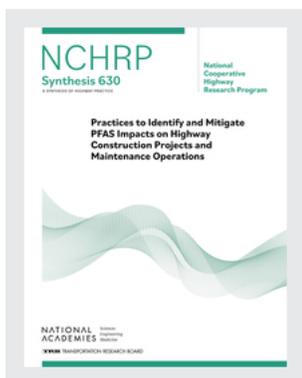


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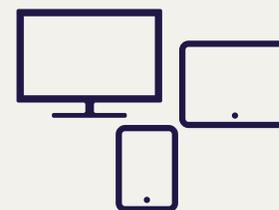
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NCHRP

Synthesis 630

A SYNTHESIS OF HIGHWAY PRACTICE

National
Cooperative
Highway
Research Program

Practices to Identify and Mitigate PFAS Impacts on Highway Construction Projects and Maintenance Operations



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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP SYNTHESIS 630

**Practices to Identify and Mitigate
PFAS Impacts on Highway
Construction Projects and
Maintenance Operations**

A Synthesis of Highway Practice

**Joseph A. Charbonnet
Roy E. Sturgill, Jr.**

**DEPARTMENT OF CIVIL, CONSTRUCTION, AND ENVIRONMENTAL ENGINEERING
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Systematic, well-designed, and implementable research is the most effective way to solve many problems facing state departments of transportation (DOTs) administrators and engineers. Often, highway problems are of local or regional interest and can best be studied by state DOTs individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation results in increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

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The needs for highway research are many, and NCHRP can make significant contributions to solving highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement, rather than to substitute for or duplicate, other highway research programs.

NCHRP SYNTHESIS 630

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ABOUT THE NCHRP SYNTHESIS PROGRAM

Highway administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to highway administrators and engineers. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the entire highway community, the American Association of State Highway and Transportation Officials—through the mechanism of the National Cooperative Highway Research Program—authorized the Transportation Research Board to undertake a continuing study. This study, NCHRP Project 20-05, “Synthesis of Information Related to Highway Practices,” searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute an NCHRP report series, Synthesis of Highway Practice.

This synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems.

FOREWORD

By Jo Allen Gause

Staff Officer

Transportation Research Board

Per- and polyfluoroalkyl substances (PFAS) are a class of contaminants of emerging concern that can harm both ecosystems and human health. These anthropogenic compounds contain carbon-fluorine bonds, which make them stable and persistent in the environment, earning them the nickname “forever chemicals.” PFAS regularly migrate from sources of contamination, including fire training areas at military sites and airports, PFAS manufacturing sites, land-applied wastewater biosolids, and landfills. PFAS can be found at low levels in soils and water far from any likely source.

There are currently no binding federal regulations for PFAS. However, the EPA has begun the process of designating several PFAS as hazardous substances. This designation would likely restrict the ways in which state departments of transportation (DOTs) handle and dispose of impacted materials. The objective of this synthesis was to document current state DOT practices for identifying locations of potential PFAS contamination and for mitigating the impacts of PFAS related to highway construction and maintenance operations.

Information for this study was gathered through a literature review, a survey of state DOTs, and follow-up interviews with selected DOTs. Case examples of eight state DOTs provide additional information on identifying and mitigating PFAS impacts on highway construction projects and maintenance operations.

Joseph A. Charbonnet and Roy E. Sturgill, Jr., of the Department of Civil, Construction, and Environmental Engineering at Iowa State University, collected and synthesized the information and wrote the report. The members of the topic panel are acknowledged on page iv. This synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.


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SUMMARY

Practices to Identify and Mitigate PFAS Impacts on Highway Construction Projects and Maintenance Operations

Per- and polyfluoroalkyl substances (PFAS) are a class of more than 6,000 contaminants of emerging concern that can harm both ecosystems and human health. These anthropogenic compounds contain carbon–fluorine bonds that make them stable and persistent in the environment, earning them the nickname “forever chemicals.” PFAS regularly migrate from the sources of their contamination, including fire training areas at military sites and airports, PFAS manufacturing sites, and land-applied wastewater biosolids and landfills, such that they are commonly found at low levels, even in soils and water far from any likely source. PFAS bioaccumulate in the food chain and are found in the blood of nearly all humans, where they are associated with cancer, thyroid disease, increased cholesterol, and other health problems, even at low levels of exposure.

There are currently no binding federal regulations for PFAS, leaving regulation largely to the states. However, federal maximum contaminant levels (MCLs) have been proposed for drinking water and more rulemaking is under way. The EPA has begun designating several PFAS as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. The designation of PFAS as hazardous substances would restrict how departments of transportation (DOTs) could handle and dispose of impacted materials and would give the EPA authority to direct cleanup of PFAS contamination. Additionally, cleanup, disposal, and discharge could be affected if the EPA designates PFAS as hazardous waste under the Resource Conservation and Recovery Act of 1976 or designates a specific level of PFAS as harmful to aquatic life.

State-level regulations for PFAS vary widely. At least 15 states have set their own MCLs for PFAS. Additionally, several states regulate PFAS in groundwater and applications such as firefighting foam and food contact papers.

The objective of this synthesis is to document current state DOT practices for identifying locations of potential PFAS contamination and mitigating the impacts of PFAS related to highway construction and maintenance operations. This study considers PFAS impact and mitigation efforts in all phases of highway project development (i.e., planning, design, right-of-way acquisition), construction, and maintenance.

The study gathered information on written DOT policies, methodologies for identifying and mitigating PFAS impacts, screening approaches, and the identification of PFAS-containing materials. To collect data, the synthesis used a literature review, a practitioner survey, and case examples from interviews. The practitioner survey was sent to the DOTs of all 50 states and the District of Columbia. A total of 44 survey responses were received, yielding an 86% response rate. In addition, eight case example interviews were conducted to

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gather more detailed feedback. The case example participants were systematically selected to yield feedback from all four AASHTO regions and from states with formal, informal, and no policies related to PFAS.

The survey responses revealed that 39% (17/44) of the responding states have formal or informal procedures, policies, or guidance for identifying and mitigating potential PFAS contamination within a state agency other than the DOT; the remaining 61% (27/44) do not have such measures in place or are unsure. However, 23% (10/44) of the responding states have such procedures, policies, or guidance within the state DOT itself. Among the states that do have DOT-specific guidance, 70% (7/10) have informal procedures, policies, or guidance.

Additionally, 27% (11/41) of responding states have action plans related to PFAS; of those plans, 45% (5/11) were developed with the involvement of the state DOT. Similarly, 50% (20/40) of responding states have an interagency group addressing human exposure to PFAS; of those groups, 40% (8/20) involve the state DOT.

Of the responding state DOTs, 21% (9/42) reported encountering PFAS contamination on projects or within existing right-of-way areas. Another 30% (11/37) of the responding state DOTs are considering active remediation or removal of PFAS-containing materials or media at construction, maintenance, or storage sites. Moreover, 11% (4/37) of the responding state DOTs conduct testing or chemical monitoring for PFAS contamination on construction or maintenance project sites. All the responding state DOTs use private or contract laboratories for PFAS testing (4/4), whereas 25% (1/4) of these DOTs also use public or state laboratories.

One notable theme from the case examples was state DOTs anticipating new regulations related to PFAS. Of the DOTs interviewed in the case examples, 88% (7/8) explicitly stated that they expect new federal or state regulations related to PFAS in the future. All (8/8) case example states with no or informal PFAS-related policies expressed reluctance to finalize their policies until the pending federal regulations are established. Moreover, 88% (7/8) of the DOTs interviewed in the case examples stated the importance of communicating with state environmental agencies to understand the changing PFAS regulatory landscape.

Another theme from the case examples was state DOTs facing challenges related to restrictions on landfill disposal of PFAS-containing waste, such as soil from construction projects. Of the DOTs interviewed in the case examples, 75% (6/8) mentioned concern about the cost and logistical challenges of disposing of PFAS-contaminated waste. Of those DOTs, 83% (5/6) indicated that they had already experienced challenges because of PFAS restrictions from landfills.

The synthesis identified knowledge gaps that could be addressed by a study that produces a comprehensive guidance document to consolidate knowledge about PFAS across jurisdictions and assist DOTs in developing policies related to PFAS impacts on highway construction and maintenance projects. Such a document could include guidance on identifying common sources of PFAS, evaluating which products might contain PFAS, selecting and implementing testing methods, and deciding when and where DOTs should or should not test for PFAS.

Introduction

Per- and polyfluoroalkyl substances (PFAS) are a class of more than 6,000 contaminants of emerging concern that can harm ecosystem and human health (1). PFAS contain strong carbon–fluorine bonds, which give them unusual—and commercially valuable—properties (2). For instance, PFAS repel both water and oils and are chemically stable (3). For these reasons, PFAS have been used since the mid-twentieth century in consumer products, industrial applications, and, notably, firefighting foams at airports and military installations (4).

However, the carbon–fluorine bonds that make PFAS useful also contribute to their hazard risk. The chemical stability of PFAS leads to their extreme environmental persistence, earning them the nickname “forever chemicals” (5). Further, PFAS bioaccumulate at high levels of the food chain (6). PFAS are associated with deleterious health endpoints, including kidney and testicular cancer, thyroid disease, increased cholesterol levels, lowered immune response, reproductive harm, and developmental delays, even at low levels of exposure (7).

PFAS regularly migrate from the source of their contamination through surface water and groundwater plumes, atmospheric deposition, and the engineered conveyance of impacted materials (8, 9). For example, PFAS may migrate from sources such as fire training areas or fields where wastewater biosolids are applied onto rights-of-way controlled by a department of transportation (DOT) (10). Fire training areas at military sites and airports, PFAS manufacturing sites, metal plating operations, land-applied wastewater biosolids, landfills, and pulp and paper mills are known sources of contamination from which PFAS may migrate (10). Because of their widespread use, persistence, and mobility, PFAS are now ubiquitous in soils and can be detected at low concentrations, even in soils distant from any likely source (11). However, these background concentrations are typically much lower than those near directly affected sites (12).

The following definitions are intended to clarify the terminology used within this report to refer to PFAS:

- **PFAS (per- and polyfluoroalkyl substances):** A class of at least 6,000 anthropogenic chemicals whose structures contain carbon bonded to fluorine. Precise definitions vary but encompass all compounds that contain multiple carbon–fluorine bonds and are used for their film-forming or water-, oil-, or grease-repellent properties, as well as their chemical precursors.
- **PFCs (perfluorocarbons):** Colorless, odorless gases containing only fluorine and carbon. Occasionally, this term is mistakenly applied to PFAS.
- **PFOA (perfluorooctanoic acid):** The eight-carbon (or C8) perfluorinated alkyl carboxylic acid. This is a single member of the PFAS class. Because PFOA is ubiquitous, it is sometimes mistaken for the entire PFAS class.
- **PFOS (perfluorooctane sulfonate):** The eight-carbon (or C8) perfluorinated alkyl sulfonate. This is a single member of the PFAS class. PFOS is sometimes mistaken for the entire PFAS class because of its ubiquity and the similarity of their names.

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- **Total PFAS:** Methods such as total organic fluorine analysis or the total oxidizable precursor assay can quantify in aggregate nearly all PFAS in a sample but do not differentiate individual chemical species.

Despite long-standing evidence of PFAS toxicity, regulation of these compounds only began recently. The first federal maximum contaminant levels (MCLs) were proposed for drinking water in March 2023: the EPA-proposed MCLs at parts per trillion levels in drinking water for PFOA, PFOS, and four other PFAS (perfluorononanoic acid, hexafluoropropylene oxide dimer acid, perfluorohexane sulfonic acid, and perfluorobutane sulfonic acid) (13).

Additional federal rulemaking is also under way. Most notably, public comment has been completed for the designation of nine species, including PFOA, PFOS, and their chemical precursors, as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, also known as the Superfund Act) (14). The designation of PFAS as hazardous substances would restrict how DOTs could handle and dispose of impacted materials (15). It would also give the EPA authority to direct and apportion liability for cleanup (16).

Several states regulate PFAS at varying concentrations. However, existing PFAS regulations vary according to environmental matrix (e.g., drinking water, land-applied solids, soil) and jurisdiction (17, 18, 19). Many of the states regulating PFAS in drinking water have equally stringent standards for groundwater. In the absence of federal regulation on soils or leaching standards, state and private entities (e.g., landfills) may individually evaluate the risk and liability of relocating PFAS-impacted soil.

Several states have developed action plans and interagency groups to mitigate the harm from PFAS. However, these action plans may not sufficiently address the effect of PFAS contamination on DOT construction and maintenance sites. Agencies including the Michigan DOT, Minnesota DOT, and New Hampshire DOT are navigating PFAS-related issues at significant expense. Situations include the following:

- DOT-owned legacy sites contaminated with PFAS;
- Road construction and improvement through soil and groundwater impacted by PFAS from aerial deposition, stormwater runoff, and groundwater migration;
- Increased assessment and analytical costs for soils to be graded, cut, or excavated;
- Storage and disposal of spoil materials from roadway maintenance in areas with PFAS aerial deposition;
- PFAS being found in dewatered construction groundwater, in excess of the requisite parts per trillion treatment goals; and
- Landfill testing requirements and restrictions leading to increased transportation and disposal costs.

Synthesis Objective

The objective of this synthesis is to document current state DOT practices for identifying locations of potential PFAS contamination and mitigating the impacts of PFAS related to highway construction and maintenance operations. This study considers PFAS impact and mitigation efforts in all phases of highway project development (i.e., planning, design, right-of-way acquisition), construction, and maintenance. The synthesis gathered information such as

- Written DOT policies and guidance for identifying and mitigating locations of PFAS contamination;
- Methodologies for identifying and mitigating PFAS impacts related to highway construction and maintenance operations (e.g., site screening, sampling, geographic tracking, new and

existing approved product lists, management and disposal considerations, pollutant source assessments, regulatory restrictions, liability considerations, ways to address legacy DOT right-of-way acquisitions impacted by PFAS);

- Timing and approaches used to screen for PFAS contamination in construction sites; and
- Identification of materials used currently or formerly by state DOTs on construction sites that may contain PFAS or be cross-contaminated (e.g., containers with PFAS).

Study Approach

This synthesis used a literature review, a practitioner survey, and case example interviews for data collection. First, an extensive literature review on PFAS provided the initial understanding of the current state of research and practice regarding the identification and mitigation of the effects of PFAS on highway construction projects and maintenance operations. The existing literature and previous discussions with DOTs assisted with the development of the survey questionnaire.

The survey was created to document current state DOT practices related to PFAS impacts, mitigation, and related procedures and practices. Under the guidance of the topic panel, the survey was divided into the following categories:

- Demographic information for respondents,
- Policies and procedures,
- Construction and maintenance site sampling,
- Sample evaluation,
- PFAS-containing materials, and
- Follow-up.

Once the final draft of the survey was approved, an e-mail request with the Qualtrics survey link and a PDF version of the survey were distributed to the voting membership of the AASHTO Committee on Environment and Sustainability (CES), and this list was supplemented when applicable by members of the CES Hazmat Working Group. Survey recipients constituted state DOT members from each of the 50 U.S. states and the District of Columbia. The recipients were asked to distribute the survey to individuals with knowledge of their DOT's PFAS policies and processes. The complete survey is shown in Appendix A.

A total of 44 responses were collected, providing an 86% response rate from the 51 DOTs. The aggregated graphical representations of the survey responses and associated discussion are presented in Chapter 3. The aggregate and individual results of the survey are presented in Appendix B.

Following the analysis of the survey responses, subsequent case example interviews were conducted to gather further detailed information on the topic. Interviews were conducted with the following state DOTs based on their PFAS policies and procedures: Colorado, Illinois, Maine, Michigan, Minnesota, New Hampshire, Pennsylvania, and Tennessee. Details of the individual case examples are outlined in Chapter 4, and the questions asked during the interviews can be found in Appendix C.

This report seeks to document current DOT practices to identify and mitigate PFAS impacts on highway construction projects and maintenance operations. The authors' charge in this report is to present information collected void of opinion and bias. The opinions expressed in the synthesis from detailed case examples are those of the state DOT professionals and should be viewed as such. The report is organized as follows:

- Chapter 2 is a review of available academic literature as well as published DOT procedures and policies for identifying and mitigating PFAS contamination,

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- Chapter 3 summarizes the survey results,
- Chapter 4 provides the case example selection criteria and interviews with DOTs selected based on their procedures for identifying and mitigating PFAS contamination,
- Chapter 5 draws conclusions based on findings in previous chapters,
- Appendix A contains the survey questionnaire for state DOTs,
- Appendix B contains the results of the survey questionnaire, and
- Appendix C contains the case example interview questions.

Literature Review

This literature review summarizes background information, current practices, and recent research regarding identifying and mitigating locations of PFAS contamination among DOTs. This information influenced the development of the survey questionnaire and its accompanying presentation of the responses, as described in Chapter 3. The literature reviewed also informed the collection of the case examples described in Chapter 4.

The following topics of information were reviewed:

- Definitions related to PFAS contamination and associated regulations or planned regulations;
- Methodologies for identifying and mitigating PFAS impacts related to highway construction and maintenance operations;
- Written DOT policies and guidance for identifying and mitigating locations of PFAS contamination;
- DOT timing and approaches for PFAS screening, sampling, tracking, and pollutant source assessments;
- DOT management and disposal considerations regarding PFAS-contaminated materials, related liability considerations, and legacy DOT right-of-way acquisitions with PFAS contamination; and
- Identification of current or past construction and maintenance materials that may contain PFAS or be cross-contaminated (e.g., containers with PFAS).

Overview of PFAS

PFAS are a class of anthropogenic chemicals first synthesized in the 1930s and valued for their ability to repel grease, oil, and water (4). However, over the last 30 years, research on the toxicity and persistence of PFAS has focused attention on these chemicals as a major concern for human and ecosystem health (20, 21).

PFAS were first produced at a commercial scale in the 1940s and by the 1950s, various PFAS were mass produced and applied to military, industrial, and everyday household products (4). PFAS are used in fluoropolymer coatings on nonstick cookware, water-repellent clothing, stain-resistant fabric and carpet, and other consumer products that resist grease, water, and oil (3, 6). Notably, PFAS are also found in aqueous film-forming foams (AFFFs, also known as aqueous firefighting foams), which are valuable for extinguishing hydrocarbon (e.g., aircraft fuel) fires at airports and military installations (3).

PFAS are defined as “substances that contain one or more C atoms on which all the H substituents present in the nonfluorinated analogues from which they are notionally derived have been replaced by F atoms, in such a manner that they contain the perfluoroalkyl moiety C_nF_{2n+1} ” (22, p. 515).

