Geographic Accessibility - Providing government services in an spatially equitable manner: Perspectives for Fire Station location

CSIR: Built Environment

October 2012

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Basic approach and principles of facility location planning:
WHO gets WHAT, WHERE and HOW MUCH

Objective 1:

Improvement of service accessibility and availability from the perspective of existing and potential customers

Analyse Existing Service Accessibility and Availability

PROCESS

Explore & adjust facility locations & sizes in relation to:

- spatial distribution of demand
- threshold targets
- other facilities /clusters/ nodes

Planning Considerations

- Settlement pattern and density
- Facility size and distribution
- Facility operational thresholds- max & min size

Objective 2:

Attraction of the threshold volume of customers that is needed to cover the overheads and make the service viable

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Accessibility analysis

- Accessibility analysis models the access of residents to facilities - assuming people will go to their nearest facility for service

- If an analysis is done for a large area, this will show whether provision is
  - **Sufficient** and
  - **Equitable**

  .. if both capacity (threshold) and distance parameters are included

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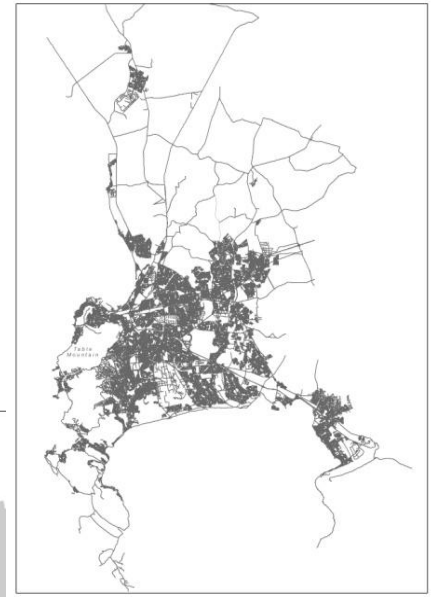
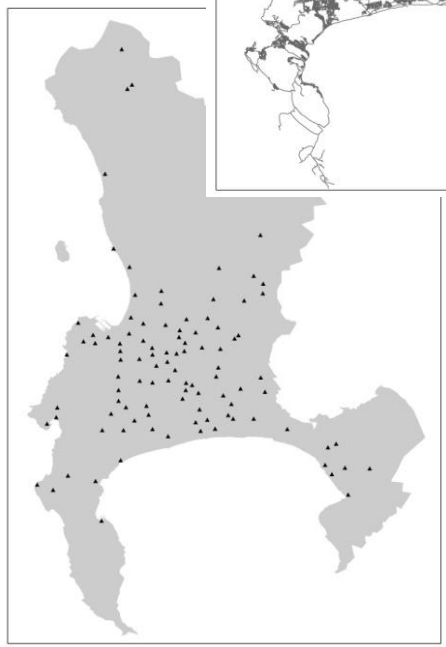
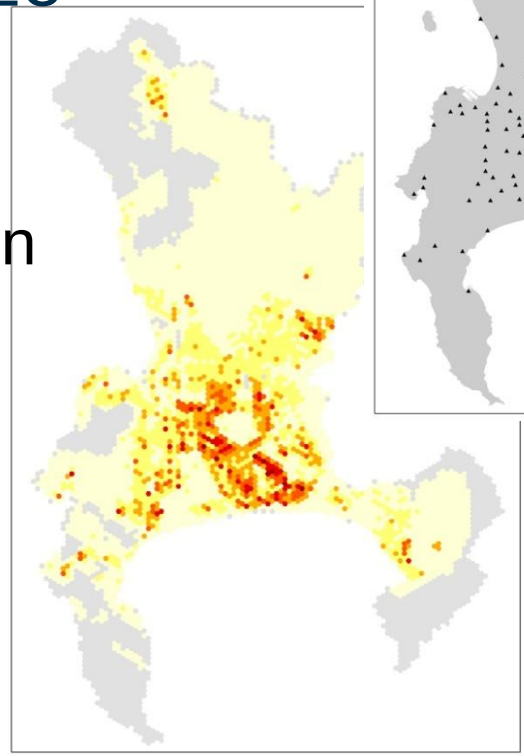
Data layers used for accessibility analysis

- Road network- used to calculate travel distance
- Facility locations with capacity, i.e. staff or size
- Population distribution
  - disaggregated to hexagon layer
  - hexagon = 20ha







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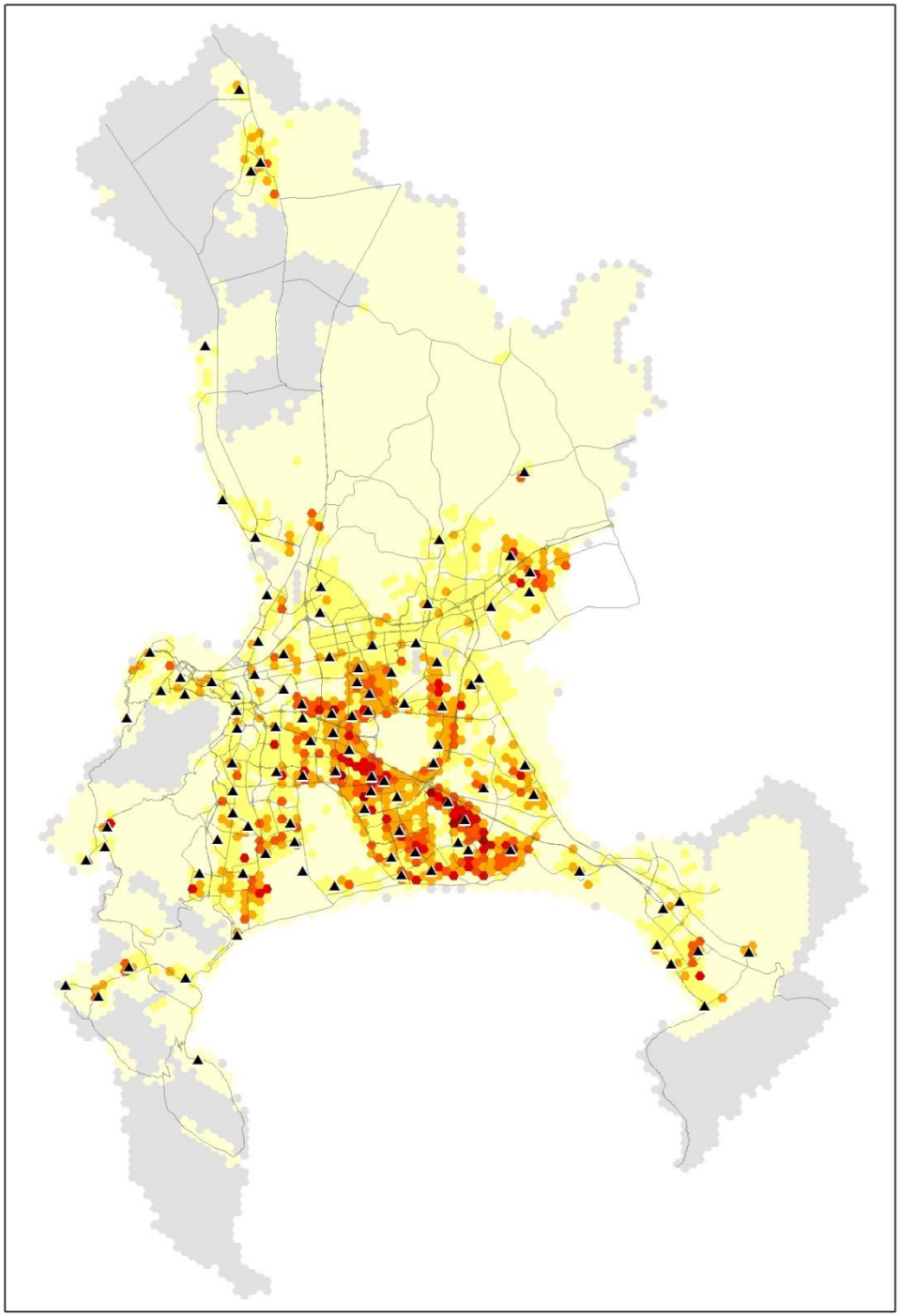

