Chapter 3
Contaminants of Emerging Concern

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3.1 Introduction

Contaminants of Emerging Concern (CECs), sometimes referred to as Emerging Contaminants, can generally be categorized as contaminants that fall into one or more of the following scenarios: 1) the contaminants have only recently been discovered through limited testing that targets the contaminant; 2) the contaminants have only recently been discovered or detected due to improvements in analytical capability or detection limits; 3) the contaminants were known about but their environmental effects were not fully understood; or 4) the contaminants were known about, but new information has been generated regarding their risks. The new risk assessment has led to a greater concern over the safety of their presence in the environment.

The FSPM is designed to help parties responsible for conducting environmental sampling as part of requirements established by the New Jersey Department of Environmental Protection (NJDEP). CECs are not currently regulated or need regulatory reassessment and therefore the assessment and investigation of these contaminants can be difficult. Over time, the list of what is considered a CEC will change, new contaminants will be added, and other contaminants will be removed as testing becomes more common and regulatory standards are developed. This chapter of the FSPM was written to give additional information and considerations related to the sampling and analysis when a CEC is being investigated at a site.

The New Jersey Department of Environmental Protection (NJDEP) maintains a library of guidance manuals on its website at https://www.nj.gov/dep/srp/guidance/. It is recommended the reader access the website and review the guidance manuals pertinent to the respective task. Additional guidance may also be found at websites of the United States Environmental Protection Agency (USEPA) and the American Society for Testing and Materials (ASTM). Examples of some of the relevant guidance pertaining to this chapter are:

https://www.nj.gov/dep/srp/emerging-contaminants/

https://dep.nj.gov/pfas/

Emerging Contaminants - ITRC (itrcweb.org)

https://www.epa.gov/environmental-topics/chemicals-pesticides-and-toxics-topics

3.2 What is a Contaminant of Emerging Concern

3.2.1 What is a Contaminant of Emerging Concern

Contaminants of Emerging Concern (CECs) are those that present a concern for both hazard and exposure to public or ecological health, occur in the environment (e.g. media, substances, products) and are not currently regulated or need regulatory reassessment. CECs include substances and microorganisms including physical, chemical, biological, or radiological materials. They may be new or known contaminants and are considered a CEC due to a change in information including new analytical capabilities (methods or reporting limits), new toxicity/health effects information, new occurrence data, and/or new exposure information.

3.2.1.1 Existing Lists of Contaminants of Emerging Concerns

CECs can include various types of chemicals and pollutants, including but not limited to synthetic chemicals (e.g., per- and polyfluorinated alkyl substances (PFAS)), pharmaceuticals and personal care products (PPCPs), disinfectants, microplastics, microorganisms, and pesticides. The list of CECs

continually changes as additional research is conducted. Below are agency websites regarding emerging contaminants:

https://www.epa.gov/wqc/contaminants-emerging-concern-including-pharmaceuticals-and-personal-care-products

https://itrcweb.org/teams/active/cec

https://www.nj.gov/dep/srp/emerging-contaminants/

6PPD-Focus-Sheet-Web-Layout-9.pdf (itrcweb.org)

https://pfas-1.itrcweb.org/

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10753268/

3.2.2 Understanding Evolving Contaminants of Emerging Concern

The evolving development of candidate CECs for regulatory consideration represents a dynamic and multifaceted challenge in environmental science and public health. As the understanding of the occurrence of CECs increases with improvements in detection and laboratory analytical methods, new CECs are continually identified. Regulatory agencies, research groups, policy makers, and environmental groups strive to keep pace with this issue by understanding the impacts to human health and the environment, monitoring CECs, assessing their risk, and developing strategies for their management, and mitigation. Collaboration between the scientific community, industry, and government agencies is important in addressing the ever-changing spectrum of CECs and their effects on human health and the environment.

