# ARR :
# 2D Direct Rainfall Testing

Rhys Thomson

Australian Rainfall & Runoff

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# Supported By

Australian Government

# Overview

- The Questions:
  - How does current best practice hydrological modelling for urban catchments compare with FFA?
  - How do the results compare for models established independently?

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# Overview

- Background on the Catchments
- WA
  - Assumptions
  - Results
- Vic
  - Assumptions
  - Results
- Sensitivity Testing



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# Study Areas

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# Study Area - WA

Area = 8.2 ha

TIA = 2.9ha



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# Study Area - Vic

Area = 201.8 ha

TIA = 121.5 ha

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# Available Information

| Data Set | Victoria | WA |
|---|---|---|
| Pits and Pipes | Only the trunk drainage system available, minimum 450mm diameter pipes | The majority of pit and pipe data is available. |
| Terrain | LiDAR | LiDAR |
| Aerial Photo | Yes | Yes |
| Flow gauge record length | 1977 to 2012 (35yrs) | 1983 to 1993 (10yrs) |

# WA – FFA Analysis

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# WA – IFD Analysis

# Vic – FFA Analysis

# Vic – IFD Analysis

# 2D Direct Rainfall Testing

- Three modellers
  - Cardno
    - Sydney
    - Melbourne
  - WMA Water
- Their Mission:
  - To create a Direct Rainfall model for each catchment, using best practice parameters
- Testing undertaken using 1987 IFDs



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# Assumptions - WA

| Parameter | Modeller 1 | | | Modeller 2 | Modeller 3 |
|---|---|---|---|---|---|
| Scenario | 1 | 2 | 3 | 1 | 1 |
| Software | Tuflow | RORB | SWMM (runoff module only) | SOBEK | Tuflow |
| Grid Size | 2m | - | - | 2m | 2m |
| Buildings | Nulled with rainfall increase to compensate | - | - | Modelled with property roughness | Buildings "raised" (by 3m) |
| **Roughness (MANNINGS n VALUE)** | | | | | |
| Roads | 0.018 | - | 0.02 | 0.015 | 0.015 |
| Urban/ Residential | 0.08 | - | 0.03 | 0.05 (0.1 for buildings) | 0.013 |
| **LOSSES** | | | | | |
| IL Impervious (mm) | 1 | 2 | 1 | 1.5 | 1.5 (pre-wetted) |
| CL Impervious (mm/hr) | 0 | 0 | 0 | 0 | 0 |
| IL Pervious (mm) | 20 | 20 | 20 | 15 | 20 |
| CL Pervious (mm/hr) | 3 | 3 | 3 | 4.0 | 2.5 |

# Assumptions - WA

- Traditional Hydrology
  - XP-SWMM model
  - RORB model
  - Both single catchment



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# Direct Rainfall Modelling

**ALBANY, WESTERN AUSTRALIA**

N

50 0 50

Meters

**Legend**

Study Area

**Depth (m)**

| | | |
|---|---|---|
| 0.28 to 0.6 | 0.08 to 0.1 | 0.04 to 0.05 |
| 0.18 to 0.28 | 0.07 to 0.08 | 0.03 to 0.04 |
| 0.15 to 0.18 | 0.06 to 0.07 | 0.02 to 0.03 |
| 0.1 to 0.15 | 0.05 to 0.06 | 0.01 to 0.02 |

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Map Produced by Cardno NSW/ACT Pty Ltd
Date: 16/06/2014
Coordinate System: Zone 50 MGA/GDA 94
GIS MAP REF:
\\AUMELCFS01.cardno.corp\Water_Resources\Jobs\SYDNEY
\Direct_Rainfall_WA_Catchment\Mapinfo\Workspaces\
DR_Results_WA.wor

# Results

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# Results

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# Results

Pre-wetting applied

# WA-Results

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# Rational Method

# WA – Modeller 1 – Additional Tests

| Parameter | Modeller 1 | | |
|---|---|---|---|
| Scenario | 1 | 6 | 7 |
| Software | Tuflow | Tuflow | Tuflow |
| Grid Size | 2m | 4m | 2m |
| Buildings | Nulled with rainfall increase to compensate | Nulled with rainfall increase to compensate | Modelled with building roughness of 0.5 |
| **Roughness (MANNINGS n VALUE)** | | | |
| Roads | 0.018 | 0.018 | 0.018 |
| Urban/ Residential | 0.08 | 0.08 | 0.08 |
| **LOSSES** | | | |
| IL Impervious (mm) | 1 | 1 | 1 |
| CL Impervious (mm/hr) | 0 | 0 | 0 |
| IL Pervious (mm) | 20 | 20 | 20 |
| CL Pervious (mm/hr) | 3 | 3 | 3 |

