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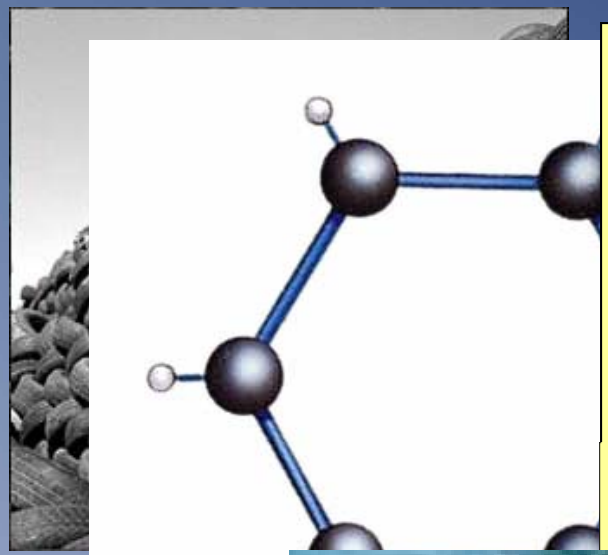
science for a changing world

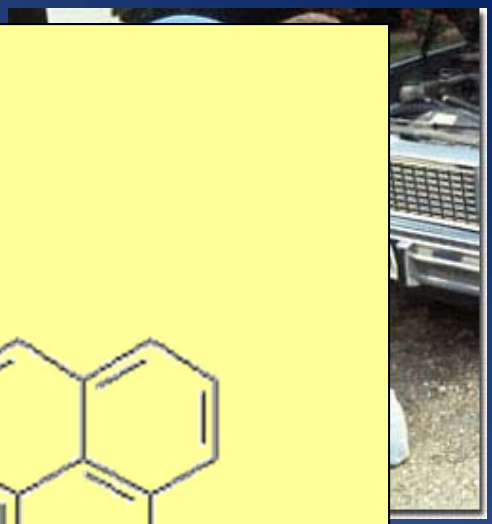
You're standing on it!

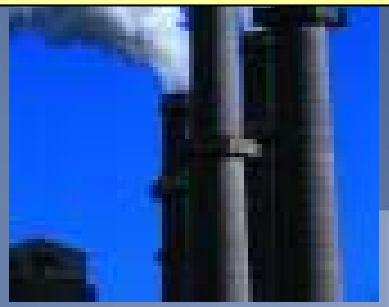
Coal-tar-based pavement sealcoat, PAHs, and Environmental Contamination

U.S. Department of the Interior
U.S. Geological Survey

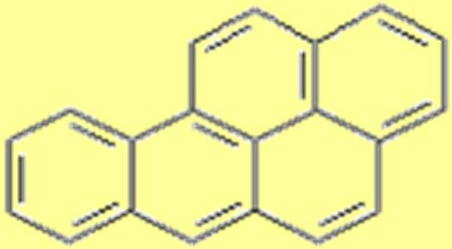
Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous in the urban environment

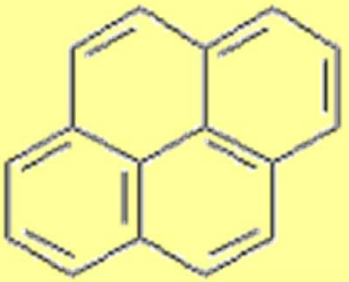




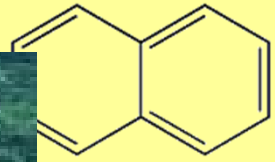


Benzo(a)pyrene





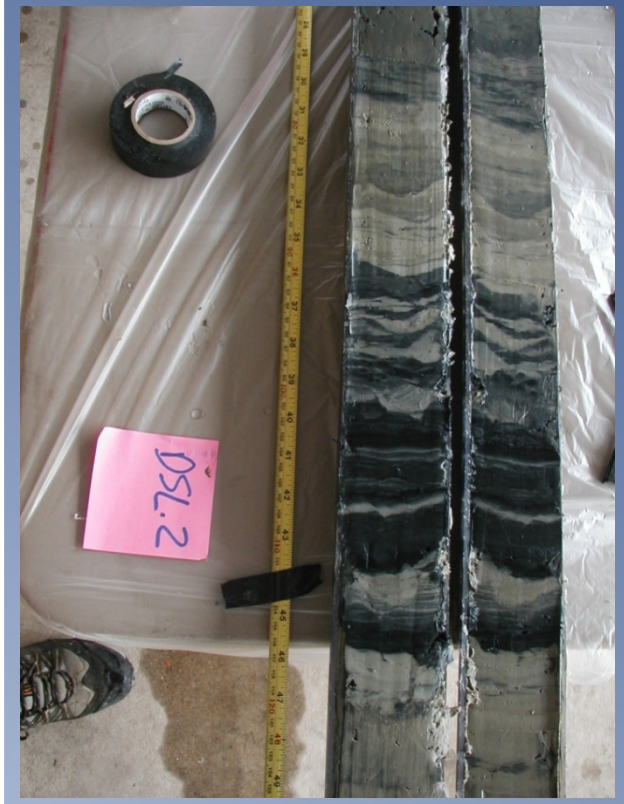
Pyrene



Naphthalene

NAWQA: Contaminant Trends in Lake Sediment

http://tx.usgs.gov/coring/index.html



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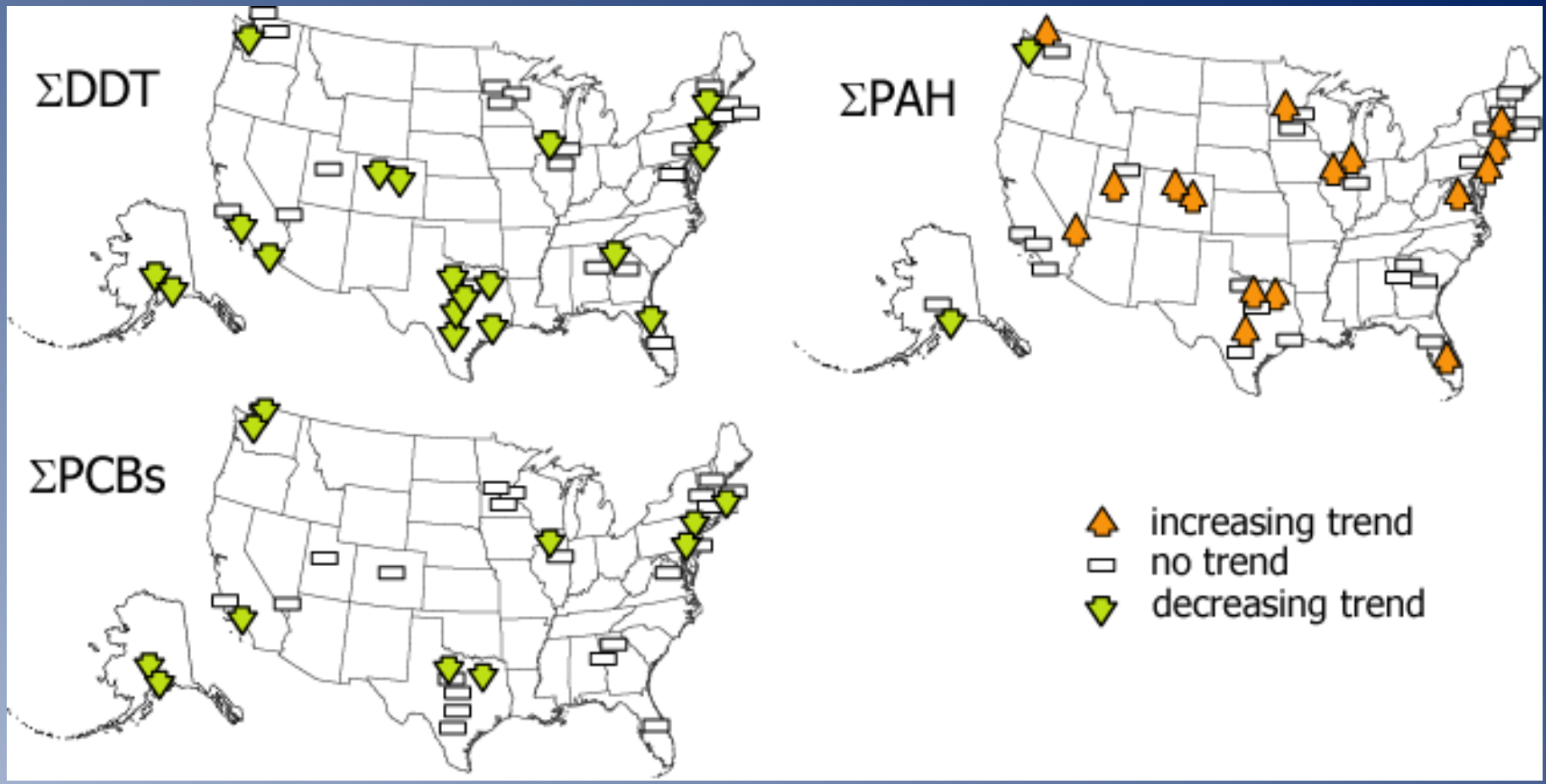
Trends since 1970



Van Metre et al., 2000, Environ. Sci. &Tech.
Van Metre and Mahler, 2005, Environ. Sci. & Tech.

