AITPM – TMN – ACT Event, September 2022
Canberra, TCCS

ACT GOVERNMENT

Development of a Geographic Information System (GIS) for Riverine Flood Disaster Evacuation in Canberra, Australia: Trip Generation and Distribution Modelling

Authors:

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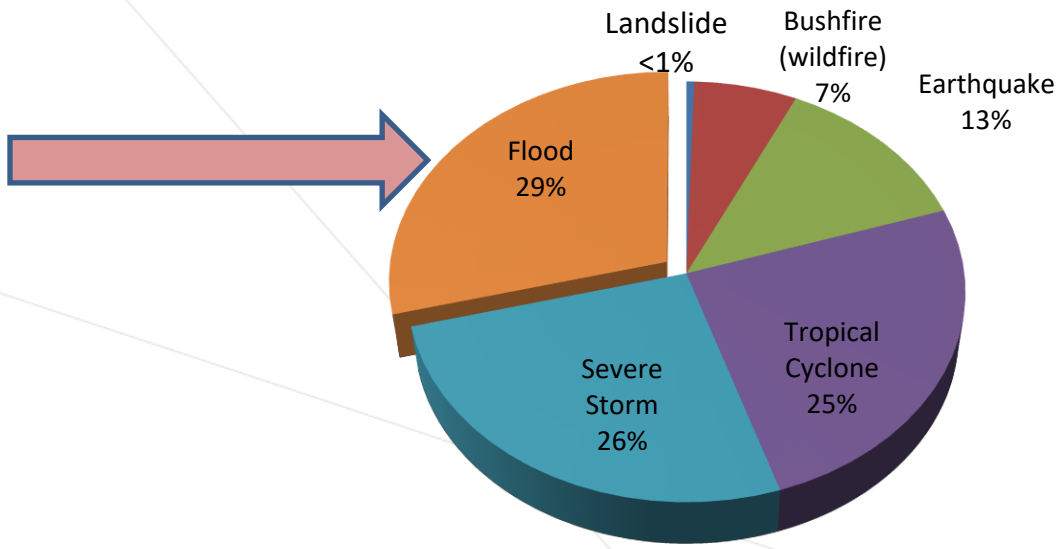
ACT Government
Transport Canberra and City Services

Flood Disaster Impacts

In Australia:
Average proportional annual cost of natural disasters (1967 to 1999)



Source: Middelmann (2007 p. 19)

Sources:
** Jennings and Gruntfest 2003 p. 691*
*** World Bank 2010 p.43, 30-33*
**** Queensland Floods Commission of Inquiry, 2012 p. 31*

Country and Year	Death Toll	Affected Population	Affected Property	Environmental Damage	Economic Losses	Reconstruction Cost
Venezuela 1999*	20,000					
Pakistan 2010**	1,800	20 mil		US$ 11.67 mil		US$ 6.8-8.9 bil
Queensland 2011***	33	2.5 mil	29,000		$11 bil	

Evacuation is the most appropriate protective measure for riverine flood disasters!!!!

Unplanned Evacuation Pakistan's Flood 2010

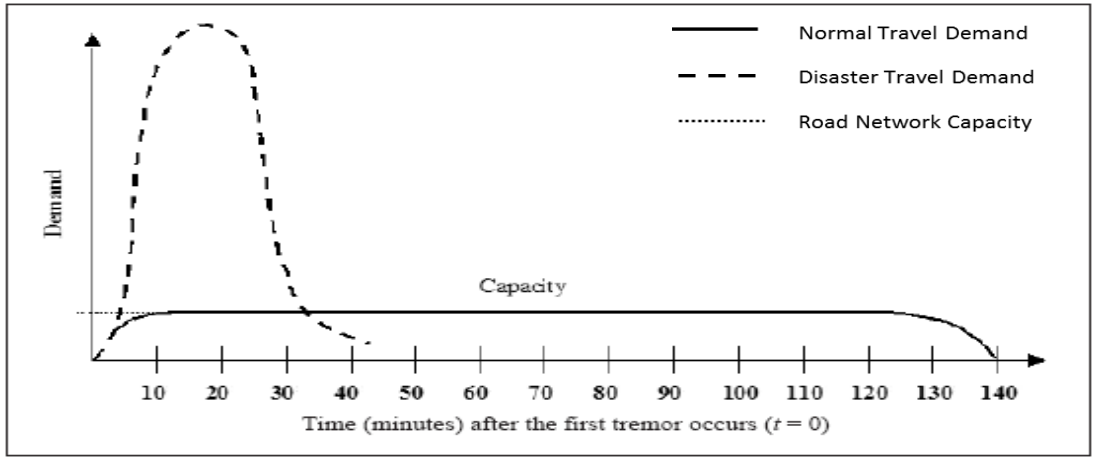
Unplanned Evacuation Queensland's Floods

Improper Planned Evacuation Rita Hurricane 2005

100 miles traffic jam

Out of fuel

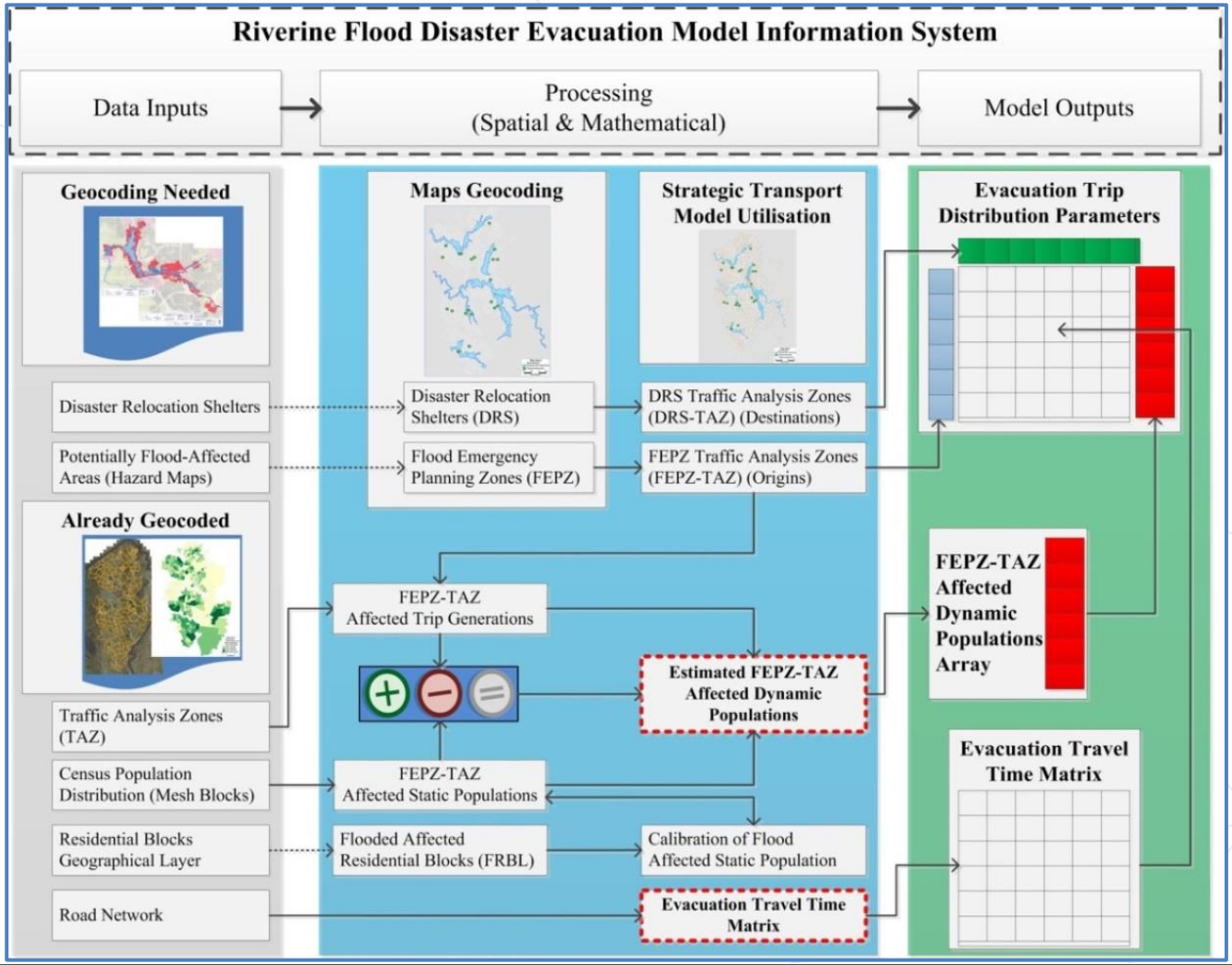
Exposed to more risks



Source: Petruccelli 2003

Riverine Flood Evacuation Model Information System

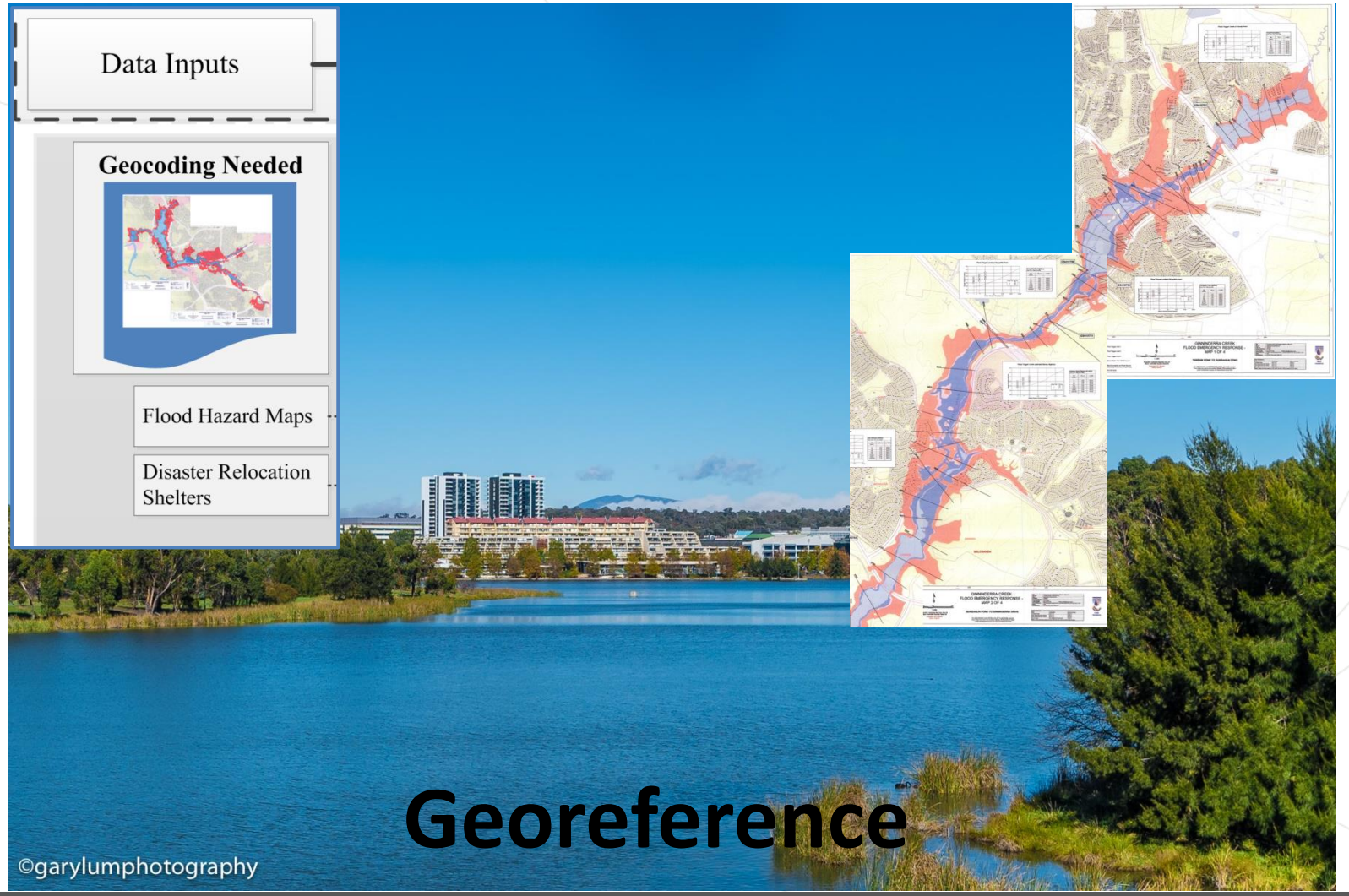
GIS-BASED Riverine Flood Evacuation Model



