Predicting pollutant retention in SUDS, with a rain garden application.

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Outline

Problem

- Conventional Urban Drainage Systems - Pollution

Solution

- Sustainable Urban Drainages Systems – Rain Gardens
- Previous Research

My Contribution

- Pollution Retention Model
  - Heavy Metal Modelling
  - Water Modelling

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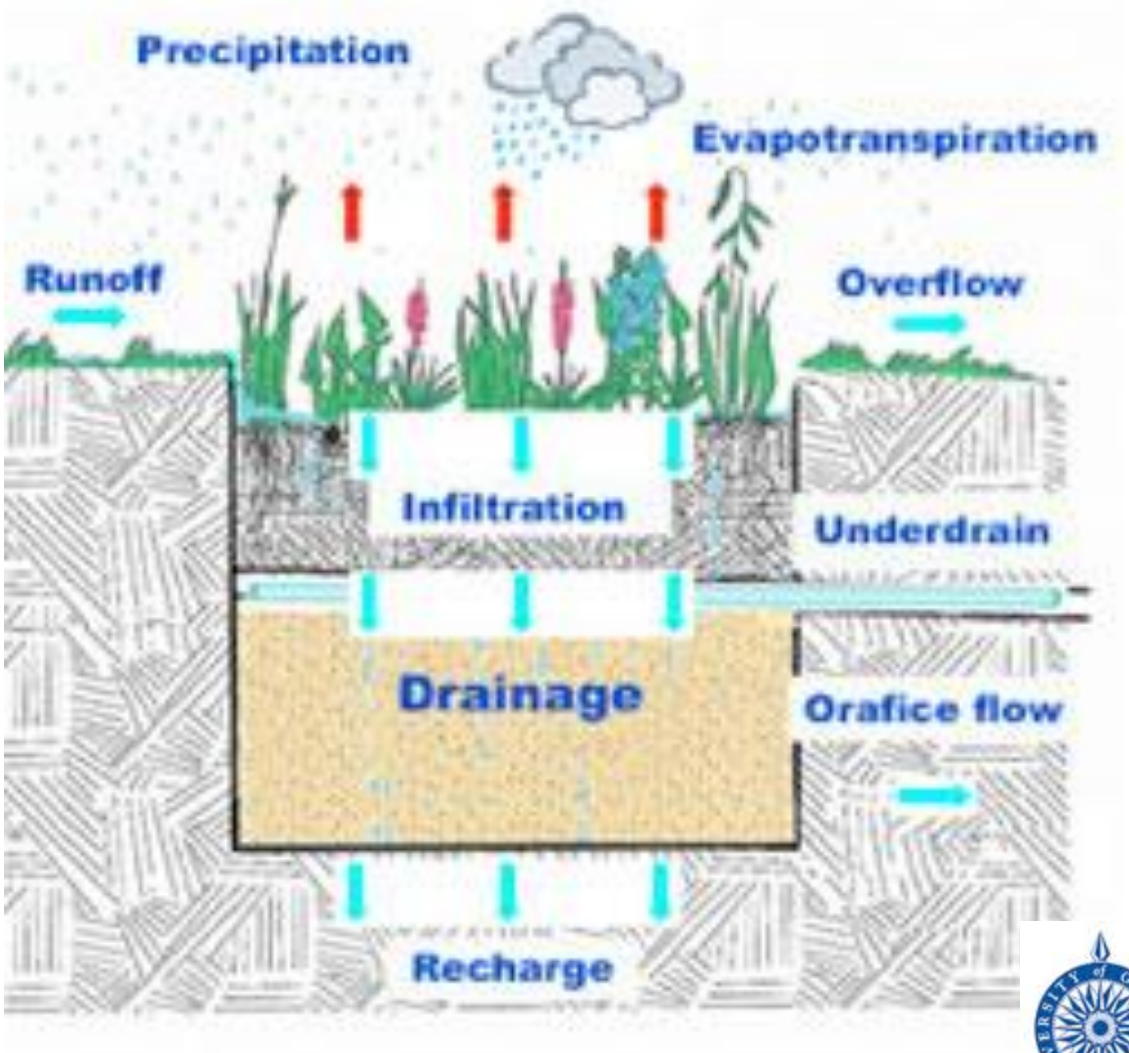
Rain Garden Diagram



