

## Improving Water Quality Through Total Water Cycle Management

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- Adjunct Professor Don Bursill
- Adjunct Professor Chris Saint
- Dr Guna Hewa – Lecturer in Water Engineering

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### Where Are We Now?

### Sustainable Development

- Economic development
- Environmental protection
- Social inclusion
- Prudent use of resources

*Need to set clear visions for communities and help to integrate the wide range of activities relating to development and regeneration*

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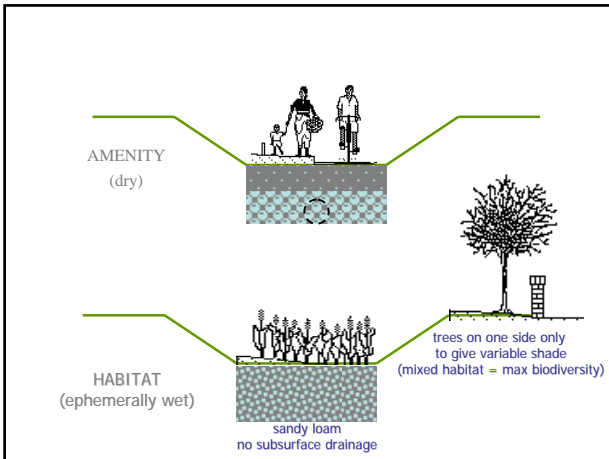
### WSUD Triangle

- currently 3 dimensions
- should be 4

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### WSU4D

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### Innovate or Enervate

- designers of WSUD systems will be distinguished by their capacities for innovation
- generic skills
  - initiative
  - originality
  - critical ability
- field of practice skills
  - greater understanding of biological systems and their interaction with our water infrastructure

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### WSUD Case Study: Permeable Pavements

porous pavers

pavers with canals

small apertures

wide joints

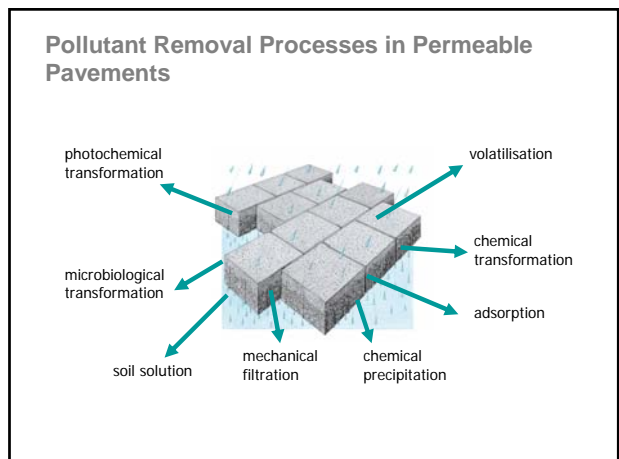
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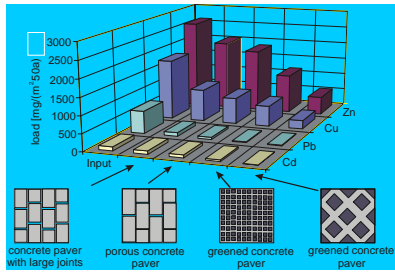
### Typical Permeable Pavement Design

- traditional roadbeds not designed to store & transport water
  - objective of sub-base is to remove water as quickly as possible to prevent structural damage of the pavement
- bearing capacity of roadbed must be as high as bearing capacity for traditional pavements, even during rain events
- permeable pavements are vulnerable to clogging

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### Heavy Metals Retention: Laboratory Studies

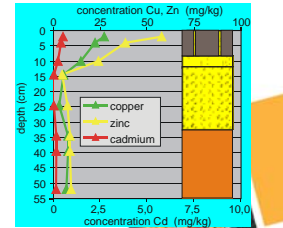


from Dierkes et al. (2002)

### Heavy Metals Retention: Field Studies



parking area of a supermarket in Stadtlonn, Germany



from Dierkes et al. (2002)

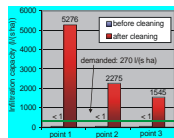
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### Cleaning Permeable Pavements



cleaning device cost 1.5 Euro/m<sup>2</sup>



from Dierkes et al. (2002)



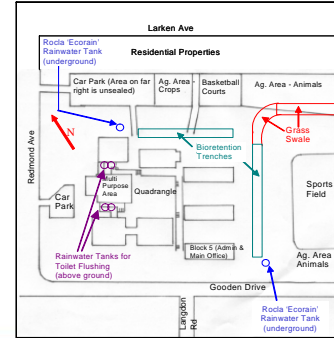
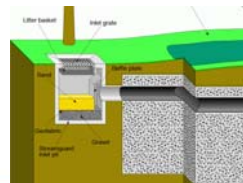
cleaning mechanism

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### WSUD Case Study: Model Farm High School

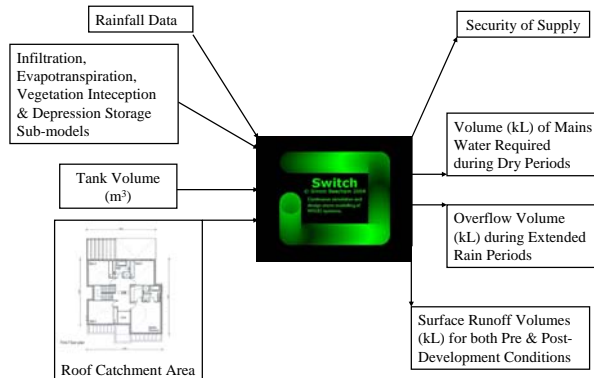
- Demonstration Site
- Designed to educate council officers, councillors, developers, designers and community groups the benefits of WSUD



