Plume Entrainment

The Airshed was commissioned to help determine how plume entrainment from an animal rendering plant could be reduced. The client had installed two new thermal oxidisers to provide a high level of odour abatement. Thermal oxidisers release a condensing plume. In some conditions this plume was visibly grounding near the site boundary.

The Airshed had previously conducted an air quality impact assessment for residual odour and combustion pollutants for the process as part of a Planning and Pollution Prevention & Control (PPC) application. This had considered a range of stack heights up to 40m.

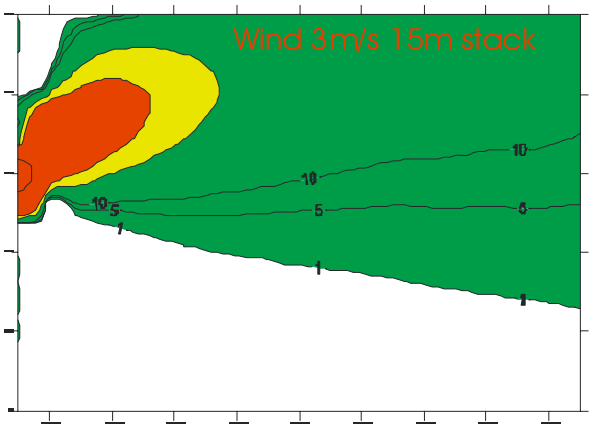
This assessment had concluded that emissions would comply with Air Quality Standards and PPC Guidance with a 15m stack. The stacks were kept as low as possible to minimise potential visual intrusion.

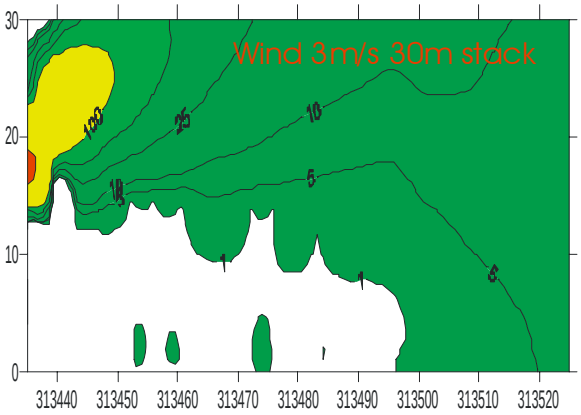
In practice, once operational, emissions tests confirmed that the emission rates used in the assessment had been too optimistic. The predicted odour concentrations were above 5 OU_E/m^3 at the nearest receptor and the visible condensing plume grounding was unacceptable. A further assessment was conducted by the Airshed to determine the optimum stack height to ensure effective dispersion.

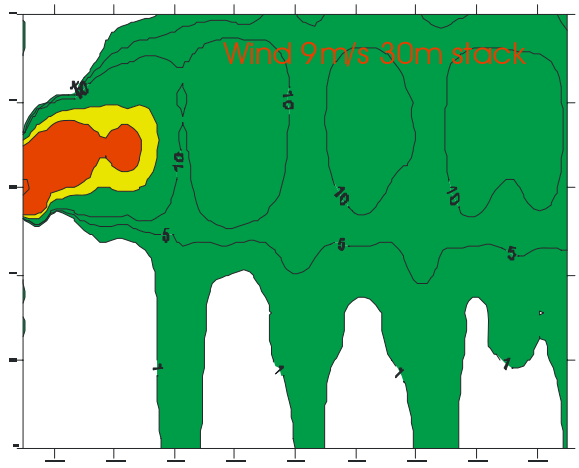
From observations it became clear that plume entrainment was due to the effect of adjacent buildings. The emissions from the short stacks were being caught within the re-circulating wake of the buildings. The results from the dispersion model (ADMS 3.3) indicated that this would occur in most wind directions, under even moderate wind speeds <3m/s.

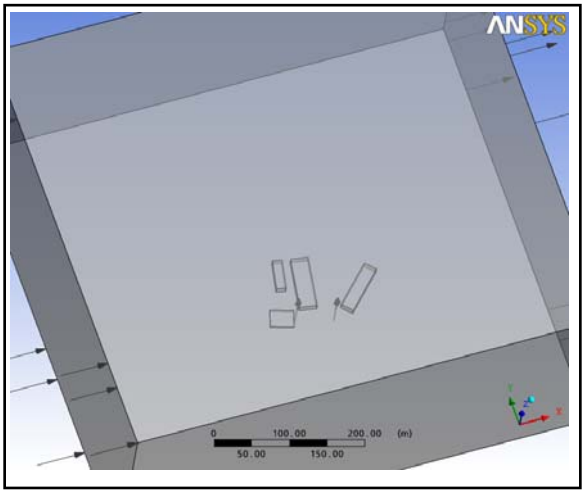
The dispersion model was used to predict building entrainment for a range of stack heights. This concluded that a minimum height of 27m would be required to reduce the residual impact to acceptable levels and mimimise visible plume grounding.

The model confirmed that a taller stack would reduce the incidence of plume grounding and that the resultant concentrations at the nearest receptor would be an order of magnitude lower. Subsequent additional modelling conducted using CFD for critical conditions confirms these conclusions.









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