crc•si Spatially Enabling Australia and New Zealand

Dynamic Styling For Thematic Mapping

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Curtin University of Technology

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An Australian Government Initiative

CRC AUSTRALIA

Introduction

- Data exploration:
  - Automated data processing
  - Hypothesis testing
    - Interact with derived outputs
    - Explore data through visualisations
- User/query driven web GIS
- Aim: Web service for thematic visualisation
- Exploration of methods, functionality, and parameters to achieve this

Data Exploration

- Data exploration – presentation of data
  - Data access (WFS)
  - Data interpretation (WPS) – Query driven
  - Data presentation (thematic styling)
    - Present results:
      - **Publish** derived results from data
      - **Static** - Known styling
    - Present data:
      - Dynamic - Processed on the fly (virtual layer)
      - Flexible method of data presentation required

Information Visualisation

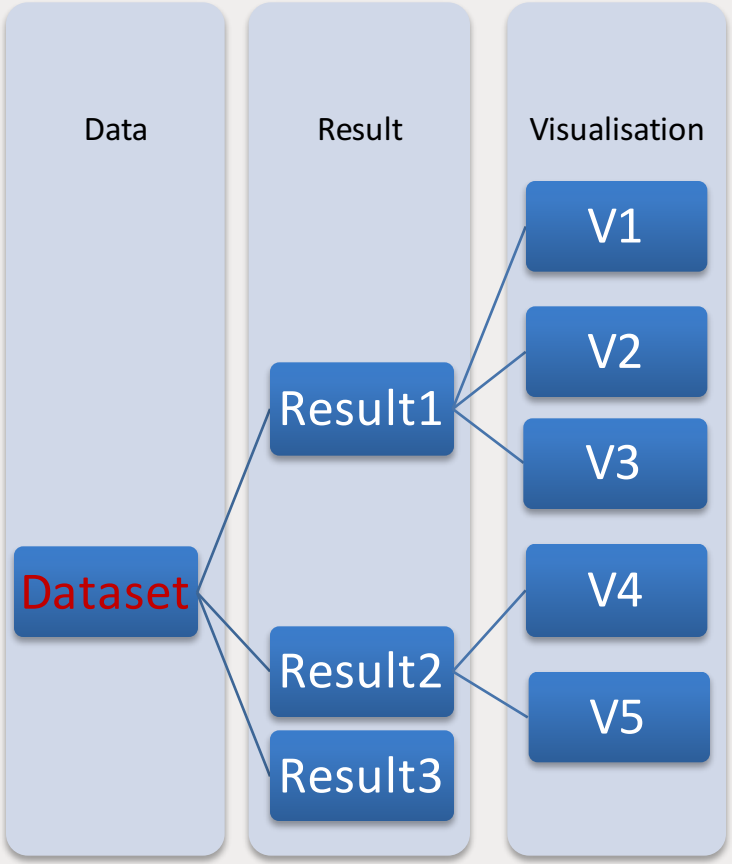
- Information visualisation:
  - Interactive graphical presentation of data for exploration and identification of patterns[1]
  - Dynamic visualisation – visually encapsulate aspects of a dataset to reveal underlying properties and trends
- Spatial data - thematic maps
  - For example: Choropleths
  - Determined using
    - Method for partitioning feature space (attribute vector)
    - A choice of colour to represent the partitioning of the feature space
  - What method should be used
    - Data or question specific?

1. Mazza, R. (2009). Introduction to Information Visualization. Springer, London.

Multiple Results and Visualisations

- Visualisation Process:
  - Extract data.
  - Render.
- Analysis:
  - Data -> Multiple ***Results***.
  - Result -> Multiple visualisations.

- Multiple views/variables can be presented simultaneously.

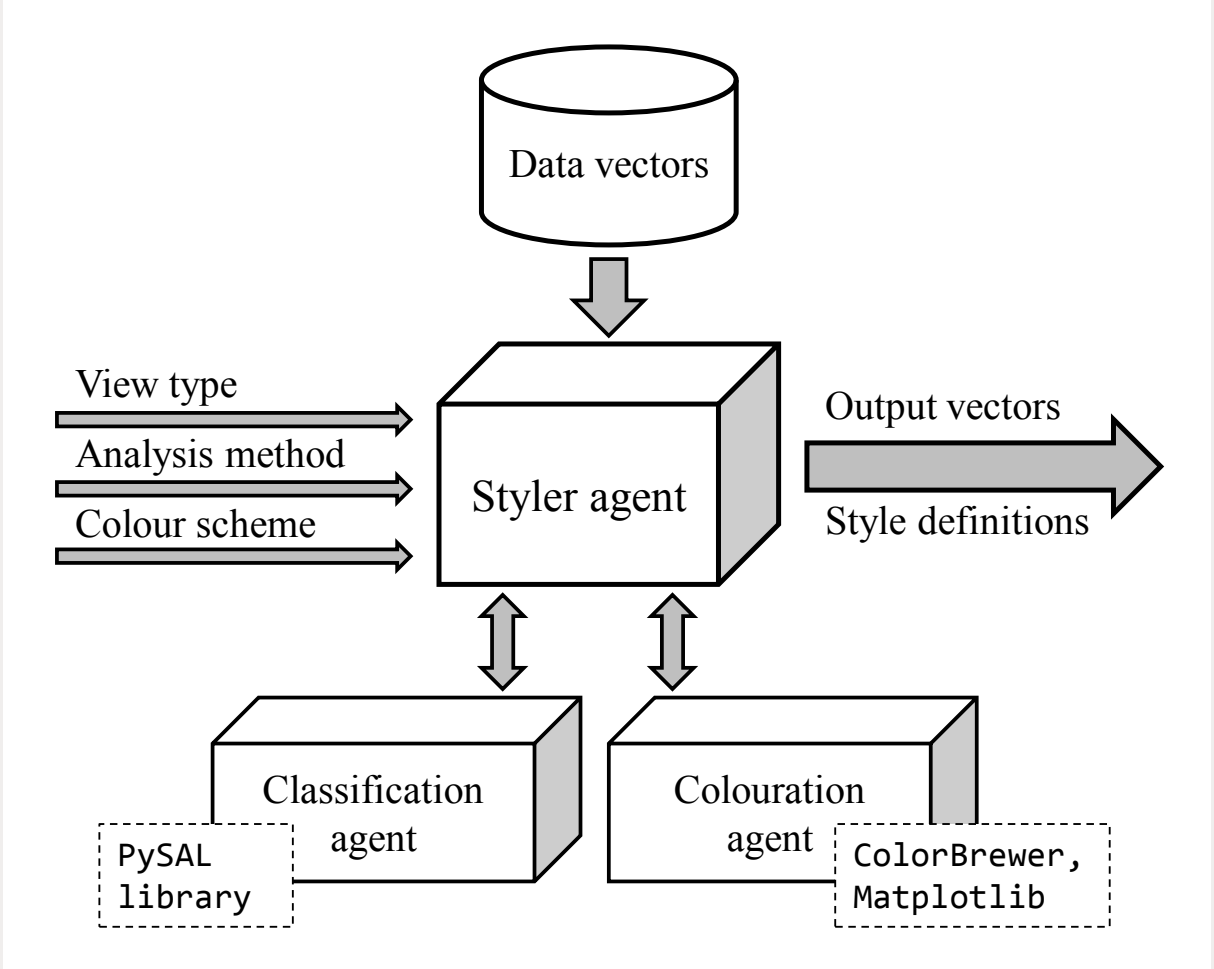


Map Styling – A Quick Intro

- Map Classification
  - Classify the feature spaces into *n* discrete categories using different criteria
  - PySAL map classification – made available through a web service
  - Colour Schemes to be assigned
    - ColorBrewer colour schemes adopted[1]
  - Where
    - Server – WPS/WMS, SLD server etc.
    - Client – GeoJSON with dynamic styling done within the JS environment.

1. Harrower, M. and Brewer, C. A. (2003). Colorbrewer.org: An online tool for selecting colour schemes for maps. Cartographic Journal, The, 40(1):27–37.