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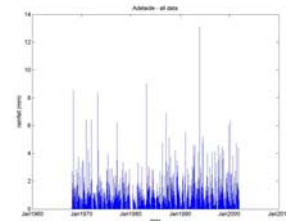


### Model Outline



### Research Projects: Climate Change

- member NSW State Government's Sydney Climate Change Think Tank
- engaged by the UK Environment Agency to study effects of sea level rise on the UK's longest inland tidal river
- currently investigating non-stationarity of Australian rainfall (with Imperial College and BoM)



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## Increasing demands on water and the environment

- Climate change
  - water resources set to decrease
  - Intensity and frequency of flooding set to increase
- Rapid urbanisation and population growth
- Drive for higher standards of living



14 of the warmest years ever recorded are since 1980

- 10 minutes of the sun's full solar output would power the Earth for a year

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## Water Sensitive Urban Design ARC Linkage (LP0454374), 2004-2006



Alison Dunphy, APAI

- Development of a model of confined stormwater filtration/infiltration treatment systems
- Three field systems
- Laboratory studies with focus on substrate media material

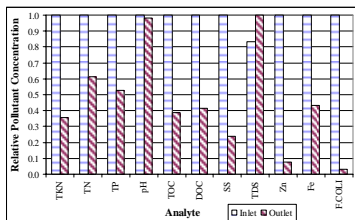


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## Engineered Soils to Enhance Pollutant Removal

Hindmarsh Park, Kiama



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## Smart Technologies to Minimise Maintenance



- pipes injected with ferrous oxide to precipitate metals and phosphorous
- permeable soffits with impermeable inverts to retain sediments
- engineered soils (sand/GAC/zeolite) to produce drinking water quality
  - the ground becomes a water treatment works



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## Where to from Here?

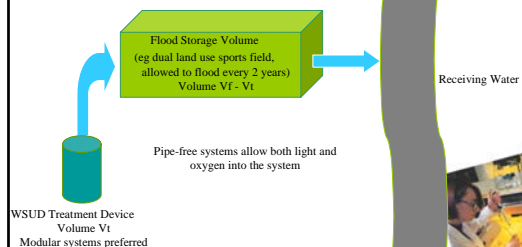
- need to identify flood fringe areas that can still be developed
  - engage with insurance industry
- optimise lot returns to fund habitat connections
  - bring ecology back into the urban environment
- permit 3<sup>rd</sup> party access to water infrastructure
  - cluster-scale water recycling



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## Combining Treatment and Flood Storage

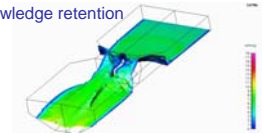


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## Research Projects: Cyber-Infrastructure

- future also involves embracing cyber-infrastructure
- electronic networks of entire water systems
- facilitates
  - integrated modelling and management of total water cycle systems
  - data sharing
  - knowledge retention



CFD model of free surface flow around a walkway over a bioretention swale



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## Peter Brady Computational Fluid Dynamics ARC LIEF (LE0561035), 2005

- 3-D modelling of free surface flows around obstructions



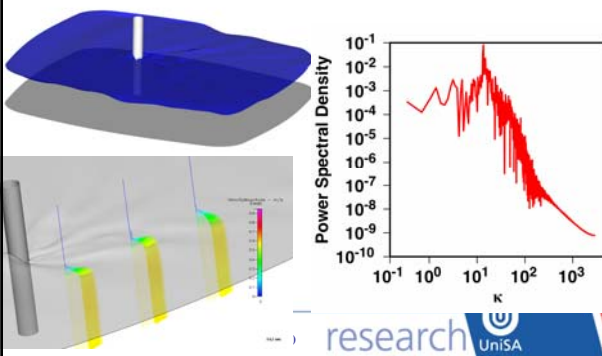
Peter Brady, APA



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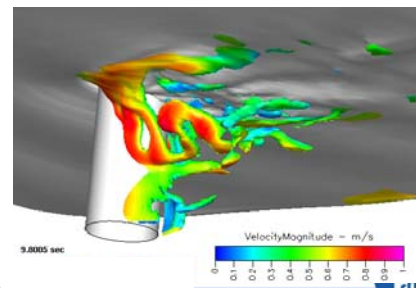
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## Validation Results



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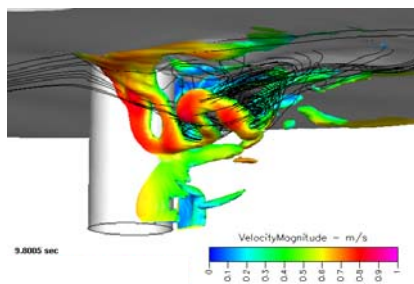
## Two Fluid Time Series Animation



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## Vorticity



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## Conclusions

- traditional approaches to water resource management will present major constraints to new development
  - this is already occurring and will be exacerbated by climate change
- future lies in multi-function landuse
  - habitat connections, flood storage, WSUD, social amenity all in the same land corridors
  - this will release flood fringe areas and enhance urban ecology
- research is needed to inform practice in this area

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*Arcology by Paolo Soleri*



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