressed by the MO-1 RS.
- (3) The impacted soil and/or groundwater under investigation are in declining conditions, i.e., the constituent mass is not increasing, the source of the release has been mitigated, and the area of constituent concentrations above the SS is not expanding. [The environmental fate and transport models used to develop the cross-media transfer RS assume steady-state concentrations over the AOI.]
- (4) NAPL is not present (i.e., If NAPL was present at the site but has been, or will be, removed to the extent practicable, the adsorbed concentrations in soil and/or the

dissolved concentrations in groundwater may be addressed in the MO-1 evaluation). [Note: The environmental fate and transport models used to develop the cross-media transfer RS assume that NAPL is not present.] MO-1 may be applied at a soil AOC/AOI where NAPL is present, if approved by the Department for the purpose of demonstrating that a CAP (refer to Section 1.2.3) is protective of human health and the environment (i.e., constituent concentrations at or reaching current or potential exposure points or cross-media transfer points are less than or equal to the MO-1 limiting RS).

- (5) The area of impacted soil is approximately 0.5 acre or less. [The Q/C parameter for the calculation of the volatilization factor for $Soil_i$ and $Soil_{ni}$ and the S_w parameter for the calculation of the dilution factors (DF2 and DF3) are based on an area of impacted soil that is 0.5 acre in size.]

Exceptions to this criterion:

- (a) The limiting MO-1 RS is based on a quantitation limit, the soil saturation concentration ($Soil_{sat}$), the ceiling concentration of 100,000 ppm, or an approved background concentration (the VF and DF are not applicable); or
- (b) The limiting MO-1 RS is based on the $Soil_{GW1}$ or the GW_1 (a DF is not applicable).

Note: If a COC is discharging via groundwater to a surface water body, then surface water, sediment, and/or biota shall be addressed under MO-3.

The Submitter shall demonstrate to the Department that the AOC or the AOI for soil and groundwater meets the above criteria to qualify for management under MO-1 and that a site evaluation has been conducted in accordance with the guidelines in Appendix B. If the AOC or the AOI for soil and groundwater does not meet **all** of these criteria, then LDEQ considers the AOC or the AOI to be sufficiently complex to warrant a more detailed assessment of risk and the AOC or the AOI shall be addressed under MO-2 or MO-3 depending on site-specific exposure conditions.

Different AOC or AOI within a facility may be managed under different Management Options if the areas meet the criteria for management under the Options selected by the Submitter.

4.2 MO-1 RECAP Standards

4.2.1 MO-1 Soil RECAP Standards

Soil_{ni} The $Soil_{ni}$ represents a constituent concentration in soil that is protective of human health for non-industrial land use. The exposure pathways addressed by the $Soil_{ni}$ include the ingestion of soil, the inhalation of volatile emissions and particulates released from soil to the ambient air, and dermal contact with soil. The $Soil_{ni}$ is applicable to surface soil.

Soil_i The Soil_i represents a constituent concentration in soil that is protective of human health for industrial/commercial land use. The exposure pathways addressed by the Soil_i include the ingestion of soil, the inhalation of volatile emissions and particulates released from soil to the ambient air, and dermal contact with soil. The Soil_i is applicable to surface soil.

Soil_{GW} The Soil_{GW} represents a constituent concentration in soil that does not result in the leaching of an unacceptable constituent concentration from soil to groundwater. The Soil_{GW} shall be based on the classification of the groundwater to be protected: **Soil_{GW1}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 1 (the Soil_{GW1} shall not result in a groundwater concentration that exceeds the GW₁); **Soil_{GW2}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 2 (the Soil_{GW2} shall not result in a groundwater concentration that exceeds the GW₂ at the POE); **Soil_{GW3DW}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 3 that may potentially discharge to a surface water body designated as a drinking water source (the Soil_{GW3DW} shall not result in a groundwater concentration that exceeds the GW_{3DW} at the POE); and **Soil_{GW3NDW}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 3 that may potentially discharge to a surface water body designated as a non-drinking water source (the Soil_{GW3NDW} shall not result in a groundwater concentration that exceeds the GW_{3NDW} at the POE). The **Soil_{GW2}** shall be multiplied by a dilution factor (DF2) that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient property boundary. The **Soil_{GW3}** shall be multiplied by a dilution factor (DF3) that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient surface water body. The dilution factor (DF) shall be obtained from Section 4.2.3. **As an alternative to the Soil_{GW} RS, the soil to groundwater pathway may be evaluated using a leach test.** The soil to groundwater pathway shall be evaluated for surface soil and subsurface soil.

Soil_{sat} The Soil_{sat} concentration represents a chemical-physical limit where saturation of the soil occurs. A constituent concentration in soil at or above the Soil_{sat} indicates the potential for NAPL to be present in the soil. **If the Soil_{sat} is exceeded, the potential for NAPL to be present may be evaluated using an alternate approach.** This approach shall address the most heavily impacted soils within the AOI and is subject to Department approval. The Soil_{sat} parameter is only applicable to constituents present in a liquid phase at ambient temperatures (constituents with melting points greater than 20°C). The Soil_{sat} is applicable to surface soil and subsurface soil.

Soil_{LS} The Soil_{LS} is the soil RECAP standard that is compared to the soil leachate test result for the evaluation of the soil to groundwater pathway. **Soil_{LS1}** shall not result in a groundwater concentration that exceeds the GW₁; **Soil_{LS2}** shall not

result in a groundwater concentration that exceeds the GW_2 at the POE; **Soil_{LS3DW}** shall not result in a groundwater concentration that exceeds the GW_{3DW} at the POE; and **Soil_{LS3NDW}** shall not result in a groundwater concentration that exceeds the GW_{3NDW} at the POE. The soil leachate concentration shall be representative of the most heavily impacted soils within the AOI.

For MO-1, the soil RS shall be obtained from Table 2. For a constituent not listed in Table 2, soil RS shall be calculated in accordance with Appendix A. Refer to Section 2.3.2.1 for Groundwater Classification definitions, Section 2.3.2.2 for guidance on establishing the POC and POE, and below for GW_1 , GW_2 , GW_{3DW} , and GW_{3NDW} definitions.

