

APPENDIX A: ACRONYMS AND ABBREVIATIONS

ABS	Australian Bureau of Statistics
AEMI	Australian Emergency Management Institute
AEP	annual exceedence probability
AGSO	Australian Geological Survey Organisation
AHD	Australian Height Datum
ANU	Australian National University
ARI	average recurrence interval
AVHRR	Advanced Very High Resolution Radiometer
BLEVE	boiling liquid expanding vapour explosion
BoM	Bureau of Meteorology
C	Celsius
CBD	central business district
CCD	Census Collection District
CHEM	Chemical Hazards and Emergency Management (Unit)
cumec	cubic metres per second
DDC	Disaster District Coordinator
DEM	digital elevation model
DES	(Queensland) Department of Emergency Services
EDRI	Earthquake Disaster Risk Index
FEMA	(US) Federal Emergency Management Agency
FNQEB	Far North Queensland Electricity Board
FNQR	Far North Queensland Regiment
GIS	geographic information system
GMS	Global Meteorological Satellite
ha	hectares
HAT	highest astronomical tide
hPa	hecto-pascals
HQ	headquarters
hr(s)	hour(s)
ICA	Insurance Council of Australia
JUHI	Joint Underground Hydrant-refuelling Installation
JUMP	Joint Urban Monitoring Program
km	kilometres
km/hr	kilometres per hour
LDC	Local Disaster Committee
LPG	liquid petroleum gas
m	metres
max	maximum
min	minimum
ML	Local (or Richter) magnitude
mm	millimetres
MM	Modified Mercalli intensity
m/sec	metres per second
MEOW	maximum envelope of water
MMI	Modified Mercalli Intensity
NIBS	(US) National Institute of Building Sciences
NOAA	(US) National Oceanographic and Atmospheric Administration
PGA	peak ground acceleration

PNG	Papua New Guinea
QPS	Queensland Police Service
QUAKES	Queensland University Advanced Centre for Earthquake Studies
RAN	Royal Australian Navy
RFDS	Royal Flying Doctor Service
SEIFA	Socio-Economic Indexes for Areas
SES	State Emergency Service
IDNDR	International Decade for Natural Disaster Reduction
SLA	Statistical Local Area
SP	short period (seismograph)
TCCIP	Tropical Cyclone Coastal Impacts Program
temp	temperature
UHF	ultra high frequency
UNDRO	United Nations Disaster Relief Organisation
VHF	very high frequency
WWSSN	World Wide Standardised Seismograph Network

APPENDIX B: PARTNERS

Operational Partners

Bureau of Meteorology
Emergency Management Australia
Queensland Department of Emergency Services
Cairns City Council

Research Partners

Australian National University (Centre for Resource and Environmental Studies)
James Cook University (Centre for Disaster Studies)
James Cook University (Cyclone Testing Station)
Macquarie University (Natural Hazards Research Centre)
University of Queensland (Queensland University Advanced Centre for Earthquake Studies)

Supporting Partners

Aboriginal Coordinating Council
Australian Coordinating Committee for the IDNDR
Australian Survey and Land Information Group
Cairns Port Authority
Centre for Earthquake research in Australia
CSIRO (various divisions)
Department of Natural resources
Department of Mines and Energy
Department of Environment and Heritage
ERSIS Australia P/L
Far North Queensland Electricity Board
Fred Baynes P/L
Golder Associates P/L
Gutteridge Haskins & Davey P/L
Mulgrave Central Mill P/L
Yarrabah Community Government

APPENDIX C: ELEMENTS AT RISK DETAILS

Table C1: Cairns building use by suburb

SUBURB	Av. elev	Buildings	Houses	Flats	Accom	Business	Logistic	Safety	Comm.
Aeroglen	5.4	245	148	3		19	60	6	6
Bayview Heights	52.9	1456	1446	5					3
Bentley Park	27.6	1293	1202	59		21	5		4
Brinsmead	25.3	1050	1037	1	3	2	1		3
Cairns North	2.7	871	471	161	68	69	15	15	47
Caravonica	12.2	546	532	8	1			1	3
City	2.1	581	53	31	63	316	22	26	56
Clifton Beach	9.8	695	649	23	7	2	2		6
Earlville	19.0	1206	1040	75	3	49	9	3	20
Edge Hill	13.9	1382	1215	107	3	15	4	1	34
Edmonton	21.0	1576	1407	115	4	21	3	3	18
Freshwater	22.9	606	534	48	4	6	3	1	8
Gordonvale	19.9	1697	1526	54	4	33	8	20	40
Holloways Beach	5.1	840	694	120	17	5		1	2
Kamerunga	20.9	247	239	3	1	1			2
Kanimbla	44.8	291	281	5					
Kewarra Beach	12.1	946	903	33	1		1		8
Machans Beach	2.3	413	398	4		1	3		5
Manoora	5.9	1307	1068	191	7	22	5	3	11
Manunda	2.4	1526	1015	229	46	85	14	9	118
Moorooloolool	20.5	2062	1951	91		2	1		16
Mount Sheridan	30.6	1003	971	27		2			3
Palm Cove	13.2	310	208	29	47	7		2	7
Parramatta Park	2.3	989	667	122	2	133	13	7	37
Portsmith	2.3	812	184	39	4	392	148	8	11
Redlynch	37.6	913	875	13	3	5	4		10
Smithfield	22.0	1060	1008	2		21	9	4	14
Stratford	16.6	395	339	17	4	16	4	2	8
Trinity Beach	10.9	1019	900	78	19	9	1	2	10
Trinity Park	3.3	333	327	1		1	1		3
Westcourt	2.7	1882	1155	260	16	317	34	27	59
White Rock	9.5	1051	962	68	2	8	2		6
Whitfield	20.6	1474	1268	173	1	3	3	23	2
Woree	22.1	1298	1003	191	14	24	16	5	37
Yarrabah	6.7	312	215	17		7	3	14	42
Yorkeys Knob	4.3	721	559	130	10	4	4		11
TOTALS		34408	28450	2533	354	1618	398	183	670

- Notes:
- Counts relate to individual buildings rather than 'dwelling units' in the case of flats or 'facilities' in the case of business, etc.
 - Av. Elev** is the average ground-level elevation of all buildings in the suburb above AHD.
 - Accom** includes all commercial accommodation such as hotels, motels and caravan parks.
 - Business** includes all industrial and office buildings most commercial buildings.
 - Logistic** includes all bulk supply, cold stores, transport, storage and fuel distribution buildings major plus supermarkets and shopping malls.
 - Safety** includes all defence, police, fire ambulance, SES and medical facilities.
 - Comm.** (community) includes facilities such as churches, halls, public toilets, etc; schools and child care; recreational facilities; and government buildings.
 - The tally of individual uses may not agree with the total buildings because minor uses, such as utilities and developed open space, have not been included.

