A climate impact related transport infrastructure risk assessment for the City of Cape Town

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Aim of the analysis

To quantify the volume of transport infrastructure at risk of weather-related hazards in the City of Cape Town and to estimate the direct economic value thereof.





Climate Forecast for the CoCT

- Decreased annual average rainfall
- Change in the seasonality of rainfall
- Increased mean annual temperatures
- Higher maximum temperatures (more hot days, and more frequent and intense heatwaves)
- Increased average wind strength
- Increased intensity and frequency of storms, leading to short, high intensity rainfall events
- Increased size and duration of coastal storms
- Sea level rise





Greenham et al 2022

Risk Estimation Methodology



Transport Infrastructure Risk Assessment



Summary of Transport Infrastructure at Risk

		High	Coastal	Coastal			Low Fire		
		Exposure	Flooding	Flooding	Flooding	Flooding	Station	Combined	Whole
Infrastructure	Unit	Areas	High Risk	All Risk	High Risk	All Risk	Proximity	Exposure	CoCT
All roads	m	2 932 960	404 582	525 902	304 060	489 759	2 110 100	13 945	12 128 700
National roads	m	30 361	26 174	30 337	25 977	30 359	252 299	1422	491 515
Minibus taxi									
ranks	No.	30	2	4	0	1	4	0	57
MyCiti stops	No.	247	340	391	23	52	326	12	1 810
GABS stops	No.	1 321	229	278	105	173	635	16	5 674
Railroads	m	131 680	32 198	35 219	18 583	23 425	244 374	28	568 872
Rail stations	No.	31	12	14	5	11	4	0	92

Public Transport Route Distribution in the CoCT



Road-based public transport services at risk

		High	Coastal	Coastal	Flooding		Low Fire		
Mobility		Exposure	Flooding	Flooding	High	Flooding	Station	Combined	Whole
impacts	Unit	Areas	High Risk	All Risk	Risk	All Risk	Proximity	Exposure	CoCT
Minibus									
taxi									
routes	Route-m	6 364 790	1 487 030	1 998 070	598 222	1 443 490	4 807 000	68 069	23 736 600
Minibus									
taxi stops	No.	21 196	1 261	2 800	892	1 828	5 367	31	60 617
MyCiti									
routes	Route-m	280 596	242 149	295 166	48 341	122 501	327 160	10 841	1 620 520
GABS									
routes	Route-m	14 532 100	1 891 680	2 630 410	1 309 860	2 140 990	7 758 200	51 482	62 297 100

Socio-Economic Impacts

Socio- economic impacts	Unit	High Exposure Areas	Coastal Flooding High Risk	Coastal Flooding All Risk	Flooding High Risk	Flooding All Risk	Low Fire Station Proximity	Combined Exposure	Whole CoCT
Education	Number of schools	266	13	16	21	32	866	0	1754
Healthcare	Number of facilities	46	2	2	2	6	16	Ο	160
Employment	Number of people	1094980	375264	412870	632394	813232	38750	55162	1341950
Population at risk	Number of people	3070620	1006790	1115040	1752990	2179210	96200	152814	3856350

Total value of infrastructure at risk in the CoCT (2021 billion Rand equivalents)

		Transp	ort infrastr	ucture	Socio-econ	Combined				
Risk arouning		((R bn 2021)		(F	(R bn 2021)				
	Roads (rebuild)	MyCiti	GABS	Taxi ranks	Rail (steep slope)	Transport total	Healthcare facilities	Schools	Socio- economic total	Total
High Exposure Areas	12.11	2.07	0.07	0.99	4.73	19.98	27.02	6.32	33.35	53-33
High Risk of Coastal Floods	1.74	3.05	0.01	0.04	1.26	6.11	1.59	0.31	1.90	8.00
All Risk for Coastal Floods	2.24	3.27	0.02	0.23	1.40	7.16	1.59	0.38	1.97	9.13
High Risk of Floods	1.29	0.58	0.01	-	o.68	2.56	0.00	0.50	0.50	3.06
All Risk of Floods	2.18	2.04	0.01	0.02	0.97	5.22	3.18	0.76	3.94	9.16
High Fire Damage Risk	9.05	1.72	0.04	0.14	7.51	18.45	3.19	20.58	23.77	42.22
Simultaneous Risk Exposure	0.07	0.32	0.00	-	0.00	0.39	-	-	-	0.39
Areas										

Mitigation

Increasing transport resilience: (Greenham et al, 2022) Anticipate – actions to prepare in advanceto respond to shocks and stresses

Resist – actions taken in advance to help withstand or endure shocks and stresses

Absorb – actions that aim to lessen impacts (accepting that impacts will occur)

Recover – actions that help restore expected service levels quickly

Adapt – actions that modify the system to enable it to continue to deliver services

Transform – actions that regenerate and improve infrastructure systems.

Conclusions

Three main threats to the city:

- Coastal flooding potential to incur R6-7 billion worth of damage
- Flooding of low-lying areas potential to damage R2.5-5 billion worth of infrastructure
- Fire poses a risk to **12 892** kms of public transport routes in the CoCT

High risk areas contain infrastructure assets worth R20 billion

• Almost **25%** of the city's roads and more than **50%** of all substantial taxi ranks

Nearly **33%** of taxi routes and **50%** to **80%** of its labour force could be impacted

Conclusions

Infrastructure traversing the **Paarden Eiland/Maitland/Brooklyn** and **Strand** areas are the most exposed to climate related hazards

Coastal flooding will mainly affect the MyCiti system and portions of the rail network

The road network is most exposed to fire risks – fire safety protocols and disaster response plans are critical

This analysis can be used to identify and develop custom mitigation plans for critical infrastructure elements that are at high risk

Future work can include tunnels and bridges in the analysis

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