Landcare Research
Manaaki Whenua

Toxic effects of air pollution and it's mitigation by urban vegetation

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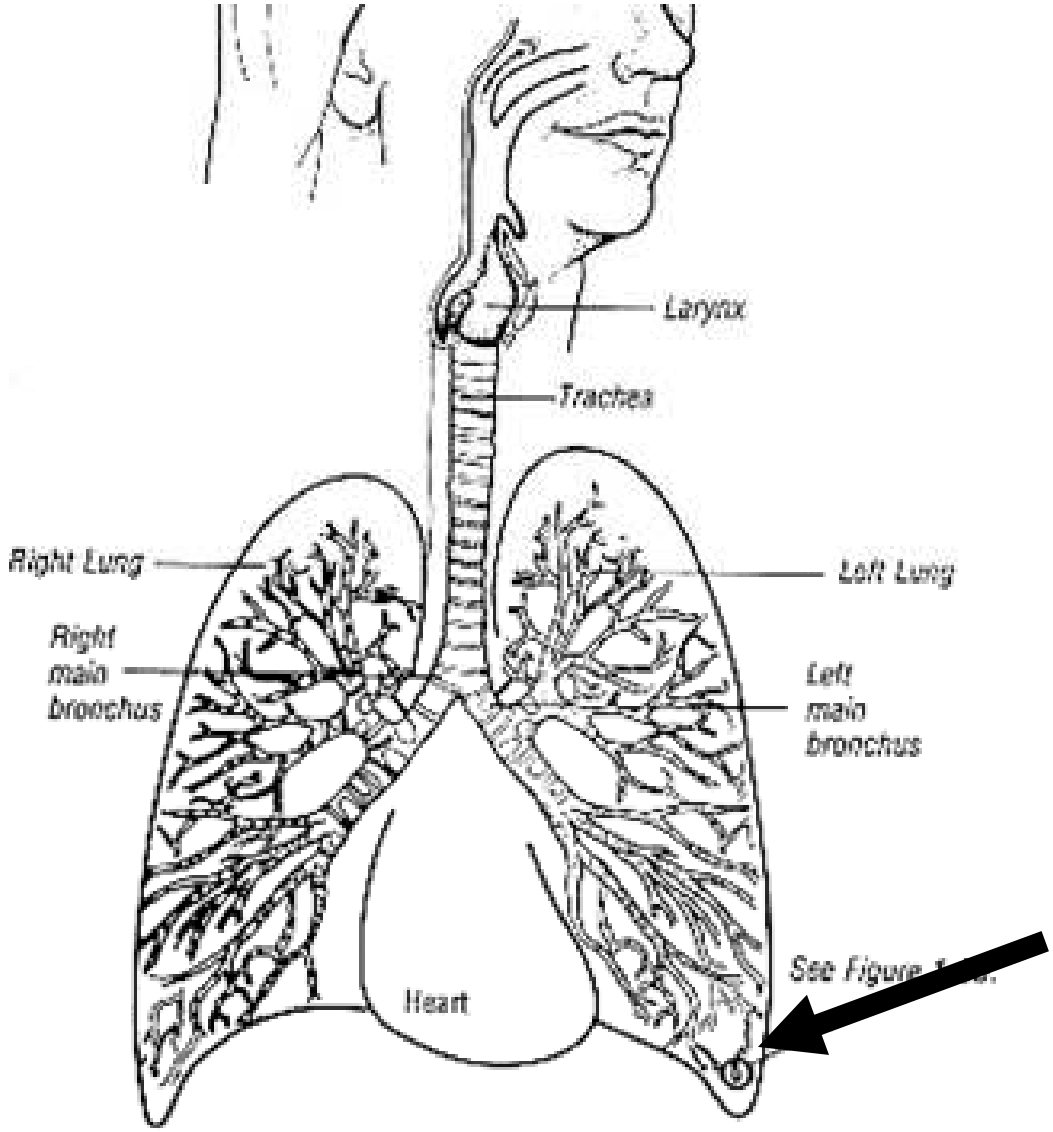
Health effects of air pollution

- Respiratory effects –
  - Impaired lung function (developmental effects in children)
  - Asthma incidence
  - Chronic obstructive pulmonary disease (e.g. chronic bronchitis, emphysema)
- Cancer
- Cardiovascular disease