9. The rural suburbs of Barron, Kamma, Mount Peter and Wright's Creek are not included.

Table C2: Structural characteristics of Cairns houses

SUBURB	Sample Ratio	Floor height		Wall Material						Roof Material		
		Slab	<1m	>1m	Brick	Block	Timber ^r	Fibro	Metal	Metal	Tile	Fibro
Aeroglen	134:14:0	60	13	75	5	38	75	27	3	145	1	2
Bayview Heights	1362:75:9	1100	252	94	441	877	57	67	4	1311	132	3
Bentley Park	1138:57:7	1202			2	1200				1200	2	
Brinsmead	901:114:25	1005	4	28	101	860	62	10	4	1017	20	
Cairns North	438:34:1	118	40	313	18	39	279	107	28	454	6	11
Caravonica	501:31:0	514	2	16	18	451	41	20	2	482	50	
City	48:5:0	17	5	31	6	5	24	14	4	48	3	2
Clifton Beach	617:33:0	568	55	26	73	503	44	14	15	592	56	1
Earlville	1005:35:0	621	117	302	223	344	343	68	62	1017	20	3
Edge Hill	1170:47:0	692	124	399	236	428	367	157	27	1169	39	7
Edmonton	268:1139:0	1372	22	13	15	1355	18	16	3	1399	6	1
Freshwater	486:48:0	349	36	149	102	203	155	64	9	503	29	2
Gordonvale	184:441:901	1417	75	34	14	515	50	32	14	624		1
Holloways Beach	685:9:0	621	42	31	65	519	42	58	10	666	19	9
Kamerunga	136:103:0	186	6	47	11	143	75	6	4	237	2	
Kanimbla	254:26:1	278		3	22	254	3	2		258	23	
Kewarra Beach	769:134:0	891	7	5	37	833	25	6	2	805	98	0
Machans Beach	398:0:0	193	68	137	9	87	114	177	11	393	1	4
Manoora	1034:34:0	678	167	223	144	495	163	217	49	1051	16	1
Manunda	973:42:0	449	263	303	150	270	309	210	76	990	17	8
Mooroobool	1829:122:0	1784	77	90	539	1181	139	57	35	1776	175	
Mount Sheridan	768:203:0	971			9	960	2			964	7	
Palm Cove	201:6:0	170	19	15	8	157	21	19	3	193	14	1
Parramatta Park	659:8:0	150	86	431	23	69	376	131	68	658	4	5

Portsmouth	181:30	50	63	71	7	24	87	43	23	183	1
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Table C2 (cont.): Structural Characteristics of Cairns Houses

SUBURB	Sample ratio	Floor height		Wall Material					Roof Material			
		Slab	<1m	>1m	Brick	Block	Timber	Fibro	Metal	Metal	Tile	Fibro
Redlynch	667:66:142	808	8	59	25	643	12	52	1	723	10	
Smithfield	962:44:2	968	6	34	91	802	89	18	4	971	34	
Stratford	333:7:0	147	41	151	39	80	179	32	9	334	1	4
Trinity Beach	884:19:0	859	12	29	66	704	101	21	6	866	31	3
Trinity Park	327:0:0	290	28	9	17	284	11	10	4	325	1	1
Westcourt	1123:33:0	426	325	404	224	214	411	193	113	1107	17	31
White Rock	797:100:65	863	63	36	91	729	42	38		884	15	1
Whitfield	1205:63:0	876	148	244	316	591	255	89	17	1192	69	7
Woree	977:25:0	767	198	38	161	791	20	28	3	956	47	
Yarrabah	215:0:0	78	99	38		107	15	66	27	214		1
Yorkeys Knob	538:21:0	500	30	29	33	391	62	64	6	530	20	9
TOTALS		22038	2501	3907	3342	17070	4069	2134	647	26280	905	119

NOTES:

1. **Sample ratio** is the ratio between houses for which the data have been observed in the field, to those estimated (typically based on field sampling only), to those which remain unknown. Note that the largest proportion of 'unknown' are in suburbs with high proportions of rural dwellings such as Freshwater, Gordonvale and Redlynch.
2. **Slab** is taken to be 0.3m above ground level. A floor height of 0.3m (i.e. slab) has been set as the default value for 'estimated' and 'unknown' classes for inundation modelling purposes only.
3. **<1m** relates only to suspended floors.
4. **Wall Material** relates to the dominant material. In older areas there may be as many as four different wall materials in the one house.
5. **Metal** walls include aluminium and vinyl cladding, typically replacing (or covering) fibro.
6. The numbers in each group should be seen more as reflecting ratios rather than definitive and absolute values because of incomplete data in some of the southern suburbs.

Table C3: Cairns household access to vehicles (% of total households) 1996

SUBURB	0 car	1 car	2 cars	3+ cars	N/S
Aeroglen	3.8	44.8	32.2	15.3	3.8
Bayview Heights	1.1	34.1	37.2	24.1	3.4
Bentley Park	2.5	33.9	48.3	10.2	5.1
Brinsmead	2.1	30.4	45.7	17.4	4.4
Cairns North	28.6	35.4	19.4	5.1	11.4
Caravonica	8.2	42.6	39.3	4.9	4.9
City	36.2	33.0	8.5	3.2	19.1
Clifton Beach	7.7	40.6	38.3	7.7	5.7
Earlville	5.4	40.0	29.2	9.2	16.2
Edge Hill	4.4	36.4	35.1	21.5	2.6
Edmonton	7.9	44.3	36.2	6.2	5.3
Freshwater	10.5	42.6	30.2	8.5	8.1
Gordonvale	4.0	39.4	45.1	9.1	2.4
Holloways Beach	7.5	46.0	31.5	7.0	8.0
Kamerunga & Redlynch	8.2	34.7	40.8	11.2	5.1
Kanimbla	3.5	38.1	39.2	14.8	4.4
Kewarra Beach	1.4	43.9	44.9	7.1	2.7
Machans Beach	12.0	44.0	28.0	6.0	10.0
Manoora	14.5	46.6	28.1	4.1	6.8
Manunda	15.2	45.5	26.1	7.9	5.5
Mooroobool	1.5	25.0	49.5	13.5	10.5
Mount Sheridan	3.3	32.6	48.5	14.4	1.1
Palm Cove	9.1	53.6	24.6	6.0	6.7
Parramatta Park	17.2	45.2	21.5	6.5	9.7
Portsmith	42.3	38.3	9.5	0.0	10.0
Smithfield	4.2	37.9	39.1	14.2	4.6
Stratford	6.8	37.4	35.6	13.5	6.8
Trinity Beach	8.7	45.8	34.4	4.0	7.1
Trinity Park	6.0	38.6	39.5	14.1	1.8
Westcourt	24.3	42.4	19.0	7.3	7.0
White Rock	10.9	57.0	20.6	4.2	7.2
Whitfield	11.1	47.5	27.3	11.4	2.6
Woree	2.6	32.5	47.2	13.9	3.9
Yarrabah	45.2	32.8	10.7	3.8	7.5
Yorkeys Knob	19.9	45.3	24.3	3.6	6.9
TOTALS	7.9	32.0	27.6	9.5	5.7

Source: derived from data contained in *CData 96 Final Release* (ABS, 1998a)

Table C4: Variables used in the SEIFA *Index of Socio-Economic Disadvantage* (ABS, 1998b)

Variables with weights between 0.2 and 0.3

persons aged 15 and over with no qualifications (%)
families with income less than \$15,000 (%)
families with offspring having parental income less than \$15,600 (%)
females (in labour force) unemployed (%)
males (in labour force) unemployed (%)
employed females classified as 'Labourer & Related Workers' (%)
employed males classified as 'Labourer & Related Workers' (%)
employed males classified as 'Intermediate Production and Transport Workers' (%)
persons aged 15 and over who left school at or under 15 years of age (%)
one parent families with dependent offspring only (%)
households renting (government authority) (%)

