

# It Wasn't Me! Real-Time Monitoring and Forecasting of Odors



January 28, 2022

# Presentation Outline

**1.**

**ODORS ASSOCIATED WITH  
WASTEWATER TREATMENT**

**2.**

**ODOR CHARACTERIZATION AT  
TREATMENT PLANTS**

**3.**

**ODOR DISPERSION MODELING**

**4.**

**REAL-TIME MONITORING AND  
FORECASTING OF ODORS**



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# **Odors Associated with Wastewater Treatment**



# OU or D/T

Odor units (OU) or dilutions-to-thresholds (D/T) allow for evaluation for total impact of numerous compounds





# Odor Perception

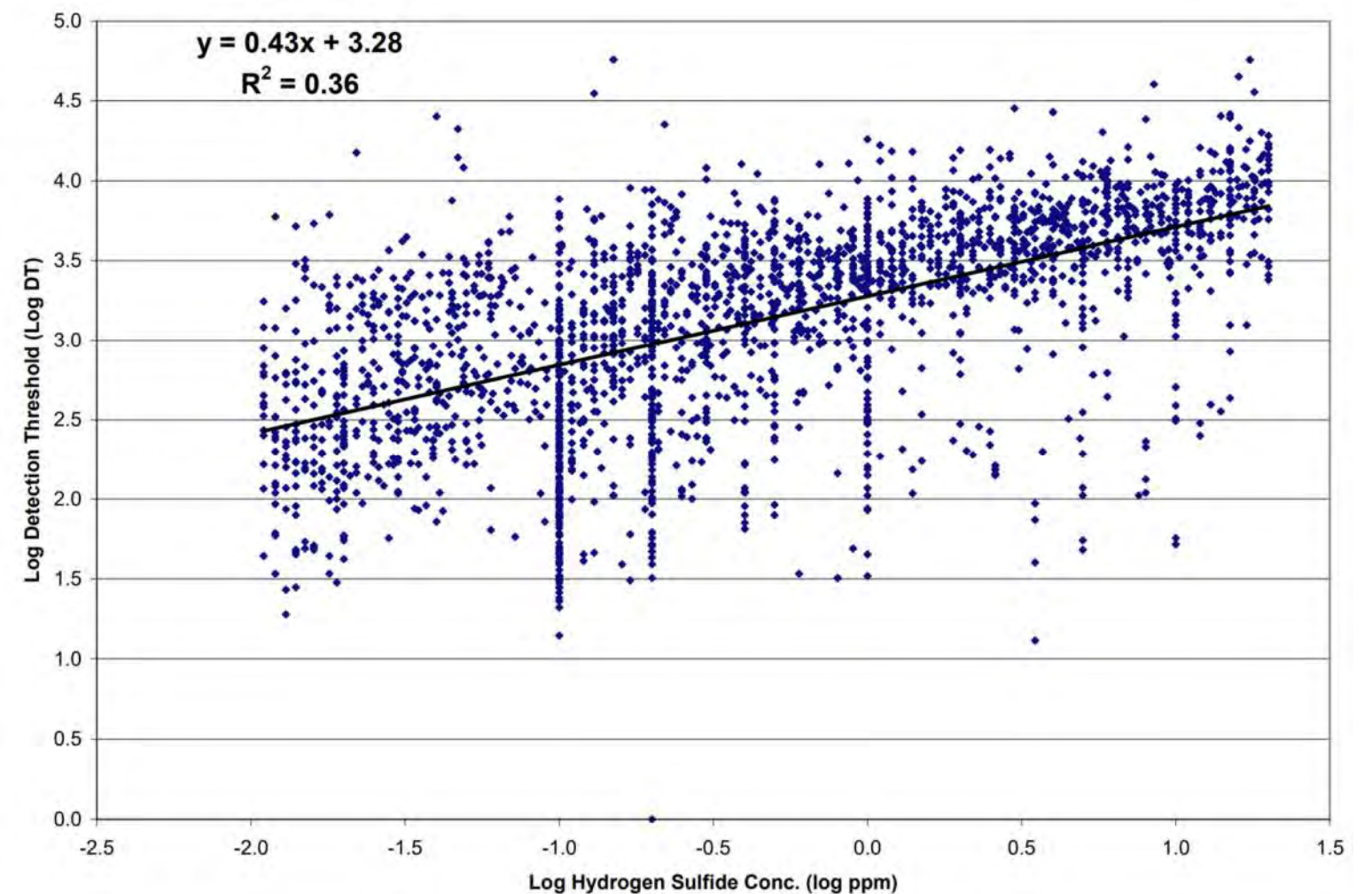
<b>Odor Unit</b>	<b>Olfactory Perception</b>
1 o.u.	50% of the population can start detecting an odor
3 o.u.	50% of the population can start qualifying an odor
5 o.u.	Odor is recognizable (can be identified)
Approx. 20 - 50 o.u.	Someone's perfume
Approx. 250 o.u.	Freshly cut grass
Approx. 500 o.u.	Old household garbage that needs to be taken outside

- Odor intensity does not vary proportionally with the concentration of odorant
- Odors from different treatment processes are not additive

# Wastewater Odorants

- Hydrogen sulfide (H<sub>2</sub>S) is primary odorant used to assess potential for nuisance odors from wastewater conveyance and treatment processes
- A relationship between H<sub>2</sub>S and odor perception is not clear, especially in complex odorous gas mixtures.

Odor Threshold Emission Factors  
for Common WWTP Processes  
St. Croix Sensory, Inc.  
Odors and Air Emissions 2008



# Odor Regulations

30 TAC 101.4 *Nuisance* states:

*No person shall discharge from any source whatsoever one or more air contaminants or combinations thereof, in such concentration and of such duration as are or may tend to be injurious to or to adversely affect human health or welfare, animal life, vegetation, or property, or as to interfere with the normal use and enjoyment of animal life, vegetation, or property.*

Texas Health and Safety Code § 382.085(b) *Unauthorized Emissions Prohibited* states:

*(b) A person may not cause, suffer, allow, or permit the emission of any air contaminant or the performance of any activity in violation of this chapter or of any commission rule or order.*

# Odor Regulations

30 TAC 112.31 to 32 *Control of Hydrogen Sulfide* states:

*“No person may cause, suffer, allow, or permit emissions of hydrogen sulfide from a source or sources operated on a property or multiple sources operated on contiguous properties to exceed a net ground level concentration of 0.08 parts per million averaged over any 30-minute period if the downwind concentration of hydrogen sulfide affects a property used for residential, business, or commercial purposes.”*

and

*“No person may cause, suffer, allow, or permit emissions of hydrogen sulfide from a source or sources operated on a property or multiple sources operated on contiguous properties to exceed a net ground level concentration of 0.12 parts per million averaged over any 30-minute period if the downwind concentration of hydrogen sulfide affects only property used for other than residential, recreational, business, or commercial purposes, such as industrial property and vacant tracts and range lands not normally occupied by people.”*



