APPENDIX A: ABBREVIATIONS AND ACRONYMS

ABS	Australian Bureau of Statistics
AC	asbestos cement
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
AWS	automatic weather station
BLEVE	boiling liquid expanding vapour explosion
BoM	Bureau of Meteorology
BPA	Beach Protection Authority
C	Celsius
CBD	central business district
CCD	Census Collection District
CHEM	Chemical Hazards and Emergency Management (Unit)
cumec	cubic metres per second
DCILGP	Department of Communication and Information, Local Government and Planning
DDC	Disaster District Coordinator
DEM	digital elevation model
DES	(Queensland) Department of Emergency Services
DNR	Department of Natural Resources
EDRI	Earthquake Disaster Risk Index
ENSO	*El Niño* - Southern Oscillation
FEMA	(US) Federal Emergency Management Agency
FWC	Flood Warning Centre
FWCC	(Queensland) Flood Warning Consultative Committee
GIS	geographic information system
GMDS	Global Marine Distress and Safety System
GMS	Global Meteorological Satellite
ha	hectares
HAT	highest astronomical tide
hPa	hecto-pascals
HQ	headquarters
h(s)	hour(s)
IPCC	Intergovernmental Panel on Climate Change
IPO	Inter-decadal Pacific Oscillation
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
MPI	maximum potential intensity
MSL	mean sea level
NIBS	(US) National Institute of Building Sciences
NOAA	(US) National Oceanographic and Atmospheric Administration
PGA	peak ground acceleration
PMF	probable maximum flood
PNG	Papua New Guinea
PVC	polyvinyl chlorate
QFRA	Queensland Fire and Rescue Authority
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
SOLAS	Safety of Life at Sea
SST	sea surface temperature
TC	tropical cyclone
IDNDR	International Decade for Natural Disaster Reduction
SCDO	State Counter Disaster Organisation
SEQWB	South-East Queensland Water Board
SEWS	Standard Emergency Warning Signal
SLA	Statistical Local Area
SOI	Southern Oscillation Index
SP	short period (seismograph)
TCCIP	Tropical Cyclone Coastal Impacts Program
TCWC	Tropical Cyclone Warning Centre
temp	temperature
UHF	ultra high frequency
UNDRO	United Nations Disaster Relief Organisation
UNEP	United Nations Environment Program
UTC	Universal Time
VC	vitreous china
VHF	very high frequency
WMO	World Meteorological Organisation
WWSSN	World Wide Standardised Seismograph Network

APPENDIX B: THE SEIFA INDEXES

The following tables list the variables used by the Australian Bureau of Statistics the produce the Socio-Economic Index for Areas (SEIFA) index values used in this study. For further details of the SEIFA indexes and the methodology used to construct the most appropriate reference is ABS (1998b).

Table C1: Variables used in the SEIFA *Index of Socio-Economic Disadvantage*

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 C2: Variables used in the SEIFA *Index of Economic Resources*

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 C3: 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 (%)

APPENDIX CD: METHODOLOGY FOR ASSESSING RELATIVE COMMUNITY VULNERABILITY IN SOUTH-EAST QUEENSLAND

Ken Granger

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:

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

In Chapters 2 and 3 we describe individual aspects of the specific community under study and the contribution they make to community vulnerability. We also present an assessment of their relative contribution to the overall vulnerability of that community. In this Appendix we describe the methodology we have developed to produce that relative assessment and the philosophy that underpins it.

The Challenge

A large amount of high resolution data has been accumulated on the hazard phenomena, properties, infrastructure and people across South-East Queensland. The resolution and scope of this information varies between the eight local governments included in the South-East Queensland project area, however, there is a broad range of information that is common and consistent across the region. Whilst those data provide a detailed quantitative description of specific aspects of the each community'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 community. We considered it to be highly desirable, however, to be able to identify those parts of the community under study 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 neighbourhoods (as represented by CCDs) on the basis of their contribution to overall risk.

Vulnerability Indexes

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 has been used recently to compare the earthquake risk in some 72 cities around the world 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 world 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, however, 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 the analytical tools of the MapInfo GIS and Microsoft Excel software products rather than specialised and sophisticated statistical analysis software. This computationally less demanding approach was felt to be important given that our methodology is intended for use by local governments and others responsible for undertaking risk assessments at the local level who would not necessarily have access to the more sophisticated tools.

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.

The approach we have developed was first used in the Cairns case study (Granger and others, 1999). In the Cairns study we chose to present our analyses at the suburb level given that most members of the community already identify themselves at home and at work with a suburban locality. For the South-East Queensland study, however, we have adopted a different strategy, namely constructing the analysis at the level of the CCDs used in the 1996 national census. There are 3219 CCD covering the full South-East Queensland region under study. These units typically contain approximately 200 households.

We have chosen this approach for two reasons. First, suburb boundaries do not match well with CCD boundaries across the region, so it was difficult to adequately translate the census-derived statistics to the suburban level. Second, the variation in suburb size would significantly distort the statistics to such an extent that the results would have been largely meaningless.

Assumptions

Because we are interested in showing the relative importance of each CCD to overall community vulnerability it was assumed that the most appropriate statistic to use would be the rank of the CCD 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 CCDs.

A systematic sensitivity analysis of the Cairns methodology was undertaken for AGSO by the James Cook University Centre for Disaster Studies (King, Moloney and MacGregor, 2000). This analysis broadly verified the statistical integrity of the method. It also endorsed the philosophical basis of the method.

The Setting

Given that the 'setting' group of variables relates mainly to external factors (e.g. the source of power supply), or to factors that apply equally across all suburbs (e.g. jurisdictions), only four variables were selected.

Terminal facilities: The facilities that provide the interface between the study area and the rest of the world are extremely important. The facilities selected for inclusion are those that facilitate the entry of goods or services into the study area (e.g. power substations and fuel depots), export of goods from the study area (e.g. bulk loading facilities) and bi-directional facilities (e.g. airfields and telephone exchanges). In determining CCD rank, those facilities that have both an import and export function were weighted by a value of 2, whilst those with either import or export functions only were weighted by a value of 1. Those of international significance are further weighted by a multiplier of 3 (e.g. Brisbane International Airport would have a value of 6); those of national or state-wide significance are multiplied by 2 (e.g. the headquarters of a State Government department would have a value of 4). The terminals selected in the Council area are listed in Table 2.2.

Population: Clearly the most significant element at risk is the population of the community. CCDs were ranked on the basis of their total population ranging from highest value to lowest

value. The reasoning is that the larger the population, the greater the number of elements at risk and thus the greater the level of vulnerability.

Population density: CCD boundary design aims to encompass neighbourhoods of roughly equal size. To balance the absolute population figures, which are sensitive to CCD boundaries, we have also included population density, taken as the number of people per square kilometre. CCDs are ranked from the most densely populated to the least densely populated on the assumption that more densely populated areas carry a higher level of vulnerability.

Gender: The gender ratio measured in terms of the number of males for every 100 females provides a crude measure of the structure of the population. At the CCD level, it appears sensitive to the presence of institutions such as nursing homes, boarding schools and prisons where highly skewed gender ratios can be expected. CCDs were ranked from lowest value (least masculine) to highest value (most masculine) on the possibly questionable, but widely held assumption, that males are more resilient than females.