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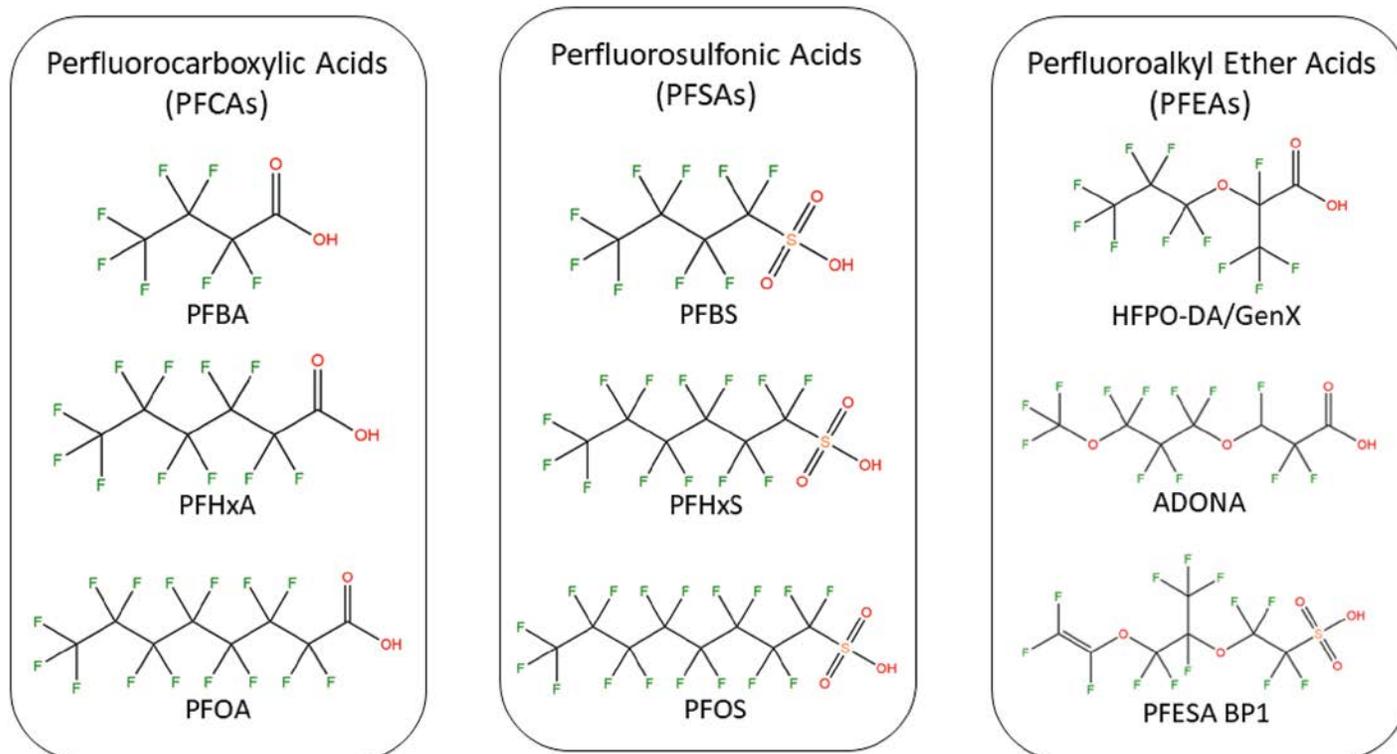


Figure 2.1. Structures of common PFAS grouped by subclass.

In more common parlance, this means that PFAS are molecules that contain multiple fluorine atoms bonded to carbon. Assorted PFAS structures are presented in Figure 2.1.

Because the carbon–fluorine bond is particularly strong, PFAS do not naturally break down into safer substances and persist in the environment for thousands of years, earning them the nickname “forever chemicals” (6). Their persistence in the environment and affinity for proteins cause PFAS to bioaccumulate in food webs; PFAS can be found in the blood serum of 99% of humans and virtually all animals (5). A study of more than 18,000 people in the United States between 1999 and 2018 found PFOS, PFOA, perfluorohexanesulfonic acid (PFHxS), or perfluorononanoic acid (PFNA) in the blood of all participants (6).

Those PFAS that have been well studied are associated with multiple cancers, cell toxicity and mortality, genotoxicity, changes in body development, and deleterious effects on the circulatory system, endocrine system, immune system, metabolic and digestive system, musculoskeletal system, nervous system and behavior, reproductive system, respiratory system, urinary system, and sensory system (7). However, most members of this large chemical class have not yet been screened for health effects.

Typical Sites of PFAS Contamination

PFAS contamination is found throughout the world, with the highest concentrations often near and around firefighting training facilities, airports, and military installations (23, 24). Since the 1970s, the U.S. Department of Defense (DoD) has used AFFFs extensively for extinguishing chemical fires, crash crew training exercises, hangar system operations and testing, and other emergency response actions. The DoD phased out PFOS- and PFOA-containing AFFFs in 2015, but old stock is still in use. The DoD is working with the Strategic Environmental Research and

Development Program and the Environmental Security Technology Certification Program to develop fluorine-free foams to replace AFFFs (24).

PFAS have been used extensively in vapor suppression systems for metal plating industries and are often found in and near metal plating shops (24). PFAS are also concentrated in water sources, wastewater, and agricultural sites near manufacturing plants that apply PFAS (23, 25).

PFAS regularly migrate from the source of their contamination through surface water and groundwater plumes, atmospheric deposition, and the engineered conveyance of affected materials (8, 9). Fire training areas at military sites and airports, PFAS manufacturing sites, metal plating operations, land-applied wastewater biosolids, landfills, and pulp and paper mills are known sources of contamination from which PFAS may migrate (10). Because of their widespread use, persistence, and mobility, PFAS are now ubiquitous in soils and can be detected at low concentrations even in soils distant from any likely source (11). These background concentrations, however, are typically much lower than those near directly affected sites (12).

PFAS manufacturers voluntarily phased out production of PFOA and PFOS for all uses in 2015 and shifted production to structurally similar replacements (26). A common replacement PFAS is hexafluoropropylene oxide dimer acid (HFPO-DA), sometimes called GenX. This compound belongs to the subclass of perfluoroalkyl ether acids. Other common replacement PFAS are short-chain perfluorocarboxylic acids (PFCAs), such as perfluorobutanoic acid, and short-chain perfluorosulfonic acids (PFSAs), such as perfluorobutanesulfonic acid.

Because of nuances in historical use and complex nomenclature, differentiating legacy PFAS (e.g., PFOS) from novel replacement PFAS (e.g., perfluoroalkyl ether carboxylic acids) is challenging for many engineers and practitioners. Such differentiation can be useful for determining the age and source of PFAS contamination. Likewise, distinguishing PFAS subclasses can provide insights into the probable origins and extent of PFAS contamination. For example, semivolatile fluorotelomer alcohols are easily transported via atmospheric deposition and may be confined to surficial soil and water, whereas subsurface plumes from AFFFs typically have greater concentrations of PFSAs than PFCAs.

Similarly, physicochemical properties influence which PFAS are most likely to be found in environmental compartments of concern to DOTs. For instance, anionic PFAS are more likely to be found in aqueous matrices, such as stormwater and dewatered construction groundwater, whereas cationic and zwitterionic PFAS (e.g., fluorotelomer betaines) are more likely to associate with soils. Therefore, an understanding of matrix effects is essential for properly contextualizing DOT sampling and analyses. DOTs can employ numerous quantification methods—including EPA standard methods—to quantify aggregated (e.g., total oxidizable precursor assay) or targeted (e.g., EPA Draft Method 1633) PFAS concentrations.

Federal Regulations

The EPA has provided guidance for measuring PFAS contamination but thus far has largely left regulation to the states. There are currently no binding federal regulations for PFAS. However, maximum contaminant levels (MCLs) have been proposed for drinking water (Table 2.1) and more rulemaking is under way. The EPA has also issued lifetime health advisory levels for PFAS in drinking water as nonregulatory guidance to protect human health (Table 2.2).

The EPA has begun the process to designate PFOA, PFOS, their chemical precursors, and seven other PFAS as hazardous substances under CERCLA (16), stating that, “This proposed rulemaking would increase transparency around releases of these harmful chemicals and help to hold polluters accountable for cleaning up their contamination” (14). The designation of PFAS as

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Table 2.1. EPA-proposed MCLs of PFAS in drinking water (as of March 13, 2023) (13).

Species	Maximum Contaminant Level (ppt) ^a
PFOA	4
PFOS	4
PFNA ^b	10
PFHxS ^b	9
GenX/HFPO-DA ^b	10
PFBS ^b	2,000

^aParts per trillion^bRegulated as a mixture based on combined concentrations contributing to a hazard index.**Table 2.2. EPA lifetime health advisory levels for PFAS in drinking water (as of June 15, 2022) (27).**

Species	Advisory Level (ppt) ^a
PFOA	0.004
PFOS	0.02
GenX/HFPO-DA	10
PFBS	2,000

^aParts per trillion

hazardous substances would restrict how DOTs could handle and dispose of impacted materials (16). It would also give the EPA authority to direct cleanup and apportion liability among potentially responsible parties, possibly including DOTs with impacted rights-of-way (15). Litigation is common among potentially responsible parties seeking to contest apportionment of site remediation costs.

Additional pending federal regulation that could affect DOTs includes the designation of PFAS as hazardous waste under the Resource Conservation and Recovery Act of 1976, which would affect the cleanup of contaminated sites and disposal of contaminated wastes (28). Further, the EPA will revise effluent limitations guidelines for landfill leachates, textile manufacturers, and wastewater treatment plants, which may affect sources of PFAS on DOT construction and maintenance sites, and designate harmful levels of PFOA and PFOS for aquatic life, which may affect their discharge from construction and maintenance sites (28).

State Regulations

Indiana, Louisiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, North Carolina, Oregon, Rhode Island, Vermont, Washington, West Virginia, and Wisconsin have set their own MCLs, regulations, or advisory levels for PFAS in water sources used for consumption and in public water systems.

Selected state MCLs are listed in Table 2.3.

Table 2.3. State MCLs (in ppt)^a for PFAS.

State	All PFAS	PFOA	PFOS	PFHxS	GenX/ HFPO-DA	PFBS	PFNA	PFHxA
MA	20	–	–	–	–	–	–	–
MI	–	8	16	51	370	420	6	400,000
NH	–	12	15	18	–	–	11	–
NJ	–	14	13	–	–	–	13	–
NY	–	10	10	–	–	–	–	–
NC	–	2,000	–	–	140	–	–	–
OR	–	30	30	30	–	–	30	–
VT	20	–	–	–	–	–	–	–
WA	–	10	15	65	–	345	9	–
WI	70	–	–	–	–	–	–	–

^aParts per trillion
 – = not applicable

States that have not set MCLs may use the EPA's health advisory levels or MCLs as guidance in decision making (29).

Some states have also imposed regulations that ban PFAS in specific products or drinking water regulations that address PFAS for surface water and groundwater (23, 30, 31, 32). Maine has passed nine regulations addressing PFAS MCLs for drinking water, food products, land application of sludge and septage, landfill disposal, landfill leachate, and state-owned facilities; these regulations specify how to test for PFAS in each situation (17).

Testing Procedures

The EPA has developed standard analytical methods for PFAS, including Methods 533 and 537.1, which test for PFAS in water and soil samples, respectively (33, 34). The EPA is currently drafting Method 1633 to standardize testing procedures for PFAS in aqueous, solid, biosolid, and tissue samples (35). Further, Pennsylvania, New Hampshire, Oklahoma, Tennessee, Vermont, and West Virginia have developed their own testing procedures and studies. Pennsylvania prioritizes testing at sites that may affect community water systems, such as military bases, fire training schools and sites, airports, landfills, Hazardous Sites Cleanup Act sites, superfund sites, and manufacturing facilities (19). New Hampshire and Oklahoma provide guidance on testing for public and private water systems (36, 37).

Several states are engaged in statewide PFAS monitoring efforts. Tennessee is testing all drinking water sources in the state. If a public water system has a contaminated water source, then the public water system is also tested (38). Vermont's testing plan is not specifically for PFAS and includes 94 other contaminants of concern in the state's water systems (39). West Virginia conducted a statewide PFAS sampling project from June 2020 to May 2021 that sampled 26 water sources and 27 schools and day cares (40). Iowa has also extensively tested water supplies around the state, as specified in its PFAS Action Plan (41).

Action Plans

Alaska, Colorado, Iowa, Michigan, Minnesota, Missouri, Montana, Nevada, North Carolina, Pennsylvania, Washington, and Wisconsin have statewide action plans specifically for PFAS contamination. The Iowa, Missouri, and Wisconsin plans have been issued by their respective

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departments of natural resources (41, 42, 43). The Alaska and Colorado DOTs are the only state DOTs leading their own PFAS action plans (44, 45). The Alaska DOT is evaluating groundwater, surface water, drinking water, and soils at all its past and present airports and DoD sites for PFAS contamination. If a site is found to be contaminated and affecting a water source, then the affected towns will be supplied with an alternate water source. The Alaska DOT is also seeking nonfluorinated AFFF replacements for use at airports (44). Colorado DOT's plan is similar to Alaska's plan, focusing on commercial airports (45). The Connecticut, Michigan, and New Hampshire DOTs are members of their respective states' PFAS response teams (46, 47, 48).

The PFAS action plans of several states directly address biosolids and wastewater treatment; drinking water sources (e.g., groundwater and soil near the water table); sources that impact air quality; landfills or other waste disposal sites; food safety; and airports where firefighting foams containing PFAS (AFFFs) were known to have been used (the Alaska Department of Environmental Conservation in 2021, the Massachusetts Department of Environmental Protection in 2021, and the Michigan PFAS Action Response Team in 2019, among others).

Several states have formed interagency groups to minimize human exposure to PFAS within their state. These groups are developing PFAS management strategies, locating likely contaminated areas, building guidance on sample collection and analysis, developing remediation and removal strategies, and surveying materials and storage practices for products containing PFAS. For example, the Connecticut Interagency PFAS Task Force developed an action plan to address challenges related to PFAS (49). This group consists of 16 organizations and is led by the Connecticut Department of Public Health and Department of Energy and Environmental Protection. Other states have formed similar interagency groups, including Michigan (50), Minnesota (51), Pennsylvania (52), and Wisconsin (53). However, none of the identified state action plans explicitly address the effect of PFAS contamination on state DOT construction and maintenance operations.

With a few state DOTs having their own PFAS action plans, the U.S. DOT has announced that it is producing a new action plan that will use procurement policies to prioritize products free of harmful pollutants, such as PFAS, in an attempt to give state DOTs more guidance (54).

Literature Review Summary

Research is prevalent on PFAS themselves and PFAS in relation to airports, but there is relatively little DOT-focused research on PFAS effects. In 2017, the National Academies of Sciences, Engineering, and Medicine published a comprehensive resource document for airport industry practitioners on best practices for management and remediation of PFAS found at airport sites (55). No similar guidance exists addressing PFAS management for state DOTs, and no state DOTs have their own comprehensive guides for identifying or managing PFAS if encountered during construction or maintenance operations outside airport source sites. Nonetheless, the information and resources summarized within this chapter provided the background from which to develop and conduct the synthesis survey discussed in the following chapter.

State of the Practice

This chapter presents the findings of the state DOT survey questionnaire regarding PFAS impacts and mitigation approaches within highway construction and maintenance operations. The objective of this survey was to gather current state DOT practices for identifying locations of potential PFAS contamination and for mitigating the effects of PFAS related to highway construction and maintenance operations.

The survey was distributed to the voting membership of the AASHTO CES, and this list was supplemented when applicable with members of the CES Hazmat Working Group. This distribution list constituted state DOT members from each of the 50 U.S. states and the District of Columbia. The recipients were also asked to distribute the survey to individuals with knowledge of their DOT's PFAS policies and processes.

Responses were collected from 44 DOTs, providing an 86% response rate (Figure 3.1). Aggregated graphical representations of the survey responses and associated discussion are presented in this chapter.

Respondents were not required to respond to every question in the survey.

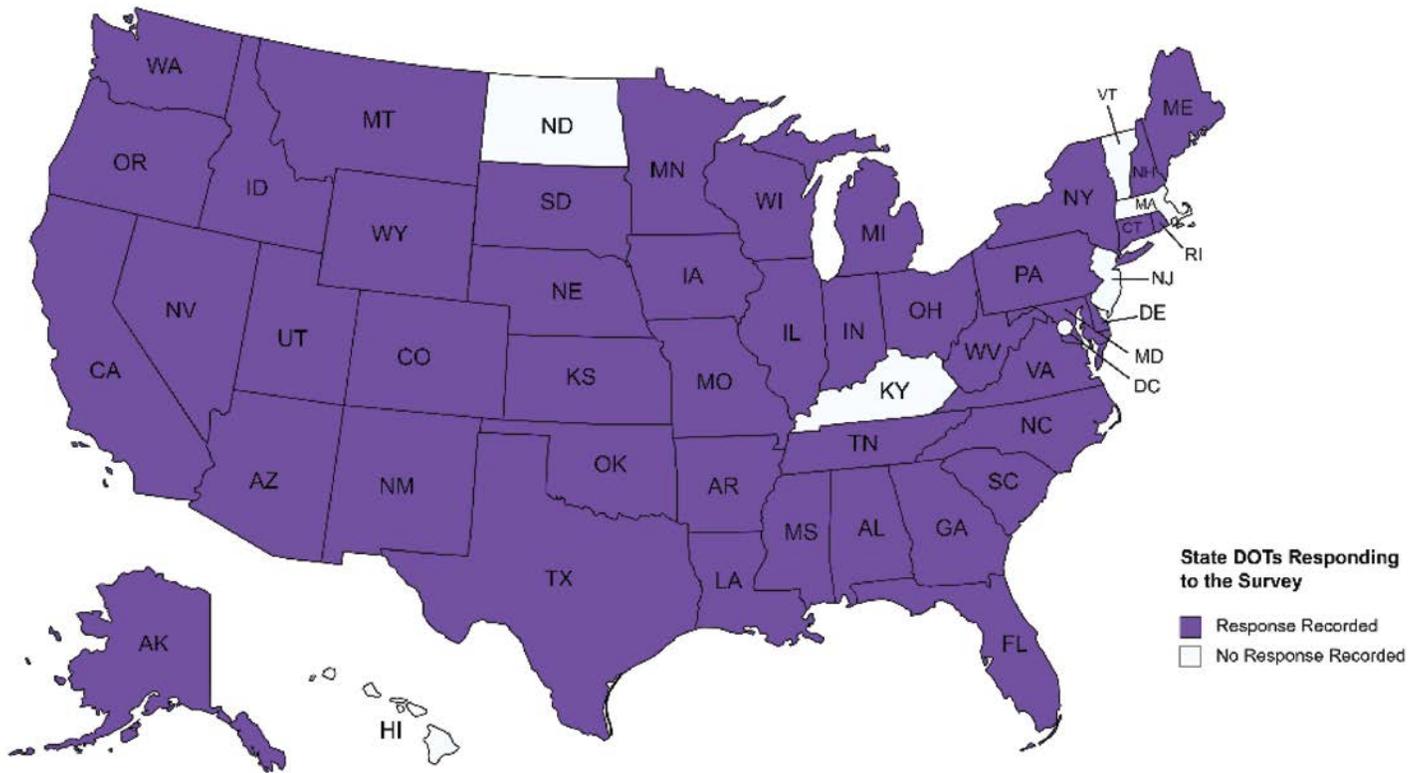
As a result, the sample size (n) of each question varies and is less than 44 for the numerous questions not answered by every respondent. Appendix A provides the complete survey questionnaire, and Appendix B compiles all agency responses to each survey question. The following sections discuss the key findings from the survey in detail.

