PAHs And Parking Lots: A Field Study on PAHs Exported From Sealed and Unsealed Parking Lots at the UNH Stormwater Center

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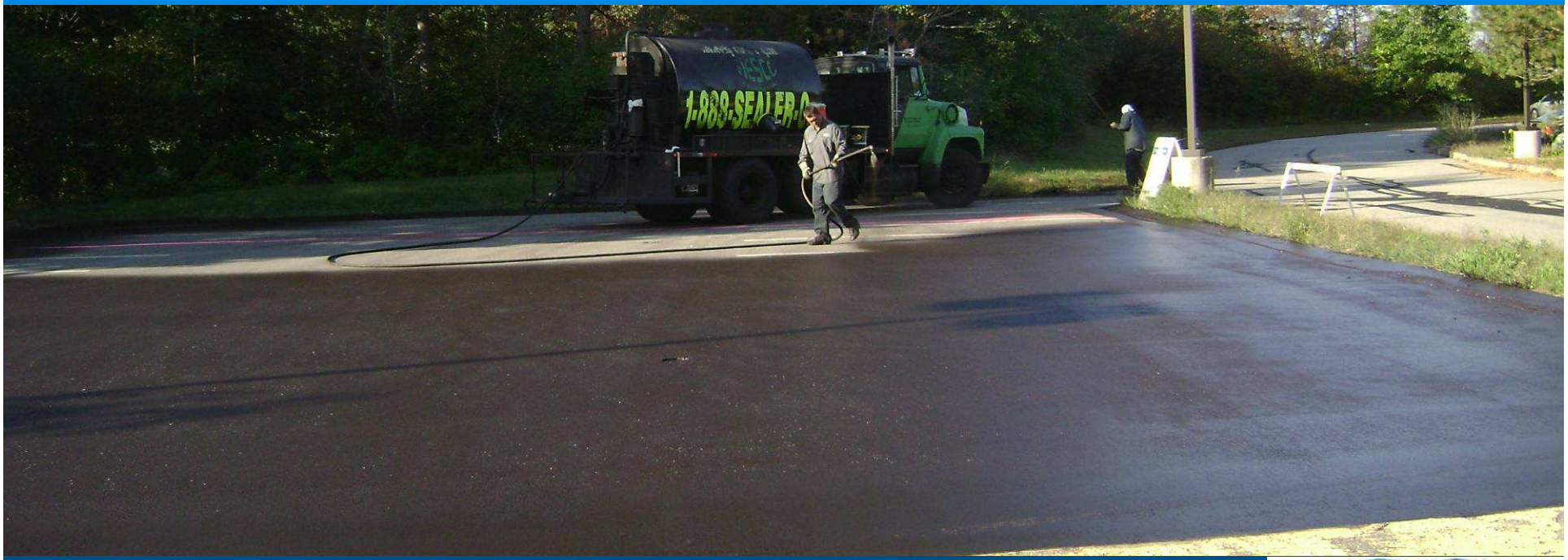

National Monitoring Conference
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UNIVERSITY OF NEW HAMPSHIRE
STORMWATER CENTER

Dedicated to the protection of water resources through effective stormwater management

CICEET

Sea Grant
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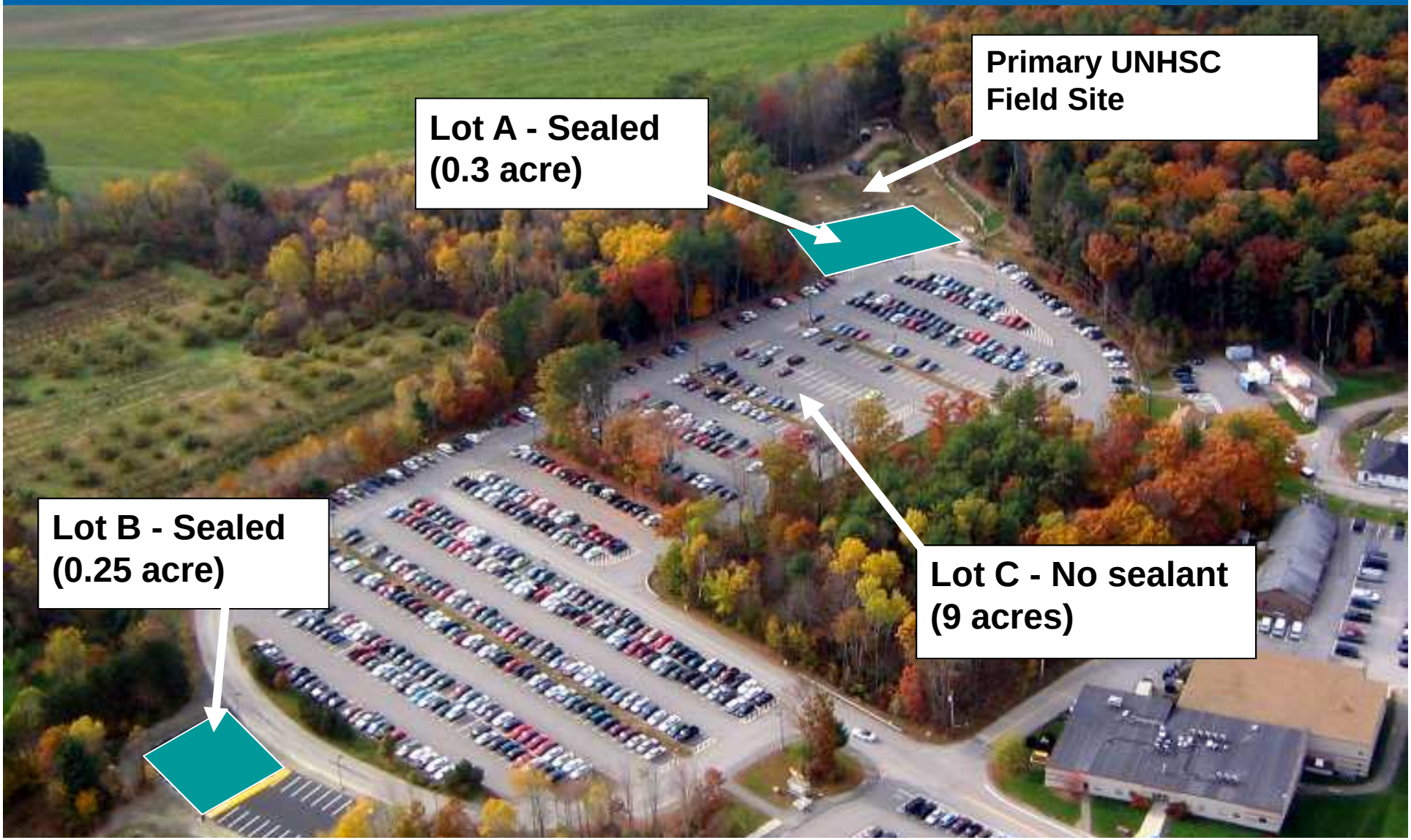
NOAA
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Field Facility at the UNH WEST EDGE LOT