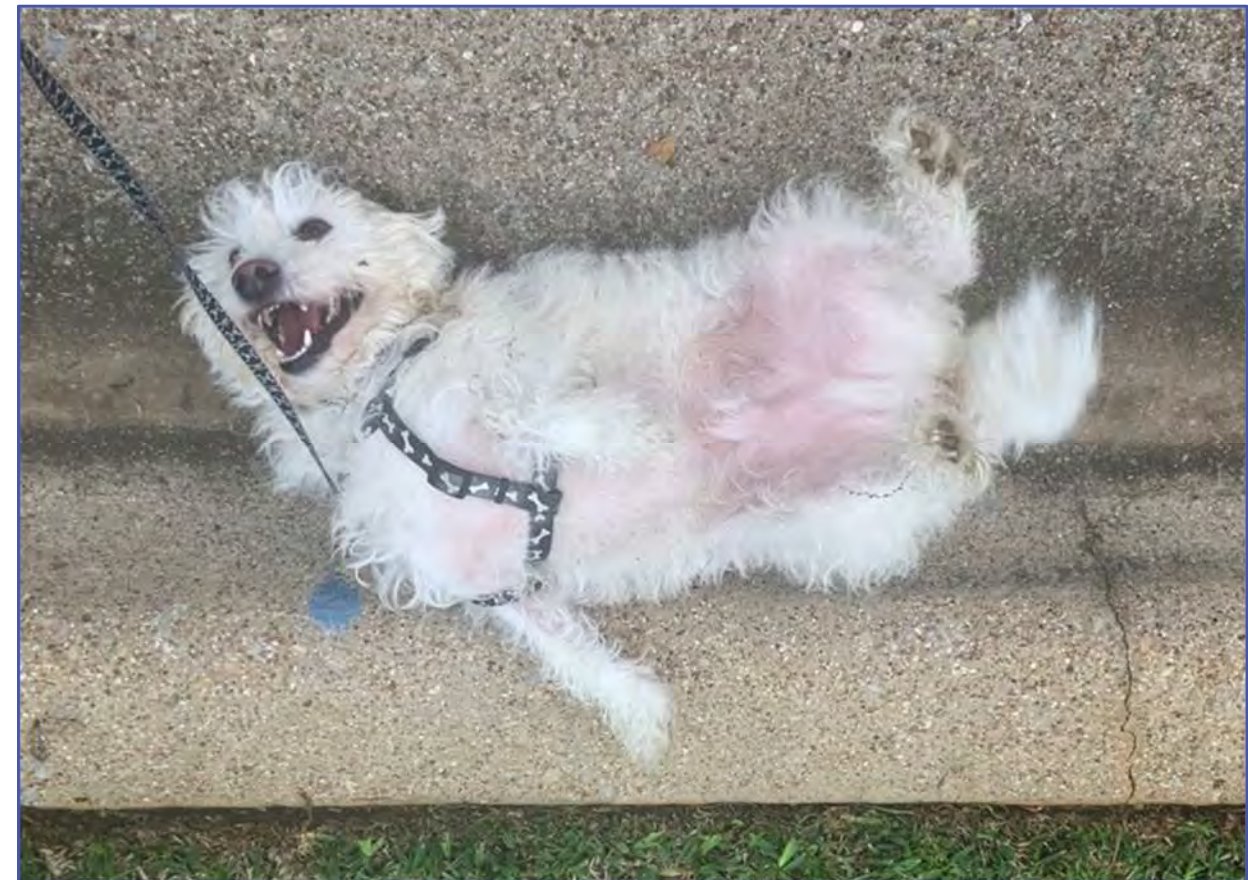
# FIDO

[www.tceq.texas.gov/compliance/complaints/odor\\_complaint.html](http://www.tceq.texas.gov/compliance/complaints/odor_complaint.html)

Highlights poultry and oil & gas facilities

## FIDO

- Frequency
- Intensity
- Duration
- ✓ Offensiveness



# Odor Characterization at Treatment Plants



# City of Garland Wastewater Treatment



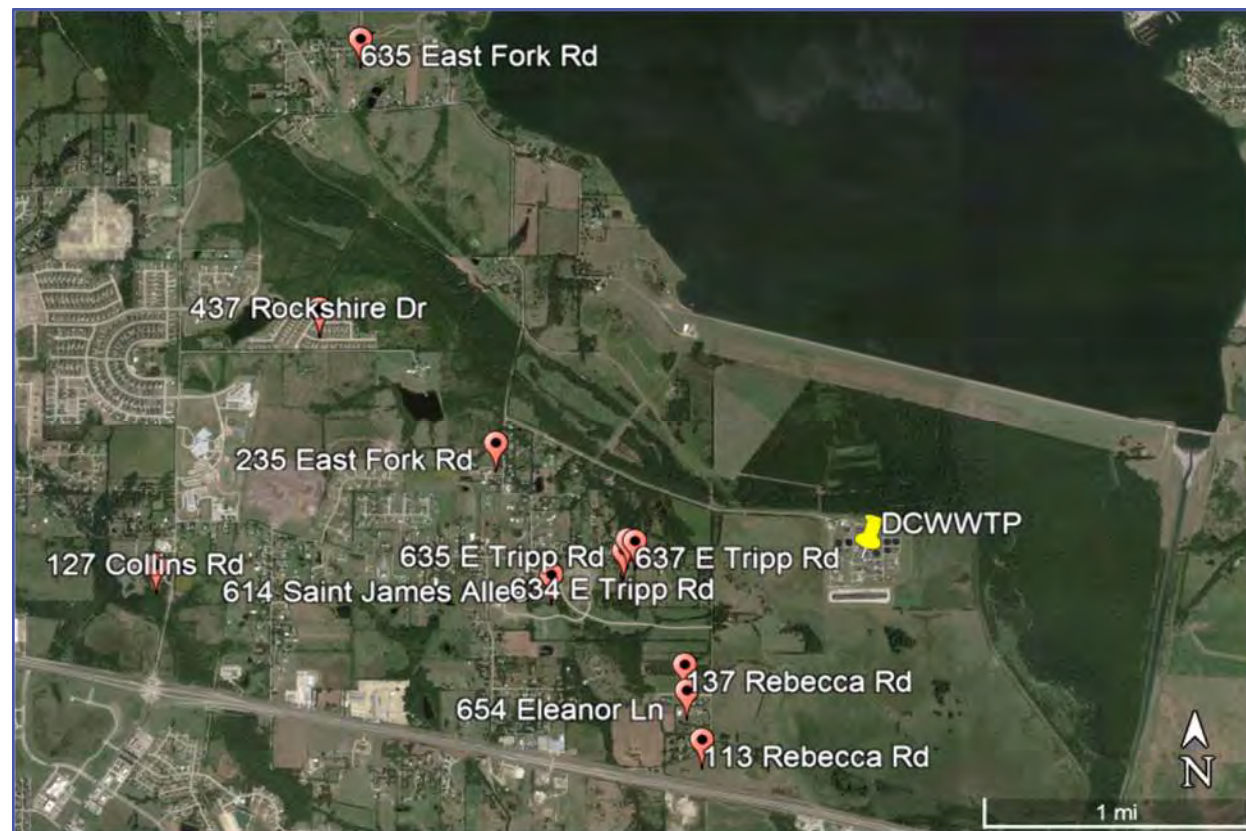
Duck Creek WWTP  
Permitted Design Flow 40 MGD  
Originally constructed in 1962

