3 Regulatory Framework

This section presents federal and state regulations and statutes that are applicable during the assessment and cleanup of petroleum releases to the environment. It describes how regulations and statutes have been applied for risk-based closure of petroleum-contaminated sites. It also presents some of the regulatory challenges that both regulators and practitioners face regarding TPH and provides options and guidance to navigate those challenges. Finally, it discusses some of the interesting regulatory tools that one may use or encounter during the cleanup and risk assessment process.

Both federal and state statutes require either the cleanup or the management of petroleum released to the environment. However, the approaches for the remediation and risk management of TPH contamination are not consistent across the United States and may not consistently address both short- and long-term environmental concerns associated with petroleum contaminant mass. Regulatory programs may address TPH in the jurisdiction of hazardous waste programs, nonhazardous waste programs, or specific programs or agencies that regulate the oil and gas industry exclusively. TPH cleanup programs are implemented mainly through threshold concentration metrics, such as screening, cleanup, or target levels (e.g., 100 ppm in soil, 1 ppm in water), or a combination of threshold concentration metrics and risk evaluation.

Well into the 1990s, many states and local regulators required petroleum cleanup to nondetect concentrations, which is often technically and/or economically infeasible. Presently, most states have moved forward with statute, regulation, and/or guidance based on risk (see States Survey). It is commonplace for sites to be managed and closed using risk-based methodologies that leave residual petroleum in soil and groundwater, usually anticipating that natural biodegradation will complete the final remedial steps. Less commonly, sites can be closed with small volumes of source petroleum left in place when it is not practicable to access the source and completely remove or remediate.

In developing this guidance, the ITRC team conducted a survey of all 50 states and territories; the results are provided in States Survey. A variety of risk-based corrective action (RBCA) and state-specific cleanup approaches were reported. We present survey results throughout this portion of the guidance.

3.1 History of TPH Regulation

Both TPH cleanup levels and TPH analytical methods have changed over time from what were generally arbitrarily selected cleanup levels to risk-based cleanup levels. The adoption of various analytical methods by the USEPA and their inclusion in state regulatory approaches for petroleum risk evaluation has been documented over time through surveys of state cleanup standards Tomlinson and Ruby 2016.

The first TPH test methods were gravimetrically based (based on weight, i.e., EPA Method 413) and were used to measure oil and grease concentrations, as this parameter was required early on in federally regulated wastewater treatment monitoring programs. At that time, only a few states used methods analyzing broad TPH ranges such as gasoline range organics (GRO) and diesel range organics (DRO) or evaluated individual chemicals, such as benzene, toluene, ethylbenzene, and xylenes (BTEX).

In the mid-1990s, there was a rise of risk-based evaluation methods for corrective action at petroleum-impacted sites (for example, the release of ASTM E1739 Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites in 1995) . These risk-based evaluations commonly used concentrations of indicator compounds (i.e., BTEX) in addition to TPH. At this time, tests for fractionated ranges of hydrocarbons were also developed to measure specific molecular weight ranges for both aliphatics and aromatics, such as “C6–C12 aromatics” or “C12–C28 aliphatics” with better defined toxicity (see TPH Fundamentals). These methods were first used by the Massachusetts Department of Environmental Protection (DEP) for regulatory purposes in the early 1990s.

Survey data from 2000 indicated that total TPH analysis was widely superseded by fractionated measurements of GRO/DRO/oil range organics (ORO) and that a dozen states had abandoned TPH analysis entirely while only a small number of states adopted further fractionated TPH cleanup standards. In contrast, at that time, measurement of individual chemicals (e.g., BTEX) had become almost universal for regulatory compliance purposes. That general trend has slowly continued with

several additional states eliminating TPH standards entirely and a few others adopting fractionated TPH standards by 2012/2014. However, Tomlinson and Ruby 2016 report that TPH cleanup levels, while nominally risk-based, still evidence wide variability.

The current status of the application of fractionated TPH to the regulatory management of petroleum release sites was documented through questions 5 and 11 of the States Survey. When asked about why fractionated hydrocarbons are not used, 30% of respondents indicated they currently use fractionated hydrocarbons in some capacity while a similar fraction feel that total TPH standards are adequate or that indicator compounds are adequate. Only a small number of respondents expressed concern for the cost of fractionated analysis.

