



Emissions from Oil and Gas Operations and Potential Human Health Risk

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How is the Air Evaluated?

- Federal Values
 - NAAQS
 - EPA RfCs & URFs; ATSDR MRLs
- Texas Developed Air Values
 - Effects Screening Levels (ESLs) – Air permitting
 - Air Monitoring Comparison Values (AMCVs) – Air monitoring



Evaluating Risk from Air Emissions

- Short-Term
 - 1 hour
 - Health, odors, vegetation
 - Compare instantaneous, 1 hour air monitoring samples; 24 hour air monitoring samples with caution
- Long-Term
 - Lifetime
 - Health, vegetation
 - Cancer, Non-cancer
 - Compare at least annual averages of air monitoring data to long-term AMCVs



Air Monitoring in Texas

- Mobile Monitoring and Regional Investigations

- Short-term Data

- Surveys

- GasFind IR camera
- MiniRAE, AreaRAE, TVA
- Jerome H₂S analyzer

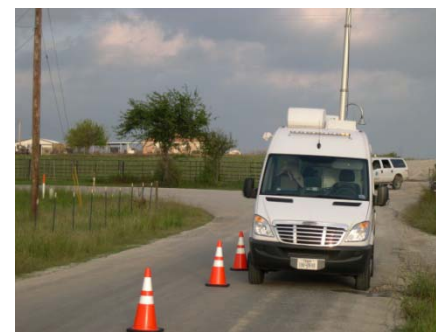


- Summa Canisters (instantaneous, 30-minute, 1-hour)

- VOCs

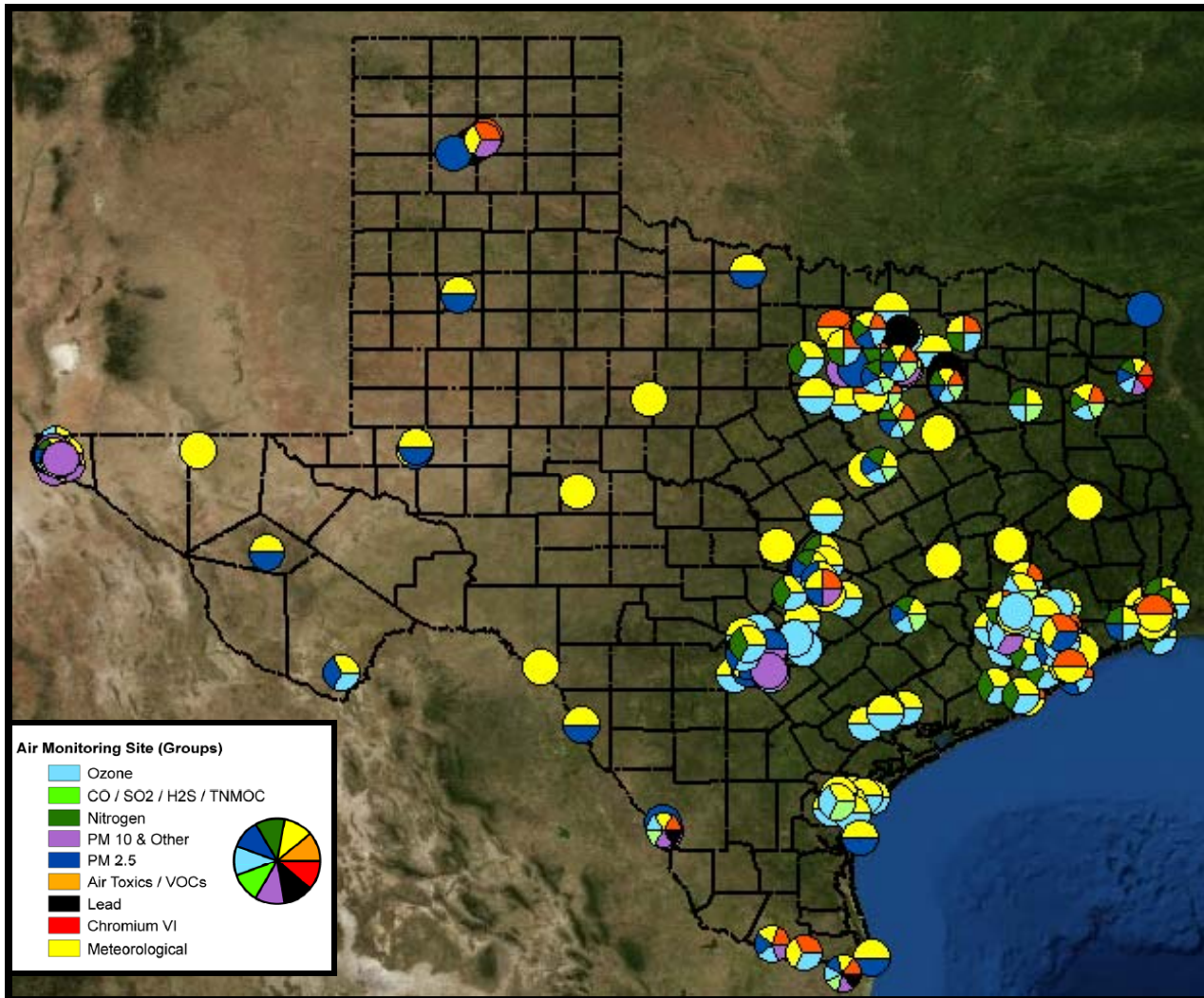
- Mobile Laboratory

- VOCs, SVOCs (PAHs)
- Carbonyls
- SO₂, H₂S, and Reduced Sulfur Compounds
- TSP, PM₁₀, PM_{2.5}
- Metals (from particulate samples)
- Ammonia, NO_x





Air Monitoring in Texas



- Ambient Air Monitoring Networks
 - Long-term and Short-term Data
- Monitor for:
 - CO/NO_x/O₃
 - SO₂/H₂S
 - VOCs and SVOCs
 - Carbonyls
 - Chromium VI
 - TSP, PM₁₀, PM_{2.5}
 - Lead

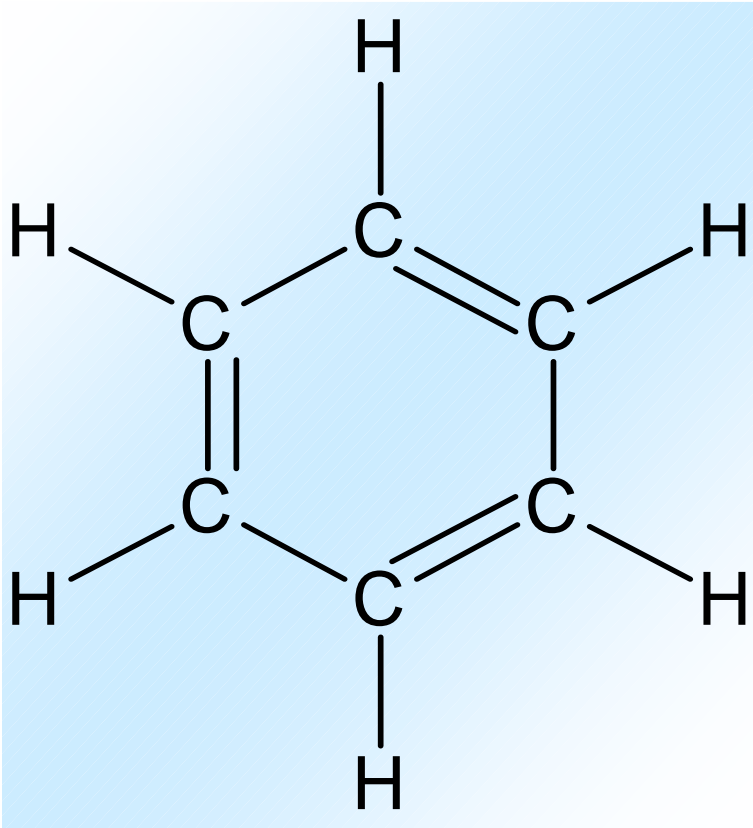


Emissions from Oil and Gas Operations

Methane	2-Methylpentane	Methylcyclohexane	Hydrogen Sulfide
Ethane	3-Methylpentane	Toluene	Sulfur Oxides
Propane	n-Hexane	2-Methylheptane	Methyl Mercaptan
Isobutane	Methylcyclopentane	3-Methylheptane	Ethyl Mercaptan
1-Butene	2,4-Dimethylpentane	n-Octane	Dimethyl Sulfide
n-Butane	Benzene	Ethylbenzene	Dimethyl Disulfide
Isopentane	Cyclohexane	Xylenes	Formaldehyde
n-Pentane	2-Methylhexane	n-Nonane	
2,2-Dimethylbutane	2,3-Dimethylpentane	1,2,3-Trimethylbenzene	
Cyclopentane	3-Methylhexane	n-Undecane	
2,3-Dimethylbutane	n-Heptane	Carbon Monoxide	



