



O&G Toxicology Issues

Michael Honeycutt, Ph.D.



Effects Screening Levels

- Chemical-specific level in air set to prevent short-term and long-term health effects and nuisance odor conditions
- New guidelines November 2006
 - External scientific peer review
 - 2 rounds public comment
- Used in air permitting and for evaluating air monitoring data



ESL Averaging Time

■ Short-Term

- 1 hour
- Health, odors, vegetation
- Compare 1 hour air monitoring samples; instantaneous & 24 hour air monitoring samples with caution
- Ethanol = CNS effects

■ Long-Term

- Lifetime
- Health, vegetation
- Cancer, Non-cancer
- Compare at least annual averages of air monitoring data; longer time periods more appropriate
- Ethanol = Liver, reproductive, cancer



Monitoring vs. Permitting

- Health-based value (ReV) = AMCV
- Health-based value $\times 0.3$ = Permitting ESL
- Noncarcinogens adjusted for cumulative (aggregate) exposure



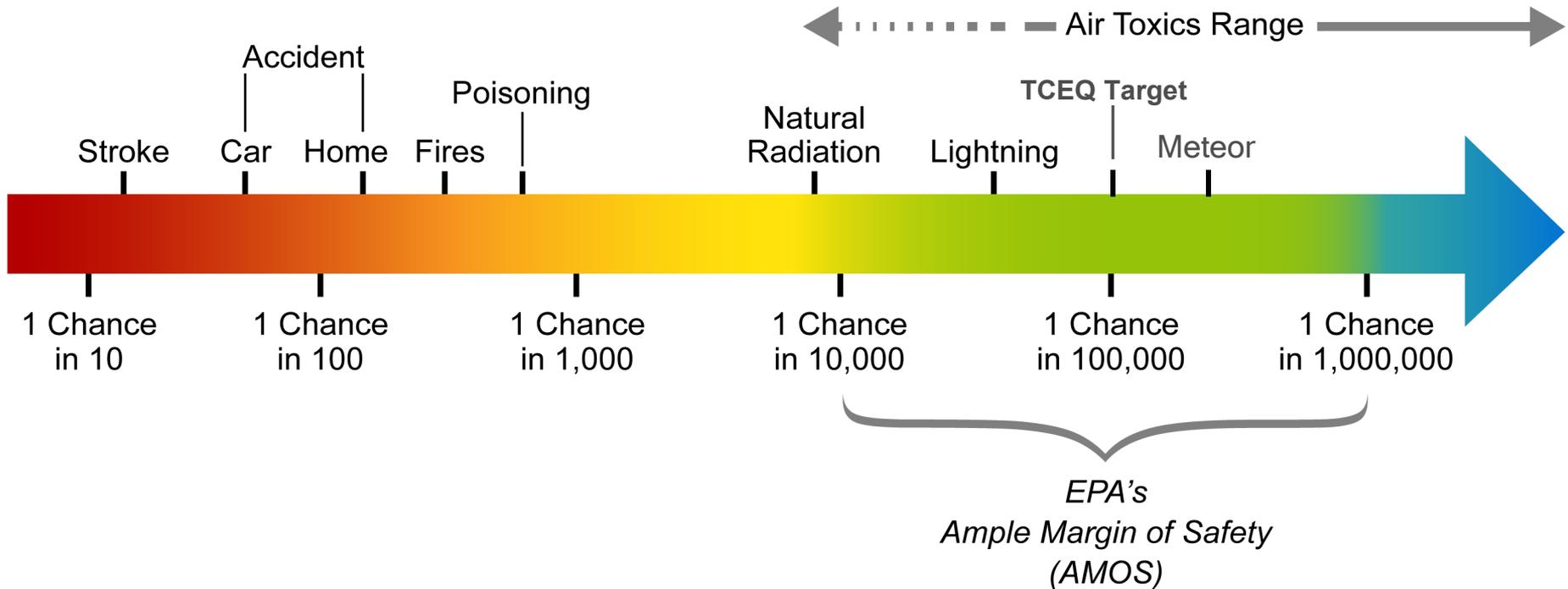
Carcinogens

- No cumulative adjustment
- Rarely permit more than 1 known human carcinogen
- Set at 1 in 100,000 theoretical cancer risk level
- 1 in 10,000 is upper bound of acceptable range



Risk Perspective

(Range of Lifetime Risk of Fatality Compared with AMOS)



Adapted from U.S. EPA 450/3-90-022, Mar. 1991, http://www.epa.gov/air/oaqps/air_risc/3_90_022.html (1996)