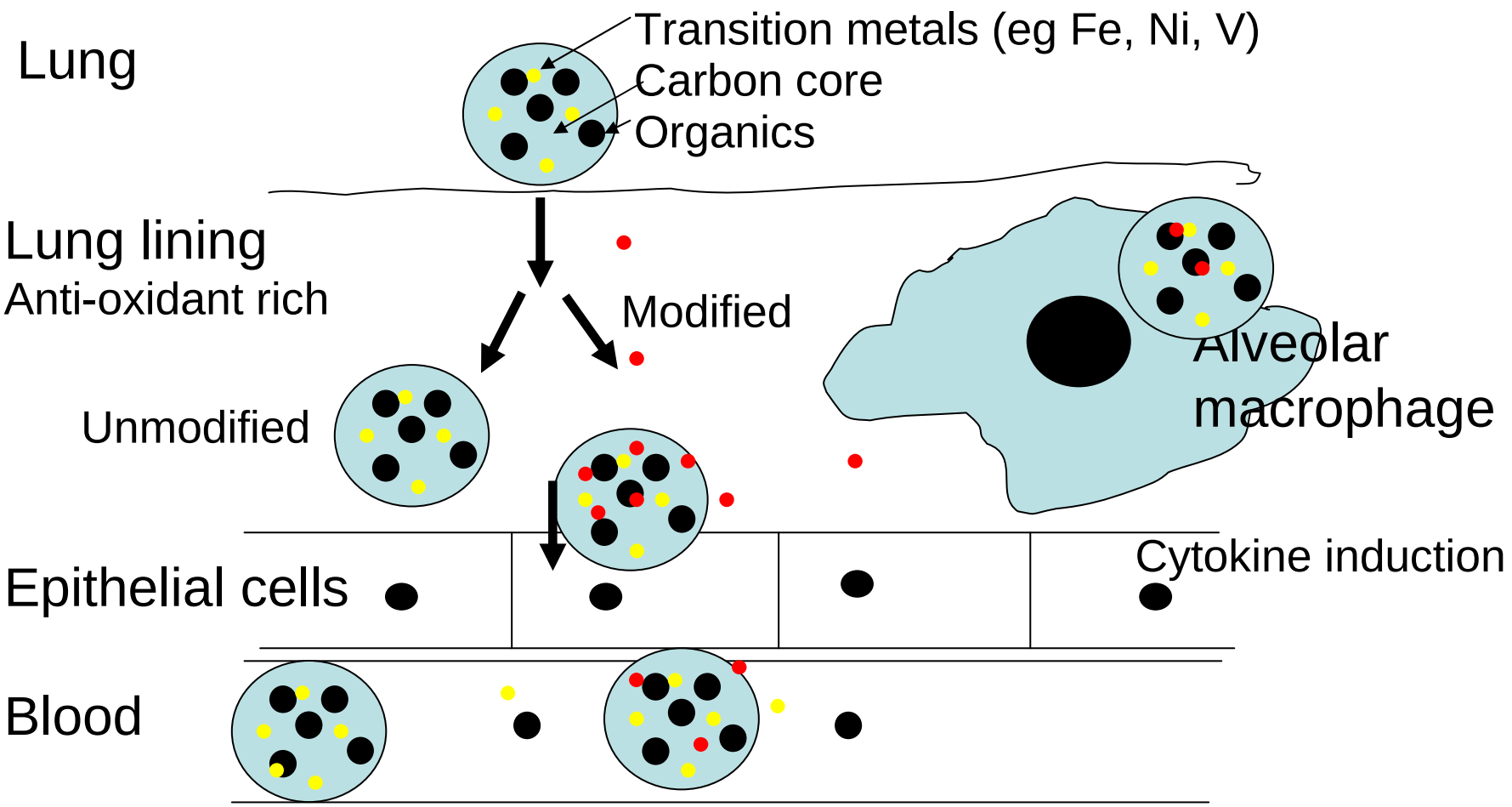
Investigation of health effects

- Epidemiology
  - Study of population effects
- Toxicology
  - Study of mechanisms of effects
  - Role of different physico-chemical properties of particulates

Sites of First Contact



How do we do it??