Suburb-level composite: A composite view of the setting group of variables at the CCD level was produced by simply adding the ranks for each CCD for each setting variable and standardising the sum by expressing it as a percentage of the maximum possible setting rank sum (ie the number of CCDs times 4 – the number of variables in the 'setting' group). This is the 'setting vulnerability index' used in Chapter 3 in which the lower the index value, the higher is the assumed level of that CCD's contribution to overall community vulnerability within the setting category.

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. CCDs were ranked on the number of houses included in the 1996 census data provided in ABS (1998a) even though it is now four years out of date. This is clearly a problem in an area like South-East Queensland where growth since 1996 has been large and rapid, but uneven. It was considered preferable to use this source, rather than sources such as local government land use data, for consistency across the region. CCDs are ranked from largest number of houses to smallest, on the assumption that more houses equate to higher levels of vulnerability.

Average house occupancy: CCDs were ranked on the average number of people living in separate houses at the 1996 census. This is a reasonable measure of household size. CCDs were ranked from highest value to lowest value on the basis that larger households are more vulnerable than small households.

Flats: Flats are the second most significant form of shelter. The census data provides tallies of the number of individual dwelling units rather than buildings. CCDs were ranked from highest value to lowest value on the same basis as used for houses.

Average flat occupancy: Household size in flats was assessed from the average number of people living in flats in each CCD. These data were also taken from the 1996 census and relate to the occupancy of individual flats. CCDs were ranked from largest average household to smallest average household.

Residential ratio: The proportion of properties used for residential purposes to the total number of properties provides a measure of relative dominance of residential land use. Residential buildings were taken to include houses and flats and were based on land use data provided by each of the local governments in the region. The strategy of ranking CCDs from highest residential ratio value to lowest ratio value reflects the disaster management priority given to people before other elements at risk. This variable also provides some degree of update on the population distribution changes since the 1996 census.

Road network density: The road network provides the means for people to move to and from shelter. The assumption is made that the more dense the network, the greater will be urban mobility. Nodes (i.e. road intersections) were extracted from the road network data used in the GIS and the ratio of nodes to total road length in each CCD was tallied to give a measure of network density. This was chosen as a better measure of network density than road length alone; the ranking of the larger, rural CCDs can be inflated due to the longer road lengths involved, even if the density of the network is very low.

Cars: Private cars are clearly amongst the most important assets owned by households. They are also susceptible to damage or loss from a wide range of hazards. CCDs were ranked on the estimated total number of cars to which households had access. This figure was derived from the statistics provided in the 1996 census data for household access to vehicles. Whilst it may not be a completely accurate absolute measure, it is felt to be a good relative measure. CCDs were ranked from most cars to least cars as simple measure of the number of elements-at-risk present.

Households with no car: This variable has both socio-economic significance and great relevance for emergency managers should evacuations be required. The value used here is the proportion of households within each CCD that do not have access to a car according to the 1996 census. CCDs are ranked from greatest proportion of car-less households to lowest proportion on the assumption that households with limited independent mobility are more vulnerable.

Suburb-level composite: A composite view of the shelter group of variables at the CCD level was produced by simply adding the ranks for each CCD for each shelter variable and standardising the sum by expressing it as a percentage of the maximum possible shelter rank sum (ie the number of CCDs times 8 – the number of variables in the 'shelter' group). This is the 'shelter vulnerability index' used in Chapter 3 in which the lower the index value, the higher is the assumed level of that CCD's contribution to overall community vulnerability within the shelter category.

Sustenance

The variables potentially available for use to assess the vulnerability derived from the facilities that sustain the community differ from local government to local government across the region because of the wide disparity in available relevant data. Five variables were available consistently for each area and these were adopted as the standard measures for the sustenance group of elements at risk.

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 total number of properties classified as having a logistic or transport and storage function, based on council land use data, are tallied for each CCD. CCDs are ranked from largest number of logistic facilities to

the lowest. No attempt is made to weight facilities on the basis of their size or function though this may be considered as a future refinement.

Water supply facilities: The number of above-ground facilities supporting the water supply and sewerage systems, such as treatment plants, pumping stations and reservoirs, have been tallied for each CCDs. These data are based on council land use data and other sources, including field inspections and the UBD. Again, CCDs were ranked from greatest number to smallest number on the basis that the more facilities exposed, the greater the risk to the community.

Power supply facilities: The number of above-ground facilities supporting the power reticulation system, especially power substations and switching yards, have been tallied for each CCD. These data are based on council land use data and details provided by both Energex and Powerlink. Again, CCDs were ranked from greatest number to smallest number on the basis that the more facilities exposed, the greater the risk to the community.

Telecommunications facilities: The number of telephone exchanges, as identified by Telstra, were tallied for each CCD. CCDs were again ranked from greatest number to smallest number on the basis that the more facilities exposed, the greater the risk to the community.

Lifeline length: Unfortunately, not all councils in the South-East Queensland region have available detailed data on their utility assets in a form suitable for this study, nor was it possible to obtain adequate data on telecommunications and some power reticulation infrastructure. It was considered that the total length of road in each CCD would be a suitable (and available) surrogate. We feel that this is reasonable because lifelines such as water supply, sewerage, power supply and telephone cabling are closely related spatially to the road network. CCDs are ranked on from the highest value(s) to the lowest.

Suburb-level composite: A composite view of the sustenance group of variables at the CCD level was produced by simply adding the ranks for each CCD for each sustenance variable and standardising the sum by expressing it as a percentage of the maximum possible sustenance rank sum (ie the number of CCDs time 5 – the number of variables in the 'sustenance' group). This is the 'sustenance vulnerability index' used in Chapter 3 in which the lower the index value, the higher is the assumed level of that CCD's contribution to overall community vulnerability within the sustenance category.

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) 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, 1998b).

Public safety: Ambulance, fire, defence force, police, SES, life saving and coast guard 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 tally of these facilities in each CCD, based on council land use data and other collateral sources (including the Department of Emergency Services, the College of General Practice and the Department of Health) is used. CCDs are ranked from the

largest number of facilities to the smallest number. No attempt has been made to weight the tally on the basis of the size or importance of each facility.

Business premises: These facilities make a significant contribution to the overall economy and employment situation, as well as facilitating the production and distribution of goods and services. Again, the tally of facilities classified as having a business or industrial function in each CCD, based on council land use data and other collateral sources, is used. Again, CCDs were ranked from largest number to smallest number without weighting.

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 C1). The resulting index has been standardised to have a mean of 1000 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 1200. A value above 1200 reflects a significantly high degree of advantage, whilst a value of less than 800 reflects a significantly high level of disadvantage. CCDs are ranked from lowest index value (most disadvantaged) to highest (least disadvantaged).

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 C2). This index is also standardised with a national mean of 1000 and a standard deviation of 100. Again CCDs were ranked from lowest index value (lowest resource levels) to highest value (greatest resources).

People under 5 years of age: The very young are felt to be physically less resilient in the face of disaster impacts than older children and adults. For this attribute, we have taken the proportion of the total CCD population at the 1996 census that was under five years of age. CCDs are ranked from greatest proportion to smallest proportion.

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 CCD population at the 1996 census that was over 65 years of age. Again, CCDs are ranked from greatest proportion to smallest proportion.

Households renting: The proportion of households that were renting their accommodation is also seen as an indicator of economic susceptibility. The statistic is calculated as the proportion of all households that are renting their accommodation. CCDs are ranked from largest proportion to smallest proportion.

Unemployment: A widely used indicator of economic vulnerability is the rate of unemployment. The rate for each CCD is included in the 1996 census data and was used here because of its availability and consistency with other measures. We have assumed that whilst the actual rates of unemployment may have changed since 1996, the relative distribution probably has not. CCDs are ranked from highest unemployment rate to the lowest.