M07176b



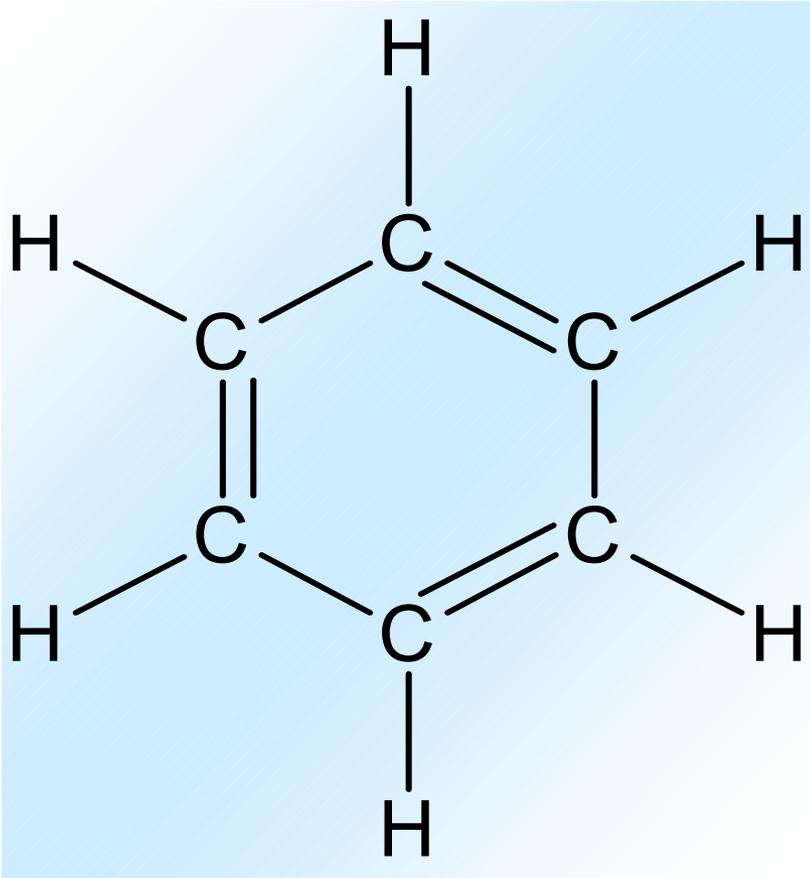
Carcinogens

- “Acceptable” =
1 in 10,000 to
1 in 1 million
- Set at 1 in
100,000 cancer
risk level
- In toxicology, an
order of
magnitude is a
big jump

Benzene annual ESL	Risk Level
14 ppb	10^{-4}
1.4 ppb	10^{-5}
0.14 ppb	10^{-6}



What is Benzene?



- Clear, sweet-smelling liquid at room temperature
- Highly flammable
- Evaporates into the air very quickly
- Very common - in the top 20 of chemicals produced in the United States
- Rapidly degraded in the atmosphere
- **Known human carcinogen**



Benzene Exposure

- Benzene is ubiquitous
- Stricter air regulations have led to significant decreases in benzene levels over the last several decades
- Major sources are
 - Petrochemical industry
 - Motor vehicles
 - Cigarettes
- Indoor concentrations are around twice as high as outdoor concentrations



Table 4. Derivation of the Acute ReV and ^{acute}ESL

Study	Rozen et al. (1984), supported by Dempster and Snyder (1991) and Corti and Snyder (1996)
Study population	C57BL/6J mice (male)
Study quality	medium-high
Exposure Methods	6 h per day for 6 days via inhalation from 0 to 301 ppm
LOAEL	10.2 ppm (average analytical concentration)
NOAEL	None
Critical Effects	depressed peripheral lymphocytes and depressed mitogen-induced blastogenesis of femoral B-lymphocytes
POD	10.2 ppm (LOAEL)
Exposure Duration	6 h
Extrapolation to 1 h	TCEQ (2006) default procedures with n=3
POD _{ADJ} (extrapolated 1 h concentration)	18.5 ppm
POD _{HEC}	18.5 ppm (RGDR = 1)
Total Uncertainty Factors (UFs)	100
<i>Interspecies UF</i>	3
<i>Intraspecies UF</i>	10
<i>LOAEL UF</i>	3
<i>Incomplete Database UF</i> <i>Database Quality</i>	1 high
acute ReV [1 h] (HQ = 1)	580 µg/m³ (180 ppb)
^{acute}ESL [1 h] (HQ = 0.3)	170 µg/m³ (54 ppb)