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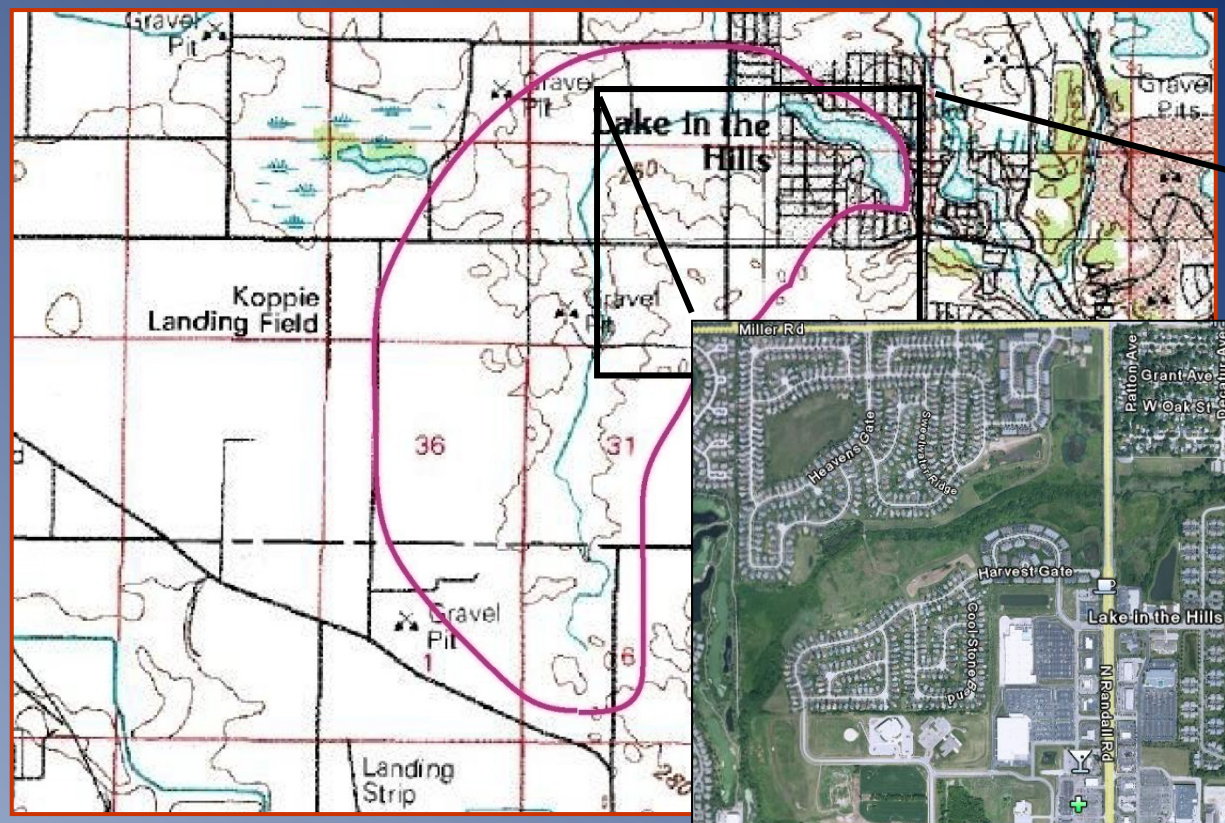
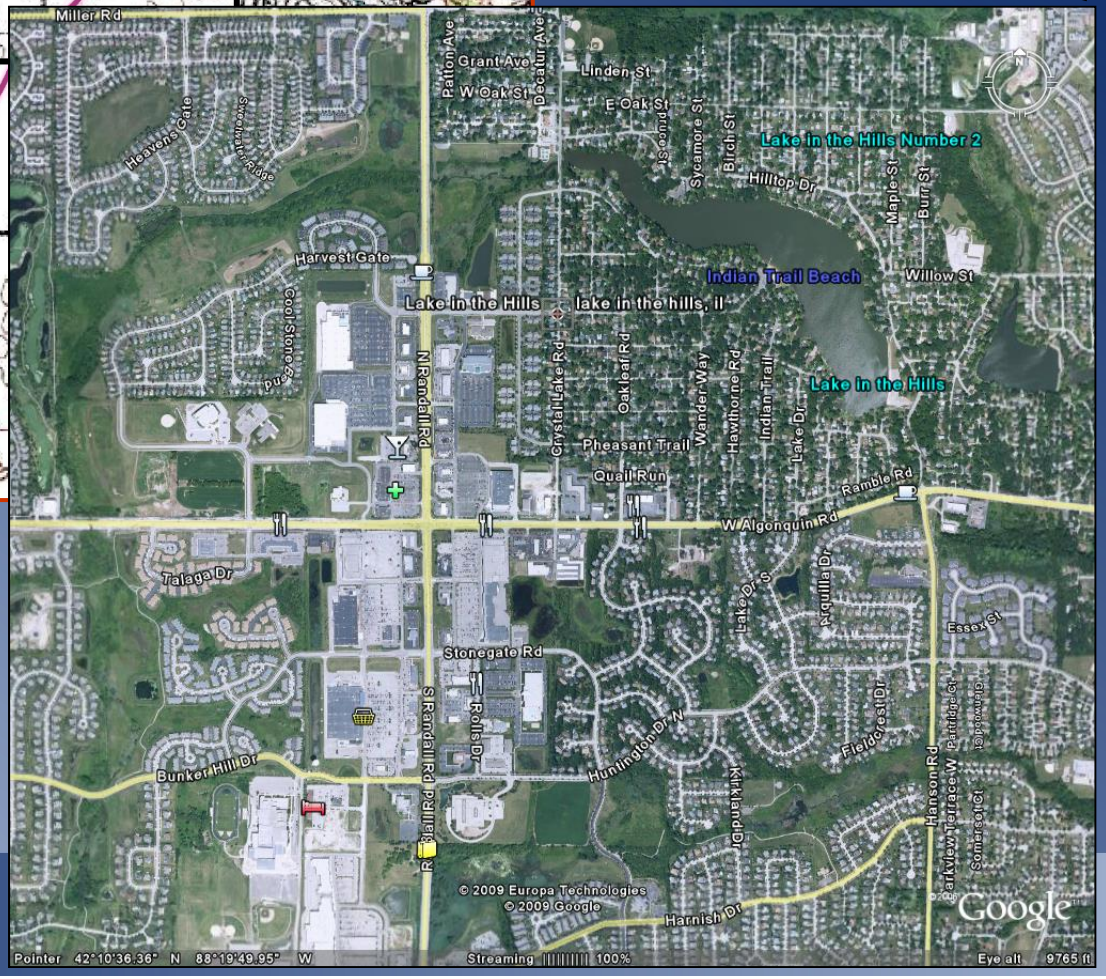
Lake in the Hills, near Chicago



In 1975, 11% urban



In 2000, 78% urban

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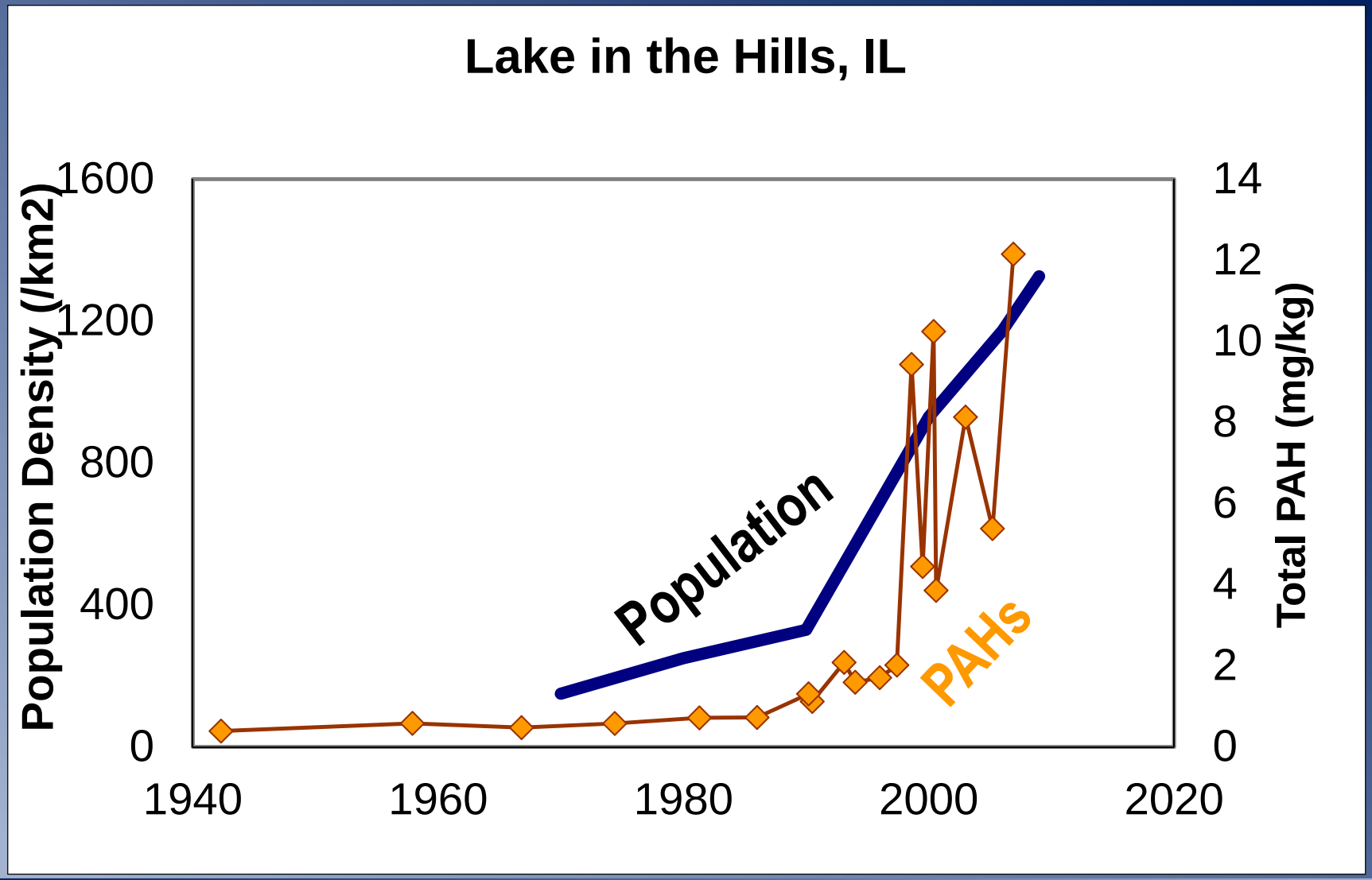
Population and PAH in lake sediment



