# **Massachusetts Department of Environmental Protection (MassDEP)**

# **PFAS & Residuals Stakeholder Process**

# **Handouts for Meeting #1 September 29, 2020**

# **Definitions**

## AOS- Approval of Suitability

## Dry weight- The weight of a substance not including its moisture content

## EPA Regulations Title 40 Part 503 regulating biosolids, Classified as Class A or B Products

## Facility- Site or works for the treatment or storage of water, wastewater, septage or sludge

## Food-chain crop- Tobacco, any crop grown for human consumption, or any crop grown for consumption by animals which are to be consumed by humans

## Groundwater- Water below the land surface in a zone of saturation

## Groundwater table- The top of the saturated zone in the soil, as indicated by the level at which water stands in an open borehole after adequate time is allowed for the establishment of a stable water level

## Industrial discharge means discharge of wastewater consisting in whole or in part of industrial process waste

## Land application means fertilizing or amending soil by: (a) applying to the surface of soil by spreading, spraying, or other similar means, and/or (b) mixing or working into the soil or beneath the surface of the soil within the root zone of the crop by harrowing, plowing, rototilling, injecting, or other similar means

## MassDEP Regulation (310 CMR 32.00) include residuals land applied for reuse, Classified as Type I, II, or III products

## Pasture land- Land which is or is intended to be grazed by animals intended for human consumption, or whose milk is intended for human consumption, or land on which one or more forage crops are or are intended to be grown

## Potential groundwater public water supply means: (a) a groundwater source which has capability of sustaining a yield of 100 gallons or more per minute of drinking water, as designated by the United States Geological Survey Hydrological Atlas, and which has less than 10,000 ppm total dissolved solids, or (b) groundwater within land procured by a body politic for the purpose of supplying drinking water. The term potential groundwater public water supply does not include an aquifer which is not an underground source of drinking water pursuant to 310 CMR 27.00: Underground Water Source Protection

## Private drinking water supply well- A well used as a source of drinking water, supplying a non-public water system with any volume of groundwater from any source. Public water supply means a source of drinking water supplying a public water system

## Public water supply- A source of drinking water supplying a public water system. Public water system means a public water system as defined in 310 CMR 22.02, as may be amended from time to time

## Public water system- A public water system as defined in 310 CMR 22.02, as may be amended from time to time.

## Septage- liquid, solid, and semi-solid contents of privies, chemical toilets, cesspools, holding tanks, or other sewage waste receptacles. (The land application of hazardous waste is not authorized by 310 CMR 32.00 and is subject to 310 CMR 30.000.)

## Sludge- Solid, semi-solid, and liquid residue that results from a process of wastewater treatment or drinking water treatment. This residue does not include grit, screening, or grease and oil which are removed at the headworks of a facility. (The land application of hazardous waste is not authorized by 310 CMR 32.00 and is subject to 310 CMR 30.000.)

## Surface soil- The soil ordinarily moved in tillage or its equivalent in uncultivated soil, ranging in depth from four to ten inches below the surface, and frequently designated as the "plow layer" or the "Ap horizon".

## Surface water- Water that is visible on the ground surface, including, without limitation, streams, brooks, rivers, lakes, ponds, and wetlands

## Use- Land application or to land apply

# **Units Conversion Reminder**(often important for PFAS)

## **WATER**

|  |  |  |
| --- | --- | --- |
| (parts-per-million, ppm) | (parts-per-billion, ppb) | (parts-per-trillion, ppt) |
| 1 mg/L | = 1,000 µg/L | = 1,000,000 ng/L |
| 0.001 mg/L | = 1 µg/L | = 1,000 ng/L |
| 0.000001 mg/L | = 0.001 µg/L | = 1 ng/L |

## **SOIL**

|  |  |  |
| --- | --- | --- |
| (parts-per-million, ppm) | (parts-per-billion, ppb) | (parts-per-trillion, ppt) |
| 1 mg/kg | = 1,000 µg/kg | = 1,000,000 ng/kg |
| 0.001 mg/kg | = 1 µg/kg | = 1,000 ng/kg |
| 0.000001 mg/kg | = 0.001 µg/kg | = 1 ng/kg |

#  **310 CMR 32.00, MassDEP Residuals Regulations**

Since 2019 MassDEP has been requiring residuals to perform PFAS testing according to the following citation:

310 CMR 32.13(5)(c) Sampling and analysis shall include, ”any additional substance for which sampling and analysis is required by the Department, before or after the sludge or septage is approved by the Department pursuant to 310 CMR 32.11. Such a requirement may be either at the request of the board of health of a city or town in which sludge or septage is to be land applied or on the Department's own initiative upon review of information submitted in compliance with 310 CMR 32.13(1) and (2) or any other information.”

