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# Superfund Health Risk Technical Support Center

## FY18 Annual Report
## October 2017 – September 2018


National Center for Environmental Assessment
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268

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## DISCLAIMERS

This report is intended to inform the public, Remedial Project Managers, On-Scene Coordinators, and Superfund Technology Liaisons of progress at the Superfund Health Risk Technical Support Center (STSC) involved sites, cutting-edge approaches, and STSC operations.

This document has been reviewed by the U.S. Environmental Protection Agency, Office of Research and Development, and approved for publication.

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The Superfund Health Risk Technical Support Center (STSC) is part of a core group of technical support centers and regional forums established and maintained under the Technical Support Project.

The STSC acknowledges the following individuals for their support in the preparation of Provisional Peer-Reviewed Toxicity Values (PPRTVs) and STSC technical responses during the 2018 Fiscal Year:

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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ATSDR | Agency for Toxic Substances and Disease Registry |
| U.S. EPA | United States Environmental Protection Agency |
| FY | fiscal year |
| HEAST | Health Effects Assessment Summary Tables |
| IRIS | Integrated Risk Information System |
| NCEA | National Center for Environmental Assessment |
| OLEM | Office of Land and Emergency Management |
| ORD | Office of Research and Development |
| OSRTI | Office of Superfund Remediation and Technology Innovation |
| p-IUR | provisional inhalation unit risk |
| p-OSF | provisional oral slope factor |
| PPRTV | provisional peer-reviewed toxicity value |
| p-RfC | provisional reference concentration |
| p-RfD | provisional reference dose |
| STSC | Superfund Health Risk Technical Support Center |

# INTRODUCTION

The primary goal of the Superfund Health Risk Technical Support Center (STSC) is to provide scientific technical support in the area of human health risk assessments for the Office of Land and Emergency Management (OLEM), state, and regional partners. The STSC is operated by the U.S. Environmental Protection Agency (EPA or Agency) Office of Research and Development's (ORD's) National Center for Environmental Assessment (NCEA) in Cincinnati, Ohio.

The STSC is one of five active technical support centers (TSCs) established as part of the Technical Support Project (TSP) partnership (Figure 1). In 1987, OLEM (formerly the Office of Solid Waste and Emergency Response [OSWER]), Regional Superfund Office, and ORD established the Superfund TSP to provide technical assistance to regional remedial project managers (RPMs) and on-scene coordinators. The TSP consists of a network of regional forums, the Environmental Response Team, and specialized TSCs.