3.1.1 Federal TPH Regulations

3.1.1.1 Clean Water Act (CWA)

Typically, the United States invokes sovereign immunity regarding the need to comply with state laws that might be different or more stringent than federal law (Clean Water Act:[1] Sections 313 and 404, subdivision (t)). However, in the case of the federal Clean Water Act, established in 1973, the United States has waived its sovereign immunity with respect to state water pollution laws and is required to comply with state law when it is more stringent than federal law, just like other responsible parties and dischargers. It is important to understand this hierarchy when petroleum cleanup is occurring on federal property.

▼*Read more*

3.1.1.2 Petroleum Cleanup

For the purposes of this guidance document, it is sufficient to note that the waters of the United States include surface water and surface water tributaries and exclude groundwater. The federal CWA clearly prohibits the discharge of waste to surface water without a National Pollutant Discharge Elimination System (NPDES) permit and provides for the enforcement of the statute. In addition, the federal National Contingency Plan (NCP) requires the cleanup of oil spills to ocean waters. The U.S. Coast Guard is the lead federal response agency for spills in coastal waters, and the federal EPA is the lead federal response agency responsible for the cleanup oversight for spills to inland waters. Their authority comes from the CWA amendment entitled, “The Oil Pollution Act of 1990.”

The Oil Pollution Act (OPA) includes explicit requirements for spill prevention, control, and countermeasure (SPCC) requirements. However, the CWA and OPA do not address the discharge of petroleum to inland soil and groundwater. Federal requirements address this through other regulations, including the Resource Conservation and Recovery Act (RCRA). These regulations require the proper management of solid and hazardous waste and, in particular, for petroleum, include underground storage tank (UST) regulations in United States Code, Subchapter 9 and RCRA Subtitle I. The UST regulations require UST monitoring, leak detection, and release corrective action. Rather than focusing on the protection of water resources, beneficial uses, or the environment, RCRA requires the safe management of waste and petroleum from “cradle to grave.”

3.1.1.3 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

CERCLA, the federal Superfund statute, specifically does not address the investigation and cleanup of petroleum. This is often referred to as the “petroleum exclusion.” At federally owned properties, such as former Department of Defense bases, this petroleum exclusion often leads to a bifurcated cleanup, with a separate group focusing on petroleum cleanup, relying on RCRA and state statute for TPH cleanup requirement authority. However, at times, TPH cleanup does occur under CERCLA when the TPH is co-located with a hazardous constituent such as PCBs or benzene. An overview of CERCLA can be found here: https://www.epa.gov/superfund/superfund-cercla-overview

Although CERCLA itself does not apply to many petroleum sites, the National Oil and Hazardous Substances Pollution Contingency Plan required under CERCLA does provide the structure for risk-based decision making that is applied at petroleum and other sites. The NCP codifies the range of “acceptable risk” for these sites, the ability to develop “alternate concentration limits” (equivalent to site-specific target levels), the general steps for developing and carrying out remedial investigations and feasibility studies, and the nine criteria for evaluating remedial alternatives.

USEPA publishes, and updates regularly, Regional Screening Levels (RSLs), including a user’s guide that can be found here: https://www.epa.gov/risk/regional-screening-levels-rsls. The guidance includes RSLs for TPH fractions and guidance on how to use these RSLs, how they were calculated, and how to apply them at CERCLA sites.

3.1.1.4 Safe Drinking Water Act (SDWA)

Enforcement of the SDWA protects the quality of drinking water in the United States. This law focuses on all waters currently or potentially designated for drinking use, whether from aboveground or underground sources. Although this act focuses on the quality of water provided at the tap, it could indirectly be used to require environmental cleanup. The SDWA sets forth the minimum requirements for drinking water quality. States either incorporate these requirements or implement requirements that are more stringent. Drinking water standards for TPH constituents are often considered when establishing risk-based cleanup standards for TPH sites.

