

Environmental Council of the States & EPA  
PFAS Call  
December 12, 2017

# Evaluating Historical Industrial PFOA Emissions through Air Deposition Modeling

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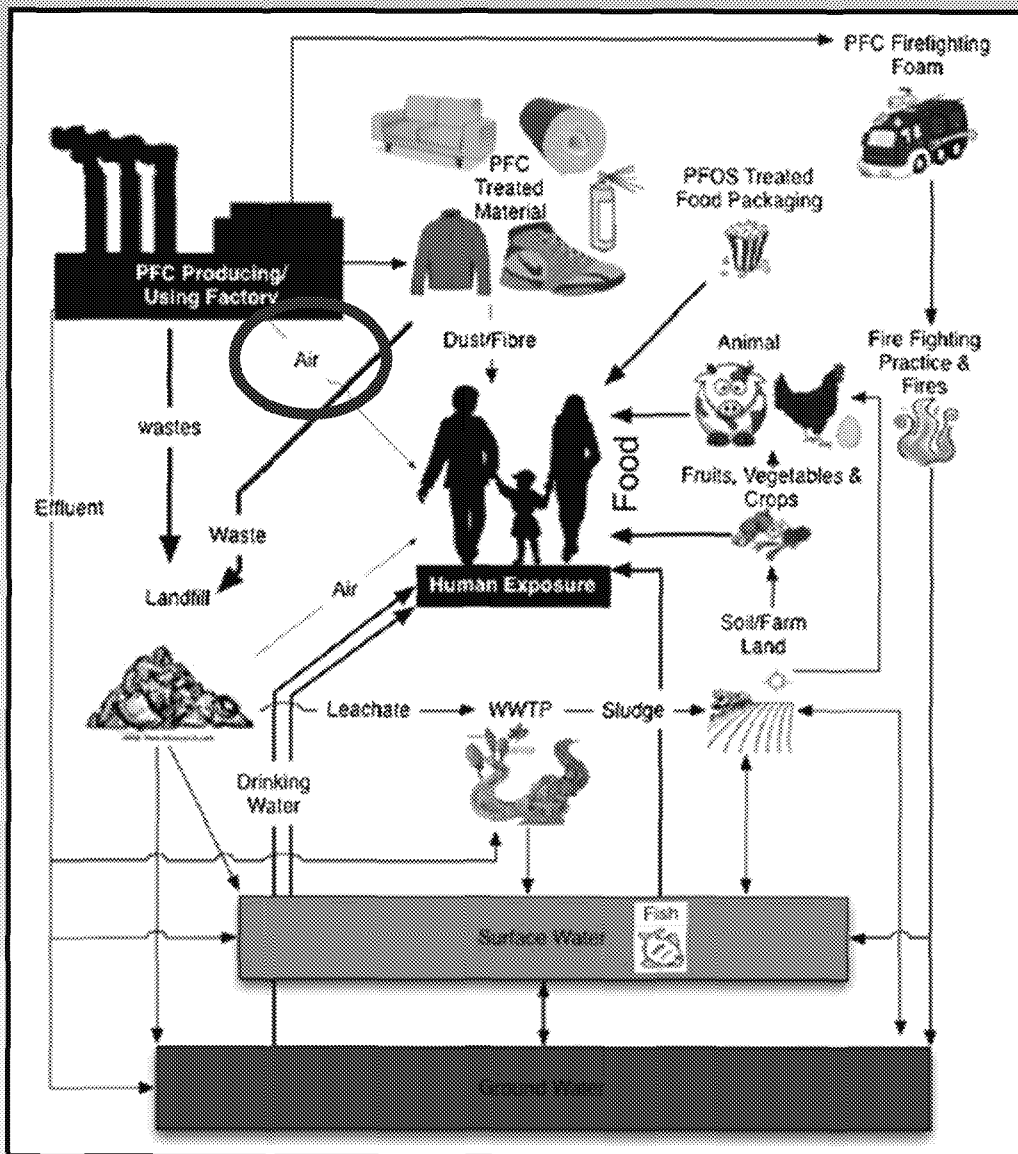