Data Input


Data Inputs
Geocoding Needed
Flood Hazard Maps
Disaster Relocation Shelters
Georeference
©garylumphotography

Data Input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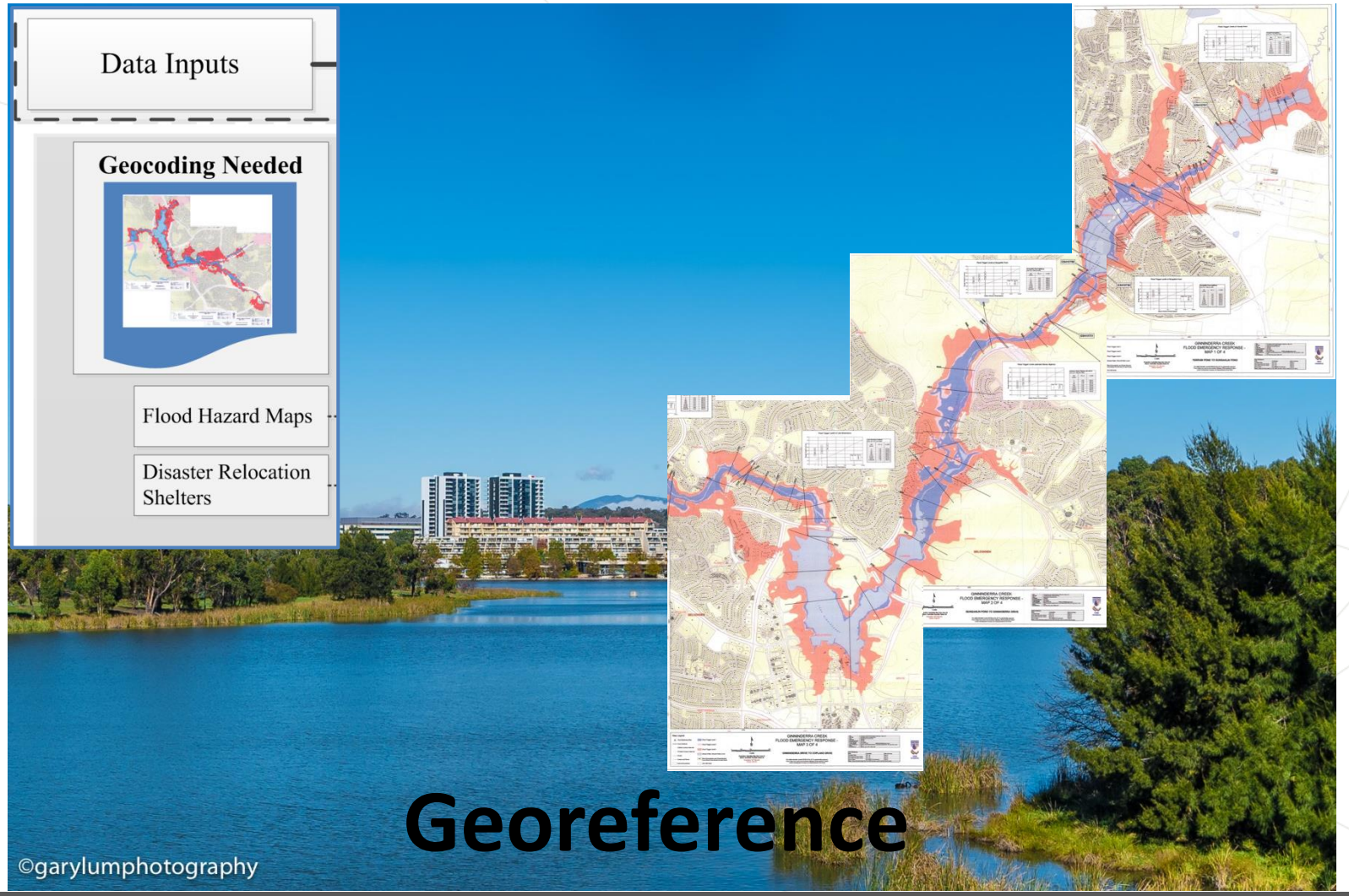
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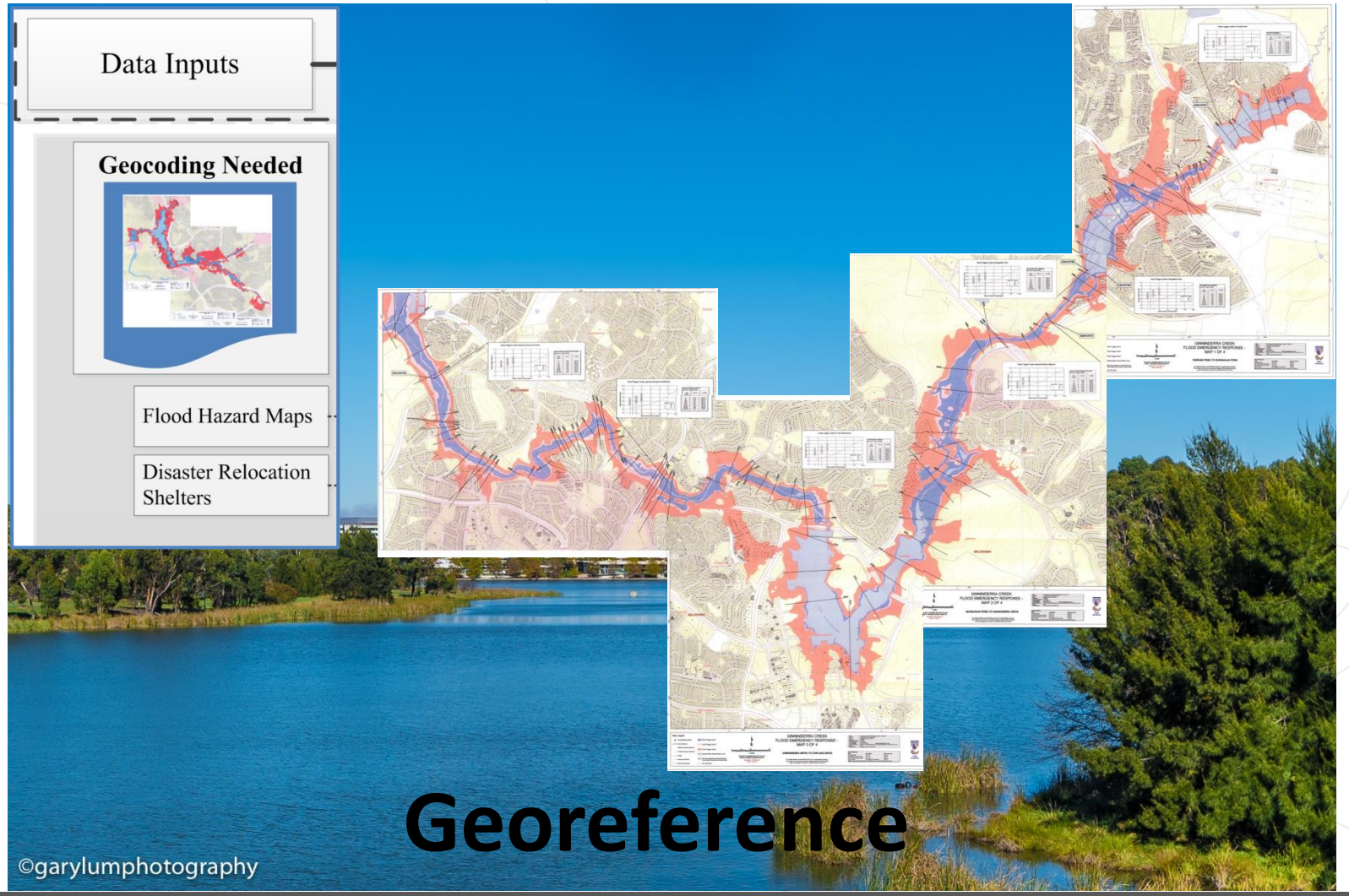
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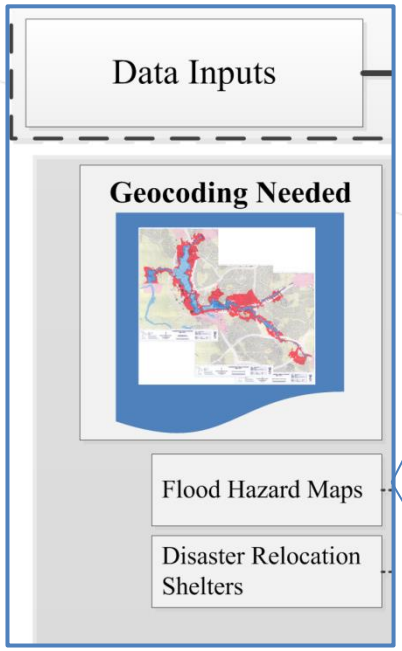
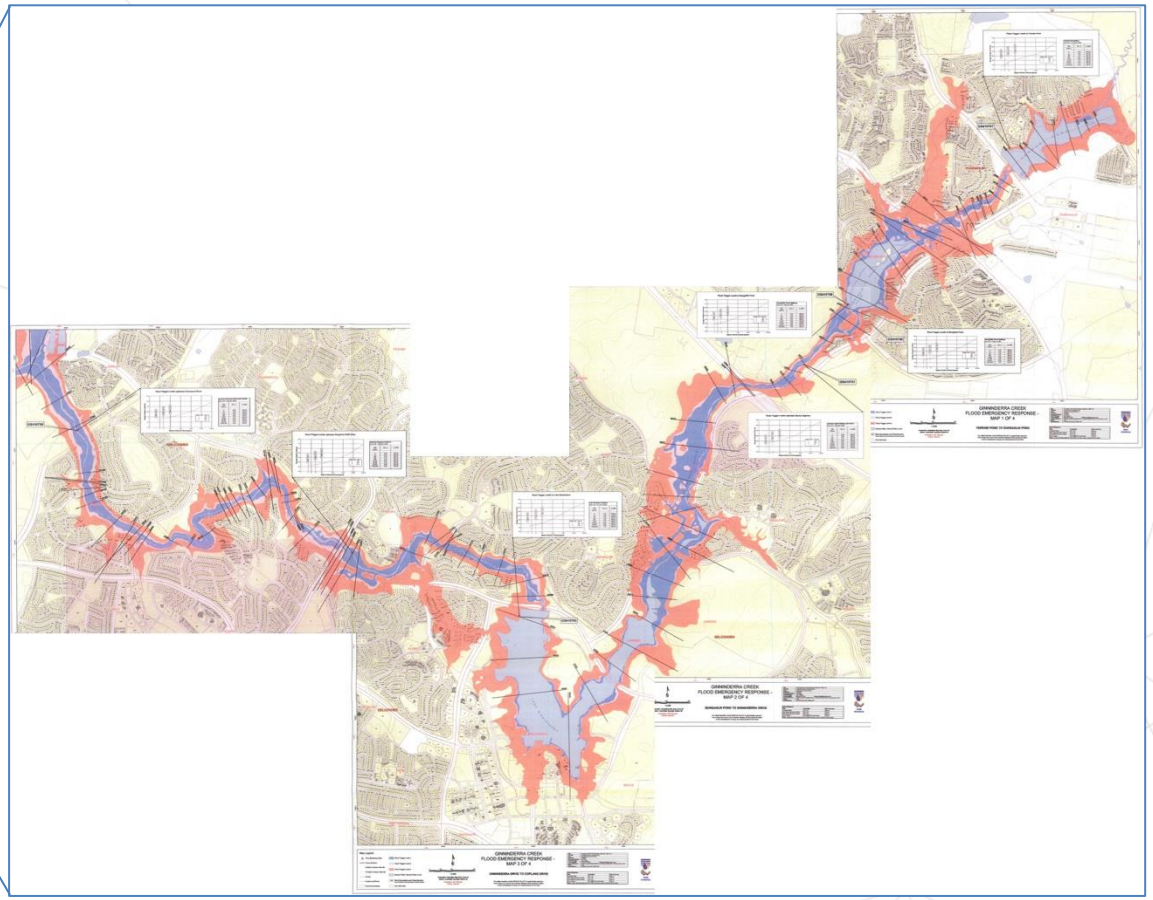