The first clue: high PAH in Austin stream sediment

- Extremely high (>1,500 mg/kg) PAHs in some small drainages
- Compare to Probable Effect Concentration (PEC) of 23 mg/kg
- So … what's upstream?

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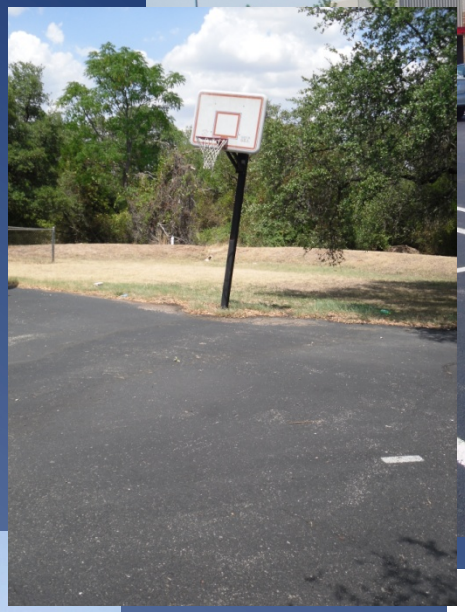

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PAHs in urban sources

All concentrations in mg/kg (averages of up to 6 studies)

Fresh asphalt	**1.5**
Weathered asphalt	**3**
Fresh motor oil	**4**
Brake particles	**16**
Road dust	**24**
Tire particles	**86**
Diesel engine	**102**
Gasoline engine	**370**
Used motor oil	**440**

Pavement Sealcoat

- **Asphalt Based**

~ 50

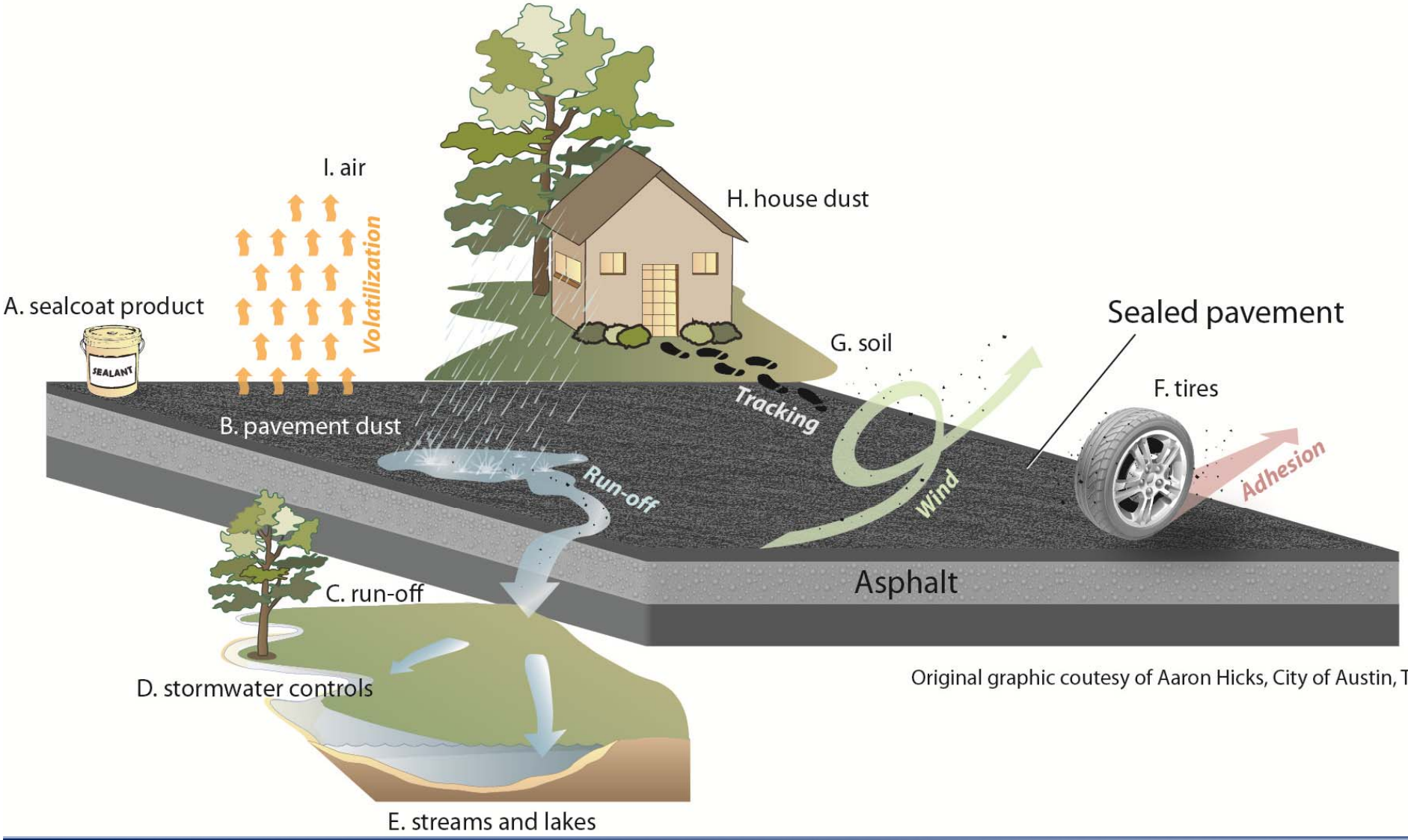
- **Coal-tar-based**

~70,000

Is use of sealcoat extensive?

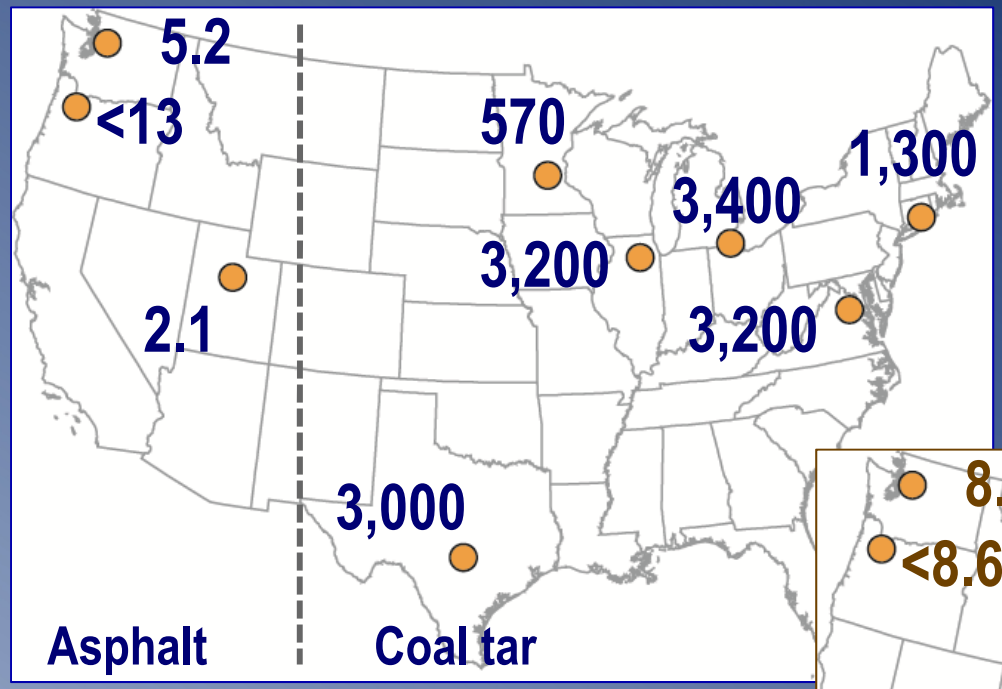
- 85 million gallons per year (per industry)
- 170 mi^2, or 110,000 ac covered