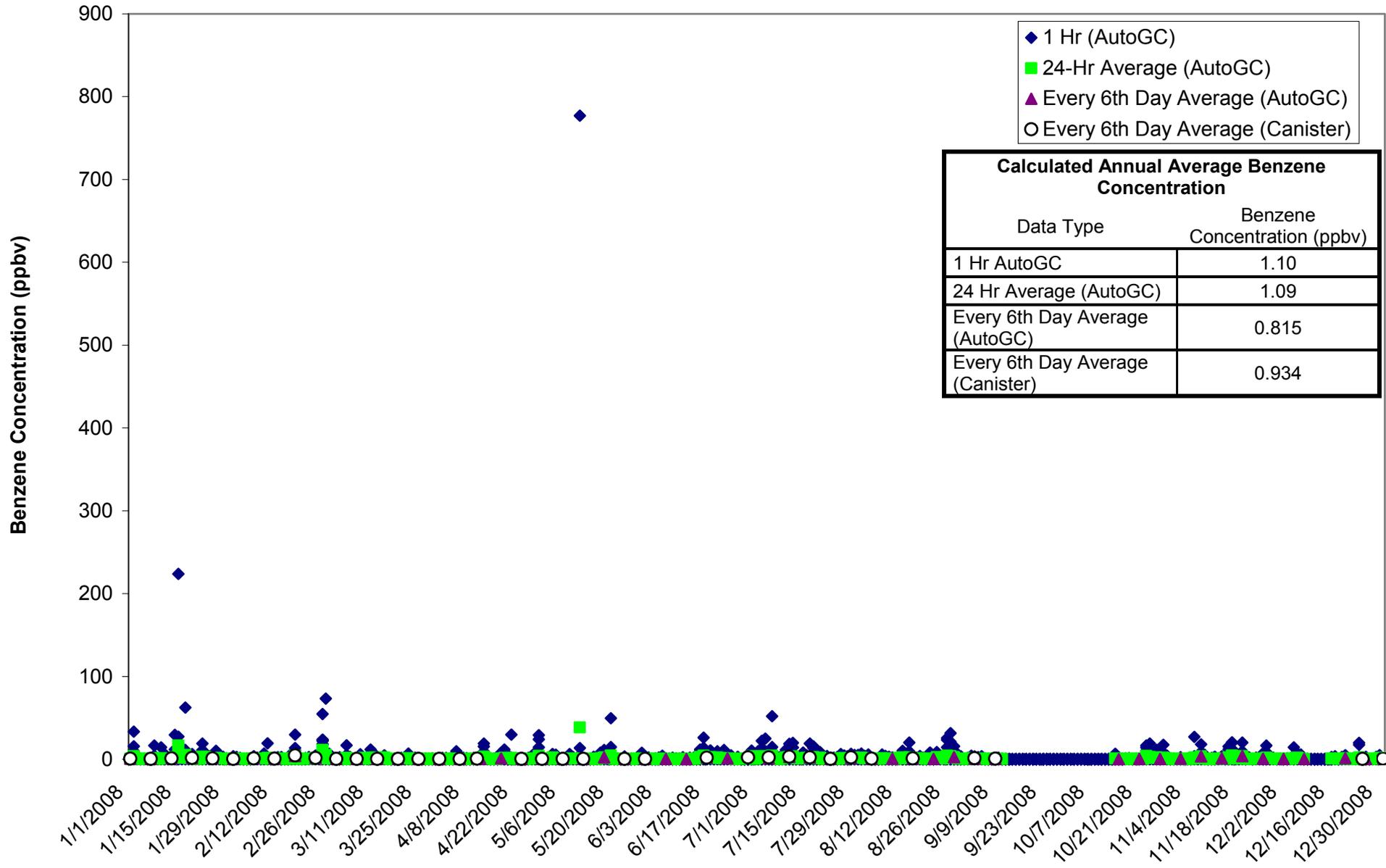
Carcinogenic Evaluation

- Pliofilm Cohort (3 factories in Ohio) from Rinsky, et al. (1981, 1987) with Crump (1994) exposure estimates
- Acute myelogenous and monocytic leukemia (AMML)
- Linear multiplicative risk model and life-table analyses using the BEIR IV approach (NRC 1988)
- Weighted cumulative exposure metric with US background mortality rates (95% UCL on β)
- 1.4 ppb at 10^{-5} risk



