

If the maximum soil or groundwater concentrations exceed the default target levels (DTLs), the remediating party may choose to complete a Tier 1 Risk Assessment in lieu of cleanup to the DTLs. As shown in Table 2-1, a Tier 1 Assessment may use the concept of representative concentrations as opposed to maximum concentrations. Refer to Appendix C for a discussion of representative concentrations. An Ecological Risk Assessment is required and Activity and Use Limitations (AULs) may be needed.

After sufficient quality and quantity of data (Section 6.0) has been collected and the chemicals of concern (COCs) are identified, a Tier 1 risk assessment can begin. To complete a Tier 1 risk assessment, the following steps must be completed:

1. Compile data and identify data gaps,
2. Develop exposure model,
3. If necessary, collect data to fill data gaps,
4. Calculate media and pathway-specific representative concentrations for COCs,
5. Select relevant Tier 1 risk-based target levels from lookup tables and compare with site concentrations,
6. If necessary, calculate cumulative site-wide risk and compare with acceptable risk,
7. Evaluate the next course of action, and
8. Document Tier 1 risk assessment and recommendations.

The Ecological Risk Assessment levels used to evaluate the site are independent of the human-health-based tier assessments. In other words, a Tier 1 risk assessment could include a Level 3 Ecological Risk Assessment. Conversely, a Tier 3 Risk Assessment could be completed in conjunction with a Level 1 Ecological Risk Assessment.

Details of each step are presented below.

8.1 STEP 1: COMPILE DATA AND IDENTIFY DATA GAPS

The objective of this step is to compile available relevant data, evaluate the data, and identify any data gaps. This step and Step 2 (development of an exposure model) should be completed simultaneously because the development of an exposure model may also help identify data gaps.

Because a Tier 1 risk assessment can be performed with minimal data, additional data may not be necessary at sites that have been characterized prior to the effective date of this guidance. However, examples of Tier 1 data gaps include:

- Lack of a current land use map,
- Lack of soil or groundwater COC concentrations representative of current conditions (for example, soil or groundwater COC data is too old or not representative of recent releases or the exposure domain),
- Insufficient delineation of contamination at the site,
- Lack of soil and groundwater data for certain COCs,

- Lack of soil characterization or classification information, and
- Inadequate determination of complete pathway for domestic use of groundwater.

To ensure that all data gaps have been identified, the remediating party should refer to Section 6.0 and the references contained in that section.

8.2 STEP 2: DEVELOP EXPOSURE MODEL

This step is necessary to identify exposure pathways at a site that are currently complete or that are reasonably likely to become complete in the future. The presence of exposure pathways and receptors is dependent on current and reasonably anticipated future use of the site. If contamination could potentially migrate off site, any affected properties must also be considered when developing the exposure model.

Pathways are determined by considering the locations of the point and size of release, the extent of contamination, the location of receptors, and the media through which chemicals migrate from the location of the release to the receptors. Prior to determining exposure pathways, sufficient site characterization must be conducted such that the horizontal and vertical extent of COCs in soil and groundwater has been determined to appropriate risk-based levels. Otherwise, pathways of concern may be excluded or pathways not of concern (due to their location relative to the location of soil or groundwater contamination) may be erroneously included in the evaluation. Delineation of impacts may be an iterative process as discussed in Section 6.10.

Thus, in Step 2, an exposure model is developed to identify:

1. All complete exposure pathways for current and reasonably anticipated future land use,
2. The exposure domain for each complete exposure pathway, and
3. The point of exposure for each exposure pathway.

Determination of the exposure domain(s), as defined in Section 8.4 and discussed further in Appendix C, for each complete or potentially complete pathway is necessary because the data collected within an exposure domain only will be used to estimate the representative concentration.

As part of this step, the exposure model should be clearly documented. Specifically, the remediating party must:

1. Document the pathways that are complete under current and reasonably anticipated future conditions,
2. Explain the rationale for pathway decisions, both complete and incomplete,
3. Identify the locations within the exposure domains identified above that will be used to estimate representative chemical concentrations for each pathway.

Under the second step above, the following is an example of an appropriate justification for an incomplete pathway for vapor intrusion under a building: the COCs are non-volatile chemicals, such as metals (except for mercury).