- 4 watersheds in Texas: 1-2% area
- 1 watershed in Illinois: 4% of area
  - 42% of parking lot area
  - 89% of driveway area

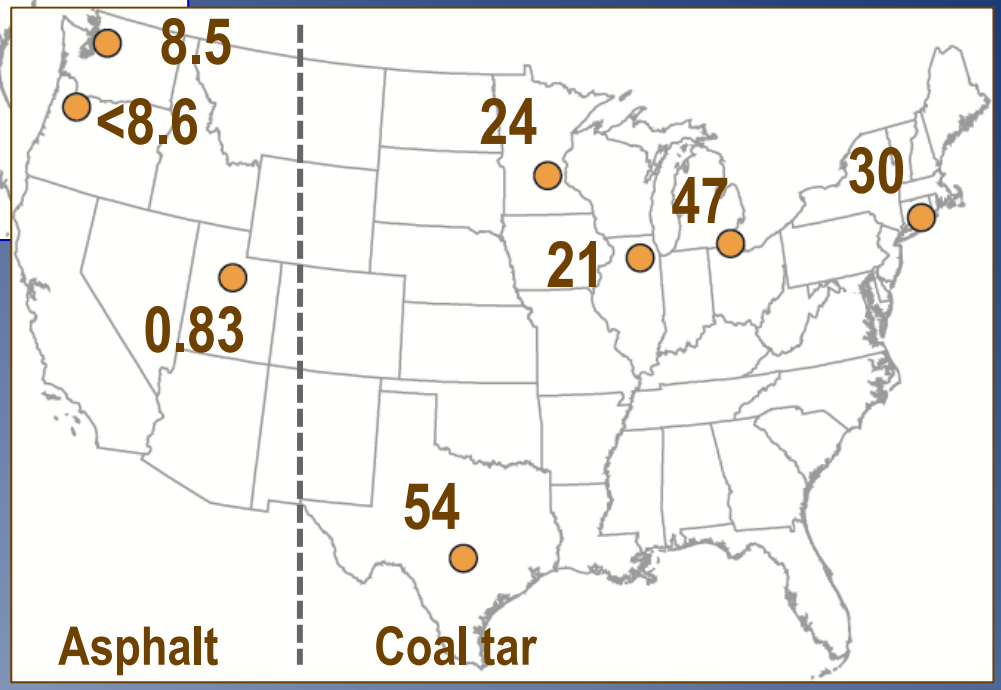


Original graphic coutesy of Aaron Hicks, City of Austin, Tex.

Sealed pavement dust
Total PAH (mg/kg)



Unsealed pavement dust



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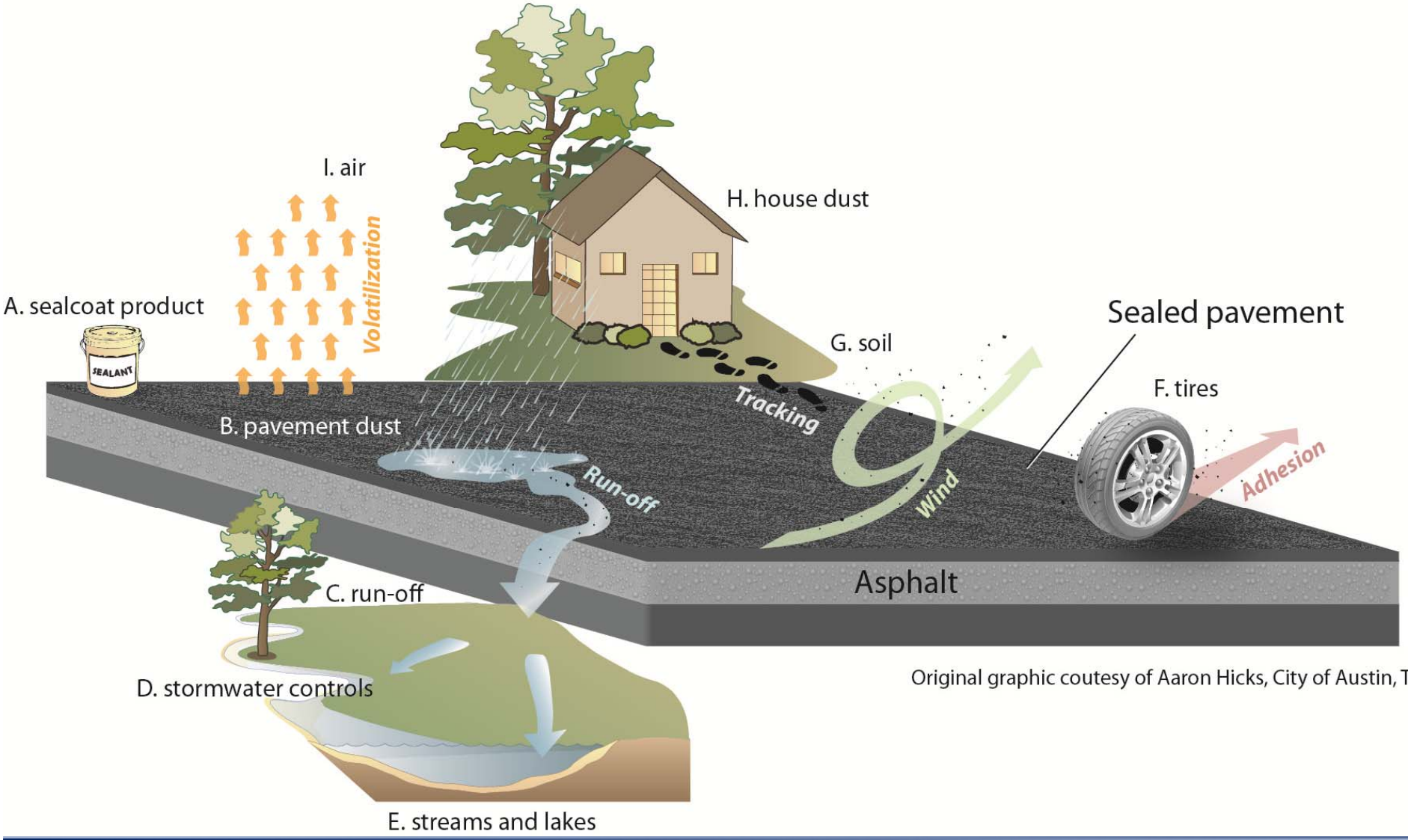
Van Metre et al., 2009, Environ. Sci. & Tech.