3.2.2.1 How Does a Chemical Become a Contaminant of Emerging Concern?

USEPA periodically evaluates chemicals as 'emerging contaminants' that are characterized by a perceived, potential, or real threat to human health or the environment based on preliminary health screening values, or lack of published health standards. A contaminant also may be 'emerging' because of a new exposure pathway to humans or a new synthetic chemical that has been detected in the environment or utilized commercially. Contaminants of emerging concern can include, but are not limited to, chemicals, personal care products, biota, pesticides, and pharmaceuticals. CECs also includes toxins produced by organisms or chemicals that are magnified up the food change and are detected in biota but not detected in the ambient environment. The USEPA and United States Geologic Survey (USGS) conduct surveillance studies to monitor the nations' water bodies and drinking water supply for contaminants of emerging concern. The USEPA convenes Science Advisory Boards and Working Groups to evaluate the environmental impacts of potential contaminants of emerging concern to determine if regulation is necessary.

Under the U.S. Clean Water Act (CWA) (33 U.S.C. Sections 1251-1387), the USEPA is required to take a number of actions to protect and restore the ecological integrity of the Nation's water bodies. Under Section 304(a) of the CWA, the USEPA must develop and publish ambient water quality criteria. The development of criteria for CECs is focused on chemicals that demonstrate a reasonable potential to adversely affect aquatic life. These criteria are based solely on data and scientific determinations on the relationship between environmental concentrations of the pollutant and its effects. These criteria do not consider social and economic impacts, or the technological feasibility of meeting the chemical concentration values in ambient water.

In 1985, the USEPA published the *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*. The Guidelines have provided uniformity and transparency in the derivation methodology of aquatic water quality criteria for a large number of compounds among several classes of chemicals. The term "contaminant of emerging concern" is being used within the USEPA Office of Water to replace "emerging contaminant," a term

that has been used loosely since the mid-1990s by the USEPA and others to identify chemicals and other substances that have no regulatory standard, have been recently "discovered" in natural streams (often the development of more sensitive analytical techniques with lower analytical chemistry detection levels), and potentially cause deleterious effects in aquatic life at environmentally relevant concentrations.

3.2.2.2 Substitute Compounds

Substitute compounds refer to chemical compounds or substances that emerge as alternatives to known contaminants, often as a response to regulatory actions or environmental concerns. This category typically arises when certain chemicals are phased out or regulated due to their detrimental impacts on human health and the environment. To address these concerns, industries and manufacturers may introduce substitute compound(s) that are believed to be less harmful. However, the emergence of these substitutes can give rise to new environmental and health concerns. Chemical review, occurrence studies, and development of sensitive analytical methods are critical to evaluating the potential risk(s) associated with substitute compounds, which are most often unregulated and not well understood.

3.2.2.3 Fate and Transport of CECs

Understanding the fate and transport of CECs through naturally occurring and/or remediation processes is critical to evaluating effects on water quality, soil, ecological receptors, and human health. For many CECs, little is known about fate and transport and/or degradation in the environment due to limited research or currently available information. Continued research is required to evaluate acute and chronic long-term effects of CECs and the degradation and/or secondary contaminants that may be generated.

3.2.3 Environmental and Health Impacts

CECs have raised concerns about potential impacts to human health and the environment due to their increasing prevalence and/or advances in analytical methods, instrumentation, and data analysis. These contaminants can include compounds that are suspected or known carcinogens or endocrine disruptors. Health effects of many CECs are still being studied. The evolving nature of CECs supports the need for ongoing research to further understand how these contaminants persist in the environment and affect various organisms.

3.2.3.1 New Toxicology Evaluations

The USEPA maintains the Integrated Risk Information System (IRIS) which provides information on the health effects of various chemicals and substances found in the environment. The IRIS assessments include toxicity values for chronic exposure to chemicals. Due to the limited information on CECs, the impact of long-term exposure to these substances requires additional research on their toxicological effects.

The USEPA IRIS guidelines, assessments, and documents can be found on the USEPA's website: https://www.epa.gov/iris. Additional information related to the health effects of the various chemicals can be found at Agency for Toxic Substances and Disease Registry (cdc.gov) and Provisional Peer-Reviewed Toxicity Values (PPRTVs) | US EPA.

