Image: Market Sconsulting RORBwin An enabling tool for ARR2016

David Stephens Hydrology and Risk Consulting

 $\pi_{ab} \pm 0.045w + \pi(4-\mu) \approx \langle y \leq d^2 + e^2 \rangle \int \Sigma \{m/n^2\} \hat{H} \infty (b^3)$ a⁵(4-µ) ≈ <y≤w² + y²> 6.667[‡]/∂ - [f/ø] (4.5^b + jw²... + mn <y≤w² + y²> 8Ω ‡/∂ - [f/ø] (4.5° + jw³... + mn k14.5π/ü r <y≤d² + G²> J.∑ {m/n²} U ∞ (b³) - ma + p2/k≈b⁶ p16.06 w (4-µ) ≈ <y≤w2 + y2> 6.667#/d - [f/ø] (4.5b + jwrv/ ¶ t3 J.Σ {m/n²} U ∞ (b³) - ma + p2/k≈b⁶ p1/n²} U ∞ (b³) 6.89 $#8.0\mu.T^{3}67^{\dagger}/\partial - [f/\phi](4.5^{\circ} + jw^{\circ}... + mn45w + \pi(4-\mu) =$ [f/ø] (4.5^b + jw⁹... + mn k14.5π /n²} U ∞ (b³)⁸ rtk/∫ 2.34 f! (9.9/a5) U ∞ (b3) - ma ÷ p2/k≈b6 p1/d - [f/ø] (4.5) 2.3 k6.7 = xCARTOONSTOCK .com Search ID: rman13860 Biles

"...Therefore, we're in complete compliance with all federal guidelines."

Some background...

- RORBwin rainfall runoff model
- Widely used in Victoria since late 1970s
- Originally developed by Laurenson and Mein (Monash Uni)



Conceptual forebearer to numerous other modelling packages



Why RORB?

- Simplicity!
- Pedigree and history of application
- Continual development process
- Preferred hydrologic model for a number of authorities
- GIS plug-ins
- Provided free of charge to industry

RORB – recent enhancements

- Directly / indirectly connected impervious fractions
- Pre-burst rainfall
- Embedded burst filtering
- Automated extraction of median hydrographs

The nature of the problem



The nature of the problem

1% AEP rainfall could yield a flood between 400 and 2,000 m³/s



The nature of the problem



1,000 m³/s flood could result from a rainfall AEP that ranges between 20% and 0.1% AEP



Modelling frameworks



Modelling frameworks



Where to from here?

- RORB has been carefully developed to make implementation of ensemble and MC easy
- Reads IFD and Data Hub text files
- Ensembles don't need to be 10x the work!



1 THOUGHT I WAS



Data sources

- IFD data still available from BoM website
- Download as csv file and read into RORB
- Editable in Excel
- Some manual manipulation required if using AEPs rarer than 1%
- http://www.bom.gov.au/water/designRainfalls/revisedifd/?year=2016







Download to text file



Data sources

- ARR Data Hub
 - Areal reduction factors
 - Temporal patterns
 - Pervious area losses
 - Pre-burst depths
- Download as text file and CSV file and read into RORB
- No editing required
- <u>http://data.arr-software.org/</u>



Region Information

Input Data

Selected Regions (clear)

Areal Temporal Patterns

Temporal Patterns

Longitude

Latitude

Data Category	Region
River Region	Bunyip River
ARF Parameters	Southern Temperate
Temporal Patterns	Southern Slopes (Vic/NSW)

Data

Storm Losses	Layer Info
Note: Burst Loss = Storm Loss - Preburst	
Note: These losses are only for rural use and are NOT FOR USE in urban areas	

Storm Initial Losses (mm)	23.0	Time Accessed	15 May 2018 09:18AM
Storm Continuing Losses (mm/h)	3.8	Version	2018_v1