PM_{10} collection Extraction Analysis

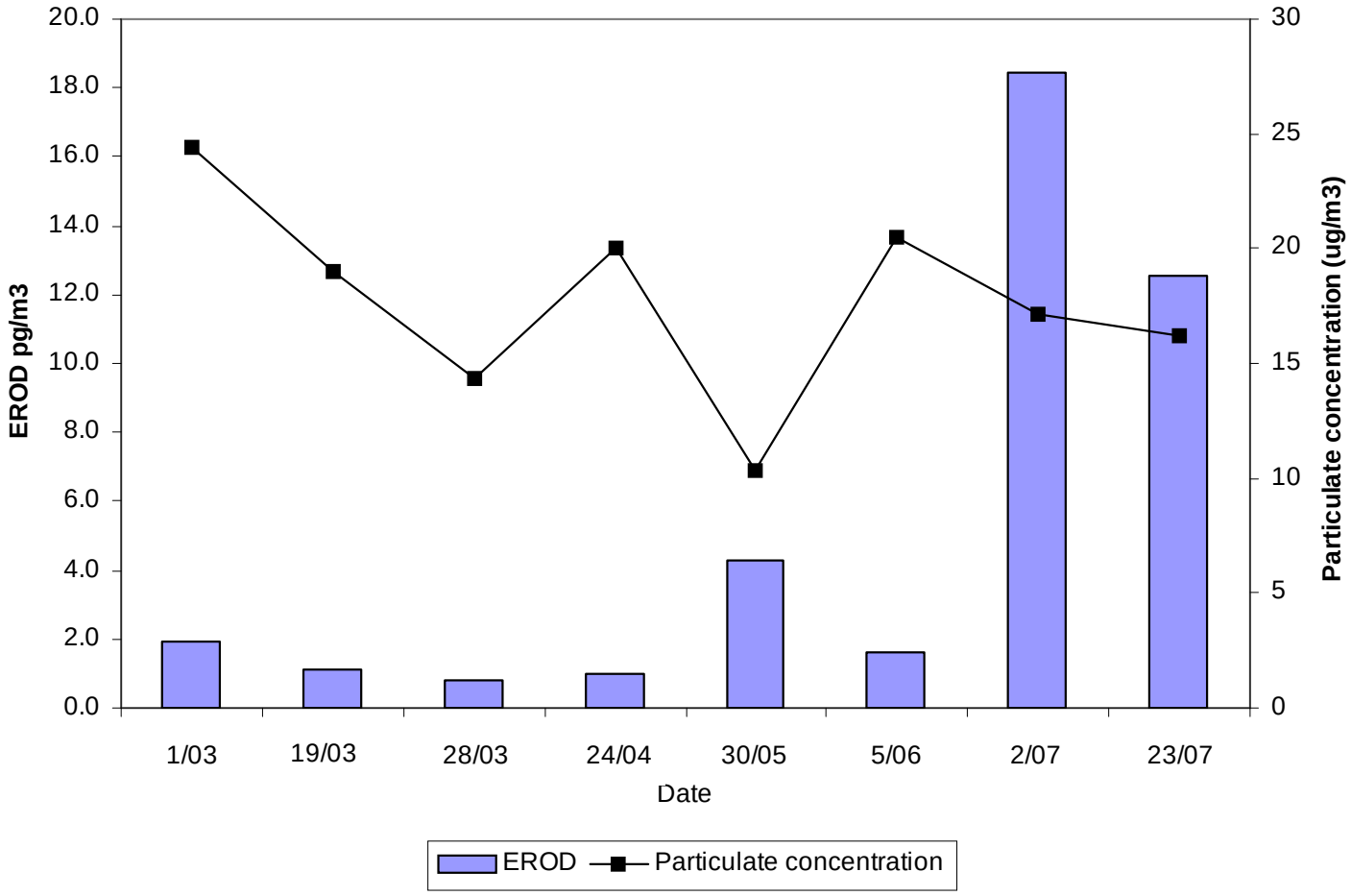
Filter **Soxhlet extraction** **GC-MS analysis**

What are we looking at?…..