8.3 STEP 3: COLLECT DATA TO FILL DATA GAPS

Step 3 is necessary only if data gaps are identified in Step 1. If additional environmental measurements or testing is needed at this step, the remediating party must develop an additional sampling and analysis plan. Refer to Section 6.0 for information on data collection activities. If additional soil or groundwater data are necessary, soil geotechnical parameters, typically required for a Tier 2 risk assessment, may also be collected at this time because doing so may avoid a second field mobilization and hence would be more cost-effective.

After completion of this step in a timely manner, in conformance with an approved work plan, and with appropriate documentation of the field work, the remediating party can proceed to Step 4. Depending on the specifics of the data gaps, it may not be necessary to submit a separate data collection work plan to the department. Instead, it may be submitted as an attachment to the Tier 1 Risk Assessment Report.

8.4 STEP 4: CALCULATE REPRESENTATIVE CONCENTRATIONS

Using the information from Steps 1 through 3, the remediating party must calculate representative chemical concentrations for each exposure domain, as discussed in Appendix C. “Exposure domain” refers to the portion of an impacted area/volume of media that contributes to the risk for a particular pathway. The need to calculate representative concentrations may be avoided by initially using the maximum media-specific concentrations for each pathway as the representative concentration. If the risk calculated with the use of the maximum concentrations (which are the most conservative numbers) meet the Tier 1 risk-based target levels, calculation of representative concentrations is not necessary. For target levels for lead, refer to Appendix E, Section E10.

Depending on site conditions, multiple representative concentrations (one for each exposure domain) may have to be calculated. For example, in the following three complete exposure pathways at the same site, the exposure domains will likely be different and hence the representative concentrations may differ:

1. Subsurface soil concentration for the indoor inhalation exposure pathway for the on-site non-residential worker,
2. Surficial soil concentration for direct contact pathway for the on-site non-residential worker, and
3. Soil concentration for the on-site construction worker.

At certain sites, multiple representative concentrations may be necessary for the same exposure pathway. For example, if a groundwater plume has migrated below a commercial building and a residential building, representative groundwater concentrations for the volatilization from groundwater to indoor air could be different for the residential and the non-residential receptors.

If a Level 2 Ecological Risk Assessment (Section 6.11) is necessary, representative concentrations for the relevant media and relevant COCs may also be calculated.

Appendix C contains a detailed discussion of calculating representative concentrations based on an averaging approach to chemical concentrations in environmental media. In some cases, this discussion is explicit with respect to the type of averaging that should be used (i.e., arithmetic versus weighted average) in calculating representative concentrations. In many cases, however, Appendix C simply refers to an “average” without regard to the type. The representative concentrations used to assess human health and environmental risk should reflect the average concentrations to which receptors might reasonably be exposed across an area of impact.

The issue of average concentration is especially important to screening and evaluation of the risks associated with contaminated soils. For example, if a regular “grid” pattern (horizontal and/or vertical) has been used in the sampling of contaminated soil across an area of impact, then use of an arithmetic average soil concentration as the representative concentration is generally appropriate (assuming the grid pattern established over the area of impact is fine enough). If biased soil sampling is performed (as is often the case); it may be necessary to calculate an area-weighted average concentration as an estimate of the representative concentration to offset the effects of the biased sampling. For example, a contaminated area with one or two samples in the area of highest impact and many samples near the margin of the area of impact could unfairly bias the representative concentration on the low side if the arithmetic average of the results is used. In this case, each sample should probably not be accorded the same “weight” in calculating the average that will serve as the representative concentration for screening and/or risk evaluation. There are several techniques that can be used to calculate an area weighted average for use as the representative concentration. These techniques range from hand calculation using the measured contaminant concentrations coupled with designated “areas” based on best professional judgement to fully automated calculations using available computer software using geostatistical techniques. Ultimately, prior to calculating area-weighted averages, the remediating party should discuss the specifics of the procedure to be used with the project manager.