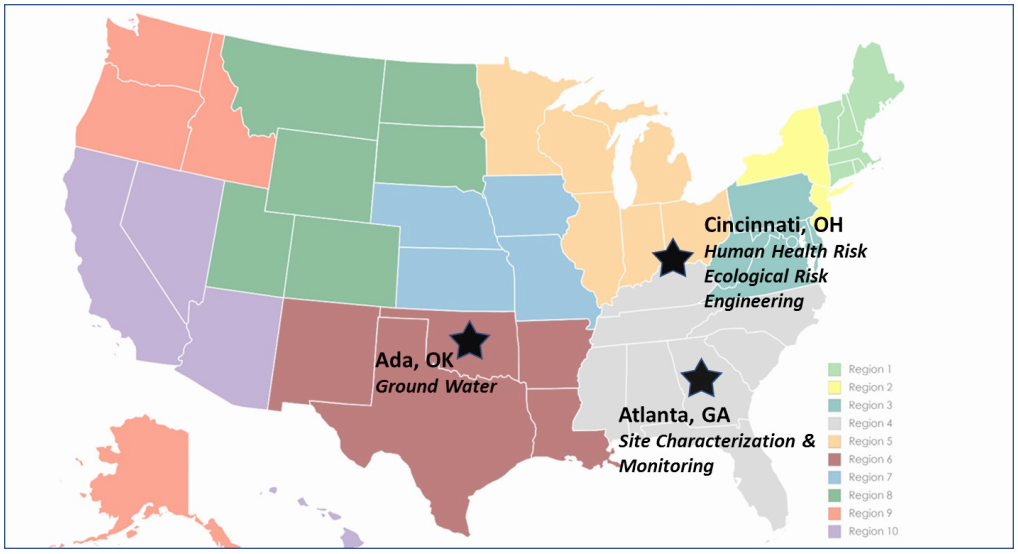


**Figure 1. Locations of ORD Technical Support Centers**

Each TSC has a specific focus of expertise and is dedicated to serving the EPA and its clients by supplying high-quality, quick-response, technical support services for contaminated sites. Clients of the STSC are scientific staff supporting the Superfund program. Specific clients include EPA regional scientists and risk managers, authorized contractors, state scientists, and others. The STSC performs two general functions to support the Superfund program: (1) preparation and distribution of Provisional Peer-Reviewed Toxicity Value (PPRTV) assessments and (2) scientific/technical consultations in support of states, EPA regional scientists, and associates regarding issues related to contaminated sites. This report provides an overview of these functions of the STSC and a selection of technical responses provided in FY2018.

# STSC ACCOMPLISHMENTS

In FY2018, the STSC provided technical support through the development and release of four PPRTV assessments and by responding to 32 technical requests from various EPA regions, state agencies, and international requestors.

The STSC support staff tracks requests and activities, including requestor and site information, initiation and completion dates, summaries of the requests, and hours associated with that request. The information is compiled into an internal tracking database.

## PROVISIONAL PEER-REVIEWED TOXICITY VALUE (PPRTV) ASSESSMENTS

The STSC's PPRTV Program supports the Agency's mission to protect human health and the environment by identifying and characterizing the health hazards of chemicals of interest to the Superfund Program. PPRTV assessments are an important source of toxicity information and toxicity values for use by OLEM. Derivation of PPRTVs for use by OLEM is necessary when such values are not publicly available elsewhere. PPRTV assessments provide provisional toxicity values (e.g., provisional oral reference doses [p-RfDs], inhalation reference concentrations [p-RfCs], and cancer risk values such as provisional oral slope factors [p-OSFs] and provisional inhalation unit risks [p-IURs]) for subchronic or chronic exposure to chemicals. Importantly, the information in PPRTV assessments can be used in combination with exposure metrics to characterize the public health risks of a given substance at a particular Superfund site. These risk characterizations can form the basis for risk-based decision making, regulatory activities, and other risk management decisions designed to characterize and protect human health.

PPRTVs are derived after a review of the relevant scientific literature and use Agency methodologies, practices, and guidance for the development of toxicity values. All PPRTV assessments receive internal review by EPA scientists and external peer review by independent scientific experts. For additional information on PPRTVs and the methodologies used, please refer to https://www.epa.gov/pprtv. PPRTV assessments are eligible to be updated as requested by the Agency to incorporate new data or methodologies that might impact the science and decisions used to derive provisional toxicity values, and are revised as appropriate.

In addition, screening PPRTVs can be derived in the appendix of a PPRTV assessment when the data do not meet all requirements for deriving a toxicity value in the main body. Screening values can be subchronic and chronic p-RfDs and p-RfCs, as well as p-OSFs and p-IURs. Screening PPRTVs are derived using the same methodologies and undergo the same development and review processes (i.e., internal and external peer review, etc.) as provisional values presented in the main body of an assessment. Users of screening PPRTVs are made aware that there is more uncertainty associated with the derivation of these values than for values presented in the main body of a PPRTV assessment.

The STSC, in consultation with OLEM's Office of Superfund Remediation and Technology Innovation (OSRTI), prioritizes candidate chemicals for PPRTV development. In FY2018, the STSC developed four PPRTV assessments, providing the Superfund Program with eight provisional toxicity values (Figure 2). Three of these provisional toxicity values were developed as screening values as a result of limited data that did not meet all the requirements for a toxicity value. Table 1 provides a list of each assessment as well as the type of value(s) derived in each assessment.