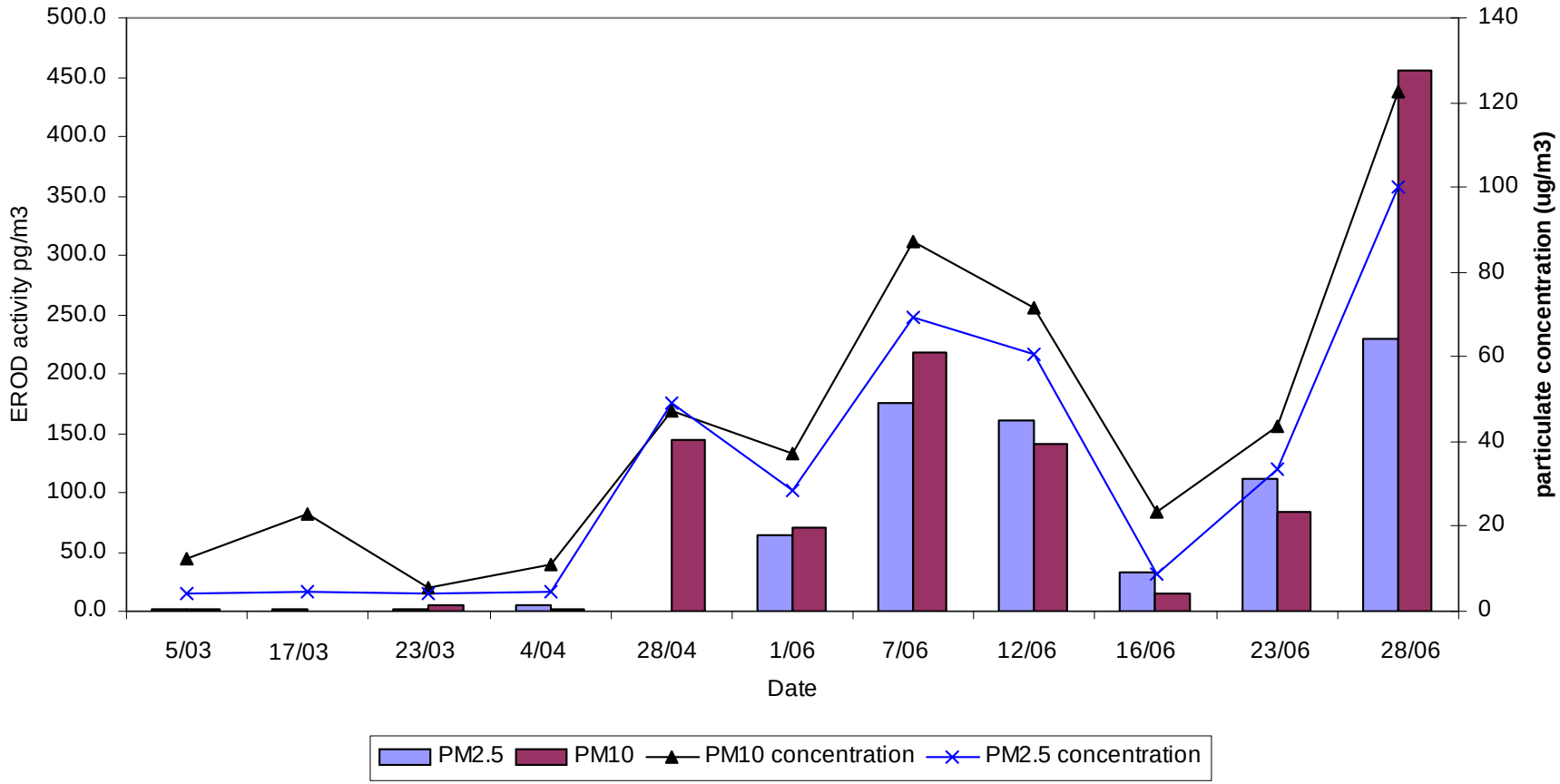
- Carcinogenic potential (organic fraction)
  - Dioxin-like activity
  - mutagenicity
- Inflammatory potential (primarily soluble (metals) fraction)
  - Inflammatory markers (IL-6, TNF-a)
  - cytoxicity

