Proposal to Amend Remediation Standards N.J.A.C. 7:26D to add Extractable Petroleum Hydrocarbons

External Stakeholder Meeting
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EPH - Purpose

- Department is mandated by the Brownfield and Contaminated Sites Act to employ a health-based approach when developing remediation standards
- Describe the development of the Direct Contact Soil Remediation Standards (DCSRS) for Extractable Petroleum Hydrocarbons (EPH)
- Rest of EPH Protocol still applies as guidance

EPH - Principles Applied to DCSRS

- Same as in the 4/15/2014 Presentation
- Rely on USEPA risk equations
  - http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/equations.htm
- Toxicity information from established databases
- Toxicity Values - Hierarchy of toxicity sources

EPH - Pathway

- Used Combined Ingestion-Dermal Pathway - Described in 4/15/2014 stakeholder meeting
- Inhalation (Inh) and IGW (MGW) pathways for EPH use naphthalene (Inh) and 2-methylnaphthalene (IGW) as surrogates
- Noncancer endpoint only
- Use HQ of 1
- Residential and Nonresidential Standards

EPH - Definition

- Petroleum Hydrocarbons (PHC): Complex mixture with varying molecular weights and toxicities
- EPH: Extractable Petroleum Hydrocarbons, analytically defines PHC using Equivalent Carbon (EC) Ranges
- Includes No.2 Fuel Oil and heavier petroleum mixtures (e.g., No. 6 FO, Waste Oil, etc.)
- Category 1: No. 2 Fuel Oil and Diesel Fuel
- Category 2: PHC Mixtures other than Category 1
- Excludes volatile PHC (e.g., gasoline)

EPH – Standards Determination

- Follows Massachusetts DEP and Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) approach
- 8 EC fractions (4 aliphatic + 4 aromatic)
- Equivalent carbon ranges paired with representative toxicity factor
- Aliphatic Surrogates: PHC Mixtures EC9–EC12 & EC12–EC16; White Mineral Oil EC16-21 & EC21-EC40
- Aromatic Surrogates: Naphthalene EC10-EC12; Acenaphthene EC12-EC16; Fluorene EC16-EC21; and Fluoranthene EC21-EC36

Residential Equation

Noncancer:

$$SRS = \frac{THQ * BW * AT * 365d / yr}{(EF * ED * 10^{-6} kg / mg)[(\frac{1}{RfD_O} * IR) + (\frac{1}{RfD_{ABS}} * AF * ABS_d * EV * SA)]}$$

SRS = Health-Based Soil Remediation Criterion (ingestion/dermal)	Chemical-specific	mg/kg
THQ = Target Hazard Quotient	1	unitless
BW = Body Weight	15	kg
AT = Averaging Time	6	years
EF = Exposure Frequency	350	days/year
ED = Exposure Duration	6	years
RfD_O = Oral Reference Dose	Chemical-specific	mg/kg-day
IR = Soil Ingestion Rate	200	mg/day
RfD_{ABS} = Dermally Adjusted Reference Dose	Chemical-specific	mg/kg-day
AF = Skin-soil Adherence Factor	0.2	mg/cm^2-event
ABS_d = Dermal Absorption Fraction	Chemical-specific	unitless
SA = Skin Surface Exposed - child	2,800	cm^2
EV = Event Frequency	1	events/day

* http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/equations.htm

Non-Residential Equation

Noncancer:

$$SRS = \frac{THQ * BW * AT * 365d / yr}{(EF * ED * 10^{-6} kg / mg)[(\frac{1}{RfD_O} * IR) + (\frac{1}{RfD_{ABS}} * AF * ABS_d * EV * SA)]}$$

SRS = Health-Based Soil Remediation Criterion (ingestion/dermal)	Chemical-specific	mg/kg
THQ = Target Hazard Quotient	1	unitless
BW = Body Weight	70	kg
AT = Averaging Time	25	years
EF = Exposure Frequency	225	days/year
ED = Exposure Duration	25	years
RfD_O = Oral Reference Dose	Chemical-specific	mg/kg-day
IR = Soil Ingestion Rate	100	mg/day
RfD_{ABS} = Dermally Adjusted Reference Dose	Chemical-specific	mg/kg-day
AF = Skin-soil Adherence Factor	0.2	mg/cm^2-event
ABS_d = Dermal Absorption Fraction	Chemical-specific	unitless
SA = Skin Surface Exposed	3,300	cm^2
EV = Event Frequency	1	events/day

* http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/equations.htm

EPH – Exposure Equation

$$C_{total} = \frac{HQ}{\frac{f_{(1)}}{SRS_{(1)}} + \frac{f_{(2)}}{SRS_{(2)}} + \frac{f_{(3)}}{SRS_{(3)}} + \frac{f_{(4)}}{SRS_{(4)}} + \frac{f_{(5)}}{SRS_{(5)}} + \frac{f_{(6)}}{SRS_{(6)}} + \frac{f_{(7)}}{SRS_{(7)}} + \frac{f_{(8)}}{SRS_{(8)}}}$$

- Combined equation for EPH (8 EC Ranges)
  - Hazard Quotient (*HQ*)
  - Weight fraction adjustment (*f*)
  - Soil Remediation Standard (*SRS*)

