Section 11 TPH Risk Case Studies: Printed from Interstate Technology & Regulatory Council (ITRC). 2018. TPH Risk Evaluation at Petroleum-Contaminated Sites. THPRisk-1. Washington, D.C.: Interstate Technology & Regulatory Council, TPH Risk Evaluation Team. https://tphrisk-1.itrcweb.org

11 TPH Risk Case Studies

This section provides an overview of the application of key items for real-life petroleum site scenarios. This section uses case study information published by the Hawaii Department of Health HIDOH 2018, and highlights the use of TPH and carbon range data for the investigation, assessment, risk assessment, and remediation under varying petroleum release scenarios. Links to key themes highlighted in the main guidance document are provided for additional detail, where appropriate.

The Hawaii Department of Health has published a series of five hypothetical case studies and supporting information on the risk-based use of TPH data for the investigation, assessment, remediation, and long-term management of petroleum contamination under different release scenarios HIDOH 2018. A summary of themes incorporated into each of the case studies is provided in Table 11-1. Refer to the Hawaii document for details on the topics highlighted in the table and the individual case study summaries.

Table 11-1. Summary of key topics incorporated into case studies.

Topic	#1: Tank Farm	#2: Gas Station	#3: Tanker Truck	#4: Oil Pipeline	#5: Oil E&P
Site Status:					
Active		X		X	X
Inactive	X		X		
Redevelopment	X				
Petroleum Type:					
Gasoline (standard)	X	X			
Gasoline (low-benzene)		X			
Diesel	X		X		X
Crude Oil				X	X
Impacted Media:					
Soil	X	X	X	X	X
Soil Vapor	X	X		X	
Groundwater	X	X		X	X
Sediment			X	X	
Surface Water			X	X	
Environmental Concerns:					
Soil					
Direct Exposure	X	X	X		X
Vapor Intrusion	X	X			
Gross Contamination	X	X	X	X	X
Leaching	X	X	X		X
Groundwater					
Drinking Water (toxicity)		X			X
Vapor Intrusion	X	X			

Topic	#1: Tank Farm	#2: Gas Station	#3: Tanker Truck	#4: Oil Pipeline	#5: Oil E&P
Aquatic Toxicity	X		X	X	
Gross Contamination	X	X	X	X	X
<u>Surface Water</u>					
Drinking Water (toxicity)					
Aquatic Toxicity (pelagic)			X	X	
Gross Contamination			X	X	X
<u>Sediment</u>					
Aquatic Toxicity (benthic)			X	X	
Gross Contamination			X	X	
Screening Levels:					
Fractions (generic)				X	
Fractions (site-specific)	X	X			
Fraction-Weighted TPH (generic)	X	X	X	X	X
Fraction-Weighted TPH (site-specific)	X	X			X
Drinking Water Metabolites		X			X
Other Topics:					
Short-Term Vapor Emissions			X	X	
Silica Gel Cleanup	X	X	X	X	X
Expanded ISM Sample Notes			X	X	
Expanded Fate and Transport Notes		X		X	X
Methane Generation	X				
Background Organic Carbon (water)				X	
Aquatic Toxicity (site-specific)				X	
De Minimis Risk		X			X

Relative Applicability:

- Brownfield redevelopment of petroleum sites,
- Small-to mid-size tank farms (i.e., gasoline distribution)
- Small ports that handle petroleum products

Case Study #1 involves redevelopment of a former fuel storage terminal impacted with diesel and gasoline. Significant, long-term leakage of pipelines resulted in widespread light nonaqueous phase liquid (LNAPL) above and below the water table. The LNAPL poses vapor intrusion risks for new buildings, as well as logistical challenges for management of impacted soil and groundwater during redevelopment.

Widespread contamination of groundwater poses concerns for intentional or inadvertent discharges into a nearby harbor. Carbon range-weighted screening levels for TPH published by the overseeing regulatory agency are primarily used to carry out the site investigation and design remedial actions, although site-specific carbon range data are obtained for vapors in diesel-impacted areas to better assess vapor intrusion risk (HIDOH case studies document).

HIDOH Key Lessons Learned/Considerations:

- TPH site characterization and assessment should consider all media and complete/incomplete pathways.
- Consider incremental sampling methodology (ISM) approaches for confirmation of remedial actions, rather than

reliance on discrete sample data use to initially guide the remediation actions ITRC 2012; HIDOH 2016.

- Consider collection of additional carbon range data in areas of the site where the composition of the TPH is uncertain or predicted to be highly
- Consider the collection of soil vapor data to assess potential vapor intrusion risks.