Interaction between layers

All three layers interact within set standards to determine

- Which part of **population**
- Will travel **how far**
- To a **facility** with set capacity

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GIS-based accessibility analysis allows:

- Evaluate facility location vis-à-vis where people live
- Know where the closest facility with capacity is located
- Compare service backlogs
- Seek optimal solutions for an affordable number of facilities
- Prioritise investment / budget allocation
- Right-size facility to match density within catchment
- Rationalise or reallocate underutilised facilities
- Visualise results & improve stakeholder communication

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Planning for Fire Protection in eThekwini

Fire Station analysis

Facilities analysed	Fire Stations (19)
Travel mode & access distance	Travel time according to risk category: **A Risk** – (CBD/ high) = 8 Minutes **B Risk** – (industry & commercial / moderate = 10 minutes **C Risk** – (brick residential / low) = 13 minutes **D Risk** – rural = 23 minutes **Special Risk** = 8 minutes
Demand	Total land area of eThekwini 238 160 hectare Total population in 2011 - 3 667 188
Supply	19 current fire stations
Analysis undertaken	- Unconstrained travel time to nearest fire station - GIS query analysis constrained by travel time = fire risk
Options tested	- Re-open Cato Ridge Station - Addition of 6 selected locations for new fire stations

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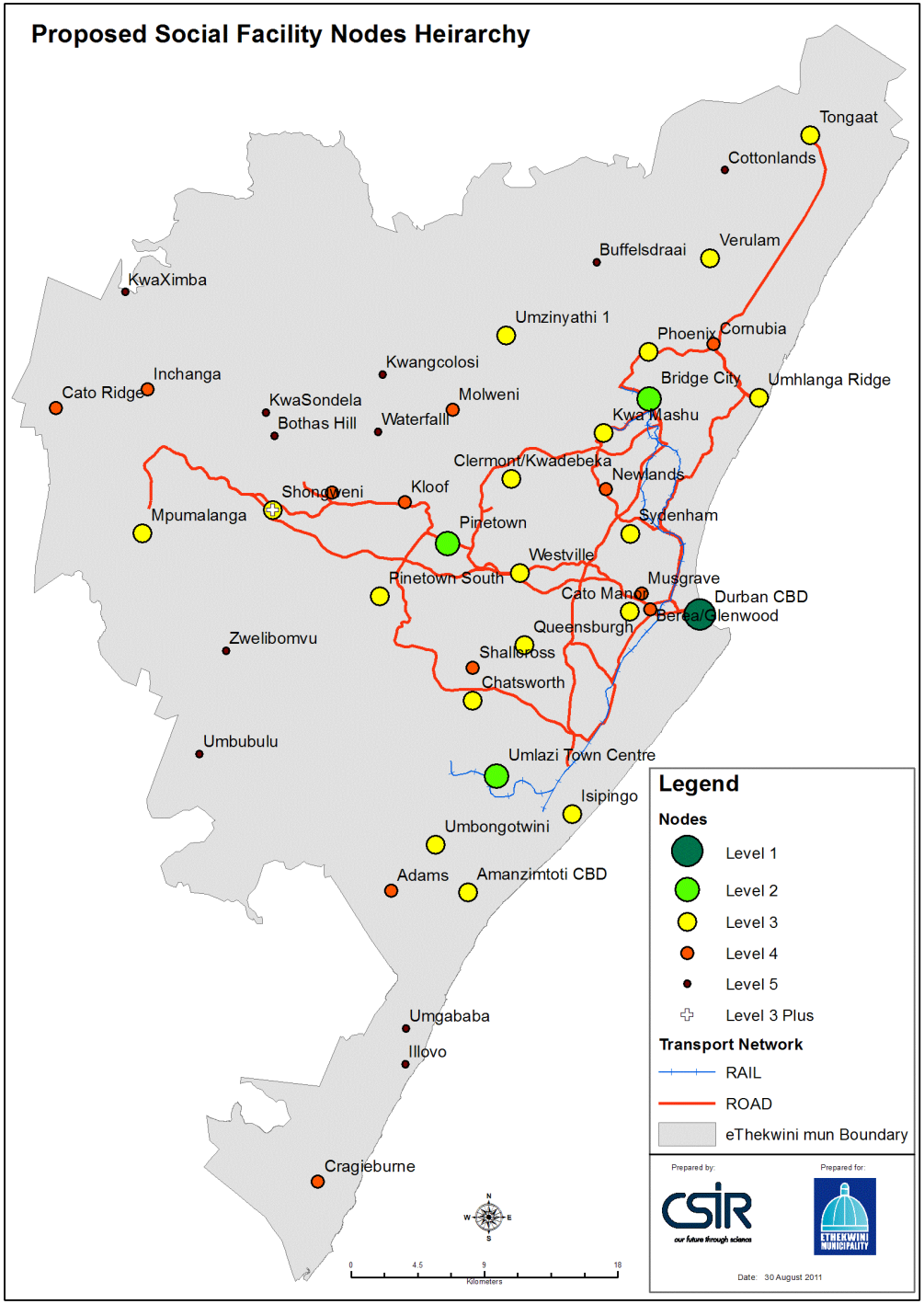
eThekwini Social Facility Nodes