3.1.1.5 Clean Air Act (CAA)

The Clean Air Act protects air quality in the United States. The USEPA website states, “In addition to creating programs to solve identified pollution problems, Congress drafted the act with general authorities that can be used to address pollution problems that emerge over time, such as greenhouse gases that cause climate change USEPA 2017a. Volatile constituents in TPH, such as BTEX and hexane, are regulated as hazardous air pollutants under the CAA. More recently, USEPA has undertaken initiatives under the CAA to reduce emissions of greenhouse gases, including methane. USEPA rules under the CAA regarding greenhouse gases continue to evolve and should be monitored when determining risk management strategies for TPH sites.

3.1.1.6 Toxic Substances Control Act (TSCA)

The Toxic Substances Control Act regulates the production, use, and disposal of specific chemicals used in various manufactured substances. TSCA authority is not delegated to the states. TSCA was amended in 2016 when the Frank R. Lautenberg Chemical Safety for the 21st Century Act was signed into law https://www.congress.gov/114/plaws/publ182/PLAW-114publ182.pdf. A key feature of the amendment is the adoption of a risk-based safety standard. Constituents that may be present at a TPH site, such as benzene, ethylbenzene, PCBs, or various additives, may necessitate gathering TSCA information during investigation of the site and the site history. TSCA should also be monitored for future changes as the effects of amendments to the law are evaluated.

3.1.1.7 Oil and Gas Industry Regulations and Agencies

Question 3 of our States Survey polled whether there were different closure parameters or protocols for different types of petroleum sites, including oil and gas exploration and production facilities. Two-thirds of respondents indicated that standards and protocols *did* differ between programs, with the majority indicating that there were multiple sets of standards across the various programs. How this plays out in the oil and gas exploration and production (E&P) facilities is discussed below.

Oil and gas industry E & P wastes are subject to nonhazardous waste regulation under RCRA Subtitle D and state waste regulations USEPA 2017e. E&P wastes are exempt from hazardous waste regulations under RCRA Subtitle C USEPA 2017e. However, seven environmental groups filed a lawsuit against the USEPA in May 2016 to increase regulation of oil and gas wastes Hurdle 2016. A settlement agreement was finalized in a consent decree in December 2016, which requires the EPA to review oil and gas waste regulations and determine whether a revision is necessary by March 2019. The EPA has until July 2021 to update the regulations, if a revision is deemed necessary Gilmer 2017. With this in mind, USEPA and state regulations regarding oil and gas wastes should be monitored for possible jurisdictional or regulatory changes.

With the exceptions of the other federal laws mentioned, oil and gas industry sites are regulated at the state level. Some states have an entire agency dedicated to regulating the oil and gas industry, such as the Texas Railroad Commission (TX RRC). In other states, oil and gas falls under the jurisdiction of a state environmental agency. Sometimes multiple agencies may be involved where different elements of E&P operations are regulated by different agencies.

Jurisdictional boundaries often become somewhat blurred between state agencies within a state, often necessitating a Memorandum of Understanding (MOU) or the drafting of new regulations for clarification. For example, the TX RRC and Texas Commission on Environmental Quality (TCEQ) have an MOU in place delineating jurisdictional boundaries between the two agencies. Specifically, most waste processing and disposal facilities are regulated by TCEQ, while the TX RRC regulates waste processing and disposal facilities that accept only oil and gas waste. With this in mind, preliminary agency coordination to determine jurisdiction and applicable rules and regulations is essential, especially because cleanup and/or closure standards on an E&P generating or disposal site could be quite different than a non-E&P TPH cleanup site. A list of state agencies that regulate the oil and gas industry can be found at .

3.1.1.8 Tank Programs

Cleanup of releases from underground storage tanks is mandated under U.S. Code, Title 42, Chapter 82, Subchapter IX. This law incorporates amendments to Subtitle I of the Solid Waste Disposal Act as well as the UST provisions of the Energy Policy Act of 2005 and gives EPA the authority to regulate USTs. States may have more stringent regulations than the federal requirements, but have to be no less stringent than the federal program. USTs are regulated under 40 CFR Part 280—Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST), available at: https://www.ecfr.gov/cgi-bin/text-idx?SID=f9d8304d6655a9c32a5e06c2d594c146&mc=true&node=pt40.27.280&rgn=div5 or https://www.epa.gov/UST. Please note that under the revised 2015 UST regulations, the current approved entities must reapply by October 2018 to retain their state program approval status.