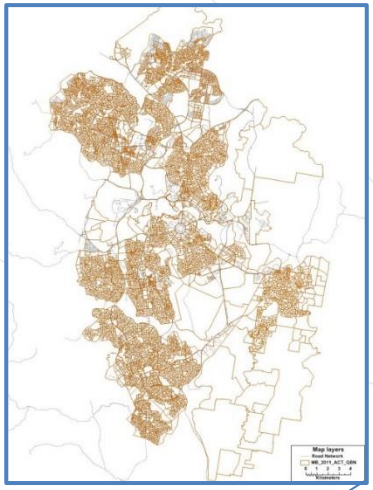
Georeferenced

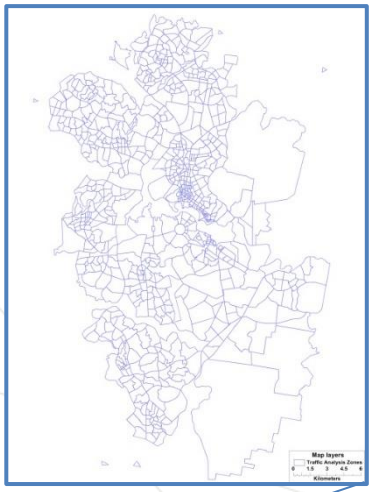
Data Input

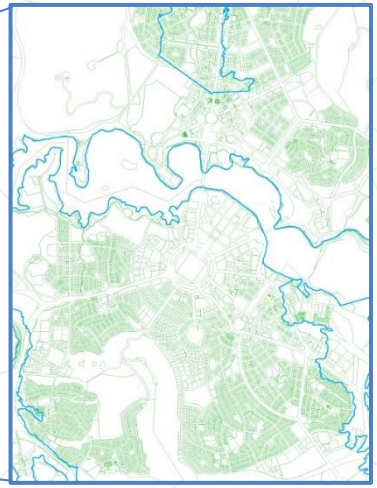
Data Inputs

Already Geocoded

- Census Population Distribution
- Traffic Analysis Zones (TAZ)
- Residential Blocks Geographical Layer
- Road Network



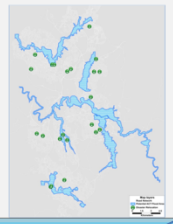




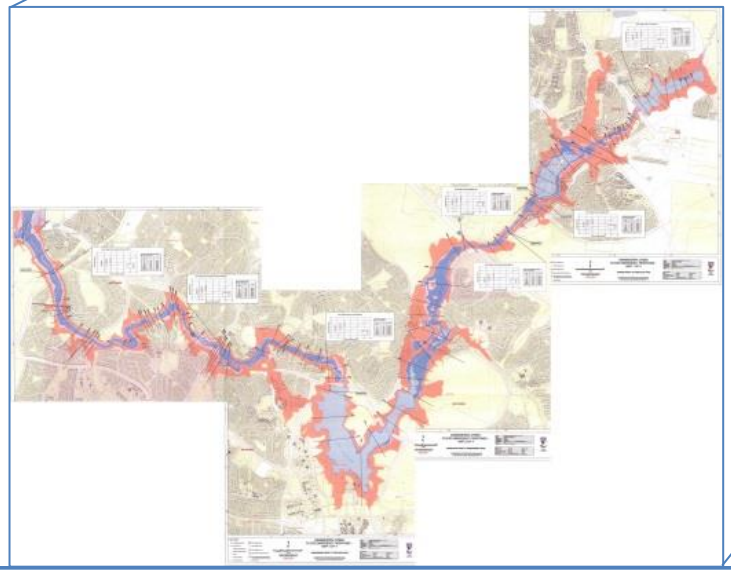
Spatial & Mathematical Processing

Processing
(Spatial & Mathematical)

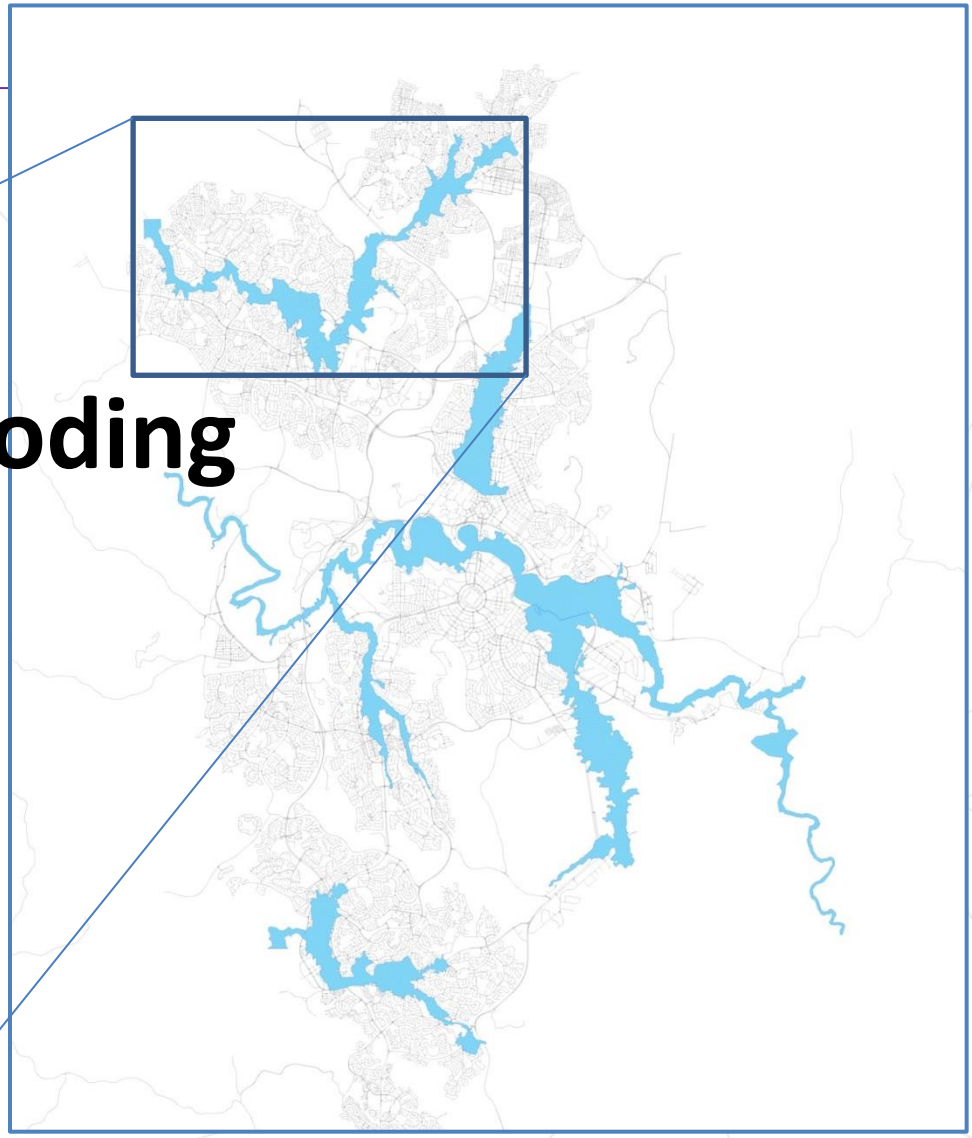
Maps Geocoding



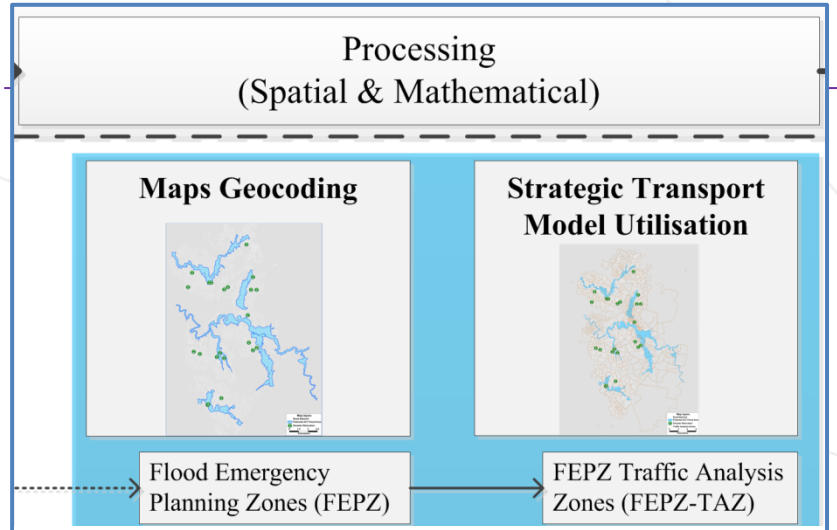
Flood Emergency
Planning Zones (FEPZ)