PFAS Policy, Guidance, and Action Plans

The survey began with a collection of demographic information followed by questions regarding policies and guidance on PFAS contamination. The intent was to determine whether the DOT has formal or informal procedures, policies, or guidance for identifying and mitigating locations of potential PFAS contamination. Questions also determined whether the state DOTs or other state agencies had developed any guidance. Figure 3.2 presents that 39% of the respondents (17 states) have state-level formal or informal procedures, policies, or guidance for identifying or mitigating locations of potential PFAS contamination. However, 50% of the respondents (22 states) do not have such procedures, policies, or guidance.

Figure 3.3 shows that 77% of the responding state DOTs (34) do not have procedures, policies, or guidance on PFAS contamination within the DOT itself. Of those states that do have state DOT-specific guidance on PFAS, 70% (7 out of 10) noted that the guidance was informal. The three state DOTs that had formal procedures, policies, or guidance on PFAS were Montana, Pennsylvania, and Wisconsin.

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Created with mapchart.net

Figure 3.1. Map of state DOTs that responded to survey on PFAS impacts.

Q11: Does your state (within an agency other than the DOT) have formal or informal procedures, policies, or guidance for identifying and/or mitigating locations of potential PFAS contamination?

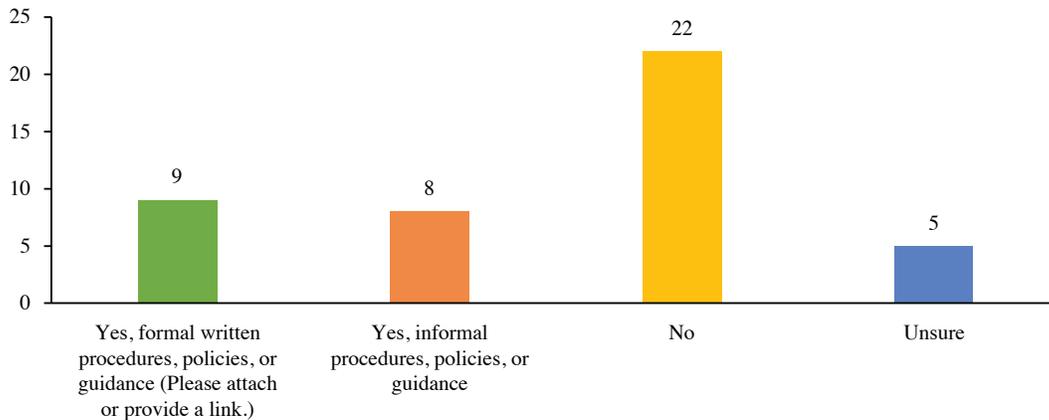


Figure 3.2. States with formal or informal procedures, policies, or guidance on PFAS (n = 44).

Q14: Does your DOT currently have formal or informal procedures, policies, or guidance for identifying and/or mitigating locations of potential PFAS contamination?

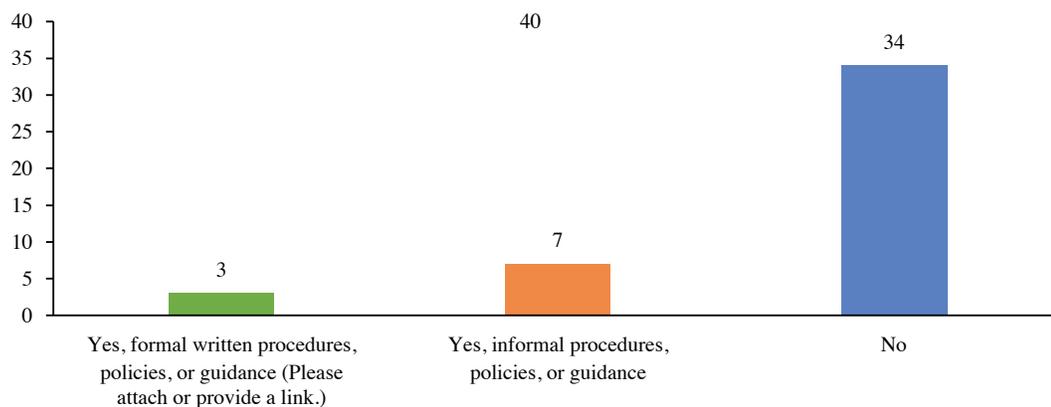


Figure 3.3. State DOTs with formal or informal procedures, policies, or guidance on PFAS (n = 44).

Figure 3.4 shows that nine state DOT respondents had knowingly encountered PFAS contamination on a project or in a right-of-way: Alaska, Colorado, Illinois, Maine, Michigan, Minnesota, New Hampshire, New York, and Oregon.

Three of those nine cases that had encountered PFAS (Alaska, Illinois, and Maine) indicated that the instance set a precedent for addressing PFAS contamination in construction project sites or areas of maintenance operations.

The survey respondents with policies or procedures indicated that the most common methodologies for identifying and mitigating PFAS impacts related to highway construction and maintenance operations included sampling soils or water for PFAS contamination and pollutant source assessments (i.e., evaluation of nearby PFAS sources and potential PFAS migration). Figure 3.5 presents the recommendations and requirements state DOT respondents mentioned.

Q15: Has your agency ever knowingly encountered PFAS contamination on any project or existing right-of-way?

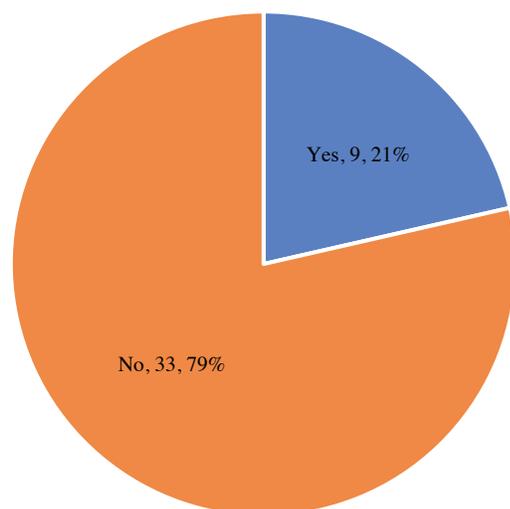


Figure 3.4. State DOTs that have encountered PFAS contamination (n = 42).

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Q20: Do your DOT's procedures recommend or require any of the following methodologies for identifying and mitigating PFAS impacts related to highway construction and maintenance operations?

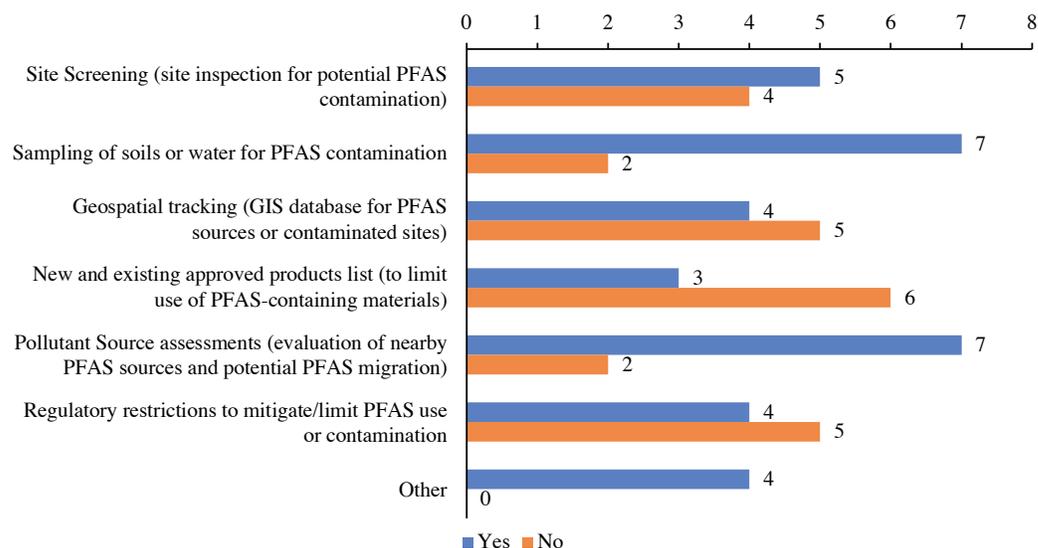


Figure 3.5. State DOT procedures for identifying and mitigating PFAS (n = 9).

Figure 3.6 reports that 73% of states do not have action plans in place to address PFAS contamination. The states that do have action plans (27%, 11 states) are Alabama, Alaska, Arkansas, Connecticut, Illinois, Michigan, Minnesota, Montana, New Hampshire, Utah, and Wisconsin.

Of the 11 states that have action plans, five respondents noted that their state DOT was involved in the development of that action plan: Alaska, Connecticut, Illinois, Michigan, and Wisconsin (Figure 3.7).

Q17: Does your state have an action plan in place regarding PFAS contamination?

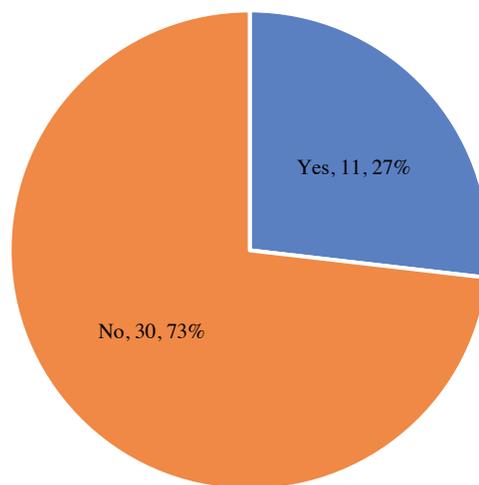


Figure 3.6. States with action plans for PFAS contamination (n = 41).

Q18: Is/was your DOT involved in the development of that action plan?

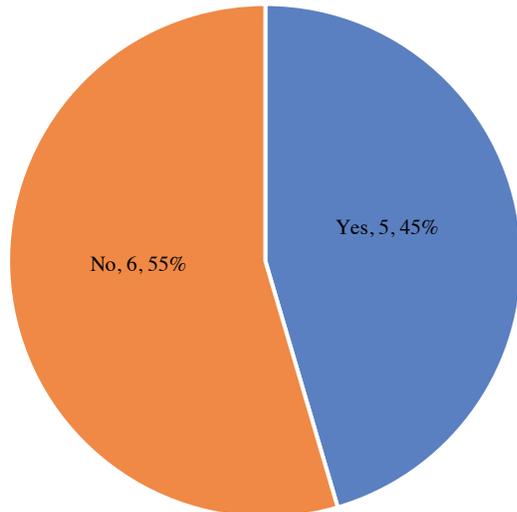


Figure 3.7. DOT involvement with state PFAS contamination action plans (n = 11).

Twenty respondents also noted that their state had an interagency group addressing human exposure to PFAS (Figure 3.8).

Figure 3.9 notes that of the 20 states with interagency groups addressing human exposure to PFAS, eight (40%) indicated their state DOT is involved in this interagency group.

These interagency groups often aid in setting procedures or practices regarding PFAS remediation and mitigation at state DOTs.

Q19: Does your state have an interagency group to address minimizing human exposure to PFAS?

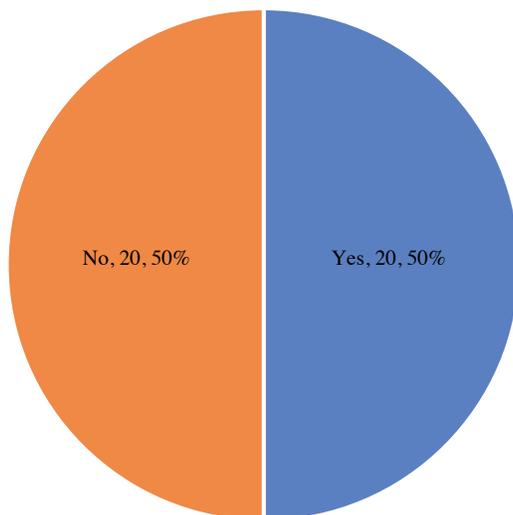


Figure 3.8. States with interagency groups to address human exposure to PFAS (n = 40).

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Q19a: Is/was your DOT involved in that group?

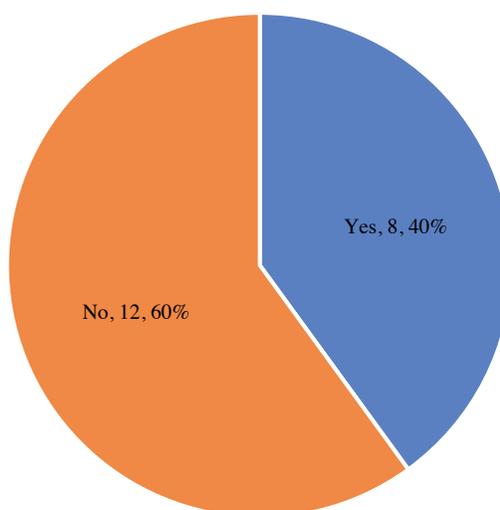


Figure 3.9. DOTs involved in state PFAS interagency groups (n = 20).

PFAS Remediation and Mitigation

The next series of questions within the survey was related to remediation or mitigation of PFAS contamination. Seven respondents with DOT PFAS procedures noted that their state DOTs require special considerations for management or disposal of PFAS-contaminated soil or water from construction or maintenance projects, while two noted that they do not.

The survey respondents were also asked about any restrictions on forms of disposal of PFAS-contaminated materials. A similar percentage of respondents, between 21% and 26% (i.e., 8 to 10 respondents), have disposal restrictions for environmental discharge, land application, or landfilling of PFAS-contaminated materials (Figure 3.10).

Q22: Are there PFAS-related regulatory or receiving restrictions on any forms of material disposal for your DOT or their contractors?

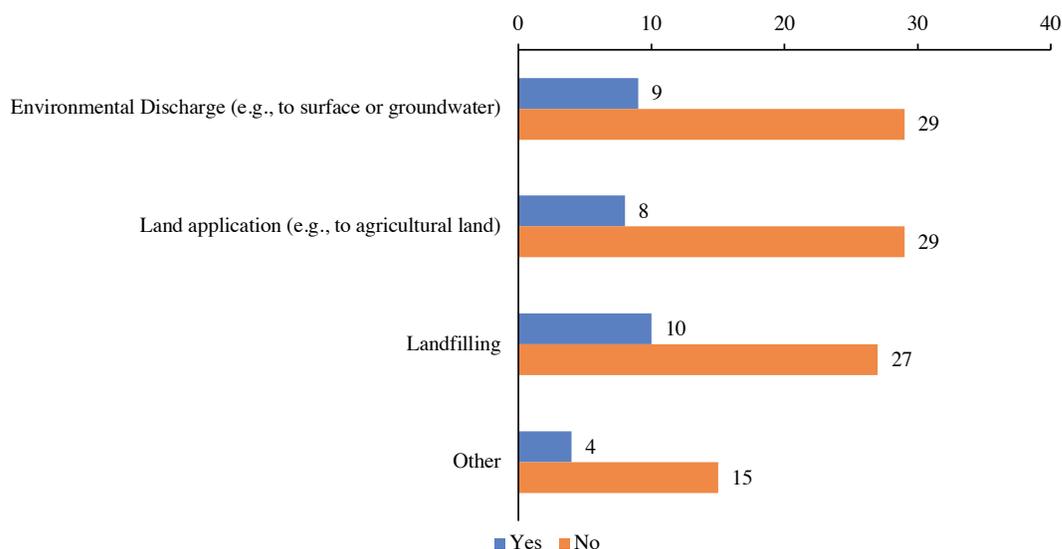


Figure 3.10. DOTs or contractors that encountered PFAS-related regulatory or receiving restrictions for material disposal (n = 38).

Q23: Does your DOT consider liability for PFAS-related impacts in the acquisition, sale, maintenance, or disturbance of rights-of-way or project sites?

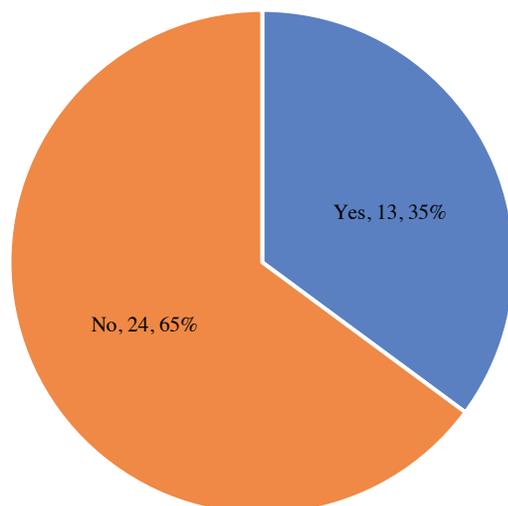


Figure 3.11. State DOTs considering liability for PFAS-related impacts on rights-of-way (n = 37).

Liability for PFAS contamination has also been a concern of state DOTs. Thirteen respondents (35%) noted that their DOTs consider liability for the effects of PFAS in the acquisition, sale, maintenance, or disturbance of rights-of-way or project sites. These responses are reported in Figure 3.11.

Liability can also be a concern with PFAS-related impacts in the acquisition, use, or storage of materials. Figure 3.12 shows that 11 respondents (30%) consider this liability.

State DOT respondents were also asked whether they consider active remediation or removal of PFAS-containing materials or media at DOT construction, maintenance, or storage sites. Per Figure 3.13, 11 state DOTs (30%) make such considerations.

Q24: Does your DOT consider liability for PFAS-related impacts in the acquisition, use, or storage of materials?

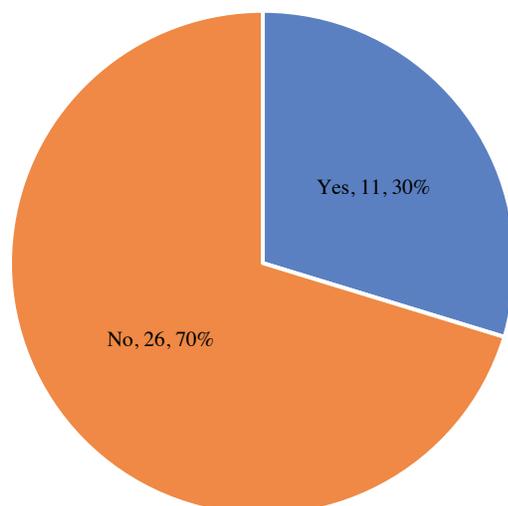


Figure 3.12. State DOTs considering liability for PFAS-related impacts when managing materials (n = 37).