# 310 CMR 32 Acceptable Process for Additional Pathogen Reduction, Type I

32.81: Appendix B: Acceptable Processes for Additional Pathogen Reduction

Additional processes which will further reduce pathogens are listed below. The processes listed in 310 CMR 32.81(5), (6), and (7) are in addition to processes listed or described in 310 CMR 32.80.

(1) High Temperature Composting: A composting process using either the windrow, within-vessel, or static-aerated pile method; provided that whenever the windrow method is used, a composting temperature of not less than 55°C shall be continuously maintained for at least 15 days during the composting period, and that the windrow shall be turned at least five times during this 15-day period; and provided that whenever the static-aerated pile method or the within-vessel method is used, a composting temperature of not less than 55°C shall be continuously maintained for at least three consecutive days.

(2) Heat Drying: A process in which a dewatered sludge cake is dried by direct or indirect contact with hot gases, and the moisture content is reduced to 10% or lower. Sludge particles shall reach temperatures well in excess of 80°C, or the wet bulb temperature of the gas stream in contact with the sludge at the point where it leaves the dryer shall be in excess of 80°C.

(3) Heat Treatment: A process in which liquid sludge or septage is maintained at temperature of at least 180°C for at least 30 consecutive minutes.

(4) Thermophilic Aerobic Digestion: The process by which liquid sludge or septage is agitated with air or oxygen to maintain aerobic conditions at a residence time of ten days at 55°C through 60°C, and has a volatile solids reduction of at least 38%.

(5) Electron Radiation: A process in which sludge or septage is irradiated with electrons from an accelerator at dosages of at least 1.0 megarad at room temperature, i.e., approximately 20°C.

(6) Gamma Ray Irradiation: A process in which sludge or septage is irradiated with gamma rays from certain isotopes, such as Cobalt-60 or Cesium-137, at dosages of a least 1.0 megarad at room temperature, i.e., approximately 20°C.

(7) Pasteurization: A process in which sludge or septage is maintained for at least 30 continuous minutes at a temperature of not less than 70°C.

(8) Other Methods: Other methods or operating conditions may be deemed acceptable by the Department if the owner or operator can provide data showing that the pathogen and vector attraction of the volatile solids are reduced to an extent equivalent to the reductions achieved by any of the other methods listed in 310 CMR 32.81. Written approval of equivalency by the Department shall be required.

# 310 CMR 32 Acceptable Processes for Pathogen Reduction, Type II

32.80: Appendix A: Acceptable Processes for Pathogen Reduction

Acceptable processes which will significantly reduce pathogens are:

(1) Aerobic Digestion: A process during which sludge or septage is broken down by bacteria by agitating the sludge or septage, mixing it with air or oxygen, and maintaining residence times ranging from 60 days at 15°C to 40 days at 20°C, with a volatile solids reduction of at least 38%.

(2) Air Drying: A process in which sludge or septage is allowed to drain and/or dry on under-drained sand beds, or paved or unpaved basins in either of which the sludge or septage is at a maximum depth of nine inches. This process is acceptable only if it occurs for at least three months during which temperatures must average, on a daily basis, above 0°C for two months.

(3) Anaerobic Digestion: A process during which sludge or septage is broken down by bacteria in the absence of oxygen at residence times ranging from 60 days at 20°C to 15 days at 35°C through 55°C, with a volatile solids reduction of at least 38%.

(4) Low Temperature Composting: A composting process using the within-vessel, static aerated pile, or windrow methods. For all three methods, the composting temperature shall be not less than 40°C for five consecutive days, and not less than 55°C during four hours of this five day period.

(5) Lime Stabilization: A process in which lime is added to sludge or septage to produce a pH of 12 after two hours of contact with the sludge or septage.

(6) Other methods: Other methods or operating conditions may be deemed acceptable by the Department if the owner or operator can provide data showing that the pathogen and vector attraction of the volatile solids are reduced to an extent equivalent to the reductions achieved by any of the other methods listed above in 310 CMR 32.80. Written approval of equivalency by the Department shall be required.