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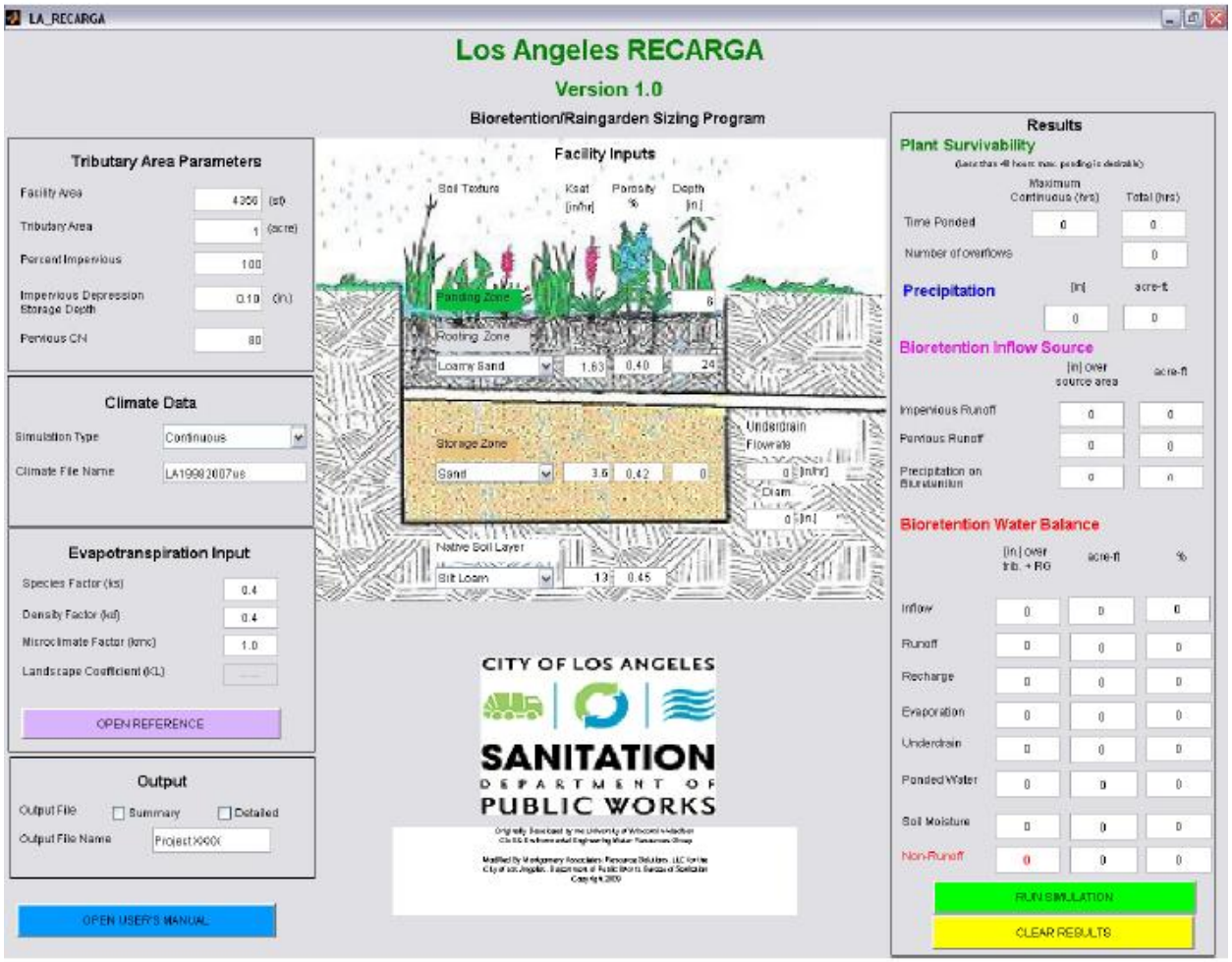
Previous Research-Modelling