# Objectives of the Presentation

- ▶ Provide an overview of Per- and Polyfluoroalkyl Substances (PFAS)
  - Potential Sources
  - NH's Air Emission Source Experience
  
- ▶ Air Modeling for PFOA Deposition
  - Methodology
  - Inputs
  
- ▶ Lessons Learned thus far



# Possible Sources of PFAS Releases



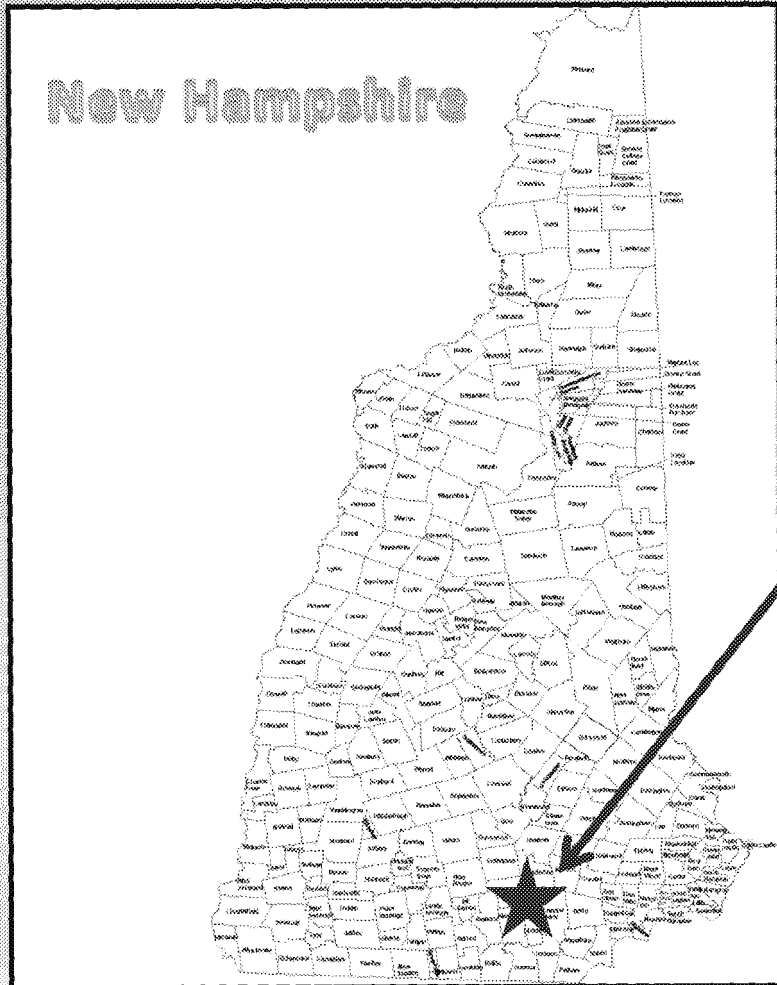
Used for decades to make products that resist heat, oils, grease, stains and water

- ▶ Textiles, Upholstery, Apparel and Carpets
- ▶ Paper, Packaging, Non Woven Fibers
- ▶ Metal Plating (mist suppressant)
- ▶ Semiconductor
- ▶ Wire Coating
- ▶ Firefighting Aqueous Film-Forming Foam

From Oliaei 2013,  
Environmental Science  
Pollution Research



# NH PFOA Air Deposition Locations



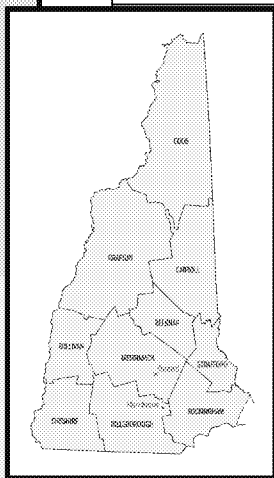
- ▶ Two glass fabric coating facilities (located in three nearby cities)
- ▶ Merrimack, Amherst, Manchester, NH
- ▶ Merrimack facility notified NHDES that PFOA had been detected in their faucet water



# NH Investigation of Potential PFAS Sources at Industrial Facilities

List of Companies for Which No Further Investigation is Deemed Necessary by NHDES  
as Part of Southern NH PFOA in Drinking Water Investigation  
(updated as of January 27, 2017)