Benzene

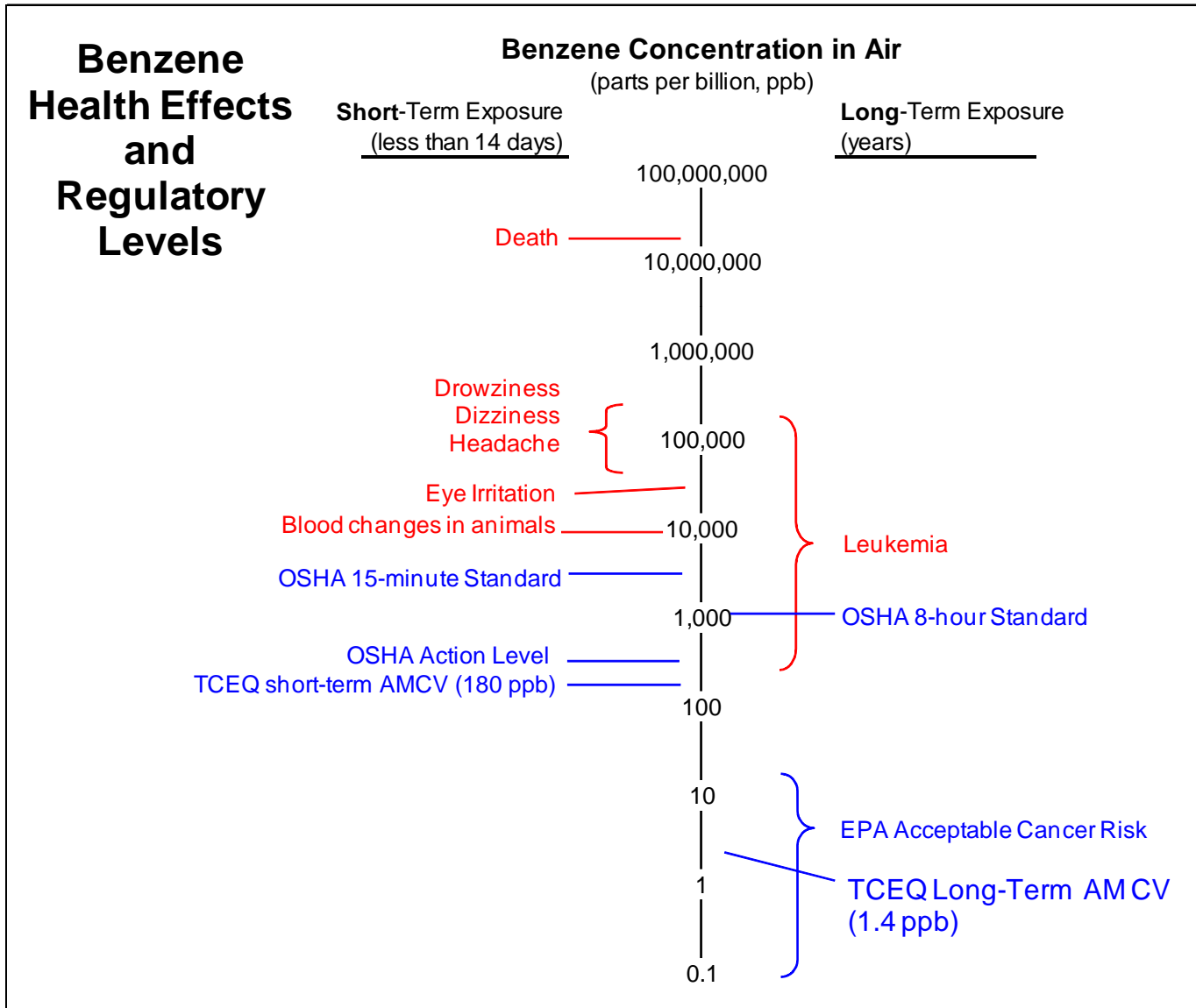


Short term AMCV = 180 ppb
Long term AMCV = 1.4 ppb

- Very common - in the top 20 of chemicals produced in the United States
- Rapidly degraded in the atmosphere
- Known human carcinogen
- Major sources:
 - Petrochemical industry
 - Motor vehicles
 - Cigarettes
- Indoor air twice as high as outdoor air



Benzene Health Effect Levels





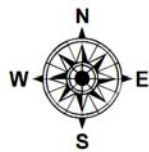
Monitored Issues at Oil and Gas Sites in Texas



Texas Commission on Environmental Quality
 Chief Engineer's Office
 Air Quality Division
 PO Box 13087 (Mail Code 164)
 Austin, Texas 78711-3087

Texas Active Oil and Gas Wells as of January 2011

**426,235 - Active Oil and Gas Wells
 With an estimated 1,000,000 +
 associated sources.**



Legend

- Oil Wells
- Gas Wells
- Oil/Gas Wells
- Texas-Interstates
- Major Water
- Major Cities
- Counties



