

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

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# Outline

## Problem

- Conventional Urban Drainage Systems - Pollution

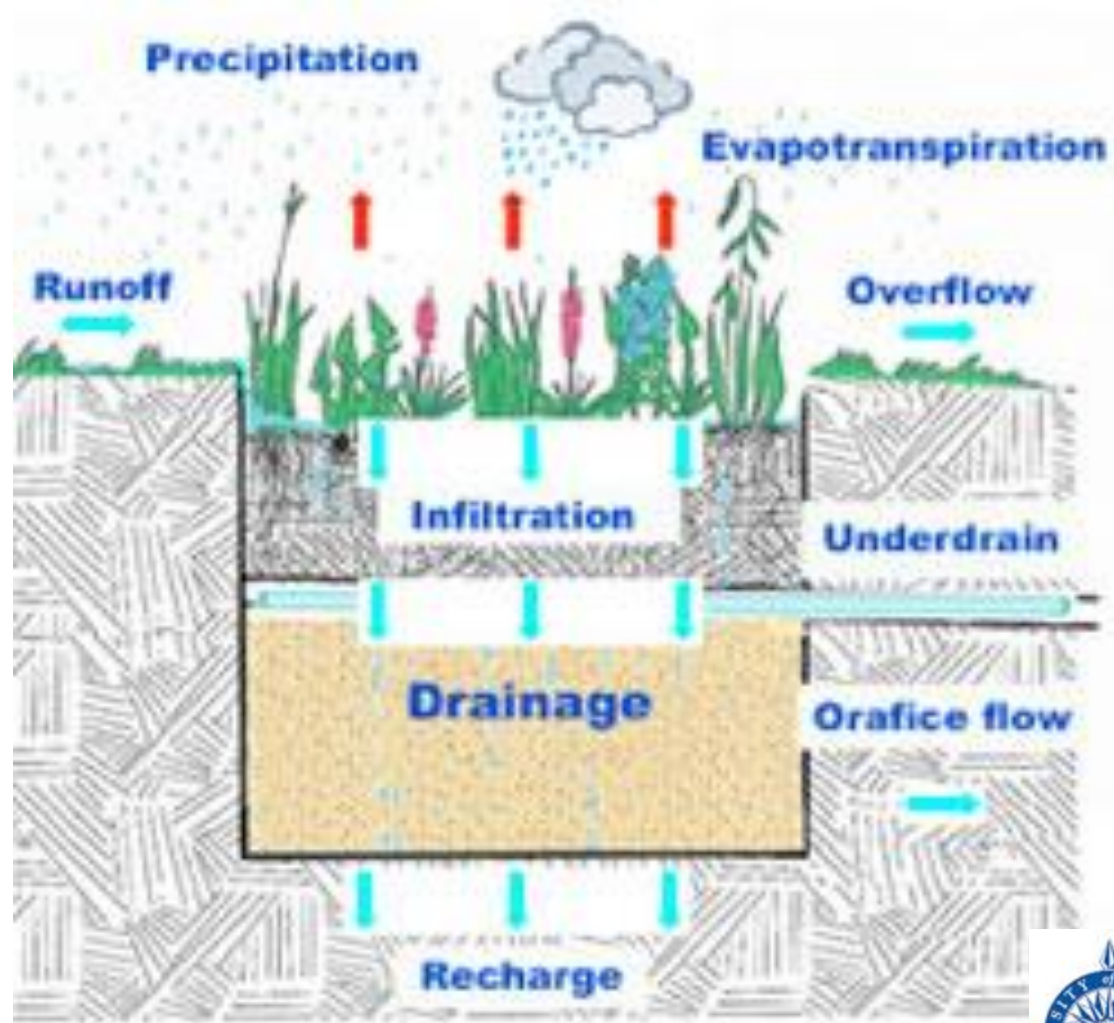
## Solution

- Sustainable Urban Drainages Systems – Rain Gardens
- Previous Research

## My Contribution

- Pollution Retention Model
  - Heavy Metal Modelling
  - Water Modelling

# Rain Garden Diagram



# Previous Research-Modelling

LA\_RECARGA

## Los Angeles RECARGA

Version 1.0

Bioretention/Raingarden Sizing Program

### Tributary Area Parameters

Facility Area: 4300 (sq ft)