Relative Applicability:

- USTs
- Petroleum product transfer terminals
- Additives/blending agents terminals

Case Study #2 focuses on the use of TPH data to assess potential risks caused by past and recent releases of gasoline at an operating gasoline station. The first release was identified during removal of a former underground storage tank and was largely remediated, although a small volume of contaminated soil (<10 cubic yards) had to be left in place due to structural concerns for an adjacent maintenance building. Although concentrations of TPH in soil and soil vapor are relatively high, modeling suggested that the mass of LNAPL remaining was insufficient to pose a long-term, vapor intrusion risk and no further action was required, other than proper management and disposal of the soil, if disturbed, during future subsurface work at the site. The second release was more extensive and reached groundwater at a depth of 25 feet below grade. Soil vapor data suggest potential vapor intrusion concerns for the overlying store. A shallow water well used by an adjacent school for irrigation is threatened by a dissolved-phase plume of heavily degraded petroleum emanating from the site. Data for perimeter monitoring wells are compared to risk-based screening levels (RBSLs) for metabolite mixtures in groundwater to assess risks to workers and students who might inadvertently use the well for drinking water. The development of example screening levels for metabolites is presented in Attachment 5 of the HIDOH document (HIDOH case studies document).

HIDOH Key Lessons Learned/Considerations:

- CSM development and periodic updates are critical for legacy
- Consider fractionating all obtained TPH data for a robust
- TPH risk evaluation should consider cumulative risks in arriving at remedial management decisions.

Relative Applicability:

- Emergency spill response/triage

Case Study #3 considers the release of 3,000 gallons of diesel fuel following a tanker truck accident in a dense, urban area. Much of the fuel remained ponded in the street, but some fuel spilled over the curb into a resident's front yard. Some of the fuel also flowed into a storm drain and entered a nearby stream. Data for vapor samples collected in front of the home exceeded screening levels for both TPH and benzene. Impacted soil was excavated from the yard the following day. Confirmation soil samples collected using ISM approaches identified the need for additional excavation in one area. Booms were placed in the stream to minimize the spread of fuel. Free-phase LNAPL and gross contamination were removed as practical as part of the emergency response. The acceptability of allowing the remaining contamination to naturally attenuate over time is under review (HIDOH case studies document).

HIDOH Key Lessons Learned/Considerations:

- Fuel characteristics such as toxicity, density, vapor pressure, and biodegradation rates, and soil properties such as soil wetting and clay content should be considered when responding to an emergency response fuel discharge to the surface, and when making rapid response decisions regarding prioritizing environmental and human health pathway assessment and testing.
- The availability of preapproved, carbon range-weighted screening levels for TPH in soil and surface water expedited characterization and remediation of contaminated soil without the need for a follow-up, detailed risk
- Emergency response for fuel release sites should consider OSHA protocols and permissible exposure limits for a target contaminant to immediately mitigate and manage human health and risk to other receptors.

Relative Applicability:

- Wetland/marsh areas
- Ecological receptors

Case Study #4 involves the release of a large amount of lightweight oil from a ruptured pipeline in a remote area. The oil quickly spread into an adjacent marsh area with significant impacts to aquatic flora and fauna. Heavy contamination in the area of the rupture was quickly removed and the pipeline repaired. Soil, sediment, and water samples were collected using ISM approaches and used to monitor the subsequent fate and transport of the petroleum over time and assess the benefit of additional remedial action versus allowing the contamination to naturally degrade over time (HIDOH case studies document).

HIDOH Key Lessons Learned/Considerations:

- Emergency response to spills in remote areas should consider nearby aquatic and benthic communities.
- Engagement of federal, state, local, and tribal stakeholders is essential in remedial action planning and
- Alternate considerations beyond TPH (nonvolatile dissolved organic carbon, etc.) are crucial in dealing with wetlands and associated sensitive

Relative Applicability:

- Active oil and gas fields
- Drilling waste pits

Case Study #5 presents approaches for the assessment and remediation of petroleum-release impacts, specifically TPH, at an upstream oil and gas exploration and production (E&P) site within a 3,000-acre, remote, active cattle ranch. Petroleum releases from buried drilling waste adjacent to the active crude oil production well location were noted by the site owner. Topics addressed include site characterization using TPH and carbon range data in conjunction with indicator compounds to assess and manage risk for source material, comparison to default and development of site-specific screening levels, remediation of LNAPL-impacted soils, groundwater impacts, and residual management (HIDOH case studies document).

HIDOH Key Lessons Learned/Considerations:

- Consider the potential for eco-risks. Site use and discovery of the release indicated a need to account for potential impacts to cattle and
- Organic additives in drilling fluids often show up as TPH; a thorough understanding of oil-based and water-based drilling fluids used in oil and gas sites is necessary (i.e., above and beyond the safety data sheet).
- Biodegradation alone could not be relied on due to the presence and high concentrations of constituents in drilling fluids that inhibit or retard biodegradation, such as salts and high molecular weight organic compounds, as well as anaerobic