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Static Vs Dynamic Odour Control A Better & More Cost Effective Solution

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Chesapeake-Elizabeth WwTP

- **24 MGD US (91 MLD)**
- **Virginia Beach**
- **USA**

- Physical-Chemical-Biological Secondary treatment plant
- Without Primary Clarification
- Partially covered ASP + OCU
- Peroxide Regenerated Iron Sulfide Odour Control at Headworks
- OdoWatch real-time odour monitoring & modelling

Typical Chemicals Responsible for Odours

- **Sulphides** (H_2S, DMS, DMDS, CS_2, Methanethiol)
- **Volatile Fatty Acids** (Acetic Acid, Butyric Acid, Propionic Acid)
- **Nitrogen Compounds** (Ammonia, Trimethylamine)
- **Plus** Many Others depends on waste stream and the process used!

Unfortunately No single tracer gas for estimating off site odour impacts (Odour is a blend of multiple components… many at the detection limits of existing methods)

Must rely on olfactometry (D/T or O.U./m^3) and modelling

Olfactometry Definitions

- **Odour Unit: by definition, 1 o.u./m^3 when odour is perceived by 50% of a human panel (1 o.u./m^3 corresponds to the detection threshold)**

  Also Dilution to Threshold (D/T)

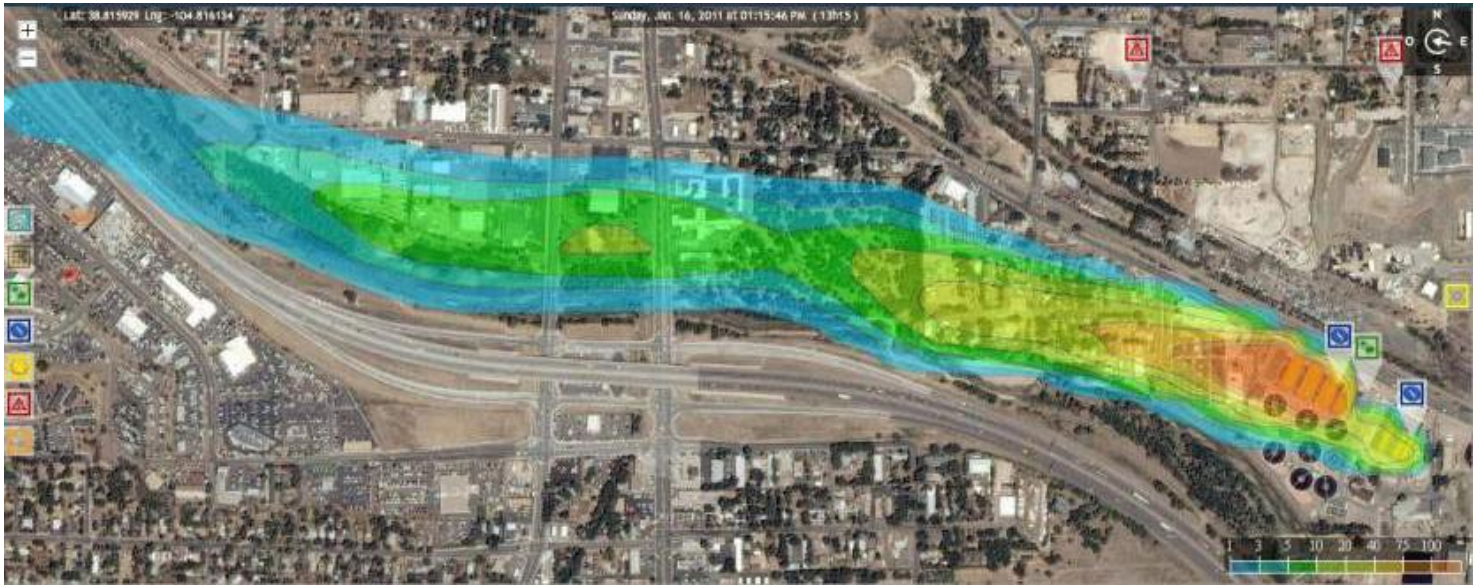
- **Odour Concentration (c) (number of odour units): Number of dilutions (with odourless air) of the sample required to obtain 1 o.u./m^3**
- Example: if c = 10,000 o.u./m^3 means it takes 10 thousand dilutions to reach the detection threshold for this sample

The Costs of Odour Problems

- Forced Shutdowns
- Revoked or Refused Permits
- Fines and Penalties
- Lawsuits and Lawyers
- Massive Investment in Technology Upgrades
- Daily Operation & Consumables Costs
- Difficult Public Relations with Neighbours

Odour Dispersion Modelling

- **Defines relationship** between the emission source and receptors
- **Compliance** with nuisance standards depend on whether the odour levels at the receptor have been reduced with respect to their Frequency, Intensity, Duration, Offensiveness and Location (FIDOL, also FIDOR)



