If any of the representative concentrations at the site are above the Tier 1 risk-based target levels or if the cumulative site-wide risk exceeds acceptable target risk levels, the remediating party may choose to complete a Tier 2 risk assessment in lieu of cleanup to the Tier 1 risk-based target levels. A Tier 2 risk assessment would typically be conducted if the Tier 1 risk is unacceptable and it is not feasible or cost effective to meet Tier 1 risk-based target levels. At sites where a preliminary review of data indicates that the chemicals of concern (COCs) will not meet the Tier 1 levels, a Tier 2 risk assessment may be performed directly without performing and submitting a Tier 1 risk assessment.

A Tier 2 risk assessment may also be required by the department if the site-specific fate and transport parameters or other site conditions are clearly different from the default assumptions used to develop Tier 1 risk-based target levels. In such cases, a Tier 1 risk assessment may not be protective of human health, public welfare and the environment. For example, if the critical exposure pathway is indoor inhalation and the volumetric water content in the soil is significantly less than the default value or if the fractional organic carbon content is significantly less than its default value, then Tier 1 risk-based target levels may not be protective of human health, public welfare and the environment.

As noted in Table 2-1, compared to a Tier 1 risk assessment, a Tier 2 risk assessment uses site-specific fate and transport parameters or default values if they can be justified.

A Tier 2 risk assessment must include the following steps:
1. Compile site-specific fate and transport parameters,
2. Calculate Tier 2 risk levels,
3. Compare Tier 2 risk levels with acceptable risk,
4. Recommend the next course of action, and
5. Document Tier 2 risk assessment.

Details of each of these steps are presented below.

9.1 STEP 1: COMPILE SITE-SPECIFIC FATE AND TRANSPORT PARAMETERS

A Tier 2 risk assessment allows for the application of site-specific fate and transport parameters. Fate and transport parameters will be considered site-specific if they are:
- Correctly measured on site at the appropriate location using approved methods,
- Literature values that can be justified as being representative of site conditions,
- Default values that can be justified as representative of current conditions at the site or shown to be conservative based on site conditions, or
- Documented values, such as may be obtained from Hazardous Waste Program site files, from a nearby site in a similar hydrogeologic setting.

This section discusses the fate and transport parameters that must be modified, unless the default values are representative of the site and can be justified, for a Tier 2 risk assessment. Refer to Appendix E, Table E-5 for the Tier 1 fate and transport default values. The remediating party must review the site information and select values for each of these parameters and provide justification for the selection of each specific value. For some fate and transport parameters, literature values consistent with the site stratigraphy may be used in lieu of field measurements.

For a variety of reasons (such as soil heterogeneity, climatic changes and measurement uncertainties), fate and transport parameters show considerable variability, hence it is recommended that the remediating party perform sensitivity analysis to understand the impact of the variability on the estimated risk and target levels. In cases that show considerable variability, the department may require such a sensitivity analysis.

9.1.1 Soil Parameters

Dimension of Exposure Domain for Surficial Soil Parallel to Wind (W_a)

This parameter is used to calculate the risk for outdoor inhalation of vapors and particulates from surficial zone. It represents the longest dimension of the exposure domain for direct contact with the surficial soil pathway that is parallel to the wind direction. If wind direction is variable or unknown at the site, the longest dimension of the exposure domain must be used.

Depth to Subsurface Soil Sources (d_{ts})

This parameter is used to calculate the risk due to indoor inhalation from subsurface soil. Tier 2 requires the use of the actual measured depth of COCs in soil for which risk is calculated. The most conservative value of this parameter would be the shallowest levels at which the COC is detected or an average of the shallowest depths at which the COC was detected from multiple borings within the exposure domain for this pathway. Either way, the measurements should reflect the distance from the surface to the top of the first zone of impacted soil.