Subtitle I allows state UST programs approved by the federal EPA to operate in lieu of the federal program, and the federal EPA's state program approval regulations set standards for state programs (https://www.epa.gov/ust/state-underground-storage-tank-ust-programs#apply) As of September 2017, 38 states, plus Washington, D.C., and Puerto Rico have approved UST programs.

Aboveground Storage Tanks (ASTs) are regulated under 40 CFR Part 112—Oil Pollution Prevention. Information is available at: https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr112_main_02.tpl

3.1.1.9 Construction Wastewater Discharge Requirements (NPDES)

The national NPDES stormwater program requires permits for discharges from construction activities that disturb one or more acres, and discharges from smaller sites that are part of a larger common plan of development or sale. Depending on the location of the construction site, either the state (if it has been authorized to implement the NPDES stormwater program) or EPA will administer the permit. In areas where EPA is the permitting authority, operators of regulated construction sites are generally permitted under EPA's 2017 Construction General Permit (see Special Considerations). Fuels are a commonly encountered pollutant at construction sites and therefore TPH is a commonly measured parameter in an NPDES permit. Potential discharge via NPDES should be considered when evaluating site-specific target levels (see Risk Calculators).

3.1.2 State TPH Regulations

3.1.2.1 Framework

Individual states tend to protect and regulate their water similar to the federal Clean Water Act by protecting beneficial uses and prohibiting discharges to water without a permit. However, their authority clearly extends to the protection of groundwater. Based on the results of Question 3 of our States Survey, most states have specific laws that address oil storage facilities and often specifically USTs. This allows the states to nimbly regulate both petroleum-impacted surface water and groundwater. Many states also have formal approval by the federal EPA to implement the federal statutes, including the federal NPDES program, RCRA Subtitle I, and the federal UST program.

3.1.2.2 Tank Programs

The state UST programs are run for the most part by the department in charge of environmental quality, natural resources, or conservation, and less frequently by the state fire marshal's office. States generally regulate aboveground storage tanks in a similar manner. To determine which office regulates tanks, see the list of state contacts at the USEPA website: (https://www.epa.gov/ust/underground-storage-tank-ust-contacts#states). Most state UST programs have TPH screening levels for TPH in soil and groundwater and may have guidance on developing site-specific target levels.

3.2 What is the Legal Basis for Risk-Based Closure of Petroleum Sites?

3.2.1 What Is a Permit in the TPH Cleanup World?—How Regulatory Permission Is Granted Based on Risk

The word "permit" literally means "permission," or as it applies to the regulation of TPH cleanup, an authoritative or special certificate of permission. Throughout this section we use the word "permit" to mean formal or informal permission from a regulatory agency.

Both federal and state statutes require permits from regulatory agencies for the discharge of anything to the waters of the

state or the United States. This is clear in the wastewater world where sewage treatment plants receive permits from agencies to discharge their effluent to surface waters or the ground. It is clear for construction and industrial sites that are required to have permits to discharge the stormwater that runs across their facility. How does it work in the TPH cleanup world? How does permitting work when a responsible party is doing a TPH cleanup? Although there are not typically "permits," there are approvals, concurrences, no further action letters, and orders. These regulatory communications constitute the permits in the TPH cleanup world. Once you have "regulation" through the documents referenced previously, you have been granted permission, which in statute is called a "permit."

One of the most misunderstood concepts is the "low risk closure" concurrence. What is tricky about these closures is that they appear to approve leaving waste (TPH contamination) in place, when in fact they are just approving a long-term cleanup strategy that will lead to restoration of the beneficial uses and/or "acceptable risk" within a longer time frame. Actually leaving waste in place, without a cleanup time frame, requires a different type of permit that in some states is called waste discharge requirements. These are the types of permits granted to municipal and hazardous waste landfills and surface impoundments. See the ITRC report on institutional controls for more information.