If there are multiple constituents that elicit noncarcinogenic effects on the same target organ or have the same critical effect, then the $Soil_{ni}$ or $Soil_i$ shall be adjusted to account for additive health effects. Refer to Section 2.5.2 for further guidance and Table 4 for the targets for the MO-1 RS based on noncarcinogenic health effects.

The **MO-1 Soil Limiting RECAP** Standard (LRS) shall be the lowest of: 1) $Soil_{ni}$ or $Soil_i$ (adjusted for additive health effects if applicable); 2) $Soil_{GW} \times DF$ (if applicable); and 3) $Soil_{sat}$. Refer to Section 4.2.3 for the MO-1 DF.

4.2.2 MO-1 Groundwater Standards

GW₁ The GW_1 represents a constituent concentration in groundwater that is protective of human health. The exposure pathways addressed by the GW_1 include the ingestion of groundwater, dermal contact with groundwater, and the inhalation of volatile emissions associated with indoor groundwater use. The GW_1 RS is applicable to groundwater meeting the definition of Groundwater Classification 1.

GW₂ The GW_2 represents a constituent concentration that is protective of human health. The exposure pathways addressed by the risk-based GW_2 include the ingestion of groundwater, dermal contact with groundwater, and the inhalation of volatile emissions associated with indoor groundwater use. The GW_2 shall be multiplied by a dilution factor (DF2) that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient property boundary (POE). The dilution factor (DF2) shall be obtained from Section 4.2.3. The GW_2 RS is applicable to groundwater meeting the definition of Groundwater Classification 2.

GW₃ The GW_3 represents a constituent concentration in groundwater that will not result in the cross-media transfer of a constituent from groundwater to a downgradient surface water body. The **GW_{3DW}** shall be based on the protection of a downgradient surface water that is classified as a drinking water source. The **GW_{3NDW}** shall be based on the protection of a downgradient surface water that is classified as a non-drinking water source. The GW_{3DW} or

the GW_{3NDW} shall be multiplied by a dilution factor (DF3) that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient surface water body (POE). The default dilution factor (DF3) shall be obtained from Section 4.2.3. A GW_3 standard shall not result in a constituent concentration in groundwater that poses unacceptable health risk for other pathways of exposure such as the inhalation of volatile emissions to an enclosed structure. The GW_3 RS is applicable to groundwater meeting the definition of Groundwater Classification 3.

Water_{sol} The $Water_{sol}$ represents a chemical-physical limit where saturation of the water occurs. Constituent concentrations in water at or above the water solubility limit indicate a potential for NAPL to be present.

Refer to Section 2.3.2.1 for Groundwater Classification definitions and Section 2.3.2.2 for guidance on establishing the POC and POE.

The GW RS shall be obtained from Table 3. For a constituent not listed in Table 3, a MO-1 groundwater RS shall be developed in accordance with Appendix A.

If there are multiple constituents that elicit noncarcinogenic effects on the same target organ or have the same critical effect, then the GW_1 and GW_2 shall be adjusted to account for additive health effects. A GW_1 or GW_2 based on a SDWA MCL, treatment technology (TT), action level, or taste/odor advisory level is not required to be adjusted for additive health effects. Refer to Section 2.5.2 for additional guidance and Table 4 for the targets for the MO-1 RS based on noncarcinogenic effects.

The **MO-1 Groundwater Limiting RECAP Standard (LRS)** shall be the lower of: 1) GW_1 , $GW_2 \times DF2$, or $GW_3 \times DF3$; and 2) $Water_{sol}$.

4.2.3 MO-1 Dilution Factors

For $Soil_{GW2}$, GW_2 , $Soil_{GW3}$, and GW_3 , identify the MO-1 dilution factor from the table below based on: (1) the shortest distance between the POC and the nearest downgradient POE; the POE for a GW 2 zone shall be the nearest downgradient property boundary (DF2) and the POE for a GW 3 zone shall be the nearest downgradient surface water body (DF3); and (2) the thickness of the impacted groundwater within the permeable zone (S_d). If the S_d is greater than 20 feet then a site-specific dilution factor shall be calculated under MO-2 or MO-3. If the distance from the source is greater than 2000 feet, then: (1) the DF for 2000 feet may be used; or (2) a site-specific dilution factor may be calculated under MO-2 or MO-3. **Note:** If there is the potential for constituent migration to be influenced by pumping activities within the zone, then the DF values presented below are not valid and shall not be used.

Distance from POC to POE (feet)	MO-1 Longitudinal DF (dimensionless)			
	$S_d \leq 5$ ft	$S_d = 6-10$ ft	$S_d = 11-15$ ft	$S_d = 16-20$ ft
0 - 50	1.5	1	1	1
51 - 100	2.6	1.5	1.2	1.1
101 - 150	4.1	2.1	1.6	1.3
151 - 250	8.4	4.3	3	2.3
251 - 500	29	15	9.8	7.4
501 - 750	63	32	21	16
751 - 1000	111	57	37	28
1001 - 1250	173	86	58	43
1251 - 1500	248	124	83	62
1501 - 1750	337	169	113	84
1751 - 2000	440	220	147	110

4.2.4 Other Considerations in the Selection of the Limiting RECAP Standard

Refer to Section 2.5.3 for other factors that require consideration in the identification of the limiting RECAP MO-1 Standards.

4.3 Management Option 1 Soil and Groundwater Assessment

4.3.1 Soil

To determine if soil warrants further evaluation under RECAP, the soil LRS shall be compared to the soil AOIC. If the AOIC exceeds the LRS, then the Submitter may: (1) remediate to the MO-1 limiting RS and comply with closure and/or post-closure requirements for MO-1; or (2) proceed with a MO-2 or MO-3 evaluation. If the AOIC is less than or equal to the LRS, then the COC does not require further evaluation. Refer to Section 2.3.1.3 for guidelines on determining the AOIC.

