

COLORADO DEPARTMENT OF LABOR AND EMPLOYMENT  
DIVISION OF OIL AND PUBLIC SAFETY

CLOSURE CRITERIA GUIDANCE

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# INTRODUCTION

An owner or operator of a regulated petroleum storage facility is responsible for assessing and remediating a petroleum release upon discovery. The Colorado Division of Oil and Public Safety (OPS) utilizes a formal method of risk evaluation based on the American Society of Testing and Materials Standard E 1739-95, *Standard Guide for Risk-Based Corrective Action (RBCA) Applied at Petroleum Release Sites*. This approach of risk evaluation allows for multiple closure criteria, or tiers, to be applied to a petroleum release.

The purpose of this guidance document is to describe the tiered closure approach utilized by OPS. Common elements associated with all petroleum release closure evaluations will be presented, along with the criteria and applicability associated with each tier of risk evaluation.

## *OBTAINING A NO FURTHER ACTION DETERMINATION*

OPS will issue a No Further Action (NFA) letter once it has been demonstrated that the petroleum release is considered to be low risk to human health and the environment. Presentation of a well-developed Conceptual Site Model (CSM) greatly enhances the likelihood of attaining an NFA determination. All NFA letters will indicate that the petroleum release was closed based on the information available at the time of the determination and based on the existing exposure pathways' conditions. Petroleum releases will be archived in the OPS database and will indicate the appropriate closure criteria. A petroleum release may be reopened if exposure conditions change.

# PREREQUISITES OF A NO FURTHER ACTION REQUEST

All petroleum releases must be characterized and remediated, as appropriate, to be considered for an NFA determination. The following sections are not exhaustive but will briefly describe common elements associated with any no further action request. A full description of these topics is included in the OPS Petroleum Storage Tank [Owner/Operator Guidance Document](#).

## SITE CHARACTERIZATION

The purpose of site characterization is to define the extent of the petroleum release source area(s), determine the distribution of contamination in the subsurface, determine if points of exposure (POEs) are impacted or potentially impacted, evaluate all exposure pathways and determine whether active remediation is required.

As part of the site characterization, all source areas (tanks, product lines, dispensers, etc.) must be identified and either repaired, replaced or removed. Thorough site characterization will allow for a better understanding of each particular petroleum release, help evaluate the risk associated with the petroleum release and greatly aid in the development of a CSM.

### **Chemicals of Concern**

Chemicals of concern (COCs) are chemical compounds that have been identified for evaluation due to specific risks to human health and/or the environment. Benzene, toluene, ethylbenzene and total xylenes (BTEX) are considered COCs based on their carcinogenic and toxicological properties. Methyl tertiary-butyl ether (MTBE) is considered a COC based on its taste and odor characteristics. Total petroleum hydrocarbons (TPH) may indicate the presence of polynuclear aromatic hydrocarbons (PAHs), some of which are considered COCs based on their carcinogenic and toxicological properties.

All COCs must be characterized to the appropriate [Tier I risk-based screening levels \(RBSLs\)](#) during the site characterization phase of work and evaluated for threats posed to POEs through a series of exposure pathways.

### **Points of Exposure**

POEs are “locations” where a receptor (a person or sensitive environment) could become exposed to a COC. The following seven POEs must be identified and evaluated for potential COC impacts.

- Groundwater wells
- Property boundaries
- Utilities
- Structures
- Surface water
- Surficial soils
- Sensitive Environment

## Exposure Pathways

An [exposure pathway](#) is a course that a COC may take from the source area to impact a POE. Each exposure pathway accounts for both the medium in which the source resides and the mode of transport to a POE.

The following exposure pathways must be evaluated during site characterization and eliminated before an NFA determination can be considered.

- Groundwater Ingestion
- Groundwater to Indoor Air
- Surficial Soil Ingestion, Dermal Contact or Inhalation of Particulates and Vapors
- Subsurface Soil to Indoor Air
- Subsurface Soil Leaching to Groundwater

## CONCEPTUAL SITE MODEL (CSM)

A CSM presents the current understanding of the site, helps identify data gaps, summarizes the risk associated with a petroleum release and is used to determine the next steps needed to characterize, remediate or close a petroleum release. The CSM should summarize petroleum release detail, all existing site information, environmental data and corrective action efforts as they lead toward exposure pathway elimination and, ultimately, an NFA determination. A CSM should be developed upon release discovery and should be updated continuously as new information is gathered.

