Probable Effects Concentration Quotient (PECQ) for Remedial Decisions and for Allocation in Onondaga Lake

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SUMMARY

On December 16, 1994, Onondaga Lake and areas upland that contribute or have contributed contamination to the lake system were added to the U.S. EPA's National Priorities List (NPL).

The Site comprises the Lake itself, its tributaries, and the upland hazardous waste sites (sub-sites).

Contaminants present in Onondaga Lake sediments include mercury, benzene, toluene, ethylbenzene, and xylenes (BTEX), chlorinated benzenes, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and polychlorinated dioxins and furans (among others). These contaminants are primarily found in the southwestern portion of Onondaga Lake. High concentrations of some contaminants in certain locations in the southwestern portion of Onondaga Lake extend to a depth of at least 25 feet in lake sediments.

Onondaga Lake Chemicals of Concern and PECs

Parameter	PEC	
mercury	2.2	mg/kg
	ug/kg	ug/kg
ethylbenzene	175.7	0.1757
xylenes	560.8	0.5608
chlorobenzenes	428.4	0.4284
dichlorobenzenes	238.6	0.2386
trichlorobenzenes	346.5	0.3465
acenaphthene	860.7	0.8607
acenaphthylene	1300.7	1.3007
anthracene	206.7	0.2067
benz(a)anthracene	191.5	0.1915
benzo(a)pyrene	146.4	0.1464
benzo(b)fluoranthene	908.4	0.9084
benzo(ghi)perylene	779.7	0.7797
benzo(k)fluoranthene	202.5	0.2025
chrysene	253.2	0.2532
dibenz(a,h)anthracene	157.2	0.1572
fluoranthene	1436.3	1.4363
fluorene	264.3	0.2643
indeno(1,2,3-cd)pyrene	182.9	0.1829
naphthalene	917.4	0.9174
phenanthrene	542.7	0.5427
pyrene	343.8	0.3438
Total PCB	294.8	0.2948

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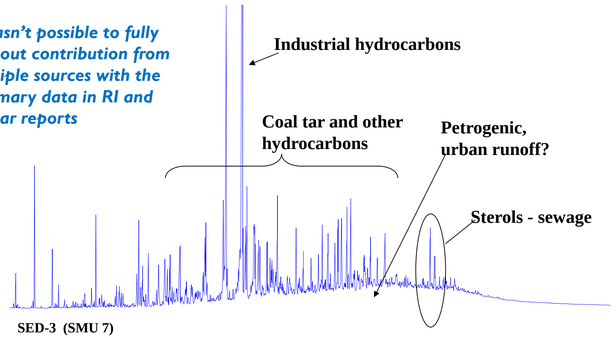
Sampling and analyses by META helped to characterize and allocate chemicals to sources

It wasn't possible to fully sort out contribution from multiple sources with the summary data in RI and similar reports



Given the complexity of the sediment chemistry, NYSDEC, USEPA, and Honeywell developed an approach for mapping remediation areas based on mean sediment quality guideline quotients called the Probable Effects Concentration Quotient (PECQ).

Probable Effects Concentrations (PECs) were determined for 46 chemicals of potential interest (CPOI) using toxicity tests. Statistical analyses were used to narrow the list to 23 chemicals.

The ROD used PECQ=1 as the remediation goal. Any location where the calculated PECQ exceeded 1, would require a remedial response.

PAHs drove remediation in some areas of the Lake. PAHs were difficult to allocate given all the potential sources, mixing, and degradation that had occurred over the decades.

PECQ Calculation

The COC chemicals are divided into 5 groups

The concentration of each chemical is divided by its PEC to give a PECQ

The PECQs for each group are averaged

The 5 average PECQs are averaged to give the sample-specific average – the PECQ

META Method for Allocation of COCs

- **First, calculate the % contribution to PECQ for each COC chemical group for each sample**
- **Next, identify and subtract out urban background PAHs**
  - Historical contribution from urban runoff estimated based on Ley Creek and Barge Canal sediment samples estimated at less than 58,800 ug/kg (58.8 ppm)
  - Simple subtraction of background PAH concentrations from each sample
- **Last, allocate non-background PAHs to each party**

The method allocates based on contribution to PECQ – the agency–approved remediation driver

The methodology was consistent with the remedy

The method was consistent with current conditions in the sediment

PECQ Allocation Example

PECQ Allocation - META Method			
Compound	PEC	Conc.	Individual Compound and Group-wise PECQ
Mercury	2.2	4.1	**1.86**
		Conc. (ug/kg)	
Ethylbenzene	175.7	8.5	0.04
Xylenes (Total)	560.8	174	0.31
VOCs			**0.18**
Chlorobenzene	428.4	1400	3.27
Total Dichlorobenzene	238.6	330	1.38
Total Trichlorobenzen	346.5	0	
Chlorobenzenes			**2.32**
Acenaphthene	860.7	170	0.2
Acenaphthylene	1300.7	250	0.19
Anthracene	206.7	570	2.76
Benz(a)anthracene	191.5	960	5.01
Benzo(a)pyrene	146.4	1000	6.83
Benzo(b)fluoranthene	908.4	1000	1.1
Benzo(g,h,i)perylene	779.7	710	0.91
Benzo(k)fluoranthene	202.5	790	3.9
Chrysene	253.2	1300	5.13
Dibenz(a,h)anthracene	157.2	230	1.46
Fluoranthene	1436.3	2800	1.95
Fluorene	264.3	0	
Indeno(1,2,3-cd)pyrer	182.9	600	3.28
Naphthalene	917.4	130	0.14
Phenanthrene	542.7	1400	2.58
Pyrene	343.8	2000	5.82
PAHs			***2.75***
Total PCBs	294.8	2123	**7.2**
		total PECQ	14.31066667

	No. Exceeding PECQ	% Total PECQs	Parameters requiring cleanup
Mercury	1	25	Y
VOCs	0	0	N
Chlorobenzenes	1	25	Y
PAHs	1	25	Y
PCBs	1	25	Y
Sample PECQ	2.865		

Final Allocation for Sediment Management Unit 6		
Data Set (when QC and PECQ < 1 and other misc samples are removed, 109 remain)		167 samples
Remedial Driver (contribution to PECQ)		PAHs 67.5 % PCBs 14.7 Hg 12.2 EX 3.4 CBs 2.1
Background PAH Conc.		58,800 ug/kg
Calculation of Remedial Share	% non-background PAHs	19.4 % (Percent non-background PAH contribution where PECQ > 1)
	Correct for background	13.1 % (19.4% of 67.5%)
	Final contribution	6.5 % (50:50 split of the parties to non-background PAHs)