Variables with weights between 0.1 and 0.2

persons aged 15 and over separated or divorced (%)
dwellings with no motor cars at dwelling (%)
employed females classified as 'Intermediate Production & Transport Workers' (%)
employed females classified as 'Elementary Clerical, Sales & Service Workers' (%)
employed males classified as 'Tradespersons' (%)
persons aged 15 and over who did not go to school (%)
Aboriginal or Torres Strait Islanders (%)
occupied private dwellings with two or more families (%)
lacking fluency in English (%)

Table C5: Variables used in the SEIFA *Index of Economic Resources* (ABS, 1998b)

Variables with weights between 0.2 and 0.4

households owning or purchasing dwelling (%)
dwellings with 4 or more bedrooms (%)
families with family structure other than two parent or single parent with dependent offspring
 or consisting of a couple only, and income greater than \$77,999 (%)
families consisting of a couple only, and with income greater than \$62,399 (%)
families consisting of a single parent with dependent offspring, with income greater than
 \$31,199 (%)
mortgage greater than \$1,300 per month (%)
rent greater than \$249 per week (%)

Variables with weights between 0 and 0.2

households purchasing dwelling (%)
households owning dwellings (%)
dwellings with 3 or more motor cars (%)
average number bedrooms per person (%)

Variables with weights between -0.2 and 0

- households in improvised dwellings (%)
- households renting (government authority) (%)
- households renting (non-government authority) (%)
- dwellings with 1 or no bedrooms (%)
- rent less than \$74 per week (%)
- families consisting of a single parent with dependent offspring, with income less than \$15,600 (%)

Variables with weights between -0.3 and -0.2

- families consisting of a couple only, and with income less than \$15,600 (%)
- families with family structure other than two parent or single parent with dependent offspring
 - or consisting of a couple only, and income less than \$26,000 (%)
- families consisting of a two parent family with dependent offspring, and income less than \$26,000 (%)
- dwellings with no motor cars (%)

Table C6: Cairns Schools

SCHOOL	ADDRESS	LOCALITY	PRE	PRI	SEC	STAFF
Aloomba State School	Neilsen Street	Aloomba		41		2
Balaclava State School	418 Mulgrave Road	Westcourt	62	561		32
Cairns Central State School	Aplin Street	City		na		na
Cairns Christian College	Brinsmead Road	Brinsmead			na	na
Cairns North State School	381 Sheridan Street	Cairns North	18	171		12
Cairns School of Distance Ed	Hoare Street	Manunda				na
Cairns SDA School	Bosanko & Gatton	Manunda		na		na
Cairns State High School	156 Sheridan Street	Cairns North			886	70
Cairns West State School	14-36 Mayers Street	Manunda	62	540		35
Caravonica State School	Kamerunga Road	Caravonica	39	531		32
Edge Hill State School	254 Pease Street	Edge Hill	100	663		41
Emmanuel College	83 Pease Street	Manoora			na	na
Freshwater State School	60 Old Smithfield Rd	Freshwater	50	437		25
Gordonvale State High Sch	85-107 Sheppards St	Gordonvale			498	40
Gordonvale State School	28 George Street	Gordonvale	88	458		29
Hambleton State School	77-81 Stokes Street	Edmonton	50	556		32
Holy Cross School	Reed Road	Trinity park		na		na
Machans Beach State School	61 Machans Street	Machans B		107		
Mother of God Counsel Sch	392 Sheridan Street	Cairns North		na		na
Our Lady Help of Christians	18 Balaclava Road	Earlville		na		na
Parramatta State School	122 Mulgrave Road	Parramatta Pk	66	312		28
Redlynch State School	Jungara Road	Redlynch	50	265		19
Smithfield State High School	O'Brien Road	Smithfield			966	70
St Augustine's College	Scott Street	Parramatta Pk			na	na

St Francis Xavier's School	5 Atkinson Street	Manunda		na		na
St Gerard Majela	63 Anderson Road	Woree		na		na
St Joseph's School	11 Loeven Street	Parramatta Pk		na		na
St Mary Catholic College	Anderson Road	Woree			na	na
St Michael's School	58 Mill Street	Gordonvale		na		na
St Monica's College	179 Abbott Street	City			na	na
St Therese's School	135 Roberts Road	Bentley Park		na		na
Trinity Anglican School	Poolwood Road	Kewarra Bch		na		na
Trinity Anglican School	Leftwich Street	White Rock		na		na
Trinity Bay State High School	Hoare Street	Manunda			1085	80
Trinity Beach State School	Wewak Street	Trinity Beach	98	702		40
White Rock State School	Progress Road	White Rock	50	401		22
Whitfield State School	McManus & Marino	Whitfield	38	425		25
Woree State High School	Rigg Street	Woree			910	67
Woree State School	82-96 Windarra St	Woree	96	775		43
Yarrabah State High School	Back Beach Road	Yarrabah			76	na
Yarrabah State School	Beach Street	Yarrabah	105	307		36
Yorkeys Knob State School	Clinton Street	Yorkeys Knob		156		8

NOTE: The enrolment and teacher statistics for state schools were derived from Department of Education data for 1996. No comparable data are available for non-government schools. State preschools are typically (but not exclusively) co-located with their respective primary school.

Table C7: Cairns Child Care Centres

CENTRE	ADDRESS	SUBURB
Bayview Heights Community Kindergarten	6-8 Jasper Street	Woree
Bib an Baya Day Care	9 Brose Street	White Rock
Boopa Werem Kindergarten	12 Barrett Street	Westcourt
Brinsmead Valley Child Care	Loridan Drive	Brinsmead
Cairns Noahs Ark	92 Little Street	Manunda
Callum Early Learning Daycare	100 Callum Street	Mooroobool
Casey Clowns Childcare	274 Buchan Street	Westcourt
Cat and Fiddle Kindy and Childcare	60-64 Roberts Road	Bentley Park
Child Care and Development Association	108 Collins Avenue	Edge Hill
Childrens Centre	88 Balaclava Road	Earlville
Childs Play Day Care Centre	38 James Street	Manunda
Community Childcare Centre	Newton Street	Manunda
Eastville Early Learning	29 Cavallaro Avenue	Earlville
Edmonton Community Kindergarten	19 Hartill Street	Edmonton
Gordonvale Community Childcare	69-75 Moller Street	Gordonvale
Holloways Beach Kindergarten	7 Jacaranda Street	Holloways beach
Jack and Jill Daycare	70 Anderson Street	Manunda
Juniors Childcare Centre	160-162 Hoare Street	Manoora
Just Kids Childcare Centre	219 Draper Street	Parramatta Park
Karatane Kindy and Child care	2-4 kangaroo Street	Bentley Park
Kawana Day Care	3 Charlotte Close	Woree
Kewarra Beach Early Learning	11-13 Cottesloe Drive	Kewarra Beach
Kiddie Academy	12-14 Reservoir Road	Manoora
Kids and Hugs Day Care	Alfred Street	Manunda
Kids Corner Day Care	24 Ravizza Drive	Edmonton
Kindercare	21-23 Fisher Road	Gordonvale
Kindergarten Woree	614 Bruce Highway	Woree
Mulgrave Day Care	466 Mulgrave Road	Earlville
Mulgrave Road Day Care	464 Mulgrave Road	Earlville
Novotel Palm Cove Child Care Centre	Coral Coast Drive	Palm Cove
Preschool Day Care Centre	3 Marino Street	Whitfield
Seventh Day Adventist Child Care Centre	282-284 Birch Street	Manunda
Smithfield Childcare Centre	Cheviot Street	Smithfield
Sheridan Childcare	381 Sheridan Street	Cairns North
Tamarind Gardens Child Care	36-38 Trafalgar Road	Mount Sheridan
Tot Stop Child Care and Preschool	2-4 Slathiel Street	Brinsmead
Waratah Day Care Centre	8 Waratah Drive	Manunda
Windarra Day Care Centre	27 Windarra Street	Woree