Purpose of Dispersion Modelling

Understand fate of odour emissions as a function of weather conditions

Impact assessment

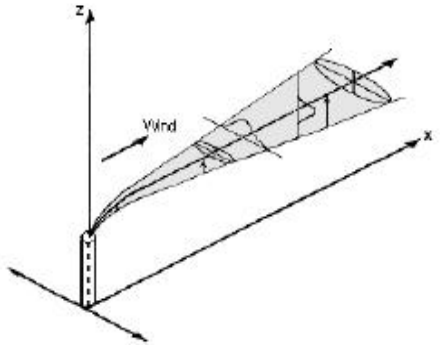
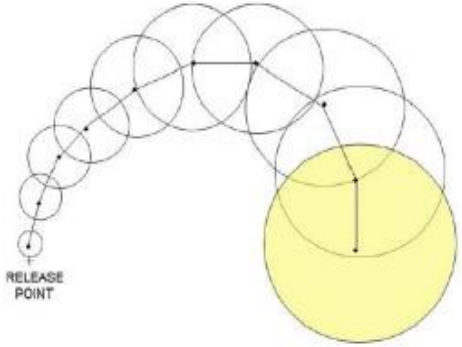
Retrofit & control
- new technology
- largest contributor
- stack design

Complaints
- validity
- distribution
- anticipation

Permitting and compliance

Operation management

AERMOD v CALPUFF Modelling

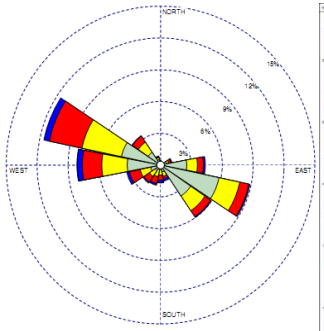
AERMOD	CALPUFF
	

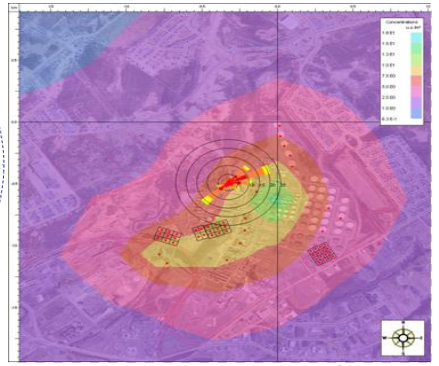
Static Modelling

- Sources sampled at a single campaign
- Olfactometric results define the source
- Modelling with historical metrological data (1 to 5 years)
- The result pairs "worst case" emissions with "worst case" dispersion
- Compliance = some "acceptable" level of exceedance as a percentile of hours
- Static modelling only option on new or proposed sources, as the does not exist

Static modelling is '*Odour Dispersion Modelling Assessment' or 'Odour Impact Study'*

Sampling → **Olfactometry** → **Weather data** → **Modelling**





Dynamic Modelling

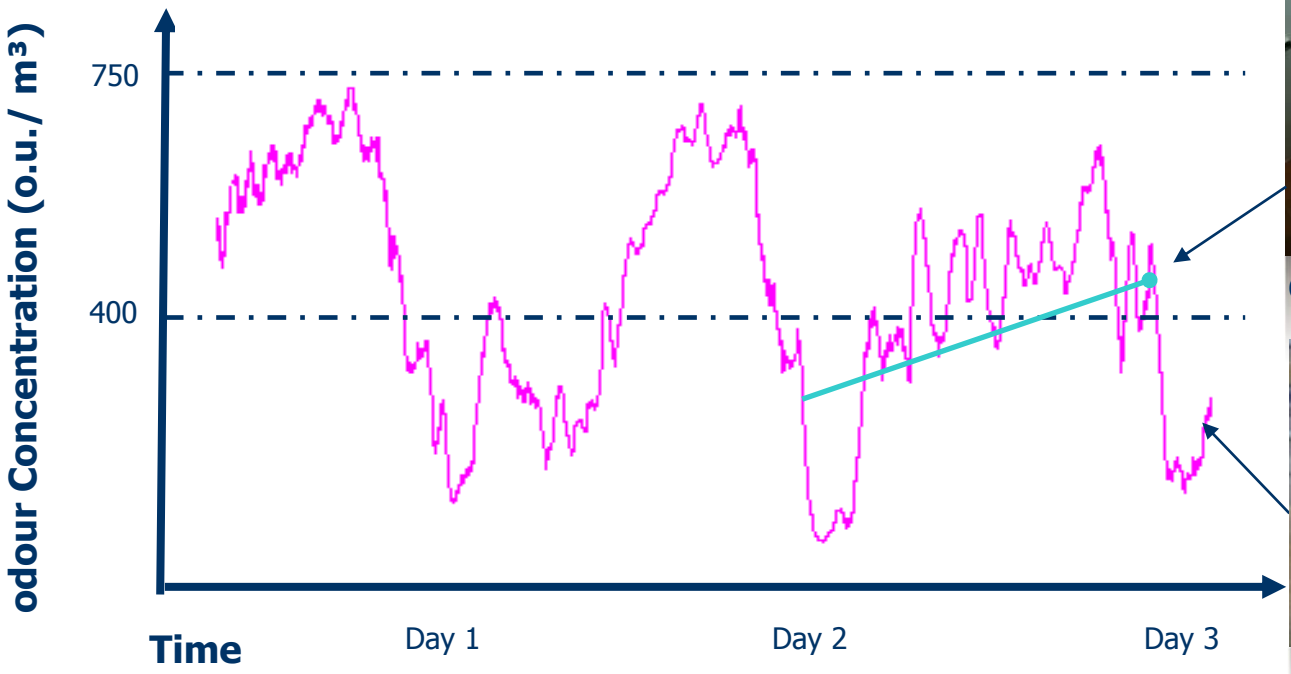
- Pairs real time monitored odour emissions and measured real-time meteorology
- Emissions and dispersion no longer independent parameters
- Odour control measures can be applied dynamically, not worst case condition
- Dynamic modelling preferred option on large open emission source
- Also applicable to control/optimisation of OCU's