Tributary Area: 1 (acre)

Percent Impervious: 100

Impervious Depression Storage Depth: 0.10 (in)

Pervious CN: 80

### Facility Inputs

Soil Texture	Ksat (in/hr)	Porosity %	Depth (in)
Loamy Sand	1.63	0.40	24
Sand	3.6	0.42	0
Silt Loam	1.3	0.45	

### Results

#### Plant Survivability

(Less than 48 hours from planting to details)

	Maximum Continuous (hrs)	Total (hrs)
Time Ponded	0	0
Number of overflows	0	0

#### Precipitation

(in)	acre-ft
0	0

#### Bioretention Inflow Source

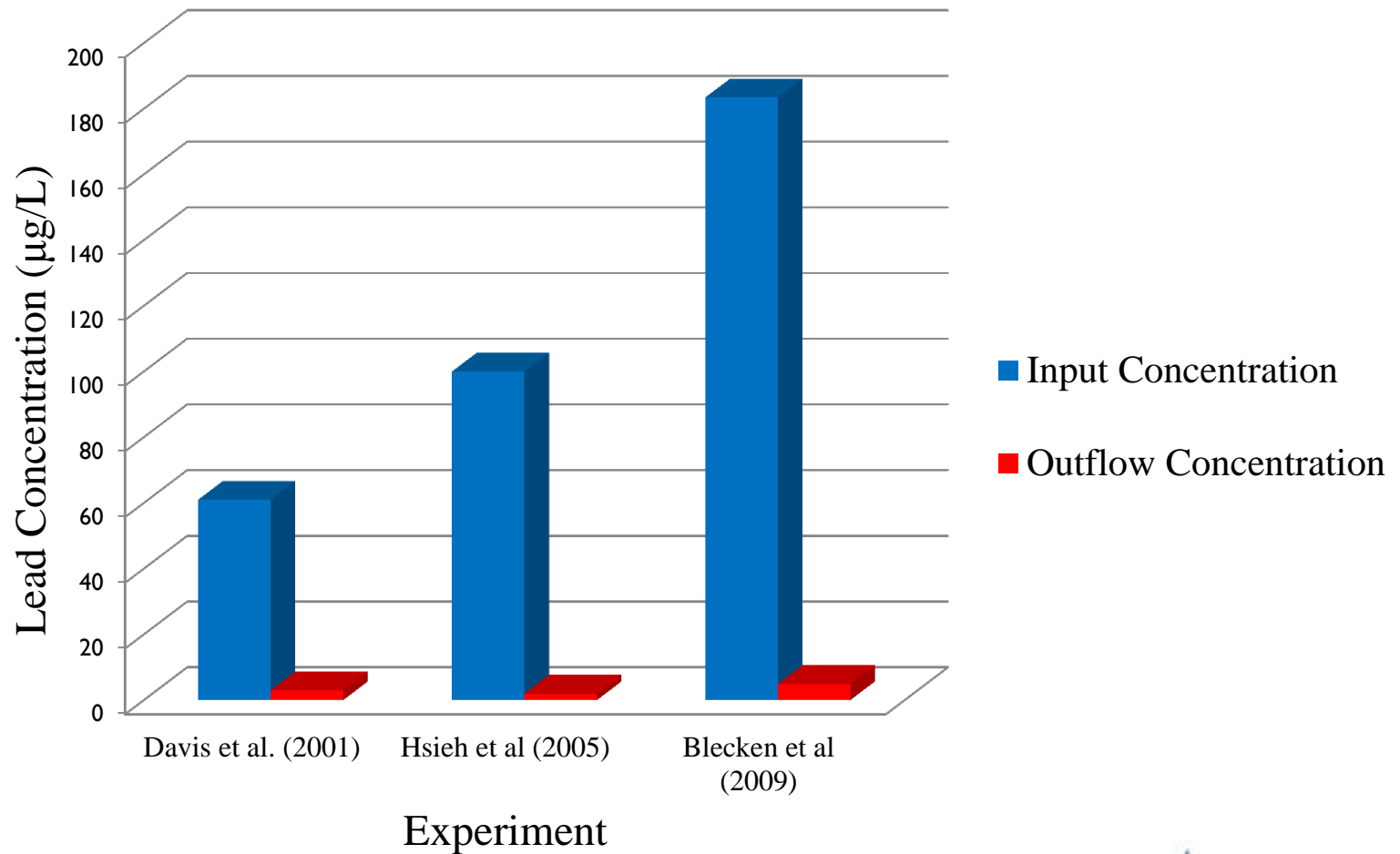
(in) over source area	acre-ft
Impervious Runoff	0
Pervious Runoff	0
Precipitation on Bioretention	0