Rowlett Creek WWTP  
Permitted Design Flow 24 MGD  
Originally constructed in 1952





# Historical Odor Complaints



- Recording where and when odor was perceived is critical  
In addition to timing of odor complaint and location of complainant
- Odor duration, intensity, constant/intermittent, descriptors
- Backcheck reported meteorological against historical data



# Emission Sources

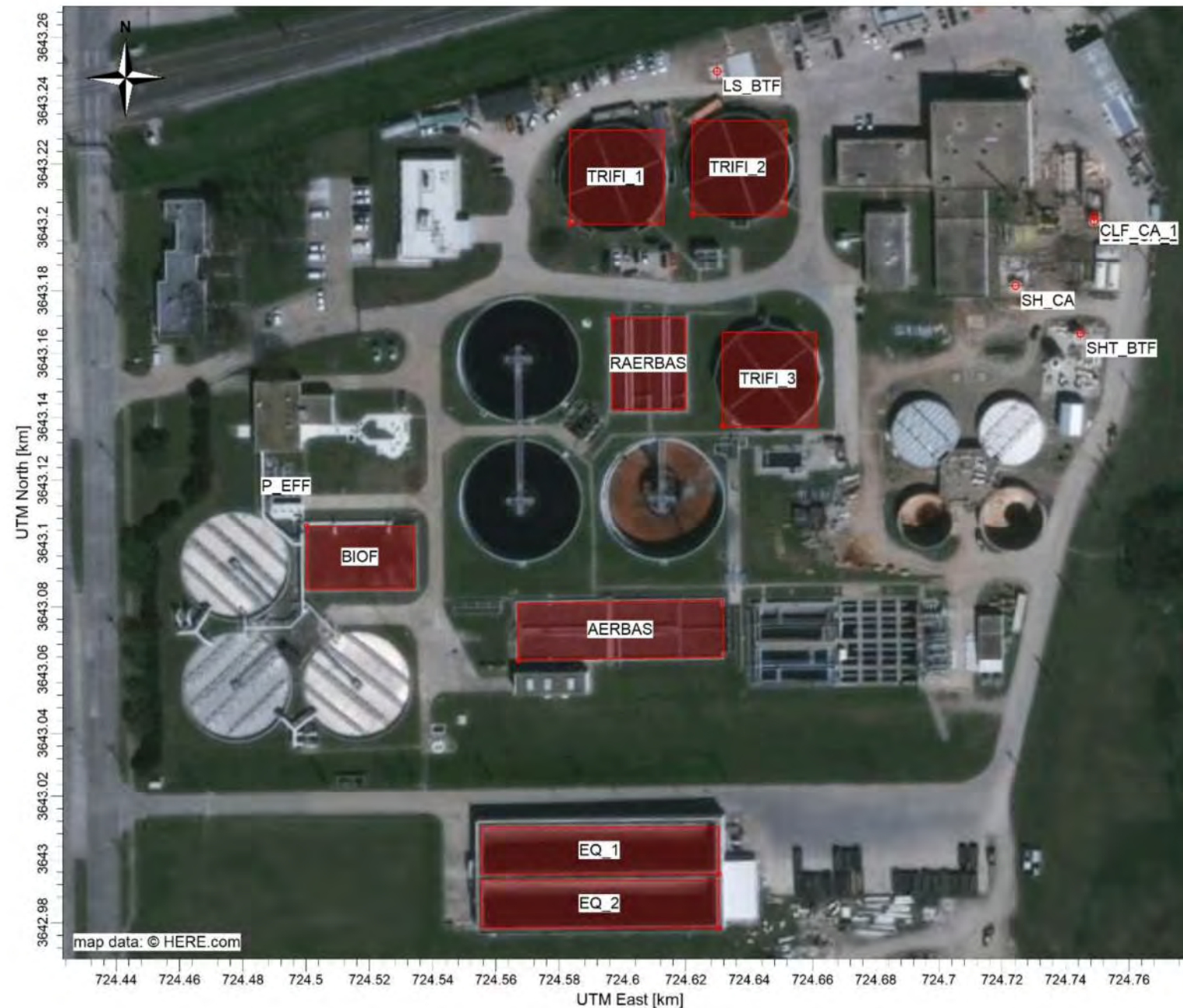


Figure 2: Emission Sources

- **Point Sources (OU/sec)**  
Vertical Discharge through Stack or Vent
- **Area Sources (OU/sec/m<sup>2</sup>)**  
Open Area where Emissions are Released Passively
- Model allows for turning on and off sources
- Emission rates can be varied