PPRTVs are publicly available for download from the "PPRTV Assessments Electronic Library" at https://www.epa.gov/pprtv.

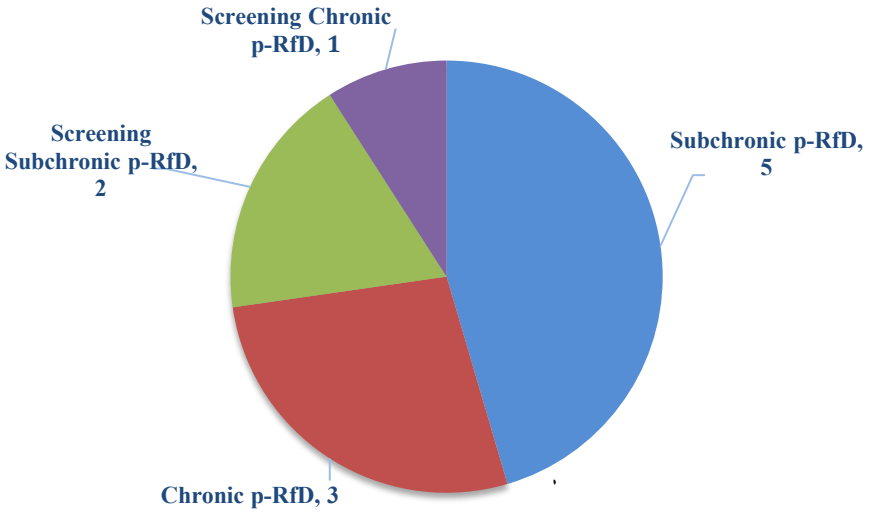


**Figure 2. Number and Description of Provisional Toxicity Values Derived in FY2018**

| Table 1. PPRTVs Developed in FY2018 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Assessment Information** | | | **Provisional Values Derived** | | | | | | |
| **Chemical** | **CASRN** | **New/ Update** | **Chronic p-RfD (mg/kg-d)** | **Subchronic p-RfD (mg/kg-d)** | **Chronic p-RfC ($mg/m^3$)** | **Subchronic p-RfC ($mg/m^3$)** | **p-IUR $(mg/m^3)^{-1}$** | **p-OSF $(mg/kg\text{-}d)^{-1}$** | **WOE Descriptor[b]** |
| Soluble Gadolinium | 7440-54-2 | Update | NDr | $4\times10^{-2}$ [a] | NDr | NDr | NDr | NDr | *Inadequate* |
| Soluble Lanthanum | 7439-91-0 | New | $5\times10^{-5}$ | $5\times10^{-5}$ | NDr | NDr | NDr | NDr | *Inadequate* |
| Soluble Lutetium | 7439-94-3 | Update | NDr | $4\times10^{-1}$ | NDr | NDr | NDr | NDr | *Inadequate* |
| Technical Toxaphene/Weathered Toxaphene | 8001-35-2 | New | $9\times10^{-5}/3\times10^{-5}$ [a] | $3\times10^{-4}/3\times10^{-5}$ [a] | NDr | NDr | IRIS value cited (U.S. EPA, 1988) | IRIS value cited (U.S. EPA, 1988) | *Inadequate* |

[a]Denotes a(n) screening/appendix value.
[b]Cancer WOE descriptors according to U.S. EPA *Guidelines for Carcinogen Risk Assessment* (U.S. EPA, 2005) are defined as:
*Carcinogenic = Carcinogenic to Humans; Likely = Likely to be Carcinogenic to Humans; Suggestive = Suggestive Evidence of Carcinogenic Potential; Inadequate = Inadequate Information to Assess Carcinogenic Potential; Not Likely = Not Likely to be Carcinogenic to Humans.*

CASRN = Chemical Abstracts Service registry number; FY = fiscal year; IRIS = Integrated Risk Information System; NDr = not determined; p-IUR = provisional inhalation unit risk; p-OSF = provisional oral slope factor; PPRTV = provisional peer-reviewed toxicity value; p-RfC = provisional reference concentration; p-RfD = provisional reference dose; WOE = weight of evidence.