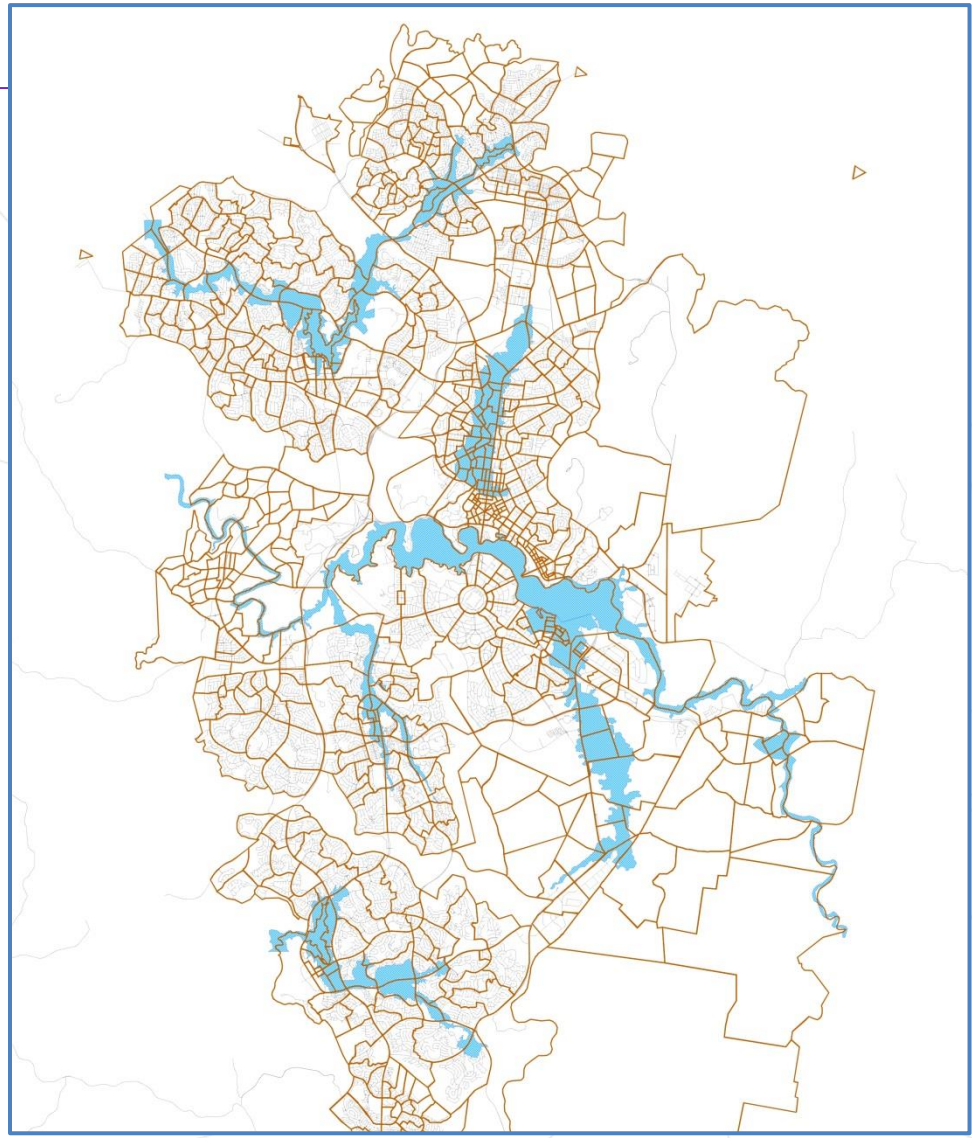
Geocoding



Spatial & Mathematical Processing



Geospatial Join



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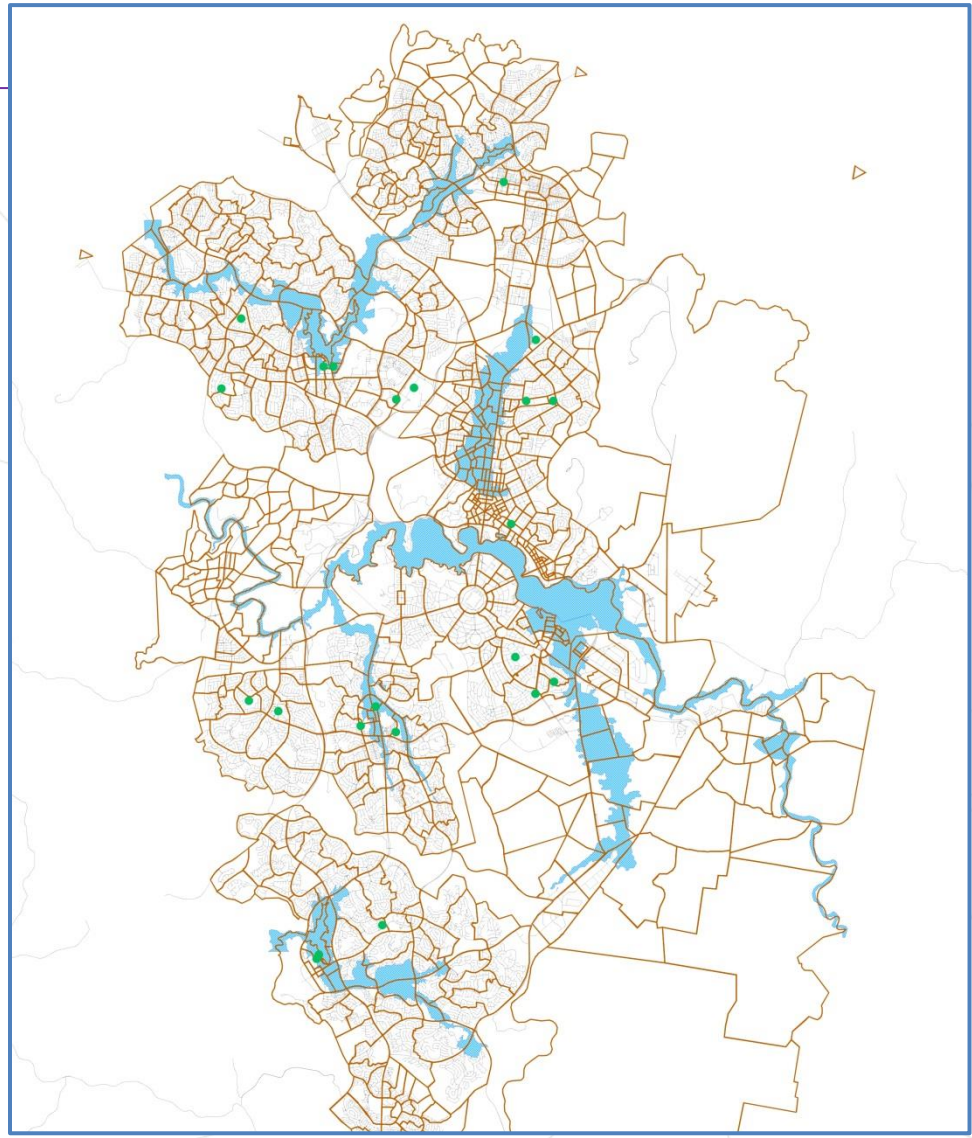
Geospatial Join



Spatial & Mathematical Processing

Processing
(Spatial & Mathematical)

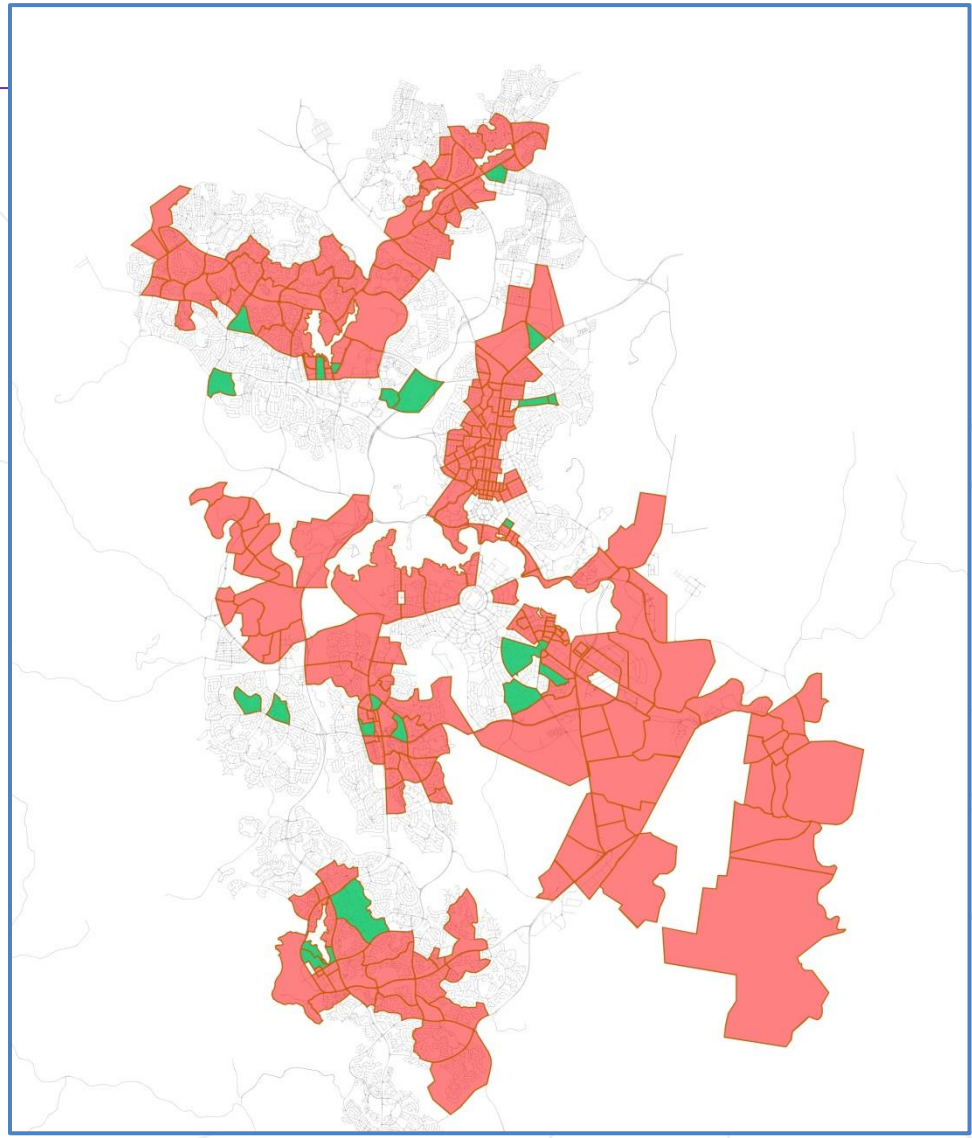
Strategic Transport Model Utilisation

FEPZ Traffic Analysis Zones (FEPZ-TAZ)