Source Data: Railroad Commission of Texas, Jan. 2011, 10/16/11
 This map was generated by the Chief Engineer's Office, Air Quality Division
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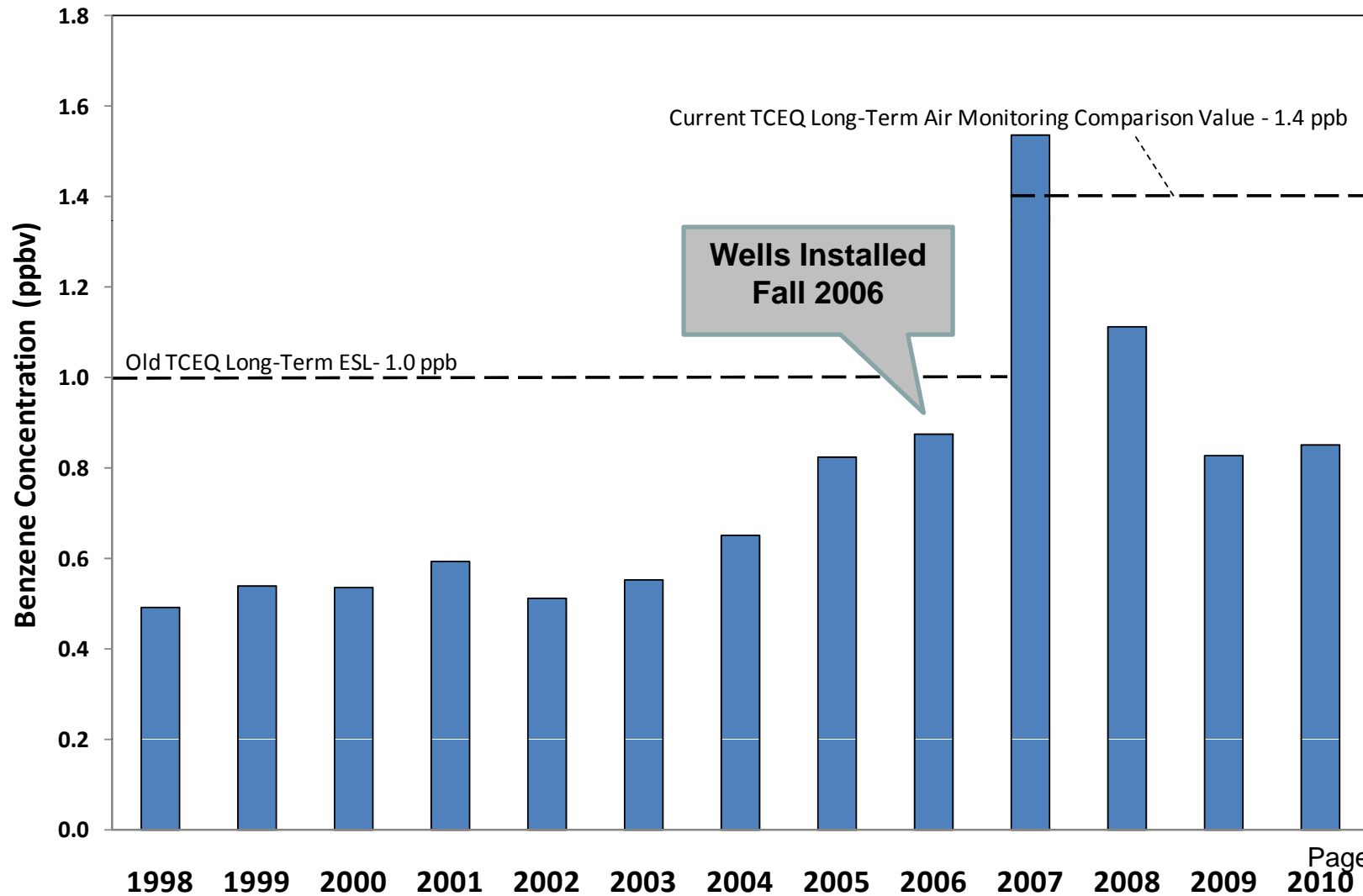
Longview

Chinn Exploration Company



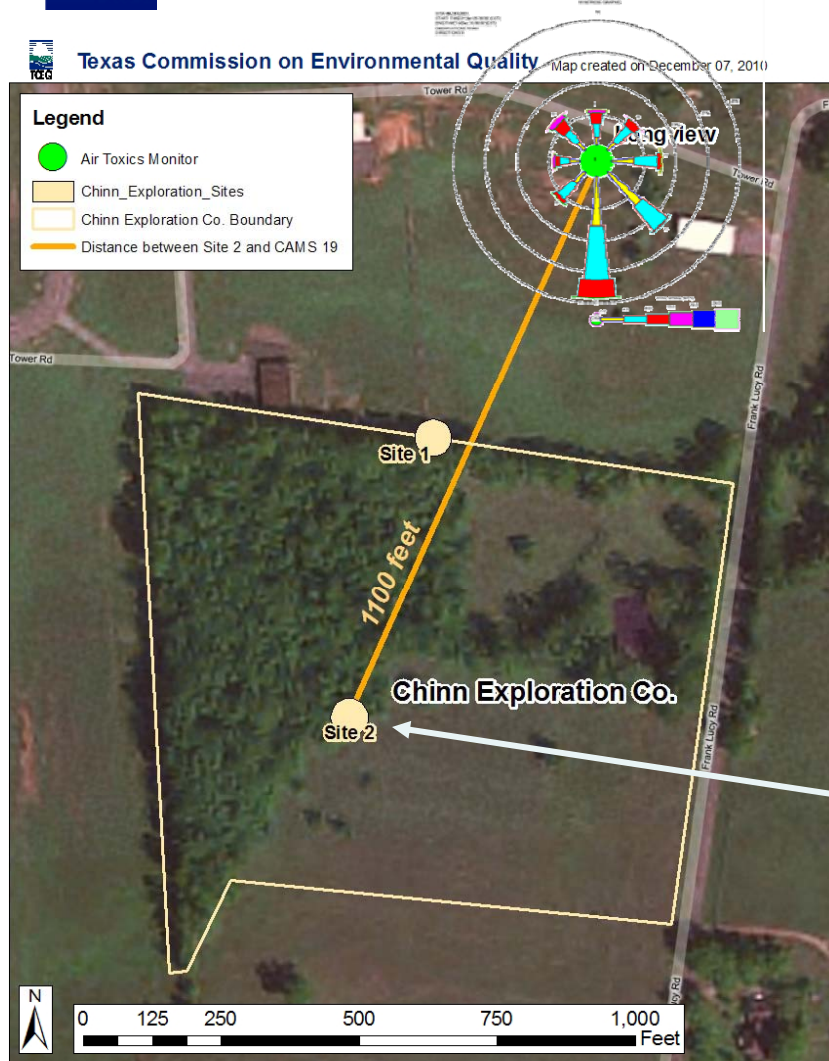
TCEQ Region 5 – Longview

Annual Average Benzene Concentrations at the Longview Monitor
(based on 24-hr every-sixth-day measurements)





