New International Handbook on the Assessment of Odour Exposure Using Dispersion Modelling

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Purpose of the New International Handbook

For regulatory purposes much of the focus of attention in the last couple of decades has been in trying to establish odour guidelines in the hope of bringing a degree of consistency to the control and regulation of odours.

Less effort has been spent assessing the best tools suited to compute odour impacts with respect to accurate emission rates, source characterization, the important role of local meteorology, interpretation of modeled results, or the suitability and applicability of one dispersion model over another.

The handbook aims to address several of these key issues central to the t[illegible] effective management and odour regulation.

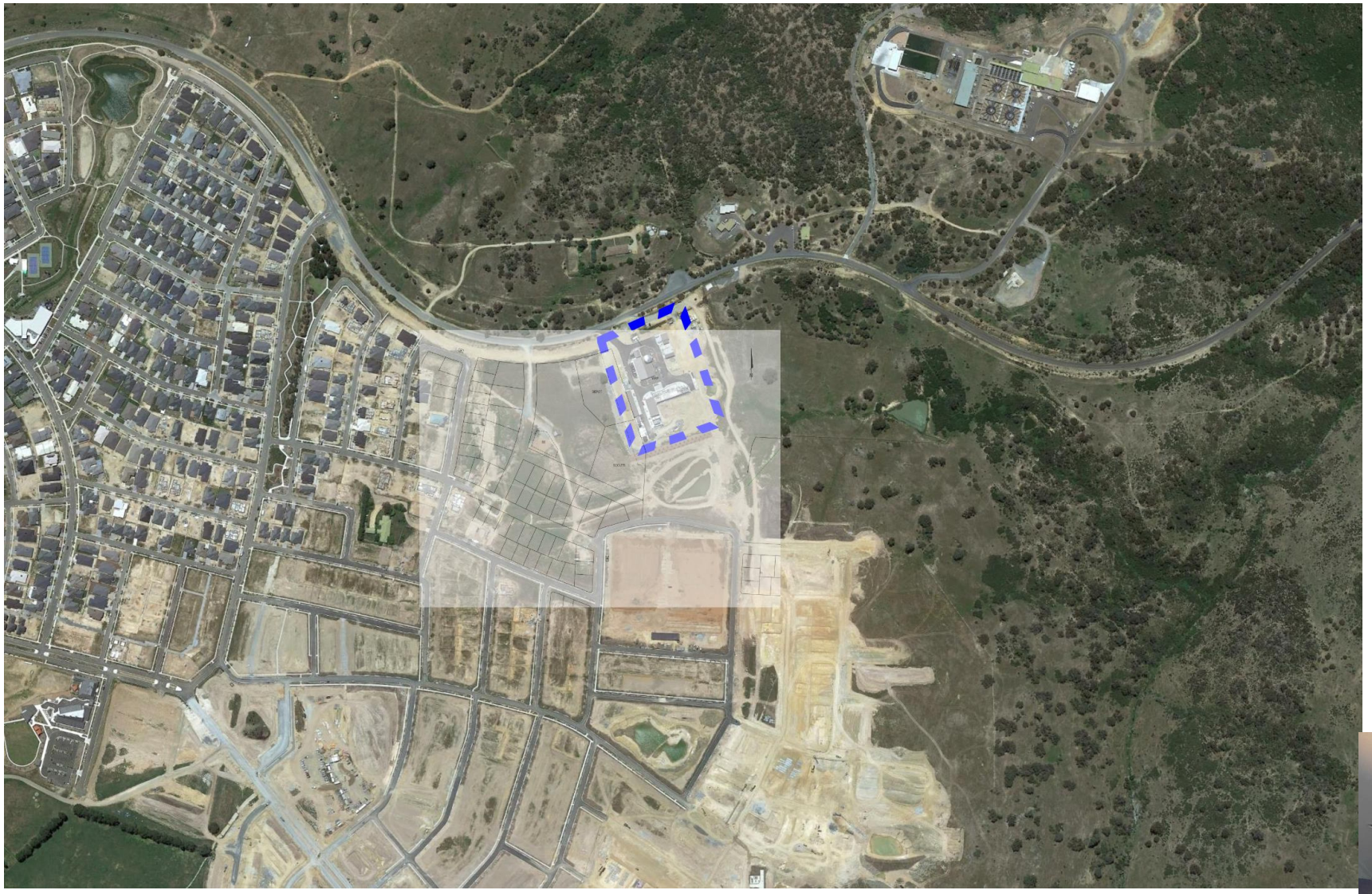
Aims of the Handbook

- Provide guidance that will benefit **all** countries, even those with advanced odour regulation.
- Define ambiguous odour terms that have different meanings in different countries.
- Use one universal set of definitions, terms and units.
- Future looking to make best use of International experts whilst acknowledging that odour regulation change evolves slowly.
- Meet like-minded experts from around the world
- Collaborative work by 50+ international experts from 17 countries around the world.
- Meet once a month with special task groups meeting monthly

The Problem With Odours

- Odours are the **single most important environmental issue** in siting and implementing wastewater treatment and bio solids management facilities in the world today.
- Odours are often the responsible for the most number of complaints at most local councils.
- Once isolated facilities are now being encroached by increasing residential expansion.
- Facilities are being held accountable regardless of the fact that they were there first.
- Increasingly higher aesthetic, environmental expectations of citizens, who are less tolerant of odours than in the past

The Problem With Odours



Why Model Odours

- Predict quantitative air quality impacts at many points over a wide geographical area
  - Receptors are inexpensive
  - Not restricted to a few measurement points
- Evaluate impacts of proposed future sources
- Conduct detailed source contribution analyses
- Source mitigation and control scenario evaluation
  - Engineering design
  - Cost-benefit analysis
- Planning studies
  - Site selection for new facilities
  - Optimize source layout
  - Design buffer zones and fence line locations
  - Design and optimize monitoring networks
  - Land use planning to minimize pollutant exposure to populations
- Dispersion models can objectify what is a subjective process – they are able to remove the 'er
- Models can address some factors of FIDOL (frequency, intensity, duration, offensiveness and l