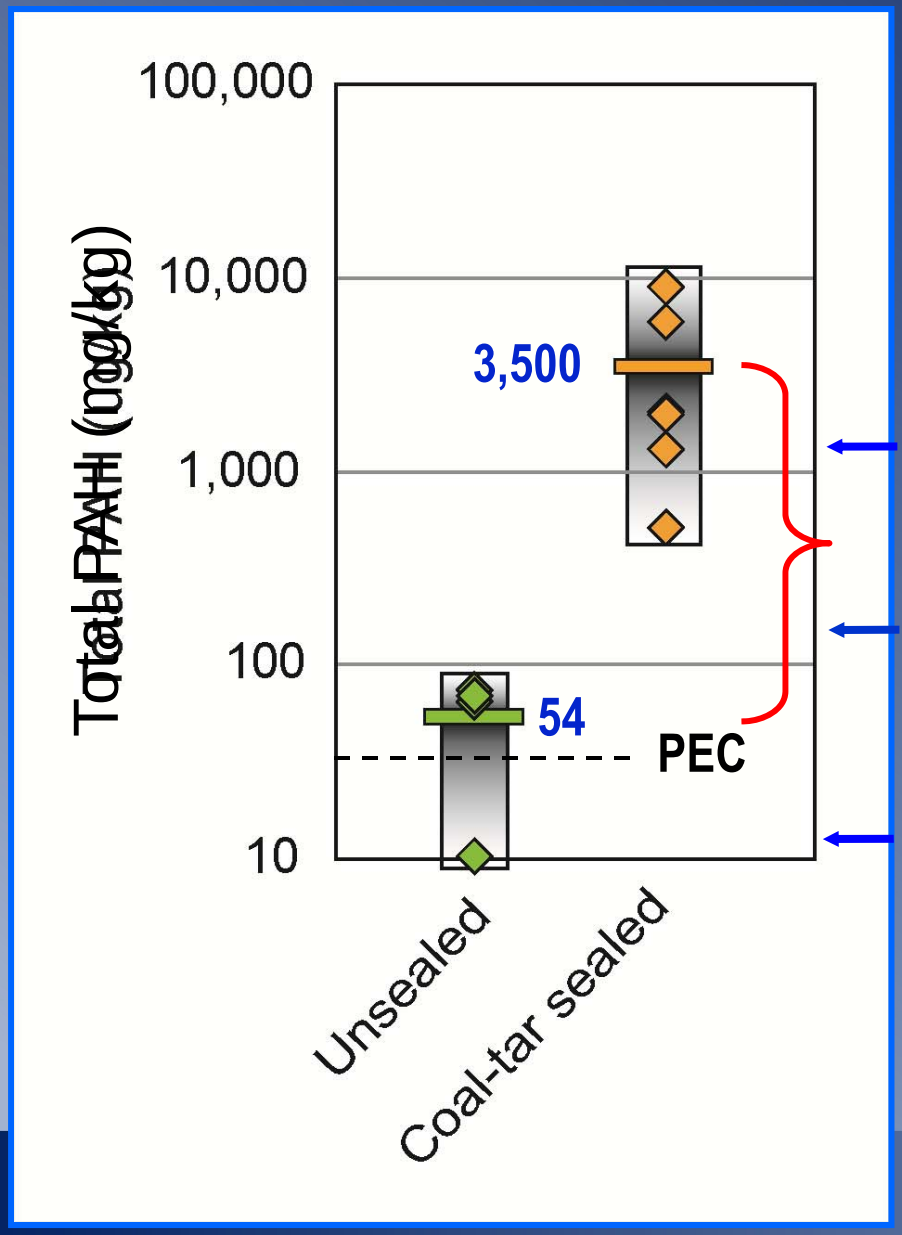


Original graphic coutesy of Aaron Hicks, City of Austin, Tex.

PAH in runoff

- Sampled runoff from 13 parking lots
- Analyzed particles and water for PAHs

PAH in particles from parking lots



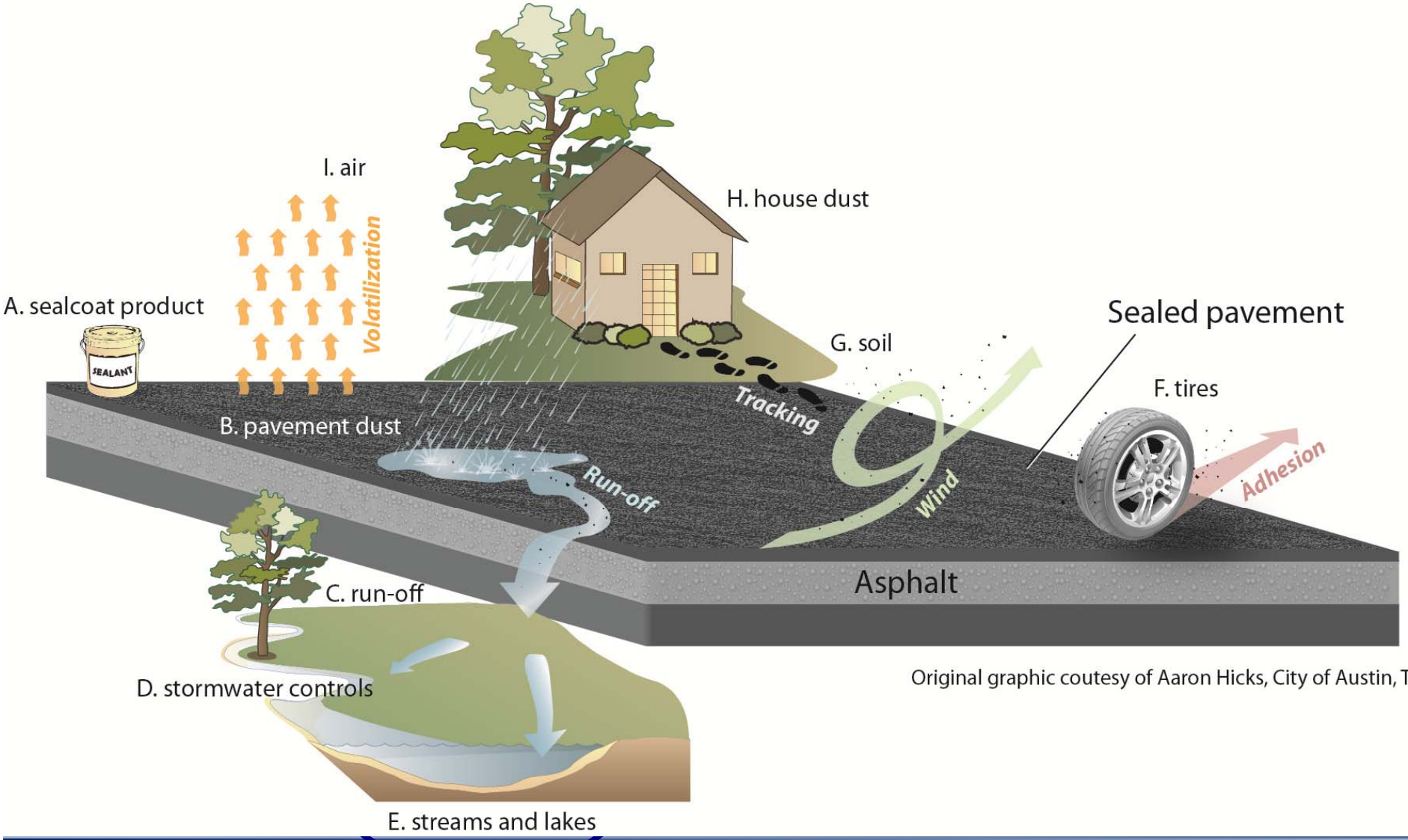
Black R. Ohio, EPA Superfund Site 1,100 mg/kg

Mean concentration is 65 times greater

Chattes River 130 mg/kg

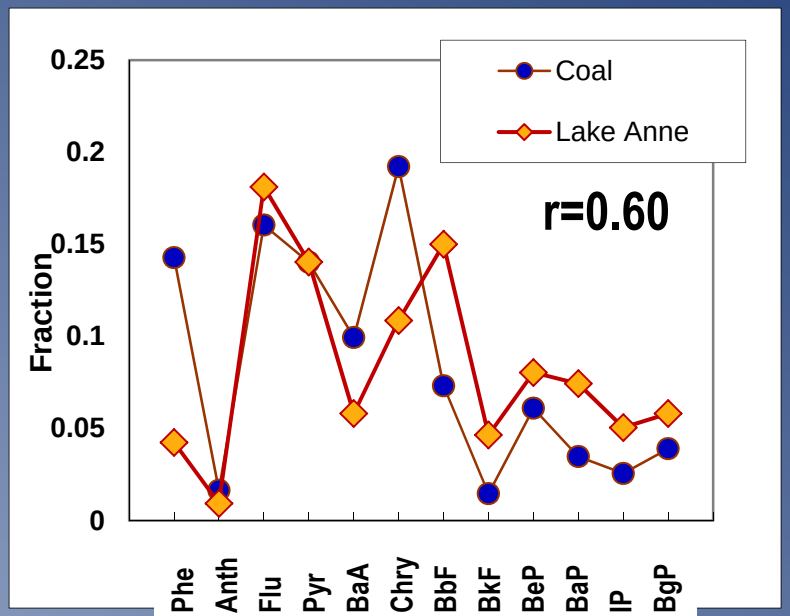
Mean Urban Lakes 12 mg/kg

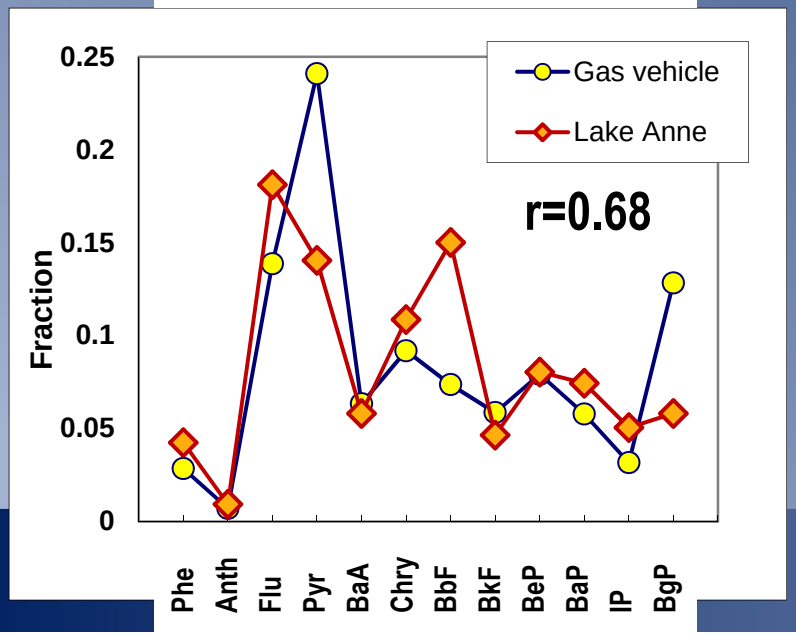
Mahler et al., 2005, Env. Sci. & Tech.