#### Bioretention Water Balance

(in) over trib. + RG	acre-ft	%
Inflow	0	0
Runoff	0	0
Recharge	0	0
Evaporation	0	0
Underdrain	0	0
Ponded Water	0	0
Soil Moisture	0	0
Non-Runoff	0	0

Originally developed by the University of Wisconsin-Madison  
 CDRSC Engineering and Engineering Water Resources Group  
 Modified by Montgomery Associates, Pasadena, California, LLC for the  
 City of Los Angeles, Department of Public Works, Bureau of Sanitation  
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# Previous Research-Experiments



# 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.

# Pollutant Retention Modelling

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

## Water Parameters needed

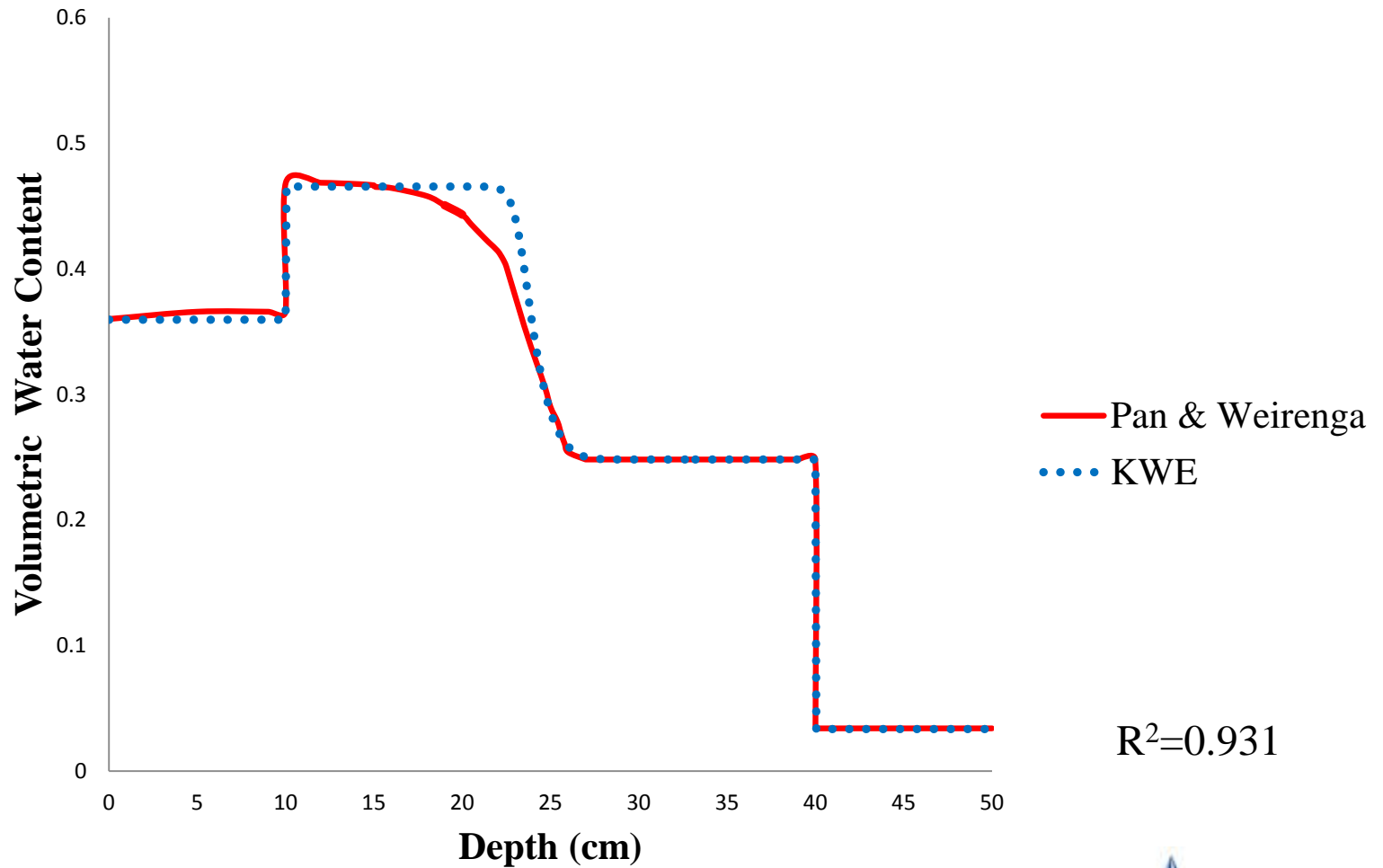
- Water Velocity
- Soil Moisture Content
- Diffusion