8.5 STEP 5: SELECT RELEVANT TIER 1 LEVELS

In Step 5, Tier 1 risk-based target levels for each chemical, each receptor, and each exposure pathway must be selected from Appendix B. Tier 1 risk-based target levels have been developed for three different vadose zone soil types. As shown in Appendix E, Table E-5, these include (i) soil type 1 representative of a sandy soil, (ii) soil type 2 representative of a silty soil, and (iii) soil type 3 representative of a clayey soil. Appendix O contains specific guidance on classification of soil types. For residential land use, Tier 1 values must be selected for three receptors: child, adult, and age-adjusted individual.

The Tier 1 risk-based target levels for each complete exposure pathway and each COC must be compared with the appropriate representative concentration. For target levels of lead, refer to Appendix E, Section E.10.

If it is necessary to perform a Level 2 Ecological Risk Assessment, the remediating party must identify published concentrations protective of ecological receptors and compare the maximum or representative concentrations with these values.

8.6 ANALYTICAL DETECTION LIMITS

During the course of demonstrating that target concentrations have been achieved, the analytical detection limit for certain COCs in environmental media may be higher (sometimes by orders of magnitude) than the corresponding target cleanup level (e.g., DTL, Tier 1) for that chemical. This happens because the concentrations of chemicals that can be positively detected are limited by the capabilities of the analytical method used.

Because Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846) are widely used, we have identified the following in Appendix B:

- COCs with DTLs, WQC, or Tier 1 Risk-Based Target Levels lower than the detection limit or a Practical Quantitation Limit (PQL) (as judged by the department's Environmental Services Program) of methods contained in SW-846, and
- COCs that do not have a standard method listed in SW-846.

Analysis and detection of COCs are not limited to SW-846 methods. Any Performance Based Analytical method that meets National Environmental Laboratory Accreditation Conference (NELAC) standards may be used for the analysis of COCs in the MRBCA process as approved in the data collection work plan.

This discussion identifies the approaches that may be used in instances where the target cleanup level for a particular COC(s) cannot be achieved using standard analytical methods. In such circumstances, the following approaches may be useful:

1. Check the data to confirm that the standard detection limits are indeed higher than the DTLs, WQC or risk-based target levels and that no errors were committed (for example, transposing numbers, misplacing a decimal point, or unit conversion),
2. With department approval, use alternative analytical methods that achieve lower detection limits than the DTLs, WQC or risk-based target levels.
3. Perform a focused Tier 2 or Tier 3 Risk Assessment to determine if the levels that can be analytically quantified are protective of human health and the environment given the complete and/or potentially complete exposure pathways. This approach could involve the use of a detection-based scenario (i.e., using the maximum detection limit of the COCs) in conjunction with alternate site-specific exposure factors to calculate if the risk is acceptable.
4. Develop areal contaminant trends that can then be used to extrapolate contaminant extent to the target level(s) followed by calculation of average concentrations based on those extrapolations. Fate and transport models used in conjunction with "above analytical detection limit results" for certain problematic chemicals could also be used to extrapolate contaminant extent, thereby facilitating calculation of average concentrations for comparison to target cleanup levels.

These approaches may be most useful where short-term decisions regarding the completion of cleanup are desired. Other approaches may be appropriate if a longer-term cleanup is anticipated. In longer-term situations where cleanup is required, it may not be productive to engage in protracted up-front discussion of analytical detection limits that are above applicable health-based cleanup levels for certain COCs. Remediating parties typically recognize the need to continue monitoring for such chemicals while deferring further discussion of the detection limit issue until such time as the other COCs that are present (those that can be analytically quantified) are approaching their respective cleanup levels. At that time, the detection limit issue for those problem chemicals with low health- or ecological-based limits would need to be addressed in more detail.

A long-term approach to this issue is to establish an interim target cleanup level corresponding to the site-specific laboratory's method detection limit (assuming that limit is acceptable to the department). This approach would typically be accompanied by a listing or acknowledgement of the lower health-based limit and a contingency that requires remediating parties to change to new, more "sensitive" analytical methods, and therefore updated target levels, if such analytical methods become available during the course of cleanup. Sample language for this approach, as might be included in a work plan, follows:

The risk-based groundwater cleanup target level for some of the COCs is below the lowest, reasonably achievable method detection limit due to limitations of current analytical technology. The interim groundwater cleanup target level has therefore been set at the method detection limit for those chemicals. A list of the corresponding risk-based concentrations for those chemicals is also provided.