Thickness of Capillary Fringe (h_c)

This parameter is used to calculate the risk due to indoor inhalation from groundwater. The thickness of the capillary fringe must be representative of the site soils/sediments and is primarily dependent on soil grain size. Typically, the thickness of the capillary fringe is based on literature values because direct measurement is impractical. The sum of the thickness of the capillary fringe and the thickness of the vadose zone should equal the depth to groundwater (i.e., $h_c + h_v = L_{gw}$). Note the groundwater vapor emission model assumes that the capillary fringe is uncontaminated. This may not be an accurate assumption as the capillary fringe may be contaminated; hence a conservative estimate as well as a sensitivity analysis for this parameter may be needed.

Thickness of Vadose Zone (h_v)

This parameter is used to calculate the dilution attenuation factor in the vadose zone. At Tier 2, the thickness of the vadose zone is calculated by subtracting the capillary fringe thickness from the depth to groundwater ($L_{gw} – h_c = h_v$).

Vadose Zone Dry Soil Bulk Density (ρ_s)

This parameter is used for the calculation of risk from all indirect exposure pathways that involve equilibrium calculations between various phases. Examples include leaching to groundwater and indoor and outdoor inhalation from soil and groundwater. See Section 6.7.2 for a discussion related to the determination of dry soil bulk density. If multiple measurements from the vadose zone are available or when multiple values are necessary to represent different soil types, use the average value.

Fractional Organic Carbon Content in Vadose Zone (f_{ocv})

This parameter is used for the calculation of risk from all indirect exposure pathways that involve equilibrium calculations between various phases. See Section 6.16 for a discussion of sample collection and laboratory methods. If measurements of fractional organic matter (not the same as fractional organic carbon) are available, the value must be converted to fractional organic carbon as discussed in Section 6.7.5. Where soil lithology is significantly heterogeneous, samples should be collected at each change in lithology and may be composited into one sample for fractional organic carbon content analysis.

If multiple values are available (as is recommended), and if technically appropriate, the average value should be used. For example, assume that soil is impacted between 10 to15 feet below ground surface (bgs) and the water table is at 25 feet bgs. If three soil samples at 5, 12, and 20 feet have been collected for geotechnical parameters, it would not be appropriate to average the values across all three zones. For the evaluation of indoor inhalation from soil, the sample collected at 20 feet is irrelevant because the sample was taken from below the contaminated zone and vapors would move upward; hence, the average of the values from the samples at 5 and 12 feet may be used. Similarly, for soil leaching to the groundwater pathway, the sample collected at 5 feet should not be used because the sample at 5 feet comes from above the contaminated soil and the lecheate would not move upward through this zone. This concept would apply to all the soil geotechnical parameters - fractional organic carbon content, porosity, volumetric water content, and volumetric air content.

If it is not appropriate to use the average value, different values may be used for different exposure pathways.

Porosity in the Vadose Zone (θ_T)

This parameter is used to calculate risk from all indirect exposure pathways that involve equilibrium calculations between various phases. It is also used to calculate the effective diffusion coefficient of the COC in the vadose zone. Both Tier 1 and Tier 2 assessments assume that the porosity of the vadose zone, capillary fringe, and soil that fills the foundation or wall cracks is identical. This assumption is necessary because measuring porosity in the capillary fringe and in foundation and wall cracks is generally not practical. See Section 6.7.3 for a discussion of methods used to estimate porosity. If multiple porosity values are available, an average value should be used. Where total and effective porosity differ or are expected to differ, the effective porosity value must be used.

Volumetric Water Content in Vadose Zone (θ_{ws})

This parameter is used to calculate the risk from all indirect exposure pathways that involve equilibrium calculations between various phases and to calculate the effective diffusion coefficient of COCs in the vadose zone. Volumetric water content is typically measured as discussed in Section 6.7.4 and generally expressed on a weight basis (gravimetric: grams of water/grams of dry soil) and must be converted to a volumetric value (cm^3 of water/cm^3 of soil) as discussed in Section 6.7.4. An average value based on multiple representative samples should be used. Care should be exercised to make sure that water content measurements from the capillary fringe are not assumed to be values representative of the vadose zone. Moisture content values may be obtained from soil samples being analyzed for COCs. (The remediating party must direct their laboratories to report soil COCs concentration on a dry weight basis and the moisture content of each sample).