Architecture



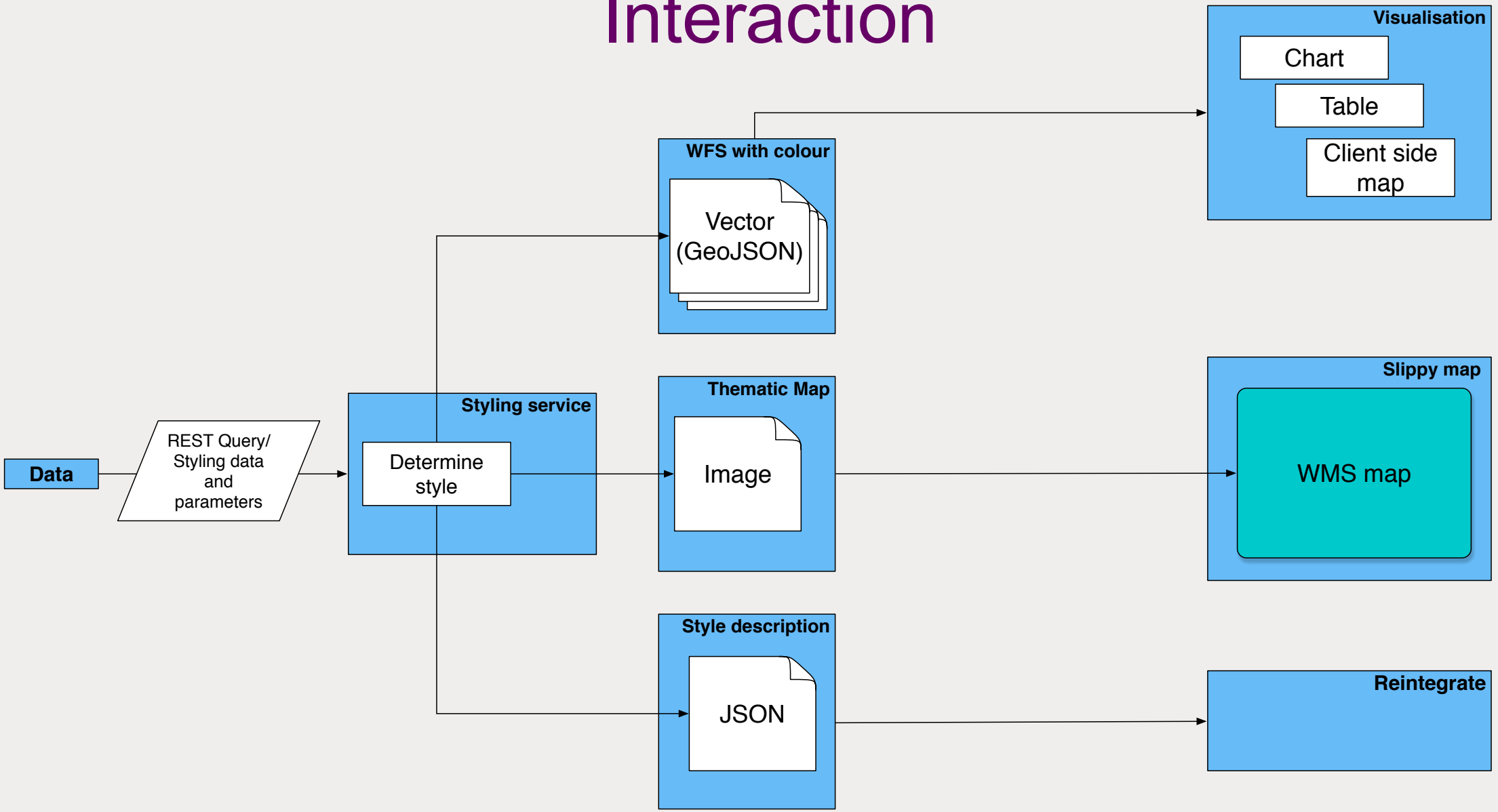
Parameters

- Styling Attribute(s)
- Polygon options:
  - Boundary – colour, thickness
  - Opacity (can be done on the client)
  - Label?
- Point options:
  - (x,y) radius –
    - x and y can differ and can be linked to thematic styling
    - Relative to map
  - Label
  - Opacity and border

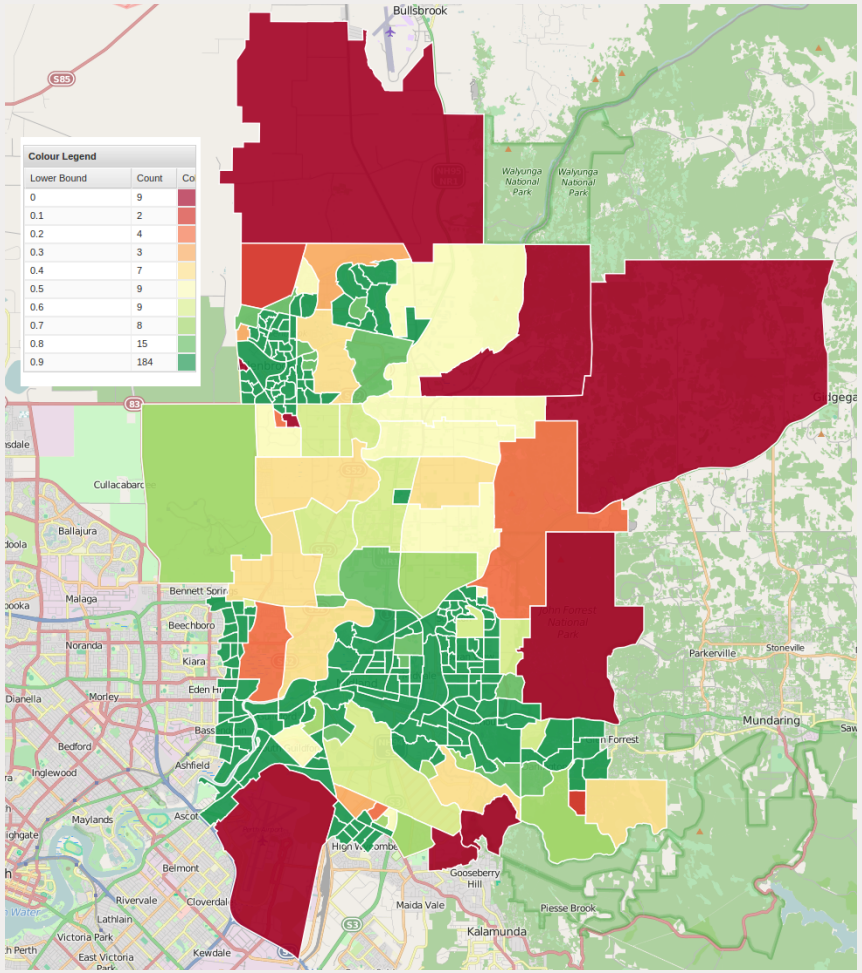
Test Data

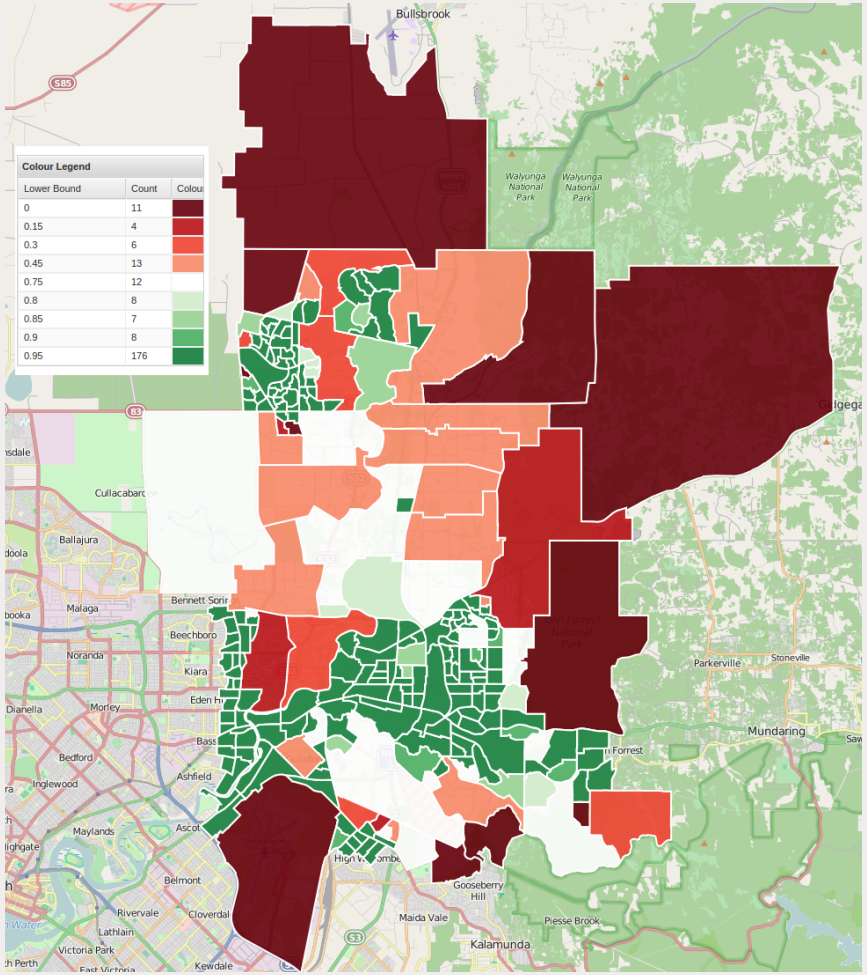
- Health data (spatial context):
  - Hospitalisation (~11 million records)
  - Summary statistics with a thematic map as output.
- Sensor data:
  - Gauge data (e.g. rainfall)
  - Bore data
- Service data:
  - Bus stops
  - Hospitals and health services

Interaction

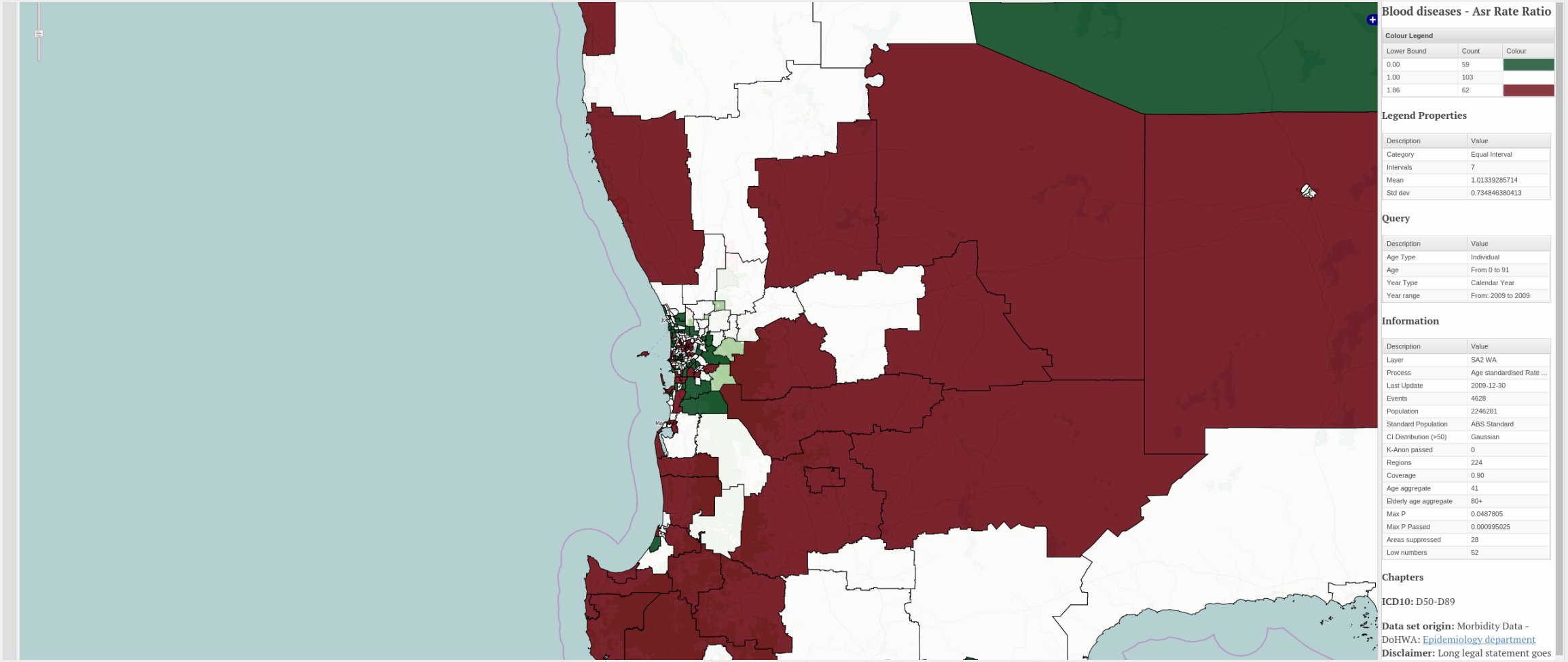


Probability – Pivot point





Ratio Style



Blood diseases - Asr Rate Ratio

Colour Legend

Lower Bound	Count	Colour
0.00	59	
1.00	103	
1.86	62	

Legend Properties

Description	Value
Category	Equal Interval
Intervals	7
Mean	1.01339285714
Std dev	0.734846380413