The unregulated contaminant monitoring rule (UCMR) program was developed in response to the 1996 amendment to the Safe Drinking Water Act and the amendments by Section 2021 of America's Water Infrastructure Act of 2018 (AWIA) in coordination with the Contaminant Candidate List (CCL). The CCL is a list of contaminants that are not regulated by the National Primary Drinking Water Regulations, but are known or anticipated to occur in public water systems. Monitoring for unregulated contaminants occurs every 5 years for public water systems (PWS) with more than

10,000 service population and, if appropriations and sufficient laboratory capacity are available, monitoring can include smaller PWS. The analytical results of these efforts are archived in the National Contaminant Occurrence Database (NCOD). Many of the emerging contaminants that are present on the CCL spark New Jersey specific investigations of raw and finished drinking water, surface water, and ground water contaminants in the state. Hazardous algae bloom toxin method development and analysis, PFAS, and 1,4 dioxane investigations are just a few of the emerging contaminant investigations that have been or are actively being investigated. Each has their own specific sample collection, preservation, storage, and shipment procedures that should be considered.

The USEPA UCMR guidelines, assessments, and documents can be found on the USEPA's website: Monitoring Unregulated Contaminants in Drinking Water | US EPA.

3.3 History and Use of Site

A careful review of products used over the history of the site and potential release mechanisms could help identify emerging contaminants that should be considered in the development and design of the conceptual site model. Background/ambient concentrations should be considered when developing the conceptual site model. The conceptual site model and the sampling plan should be updated to address the occurrence of the CEC at the site if the review of the history and use of the site reveals a CEC was present. For further Preliminary Assessment requirements for historical searches please see the Preliminary Assessment (PA) Technical Guidance. CECs may not appear on safety chemical data sheets or active ingredients lists, and manufacturers may not be aware of the presence of CECs in the products they use in their manufacturing products.

3.4 Analytical Method and Remedial Standard Challenges

3.4.1 Analytical Method Selection Considerations

The analytical chemistry approach for a project should include consideration of several factors, such as target analyte list, sample preparation protocols, analytical instrumentation, analytical method, analytical sensitivity, laboratory accreditation or certification, Quality Control (QC) excursions, data of known quality protocols (DKQP), data quality objectives (DQOs), data usability review, evaluation, and validation plans. Practitioners should discuss these analytical chemistry factors with the laboratory in advance of sample collection. The laboratory should also be informed of the purpose of the sampling program, such as site screening, site characterization, final site remediation, or regulatory compliance monitoring. Below are examples of parameter specific guides for sampling.

Refer to ASTM E3302-23 for information on PFAS analytical methods selection considerations (https://www.astm.org/e3302-23.html).

Refer to the ITRC Technical Resources for Addressing Environmental Releases of 1,4-Dioxane (https://14d-1.itrcweb.org/#gsc.tab=0). This guide and related fact sheets include information on sample collection and analytical methods selection.

Refer to National Environmental Methods Index (nemi.gov) to find and compare analytical methods and field methods for all phases of environmental monitoring.

3.4.2 Analytical Methods Certification

Certification for analytical methods is determined by NJDEP Office of Quality Assurance (OQA) however not all CEC's will have certified analytical methods. The parameters and associated techniques and approved methods that are eligible for certification by the NJDEP OQA are listed in the Part III –

Analytical Testing Parameters form on the OQA website at: https://dep.nj.gov/dsr/oqa/. The current accreditation status of a laboratory can be checked by reviewing the laboratory's certificate and Annual Certified Parameters List (ACPL) issued by the NJDEP as listed on the NJDEP Data Miner website or by contacting the laboratory or the NJDEP OQA staff. Laboratories may report data under their NJ certification for analytical methods for which NJDEP OQA does not offer certification. If NJDEP offers certification for a method, a laboratory must obtain NJDEP certification for that method prior to reporting data for New Jersey projects. Laboratory modified method SOPs can be accepted for certification by petition to OQA through its Alternate Test Procedure approval process.

There may be a need to use analytical methods that are not OQA certified methods in occurrence studies to preliminarily identify CECs. These may be approved by OQA for research only if no regulatory assessment needs to be made and would typically be addressed through a Quality Assurance Project Plan (QAPP) with the program.

3.4.3 Analytical Interferences

The laboratory may experience a range of sample processing issues due to sample matrix interferences, elevated levels of target and non-target analytes, elevated levels of suspended solids present in aqueous samples, and elevated moisture levels present in solid sample matrices. These issues can cause decreased levels of analytical sensitivity, resulting in elevated reporting limit. This may require sample dilutions, re-extraction, and re-analysis, and reporting of results qualified with QC excursions.