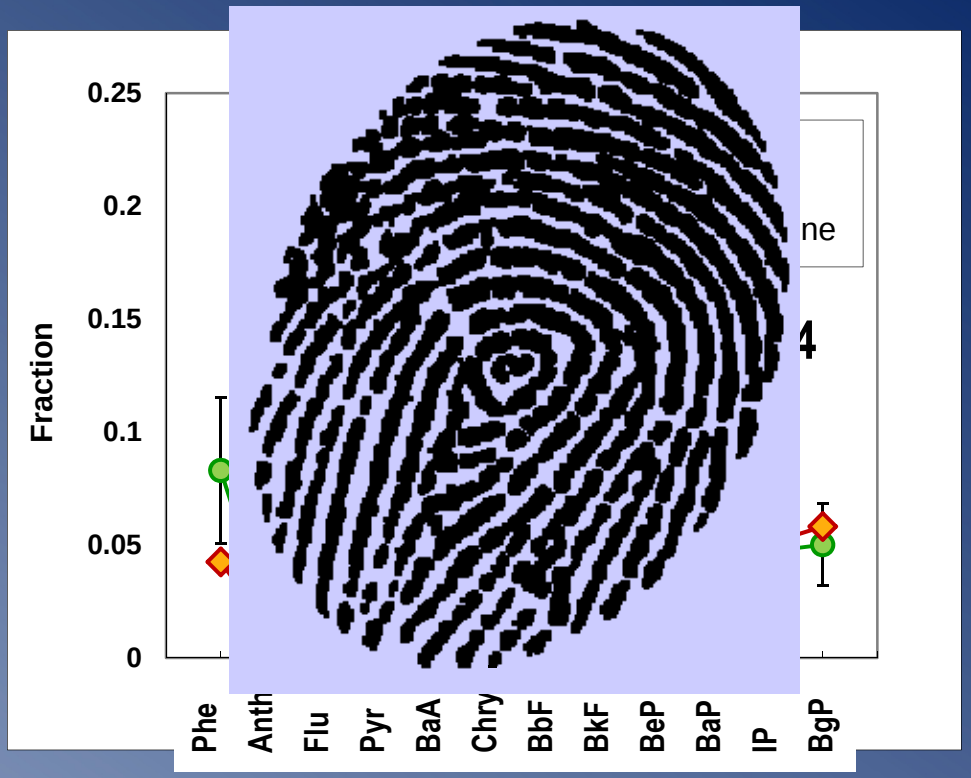


Original graphic coutesy of Aaron Hicks, City of Austin, Tex.

Environmental Forensics: PAH fingerprints







CMB* source apportionment

- **Vehicle / traffic related**

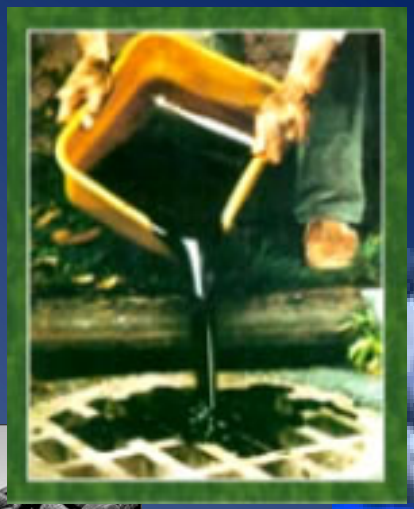
  Gasoline and diesel soot and exhaust, tunnel air, used oil, tires, asphalt wear
- **Coal combustion**

  Residential, power plant, and coking plant emissions
- **Fuel oil combustion**
- **Wood burning**

  Pine-wood soot particles
- **Coal-tar-based sealcoat**

  NIST standard, products, scrapings, and pavement dust

*EPA contaminant mass balance model



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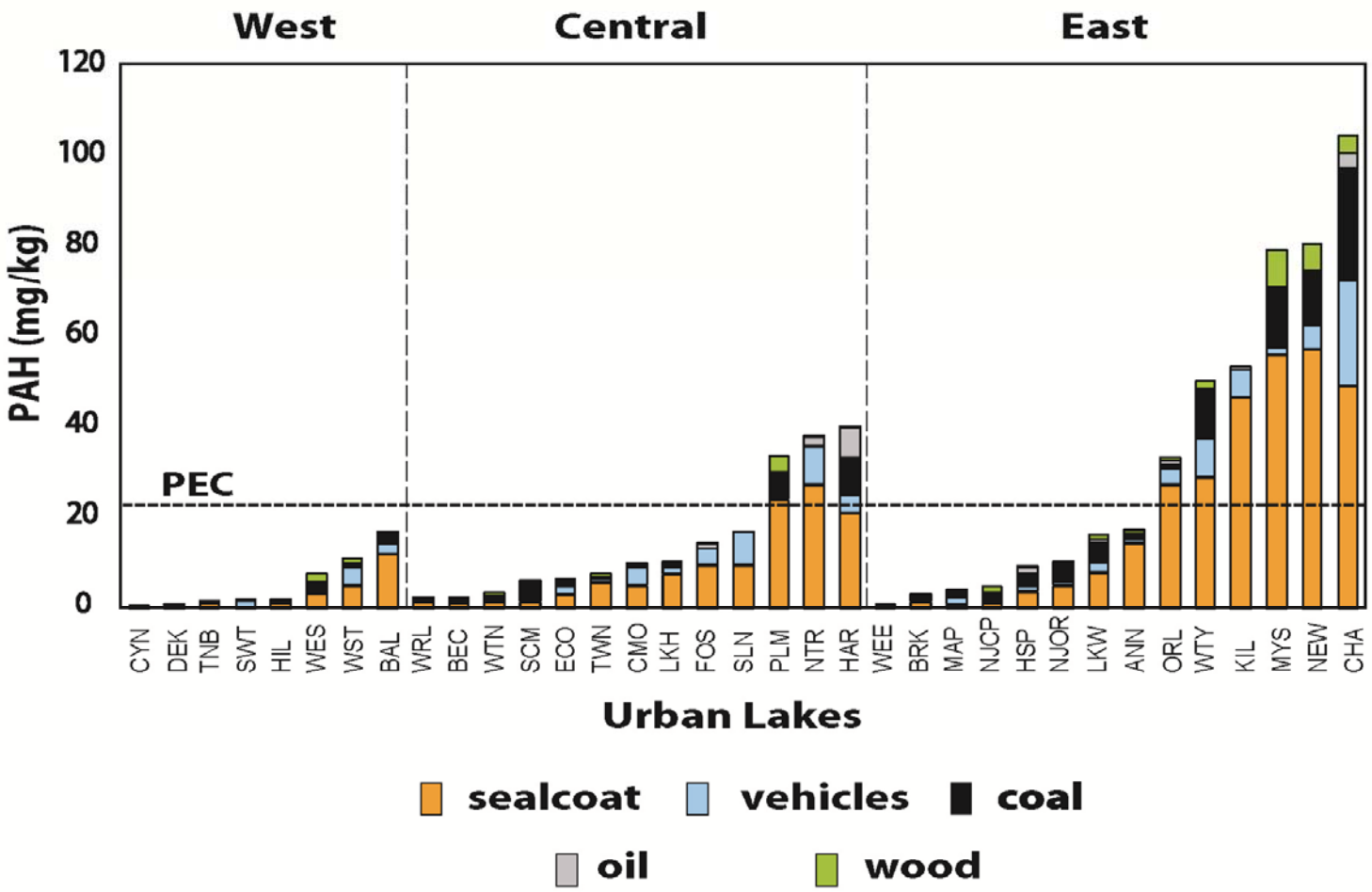
PAH sources to U.S. urban lakes