Query

Description	Value
Age Type	Individual
Age	From 0 to 91
Year Type	Calendar Year
Year range	From: 2009 to 2009

Information

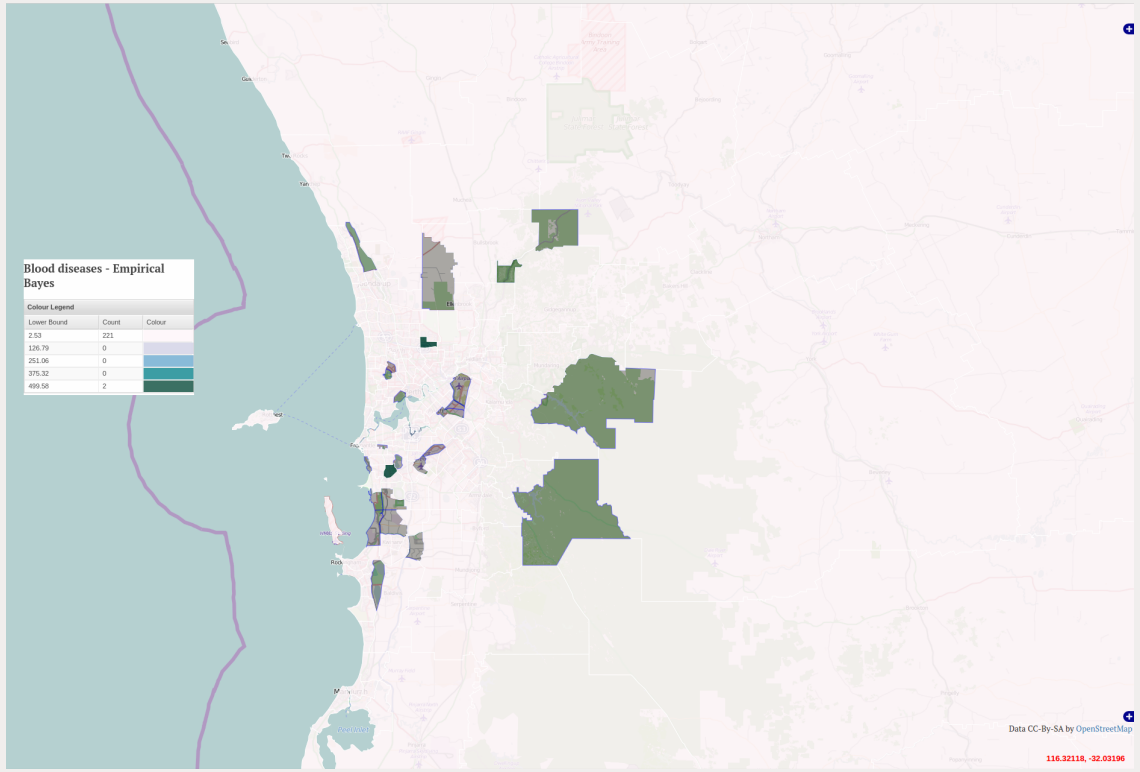
Description	Value
Layer	SA2 WA
Process	Age standardised Rate ...
Last Update	2009-12-30
Events	4628
Population	2246281
Standard Population	ABS Standard
CI Distribution (>50)	Gaussian
K-Anon passed	0
Regions	224
Coverage	0.90
Age aggregate	41
Elderly age aggregate	80+
Max P	0.0487805
Max P Passed	0.000995025
Areas suppressed	28
Low numbers	52

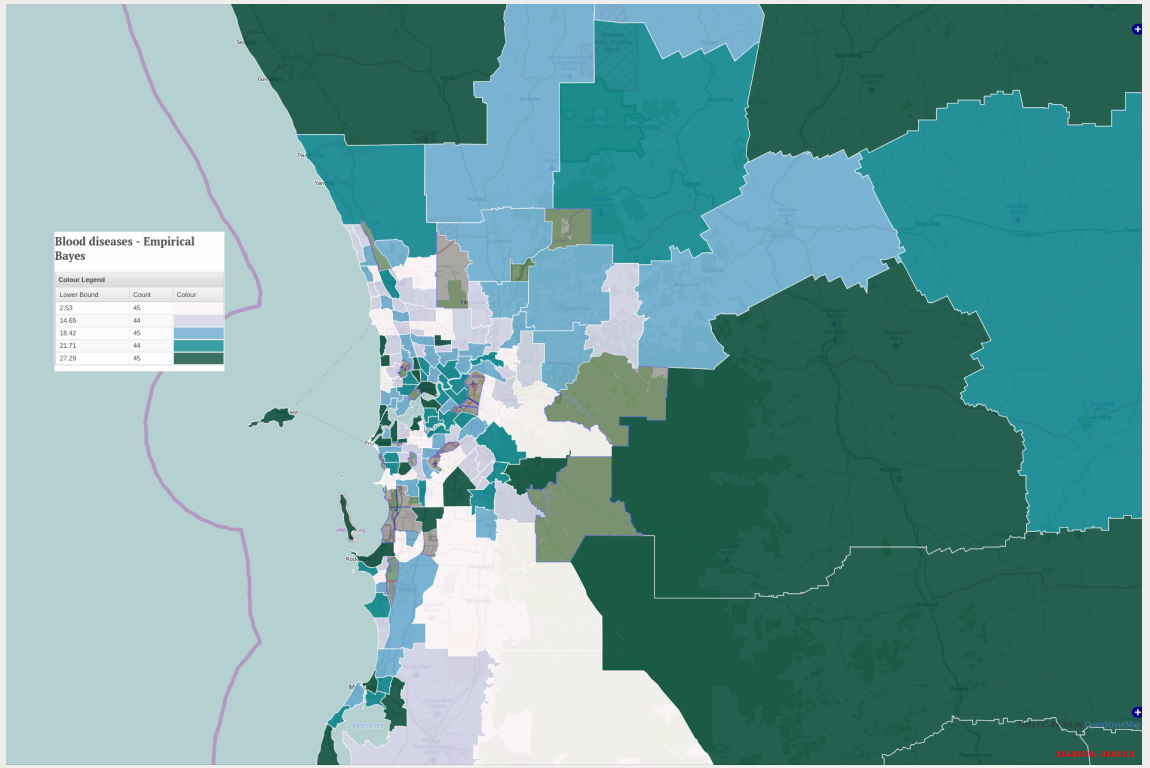
Chapters

ICD10: D50-D89

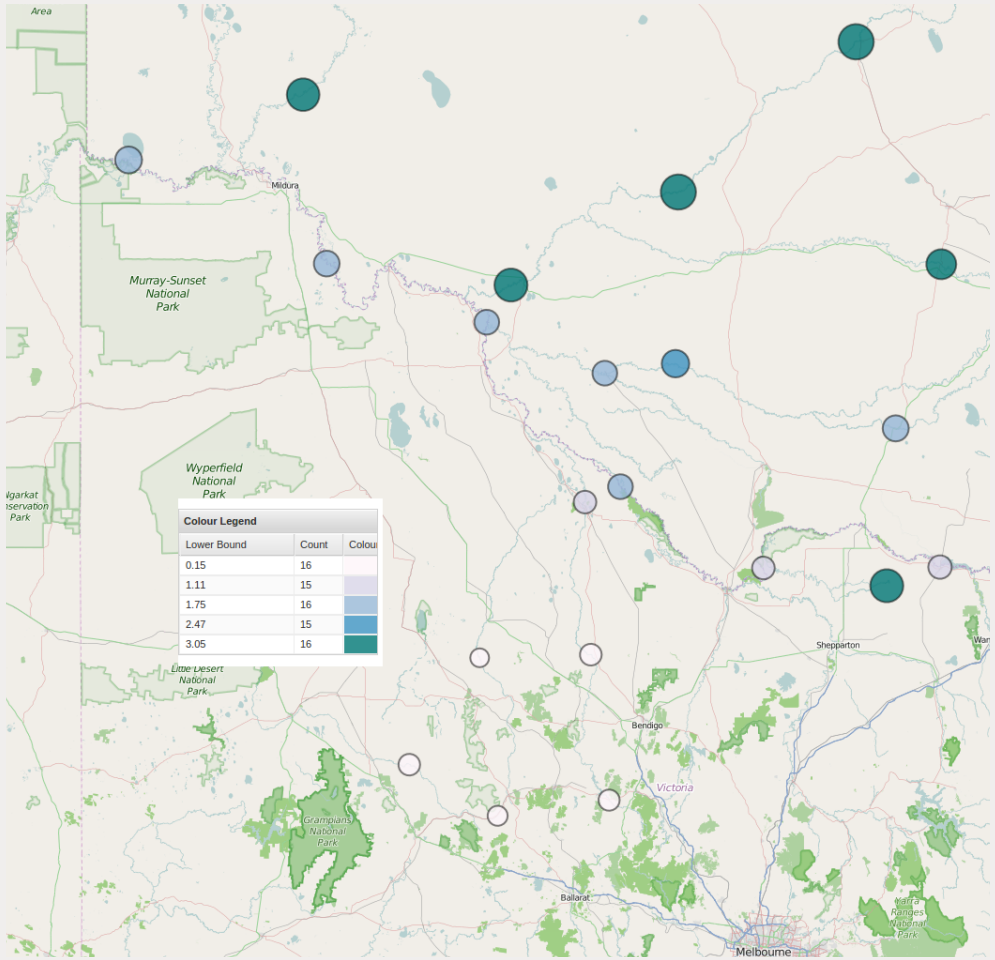
Data set origin: Morbidity Data - DoHWA: Epidemiology department
Disclaimer: Long legal statement goes