If leachate testing is used in lieu of the Soil_{GW} to evaluate the soil to groundwater pathway, then the soil leachate testing shall be conducted in the area of the most heavily impacted soil. The leachate test results shall be compared to the appropriate Soil_{LS} as follows:

Groundwater Classification 1 Soil Leachate Standard (Soil_{LS1}): $GW_1 \times 20^*$

Groundwater Classification 2 Soil Leachate Standard (Soil_{LS2}): $GW_2 \times 20^* \times DF2^{**}$

Groundwater Classification 3 Soil Leachate Standard (Soil_{LS3}): $GW_3 \times 20^* \times DF3^{***}$

If the leachate test results are less than or equal to Soil_{LS}, then no further evaluation of the soil to groundwater pathway is warranted. If the leachate test results are greater than Soil_{LS}, then further evaluation of the soil to groundwater pathway is required. *The MO-1 default Summers Dilution Factor (DF_{Summers}) is 20. **Domenico longitudinal dilution

factor (DF2) for a GW 2 zone; refer to Section 4.2.3. ***Domenico longitudinal dilution factor for a GW 3 zone; refer to Section 4.2.3.

4.3.2 Groundwater

To determine if groundwater warrants further evaluation, the groundwater LRS shall be compared to the groundwater CC. If the groundwater CC exceeds MO-1 LRS, then the Submitter may: (1) remediate to the MO-1 limiting RS and comply with closure and/or post-closure requirements for MO-1; or (2) proceed with a MO-2 or MO-3 evaluation. If the CC is less than or equal to the LRS, then the COC does not require further evaluation. Refer to Section 2.3.2.4 for guidelines on determining the CC.

4.4 Management Option 1 Submittal Requirements

A Management Option 1 Submittal Report shall be submitted to the Department for approval. This report shall, at a minimum, meet the submittal requirements listed in Table 5. Any variance from these requirements is subject to Department approval prior to submission of the MO-1 report. Refer to Appendix C for the RECAP Forms.

5.0 MANAGEMENT OPTION 2

Management Option 2 (MO-2) provides for the development of soil and groundwater RS using site-specific data for the evaluation of constituent fate and transport and default RME assumptions for the protection of human health. The MO-2 RS represent constituent concentrations in media that are protective of human health and the environment under site-specific conditions. The MO-2 RS shall be developed in accordance with the risk assessment methodologies and analytical fate and transport models included in Appendix A. MO-2 RS shall only be developed for soil and groundwater for standard nonindustrial (residential) and industrial scenarios. In the absence of site-specific fate and transport data, protective default assumptions as specified in Appendix A shall be used. MO-2 RS based on site-specific data are only applicable at the AOI for which they were developed. MO-2 RS developed for one AOI shall not be applied at another AOI unless it is adequately documented that the RS are appropriate for the AOI and the Department concurs. The MO-2 RS shall comply with ARAR and shall consider the protection of resource aesthetics.

5.1 Criteria for Management of Soil and Groundwater Under Management Option 2

An AOI must meet the criteria listed below to be managed under MO-2. Application of the MO-2 RS at an AOC or an AOI that does not meet all of the criteria for management under MO-2 shall receive Department approval prior to submission of the MO-2 assessment.

- (1) A non-industrial or industrial exposure scenario is applicable at the AOC/AOI.
- (2) All likely human exposure pathways associated with soil and groundwater at or adjacent to the AOC/AOI are addressed by the MO-2 RS as defined in Appendix A.
- (3) The impacted soil and/or groundwater under investigation are in declining conditions, i.e., the constituent mass is not increasing, the source of the release has been mitigated, and the area of constituent concentrations above the SS is not expanding. [The environmental fate and transport models used to develop the cross-media transfer RS assume steady-state concentrations over the AOI.]
- (4) NAPL is not present (i.e., If NAPL was present at the site but has been, or will be, removed to the extent practicable, the adsorbed concentrations in soil and/or the dissolved concentrations in groundwater may be addressed in the MO-2 evaluation). [Note: The environmental fate and transport models used to develop the cross-media transfer RS assume that NAPL is not present.] MO-2 may be applied at a soil AOC/AOI where NAPL is present, if approved by the Department for the purpose of demonstrating that a CAP (refer to Section 1.2.3) is protective of human health and the environment (i.e., constituent concentrations at or reaching current or potential exposure points or cross-media transfer points are less than or equal to the MO-2 limiting RS).

Note: If a COC is discharging via groundwater to a surface water body, then surface water, sediment, and/or biota shall be addressed under MO-3.

The Submitter shall demonstrate to the Department that the AOC or the AOI meets the above criteria to qualify for management under MO-2 and that a site evaluation has been conducted in accordance with the guidelines in Appendix B. If an AOC or an AOI does not meet all of these criteria, then the LDEQ considers the AOC or the AOI to be sufficiently complex to warrant a more detailed assessment of risk and the AOC or the AOI shall be addressed under MO-3.

5.2 MO-2 RECAP Standards

5.2.1 MO-2 Soil RECAP Standards

Soil_{ni} The Soil_{ni} represents a constituent concentration in soil that is protective of human health for non-industrial land use. The exposure pathways addressed by the Soil_{ni} include the ingestion of soil, the inhalation of volatile emissions and particulates released from soil to the ambient air, and dermal contact with soil. **For MO-2, site-specific environmental fate and transport data shall be used in conjunction with default exposure assumptions to calculate a site-specific Soil_{ni}.** The Soil_{ni} is applicable to surface soil.

Soil_i The Soil_i represents a constituent concentration in soil that is protective of human health for industrial/commercial land use. The exposure pathways addressed by the Soil_i include the ingestion of soil, the inhalation of volatile emissions and particulates released from soil to the ambient air, and dermal contact with soil. **For MO-2, site-specific environmental fate and transport data shall be used in conjunction with default exposure assumptions to calculate a site-specific Soil_i.** The Soil_i is applicable to surface soil.