Yarrabah Preschool Centre	Smith Street	Yarrabah
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Table C8: Variables used in the SEIFA *Index of Education and Occupation* (ABS, 1998b)

Variables with weights between 0.2 and 0.4

- employed males classified as 'Professionals' (%)
- employed females classified as 'Professionals' (%)
- persons aged 15 and over at CAE or university (%)

Variables with weights between 0 and 0.2

- employed males classified as 'Associate Professionals' (%)
- employed females classified as 'Advanced Clerical & Social Workers' (%)
- employed males classified as 'Advanced Clerical & Social Workers' (%)
- employed males classified as 'Intermediate Clerical, Sales & Service Workers' (%)

Variables with weights between -0.2 and 0

- employed females classified as 'Tradespersons' (%)
- employed males classified as 'Tradespersons' (%)
- employed females classified as 'Elementary Clerical, Sales & Service Workers' (%)
- employed females classified as 'Intermediate Production & Transport Workers' (%)

Variables with weights between -0.4 and -0.2

- employed males classified as 'Intermediate Production & Transport Workers' (%)
- employed females classified as 'Labourer & Related Worker' (%)
- employed males classified as 'Labourer & Related Worker' (%)
- males (in labour force) unemployed (%)
- females (in labour force) unemployed (%)
- person aged 15 and over who left school at or under 15 years of age (%)
- person aged 15 years and over with no qualifications (%)

Table C9: Cairns Community Organisations

SPORTS AND HOBBIES REPRESENTED	SERVICES REPRESENTED
Archery	Aboriginal and Torres Strait communities
Athletics	Apex
Badminton	Asthma Association
Baseball	Australian American Association
Basketball	Blind Association
Bird fanciers	Boy Scouts
Bowling	Chamber of Commerce and Industry
Cars and motor racing	Conservation and environmental groups
Cats	Country Women's Association
Chess	Croatian community
Country music	Diabetes Association
Coursing and kennel	Endeavour Foundation
Cricket	Epilepsy Association
Dance	German community
Fishing	Girl Guides
Flying and gliding	Historical Society
Football (all codes)	Hungarian community
Gem and lapidary	Jaycees International
Golf	Lyons International
Gymnastics	Masonic and other lodges
Hockey	Police and Citizens Youth Club
Life saving and surfing	Professional and business groups
Martial arts	Rape Crisis and Incest Services
Model aeroplanes	Red Cross
Netball	Returned Services League
Racing, hunting and pony	Rotary
Scuba diving	Rotaract
Shooting	RSPCA
Squash	St Johns Ambulance
Swimming	Soroptimists International
Table tennis	UFO Research
Tennis	Women's Information and Referral
Vigoro	Yarrabah Women's Resources Centre
Volleyball	Young Australia League
Yachting and boating	Zonta International

Table C10: Cairns Critical Facilities

FACILITY	STREET	SUBURB	HAZARDOUS
ABC Studios	Sheridan St	City	
ABC Radio Transmitters	Warner Rd	Gordonvale	
Airport Control Tower	Airport Ave	Aeroglen	
Airport Rescue and Fire Service	Sir Sydney Williams St	Aeroglen	
Ambulance Station Cairns	Anderson St	Manunda	
Ambulance Station Edmonton	Hartill St	Edmonton	
Ambulance Station Gordonvale	Cannon St	Gordonvale	
Ambulance Station Smithfield	Stanton Rd	Smithfield	
Ambulance Station Yarrabah	Stanley Rd	Yarrabah	
Ampol Fuel Depot	Bunda St	Portsmith	major
Bethlehem Nursing Home	Gatton St	Westcourt	minor
Boral Gas Depot	Draper St	Portsmith	major
Cairns Central	McLeod St	City	yes
Cairns City Council Centre	Little Spence St	Portsmith	
Cairns City Council Works Depot	Martyn St	Manunda	yes
Cairns City Council Works Depot	Highleigh Rd	Gordonvale	yes
Cairns Crocodile Farm	Redbank Rd	Kamma	yes
Cairns Hospital	Abbott St	Cairns North	yes
Cairns Port Facilities	Wharf St	Portsmith	yes
Caltex Fuel Depot	Kenny St	Portsmith	major
Calvary Hospital	Abbott St	City	yes
Country Bake Bakery	Spence St	Westcourt	
Country Bake Bakery	Supply Rd	Bentley Park	
CSR Bulk Sugar Terminal	Cook St	Portsmith	yes
FARNOHA Nursing Home	Lyons St	Westcourt	minor
Festival Faire	Alfred St	Manunda	yes
Fire Station Cairns	Gatton St	Westcourt	minor
Fire Station Gordonvale	Cannon St	Gordonvale	
Fire Station Smithfield	Lesley St	Smithfield	
FNQEB Cairns Substation	Hartley St	City	yes
FNQEB Gordonvale Substation	Highleigh Rd	Gordonvale	yes
FNQEB Kamerunga Bulk Supply	Kamerunga Rd	Caravonica	yes
FNQR 51 st Battalion Depot	Coxall St	Westcourt	yes

Fresha Products Cold Stores	Redden St	Portsmith	yes
Fortuna Seafood Cold Stores	Tingiri St	Portsmith	yes
Garozzo Agencies Wholesale Food	Redden St	Portsmith	yes
Gordonvale Memorial Hospital	Alley St	Gordonvale	minor
Good Samaritan Nursing Home	Tills St	Westcourt	minor
HMAS Cairns	Draper St	Portsmith	major
INCITEC	Dutton St	Portsmith	major
Mobil Fuel Depot	Kenny St	Portsmith	major
Nazareth Village Nursing Home	Gatton St	Westcourt	minor
Police Station Cairns	Sheridan St	City	
Police Station Smithfield	Captain Cook Hwy	Smithfield	
Police Station Yarrabah	Back Beach Rd	Yarrabah	
Portsmith Cold Stores	Redden St	Portsmith	yes
Pyramid Retirement Centre	Cairns Rd	Gordonvale	minor
Sewerage Treatment Plant	Greenbank rd	Aeroglen	yes
Shell Fuel Depot	Draper St	Portsmith	major
Smithfield Plaza	Captain Cook Hwy	Smithfield	yes
Southern Pollution Control Centre	Maconachie St	Woree	yes
FACILITY	STREET	SUBURB	HAZARDOUS
Stockland Plaza	Mulgrave Rd	Earlville	yes
Telephone Exchange Cairns	Shields St	City	yes
Tong Sing Wholesale Fruit & Veg	Little Spence St	Portsmith	yes
Water Treatment Plant Kanimbla	Reservoir Rd	Kanimbla	yes
Water Treatment Plant Yarrabah	Back beach Rd	Yarrabah	yes
WB Winfield Nursing Home	McManus St	Whitfield	minor
Westcourt Plaza	Mulgrave Rd	Westcourt	yes
Yarrabah Hospital	Smith St	Yarrabah	minor
Yarrabah Council Works Depot	Workshop Rd	Yarrabah	yes

Notes:

- major = nature and quantity of hazardous materials poses a major potential threat
- yes = nature and quantity of hazardous materials poses a moderate threat
- minor = nature and quantity of hazardous materials poses a minor threat

APPENDIX D: CAIRNS BUILDING DATABASE FORMAT

The following list provides details of the table structure employed for the *BUILDING* database.