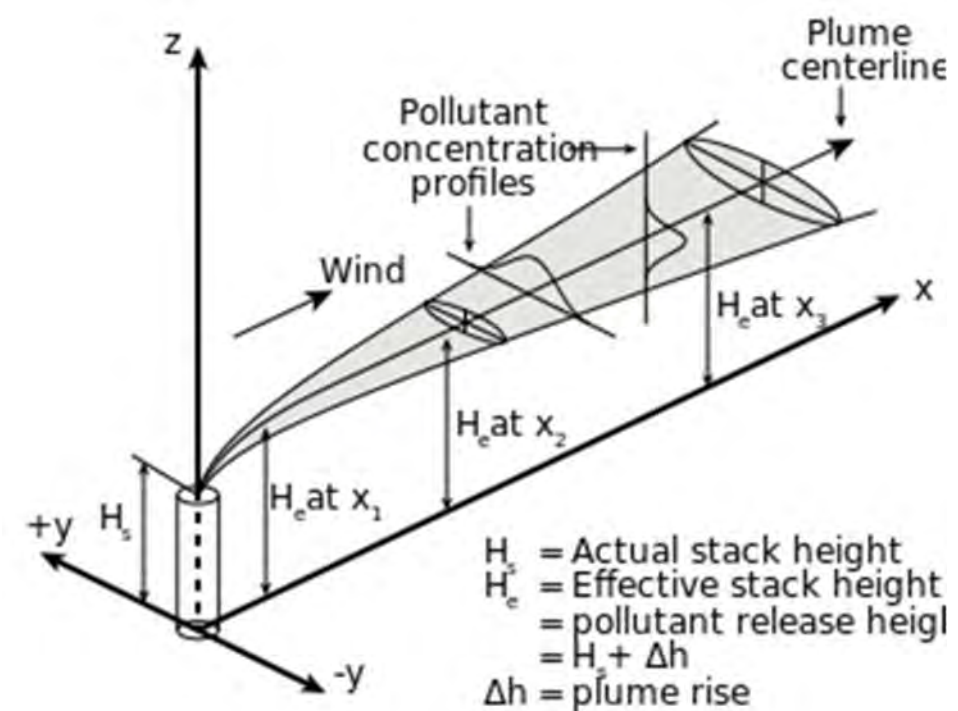
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# Odor Dispersion Modeling



# Odor Dispersion Modeling

- Illustrates how odors generated by wastewater conveyance and treatment are transported offsite
- Predicts the intensity, frequency, and spatial extent of nuisance odors
- Effective in public relations presentations



# CALPUFF vs. AERMOD

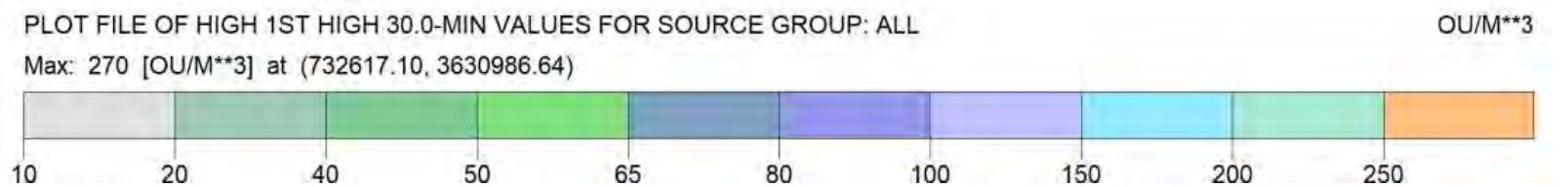
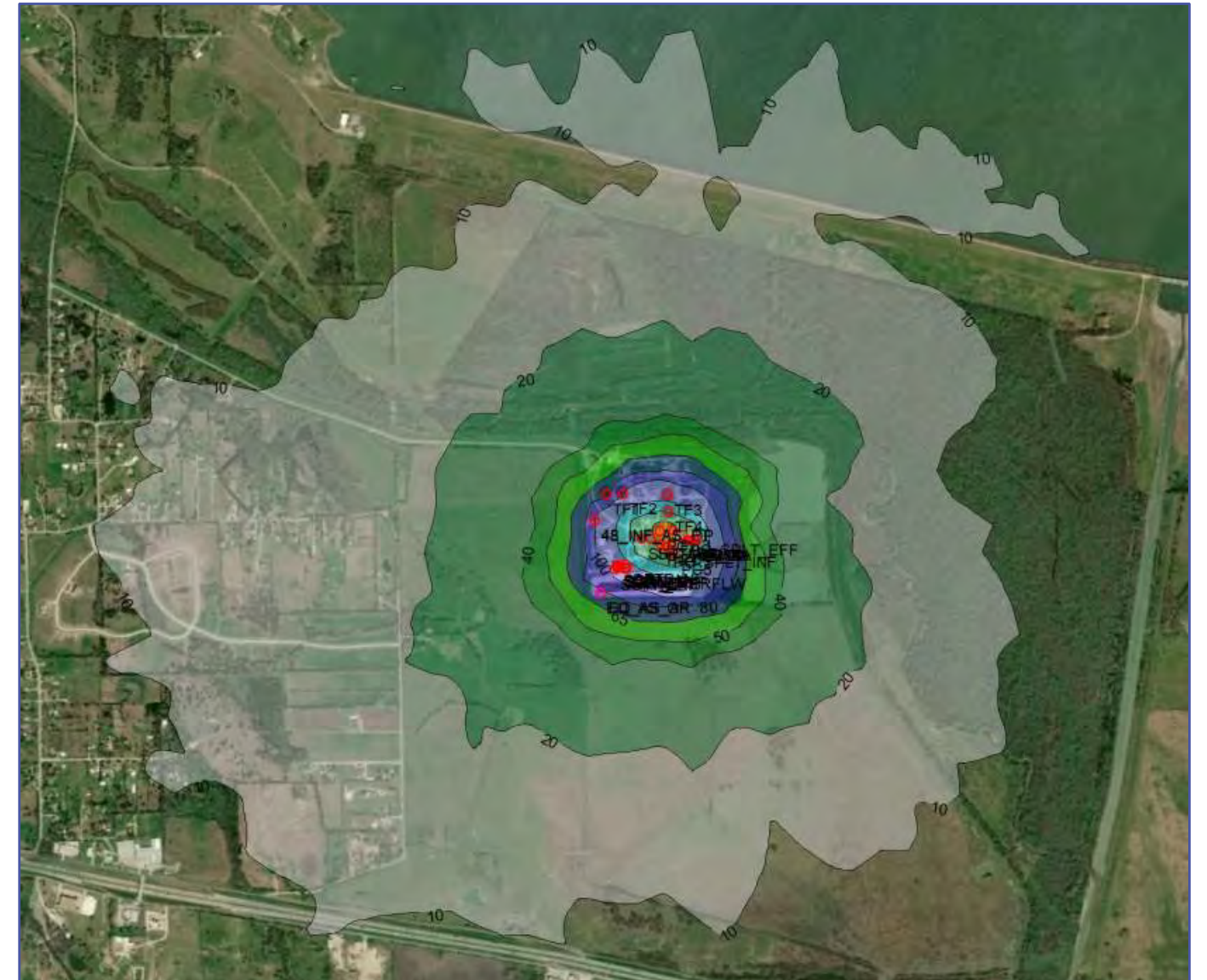
- California Puff Model (CALPUFF)
  - Non steady-state Lagrangian dispersion model
  - American Meteorological Society (AMS)/Environmental Protection Agency (EPA) Regulatory Model (AERMOD)
  - Steady-state Gaussian plume dispersion model
- 
- AERMOD is preferred model of EPA and frequently updated
  - During the day, i.e. with unstable conditions, the results of the two models are in agreement
  - CALPUFF, utilized by real-time models, more suitable for complex terrain and calm wind conditions