Suburb-level composite: A composite view of the security group of variables at the CCD level was produced by simply adding the ranks for each CCD for each security variable and standardising the sum by expressing it as a percentage of the maximum possible security rank

sum (ie the number of CCDs time 8 – the number of variables in the 'security' group). This is the 'security vulnerability index' used in Chapter 3 in which the lower the index value, the higher is the assumed level of that CCD's contribution to overall community vulnerability within the security category.

Society

Eight variables are used to reflect the social elements at risk.

Community facilities: A wide range of practical, social and cultural services support the community. These range from schools, churches and libraries, to sporting and social clubs, and from public toilets to government offices. The number of such facilities in each CCD, based on council land use data and collateral information, was tallied and CCDs ranked from greatest number to least number.

Large families: In a disaster situation, especially where evacuations are involved, larger families are frequently at a disadvantage. In this context 'large' families were taken to be those with three or more children or other dependants living at home. The proportion of the total number of families that are classed as 'large' in each CCD was calculated from the 1996 census data. CCDs are ranked from greatest proportion to lowest proportion.

Single parent families: Single parent families, especially those who are 'women-led', are also felt to be particularly vulnerable, both socially and economically. The 1996 census data does not permit women-led single parent families to be separately identified from the total, though it seems safe to assume that the majority of such families will have a female as the sole adult. This is supported by the fairly strong correlation between high values of single parent households and high femininity values from the 'setting' group. The proportion of all families which have only a single parent present was calculated and CCDs ranked from largest proportion to smallest proportion.

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. In many tourist destinations they are also the group that has the greatest concentration of non-English speakers. The percentage of visitors (both overseas and domestic) in the total CCD population in the 1996 census is used. CCDs are ranked from greatest proportion of visitors to lowest.

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 C3). High scores reflect communities with high concentrations of people with higher education or undergoing further education and with people employed in higher skilled occupations; conversely low index values indicate low educational levels and largely unskilled employment categories. CCDs are ranked from lowest index value (low education and occupation status) to largest index value (high education and occupation status).

New residents: People who had lived at their census address for less than five years have been included as an indicator of the potential lack of awareness of the local disaster environment and of potentially low levels of community coherence. Whilst the census data on these 'new residents' include longer-term residents who have simply moved residence within the area, the

great majority have moved from other statistical local areas (SLA). CCDs are ranked on the proportion of the total population that were living at a different address to that at the 1991 census with ranking from greatest proportion to least proportion.

No religious adherence: Lack of strong social links, such as adherence to a religion, is seen as an indicator of weaker community ties, and thus susceptibility. CCDs were ranked on the proportion of the total population who indicated in their response to the 1996 census that that they had 'no religion', from greatest proportion to least proportion.

Elderly living alone: Experience with evacuations and disaster response, and with hazards such as heat wave, suggests that elderly people who are living alone represent a special category of people in the community who are especially susceptible. Not only do they have general lower mobility, they tend to be somewhat isolated, apart from support by services such as home nursing and meals on wheels. The proportion of the total population who are over 65 years of age and living alone in each CCD at the 1996 census is the statistic used. CCDs are ranked from largest proportion to smallest proportion.

Suburb-level composite: A composite view of the societal group of variables at the CCD level was produced by simply adding the ranks for each CCD for each societal variable and standardising the sum by expressing it as a percentage of the maximum possible societal rank sum (ie the number of CCDs time 8). This is the 'societal vulnerability index' used in Chapter 3 in which the lower the index value, the higher is the assumed level of that CCD's contribution to overall community vulnerability within the societal category.

Composite Ranking

To provide a composite rating of the **relative contribution of each CCD to overall community vulnerability**, the ranks for all variables for each CCD are summed and standardised by expressing them as a percentage of the maximum possible total rank sum (ie the number of CCDs time 33). This produces the composite index used in Chapter 3 in which the lower the index value, the higher is the assumed level of that CCD's contribution to overall community vulnerability.

Ranking Strategy

Where values of a given variable were equal in two or more CCDs, the same rank was applied to each. Where there were multiple CCDs with no value recorded (e.g. no power supply facilities present) a strategy was adopted to rank the zero-value CCDs with the median value of remaining ranks so as to maximise the difference between low and no values. For example, in a set of 100 CCDs where only the first 20 had values, rather than giving all the zero values a rank of 21, they were given the rank of 60 (i.e. the mid point of the remaining values).

Further Development

It is clear that this methodology is still evolving and that it requires further work. We would welcome any suggestions, comments and/or advice, that readers may have to further improve it.

Weighting: Apart from the 'terminals' variable, no attempt has been made to weight the individual variables within each group. Our research has not reached the stage where we can confidently judge the relative significance of, for example, houses as opposed to flats, as opposed to the road network, in the shelter group; nor can we yet judge the relative contribution of each group to the overall evaluation.

There is, none-the-less, a weight inferred by simply including the attribute in the assessment.

Facility importance: By contrast, the importance of individual facilities such as airports, hospitals, rail terminals, ports and police headquarters to overall community vulnerability are probably under-stated because they are each simply dealt with as a single facility. This is particularly an issue for those facilities, such as airports and police stations that have only limited distribution, but service a wide area. Further research is needed to incorporate their catchment or service areas in addition to the neighbourhoods 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 facilities that have dual or multiple functions - should they be counted in more than one attribute? Where we have adequate information we have added 'facilities' to reflect those additional functions. For example, where the local counter disaster coordination centre is housed in the council offices, a 'public safety' facility has been added.

Further consideration is also needed to take account of the functional significance of facilities and the degree to which the functions they provide can be taken up by other facilities in the event of loss or isolation. Functional significance can be measured in terms of the extent of the impact of a facility being lost. A local 'corner store', for example, has a relatively localised catchment and people who rely on it can easily find an alternate source of the same services in an adjacent neighbourhood or at a higher order facility such as the suburban supermarket or regional shopping plaza. It has a low order of functional significance and a high degree of redundancy. A fuel refinery, power station or an international airport, by contrast, have at least international, national and State-level significance, in addition to their local significance. The loss of those facilities would cause a significant dislocation to the local, state and national economies, especially if alternate facilities within the region did not have the capacity to easily handle the extra demand. Such facilities have a high order of functional significance and a low degree of redundancy.

Conclusion

Regardless of the obvious limitations in the methodology employed here to provide a measure of the relative contribution each neighbourhood 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 will undoubtedly produce further refinements. We are none-the-less encouraged by the endorsement of our methodology by King and MacGregor (2000) who make the comment:

> *The selection of the social indicators is based on the definitions of the elements of vulnerability in the model. Thus rather than debate the pros and cons of different variables, or attempt to weight some of the indicators, which we know will change the ranking of individual communities, it is worthwhile refining the (*AGSO*) model towards adoption as a standard for measuring vulnerability. If we use a standard in all locations as a basis for* (measuring) *vulnerability to multiple hazards, measurements can be recalculated and added to relatively easily, thereby maintaining a continually available classification of community vulnerability for all communities.*

We certainly see our the method described here as the first step on what will hopefully be a fruitful journey.