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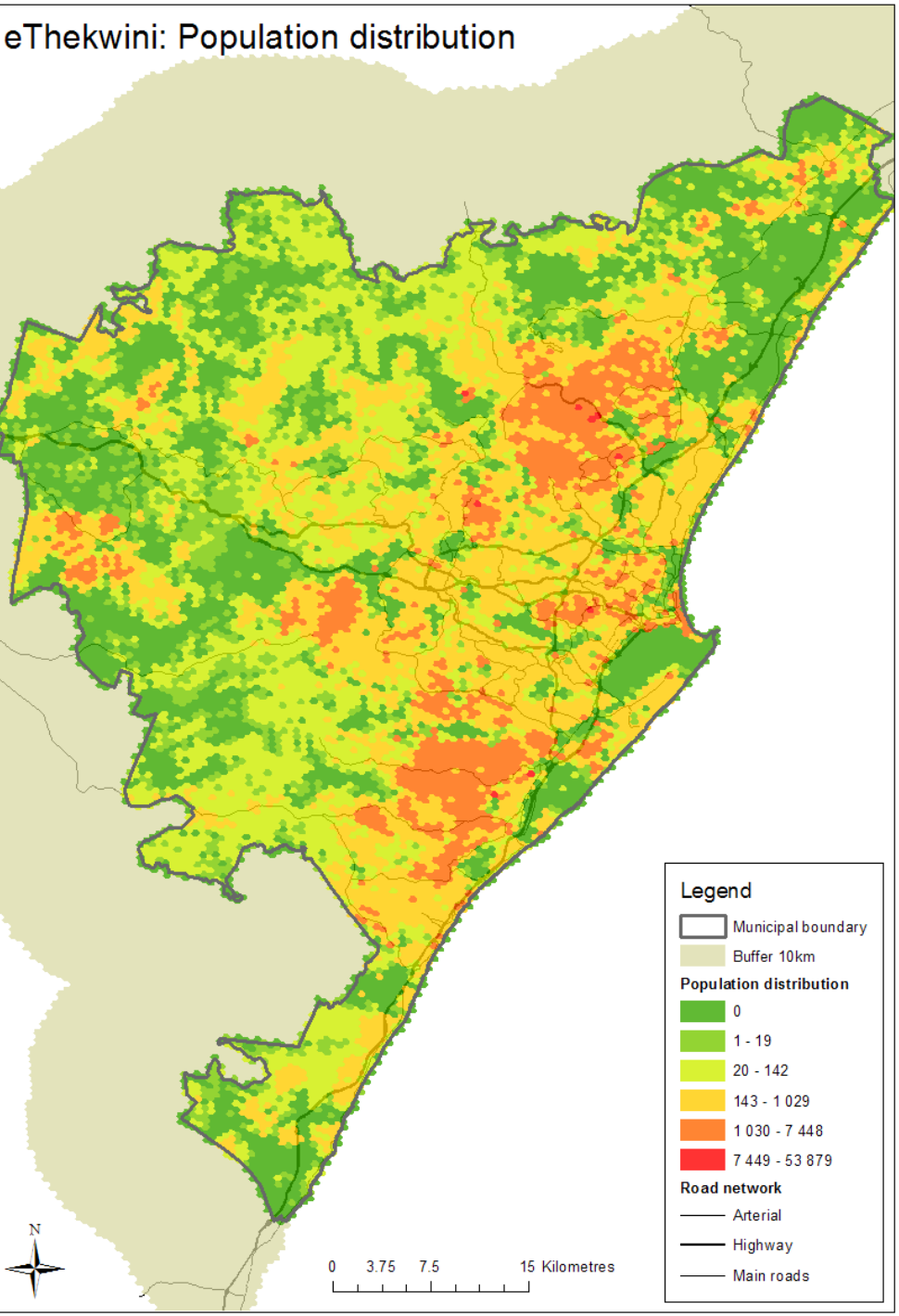
2011 Population Distribution of eThekwini



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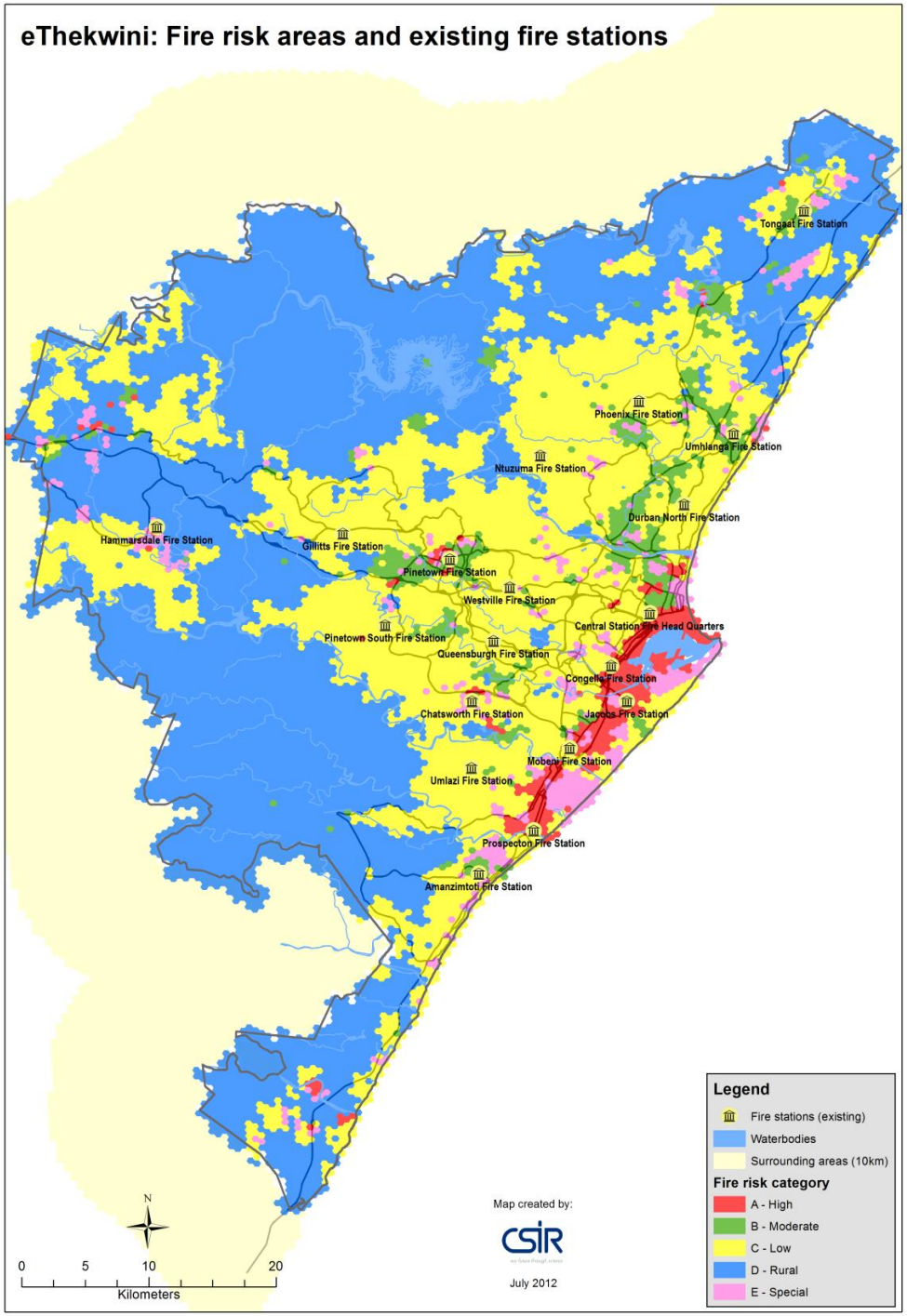

Fire risk areas – SABS 1009 (updated 2012)

Can be weighted by other data if available, for example:

- Historical data on call outs
- Property value
- No. of non-fire events, i.e. accidents

Density Zones	Area (ha)
Rural 1p/Ha	83 980
Dense rural 10p/Ha	39 800
Urban 28p/Ha	114 380
Total	**238 160**