3.2.2 No Vested Discharge Right—How to Talk to Your Regulator

The frequency of the likely approval of a TPH risk-based closure has at times led to the false impression that dischargers/responsible parties have the right to leave residual petroleum in place, rather than the goal of restoring the natural resource beneficial uses and corresponding environmental health benefits to the people of the state or United States. This misconception often leads to argumentative and unproductive negotiations regarding appropriate remedial goals. Our hope is that a better understanding of the actual regulatory framework will improve those conversations.

Generally, under both state and federal law, leaving residual petroleum in soil and groundwater based on risk is not a right without appropriate regulatory oversight. The approval to leave residual petroleum in place is usually granted through a state review process that involves the collection and evaluation of data and the determination that managing residual petroleum in place will not pose an unacceptable risk to human health, the environment, or beneficial uses. In some states, regulatory concurrence is granted with the understanding that residual petroleum can remain in soil and groundwater for a limited and reasonable time, with the expectation that biodegradation will restore the water resource to beneficial uses. The federal CWA reinforces the notion that there is no vested right in causing contamination by stating that except as in compliance with a permit, the discharge of any pollutant by any person shall be unlawful and that the permit can be terminated or modified for cause (33 U.S.C 1311(a), 33 U.S.C. 1342 (b)(1)(c)).

Question 8 of our States Survey polled 48 states to assess whether there are exceptions to the need for regulatory concurrence for risk-based closures. Most states indicated that regulatory review was required prior to leaving low risk TPH behind. Those that indicated yes, dischargers/responsible parties have the right to leave low risk petroleum in place, largely indicated as a comment that some regulatory approval was still required.

3.2.3 Enforcement Discretion—Allowing Time to Clean Up

The phrase "enforcement discretion" refers to the discretion that regulatory agencies can employ with regards to enforcing the "letter of the law." The discretion allows the agency to ensure that overall, their regulatory enforcement provides the most benefit to the people of the state or United States. One example would be the determination that a spill volume is "de minimis," which means that the spill is too trivial or minor to merit consideration. Such discretionary determinations allow regulatory agencies to focus on spills that really matter and require regulatory intervention and oversight.

The volume and magnitude of TPH release sites across the country, along with the significant resources that are required to enforce the many associated laws and regulations, and the relatively low risk associated with many TPH cases, all combine to make practical enforcement approaches necessary, which makes discretionary enforcement significant for TPH sites. It allows flexibility for regulators to recognize the good-faith efforts of responsible parties to return to full regulatory compliance and allows work to move forward, which clearly benefits water quality.

State and federal regulators grant cleanup permits using regulatory vehicles, such as a reviewed work plan or closure request. However, they can also use enforcement discretion to allow cleanup activities to move forward without a formal permit (e.g., voluntary cleanups). Discretionary measures may include: (1) choosing not to complete formal enforcement, such as a cleanup and abatement order, at their discretion, which gives the discharger time to abate the petroleum; or (2) approval of a plan to allow petroleum to remain in place for a specific amount of time with specific requirements, also at regulators' discretion. These regulatory actions are completed in place of requiring immediate abatement and may be

rescinded should human health, safety, or environmental health be threatened. In states with low-threat closure policies, the enforcement discretion regulatory tool is formalized in policy and would not typically be considered discretionary.

Enforcement discretion is often used to allow work to move forward without a permit when there are clear benefits to the environment, such as improved water quality. Such measures may include the injection of chemicals to enhance TPH biodegradation or the test of a remediation system that requires the discharge of its effluent to surface water for a short period of time. Usually the letter of the law would require a formal permitting process for these activities, but many regulatory agencies will use their enforcement discretion and allow the activities to move forward without a formal permit.

3.3 TPH-Specific Regulatory Challenges

A brief discussion of some TPH-specific technical issues is included here because there can be significant misunderstandings at the regulatory level regarding how these issues can affect regulatory decision making.