TCEQ Region 5 – Longview

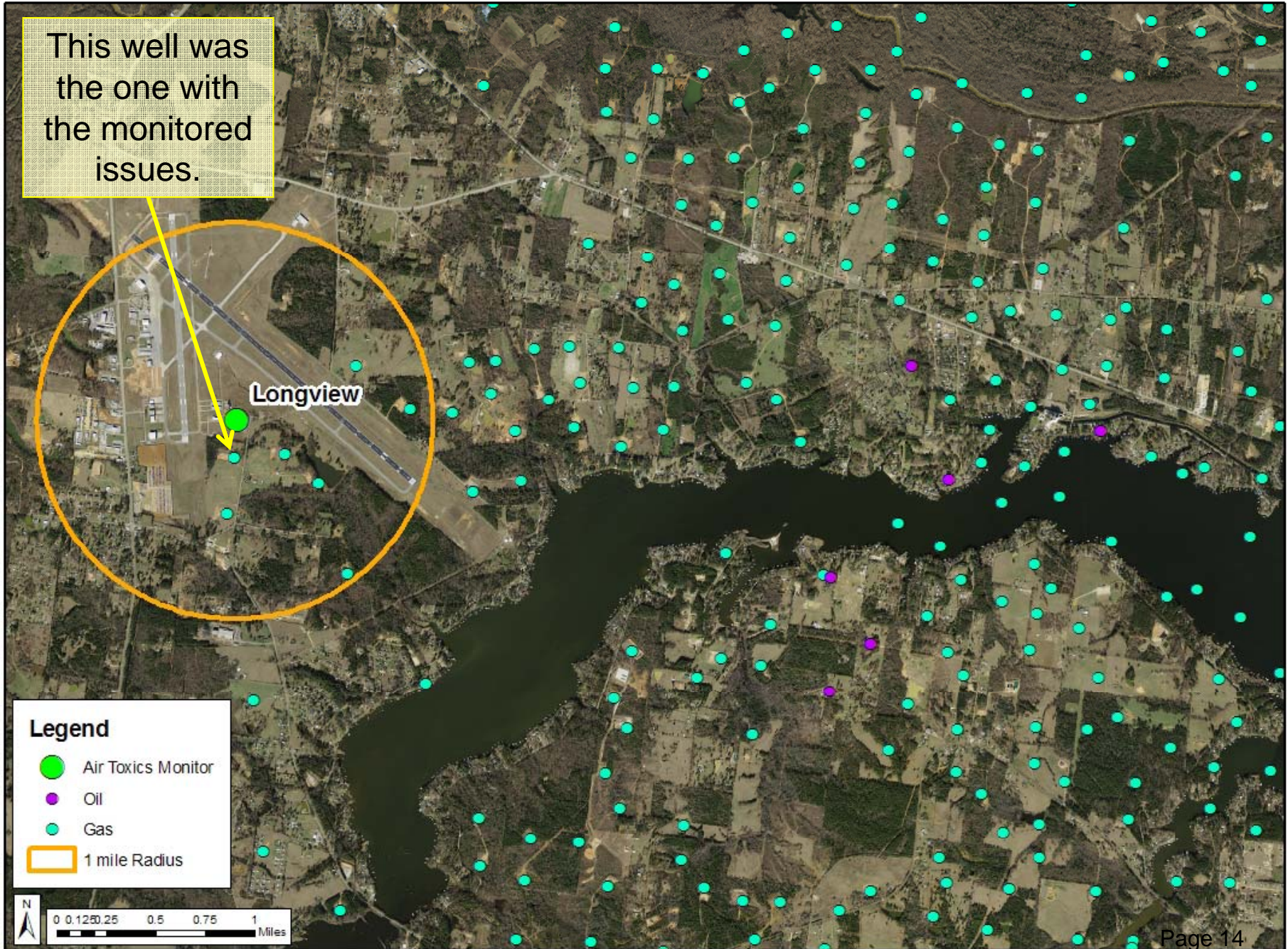


- Mobile Monitoring Investigation in January 2009
 - Used IR camera to survey
 - Collected air samples
 - Max instantaneous benzene concentration of 1100 ppb at Site 2 Tank Battery
- Most likely source of elevated benzene was Chinn Exploration Co.
- In 2008 benzene levels decreased to <1.4 ppb



Storage Tank Battery located at Site 2

This map was generated by the Toxicology Division (TD) of the TCEQ. No claims are made to the accuracy or completeness of the data, or to the suitability of the map for a particular use. For more information regarding this map, please contact the TD at (512) 239-1795.



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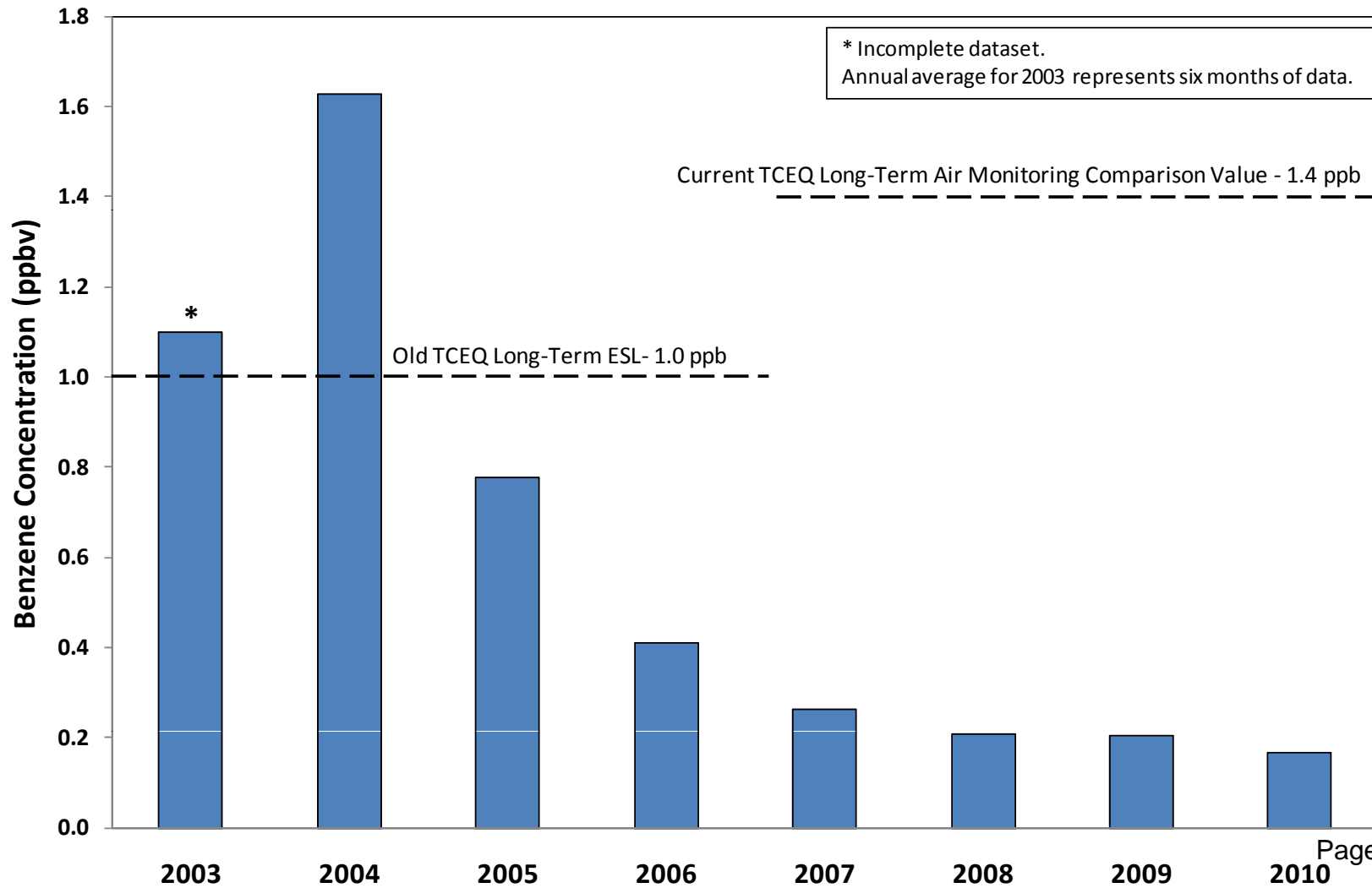
Texas City

Black Marlin Pipeline



TCEQ Region 12 - Texas City

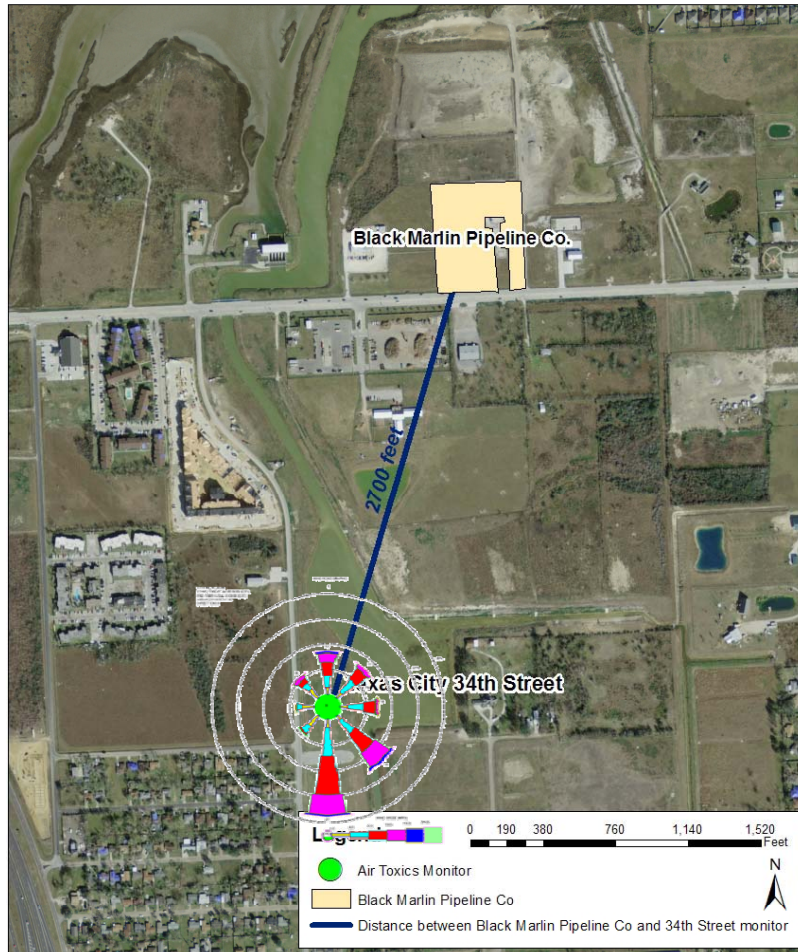
Annual Average Benzene Concentrations at the Texas City 34th St Monitor
(based on hourly autoGC measurements)