Some preliminary results…….ambient air samples

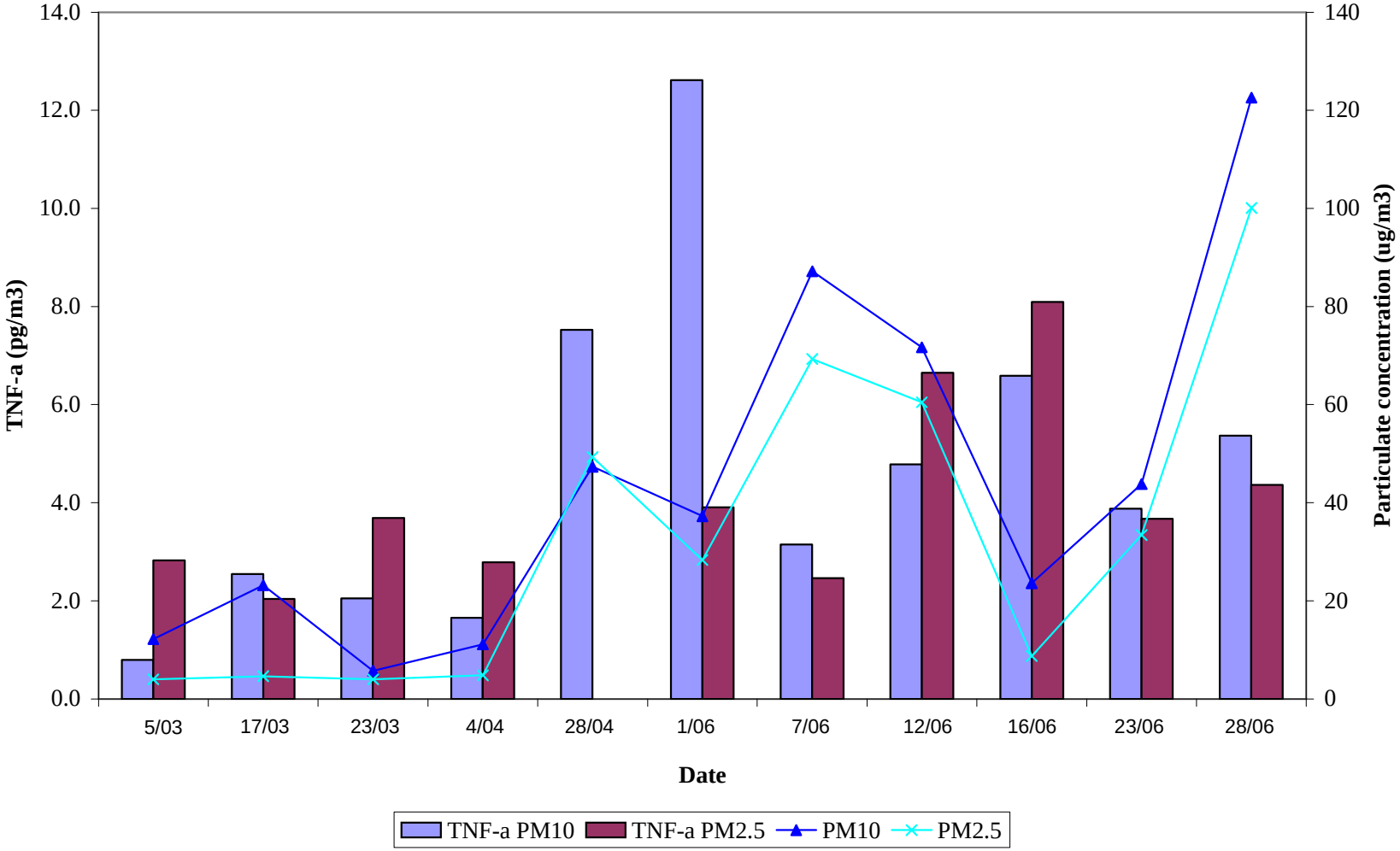
Auckland – dioxin-like activity (/m3)