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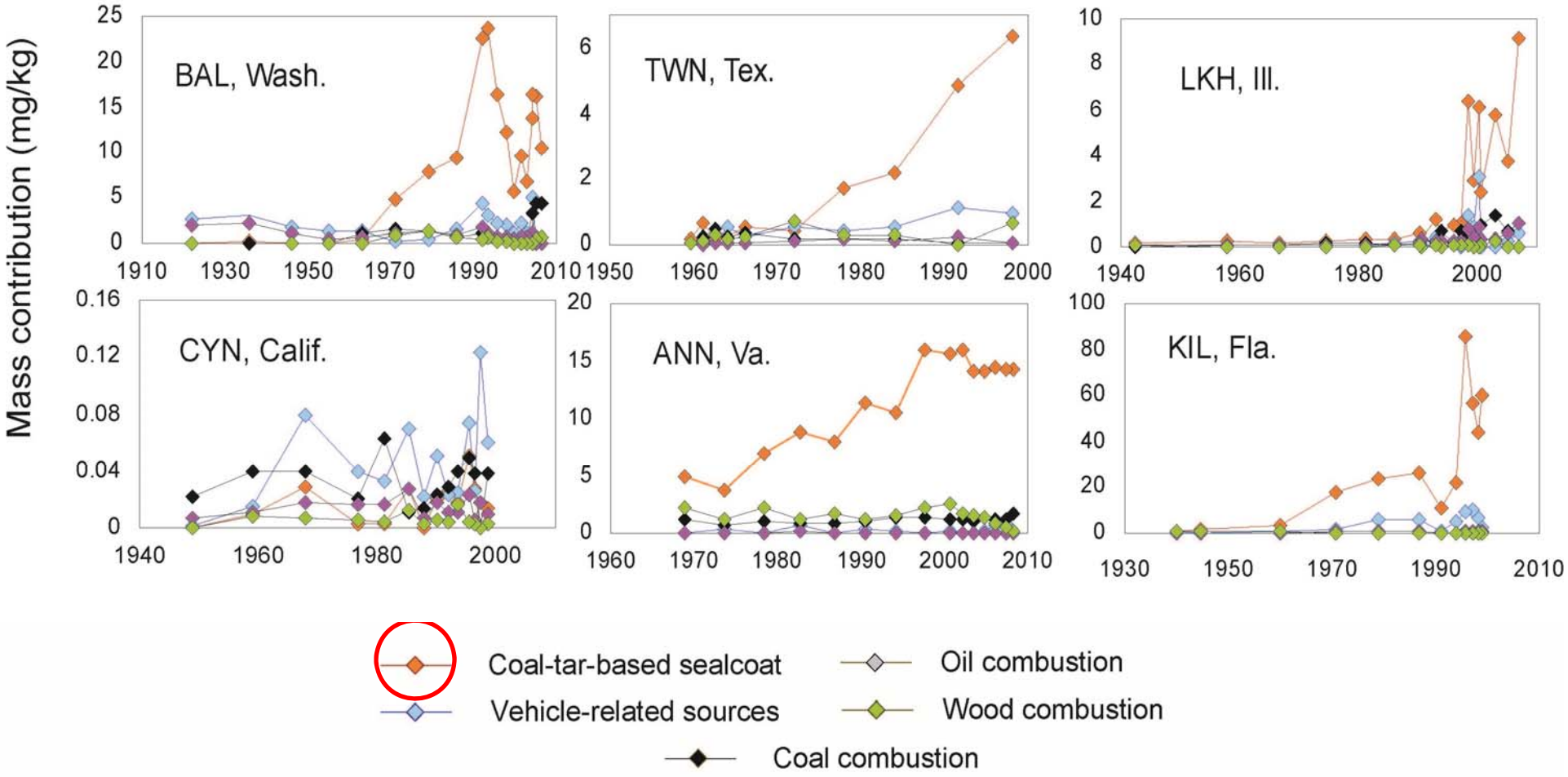
Van Metre and Mahler, 2010, STOTEN

PAH Trends in New Urban Lakes



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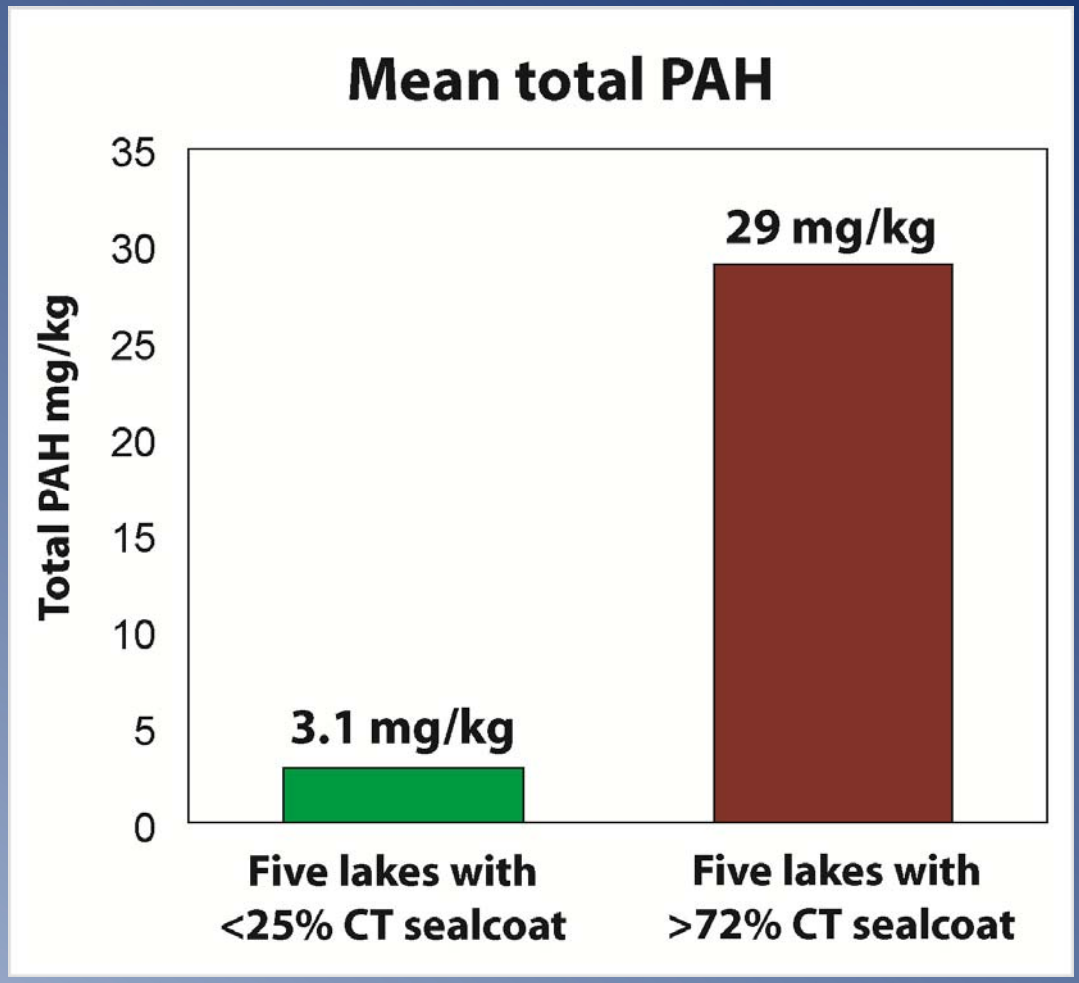
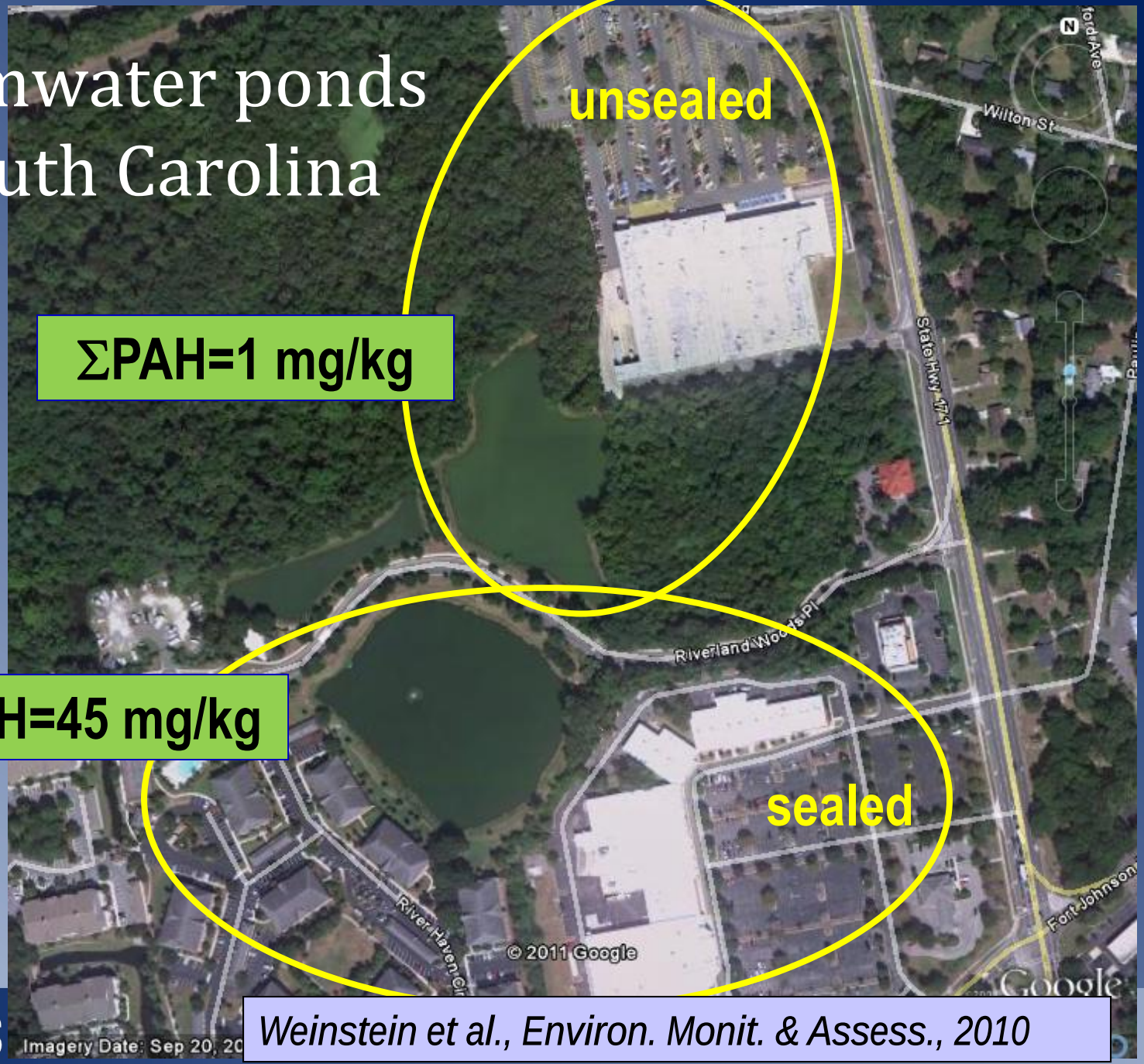
A large coal-tar-sealcoat contribution translates to high PAH concentrations



