PFAS Update

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Interim Soil and Soil Leachate Remediation Standards for PFAS

- Interim Remediation Standards for soil and soil leachate were developed for PFNA, PFOA, PFOS, and GenX
- Publication in New Jersey Register October 17, 2022
- Remediation Standards (N.J.A.C. 7:26D)
  - Ingestion-Dermal Exposure Pathway
  - Inhalation Exposure Pathway
  - Migration to Ground Water Exposure Pathway
Interim Soil Remediation Standards (SRS)
Ingestion-Dermal Exposure Pathway

- SRS for PFNA, PFOA, PFOS, and GenX calculated using the procedures, risk-based equations, and default residential and nonresidential exposure parameters contained at N.J.A.C. 7:26D
- Oral toxicity information and risk assessment methods used to generate SRS are consistent with those used to develop the GWQS and MCLs for PFNA, PFOA, and PFOS. USEPA Office of Water Reference Dose used for GenX
- SRS are based on a Hazard Quotient of 1 for noncarcinogens and a 1 in one million lifetime cancer risk level, pursuant to the Brownfield and Contaminated Site Remediation Act (N.J.S.A. 58:10B-1 et seq.)
Interim Soil Remediation Standards
Inhalation Exposure Pathway

• Interim SRS for the inhalation exposure pathway have not been developed
  • Limited inhalation toxicity information
  • Inadequate chemical properties information
Interim Soil Remediation Standards
Migration to Groundwater Exposure Pathway

• Generic SRS-MGW for PFNA, PFOA, and PFOS cannot presently be calculated
• The calculation relies on the soil-water partitioning coefficient ($K_d$)
  • Up to a five order of magnitude difference in reported $K_d$ values
  • Complexity of PFAS-soil interactions
• SRS-MGW will be calculated on an AOC/site-specific basis using the Synthetic Precipitation Leaching Procedure (SPLP) as described in N.J.A.C. 7:26D
Interim Soil Leachate Remediation Standards
Migration to Groundwater Exposure Pathway

• SLRS-MGW for PFNA, PFOA, and PFOS calculated using the procedures, equations, and parameters contained at N.J.A.C. 7:26D
  • GWRS multiplied by the default dilution-attenuation factor (DAF) of 20
• SLRS-MGW are compared to field leachate concentrations calculated using the Department’s SPLP calculator
# Interim Soil and Soil Leachate Remediation Standards for PFAS

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>CAS No.</th>
<th>Soil Remediation Standard: Ingestion-Dermal Residential (mg/kg)</th>
<th>Soil Remediation Standard: Ingestion-Dermal Nonresidential (mg/kg)</th>
<th>Soil Remediation Standard: Migration to Ground Water (mg/kg)</th>
<th>Soil Leachate Remediation Standard: Migration to Ground Water (ppt)</th>
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<tbody>
<tr>
<td>PFNA</td>
<td>375-95-1</td>
<td>0.047</td>
<td>0.67</td>
<td>AOC/Site-specific</td>
<td>260</td>
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<tr>
<td>PFOA</td>
<td>335-67-1</td>
<td>0.13</td>
<td>1.8</td>
<td>AOC/Site-specific</td>
<td>280</td>
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<td>PFOS</td>
<td>1763-23-1</td>
<td>0.11</td>
<td>1.6</td>
<td>AOC/Site-specific</td>
<td>260</td>
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<tr>
<td>GenX</td>
<td>13252-13-6 &amp; 6203780-3</td>
<td>0.23</td>
<td>3.9</td>
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</table>
Interim Soil and Soil Leachate Remediation Standards Website

• https://www.nj.gov/dep/srp/guidance/rs/interim_soil_ia_rl_r_s.html
### Table of Interim Soil Remediation Standards for the Ingestion-Dermal Exposure Pathway

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>CAS No.</th>
<th>Non-Carcinogenic Health-Based Criterion (mg/kg)</th>
<th>Carcinogenic Health-Based Criterion (mg/kg)</th>
<th>Reporting Limit (mg/kg)</th>
<th>Interim Soil Remediation Standard (mg/kg)</th>
<th>Effective Date</th>
<th>Fact Sheet</th>
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<tr>
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<td>Residential Criterion</td>
<td>Nonresidential Criterion</td>
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There are currently no interim standards.

**Explanation of Terms:**
CAS No. = Chemical Abstracts System Registration Number

### Table of Interim Soil Remediation Standards for the Inhalation Exposure Pathway

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>CAS No.</th>
<th>Non-Carcinogenic Health-Based Criterion (mg/kg)</th>
<th>Carcinogenic Health-Based Criterion (mg/kg)</th>
<th>Soil Saturation Limit (mg/kg)</th>
<th>Reporting Limit (mg/kg)</th>
<th>Interim Soil Remediation Standard (mg/kg)</th>
<th>Effective Date</th>
<th>Fact Sheet</th>
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<td>Residential Criterion</td>
<td>Nonresidential Criterion</td>
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<td>Nonresidential Criterion</td>
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There are currently no interim standards.

