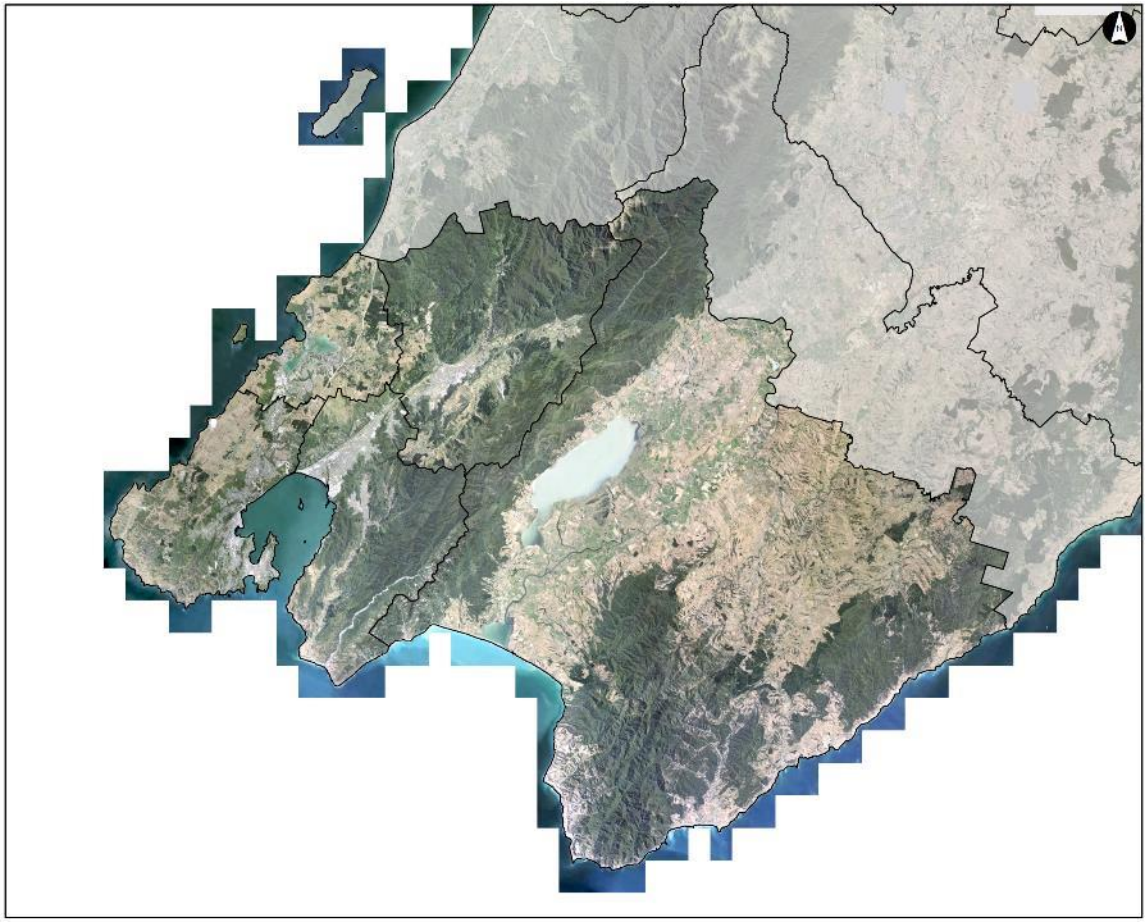


Wellington Region Runoff Hydrograph Calculator

Charlotte Lockyer

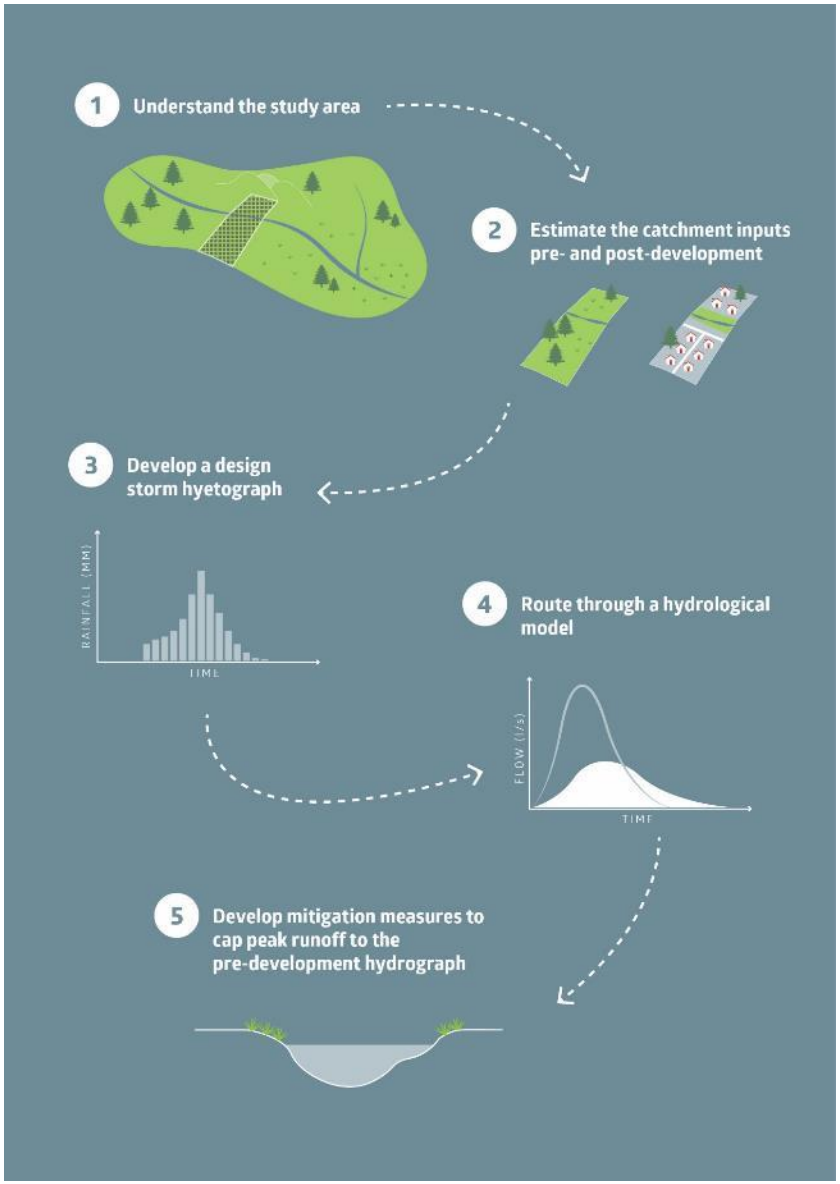
Stantec

Agenda