Auto-GC vs. Canister Data

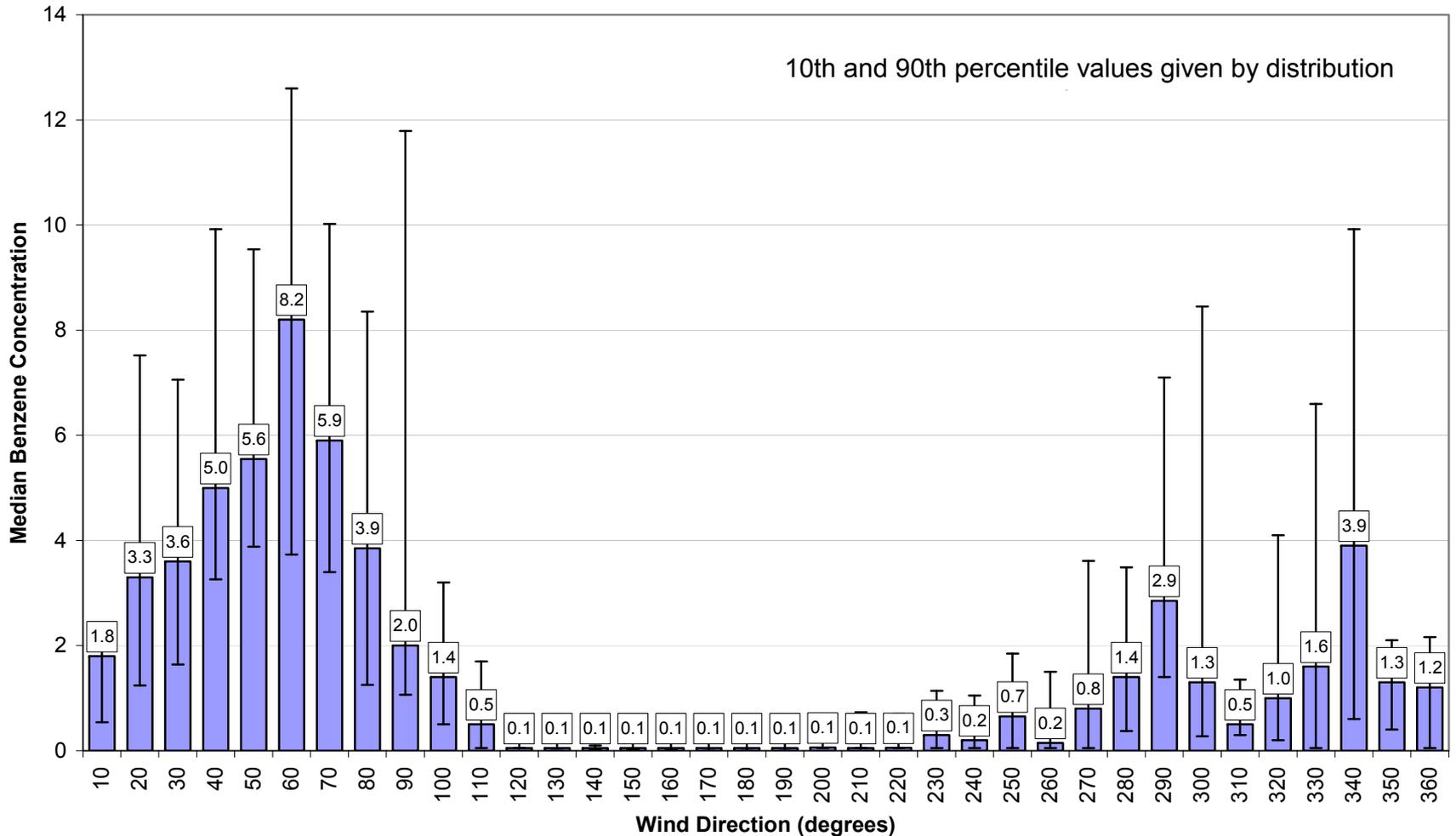
Benzene Concentrations at Different Samplers at the Lynchburg Ferry Monitoring Site, 2008



Calculated Annual Average Benzene Concentration	
Data Type	Benzene Concentration (ppbv)
1 Hr AutoGC	1.10
24 Hr Average (AutoGC)	1.09
Every 6th Day Average (AutoGC)	0.815
Every 6th Day Average (Canister)	0.934

Value of Auto-GC Data

Median Benzene Concentration by 5-min Wind Direction
URS Huisache St. Site
June 18 through July 28, 2003