The following section highlights the impact and scientific challenges addressed by a selection of FY2018 PPRTV assessments.

## PPRTVs for Technical Toxaphene, Weathered Toxaphene and Toxaphene Congeners - EPA Region 4

Throughout the mid-1940s, technical toxaphene was manufactured for use as an insecticide, piscicide, and pesticide. Mainly, toxaphene was utilized as pest control on cotton crops but it was also found to control pests in livestock and poultry, and other field crops (Figure 3). U.S. EPA canceled most of its uses in 1982 and completely canceled all uses in 1990. Terry Creek Superfund site near Brunswick, Georgia has been contaminated with technical toxaphene discharged from Hercules, Inc during its manufacturing for over 30 years. Though the former plant no longer produces toxaphene, toxaphene continues to be identified in exposure samples and questions are posed as to the potential hazard to human health. Without toxicity values to characterize the potential health hazard of technical toxaphene, EPA Region 4 was unable to set risk-based remedial goals or respond to community concerns about exposure. These concerns led to Office of Inspector General (OIG) recommendations on updating analytical methods and evaluating the risks of toxaphene exposure.


**Figure 3. 1951 Advertisement by Hercules Incorporated**
(Photo Credit: Science History Institute)

In its physical state, technical toxaphene is a waxy yellow solid and is composed of a complex mixture of hundreds of chlorinated terpenes. Once released into the environment, the congeners of technical toxaphene undergo transformations from abiotic and biotic processes which results in different mixtures of toxaphene congeners known as weathered toxaphene. As no noncancer toxicity values were publicly available for technical toxaphene, weathered toxaphene, or individual toxaphene congeners, the *Provisional Peer-Reviewed Toxicity Value assessment for Technical Toxaphene, Weathered Toxaphene, and Toxaphene Congeners (CASRN 8001-35-2) (EPA/690/R-18/002)* was developed. This PPRTV evaluated a complex database for technical toxaphene and derived subchronic and chronic provisional oral reference doses for technical toxaphene. In addition, it was concluded that the limited human and animal toxicity data that exists for weathered toxaphene and toxaphene congeners was insufficient to derive provisional oral reference doses for these compounds. Thus, additional approaches were considered for deriving screening provisional oral reference doses for these compounds leading to the derivation of

screening subchronic and chronic provisional oral reference doses for weathered toxaphene based on technical toxaphene (U.S. EPA, 2018d). This PPRTV provides a definitive assessment of the available science regarding toxaphene, weathered toxaphene, and toxaphene congeners, which had been an ongoing technical issue for the Region's project managers for more than a decade enabling Region 4 to establish risk-based screening levels for soil and fish, estimate potential risks for the ingestion pathway, and establish clean-up goals where potential risks for direct exposure via ingestion have been determined to be unacceptable.

## PPRTVs for Stable (Nonradioactive) Soluble Lanthanum - EPA Region 2

The metallic rare earth element lanthanum naturally occurs in the earth's crust. Lanthanum can be used during water treatment and lanthanum salts are used in electronic devices, pyrophoric alloys, rocket propellants, reducing agent catalyst for conversion of nitrogen oxides to nitrogen in exhaust gases, and phosphors in X-ray screens. Soluble lanthanum salts differ substantially from insoluble salts with respect to absorption, distribution, and elimination in the body. Therefore, the insoluble salts are not included in the PPRTV assessment.

**Figure 4. Remedial Excavation Commercial Site Properties**
(Photo Credit: Formerly Utilized Sites Remedial Action Program (FUSRAP) Maywood Superfund Site.)