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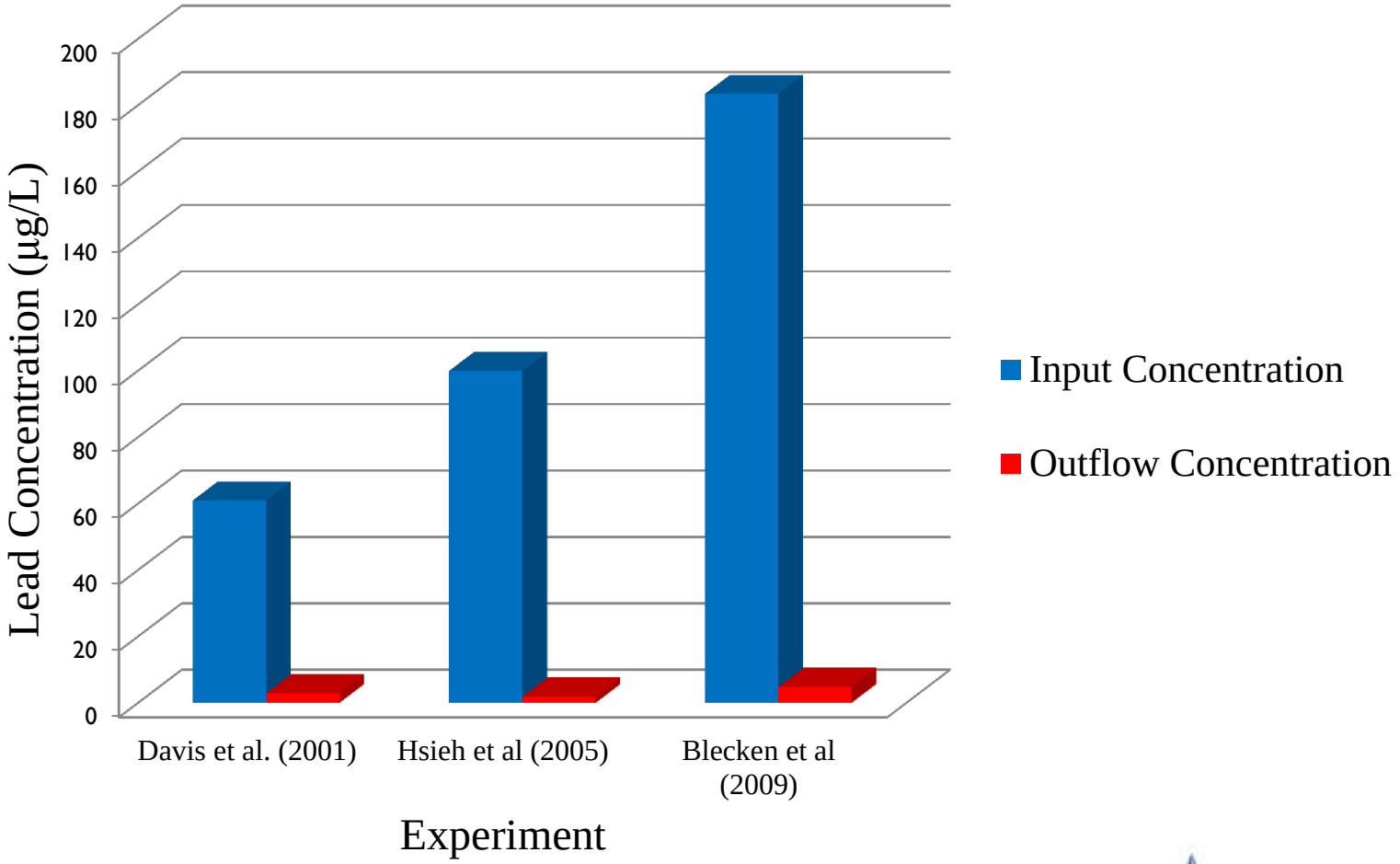
Previous Research-Experiments



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Objectives

- Simple design tool predicts heavy metal capture in bioretention facilities.
- Model must account for the effects of macropore flow.
- Provide results for retention and heavy metal build-up.

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Pollutant Retention Modelling

- Linear Isotherm
- Freundlich Isotherm (includes pH)
- I-D adsorption-advection-diffusion equation

Water Parameters needed

- Water Velocity
- Soil Moisture Content
- Diffusion

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Water Modelling

- Dual-permeability modelling
- Initiation of Macropore Flow
  - High Intensity
  - Saturation
- Infiltration
  - Kinematic Wave Equation
  - Van Genuchten's Equations
- Interaction
  - Simple Equation