N

E

S

W

N

Lynchburg Ferry

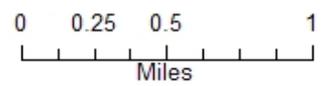
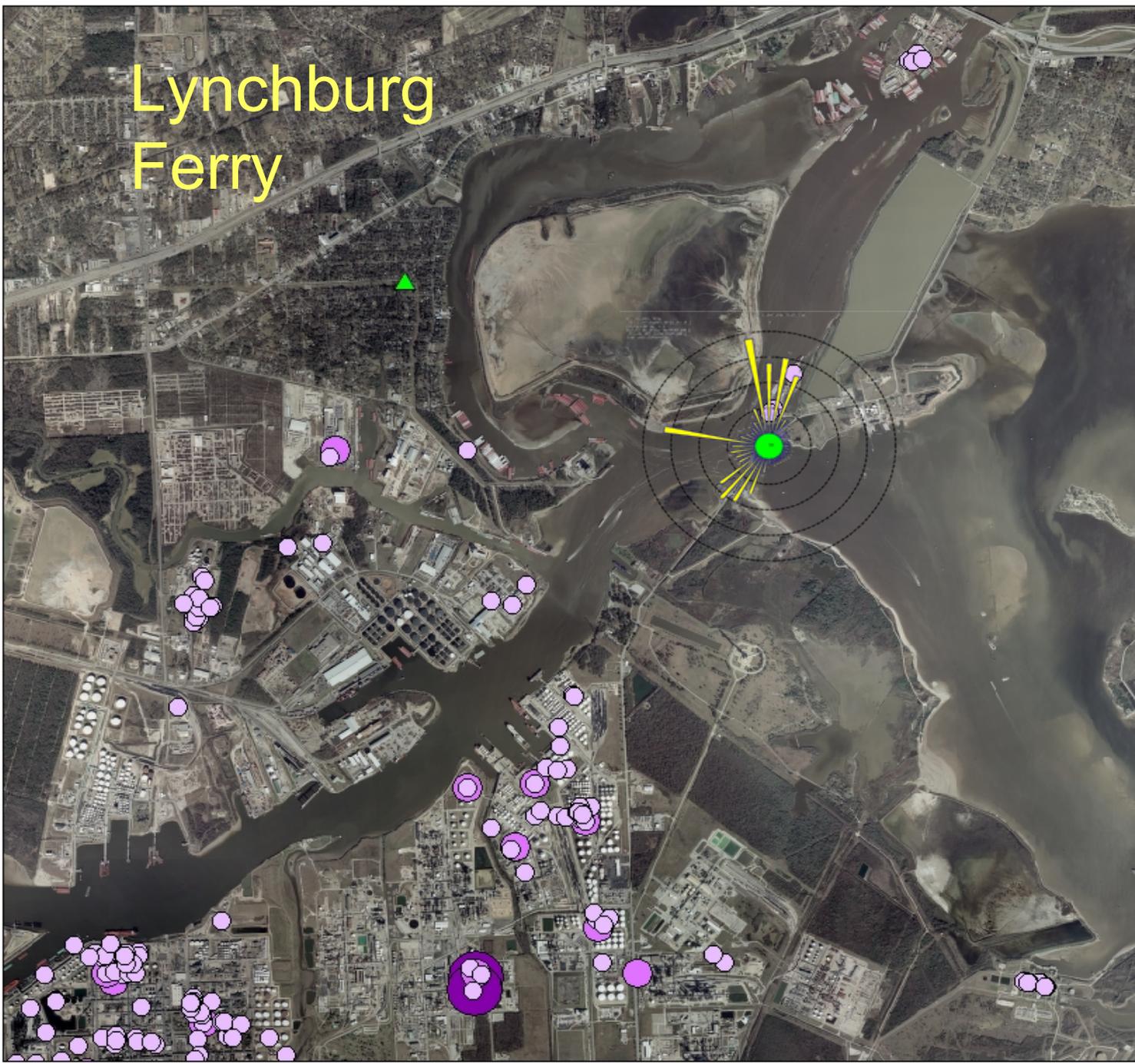
Legend