Volumetric Air Content in Vadose Zone (θ_{as})

This parameter is used for the calculation of risk from all indirect exposure pathways that involve equilibrium calculations between various phases as well as to calculate the effective diffusion coefficient of COCs in the vadose zone. Volumetric air content in the vadose zone is rarely measured but can be calculated as the difference between the total soil porosity and the volumetric water content in the vadose zone (i.e., $\theta_T - \theta_{WS} = \theta_{as}$).

Volumetric Water Content in Capillary Fringe (θ_{wcap})

This parameter is used to estimate the effective diffusion coefficient of COCs in the capillary fringe. Volumetric water content in the capillary fringe is typically estimated as 90 per cent of the total vadose zone soil porosity (i.e., $0.9\theta_T$). Total soil porosity in the capillary fringe is typically assumed to be equal to the total vadose zone porosity.

Volumetric Air Content in Capillary Fringe (θ_{acap})

This parameter is used for the calculation of the effective diffusion coefficient of COCs in the capillary fringe. Volumetric air content in the capillary fringe is rarely measured but can be calculated as the difference between the total soil porosity in the capillary fringe and the volumetric water content in the capillary fringe ($\theta_{Tcap} - \theta_{wcap} = \theta_{acap}$).

Volumetric Water Content in Foundation or Wall Cracks (θ_{wcrack})

This parameter is used to calculate the effective diffusion coefficient of COCs in the foundation or wall cracks. The volumetric water content in soil that fills foundation or wall cracks is assumed to be the same as the volumetric water content of the soil in the vadose zone ($\theta_{wcrack} = \theta_{ws}$).

Volumetric Air Content in Foundation or Wall Cracks (θ_{acrack})

This parameter is used to calculate the effective diffusion coefficient of COCs in the foundation or wall cracks. The volumetric air content in foundation or wall cracks is assumed to be the same as the volumetric air content of the soil in the vadose zone. The latter is determined as described above.

Section 9.1.2 Biodecay Rate (λ)

This parameter is an input to the Domenico's model that is used to estimate the migration of chemicals in the saturated zone. Specifically, it is used in the backward mode of risk assessment to estimate the dilution attenuation factor. In the forward mode, the parameter may be used to calculate downgradient concentration based on a known source.

In a Tier 1 risk assessment, the biodecay rate is assumed to be zero. In a Tier 2 and Tier 3 risk assessment, a site-specific non-zero biodecay rate may be used. Prior to using the biodecay rate, the remediating party must provide evidence for department approval that supports the use of any specific value used. The remediating party is encouraged to consult the open literature to identify technical approaches to estimate site-specific biodecay rates. The site-specific estimation of biodecay rate may require an understanding of the site-specific three-dimensional distribution of the plume based on multilevel sampling. For additional details, also refer to Robbins (2002).

9.1.3 Groundwater Parameters

Depth to Groundwater (L_{gw})

This parameter is used to estimate the risk due to indoor inhalation from groundwater and the dilution attenuation factor in the vadose zone.

Because the depth to groundwater fluctuates due to seasonal variations, the average depth to groundwater should be based on several years of data. Thus, calculating an average depth to groundwater using data collected from several monitoring events over an extended period of time is preferable. If such data are available for multiple wells in an exposure domain, first, the average depth should be calculated for each well. Second, (for modeling purposes) the average of the average depth of all of the wells should be calculated and considered the average depth to groundwater. In areas where there is a systematic long-term water level change, only recent data should be used.

For consistency, static water levels should be used unless justification can be provided for the use of the depth to the "first water encountered while drilling." If data collected over an extended period of time is not available, the site-specific average depth to groundwater should be calculated by determining the depth to groundwater in each well and then averaging the single well water depths. However, where significant differences in static water levels occur across the site, conservatively the shallowest average depth to groundwater should be used (that is, a single well average using data from the well showing the shallowest depth to groundwater).