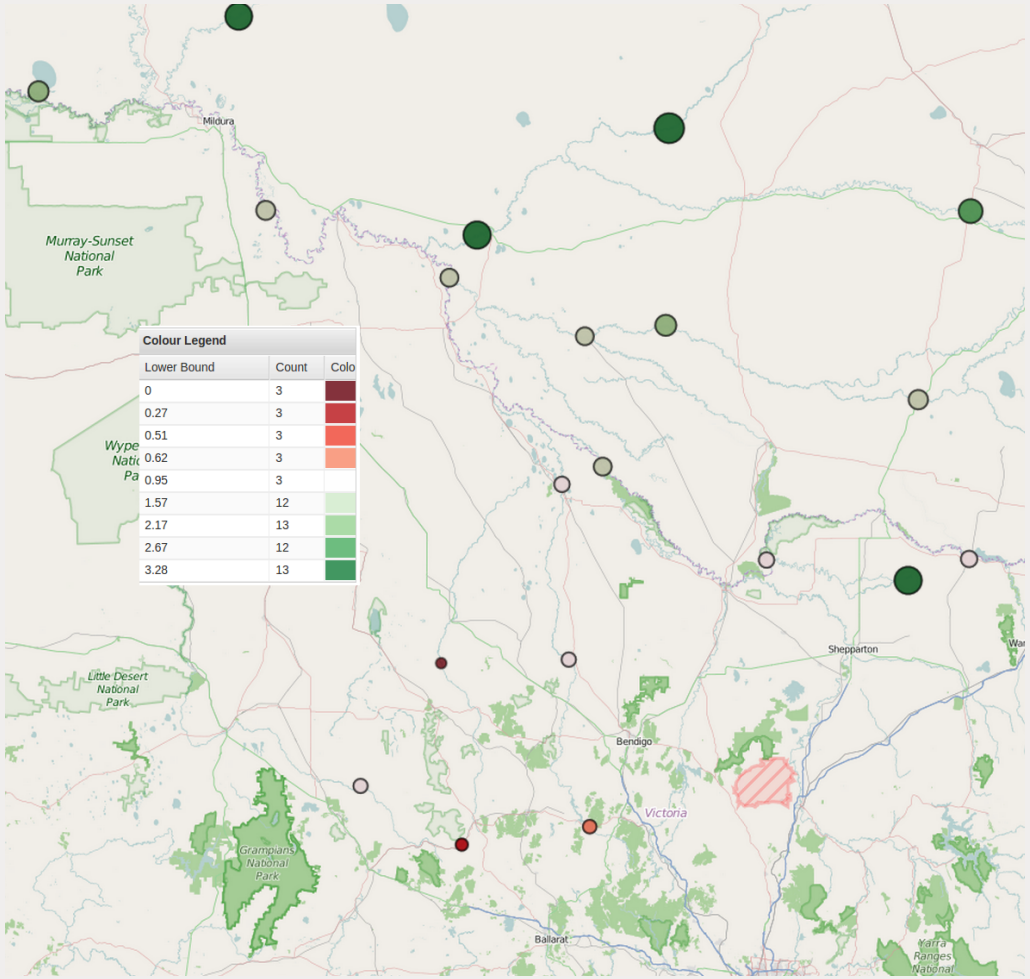
Equal Intervals – Quintile



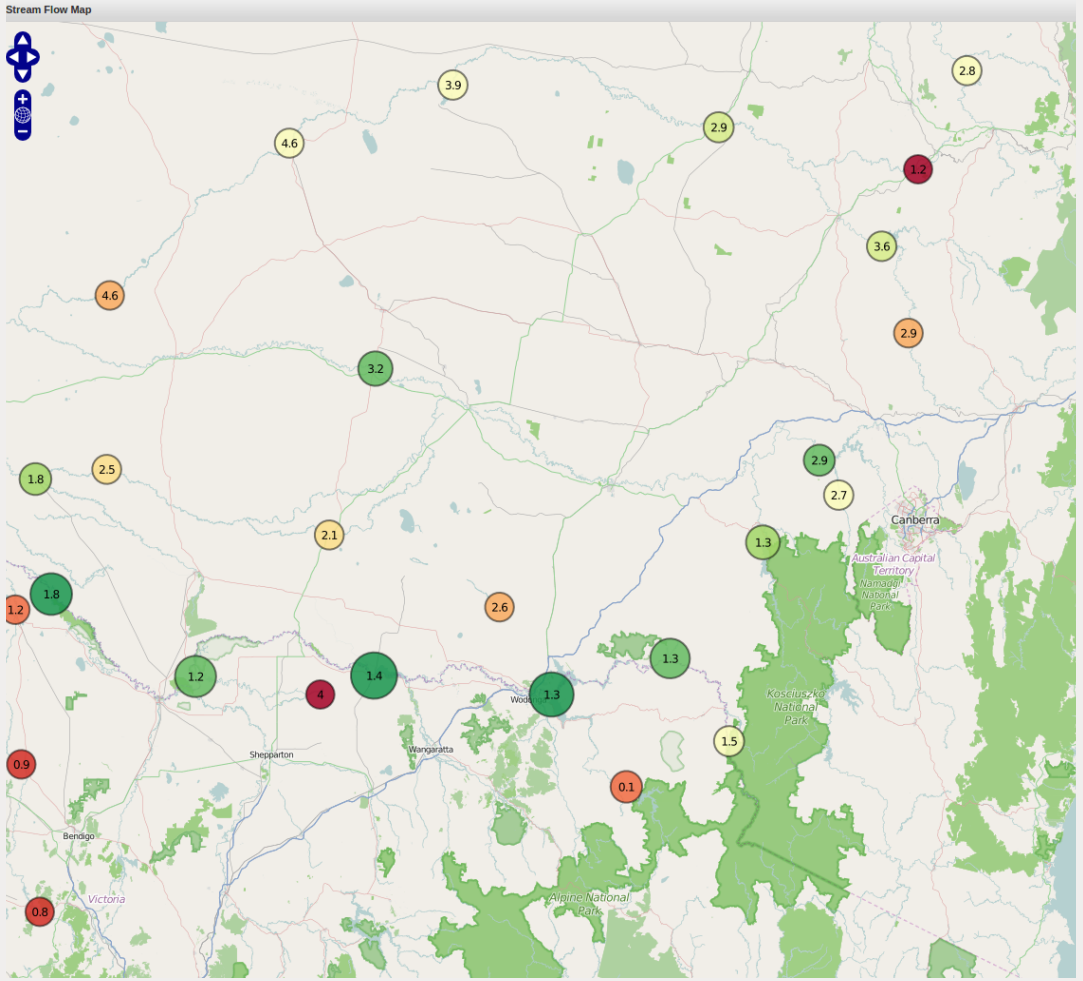


Single – Diverging colour schemes

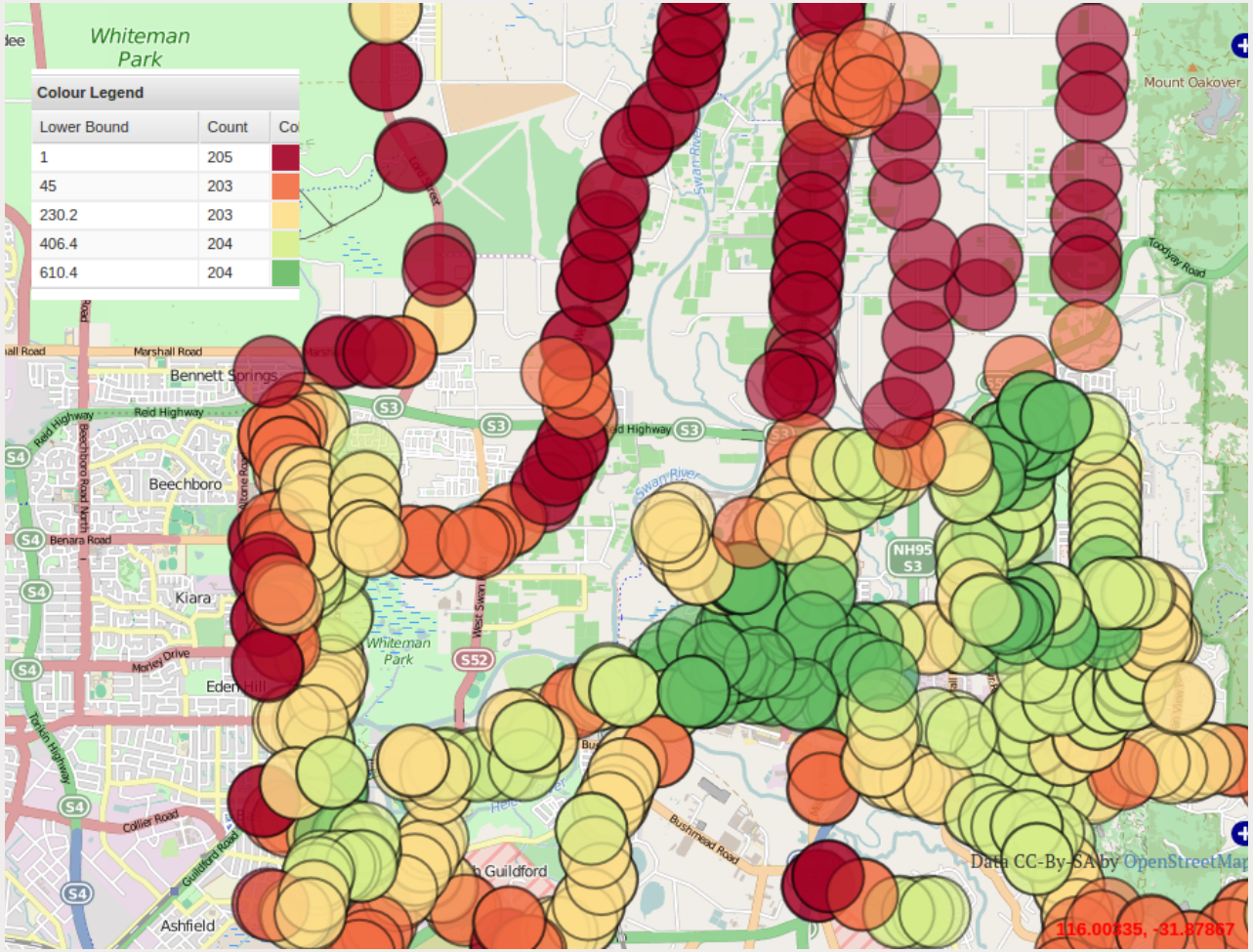




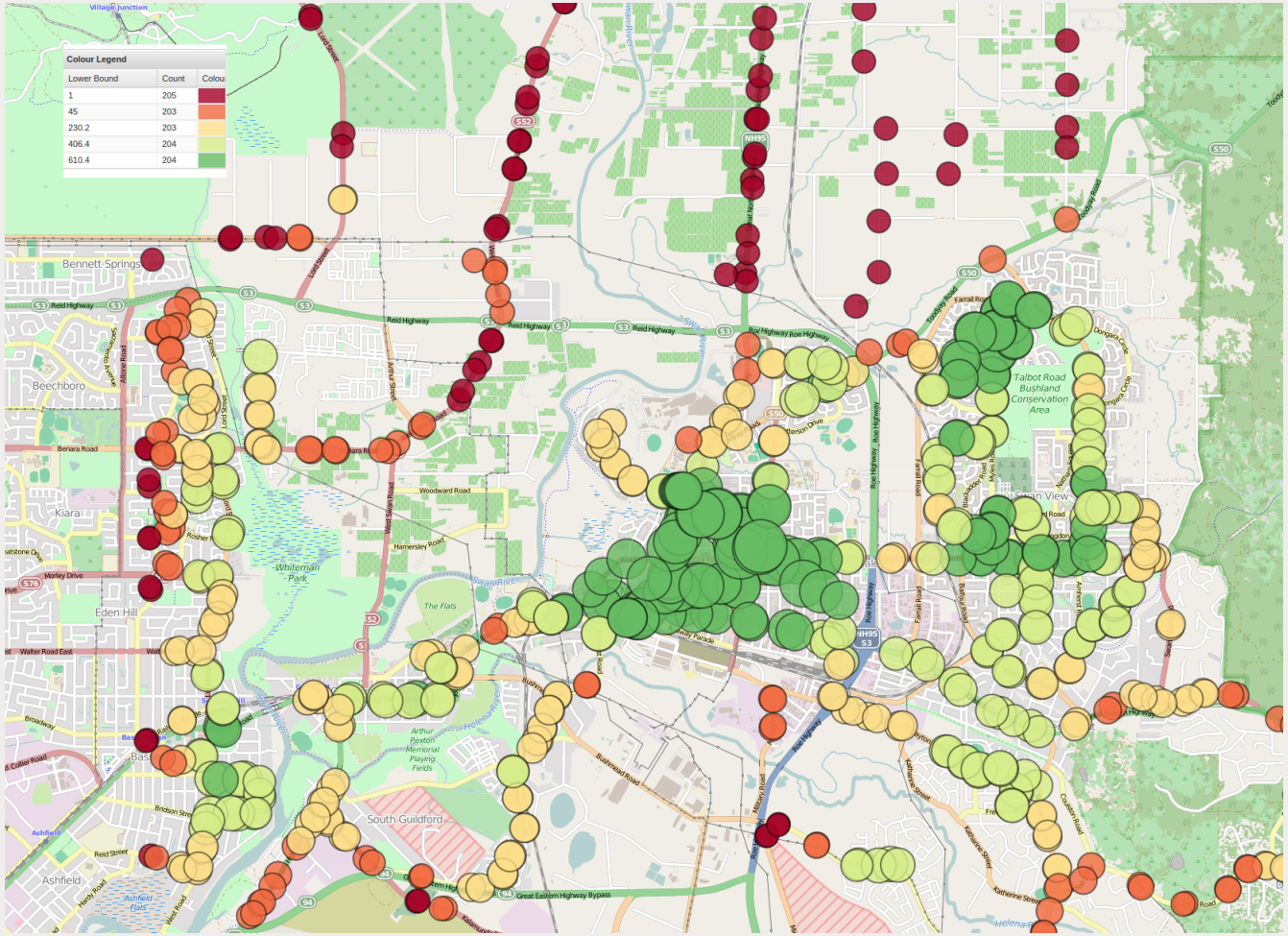
Multiple Attributes



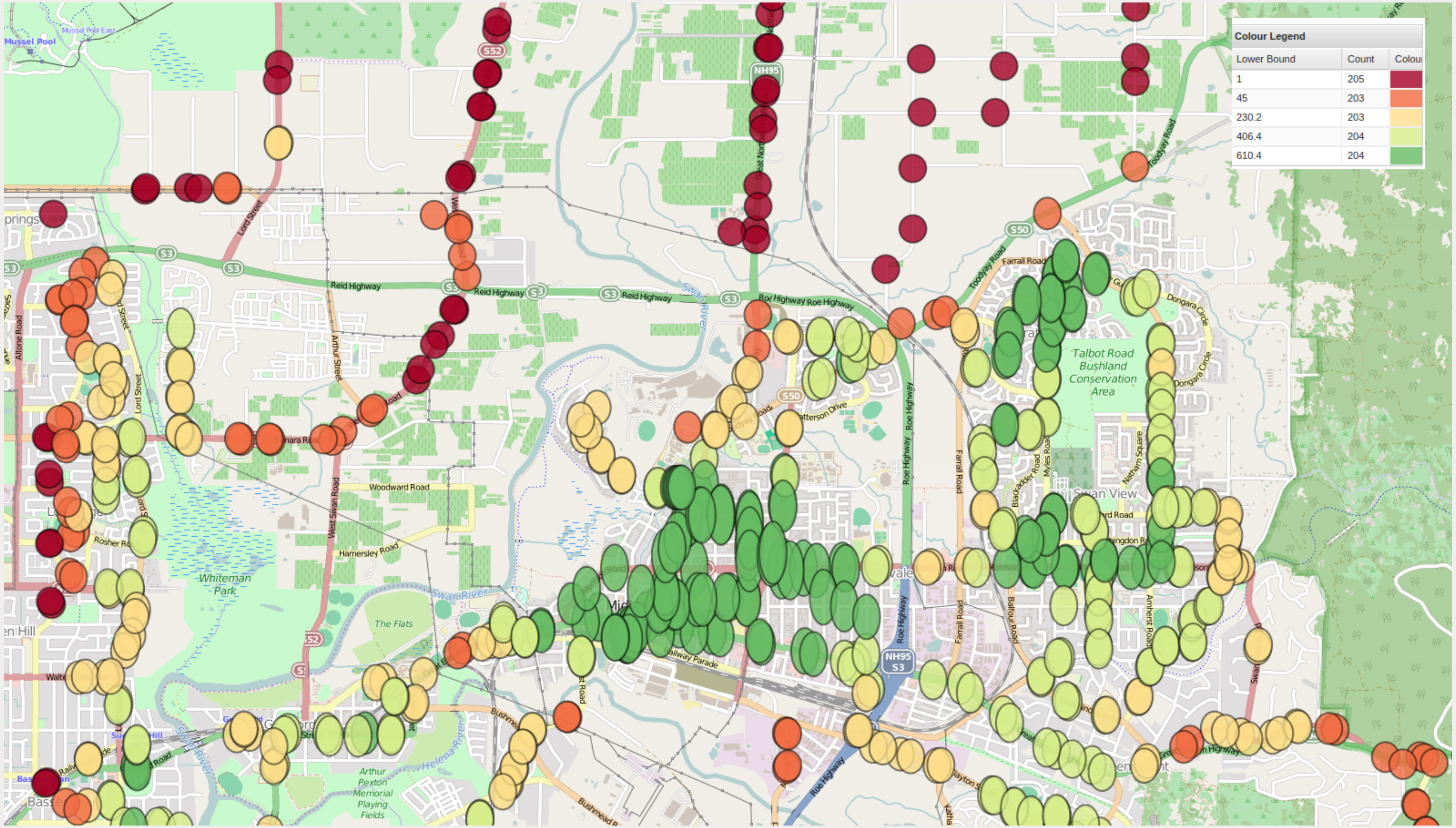