UNHSC Study
Controlled field experiment



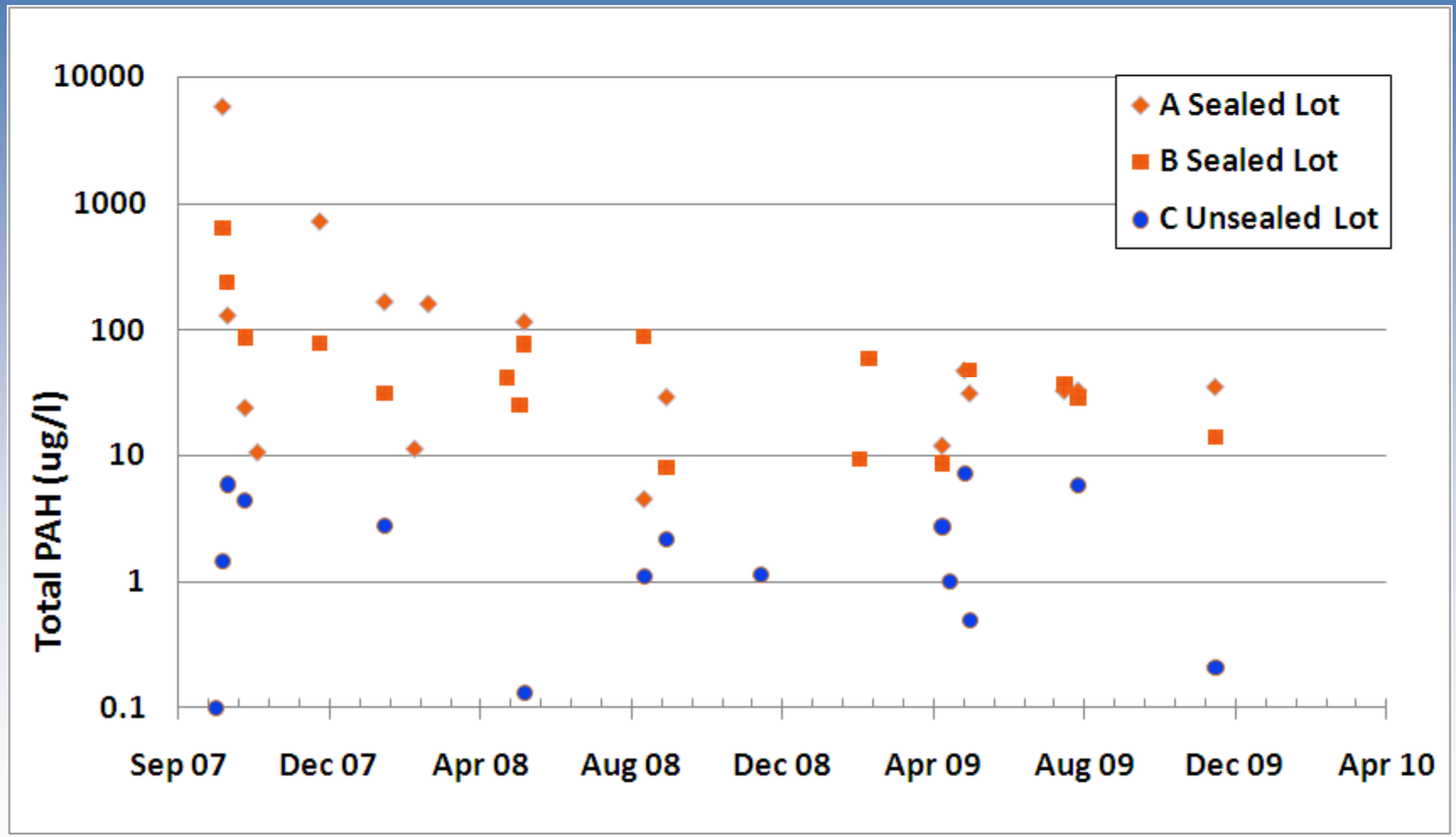
Sampling

Objective – Measure mass of PAH in each pathway

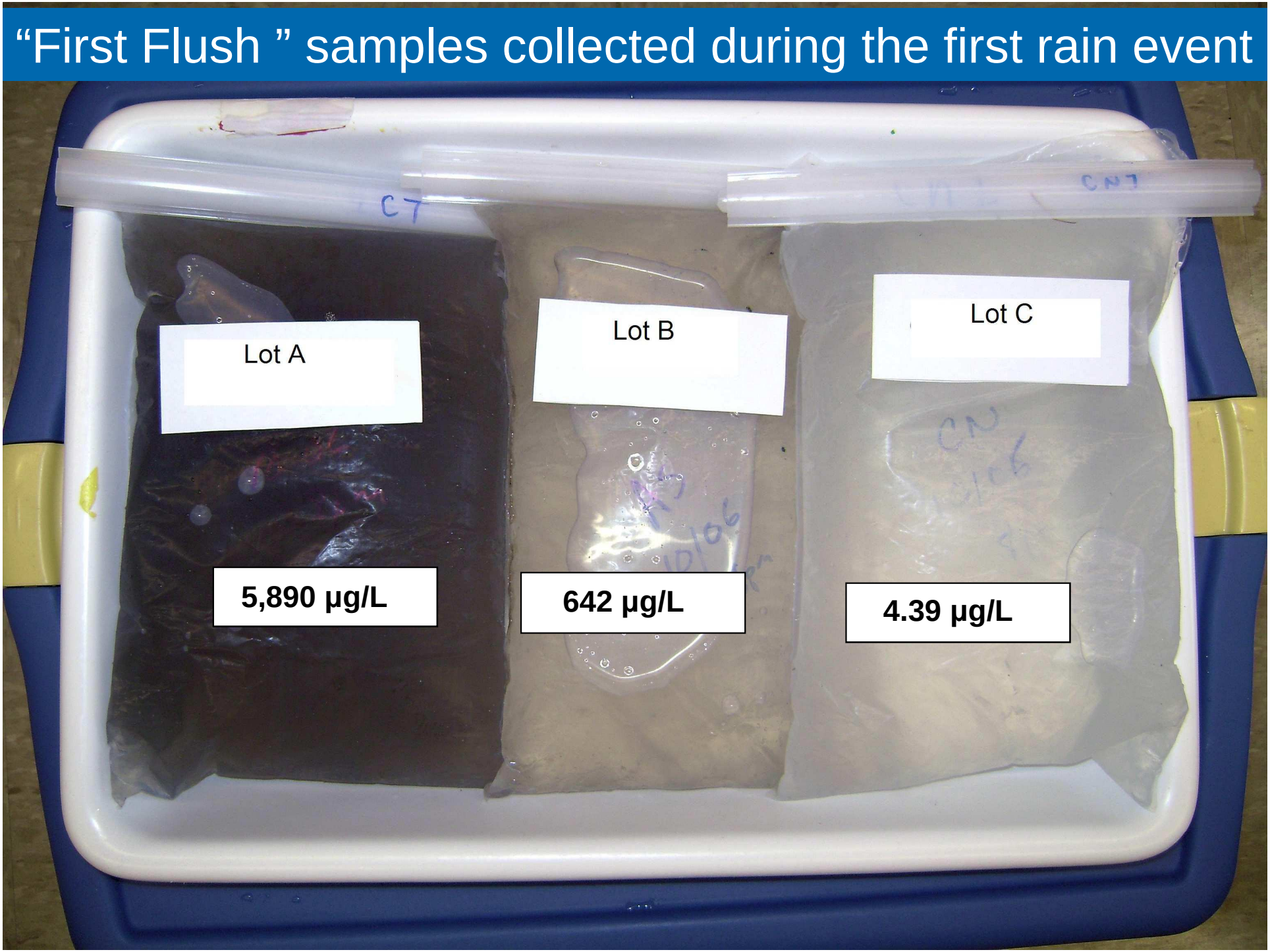
- **Stormwater runoff (24 storms, 11/07-12/09)**
- **Downstream sediments Swale, stormwater devices**
- **Adjacent surface soil**
- **Pavement dust**
- **Air**