Width of Groundwater Source Area Perpendicular to Groundwater Flow Direction (Y)

This parameter, as used by Domenico's model, is used to simulate migration in the saturated zone and estimate the saturated zone dilution attenuation factor. This parameter is necessary only in cases where horizontal migration of COCs in the groundwater is quantitatively evaluated. The Tier 2 risk assessment assumes that COCs migrate vertically downward from the area of release to groundwater. By projecting the area of release to the water table, the dimension Y can be estimated. Figure 9-1 shows a schematic of the groundwater source that is considered by Domenico's groundwater model.

Length of Groundwater Source Area Parallel to Groundwater Flow Direction (W_{ga})

This parameter is necessary when the horizontal migration of COCs in groundwater is quantitatively evaluated. As mentioned above, a Tier 2 risk assessment assumes that COCs migrate vertically downward from the area of release to groundwater. Figure 9-1 shows a schematic of the groundwater source that is considered by Domenico's groundwater model. By projecting the area of release to the water table, W_{ga} can be estimated.

Porosity in Saturated Zone (θ_{TS})

Porosity in the saturated zone is necessary only when biodecay is considered in the horizontal migration of COCs. Refer to Section 6.7.3 for methods used to estimate site-specific values of porosity in the saturated zone. If the unsaturated and saturated zone stratigraphies are similar, the saturated zone porosity may be set equal to the vadose zone porosity. If multiple values are available, an average should be used. If the vadose and saturated zone soil stratigraphies are significantly dissimilar, the porosity of the saturated zone must be measured in the field. If a literature value is used, it must be justified based on the site-specific conditions. Where total and effective porosity differ or are expected to differ, the effective porosity value must be used.

Saturated Zone Dry Soil Bulk Density (ρ_{ss})

An accurate estimate of the dry soil bulk density in the saturated zone is essential only when biodecay is considered in the horizontal migration of COCs. Refer to Section 6.7.2 for methods used to estimate site-specific values of saturated zone dry soil bulk density. If the unsaturated and saturated zone stratigraphies are similar, the saturated zone dry soil bulk density may be set equal to the vadose zone dry soil bulk density. If multiple values are available, an average should be used. If the vadose and saturated zone stratigraphies are significantly dissimilar, the dry soil bulk density of the saturated zone must be measured in the field or an appropriate literature value used.

Fractional Organic Carbon Content in Saturated Zone (f_{ocs})

An accurate estimate of the fractional organic carbon content in the saturated zone is essential only when biodecay is considered in the horizontal migration of COCs. Refer to Section 6.7.5 for discussion of this parameter. If a site-specific value for saturated zone fractional organic carbon content is to be used at Tier 2, the value must be determined based on field samples collected below the water table or by choosing a justifiable literature value.

Groundwater Mixing Zone Thickness (δ_{gw})

Mixing zone thickness is used by Summers and Domenico's model to estimate the dilution attenuation factors in the saturated zone. The groundwater mixing zone thickness is a measure of the thickness over which COCs mix within the saturated zone, primarily due to water table fluctuations. While difficult to estimate accurately, the mixing zone thickness may be approximated based either on photoionization detector (PID) readings, soil concentrations measured in borings extending below the water table or by measuring groundwater concentrations at various depths. The 200 cm Tier 1 default value should be considered a minimum. The USEPA's Soil Screening Guidance (1996, page 45, equation 45) contains an equation to calculate the groundwater mixing zone thickness that may be used at Tier 2. Other procedures for determining the mixing zone thickness may be used with the prior approval of the department. The mixing zone thickness should not exceed the thickness of the aquifer.

Groundwater Darcy Velocity (U_{gw})

This parameter may be used by models that calculate soil and groundwater target concentrations protective of the domestic use of water, such as the Summers and Domenico's model to estimate the dilution attenuation factors in the saturated zone. At

Tier 2, the groundwater Darcy velocity must be a site-specific value. The value is the product of the saturated zone hydraulic conductivity and the hydraulic gradient.