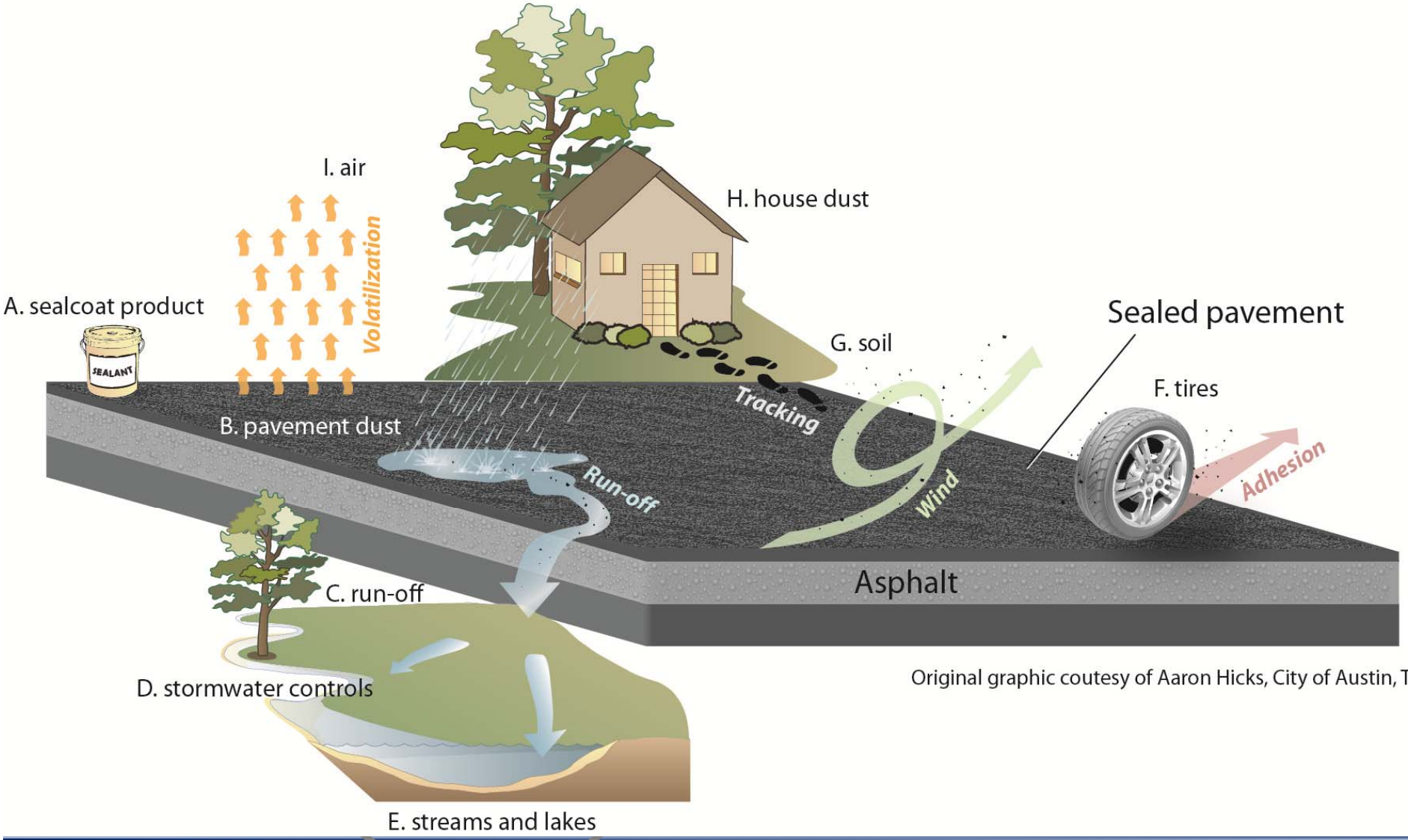
Stormwater ponds in South Carolina



Weinstein et al., Environ. Monit. & Assess., 2010

Effects on aquatic biota

Bommarito et al., 2010, Ecotoxicology
Bommarito et al., 2010, Chemosphere
Bryer et al., 2009, Environ. Poll.
Bryer et al., 2006, Ecotoxicology
Scoggins et al., 2006, J. NABS



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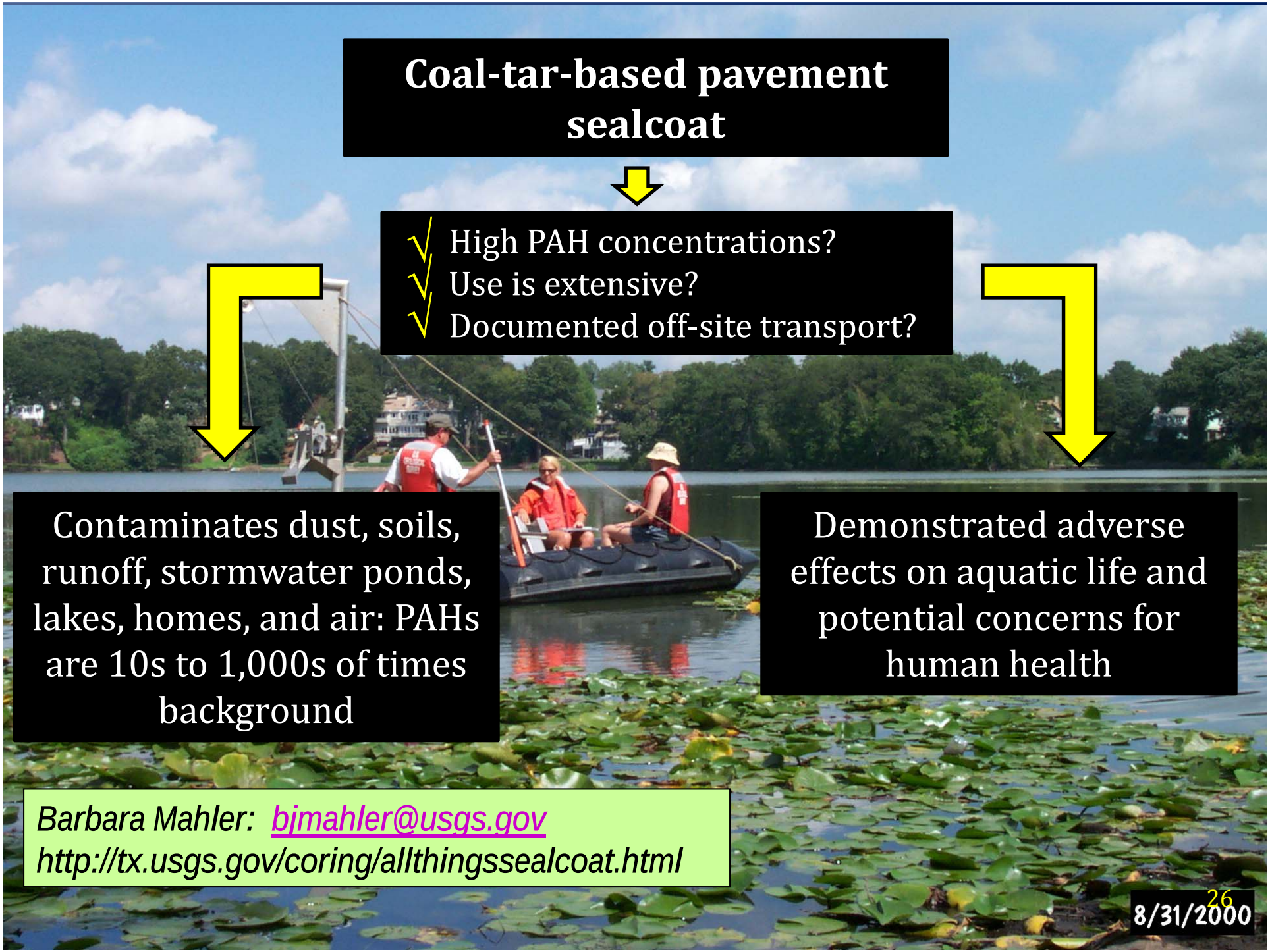
Coal-tar-based pavement sealcoat
√ High PAH concentrations?
√ Use is extensive?
√ Documented off-site transport?
Contaminates dust, soils, runoff, stormwater ponds, lakes, homes, and air: PAHs are 10s to 1,000s of times background
Demonstrated adverse effects on aquatic life and potential concerns for human health
Barbara Mahler: bjmahler@usgs.gov
http://tx.usgs.gov/coring/allthingssealcoat.html
8/31/2000