Radius Relative to Ground Distance



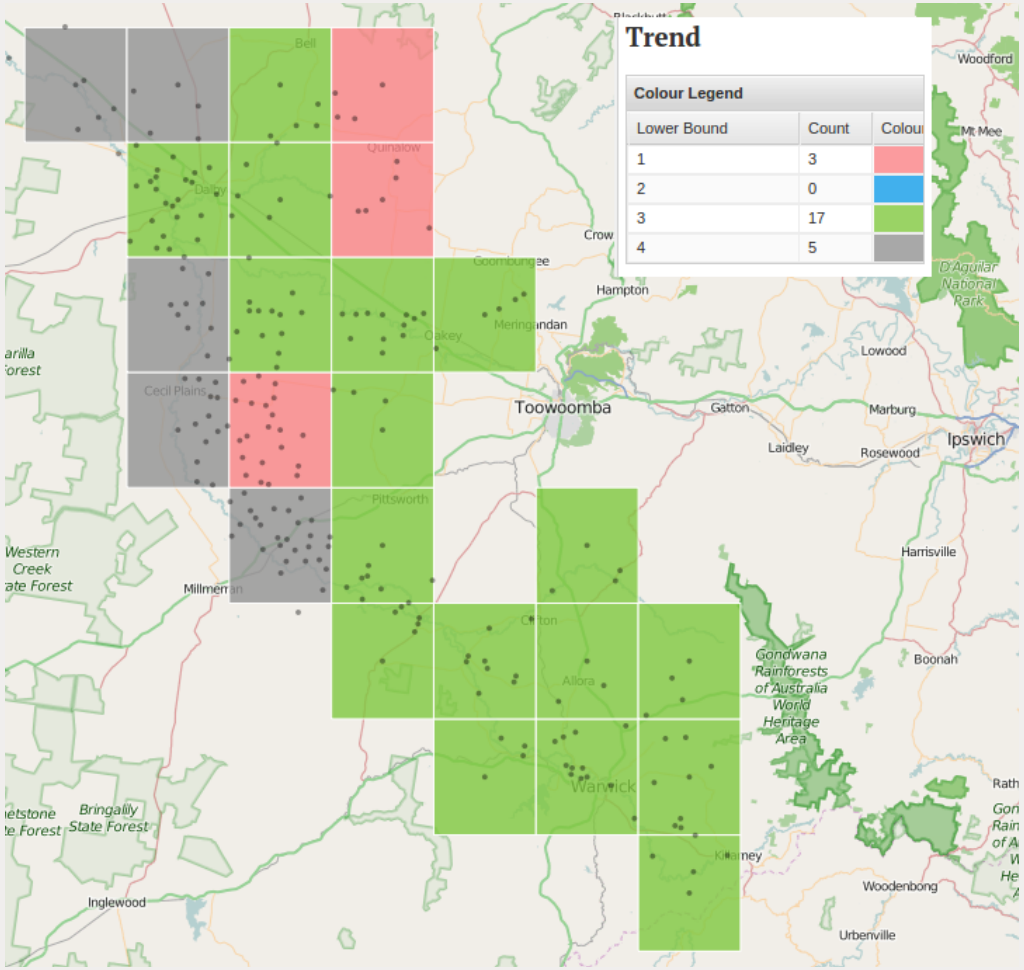
Radius Relative to Attribute



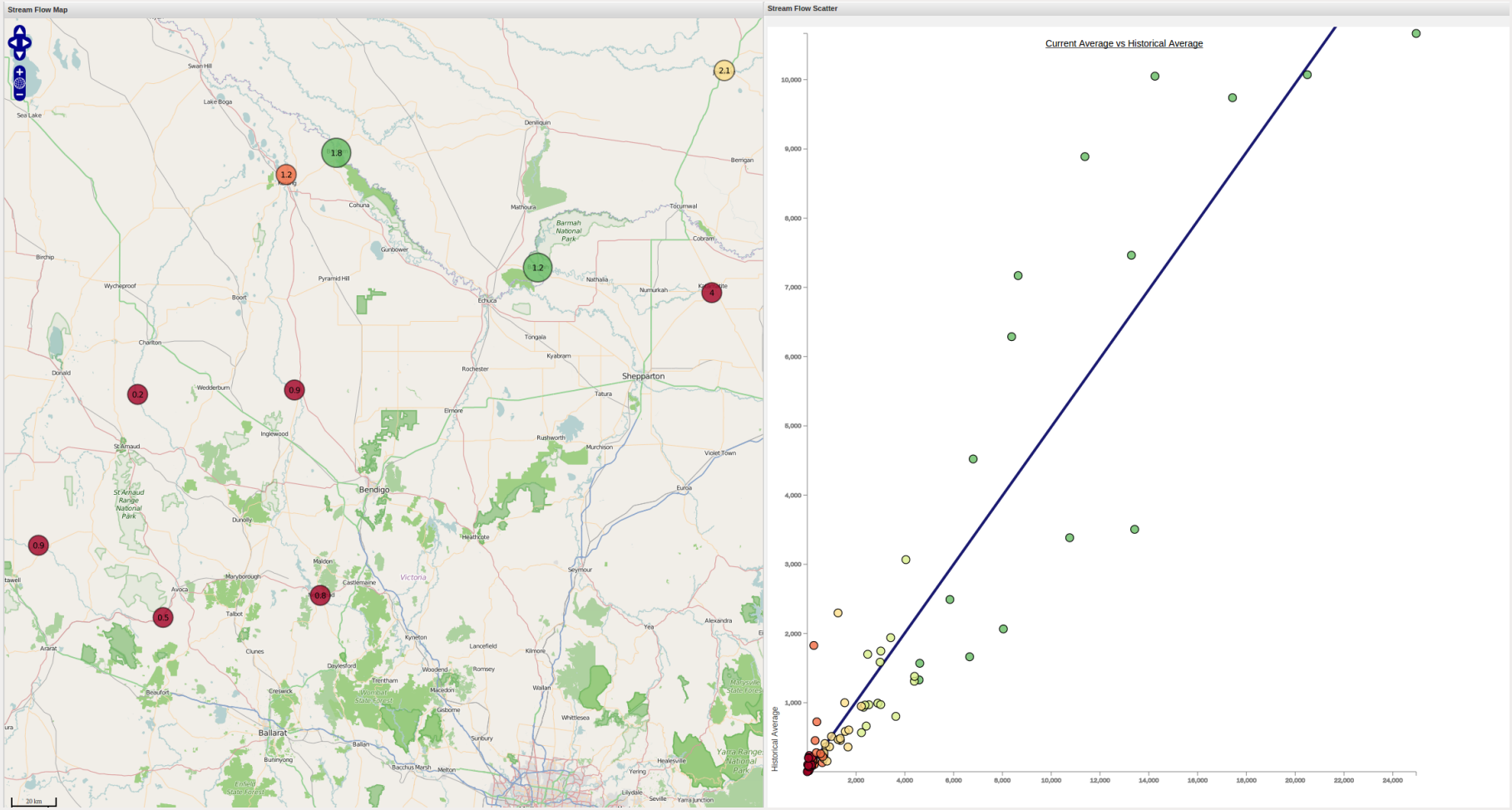
Ellipse


Colour Legend
Lower Bound
Count
Colour
1
205
45
203
230.2
203
406.4
204
610.4
204
Reid Highway
Roe Highway
Woodward Road
Hamersley Road
West Swan Road
Arthur Street
Lord Street
Whiteman Park
The Flats
Swan River
Talbot Road Bushland Conservation Area
Swan View
Farrall Road
Toodyay Road
Dongara Circle
Railway Parade
Arthur Pexton Memorial Playing Fields
Mussel Pool
Rosher Road