DRS Traffic Analysis Zones (DRS-TAZ)

Flood-Affected TAZ

Disaster Relocation Shelter TAZ



Spatial & Mathematical Processing

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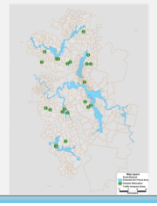
(Spatial & Mathematical)

Strategic Transport Model Utilisation



Traffic Analysis Zones
Affected Populations

$$Pop_i^d = \sum CFP_i^s + \left[(A_i - P_i) \times \frac{\sum CFP_i^s}{\sum CP_i^s}\right]$$

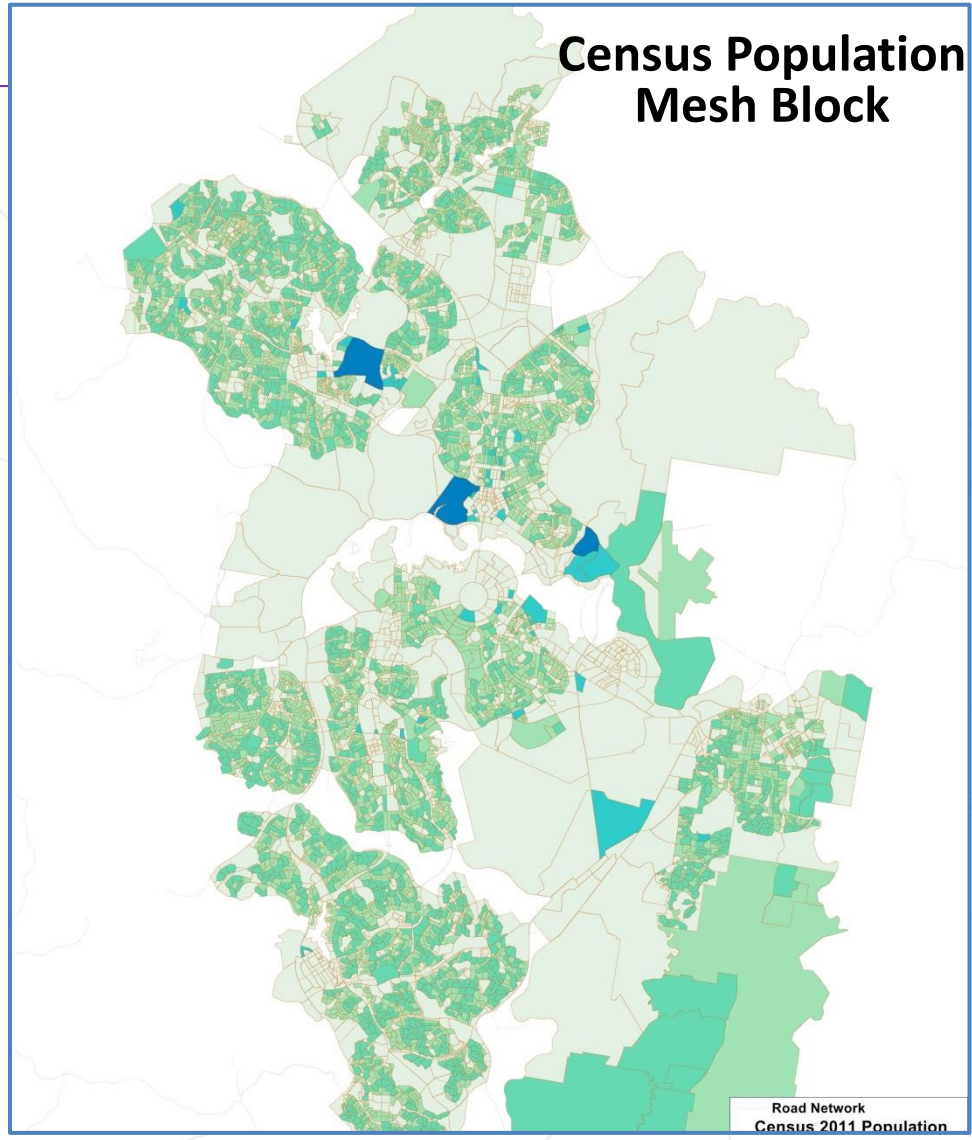
Pop_i^d: is the cumulative diurnal/dynamic population of TAZ i,

$\sum CP_i^s$: is the census MB population of TAZ i (as a static population),

$\sum CFP_i^s$: is the total census MB flood-affected population located in TAZ i, as an apportioned percentage of the TAZ i's area,

Ai: is the cumulative attracted trips to TAZ i,

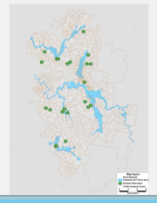
Pi: is the cumulative produced trips from TAZ i,



Spatial & Mathematical Processing

Processing
(Spatial & Mathematical)

Strategic Transport Model Utilisation



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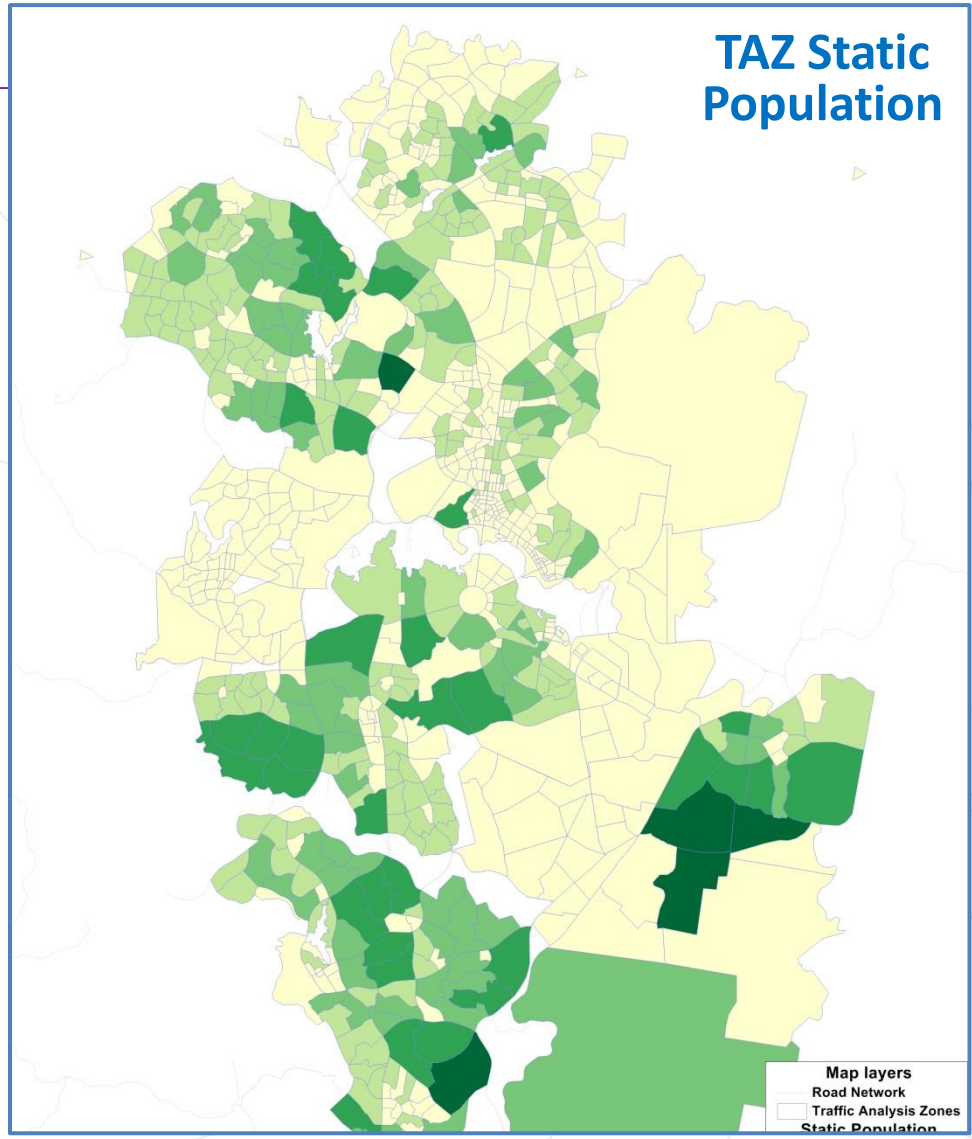

Spatial & Mathematical Processing

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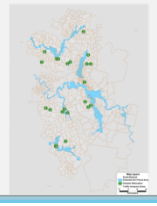