Temporal Patterns | Download (.zip)

code	SSmainland	Time Accessed	15 May 2018 09:18AM	
Label	Southern Slopes (Vic/NSW)	Version	2018_v2	

Areal Temporal Patterns | Download (.zip)

Lay	er	Info	0

Layer Info

code	SSmainland	Time Accessed	15 May 2018 09:18AM
arealabel	Southern Slopes (Vic/NSW)	Version	2016_v2



Download TXT Download PDF



Region Information

Input Data

Selected Regions (clear)

Areal Temporal Patterns

Temporal Patterns

Longitude Latitude

Data Category	Region
River Region	Bunyip River
ARF Parameters	Southern Temperate
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Data S

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Temporal Patterns | Download (.zip)

code	SSmainland	Time Accessed	15 May 2018 09:18AM	
Label	Southern Slopes (Vic/NSW)	Version	2018_v2	

Layer Info

Layer Info

Areal Temporal Patterns | Download (.zip)

code	SSmainland	Time Accessed	15 May 2018 09:18AM
arealabel	Southern Slopes (Vic/NSW)	Version	2018_v2



Download TXT Download PDF

Download losses, pre-burst and ARFs to text file



Region Information

Input Data

Temporal Patterns

Areal Temporal Patterns

Longitude

Latitude

Data Category	Region
River Region	Bunyip River
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Areal Temporal Patterns Download (.zip)		Layer Info		
code	SSmainland	Time Accessed	15 May 2018 09:18AM	
arealabel	Southern Slopes (Vic/NSW)	Version	2018_v2	



Download TXT Download PDF



Region Information

Input Data

Selected Regions (clear)

Areal Temporal Patterns

Temporal Patterns

Longitude

Latitude

Data Category	Region
River Region	Bunyip River
ARF Parameters	Southern Temperate
Temporal Patterns	Southern Slopes (Vic/NSW)

Data

code

Storm Losses	Layer Info	
Note: Burst Loss = Storm Loss - Preburst		
Note: These losses are only for rural use and are NOT FOR USE in urban areas		

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Storm Continuing Losses (mm/h)	3.8	Version	2016_v1	
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Temporal Patterns Download (.2lp)		Layer Into		

code	SSmainland	Time Accessed	15 May 2018 09:18AM	
Label	Southern Slopes (Vic/NSW)	Version	2016_v2	

Download areal temporal patterns to CSV file Areal Temporal Patterns | Download (.zip) Need the "_increments.csv" file SSmainland Version

Southern Slopes (Vic/NSW) arealabel

2018_v2



Download TXT Download PDF

Temporal patterns

- Point temporal patterns
- Areal temporal patterns

 (area > 75 km²)
- Different area 'bins'







1

Design Rainfall Specification (ARR2016)	×
Data Hub files	
Main Data Hub file (*.txt, contains ARFs and losses)	Use regional losses
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Cancel Help	ОК

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Outputs

Program version 6.32 (last updated 3rd September 2017) Copyright Monash University and Hydrology and Risk Consulting

Date run: 11 May 2018 15:55

Catchment file : .\Delatite.catg Rainfall location: User defined Temporal pattern : ARR2016 areal temporal patterns, 500 km² standard area Spatial pattern : Uniform Areal Red. Fact. : Based on ARR 2016 (Book 2 Chapter 4) Loss factors : Constant with ARI

Parameters: kc = 25.00 m = 0.80

Loss parameters Initial loss (mm) Cont. loss (mm/h) 27.00 4.30

Peak Description

01 Calculated hydrograph, TongaBridge

Run	Duration	AEP	TPat	Rain(mm)	ARF	Peak0001
1	12 hour	10%	1	69.40	0.89	48.5609
1	12 hour	10%	2	69.40	0.89	62.7997
1	12 hour	10%	3	69.40	0.89	68.8250
1	12 hour	10%	4	69.40	0.89	57.7552
1	12 hour	10%	5	69.40	0.89	18.2086
1	12 hour	10%	6	69.40	0.89	34.7888
1	12 hour	10%	7	69.40	0.89	44.4580
1	12 hour	10%	8	69.40	0.89	44.8110
1	12 hour	10%	9	69.40	0.89	34.1419
1	12 hour	10%	10	69.40	0.89	70.4261
2	24 hour	10%	1	91.90	0.93	19.9730
2	24 hour	10%	2	91.90	0.93	38.7507
2	24 hour	10%	3	91.90	0.93	24.1128