# Water Modelling

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

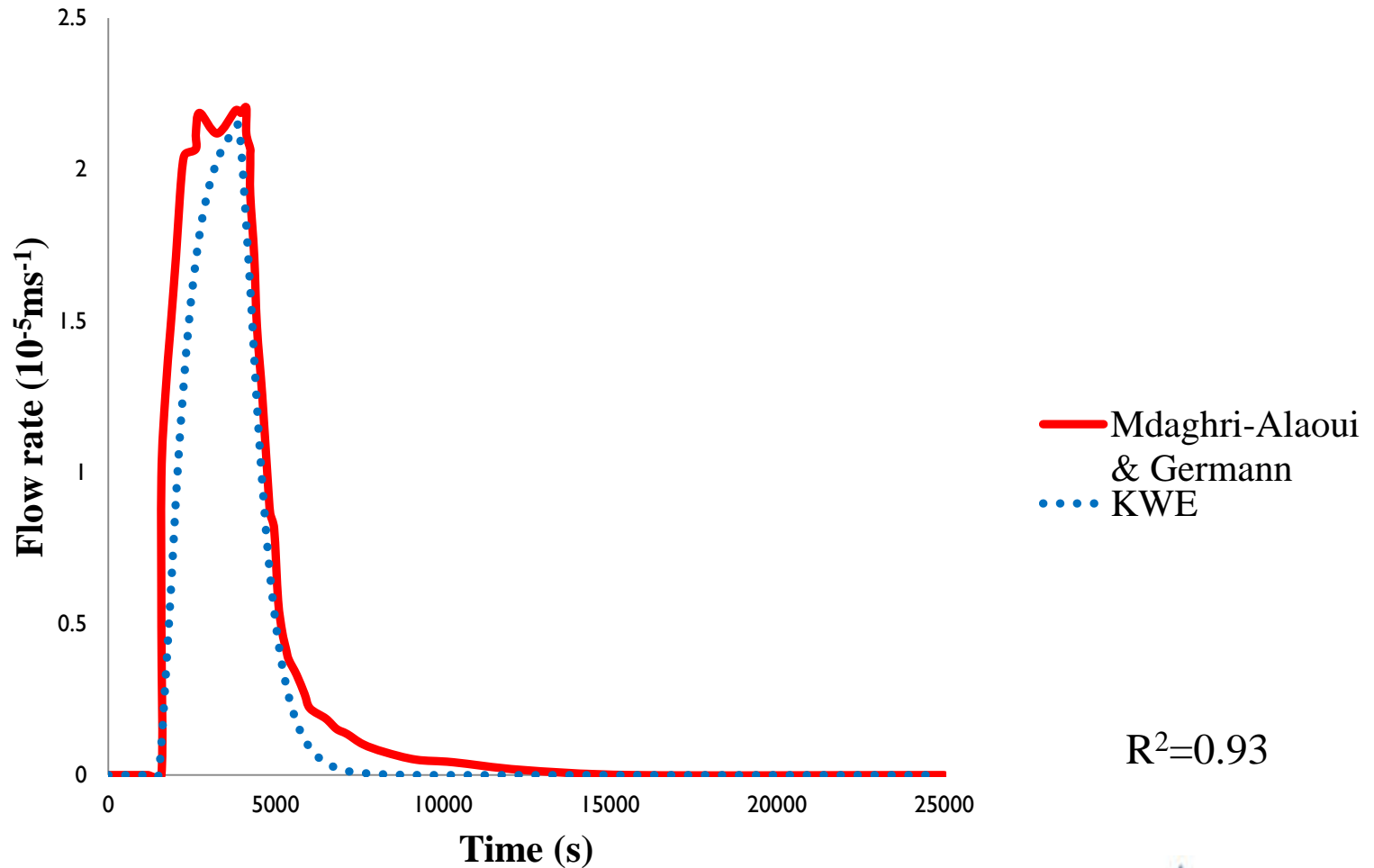