# TIERED CLOSURE APPROACH

OPS has developed a tiered approach for petroleum release closure evaluations. The following subsections will present the criteria and applicability associated with each tier of risk evaluation.

## TIER I CLOSURE CRITERIA

Tier I evaluations involve a comparison of COC concentrations to [Tier I RBSLs](#). An NFA determination can be requested if all COC concentrations are below the Tier I RBSLs. A Tier IA or Tier II closure evaluation would be the next step to take if the Tier I closure criteria cannot be met.

## TIER IA CLOSURE CRITERIA

Tier IA evaluations allow for the input of site-specific data or default parameters into a simplified [Excel-based spreadsheet](#) for the development of potentially less stringent, but equally protective, Tier IA site-specific risk-based screening levels (SS-RBSLs).

Tier IA closure evaluations can be used to develop SS-RBSLs that will be used to evaluate the subsurface soil to indoor air and subsurface soil leaching to groundwater exposure pathways for petroleum releases that do not meet Tier I RBSLs. A Tier IA closure evaluation cannot be used to develop SS-RBSLs for groundwater or surficial soils because they are considered POEs.

An NFA determination may be requested if source concentrations are shown to be less than the calculated Tier IA SS-RBSLs for the applicable exposure pathways. A Tier II closure evaluation would be the next step if actual concentrations exceed the Tier IA SS-RBSLs or if the groundwater ingestion pathway is complete.

## TIER II CLOSURE CRITERIA

Tier II evaluations allow for the input of site-specific data into fate and transport model software for the development of potentially less stringent, but equally protective, site-specific target levels (SSTLs). Tier II evaluations may be used to calculate onsite SSTLs for soil and groundwater, but they cannot be developed for offsite contamination or surficial soils.

### **Fate and Transport Modeling**

Predictive fate and transport models utilize site-specific data to predict how the COCs will migrate through a particular medium over time. The resultant model is then compared to existing empirical site data as a form of validation.

Predictive fate and transport models can be used as a line of evidence to:

- demonstrate that a point of compliance (POC) monitoring well, established prior to the nearest POE, will not become impacted above the Tier I RBSL;
- develop an SSTL; and/or
- demonstrate that an exposure pathway is not complete.

Default input parameters, which are found in the OPS Petroleum Storage Tank [Owner/Operator Guidance Document](#), should be utilized when site-specific data are not available.

### **Site- Specific Target Levels (SSTLs)**

SSTLs can be developed for onsite source areas that are above the Tier I RBSLs. The SSTL for a source area is the maximum concentration determined by a model that is predicted to be protective of the nearest POE to the Tier I RBSL.

Once an SSTL is developed for a source location, it is then compared to the actual source data. Remedial action may be required if the actual source concentrations are above the calculated SSTL.

### **Exposure Pathway Elimination**

Predictive fate and transport modeling and the development of SSTLs may be utilized as lines of evidence to request elimination of an exposure pathway.

The following criteria are required for elimination of an exposure pathway to be considered valid under a Tier II fate and transport model.

- POEs must not be impacted by any COC above the Tier I RBSLs
- POC monitoring wells must be below the Tier I RBSLs at, or prior to, the nearest POE
- Light non-aqueous phase liquid (LNAPL) must be removed to the maximum extent practicable (MEP)
- The source COC concentration input value(s) must be representative of the source area and not under the influence of a remedial method
- For petroleum releases with active remediation, post-remediation environmental monitoring must be conducted for an adequate period of time to demonstrate that dissolved-phase plume sizes are stable or decreasing and that the environmental data is representative of natural conditions

### **Tier II Closure Evaluation**

An NFA determination can be requested under Tier II criteria if source COC concentrations for impacted media are lower than SSTLs for the applicable exposure pathway(s), POC monitoring wells upgradient of the nearest POE are below the Tier I RBSLs and fate and transport modeling predicts that POEs will not become impacted in the future at concentrations above the Tier I RBSL.