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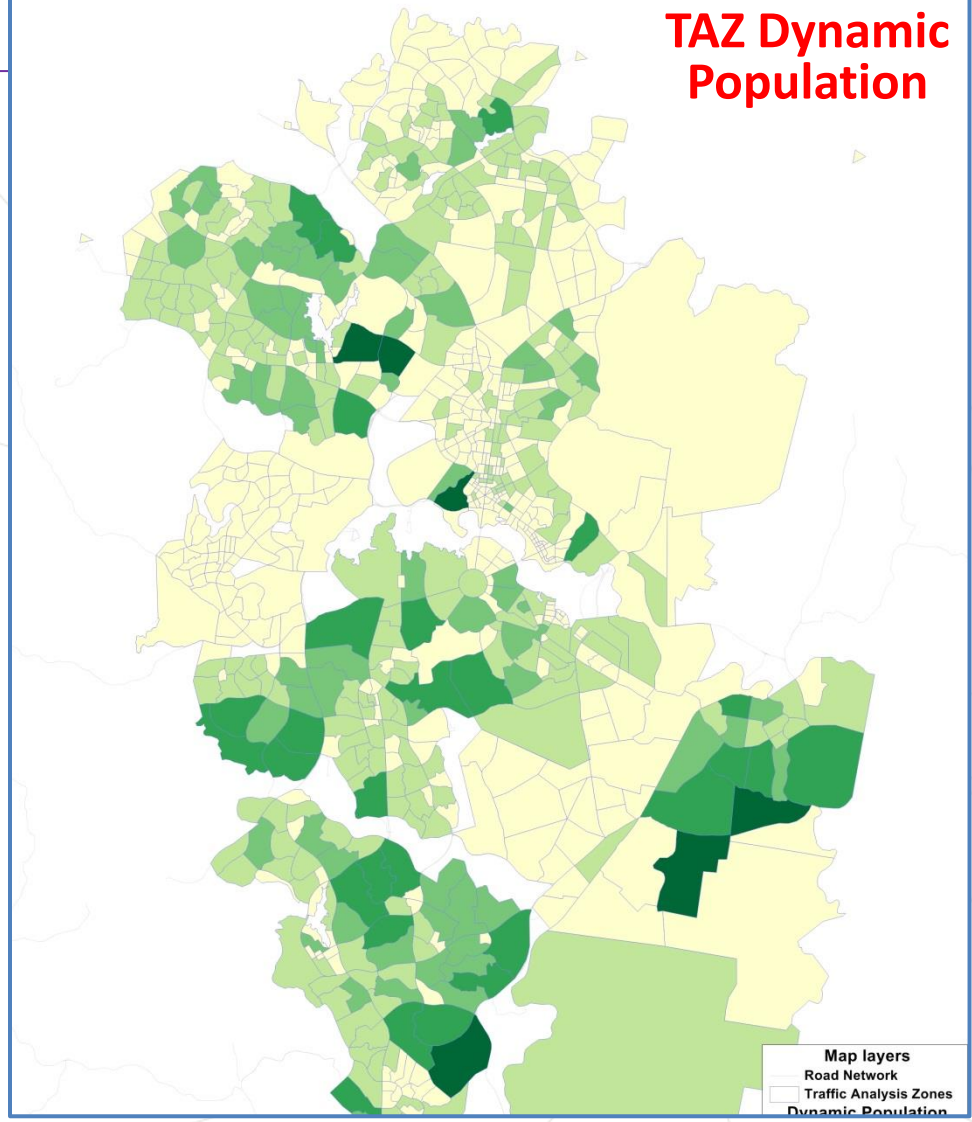
TAZ Dynamic Population



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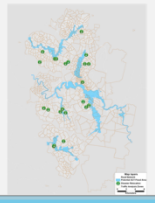

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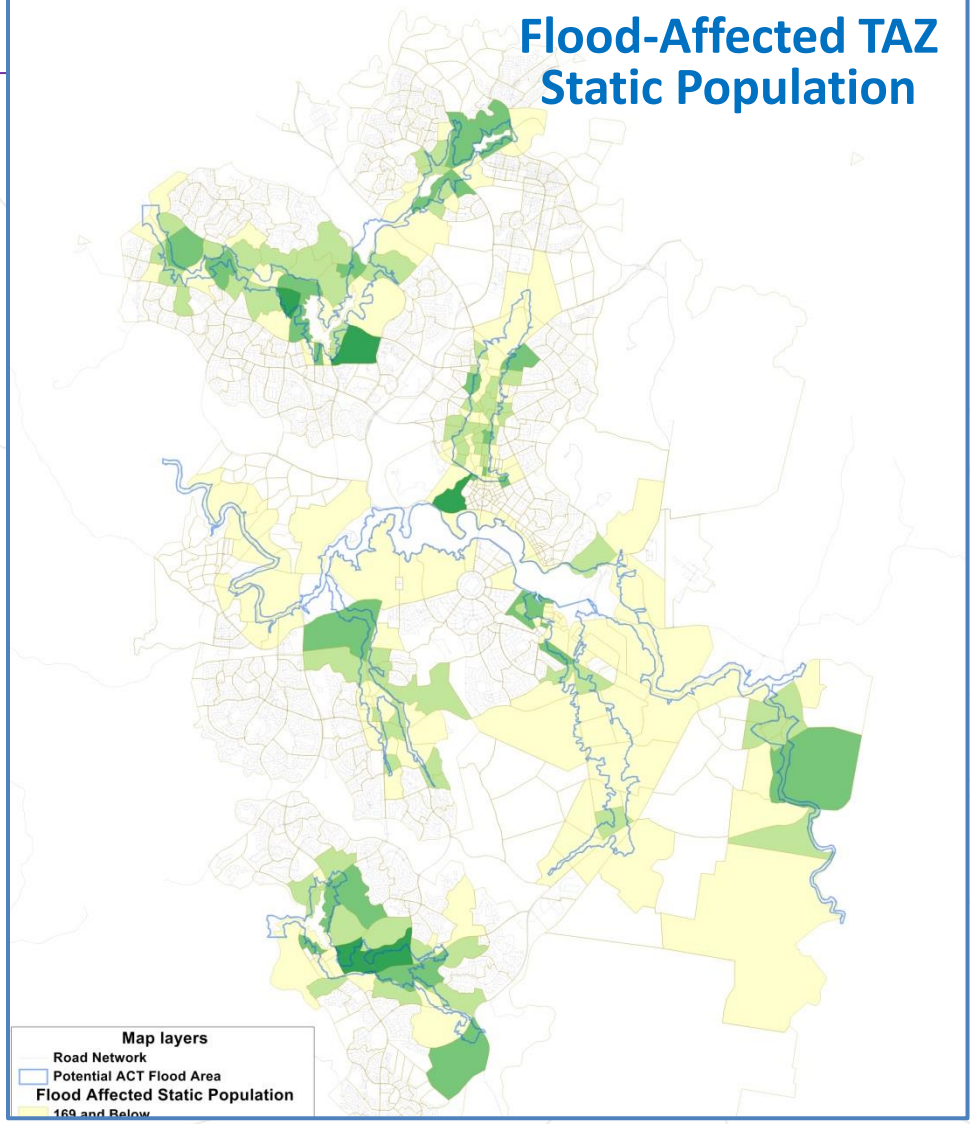
Flood-Affected TAZ Static Population



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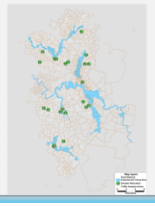

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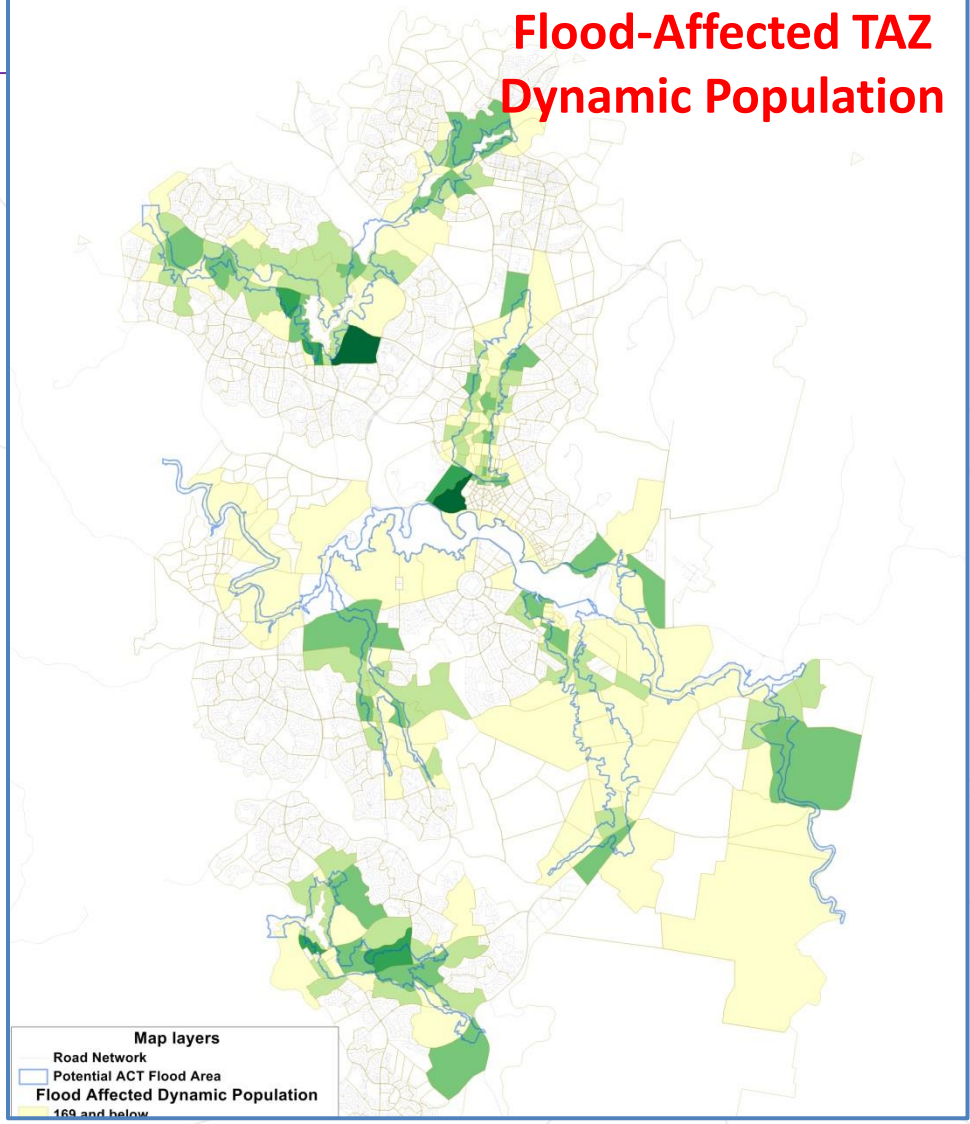

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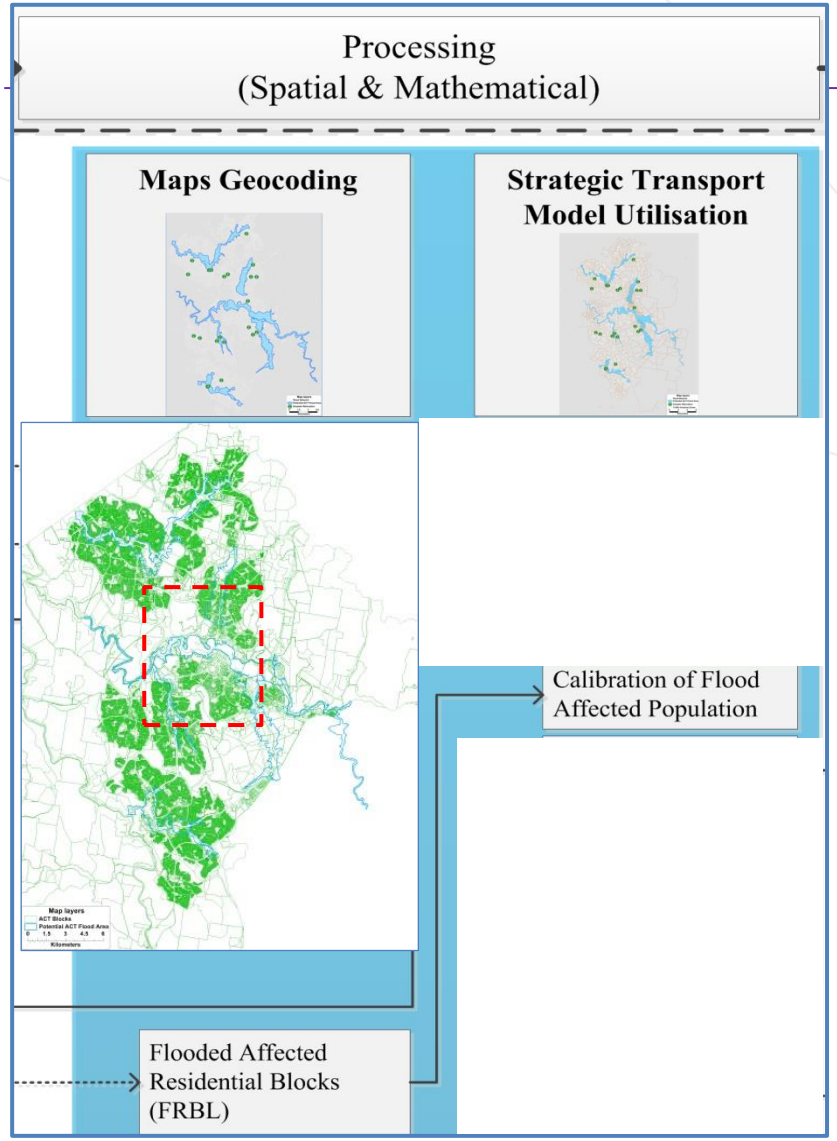