3.5 General Sampling Considerations

Sampling CECs may differ from other sampling events due to the unknown nature of the contaminant. Therefore, special considerations should be taken when planning and conducting a sampling event.

3.5.1 Sampling Objectives

It is recommended that a project specific QAPP be developed before conducting any CECs sampling. The QAPP should include the analyte list, method of analysis, environmental matrices, and reporting limits, which are based on the project objectives.

3.5.2 Potential Cross Contamination

Potential sources of cross-contamination in a typical sampling environment can include water used during drilling or decontamination, materials used within the sampling environment, sampling equipment, field clothing and personal protective equipment (PPE), sun and biological protection products, personal hygiene and personal care products (PCPs), food packaging, and the environment itself. However, when sampling for a CEC the potential sources of cross-contamination may not be known. Sources of potential direct or indirect cross contamination should be identified and avoided when planning a sampling event via a robust sampling and analysis plan that includes collection of field quality control samples. For additional information refer to Chapter 2 of the FSPM.

A list of potential sources of cross-contamination for the specific CECs being sampled can be found at https://www.nj.gov/dep/srp/emerging-contaminants/. In addition, the sampler should identify the specific conditions under which CEC sampling needs to be performed.

The type of sampling equipment and supplies may also affect sampling results. The composition of sampling equipment and materials may positively or negatively bias a particular contaminant result and thereby not be appropriate. For example, low-density polyethylene (LDPE) materials should not be used for PFAS sampling due to adsorption and fluoropolymer materials should not be used due to potential leaching of PFAS into the sample.

3.5.3 Sampling Sequence

Sampling sequence should be planned in advance of the field sampling event. Sample collection should in general proceed from areas of concern that are known or suspected to be less impacted, and progress through from these low impact areas to medium impact areas to higher impact areas. In addition, potable water samples are typically collected first, before other environmental media are sampled. Potable water samples collected for CECs should be segregated from non-potable water, soil, sediment, sludge/biosolids, and waste sample media.

3.5.4 Decontamination Considerations

Decontamination is an important part of achieving reliable samples because some CECs have a greater potential for cross contamination. Equipment should be decontaminated prior to and at the end of a sampling event. See Chapter 5 for further decontamination guidance. If the previous user of the equipment is not known, and it is unclear how the equipment was handled, especially rental equipment, the equipment should be decontaminated prior to use. Decontamination procedures should be implemented to prevent cross-contamination, especially between individual sample locations. It is important to collect trip blanks and field blanks for CECs to evaluate adequacy of the decontamination procedures. See Chapter 2 for further information on trip and field blanks.

3.5.5 Investigation Derived Waste Disposal

Project planning should include consideration of disposal options for investigation derived waste (IDW). Typically, these wastes are containerized and stored on site until sampling results can be used to develop a waste profile for disposal facility approval.

Special consideration should be made for PFAS-impacted IDW, as some disposal facilities have banned acceptance of these wastes out of an abundance of caution. It is recommended that if PFAS contamination is known, potentially known, or suspected in the IDW generated, waste classification sampling is performed to evaluate appropriate handling and disposal options. PFAS IDW may also contain other contaminants which may complicate and/or limit disposal options. Some disposal facilities and/or treatment options may have limitations and restrictions such as the temporary prohibition of incineration of PFAS materials at US Department of Defense (DOD) sites. As such, the investigator and/or waste generator should discuss disposal options with a licensed waste hauler/facility to understand acceptance limitations and considerations. For more information refer to: ASTM E3274-21 - Standard Guide for Management of Investigation-Derived Waste Associated with PFAS (https://www.astm.org/e3274-21.html).

Supporting guidance and recommendations for PFAS IDW are included in the following:

ASTM – Technical Resources for Addressing Environmental Releases of Per- and Polyfluoroalkyl Substances (PFAS) – Section 10 – Site Characterization: https://pfas-1.itrcweb.org/10-site-characterization/

USEPA – Interim Guidance on Destroying and Disposing of Certain PFAS and PFAS-Containing Materials That Are Not Consumer Products: https://www.epa.gov/pfas/interim-guidance-destroying-and-disposing-certain-pfas-and-pfas-containing-materials-are-not