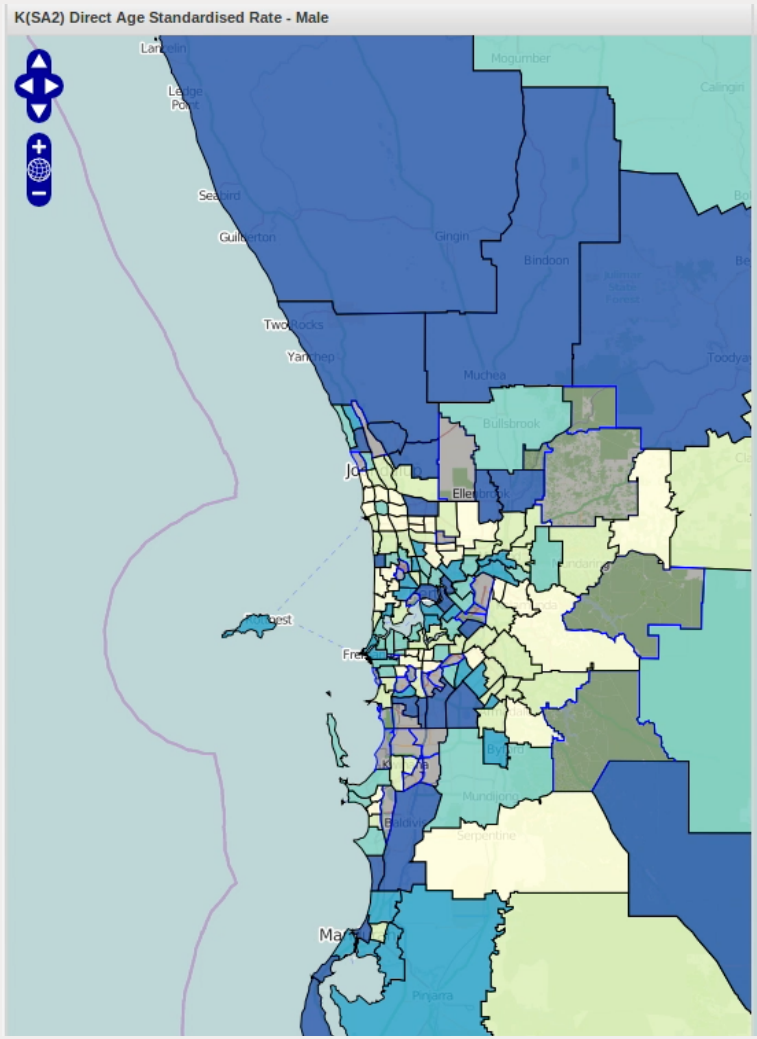
Style Layer Descriptor Input

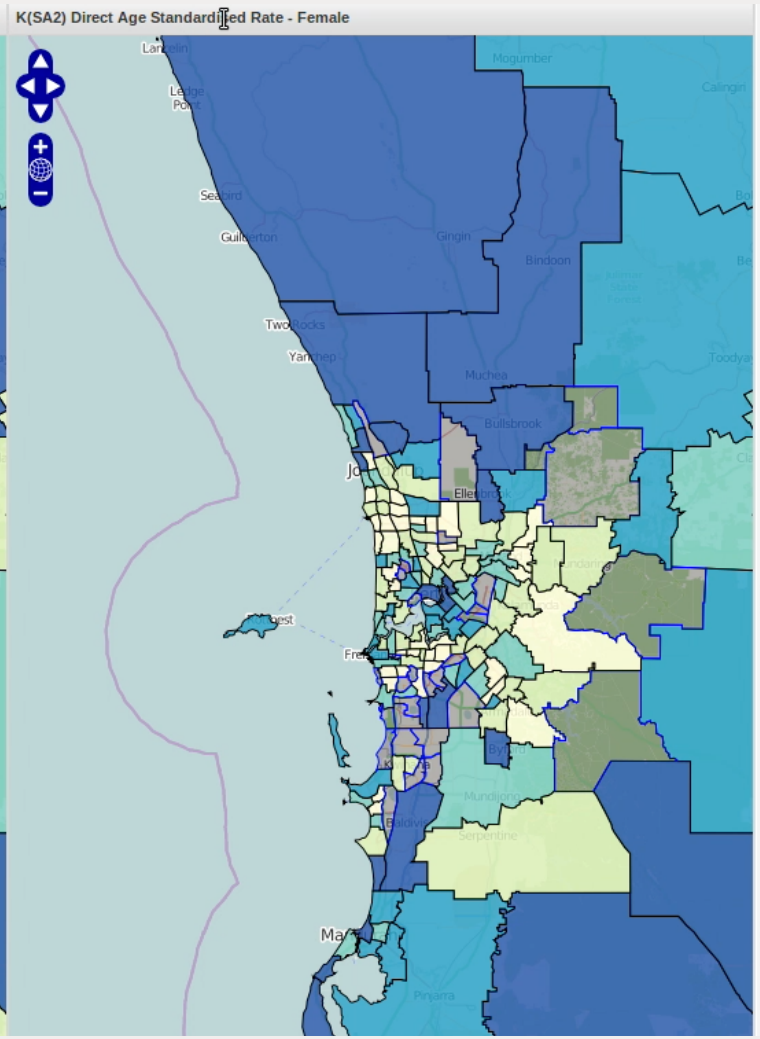


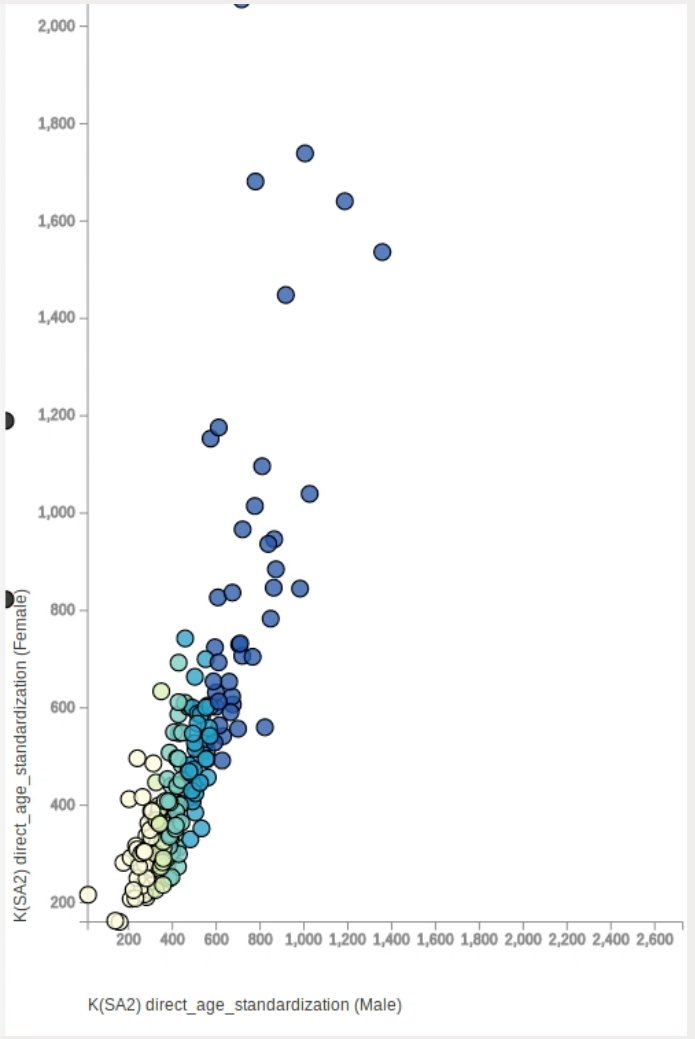
Linked Visualisations



Comparison


K(SA2) Direct Age Standardised Rate - Male


K(SA2) Direct Age Standardised Rate - Female


2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
K(SA2) direct_age_standardization (Female)
200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000 2,200 2,400 2,600
K(SA2) direct_age_standardization (Male)

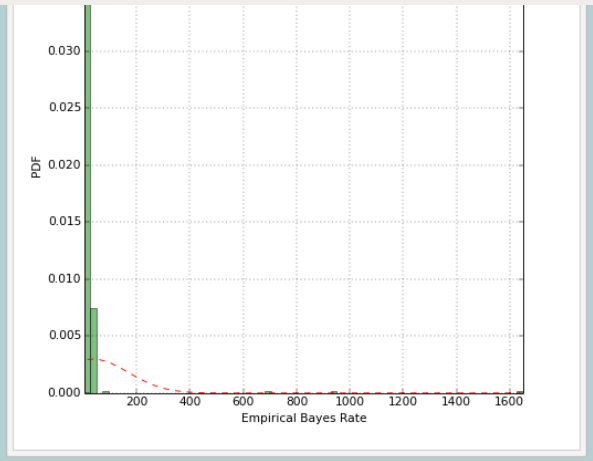
Tabular

SLA	Z(Agg) ASR	Z(Agg) direct_age_standardization_CI	Colour
East Pilbara (S)	0.121418058872	0.0141493547708	
Northam (T)	0.0930159687996	0.00802752468735	
Northam (S)	0.0667648389935	0.00909364409745	
Quairading (S)	0.137164309621	0.0290194265544	
Tammin (S)	0.187934309244	0.052290417254	
Toodyay (S)	0.1205599159	0.0126189095899	
Wongan-Ballidu (S)	0.12522277236	0.0203968081623	
York (S)	0.150914981961	0.0164432097226	
Bruce Rock (S)	0.139487564564	0.0294607952237	
Kellerberrin (S)	0.107964262366	0.0236383844167	
Merredin (S)	0.0912272259593	0.0106345480308	
Mukinbudin (S)	0.103548459709	0.0273697879165	
Narembeen (S)	0.134215474129	0.0293014980853	
Yilgarn (S)	0.211626201868	0.0271776821464	
Kalgoorlie/Boulder (C) - Pt A	0.103097558022	0.00468886038288	
Vincent (T)	0.111652120948	0.00464837392792	
Cambridge (T)	0.0711461976171	0.00353447021917	
Claremont (T)	0.119937285781	0.0081206150353	
Cottesloe (T)	0.0839824825525	0.00699083786458	
Mosman Park (T)	0.0947766304016	0.00701085291803	
Nedlands (C)	0.077155187726	0.00417835637927	
Peppermint Grove (S)	0.115076810122	0.0215539652854	
Perth (C) - Remainder	0.504745900631	0.0234876014292	
Subiaco (C)	0.12198472023	0.0059984466061	
Bassendean (T)	0.0741475522518	0.00475728558376	
Bayswater (C)	0.084384649992	0.00250119366683	
Kalamunda (S)	0.0621913634241	0.00224396120757	

- Data Sources
  - ABS Census Demographic Data
    - SA2_WA
    - SLA2011
    - WA_SLA_2006
    - WA_SLA_2006_Indig
  - ABS Medians (SA)
  - ABS Medians (SLA2006)
  - ABS Medians (SLA2011)
  - Health Data
  - Health Data (SA2)
    - A(SA2)
    - B(SA2)
    - C(SA2)
    - D(SA2)
    - E(SA2)
    - F(SA2)
    - G(SA2)
    - H(SA2)
    - I(SA2)
    - J(SA2)
    - K(SA2)
    - L(SA2)
    - M(SA2)
    - N(SA2)
    - O(SA2)
    - P(SA2)
    - Q(SA2)
    - R(SA2)
    - S(SA2)
    - T(SA2)
    - Z(SA2)
  - Health Data (SLA)