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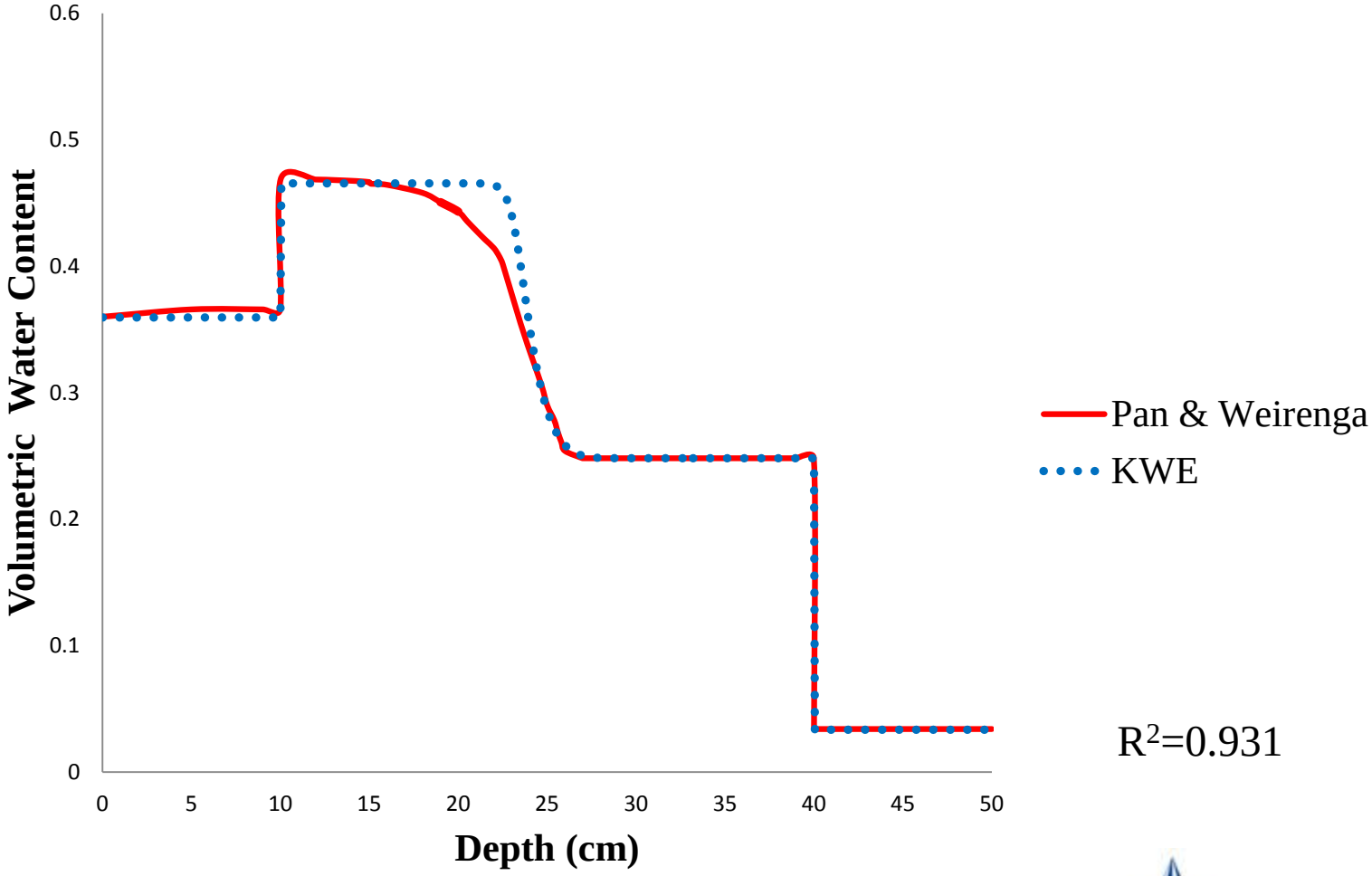
Results - Matrix Region