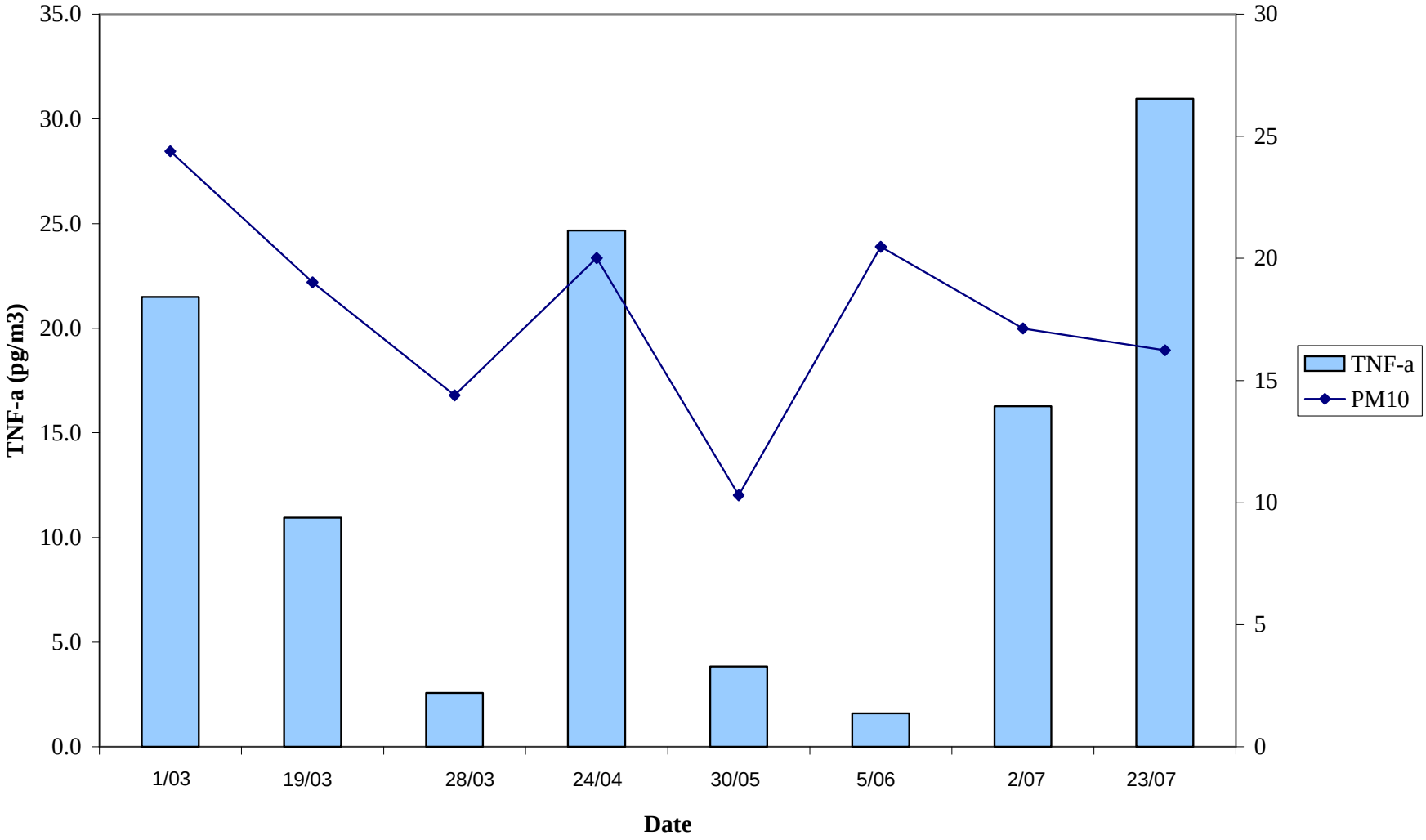
Christchurch - dioxin-like activity (/ m^3)



Christchurch - inflammatory activity (water soluble fraction, / m³)



Auckland - inflammatory activity (water soluble fraction, / m3)