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# Modeller 1 – Additional Tests

- Increase in grid size has minimal impact
- Modelling buildings with higher roughness decreases the flows (~ 30 to 35%)

# Assumptions - Vic

Allocated micro-sub areas

| Parameter | Modeller 1 | | Modeller 2 | Modeller 3 | |
|---|---|---|---|---|---|
| | Scenario 1 | Scenario 2 | Scenario 1 | Scenario 1 | Scenario 2 |
| Software | Tuflow | RORB | SOBEK | Tuflow | Tuflow |
| Grid Size | 2m | - | 2m | 3m | 3m |
| Buildings | Modelled with property roughness | - | Modelled with property roughness | Buildings "raised" (by 3m) | Buildings "nulled" |
| Roughness (Mannings n value) | | | | | |
| Roads | 0.018 | - | 0.015 | 0.015 | 0.015 |
| Urban/ Residential | 0.10 | - | 0.05 | 0.03 | 0.03 |
| Medium Veg | 0.05 | - | 0.03 | 0.06 | 0.06 |
| Open Space | 0.035 | - | 0.02 | 0.03 | 0.03 |



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# Assumptions - Vic

- Traditional Hydrology
  - RORB model
    - Used a previous established model, but converted to use IL/CL

| Losses | Modeller 1 | | Modeller 2 | Modeller 3 | |
|---|---|---|---|---|---|
| | Tuflow | RORB | SOBEK | Scenario 1 | Scenario 2 |
| IL – imp (mm) | 1.5 | 1.5 | 7 | 1.5 (pre-wetted) | 1.5 |
| CL – imp (mm/hr) | 0 | 0 | 2 | 0 | 0 |
| IL – per (mm/hr) | 15 | 15 | 7 | 15 | 15 |
| CL – per (mm/hr) | 2.5 | 2.5 | 2 | 2.5 | 2.5 |

# Direct Rainfall Modelling

## KINKORA ROAD, VICTORIA

N

50 0 50

Meters

**Legend**

Study Area

**Depth (m)**

| | | |
|---|---|---|
| 1.8 to 3.5 | 0.2 to 0.3 | 0.04 to 0.05 |
| 0.8 to 1.8 | 0.1 to 0.2 | 0.03 to 0.04 |
| 0.5 to 0.8 | 0.07 to 0.1 | 0.02 to 0.03 |
| 0.3 to 0.5 | 0.05 to 0.07 | 0.01 to 0.02 |

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Map Produced by Cardno NSW/ACT Pty Ltd
Date: 16/06/2014
Coordinate System: Zone 50 MGA/GDA 94
GIS MAP REF:
\\AUMELCFS01.cardno.corp\Water_Resources\Jobs\SYDNEY
\Direct_Rainfall_VIC_Catchment\Mapinfo\Workspaces\
DR_Results_Vic.wor

Log Pearson 3 Fitted Curve
90% Confidence Limits
Gauged Flows
Modeller 1
Discharge(m3/s)
5
10
20
50
100
Average Recurrence Interval (1 in Y)

Log Pearson 3 Fitted Curve
90% Confidence Limits
Gauged Flows
Modeller 1
RORB
Discharge(m3/s)
5
10
20
50
100
Average Recurrence Interval (1 in Y)

Log Pearson 3 Fitted Curve
90% Confidence Limits
Gauged Flows
Modeller 1
Modeller 2
RORB
Discharge(m3/s)
5
10
20
50
100
Average Recurrence Interval (1 in Y)

Log Pearson 3 Fitted Curve
90% Confidence Limits
Gauged Flows
Modeller 1
Modeller 2
RORB
Modeller 3 - Scenario 1
Discharge(m3/s)
5
10
20
50
100
Average Recurrence Interval (1 in Y)

Micro-subareas has lower runoff than Direct Rainfall

# Results - Vic

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Log Pearson 3 Fitted Curve
90% Confidence Limits
Gauged Flows
Modeller 1
Modeller 2
RORB
Modeller 3 - Scenario 2
Modeller 3 - Scenario 1
Modeller 1 - Rational
Modeller 3 - Rational
Discharge(m3/s)
5
10
20
50
100
Average Recurrence Interval (1 in Y)

# New IFDs

- Typical Changes
  - Vic
    - For less 1 hour duration, generally less than 5% difference (reduction)
  - WA
    - For 30min, less than 10% generally (reduction)



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