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Q25: Does your DOT consider active remediation or removal of PFAS-containing materials or media at DOT construction, maintenance, or storage sites?

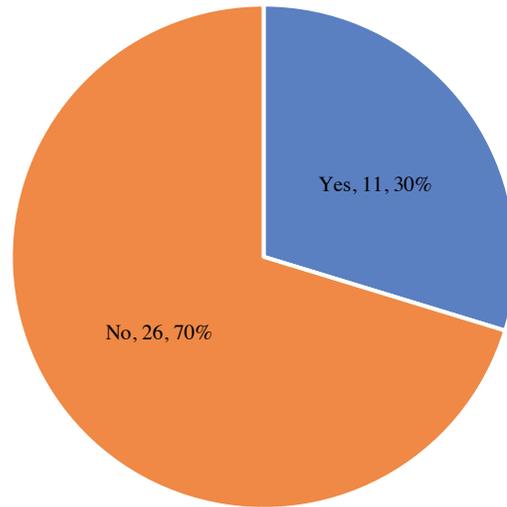


Figure 3.13. State DOTs considering active remediation or removal of PFAS-contaminated materials (n = 37).

PFAS Screening and Testing

The state DOT respondents were also asked about their practices in screening and testing for PFAS contamination. Four state DOTs, or 11% of respondents, test or chemically monitor for PFAS contamination on construction or maintenance project sites (Figure 3.14). These states are Alaska, Illinois, Minnesota, and New Hampshire.

The four state DOTs that test or chemically monitor for PFAS contamination investigate soil, groundwater, or both, as presented in Figure 3.15.

Q27: Does your DOT test or chemically monitor for PFAS contamination at any time on construction or maintenance project sites?

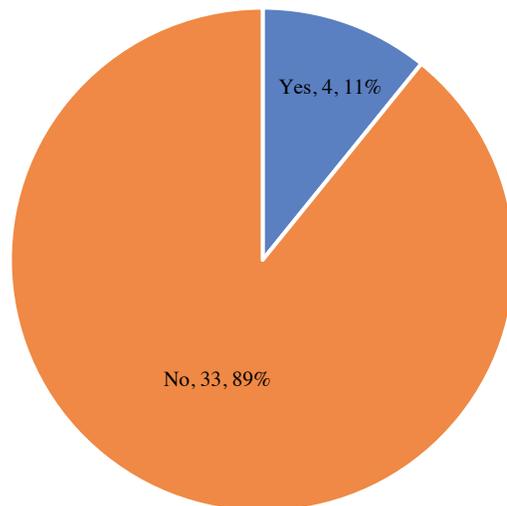


Figure 3.14. State DOTs monitoring for PFAS contamination in construction or maintenance (n = 37).

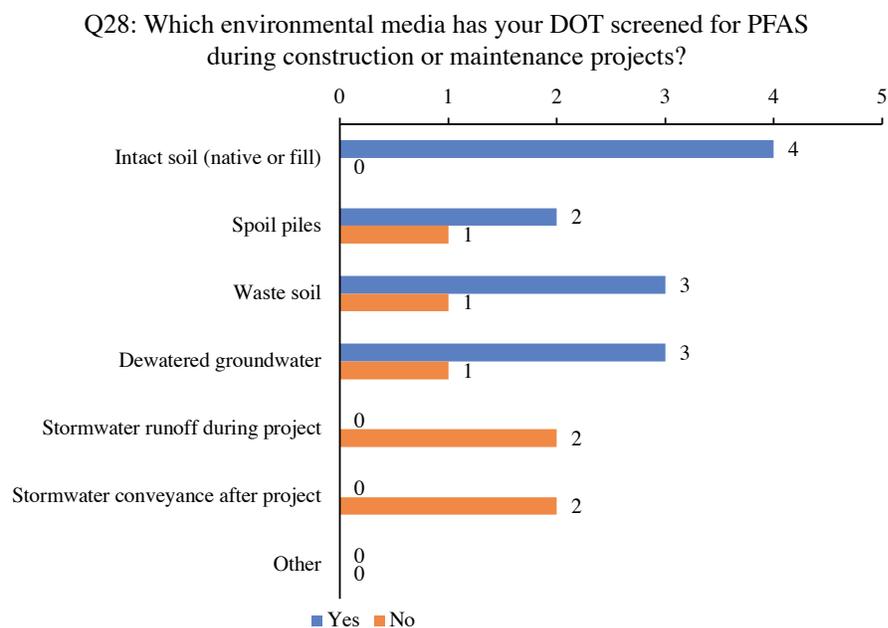


Figure 3.15. Media screened for PFAS during state DOT construction or maintenance (n = 4).

All four state DOTs that monitor PFAS contamination conduct this assessment before a project is awarded.

Additionally, while all four state DOTs that test for PFAS contamination use private or contract laboratories, only one (Minnesota) mentioned the use of public or state laboratories for testing. Three of the four state DOT respondents reported paying between \$200 and \$500 per sample, while one noted paying more than \$500 per sample.

The state DOTs also reported how quickly PFAS testing results were returned. Two state DOTs noted that results were returned within 3 weeks, and two state DOTs noted results were returned within 6 weeks.

Considering the minimal PFAS regulations, state DOTs that conducted testing were asked which PFAS they test. One state tests for some PFAS even though there is no regulation, one state tests only for the PFAS regulated in their state, and two state DOTs test for more PFAS than are regulated by the state.

Finally, Figure 3.16 presents the PFAS for which state DOTs monitor.

Inventorying and Monitoring PFAS Substances

Beyond screening and testing, state DOTs were also asked about the substances they use or store that may contain PFAS. State DOTs were asked whether they identify, inventory, and monitor these substances and how they are stored. Figure 3.17 presents that four (11%) state DOTs have procedures in place for identifying PFAS-containing materials.

Figure 3.18 presents that two (5%) state DOTs (Alaska and Colorado) have procedures in place for identifying containers that may have held PFAS-containing materials.

The state DOTs with PFAS-related procedures were asked whether they have a standard labeling protocol for materials or containers that may contain PFAS. Two respondents in this group of four state DOTs have such procedures.

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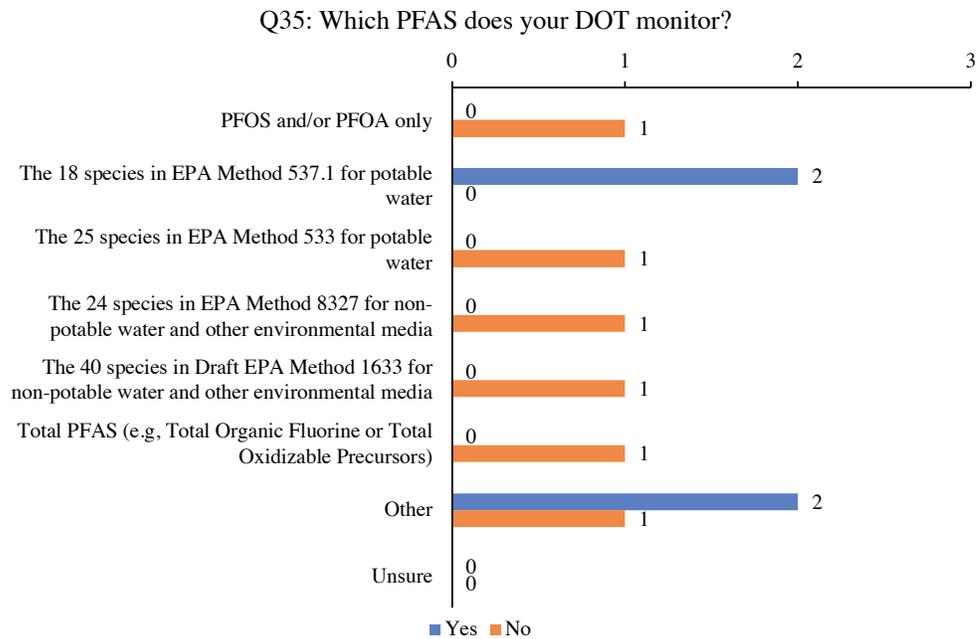


Figure 3.16. Types of PFAS monitored by state DOTs (n = 4).

Three state DOTs reported that they identify materials or containers containing the PFAS they previously used or actively use. These states are Alaska, Colorado, and Connecticut. Of these three states, only Connecticut now monitors the areas where these materials were used.

Finally, one predominant source of PFAS is Class B and MilSpec firefighting foams. State DOTs were asked whether they use or store any of these materials. Figure 3.19 shows that nine state DOTs (26% of respondents) reported using or storing such materials.

Of these nine state DOTs, 67% label Class B or MilSpec firefighting foams as containing PFAS, 22% report that labeling is inconsistent, and 11% report that labeling does not indicate the foams contain PFAS.

Q37: Does your DOT have a procedure for identifying PFAS-containing materials?

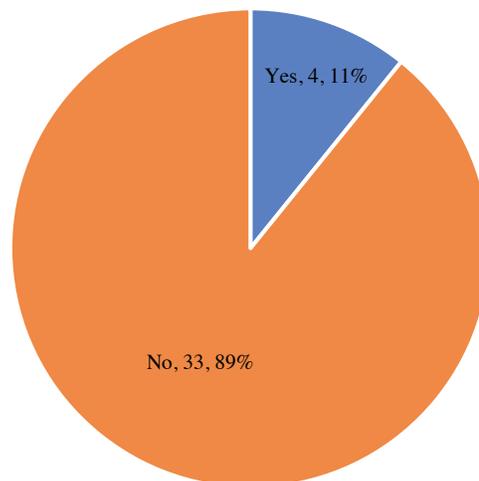


Figure 3.17. State DOTs with a procedure for identifying PFAS-containing materials (n = 37).

Q38: Does your DOT have a procedure for identifying containers which may have previously held PFAS-containing materials?

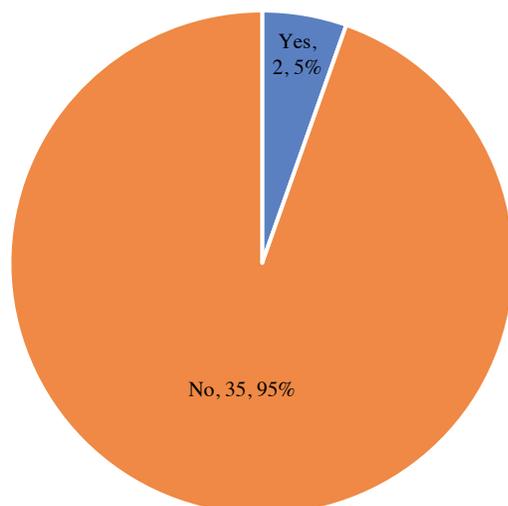


Figure 3.18. State DOTs with a procedure for identifying containers that held PFAS-containing materials (n = 37).

Q42: Does your DOT use or store any Class B or MilSpec firefighting foams (for example, at airports)?

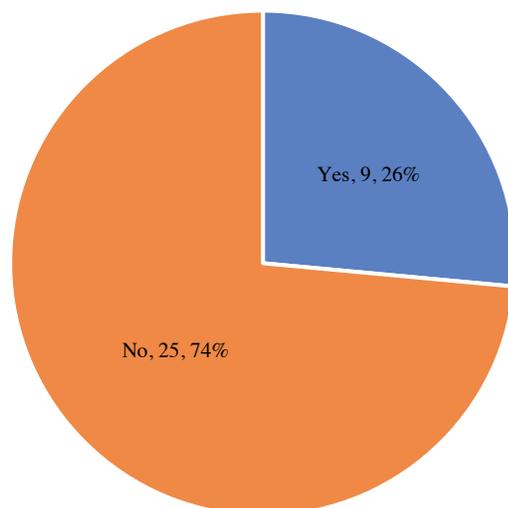


Figure 3.19. State DOT use or storage of Class B or MilSpec firefighting foams (n = 34).

Summary

This chapter describes the practices state DOTs use to identify and mitigate the effects of PFAS on highway construction projects and maintenance operations. An analysis of 44 respondents of a national survey distributed to the DOTs of all 50 states and the District of Columbia found that 39% (17/44) of the responding states have formal or informal procedures, policies, or guidance for identifying and mitigating potential PFAS contamination within a state agency other than the DOT. The remaining 61% (27/44) do not have such measures or are unsure. However, just 23% (10/44) of the responding DOTs have such procedures, policies, or guidance

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within the DOT itself. Among the states that do have DOT-specific guidance, 70% (7/10) have informal procedures, policies, or guidance, whereas 30% (3/10) have formal written policies.

Of the responding state DOTs, 21% (9/42) reported knowingly encountering PFAS contamination on projects or within existing right-of-way areas. Active remediation or removal of PFAS-containing materials or media at construction, maintenance, or storage sites is considered by 30% (11/37) of the responding state DOTs. Moreover, 11% (4/37) of state DOTs conduct testing or chemical monitoring for PFAS contamination at any time on construction or maintenance project sites. All the responding state DOTs that test for PFAS (4) use private or contract laboratories, and 25% (1/4) of these DOTs mentioned the use of public or state laboratories.

The responses also indicate variability in approaches. For example, 27% (11/41) of responding states have action plans related to PFAS; of those, 45% (5/11) were developed with the involvement of the state DOT. Similarly, although 50% (20/40) of responding states have an interagency group addressing human exposure to PFAS, only 40% (8/20) of them involve the state DOT.

The literature review and analysis of the state-of-the-practice questionnaire were used to identify state DOTs for follow-up interviews to facilitate the development of case examples. These case examples are presented in the following chapter.


CHAPTER 4

Case Examples

This chapter summarizes the findings of eight case example interviews conducted to gain a more nuanced understanding of how state DOTs are addressing PFAS contamination. The interviews were conducted with selected survey respondents to gather more detailed feedback. They covered both informal and formal policies, procedures, and guidance related to PFAS contamination. The interviews also discussed any effects PFAS have had on state DOT construction and operations. This information can help other state DOTs plan appropriate next steps for managing PFAS contamination and contextualize their own policies relative to those of other DOTs.

The selection of these cases was systematic, with a goal to collect feedback from state DOTs with different extents of PFAS-related policies and procedures. Feedback from state DOTs with different policies at either the state or agency level illustrates the spectrum of the development of PFAS-related procedures. All four AASHTO regions were represented, as were states with formal, informal, and no procedures, policies, or guidance. A final factor in the case example selection was a state DOT's willingness to participate in the interview.

The following sections summarize the findings of the case examples, including detailed accounts of the information gathered during the interviews. The responses represent the perspectives of respective DOT representatives and not necessarily best practices. The initial interview questions focused on the objective findings of the survey. Follow-up questions sought to garner more detail on the effects of PFAS on maintenance and construction operations at the state DOT. The questions asked of each state DOT are included in Appendix C. Some respondents were able to provide more detail than others, but in all instances, the willingness and generosity of participants facilitated the collection of useful information. Table 4.1 provides the state DOT selection information for the case examples.

Colorado DOT

The Colorado DOT indicated in their survey response that they currently do not have formal or informal policies or guidance related to PFAS. This DOT was selected for a case example because of their efforts to identify and inventory PFAS within their agencywide system.

Policy on Identifying and Mitigating PFAS Contamination

As noted, at the time of their interview, the Colorado DOT did not have formal policies or guidance on identifying and mitigating PFAS contamination. However, the agency is aware of a need for PFAS policies and guidance and is beginning to develop them.

The Colorado DOT did conduct an agencywide investigation and inventory of where they own and maintain substances containing PFAS. The DOT identified two long tunnels where firefighting equipment and trucks outfitted with firefighting materials containing PFAS were stored for

Table 4.1. State DOT selection information for case examples.

State	Does your state (within an agency other than the DOT) have formal or informal procedures, policies, or guidance for identifying and/or mitigating locations of potential PFAS contamination?	Does your DOT currently have formal or informal procedures, policies, or guidance for identifying and/or mitigating locations of potential PFAS contamination?	Are you willing to participate in a follow-up phone interview to gain additional insight into your DOT's PFAS-related practice for a case example in the final report? Your DOT will be identified, but interviewee names will remain anonymous.	AASHTO Region
Colorado	No	No	Yes	4
Illinois	Yes, informal procedures, policies, or guidance	Yes, informal procedures, policies, or guidance	Yes	3
Maine	Yes, informal procedures, policies, or guidance	Yes, informal procedures, policies, or guidance	Yes	1
Michigan	Yes, formal written procedures, policies, or guidance (Please attach or provide a link.)	Yes, informal procedures, policies, or guidance	Yes	3
Minnesota	Yes, informal procedures, policies, or guidance	Yes, informal procedures, policies, or guidance	Yes	3
New Hampshire	Yes, formal written procedures, policies, or guidance (Please attach or provide a link.)	Yes, informal procedures, policies, or guidance	Yes	1
Pennsylvania	Yes, formal written procedures, policies, or guidance (Please attach or provide a link.)	Yes, formal written procedures, policies, or guidance (Please attach or provide a link.)	Yes	1
Tennessee	Yes, informal procedures, policies, or guidance	No	Yes	2

use. This equipment was specialized to these tunnels, as other fires on roadways are managed by local firefighting forces. The containers have been removed from service and are awaiting a buy-back program from the health department. The Colorado DOT has no PFAS-containing material remaining in their inventories.

The Colorado DOT noted that PFAS are sometimes used and contaminate their right-of-way. In these cases, the agency seeks mitigation from the responsible parties or uses their own contracts to mitigate the contamination.

Screening for PFAS Contamination on Construction and Maintenance Sites

There is no state requirement for testing sites for PFAS, but the Colorado DOT is prepared to test for PFAS if known sources are suspected of being on project sites. The respondent noted concerns about ground dewatering permits being denied because such an incident occurred at a small regional Colorado airport. The DOT is aware that PFAS are becoming a concern for the

Colorado Department of Public Health and Environment, and although the DOT currently does not test for PFAS, they believe the need to do so is forthcoming. Still, the Colorado DOT is taking steps to minimize their PFAS-related impacts.

The Colorado DOT has taken action to make sure they are no longer a source of PFAS contamination, but they acknowledge that they could still be responsible for the remediation of PFAS contamination on their rights-of-way.

The Colorado DOT understands that PFAS removal is expensive and difficult. They view PFAS as unique hazardous wastes that are especially difficult to dispose of. Therefore, potential contamination presents concerns for DOT construction and maintenance operations.

Methodologies for Mitigating PFAS Impacts

There are other sources of PFAS beyond the Colorado DOT itself on agency rights-of-way. Some fires have been fought on rights-of-way using PFAS-containing materials, which then became elicited discharges. These areas have been identified as hazardous spills. State authorities are attempting to require responsible parties to clean these sites, or they have used their own hazardous materials services to clean them.