Soil_{GW} The Soil_{GW} represents a constituent concentration in soil that does not result in the leaching of an unacceptable constituent concentration from soil to groundwater. The Soil_{GW} shall be based on the classification of the groundwater to be protected: **Soil_{GW1}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 1; **Soil_{GW2}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 2; **Soil_{GW3DW}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 3 that may potentially discharge to a surface water body designated as a drinking water source; and **Soil_{GW3NDW}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 3 that may potentially discharge to a surface water body designated as a non-drinking water source. The Soil_{GW2} shall be multiplied by a site-specific dilution factor that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient property boundary. The Soil_{GW3} shall be multiplied by a site-specific dilution factor that accounts for the reduction in

constituent concentration with groundwater migration from the source to the nearest downgradient surface water body. **For MO-2, site-specific environmental fate and transport data shall be used to calculate a site-specific Soil_{GW} RS and dilution factor. As an alternative to the Soil_{GW} RS, the soil to groundwater pathway may be evaluated using a leach test.** The soil to groundwater pathway shall be evaluated for surface soil and subsurface soil.

Soil_{LS} The Soil_{LS} is the soil RECAP standard that is compared to the soil leachate test result for the evaluation of the soil to groundwater pathway. **Soil_{LS1}** shall not result in a groundwater concentration that exceeds the GW₁; **Soil_{LS2}** shall not result in a groundwater concentration that exceeds the GW₂ at the POE; **Soil_{LS3DW}** shall not result in a groundwater concentration that exceeds the GW_{3DW} at the POE; and **Soil_{LS3NDW}** shall not result in a groundwater concentration that exceeds the GW_{3NDW} at the POE. The soil leachate concentration shall be representative of the most heavily impacted soils within the AOI. **Site-specific environmental fate and transport data shall be used to calculate a site-specific dilution factors.**

Soil_{sat} The Soil_{sat} concentration represents a chemical-physical limit where saturation of the soil occurs. A constituent concentration in soil at or above the Soil_{sat} indicates the potential for NAPL to be present in the soil. **If the Soil_{sat} is exceeded, the potential for NAPL to be present may be evaluated using an alternate approach.** This approach shall address the most heavily impacted soils within the AOI and is subject to Department approval. The Soil_{sat} parameter is only applicable to constituents present in a liquid phase at ambient temperatures (constituents with melting points greater than 20°C). **The Soil_{sat} shall be calculated using site-specific environmental fate and transport data.** The Soil_{sat} is applicable to surface soil and subsurface soil.

The site-specific MO-2 Soil RS shall be calculated in accordance with Appendix A using site-specific fate and transport data.

Refer to Section 2.3.2.1 for Groundwater Classification definitions, Section 2.3.2.2 for guidance on establishing the POC and POE.

If there are multiple constituents that elicit noncarcinogenic effects on the same target organ or have the same critical effect, then the Soil_{ni} or Soil_i shall be adjusted to account for additive health effects. Refer to Section 2.5.2 for additional guidance. The noncarcinogenic targets shall be the threshold effects for the RfD and RfC used in the calculation of the MO-2 RS.

The **MO-2 Soil Limiting RECAP** Standard (LRS) shall be the lowest of: 1) Soil_{ni} or Soil_i (adjusted for additive health effects if applicable); 2) Soil_{GW} x DF (if applicable); and 3) Soil_{sat}. Refer to Section 5.2.3 for guidance on MO-2 DF.

5.2.2 MO-2 Groundwater RECAP Standards

- GW₁** The GW₁ represents a constituent concentration in groundwater that is protective of human health. The exposure pathways addressed by the GW₁ shall include the ingestion of groundwater, dermal contact with groundwater, and the inhalation of volatile emissions associated with indoor groundwater use. The GW₁ RS is applicable to groundwater meeting the definition of Groundwater Classification 1.
- GW₂** The GW₂ represents a constituent concentration that is protective of human health. The exposure pathways addressed by the risk-based GW₂ shall include the ingestion of groundwater and the inhalation of volatile emissions associated with indoor groundwater use. The GW₂ shall be multiplied by a site-specific dilution factor that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient property boundary (POE). **Site-specific environmental fate and transport data shall be used to calculate a site-specific dilution factor (DF2).** This standard does not authorize the migration of COC offsite to adjacent property but rather serves to evaluate the acceptability of constituent concentrations with respect to human health and the environment. The GW₂ RS is applicable to groundwater meeting the definition of Groundwater Classification 2.
- GW₃** The GW₃ serves to protect groundwater meeting the definition of Groundwater Classification 3. The GW₃ represents a constituent concentration in groundwater that will not result in the cross-media transfer of a constituent from groundwater to a downgradient surface water body. The **GW_{3DW}** shall be based on the protection of a downgradient surface water that is classified as a drinking water source. The **GW_{3NDW}** shall be based on the protection of a downgradient surface water that is classified as a non-drinking water source. The GW_{3DW} or the GW_{3NDW} shall be multiplied by a site-specific dilution factor that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient surface water body (POE). **Site-specific environmental fate and transport data shall be used to calculate a site-specific dilution factor (DF3).** The GW₃ is applicable to groundwater meeting the definition of Groundwater Classification 3.
- Water_{sol}** The Water_{sol} represents a chemical-physical limit where saturation of the water occurs. Constituent concentrations in water at or above the water solubility limit indicate a potential for NAPL to be present.

The GW RS shall be obtained from Table 3. For a constituent not listed in Table 3, a MO-2 groundwater RS shall be developed in accordance with Appendix A.

If there are multiple constituents that elicit noncarcinogenic effects on the same target organ or have the same critical effect, then the GW₁ and GW₂ shall be adjusted to account for additive health effects. A GW₁ or GW₂ based on a SDWA MCL, treatment

technology (TT), action level, or taste/odor advisory level is not required to be adjusted for additive health effects. Refer to Section 2.5.2 for additional guidance.

Refer to Section 2.3.2.1 for Groundwater Classification definitions and Section 2.3.2.2 for guidance on establishing the POC and POE.

The **MO-2 Groundwater Limiting RECAP Standard (LRS)** shall be the lower of: 1) GW_1 , $GW_2 \times DF2$, or $GW_3 \times DF3$; and 2) $Water_{sol}$.

5.2.3 MO-2 Site-Specific Dilution Factors

A site-specific DF shall be calculated using site-specific environmental fate and transport data and the Domenico model (Appendix A, Section A6.0).

5.2.4 Other Considerations in the Selection of the Limiting RECAP Standard

Refer to Section 2.5.3 for other factors that require consideration in the identification of the limiting MO-2 RECAP Standards.