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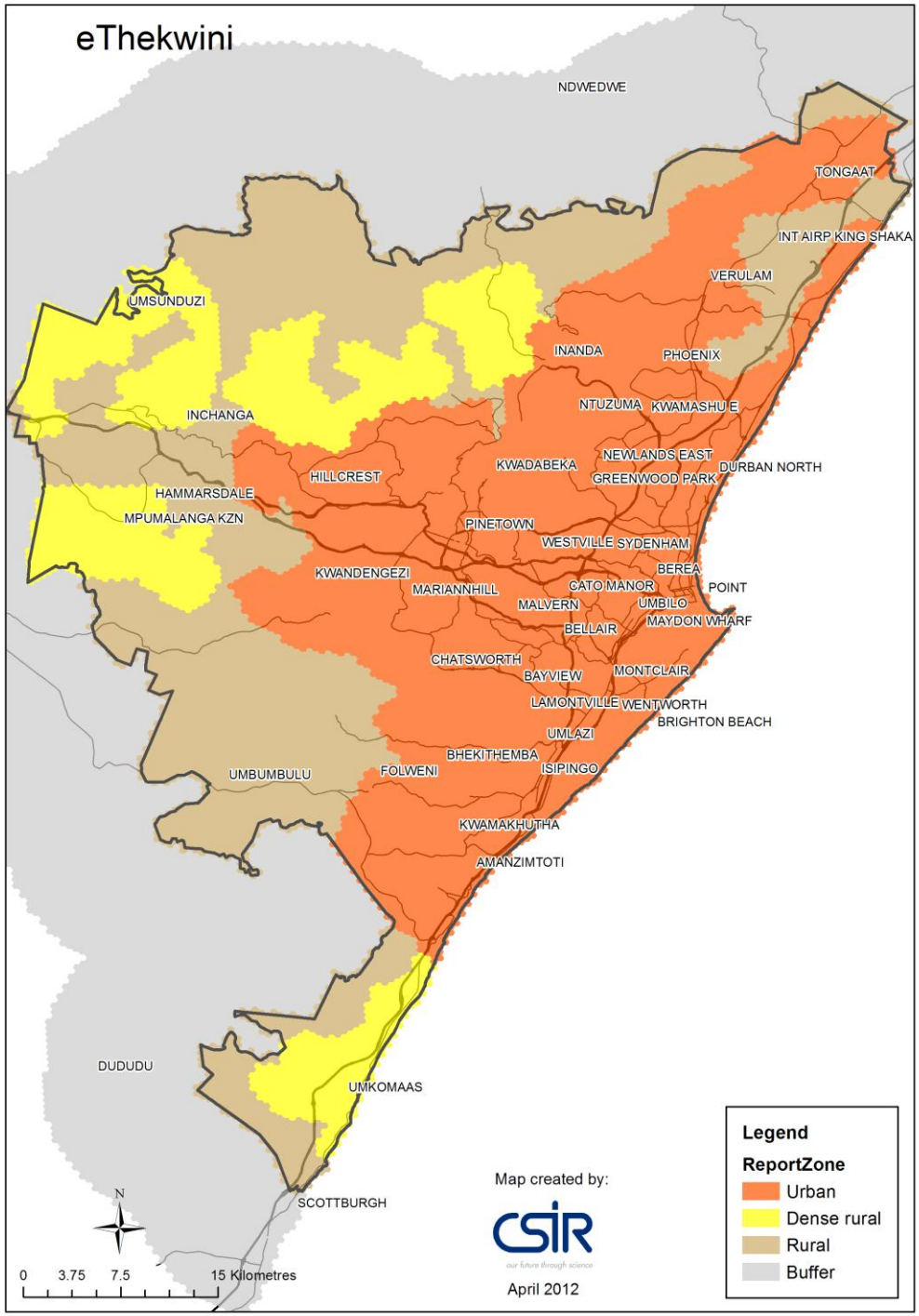
Reporting / Density Zones



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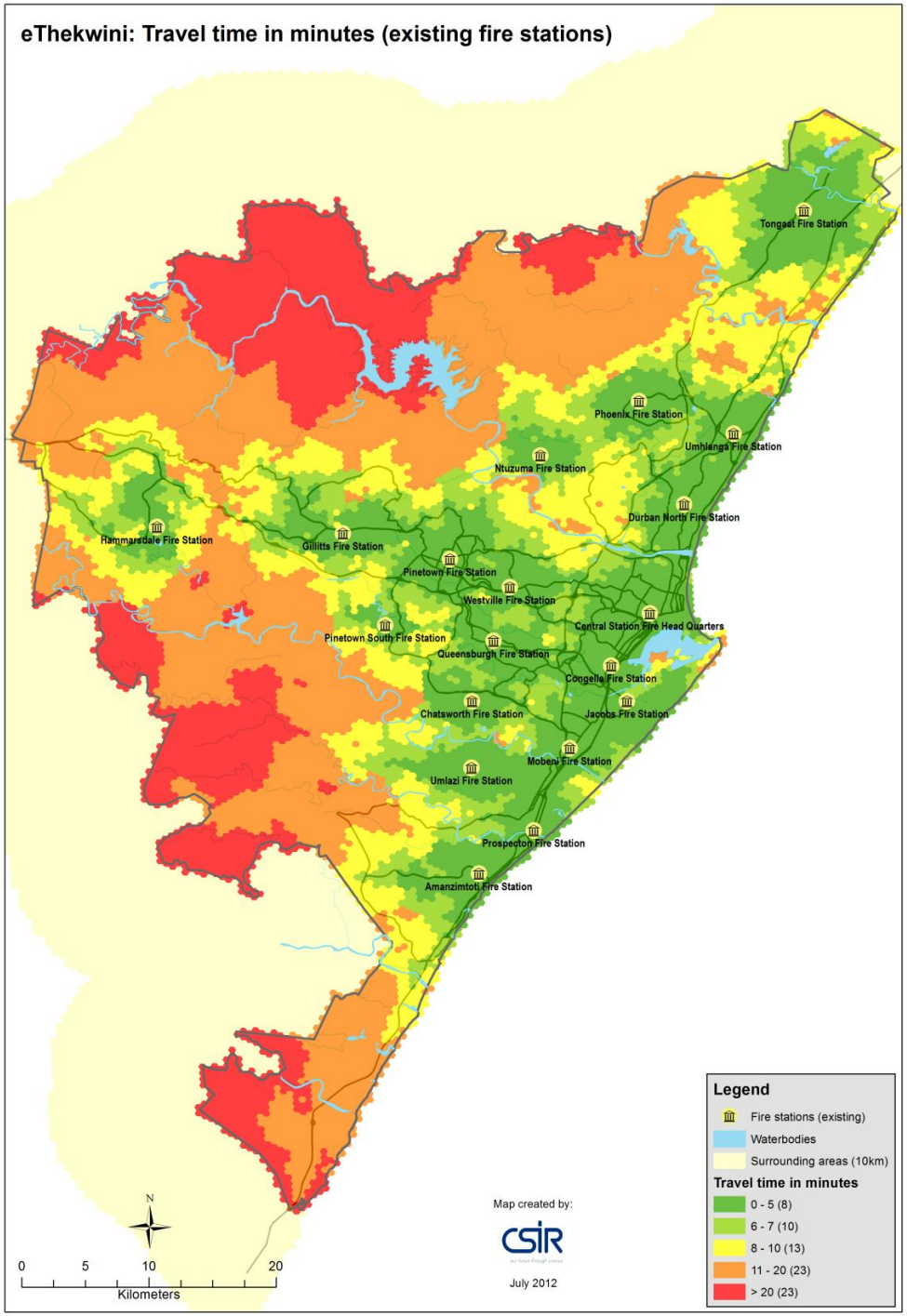
Travel time from current Fire Stations (in minutes)