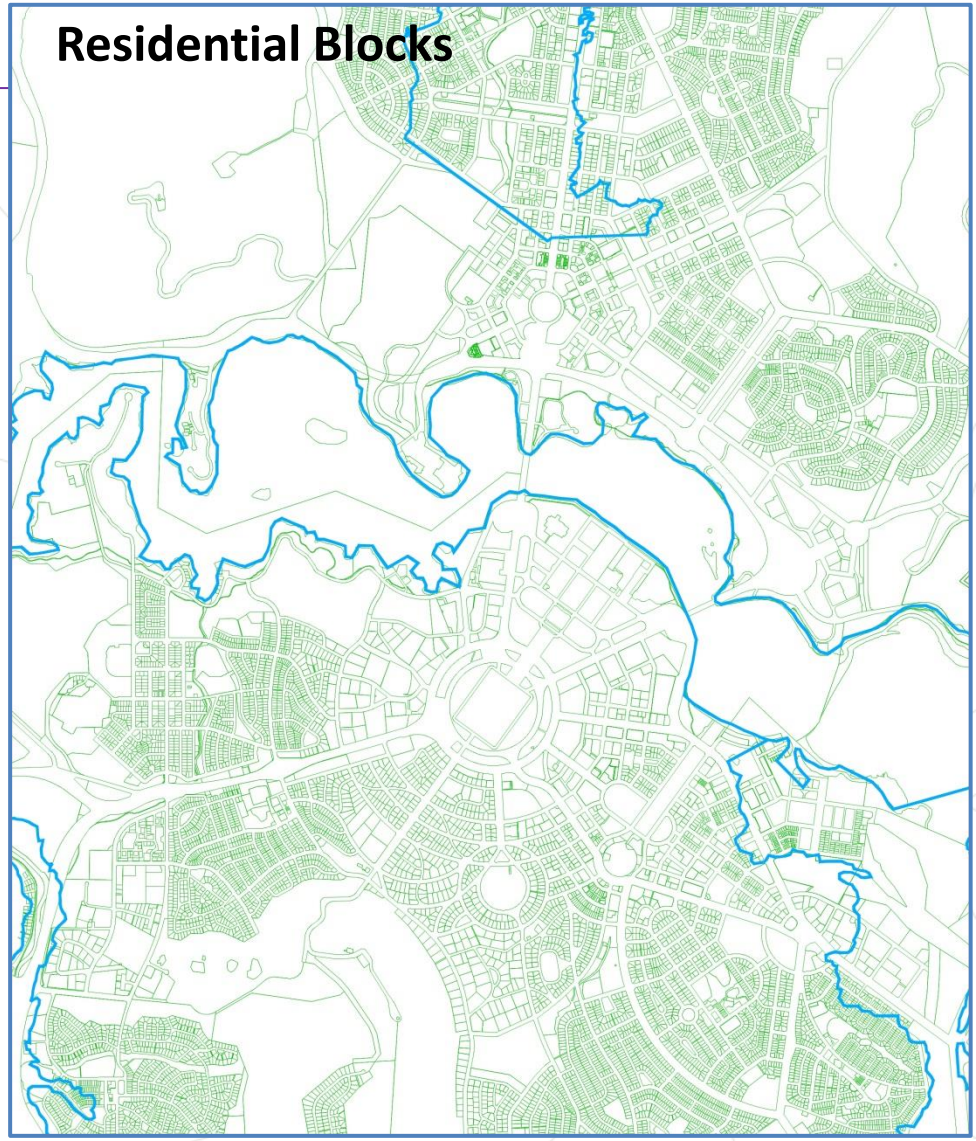

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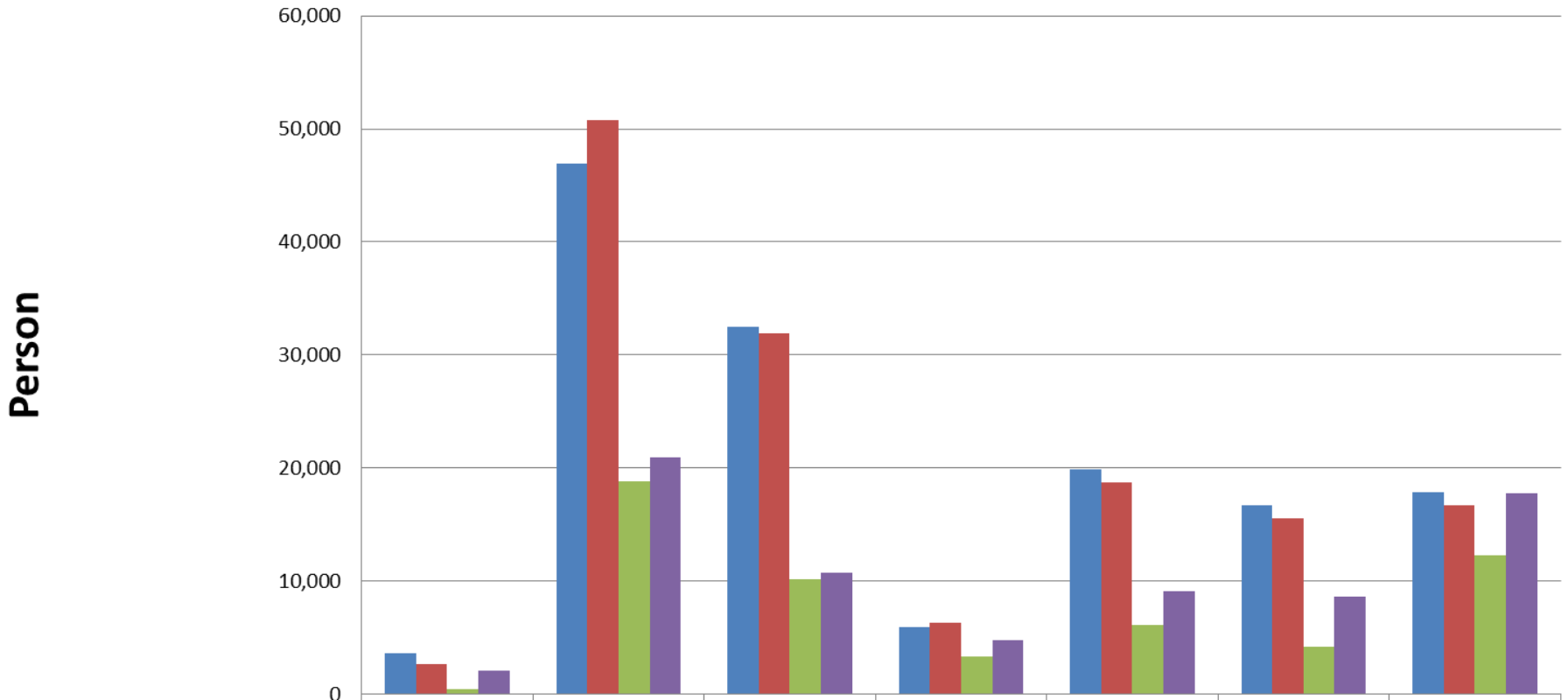
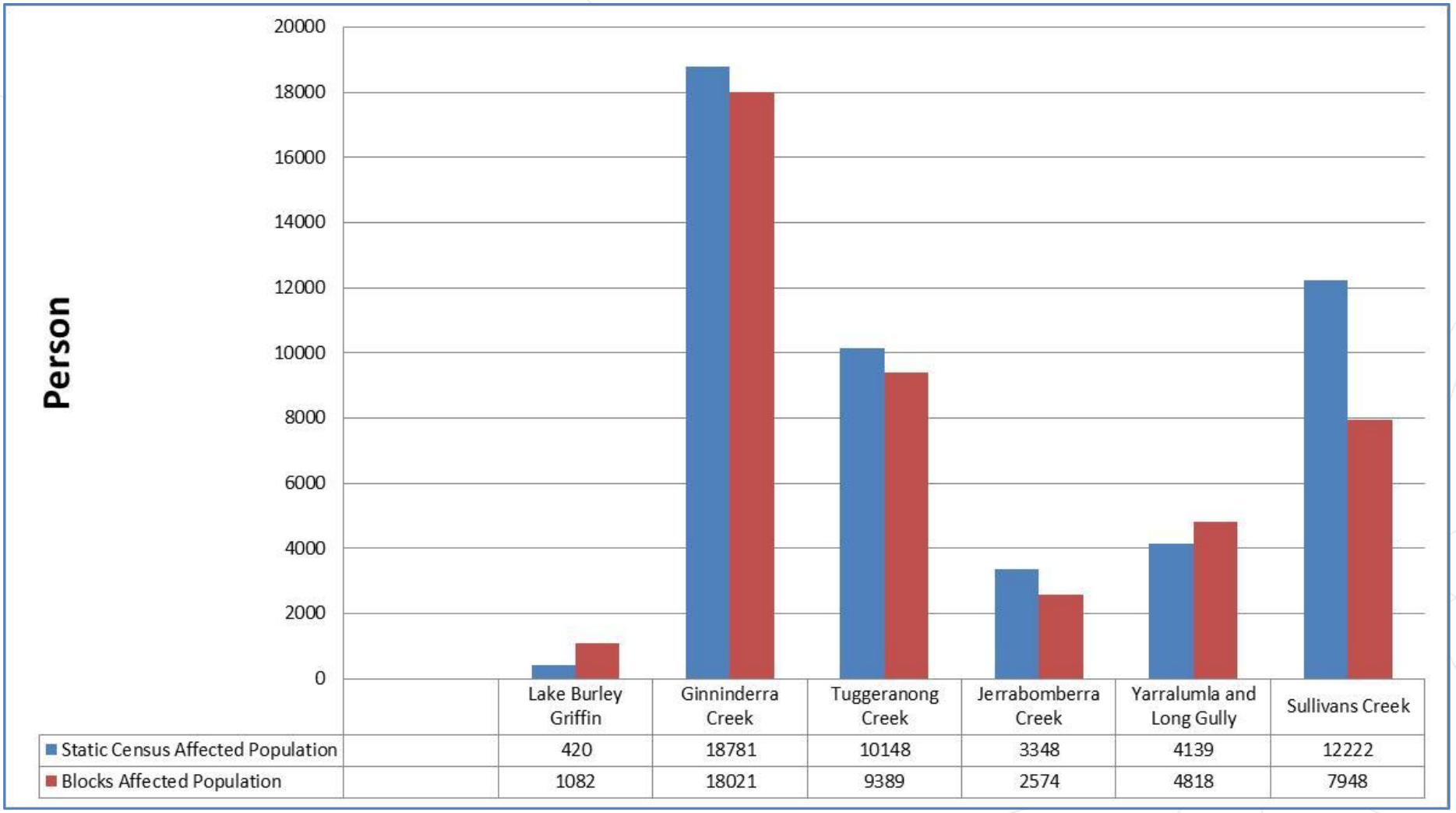