# Results - Matrix Region

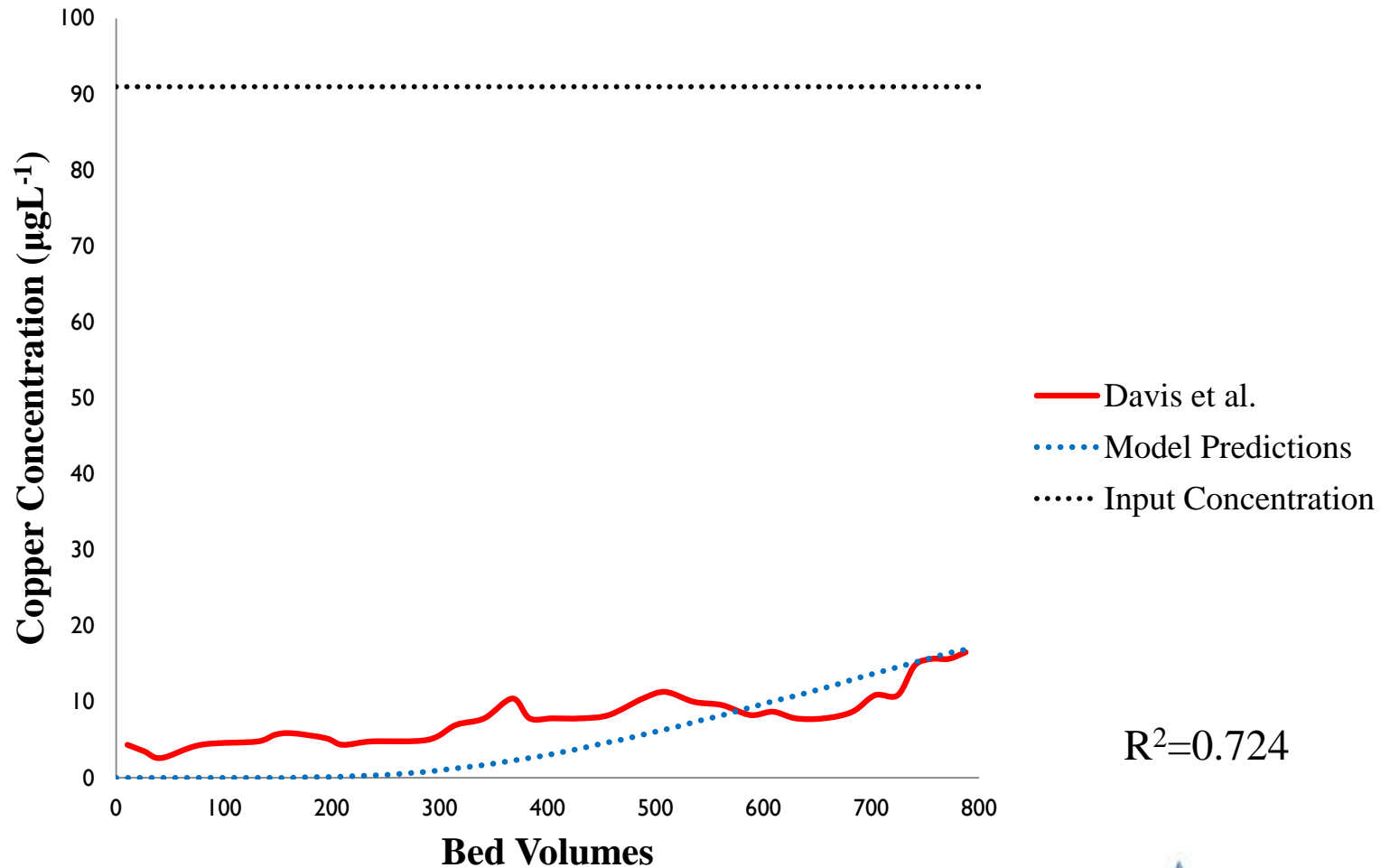


$R^2=0.931$

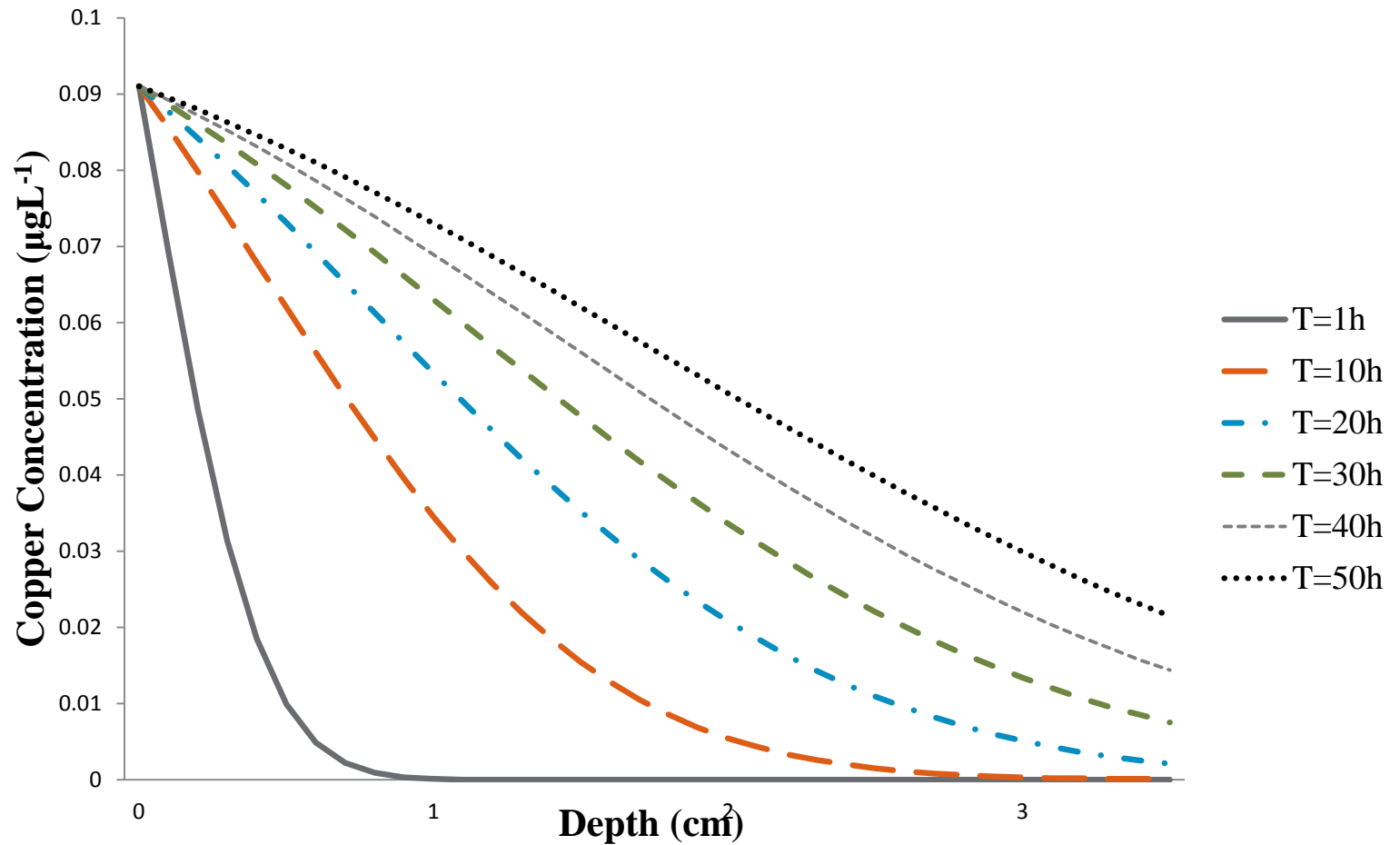