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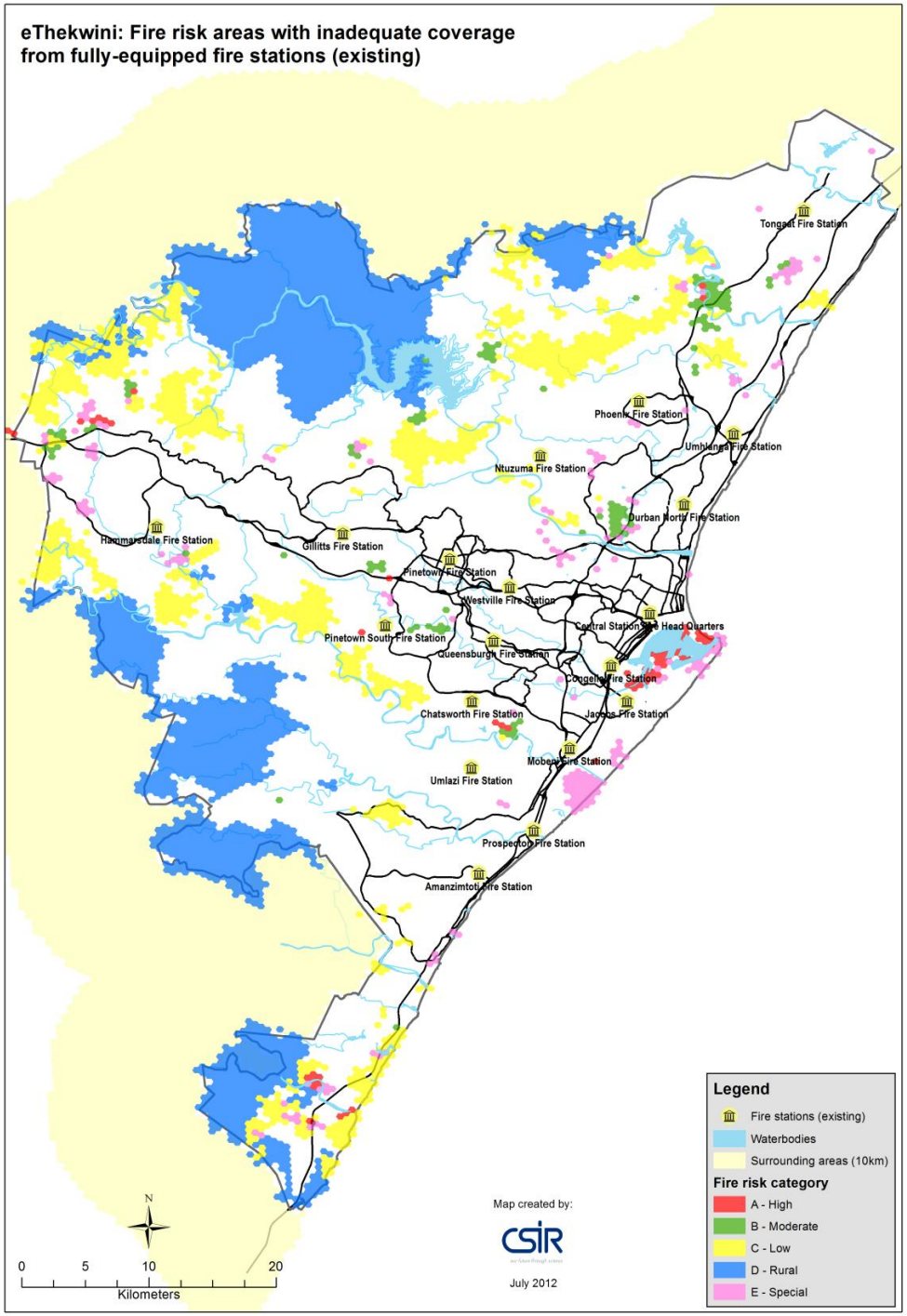

Areas with inadequate coverage

Fire stations : Current level of access

Density zones	*Unserved*	Served	% Served	Total population
Dense rural	*163 505*	238 390	59.32	401 895
Rural	*53 279*	59 286	52.67	112 565
Urban	*280 351*	2 872 377	91.11	3 152 728
Grand Total	***509 731***	**3 170 220**	**86.45**	**3 667 188**