# Static Odor Dispersion Modeling

## Odor Isopleths

Illustrate areas impacted by odors at the OU level corresponding to the legend for a defined duration once per year





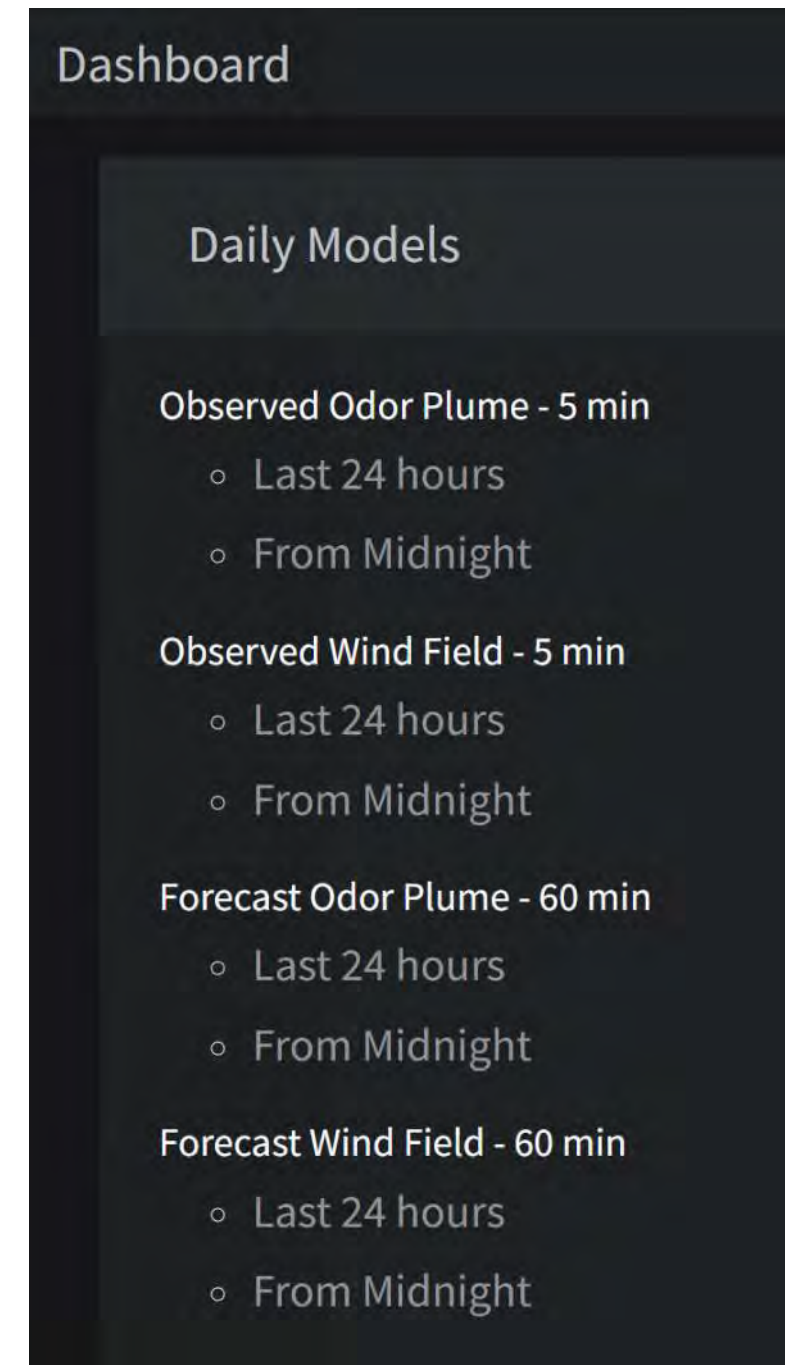
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# Real-Time Monitoring and Forecasting of Odors



# Real-Time Monitoring

- Notify staff when odors approach areas outside of predetermined parameters
- Helps prevent odors before perceived offsite
- Real-time odor model typically always includes an on-site weather station





# Weather Station

Wind speed | Wind direction | Temperature | Rainfall  
Barometric pressure | Humidity

- Tower about \$2,000 plus installation
- Locate four times the distance away from height of nearest structure
- 30' above grade





# H<sub>2</sub>S and Other Monitors

- Hydrogen Sulfide (H<sub>2</sub>S), Ammonia (NH<sub>3</sub>), Methyl Mercaptan, TVOC (Benzene, Toluene, Xylene), Formaldehyde (CH<sub>2</sub>O), Sulfur Dioxide (SO<sub>2</sub>), Chlorine (Cl<sub>2</sub>)
- Electronic Nose