# 310 CMR 32 Type I Limits

TABLE 32.12(2)(a)

|  |  |
| --- | --- |
| **Heavy Metals or Chemicals** | **Maximum Allowable Concentration in Parts Per Million Dry Weight** |
| Cadmium | 14 |
| Lead | 300 |
| Nickel | 200 |
| Zinc | 2500 |
| Copper | 1000 |
| Chromium (Total) | 1000 |
| Mercury | 10 |
| Boron (water soluble) | 300 |
| Molybdenum | 40 |
| PCBs in Type I sludge which is a commercial fertilizer pursuant to 3l0 CMR 32.11(6) | 2 |
| PCBs in Type I sludge which is soil conditioner pursuant to 310 CMR 32.11(6) | 1 |

# 310 CMR 32 Type II Limits

TABLE 32.12(2)(b)

|  |  |
| --- | --- |
| **Heavy Metals or Chemicals** | **Maximum Allowable Concentration in Parts Per Million Dry Weight** |
| Cadmium | 25 |
| Lead | 1000 |
| Nickel | 200 |
| Zinc | 2500 |
| Copper | 1000 |
| Chromium (Total) | 1000 |
| Mercury | 10 |
| Boron (water soluble) | 300 |
| PCBs | 10 |
| Molybdenum | 40 |

# **Vermont Background- Additional Information:**

# **VT Soil “Background” PFAS Concentrations**

PFAS Background in Vermont Shallow Soils, February 8, 2019

Authors: Wenyu Zhu, PhD, Postdoctoral Associate, Civil and Environmental Engineering, University of Vermont; Harrison Roakes, PE, Project Manager, Sanborn, Head & Associates, Inc.; and Appala Raju Badireddy, PhD, Assistant Professor, Civil and Environmental Engineering, University of Vermont