Facility	City	Response Received	Determination <sup>1</sup>
Aero Dynamics Inc.	Seabrook	Y	No further investigation necessary
Albany Engineered Composites Inc.	Rochester	Y	No further investigation necessary
Alden Broden	Nashua	NA	Inspected 05/27/16; No further investigation necessary
Amatex Corporation	Laconia	Y	Sampling conducted; Results obtained; No further investigation necessary <sup>2</sup>
Amatex Corporation	Meredith	Y	No further investigation necessary
Chemtan Co, Inc.	Lee	Y	No further investigation necessary
Foss Manufacturing Company LLC	Hampton	Y	Sampling conducted; Results obtained; No further investigation necessary <sup>2</sup>
Hayden Kerk Motion Products	Milford	Y	No further investigation necessary
Hayden Kerk Motion Products	Hollis	Y	No further investigation necessary
Ingeniven USA	Hampton	Y	No further investigation necessary
J & E Specialty Inc	Dover	Y	No further investigation necessary
Kluber Lubrication North America L.P.	Londonderry	Y	No further investigation necessary
nt, Inc.	Dover	Y	No further investigation necessary
re Technologies	Lisbon	Y	Inspection 06/16/16; Sampling conducted; Results obtained; No further investigation necessary <sup>2</sup>
Ball Bearings Inc.	Peterborough	Y	No further investigation necessary
Ball Bearings Inc.	Laconia	NA	Inspected 05/11/16; Sampling conducted; Results obtained; No further investigation necessary <sup>2</sup>
sion CNC	Dover	Y	No further investigation necessary
	Bow	Y	No further investigation necessary
	Manchester	Y	No further investigation necessary

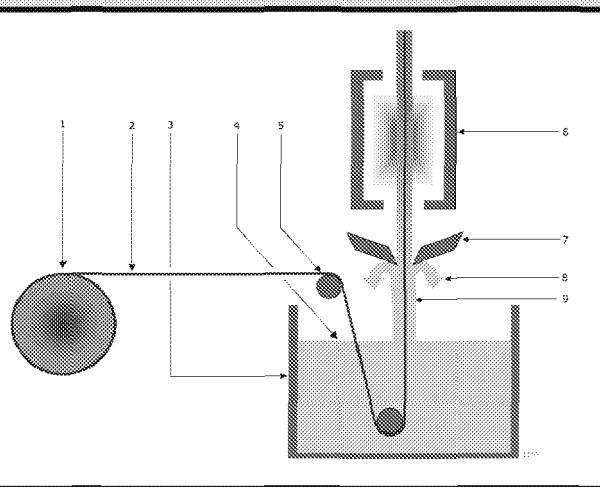


# Glass Fabric Coating Sources

## Air Emission Pathway

- ▶ Coating (dispersion) = PTFE particles + surfactants + water
- ▶ Surfactants historically contained Ammonium perfluorooctanoate (APFO)
- ▶ APFO dissociates into PFOA and ammonium ions in the dispersion
- ▶ 3 heating zones (drying, baking, fusing)
- ▶ PFOA vaporized in baking and fusing zones

▶ PFOA exits the stack



Gas-phase NMR Technique for Studying the Thermolysis of Materials: Thermal Decomposition of Ammonium Perfluorooctanoate (Krusic. et al., 2004)

Gas-phase NMR Studies of the Thermolysis of Perfluorooctanoic Acid (Krusic. et al., 2005)