Real-Time measurements → **Live Weather Data** → **Modelling iteration every 4 minutes**




Odour Concentration & Emission Rates

- ***Static Modelling:***
  - Emission rate limited to the odour concentration obtained during the sampling campaign and olfactometry analysis
- ***Dynamic Modelling:***
  - Emission rate measured/calculated continuously
  - Updated for at each model iteration
  - Considers fluctuation from unsteady state processes and/or weather variations




Olfactometry


E-Nose

Static vs. Dynamic odour modelling

Source Parameters

- ***Static Modelling:***
  - Values represent worst case release scenario at time of sampling

- ***Dynamic Modelling:***
  - Exhaust gas temperature and exit velocity considerd for each model iteration
  - Adjusts for operational variable (e.g. influent wastewater quality)
  - Include open/closed door conditions (e.g. Sludge Dewatering Building)



Meteorological Data

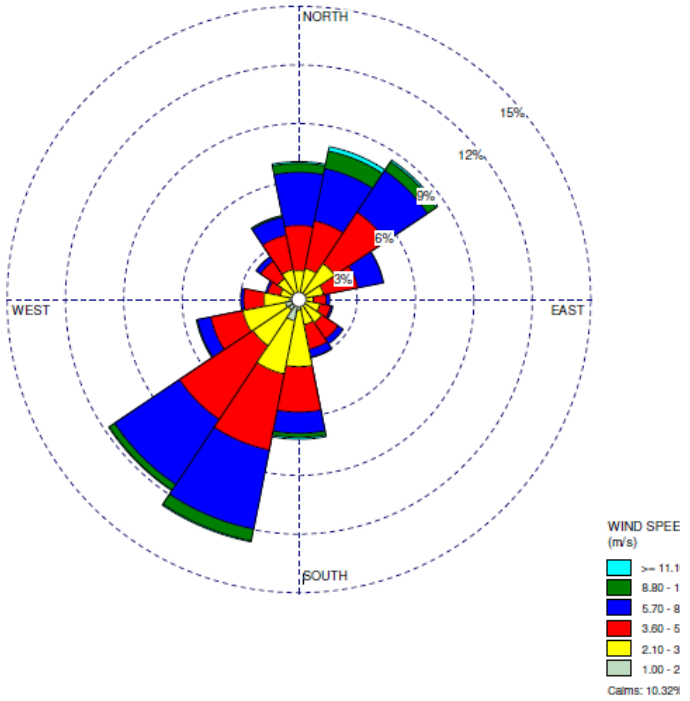
- ***Static Modelling:***
  - Historical data from the nearest airport.
  - Meteorological data is an independent variable from the odour emissions
  - The static modelling often predicts maximum odour impact on
    - calm winter morning
    - and maximum odour emissions on warm summer days.
  - Data is often not local (distance from data source to site)
  - Weather data doesn't reflect micro scale changes at site or surroundings

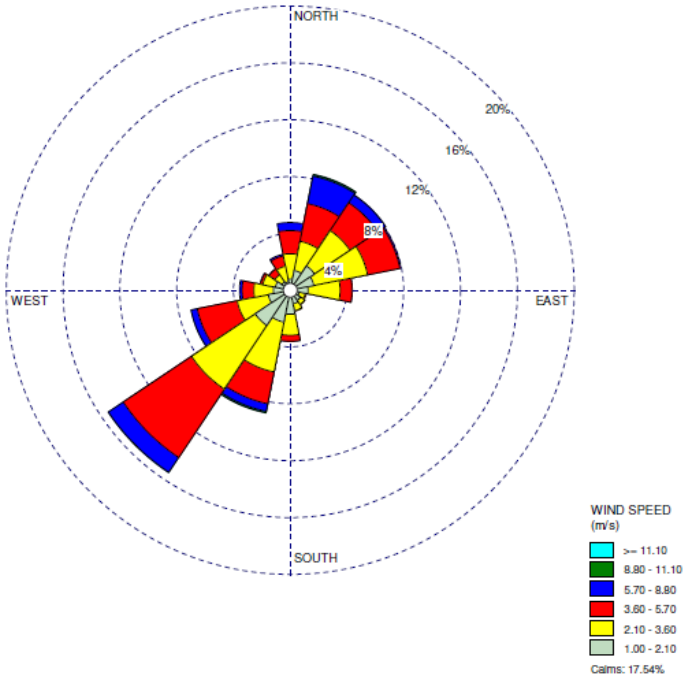
- **Dynamic Modelling:**
  - On-site weather tower data
  - Linked to real-time odour monitoring
  - Calculates real-time emission rates