BENZENE 2006 EI

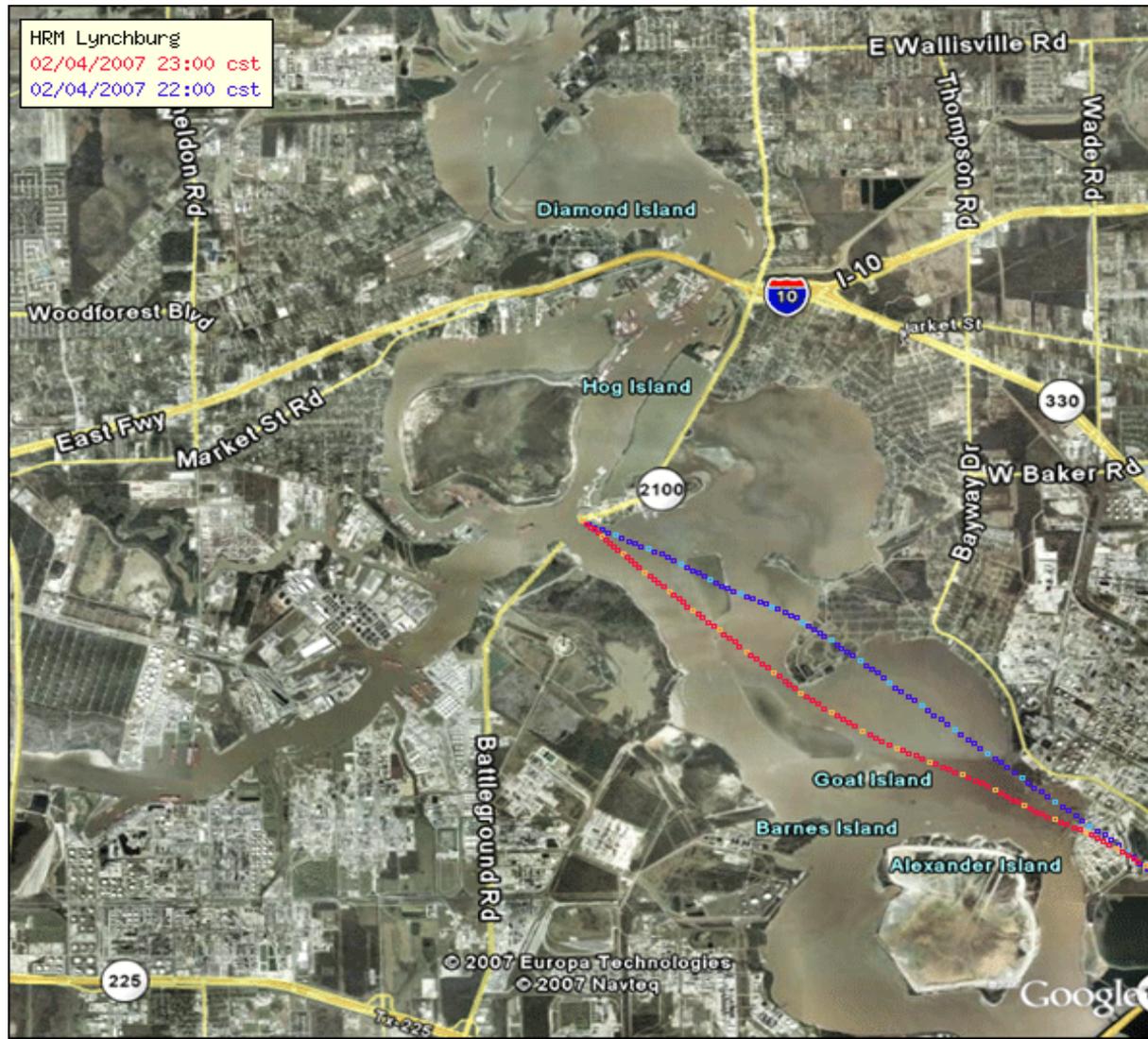
Annual TPY

- 0.0000 - 1.0000
- 1.0001 - 3.0000
- 3.0001 - 10.0000
- 10.0001 - 20.0000