R^2=0.931

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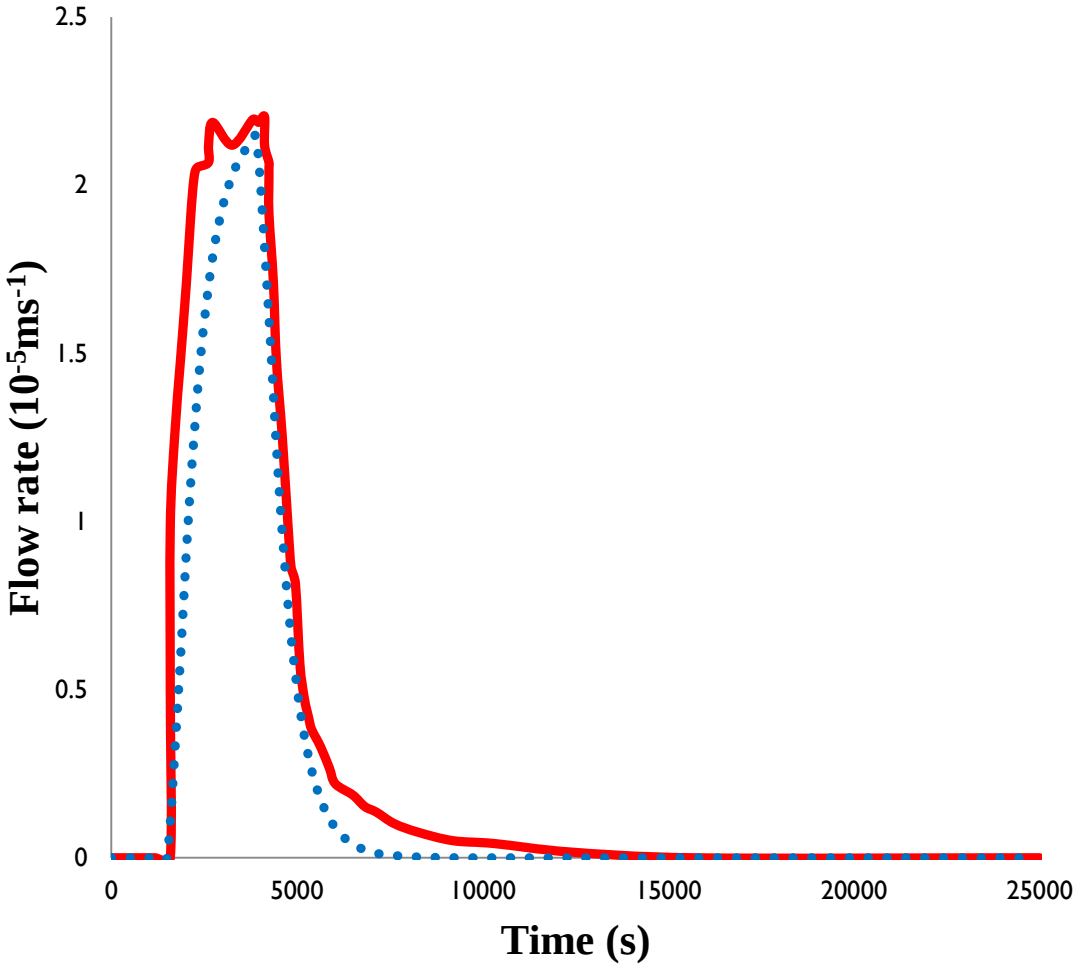
Results - Macropore Region