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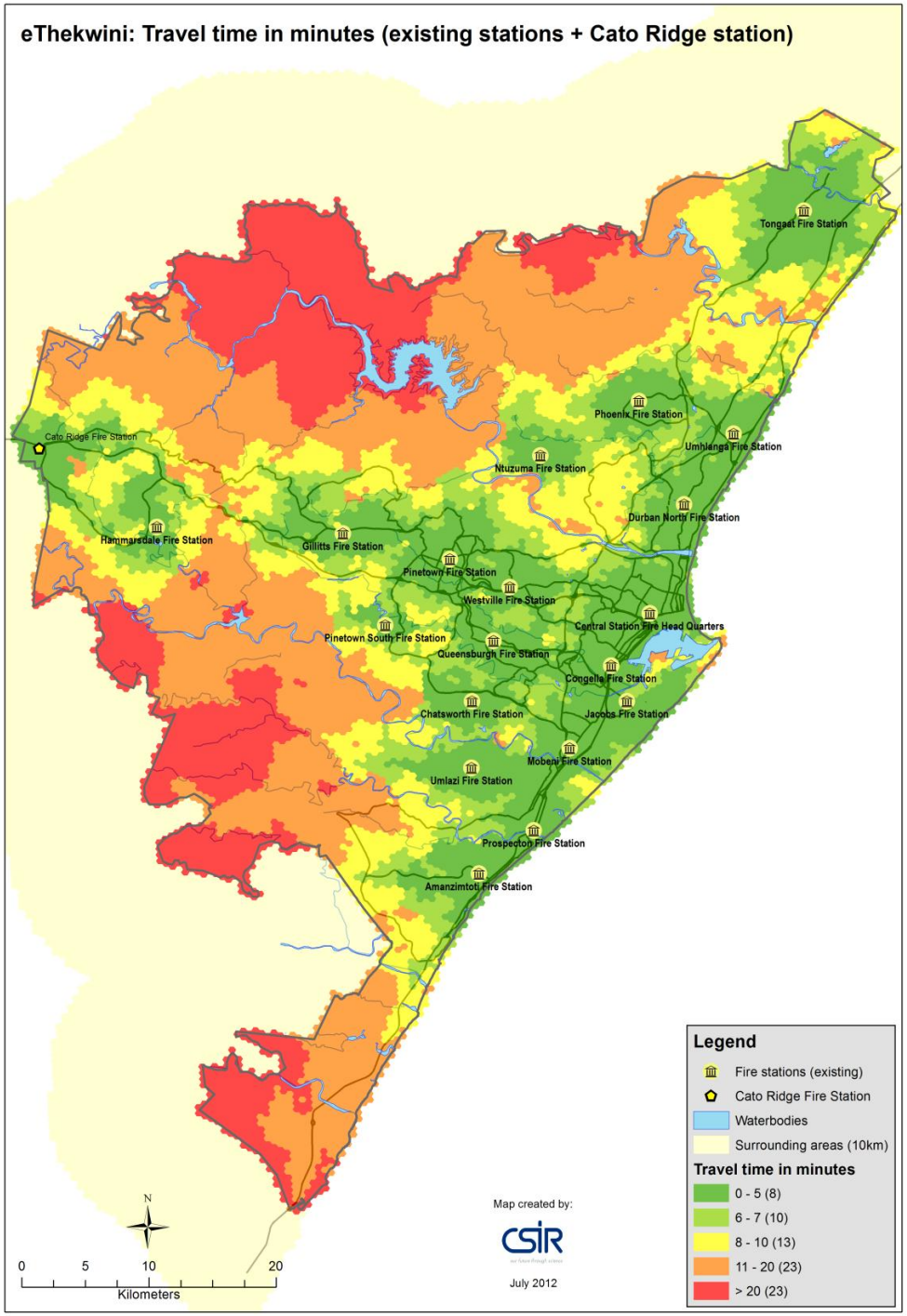
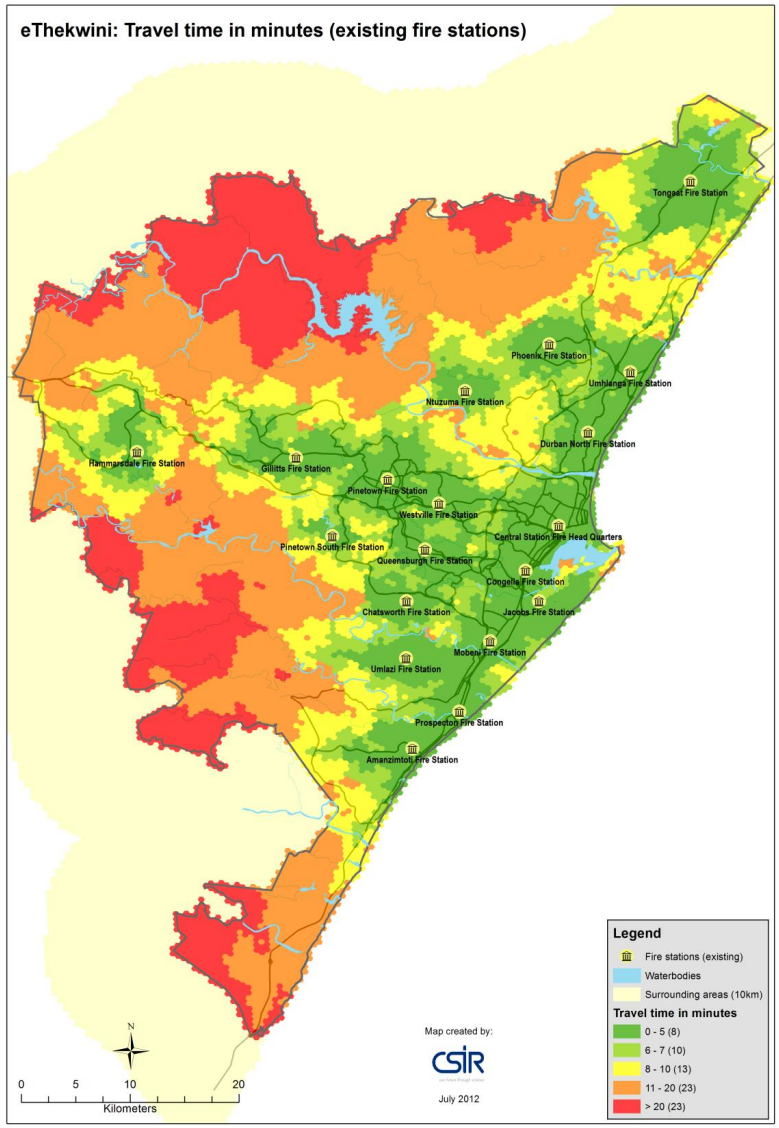
Impact of re-opening Cato Ridge Station





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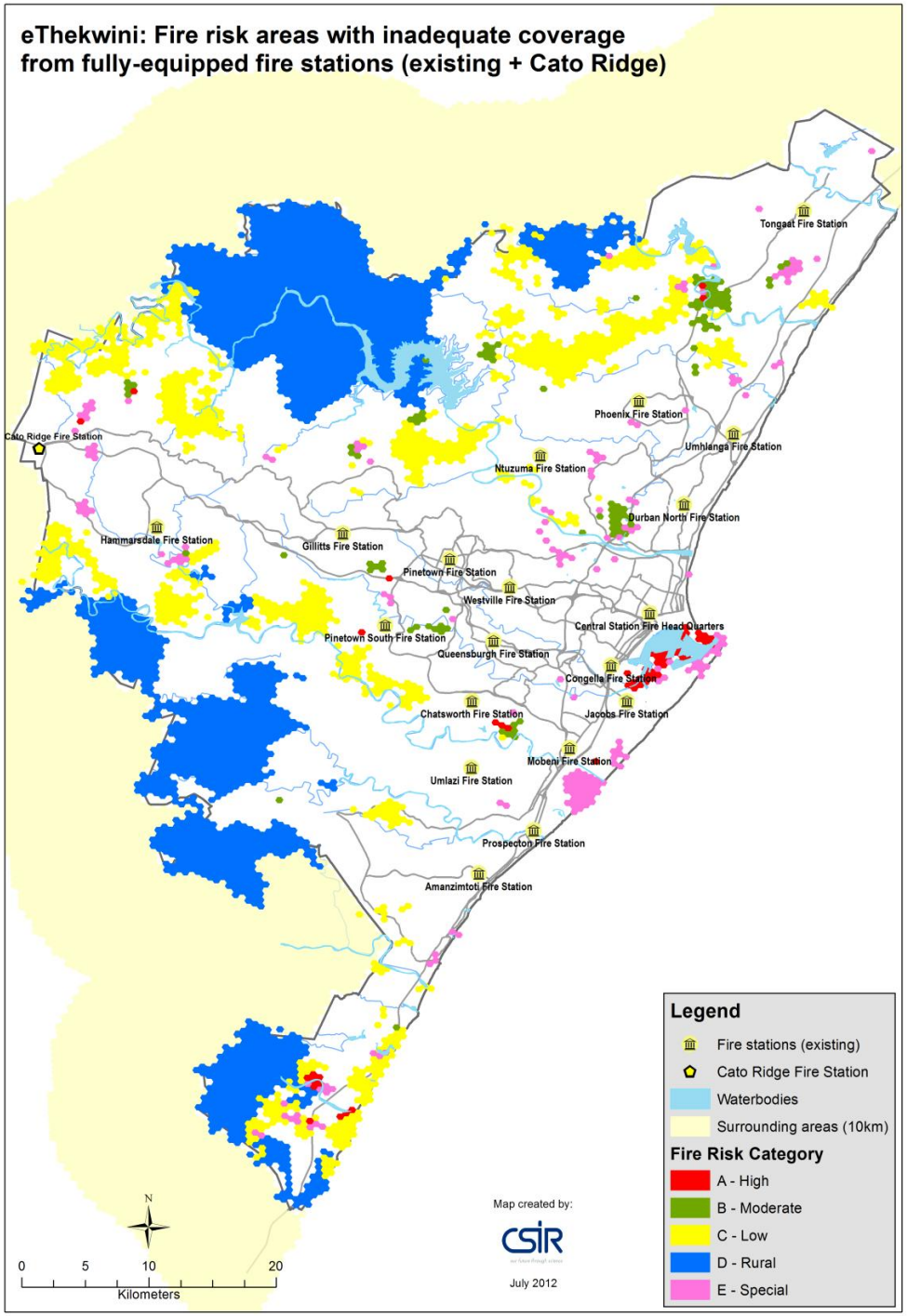
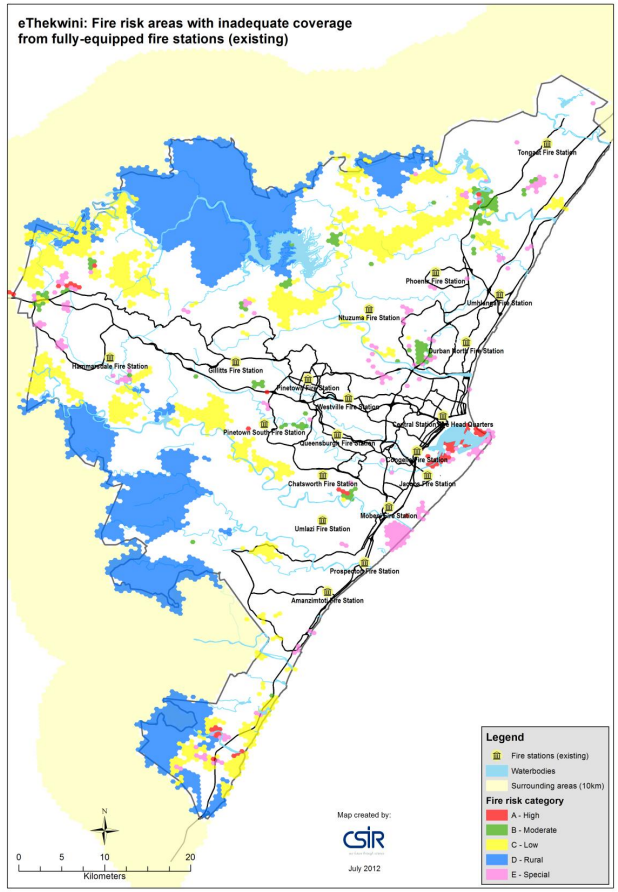
Impact of Cato Ridge Station