UFI	Integer	
Feature	Character	35
Address	Character	35
Suburb	Character	25
Type	Character	1
Fl_ht	Decimal	3,1
Gd_ht	Decimal	6,2
Stories	Decimal	2,0
Walls	Character	1
Roof	Character	1
Ro_shape	Character	1
Ro_pitch	Character	1
Windows	Character	1
Plan_reg	Character	1
Vert_reg	Character	1
Age	Character	1
Bldg_year	Character	4
Units1	Decimal	2,0
Units2	Decimal	2,0
Units3	Decimal	3,0
Plan_reg	Character	1
Vert_reg	Character	1
Status	Character	1
Comments	Character	35
Lot_plan	Character	15
Longitude	Decimal	9,4
Latitude	Decimal	9,4
Std50	Character	1
Std100	Character	1
Std500	Character	1
Std1000	Character	1
Std10000	Character	1
V_zone	Decimal	4,2
Velocity	Character	1
Slope	Integer	
Aspect	Character	2

NOTE: in the following description, attributes in **bold** need to be collected in the field; attributes underlined are typically derived from council data but need to be verified in the field; attributes in plain text are derived from other sources.

A brief explanation of the thresholds adopted is also provided where appropriate.

The first group of fields provide for unique identification and description of the feature.

- UFI* Unique Feature Identifier - unique number for each record. Computer generated.
- Feature* Name of the feature or its occupant or use as indicated by signs on or at the feature.
- Number* The building number in the street - used for mapping annotation purposes only.
- Address* Street address of the feature including number and street name.
- Suburb* Suburb, town or locality name.
- Type* Major activity conducted at feature as identified from field observation. The following broad activity groups have been used and features displayed with the symbols indicated in the following table:

CODE	CLASSIFICATION	SYMBOL	COMMENTS
P	Public safety - police, fire, ambulance, SES, defence, etc	12pt solid cross, black	<i>Sensitive facilities</i> related to the provision of emergency response
S	Storage and transport - features that support road, rail, air and sea transport and storage (eg warehouses)	12pt solid dot, orange	<i>Sensitive facilities</i> that contribute significantly to community sustainability
L	Logistics - bulk supplies of fuel, gas & food including supermarkets and service stations	12pt solid dot, yellow; 18pt solid dot yellow is used for major complexes	<i>Sensitive facilities</i> that contribute significantly to community sustainability
D	Doctors and other health services - hospitals, nursing homes, clinics, dentists, etc	12pt solid cross, green	<i>Sensitive facilities</i> that provide all forms of health service
U	power Utilities - generation, distribution and service facilities	12pt solid star, black	<i>Sensitive facilities</i> that provide, manage or service power supplies
W	Water supply and sewerage utilities - above ground storage, treatment, pumping, etc	12pt solid dot, light blue	<i>Sensitive facilities</i> that store, treat or reticulate water and sewerage services or manage and service those utilities
T	Telecommunications - radio, telephone, TV, etc	12pt asterisk, black	<i>Sensitive facility</i> that provide, manage or service communications services

A	Accommodation - commercial (non private) accommodation such as hotels, motels & resorts	10pt solid square, red	<i>Special risks</i> associated with commercial accommodation where concentrations of people are found - typically short term accommodation
B	Business - commercial and professional facilities such as shops, offices, etc	10pt solid square, yellow	<i>Special risks</i> associated with shopping centres and other places of business
E	Education - schools, TAFE, convents, child care centres, etc	12pt 'flagged building', red	<i>Special risks</i> associated with concentrations of children
R	Recreation facility - sporting clubs, grandstands, etc	10pt solid square, green	<i>Special risks</i> associated with periodic concentrations of people
I	Industry - manufacturing and processing industries such as sawmills, sugar mills, cement plants, ship building, etc	12pt solid triangle, yellow	<i>Special risks</i> associated with either processes and materials used and/or concentrations of people
H	Houses - private, detached houses only	9pt solid diamond, black	Detached houses only
F	Flats - includes all multi-occupant private dwellings including units, town houses and apartments	9pt solid diamond, red	All forms of private accommodation other than detached houses - includes self contained holiday units or apartments typically used for longer stays than motels, resorts, etc
C	Community facilities - churches, halls, public toilets, libraries, scout huts, monuments, etc	12pt solid dot, purple	Mainly non-government facilities providing direct service to the community
G	Government facilities - offices, depots, etc of all levels of government	12pt solid dot, dark blue	Facilities from which government services are provided or administered
Z	Miscellaneous features - eg sheds, car parking structures, etc	10pt open square, black	Generally minor or low use features
O	Open space - features such as parks, reserves, etc	10pt open green square	Land without buildings used for parks, reserves, etc
V	Vacant land	9pt solid circle, pale green	Used only for land that is intended for buildings.

The next group of attributes describe aspects of the building that contribute to its vulnerability to a range of hazards.

Fl_ht Height of the floor above ground level. Estimated to the nearest 10cm. A value of 0.3 indicates a slab construction. A default value of 0.3 is also used where field observed data are not available

Gd_ht Height of the ground (above the Australian Height Datum - AHD) at the centre of the

feature. Derived from DEM.

Stories The number of stories above ground.

Walls Material from which the features walls are constructed with the following codes:

B brick, masonry or stone
C concrete block
P precast concrete slab
R reinforced concrete frame
T timber
F fibro
M metal

Roof Material from which the roof is constructed with the following codes:

T tiles
F fibro
M metal
C concrete

Ro-shape Predominant roof shape with the following codes:

H hip ended
G gable ended

Flat roofs are automatically gable ended.

Ro_pitch Roof pitch with the following codes:

H high (>1:4 slope)
L low (< 1:4 slope)
F Flat

Tiled roofs are automatically high pitch. The thresholds were recommended by Mr Greg Reardon of the James Cook University Cyclone Testing Station to differentiate slopes that will have greater (low slope) or lesser (high slope) 'lift' from strong winds.

Windows The relative size of individual windows with the following codes:

L large windows or glass doors (i.e. greater than 75% of wall height occupied by glass in a given window or door)
S small windows
N no windows
O open walls

Plan_reg Plan regularity - an observation of the plan configuration geometry regularity of the building based on Figure A1 of AS1170.4-1993 (*Earthquake loads*) with the following codes:

R regular (essentially square or rectangular)

- I irregular (“T”, “L”, “U” or other irregular shape)
- U unknown, not observed

If collateral evidence exists of plan irregularity other than geometric (eg mass resistance eccentricity or discontinuity of diaphragm stiffness) then the appropriate code should be used with details placed in the *Comments* field.

Vert_reg
regularity

Vertical regularity - an observation of the vertical configuration geometry and stiffness ratio (eg ‘soft story’ construction) based on Figure A2 of AS1170.4-1993 (*Earthquake loads*) with the following codes:

- R regular
- I irregular
- U unknown, not observed

‘Queenslander’ style houses or ‘six pack’ blocks of flats in which the main mass of the building is elevated on posts or piles and the open under-space occupied by garages etc should be coded as Irregular. If collateral evidence exists of other forms of vertical irregularity (eg in mass ratio irregularity caused by a roof-top swimming pool) then the appropriate code should be used with details placed in the *Comments* field.