Appendix D: Tropical Cyclone IMPACTS in South-East Queensland

Date of event / cyclone	Impact
17-19 Mar 1864	Long period of gales in Brisbane. Finished and unfinished houses, stores, sheds, awnings, and signs blown down; roofs and portion of roofs carried away; trees blown down and gardens devastated. Tremendous gales off the coast on 18th. Stone jetty washed away at Cleveland. Considerable wind and rain damage at Toowoomba and trees down at Gladstone. Severe flood at Maryborough reached 27 feet (8.2m) above low water. Water reached the eaves of cottages and one homestead was swept away. The barque *Panama,* 414 tons, was wrecked on the 18th on Breaksea Spit near Sandy Cape with 10 people on board. At 4 am on 19th wind shifted from ESE to NW with increased violence. The ship was then driven onto the beach and broke in two. One of the crew drowned and ten were lost and never seen again.
21 Apr 1867	Severe flood and gale at Brisbane and Ipswich; loss of life occurred; houses were unroofed and damage was done to the new Victoria Bridge works.
26-28 April 1867	Heavy gales and floods in South-East Queensland. Wind lasted several hours at Ipswich (27th) and trees uprooted in all directions with some houses damaged and cattle killed or maimed by falling branches. Great damage done to crops and railway embankments. At Logan (27th), trees uprooted in all directions. At Warwick verandah coverings torn to ribbons. Lowest wharves covered by floods in Brisbane. Many dwelling houses flooded. Fences were blown in all directions, windows were smashed and verandahs carried away. Trees were blown out of the ground. Wind lifted house off its foundations and carried it 9 metres. Barometer down to 993 hPa at sea level in Brisbane. Floods destroyed the bridge at Ipswich.
19-25 Jan 1887	Heavy gale and rains over southern part of Queensland with intense damage. 19th-21st - W to NW gale off Double Island Point with telephone lines down along the coast - Goodna flooded, houses under water. 22nd - rail lines cut out of Brisbane - Bowen Bridge 5 feet (1.5m) under water at 4pm, washed away by 6.30pm. 23rd - very high flood Brisbane with several lives lost by drowning and widespread property damage. 24th - 18 inches of rain (457mm) in 24 hours at Brisbane - railway line washed away; Laidley- boats rescuing people; South Brisbane - two men drowned - enormous amount of timber lost to sea - all the bathing houses washed away at Sandgate - large trees blown down in different directions - fearful loss of property on the Logan River with the destruction of the railway bridge. 25th - The steamer *Barrabool* ran aground in Brisbane River and two sailors drowned. Flooding also at Bundaberg, Maryborough and Gympie (river 40 feet (12.2 m) above normal). One newspaper (Maryborough *Chronicle*) had the loss of life around Brisbane as 70.
11 Mar 1890	TC crossed south Queensland coast. Brisbane River flooded. 24 hour rainfall totals to 360 mm. Barometer at Maryborough 996 hPa 9.30 pm 9th with freshening and veering SW to NW winds, barometer down to 985 hPa 7 am 10th. Flood at Gympie 47 feet (14.3 m) above normal. Cyclonic affects at Gunalda 9th/10th
2 Apr 1892	TC recurved over Brisbane with 2 deaths. Wind raged from 8am to 4pm Sat 2nd and the lowest barometric pressure at Brisbane (corrected to sea level) was 991.5 hPa at 2.30 pm. Clement Wragge quoted the wind strength in Brisbane at 60 to 70 knots. 4.94 inches (125mm) of rain fell in Brisbane during the storm. Details of damage in inner parts of Brisbane: City - fences down, glass cracked, iron structure blown over and landslide at North Quay. New Farm area – several houses partially unroofed and balconies badly damaged at Bowen Terrace. Chimney blown over at Teneriffe. South

Date of event / cyclone	Impact
	Brisbane- sheds and outhouses unroofed, fences down, house unroofed on Julia St and church destroyed on top of Highgate Hill. Kangaroo Point - several houses destroyed and unroofed, St Mary's Church of England (stone building) badly damaged. Spring Hill- roof from house hit horse and killed it. Another house unroofed in Upper Edward Street and fences down. Botanic Gardens- large shade trees levelled, snapped off close to roots. Red Hill- two shops completely demolished in Musgrave Road, a veranda blown away in Cairns Street and a house destroyed corner of Latrobe Terrace and Enoggera Terrace. Brisbane River- wind blew funnel of *Bonito* off, three of the crew blown overboard and one drowned. Samford Road –farmer killed when his cart overturned trying to dodge fallen trees. Breakfast Creek - rose rapidly at high tide at noon and kept rising during the afternoon, flooding low parts. House blown over at Eildon Hill and some houses partially unroofed and verandas wrecked at Hamilton. Beenleigh - a great deal of damage, iron ripped from many roofs, windows blown in, trees uprooted and fences blown down. Widespread damage Southport and Tweed. Schooner *Bellringer* with cargo of 49,000 feet of cedar driven ashore at Stradbroke Island.
21 Jan 1893	TC recurved over Brisbane. Many trees uprooted , signboards carried away and a few houses in the suburbs demolished. At Maryborough on the 21st, winds were southerly in the morning, west in the afternoon and turned cyclonic north-westerly in the evening with the greatest force at night.
11 Feb 1893	Short lived TC crossed the coast at Bustard Heads adding to Brisbane floods. Schooner (150 tons) wrecked at Inskip Point and the body of a man washed ashore. Bar dropped to 982 hPa on the *Fitzroy* in Hervey Bay on the night of the 10th/11th.
17 Feb 1893	TC crossed the coast at Bundaberg. Floods in Brisbane River rose again and at 1020 am 19 Feb came within 25 cm of peak reached a fortnight earlier. Two children drowned. TC-induced tornado in Moreton Bay levelled 20 m wide path in forest and lifted boats out of water. Blew down several houses. House at Redcliffe blown along some distance and buggies lifted into trees. Floods from Rockhampton to Grafton.
19 Feb 1894	TC passed east of Brisbane. 0.58 m storm surge measured on the Moreton Bay tide gauge.
11 Jan 1911	TC passed from the Gulf south through inland Queensland. Severe damage at Marburg and gales experienced along the whole South-East Queensland coast.
2 Apr 1927	Severe TC east of Gold Coast. Record high tide Gold Coast. One drowning and shipping disrupted.
14 Feb 1928	TC crossed the coast at Brisbane. Subsequent serious floods in South-East Queensland with 5 people drowned. Around 6am to 7am Tuesday 14/2/1928 a severe gale hit Coolangatta and Tweed Heads fairly suddenly. The winds veered from NE to E to SE. Tweed Heads Pacifique and Wells Hotels badly damaged. Heavy timber from front balconies became missiles, damaging many buildings in town which then suffered water damage. A whole section of roof with hardwood battens and 22 sheets of iron lifted and carried 120 yards. Buildings also unroofed near the Railway Station. Coolangatta: Hotel Grande had its balcony destroyed. House unroofed in Rainbow Bay. House lifted off its stumps in Dixon Street and wrecked. Tree uprooted on Greenmount Hill. Bilinga: several houses and buildings damaged. Murwillumbah: roofing iron torn off a number of houses. Several chimneys toppled over. Trees uprooted. Mullumbimby, Byron Bay and Bangalow – houses unroofed and trees blown down. Tweed Valley: house unroofed at Barneys Point and crops badly damaged. Two houses completely unroofed at Duranbah and farm buildings damaged. House unroofed at Bingham Point.