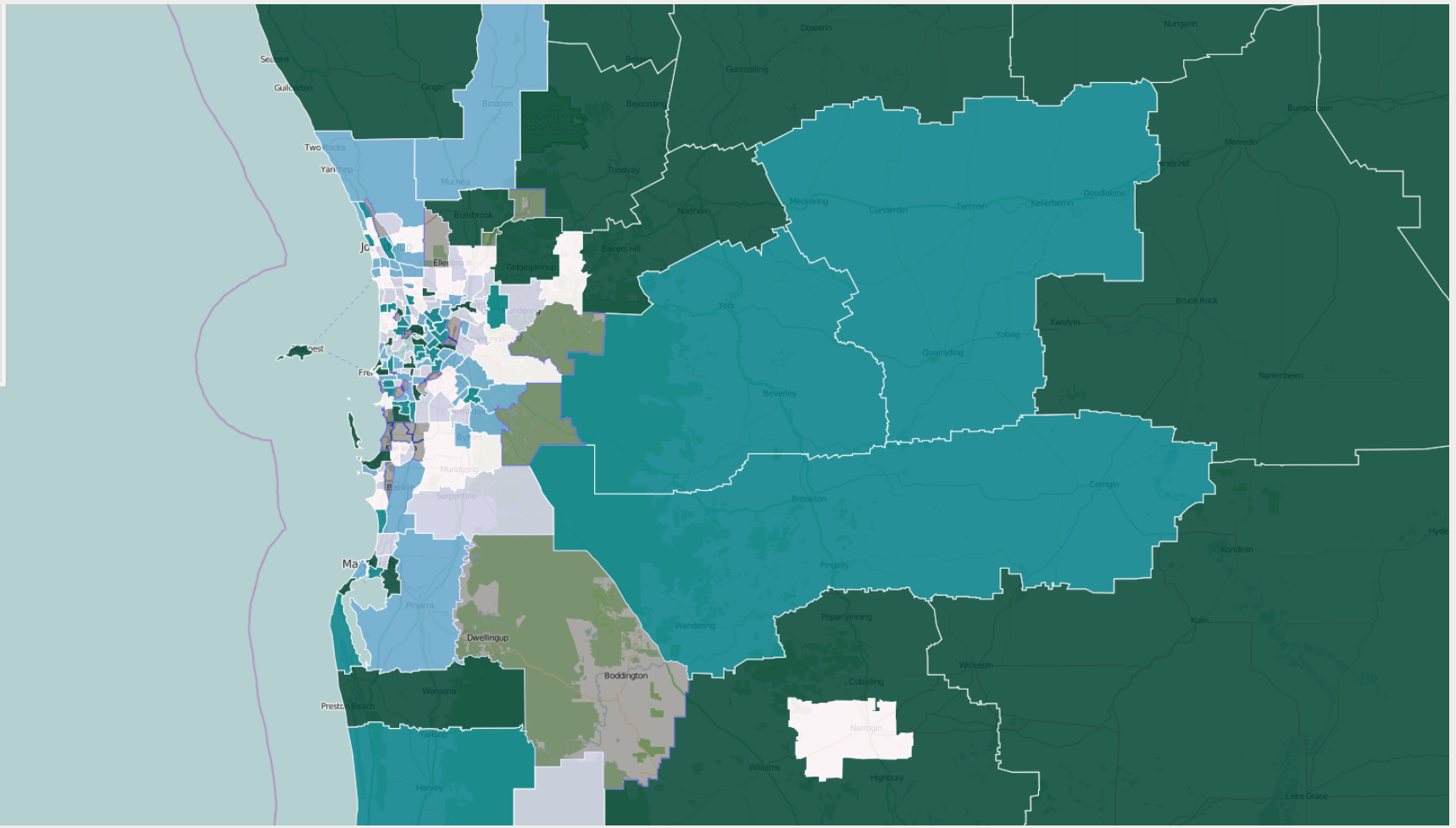
Name	Population	SA Med mortg rep mon	SA Med age persns	SA Average hh size	SA Med tot hh inc wee	SA Avg num p per brm	SA Med Famly inc we	SA Med rent weekly	SA Med person inc we	K(SA2)direct age standa	K(SA2)direct age standa
Albany	13527	1083	41	2.3	772	1.1	1062	155	423	37.0204696655	447.869903564
Albany Region	2880	1083	41	2.7	935	1.1	1073	80	418	153.809661865	557.805969238
Alexander Heights - Koondoola	11320	1083	33	2.9	1047	1.1	1142	170	436	39.2858200073	300.552490234
Applecross - Ardross	9854	1900	41	2.5	1319	1	1771	237	596	38.8549041748	347.841674805
Armadale - Wungong - Brookdale	14101	867	34	2.5	746	1.1	947	150	374	32.3164405823	366.895568848
Ashburton (WA)	8036	253	35	2.8	1835	1.1	2400	38	1014	118.610954285	490.754241943
Augusta	3885	1127	42	2.4	801	1.1	1025	150	431	104.200950623	866.069030762
Australind - Leschenault	11109	1200	35	2.9	1265	1	1376	200	521	49.954574585	467.436431885
Balcatta - Hamersley	14233	1200	38	2.3	979	1	1169	180	478	31.8370800018	348.914611816
Baldivis	6573	1546	33	3.1	1461	1	1517	250	589	158.438995361	1380.88513184
Balga - Mirrabooka	15651	919	32	2.7	712	1.1	838	150	345	34.2533302307	339.489624023
Ballajura	19060	1127	32	3.1	1151	1.1	1226	195	468	35.2748451233	300.744689941
Banjup	8378	1387	30	3.2	1470	1	1524	250	652	186.765472412	1090.3223877
Bassendean - Eden Hill - Ashfield	13195	1099	38	2.3	952	1.1	1180	160	478	32.869594574	357.834472656
Bateman	3423	1300	39	2.9	1340	1	1520	200	500	59.5607566833	266.168487549
Bayonet Head - Lower King	3681	1040	37	2.7	1021	1.1	1097	175	447	115.462882996	512.485229492
Bayswater - Embleton - Bedford	18876	1300	38	2.3	1006	1.1	1245	165	501	29.4139652252	405.485809326
Beckenham - Kenwick - Langford	15692	1000	33	2.6	919	1.1	1061	163	434	31.3678798676	314.447509766
Beechboro	13897	1150	31	2.9	1091	1.1	1170	170	474	41.4257354736	295.123840332
Beeliar	4413	1333	29	3.1	1255	1	1343	220	545	226.137954712	952.808532715
Belmont - Ascot - Redcliffe	11557	1213	37	2.2	955	1.1	1174	165	505	39.0356292725	428.393768311
Bentley - Wilson - St James	17037	1213	32	2.2	684	1.1	1011	157	344	37.7885627747	456.8331604
Bertram - Wellard (West)	3333	1500	28	2.9	1360	1	1418	230	637	223.334579468	1052.00036621
Bicton - Palmyra	12005	1387	41	2.1	996	1	1377	190	548	37.1882514954	403.940002441
Booragoon	13263	1625	41	2.4	1196	1	1640	210	567	31.5149822235	327.007598877
Boulder	7475	1083	30	2.6	1271	1.1	1429	165	585	78.9025268555	543.17565918
Bridgetown - Boyup Brook	5252	880	43	2.4	776	1.1	1023	115	401	74.5243377686	610.345947266
Brookton	3484	682	41	2.4	738	1.1	996	70	424	97.8299484253	690.716003418
Broome	16420	1722	39	2.6	1147	1.2	1370	170	582	50.6388206482	384.911010742
Bull Creek	7563	1281	43	2.7	1215	1	1543	220	483	41.3994598389	260.417022705
Bullsbrook	3842	1216	35	2.8	1143	1.1	1210	170	517	99.3924026489	473.416015625
Bunbury	16672	1083	38	2.3	924	1	1170	170	476	30.1797981262	392.580596924

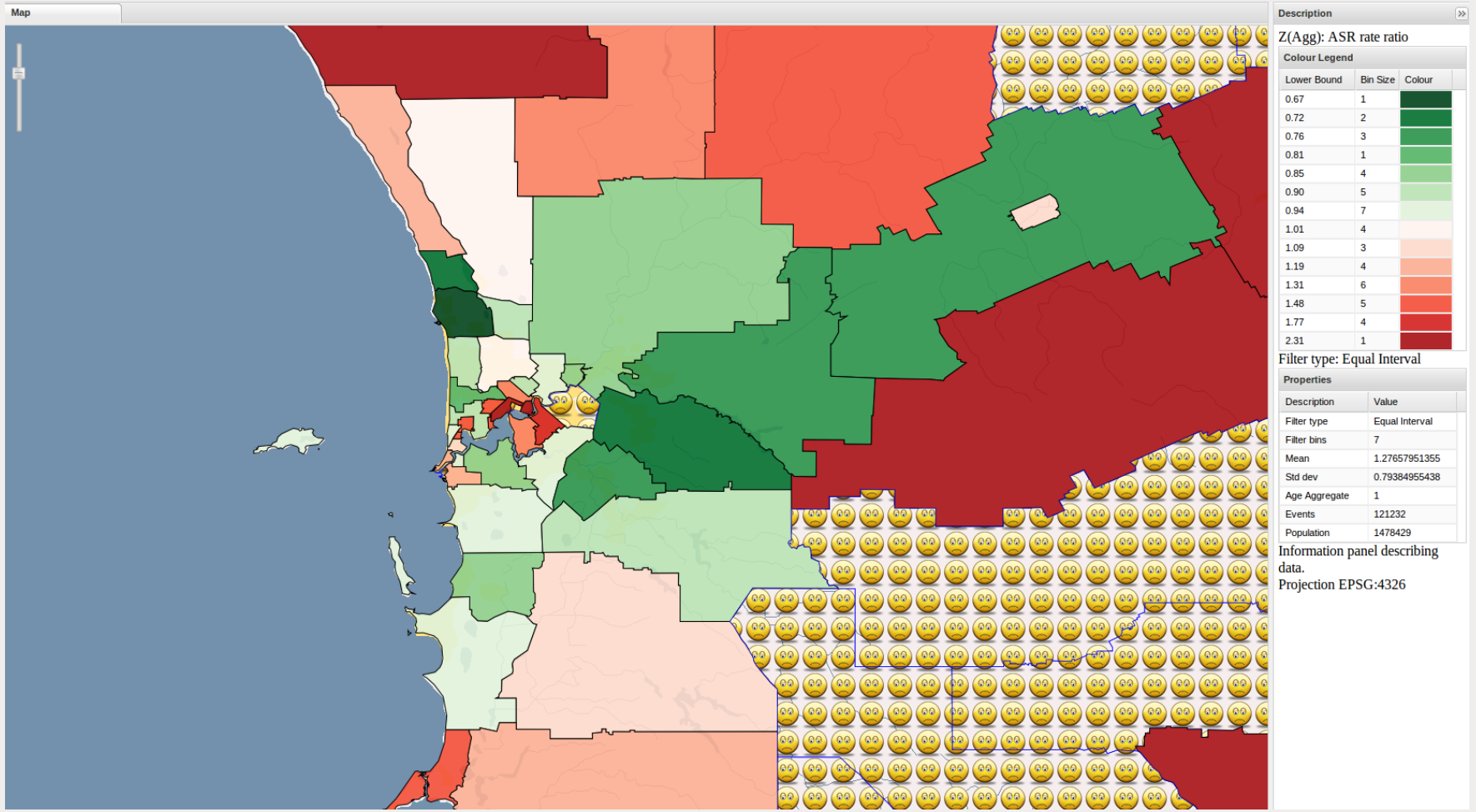
Multiple Visualisations



Congenital Malformations - Empirical Bayes

Colour Legend		
Lower Bound	Count	Colour
4.63	44	
13.91	44	
17.18	44	
21.10	44	
26.21	44	




Map
Description
Z(Agg): ASR rate ratio
Colour Legend
Lower Bound | Bin Size | Colour
0.67 | 1
0.72 | 2
0.76 | 3
0.81 | 1
0.85 | 4
0.90 | 5
0.94 | 7
1.01 | 4
1.09 | 3
1.19 | 4
1.31 | 6
1.48 | 5
1.77 | 4
2.31 | 1
Filter type: Equal Interval
Properties
Description | Value
Filter type | Equal Interval
Filter bins | 7
Mean | 1.27657951355
Std dev | 0.79384955438
Age Aggregate | 1
Events | 121232
Population | 1478429
Information panel describing data.
Projection EPSG:4326

*Visual Analytics - "detect the expected and discover the unexpected"**

Thank You

*[Thomas and Cook, 2005] J.J. Thomas and K.A. Cook, eds., Illuminating the Path: The Research and Development Agenda for Visual Analytics, IEEE CS Press, 2005.