1. Reference Guide Update
2. Runoff Hydrograph Calculator

Reference Guide update

SCS Runoff Curve Number Method

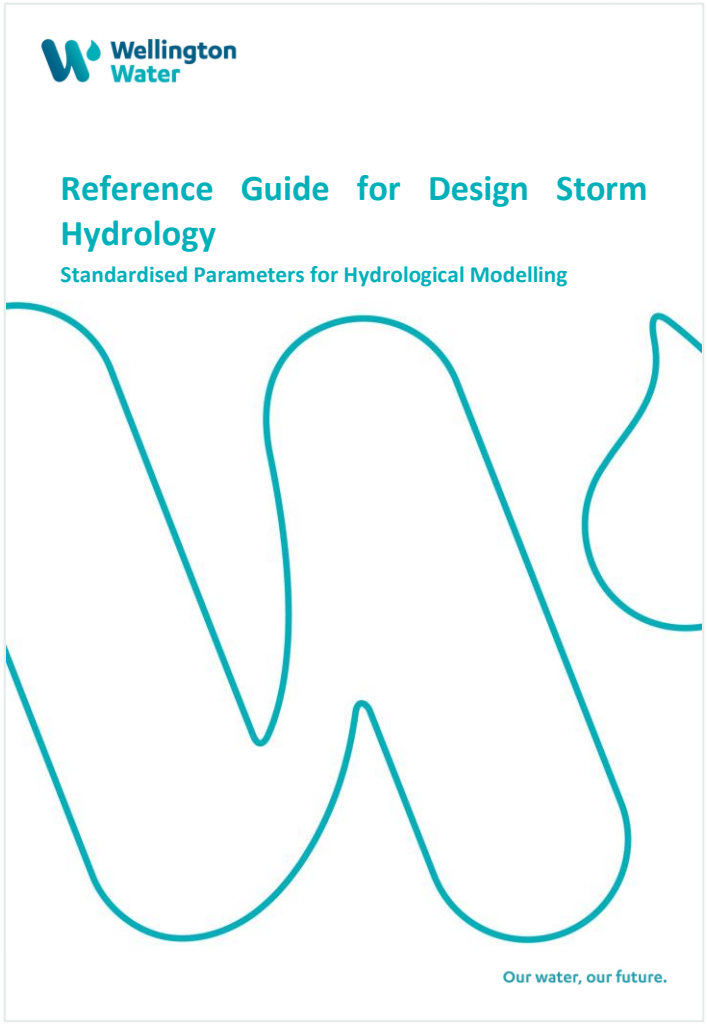


Input parameters:

- Area
- Initial abstraction
- Curve number
- Time of concentration
- Rainfall

Reference Guide Update

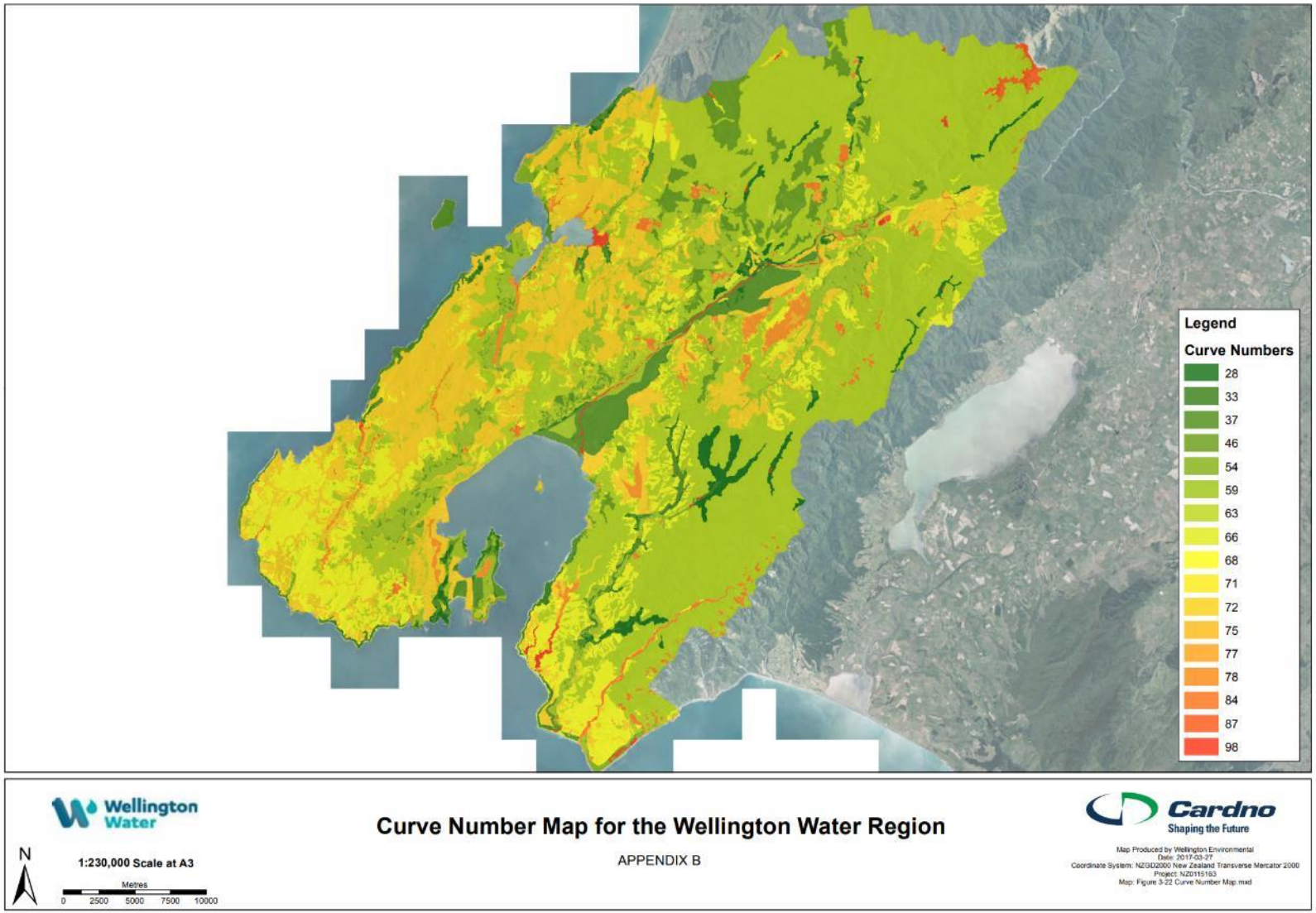
Three key changes



1. Curve number map > Soil group & land cover map
2. Sub-catchment delineation
3. Post-development reduction in soil group