Site-specific hydraulic conductivity can be estimated based on the results of site-specific pump tests, if available, or using literature values based on site-specific lithology. The hydraulic gradient should be estimated (as the average gradient) using groundwater elevation data not more than two years old. At sites where the groundwater flow direction shows marked variations, the hydraulic gradient and, hence, the Darcy velocity may need to be estimated for more than one direction and/or a range of velocities presented.

Infiltration Rate (I)

The Summers model uses the Infiltration Rate (I) to estimate the dilution attenuation factor in the groundwater mixing zone. Unless site-specific information is available, the infiltration rate may be estimated as 10 per cent of the average annual rainfall at the site. Average annual rainfall values are based on a 30-year average and may be obtained from literature.

9.2 STEP 2: CALCULATE TIER 2 RISK

Step 2 estimates the carcinogenic and non-carcinogenic risk for all COCs, receptors and exposure pathways. At Tier 2, risk values must be individually calculated for each COC and each complete exposure pathway as per the exposure model. Then, the total risk for each COC and the cumulative site-wide risk must be calculated.

In calculating the Tier 2 risk, the models, physical-chemical properties, toxicological properties, and exposure factors will be the same as used in the Tier 1 risk calculations and are presented in Appendix E.

As discussed in Section 6, Ecological Risk Assessment, the remediating party must also identify appropriate levels protective of ecological receptors if needed.

9.3 STEP 3: COMPARE TIER 2 RISK WITH ACCEPTABLE RISK LEVELS

In Step 3, Tier 2 risks for each COC as well as the cumulative site-wide risk will be compared with their respective acceptable risk level. The total acceptable individual excess lifetime cancer risk (IECLR) for each COC is 1×10^{-5}. The acceptable risk level for the cumulative site-wide IECLR is 1×10^{-4}. The acceptable hazard index (HI) for each COC and all exposure pathways as well as the cumulative site-wide hazard index is 1. The comparison will result in the following possibilities:

- The calculated IELCR for each COC and the cumulative site-wide IELCR are below the acceptable risk levels. In this case, it will not be necessary to develop Tier 2 site-specific target levels for carcinogenic effects.

- Either the individual COC or the cumulative site-wide IELCR exceeds the acceptable risk level. In this case, Tier 2 site-specific target levels must be developed. As explained in Appendix I, considerable flexibility is allowed in the calculation of site-specific target levels. Therefore, the remediating party must carefully explain the method and the assumptions used to calculate the target levels.

- The calculated cumulative site-wide hazard index (sum of the hazard quotients for all chemicals for all exposure pathways) is acceptable (less than 1.0). In this case, the non-carcinogenic risk is deemed acceptable and it will not be necessary to develop Tier 2 site-specific target levels for non-carcinogenic adverse health effects.

- The hazard index for each COC and all exposure pathways is acceptable (less than unity), but the cumulative site-wide hazard index is unacceptable (greater than unity). In this case, it may be appropriate to segregate the COCs by target organ, system or mode of action and derive hazard indices for each. As an example, if there are 10 COCs at a site, four of which affect the kidney only, three affect the central nervous system only, and three affect the liver only. In this case, the COCs may be grouped into three categories, those that affect the (1) kidney, (2) central nervous system, and (3) liver. A cumulative hazard index for each of these organs must be developed. In this example, the remediating party would develop three cumulative hazard indices: one each for the kidney, central nervous system and the liver. If each of these cumulative hazard indices is acceptable (less than one), it will not be necessary to develop Tier 2 site-specific target levels for these COCs for non-carcinogenic health effects. If not acceptable, it will be necessary to develop the target levels for the COCs in the group that exceed the hazard index of unity.

  A professional must perform the organ-specific, health-effects analysis that is conceptually described above. Note that COCs may affect multiple organs and have multiple adverse health effects. In calculating the hazard index, COCs with multiple effects must be included in each category of organ that the COC affects. This professional should be knowledgeable about the adverse health effects of chemicals on human beings and application of quantitative toxicity factors in risk assessment. The knowledge may be a result of formal education, participation in continuing education courses or professional experience.