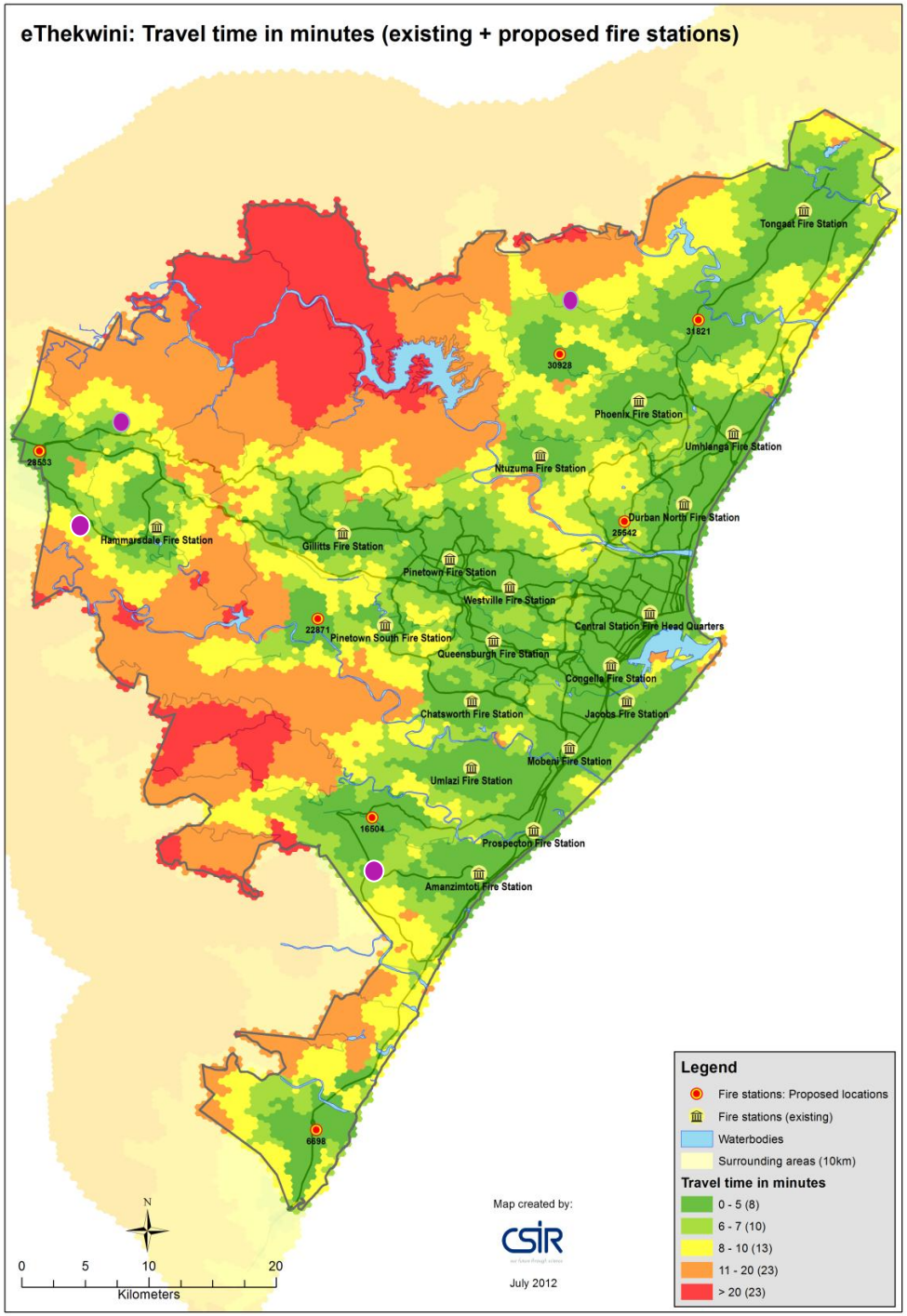
Serves additional 10 360 people in dense rural areas but covers some high risk area and has good access to high accident zone on N3

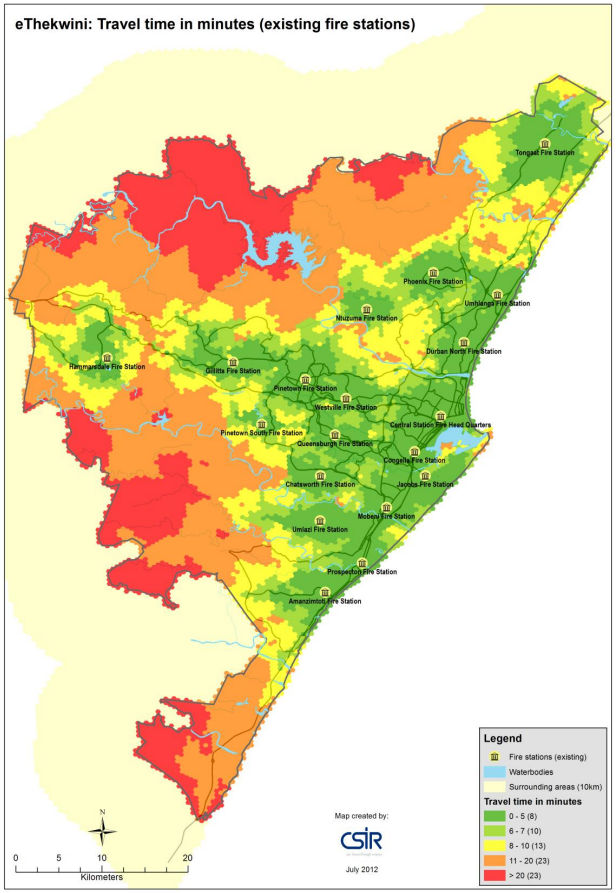




Impact of 7 new stations (Cato Ridge station + 6 proposed)