All samples analyzed for PAHS, GC/MS, subset analyzed for PAHs/homologs/SIMs

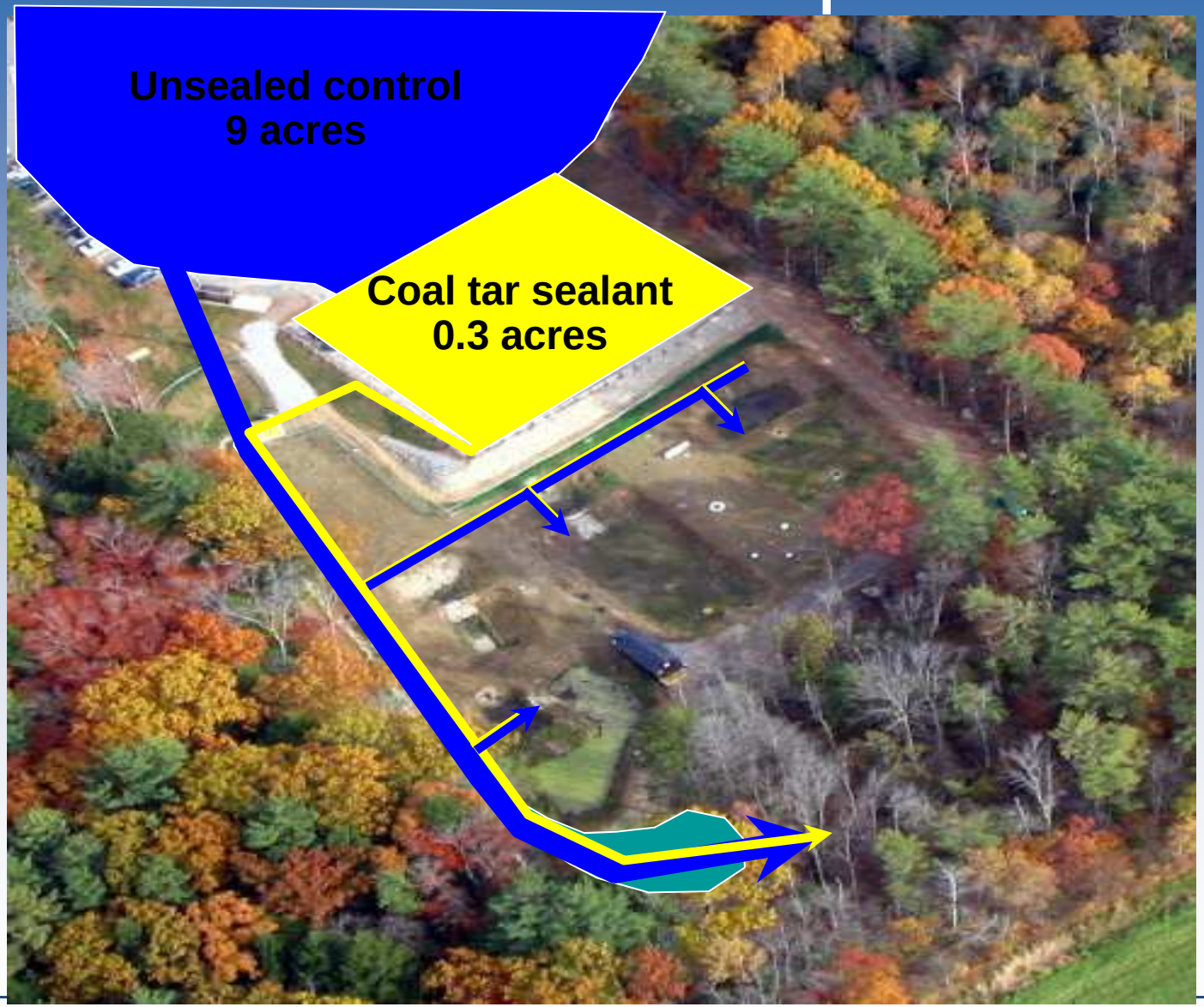
PAH (Σ 16) Concentrations
Unfiltered Composite Stormwater Samples