In addition to the above human health risk assessment, the representative concentrations must also be compared with the ecological screening levels, if needed, and identified in Step 2.

Site-specific target levels for lead may be calculated using the methodology presented in Appendix E, Section E.10. In a Tier 2 risk assessment, it may not be necessary to calculate site-specific risks or target levels for lead. The target levels of lead presented in Section E.10 may be used. Further, lead is not included in the estimation of site-wide cumulative risks.

9.4 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 Tier 2 target cleanup level 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, the following are identified 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.

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, approaches that may be useful include:

1. Check the data to confirm that the standard detection limits are indeed higher than the Tier 2 target cleanup levels and that no errors were committed (for example, transposing numbers, unit conversion, or misplacing a decimal point),
2. With department approval, use alternative analytical methods that achieve lower detection limits than the Tier 2 target levels.
3. Perform a more focused 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 highest detection limit that was available in the historic data for 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 the 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 risk-based target level 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 cleanup target levels. This may result in the establishment of final cleanup target levels that are above the method detection limits for those 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.3 for guidance on handling non-detect values.

9.5 STEP 4: RECOMMEND THE NEXT COURSE OF ACTION

Depending on the results of the comparison, one of the following alternatives is available:

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 concentrations for all COCs and all the exposure pathways are below the Tier 2 site-specific target levels.

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

Condition 1: The plume, if one exists, is stable or shrinking (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/or 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 or. 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 calculated Tier 2 site specific target levels as the cleanup levels and conduct corrective action to meet these levels or to perform a Tier 3 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 exceed the calculated Tier 2 site specific target levels.

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

1. Remediation to Tier 2 site-specific target levels (if the remediating party decides to remediate the site to Tier 2 site-specific target levels, the cleanup levels will be the lower of concentrations protective of human health, both carcinogenic and non-carcinogenic, and ecological receptors), or
2. Performance of a Tier 3 risk assessment.

The chart below summarizes several combinations of outcomes and necessary actions that can be pursued in lieu of a Tier 3 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 SSTLs.
E	E	E	E	Both carcinogenic and non-carcinogenic SSTLs must be developed.
NE	E	NE	E	Both carcinogenic and non-carcinogenic SSTLs must be developed.

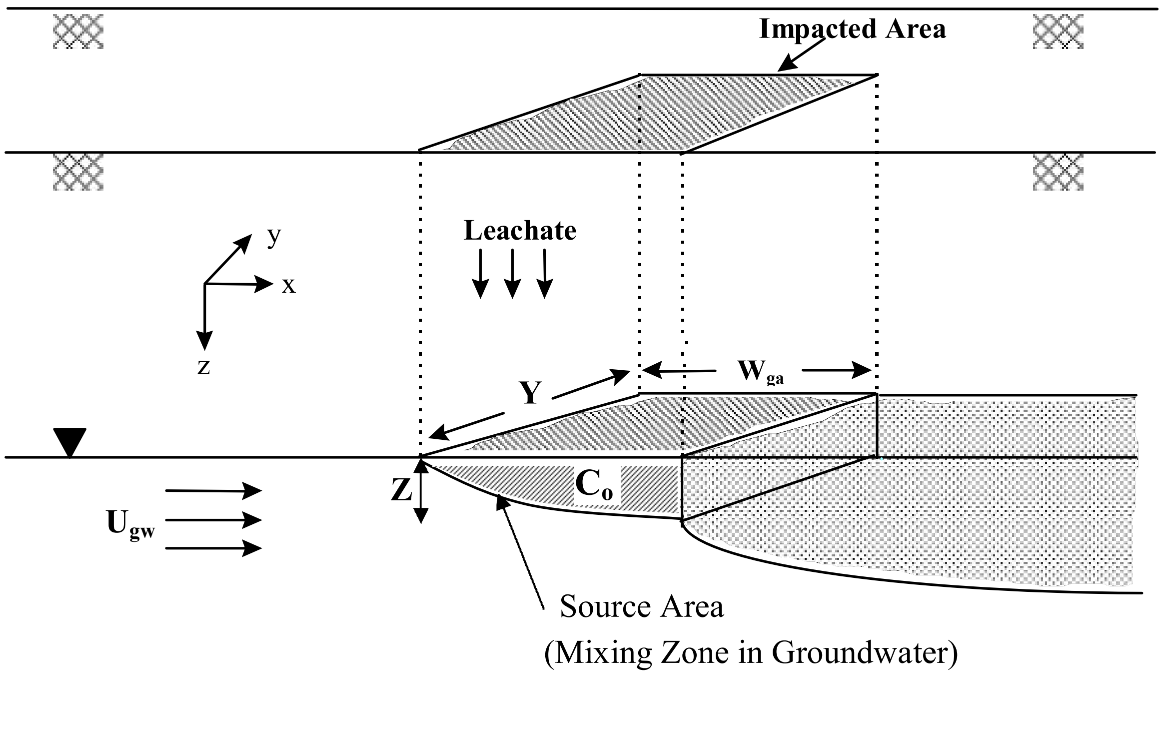
E	NE	E	NE	Both carcinogenic and non-carcinogenic SSTLs must be developed.
NE	NE	E	NE	Non-carcinogenic SSTLs must be developed.
NE	NE	NE	E	Non-carcinogenic SSTLs must be developed.
E	NE	NE	NE	Carcinogenic SSTLs must be developed.
NE	E	NE	NE	Carcinogenic SSTLs must be developed.