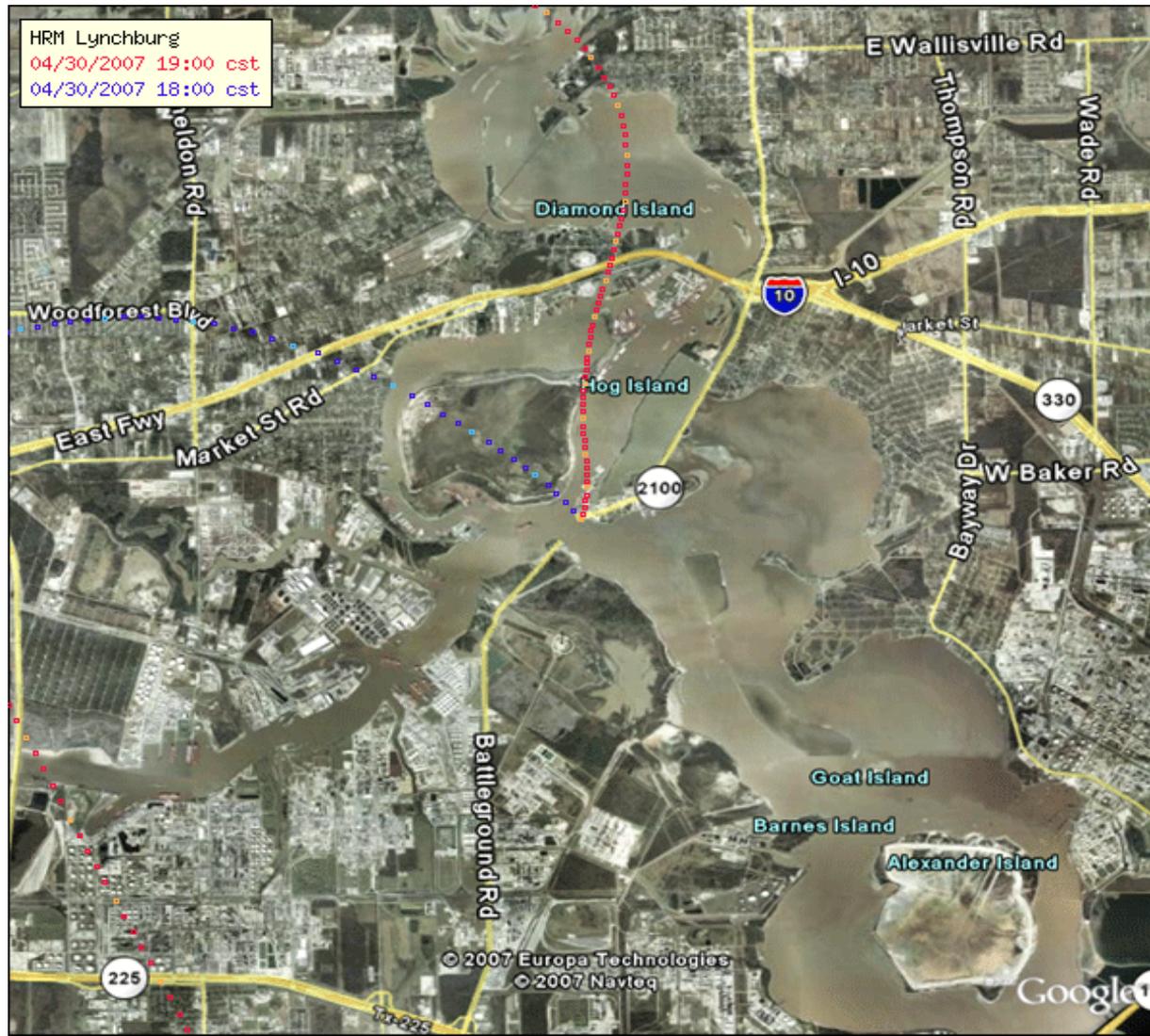
▲ Air Monitoring Sites



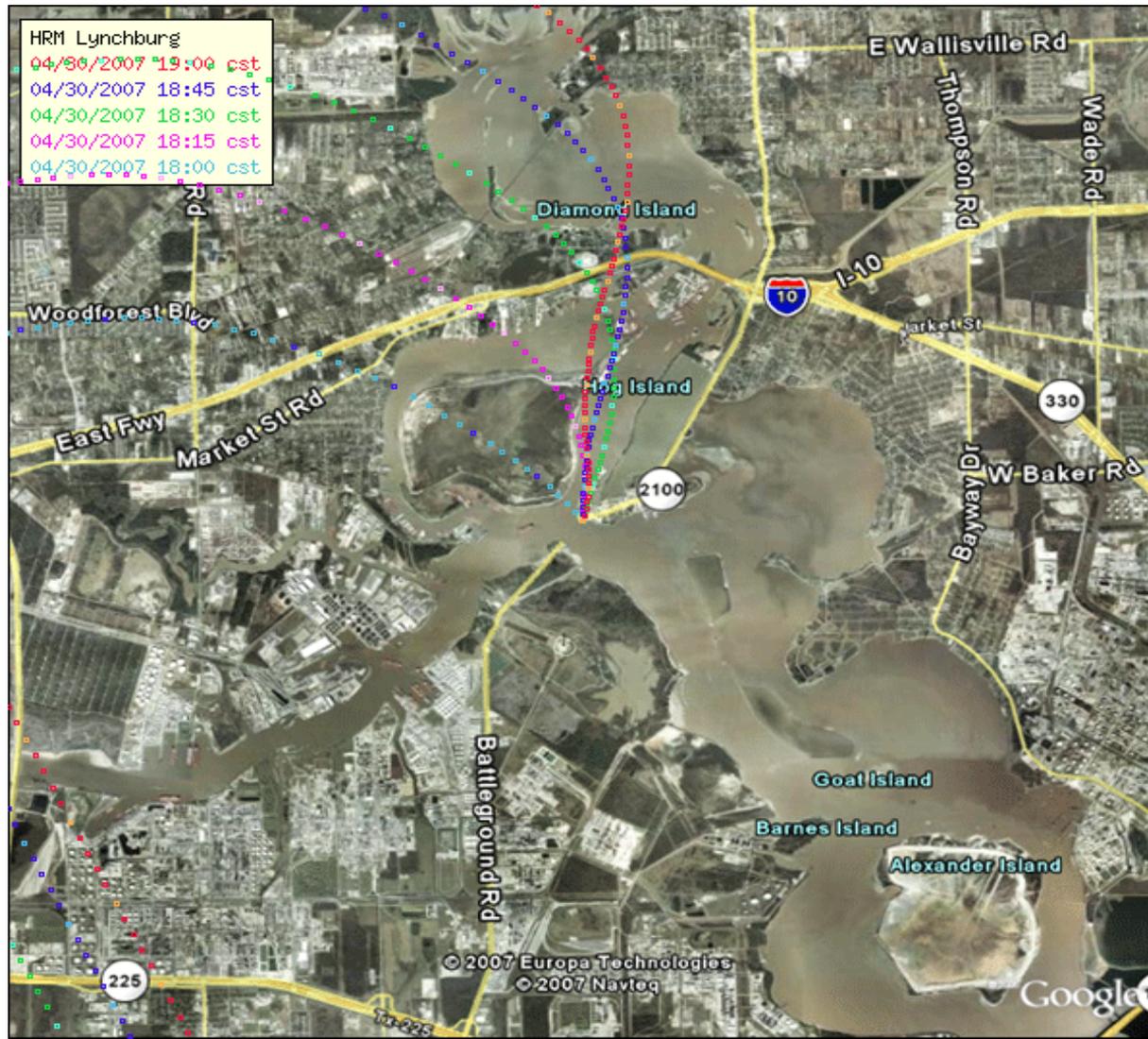
Back Trajectory Lynchburg Monitor, February 04, 2007, 110 ppb-v