From 1916 through 1955, Maywood Chemical Company processed radioactive thorium ore. Located in northern New Jersey, the chemical company generated several waste products from their process including lanthanum, lithium compounds, detergents, and alkaloids that have contaminated the local area. On-site remedial actions were initiated in the 1960s by the Stepan Company which bought Maywood Chemical Company; however, tests have revealed the lingering presence of lanthanum chemicals. The site is currently being addressed with Federal and Stepan Company action and EPA oversight (Figure 4). Because of the interest in potential health effects from the lingering contamination, a *Provisional Peer-Reviewed Toxicity Values assessment for Stable (Nonradioactive) Soluble Lanthanum (CASRN 7439-91-0)* was developed. This PPRTV assessment identified information sufficient for derivation of subchronic and chronic provisional reference values that informs risk associated with oral exposures (U.S. EPA, 2018b).

### PPRTVs for Stable (Nonradioactive) Soluble Lutetium and Stable (Nonradioactive) Soluble Gadolinium

In FY2018, two additional lanthanide series rare earth metals were evaluated, lutetium and gadolinium (Figure 5). The assessments pertain exclusively to stable soluble forms of the metals. In general, lanthanide salts of chloride, nitrate, and perchlorate are soluble, while salts of hydroxide, carbonate, phosphate, and fluoride are insoluble.

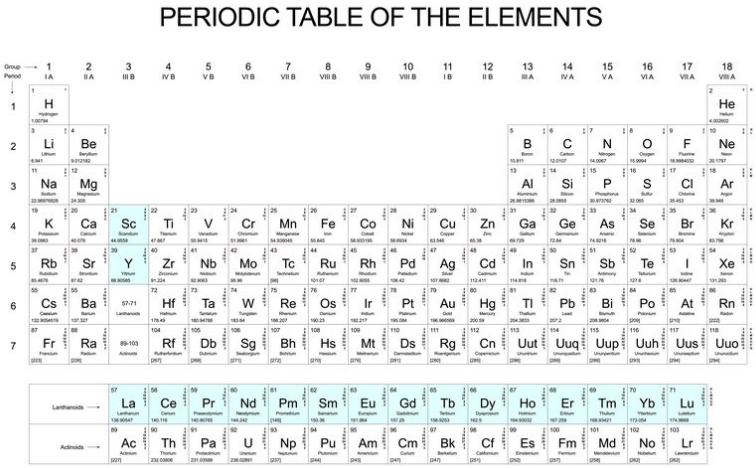


**Figure 5. Rare earth elements include the lanthanides, highlighted in blue**
(Photo Credit: pbs.org)

Lutetium occurs naturally in the earth's crust and is a soft, ductile, silvery-white metal that is stable in air and reacts slowly with water. The *Provisional Peer-Reviewed Toxicity Values assessment for Stable (Nonradioactive) Soluble Lutetium (CASRN 7439-94-3)* updated a PPRTV assessment for "Stable Lutetium" from 2007 based on recent scientific literature and current PPRTV assessment practices. The PPRTV assessment identified information sufficient for derivation of a subchronic provisional reference dose that informs risk associated with oral exposure (U.S. EPA, 2018c).

Gadolinium is a metallic element that is also found in the earth's crust and is a component of several minerals, including gadolinite and two commercially important minerals, monazite and bastnäsite. Gadolinium exhibits a high degree of magnetism, has superconductive properties, and is used in neutron shielding, in synthetic garnets to filter microwaves, as a phosphor activator, as a catalyst, and as a scavenger for oxygen in titanium production. The *Provisional Peer-Reviewed Toxicity Values assessment for Stable (Nonradioactive) Gadolinium (CASRN 7440-54-2) and Soluble Salts* updated a PPRTV assessment from 2007 based on recent scientific literature and current PPRTV assessment practices. Information available on the toxicity of oral exposure to soluble gadolinium was limited and uncertainties in the database led to not deriving provisional subchronic and chronic reference doses. However, to support the needs of the Superfund Program, a screening subchronic provisional reference dose was derived for soluble gadolinium that may be of use to risk assessors (U.S. EPA, 2018a).