H<sub>2</sub>S Monitor 02

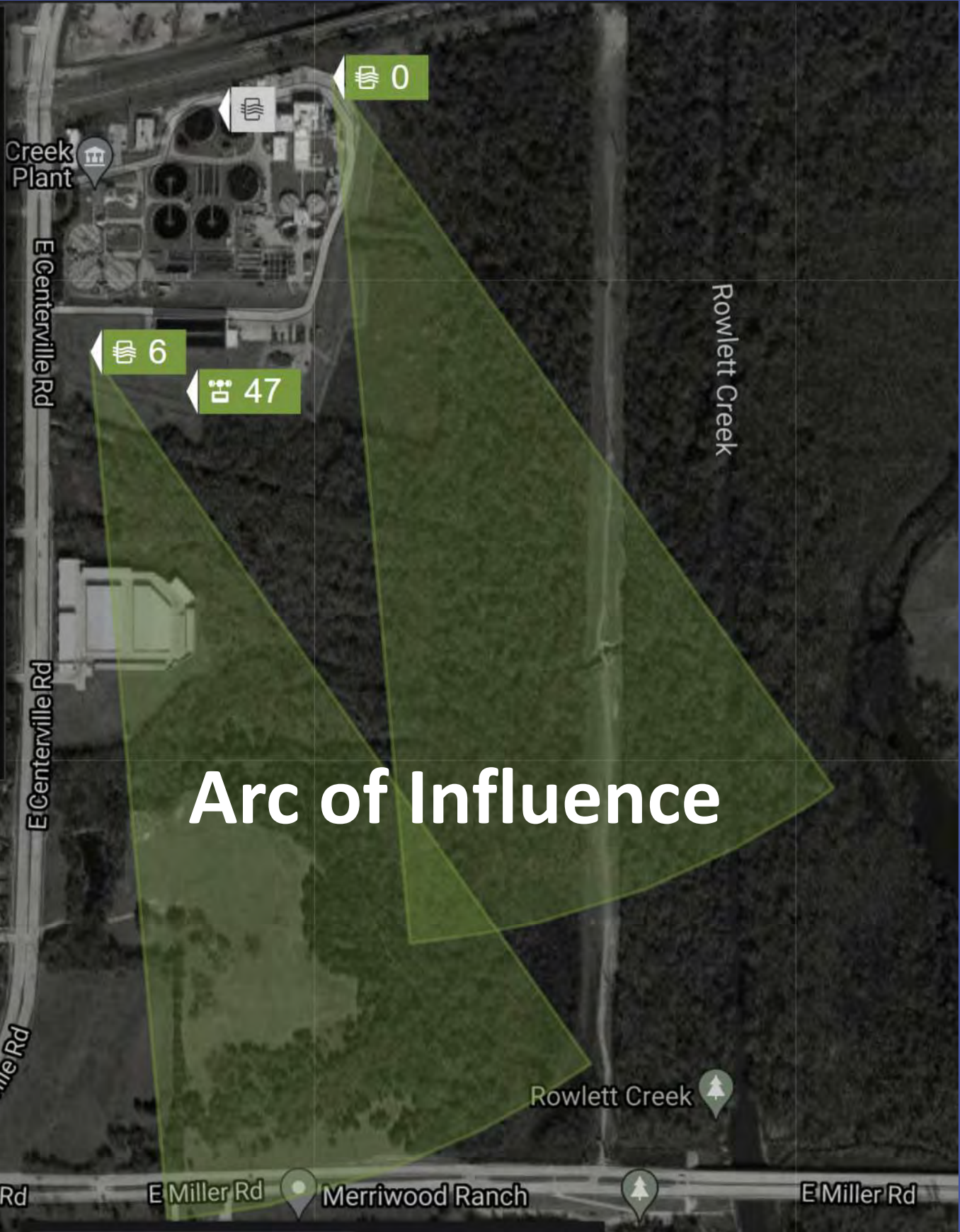
10:17 AM

H <sub>2</sub> S - 15 min	5.6 ppb
H <sub>2</sub> S - Concentration	4.0 ppb
External Battery Voltage	0.0 V

10:17 AM

20  
15  
10  
5  
0

12 03 06 09 12 03 06 09 12



Arc of Influence



# Alert Points

- Geographic points where user sets odor exceedance thresholds
- Alerts are transmitted to selected staff via email or text when model predicts an odor exceedance at an alert point
- System able to tailor alerts for different selected personnel for low, medium and high odor exceedances