R^2=0.93

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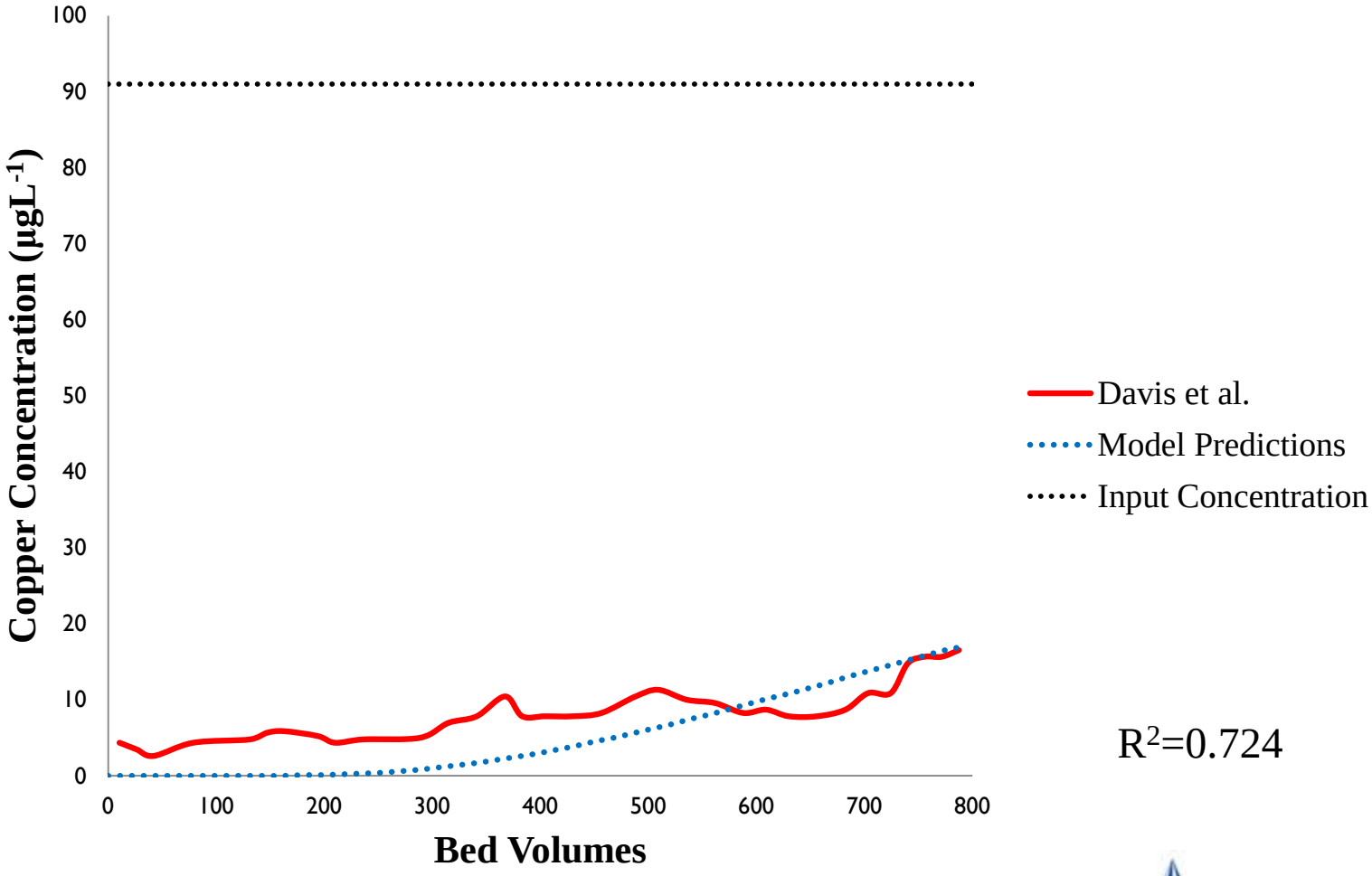
Results - Pollutant Retention



R^2=0.724

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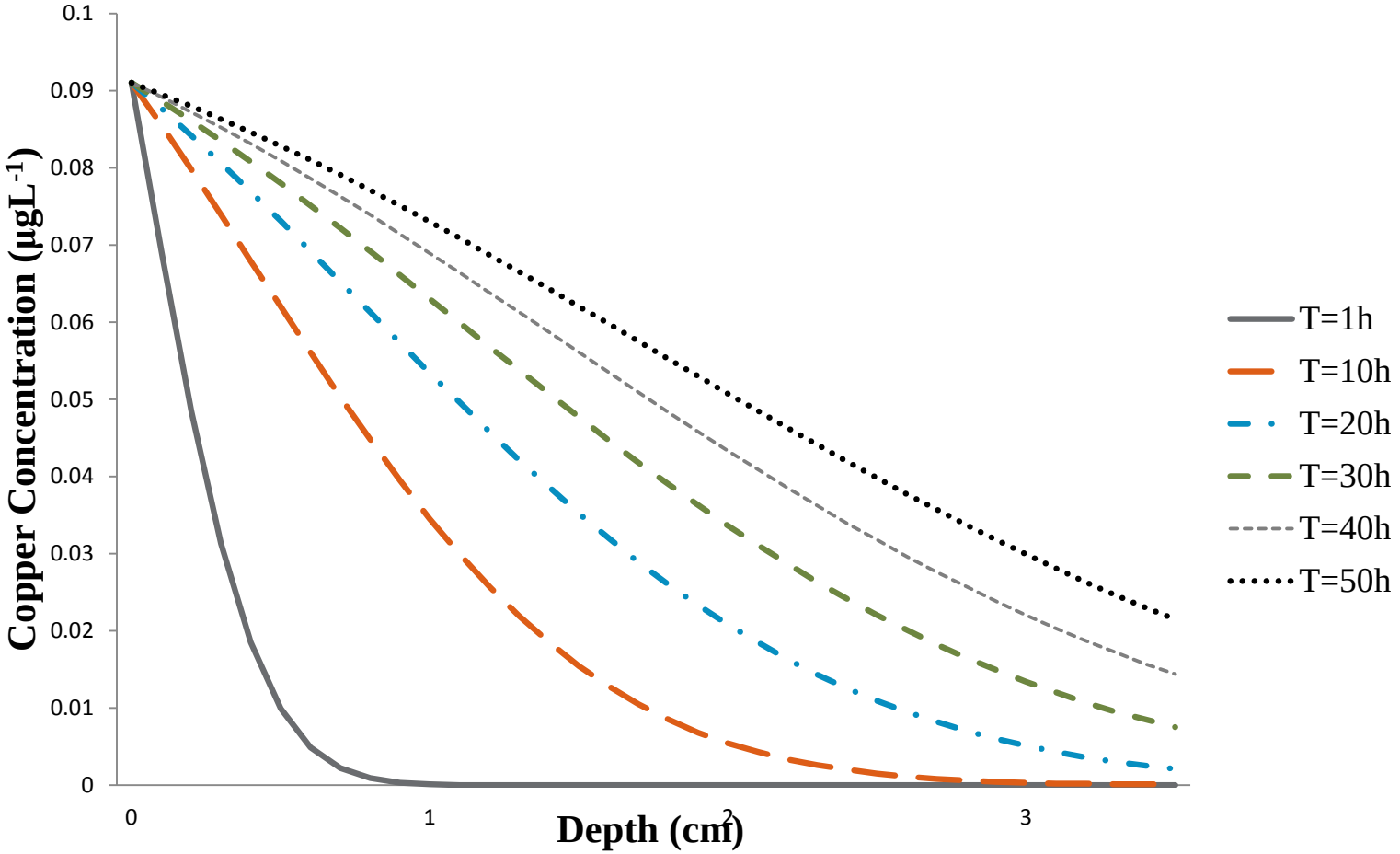
Results - Pollutant Retention