Travel time in minutes





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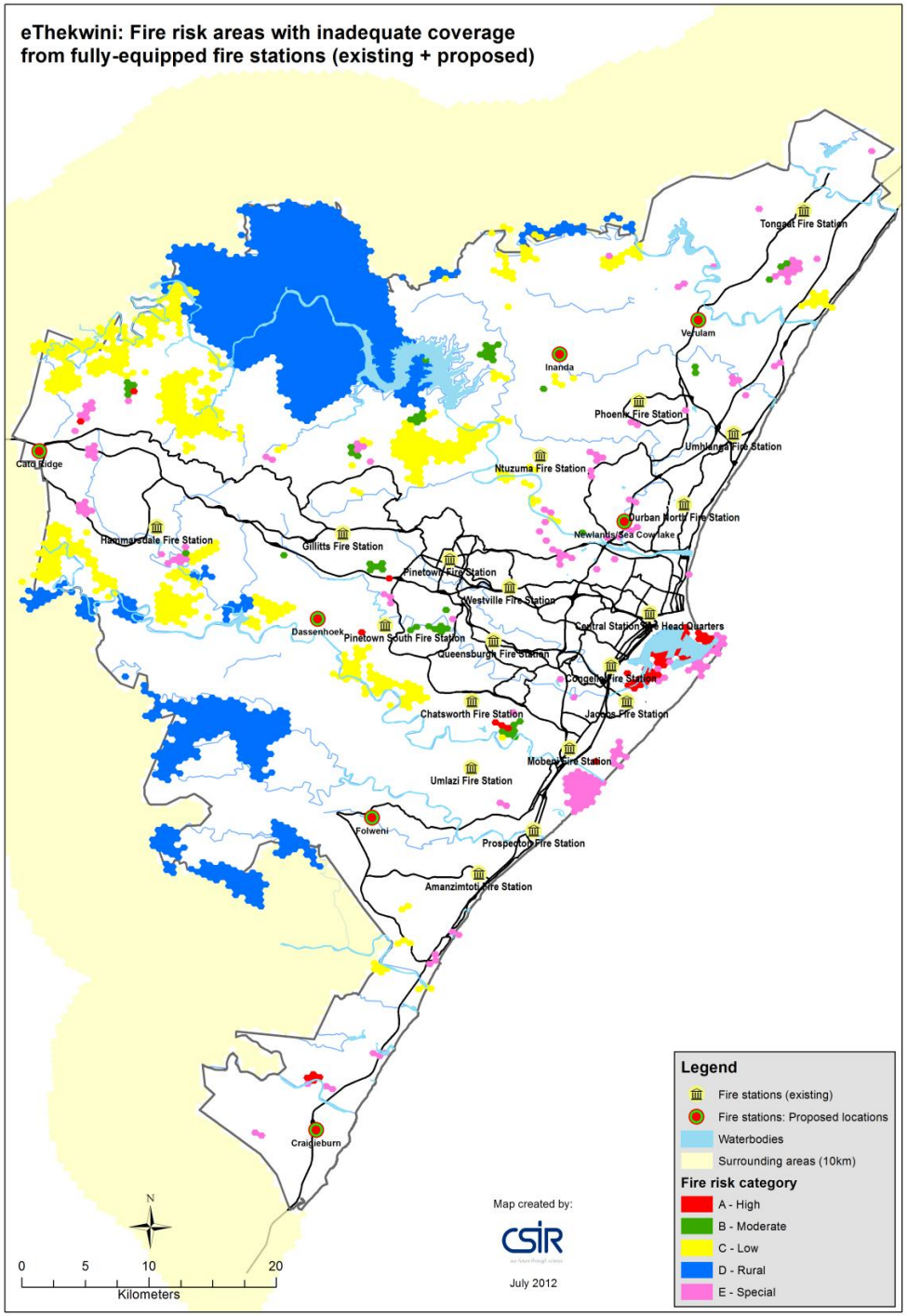

Areas with inadequate coverage after addition of 7 new stations

Fire stations (Existing + Proposed): Level of Access

Density zones	*Unserved*	Served	% Served	Total population
Rural	*30 878*	81 687	72.57	112 565
Dense rural	*117 827*	284 068	70.68	401 895
Urban	*100 444*	3 052 284	96.81	3 152 728
Grand Total	***249 149***	**3 418 039**	**93.21**	**3 667 188**

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Service statistics for proposed stations with respect to the 2011 population

Proposed hex location	Name	Hexagons in catchment	Population served*	Percent of total population served	Total area (ha) served
16504	Folweni	743	146 986	4.01%	14 860
22871	Dassenhoek	512	75 804	2.07%	10 240
25542	Newlands / Seacow lake	126	65 053	1.77%	2 520
28533	Cato Ridge	474	25 917	0.71%	9 480
30928	Inanda	586	104 628	2.85%	11 720
31821	Verulam	680	119 181	3.25%	13 600
6698	Craigieburn	674	57 928	1.58%	13 480
Grand Total		**3795**	**595 496**	**16.24%**	**75 900**

*includes previously unserved plus currently served

Detail statistics of potential coverage of population and area by fire risk category for the 7 proposed new locations

Proposed hex location	Proposed fire location	Fire risk category	Population served*	Total area (ha) served
28533	Cato Ridge	A - High	7	80
28533	Cato Ridge	B - Moderate	399	260
28533	Cato Ridge	C - Low	16 587	1 180
28533	Cato Ridge	D - Rural	8 878	7 820
28533	Cato Ridge	E - Special	45	140
6698	Craigieburn	A - High	1 411	160
6698	Craigieburn	B - Moderate	177	20
6698	Craigieburn	C - Low	28 262	2 460
6698	Craigieburn	D - Rural	25 875	10 660
6698	Craigieburn	E - Special	2 203	180
22871	Dassenhoek	A - High	-	-
22871	Dassenhoek	C - Low	63 869	1 480
22871	Dassenhoek	D - Rural	11 935	8 760
16504	Folweni	B - Moderate	271	60
16504	Folweni	C - Low	75 889	1 320
16504	Folweni	D - Rural	70 826	13 480
30928	Inanda	B - Moderate	-	-
30928	Inanda	C - Low	78 311	2 760
30928	Inanda	D - Rural	26 317	8 960
25542	Newlands/Sea Cow lake	B - Moderate	3 469	500
25542	Newlands/Sea Cow lake	C - Low	59 481	1 780
25542	Newlands/Sea Cow lake	D - Rural	1 918	220
25542	Newlands/Sea Cow lake	E - Special	185	20
31821	Verulam	A - High	199	40
31821	Verulam	B - Moderate	5 494	800
31821	Verulam	C - Low	90 193	4 800
31821	Verulam	D - Rural	22 085	7 900
31821	Verulam	E - Special	1 210	60

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Recommendations

- Use model outputs such as population and area served together with local knowledge, call out history, etc. to motivate future expansion programme
- May need to specifically map informal settlements and backyard shacks
- Consult with local planners on growth strategy
- Test existing location coverage, as well as proposed, against growth scenario plan

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