# Results - Macropore Region



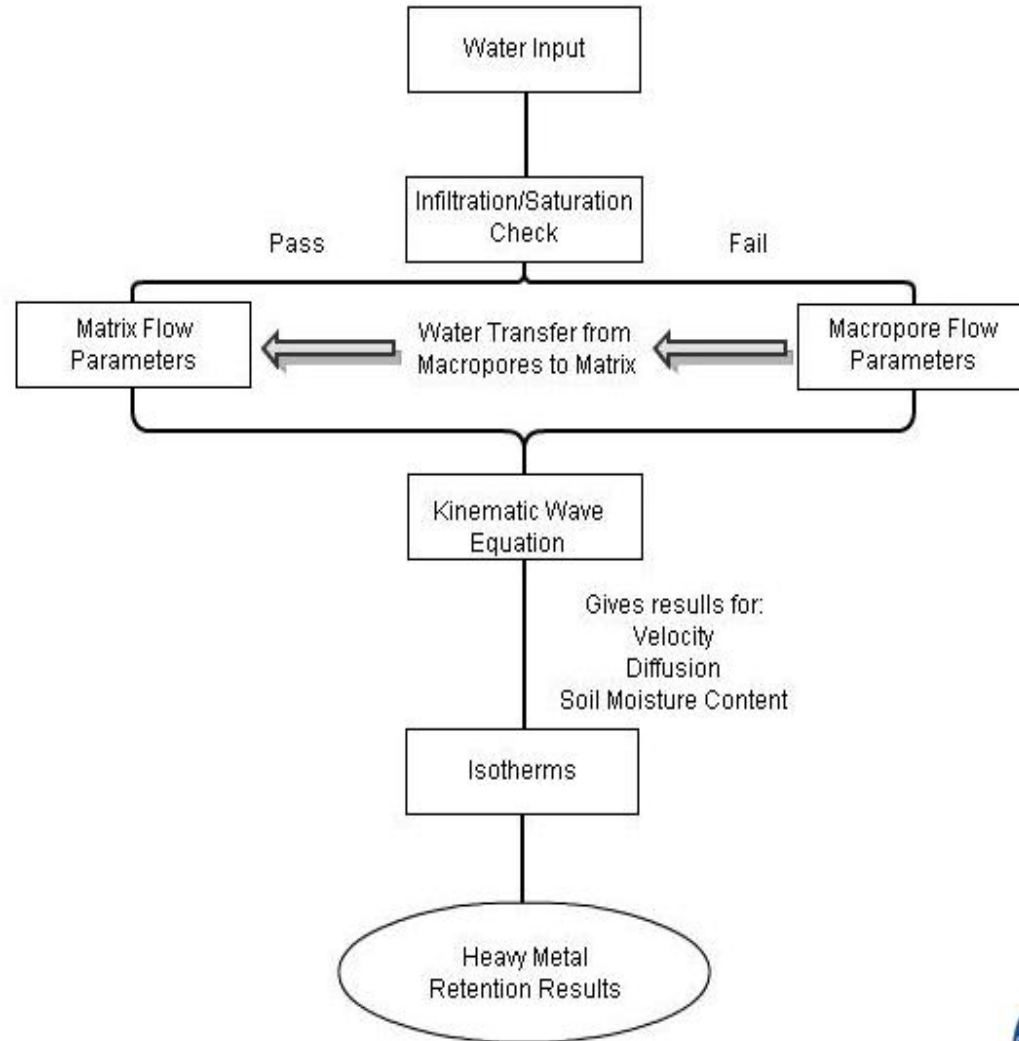
# Results - Pollutant Retention



# Results - Pollutant Retention