5.3 Management Option 2 Soil and Groundwater Assessment

5.3.1 Soil

The soil AOIC shall be compared to the site-specific MO-2 limiting RS. If the soil AOIC for all COC are less than or equal to the site-specific MO-2 limiting RS, then typically, NFA-ATT is required for soil. If a constituent-specific soil AOIC exceeds a MO-2 limiting RS, the Submitter may: (1) remediate to the MO-2 limiting RS and comply with closure requirements for MO-2 (and post-closure requirements if warranted); or (2) proceed with a MO-3 evaluation. Refer to Section 2.3.1.3 for guidelines on determining the AOIC.

If leachate testing is used in lieu of the $Soil_{GW}$ to evaluate the soil to groundwater pathway, then the soil leachate testing shall be conducted in the area of the most heavily impacted soil. The leachate test results shall be compared to the appropriate $Soil_{LS}$ as follows:

Groundwater Classification 1 Soil Leachate Standard ($Soil_{LS1}$): $GW_1 \times 20^*$

Groundwater Classification 2 Soil Leachate Standard ($Soil_{LS2}$): $GW_2 \times 20^* \times DF2^{**}$

Groundwater Classification 3 Soil Leachate Standard ($Soil_{LS3}$): $GW_3 \times 20^* \times DF3^{***}$

If the leachate test results are less than or equal to $Soil_{LS}$, then no further evaluation of the soil to groundwater pathway is warranted. If the leachate test results are greater than $Soil_{LS}$, then further evaluation of the soil to groundwater pathway is required. *A site-specific $DF_{Summers}$ may be calculated in lieu of using the default of 20. ** A site-specific

Domenico longitudinal dilution factor for a GW 2 zone (DF2) shall be used; ***A site-specific Domenico longitudinal dilution factor for a GW 3 (DF3) zone shall be used.

5.3.2 Groundwater

The groundwater CC shall be compared to the site-specific MO-2 limiting RS. If the groundwater CC for all COC are less than or equal to the site-specific MO-2 limiting RS, then typically, NFA-ATT is required for groundwater. If a constituent-specific groundwater CC exceeds a MO-2 limiting RS, the Submitter may: (1) remediate to the MO-2 limiting RS and comply with closure requirements for MO-2 (and post-closure requirements if warranted); or (2) proceed with a MO-3 evaluation. Refer to Section 2.3.2.4 for guidelines on determining the CC.

5.4 Management Option 2 Soil and Groundwater RECAP Standards for Typical UST and Other Small Petroleum Hydrocarbon Release Sites

A site-specific MO-2 evaluation has been performed for typical UST and other small petroleum hydrocarbon release sites. Relative to sites at large facilities (landfills, RCRA facilities, chemical plants, etc.), these sites are unique because: (1) most sites are similar in size; (2) the COC are relatively limited and identical; (3) the sources of COC are generally limited (i.e. tank hold, pipe chase, and dispenser islands); and (4) the exposure conditions at the site are similar. Due to these factors and the abundance of information that has been obtained from numerous UST and other small petroleum release sites in Louisiana and across the country, a site-specific MO-2 RECAP evaluation has been developed by the Department for these sites (refer to Appendix H). The RS presented in the Appendix H may be applied at typical UST and small petroleum release sites which meet the criteria presented in Appendix H. Appendix H incorporates site-specific environmental fate and transport information that will be gathered during site investigation activities at UST sites. Sites are classified according to the fractional organic carbon present in soil that is unimpacted but representative of the impacted area.

Sites evaluated using Appendix H are required to meet all Appendix H submittal requirements. Although this MO-2 evaluation will be used at many UST and other small petroleum hydrocarbon release sites that meet Appendix H management criteria, a more site-specific MO-2 analysis or a MO-3 analysis may be required by the Department on a site-specific basis dependent on site conditions. Exposure pathways not addressed in Appendix H may be addressed under a site-specific MO-2 conducted in conjunction with the Appendix H evaluation.

5.5 Management Option 2 Submittal Requirements

A Management Option 2 Submittal Report shall be submitted to the Department for approval. This report shall, at a minimum, meet the submittal requirements listed in Table 5. Any variance from these requirements is subject to Department approval prior to submission of the MO-2 report. Refer to Appendix C for the RECAP forms.

6.0 MANAGEMENT OPTION 3

Management Option 3 (MO-3) provides for: (1) the development of site-specific RS using site-specific exposure and environmental fate and transport data; and (2) the evaluation of all environmental media (i.e., soil, groundwater, air, surface water, sediment, and biota), fate and transport pathways, and exposure pathways. Any AOC or AOI may be managed under MO-3. A NFA-ATT determination shall only be considered for an AOC or an AOI where the source of the release has been removed or mitigated. The Submitter may choose to proceed through the SO, MO-1, and/or MO-2 prior to managing the AOI under MO-3, or the Submitter may proceed directly to MO-3.

The MO-3 RS shall consider the protection of human health, the prevention of cross-media transfer, compliance with ARAR, the protection of resource aesthetics, and the ceiling limit of 10^5 mg/kg (soil). Site-specific exposure data shall be used when available and shall be accompanied by supporting documentation. Site-specific exposure assumptions representative of a RME scenario for the identified receptor activity patterns at the AOI shall be used in the development of the MO-3 RS. The RME shall be estimated using protective assumptions regarding exposure (intake or contact rate, exposure frequency, exposure duration, body weight, etc.) at the AOI. In the absence of site-specific exposure data, protective default exposure assumptions consistent with current EPA recommendations shall be used. If the site-specific exposure time and/or exposure frequency is significantly less than the standard exposure frequency for an industrial scenario (8 hours/workday; 250 days/year), **financial assurance and institutional controls may be required** depending on site-specific considerations such as current and future land use and receptor activities at, and in the vicinity of, the AOI. **The Submitter shall ensure that the property remains suitable for commerce and, at a minimum, suitable for industrial use.** The target risk (TR) and/or target hazard quotients (THQ) shall be determined in accordance with guidelines presented in Section 2.5.