Chesapeake-Elizabeth WwTP

Meteorological Data	Static Modelling	Dynamic Modelling
Period	Historical 1 to 5 years	Real-time and historical data
Frequency	1 hour average	As low as 4 minute intervals
Representation	Regional scale	Local scale next to the source
Location	Nearest airport	On-site
Upper air	Two (2) per day usually remote location far from the site (50+km)	Assumes unlimited surface mixing layer
Topography & Receptor Array	Taken in consideration	Taken in consideration
Complex Changing Local Patterns	Not considered	Taken in consideration

Wind Rose Variations (2013)





Norfolk International Airport

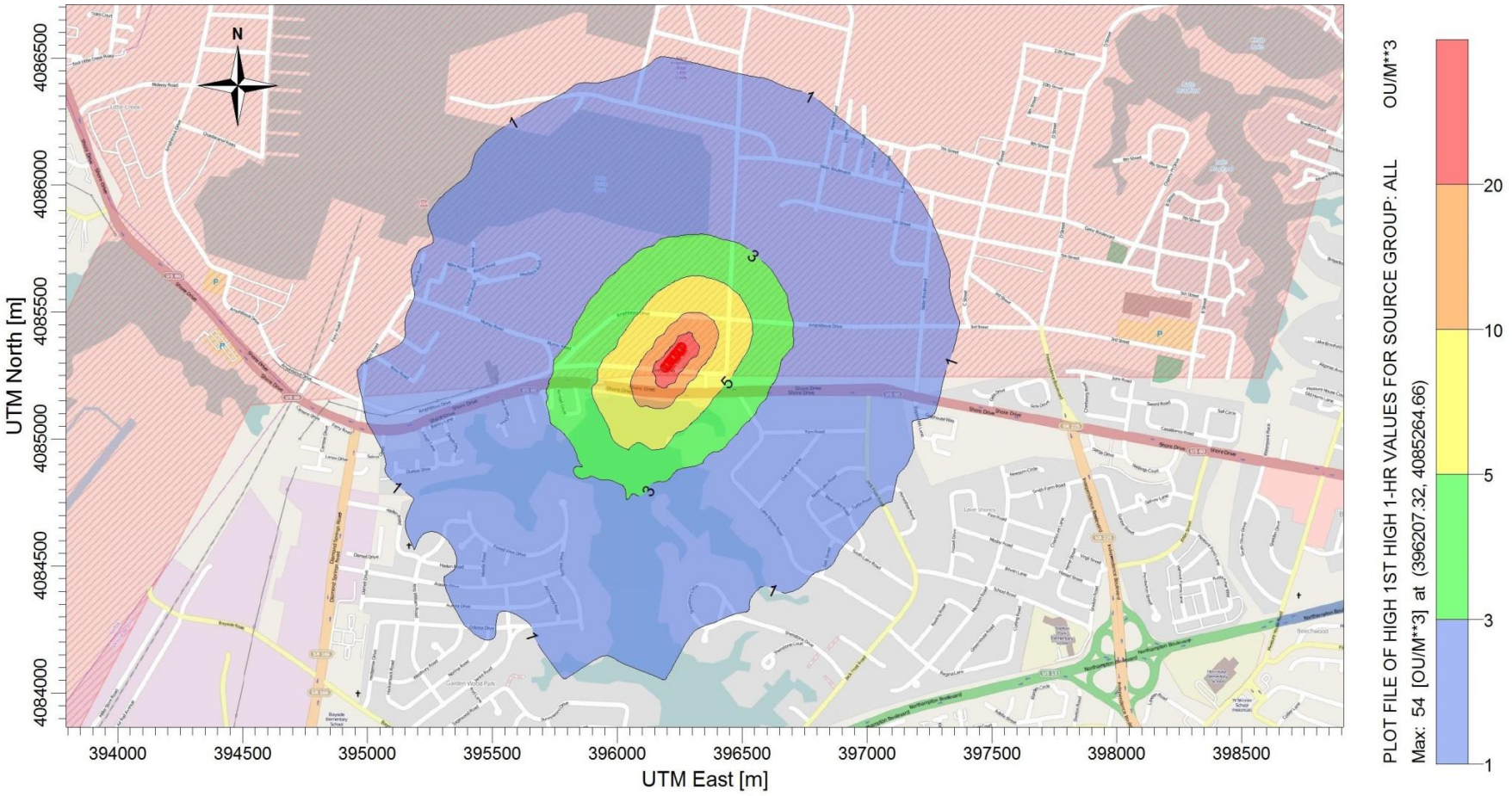
On-site Station at CETP

'wind blowing from'