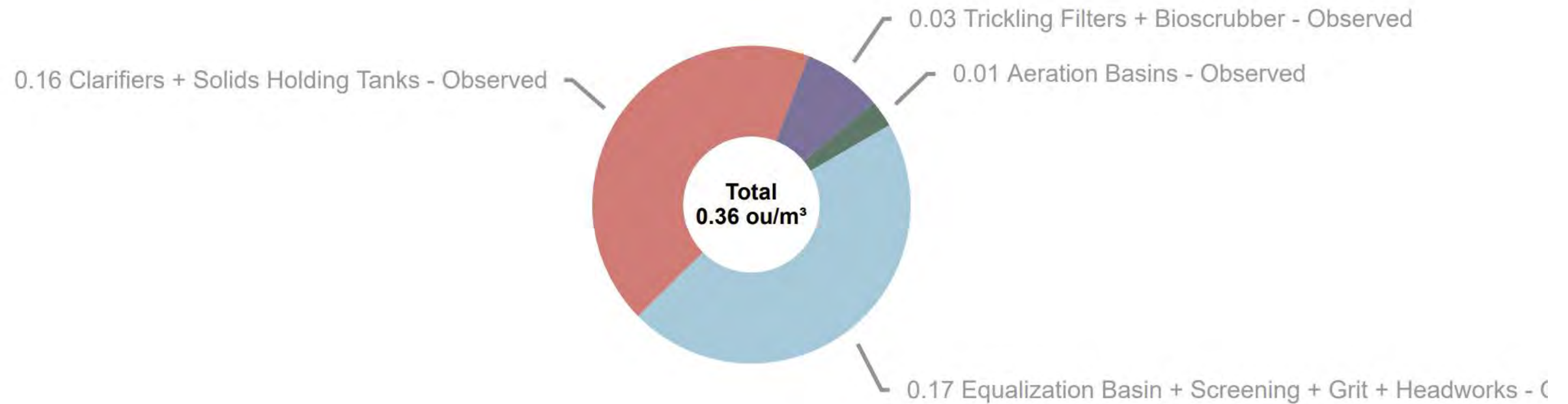
# Observed Odor Plume





# Identify Odor Contributors

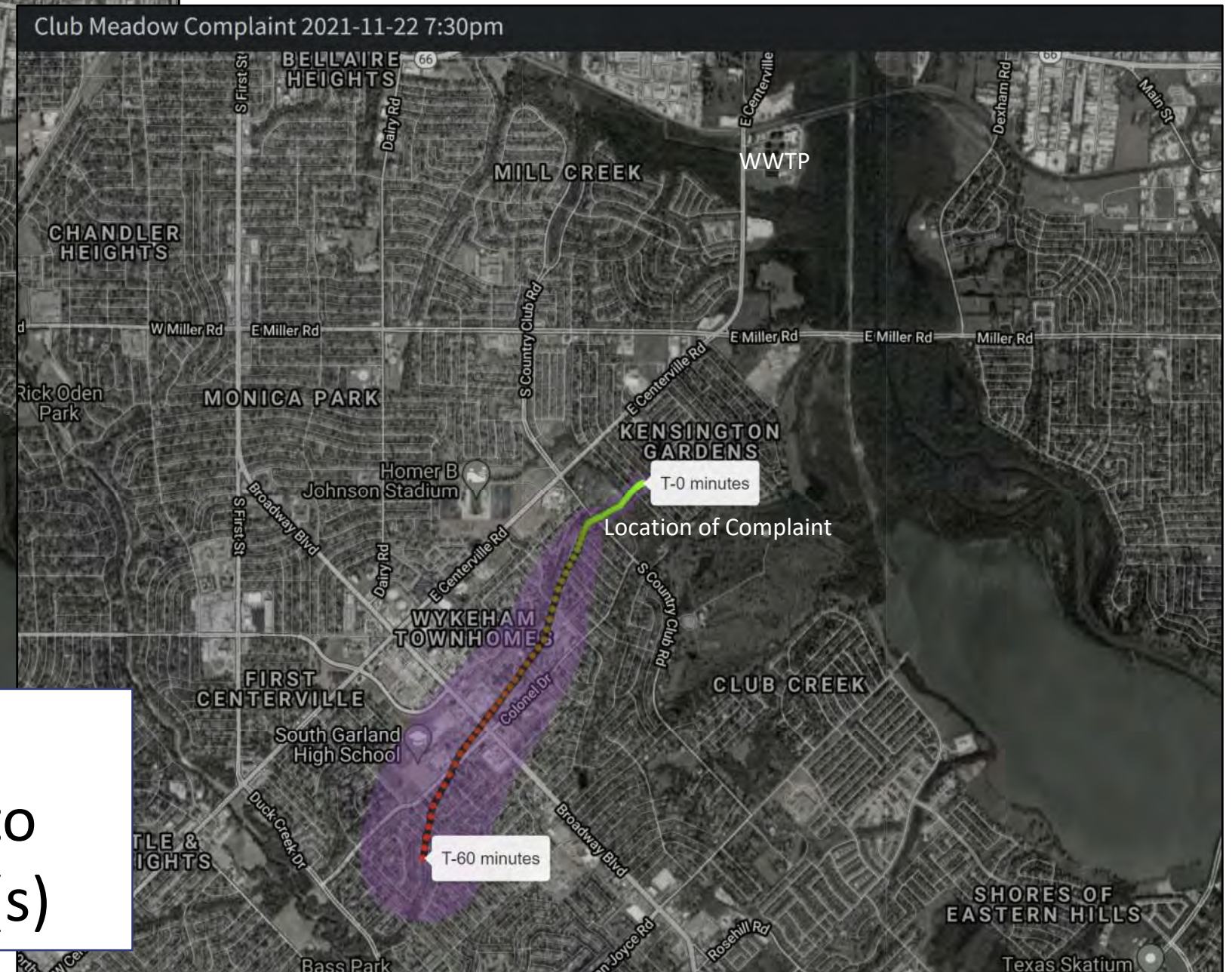
Rebecca Rd at E Tripp Rd



- Equalization Basin + Screening + Grit + Headworks - Observed [46%]
- Clarifiers + Solids Holding Tanks - Observed [43%]
- Trickling Filters + Bioscrubber - Observed [8%]
- Aeration Basins - Observed [3%]



# Reverse Trajectories

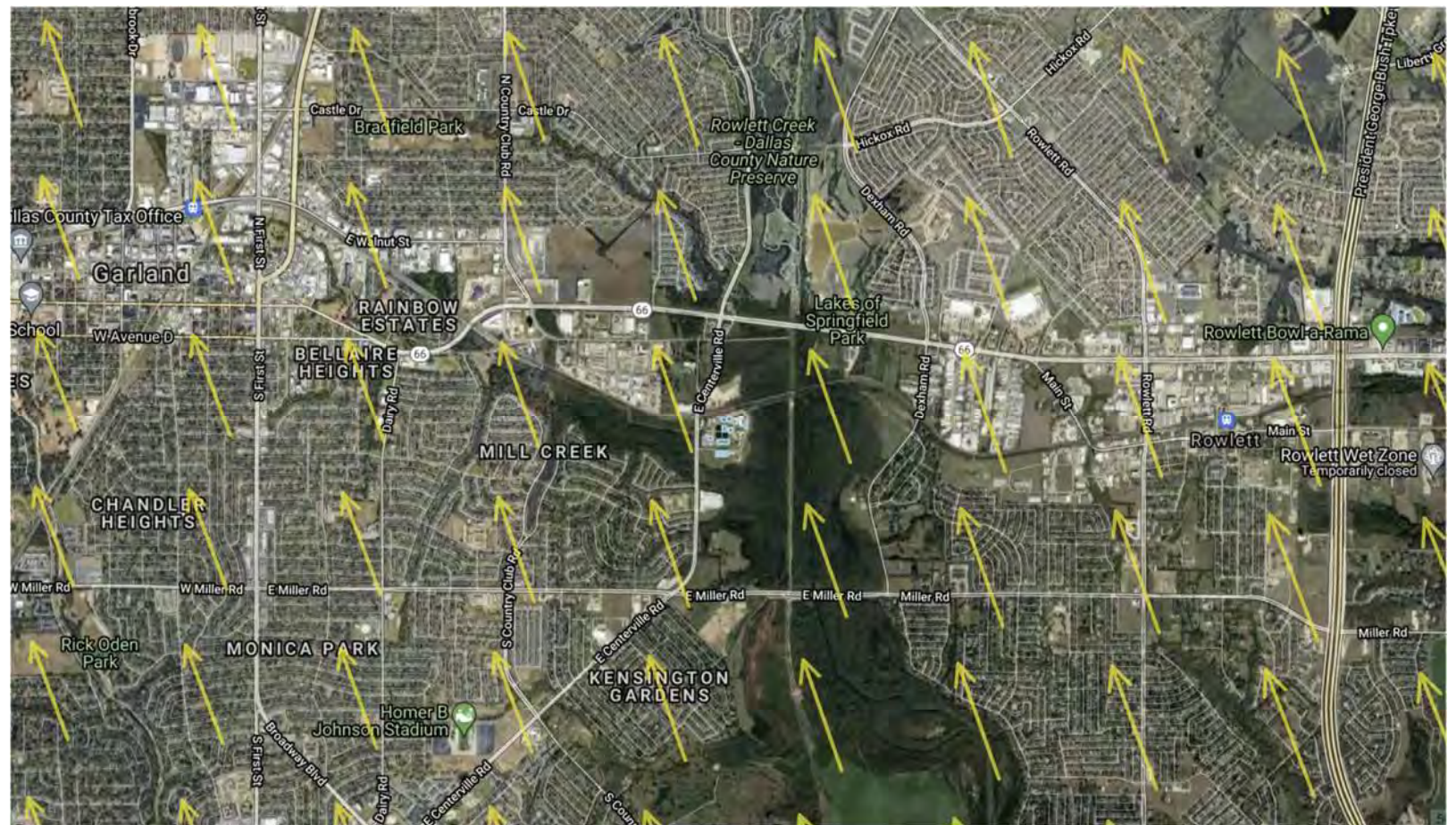


Reverse-trajectory model from location and time of complaint to investigate the probable source(s)