The allowable maximum detection limit for the referenced COCs can never be greater than the interim groundwater cleanup target levels. If the allowable maximum detection limit for specific COCs cannot be achieved due to matrix interferences or other reasonable analytical limitations (appropriate supporting documentation must be provided), the affected sample and associated chemical analyses will be exempted from this requirement. However, such an exemption does not in any way relieve the remediating party from complying with the interim groundwater cleanup target levels.

The department reserves the right to modify the interim groundwater cleanup target levels based on future advances in analytical technology. Any such modifications would be to facilitate comparison of residual concentrations of chemicals in groundwater with then current risk-based groundwater cleanup target levels.

The above approach will most often apply in situations where the remediating party initially chooses to use the DTL or Tier 1 groundwater concentration as the interim target cleanup level. However, many remediating parties that initially pursue this approach may, after collecting substantial long-term data, choose to pursue a Tier 2 or Tier 3 Risk Assessment to develop, final groundwater cleanup target levels. This may result in the

establishment of final cleanup target levels that are above the method detection limits for the problem chemicals, thereby resolving the “detection limit” issue.

If any disparity between target levels and analytical detection limits occurs when determining representative concentrations, see Appendix C for guidance on handling non-detect values.

8.7 STEP 6: IF NECESSARY, CALCULATE CUMULATIVE SITE-WIDE RISK AND COMPARE WITH ACCEPTABLE RISK

For the MRBCA process, the acceptable risk levels are:

Carcinogenic Risk

- The total risk for each chemical, which is the sum of risk for all complete exposure pathways for each chemical, must not exceed 1×10^{-5} .
- The cumulative site-wide risk (sum of risk for all chemicals and all complete exposure pathways) must not exceed 1×10^{-4} .

Non-carcinogenic Risk

- The hazard index for each chemical, which is the sum of hazard quotients for all complete exposure pathways for each chemical (the total risk), must not exceed 1.0.
- The site-wide hazard index, which is the sum of hazard quotients for all chemicals and all complete exposure pathways, must not exceed 1.0.

If the hazard index exceeds 1.0, a qualified professional may calculate the hazard index corresponding to a specific toxicological end point. In this case, the specific hazard indices for each toxicological end point must be less than unity (1.0). This concept of adding hazard quotients for only those chemicals or exposure pathways that result in similar toxicological impacts is applicable to all instances when a hazard index is being calculated.

Step 6 will apply only in cases where the number of COCs and exposure pathways may warrant the calculation of cumulative site-wide risk. In such cases, the project manager should discuss this issue with the remediating party and may request an evaluation to estimate the cumulative site-wide risk. For example, former manufactured gas plants, which often have a multitude of contaminants with high toxicity associated with them, are examples of sites where the cumulative site-wide risk may move the site beyond the acceptable cumulative site-wide IELCR risk level of 1×10^{-4} and a Hazard Index of 1. At such a site, the analysis discussed in this step may be required. Other cleanup authorities, such as RCRA and CERCLA, operate under the presumption of equivalence with federal guidance and regulation and may require the consideration of cumulative site-wide risk in all cases.

In the instance where Step 6 would be needed, the cumulative site-wide risk is calculated for each receptor using the following two-step process. First, the total risk of each chemical for each complete or potentially complete exposure pathway must be calculated. Second, the total risk for each chemical (sum of risk for all the exposure pathways) and

the site-wide risk (sum of risk of all chemicals for all routes) for each receptor must be calculated.

1. Calculate risk for each chemical and each potentially complete exposure pathway:

$$IELCR_{ij} = 1 \times 10^{-5} \times \frac{C_{ij}^{rep}}{C_{ij}^{T1}} \quad (8-1a)$$

$$HQ_{ij} = \frac{C_{ij}^{rep}}{C_{ij}^{T1}} \quad (8-1b)$$

where,

- $IELCR_{ij}$ = Individual excess lifetime cancer risk (IELCR) for chemical i and pathway j ,
- HQ_{ij} = Hazard quotient (HQ) for chemical i and pathway j ,
- C_{ij}^{rep} = Representative concentration for chemical i and pathway j , and
- C_{ij}^{T1} = Tier 1 target concentration for chemical i and pathway j from tables in Appendix B.