	Lake Burley Griffin	Ginninderra Creek	Tuggeranong Creek	Jerrabomberra Creek	Queanbeyan	Yarralumla and Long Gully	Sullivans Creek
TAZ Population	3627	46892	32456	5953	19876	16685	17896
2011 Census Population	2666	50800	31912	6310	18706	15551	16730
Flood Affected Census Population	420	18781	10148	3348	6106	4139	12222
Flood Affected Dynamic Population	2023	20971	10712	4778	9078	8644	17757

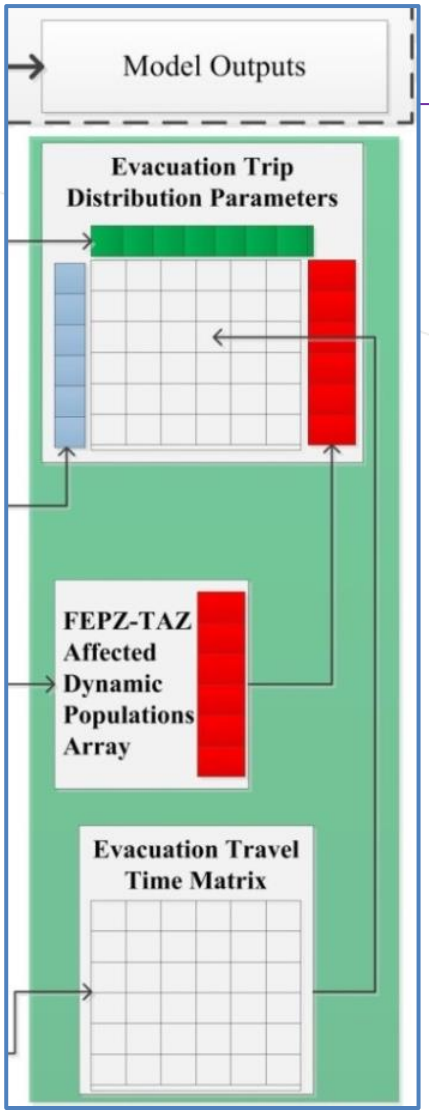
Spatial & Mathematical Processing



	Lake Burley Griffin	Ginninderra Creek	Tuggeranong Creek	Jerrabomberra Creek	Yarralumla and Long Gully	Sullivans Creek
Static Census Affected Population	420	18781	10148	3348	4139	12222
Blocks Affected Population	1082	18021	9389	2574	4818	7948

Calibration of Flood-Affected Static Populations

Information Output



Model	Origins Zones	Destinations Zones	Average Travel Time Minutes	Maximum Travel Time Minutes
ACT-Queanbeyan CSTM	798	798	17	103
Evacuation Model	277	14	14.8	39

Disaster Relocation Shelters

Affected Areas	53	181	190	191	251	260	265	271	274	279	323	329	353	364	371	386	388	400	493	703	704	741
Flooded DRS		70						96	99	104			126	132						230	231	249
28	2.50	6.49	5.09	5.54	6.78	8.82	8.19	10.14	12.35	11.30	10.33	10.92	7.30	6.79	10.92	6.38	7.35	9.69	12.29	15.83	15.60	16.47
29	2.15	6.54	4.95	5.44	7.03	9.07	8.47	10.40	12.61	11.56	10.85	11.45	7.64	7.14	11.26	6.73	7.79	10.03	12.35	18.02	17.79	16.75
30	2.21	6.34	4.76	5.24	7.04	9.08	8.48	10.41	12.62	11.57	10.88	11.47	7.44	6.93	11.06	6.52	7.59	9.83	12.14	18.04	17.80	16.77
31	1.85	6.60	4.78	5.26	7.26	9.30	8.70	10.63	12.84	11.79	11.09	11.68	7.70	7.19	11.32	6.78	7.85	10.09	12.40	18.31	18.07	16.99
47	2.78	6.69	5.30	5.74	7.25	9.29	8.69	10.60	12.81	11.76	10.47	11.07	7.12	6.61	10.74	6.20	7.17	9.51	12.49	15.96	15.73	16.93
48	2.66	6.54	5.14	5.59	7.28	9.32	8.72	10.65	12.86	11.81	10.55	11.15	7.08	6.57	10.70	6.16	7.13	9.47	12.34	16.04	15.81	17.01
49	2.63	6.61	5.22	5.67	7.07	9.11	8.48	10.42	12.63	11.58	10.61	11.21	7.22	6.72	10.84	6.31	7.28	9.61	12.41	16.12	15.88	16.76
57	3.00	7.97	6.58	7.03	5.41	7.47	6.85	8.80	11.01	9.96	10.53	11.12	9.16	8.66	12.77	8.25	9.23	11.53	13.77	17.00	16.76	15.15
58	3.59	8.71	7.32	7.77	8.21	9.68	9.65	11.59	13.80	12.75	9.97	10.57	9.47	8.97	13.09	8.57	9.54	11.19	14.51	15.39	15.15	14.54
59	3.38	8.13	6.73	7.18	8.06	10.10	9.50	11.44	13.65	12.60	11.37	11.97	7.99	7.49	11.61	7.08	8.04	10.38	13.93	16.79	16.55	15.90
60	4.30	8.24	6.84	7.29	8.98	11.02	10.42	12.35	14.55	12.47	10.65	11.25	7.38	6.87	11.00	6.46	7.43	9.77	14.04	16.07	15.83	15.13
62	2.58	5.96	4.57	5.02	7.36	9.41	8.81	10.73	12.94	11.89	11.14	11.73	8.01	7.51	11.63	7.10	7.21	10.40	11.76	18.13	17.89	17.09
63	2.65	6.19	4.80	5.25	7.43	9.47	8.88	10.80	13.01	11.96	10.95	11.54	7.74	7.23	11.36	6.82	7.44	10.13	11.99	16.45	16.22	17.16
64	3.02	5.86	4.47	4.92	7.80	9.84	9.25	11.17	13.38	12.33	11.58	12.18	7.83	7.32	11.45	6.91	7.11	10.22	11.67	18.55	18.31	17.53
65	3.15	5.98	4.58	5.03	7.93	9.97	9.37	11.30	13.51	12.46	11.49	12.09	7.70	7.20	11.32	6.79	7.23	10.09	11.78	17.00	16.77	17.66
66	3.21	6.04	4.65	5.10	8.00	10.04	9.44	11.37	13.58	12.53	11.31	11.91	7.52	7.01	11.14	6.60	7.29	9.91	11.84	16.83	16.60	17.73
67	3.70	6.56	5.16	5.61	8.49	10.54	9.94	11.89	14.10	13.05	12.85	13.45	6.78	6.28	10.40	5.87	6.84	9.17	12.36	18.27	18.03	17.96
68	4.63	6.76	5.36	5.81	9.43	11.47	10.87	12.83	15.04	13.99	12.83	13.42	6.75	6.25	10.37	5.84	6.81	9.15	12.56	18.24	18.01	17.43
69	4.83	6.67	5.27	5.73	9.63	11.67	11.07	13.02	15.23	14.18	12.99	13.59	6.34	5.84	9.96	5.43	6.39	8.73	12.19	18.41	18.17	17.59
70	4.42	6.36	4.96	5.41	9.22	11.26	10.66	12.62	14.83	13.78	13.05	13.65	6.42	5.92	10.04	5.50	6.47	8.81	12.16	18.47	18.23	17.63
71	4.73	6.06	4.66	5.11	9.54	11.58	10.98	12.94	15.15	14.09	13.40	14.00	6.83	6.32	10.45	5.91	6.89	9.22	11.86	18.82	18.58	18.19
72	5.62	5.94	4.54	4.99	10.22	12.26	11.66	13.61	15.82	14.76	14.19	14.78	7.65	7.14	11.27	6.73	7.14	10.04	11.74	19.63	19.39	19.56
73	5.70	5.67	4.27	4.72	10.37	12.41	11.82	13.77	15.98	14.93	14.16	14.76	7.63	7.12	11.25	6.71	6.89	10.02	11.47	19.60	19.36	19.80
74	5.45	5.40	4.00	4.45	10.22	12.27	11.66	13.59	15.81	14.76	14.59	15.18	7.83	7.33	11.45	6.92	6.67	10.22	11.20	20.37	20.14	19.91
75	5.14	5.89	4.49	4.94	9.94	11.98	11.38	13.32	15.53	14.48	13.93	14.53	7.10	6.59	10.72	6.18	7.07	9.49	11.69	19.38	19.15	19.28
76	5.79	5.24	3.84	4.29	10.53	12.57	11.97	13.90	16.11	15.06	14.44	15.04	7.83	7.32	11.45	6.91	6.44	10.22	11.04	19.93	19.69	20.14
77	5.94	4.68	3.28	3.73	10.72	12.76	12.16	14.09	16.30	15.26	14.52	15.11	7.04	6.54	10.66	6.13	5.88	9.43	10.48	19.99	19.76	20.34
78	5.62	4.97	3.58	4.03	10.39	12.44	11.83	13.76	15.97	14.92	14.76	15.35	7.34	6.84	10.96	6.43	6.18	9.73	10.78	20.54	20.31	20.08
[illegible]	[illegible]	5.00	3.17	3.62	[illegible]	[illegible]	[illegible]	13.72	15.93	14.88	14	[illegible]	[illegible]	7.15	11.28	6.74	6	[illegible]	[illegible]	21.05	20.82	20.07
[illegible]	[illegible]	5.40	3.85	4.30	[illegible]	[illegible]	[illegible]	[illegible]	15.68	14.63	[illegible]	[illegible]	[illegible]	[illegible]	11.68	7.15	[illegible]	[illegible]	[illegible]	[illegible]	20.59	19.82

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THANK YOU.