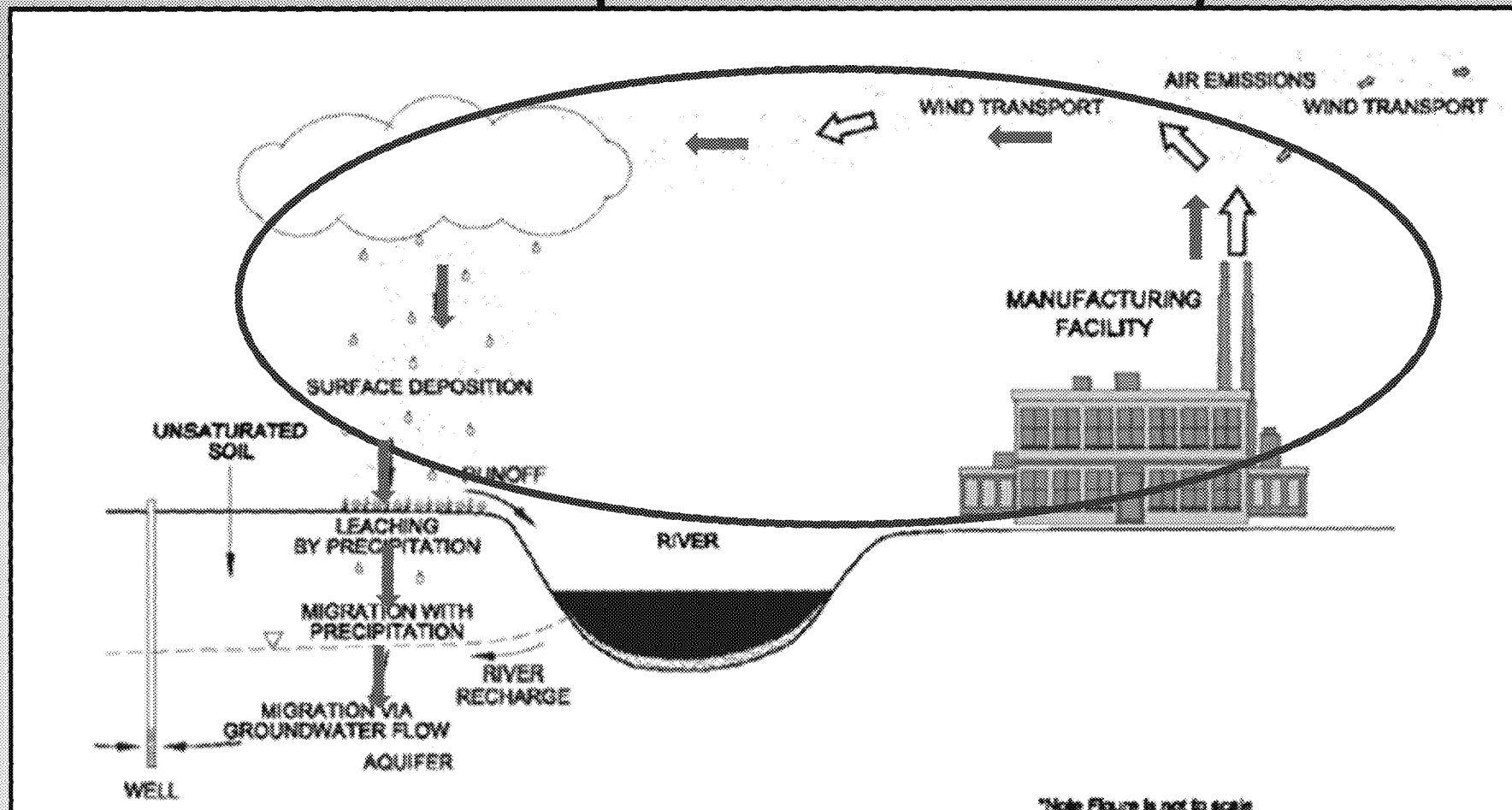


# Air Inhalation Pathway

- ▶ NH State Air Toxics Regulation (Env-A 1400)
- ▶ AAL – Ambient Air Limits
  - APFO (1997)
  - $0.050 \mu\text{g}/\text{m}^3$  (24-hr)
  - $0.024 \mu\text{g}/\text{m}^3$  (annual)
- ▶ ACGIH developed a threshold limit value (TLV) of  $0.01 \text{mg}/\text{m}^3$  (1992)
  - NHDES, EHP reviewed literature and set a Toxicity Factor and a Time Adjustment Factor based on high reproductive and development effects in rats and acute toxicity.