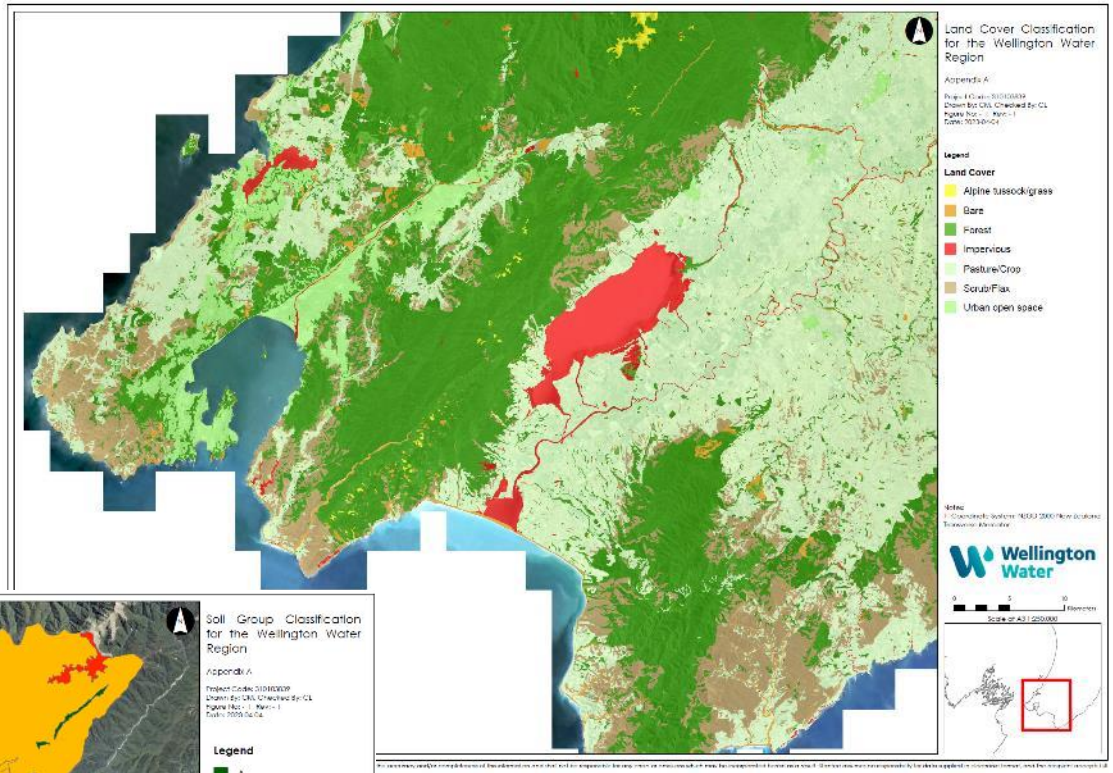
Reference Guide Update

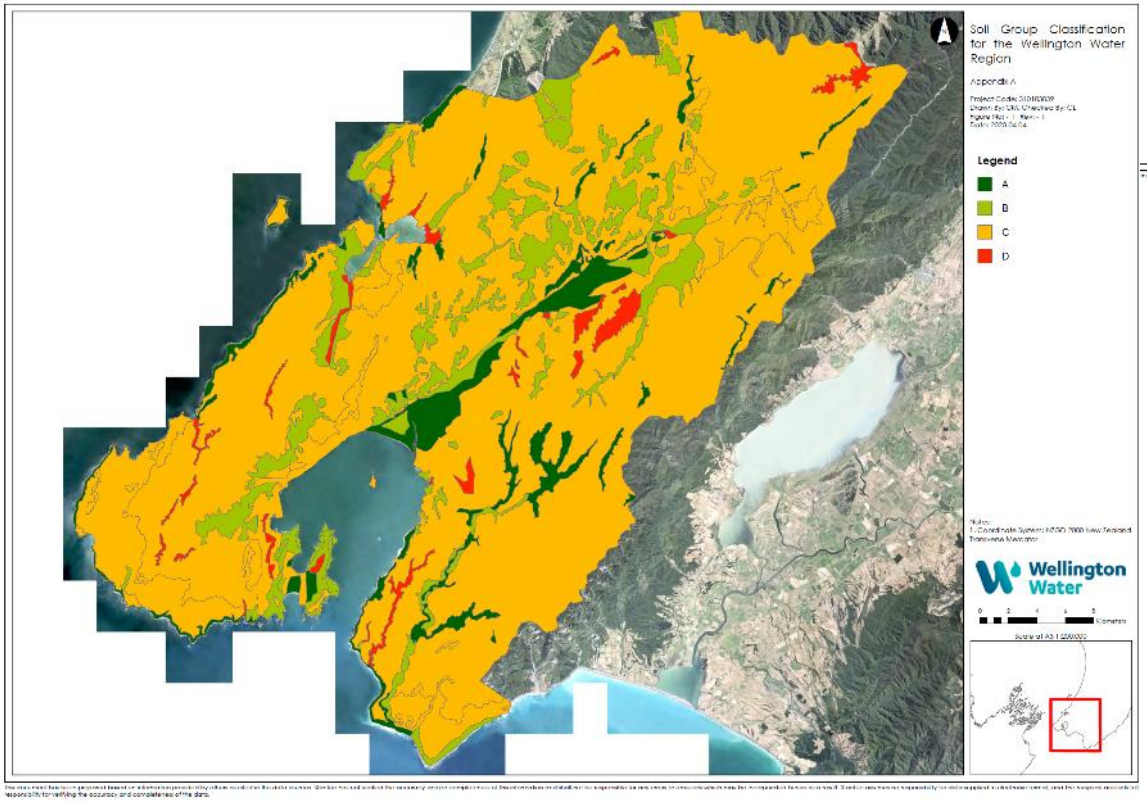
Gone from…



Reference Guide Update

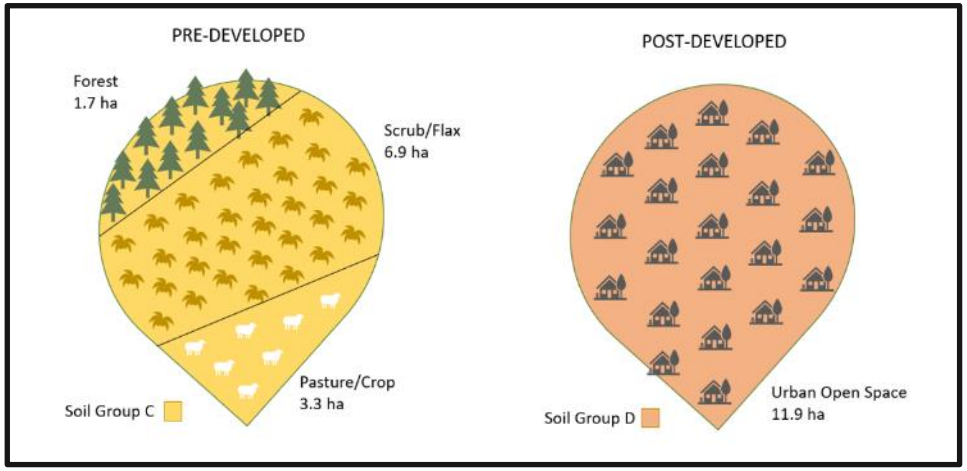
To…

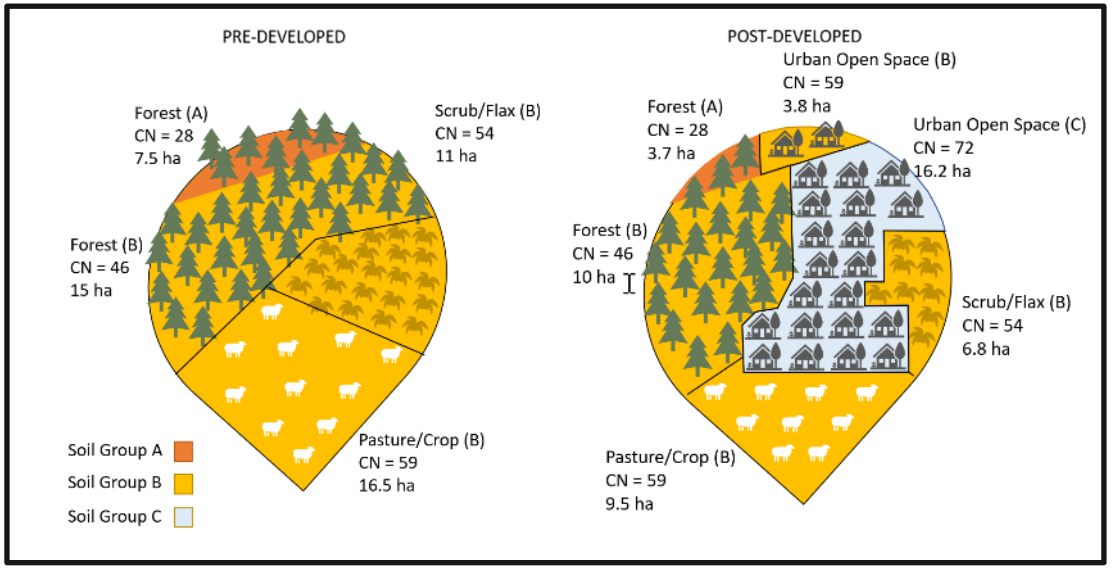