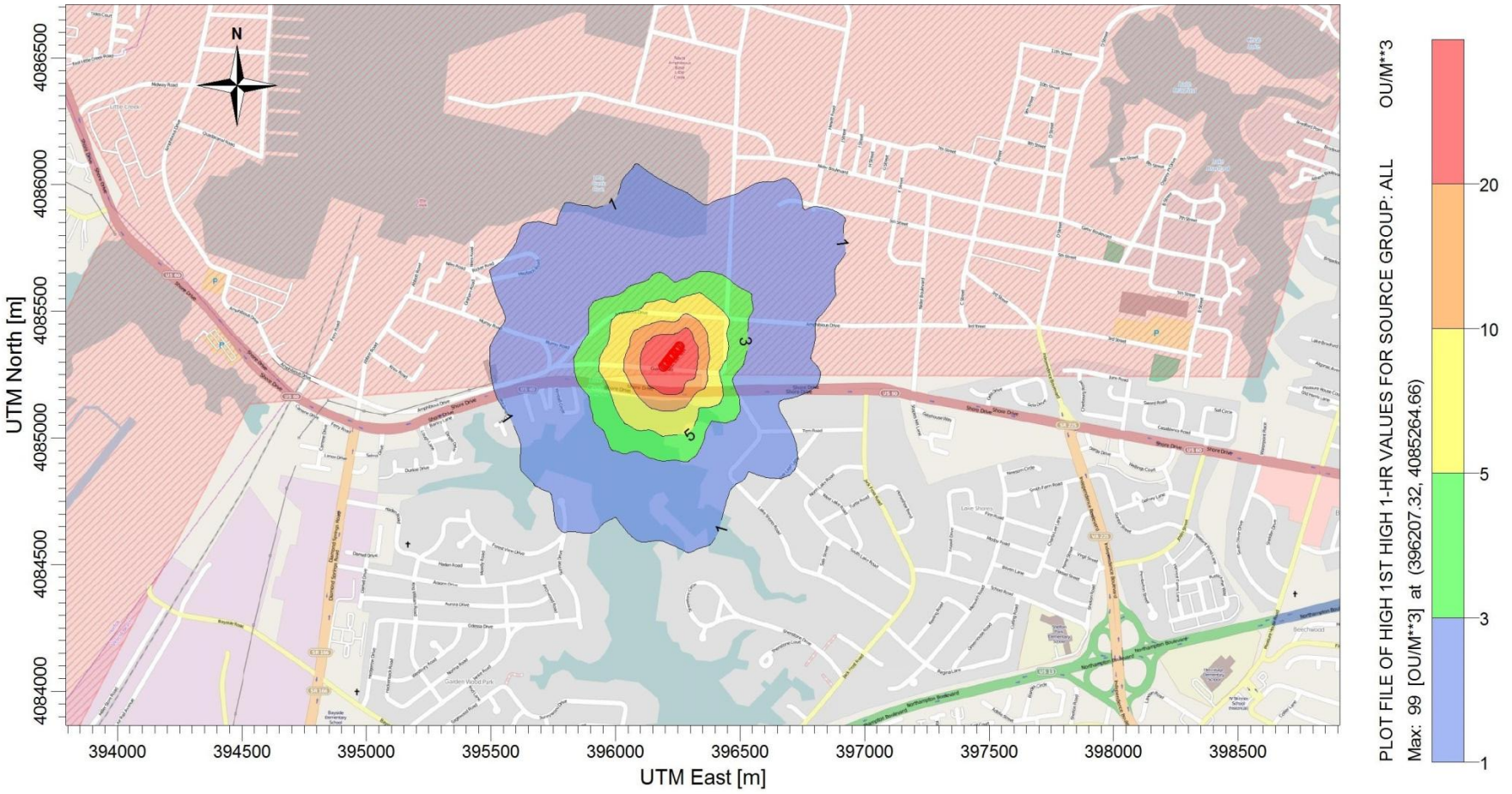
Utilisation Source Characteristics

Utilizations	Static Modelling	Dynamic Modelling
Alert upon threshold exceedance	Not possible	Visual, sound or email
Proactive	Not possible	Can trigger measures to mitigate odour emissions
Compliance determination	For new sources and existing sources	For existing sources
Review of specific odour event	No	History of all archived plumes. Animation (movies) of odour events in the last 24 hours
Current compliance assessment	No	Yes
Complaint validation	Yes but limited to average exposure	Yes on a case by case event
Automated report	No	Yes on demand
Process optimization	Limited to average results	Process optimization with control loop adjusted every model iteration