2. After calculating the risk for each chemical and each exposure pathway, calculate the total risk for each chemical and the cumulative site-wide risk:

$$IELCR_{Ci} = \sum_{j=1}^n IELCR_{ij} \quad (8-2a)$$

$$HI_{Ci} = \sum_{j=1}^n HQ_{ij} \quad (8-2b)$$

$$IELCR_T = \sum_{i=1}^m IELCR_{Ci} \quad (8-2c)$$

$$HI_T = \sum_{i=1}^m HI_{Ci} \quad (8-2d)$$

where,

- $IELCR_{Ci}$ = Sum of risk for carcinogenic adverse health effect of all exposure pathways for chemical i ,
- HI_{Ci} = Sum of Hazard Index (HI) for non-carcinogenic adverse health effect of all exposure pathways for chemical i ,
- $IELCR_T$ = Cumulative site-wide risk for carcinogenic adverse health effect of all chemicals and all exposure pathways,
- HI_T = Cumulative site-wide Hazard Index for non-carcinogenic adverse health effect of all chemicals and all exposure pathways,
- m = Total number of chemicals of concern, and
- n = Total number of complete exposure pathways.

To facilitate the calculation of risk for each chemical and each exposure pathway and the cumulative risk, the representative concentrations should be organized as shown in example Table 8-1(a) and Table 8-1(b) for carcinogenic and non-carcinogenic adverse health effects respectively. A separate table must be developed for each receptor - most

commonly residential child, adult, age-adjusted, non-residential worker, and construction worker. Concentration in each cell of Table 8-1(a) is referred to as C_{ij}^{rep} , where i refers to any one of the 'm' chemicals of concern, j refers to any one of the 'n' pathways, and 'rep' refers to representative concentration.

To facilitate the calculation of risk in Step 6, target levels from Appendix B can be organized as shown in example Table 8-2(a) and Table 8-2(b) for carcinogenic and non-carcinogenic adverse health effects respectively. As above, a separate table must be developed for each receptor. Each value in Table 8-2(a) is referred to as C_{ij}^{T1} , where i refers to any one of the 'm' chemicals of concern, j refers to any one of the 'n' pathways, and $T1$ refers to the Tier 1 risk-based target level from Appendix B.

To facilitate the above calculations, the risk values may be organized as shown in Table 8-3(a) and Table 8-3(b) for carcinogenic and non-carcinogenic adverse health effects respectively. Tables 8-1 to 8-3 have been developed in a computer spreadsheet, which may be obtained from the department.

Next, the cumulative site-wide risks calculated in this step are compared with acceptable cumulative site-wide risk levels. For carcinogens, cumulative site-wide $IELCR_T$ must be less than 1×10^{-4} . Further, if the total $IELCR_{Ci}$ (sum across all pathways) for any one chemical is greater than 1×10^{-5} , additional discussions between the remediating party and the department's project manager may be warranted. For non-carcinogenic risk, the site-wide HI_T for all COCs and all complete exposure pathways must be less than 1.0. Further, cumulative HI_{Ci} (over all exposure pathways) for each chemical must be less than 1.0.

8.8 STEP 7: EVALUATE THE NEXT COURSE OF ACTION

Depending on the result of Step 5 and Step 6 (if necessary), one of the following alternatives is possible.

Alternative 1: The remediating party may request that the department issue a letter of completion for the site if:

1. The analysis in Steps 5 or 6 indicates that both the cumulative site-wide risk (all chemicals and all complete pathways, $IELCR_T$ and HI_T) and the risk for each chemical (all pathways, $IELCR_{Ci}$ and HI_{Ci}) for all receptors is acceptable, or
2. The representative concentration for all COCs and all exposure pathways are below the Tier 1 risk-based target levels.

In each case above, the following four conditions must be met.

Condition 1: The plume, if one exists, is stable or decreasing (refer to Section 6.13.2 for discussion of plume stability). If this condition is not satisfied, the remediating party must continue groundwater monitoring until the plume is demonstrably stable. Actions may be taken to hasten plume stability. This recommendation must include a sampling plan with specifics such as:

- Wells to be sampled,
- Frequency of sampling,
- Laboratory analysis method,
- Method to be used to demonstrate that the plume is stable or shrinking, and
- The format and frequency of reporting requirements.