Reference Guide Update

Sub-catchment delineation & reduction in post-development soil group

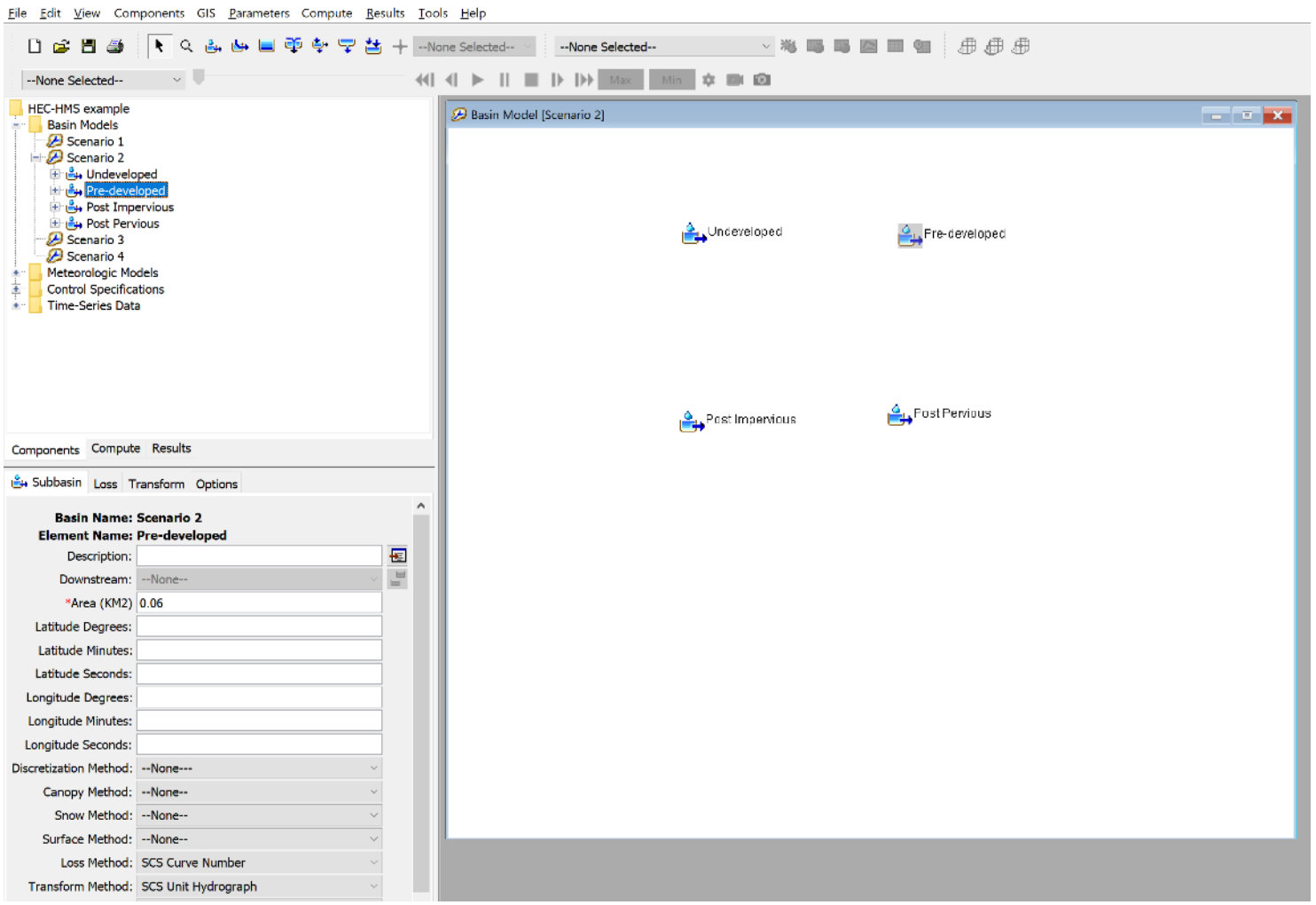




Runoff Hydrograph Calculator

Wellington Region Runoff Hydrograph Calculator

The alternative



Wellington Region Runoff Hydrograph Calculator

Runoff Hydrograph Calculator (RuHC)

WELLINGTON WATER LIMITED
Runoff Hydrograph Calculator
v1 Jan 2023

Input parameters to be derived from the methodology outlined in the Reference Guide for Design Storm Hydrology.