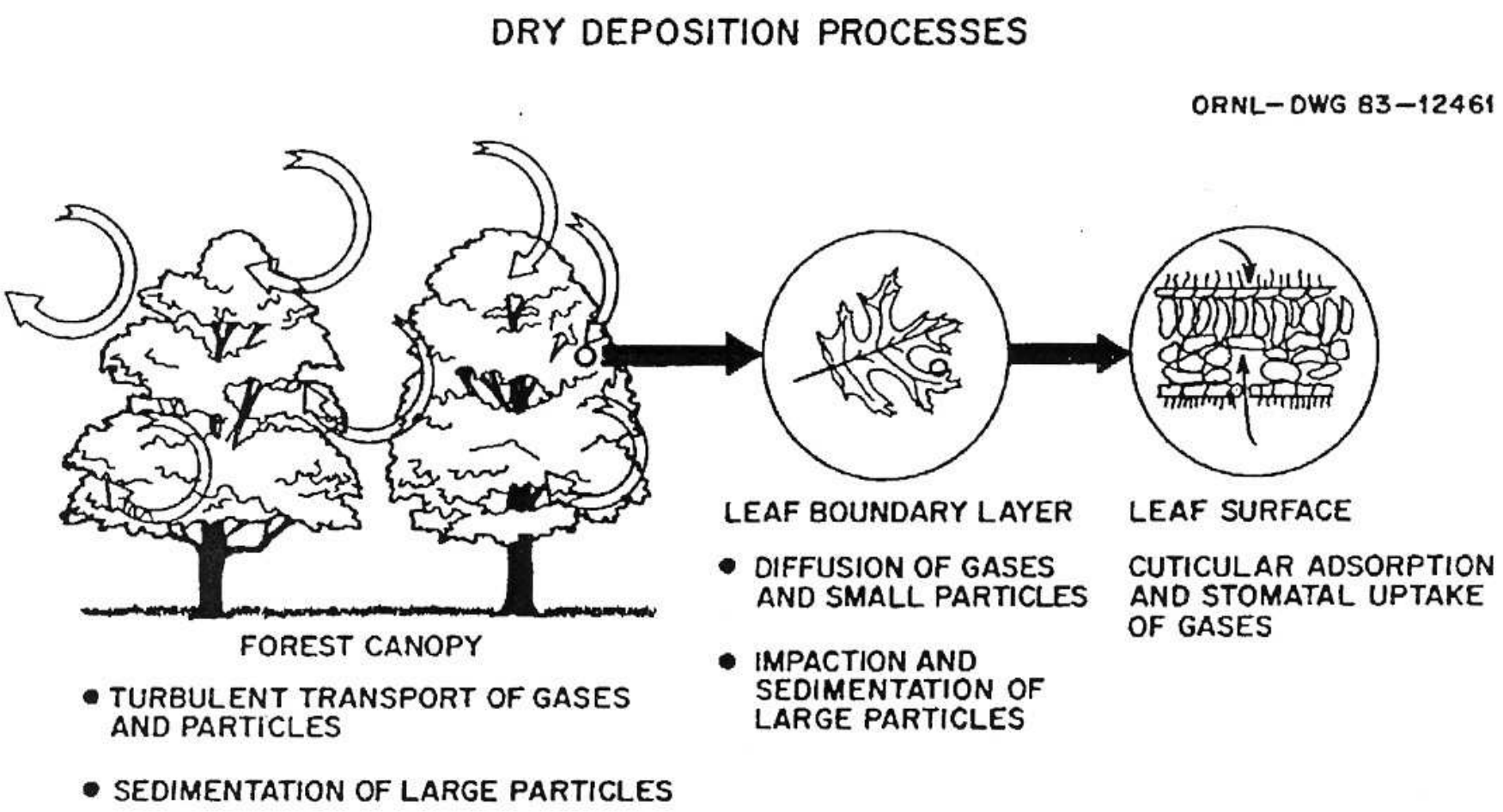
Mitigation of air pollution

- Policy options
  - Warm homes initiatives
  - Vehicles emissions testing
  - Vehicle maintenance
- Technological solutions
  - Improved fuel quality/alternative fuel types
  - Engine efficiency/catalysts
- **Urban vegetation**

Significance of urban vegetation

- Estimated health benefit of £900,000 for Britain
- Saving of 140 lives by doubling the number of trees planted in the West Midlands, UK
- Removal of 234 t of particulates annually from Chicago’s air
- Preliminary estimates indicate1320 t PM10, 2740t NO2 removed by trees in Auckland

Processes for pollutant removal



Roadside vegetation

- Already has a number of purposes
  - Visual amenity
  - Road run-off control/treatment
  - Visual aid to enhance road safety
- Few (no) studies have investigated the efficacy of roadside vegetation in enhancing air quality

Evidence for mitigation effects

- Dust accumulation on leaves of trees close to roadways
- Increased concentrations of contaminants in soil underneath roadside vegetation
- Increased concentrations of contaminants in leaves of trees close to roadways