Notes:
E: Exceeds acceptable risk level (refer to Appendix B)
NE: Does not exceed acceptable risk level
SSTL: Site-specific target level

9.6 STEP 5: DOCUMENT TIER 2 RISK ASSESSMENT AND RECOMMENDATIONS

To facilitate the review of the Tier 2 risk assessment by the department and other interested parties, the risk assessment must be clearly documented. If a Tier 1 risk assessment is also conducted, both Tier 1 and Tier 2 risk assessments may be submitted as one report. At a minimum, the Tier 2 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 assumptions,
- Documentation and justification of all fate and transport parameters,
- Estimated risk for each COC, each exposure pathway, each receptor, and the cumulative site-wide risk for each receptor and media,
- Recommendations based on the Tier 2 risk assessment, and
- If a Letter of Completion is requested, documentation that all four of the conditions in Section 9.4, Alternative 1, have been met.



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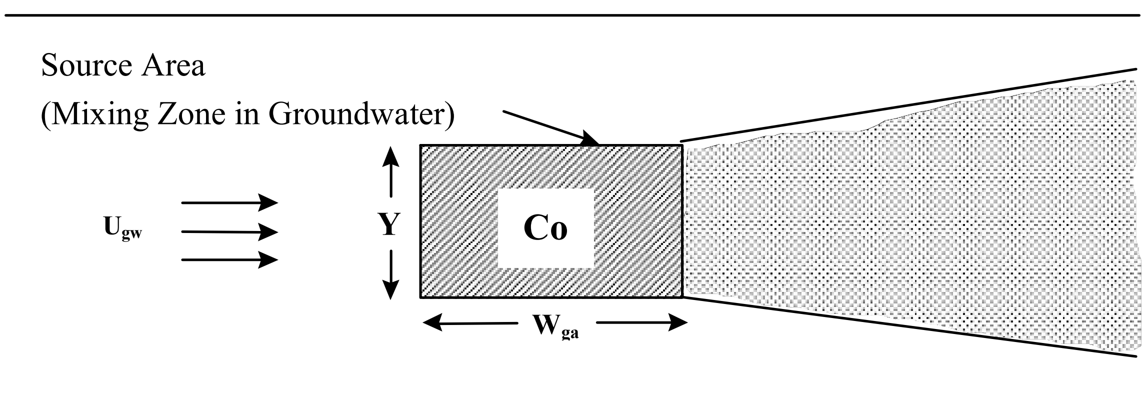

PLAN

Figure 9-1. Schematic Description of Domenico's Model