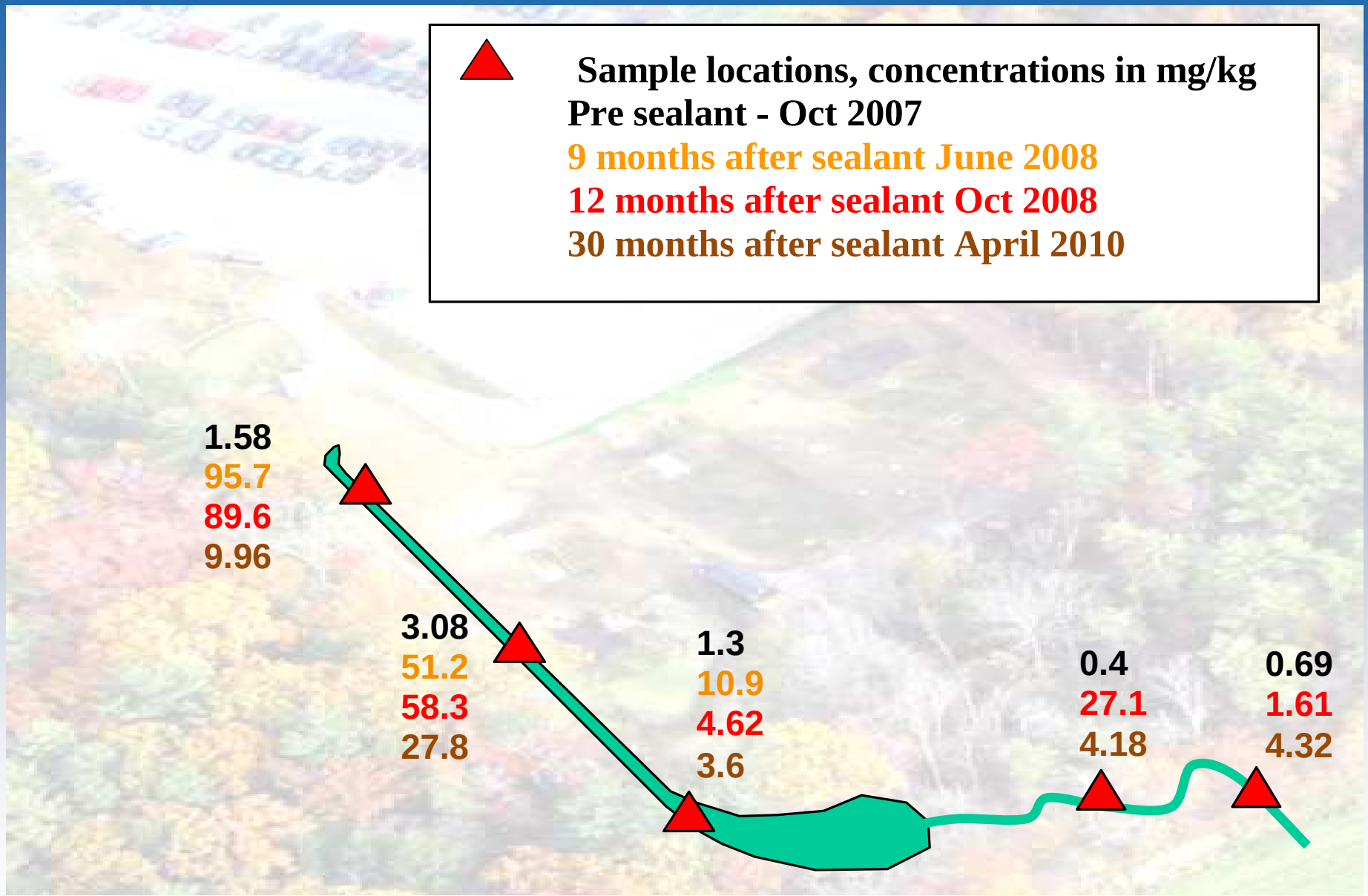


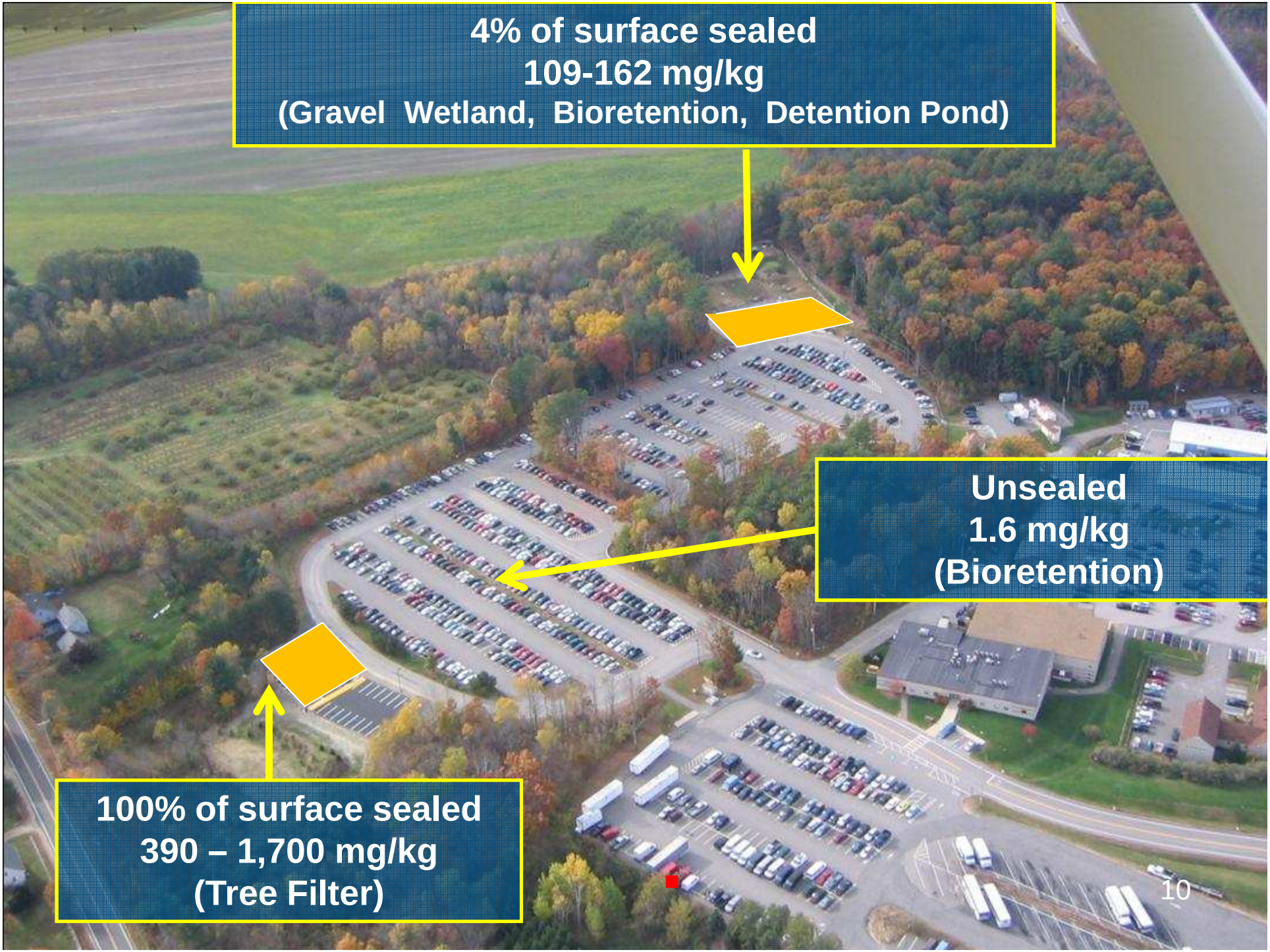
“First Flush ” samples collected during the first rain event