# Air Deposition Pathway



Davis et al., 2007, *Chemosphere*



# Air Deposition Modeling Purposes

- ▶ To identify potential areas in which to conduct additional sampling of wells to ensure the public was not consuming water above the AGQS
- ▶ To determine the geographic scope of PFOA deposition of airborne particles
- ▶ Identification of potential areas of interest to be further evaluated during the site investigation (e.g. soil or groundwater testing)

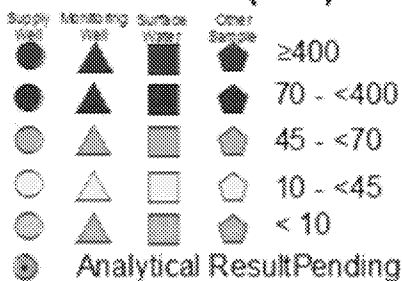




# SOUTHERN NH PFAS INVESTIGATION May 4, 2017



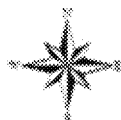
## PFOA + PFOS (PPT)



## Public Water Supplies

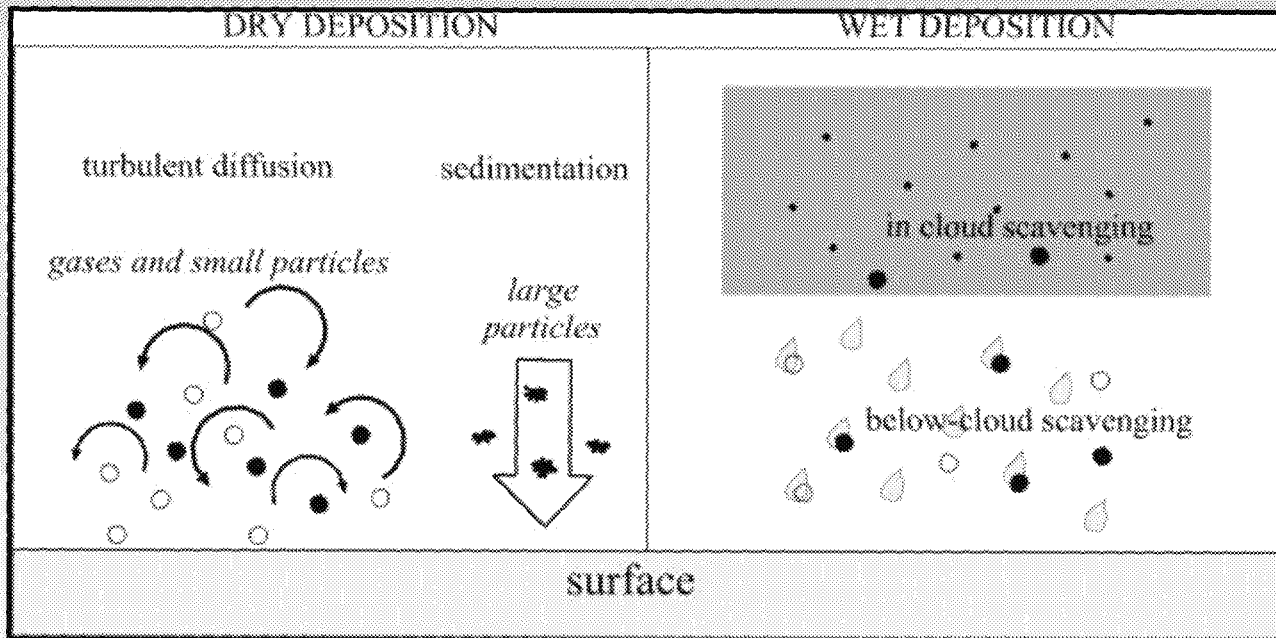


1 inch = 5,000 feet



# Modeling Methodology

- ▶ AERMOD Version 16216r (deposition modeling analysis)
- ▶ AERMET Version 15181 (processing the meteorology)
- ▶ BPIPPRM Version 04274 (building downwash analysis)
- ▶ Rural dispersion coefficients
- ▶ Dry, wet and total deposition