TCEQ Region 12 - Texas City

TCEQ Texas Commission on Environmental Quality Map created on December 9, 2010



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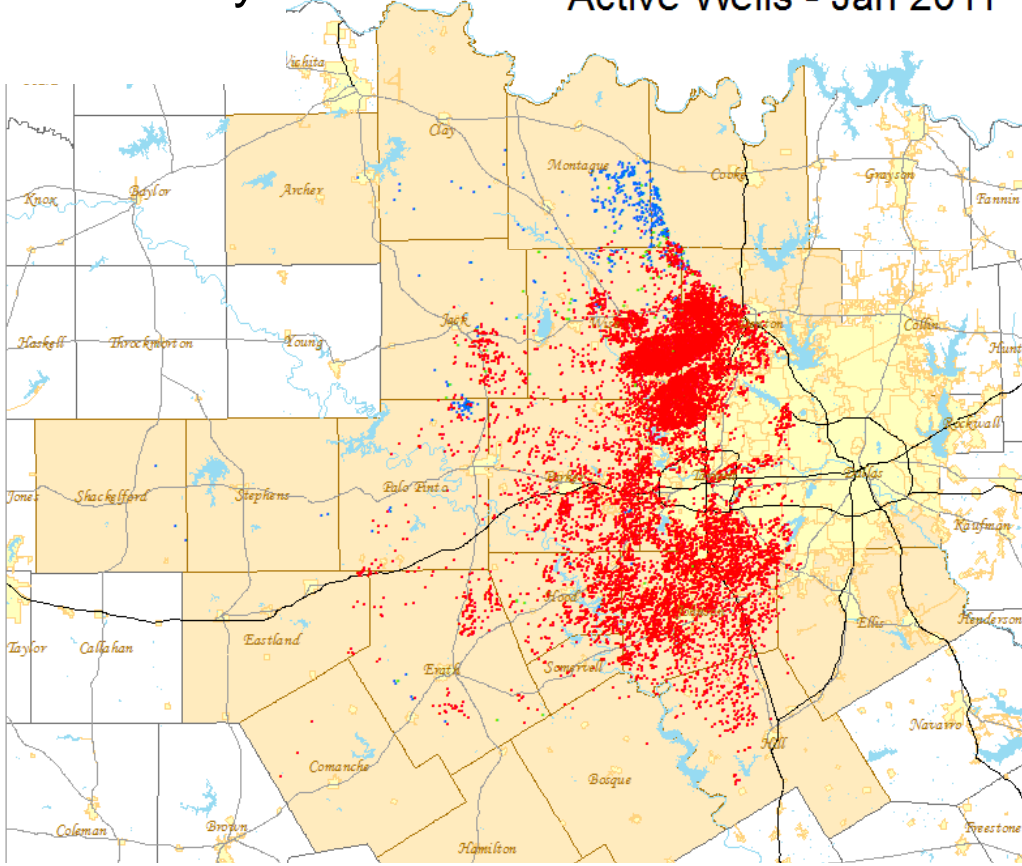
- High benzene readings at stationary and mobile monitors
- Added to the Air Pollutant Watch List in 2004
- Multiple investigations from 2001 – present
- Enforcement Order in 2004 against Black Marlin Pipeline Co
 - Failure to maintain flare logs
 - Several emission events
- Self-Audit in 2006
- Enforcement Order in 2006
 - Strict monitoring of flare activities



Barnett Shale Area

61,000 plus active oil and gas wells in the 24 county area

Newark East Field
Barnett Shale Formation
Active Wells - Jan 2011



15,000 plus active oil and gas wells in the Barnett Shale. With an estimated 50,000 plus associated sources.





TCEQ Region 4 – Barnett Shale Area

- 9 Mobile Monitoring investigations since August 2009
 - Used the GasFind IR camera to look for emission sources from natural gas operations
 - Collected air samples and analyzed them for VOCs, NO_x, H₂S, other sulfur-based chemicals, and carbonyls
- Hundreds of regional investigations
 - Used survey equipment to look for emission sources
 - Canister samples analyzed for VOCs





TCEQ Region 4 – Barnett Shale Area

Sampling Site in Wise County



Benzene = 370 ppb

One-hour Average Real Time Gas Chromatography Sample



TCEQ Region 4 – Barnett Shale Area

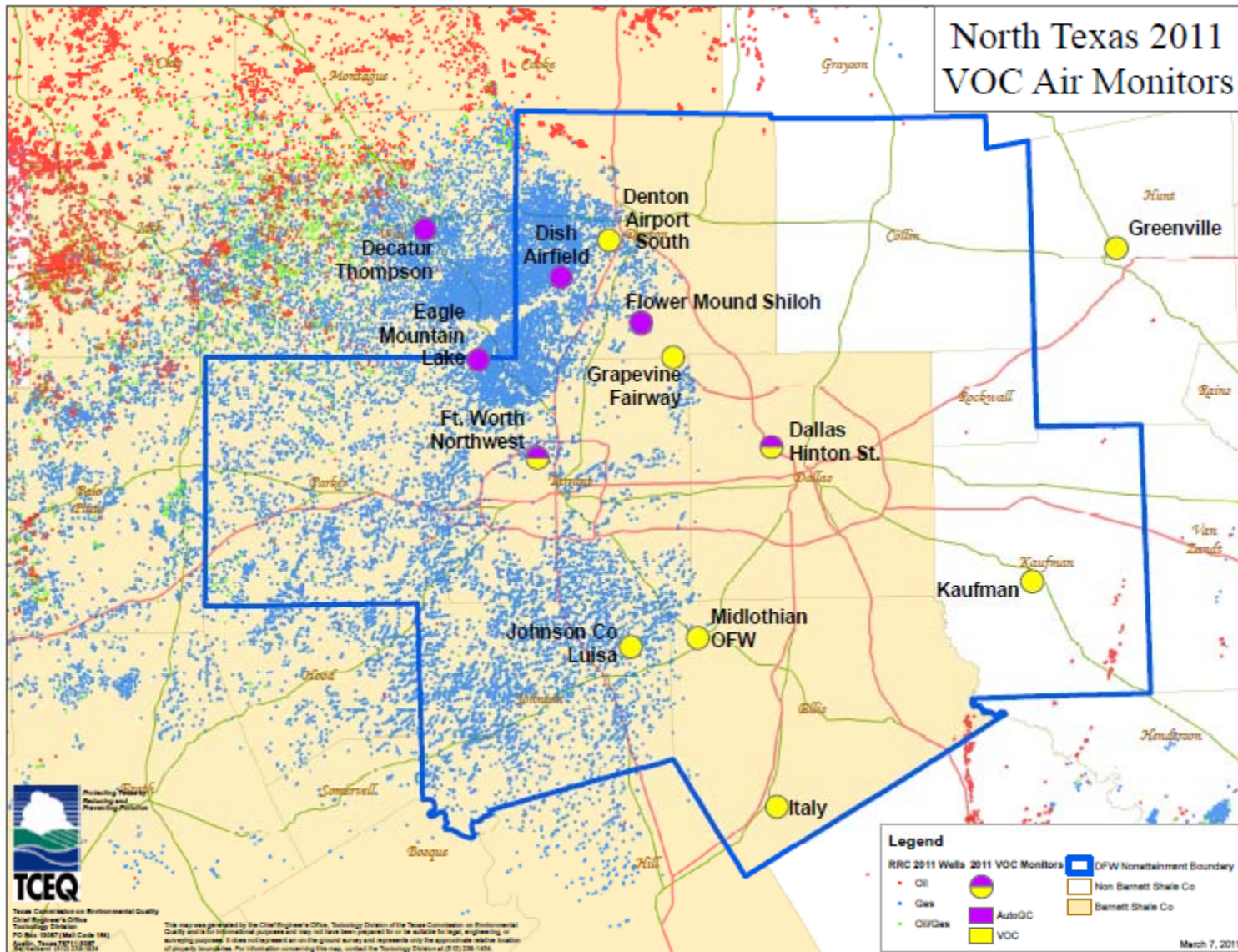


Source:

http://3.bp.blogspot.com/_9TzK4b0yCrw/S2oySQi5h3I/AAAAAAAAADSA/Y10XUjwpKd... 3/15/2011