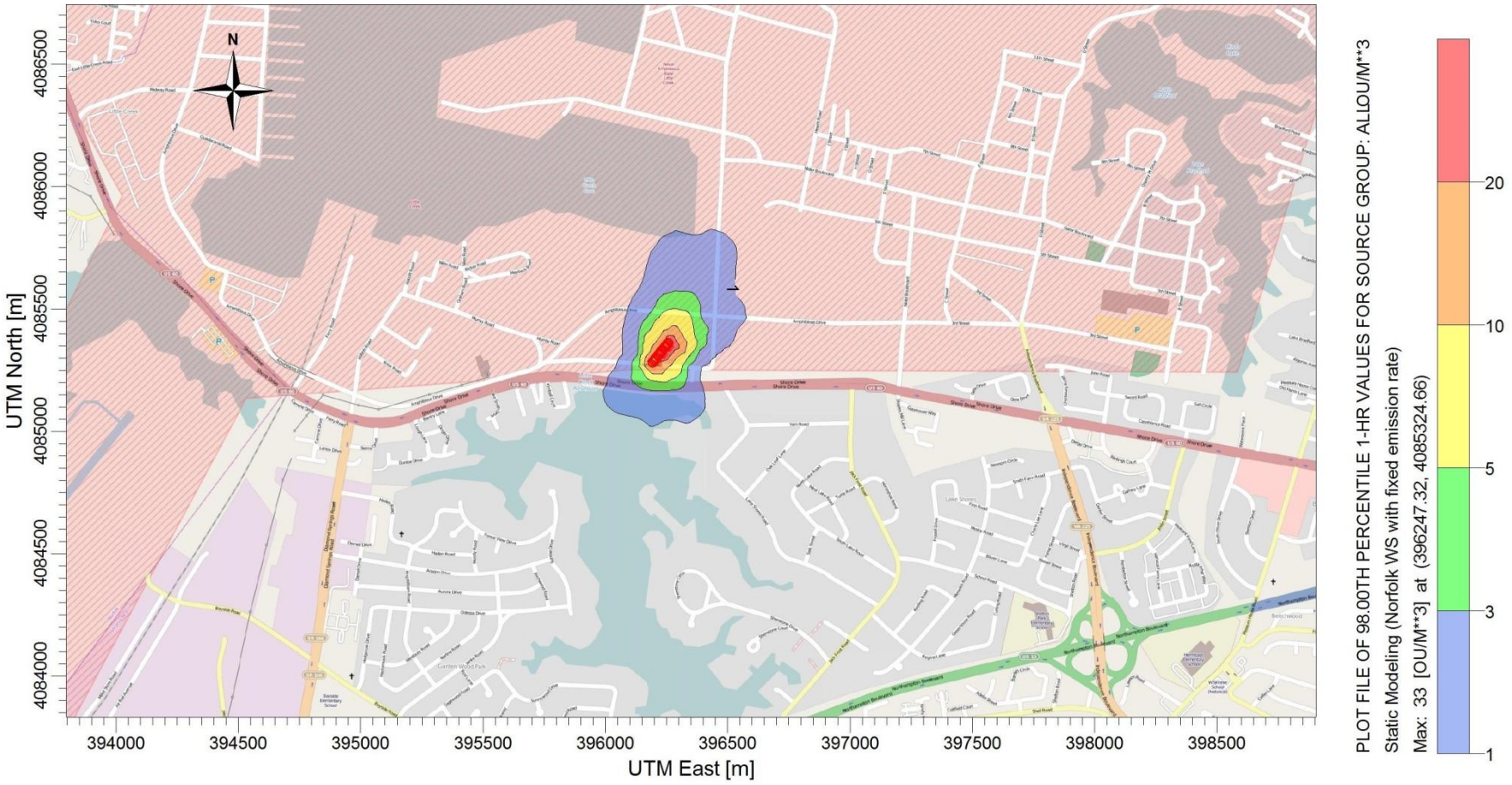
Static Modelling; Maximum Impact



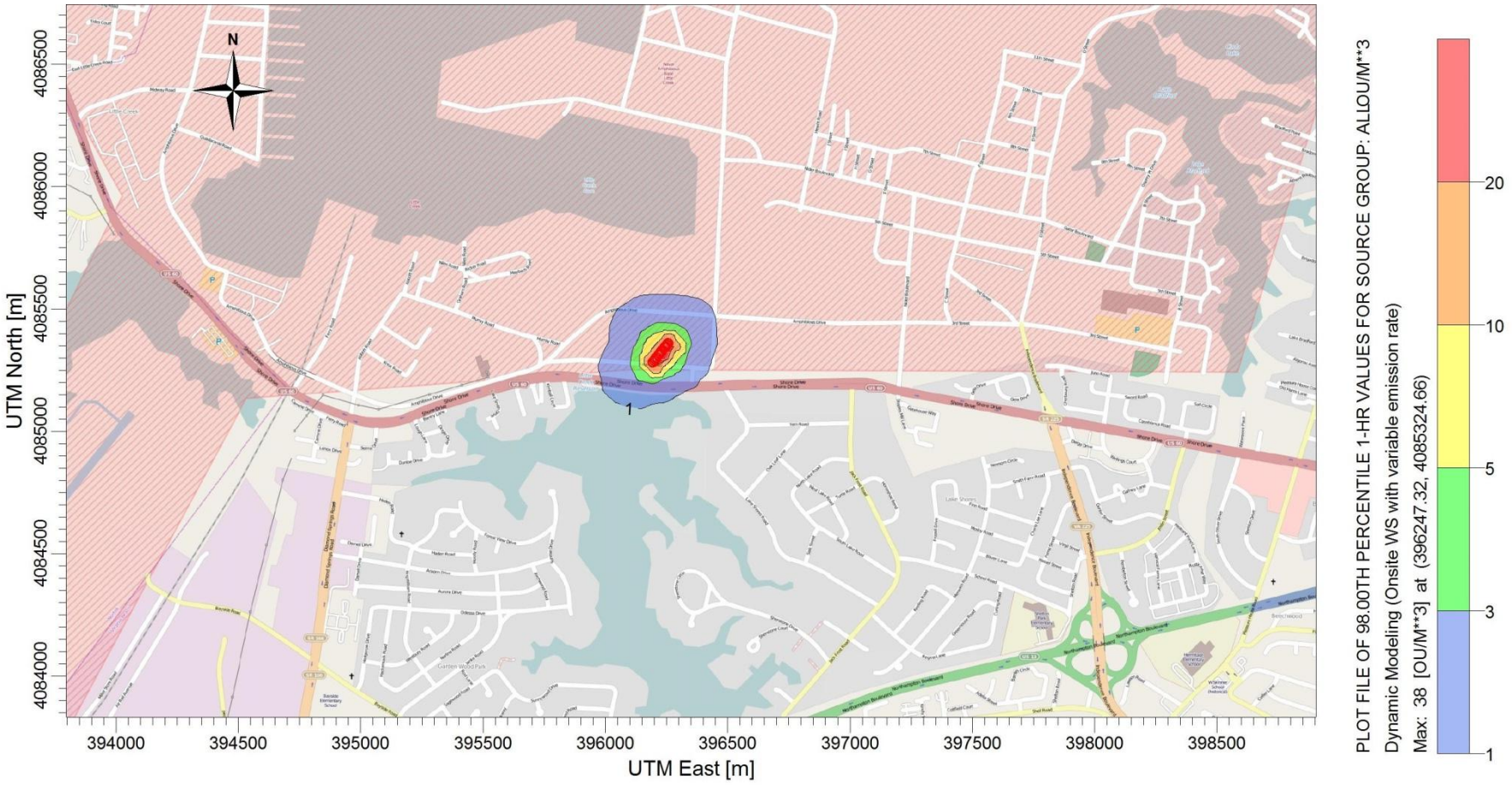
Dynamic Modelling; Maximum Impact



Static Modelling; 98%ile Impact

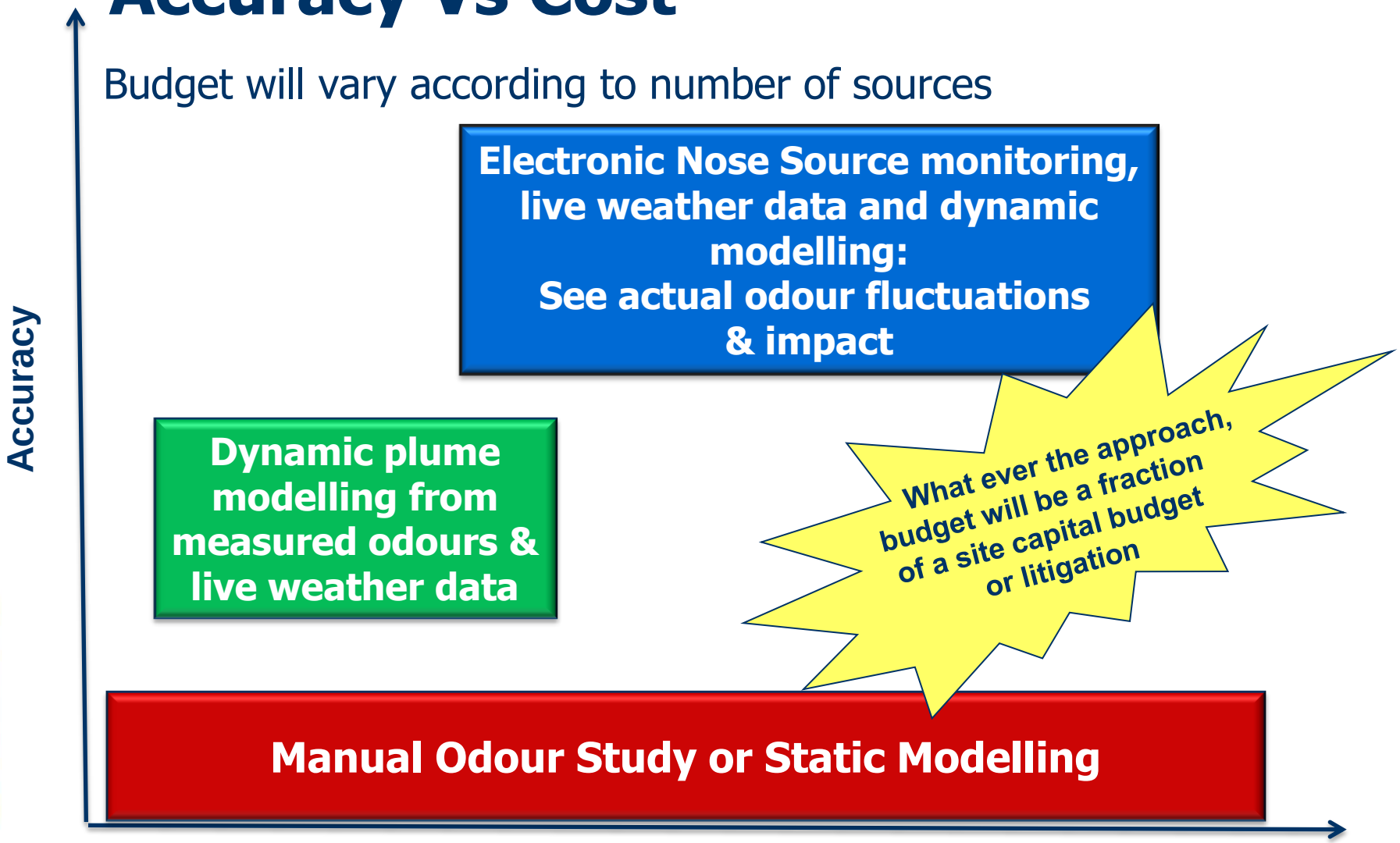


Dynamic Modelling; 98%ile Impact

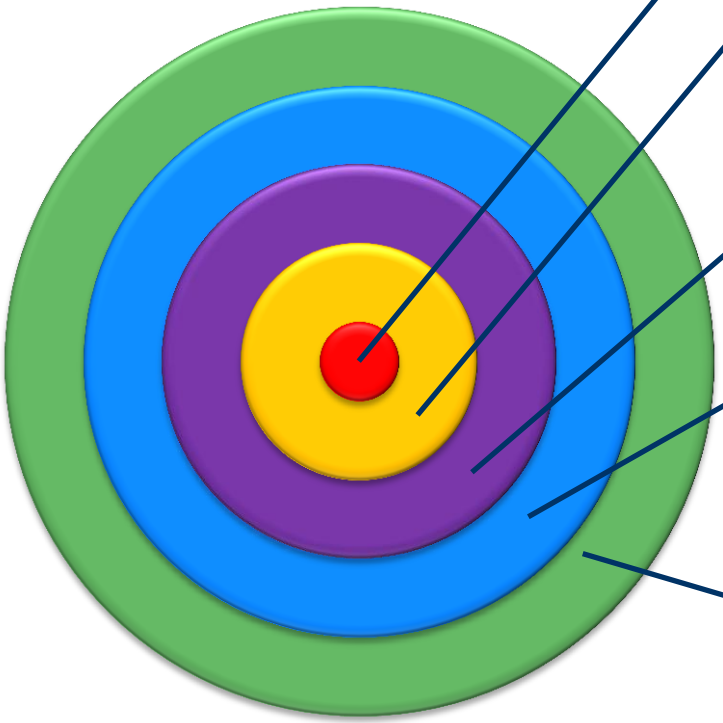


Accuracy Vs Cost

Budget will vary according to number of sources



Dynamic Odour Monitoring Value



- Minimize odour management costs (CAPEX & OPEX)
- Manage odour events in real time based on a proactive approach (reduce of off-site impacts)
- Continuous improvement possible with associated off-site impact reduction & tractability
- Rational evaluation of the project and site based on existing and anticipated constraints
- Establish a trust based relationship with stakeholders (elected officials, neighbours, regulatory agencies)

Real-time odour monitoring & modelling - OdoWatch

Economic Consequences

(Chesapeake-Elizabeth WwTP)

- **Phase 1** – Partially Cover Aeration Basins
  - Implemented + using Odour Control Unit

- **Phase 2** – (Proposed)
  - Completely Cover Aeration Basins
  - Not implemented due to high capital cost

- **Phase 2** – (Implemented)
  - Hydrogen Peroxide to control odour emissions
  - OdoWatch real-time continuous monitoring & modelling
  - +10% reduction in chemicals with OdoWatch

Thank you

- OdoWatch a real-time odour monitoring & modelling system for:
  - Continuous odour emission measurement
  - Real time, 24/7 atmospheric dispersion modelling
  - Advanced data analysis
  - Threshold alerts (alarm)
  - An operational tool for managing odour impact

Questions please contact

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