Age

Estimated date of construction with the following codes:

- A built since 1995
- B built between 1985 and 1994
- C built between 1975 and 1984
- D built between 1965 and 1974
- E built between 1955 and 1964
- F built before 1955

In general terms these dates reflect significant changes in building regulations and/or practice (eg first wind loading code introduced in 1975, upgraded in 1984-85; earthquake loading code for domestic structures effective by 1995; brick veneer construction techniques became vogue after 1955).

Bldg_year

Year in which the building was completed. Used only where adequate council records are available or where there is other evidence such as a heritage plaque.

The following fields describe the number of dwelling units contained in multi-resident features such as flats, apartments and units or businesses in commercial complexes.

Units1

The number of separate occupiable dwelling units (discrete flats, apartments, town houses, motel/motel suites, etc) with the lowest dwelling space (not including laundries, garage, etc) located on the ground floor (level 1). Estimated to be at least 95% accurate where recorded. Typically based on a count of letter boxes; some data for commercial accommodation taken from material provided by the operator of the feature or from the RACQ accommodation guide.

Units2 The number of separate occupiable dwelling units with the lowest dwelling space located on the second level. Other parameters as for *UI*.

Units3 The number of separate occupiable dwelling units with the lowest dwelling space located on the third or higher levels. Other parameters as for *UI*.

The following fields provide for additional data and for an assessment of the general data quality.

Status An indication of the source of the detailed data with the following codes:

- O observed - field collected
- E estimated - based on sample or cursory observation
- P interpreted from aerial photos
- U unknown - yet to be collected

Comments Note field for added information on the feature derived from field notes.

The following fields provide linkage to other databases such as the rates or DCDB.

Lot_plan The lot-on-plan description of the parcel of land on which the feature object is located. Derived by computer from the DCDB and/or council data.

Longitude Decimal longitude derived by computer from the feature object location using AGD84 as the datum.

Latitude Decimal latitude derived by computer from the feature object location using AGD84 as the datum.

The following fields provide information related to hazard exposure. They have been derived from other data including the DEM and floor height.

Std50 Exposure of building to a 2% AEP storm tide where:

- A more than 1 m over floor level
- B water over floor level but less than 1 m
- C water on property but not over floor level

Std100 Exposure of building to 1% AEP storm tide with coding as for *Std50*

Std500 Exposure of building to 0.2% AEP storm tide with coding as for *Std50*

Std1000 Exposure of building to 0.1% AEP storm tide with coding as for *Std50*

Std10000 Exposure of building to 0.01% AEP storm tide with coding as for *Std50*

V_zone Discounting value applied to sea wave height on top of surge height and wave setup to estimate increased inundation level. Values used are 0.8 in the first 150

metres of the coast, 0.4 in the second 150 metres and 0.2 in the third 150 m from the coast. These values were derived from data provided in Smith and Greenaway (1994).

Velocity

Distance from the shore where:

- A within 750 m of the shore
- B 750 to 1 500 m from the shore
- C greater than 1 500 m from the shore

These are more or less arbitrary values except that the 750 m threshold is, according to Smith and Greenaway (1994), the distance by which sea wave velocity is largely dissipated.

Slope

Average slope of the property derived from the DEM in the following zones:

- 3 Slopes from 0 to 3 degrees
- 6 Slopes from 3 to 6 degrees
- 12 Slopes from 6 to 12 degrees
- 17 Slopes from 12 to 17 degrees
- 30 Slopes from 17 to 30 degrees
- 90 Slopes from 30 to 90 degrees

These values are derived from AS 1170.2-1989 *Wind loads*.

Aspect

Direction to which the property faces, derived from the DEM, in the following zones:

- N North
- NE North-East
- E East
- SE South-East
- S South
- SW South-West
- W West
- NW North-West
- O Omnidirectional (flat - no obvious aspect)

APPENDIX E: A METHODOLOGY FOR ASSESSING RELATIVE COMMUNITY VULNERABILITY

In **Chapter 1** we described the approach adopted by the *Cities Project* to assess community risk. At the heart of that approach is the view of total risk as being the outcome of the interaction between a hazard phenomenon, the elements at risk in the community and their degree of vulnerability to that impact. The relationship was summarised in the expression:

$$\text{Risk}_{(\text{Total})} = \text{Hazard} \times \text{Elements at Risk} \times \text{Vulnerability}$$

In **Chapter 3** we describe individual aspects of the community and the contribution they make to community vulnerability. We also present an assessment of their relative contribution to the overall community vulnerability of Cairns. In this Appendix we describe the methodology we have developed to produce that relative assessment and the philosophy that underpins it.

The Challenge

Over the past three or four years, a large amount of high resolution data has been accumulated on the hazard phenomena, buildings, infrastructure and people of Cairns. Whilst those data provide a detailed quantitative description of specific aspects of the city's risk environment, they do not, of themselves, provide an adequate measure of overall community vulnerability. Nor do they individually reflect the relative levels of vulnerability across the city. We considered it to be highly desirable, however, to be able to identify those parts of the city that would provide a potentially disproportionate contribution to community risk, regardless of the hazard involved, because of the number and nature of the elements at risk they contained.

The challenge, then, is to develop a measure, or index, that enables us to rate suburbs on the basis of their contribution to overall risk.

Vulnerability Indices

There is little in the risk management or disaster management literature to use as a guide to construct such an index. Whilst the two workshops held at the Australian Emergency Management Institute (AEMI) at Mount Macedon in April and September 1995 contributed significantly to our understanding of vulnerability as a concept, they were not conclusive where the development of a 'vulnerability index' was concerned.

One of the few worked-through examples of a 'risk index' we have found is the Earthquake Disaster Risk Index (EDRI) approach developed by Dr Rachel Davidson (1997), now at the University of North Carolina at Charlotte. EDRI is being used to compare the earthquake risk in some 72 cities around the world, of which Cairns is one, as part of the *Understanding Urban Seismic Risk Around the World* Project.

The philosophy behind EDRI is similar to that which underpins the *Cities Project*. It is summarised by Davidson and Shah (1998) in the following terms:

Using a holistic approach, the EDRI attempts to measure the risk of an urban earthquake disaster. This is a broader concept than just the expected frequency of future earthquakes, or even their expected impact in terms of the number of deaths, injuries, or damaged buildings. In assessing earthquake disaster risk, the economic, social, political, and cultural context of the earthquake hazard plays a role too. An earthquake disaster is considered to be a function of not only the expected physical impact of future earthquakes, but also the capacity of the affected city to sustain that impact, and the implications of that impact to the city and to word affairs.

EDRI is based on data considered to ‘measure’ the contribution to overall risk under five factors described as follows:

- **Hazard** - Severity, extent, and frequency of the geological trigger phenomenon to which the city may be subject.
- **Exposure** - Size of the city. Number of people and physical objects, and the amount and type of activities they support.
- **Vulnerability** - How easily the exposed people, physical objects, and activities may be affected in the short or long-term.
- **External Context** - How impact within a city affects people and activities outside the city.
- **Emergency Response and Recovery Capability** - How effectively and efficiently a city can reduce the impact of an earthquake through formal, organised efforts made specifically for that purpose.

Davidson’s index is built on a range of weighted ‘indicator’ values that are combined to provide a standard measure by which to compare ‘earthquake disaster risk’ of individual cities.