TCEQ Region 4 – Barnett Shale Area





Additional Concerns - *Odor*

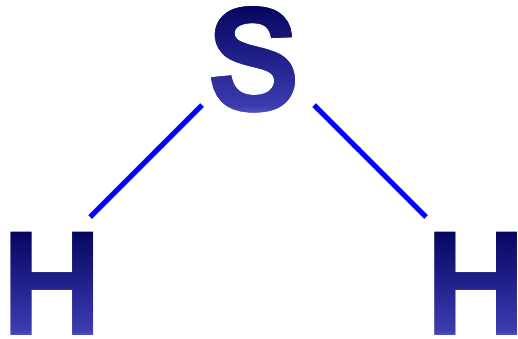
- **Hydrogen sulfide and reduced sulfur compounds** – characteristic rotten-egg odor
- **Benzene** – sweet odor
- **Formaldehyde** – pungent odor
- **Styrene** – sweet, sharp odor
- **Ethylbenzene** – gasoline-like odor
- **Xylenes** – sweet, aromatic hydrocarbon odor
- **Toluene** – sweet, pungent, aromatic hydrocarbon odor

Persistent or recurrent exposure to odorous levels may cause odor-related effects such as headache and nausea.

Regional staff investigate odor complaints – FIDO (Fréquency, Intensity, Duration, Offensiveness)



Hydrogen Sulfide

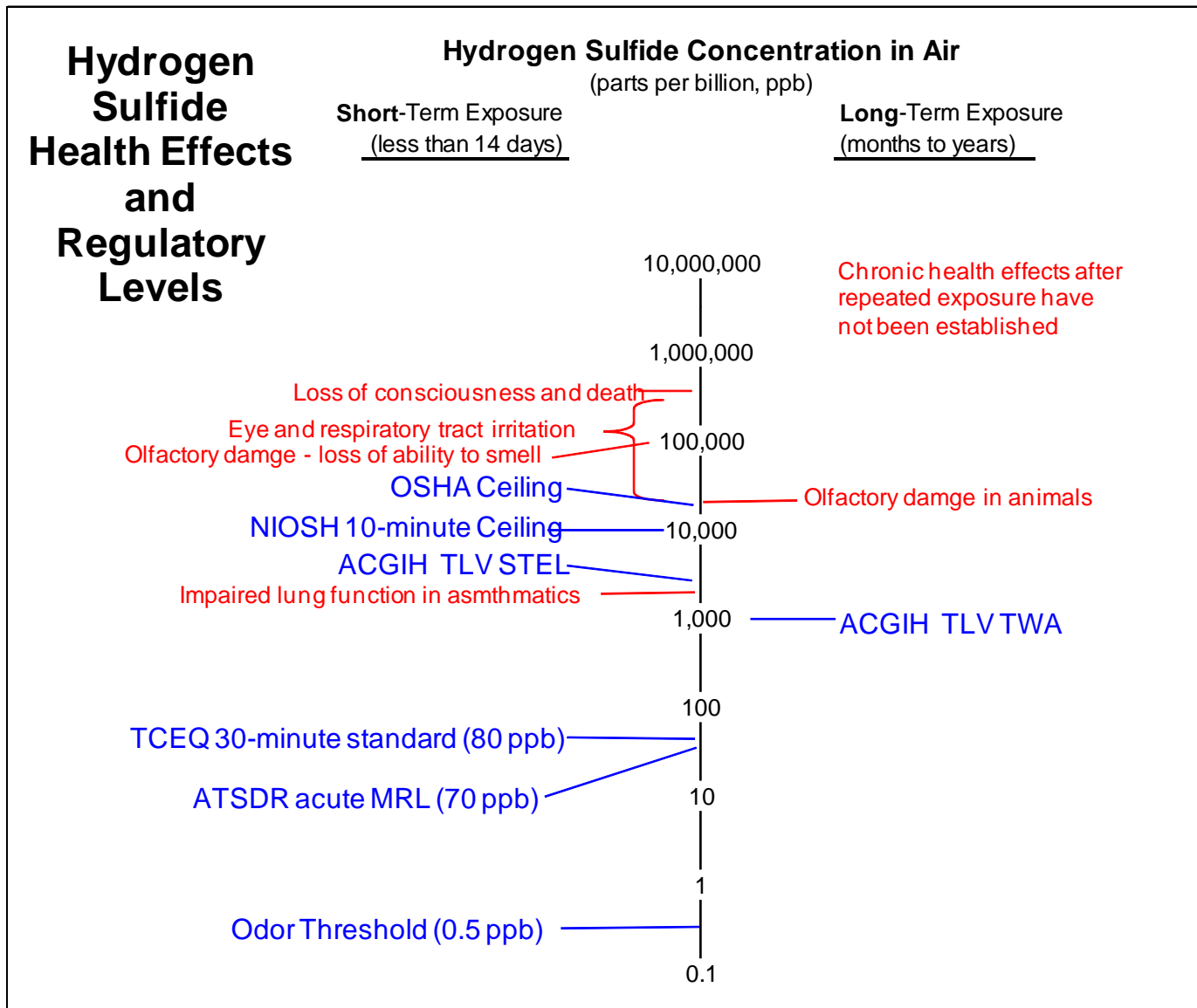


Odor threshold = 0.5 ppb
30-minute standard = 80 ppb

- “Rotten egg” odor
- Respiratory tract and eye irritant
- Major industrial sources:
 - Natural gas production
 - Pulp and paper mills
 - Sewage treatment plants
 - Petroleum refining
 - Landfills
- Major natural sources:
 - Volcanoes
 - Swamps
 - Crude petroleum and natural gas



Hydrogen Sulfide Health Effect Levels





Luling

DRAFT Report



TCEQ Region 11 - Luling

- Oil production in the area since 1920's
- Close to 200 pump jacks within the city limits
- Sour crude oil
- Renewed interest in the areas that include the Edward's and Austin Chalk Formations
- Crude oil and water mixture stored in tanks - companies either vent or flare off-gas



Source: http://en.wikipedia.org/wiki/File:Luling_pump_jack.jpg accessed on 040411



TCEQ Region 11 - Luling

- December 2010 Mobile Monitoring Project – in response to regional investigations and increased odor complaints
 - Multiple oil production and processing facilities surveyed (e.g., pumpjacks, flares, storage tank batteries)
 - Survey equipment used to look for emission sources (e.g., GasFind IR camera, TVA)
 - Canister samples collected and analyzed for benzene and other VOCs
 - Jerome H₂S analyzer used to assess H₂S levels



TCEQ Region 11 - Luling





TCEQ Region 11 - Luling



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Conclusions

- Oil and gas operations are located statewide
- Evidence that oil and gas operations can impact air quality
- Once an issue is identified, it can be corrected



Questions?