Sediment Samples




Sample locations, concentrations in mg/kg
Pre sealant - Oct 2007
9 months after sealant June 2008
12 months after sealant Oct 2008
30 months after sealant April 2010
1.58
95.7
89.6
9.96
3.08
51.2
58.3
27.8
1.3
10.9
4.62
3.6
0.4
27.1
4.18
0.69
1.61
4.32

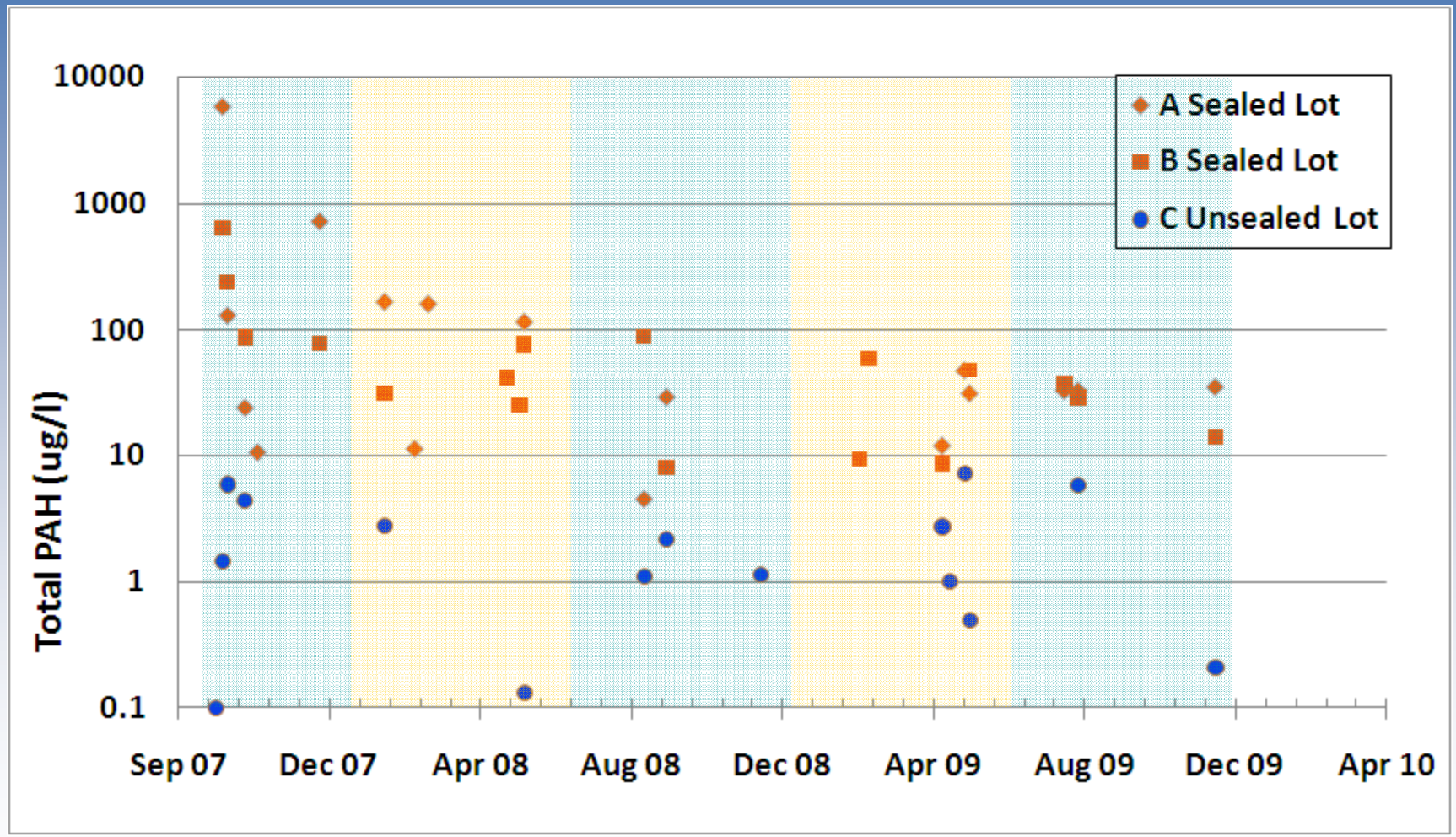

4% of surface sealed
109-162 mg/kg
(Gravel Wetland, Bioretention, Detention Pond)
Unsealed
1.6 mg/kg
(Bioretention)
100% of surface sealed
390 – 1,700 mg/kg
(Tree Filter)

Stormwater sediments (Σ16PAH):

Unsealed	**<5 mg/kg**
4% of area sealed	**100 mg/kg**
100% sealed	**1,000 mg/kg**

Concentrations increase when coal tar sealant is applied to watershed surface

Total Mass: Calculate Mean Concentration in 6 Month Intervals



Mass of PAHs Exported in Stormwater

	Total Mass of PAHs (Kg)		
	C-Unsealed **9 acre**	**A-Sealed** **0.3 acre**	**B-Sealed** **0.25 acre**
1. Oct-Dec 07	0.05	0.59	0.09
2. Dec-June 08	0.18	0.27	0.06
3. July-Dec 08	0.1	0.18	0.15
4. Jan-June 09	0.4	0.16	0.12
5. July-Dec 09	0.5	0.21	0.12
Total per lot	**1.23**	**1.41**	**0.54**
Total per acre	**0.13**	**4.27**	**2.16**

Wear: Approximately 25% of sealant remaining on A lot, 50% remaining on B lot.