Site-specific and default exposure assumptions, target risk, target hazard quotient, and site-specific and default fate and transport assumptions used under MO-3 are subject to Department approval. **The MO-3 RS are subject to Department approval prior to application at the AOI.** The MO-3 RS are site-specific and therefore are only applicable at the AOI for which they were developed. The MO-3 RS developed for one AOI shall not be applied at another AOI unless it is adequately documented that the RS are appropriate for the AOI and the Department concurs with the decision. **A MO-3 RS submitted without the appropriate documentation will not be approved by the Department.**

All methods/models, input parameters, and calculations used in the estimation of exposure shall be clearly presented and fully documented and referenced in the MO-3 submittal.

6.1 Management Option 3 Workplan

Prior to conducting a MO-3 assessment, the Submitter shall submit a detailed workplan for Department approval. The work plan shall include:

- (1) A description of the site including history, setting, size, geology, hydrology, and hydrogeology; the longitude and latitude of the primary facility entrance and location method;
- (2) Topographic map with the AOC or the AOI labeled and name of quadrangle; vicinity map with adjoining properties, cross streets and land use;
- (3) A site map with all significant features;
- (4) Available site investigation data;
- (5) Preliminary identification of the AOI and COC and a detailed AOI map with all sampling locations or proposed sampling locations;
- (6) Identification of any known data QA/QC issues;
- (7) A description of current and future land use at the AOC or the AOI and adjacent to the AOC or the AOI;
- (8) A description of groundwater use at and in the vicinity (one-mile radius) of the AOC or the AOI, groundwater classification of the aquifer of concern and supporting documentation;
- (10) Preliminary identification of site-specific fate and transport data collected to date;
- (11) Identification of site-specific and default exposure data to be used in the development of the RS;
- (12) Identification of the model(s) to be used, a discussion on the appropriateness of the model(s) for site conditions, model inputs, and model documentation;
- (13) Preliminary identification of COC for which EPA toxicity values are not available and the methods that will be used to assess these COC;
- (14) Identification of the proposed use of background levels, ARAR, or quantitation limits as RS;
- (15) Proposed target risk level that will be used in the development of the MO-3 RS;
- (16) If further site characterization is proposed, a sampling and analysis plan;
- (17) Summary of the SO, MO-1, and/or MO-2 if conducted; and
- (18) RECAP Form 11 Ecological Checklist.

6.2 Management Option 3 RECAP Standards

6.2.1. Soil

Soil_{ni} The Soil_{ni} represents a constituent concentration in soil that is protective of human health for non-industrial land use. The exposure pathways addressed by the Soil_{ni} include the ingestion of soil, the inhalation of volatile emissions and particulates released from soil to the ambient air, and dermal contact with soil. For MO-3, **site-specific exposure and environmental fate and transport data** shall be used to calculate a site-specific Soil_{ni}. The Soil_{ni} is applicable to surface soil.

Soil_i The Soil_i represents a constituent concentration in soil that is protective of human health for industrial/commercial land use. The exposure pathways addressed by

the Soil_i include the ingestion of soil, the inhalation of volatile emissions and particulates released from soil to the ambient air, and dermal contact with soil. For MO-3, **site-specific exposure data and environmental fate and transport data** shall be used to calculate a site-specific Soil_i. The Soil_i is applicable to surface soil.

Soil_{GW} The Soil_{GW} represents a constituent concentration in soil that does not result in the leaching of an unacceptable constituent concentration from soil to groundwater. The Soil_{GW} shall be based on the classification of the groundwater to be protected: **Soil_{GW1}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 1; **Soil_{GW2}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 2; **Soil_{GW3DW}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 3 that may potentially discharge to a surface water body designated as a drinking water source; and **Soil_{GW3NDW}** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 3 that may potentially discharge to a surface water body designated as a non-drinking water source. The Soil_{GW2} shall be multiplied by a site-specific dilution factor that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient property boundary. The Soil_{GW3} shall be multiplied by a site-specific dilution factor that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient surface water body. **For MO-3, site-specific environmental fate and transport data shall be used to calculate a site-specific Soil_{GW} RS and dilution factor.** As an alternative to the Soil_{GW} RS, the soil to groundwater pathway may be evaluated using a leach test. The soil to groundwater pathway shall be evaluated for surface soil and subsurface soil.

Soil_{LS} The Soil_{LS} is the soil RECAP standard that is compared to the soil leachate test result for the evaluation of the soil to groundwater pathway. **Soil_{LS1}** shall not result in a groundwater concentration that exceeds the GW₁; **Soil_{LS2}** shall not result in a groundwater concentration that exceeds the GW₂ at the POE; **Soil_{LS3DW}** shall not result in a groundwater concentration that exceeds the GW_{3DW} at the POE; and **Soil_{LS3NDW}** shall not result in a groundwater concentration that exceeds the GW_{3NDW} at the POE. The soil leachate concentration shall be representative of the most heavily impacted soils within the AOI. **Site-specific environmental fate and transport data shall be used to calculate a site-specific dilution factors.**

Soil_{sat} The Soil_{sat} concentration represents a chemical-physical limit where saturation of the soil occurs. A constituent concentration in soil at or above the Soil_{sat} indicates the potential for NAPL to be present in the soil. If the Soil_{sat} is exceeded, the potential for NAPL to be present may be evaluated using an alternate approach. This approach shall address the most heavily impacted soils within the AOI and is subject to Department approval. The Soil_{sat} parameter is only applicable to constituents present in a liquid phase at ambient temperatures (constituents with

melting points greater than 20°C). **The Soil_{sat} shall be calculated using site-specific environmental fate and transport data.** The Soil_{sat} is applicable to surface soil and subsurface soil.

The site-specific MO-3 soil RS shall be calculated in accordance with Appendix A using site-specific exposure and fate and transport data.

Refer to Section 2.3.2.1 for Groundwater Classification definitions, Section 2.3.2.2 for guidance on establishing the POC and POE.

If there are multiple constituents that elicit noncarcinogenic effects on the same target organ or have the same critical effect, then the Soil_{ni} or Soil_i shall be adjusted to account for additive health effects. Refer to Section 2.5.2 for further guidance. The targets shall be threshold effects for the RfD and RfC used to calculate the MO-3 RS.