Date of event / cyclone	Impact
	Cudgen Headland (now Kingscliff) – trees uprooted and house lifted off blocks. Casino – damage to buildings with sheets of iron torn off roofs. Water damage to most premises. Lismore – damage to telephone lines and crops. Glen Innes - immense damage to crops from wind and rain, trees also down. Grafton: South Grafton flooded. Killarney: 9.5 inches in one hour - Condamine River rose 17 feet in 40 minutes.
26 Feb 1929	TC crossed the coast near Mossman. Low lying parts of Cairns flooded. Man drowned in Little Mitchell River near Mareeba. Cairns Harbour anemometer read 32 miles in the hour from 9.30pm to 10.30pm. Mon 25th : floods in the Herbert and man drowned in Mossman River. On 28th , another person drowned, giving a total of three deaths. By 28-29 February, this cyclone recurved towards south-east and redeveloped off the Central Coast. Bar down to 986.1hPa at Double Island Point 8pm 28th . Huge seas off the south coast. A passenger ship was disabled and just made it into Brisbane. Seas came up into the surf club at Kirra with much sand erosion and the rocks on the point moved. Buildings and roads damaged in Coolangatta. The seas broke over the jetty at Byron Bay. Farms were flooded at Southport and 100 houses vacated at Lismore.
4 Feb 1931	TC entered Coral Sea near Cooktown and moved down to Hervey Bay. Initially serious flooding in north Queensland with one drowning. Then major floods in South-East Queensland with 1300 homes inundated in Brisbane on 5 Feb with two drownings. Storm surge of 0.76m on Moreton Bay tide gauge. Most of the flooding was in Breakfast Creek where 1056 houses were flooded (396 above floor level). Around noon 5 Feb before the heavy rain in the creek catchment, high tide at the mouth of Breakfast Creek tide level was 1.1 m above ordinary high water spring. The subsequent flood levels above Bowen Bridge exceeded the 1893 flood levels. Severe beach erosion, Currumbin Creek mouth breached.
1 Feb 1934	TC tracked from the Gulf down to NSW coast. Serious flooding along Central Highlands (man drowned) and in South-East Queensland (child drowned). Considerable wind damage at Hervey Bay in northerly gales. Widespread shed and tree damage in Brisbane. Flooding from storm surges and large waves in Moreton and Hervey Bays. 1.16 m storm surge on Moreton Bay tide gauge (largest on record).
22 Mar 1936	TC recurved seawards of Fraser Island. Extensive erosion Gold Coast, the Southport Spit was breached and protective timber walls were constructed at Coolangatta, Kirra, Narrowneck and Currumbin. Ships showed a very large cyclonic circulation north-east of Fraser Island at 9am Sunday 22 March 1936. *Merkur* near 24.5S 154E bar 992 hPa wind SE 48-65 knots; *Malatta* near 21S 155E bar 992 hPa wind NW 23-40 knots. Cape Leeuwin sheltering in lee of Sandy Cape wind SE 48-55 knots. *Ormiston* near 23S 152.7E wind S 48-55 knots. Captain of the *Merkur* said it was hard to estimate wave heights but they towered 50 feet above him in the troughs. Huge sea and storm tide damage. Coolangatta: damage to old Kirra SLSC clubhouse. New club protected by bringing boulders and sandbags in. Several people seriously injured in car park when wave surged up into car park and floated a pile of logs which were to be used for a retaining wall. Storm tide kept floodwaters inland, flattening cane and maize crops. Southport: new channel cut through to sea from Broadwater just north of Jubilee Bridge (between present-day Southport SLSC and Sheraton Mirage). Channel 40 feet wide and one foot deep at high tide. On Sunday night (22nd) sea came 100 yards further inland from normal high tide mark. Moreton Bay: storm tide came over retaining walls at Cribb Island, Nudgee Beach, Shorncliffe and Flinders Parade Sandgate. Houses were wrecked at Cribb Island. At Sandgate the sea flooded along 9th Avenue, Griffith St and Murray St. At Redcliffe sea walls and beach buildings were

Date of event / cyclone	Impact
	damaged. The sea broke over the sea walls at Wynnum flooding the Esplanade and damaged boats. At Cleveland the tide flooded the road to Cleveland Point. Yeppoon: waves came over the sea wall and entered a beach cafe.
16 Mar 1937	TC tracked from Kimberleys to South-East Queensland, causing widespread major flooding and gales along east coast with ship foundering. Goods train wrecked near Bundaberg. Hotel and shop washed away at Childers.
19 Jan 1938	TC crossed the coast south of Bundaberg (992hPa) with gales and high seas. Damage at Hervey Bay, lower parts of Brisbane inundated at Sandgate, Cribb Island, Breakfast Creek. Severe beach erosion. Gold Coast and South Stradbroke Island inundated by sea. Floods at Casino, Kyogle. Pile Light surge 0.52 m on 2.07 m tide. Broadwater 2.41m storm tide.
27 Mar 1938	TC recurved east of Bowen. Gales, high seas and torrential rains. Harbour works damaged and bridges washed away at Mackay. Severe beach erosion Gold Coast.
6 Mar 1939	TC crossed coast near Cape Byron.
23-25 Mar 1946	TC accompanied by flood rains crossed the coast near Double Island Pt and passed over Moreton Bay and just inland of Southport at 3pm 25th. A 0.73 m storm surge recorded on Moreton Bay tide gauge (fortunately at low tide).
4 April 1946	TC passed just to the east of Fraser Island and brought heavy to flood rains to South-East Queensland.
23 Jan 1947	TC crossed the coast near Caloundra with heavy gales and high seas. Springbrook registered 706 mm of rain in 24 hours. Record floods in South-East Queensland with water up to telephone wires. Two lives were lost and widespread damage occurred from floods and high winds. 0.55 m storm surge on Moreton Bay tide gauge.
28 Jan 1948	Severe TC passed to east of Brisbane and produced a 96 knot gust at Lord Howe Island. 0.46 m storm surge on tide gauge in Moreton Bay, 1.5 m surge on foreshore.
24 Mar 1948	TC recurved over Fraser Island. Gales and high seas caused severe beach erosion over South Coast Beaches and local structural damage in adjacent areas. Tewantin reported the worst erosion ever experienced. Flooding in coastal streams.
16/19 Jan 1950	TC tracked from Gulf to Sydney. NE gales Moreton Bay and 2 metre waves. Storm surge of 0.58m on Moreton Bay gauge. Shops and houses flooded at Sandgate with houses evacuated. Sea water inundation at Wynnum with damage to boats. 7 lives lost in NSW from cyclone including girl swept by storm surge and waves off Esplanade at Cronulla. Record pressure reading of 988 hPa in Sydney.
27-28 Feb 1950	TC recurved over Gladstone and Hervey Bay. Sea water flooding at Hervey Bay. Floods South-East Queensland including north-eastern suburbs of Brisbane .
25-30 Jan 1951	TC slow moving around Fraser Island. 50 to 60 knot winds Moreton Bay. Extensive damage to boats and structural damage to buildings. Several houses undermined by sea. One life lost at Caloundra. Severe erosion Gold Coast with Southport Spit breached and had to be closed with bulldozer. Floods from rain and storm surge caused evacuation of residents on Macintosh Island, one house on the Island was blown off its stumps. Breakers were observed on the Nerang River. The road at Mermaid Beach was “feet under water”, the Burleigh skating rink and pool were smashed and great boulders were flung across the road at Currumbin.
19 Mar 1951	TC crossed the coast near Maryborough. Heavy flood rains South Coast and Darling Downs.