Mass Balance – Stormwater

B Lot:

Mass of PAHs applied: 9 kg

1,000 liters applied
(by volume estimates, and contractors estimate)
Concentration (dried) 18,000 mg/kg => 9 kg PAHs

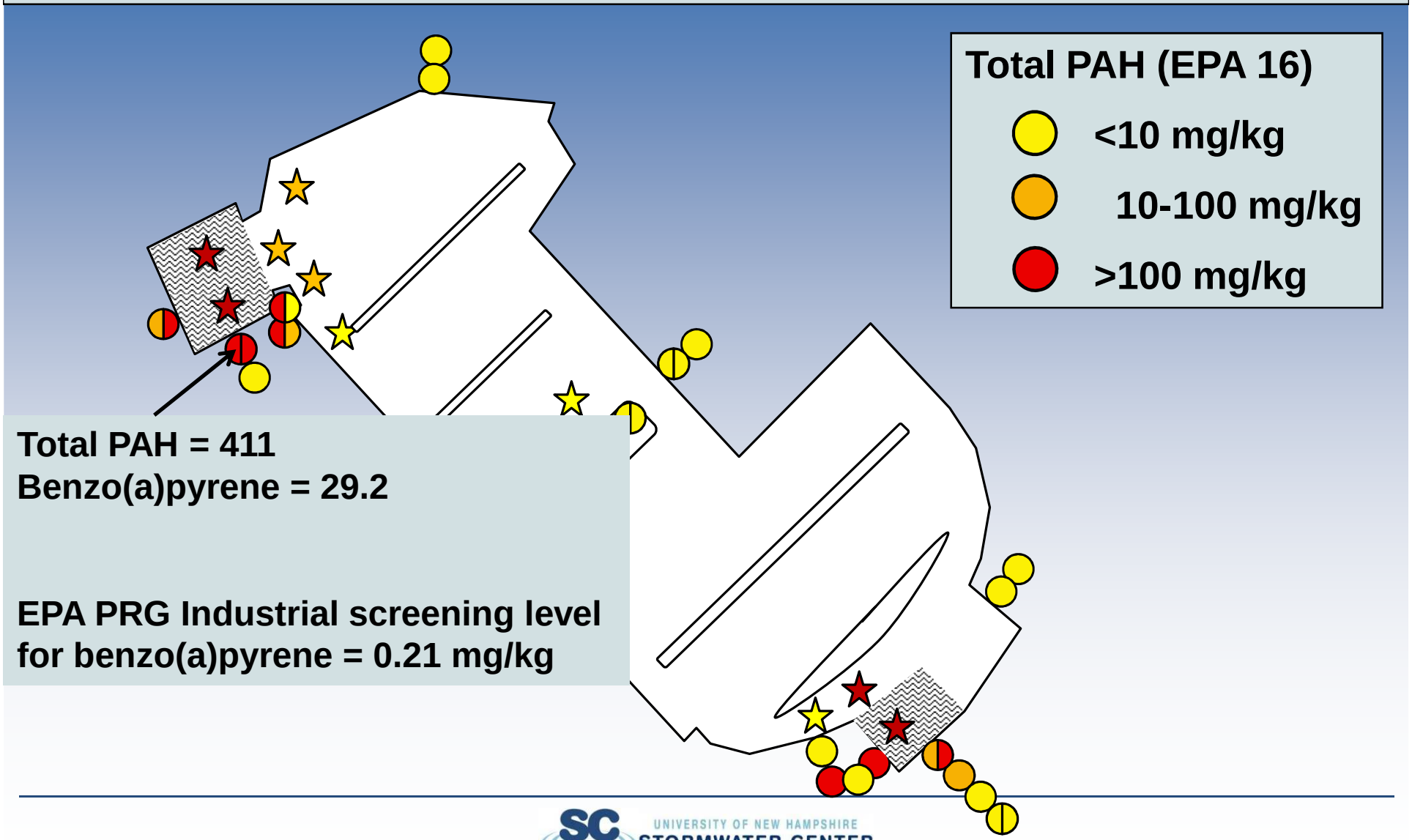
50% remaining on lot: 4.5 kg lost

Mass in stormwater runoff: 0.5 kg

Verified by volume: 1,000 liters applied
volume of sealant particles in tree filter
less than 100 liters.

Where did the rest go?

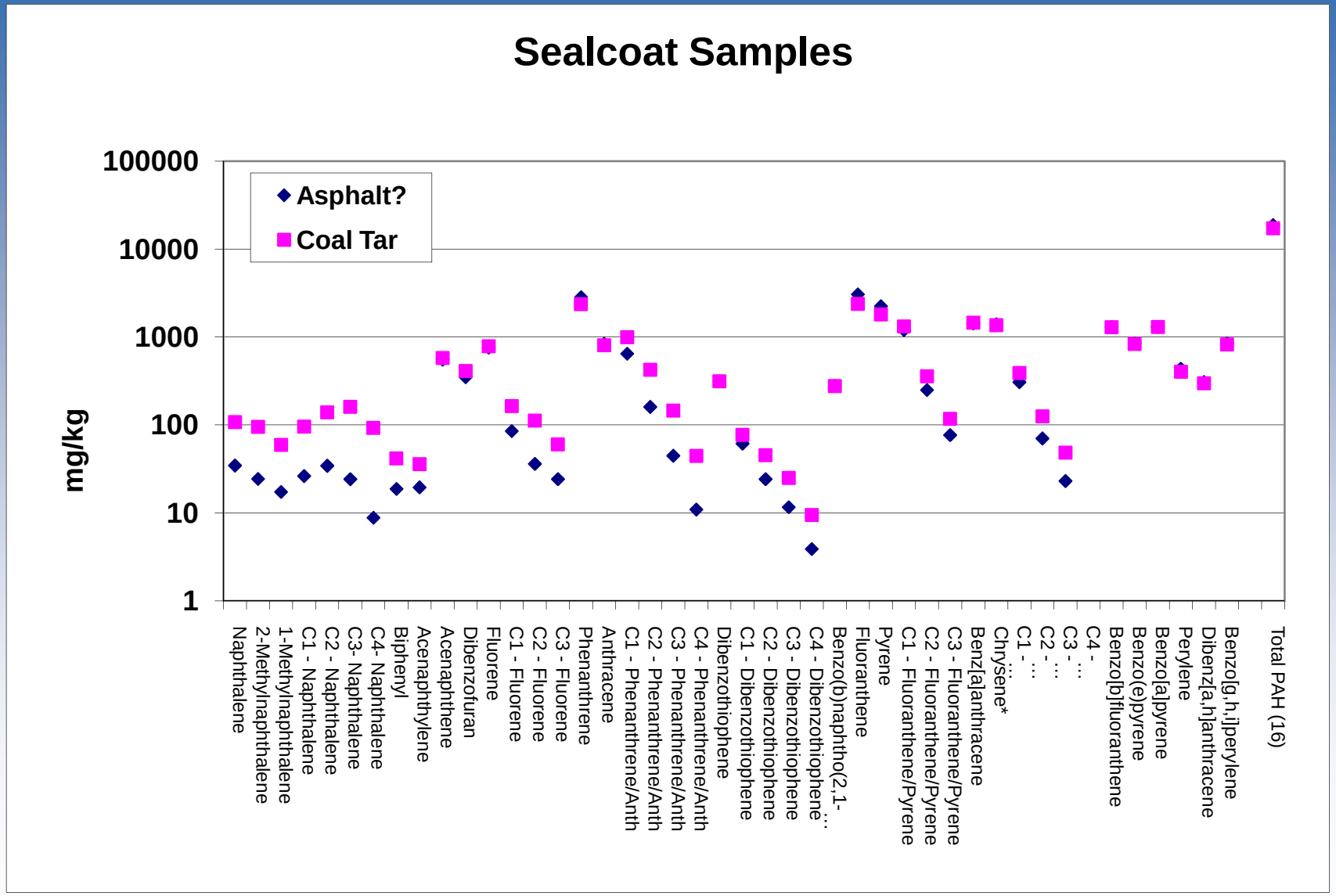
PAH Concentrations in Surface Soil ● and Dust ★