The **MO-3 Soil Limiting RECAP Standard (LRS)** shall be the lowest of: 1) Soil_{ni} or Soil_i (adjusted for additive health effects if applicable); 2) Soil_{GW} x DF (if applicable); 3) Soil_{sat}; and 4) RS for other pathways of concern identified for soil (if applicable).

6.2.2 Groundwater

GW₁ The GW₁ represents a constituent concentration in groundwater that is protective of human health. The exposure pathways addressed by the GW₁ shall include the ingestion of groundwater, dermal contact with groundwater, and the inhalation of volatile emissions associated with indoor groundwater use. **Site-specific exposure data shall not be used to develop a GW₁ RS.** The GW₁ RS is applicable to groundwater meeting the definition of Groundwater Classification 1.

GW₂ The GW₂ represents a constituent concentration that is protective of human health. The exposure pathways addressed by the risk-based GW₂ shall include the ingestion of groundwater and the inhalation of volatile emissions associated with indoor groundwater use. **Site-specific exposure data shall not be used to develop a GW₂ RS.** The GW₂ shall be multiplied by a site-specific dilution factor that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient property boundary (POE). **Site-specific environmental fate and transport data shall be used to calculate a site-specific dilution factor (DF2).** This standard does not authorize the migration of COC offsite to adjacent property but rather serves to evaluate the acceptability of constituent concentrations with respect to human health and the environment. The GW₂ RS is applicable to groundwater meeting the definition of Groundwater Classification 2.

GW₃ The GW₃ serves to protect groundwater meeting the definition of Groundwater Classification 3. The GW₃ represents a constituent concentration in groundwater that will not result in the cross-media transfer of a constituent from groundwater to a downgradient surface water body. **Site-specific data**

shall not be used to develop a GW₃ RS. The GW_{3DW} shall be based on the protection of a downgradient surface water that is classified as a drinking water source. The GW_{3NDW} shall be based on the protection of a downgradient surface water that is classified as a non-drinking water source. The GW_{3DW} or the GW_{3NDW} shall be multiplied by a site-specific dilution factor that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient surface water body (POE). **Site-specific environmental fate and transport data shall be used to calculate a site-specific dilution factor (DF3).** The GW₃ is applicable to groundwater meeting the definition of Groundwater Classification 3.

Water_{sol} The Water_{sol} represents a chemical-physical limit where saturation of the water occurs. Constituent concentrations in water at or above the water solubility limit indicate a potential for NAPL to be present.

The MO-3 GW₁, GW₂, and GW₃ RS shall be obtained from Table 3. For a constituent not listed in Table 3, a MO-3 groundwater RS shall be developed in accordance with Appendix A.

If there are multiple constituents that elicit noncarcinogenic effects on the same target organ or have the same critical effect, then the GW₁ and GW₂ shall be adjusted to account for additive health effects. A GW₁ or GW₂ based on a SDWA MCL, treatment technology (TT), action level, or taste/odor advisory level is not required to be adjusted for additive health effects. Refer to Section 2.5.2 for additional guidance.

Refer to Section 2.3.2.1 for Groundwater Classification definitions and Section 2.3.2.2 for guidance on establishing the POC and POE.

The **MO-3 Groundwater Limiting RECAP Standard (LRS)** shall be the lower of: 1) GW₁, GW₂ x DF2, or GW₃ x DF3; 2) Water_{sol}; and 3) RS for other pathways of concern identified for groundwater (if applicable).

6.2.3 RECAP Standards for Other Media

For media (e.g., sediment, biota) and/or pathways not included in Appendix A, the MO-3 RS shall be developed in accordance with current EPA methods and recommendations and shall be subject to Department approval. The development of RS for chemical residues in fish and shellfish shall be consistent with the approach presented in *Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish* and *Tissue Screening Level Guidelines for Issuance of Public Health Advisories for Select Contaminants* (LDHH, LDEQ, LDAF, and LDWF 2012).

6.2.4 Other Considerations in the Selection of the Limiting RECAP Standard

Refer to Section 2.5.3 for other factors that require consideration in the identification of the limiting MO-3 RECAP Standards.

6.3 Management Option 3 Assessment

The limiting RS for each medium/pathway of concern shall be compared to the appropriate COC concentration for each medium. Refer to Section 2.3.1.3 for soil AOIC; Section 2.3.2.4 for the groundwater CC; Section 2.3.3 for sediment AOIC; and Section 2.3.4 for biota exposure concentration. If the COC concentration is less than or equal to the MO-3 limiting RS, then typically, NFA-ATT is required. If the COC concentration is greater than the MO-3 limiting RS, then remediated to the site-specific MO-3 limiting RS shall be required and the Submitter shall comply with closure and post-closure requirements. In addition to the requirements presented this section, MO-3 evaluations shall comply with the guidelines presented in Section 2.0 and Appendices A, B, and D.

If leachate testing is used in lieu of the Soil_{GW} to evaluate the soil to groundwater pathway, then the soil leachate testing shall be conducted in the area of the most heavily impacted soil. The leachate test results shall be compared to the appropriate Soil_{LS} as follows:

Groundwater Classification 1 Soil Leachate Standard (Soil_{LS1}): $GW_1 \times 20^*$

Groundwater Classification 2 Soil Leachate Standard (Soil_{LS2}): $GW_2 \times 20^* \times DF2^{**}$

Groundwater Classification 3 Soil Leachate Standard (Soil_{LS3}): $GW_3 \times 20^* \times DF3^{***}$

If the leachate test results are less than or equal to Soil_{LS}, then no further evaluation of the soil to groundwater pathway is warranted. If the leachate test results are greater than Soil_{LS}, then further evaluation of the soil to groundwater pathway is required. *A site-specific DF_{Summers} may be calculated in lieu of using the default of 20. ** A site-specific Domenico longitudinal dilution factor for a GW 2 zone (DF2) shall be used; ***A site-specific Domenico longitudinal dilution factor for a GW 3 (DF3) zone shall be used.