**Explanation of Terms:**
CAS No. = Chemical Abstracts System Registration Number

### Table of Interim Soil Remediation Standards for the Migration to Ground Water Exposure Pathway

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>CAS No.</th>
<th>Ground Water Remediation Standard (µg/L)</th>
<th>Migration to Ground Water Soil Criterion (mg/kg)</th>
<th>Soil Saturation Limit (mg/kg)</th>
<th>Reporting Limit (mg/kg)</th>
<th>Interim Soil Remediation Standard (mg/kg)</th>
<th>Effective Date</th>
<th>Fact Sheet</th>
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<tr>
<td>Methanol</td>
<td>67-56-1</td>
<td>4,000</td>
<td>12</td>
<td>160,000</td>
<td>5</td>
<td>12</td>
<td>11/17/2021</td>
<td>April 2022</td>
</tr>
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</table>

**Explanation of Terms:**
CAS No. = Chemical Abstracts System Registration Number
Interim Soil Remediation Standards
Migration to Groundwater Exposure Pathway

• Generic SRS-MGW for PFNA, PFOA, and PFOS **cannot** presently be calculated

• The calculation relies on the soil-water partitioning coefficient ($K_d$)
  • Up to a five order of magnitude difference in reported $K_d$ values
  • Complexity of PFAS-soil interactions

• SRS-MGW will be calculated on an AOC/site-specific basis using the Synthetic Precipitation Leaching Procedure (SPLP) as described in N.J.A.C. 7:26D
Synthetic Precipitation Leaching Procedure (SPLP) and Soil Remediation Standards for the Migration to Ground Water Exposure Pathway

• National concern that PFAS adsorbs onto SPLP apparatus
• No empirical data existed to demonstrate efficacy of PFAS extraction using SPLP
• Lack of data makes using SPLP to develop SRS-MGW questionable
SPLP and Soil Remediation Standards for the Migration to Ground Water Exposure Pathway

Research

• CSRRP to determine if SPLP is a viable approach
• Design and coordinate a multi-laboratory research experiment
• Perform full validation and data review
• Conclude if SPLP could be used to establish site-specific SRS-MGW
SPLP Research Design
Laboratory Criteria

• Laboratories were chosen based on certification status
  • Certified for SPLP
  • Certified for user-defined non-potable water method
• Laboratories used their own methods for the study
• Methods were similar among the laboratories
  • SPLP
  • Analytical – 537.1 analyte list with isotope dilution
SPLP PFAS Research Design
Fortification Levels

• 5 different fortified/spiked leachate concentrations (containing PFOA, PFNA, PFOS, GenX and 14 additional PFAS), 3 duplicate analyses
  • 10 ng/L (n = 2)
  • 50 ng/L (n = 1)
  • 250 ng/L (n = 2)
  • 500 ng/L (n = 1)
  • 1000 ng/L (n = 2)
• Sample blank (0 ng/L)
SPLP Research Design
Methodology Overview

Sample Preparation

Leachate Fluid tumbled (16 – 20 hours)

Filtration of leachate fluid

Extraction of leachate fluid

Concentration of extract

After leachate fluid processing, MeOH rinse of equipment

Concentration of MeOH rinse

Analysis
PFOA, PFNA, PFOS, and Gen X Percent Recoveries (across 5 spike conc.)

Percent Recovery from SPLP Method Development: 5 spike concentrations

- Leachate % Recovery
- Rinse % Recovery

Analyte by Laboratory A, B, and C
SPLP Percent Recoveries for PFAS Leachate

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>CAS No.</th>
<th>10.0 ng/L</th>
<th>50.0 ng/L</th>
<th>250 ng/L</th>
<th>500 ng/L</th>
<th>1000 ng/L</th>
<th>Averages</th>
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</thead>
<tbody>
<tr>
<td>PFNA</td>
<td>375-95-1</td>
<td>98.2</td>
<td>82.9</td>
<td>93.6</td>
<td>96.3</td>
<td>94.0</td>
<td>93.0</td>
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<tr>
<td>PFOA</td>
<td>335-67-1</td>
<td>99.5</td>
<td>83.6</td>
<td>94.2</td>
<td>97.1</td>
<td>95.1</td>
<td>93.9</td>
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<tr>
<td>PFOS</td>
<td>1763-23-1</td>
<td>102.7</td>
<td>85.2</td>
<td>93.7</td>
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<td>93.7</td>
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<tr>
<td>GenX</td>
<td>13252-13-6 &amp; 6203780-3</td>
<td>100.7</td>
<td>83.9</td>
<td>91.9</td>
<td>107</td>
<td>91.2</td>
<td>94.9</td>
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</table>
## SPLP Percent Recoveries for PFAS MeOH Rinsate

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>CAS No.</th>
<th>Range</th>
<th>Averages</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFNA</td>
<td>375-95-1</td>
<td>0 – 7.7</td>
<td>2.6</td>
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<td>PFOA</td>
<td>335-67-1</td>
<td>0 – 9.6</td>
<td>1.4</td>
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<tr>
<td>PFOS</td>
<td>1763-23-1</td>
<td>0 – 13</td>
<td>4.4</td>
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<tr>
<td>GenX</td>
<td>13252-13-6 &amp; 6203780-3</td>
<td>0 – 9.8</td>
<td>1.1</td>
</tr>
</tbody>
</table>
Data indicate acceptable percent recoveries for PFOA, PFNA, and PFOS without having to modify the SPLP method.

Data indicate acceptable percent recoveries for GenX.

SPLP can be used to generate site-specific SRS-MGW using the ARS process.

Data and conclusions will be shared with other state agencies and EPA.
Questions?