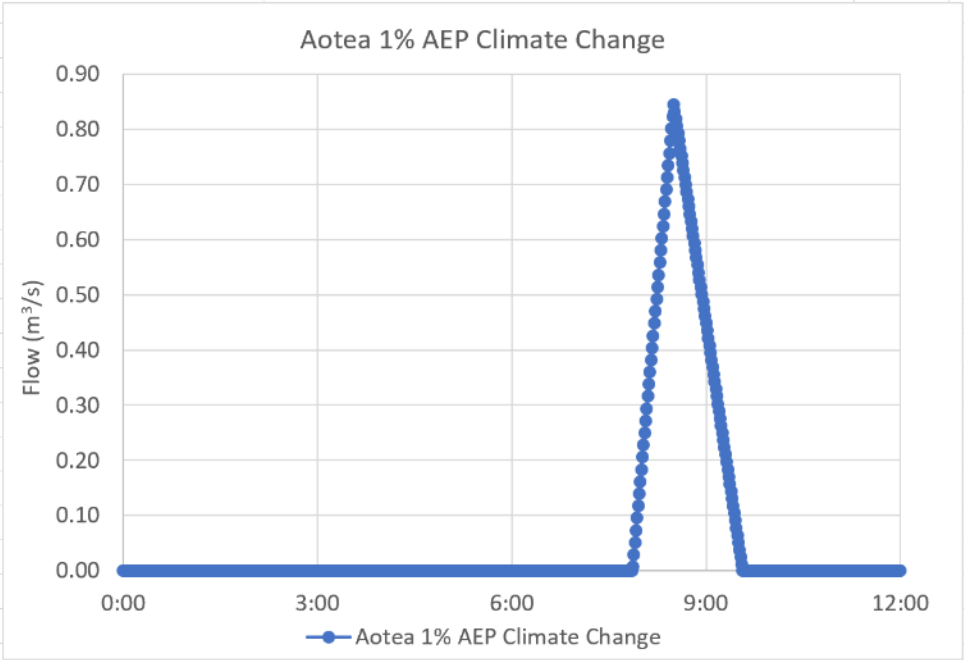
Site ID	Aotea	← ID & reference details
Event	1% AEP Climate Change	
Area (km2)	0.0500	← Input parameters
Initial Abstraction (mm)	21.6	
Soil Group	C	
Landcover	Forest	
Curve Number default	63	
Curve Number proposed	63	Justification for CN override:
Time of Concentration (minutes)	10.0	
12-hour rainfall depth (mm)	139.2	
Peak flow (m3/s)	0.845	← Results
Volume (m3)	2590.7	

Wellington Region Runoff Hydrograph Calculator

Results

Peak flow (m3/s)	0.845
Volume (m3)	2590.7

Time (minutes)	**Flow (m3/s)**
0:00	0.00
0:01	0.00
0:02	0.00
0:03	0.00
0:04	0.00
0:05	0.00
0:06	0.00
0:07	0.00
0:08	0.00
0:09	0.00
0:10	0.00
0:11	0.00
0:12	0.00
0:13	0.00
0:14	0.00
0:15	0.00
0:16	0.00
0:17	0.00
0:18	0.00
0:19	0.00
0:20	0.00
0:21	0.00



Wellington Region Runoff Hydrograph Calculator

Disclaimer

WELLINGTON WATER LIMITED
Runoff Hydrograph Calculator
v1 Jan 2023

Wellington Water

Input parameters to be derived from the methodology outlined in the Reference Guide for Design Storm Hydrology.

Site ID	Aotea		
Event	1% AEP Climate Change		
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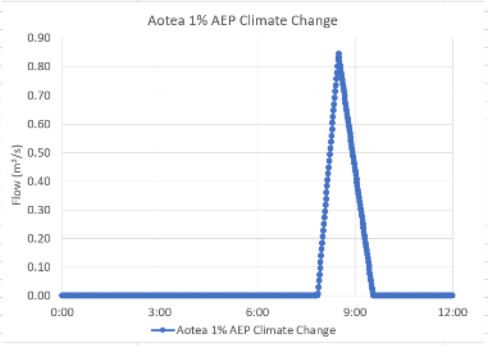
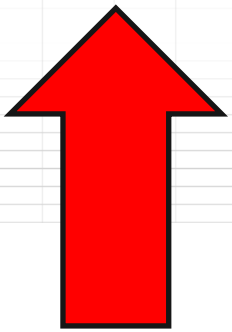
0:02	0.00
0:03	0.00
0:04	0.00
0:05	0.00
0:06	0.00
0:07	0.00
0:08	0.00
0:09	0.00
0:10	0.00
0:11	0.00
0:12	0.00
0:13	0.00
0:14	0.00
0:15	0.00
0:16	0.00
0:17	0.00
0:18	0.00
0:19	0.00
0:20	0.00
0:21	0.00



This spreadsheet has been developed to estimate flood hydrographs for small ungauged urban catchments in the Wellington Region. It has been developed by Wellington Water Ltd (WWL) for use by developers and consultants for managing and designing stormwater infrastructure as an alternative to hydrological modelling in software such as Hec-HMS. The formulae in this spreadsheet are consistent with the *Reference Guide for Design Storm Hydrology*. For details on how to calculate the input parameters, please consult the *Reference Guide*.

While this methodology is consistent with the *Reference Guide*, assumptions have been made to convert site specific variables into a regional spreadsheet. For this reason the following limitations apply to use of this estimator.