Contact email: raju.badireddy@uvm.edu

Units: ng/kg



# **MCP Additional Information:**

# **MCP Method 1 Groundwater Standards** 310 CMR 40.0974(2)

## GW-1 (drinking water):                20 ng/L

## GW-2 (vapor intrusion):             “NA”  (PFAS not particularly volatile)

## GW-3 (discharge to surface water)PFAS-specific, ranging from:                         0.5 – 40 mg/L

# **MCP Method 1 Soil Standards**310 CMR 40.0975(6)(a)-(c)

## Video description of the derivation of the Soil Standards:<https://youtu.be/CSsjcnGfKCg> (MassDEP’s YouTube channel)

## S-1, S-2 & S-3 (residential -> industrial/isolated)

## Based on direct exposure to soil & background andconsidering leaching to groundwater

## PFAS-specific, ranging from 300 – 400,000 ng/kg

# **MCP Method 2 Soil Standards** (310 CMR 40.0985(6))

## S-1, S-2 & S-3 (residential -> industrial/isolated)

## Based on direct exposure ONLY (leaching to groundwater must be specifically assessed)

## PFAS-specific, ranging from 0.3 – 0.4 mg/kg

# **MCP Method 3 Upper Concentration Limits (UCLs) in Soil & Groundwater**(310 CMR 40.0996(6))

## UCLsoil – PFAS-specific, 4 mg/kg

## UCLgroundwater – PFAS-specific, ranging from 5 – 100 mg/L

# **MCP PFAS Notification Criteria & Cleanup Standards**

## Specific Toxicity Values to use for PFAS in Method 3 Site-Specific Risk Assessments, 310 CMR 40.09993(6)

## Reference Dose (RfD): 5E-06 mg/kg/day

## Reportable Concentrations in Groundwater (RCGW), 310 CMR 40.1600

## RCGW-1: Triggers notification/action in areas protected for current or future use as drinking water source

##  VALUES: Sum of 6 PFAS, 20 ng/L

## RCGW-2: Triggers notification/action everywhere else

##       VALUES: PFAS-specific, ranging from 500,000 –      40,000,000 ng/L

## Reportable Concentrations in Soil (RCS), 310 CMR 40.1600

##  RCS-1: Triggers notification/action near residences, schools, etc...

##  VALUES: PFAS-specific, ranging from 300 - 2,000 ng/kg

## RCS-2: triggers notification/action everywhere else VALUES: PFAS-specific, each 400,000 ng/kg

# **MCP PFAS**

|  |  |  |  |
| --- | --- | --- | --- |
|  | S-1 Soil | S-2 Soil | S-3 Soil |
|  | & GW-1ng/kg (ppt) | & GW-2ng/kg (ppt) | & GW-3ng/kg (ppt) | & GW-1ng/kg (ppt) | & GW-2ng/kg (ppt) | & GW-3ng/kg (ppt) | & GW-1ng/kg (ppt) | & GW-2ng/kg (ppt) | & GW-3ng/kg (ppt) |
| Per- and Polyfluoroalkyl substances (PFAS) (sum of concentrations of the 6 PFAS listed below) | - | - | - | - | - | - | - | -- | - |
| Perfluorodecanoic acid (PFDA) | 300 | 300,000 | 300 | 400,000 | 300 | 400,000 |
| Perfluoroheptanoic acid (PFHpA) | 500 | 500 | 500 |
| Perfluorohexanesulfonic Acid (PFHxS)   | 300 | 300 | 300 |
| Perfluorononanoic Acid (PFNA) | 320 | 320 | 320 |
| Perfluorooctanesulfonic Acid (PFOS)  | 2,000 | 2,000 | 2,000 |
| Perfluorooctanoic Acid (PFOA) | 720 | 720 | 720 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | GW-1 Standardng/L (ppt) | GW-2 Standardng/L (ppt) | GW-3 Standardng/L (ppt) |
| Per- and Polyfluoroalkyl substances (PFAS) (sum of concentrations of the 6 PFAS listed below) | 20 | N/A | - |
| Perfluorodecanoic acid (PFDA) | See PFAS | N/A | 40,000 |
| Perfluoroheptanoic acid (PFHpA) | See PFAS | N/A | 40,000 |
| Perfluorohexanesulfonic Acid (PFHxS)   | See PFAS | N/A | 500 |
| Perfluorononanoic Acid (PFNA) | See PFAS | N/A | 40,000 |
| Perfluorooctanesulfonic Acid (PFOS)  | See PFAS | N/A | 500 |
| Perfluorooctanoic Acid (PFOA) | See PFAS | N/A | 40,000 |

# **Maine Methodology for PFAS Screening Levels in Residuals**

# Maine Department of Environmental Protection, 06-096 Solid Waste Management Rules Chapter 418, Beneficial Use of Solid Wastes

|  |  |
| --- | --- |
| Chemical | Soil Concentration (ng/kg) |
| Perfluorobutane sulfonic acid (PFBS) | 1,900,000 |
| Perfluorooctane sulfonate (PFOS) | 5,200 |
| Perfluorooctanoic acid (PFOA) | 2,500 |

# Based on leaching model results with target of 205 ppt PFOS and PFOA in groundwater

* In 2019 Maine used this approach to become the first state to regulate PFAS in residuals

Calculation of screening values on residuals:

1. MEDEP requested **application rate** and **percent solids** from residuals provider (e.g., one producer provided the following **4.25 wet tons/ acre** and **94% Solids**)
2. Loading Rate using MEDEP Ch 419 conversions:

D. Common Conversions

 (1) Dry tons / acre \* 2.24 = Dry metric tons/hectare

 (2) Wet tones \* (% solids \* 0.01) = Dry Tons

Example – Conversion of loading rate:

4.25 wet tons/acre x .94 x 2.24 = 8.95 dry metric tons/hectare

**Maine's Solid Waste Management Rules: Agronomic Utilization of Residuals, Chapter 419, Appendix A**

SI = (RPc \* LR \* SL) / (2000)

Where:

SI – Cumulative soil concentration increase in mg-pollutant/kg-soil

RPc – Pollutant concentration in the residual in mg-pollutant/kg-residual

LR – Residual loading rate in mt-residual/ha/yr (amount of residual applied in a year)

SL – Site Life, or the number of times the residual will be applied at the site in 100 years, in years.

2000 – is the assumed dry mass of soil in mt/ha (dry weight) in a plow layer 15 cm thick (based on a bulk density of 1.33 g/cm3)

Note on units: If RPc (above) in ng/kg, SI (above) will be in ng/kg

Example from MEDEP

Based on PFOA of 650 ng/kg

 