Outputs

Program version 6.32 (last updated 3rd September 2017) Copyright Monash University and Hydrology and Risk Consulting

Date run: 11 May 2018 15:55

```
Catchment file : .\Delatite.catg
Rainfall location: User defined
Temporal pattern : ARR2016 areal temporal patterns, 500 km<sup>2</sup> standard area
Spatial pattern : Uniform
Areal Red. Fact. : Based on ARR 2016 (Book 2 Chapter 4)
Loss factors : Constant with ARI
```

Parameters: kc = 25.00 m = 0.80 Loss parameters Initial loss (mm) Cont. loss (mm/h) 27.00 4.30

Peak Description

01 Calculated hydrograph, TongaBridge

Run	Duration	AEP	TPat	Rain(mm)	ARF	Peak0001
1	12 hour	10%	1	69.40	0.89	48.5609
1	12 hour	10%	2	69.40	0.89	62.7997
1	12 hour	10%	3	69.40	0.89	68.8250
1	12 hour	10%	4	69.40	0.89	57.7552
1	12 hour	10%	5	69.40	0.89	18.2086
1	12 hour	10%	6	69.40	0.89	34.7888
1	12 hour	10%	7	69.40	0.89	44.4580
1	12 hour	10%	8	69.40	0.89	44.8110
1	12 hour	10%	9	69.40	0.89	34.1419
1	12 hour	10%	10	69.40	0.89	70.4261
2	24 hour	10%	1	91.90	0.93	19.9730
2	24 hour	10%	2	91.90	0.93	38.7507
2	24 hour	10%	3	91.90	0.93	24.1128

12 hour, 10% AEP ensemble results



Outputs

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Date run: 11 May 2018 15:55

```
Catchment file : .\Delatite.catg
Rainfall location: User defined
Temporal pattern : ARR2016 areal temporal patterns, 500 km<sup>2</sup> standard area
Spatial pattern : Uniform
Areal Red. Fact. : Based on ARR 2016 (Book 2 Chapter 4)
Loss factors : Constant with ARI
```

Parameters: kc = 25.00 m = 0.80 Loss parameters Initial loss (mm) Cont. loss (mm/h) 27.00 4.30

Peak Description

01 Calculated hydrograph, TongaBridge

Run	Duration	AEP	TPat	Rain(mm)	ARF	Peak0001
1	12 hour	10%	1	69.40	0.89	48.5609
1	12 hour	10%	2	69.40	0.89	62.7997
1	12 hour	10%	3	69.40	0.89	68.8250
1	12 hour	10%	4	69.40	0.89	57.7552
1	12 hour	10%	5	69.40	0.89	18.2086
1	12 hour	10%	6	69.40	0.89	34.7888
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12 hour, 10% AEP ensemble results

Median = $46.7 \text{ m}^{3}/\text{s}$



Outputs

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Date run: 11 May 2018 15:55

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01 Calculated hydrograph, TongaBridge

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12 hour, 10% AEP ensemble results

Median = $46.7 \text{ m}^{3}/\text{s}$

Use run 1 for design



Outputs

- Results provided as details of individual runs and batch summary
- Box plots can be constructed to determine medians and critical durations
- Individual runs for hydraulics/design easily identified and extracted from summary results

RORB - future directions

- Melbourne training course to be run May
- Major modernization project underway
- Regular minor enhancements and bug fixes