Identifying Materials or Containers That May Contain PFAS

In approximately 2020, the Colorado Department of Public Health and Environment sent a survey to the DOT asking about materials containing PFAS. The Colorado DOT quickly inventoried and investigated their materials. The identification of PFAS in this investigation highlighted a concern, and the agency immediately addressed the situation.

Coordination and Communication Between State Agencies on PFAS

The Colorado DOT stated that there is no guidance or policy on PFAS from health or environmental agencies in Colorado. State agencies are still defining the problem and are limiting new sources of PFAS. The DOT has staff with hazardous materials expertise who keep up to date with PFAS and related regulations. While the Colorado DOT is awaiting direction and pending regulations from the state or federal authorities, DOT leadership supports being proactive in eliminating PFAS use and investigating PFAS management.

PFAS Impacts on DOT Operations

The Colorado DOT stated that PFAS have had no impacts on operations. In the absence of specific requirements, the agency aims to be as proactive as they can.

Lessons Learned Regarding PFAS Identification and Mitigation

The Colorado DOT noted that dealing with PFAS can be problematic because of a lack of regulations. Airport officials have reported that insurance agencies once required hangars to have firefighting foams containing PFAS as a condition to insure aircrafts. While that practice has since changed, it indicated that not all divisions may be aligned in the elimination of PFAS use.

The Colorado DOT noted that assessment and review to locate and identify PFAS are difficult. Internal investigations can be ignored or postponed by groups. The respondent recommended building a network of personnel who understand the problem and want to be proactive. Prompted by the survey, the Colorado DOT used their network of resources to quickly search for PFAS sources and then took those sources out of service for disposal.

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The Colorado DOT indicated that, from their perspective, being proactive is key: The first step should be to eliminate use of PFAS. The respondent also noted the need for research and support for alternatives to PFAS, for PFAS destruction, and for guidance in identifying and mitigating PFAS at DOTs.

Illinois DOT

Responses to the survey from the Illinois DOT indicated that the agency has informal policies and guidance related to PFAS, as do other Illinois state agencies. The agency further indicated that they have been testing intact soil for PFAS contamination at construction sites on a limited basis. With the goal of gaining more details about these policies, the synthesis team requested an interview with an Illinois DOT representative, who agreed to participate.

Policy on Identifying and Mitigating PFAS Contamination

The Geologic and Waste Assessment (GeoWaste) unit of the Illinois DOT has independently developed informal policies on PFAS because the state has passed no substantive regulations related to PFAS in soil. (However, the state has passed some groundwater regulations.) Unlike formal policy changes, these informal DOT policies currently do not require approval from agency directors. The unit has been in close communication with the Illinois EPA to verify that they operate in a manner consistent with their intent and current rules or regulations.

The GeoWaste Unit of the Illinois DOT is observing how the problem of PFAS contamination evolves and aims to develop strategies proactively, especially to minimize the costs associated with PFAS contamination. There is particular concern about the cost of treating dewatered groundwater. For example, it is much more cost-effective to discharge water under a National Pollutant Discharge Elimination System permit using a bag filter than to treat the water as special waste, which can cost 25 to 50 cents per gallon to dispose. There is also concern that many Illinois landfills will not accept PFAS-containing soil for disposal.

Screening for PFAS Contamination on Construction and Maintenance Sites

In the absence of a previously identified PFAS source, the standard list of contaminants for which the Illinois DOT tests does not include PFAS. However, during a Preliminary Environmental Site Assessment, the Illinois DOT identifies locations of likely PFAS contamination through professional judgment and a review of the site's history. Locations that were former sites of industrial activity or car fires extinguished using firefighting foams often receive special attention. The agency flags these locations as potential recognized environmental conditions and collects samples for PFAS.

One of several environmental firms under contract with the Illinois DOT collects samples and produces reports outlining potential restrictions based on test results. Testing is performed by labs approved by the National Environmental Laboratory Accreditation Program, with the contract typically awarded to the lowest bidder, usually Eurofins.

Methodologies for Mitigating PFAS Impacts

The Illinois DOT does not remediate sites but will manage the materials excavated during construction. Particularly when contamination affects the right-of-way, the agency accounts for the health and safety of workers, the public, and the environment. The agency tends to adopt the site and material classifications most protective of human health and the environment.

Identifying Materials or Containers That May Contain PFAS

The Illinois DOT does not identify materials or containers that may contain PFAS or may be cross-contaminated by PFAS. The DOT evaluates construction and maintenance sites only on a case-by-case basis.

Coordination and Communication Between State Agencies on PFAS

The Illinois DOT expressed a desire to maintain compliance with any regulations. Because the agency believes that PFAS regulations are in their preliminary stages, they communicate regularly with the Illinois EPA. Several former Illinois EPA employees currently work in the GeoWaste unit, are sensitive to issues related to PFAS contamination, and can provide context to assist with potential regulation from the Illinois EPA.

PFAS Impacts on DOT Operations

When the Illinois DOT has encountered PFAS contamination, it has had difficulty disposing of it in landfills. The DOT has found that most landfills do not want to accept PFAS-contaminated waste. Additionally, the remaining permitted hazardous waste landfill in Illinois only accepts waste from a single client. Therefore, all hazardous waste from Illinois DOT projects is required to be transported to Michigan. This is impractical and expensive, particularly for sites in southern Illinois. Costs for disposal may be \$400 to \$500 dollars per cubic yard, which is prohibitive given the scale of some projects.

Further, sampling for PFAS is complicated. Environmental firms must be trained on specific requirements from testing labs before sampling. The firms the Illinois DOT uses have been trained and understand the procedures. Nonetheless, sampling for PFAS is time consuming and expensive.

Lessons Learned Regarding PFAS Identification and Mitigation

The Illinois DOT believes that managing PFAS contamination will be expensive in the future, particularly when soil regulations are implemented. The agency would like to balance good stewardship of the environment with financial responsibility, particularly if landfills are unwilling to accept even low-level concentrations of PFAS.

The agency believes that unless there is a specific reason to expect PFAS contamination to be present at a site, PFAS should not be tested for. However, if there is a reason to expect contamination, then samples should be taken for PFAS analysis.

Maine DOT

Responses to the survey from the Maine DOT indicated that both the Maine DOT and other state agencies have informal policies and guidance related to PFAS. Responses further indicated that the agency does track potential sources of PFAS contamination at construction and maintenance sites and that they have special considerations for the management and disposal of PFAS-impacted soil and water. With the goal of gaining more details about these policies, the synthesis team arranged an interview with the Maine DOT.

Policy on Identifying and Mitigating PFAS Contamination

The Maine DOT explained that Maine has informal policies or guidelines regarding PFAS but that nothing is set in writing yet. The DOT indicated that they are waiting for regulatory agencies

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to clarify PFAS final regulations before developing formal policies. Though federal regulations have some influence, the Maine DOT primarily deals with the Maine Department of Environmental Protection (DEP).

The Maine DOT has not actively searched for PFAS contamination, and regulatory agencies have not yet pushed the issue. Motivators for the approach include the logistical challenges of disposal and the high cost associated with transporting PFAS-contaminated material to landfills. The simplest disposal of PFAS-contaminated waste involves transporting it to Wayne, Michigan, or Montreal, Canada.

The agency has conducted more thorough investigations of selected sites with potential PFAS contamination near military bases and a field affected by wastewater sludge application. These sites were identified through a web-accessible geographic information system (GIS) database maintained by the state. Among other PFAS sources, Maine tracks the locations where sludge has been spread.

Screening for PFAS Contamination on Construction and Maintenance Sites

The Maine DOT has sampled for PFAS at construction sites near military bases and at a field in the northern part of the state where sludge has been applied. After careful consideration, Maine DOT employees collected samples for analysis. Sampling focused on characterizing media in soils; groundwater was not a concern.

Methodologies for Mitigating PFAS Impacts

The Maine DOT has developed special provisions based on the Maine DEP's guidelines. This guidance focuses on managing and containing the PFAS on-site. Greater concern arises regarding surplus material, which is difficult and costly to dispose. The agency expressed worry that such disposal could become increasingly difficult as detection limits for PFAS become smaller.

Identifying Materials or Containers That May Contain PFAS

The Maine DOT has not had concerns with PFAS in materials or containers. In the absence of regulation, the agency has limited its focus to ongoing construction. The Maine legislature considered an initiative on products, but that initiative has been delayed. The agency acknowledged that they have not yet addressed PFAS in personal protective equipment and similar materials.

Coordination and Communication Between State Agencies on PFAS

The Maine DOT noted that they have a good rapport with regulatory agencies and work collaboratively to address the issue of PFAS contamination. They articulated that being in a small community and state has fostered this collaborative relationship. The Maine DOT stated that they believe the DEP understands PFAS to be a major cost concern.

PFAS Impacts on DOT Operations

PFAS contamination has not affected the Maine DOT's daily operations. However, at locations with known contamination, a special provision has been put in place that outlines procedures for contractors. These provisions are largely designed to protect worker health and address right-to-know concerns for those workers who may come into contact with PFAS.

Lessons Learned Regarding PFAS Identification and Mitigation

The Maine DOT acknowledges the challenges posed by PFAS and the increasing awareness of their presence. The agency mentioned the need for regulations to catch up with this awareness and the difficulty of minimizing PFAS use in various everyday products. The Maine DOT acknowledges that PFAS is an issue they will have to address, though the issue could take many years to resolve.

Michigan DOT

Responses to the survey from the Michigan DOT indicated that the agency has informal policies and guidance related to PFAS, and other Michigan state agencies have formal policies and guidance related to PFAS. The DOT further indicated using a variety of procedures to identify and mitigate PFAS contamination. The Michigan DOT also indicated that they do consider active remediation of PFAS-containing materials. With the goal of gaining more details about these policies, the synthesis team secured an interview.

Policy on Identifying and Mitigating PFAS Contamination

During the interview, the Michigan DOT explained that they do not have formal policies associated with PFAS; however, their agency is part of the Michigan PFAS Action Response Team (MPART). This multi-agency team provides regulatory direction under the auspices of the Michigan Department of Environment, Great Lakes, and Energy (EGLE).

The Michigan DOT stated that they endeavor to identify locations with PFAS contamination before contractors are on-site. Projects that involve significant earth moving or are near sites of PFAS contamination are often flagged for soil assessment. The Michigan DOT shares data from these soil assessments with MPART.

Screening for PFAS Contamination on Construction and Maintenance Sites

The Michigan DOT begins screening for possible PFAS contamination early in the construction and maintenance phases. EGLE provides a mapping tool to help locate known contamination. Additionally, Michigan maintains high-quality, accessible property records for its right-of-way and adjacent properties, which can be reviewed for indications of PFAS contamination. The DOT conducts a random sampling around sites with elevated risk for PFAS contamination following Michigan's prescribed procedures for sampling.

Most landfills in Michigan request a PFAS screening before accepting waste from the Michigan DOT. Many will not accept waste with any detectable PFAS.

Methodologies for Mitigating PFAS Impacts

If PFAS are identified at concentrations below the hazardous threshold, the Michigan DOT may put impacted soil back in place or move it to another similarly contaminated location on the same site. Taking soil off-site often becomes expensive.

Identifying Materials or Containers That May Contain PFAS

The Michigan DOT does not identify materials or containers that may contain PFAS. The only DOT materials that may be contaminated are the linings of herbicide containers. No firefighting

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foams are within the purview of the Michigan DOT's Environmental Services Section, though a separate Aeronautics Division exists within the DOT.

Coordination and Communication Between State Agencies on PFAS

The DOT stated that Michigan maintains leadership on PFAS issues, resulting in strong coordination among state agencies. The most visible result of this coordination is the formation of MPART.

PFAS Impacts on DOT Operations

The Michigan DOT indicated that they are not responsible for any contamination if they are not the polluter. Nonetheless, if PFAS are identified at a site, the Michigan DOT still has a responsibility to be compliant with due care. This frequently means precautions are taken to ensure that workers and contractors will not come into contact with the toxic contaminants. The prevailing expectation in Michigan is that PFAS will be addressed when they are found at a construction or maintenance site.

Lessons Learned Regarding PFAS Identification and Mitigation

The Michigan DOT has found that, in general, they are more easily able to address PFAS contamination if it is identified early in projects.

The Michigan DOT stated that they have benefitted from maintaining strong communication with regulatory agencies. The DOT finds it helpful to clearly understand the expectations of these regulatory agencies when PFAS are discovered at DOT project sites. Similarly, the Michigan DOT stated that they have benefitted from working to build their capacity to characterize sites rather than assuming a defensive posture. The Michigan DOT would rather find solutions than engage in regulatory disagreements.

Minnesota DOT

Responses to the survey from the Minnesota DOT indicated that they have informal policies and guidance related to PFAS, as do other Minnesota state agencies. They further indicated that the Minnesota DOT has been testing soil for PFAS contamination at construction and maintenance sites near potential source areas. Responses showed that state regulatory agencies use GIS tracking, but such tracking is not performed by the DOT. With the goal of gaining more details about these policies, the synthesis team obtained an interview with the Minnesota DOT.

Policy on Identifying and Mitigating PFAS Contamination

The informal policy related to PFAS at the Minnesota DOT is influenced by two state regulatory authorities, the Minnesota Pollution Control Agency (MPCA) and the Minnesota Department of Health (MDH). The MDH is responsible for drinking water contamination, whereas MPCA has purview over soil and groundwater contamination. These two agencies provide guidance on what constitutes PFAS sources and what levels of contamination are subject to regulation. The Minnesota DOT stated that MPCA's regulations are typically more stringent than federal regulation. The Minnesota DOT's Office of Environmental Stewardship is not a regulatory authority but rather responsible for ensuring that the Minnesota DOT remains in regulatory compliance.

The Minnesota DOT is not yet subject to strong guidance, rules, or regulations related to PFAS. Their policies are not in active development as they anticipate more regulation from

MPCA. Minnesota DOT policy may soon be affected by the MPCA's anticipated best practices and background limits for PFAS in soils. The DOT's current policy is also influenced by some landfills in the state refusing to accept soil with even low or background PFAS levels.

Screening for PFAS Contamination on Construction and Maintenance Sites

The Minnesota DOT chemically monitors for PFAS in locations only where previous land uses indicate a likely or known PFAS-related activity. Early in a project's timeline, the Minnesota DOT evaluates sites for any observable signs or sources of contamination. Both water and soil may be sampled during the Phase II investigation, but samples are generally not collected during maintenance projects. The department may even conduct sampling during construction but attempts to minimize such testing because the 3- to 4-week turnaround for results may cause delays.

Methodologies for Mitigating PFAS Impacts

The Minnesota DOT relies heavily on their consultant pool to identify sites potentially contaminated with PFAS, including the locations and former locations of metal platers or airports with firefighting training activities. Specifically, the MPCA has published a list of businesses and practices potentially associated with PFAS contamination. The DOT can also evaluate previous land uses and North American Industry Classification System (NAICS) codes associated with sites.

If contamination is located on the site of a construction or maintenance project, the Minnesota DOT may not necessarily be held responsible for mitigation because of the way the MPCA designates liability for contamination. If off-site contamination migrates into the Minnesota DOT right-of-way from an adjacent responsible party, the DOT is the affected party, not the responsible party. Several times, a known plume has resulted in the need to install granular activated carbon filters before water is discharged from sites.

The Minnesota DOT expressed understanding that PFAS are chemicals of emerging concern and expressed worry about the possible designation of PFAS as a hazardous material. Such a designation would make disposal of contaminated soil and water much more expensive and cumbersome.

Identifying Materials or Containers That May Contain PFAS

The Minnesota DOT is not specifically aware of any PFAS-containing materials in their possession and none actively being used. The agency avoids purchasing products that contain PFAS. For example, the firefighting chemicals used in prescribed burns are PFAS-free. Further, the DOT personnel who track and inventory chemicals and hazardous waste are vigilant for PFAS.

Coordination and Communication Between State Agencies on PFAS

The Minnesota DOT indicated that the level of coordination and communication between the Minnesota DOT and other state agencies has been mixed. Much of MPCA's time and resources have been recently occupied by managing a major settlement with a large PFAS manufacturer in the state. Before finalizing their policies, the Minnesota DOT is awaiting final guidance from MPCA on background PFAS levels and how such ubiquitous low levels of contamination should—or should not—affect landfill disposal of soil and other waste.

Similarly, the MDH dedicates much of its focus to drinking water, with much less attention paid to groundwater. This makes aquifer contamination a bit of a gray area. One member of the Minnesota DOT sits on MDH committees to learn more about possible regulation.

PFAS Impacts on DOT Operations

One major impact on Minnesota DOT has been local landfills' reluctance to accept any PFAS-containing waste, even if the low PFAS concentrations indicate background levels rather than a spill. On a few occasions, a landfill has rejected soil that subsequently must be treated as hazardous. One state landfill recently created a new cell for PFAS-impacted material and soils but only from locations associated with PFAS manufacturing, so it is unavailable to the Minnesota DOT.

To lessen the effect on construction and maintenance projects, the Minnesota DOT is proactive about evaluating PFAS contamination by testing some sites as early as 3 years before construction if contamination is expected. Further, willingness by the MPCA to designate off-site contamination as a "threatened release" or "identified release" gives the DOT more freedom to avoid delays caused by contamination.

Lessons Learned Regarding PFAS Identification and Mitigation

The Minnesota DOT does not anticipate having a full understanding of PFAS impacts on construction and maintenance policies until pending regulations are finalized. However, the agency explained that PFAS are in the popular culture and consciousness in Minnesota (largely because of a large settlement with a major local PFAS manufacturer). This has resulted in significant conversation about, and awareness of, the topic.

New Hampshire DOT

The New Hampshire DOT was selected for an interview on the basis of having both formal state-level guidance and procedures related to PFAS and informal state DOT guidance and procedures. Their state DOT approaches focus on legacy sites that the DOT owns or has acquired that are contaminated, which require monitoring and the use of consultants for compliance with New Hampshire Department of Environmental Services (NHDES) rules. There are also processes and procedures for New Hampshire DOT design and construction projects when PFAS is identified or suspected. In these projects, consultants may be used to assist with conducting an evaluation, assembling a management plan, and compiling contract documents to manage PFAS during construction.

NHDES has also required extensive water sampling at remediation sites, waste sites, and water supply wells across the state. This sampling program populates a PFAS GIS mapper tool used to catalog PFAS testing results.

Policy on Identifying and Mitigating PFAS Contamination

Mitigation consists largely of long-term monitoring and reporting at active contaminated sites or former landfills owned by the New Hampshire DOT. On November 22, 2016, NHDES issued a letter to responsible parties, site owners, and permittees to include PFAS as part of their groundwater sampling programs for specific contaminated sites. Some of these sites returned PFAS levels above the ambient groundwater quality standards (AGQS) established by NHDES. The requirement is to continue monitoring those sites. If monitoring results show three consecutive rounds of sampling below AGQS levels, testing discontinuation is considered.

On some legacy sites where PFAS is detected, a review to identify private or public water supply wells within a 500-foot radius is requested, which may constitute sampling. This review is conducted to confirm whether sensitive water users are nearby and, if so, to evaluate possible PFAS contamination and mitigative actions (water treatment, bottled water, etc.).