Toxicology Division toll free number:

1-877-992-8370

Toxicology Division website:

<http://www.tceq.state.tx.us/implementation/tox/index.html>



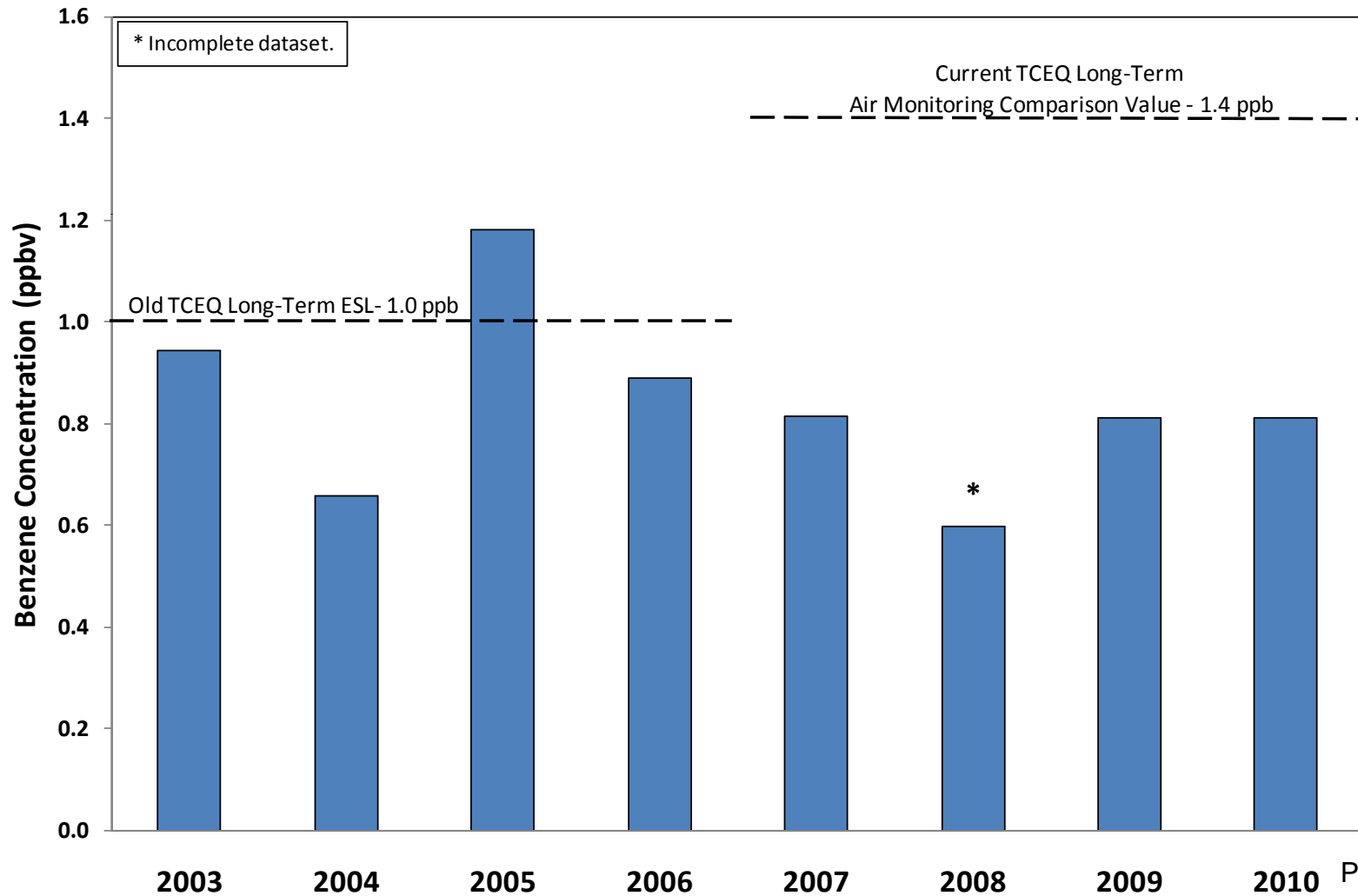
Houston

Davis Petroleum



TCEQ Region 12 – Houston

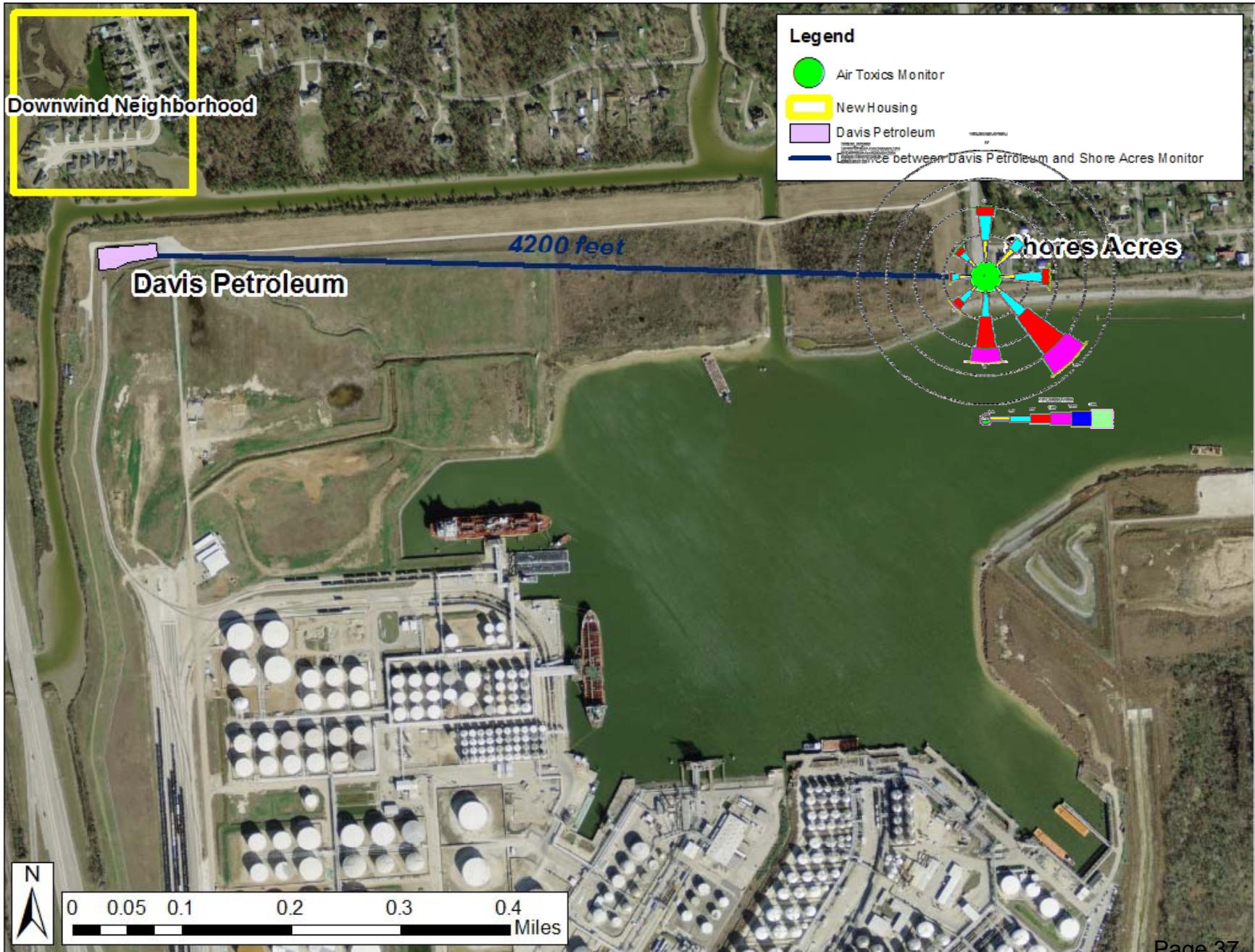
Annual Average Benzene Concentrations at the Shore Acres Monitor
(based on 24-hr every-sixth-day measurements)