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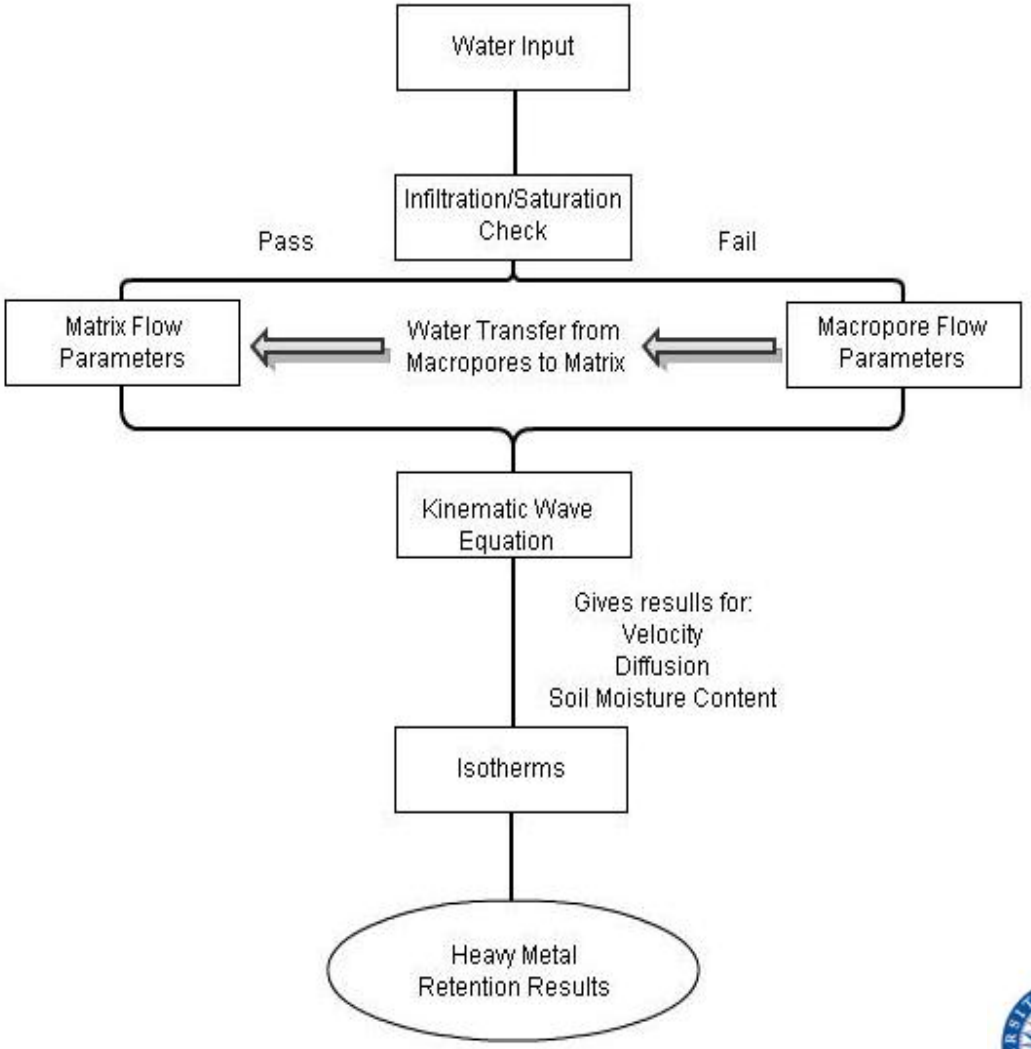
Finalised Model Design