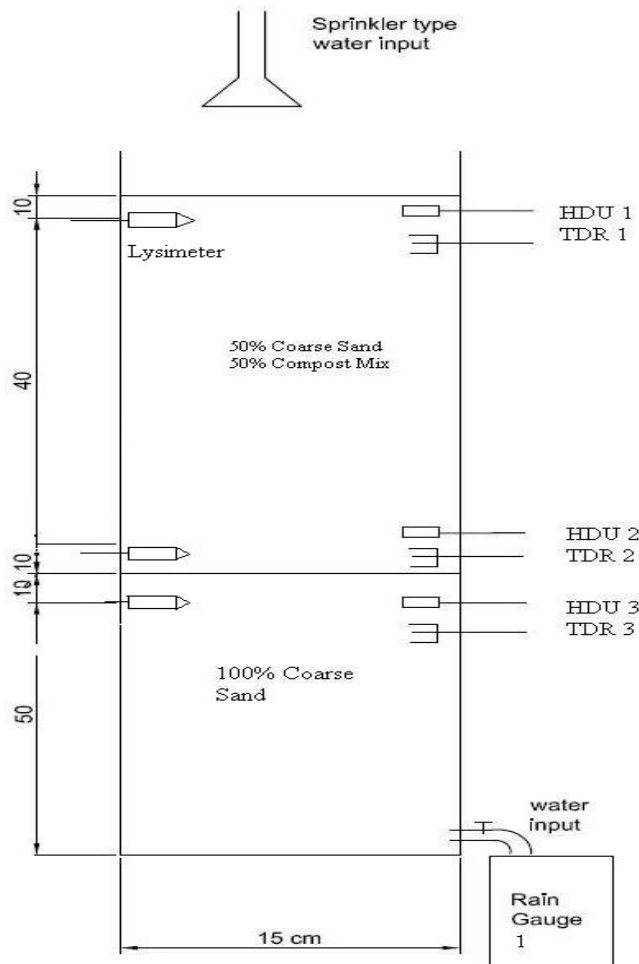
# Finalised Model Design



# 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.

# 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

# 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

Thank You