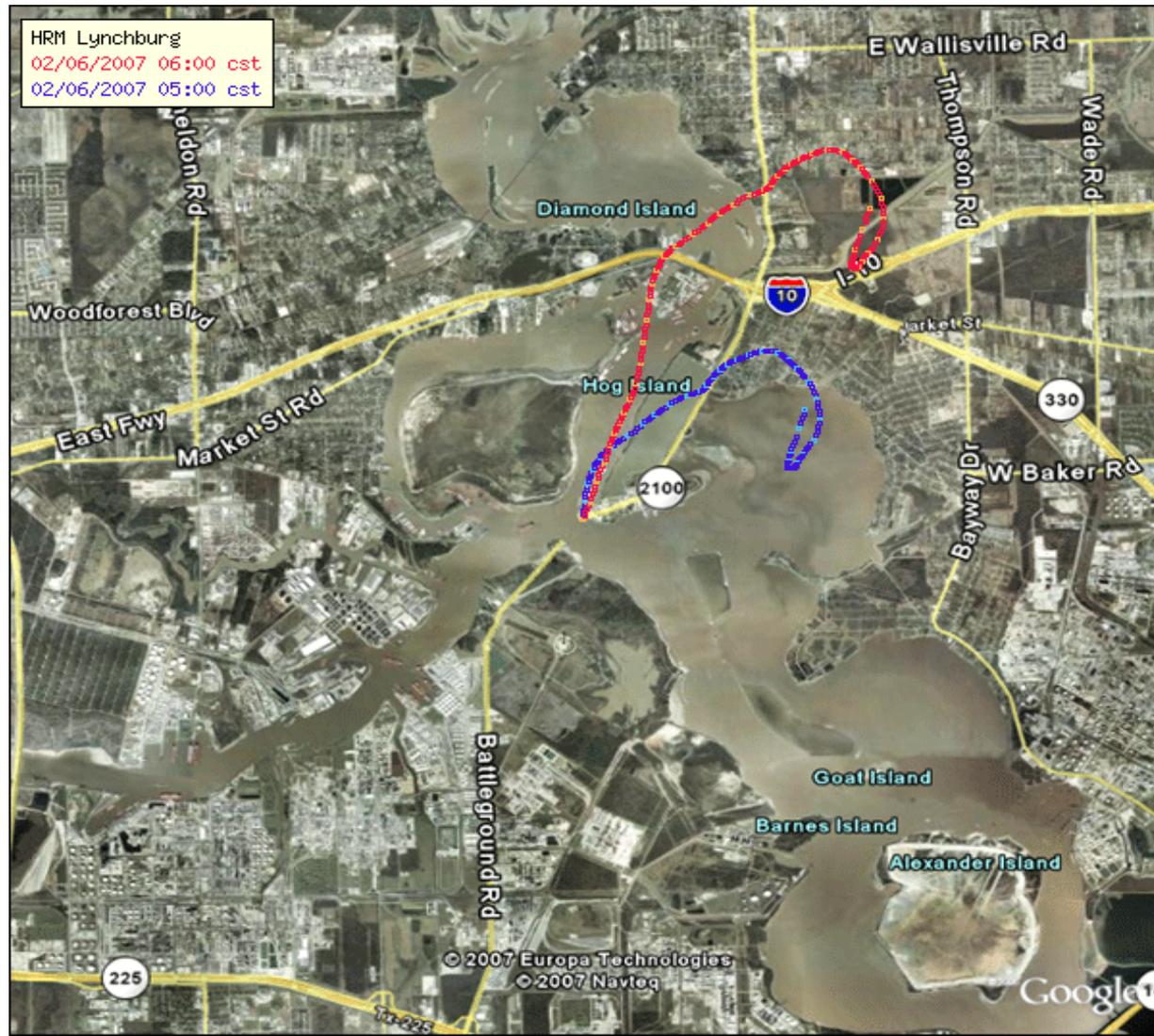
Back Trajectory Lynchburg Monitor, April 30, 2007, 213 ppb-v



Back Trajectory Lynchburg Monitor, April 30, 2007, 213 ppb-v



Back Trajectory Lynchburg Monitor, February 06, 2007, 184 ppb-v



Carbon Disulfide Comparison Values (ppb)

Agency	Short-Term	Long-Term
TCEQ	10	1
USEPA	13,000 (2,240)*	224
ATSDR	---	300
Cal EPA	2,325	300
Canada	---	32

*EPA School Monitoring Program