The urban geography literature of the 1960’s also contains examples of research aimed at classifying areas within cities to reflect particular features such as socio-economic status. Berry and Horton (1970), for example, provide a good overview of this research. Most of these examples rely on sophisticated statistical analysis such as factor analysis and analysis of variance.

The approach we have developed here is similar in most basic respects to both EDRI and the classic geographic numerical taxonomy studies. It differs from EDRI, however, in two main ways. First, it is being used to assess the risk to a range of hazards across a single city, and second, we have not been constrained by selecting indicators that are available ‘universally’. It differs from the sophisticated multi-variate statistical techniques in that it was undertaken using MapInfo and Microsoft Excel rather than specialised and sophisticated statistical analysis software. This computationally less demanding approach was felt to be important given that it is intended for use by local governments and others responsible for undertaking risk assessments at the local level.

We have also constructed it to better ‘fit’ our risk assessment process described in [Chapter 1](#), especially the ‘five esses’ approach to the analysis of vulnerability.

Given that most members of the community already identify themselves at home and at work with a suburban locality, it was decided to use suburbs as the unit of analysis. This level of aggregation also provides computational convenience.

Assumptions

Because we are interested in showing the relative importance of each suburb to overall community vulnerability it was assumed that the most appropriate statistic to use would be the rank of the suburb in each measure. The use of rank is not without its problems. Inclusion of several variables that are highly correlated or indeed derived from the same basic statistic will obviously bias the outcome. Similarly, the inclusion of variables that have little, if any, bearing on community vulnerability could also distort the results. We feel, however, that with the careful selection of variables, rank is an appropriate statistic to reflect the relative significance of suburbs.

We have not, as yet, conducted a systematic sensitivity analysis, though our observations during the development of the techniques suggest that whilst relatively minor changes to the inclusion of variables may cause some variation to individual ranks, the overall results remained largely consistent. Further research is, however, required before this technique can be said to be ‘proven’.

The choice of suburbs as the basic unit of reference is also problematic. The distribution of variables across suburbs are far from homogeneous; nor have their boundaries been designed to facilitate statistical analysis. Their choice was driven more by simplicity in presentation than any other reason. Most people relate to the suburb in which they live and/or work, few people are even aware of what CCD, for example, they live in. Further work will be done to develop risk ‘surfaces’ and to identify the most appropriate level of resolution at which to conduct urban risk assessments.

The Setting

Given that the setting group of factors relate mainly to external factors (e.g. the source of power supply) or to factors that apply equally across all suburbs (e.g. jurisdictions) only one variable (total population) was selected.

Population: Clearly the most significant element at risk is the population of the community. Suburbs were ranked on the basis of their proportion of the total Cairns population. Whilst the boundaries of the CCDs used in the 1996 census do not align perfectly with the Cairns suburb boundaries, they are, in most instances, close enough for our purposes. The poorest fit is with the three rural suburbs of Kamma, Trinity East and Wright’s Creek which are divided between two CCDs. In this instance the values from the census were assigned to Trinity East. Mooroolool, Manoora, Westcourt and Manunda are the four most populous suburbs.

Shelter

Eight variables were selected to represent the shelter group of elements at risk.

Houses: Houses provide the most widespread form of shelter in the community and, consequently, they are considered to make a specific contribution to community vulnerability. Suburbs were ranked on their proportion of the total inventory of houses. The top four suburbs are Mooroolool, Gordonvale, Bayview Heights and Edmonton.

Four variables were used to represent the sustenance group of elements at risk.

Lifelines: We consider roads to be a good general measure of lifelines. Not only do they represent an important lifeline in their own right, the location and distribution of other lifelines such as water supply, sewerage, power supply and telecommunications are also closely related spatially to the road network. As in the previous group, suburbs were ranked on their proportion of total Cairns road length. The top four suburbs for lifelines are Gordonvale, Edmonton, Kamma and Redlynch.

Logistic facilities: These facilities contribute significantly to the sustainability of the community given that they handle, store or distribute food, fuel and other essential commodities. Their loss or dislocation would significantly limit the viability of the community. The four suburbs with the greatest proportions of the community's total logistic facility inventory are Portsmith, Aeroglen, Westcourt and Parramatta Park.

Power and water supply: The proportion of above-ground facilities supporting both power and water supply, such as power sub stations and water reservoirs, have been used to rank suburbs for this variable. The four top suburbs are Cairns North, Kanimbla, Portsmith and Manunda.

Telecommunications: A similar measure, using the proportion of above ground facilities associated with telecommunications lifelines, such as telephone exchanges and microwave towers was used. The greatest concentration is in Portsmith.

To reach a composite value for the sustenance group, the individual ranks for each variable were summed and the resulting totals ranked. Here again we gave each variable equal weight. It is clear that this has led to the significant role of the airport and the suburb of Aeroglen being under-represented. This might be overcome by including a variable such as 'transport node' to the overall theme variables. The top four sustenance group suburbs overall are Gordonvale, Portsmith, Manunda and Westcourt.

Security

Eight variables were selected to represent the elements at risk that influence community security. In this context security is seen as including health, wealth and the protective services provided. Two of the variables used here have been derived from the *Socio-Economic Indexes for Areas* (SEIFA) product produced by the Australian Bureau of Statistics from the 1996 census. The SEIFA methodology is described in detail in ABS Information Paper 2039.0 (ABS, 1998).

Public safety: Ambulance, fire, defence force, police and SES facilities, together with hospitals and other medical facilities, provide the bulk of the protective services required by the community. Their loss or dislocation would have a disproportionately large impact on overall public safety. The top four suburbs for public safety buildings are Westcourt, City, Whitfield and Gordonvale. There are, however, 24 suburbs that do not contain a public safety facility.

Business premises: These facilities make a significant contribution to the overall economy and employment situation, as well as facilitation the distribution of goods and services. The four suburbs with the highest proportions of the total business inventory are Portsmith, Westcourt, City and Parramatta Park.

Sugar cane: Given the importance of the sugar industry to the Cairns economy we have included the cane lands as an element at risk. Suburbs are ranked according to their proportion of the total area of cane land available. These data are derived from material provided by the Mulgrave Central Mill Co. The top four (of 19) cane land suburbs are Gordonvale, Kamma, Wright's Creek and Edmonton.

Relative Socio-Economic Disadvantage: The SEIFA Index of Socio-Economic Disadvantage has been compiled by the ABS by undertaking a principal components analysis on 20 weighted variables from the 1996 census. The attributes, such as low income, low educational attainment, high unemployment and jobs in relatively unskilled occupations, were selected to highlight disadvantage (see **Table C7**). The resulting index has been standardised to have a mean of 1,000 and a standard deviation of 100 across all CCDs in Australia. This means that around 95% of index scores across Australia are between 800 and 1,200. A value above 1,200 reflects a significantly high degree of advantage, whilst a value of less than 800 reflects a significantly high level of disadvantage. For this work, the mean index value for all CCDs within each suburb was taken.

For Cairns, the mean suburb index values range from a high (advantaged) value of 1,093.0 in Barron to a low (disadvantaged) value of 684.96 in Yarrabah. Suburbs were ranked in inverse order (lowest to highest) of their mean index value. Yarrabah was followed by Portsmith (842.33), Manoora (921.86) and Westcourt (930.18). At the other end of the scale, following Barron are Redlynch (1,091.73), Kamerunga (1088.68) and Brinsmead (1,082.36). Apart from Yarrabah, which is more than three standard deviations below the national mean, all values are within one standard deviation of the national mean.