It may be necessary for multiple remedial actions to be completed in an effort to meet Tier I, IA or II closure criteria and it is possible that the petroleum release will not meet all of the criteria. Tier III or Tier IV closure criteria may be considered for petroleum release that cannot achieve Tier I, IA or II closure criteria.

## **TIER III CLOSURE CRITERIA**

Tier III closure criteria establish conditions where dissolved-phase COCs can remain above Tier I RBSLs at the release property boundary, but not beyond an adjoining public roadway. The following criteria must be met for a petroleum release to be considered for Tier III closure.

### **Contaminant Removal to the Maximum Extent Practicable**

Source area removal, dissolved-phase remediation, LNAPL abatement and any other remedial activities must be completed per the approved Corrective Action Plan (CAP) and subsequent CAP Modifications. Contaminant mass estimates should be included to represent initial mass estimates, mass removed during remediation and mass remaining in place upon a closure request.

Multiple remediation technologies may need to be employed to remove contaminant mass to meet the established remediation target goals. CAPs are not developed to meet Tier III removal criteria; rather, the goal of an approved CAP is to remediate impacted media to meet Tier I or Tier II closure criteria. Ultimately, it must be presented in a closure evaluation that contamination has been removed to the MEP with consideration given to available technologies, costs and site logistics.

### **Public Roadway Property Boundary is the Only Impacted POE**

A public roadway is the only POE where dissolved-phase COC concentrations may be above the Tier I RBSL. POC locations must be established immediately downgradient of the public roadway. A summary of existing and planned construction activities must be presented along with an evaluation of how potential exposure pathways will be affected based on these activities.

### **Post-Remediation Monitoring and Fate and Transport Modeling**

Post-remediation environmental monitoring must be conducted for an adequate period of time to demonstrate that dissolved-phase plume sizes and trends are stable or diminishing. Predictive fate and transport modeling, as described under Tier II criteria, must demonstrate that offsite POC monitoring wells will not be impacted above the Tier I RBSLs.

### **Offsite Property Owner Consent**

The owner or operator associated with the petroleum release and the property owner(s) of the impacted public roadway must execute a [consent agreement](#) acknowledging the conditions of the Tier III closure in order to be considered for an NFA determination. The signed consent form must be included in the NFA Request.

### **Tier III Closure Evaluation**

An NFA determination can be requested under Tier III criteria if all of the above criteria are met. OPS will provide the [Utility Notification Center of Colorado](#) with the addresses and location of impacted properties closed under Tier III. This will provide information to the public on any respective exposures from petroleum contaminants left in-situ.



Tier IV closure criteria may be applicable if the groundwater ingestion pathway remains open because of petroleum impacts extending beyond a public roadway and onto the next adjoining property.

### **TIER IV CLOSURE CRITERIA**

Tier IV closure criteria establishes conditions where dissolved-phase COCs can remain above Tier I RBSLs at offsite properties, irrespective of land use. The following criteria must be met for a petroleum release to be considered for Tier IV closure.

#### **No Active Storage Tank Systems**

The property on which the petroleum release originated cannot have an active petroleum storage tank system.

#### **Contaminant Removal to the Maximum Extent Practicable**

As described under Tier III.

#### **The Property Boundary is the Only Impacted POE**

A property boundary is the only POE where dissolved-phase COC concentrations may be above the Tier I RBSL. POC locations must be established immediately upgradient of the next nearest POE. A summary of existing and planned site uses must be presented along with an evaluation of how potential exposure pathways will be affected based on the land use.

#### **Post-Remediation Monitoring and Fate and Transport Modeling**

As described under Tier III.

#### **Offsite Property Owner Consent**

A Tier IV [consent agreement](#) must be executed as described under Tier III.

#### **Tier IV Closure Evaluations**

An NFA determination can be requested under Tier IV criteria if all of the above criteria are met. OPS will provide the [Utility Notification Center of Colorado](#) with the addresses and location of impacted properties closed under Tier IV. This will provide information to the public on any respective exposures from potential petroleum contaminants left in-situ.