Date of event / cyclone	Impact
20 Feb 1954	TC crossed the coast at Coolangatta with a reading in the eye of 973 hPa. Some reports from the Coolangatta/Tweed Heads area had pressure readings to 962 hPa. Worst damage in that area around the Cudgen in NSW where some houses were blown apart and trees more than 1 metre in diameter were twisted out of the ground. Record reading of 982.7 hPa at Brisbane. Widespread structural damage Gold and Sunshine Coasts and around Brisbane. 0.64 m storm surge on Moreton Bay gauge however much worse on foreshore with boats in the tree tops at Beachmere. Waves at Kirra brought 2 metre of water onto highway picking up cars. 900 mm of rain were recorded at Springbrook in the 24 hour period up to landfall and floods combined with storm surge on the Nerang River caused evacuations of families and a dramatic rescue of people from Macintosh Is. The floods and cyclone then hit the Lismore district with gales whipping up large waves on the then 11.3 km wide Richmond River. 26 people tragically died from these unprecedented effects. Report from Richard Everingham 195 Newnham Rd Mt Gravatt who was working at the time at the Condong Sugar Mill. There were two barometers at the mill, one an aneroid registered 28.8 inches (975 hPa) while the other read 973 hPa. The eye took two hours to pass over the mill at around 11pm.
27 Mar 1955	TC crossed the coast at Bundaberg causing some structural damage there. TC induced tornado caused considerable damage to houses and churches at Yandina in a 300 m wide swath. A record flood occurred in the Mary River while a life was lost in Brisbane River floods.
19 Feb 1957	Long lived TC which produced 109 knot gust at Willis Island and went on to cross the NSW coast south of Pt Macquarie. Severe erosion by huge waves and high tides on South coast.
Beatrice 21 Jan 1959	TC crossed the NSW coast near Lismore. Severe beach erosion occurred in South-East Queensland and Northern NSW- buildings and equipment were damaged at Jack Evan's porpoise pool at Pt Danger - 90 m of a concrete wall was undermined at Coolum . Flooding caused damage in northern NSW. Earth dam burst at Stanthorpe causing damage to bridges livestock and machinery. Steamer *NatoneI* foundered off Double Island Point on the 24th.
Connie 16 Feb 1959	TC crossed the coast at Guthalungra where pressure in the eye was recorded at 948 hPa. Severe wind damage occurred at Ayr, Home Hill and Bowen. A man was killed at Ayr when a shop fell on him. At Ayr 33% of homes severely damaged, Buffalo Hall wrecked, schools and hotels unroofed. At Home Hill 100 persons homeless and no building escaped damage with every window broken in the main shopping area. 700 windmills destroyed in the Ayr-Home Hill area. The anemometer at Bowen recorded wind gusts up to 100 knots over a 2 hour period with forty homes totally destroyed, 190 badly damaged and 300 partly wrecked. Severe damage to powerhouse, saltworks, cokeworks and railways - dozens of boats swamped. Wind also caused considerable damage at Proserpine with 50 houses and the hospital badly damaged. There was even damage at Rockhampton as the cyclone moved south. Flood waters at Mackay caused evacuations and damage - Floods swept away the Mirani railway bridge and undermined the Forgan Bridge; Clermont had the worse floods since the 1916 cyclone; Laidley had its worst flood on record with 50 shops under 8 feet of water - 200 families were evacuated and 50 people were rescued from the roof tops. Killarney also had a record flood with 2 bridges swept away. In Allora people were evacuated from their homes. On the 18th Brisbane had wind gusts to 48 knots with minor damage and power lines down. Floods extended down to north-eastern NSW where a man was killed by fallen power lines.

Date of event / cyclone	Impact
Annie 1 Jan 1963	Rapidly developing TC crossed Sunshine Coast. Houses were unroofed at Buderim, Landsborough, Mt Mellum, Flaxton and Maleny and banana plantations suffered considerably. Falling trees cut power and telephone lines. Campers lost tents and caravans were capsized and small craft wrecked. Luckily it crossed at low tide as the Moreton Bay tide gauge indicated a 0.76m storm surge. Flooded streams submerged road bridges.
24 Apr 1963	TC stayed more than 500 km off the South Coast however system generated very large swells with 1000km of the easternmost Australian coast suffering varying degrees of beach erosion. American Navy vessel suffered damage off South Coast in 13 m waves. Couple were swept offshore by southerlies at Hervey Bay resulting in one death. Winds brought down power lines on Sunshine Coast.
Audrey 13- 14 Jan1964	TC tracked from the Gulf down to Coffs Harbour. There were extensive flooding and stock losses in south-western Queensland and northern NSW with wind damage in the western Darling Downs. The cyclone hit St George at 8am 14th where 52 houses lost all or part of their roofs and 22 businesses were badly damaged - 38 mm of rain was recorded in 15 min. At Goondiwindi 50 buildings were unroofed, the railway goods shed was destroyed and a church hall was flattened. Telegraph poles were snapped off. At nearby Boggabilla every building was partially or completely unroofed. Building were also badly damaged at Windorah, Quilpie, Cheepie, Charleville, Talwood, Toobeah, Pittsworth, Glen Innes and Grafton. Very heavy rain accompanied the cyclone with major flooding. Up to 294 mm of rain was recorded in South-West Queensland towns including 181 mm in 12 hours at Eulo.
Dinah 28/30 Jan 1967	*Dinah* caused severe damage at Heron Island, initially from inundation from large NE swells and a day later from winds. It recurved and passed over Sandy Cape, which recorded a central pressure of 944.8 hPa and high water 10 metres above normal. Although the cyclone was well off the coast, many trees were blown down from Rockhampton to Grafton. Houses were unroofed at Bundaberg, Maryborough and along the Sunshine and Gold Coasts. Banana and cane crops were wiped out on the Tweed Coast and a severe wind gust overturned a car at Evans Head. Huge seas and storm surge caused severe erosion at Emu Park, Yeppoon, and in the Maryborough-Bundaberg area. Storm surge inundated cane farms at Bli Bli and was knee deep in Hastings Street, Noosa. Around Sandgate, seawater 1.5 metres deep came into houses. More than one hundred homes were flooded and at Cribb Island one house was washed into the sea. Storm surge also affected the Gold Coast, with water lapping the decking of the Jubilee Bridge (which is about 1.5 metres above highest astronomical tide). A similar storm occurred on the Tweed River isolating Fingal. A section of the esplanade collapsed at Surfers Paradise.
Barbara 22 Feb 1967	TC crossed coast near Lismore. There was wind damage in the Coolangatta area with tents down and power disrupted by falling trees and flying sheets of roof iron.
Elaine 18 Mar 1967	TC moved SSE past the South Coast. Severe flooding occurred in the Brisbane creeks and in the Logan River. Further beach erosion occurred.
Glenda 2/4 Apr 1967	TC moved south 500 km east of Brisbane. Gold Coast beaches completely eroded by large waves. Six men lost their lives in two separate boat incidents in waves to 16 m off the south Queensland coast.
Dora 17 Feb 1971	TC crossed the coast north of Brisbane. There was fairly widespread structural damage at Redcliffe, the worst case being a roof removed from a block of home units. Trees and powerlines were down. Some flooding caused traffic dislocations.