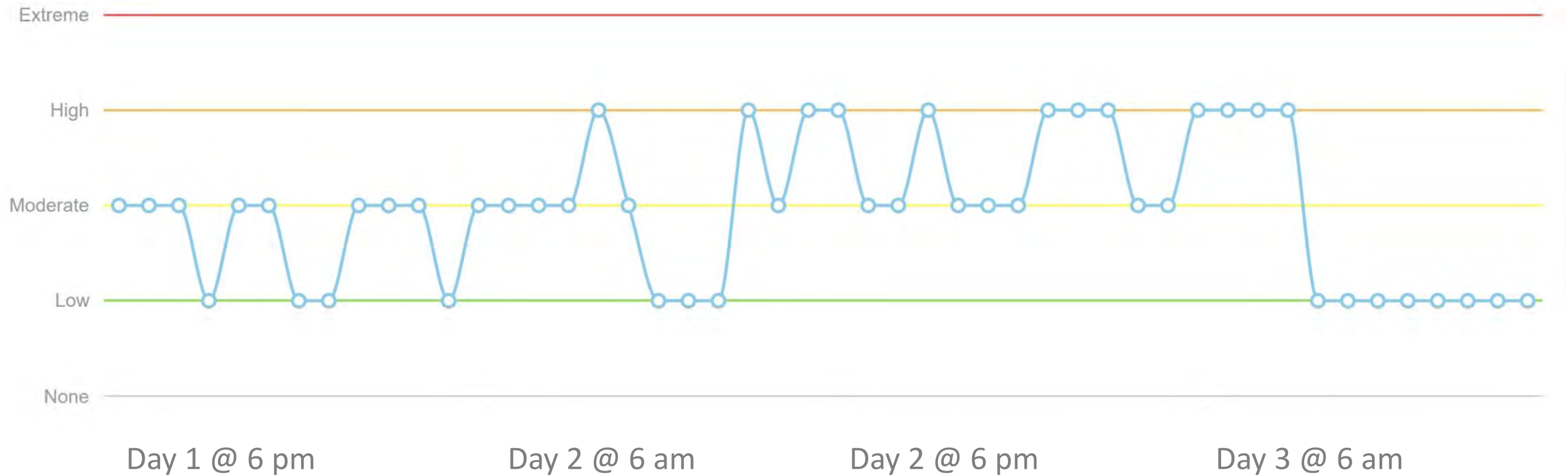
# Weather Forecast Model

- WRF stands for Weather Research and Forecasting Model
- WRF model run once a day with updated NOAA weather dataset inputs
- Outputs are a CALMET-ready dataset and hourly weather data
- Forecast model might change daily due to the update of WRF input data (NOAA dataset)



# Odor Risk Report













No Data  None  Low  Moderate  High  Extreme 





# Odor Risk Report

## Day Shift - Saturday

Hours	06 - 07	07 - 08	08 - 09	09 - 10	10 - 11	11 - 12	12 - 13	13 - 14	14 - 15	15 - 16	16 - 17	17 - 18
Risk	 High	 High	 High	 High	 Low	 Low	 Low	 Low	 Low	 Low	 Low	 Low
Wind Direction	NE	NE	NE	NE	N	N	N	N	N	N	NW	N
Mixing Height (ft)	921.66	920.07	920.57	605.93	155.95	156.63	157.02	157.72	158.22	158.64	159.11	159.28
Temperature (°F)	33.26	33.30	34.25	36.36	37.62	39.01	40.05	41.58	42.65	43.54	44.36	44.68
Rainfall (inches)	0	0	0	0	0	0	0	0	0	0	0	0
Wind Speed (mph)	5.76	5.96	4.22	4.17	5.08	4.27	7.55	4.42	7.29	5.84	3.94	4.63

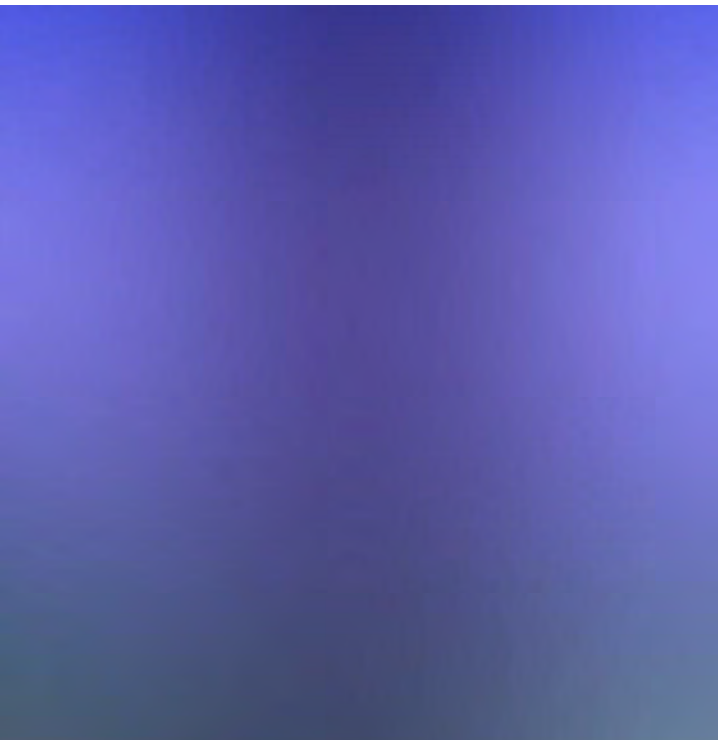
## Alerts

- Saturday 06:00 - 10:00: High odor risk due to moderate speed winds blowing towards sensitive area.
- Saturday 10:00 - 12:00: Low odor risk due to moderate speed winds not blowing towards sensitive area.
- Saturday 12:00 - 13:00: Low odor risk due to high speed winds not blowing towards sensitive area.
- Saturday 13:00 - 14:00: Low odor risk due to moderate speed winds not blowing towards sensitive area.
- Saturday 14:00 - 15:00: Low odor risk due to high speed winds not blowing towards sensitive area.
- Saturday 15:00 - 18:00: Low odor risk due to moderate speed winds not blowing towards sensitive area.




# Uses and Benefits

- When complaints are received, the system provides objective verification regarding whether WWTP facilities could have contributed
- Possible first indication of issues inside the plant
- Provides useful information for planning of future odor control capital improvements
- Provides advance notification to management for potential odor events
- Provides objective “defense” when sources other than the WWTP may be the cause of off-site odor events
- Provides information to support supplemental chemical feed or other short-term mitigation measures



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# Questions & Answers







**Thank you.**