- Models are the only tool than can simultaneously emulate, emissions, meteorology, landuse,

6 Task Groups

1. Definitions, Terms, Units
2. Meteorology
3. Emissions and Source Characterization
4. Dispersion Algorithms
5. Dose Response
6. Reporting

- Collaborative work by 50+ international experts from 17 countries around the world.
- Meet once a month with special task groups meeting monthly
- Each Task Group has approximately 5-10 members who are responsible for wr
  reviewing individual sections

Principal Themes of Handbook

Each task group is guided by a set of principal themes which are central to the document, and are as follows;

- The document will be a handbook rather than a guideline. This is to prevent conflict with those jurisdictions\states\countries that already have guidelines and regulations.
- The document is to be of benefit for jurisdictions\states\countries that have strict odor regulations, and for those who are just beginning to consider odour legislation.
- Rather than focus on any individual model and country and how they apply odor regulation, the focus of attention will be on the parameters themselves.
- Valid, workable references are a key component of the document which will include live links wherever possible.
- There will be a uniform set of units, definitions and terms across the document whilst acknowledging and discussing those countries who use a different set of units, definitions and terms.
- Individual task groups will focus on the pros and cons of key subject areas. It is not the handbook intent to criticize any existing regulations. There are many countries with advanced odour legislation that is outdated, and it can take a long time for new guidelines to progress.
- The handbook will be forward looking making the best use of the experts' experience as well as rec
changing regulations can take a long time.

Definitions, Terms, Units

- One of the most important Chapters.
- Main aim is to gather a list of International commonly used odour terms and provide a detailed definition of each term meaning.
- TG1 will also be in charge of a standard way of referencing.
- Most odour terms are international, but there are important exceptions, for instance:
    1. the definition of odour and its unit
    2. FIDOL vs FIDOS vs FIDO.

For example, (1) In Australia and Europe we use the “Odour Unit”

- (ou) Australia or (OU/m^3) Europe
- 1 ou is the concentration of odorous gas that will elicit a D_{50} physical response of a panel under laboratory conditions
- 1 OU/m^3 is the amount of odorant evaporated into one cubic meter of neutral gas. At standard conditions, it elicits a physiological response from a panel (detection threshold). This equivalent to that elicited by one European Reference Odor Mass (EROM), evaporate neutral gas (1EROM=123 µg of n-butanol)

Meteorology

This section covers a significant amount of material, and will discuss:

- The development of simple 1D meteorology to 3D meteorology
- Use and relevance of single station meteorology vs that from numerical weather prediction models
- When to use single meteorological data vs 3D data for odour assessments
- Complex meteorological conditions (sea and land breezes, upslope and downslope flows, complex terrain, coastal regions and inhomogeneous land use types
- Length of model data, and relevance of model year against the long term historic records.
- Focus will not be on any one model, but will focus on a number of worldwide regulatory models including: CALMET, AERMET, ADMS, GRAL, AUSTAL, SWIFT etc and focus on how they use critical parameters, e.g., roughness length.
- Model evaluation
- Reporting meteorology

Emissions and Source Characterization

This TG has some complex themes to address, one is; Area odour source emissions (WWTPs, Compost, land fills, pulp and paper industry) which depend strongly on the type of sampling methods :

- Two well known International methods; tunnel hood and isolation flux hood, but;
  - UP to 4-fold differences between isolate flux hood and tunnel hood
  - Wind tunnel preferred for emission sampling as the results can be adjusted for actual ground level wind speeds and the fetch lengths of area sources
  - Wind tunnels are okay when wind is a factor, but flux hood is better for stable conditions
- For both these devices the emission rate is calculated as the product of concentration and airflow through the device.
- Long 30 year standing debate about appropriate and accuracy of the equipment
- Scientific literature gives little to no guidance on selection and operation of such equipment.
- Australia is one such country that has developed odour management policy for certain facilities based on data from these devices. As a result odour criteria vary according to regulatory jurisdictions and facilities. This has ultimately created difficulties for industries that operate across different States in Australia. These anomalies are difficult to comprehend by the general community, thereby c difficulties for various regulatory agencies and producers. These issues are not unique to Aust common theme in many countries.

Dispersion Models and Algorithms

The mechanisms of odour dispersion are the same as the dispersion of other pollutants, but there are some special problems that must be considered;

- determining the emission rates of the pollutant,
- the high degree of subjectivity in the perception and intensity of odours,
- the short time period over which odours are observed, and
- the enhancing or masking of odours by the combinations of different odours

TG4 will focus on the following;

- The role of dispersion models in the frame of odour applications
- Description of dispersion model algorithms
- Operational existing models
- General well-known problems/limitations and solutions such as peak to mean ratio and problems related to the emission or meteorology
- Model suitability
- Model validation in the frame of odour applications
- New upcoming methodologies to overcome problems described above

There are two key factors that should be considered in evaluating whether to use a conventional steady-state plume model AERMOD, or a more sophisticated approach are;

- whether the steady-state assumption is valid, and,
- whether the technical parameterizations in the plume model adequately treat the situation to be modelled.

Dose Response

The role of Task Group 5 (TG5) is to discuss the dose response to odours, in other words, to assess the odour impact experienced by the community.

The acronym FIDO S/L features strongly in this section (frequency, intensity, offensiveness, duration and sensitivity and or location), where each parameter is discussed in depth.

TG5 will discuss in depth;

- FIDO factors
- Percentiles
- Peak to Mean Ratios

Reporting

The aim of this Chapter is to discuss how much and what information should be included in an odour assessment technical report.

The results must therefore be reported effectively and concisely in a manner suitable for the purpose for which they were produced.

Results must be communicated in a way that can be understood by other people who may not be experienced in interpreting model output.

TG6 has listed several key factors involved in reporting modelling results, as:

- Do not include large sections of data in a report, except as an appendix
- Always include information about all the input data (terrain, land use, meteorology, model switches) and how variations may affect the results
- Discuss the accuracy of the modeling results
- Prepare contour isopleth maps at the appropriate percentile levels as well as tabulate the model results.
- Indicate which factors are most influential in determining the peak ground level odour conce

Summary

To date, their have been 6 main meetings and up to 4 individual TG meetings since the ‘worldwide odour dispersion model group” was conceived. Individual members of the group recognize the advantages of collaborative research and learning, which includes;

- Development of higher-level thinking, oral communication, and leadership skills.
- Exposure to and an increase in understanding of diverse perspectives.
- May provide opportunities where multiple different world-wide approaches may be applied to existing problems and lead to the development of innovative solutions.
- Discussions amongst colleagues can stimulate new ideas and increase creativity.

Not least, the diverse meetings of up to 25 persons at a time from all over the world at different times of the day is a humbling experience for all those who attend them.

Thank you