Date of event / cyclone	Impact
Daisy 11 Feb 1972	*Daisy* made landfall on Fraser Island and the barometer at Sandy Cape dropped to 968.8 hPa. 200 homes were damaged at Pialba and more houses were unroofed in widely scattered townships. Forestry officials reported serious damage to forests near Maryborough and on Fraser Island. Flooding occurred throughout South-East Queensland with severe floods in Brisbane creeks. There was much damage to commercial stock in Brisbane. On the Gold Coast, the mouth of Tallebudgera Creek silted up, causing severe flooding upstream to commercial and domestic properties. Peak swell heights to 8.3 m were read at the South Nobby wave recording station on the Gold Coast. Severe erosion occurred down to Brunswick Heads and on the western side of Fraser Island where a 3 m storm surge was reported.
Emily 2 Apr 1972	*Emily* crossed the coast just to the SE of Gladstone while rapidly weakening. Wind damage was confined to trees and sheds. The cyclone had been very severe and generated huge seas. It claimed the lives of 8 seaman in three separate incidents off the southern and central Queensland coasts. Flooding occurred, with Kingaroy being isolated for a time and Breakfast Creek flooded some houses in Brisbane.
Wanda 24 Jan 1974	*Wanda* was a weak cyclone when it crossed the coast near Maryborough. The winds were strongest in the night after landfall when a high strengthened in the Tasman Sea. Tewantin and Caloundra then had easterlies averaging 50 knots and Cape Moreton had easterlies averaging 56 knots. Torrential rain followed and in the 5 days to 9am 29 Jan, falls reached 900 mm in the Brisbane area. Mt Glorious had 1318 mm. The Bureau in Brisbane recorded 314 mm in the 24 hours to 9am 26 Jan and the peak of the 1931 flood was exceeded at 9am 27 Jan. Heavy rain in the 24 hours to 3pm 27 Jan caused the major flood. In the Brisbane-Ipswich region, 6007 houses were flooded. 56 of these were destroyed or condemned. Damage on a large scale reached $200 million (1974 value). 12 people were drowned in Brisbane and Ipswich. Additionally, several elderly people suffered fatal heart attacks while being evacuated and a 2yr old child drowned in a Brisbane creek. Major floods also affected the Gold Coast and NE NSW. 700 people were evacuated from caravan parks in the Broadbeach area. Around 1000 people were evacuated from the canal estates of Miami Keys, Moana Park, Rialto, Mermaid Waters, Florida Gardens and Burleigh Waters. Houses were swamped from water up to 1.5m deep. Evacuations also occurred along the coastal strip at Surfers (where waist deep water flooded streets near the river), Miami, Nobbys (where water came up to window sills and to the tops of caravans) and Bundall Rd Southport where floods spread over the Isle of Capri and Sorrento. Evacuations were carried out at Biggera Waters, Hollywell and Paradise Point. 200 people were stranded on Hope Island and Nerang was completely isolated. In total 2500 Gold Coast people were evacuated. The Nerang River rose to a record level of 9.91 m. Heavy swells caused severe beach erosion along the southern Queensland and NE NSW coasts. The South Nobby station recorded significant swell heights to 4.5 metres. Maximum heights were probably nearly double this. The maximum storm surge associated with *Wanda* was 1.0 m between Noosa and Double Island Pt.
Pam 6 Feb 1974	*Pam* was a very large intense cyclone which passed 500 km to the east of Brisbane. However, a 0.68m storm surge was recorded on the Moreton Bay gauge and combined with a king tide, the high tide of 7 Feb on the gauge reached 3.13 m (a record).This rise in sea level flooded Brisbane creeks at high tide and caused cancellation of some bus services. Along the open coast the beaches were already severely eroded due to earlier cyclones and this amplified the effects of run up from the large waves generated by *Pam*. At Palm Beach residents had to abandon their houses and units as seawater drove

Date of event / cyclone	Impact
	over 6.2 metre boulder walls and surged through these premises. The South Nobby Wave Station recorded long period swells (13.1 sec) with a significant wave height of 3.8 m.
Zoe 13 Mar 1974	*Zoe* crossed the coast at Coolangatta and then recurved back out to sea. There was no significant wind damage, however, flooding was extensive with major floods in Brisbane creeks cutting main roads and some houses were flooded. Major flooding occurred in northern NSW and 200 people were evacuated in Murwillumbah and 500 families were evacuated at Lismore. Landslides cut the main railway line in 4 places between Casino and Coffs Harbour. There was severe erosion along the Gold coast beaches and the significant wave height at South Nobby reached 3.8 m.
David 19 Jan 1976	*David* crossed to the north of St Lawrence. It passed over Gannet Cay AWS where a central pressure of 970 hPa was recorded. It was intensifying right up to the time of landfall. A feature was its huge size with gales extending from PNG waters down to Lord Howe Is. It generated huge swells and these combined with large tides caused extensive damage to Heron Island as it passed to the north. It crossed the coast in a sparsely populated area; however, winds unroofed 30 buildings in Yeppoon and several in Mt Morgan. Wind gusts reached 95 knots at Pine Islet and 84 knots at the Gladstone Met Office. Large seas combined with high tides caused considerable damage to breakwaters, retaining walls and other structures especially at Rosslyn Bay Harbour (Yeppoon) where the breakwater was destroyed along with yachts and trawlers. Storm tides flooded houses and shops at Urangan, Noosa and Kirra. Storm surge at Beachmere on Moreton Bay cut all roads into the town. The Port of Brisbane was closed. At wave recording stations the significant wave (peak) height reached 5.8 m (9.2 m) at Double Island Point and 3.8 m (7.6 m) at Yeppoon. Tides were up to one metre above predicted levels.
Beth 22 Feb 1976	*Beth* crossed the coast just to the north of Bundaberg. The cyclone was very asymmetric, with a band of hurricane force winds on the southern flank caused by interaction with an intensifying high to the south. Widespread damage occurred in the Maryborough-Bundaberg area with 200 homes unroofed, two aircraft damaged and rainfall up to 200 mm which caused flash flooding and cut roads for 18 hours. Heavy swell pounded the south coast and the wave recording station at Double Island Point recorded a significant wave (peak) height of 5.4 m (10.0 m).
Colin 4 Mar 1976	*Colin* moved southwards and was 220 km east of Fraser Island at one point. By far the greatest impact was from the large waves it generated. Extensive beach erosion occurred along South-East Queensland beaches. The wave recording station at Double Island Point recorded a significant wave (peak) height of 6.4 m (9.6 m). Further south, waves off Sydney Heads were estimated at 12 m in height and several launches were destroyed when 2 m waves penetrated into Botany Bay. A woman was killed at Tathra (S NSW) when swept off a cliff top by a large wave.
Paul 7 8 Jan 1980	*Paul* moved from the Gulf to enter the Coral Sea near Saint Lawrence. Heavy rain caused a record flood in the Don River, which changed its course in the lower reaches near Bowen. Two houses were washed away. Severe damage was caused to the market garden industry. Large swells affected the south coast. The Brisbane wave recording station recorded significant (peak) wave heights of 4.3m (9.8m) on 8 Jan.
Ruth 12 - 14 Feb 1980	*Ruth* remained over the ocean between Australia and New Caledonia. The highest astronomical tides for 10 years, combined with large NE swells, caused damage at Heron Island. The big tides and heavy swells caused extensive foreshore erosion along the Gold and Sunshine Coasts. The Brisbane wave recording station recorded