1. Developed for small ungauged urban catchments in the Wellington area. The term 'urban' is to distinguish between large river catchments such as the Hutt River or Wainuimata Stream, and small tributaries/overland flowpaths/unnamed streams. It may be used to estimate runoff in areas where landuse is being developed from rural to urban.
2. Input parameters must be developed in accordance with the *Reference Guide*.
3. The maximum time of concentration has been capped at 120 minutes, beyond this definitely falls outside of the definition of a small ungauged urban catchment.
4. This is a simplified tool for simple calculations. For moderate to complex design, hydrological modelling using appropriate software is required. Hydrological modelling using appropriate software (with the methodology in accordance with the *Reference Guide)* can be used for all stormwater design and will supersede any outputs from this estimator.
5. It has been developed to size infrastructure with reference to larger flood events (i.e. 1% AEP flood). Where infrastructure is being sized for smaller flood events, or where there is significant storage within the catchment, hydrological modelling using appropriate software and taking into account site specific characteristics may result in smaller peak flow estimates.
6. The estimator provides a flood hydrograph for a single homogeneous sub-catchment. Where multiple sub-catchments are being evaluated, the resulting flood hydrograph across each scenario can be summed together to estimate the total peak flow and volume.
7. Hydrological modelling to estimate peak runoff rates are not highly accurate. The standard error associated with HIRDS v4 rainfall may be in the order of +/-20%. This error is further increased through hydrological modelling, and using this simplified calculator. If in doubt, apply conservatism.



Disclaimer

Wellington Region Runoff Hydrograph Calculator

The technical stuff…

Excess runoff:

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

where:

$$S = \left(\frac{1000}{CN} - 10\right) 25.4$$

Peak flow:

$$q_p = quAQFp$$

Q = runoff volume (mm)

P = direct rainfall

I_a = initial abstraction

P – I_a = maximum rainfall available for runoff

S = storage depth

CN = curve number

q_p = peak runoff

q_u = unit peak discharge

A = area

F_p = pond/swamp adjustment factor

Wellington Region Runoff Hydrograph Calculator

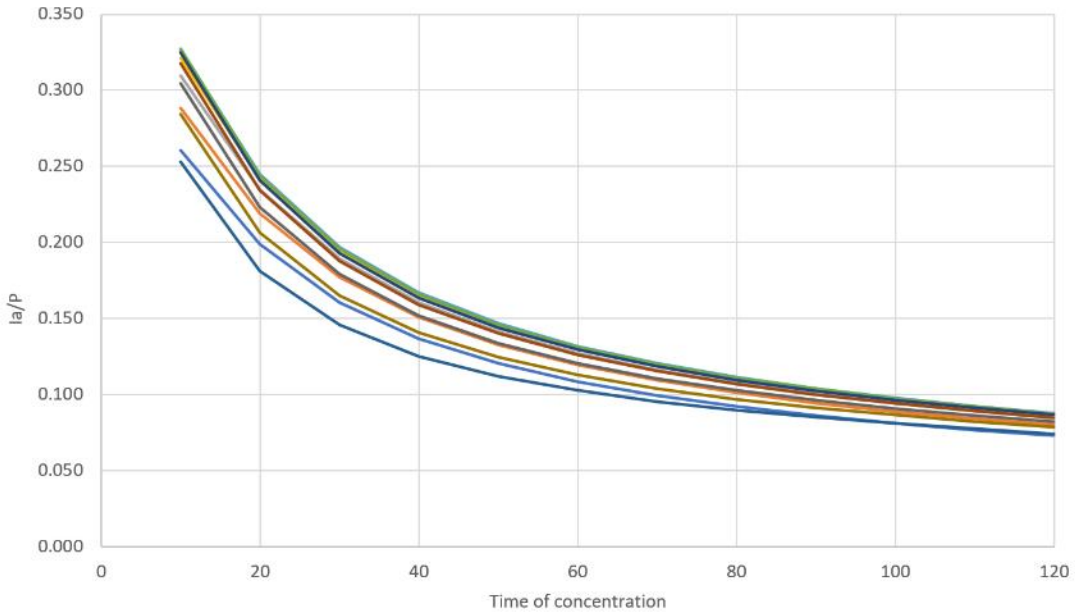
The technical stuff…

- q_u decreases exponentially as time of concentration (Tc) increases

and,

- for any given value of Tc, the value of q_u decreases with increasing values of I_a/P.

So the RuHC uses developed I_a/P vs q_u curves in the background to estimate Qp.



Summary

The Wellington Water Ltd region now has a nifty calculator that takes the hard-yards out of estimating design flood flows*.

WWL to roll this out mid-2023.

*Note the assumptions & limitations to this approach.

Without change there is no innovation, creativity, or incentive for improvement. Those who initiate change will have a better opportunity to manage the change that is inevitable.

William Pollard