3.3.1 Screening Levels vs. Cleanup Goals

It is important to not confuse screening levels with site-specific cleanup goals. Most state regulatory programs have screening levels for TPH (see States Survey). They may be called screening levels, Tier 1 risk-based screening levels, initial screening criteria, or similar. They are often developed for various media and even for various exposure scenarios and/or exposure pathways (see Conceptual Site Models). Screening levels applied as cleanup goals or final remediation target levels can result in overly conservative cleanups. Actual cleanup goals are typically site-specific and tailored to the site's unique characteristics, complete exposure pathways, and projected future land use. This refinement process is often called a Tier 2 or Tier 3 risk assessment.

Regulatory review and concurrence for the site conceptual model should be established before calculating site-specific cleanup goals (see Risk Calculators), especially if the regulatory agency's goal is to restore or protect the resource from health risk or water resource concerns. Risk calculators allow for the adjustment of hydrogeologic, exposure, and toxicologic parameters and may lead to site-specific cleanup goals that are higher than Tier 1 screening levels.

▼*Read more*

3.3.2 Indicator Compounds—When They Don't Make Sense

An indicator compound is a specific chemical that is toxicologically well characterized and can be considered representative of a mixture, or a fraction of a mixture, for site assessment and project decisions. Rather than measuring the concentration of all of the compounds in a mixture, you can monitor for a few compounds only and still make sound management or risk decisions for the entire mixture. For example; the classic indicator compounds for gasoline releases are BTEXs. Historically, the thinking was that as the concentration and volume of these compounds became lower, you could correlate that reduction with an equal reduction in risk to human health and the environment. However, we now know that you can have a significant reduction in concentrations of indicator compounds and still have a large volume of petroleum-derived compounds left in the subsurface. In cases where this occurs, it does not make sense to rely solely on the indicator compounds for site closure or remediation cessation, especially if the release is near a receptor, such as a drinking water well or a surface water body.

State Survey Question 21 polled how states are currently managing sites with TPH above screening levels, but no indicator compound concentrations. We found that active remediation was identified as by far the preferred option for addressing TPH when no indicator compounds are present. The second most frequent option was exposure pathway elimination, closely followed by the use of collecting additional analytical data and performing a Tier 2 or 3 risk assessment.

3.3.3 Silica Gel Cleanup (SGC)

SGC is an optional step in the TPH laboratory analysis that removes polar compounds from the soil or water sample's TPH extract (see SGC Fact Sheet). Polar compounds can be naturally occurring, typically in high organic-content soils, and are present in crude oils as organic molecules with nitrogen, sulfur, or oxygen. However, most polar compounds at petroleum cleanup sites come from the biodegradation of the petroleum itself and are called petroleum metabolites.

SGC is useful for determining whether biodegradation is occurring and is sometimes mistakenly assumed to be useful for determining whether there are background polar compounds interfering with analytical results. However, the best practice to determine the presence of naturally occurring polar compounds is to collect and analyze a sample from a known, clean sample location, outside the petroleum-impacted groundwater plume. SGC can also be used to determine the risk associated

with the parent hydrocarbons, by removing the petroleum metabolites and allowing for a comparison to risk thresholds that are based on only the parent hydrocarbon.

The toxicity of petroleum metabolites is even more poorly understood than that of the parent hydrocarbons. However, studies indicate that petroleum metabolite toxicity may be either lower Zemo, O'Reilly, et al. 2013 or about the same as the parent hydrocarbons Rogers et al. 2002; Thomas, Donkin, and Rowland 1995; Wolfe et al. 1995; Neff et al. 2000; Mao et al. 2009a; Melbye et al. 2009; Jonker et al. 2016; Zielinska-Park et al. 2004. One can conservatively use cleanup levels based on the parent hydrocarbons when assessing risk for petroleum metabolites. However, given the uncertainties associated with metabolite toxicity, careful consideration should be given as to the most appropriate method for evaluating them, consistent with regulatory requirements CRC CARE 2017 (see Human Health Risk).

Based on responses to Question 25 in our States Survey, respondents were evenly split between allowing and not allowing SGC in their state. A number of respondents who identified SGC as being allowed indicated that it was only to be used for removing naturally occurring polar compounds, if it is known that the fuel is fresh, and not petroleum degradation products.