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Further Work

- Combine the model parts together
- Column Experiments
  - Aim- combine measurements of hydraulic properties which effect pollutant retention with results for heavy metal capture at different intervals through the column.

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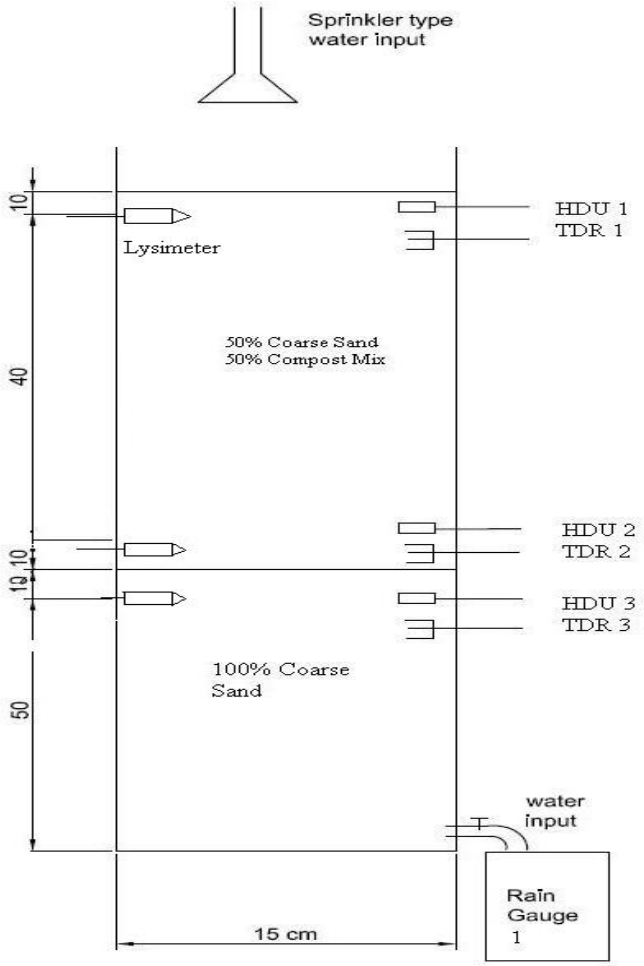
Experimental Design



- Two Sets of Columns
  - First Flush
  - Average Flow
  - Control
- Hydraulic Measurements
  - HDU-water head
  - TDR-Soil Moisture Content
  - Rain Gauge- Water Output Rate
- Pollutants Retention
  - Lysimeters

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Experimental Design

Column No.	Title	Rainfall Rate Simulated (cm/h)	Heavy Metal Conc. (mg/L)	TDR Postions (cm depth)	HDU Positions (cm depth)	Lysimeter Positions (cm depth)
1	F.F	0-3.4	0.02 Cd 0.11Cr .27Cu 0.16 Pb 1 Zn	At 10,40, 60	At 10,40, 60	At 10,40, 60
2	Ave.	0.5	0.01 Cd 0.05Cr 0.1Cu .08 Pb .6 Zn	At 10,40, 60	At 10,40, 60	At 10, 40
3	F.F	0-3.4	0.02 Cd 0.11Cr .27Cu 0.16 Pb .1 Zn	N/A	N/A	N/A
4	Ave.	0.5	0.01 Cd 0.05Cr 0.1Cu .08 Pb .6 Zn	N/A	N/A	N/A
5	Con.	0.5	N/A	N/A	N/A	N/A

Conclusions

- Simple Design Tool
  - Utilize the KWE and linear isotherm
- Macropore Flow
  - Dual-permeability model
- Pollutant retention and accumulation
  - Two different results graphs

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Thank You

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