Total PAH = 411
Benzo(a)pyrene = 29.2

EPA PRG Industrial screening level for benzo(a)pyrene = 0.21 mg/kg

And Other Issues…



Application Matters

Pavement Coatings Technology Council recommends (http://www.pavementcouncil.org/pavementcouncil/PCTCFactSheet.pdf):

- Make sure no significant rainfall is forecast for at least 48 hours after application of the sealcoat;
- Only apply sealcoat when temperatures are above 60° Fahrenheit and rising throughout the application period;
- Take appropriate measures to ensure that newly applied sealcoat does not impinge on adjacent surfaces or enter storm or sewer drains; and
- Make sure that no traffic can access the newly sealcoated surface for at least 12 hours.

Date	Min Temp (F)	Max Temp (F)	Precipitation (in)
October 5, 2007	50.1 (6:33)	83.2 (15:56)	0
October 6, 2007	57.16 (7:15)	79.8 (13:38)	0.58 (19:00)

A and C Lots installed in 1996, B Lot installed in 2006

Sunapee NH, March 2010

Conclusions

Stormwater

PAHs from sealed surfaces at least an order of magnitude higher than from unsealed control during first two years. Concentrations decrease with time. Not the only primary pathway for PAH transport from sealed sites.

Surface Soil

PAHs in adjacent surface soil up to 400mg/kg, Benzo(a)pyrene up to 29mg/kg.

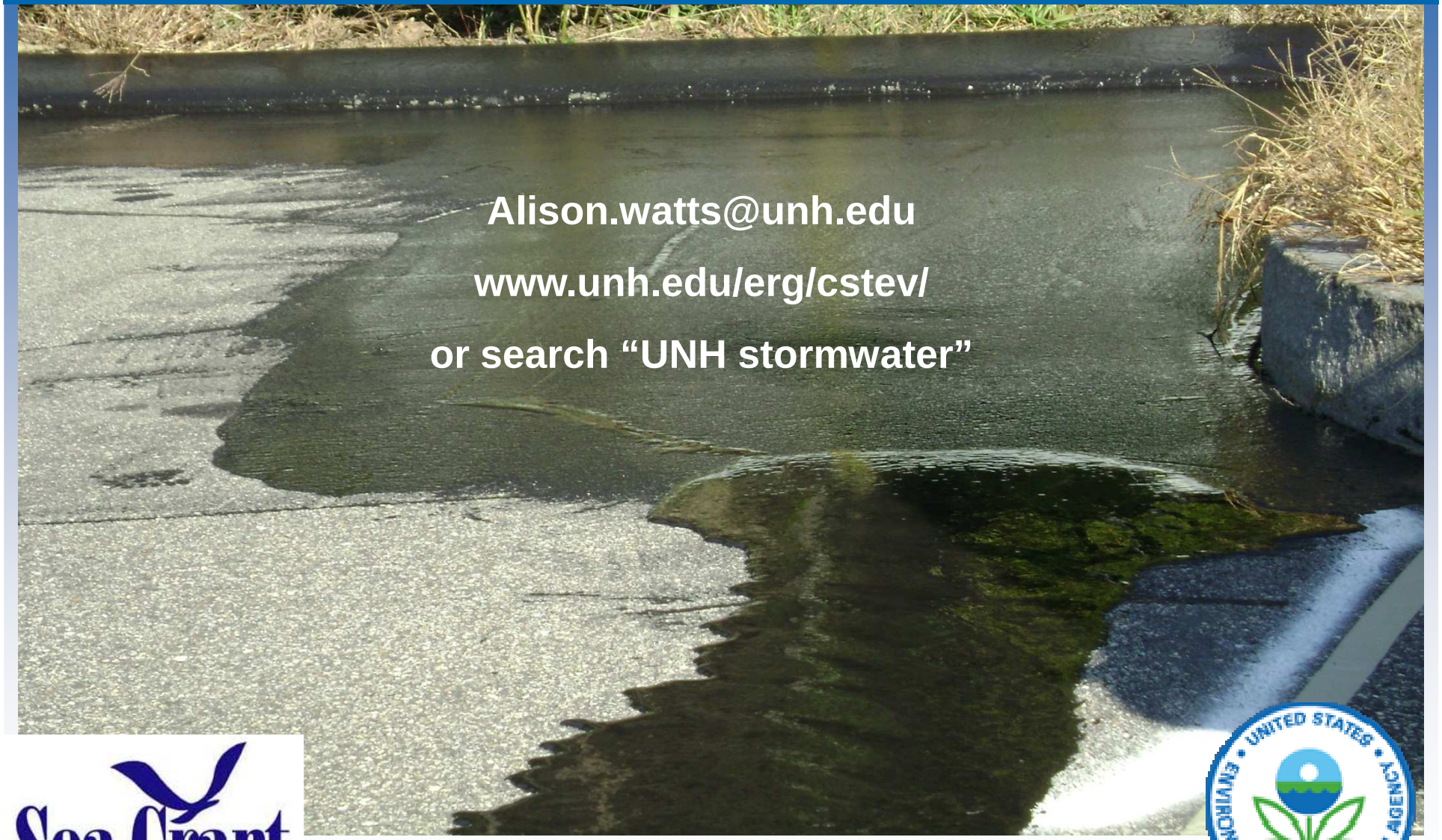
Stormwater sediments

PAHs <5 mg/kg in unsealed areas, ≈ 100mg/kg in structures receiving flow from mixed surfaces, ≈ 1,000mg/kg in fully sealed watershed.

Application Matters

Best management practices could reduce 'first flush' concentrations, but contractors should not be relied upon to enforce (or put down the correct sealant!)

QUESTIONS?