Condition 2: The maximum concentration of any COC is less than ten times the representative concentration of that COC for any exposure pathway. Note the maximum concentration here refers to the maximum concentration of a chemical in the exposure domain, not the site-wide maximum concentration. This condition can be met if an exceedance can be justified by any of the following and appropriate actions taken:

- The maximum concentration is an outlier,
- The average concentration was inaccurately calculated,
- The site is not adequately characterized,
- A hot spot may not have been adequately characterized, or
- Other explanation satisfactory to the department.

Any exceedance of this condition must be documented and the possible rationale, if any, submitted to the department. The department will determine what actions, if any, will be necessary to address the situation. For example, if a site is not adequately characterized, then further sampling and analysis may be needed.

Condition 3: Prior to issuance of a letter of completion, adequate assurance is provided that the land use assumptions used in the MRBCA evaluation are not violated for current or future conditions. This condition may require that one or more activity and use limitations (AULs) are placed on the site and plans are in place to maintain long-term stewardship (LTS) for as long as needed to protect human health, public welfare and the environment.

Condition 4: There are no ecological concerns at the site, as determined by confirmation that the maximum or representative concentrations are below levels protective of ecological receptors or completion of the Ecological Risk Assessment. If this condition is not met, the remediating party must provide recommendations to the department to manage the ecological risk. If the department approves the recommendations, their implementation and effectiveness, then this condition would be met.

Alternative 2: The remediating party must decide either to use the Tier 1 risk-based target levels as the cleanup levels and conduct corrective action to meet these levels or to perform a Tier 2 risk assessment if the analysis finds that:

1. The risk for any chemical (all pathways, $IELCR_{Ci}$ and HI_{Ci}) for any human or ecological receptors exceeds acceptable levels, or
2. The cumulative site-wide risk (all chemicals and all complete pathways, $IELCR_T$ and HI_T) exceeds acceptable levels, or
3. The representative concentrations in Step 5 exceed the Tier 1 risk-based target levels.

Based on this decision, the remediating party must recommend one of the following:

1. Remediation to Tier 1 risk-based target levels (if the remediating party decides to remediate the site to Tier 1 risk-based target levels, the cleanup levels will be the lower of the concentrations protective of human health, both carcinogenic and non-carcinogenic, and ecological receptors), or
2. Performance of a Tier 2 risk assessment.

The chart below summarizes several combinations of outcomes and necessary actions that can be pursued in lieu of a Tier 2 risk assessment when cumulative site-wide risk is considered.

Action vs. Calculated Risk

Carcinogenic Risk		Non-carcinogenic Risk		Action
Individual Chemical of Concern	Cumulative Site-wide Risk	Individual Chemical of Concern	Cumulative Site-wide Risk	
NE	NE	NE	NE	No need to calculate any RBTLs.
E	E	E	E	Both carcinogenic and non-carcinogenic RBTLs must be developed
NE	E	NE	E	Both carcinogenic and non-carcinogenic RBTLs must be developed.
E	NE	E	NE	Both carcinogenic and non-carcinogenic RBTLs must be developed.
NE	NE	E	NE	Non-carcinogenic RBTLs must be developed.
NE	NE	NE	E	Non-carcinogenic RBTLs must be developed.
E	NE	NE	NE	Carcinogenic RBTLs must be developed.
NE	E	NE	NE	Carcinogenic RBTLs must be developed.

Notes: E: Exceeds acceptable risk level.
 NE: Does not exceed acceptable risk level.
 RBTL: Risk-based target level

8.9 STEP 8: DOCUMENT TIER 1 RISK ASSESSMENT AND RECOMMENDATIONS

The Tier 1 risk assessment must be clearly documented, both to facilitate the department's review and to provide information to interested third parties. If a Tier 2 assessment is also conducted, both Tier 1 and Tier 2 risk assessments may be submitted as one report. At a minimum, the Tier 1 Risk Assessment Report must include the following:

- Site background and chronology of events,
- Data used to perform the evaluation,
- Documentation of the exposure model and its underlying assumptions,
- If cumulative risk calculation is required, the estimated risk for each chemical, each exposure pathway, each receptor, each media, and the cumulative site-wide risk for each receptor,
- Recommendations based on the Tier 1 risk assessment (either Tier 2 risk assessment or preparation of a risk management plan), and
- If a letter of completion is requested, documentation that all four of the conditions in Section 8.7, Alternative 1, have been met.