## STSC HOTLINE REQUESTS

A second major function of the STSC is to provide technical support with human health risk assessments for the Superfund Program through the operation of the STSC Hotline. In FY2018, the STSC responded to 32 requests from various regions, state agencies, and international requestors (Figure 6). Of these 32 requests, 10 were site specific, 18 were answerable using

information from readily available sources (i.e., an Integrated Risk Information System [IRIS] reference, an active PPRTV, or other existing publication), and seven requests involved additional research.

In FY2018, 25 of the requests were for chemical-specific toxicity values. When this type of a request is made, the STSC searches a list of databases (e.g., CompTox Chemicals Dashboard, IRIS, PPRTV, and other generally accepted sources [HEAST, ATSDR, California EPA]) for available toxicity values and, if available, the STSC immediately provides the client(s) reference(s) to these sources. In other cases, the request to the STSC is to address specific technical needs related to risk assessments of contaminated sites. The following sections highlight a few requests that deal with chemical or site-specific needs and provide examples of the STSC's work.

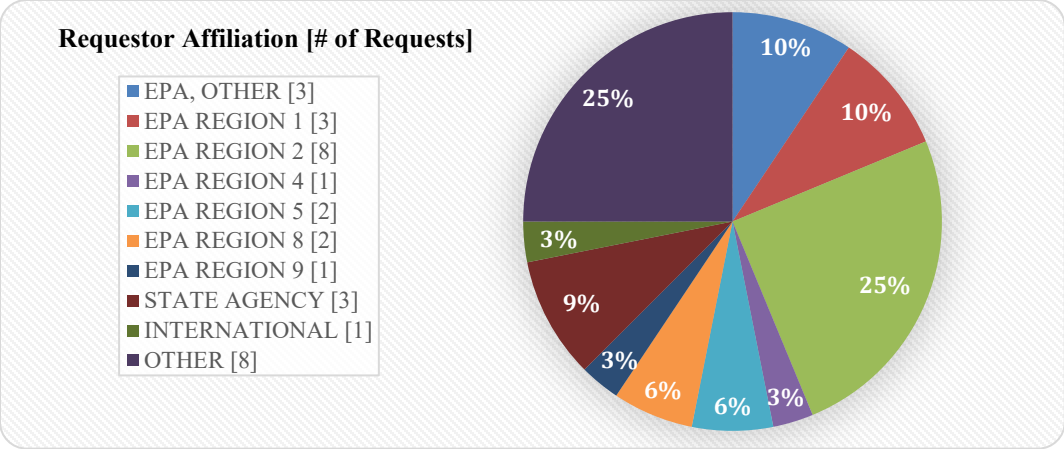


**Figure 6. FY2018 STSC Hotline Requestor Affiliation**

## Evaluation of Suitability of Chemical Surrogates

Traditional risk assessment practices rely on adequate and comprehensive toxicity studies, primarily in animals, for evaluation of potential human health hazards associated with chemical exposures. However, many chemicals of interest to Program Office and Regional partners do not meet the data requirements for conventional characterization of hazard and risk metrics. Consequently, these data-poor chemicals that do not have associated toxicity values, are not considered in the calculation of a hazard index, and do not inform cleanup levels. To address this data gap, a framework was designed to apply an expert-driven read-across approach for quantitative human health risk assessment (Wang et al., 2012). The innovative expert-driven read-across approach relies on the characterization of potential analogue chemicals in the context of structural, metabolic, and toxicity-like similarity to determine the suitability of proposed surrogates for the data-poor target chemicals. In FY2018, the STSC provided support using this approach to evaluate the appropriateness/suitability of analogue chemicals proposed as surrogates to support clean-up efforts of several data-poor target chemicals identified at Superfund sites. Examples of these STSC requests are below.