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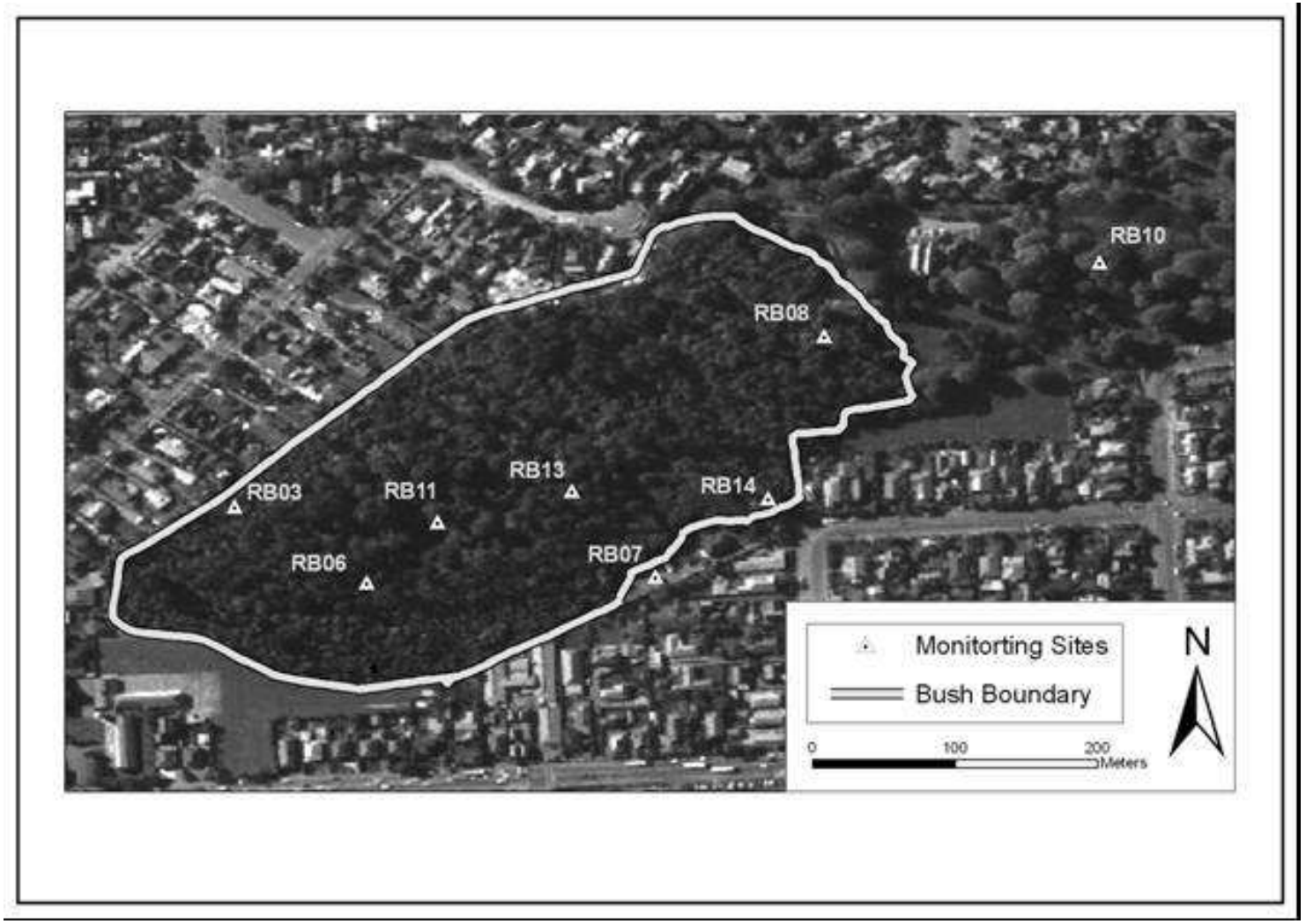
Factors influencing mitigation potential

- Dispersion of pollutants from roadways
- Vegetation ‘structure’
  - leaf surfaces
  - proximity to roadway
  - height of vegetation
- Empirical data/modelling
  - ENVI-met (microscale climate model, UC)

Roadside distribution of particulates

Deposition from roadways

Riccarton bush (UC)



Summary

- Organic fraction of ambient air particulates demonstrate carcinogenic potential
- Water-soluble fraction of ambient air particulates demonstrate inflammatory potential
- Urban vegetation, including roadside vegetation, demonstrate potential for mitigation of particulate air pollution