TCEQ Region 12 – Houston

- Davis Petroleum is a natural gas gathering facility operating under the Oil/Gas PBR and producing 2.2 MMscf of gas and 250 bbl of condensate per day
- Elevated benzene concentrations prompted TCEQ investigations on-site and with GasFindIR
- January 2007 - Davis conducted direct measurement of flash emissions and calculated site-wide VOC emissions were **384** tons per year
- Vapor recovery unit installed in October 2006 and Davis federally certified VOC emissions are at 14.26 tpy





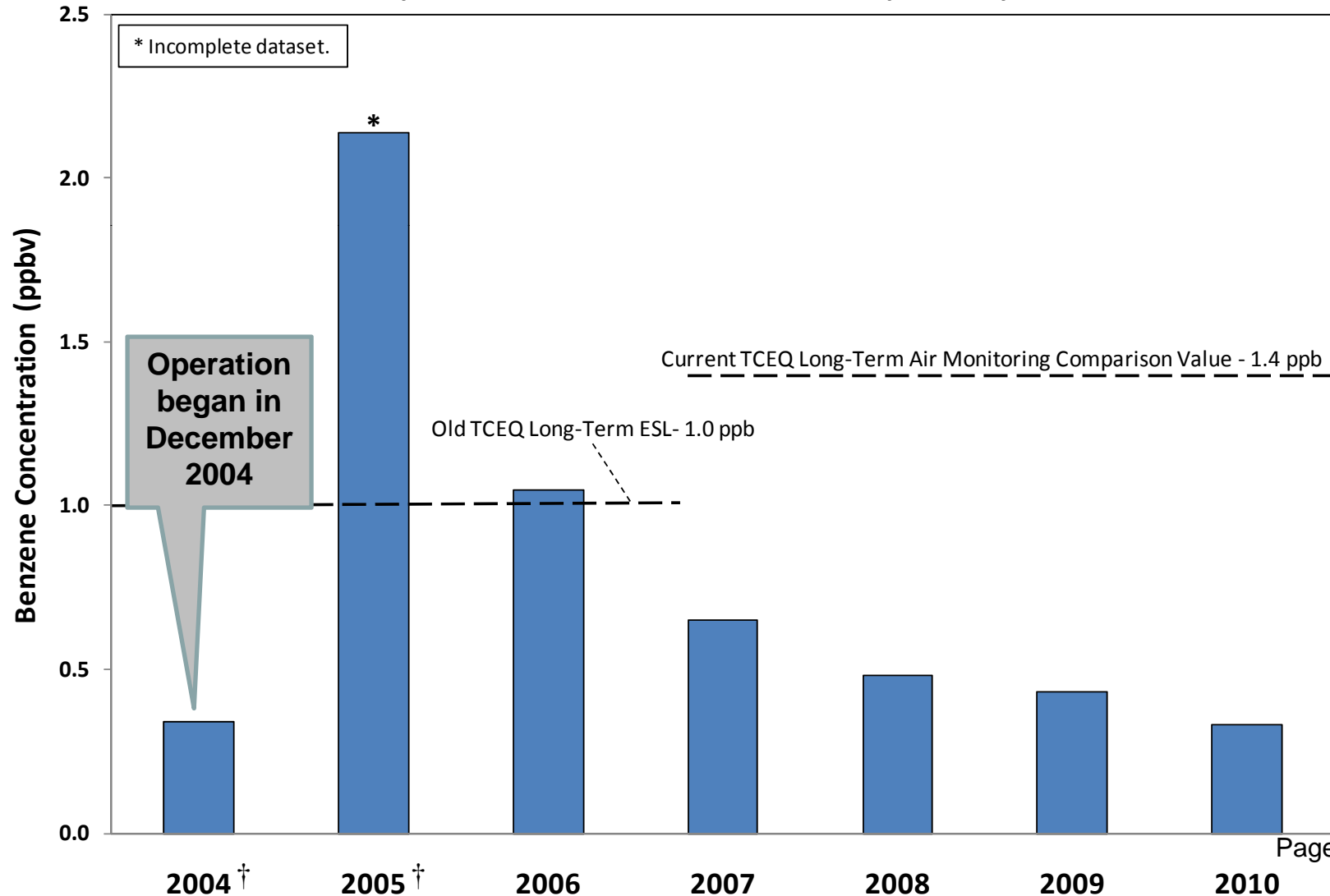
Beaumont

Hayes-Keith



TCEQ Region 10 – Beaumont

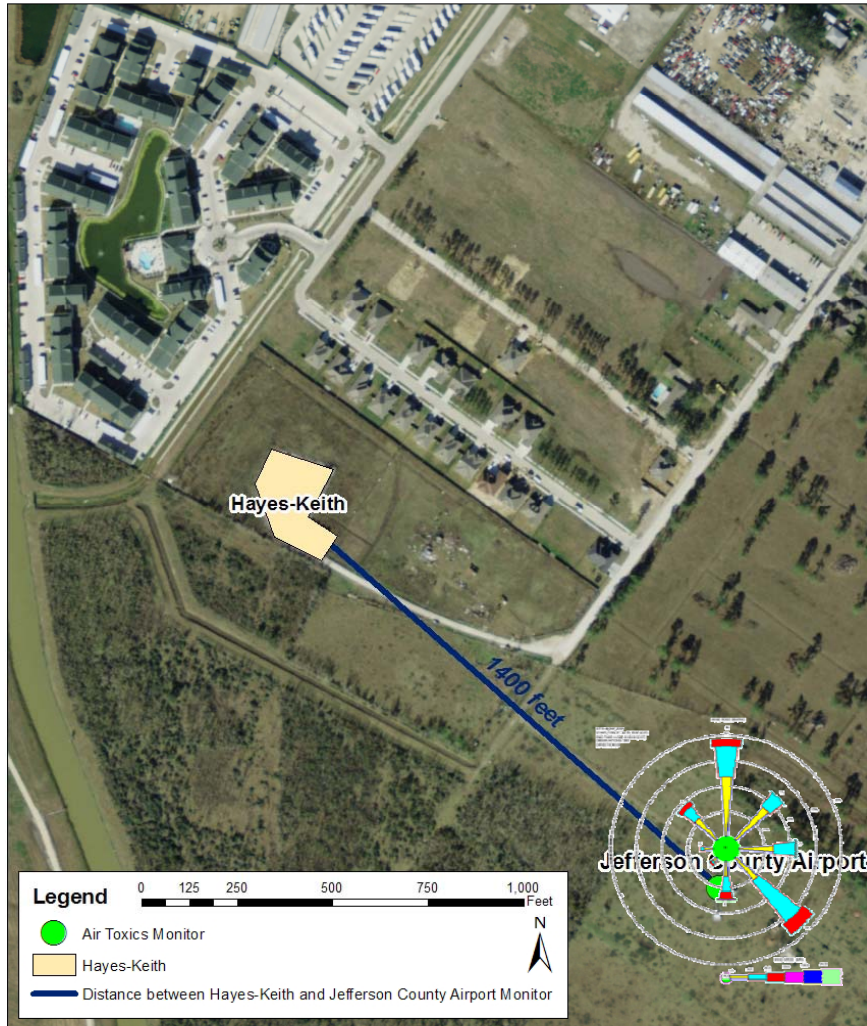
Annual Average Benzene Concentrations at the Jefferson County Airport Monitor
(based on hourly autoGC data (2004-2005)[†] or 24-hr every-sixth-day data (2006-2010))





TCEQ Region 10 – Beaumont

TCEQ Texas Commission on Environmental Quality Map created on December 9, 2010



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- Regional Sampling Events in June 2005
 - Max grab benzene concentration of 900 ppb, collected 40 yards downwind of facility
- Elevated benzene at Jefferson County Airport monitor
- August 2005 Toxicology notified R10 and other Divisions about concerns
- August 2006 autoGC relocated because it did not meet PAMS siting requirements; canister sampler still active