To identify potential contamination on their construction or maintenance projects, the New Hampshire DOT may conduct evaluations in-house or through consultant services. Identification includes the use of the NHDES PFAS GIS mapper, the NHDES OneStop GIS mapper, historical review for potential contamination, site walks, and other techniques. With every project, a 1,000-foot radius search is completed for sources of contamination (e.g., landfills, gas stations), including PFAS and other contaminants of concern. The NHDES OneStop GIS mapper can query for any remediation sites within 1,000 feet (or any other desired distance) of a project with significant excavation, dewatering, or both. These initial evaluations are sometimes performed by a consultant.

If no issues are identified, the project is considered clear. If there is suspicion of contamination, further investigation and coordination with NHDES may be sought.

Screening for PFAS Contamination on Construction and Maintenance Sites

With regard to screening and mitigation, the New Hampshire DOT shared an example of a project occurring near or within an identified PFAS atmospheric deposition site. A consultant was brought on board to assist with screening and mitigation measures. The screening of any project may involve groundwater, soils, and leachability testing. The example project included all PFAS contamination in groundwater and soil. The goal of the project was to reuse the material on-site instead of disposing off-site, such as at a landfill.

Methodologies for Mitigating PFAS Impacts

In the example project or others with PFAS contamination, the New Hampshire DOT prepares contract documents that include procedures for the contractor to follow when handling or managing PFAS contamination. For the example project, a groundwater and soil management plan was developed to maintain current site conditions (i.e., no construction-related increase in contamination). Because New Hampshire has no established rules or standards specific to remediating PFAS-impacted soils, the general approach is to consider reuse where it is geotechnically suitable and determined to be environmentally acceptable through a review or an investigation. The New Hampshire DOT wants to mitigate PFAS responsibly, controlling liability concerns and mitigating in a cost-feasible way. The department also has various approaches for managing construction dewatering liquids contaminated with PFAS.

New Hampshire DOT mitigation approaches are done with the realization that PFAS standards and requirements will be developed for surface water and soils in the future, and groundwater standards will likely become more restrictive. Other mitigation efforts could include removal to landfills, although not every landfill will accept PFAS-contaminated soils. Generally, the New Hampshire DOT tries to keep PFAS-contaminated soil on-site and within the New Hampshire DOT right-of-way in order to maintain control and limit liability. This is not unlike another approach unique to the New Hampshire DOT pertaining to roadside soils that, as indicated by nationwide information and statewide analytical data collected by the department, commonly contain metals (primarily arsenic), polycyclic aromatic hydrocarbons, and total petroleum hydrocarbons at concentrations above naturally occurring background conditions.

Identifying Materials or Containers That May Contain PFAS

The New Hampshire DOT Contamination Program is not aware of the department using any PFAS-containing materials.

Coordination and Communication Between State Agencies on PFAS

The New Hampshire DOT works closely with NHDES related to PFAS, as necessary and on a case-by-case basis.

PFAS Impacts on DOT Operations

Larger projects within the New Hampshire DOT's Division of Operations are handled as construction projects, as previously described. The DOT has PFAS special provisions, contract documents, pay items, and soil and groundwater management plans. Before contractors can excavate, they must provide a project operations plan demonstrating planned means and methods of managing soil, groundwater, and other potential sources of PFAS contamination.

Lessons Learned Regarding PFAS Identification and Mitigation

The New Hampshire DOT noted several lessons learned that might be useful to other state DOTs. First, they note that tools such as a PFAS GIS mapper are helpful, though DOTs may still need to review historic maps and similar sources for additional investigations. Second, DOTs should not assume that the plan for managing the contamination of one project will fit another project; mitigation needs to be planned project by project. For example, the New Hampshire DOT's waiver for dewatering worked on one project but not on another. Next, it is important for DOTs to understand the differences between deposition methods (air, point source, etc.) and how PFAS contamination occurs to mitigate it appropriately.

Finally, the New Hampshire DOT finds that the best approach is to be proactive and responsible to the public.

Pennsylvania DOT

The Pennsylvania DOT was selected for a case example interview based on having formal policies at both the state and DOT levels. Pennsylvania DOT staff have been closely monitoring PFAS developments for more than 5 years.

Policy on Identifying and Mitigating PFAS Contamination

Several Pennsylvania DOT publications provide policy regarding PFAS identification and mitigation. Pennsylvania DOT Publication 281 is the *Waste Site Evaluation Procedures Handbook*, which provides environmental due diligence procedures for transportation improvement projects and procedures for the management of fill. This publication will be updated to align with best practices for PFAS contamination potential by highlighting firefighting training sources, airports, and military bases. Pennsylvania DOT Publication 611, Volume 1, is the *Waste Management Guidance Manual for Project Delivery*, which details what to do with contaminated materials encountered on projects.

Pennsylvania's Land Recycling and Environmental Remediation Standards Act governs remediation requirements, procedures, and regulations, as does 25 PA Code Chapter 250, but neither is specific to PFAS. Chapter 250 on the medium-specific concentrations (MSCs) used to demonstrate attainment of statewide health standards does discuss PFAS: This resource provides recent regulations that establish state drinking water MCLs for two PFAS compounds.

Pennsylvania's DEP has not established soil or groundwater MSCs for PFAS compounds to date. Nonetheless, suspected or known PFAS sites have been included in several environmental site assessments for transportation projects during that time (mostly airports and military bases

with well-equipped firefighter training areas). However, no projects have actually encountered PFAS contamination.

Screening for PFAS Contamination on Construction and Maintenance Sites

The Pennsylvania DOT's approach has been to first identify PFAS sources near projects and then determine the likelihood that contamination migrated to the project site. DEP does well sampling for PFAS and has prepared a supply well survey presenting areas of known contamination. The associated report and website (https://www.dep.pa.gov/Citizens/My-Water/drinking_water/PFAS/Pages/default.aspx) provide the Pennsylvania DOT with a valuable resource for identifying potential areas of contamination. The Pennsylvania DOT's current challenge is educating district offices in better understanding PFAS and potential contamination.

Methodologies for Mitigating PFAS Impacts

The Pennsylvania DOT has not yet encountered PFAS on a project. However, they have determined that mitigation would include removal of contaminated materials to landfills. PFAS are not yet in landfill permits in Pennsylvania, and the DOT does not believe PFAS will be identified as a hazardous material. If that is the case, disposal of PFAS-contaminated soils will remain possible at general landfills.

The Pennsylvania DOT noted a challenge in the disposal of dewatering fluids. The leachate can create issues for wastewater treatment facilities and lead to a circular issue of moving the contamination, which could result in future testing. Testing could limit disposal opportunities and create challenges for testing laboratories. Currently, only one laboratory in Pennsylvania is certified for PFAS testing, and testing can cost \$500 to \$1,000 per sample.

Identifying Materials or Containers That May Contain PFAS

The Pennsylvania DOT has not identified any materials containing PFAS that are used in construction projects or for maintenance operations.

Coordination and Communication Between State Agencies on PFAS

Some Pennsylvania DOT staff communicate with DEP, but these relationships do not exist across each agency. For instance, an interagency task force on PFAS is led by the DEP and involves the Pennsylvania Department of Health, but the DOT is not involved. While involvement might improve the coordination of PFAS efforts, the absence of policy and regulations might make involvement less critical. However, the Pennsylvania DOT would like to be proactive in addressing PFAS contamination.

PFAS Impacts on DOT Operations

The Pennsylvania DOT is aware of potential impacts of PFAS on operations but has not been affected to date.

Lessons Learned Regarding PFAS Identification and Mitigation

The Pennsylvania DOT noted that PFAS expertise is limited within their department, so relying on consultants and building relationships with DEP staff have been vital. The DOT found communication with DEP particularly useful, enabling them to gauge the direction of regulations

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and learn about PFAS-related tools. These tools included the EPA, PFAS Analytic Tools (<https://echo.epa.gov/trends/pfas-tools>), and DEP's supply well survey.

The Pennsylvania DOT also noted that although other chemicals have a structured approach to mitigation, the lack of PFAS regulations can lead to inaction. They have found that they need a DOT champion to take interest in being proactive about PFAS and stewardship. In the absence of regulatory standards, PFAS-contaminated soil could be used as clean fill. The Pennsylvania DOT does not want that to happen, and they aim to protect property owners, water supplies, and the general public.

Tennessee DOT

Responses to the survey from the Tennessee DOT indicated that the state has informal policies and guidance related to PFAS but that the DOT itself does not have any PFAS-related policies or guidance. The survey responses further indicated that the agency does not test for PFAS contamination, nor has it identified PFAS contamination in any construction or maintenance operations. To gain more details on Tennessee policies and considerations regarding PFAS at both the state and the agency levels, the synthesis team requested an interview with the Tennessee DOT.

Policy on Identifying and Mitigating PFAS Contamination

Tennessee's informal policies related to PFAS originate from the Tennessee Department of Environment and Conservation (TDEC). TDEC is unlikely to adopt formal state-level PFAS regulations until the U.S. EPA finalizes federal regulations. However, the state agencies' current policy involves monitoring the federal regulatory landscape and preparing for the possibility of PFAS regulations.

Tennessee DOT policies may be influenced by landfills instituting analytical requirements or restrictions on PFAS-containing waste. However, no such requirements yet exist for any landfills in the state.

Screening for PFAS Contamination on Construction and Maintenance Sites

The Tennessee DOT does not screen for PFAS on construction and maintenance sites. Based on previous uses of—and industry activity on—the Tennessee DOT's construction and maintenance sites, the agency does not believe that any of its sites are likely to be significantly contaminated by PFAS. For example, no Tennessee DOT sites are associated with large amounts of firefighting chemicals.

The agency expressed concern that, given the many PFAS that exist, any governmental regulations or guidance regarding landfills should clearly indicate which PFAS to screen for. The agency already screens for a long list of chemicals and values keeping that list as concise as possible.

Methodologies for Mitigating PFAS Impacts

The Tennessee DOT does not currently apply any environmental mitigation for PFAS impacts. In any future methodologies, contractors would play a large role in the evaluation of PFAS contamination. These contractors are at liberty to choose the analytical lab they employ for testing. The DOT expressed some concern that if nationwide regulations pertaining to DOTs were to go into effect, analytical labs may be unable to meet the increased demand. The agency has well-established mitigation protocols for other contaminants that would be relevant for developing PFAS-related protocols.

Identifying Materials or Containers That May Contain PFAS

The Environmental Division of the Tennessee DOT does not monitor or identify materials or containers that may have PFAS contamination. However, many of these chemicals are associated with airports and would therefore fall under the purview of the department's Aeronautics Division. The Aeronautics Division may have separate procedures related to PFAS.

Coordination and Communication Between State Agencies on PFAS

The Tennessee DOT has good communication with TDEC. There is no formal mechanism for TDEC to communicate regulatory changes to the Tennessee DOT; however, personnel at TDEC are cordial with DOT leadership and know to contact the DOT regarding any new regulations. Communications with TDEC occur via phone and e-mail, and TDEC is responsive to the Tennessee DOT's messages. Several contractors and Tennessee DOT employees formerly worked at state environmental agencies and can assist with communication or regulatory interpretation.

PFAS Impacts on DOT Operations

PFAS have not yet appreciably affected any Tennessee DOT operations. The agency is acutely aware of this family of chemicals and anticipates developing any new procedures after pending regulations on PFAS are finalized either by the U.S. EPA or landfills.

Lessons Learned Regarding PFAS Identification and Mitigation

If PFAS become federally regulated, the Tennessee DOT stated that they would like clear guidance on the implementation of identification and mitigation procedures.



CHAPTER 5

Summary of Findings

The findings of this synthesis highlight the following key conclusions regarding PFAS impacts and challenges in DOT construction and maintenance operations.

PFAS Impacts and Challenges

The extent of PFAS impacts on DOT construction and maintenance operations varies widely among states. For 23% (10/44) of responding DOTs, PFAS are a sufficiently pressing topic to garner specific departmental procedures, policies, or guidance to address in construction and maintenance. However, among the state DOTs that do have specific guidance, the majority—70% (7/10)—have informal procedures, policies, or guidance. Three responding DOTs indicated having formal PFAS-related procedures, policies, or guidance within their agency. Most states have no formal guidance or regulation related to PFAS within an agency other than their DOT. However, 39% of responding DOTs (17/44) indicated that their state does have formal or informal PFAS-related policies, procedures, or guidance.

Nonetheless, considerations of PFAS have affected many state DOTs. Of the responding DOTs, 21% (9/42) reported knowingly encountering PFAS contamination on projects or within right-of-way areas. Of those DOTs that had encountered PFAS contamination, 33% (3/9) indicated that they had established a precedent for managing PFAS impacts on projects. Active remediation or removal of PFAS-containing materials or media at construction, maintenance, or storage sites is being considered by 30% (11/37) of the responding state DOTs. Moreover, 11% (4/37) of these state DOTs conduct testing or chemical monitoring for PFAS contamination on construction or maintenance project sites. Costs for such testing are significant: All respondents reported paying at least \$200 per sample for PFAS testing. All the responding state DOTs use private or contract laboratories for PFAS testing, whereas one DOT mentioned also using public or state laboratories.

Despite the variability among DOTs in addressing PFAS in highway construction and maintenance, several consistent themes were evident across the survey respondents and case examples. All the case example participants articulated concerns about the general cost of managing the effects of PFAS on construction and maintenance projects. Other, more specific, themes have implications for how managing PFAS may affect project costs, timelines, and personnel commitments for highway construction and maintenance:

1. *Pending federal regulation.* Although the EPA recently proposed regulations on PFAS in drinking water, no federal regulations yet exist on groundwater, soils, or hazardous substance designations. More federal and state regulation of PFAS is widely anticipated. Of the DOTs interviewed in case examples, 88% (7/8) explicitly stated that they expect new federal or state regulations related to PFAS in the future. As a consequence, some DOTs are refraining from policy changes until federal regulations are finalized.

2. *Collaboration with state regulatory agencies.* Eighty-eight percent (7/8) of the DOT representatives interviewed in the case examples stated that communicating with state environmental agencies is crucial to help their DOT understand the changing PFAS regulatory landscape. However, the extent that DOTs communicate and collaborate with state environmental agencies varies. For example, 27% (11/41) of DOTs responding to the survey have action plans related to PFAS; of those plans, 45% (5/11) were developed with the involvement of the state DOT. Similarly, 50% (20/40) of responding states have an interagency group addressing human exposure to PFAS; of those, 40% (8/20) involve the state DOT.

Of the case example participants, 75% (6/8) indicated their belief that PFAS regulation will likely come—or has already come—from the state level in addition to the federal level, although the type and extent of anticipated regulations varied from state to state. The same percentage cited the benefit of communicating with state environmental agencies to be aware of regulatory changes.

3. *Restrictions on landfill disposal.* In addition to water and soil regulations, 27% (10/37) of survey respondents indicated that their DOT or contractors are subject to PFAS-related regulatory or receiving restrictions for landfilling materials. Further, 75% (6/8) of the case example participants mentioned concern about the cost and logistical challenges of disposing of PFAS-contaminated waste; the costs to ship PFAS-contaminated soils long distances to the landfills that accept such waste may be high. Of those DOTs, 83% (5/6) indicated that they had already experienced challenges because of PFAS restrictions from landfills. Among the case example participants, 38% (3/8) specifically articulated concerns about landfills that do not accept waste with any measurable PFAS, even if concentrations do not exceed background levels.

PFAS Contamination Identification and Mitigation

A substantial majority—78% (7/9)—of responding DOTs that have encountered PFAS require special management of soil or water when PFAS are detected on a project. Potentially as a consequence of these requirements, 38% (3/8) of case example respondents indicated that they only test for PFAS when they have other cause to believe PFAS are likely present, such as past PFAS-related activities or industries. These determinations are typically informed by databases of previous land uses or PFAS-related activities, frequently maintained by state environmental agencies.

Few DOTs identify materials or containers that may contain or be contaminated with PFAS. Eleven percent (4/37) of survey respondents have a DOT-specific procedure for identifying PFAS-containing materials, and 5% (2/37) of these state DOTs have procedures in place for identifying containers that may have held PFAS-containing materials. However, two case example DOTs (25%) mentioned their states having existing or pending policies to explicitly avoid acquiring PFAS-containing materials.

When identified, PFAS contamination might be mitigated through soil disposal or storage on-site. Two case example participants indicated that storage on-site was preferred and allowable under their current procedures. Nonetheless, specific regulations designating when and how contaminated soils can be moved and relocated vary. Among survey respondents, 27% (10/37) are subject to PFAS-related restrictions for landfilling, whereas 22% (8/37) are subject to restrictions for land application. One case example participant indicated that their DOT used granular activated carbon to remediate aqueous PFAS before water was discharged.

PFAS mitigation is not necessarily a legal requirement for some DOTs, even if they have PFAS-related policies. Three case example DOTs mentioned current or pending regulatory policies that will not hold DOTs responsible for contamination that the DOT did not cause,

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particularly if that contamination has migrated from properties outside the right-of-way. Of the survey respondents, 70% (26/37) do not consider active remediation of PFAS on sites, and 65% (24/37) do not consider liability for PFAS-related impacts in the acquisition, sale, maintenance, or disturbance of rights-of-way or project sites.

Sampling, Testing, and Screening Approaches

With regard to sites identified as likely locations of PFAS contamination, all survey respondents that screen for PFAS indicated that sampling occurs in the soil phase, although 75% (3/4) test water as well. Of the case example participants, two DOTs mentioned that sampling typically requires additional training in PFAS-related protocols for contractors, including how to avoid sample contamination. Testing may be performed by either commercial or state labs, although all survey respondents indicated that they employ commercial labs certified for performing standard EPA methods for PFAS analysis.

In addition to the need for specific training in sample collection, the cost of laboratory testing fees for PFAS is typically higher than for many other environmental contaminants, and processing times can be slower.

Knowledge Gaps and Further Suggested Study

Most of the survey and interview participants came from environmental backgrounds and divisions. Therefore, the knowledge gaps noted are presented from this context and with a primary focus on core DOT functions of construction and maintenance operations for highways. Nonetheless, firefighting foams, which are often found at airports, are a significant source of PFAS contamination; airports tend to fall outside the jurisdiction of environmental divisions and instead are the responsibility of aeronautical divisions. As such, separate but harmonized identification and mitigation procedures may be needed by the aeronautical divisions.

This synthesis identified a major knowledge gap related to the effects of PFAS contamination on DOT operations. There is no unified or comprehensive guidance document for DOTs outlining PFAS regulations from states, landfills, and the federal government; tools for identifying potential sources or likely sites of PFAS contamination; standard methods and protocols for chemical screening of contamination; and means for mitigating and remediating PFAS. Such a document would consolidate knowledge across jurisdictions and assist DOTs that have thus far not substantially altered their procedures to mitigate PFAS contamination.