3.3.4 Groundwater to Surface Water Discharges

From the regulatory perspective, the discharge of TPH contamination to surface water can significantly raise the level of concern and urgency compared to inland plumes that don't threaten a drinking water well due to potential impacts to human and ecological receptors. More aggressive groundwater capture and other remedial strategies may be required to ensure that there is not harm to the surface water body or the hyporheic ecosystem. For typical cleanup sites, dilution of discharges should not be considered as part of the mitigation (see Whole Effluent Toxicity Testing).

Historically, assumptions were made regarding the hyporheic zone acting as an aggressive oxygenating biofilter and greatly reducing the TPH and petroleum metabolite concentrations prior to discharge to the surface water body. However, Landmeyer et al. 2010 studied the attenuation (concentration reduction) of oxygenates in four different hyporheic zones and found that attenuation was primarily the result of physical processes such as dilution and dispersion, with a negligible contribution attributed to attenuation by biodegradation. Although some contaminant degradation may be enhanced within this zone, there is also potential for TPH and TPH metabolite contaminant accumulation due to organic-rich sediments, resulting in toxicity to benthic organisms, which form the base of the food chain. With this new data, without site-specific evidence, it is important to not assume that contaminant degradation will occur to a sufficient degree within the hyporheic zone to prevent benthic organism toxicity without site-specific evidence. A conservative assumption is that the concentrations measured at the point of compliance are the concentrations that are being discharged to the surface water body (see Exposure to Groundwater/Surface Water).

Question 7 of the States Survey polled whether states had specific guidance regarding the discharge of TPH-impacted groundwater to surface water. Respondents were evenly split, with half the states having no guidance on discharge to surface water. Most of those indicating that there was guidance said they used surface water or specific discharge to surface water screening levels.

3.3.5 Nuisance Conditions (see also **Special Considerations**)

Due to the relatively low toxicity of many petroleum products and petroleum metabolites, regulators often find themselves having to require remedial action based on nuisance, rather than actual acute or chronic toxicity risk. Olfactory nuisance conditions are the most common nuisance associated with petroleum cleanup sites. Occasionally there are visual or contact nuisance conditions associated with petroleum seeps and gustatory (taste) nuisance associated with TPH-contaminated drinking water.

Responses to Question 2 of our States Survey revealed that over half of the respondents encounter otherwise compliant risk-based closure sites with nuisance conditions, with a smaller number, about 1 in 10, encountering this regularly. Although many state and local governments have adopted olfactory ordinances to manage olfactory nuisance, not all states have the regulatory authority to require cleanup based solely on visual or contact concerns when there is not known acute or chronic toxicity risk.

3.4 TPH-Specific Regulatory Tools

3.4.1 Long-Term Stewardship

Due to the chemical characteristics of TPH, its relatively low solubility and mobility, and the high likelihood of significant natural biodegradation in most geologic settings over time (meaning it generally gets safer with time), it lends itself to regulatory risk-based closures, which are ubiquitous throughout the country, and may require long-term stewardship (see also Special Considerations).

3.4.2 Natural Resource Damage/Injury Assessment

The cleanup of petroleum-impacted soil and groundwater usually takes a significant amount of time. In fact, the beneficial use of the groundwater resource is often not restored for decades, with the final remedy consisting of monitored natural bioattenuation. The administrative assessment of fines for the initial illicit discharge (spill) of petroleum to surface and groundwater is commonplace and is usually based on the volume of the spill and/or the number of days of discharge. It is less common for a fine to be assessed for the temporal loss of the groundwater resource during the remediation process. At this time there are about 22 states (see States Survey) that assess a fee/fine for the temporal loss during remediation, with four states considering implementing a similar program. The State of New Jersey has a standardized and well-presented Natural Resource Injury Assessment process, including a calculator, for the temporal loss of the groundwater resource during remediation NJDEP 2017b. These programs incentivize the discharger to restore groundwater beneficial uses quickly, thereby avoiding a larger fine.

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[1] 33 U.S.C. § 1251 *et seq*.