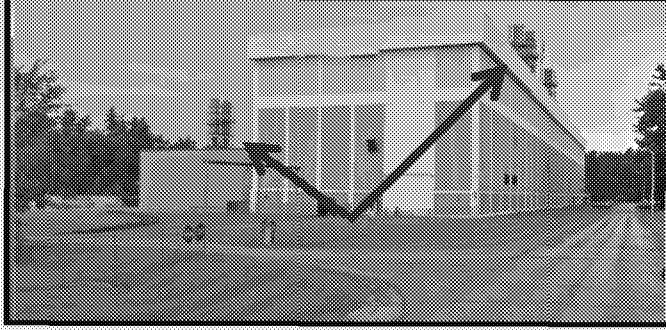
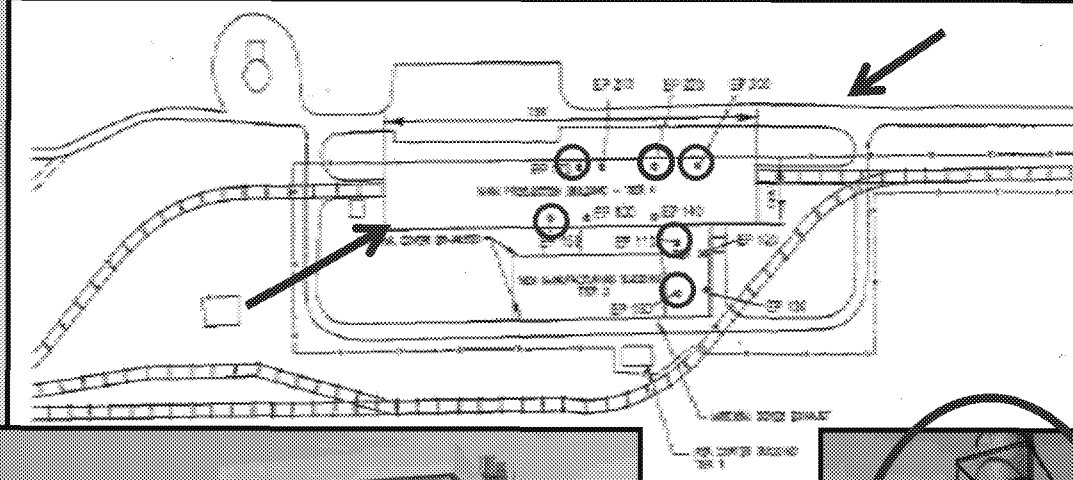
# Air Quality Modeling Inputs



- ▶ Site Characteristics (Stack and Building Parameters)
- ▶ Emission Information
- ▶ Terrain Surrounding the Emission Point
- ▶ Meteorology
- ▶ Particle Information (Density and Particle Distribution)



# Site Characteristics



Site Plan – Building, Property Boundary, Location of Stacks  
Stack Parameters – Height, Diameter, Exhaust Flow,  
Temperature, Configuration  
Emission Rates



# Air Emission Information

- ▶ Historical Raw Material Usages – Application Rates
- ▶ Hours of Operation
- ▶ Safety Data Sheet Information about Constituents
- ▶ Stack Test Data
- ▶ Dispersion Processor Material Balance Project Final Report (February, 2005)
  - Control Equipment
  - Recirculating Ovens
  - Uncontrolled

Complete report available at [www.regulations.gov](http://www.regulations.gov) Docket: EPA-HQ-OPPT-2003-0012

Agency: Environmental Protection Agency



# Emission Information Challenges

- ▶ Difficult to retrieve data back 10 -20 years ago; changes to computer data systems
- ▶ Some data no longer exists
- ▶ Reformulation means new SDS; hard to find older data
- ▶ SDS have limited data on constituents
- ▶ Changes to stack parameters (e.g. flow rates, heights?)
- ▶ New coating towers added over time; others decommissioned



# Terrain Information

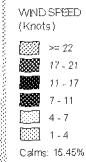
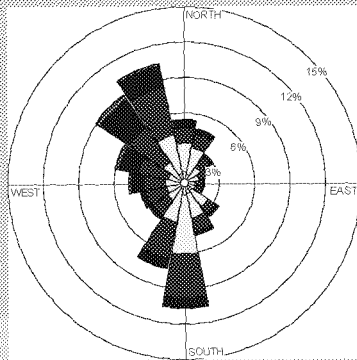
- ▶ Receptor grid spacing and size is determined.
- ▶ AERMAP (Version 11103) assigns receptor terrain elevations and hill height scales
- ▶ Plot of receptors superimposed on Google Earth images