### *Chemical Surrogate Evaluation for Griffiss Air Force Base Superfund Site - EPA Region 2*

In FY2018, the EPA Region 2 requested an evaluation on the suitability of technical Endosulfan as a chemical surrogate for Endosulfan II for the assessment of noncancer oral toxicity at the Griffiss Air Force Base Superfund site located in Rome, New York.

Technical Endosulfan is a mixture of approximately 70% Endosulfan I and 30% Endosulfan II. Structural similarity evaluations conducted by the STSC team revealed commonalities in basic chemical features and physicochemical properties important for bioavailability for the Endosulfan-related chemicals. The team also deduced that technical Endosulfan and its individual components demonstrate toxicokinetic commonalities (including oxidation to a similar metabolic product that retains toxicity) and displayed similar acute toxicity potencies in available acute lethality studies. While the acute toxicity data could not be used to infer on the relative toxicity of Endosulfan-related chemicals in longer-term/chronic exposure, it increased confidence in the selection of the surrogate chemical and the application of the read-across approach. Ultimately, the team concluded that based on the weight of evidence, technical Endosulfan is considered a suitable surrogate for Endosulfan II.

At the same Superfund site, the STSC was asked to evaluate the suitability of technical chlordane as a chemical surrogate for *cis*- and *trans*-chlordane for the evaluation of oral noncancer toxicity. *Cis*- and *trans*-chlordane are isomers of chlordane, and major components of the technical and analytical chlordane mixtures. The team determined that these compounds share common metabolites; oxychlordane is the major toxic and bioaccumulative metabolite for both technical and analytical chlordane mixtures and the cis- and trans-isomers. The technical mixture and individual isomers share similar toxicities and target organs and exert similar acute effects at similar doses. In addition, other structurally-related chlorinated compounds including major components in the chlordane mixture show similar target organ toxicities. As such, the team concluded that technical chlordane was a suitable surrogate for *cis*- and *trans*-chlordane. This work was impactful because for this case and the technical Endosulfan case described above, Region 2 was able to use the information provided by the team with site-specific exposure

information to calculate a noncancer hazard index for the target chemicals to inform cleanup decisions, and to be assured that noncancer hazards were not underestimated.

### *Chemical Surrogate Evaluation for Nepera Chemical Company Superfund Site - EPA Region 2*

Region 2 contacted the STSC to evaluate the suitability of either 4-aminopyridine (4-AP) or pyridine as a chemical surrogate for 2-aminopyridine (2-AP) to aid in cleanup goal development at the Nepera Chemical Company Superfund site located in Hamptonburgh, New York. Structural analyses performed by the STSC team revealed clear similarities shared amongst 2-AP, 4-AP (structural isomer), and pyridine (shared ring structure). An extensive analysis performed by the team of metabolic processing of these three chemicals revealed no shared metabolites, but that toxicokinetics are expected to be similar among all three chemicals. Lastly, comparison of toxicity databases by the team suggested that toxicities of the central nervous system were likely to be shared amongst all three chemicals. The analysis performed by the team concluded that 4-AP can be considered an appropriate surrogate for 2-AP, and these efforts facilitated the development of cleanup values for a data poor chemical (2-AP) of high relevance to public safety at this site.

### *Chemical Surrogate Evaluation for Naval Weapons Station EARLE Superfund Site - EPA Region 2*

Region 2 contacted the STSC to evaluate surrogate suitability for four chemicals (1,3-dichlorobenzene, acenaphthylene, benzo[*ghi*]pyrene, and phenanthrene) found at the Naval Weapons Station EARLE Superfund site in Monmouth County, New Jersey (Figure 7). This information was requested to update a human health risk assessment and determine whether the cancer risks and noncancer hazards at this site were below the protection goal.