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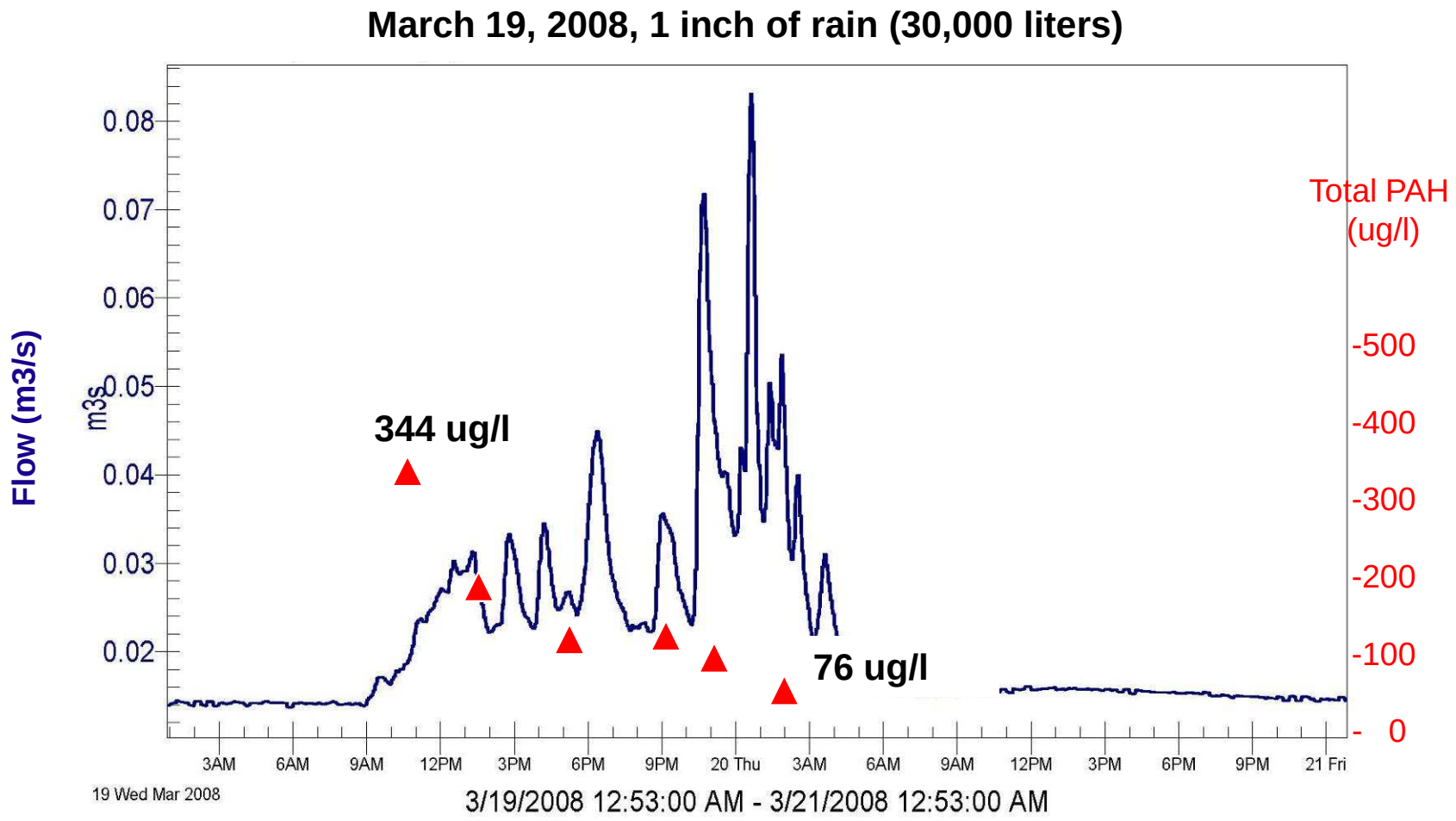
Filtered Stormwater

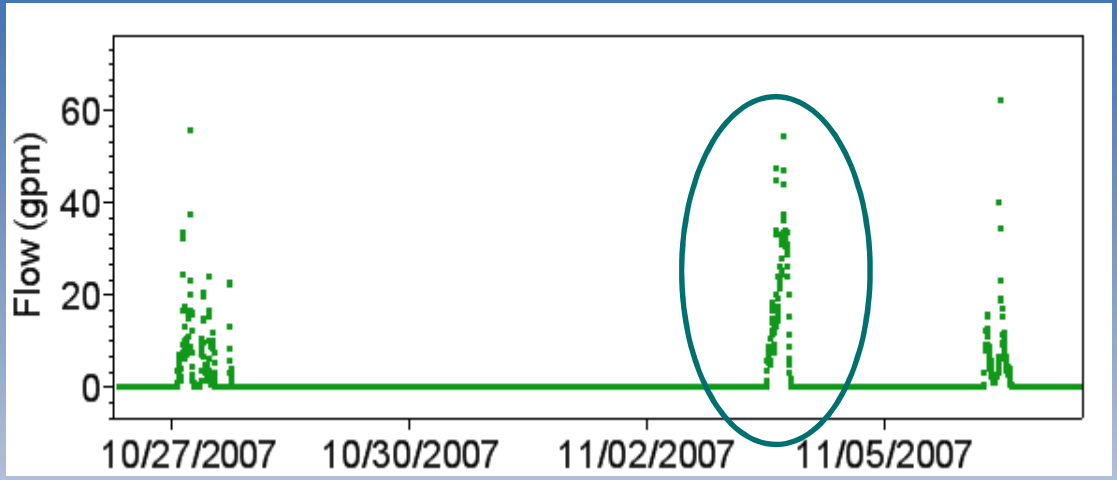
Date	Surface	Lot	Concentration (ug/l) Unfiltered	Filtered	% Reduction
5/27/2009	Sealed	A	41.4	21.9	**47**
5/28/2009		B	25.7	6.5	**75**
8/22/2009		A	33.3	3.4	**90**
8/22/2009		B	29	11.3	**61**
12/10/2009		A	36.07	0.77	**98**
12/10/2009		B	14.9	0.54	**96**
12/10/2009	Unsealed	C	0.22	0.09	**41**

Stormwater Sampling

Discrete and flow weighted composite samples analyzed for PAHs



Storm Characteristics and Total Volume



Rainfall Event	Storm Duration (min)	Rain Depth (in)	Storm Volume (liters)			Antecedent Dry Period (days)	Season	Concentration (ug/l)		
			C lot	A lot	B lot			C lot	A lot	B lot
10/6/2007	720	0.58	536557	19674	14904	7.00	Fall	1.45	5890.00	642.00
10/10/2007	235	0.24	318783	11689	8855	0.5	Fall	5.95	132.43	241.30
10/24/2007	90	0.05	63504	2328	1764	3	Fall	4.39	24.40	88.00
11/3/2007	485	1.25	1211312	44415	33648	6	Fall		10.80	
12/23/2007	470	0.27	760328	27879	21120	2	Winter		732.15	78.53
2/13/2008	815	2.74	2367721	86816	65770	2	Winter	2.80	169.95	31.10