Requests to the Department for an NFA-ATT determination under MO-3 shall demonstrate that: (1) the MO-3 RS address all impacted media, constituents, receptor populations, exposure pathways, cross-media transfer pathways of concern at the AOI; (2) the MO-3 RS address the protection of resource aesthetics; (3) the MO-3 RS comply with ARAR; (4) the MO-3 RS address cumulative exposure for current and future land use; (5) the MO-3 were developed in accordance with RECAP and have been approved by the Department; (6) the RL for non-detected site-related constituents are less than the limiting RS; (7) application of the MO-3 RS allow for beneficial use of the land and residual constituent concentrations do not result in the removal of property from commerce; (8) ecological risks are not a concern or ecological risks are acceptable; and (9) current site conditions meet the limiting MO-3 RS without the use of removal, decontamination, or control measures. If a NFA-ATT is requested, RECAP Form 12 shall be included in the submittal.

6.4 Management Option 3 Submittal Requirements

A Management Option 3 Submittal Report shall be submitted to the Department for approval. This report shall, at a minimum, meet the submittal requirements listed in

Table 5. Any variance from these requirements is subject to Department approval prior to submission of the MO-3 report. Refer to Appendix C for the RECAP Forms.

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7.0 ECOLOGICAL RISK ASSESSMENT

Ecological risk assessment (ERA) is a process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more chemical stressors. It is a process for organizing and analyzing data, information, assumptions, and uncertainties to evaluate the likelihood of adverse ecological effects in a way that is useful for environmental decision-making. The objectives of the ERA process are to: (1) identify and characterize the current and potential threats to the environment due to the release of a constituent; and (2) identify constituent concentrations that are protective of ecological receptors and natural resources. The ERA functions to: (1) document whether actual or potential ecological risks exist at an AOI; (2) identify which constituents present at an AOI pose an ecological risk; and (3) generate data to be used in evaluating corrective alternatives. Ecological risk assessments performed under the RECAP shall be conducted in accordance with current EPA guidelines (*Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, EPA 1997). These guidelines shall be used in conjunction with the guidelines presented in RECAP when conducting an ERA.

Ecological risk assessments may range from very simple to complex and resource-demanding. Ecological risk assessments are frequently designed in sequential tiers that proceed from simple, relatively inexpensive, generic evaluations to more complex, site-specific assessments. The outcome of a given level of assessment (tier) shall be to: (1) make a management decision; or (2) continue to the next level of assessment. If the results of the ERA indicate there are no unacceptable risks to ecological receptors, then typically no further evaluation shall be warranted. If the results of the ERA indicate the potential for unacceptable risks to ecological receptors, then the Submitter shall: (1) conduct a more site-specific assessment; or (2) implement corrective action. When appropriate, ecological impacts associated remedial activities shall be evaluated and the results of the evaluation shall be considered in the management of ecological risk at the AOI. An ecological risk assessment shall be considered complete when the Department has sufficient information and confidence in the results of the risk assessment to make a scientifically defensible decision concerning management of the AOI.

Ecological checklist. An ecological checklist shall be used to determine if a tier 1 (screening level) ERA is warranted. The checklist is comprised of questions concerning on-site and off-site land uses, characteristics of the environmental setting, the extent of migration, and potential impacts to ecological receptors and/or their habitats. When completing the ecological checklist, current as well as potential future impacts to receptors and/or their habitats shall be considered. If it is determined from the checklist that no significant ecological impacts are occurring or could occur, then no further evaluation shall be required. If it is determined that ecological impacts are occurring or could occur in the future, then a tier 1 ERA shall be conducted. The ecological checklist is presented in Appendix C, Form 11.

Screening-level assessment. A tier 1 (screening level) ecological risk assessment shall be a simplified assessment conducted with limited site-specific data. Where data are lacking, protective default assumptions shall be used. At the screening level, it is

important to minimize the chances of concluding that there is no risk when in fact a risk exists. Thus, for exposure and toxicity parameters for which site-specific data are lacking, assumed values shall be biased in the direction of overestimating risk. This ensures that an AOI that may pose an ecological risk is studied further. For screening methods based on the hazard quotient method, an acceptable hazard quotient (or hazard index) shall be defined as 1.0. Higher tier assessments shall incorporate site-specific data (as appropriate) for the assessment of exposure and potential ecological risks. All site-specific data shall be adequately documented. *Ecological Soil Screening Level Guidance* (EPA 2000) shall be used where determined to be applicable by the Department.

Data requirements. Refer to Section 2.2 for guidelines on site investigation, data QA/QC, and data evaluation/usability. For the collection of biological samples, guidelines may be obtained from *Superfund Program Representative Sampling Guidance Volume 3: Biological, Interim Final* (EPA 1997). For ecological assessments, surface soil shall be defined as soil present from the ground surface to a depth of 3 feet bgs. Subsurface soils shall be defined as soils present at depths greater than 3 feet bgs.

Constituents of ecological concern (COEC). All constituents detected in at least one sample (refer to Section 2.2) shall be identified as COEC for the tier 1 (screening level) assessment. The results of the screening-level assessment shall be used to identify which constituents warrant further evaluation and which may be eliminated from consideration in the next level of assessment. Those constituents found to pose negligible ecological risk during a given level (tier) of assessment may be eliminated from the list of COEC for the next level of assessment. The rationale for eliminating a constituent shall be thoroughly documented in the assessment submittal. It is important to recognize that the COEC may be different from the COC identified in the health risk assessment because of differing exposure pathways, receptor sensitivities, and receptor responses to constituents.

AOIC. For the estimation of the AOIC for screening-level ERAs, the maximum detected concentration shall be used. For other levels of assessment, the maximum detected concentration or the average concentration (unless skewed due to sampling bias) shall be used as the AOIC.

Ecological effects. NOAELs, LOAELs, exposure-response functions, and the mechanisms of toxic response shall be identified for each COEC. When evaluating the potential for adverse ecological effects using the hazard quotient approach, an acceptable total hazard index shall be defined as unity (1.0). Constituents for which toxicity information is limited or unavailable shall be addressed using best professional judgment and the impact of the data gap shall be discussed in the uncertainty analysis.

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