The objective of suggested future study would be to provide DOTs with a reference document with technical guidance on the status of PFAS regulatory requirements and risks, current PFAS impacts on DOTs, identification of common sources of PFAS (e.g., airports, military bases, leaching from landfills), and a collection PFAS testing methods and notification requirements. Additionally, this suggested study could produce a general roadmap for PFAS impacts at DOTs. This roadmap would identify, strategize, and prioritize needs to address DOT-related issues of PFAS, including additional issues identified in this synthesis, such as rejected material at landfills, potential on-site material management strategies, and the DOT's role in PFAS mitigation.



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APPENDIX A

Survey Questionnaire

NCHRP Synthesis Topic 54-01 Survey

Start of Block: Introduction

NCHRP SYNTHESIS TOPIC 54-01 PRACTICES TO IDENTIFY AND MITIGATE PFAS IMPACTS ON HIGHWAY CONSTRUCTION PROJECTS AND MAINTENANCE OPERATIONS

Dear Department of Transportation (DOT) Environmental Compliance Professional,

The Transportation Research Board (TRB) is preparing a synthesis on **practices to identify and mitigate per- and polyfluoroalkyl substances (PFAS) impacts on highway construction projects and maintenance operations** via Project 20-05 administered by the National Cooperative Highway Research Program (NCHRP). This is being done under the sponsorship of AASHTO in cooperation with FHWA.

This survey of state DOTs is a primary means of gathering information for the synthesis on practices to identify and mitigate PFAS impacts. Typically, DOT staff within an environmental compliance office would be the appropriate person to fill out this survey since it asks detailed questions about PFAS-related policies and procedures. **If you are not the appropriate person to complete this survey, please forward it to the correct person at your agency.** We would greatly appreciate a response from your agency. The survey is being sent to each state DOT. Note that DOT survey responses will be shown in the published synthesis report. However, the identity of survey respondents will remain anonymous.

Please complete and submit this survey by Friday, February 24th, 2023. We estimate that it should take no more than 45 minutes to complete the survey. If your DOT does not have many PFAS-related policies, procedures, or guidance, your survey will be completed more quickly. If your agency does not have any policies or procedures related to PFAS, please identify yourself in the demographic section and complete the few survey questions to document your agency's status concerning PFAS-related policies and procedures, then submit your response. The survey is designed so you can exit and return to it if you need to complete your responses over several time intervals and/or days.

Thank you very much for your time and expertise!

End of Block: Introduction

Start of Block: Definitions

Definitions

The following definitions are intended to provide clarity around the terminology used to refer to PFAS:

PFAS (per- and polyfluoroalkyl substances): A class of at least 6,000 manmade chemicals whose structures contain carbon bonded to fluorine. Precise definitions vary, but practically encompass all compounds that contain multiple carbon–fluorine bonds and are used for their film-forming or water-, oil-, or grease-repellent properties, and their chemical precursors.

PFCs (perfluorocarbons): Colorless, odorless gases containing only fluorine and carbon. Occasionally this term is mistakenly applied to PFAS.

PFOA (perfluorooctanoic acid): The eight-carbon (or “C8”) perfluorinated alkyl carboxylic acid. This is a single member of the PFAS class. Due to the ubiquity of PFOA, it is sometimes mistaken for the entire PFAS class.

PFOS (perfluorooctane sulfonate): The eight-carbon (or “C8”) perfluorinated alkyl sulfonate. This is a single member of the PFAS class. Due to the similarity of their names and ubiquity of PFOS, it is sometimes mistaken for the entire PFAS class.

Total PFAS: Methods such as total organic fluorine (TOF) analysis or total oxidizable precursor (TOP) assay can quantify in aggregate nearly all PFAS in a sample, but do not differentiate individual chemical species.

End of Block: Definitions

Start of Block: Demographics

D1. Name:

D2. Title:

D3. E-mail:

D4. Phone Number:

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D5. Please select your state department of transportation (DOT) from the drop-down list.

- Alabama (1)
- Alaska (2)
- Arizona (3)
- Arkansas (4)
- California (5)
- Colorado (6)
- Connecticut (7)
- Delaware (8)
- District of Columbia (9)
- Florida (10)
- Georgia (11)
- Hawaii (12)
- Idaho (13)
- Illinois (14)
- Indiana (15)
- Iowa (16)
- Kansas (17)
- Kentucky (18)
- Louisiana (19)
- Maine (20)
- Maryland (21)

- Massachusetts (22)
- Michigan (23)
- Minnesota (24)
- Mississippi (25)
- Missouri (26)
- Montana (27)
- Nebraska (28)
- Nevada (29)
- New Hampshire (30)
- New Jersey (31)
- New Mexico (32)
- New York (33)
- North Carolina (34)
- North Dakota (35)
- Ohio (36)
- Oklahoma (37)
- Oregon (38)
- Pennsylvania (39)
- Puerto Rico (40)
- Rhode Island (41)
- South Carolina (42)

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- South Dakota (43)
 - Tennessee (44)
 - Texas (45)
 - Utah (46)
 - Vermont (47)
 - Virginia (48)
 - Washington (49)
 - West Virginia (50)
 - Wisconsin (51)
 - Wyoming (52)
-

D6. What division do you work for within your agency? Select the most appropriate response.

- Highway Design (1)
- Environmental (2)
- Permitting (3)
- Construction (4)
- Right-of-Way (5)
- Maintenance/Operations (6)
- Other (7) _____

End of Block: Demographics

Start of Block: PFAS Policies and Procedures

Q10 PFAS Policies and Procedures

Q11 Does your **state** (within an agency other than the DOT) have formal or informal procedures, policies, or guidance for identifying and/or mitigating locations of potential PFAS contamination?

- Yes, formal written procedures, policies, or guidance (Please attach or provide a link.) (1)
 - Yes, informal procedures, policies, or guidance (2)
 - No (3)
 - Unsure (4)
-

Display This Question:

If Q11 = Yes, formal written procedures, policies, or guidance (Please attach or provide a link.)

Or Q11 = Yes, informal procedures, policies, or guidance

Or Q14 = Yes, formal written procedures, policies, or guidance (Please attach or provide a link.)

Or Q14 = Yes, informal procedures, policies, or guidance

Q12 Upload written procedures, policies, or guidance here:

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Display This Question:

If Q11 = Yes, formal written procedures, policies, or guidance (Please attach or provide a link.)

Or Q11 = Yes, informal procedures, policies, or guidance

Or Q14 = Yes, formal written procedures, policies, or guidance (Please attach or provide a link.)

Or Q14 = Yes, informal procedures, policies, or guidance

Q13 Provide a link(s) to written procedures, policies, or guidance here:

Q14 Does your **DOT** currently have formal or informal procedures, policies, or guidance for identifying and/or mitigating locations of potential PFAS contamination?

- Yes, formal written procedures, policies, or guidance (Please attach or provide a link.) (1)
- Yes, informal procedures, policies, or guidance (2)
- No (3)

Q15 Has your agency ever knowingly encountered PFAS contamination on any project or existing right-of-way?

- Yes (1)
- No (2)

Display This Question:

If Q15 = Yes

Q16 Did that project/instance set a precedent for how to proceed with construction or maintenance?

Yes (1)

No (2)

Q17 Does your state have an action plan in place regarding PFAS contamination?

Yes (1)

No (2)

Display This Question:

If Q17 = Yes

Q18 Is/was your DOT involved in the development of that action plan?

Yes (1)

No (2)

Q19 Does your state have an interagency group to address minimizing human exposure to PFAS?

Yes (1)

No (2)

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Display This Question:

If Q19 = Yes

Q19a Is/was your DOT involved in that group?

Yes (1)

No (2)

Display This Question:

If Q14 != No

Q20 Do your DOT's procedures recommend or require any of the following methodologies for identifying and mitigating PFAS impacts related to highway construction and maintenance operations?

	Yes (1)	No (2)
Site screening (site inspection for potential PFAS contamination) (1)	<input type="radio"/>	<input type="radio"/>
Sampling of soils or water for PFAS contamination (2)	<input type="radio"/>	<input type="radio"/>
Geospatial tracking (GIS database of PFAS sources or contaminated sites) (3)	<input type="radio"/>	<input type="radio"/>
New and existing approved products list (to limit use of PFAS-containing materials) (4)	<input type="radio"/>	<input type="radio"/>
Pollutant source assessments (evaluation of nearby PFAS sources and potential PFAS migration) (5)	<input type="radio"/>	<input type="radio"/>
Regulatory restrictions to mitigate/limit PFAS use or contamination (6)	<input type="radio"/>	<input type="radio"/>
Other (7)	<input type="radio"/>	<input type="radio"/>

Display This Question:

If Q14 != No

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Q21 Do your DOT's procedures require special considerations for management and/or disposal of PFAS-contaminated soil or water from construction/maintenance projects?

Yes (1)

No (2)

Q22 Are there PFAS-related regulatory or receiving restrictions on any forms of material disposal for your DOT or their contractors?

	Yes (1)	No (2)
Environmental discharge (e.g., to surface or groundwater) (1)	<input type="radio"/>	<input type="radio"/>
Land application (e.g., to agricultural land) (2)	<input type="radio"/>	<input type="radio"/>
Landfilling (3)	<input type="radio"/>	<input type="radio"/>
Other (4)	<input type="radio"/>	<input type="radio"/>

Q23 Does your DOT consider liability for PFAS-related impacts in the acquisition, sale, maintenance, or disturbance of rights-of-way or project sites?

Yes (1)

No (2)

Q24 Does your DOT consider liability for PFAS-related impacts in the acquisition, use, or storage of materials?

- Yes (1)
- No (2)
-

Q25 Does your DOT consider active remediation or removal of PFAS-containing materials or media at DOT construction, maintenance, or storage sites?

- Yes (1)
- No (2)

End of Block: PFAS Policies and Procedures

Start of Block: Block 4

Q26 Construction and Maintenance Site Sampling

Q27 Does your DOT test or chemically monitor for PFAS contamination at any time on construction or maintenance project sites?

- Yes (1)
- No (2)
-

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Display This Question:

If Q27 = Yes

Q28 Which environmental media has your DOT screened for PFAS during construction or maintenance projects?

	Yes (1)	No (2)
Intact soil (native or fill) (1)	<input type="radio"/>	<input type="radio"/>
Spoil piles (2)	<input type="radio"/>	<input type="radio"/>
Waste soil (3)	<input type="radio"/>	<input type="radio"/>
Dewatered groundwater (4)	<input type="radio"/>	<input type="radio"/>
Stormwater runoff during project (5)	<input type="radio"/>	<input type="radio"/>
Stormwater conveyance after project (6)	<input type="radio"/>	<input type="radio"/>
Other (7)	<input type="radio"/>	<input type="radio"/>

Display This Question:

If Q27 = Yes

Q29 When does your DOT monitor and how frequently (check all that apply)?

- Before project award/baseline assessment (1)
- During project: Daily to weekly (2)
- During project: Less often than monthly (3)
- During project: Biweekly to monthly (4)
- After project completion (5)

End of Block: Block 4

Start of Block: Sample Evaluation

Q30 Sample Evaluation (Questions will not display if your DOT does not test for PFAS)

Display This Question:

If Q27 = Yes

Q31 What laboratory(s) do you use to conduct PFAS testing/measurements (check all that apply)?

- In-house (DOT) labs (1)
 - Private/contract labs (2)
 - Public/state labs (3)
 - Other (4) _____
-

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Display This Question:

If Q27 = Yes

Q32 What are your DOT's approximate costs associated with testing for PFAS contamination?

- High (>\$500 per sample) (1)
- Medium (\$200 to \$500 per sample) (2)
- Low (3)

Display This Question:

If Q27 = Yes

Q33 How quickly does your DOT typically receive PFAS testing results?

- Within 1 week of shipping sample (1)
- Within 3 weeks of shipping sample (2)
- Within 6 weeks of shipping sample (3)
- >6 weeks after shipping sample (4)

Display This Question:

If Q27 = Yes

Q34 How do the PFAS your DOT test for compare to state regulations?

- My state does not regulate any PFAS, but we test for some (1)
- We only test for those PFAS regulated by the state (2)
- We test for more PFAS than are regulated by the state (3)
- Unsure (4)

Display This Question:

If Q27 = Yes

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Q35 Which PFAS does your DOT monitor?

	Yes (1)	No (2)
PFOS and/or PFOA only (1)	<input type="radio"/>	<input type="radio"/>
The 18 species in EPA Method 537.1 for potable water (2)	<input type="radio"/>	<input type="radio"/>
The 25 species in EPA Method 533 for potable water (3)	<input type="radio"/>	<input type="radio"/>
The 24 species in EPA Method 8327 for nonpotable water and other environmental media (4)	<input type="radio"/>	<input type="radio"/>
The 40 species in Draft EPA Method 1633 for nonpotable water and other environmental media (5)	<input type="radio"/>	<input type="radio"/>
Total PFAS (e.g., total organic fluorine or total oxidizable precursors) (6)	<input type="radio"/>	<input type="radio"/>
Other (7)	<input type="radio"/>	<input type="radio"/>
Unsure (8)	<input type="radio"/>	<input type="radio"/>

End of Block: Sample Evaluation

Start of Block: Block 6

Q36 PFAS-Containing Materials

Q37 Does your DOT have a procedure for identifying PFAS-containing materials?

- Yes (1)
- No (2)
-

Q38 Does your DOT have a procedure for identifying containers which may have previously held PFAS-containing materials?

- Yes (1)
- No (2)
-

Display This Question:

If Q37 = Yes

Or Q38 = Yes

Q39 Does your DOT have a standard labeling protocol for materials or containers which may contain PFAS?

- Yes (1)
- No (2)
-

Display This Question:

If Q37 = Yes

Or Q38 = Yes

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Q40 Has your DOT identified materials/containers containing PFAS which it previously or actively uses?

Yes (1)

No (2)

Display This Question:

If Q40 = Yes

Q41 Are areas where these materials were used now monitored?

Yes (1)

No (2)

Q42 Does your DOT use or store any Class B or MilSpec firefighting foams (for example, at airports)?

Yes (1)

No (2)

Display This Question:

If Q42 = Yes

Q43 Are they labeled for PFAS content (select all that apply)?

- Yes, firefighting foams known to contain PFAS are labeled as such (1)
- Yes, firefighting foams known to be PFAS-free are labeled as such (2)
- Labeling of firefighting foams is inconsistent (3)
- No firefighting foam labeling regarding PFAS content (4)

End of Block: Block 6

Start of Block: Block 7

Q44 Follow-up

Q45 Are you willing to participate in a follow-up phone interview to gain additional insight into your DOT's PFAS-related practice for a case example in the final report? Your DOT will be identified but interviewee names will remain anonymous.

- Yes (1)
- No (2)

End of Block: Block 7



APPENDIX B

State DOT Survey Questionnaire Responses

Response by State

NCHRP Synthesis Topic 54-01 Survey

D6. What division do you work for within your agency? Select the most appropriate response.	
Highway Design	
Environmental	AK, AZ, AR, CA, CO, CT, GA, ID, IL, IA, KS, LA, ME, MD, MI, MN, MS, MO, MT, NE, NV, NH, NY, OH, OK, PA, RI, SC, SD, TN, TX, VA, WA, WV, WI, WY
Permitting	
Construction	
Right-of-Way	
Maintenance/Operations	FL
Other	AL, DE, IN, NM, NC, OR, UT

Answer	%	Count
Right-of-Way	0.0%	0
Permitting	0.0%	0
Other	15.9%	7
Maintenance/Operations	2.3%	1
Highway Design	0.0%	0
Environmental	81.8%	36
Construction	0.0%	0
Total	100%	44

D6. Other

Other—Text
Materials and Tests
Roadside Environmental Unit
Programs and Infrastructure
Materials and Pavement
Transportation Resiliency and Sustainability
Materials and Tests
HazMat Program (Env. Geology)

Q11. Does your state (within an agency other than the DOT) have formal or informal procedures, policies, or guidance for identifying and/or mitigating locations of potential PFAS contamination?

Yes, formal written procedures, policies, or guidance (Please attach or provide a link.)	AK, CA, ID, MI, MT, NH, PA, UT, WI
Yes, informal procedures, policies, or guidance	AZ, IL, LA, ME, MN, NM, NY, TN
No	AL, CO, CT, GA, ID, IA, MD, MS, MO, NE, NV, NC, OH, OK, OR, RI, SC, SD, VA, WA, WV, WY
Unsure	AR, DE, FL, KS, TX

Answer	%	Count
Yes, formal written procedures, policies, or guidance (Please attach or provide a link.)	20.5%	9
Yes, informal procedures, policies, or guidance	18.2%	8
No	50.0%	22
Unsure	11.4%	5
Total	100%	44

Q14. Does your DOT currently have formal or informal procedures, policies, or guidance for identifying and/or mitigating locations of potential PFAS contamination?

Yes, formal written procedures, policies, or guidance (Please attach or provide a link.)	PA, MT, WI
Yes, informal procedures, policies, or guidance	AK, IL, LA, ME, MI, MN, NH

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No	AL, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IN, IA, KS, MD, MS, MO, NE, NV, NM, NY, NC, OH, OK, OR, RI, SC, SD, TN, TX, UT, VA, WA, WV, WY
----	--

Answer	%	Count
Yes, formal written procedures, policies, or guidance (Please attach or provide a link.)	6.8%	3
Yes, informal procedures, policies, or guidance	15.9%	7
No	77.3%	34
Total	100%	44

Q12. Upload written procedures, policies, or guidance here:			
State	Document Name	File Name	Website
Arizona	Arizona Public Water System PFAS Toolkit	ADEQ PFAS toolkit.pdf	https://static.azdeq.gov/wqd/pfas/toolkit.pdf
Montana	MDT Environmental Manual, Chapter 44: Hazardous Materials/Substances	MONTANA_Procedures.pdf	https://www.mdt.mt.gov/publications/docs/manuals/env/Chapter%2044%20Hazardous%20Materials-Substances.pdf
Utah	Utah Department of Environmental Quality Sampling and Analysis Plan—Statewide PFAS Monitoring Phase I: Drinking Water Systems	DWQ-2020-020973.pdf	https://documents.deq.utah.gov/water-quality/standards-technical-services/sts-public-notices/DWQ-2020-020973.pdf

Q13. Provide a link(s) to written procedures, policies, or guidance here:		
State	Website Name	Website
Alaska	Alaska PFAS Information	https://dot.alaska.gov/airportwater/
Arizona	PFAS Resources	https://www.azdeq.gov/pfas-resources
California	San Diego Region—(PFAS): Per- and Polyfluoroalkyl Substances (PFAS)	https://www.waterboards.ca.gov/sandiego/water_issues/programs/pfas/index.html
Illinois		There have not been formal written procedures prepared at this time.
Montana	Program Overview: Per and Polyfluoroalkyl Substances	https://deq.mt.gov/cleanupandrec/Programs/pfas

Pennsylvania	DEP remediation regulations, 25 Pa Code Chapter 250: Pennsylvania Bulletin	pacodeandbulletin.gov
Pennsylvania	Chapter 250 statewide health standards: Statewide Health Standards	pa.gov
Pennsylvania	PennDOT Publication 281: Pub 281	state.pa.us
Tennessee	PFAS	https://www.tn.gov/environment/policy/pfas.html
Wisconsin	PFAS	https://dnr.wisconsin.gov/topic/PFAS
Wisconsin	Facilities Development Manual, Chapter 21: Hazardous Materials Investigation	https://wisconsindot.gov/rdwy/fdm/fd-21-00toc.pdf

Q15. Has your agency ever knowingly encountered PFAS contamination on any project or existing right-of-way?