Table 8-1(a)
Example Showing Representative Concentrations for Chemicals with Carcinogenic Adverse Health Effects
Receptor A

Chemical	Surficial Soil (mg/kg)			Subsurface Soil (mg/kg)	Groundwater (mg/L)		
	Ingestion	Outdoor Inhalation	Dermal Contact	Indoor Inhalation	Indoor Inhalation	Domestic Use of Water	Dermal Contact
C1							
C2							
C3							
C4 - Cx							

Notes:

This table must be completed for each receptor of concern.

Representative concentrations are calculated based on the exposure domain for each route of exposure.

Table 8-1(b)
Example Showing Representative Concentrations for Chemicals with Non-carcinogenic Adverse Health Effects
Receptor A

Chemical	Surficial Soil (mg/kg)			Subsurface Soil (mg/kg)	Groundwater (mg/L)		
	Ingestion	Outdoor Inhalation	Dermal Contact	Indoor Inhalation	Indoor Inhalation	Domestic Use of Water	Dermal Contact
C1							
C2							
C3							
C4 - Cx							

Notes:

This table must be completed for each receptor of concern.

Representative concentrations are calculated based on the exposure domain for each route of exposure.

Table 8-2(a)
Example Showing the Tier 1 Target Levels for Chemicals with Carcinogenic Adverse Health Effects
Receptor A

Chemical	Surficial Soil (mg/kg)			Subsurface Soil (mg/kg)	Groundwater (mg/L)		
	Ingestion	Outdoor Inhalation	Dermal Contact	Indoor Inhalation	Indoor Inhalation	Domestic Use of Water	Dermal Contact
C1							
C2							
C3							
C4 - Cx							

Notes:

This table must be completed for each receptor of concern.

Values are obtained from the table in Appendix C that corresponds to the soil type, chemical, route of exposure, and receptor.

Table 8-2(b)
Example Showing the Tier 1 Target Levels for Chemicals with Non-carcinogenic Adverse Health Effects
Receptor A

Chemical	Surficial Soil (mg/kg)			Subsurface Soil (mg/kg)	Groundwater (mg/L)		
	Ingestion	Outdoor Inhalation	Dermal Contact	Indoor Inhalation	Indoor Inhalation	Domestic Use of Water	Dermal Contact
C1							
C2							
C3							
C4 - Cx							

Notes:

This table must be completed for each receptor of concern.

Values are obtained from the table in Appendix C that corresponds to the soil type, chemical, route of exposure, and receptor.

Table 8-3(a)
Example Showing the Tier 1 Individual Excess Lifetime Cancer Risk
Receptor A

Chemical	Surficial Soil			Subsurface Soil	Groundwater			Total
	Ingestion	Outdoor Inhalation	Dermal Contact	Indoor Inhalation	Indoor Inhalation	Domestic Use of Water	Dermal Contact	
C1								**
C2								**
C3								**
C4 - Cx		NA*						**
Total								***

Note:

Values in this table are calculated using values in Tables 7-1(a) and 7-2(a), and Equation 7-1a.

*NA indicates that this particular pathway for this chemical is incomplete and therefore there is no risk.

** Total risk for each chemical.

*** Cumulative site-wide risk, which equals the sum of the risk for all chemicals and all exposure pathways

Table 8-3(b)
Example Showing the Tier 1 Hazard Index
Receptor A

Chemical	Surficial Soil			Subsurface Soil	Groundwater			Total
	Ingestion	Outdoor Inhalation	Dermal Contact	Indoor Inhalation	Indoor Inhalation	Domestic Use of Water	Dermal Contact	
C1								**
C2								**
C3								**
C4 - Cx		NA*						**
Total								***

Note:

Values in this table are calculated using values in Tables 7-1(b) and 7-2(b), and Equation 7-1b.

*NA indicates that this particular pathway for this chemical is incomplete and therefore there is no risk.

** Total risk for each chemical.

*** Cumulative site-wide risk, which equals the sum of risk for all chemicals and all routes of exposure.