Economic Resources: SEIFA also provides an Index of Economic Resources. This index is based on a profile of the economic resources of families. It is compiled from 22 weighted variables that reflect the income and expenditure of families, including measures of income, rent and home ownership (see **Table C8**). This index is also standardised with a national mean of 1,000 and a standard deviation of 100. At the disadvantaged end of the spectrum the four lowest suburbs are Yarrabah (747.48), Portsmith (839.66), Manoora (881.63) and City (889.17). At the high, end the top four are Bayview Heights (1,117.03), Brinsmead (1,101.57), Redlynch (1,096.76) and Barron (1,089.42).

People under 5 years of age: The very young are felt to be less resilient in the face of disaster impacts than older children and adults. For this attribute, we have taken the proportion of the total suburb population at the 1996 census that was under five years of age. The highest ranked suburbs are Yarrabah, Bentley Park, Trinity East and Mount Sheridan.

People over 65 years of age: The vulnerability of the elderly to disaster impact is similar to that of the very young. Here we have taken the proportion of the total suburb population at the 1996 census that was over 65 years of age. The highest ranked suburbs are Westcourt (with its four nursing homes and large retirement village), Clifton Beach, Whitfield and Trinity East.

Households renting: The proportion of households that were renting their accommodation is also seen as an indicator of economic resilience. The highest values are found in Yarrabah, Cairns North, Manoora and Parramatta Park.

The census data contains a wide range of measures, such as unemployment rate and individual or household income levels that could also be used in this group. They have not been used because they are incorporated in the SEIFA indexes.

To reach a composite value for the security group, the individual ranks for each variable were summed and the resulting totals ranked. Each variable was given equal weight. The four top suburbs overall are Westcourt, Gordonvale, Yarrabah and Portsmith.

Society

Five variables were used to reflect the social elements at risk.

Community services: A wide range of practical, social and cultural services supports the community. These range from churches and libraries, to sporting and social clubs, and from public toilets to government offices. Top ranking suburbs for the proportion of community buildings are Manunda, City, Cairns North and Yarrabah.

Visitors: Visitors are considered to have a greater inherent level of vulnerability than do residents because of their lack of familiarity with the local environment and their relative isolation from the general community. They are also the group that has the greatest concentration of non-English speakers. The figures for totals for visitors (both overseas and domestic) provided in the 1996 census were used. The four suburbs that host the greatest proportion of visitors are Cairns North, City, Palm Cove and Trinity Beach.

Education and Occupation: The third SEIFA index included in this study is the Index of Education and Occupation. This index is based on an analysis of 18 weighted variables selected to reflect the educational and occupation structures of communities (see **Table C9**). High scores reflect communities with high concentrations of people with higher education or undergoing further education and with people employed in higher skilled occupations. At the low end of the scale in Cairns are Yarrabah (807.59), Portsmith (899.91), Westcourt (935.65) and White Rock (937.43). At the high end are Palm Cove (1,085.05), Kamerunga (1,071.28), Barron (1,066.10) and Freshwater (1,061.86).

New residents: People who have lived at their census address for less than five years have been included as an indicator of a lack of local knowledge or strong community links. Suburbs were ranked on the proportion of people over 5 years of age that were living at a different address to that at the 1991 census to the total suburb population over 5 years. The highest ranked 'newcomer' suburbs are Mount Sheridan, Bentley Park, Kamerunga and Kewarra Beach.

No religious adherence: Lack of strong social links, such as adherence to a religion, are seen as an indicator of susceptibility. Suburbs were ranked on the proportion the total population who indicated in their response to the 1996 census that they had 'no religion'. The suburbs that ranked highest are Machans Beach, Portsmith, Holloways Beach and Yorkeys Knob.

To reach a composite value for the social group, the individual ranks for each variable were summed and the resulting totals ranked. As with the previous groups no attempt was made to weight the individual variables. The four top suburbs overall are Parramatta Park, Manoora, Portsmith and Yorkeys Knob.

Composite Ranking

To provide a composite rating of the relative overall vulnerability of suburbs, the ranks for each of the five groups were multiplied and the resulting products ranked. They were multiplied, rather than added, to magnify the differences. The five suburbs **that contribute most to the overall vulnerability** of Cairns are Westcourt, Manunda, Edge Hill, Gordonvale and Manoora. The four lowest ranked suburbs (i.e. the least contribution) are the largely rural, low population suburbs of Barron, Mount Peter, Wright's Creek and Kanimbla. The ranking of each suburb for each group, the rank for the combined groups together with the raw score for the composite rating are provided in [Table 3.11](#).

Each of the 'five esses' were treated as contributing equally and no weights were applied. We believe that this is reasonable for an assessment that emphasises total community risk rather than exploring a particular issue such as the magnitude of economic loss.

Further Development

It is clear that this methodology is still at an early stage of its development and that it requires further work. We have already identified a number of aspects that demand further research and development. We would also welcome any suggestions, comments and/or advice, that readers may have, to improve it.

Weighting: No attempt has been made to weight the individual variables within each group, or to weight the groups in reaching the overall value. Our research has not reached the stage where we could confidently judge the relative significance of, for example, houses, as opposed to flats, as opposed to the road network, in the shelter group; nor could we yet judge the relative contribution of each group to the overall evaluation.

There is, none-the-less, an weight inferred by simply including the attribute, and the number of attributes included in each group. The total population attribute, for example, carries a significantly greater weight than any other single attribute, simply because it is the sole attribute in the setting group. At this stage we are reasonably comfortable with this potential bias because population, after all, is the thing that turns a hazard phenomenon impact into a disaster. Likewise, we are reasonably comfortable with using the road length attribute in two different groups to represent two distinct elements at risk (roads and lifelines). It carries a greater weight in the sustenance group (where it represents lifeline density) than it does in the shelter group (where it represents road network density) simply because there are more attributes included in the latter.

Facility importance: By contrast, the importance of individual facilities such as the airport, hospitals, rail terminal, port and police headquarters to overall community vulnerability are probably under-stated because they are simply dealt with as one of a number of buildings. This is particularly an issue for those facilities, such as schools and police stations that have only limited distribution, but service a wider area. Further research is needed to incorporate their catchment suburbs in addition to the suburbs in which they actually are located. Established geographic techniques, including distance decay and nearest neighbour analysis, are likely to hold potential.

A similar problem arises with buildings that have dual or multiple functions - should they be counted in more than one attribute? For example, the control tower at the airport has only been counted as a logistic support facility; in addition to its role in the operation of the airport it is a major aeronautical telecommunications hub - equivalent in many ways to the regional telephone exchange. It was not, however, counted in the telecommunications attribute.

Facilities versus buildings: In the analysis undertaken here, the total number of buildings in a given category has been used rather than the number of facilities. This has probably produced a bias where a facility is made up of a large number of individual buildings. That facility currently makes a greater contribution than an equivalent facility that consisted of a single large building. This is most notably the case with nursing homes and schools. A sensitivity analysis needs to be conducted on this aspect.

Conclusion

Regardless of the obvious limitations in the methodology employed here to provide a measure of the relative contribution each suburb makes to overall community vulnerability, we do not believe they invalidate it, or the assessment it has produced. Whilst it is hardly a scientific test, the assessment fits our intuitive assessment fairly well - it contains no surprises. Its application in other centres, including Gladstone, Mackay, Greater Brisbane, Gold Coast, Newcastle and Sydney, will undoubtedly produce further refinements.

This is the first step on what will hopefully be a fruitful journey.