EPH - Toxicity Values

Tier	Toxicity Source	RfDs Used
I	NJDWQI	0
II	IRIS	4
III	TPHCWG	1
	CCME/MADEP	1

Recommended Dermal Absorption Factor	
Source: USEPA. 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund	
Compound	**Dermal Absorption Factor (ABSd)**
Mineral Oil (Aliphatics EC16-EC40)	0.1
PAHs (Aromatics all 4 EC ranges)	0.13

EPH – Composition No. 2 Fuel Oil

- Develop number for No. 2 Fuel Oil
- No typical No. 2 Fuel Oil composition in literature
- Department EPH-TPH Field Study 2007
  - 28 Samples (2 samples per site) collected and analyzed for TPH and EPH at 14 residential sites throughout NJ
  - Sites about ½ fresh and ½ old spills
  - Near samples in excavation contain free or residual product (FRP)
  - Far samples from contaminated perimeter (odor and staining, but no FRP)

EPH – Composition No. 2 Fuel Oil

- Statistical evaluation performed
- EPH and TPH data are comparable
- 0.8473 regression coefficient (r^2)
- Near and far samples are not statistically different, so data pooled for use in EPH equation
- Study data used to calculate EPH soil numbers for Category 1 based on the weight fraction percentage for each of the 8 EC ranges

Statistical evaluation to set standard for Category 1 EPH

EPH - Residential Statistical Results

Mean	5453
Confidence Level(95.0%)	390
95% UCL	5843
95% LCL	5063

- Use LCL for Cat 1 EPH, based on 2007 study data, rounded to 5,100
- Will recalculate for SRS

Statistical evaluation to set standard for Category 1 EPH

EPH – Nonresidential Statistical Results

Mean	57,590
Confidence Level(95.0%)	3,480
95% UCL	61,070
95% LCL	54,110

- Use LCL for Cat 1 EPH, based on 2007 study data, rounded to 54,000
- Will recalculate for SRS

EPH – Category 2
Online Calculator

COMPOSITION-SPECIFIC EXTRACTABLE PETROLEUM HYDROCARBON (EPH) SOIL REMEDIATION CRITERION (SRC) CALCULATOR
FOR NON-#2 FUEL OIL/DIESEL OIL PETROLEUM HYDRCARBON MIXTURES (Version 2.01 September 5, 2012)

DATA ENTRY CELLS:
ENTER ALL CONCENTRATIONS AS MILLIGRAMS/KILOGRAM (mg/kg)
FOR NON DETECT VALUES, ENTER "0" or "ND" (without the quotation marks)
REMEMBER TO ENTER ACTUAL SAMPLE IDENTIFICATION IN PLACE OF "SAMPLE 1", ETC.
REMEMBER TO INDICATE WHETHER THE SAMPLE IS "RESIDENTIAL" (R) OR "NON-RESIDENTIAL" (N) (OR USE DROP-DOWN LIST)
ALL DATA MUST BE ENTERED FOR EACH SAMPLE TO THE EPH CRITERION TO BE CALCULATED
CLICK ON THE "CALCULATE EPH SRC" BUTTON TO CALCULATE THE SAMPLE-SPECIFIC EPH SOIL REMEDIATION CRITERION
IF YOU CHANGE ANY INPUT DATA, YOU MUST CLICK ON "CALCULATE EPH SRC" AGAIN TO RECALCULATE THE SOIL REMEDIATION CRITERION
IF THE RESULTS FROM THE GC ANALYSIS INDICATE AN EPH CONCENTRATION LESS THAN 1,700 mg/kg, IT IS NOT NECESSARY TO USE THIS CALCULATOR

EC RANGE / SAMPLE ID		1	2	3	4	5
Enter Residential or Non-Residential		Residential	Residential	Non-Residential	Non-Residential	Non-Residential
ALIPHATICS	EC9-EC12	50.0	900.0	999.0	9,000.0	2,500.0
	EC12-EC16	100.0	900.0	999.0	9,000.0	2,500.0
	EC16-EC21	100.0	900.0	999.0	9,000.0	2,500.0
	EC21-EC40	50.0	900.0	999.0	9,000.0	2,500.0
AROMATICS	EC9-EC12	50.0	900.0	999.0	9,000.0	2,500.0
	EC12-EC16	100.0	900.0	999.0	9,000.0	2,500.0
	EC16-EC21	100.0	900.0	999.0	9,000.0	2,500.0
	EC21-EC36	50.0	900.0	999.0	9,000.0	2,500.0
Total Concentration (mg/kg)		600.0	7,200.0	7,992.0	72,000.0	20,000.0

Calculated EPH SRC* (mg/kg)	2,500	3,500	37,000	37,000	37,000
Allowable** EPH SRC (mg/kg)	3,500	3,500	37,000*	37,000*	37,000*
ABOVE/BELOW ALLOWABLE EPH SRC (i.e., PASS or FAIL)	BELOW (PASS)	[illegible]	BELOW (PASS)	[illegible]	[illegible]

* = Equivalent Carbon
** = Soil Remediation Criterion
^ = Accounts for residual product
37,000* = Default maximum value for all non #2 fuel oil/diesel oil petroleum hydrocarbon mixtures

Calculate EPH SRC | Print Results | Intro Message
Reset Data | Instructions
Run Date = 04/30/2014

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Questions