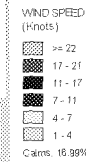
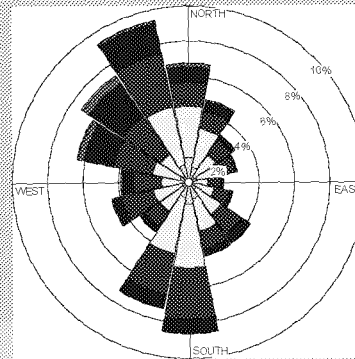
# Meteorological Information

Processed with and without AERMINUTE - Version 15272

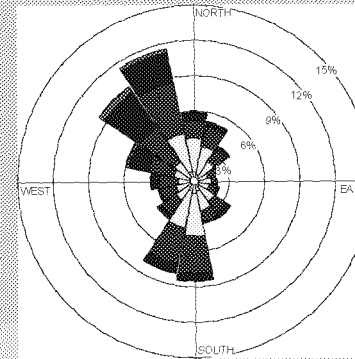
2002



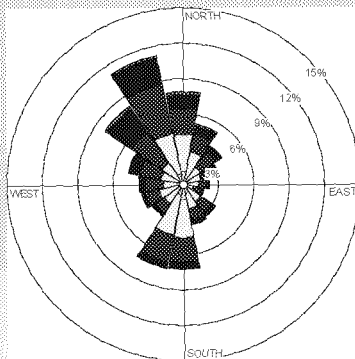
2003



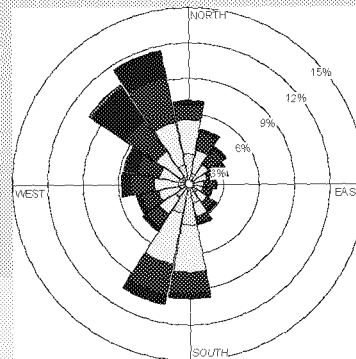
2004



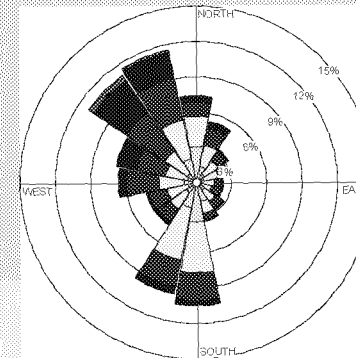
2005



2006\*



2007\*



← % calms drop →

# Method 1 vs. Method 2

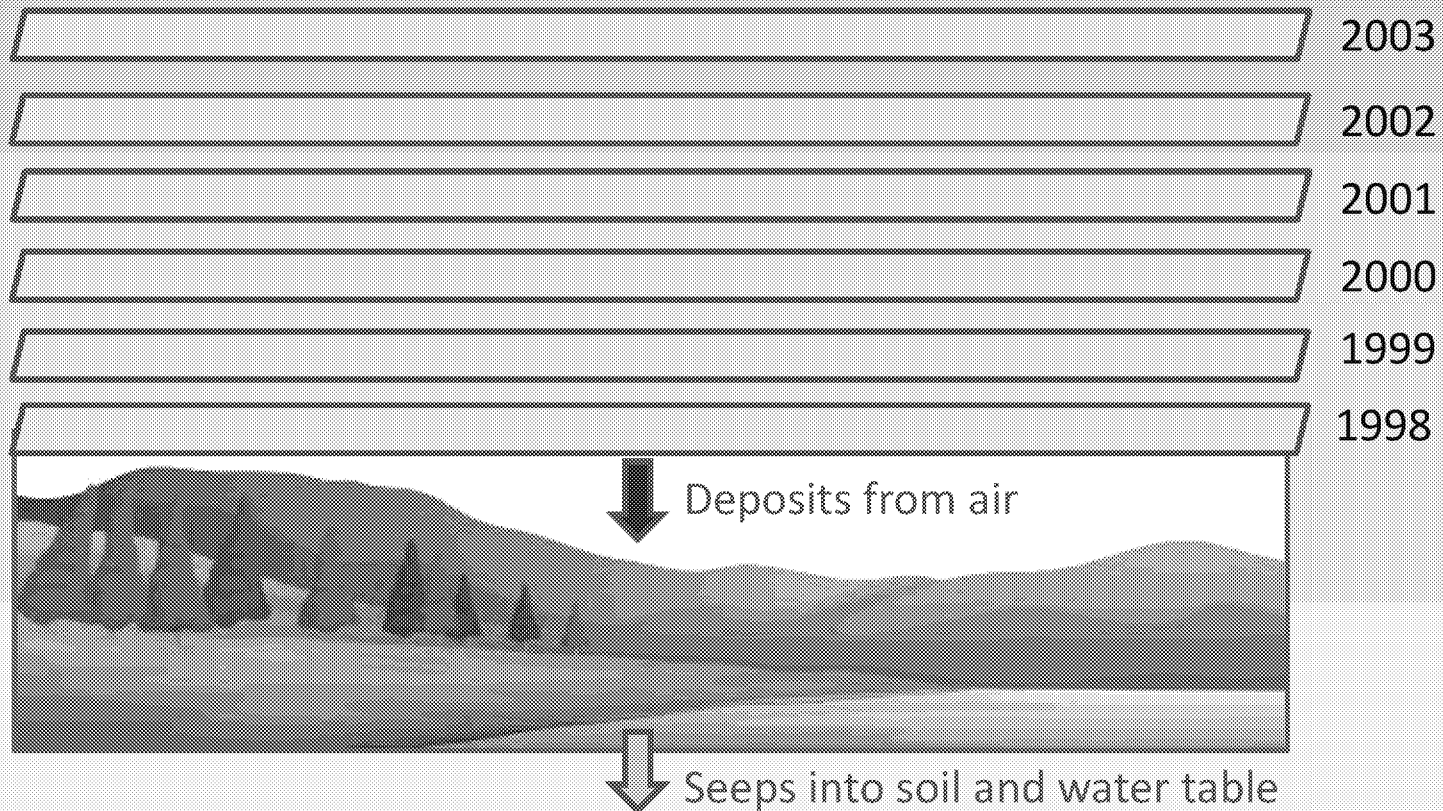
- ▶ 2 different deposition algorithms included in AERMOD
- ▶ Method 1:
  - ▶ Significant fraction ( $>10\%$ ) of total particulate mass  $10\ \mu\text{m}$  or larger
  - ▶ Particle size distribution must be reasonably well known
- ▶ Method 2:
  - ▶ Less rigorous calculation
  - ▶ Small fraction ( $<10\%$ ) of total particulate mass  $10\ \mu\text{m}$  or larger
  - ▶ Particle size distribution not well known

AERMOD Deposition Science Document  
([http://www3.epa.gov/scram001/dispersion\\_prefrec.htm](http://www3.epa.gov/scram001/dispersion_prefrec.htm)).



# Deposition is Cumulative Over Time

- ▶ Pollutant disperses into the environment
- ▶ Since the compound is stable, it doesn't break down and works into the soil and water layers
- ▶ Each year adds a new layer



# Air Modeling Programs Used for Air Dispersion Purposes

- ▶ Designed to predict areas that could have potential air quality problems (e.g. transport)
- ▶ Scenarios that may not have yet occurred (e.g. post-control installations)
- ▶ Sources not yet built (e.g. for permitting purposes)
- ▶ Typically start with conservative assumptions and use refining techniques to make more realistic
- ▶ For prediction of ambient air concentrations - well vetted



# Air Modeling Programs Used for Air Deposition Purposes

- ▶ Not heavily used in the past for deposition purposes
- ▶ Does contain algorithm for deposition
- ▶ These algorithms have not been substantially compared to actual soil data to validate
- ▶ Good for predicting where deposition may have occurred
- ▶ Less accurate for predicting how much deposition actually occurred



# Conclusions from Air Deposition Model

- ▶ Results will potentially inform:
  - Spatial patterns of deposition due to historical emissions
  - Any additional well sampling/testing campaigns
  - Conceptual site model and site investigation(s)
- ▶ Limitations:
  - Once deposited, transport fate less certain (transported in aquifers, etc.)