Yes	AK, CO, IL, ME, MI, MN, NH, NY, OR
No	AL, AZ, AR, CA, CT, FL, GA, ID, IN, IA, KS, MD, MS, MO, MT, NE, NV, NM, NC, OH, OK, PA, RI, SC, SD, TN, TX, UT, VA, WA, WV, WI, WY

Answer	%	Count
Yes	21.4%	9
No	78.6%	33
Total	100%	42

Q16. Did that project/instance set a precedent for how to proceed with construction or maintenance?

Yes	AK, IL, ME
No	CO, MI, MN, NH, NY, OR

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Answer	%	Count
Yes	33.3%	3
No	66.7%	6
Total	100%	9

Q17. Does your state have an action plan in place regarding PFAS contamination?	
Yes	AL, AK, AR, CT, IL, MI, MN, MT, NH, UT, WI
No	AZ, CA, CO, FL, GA, ID, IN, IA, KS, ME, MD, MS, MO, NE, NV, NM, NY, NC, OH, OR, PA, RI, SC, SD, TN, TX, VA, WA, WV, WY

Answer	%	Count
Yes	26.8%	11
No	73.2%	30
Total	100%	41

Q18. Is/was your DOT involved in the development of that action plan?	
Yes	AK, CT, IL, MI, WI
No	AL, AR, MN, MT, NH, UT

Answer	%	Count
Yes	45.5%	5
No	54.5%	6
Total	100%	11

Q19. Does your state have an interagency group to address minimizing human exposure to PFAS?	
Yes	AK, AR, CA, CO, CT, IL, KS, ME, MI, MN, MT, NY, OH, OR, RI, TN, UT, VA, WA, WI
No	AL, AZ, FL, GA, ID, IN, IA, MD, MS, MO, NE, NH, NM, NC, PA, SC, SD, TX, WV, WY

Answer	%	Count
Yes	50.0%	20
No	50.0%	20
Total	100%	40

Q19a. Is/was your DOT involved in that group?	
Yes	AK, CT, IL, MI, MN, OH, WA, WI
No	AR, CA, CO, KS, ME, MT, NY, OR, RI, TN, UT, VA

Answer	%	Count
Yes	40.0%	8

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No	60.0%	12
Total	100%	20

Q20. Do your DOT's procedures recommend or require any of the following methodologies for identifying and mitigating PFAS impacts related to highway construction and maintenance operations?	
Site Screening (site inspection for potential PFAS contamination)	
Yes	AK, MI, MN, PA, WI
No	IL, ME, MT, NH
Sampling of soils or water for PFAS contamination	
Yes	AK, IL, MI, MN, NH, PA, WI
No	ME, MT
Geospatial tracking (GIS database of PFAS sources or contaminated sites)	
Yes	AK, ME, PA, WI
No	IL, MI, MN, MT, NH
New and existing approved products list (to limit use of PFAS-containing materials)	
Yes	AK, MI, MN
No	IL, ME, MT, NH, PA, WI
Pollutant source assessments (evaluation of nearby PFAS sources and potential PFAS migration)	
Yes	IL, ME, MI, MN, NH, PA, WI
No	AK, MT
Regulatory restrictions to mitigate/limit PFAS use or contamination	
Yes	AK, MI, MN, WI
No	IL, ME, MT, NH, PA
Other	
Yes	IL, MN, MT, WI
No	

Question	Yes		No		Total
Site screening (site inspection for potential PFAS contamination)	55.6%	5	44.4%	4	9
Sampling of soils or water for PFAS contamination	77.8%	7	22.2%	2	9
Geospatial tracking (GIS database of PFAS sources or contaminated sites)	44.4%	4	55.6%	5	9
New and existing approved products list (to limit use of PFAS-containing materials)	33.3%	3	66.7%	6	9
Pollutant source assessments (evaluation of nearby PFAS sources and potential PFAS migration)	77.8%	7	22.2%	2	9
Regulatory restrictions to mitigate/limit PFAS use or contamination	44.4%	4	55.6%	5	9
Other	100.0%	4	0.0%	0	4

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Q21. Do your DOT's procedures require special considerations for management and/or disposal of PFAS-contaminated soil or water from construction/maintenance projects?	
Yes	AK, ME, MI, MN, NH, PA, WI
No	IL, MT

Answer	%	Count
Yes	77.8%	7
No	22.2%	2
Total	100%	9

Q22. Are there PFAS-related regulatory or receiving restrictions on any forms of material disposal for your DOT or their contractors?	
Environmental discharge (e.g., to surface or groundwater)	
Yes	AK, CO, ME, MI, MN, NH, SD, UT, WI
No	AL, AZ, AR, CA, CT, FL, GA, ID, IL, IA, KS, MD, MS, MT, NE, NM, NY, NC, OH, OR, PA, RI, SC, TN, TX, VA, WA, WV
Land application (e.g., to agricultural land)	
Yes	CO, CT, ME, MI, MN, NH, SD, WI
No	AL, AK, AZ, AR, CA, FL, GA, ID, IL, IA, KS, MD, MS, MT, NE, NM, NY, NC, OH, OR, PA, RI, SC, TN, TX, VA, WA, WV
Landfilling	
Yes	CO, CT, IL, ME, MI, MN, MT, NH, SD, WI
No	AL, AK, AZ, AR, CA, FL, GA, ID, IA, KS, MD, MS, NE, NM, NY, NC, OH, OR, PA, RI, SC, TN, TX, VA, WA, WV
Other	
Yes	MT, SD, WA, WI
No	AZ, AR, FL, GA, ID, MD, MS, NE, NM, NY, NC, OH, RI, VA

Question	Yes		No		Total
Environmental discharge (e.g., to surface or groundwater)	24.3%	9	75.7%	28	37
Land application (e.g., to agricultural land)	22.2%	8	77.8%	28	36
Landfilling	27.8%	10	72.2%	26	36
Other	22.2%	4	77.8%	14	18

Q23. Does your DOT consider liability for PFAS-related impacts in the acquisition, sale, maintenance, or disturbance of rights-of-way or project sites?

Yes	AK, CO, IL, MN, MT, NH, NM, NY, PA, SD, UT, WA, WI
No	AL, AZ, AR, CA, CT, FL, GA, ID, IA, KS, ME, MD, MI, MS, NE, NC, OH, OR, RI, SC, TN, TX, VA, WV

Answer	%	Count
Yes	35.1%	13
No	64.9%	24
Total	100%	37

Q24. Does your DOT consider liability for PFAS-related impacts in the acquisition, use, or storage of materials?

Yes	AK, CO, IL, MI, MN, MT, NM, SD, UT, WA, WI
No	AL, AZ, AR, CA, CT, FL, GA, ID, IA, KS, ME, MD, MS, NE, NH, NY, NC, OH, OR, PA, RI, SC, TN, TX, VA, WV

Answer	%	Count
Yes	29.7%	11
No	70.3%	26
Total	100%	37

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Q25. Does your DOT consider active remediation or removal of PFAS-containing materials or media at DOT construction, maintenance, or storage sites?	
Yes	AK, CO, CT, MI, MN, MT, NH, PA, UT, WA, WI
No	AL, AZ, AR, CA, FL, GA, ID, IL, IA, KS, ME, MD, MS, NE, NM, NY, NC, OH, OR, RI, SC, SD, TN, TX, VA, WV

Answer	%	Count
Yes	29.7%	11
No	70.3%	26
Total	100%	37

Q27. Does your DOT test or chemically monitor for PFAS contamination at any time on construction or maintenance project sites?	
Yes	AK, IL, MN, NH
No	AL, AZ, AR, CA, CO, CT, FL, GA, ID, IA, KS, ME, MD, MI, MS, MT, NE, NM, NY, NC, OH, OR, PA, RI, SC, SD, TN, TX, UT, VA, WA, WV, WI

Answer	%	Count
Yes	10.8%	4
No	89.2%	33
Total	100%	37

Q28. Which environmental media has your DOT screened for PFAS during construction or maintenance projects?	
Intact soil (native or fill)	
Yes	AK, IL, MN, NH
No	

Spoil piles	
Yes	AK, MN
No	IL
Waste soil	
Yes	AK, MN, NH
No	IL
Dewatered groundwater	
Yes	AK, MN, NH
No	IL
Stormwater runoff during project	
Yes	
No	AK, IL
Stormwater conveyance after project	
Yes	
No	AK, IL
Other	
Yes	
No	

Question	Yes		No		Total
Intact soil (native or fill)	100.0%	4	0.0%	0	4
Spoil piles	66.7%	2	33.3%	1	3
Waste soil	75.0%	3	25.0%	1	4
Dewatered groundwater	75.0%	3	25.0%	1	4
Stormwater runoff during project	0.0%	0	100.0%	2	2

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Stormwater conveyance after project	0.0%	0	100.0%	2	2
Other	0.0%	0	0.0%	0	0

Q29. When does your DOT monitor and how frequently (check all that apply)?	
Before project award/baseline assessment	AK, IL, MN, NH
During project: Daily to weekly	
During project: Less often than monthly	
During project: Biweekly to monthly	
After project completion	

Answer	%	Count
Before project award/baseline assessment	100.0%	4
During project: Daily to weekly	0.0%	0
During project: Less often than monthly	0.0%	0
During project: Biweekly to monthly	0.0%	0
After project completion	0.0%	0
Total	100%	4

Q31. What laboratory(s) do you use to conduct PFAS testing/measurements (check all that apply)?	
In-house (DOT) labs	
Private/contract labs	AK, IL, MN, NH
Public/state labs	MN
Other	

Answer	%	Count
In-house (DOT) labs	0.0%	0

Private/contract labs	80.0%	4
Public/state labs	20.0%	1
Other	0.0%	0
Total	100%	5

Q32. What are your DOT's approximate costs associated with testing for PFAS contamination?	
High (>\$500 per sample)	AK,
Medium (\$200 to \$500 per sample)	IL, MN, NH
Low (<\$200 per sample)	

Answer	%	Count
High (>\$500 per sample)	25.0%	1
Medium (\$200 to \$500 per sample)	75.0%	3
Low (<\$200 per sample)	0.0%	0
Total	100%	4

Q33. How quickly does your DOT typically receive PFAS testing results?	
Within 1 week of shipping sample	
Within 3 weeks of shipping sample	AK, IL
Within 6 weeks of shipping sample	MN, NH
>6 weeks after shipping sample	

Answer	%	Count
Within 1 week of shipping sample	0.0%	0
Within 3 weeks of shipping sample	50.0%	2
Within 6 weeks of shipping sample	50.0%	2

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>6 weeks after shipping sample	0.0%	0
Total	100%	4

Q34. How do the PFAS your DOT test for compare to state regulations?	
My state does not regulate any PFAS, but we test for some	IL
We only test for those PFAS regulated by the state	AK
We test for more PFAS than are regulated by the state	MN, NH
Unsure	

Answer	%	Count
My state does not regulate any PFAS, but we test for some	25.0%	1
We only test for those PFAS regulated by the state	25.0%	1
We test for more PFAS than are regulated by the state	50.0%	2
Unsure	0.0%	0
Total	100%	4

Q35. Which PFAS does your DOT monitor?	
PFOS and/or PFOA only	
Yes	
No	IL
The 18 species in EPA Method 537.1 for potable water	
Yes	AK, IL
No	
The 25 species in EPA Method 533 for potable water	
Yes	
No	IL

The 24 species in EPA Method 8327 for nonpotable water and other environmental media	
Yes	
No	IL
The 40 species in Draft EPA Method 1633 for nonpotable water and other environmental media	
Yes	
No	IL
Total PFAS (e.g., total organic fluorine or total oxidizable precursors)	
Yes	
No	IL
Other	
Yes	MN, NH
No	IL
Unsure	
Yes	
No	

Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
PFOS and/or PFOA only	2.0	2.0	2.0	0.0	0.0	1
The 18 species in EPA Method 537.1 for potable water	1.0	1.0	1.0	0.0	0.0	2
The 25 species in EPA Method 533 for potable water	2.0	2.0	2.0	0.0	0.0	1
The 24 species in EPA Method 8327 for nonpotable water and other environmental media	2.0	2.0	2.0	0.0	0.0	1
The 40 species in Draft EPA Method 1633 for nonpotable water and other environmental media	2.0	2.0	2.0	0.0	0.0	1

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Total PFAS (e.g., total organic fluorine or total oxidizable precursors)	2.0	2.0	2.0	0.0	0.0	1
Other	1.0	2.0	1.3	0.5	0.2	3
Unsure	0.0	0.0	0.0	0.0	0.0	0

Question	Yes	No	Total
PFOS and/or PFOA only	0.0%	100.0%	1
The 18 species in EPA Method 537.1 for potable water	100.0%	0.0%	2
The 25 species in EPA Method 533 for potable water	0.0%	100.0%	1
The 24 species in EPA Method 8327 for nonpotable water and other environmental media	0.0%	100.0%	1
The 40 species in Draft EPA Method 1633 for nonpotable water and other environmental media	0.0%	100.0%	1
Total PFAS (e.g., total organic fluorine or total oxidizable precursors)	0.0%	100.0%	1
Other	66.7%	33.3%	3
Unsure	0.0%	0.0%	0

Q37. Does your DOT have a procedure for identifying PFAS-containing materials?	
Yes	AK, CO, CT, MT
No	AL, AZ, AR, CA, FL, GA, ID, IL, IA, KS, ME, MD, MI, MN, MS, NE, NH, NM, NY, NC, OH, OR, PA, RI, SC, SD, TN, TX, UT VA, WA, WV, WI

Answer	%	Count
Yes	10.8%	4
No	89.2%	33
Total	100%	37

Q38. Does your DOT have a procedure for identifying containers which may have previously held PFAS-containing materials?	
Yes	AK, CO
No	AL, AZ, AR, CA, CT, FL, GA, ID, IL, IA, KS, ME, MD, MI, MN, MS, MT, NE, NH, NM, NY, NC, OH, OR, PA, RI, SC, SD, TN, TX, UT, VA, WA, WV, WI

Answer	%	Count
Yes	5.4%	2
No	94.6%	35
Total	100%	37

Q39. Does your DOT have a standard labeling protocol for materials or containers which may contain PFAS?	
Yes	AK, CO
No	CT, MT

Answer	%	Count
Yes	50.0%	2
No	50.0%	2
Total	100%	4

Q40. Has your DOT identified materials/containers containing PFAS which it previously or actively uses?	
Yes	AK, CO, CT
No	MT

Answer	%	Count
Yes	75.0%	3
No	25.0%	1
Total	100%	4

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Q41. Are areas where these materials were used now monitored?	
Yes	CT
No	AK, CO

Answer	%	Count
Yes	33.3%	1
No	66.7%	2
Total	100%	3

Q42. Does your DOT use or store any Class B or MilSpec firefighting foams (for example, at airports)?	
Yes	AK, AZ, CO, CT, MI, MT, RI, TX, WA
No	AL, AR, CA, FL, GA, ID, IL, ME, MD, MN, MS, NE, NH, NM, NC, OH, OR, PA, SC, SD, TN, UT, VA, WV, WI

Answer	%	Count
Yes	26.5%	9
No	73.5%	25
Total	100%	34

Q43. Are they labeled for PFAS content (select all that apply)?	
Yes, firefighting foams known to contain PFAS are labeled as such	AK, CO, CT, MI, MT, TX
Yes, firefighting foams known to be PFAS-free are labeled as such	
Labeling of firefighting foams is inconsistent	RI, WA
No firefighting foam labeling regarding PFAS content	AZ

Answer	%	Count
Yes, firefighting foams known to contain PFAS are labeled as such	66.7%	6
Yes, firefighting foams known to be PFAS-free are labeled as such	0.00%	0
Labeling of firefighting foams is inconsistent	22.2%	2
No firefighting foam labeling regarding PFAS content	11.1%	1
Total	100%	9

Q45. Are you willing to participate in a follow-up phone interview to gain additional insight into your DOT's PFAS-related practice for a case example in the final report? Your DOT will be identified but interviewee names will remain anonymous.

Yes	AR, CA, CO, CT, IL, IN, KS, ME, MD, MI, MN, NE, NH, OH, OR, PA, SC, TN, VA, WA, WV
No	AL, AK, AZ, FL, GA, ID, IA, MS, MO, MT, NM, NY, NC, RI, SD, TX, UT, WI

Answer	%	Count
Yes	53.8%	21
No	46.2%	18
Total	100%	39



APPENDIX C

Case Example Interview Topics

NCHRP Synthesis 20-05 Topic 54-01

PRACTICES TO IDENTIFY AND MITIGATE PFAS IMPACTS ON HIGHWAY CONSTRUCTION PROJECTS AND MAINTENANCE OPERATIONS

State Department of Transportation Case Example Interview

The objective of NCHRP Synthesis 54-01 is to document current state department of transportation (DOT) practices for identifying locations of potential PFAS contamination and for mitigating the impacts of PFAS related to highway construction and maintenance operations. The synthesis will look at PFAS impact and mitigation efforts in all phases of highway project development (planning, design, right-of-way acquisition), construction, and maintenance activities. The synthesis will consider impacts to soil, groundwater, surface water, and stormwater.

1. Please describe your formal (or informal) policy and guidance regarding the identification and mitigation of locations with PFAS contamination.
2. How has your agency identified materials that may contain PFAS or that are cross-contaminated (e.g., containers with PFAS) used within construction currently or in the past?
3. How has your agency been screening for PFAS contamination on construction sites and what is the timing associated with these screenings?
4. Please describe your agency's methodologies for identifying and mitigating PFAS impacts related to highway construction and maintenance operations (e.g., site screening, sampling, geo tracker, new and existing approved product lists, management and disposal considerations, pollutant source assessments, regulatory restrictions, liability considerations, addressing legacy DOT right-of-way acquisitions with PFAS impact).
5. How has PFAS impacted operations at your agency?
6. Has there been sufficient coordination and communication between agencies in your state about PFAS?
7. Do you have lessons learned regarding PFAS identification and mitigation to share with other departments of transportation?

Abbreviations and acronyms used without definitions in TRB publications:

A4A	Airlines for America
AAAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI-NA	Airports Council International-North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FAST	Fixing America's Surface Transportation Act (2015)
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GHSA	Governors Highway Safety Association
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S. DOT	United States Department of Transportation

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