**Figure 7. Photo of Naval Weapons Station Earle (Site A) in Colts Neck, NJ**
(Photo Credit: EPA Superfund Website)

In the case of 1,3-dichlorobenzene, the team determined that 1,4-dichlorobenzene was an appropriate surrogate for longer duration oral and inhalation exposure. Additionally, a previously

unconsidered dichlorobenzene isomer (1,2- dichlorobenzene) was determined to be a more appropriate surrogate for acute exposures to 1,3-dichlorobenzene. For the other three chemicals of concern, the team developed a weight of evidence justification for each, which was informed by expert knowledge of the bay-region theory of polycyclic aromatic hydrocarbons to ensure that the proposed surrogate chemical was health protective in the context of reactive diol epoxide intermediate formation. Significantly, based on the identification and justification of suitable surrogate chemicals by the team, the risk assessment was completed, and a decision was rendered regarding the need for action at the Superfund site.

### Understanding Effects of Exposure to Foam Containing Per- and Polyfluoroalkyl substances (PFAS) in Michigan - EPA Region 5

In FY2018, the STSC and Engineering Technical Support Center (ETSC) collaborated on a request from EPA Region 5 to address a need from the Michigan Department of Environmental Quality (MDEQ). PFAS foam was identified on Van Etten Lake and Cedar Lake in Oscoda, MI near the former Wurtsmith Air Force Base Superfund Site (Figure 8). The ETSC provided assistance by compiling guidance for existing foam and surface water sampling procedures and analysis methods. The STSC aided in "understanding the potential human health implications of per- and polyfluoroalkyl substances (PFAS) in surface water and foam by dermal absorption, ingestion, and other modes of exposure".

**Figure 8. PFAS Foam in Michigan Water, EPA Region 5**
(Photo Credit: Michigan Department of Environmental Quality)

There are several classes of PFAS compounds and their toxicities vary based on both toxicokinetic and toxicodynamic properties. The potential human health effects following oral exposure to PFAS compounds have been studied more extensively than the potential health effects following dermal or inhalation exposures. For example, comprehensive evaluations of the oral health effects and toxicokinetics of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) have been released previously and can be referred to for further information, and results of previous literature searches conducted for information relevant to the characterization of human health effects of select PFAS compounds indicate the majority of available studies examine effects following oral exposure. With the availability of toxicity information for oral exposure to PFAS, to address the gap associated with other modes of exposure, the STSC conducted literature searches to identify and retrieve literature relevant to the toxicokinetics and health effects following dermal or inhalation exposure to PFAS compounds, including PFOA and PFOS. Few studies have evaluated the health effects of PFAS following dermal or inhalation exposure; however, the STSC summarized the evidence for informing human risk of exposure. In summary, the evidence suggested that some PFAS compounds are absorbed via the dermal and/or inhalation routes, indicating the potential for human health risk following exposure to contaminated surface water and/or foam (U.S. EPA, 2018e).

# SUMMARY

The technical support summarized in this report highlight the variety and impact of technical support provided by the STSC in FY2018. PPRTV assessments for four chemicals of interest to the Superfund Program and regional risk assessors were published, providing the Superfund Program with eight unique toxicity values. These newly derived toxicity values will be used to inform site screening and cleanup levels at Superfund sites across the United States.

In addition, the STSC responded to 32 requests to provide technical support to the Superfund Program in the area of human health risk assessments from various regions, state agencies, and international requestors through the operation of the STSC Hotline. The STSC serves a unique role to the Superfund Program community as a bridge between the site-specific regional risk assessors and the ORD risk assessors. Through the STSC Hotline, ORD scientists addressed the critical and time-sensitive needs of the regional scientists by activities such as providing toxicity values for chemicals of interest and evaluating suitability of chemical surrogates. As such, the STSC acted as a key part of the larger TSC Program in ORD that is dedicated to serving the EPA and its clients ultimately resulting in lasting differences in communities across the country and ensuring public health protection.

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