Date of event / cyclone	Impact
	significant (peak) wave heights of 4.0m (6.3m)
Simon 24 Feb 1980	*Simon* was rapidly intensifying and moving towards the coast when it recurved seawards over Port Clinton with a radar eye diameter of 35 km. In this remote area it caused extensive damage to vegetation. It passed slowly to the north of Heron Is which experienced wind gusts to 93 knots and a great deal of damage. Neap tides saved the Island from swell damage. Huge swells were observed but their energy was dissipated on the exposed fringing reef. A yacht ran up onto Lady Elliot Island and a rescue helicopter turned over but there were no casualties. As the cyclone passed to the east of Fraser Island a ship near Indian Head reported wind gusts greater than 100 knots. Sandy Cape Lighthouse reported winds gusting to 92 knots. Houses lost roofing iron at Hervey Bay where there was flooding. The Burnett Heads wave recording station recorded significant (peak) wave heights of 4.5m (8.9m)
Cliff 15 Feb 1981	*Cliff* crossed Fraser Island and made landfall near Bundaberg. Sugar cane crops were damaged around Bundaberg and several houses were damaged further south. A storm surge brought water into the streets at Urangan. There was a 0.7m storm surge on the Gold Coast with a large swell. A large wave train brought a surge of water into Currumbin Creek, which swept a man off the bank, drowning him. The Brisbane wave recording station recorded significant (peak) wave heights of 4.3m (7.2m)
Lance 7-9 Apr 1984	*Lance* underwent rapid extra-tropical transition near and east of Brisbane. Sustained winds reached 60 knots with damage to boats on the western side of offshore Islands in storm force westerlies. On the Gold Coast many houses lost roofing while wind drove rain into high rise buildings and there were huge seas. The Brisbane wave recording station recorded significant (peak) wave heights of 5.1m (8.8m) on 9 Apr.
Aivu 4 Apr 1989	*Aivu* crossed the coast near Ayr, with a radar eye diameter of 30 km. Just before landfall the diameter was 22 km. A pressure of 959 hPa was read in the eye at Fredericksfield, 20 km inland from the coast. Insurance pay out for buildings, cars, boats, etc was $26 million (1990 value). Total damage was about $40 million. Agricultural damage was also around $40 million and infrastructure losses were about $10 million. Wind destroyed some houses, however, mostly it caused loss of roofing iron or awnings etc. A 3 metre storm surge destroyed numerous beachfront properties in Upstart Bay and drowned one man. Major flooding occurred in the Pioneer and Proserpine Rivers. As *Aivu* approached the coast during 2 April, flood rains affected South-East Queensland and NE NSW. Seven people were lost, presumed drowned (two in Brisbane, two in the Gold Coast hinterland and three in NE NSW).
Nancy 3 Feb 1990	*Nancy* crossed the coast near Byron Bay and then moved seawards again. The strongest wind report was a mean wind of 60 knots gusting to 73 knots at Cape Moreton Lighthouse near Brisbane. The lighthouse also recorded the lowest pressure reading of 982.7 hPa while it was experiencing the strongest wind speeds. There was some structural damage to houses on the offshore islands and elevated areas near the coast, however, the major impact was from flooding. Heavy rain (up to 530mm in 24 hrs and 132mm in 3 hours) occurred between the coast and ranges south from Brisbane causing flash floods and drowning six people (5 in NSW and one in Queensland). Damage costs from flooding in Qld and NSW reached $36 million.
Betsy 13 Jan 1992	*Betsy* passed 450 km seawards of Fraser Island but, being an exceptionally large cyclone, generated very large swells which caused severe beach erosion – particularly at Noosa where all sand was washed away. Forty people were rescued at the normally safe beach at Noosa. A yacht off Fraser Island had to be rescued by the coastguard.

Date of event / cyclone	Impact
Fran 16 Mar 1992	*Fran* crossed the coast near the Town of 1770. The maximum anemometer wind gust recorded was 76 knots on Great Keppel Island (just off the coast from Yeppoon). In Bundaberg, 40 houses were unroofed, one was blown off its stumps. The caravan park at Bargara was evacuated. Heavy damage to fruit and vegetable crops occurred in the Bundaberg district. At Burnett Heads, the marina and 3 yachts were damaged and there was extensive damage to pontoons and yachts forced against a rock wall. Powerlines, trees, and roofs were damaged at Gympie. There was roof damage along the Sunshine Coast when *Fran* crossed Fraser Island on its way back out to sea. A storm surge inundated 20 business premises, 100 houses and 50 caravans at Hervey Bay. People were evacuated from the caravan parks. At Burrum Heads, one house had seawater through lower levels. There was major flooding in the Kolan River and moderate flooding in the Burnett River. Heavy swells caused damage on Heron Island and severe erosion on the Gold and Sunshine Coasts. In total there were 2,624 insurance claims for property damage. It has been estimated that the total damage bill (with flood damage) was 8 to 10 million 1992 dollars.
Roger 17 Mar 1993	*Roger* came within 250 km of Fraser Island before turning back out to sea. The cyclone had a very large circulation and came near the coast as a ridge built up along the NSW coast. This developed an extensive area of gale to storm force winds. Six houses sustained roof damage on the Sunshine Coast There were extensive blackouts in South-East Queensland due to fallen trees. Banana growers in South-East Queensland lost about 50 % of their crop as winds twisted and uprooted the trees. In northern NSW, fallen trees closed the 64 km Tweed Range Scenic Road. The winds and seas closed the Port of Brisbane for the first time since *David* in 1976. A man drowned in the surf at Agnes Waters. Seas were still large on 20 Jan – a man was drowned at Surfers Paradise and more than 60 people were rescued. A storm surge of 0.74m was measured on the Gold Coast Seaway gauge on 17 Mar and the peak water level reached 0.16m above highest astronomical tide (HAT). There was serious beach erosion along the Sunshine Coast. The Brisbane wave recording station recorded significant (peak) wave heights to 7.5m (13.2m) on 17 March. Ship observations off Brisbane indicated that the larger swells came from the north, north-east and east.
Rewa 20 Jan 1994	*Rewa* came within 100 km of the coast as it was recurving away from Australia. Two men were rescued from a fishing trawler near Yeppoon by an army Blackhawk helicopter. The upper trough system interacting with *Rewa* as it recurved generated severe flash flood thunderstorms over Brisbane which resulted in four deaths. Three died in traffic accidents and a boy was swept down a drain. A man was also rescued by a DES helicopter when his car was swept into a flooded creek. 100 homes were damaged by the floodwaters.
Violet 8 Mar 1995	*Violet* came close to the coast near Byron Bay while weakening below tropical cyclone intensity. Earlier it passed close to Lord Howe Island where gusts reached 68 knots with tree damage across the island. Heavy swells caused severe beach erosion near Evans Head.
Yali 26 Mar 1998	*Yali* passed 500 km east of Brisbane on a southerly track. Wind gusts to 54 knots were recorded at Cape Moreton and Double Island Point. The Brisbane wave recording station recorded significant (peak) wave heights to 6.0m (11.5m) on 26 Mar. A storm surge of 0.3m coincided with high spring tides. There was beach erosion from the Sunshine Coast to northern NSW beaches and tree damage and power blackouts on the Sunshine Coast.

Appendix E: Impacts of East Coast Lows in South-East Queensland

Date of Event	Impact
19 Aug 1846	Vessel *Coolangatta* driven ashore at North Kirra Beach (just to the north of Tweed River) in easterly to north-easterly gale. Strong SW winds following day. Locality subsequently named after the vessel.
June July 1864	Tremendous gale off Queensland coast.
14-17 June 1869	Steamers unable to leave Brisbane due to tempestuous state of sea. Continuous rain in Brisbane; creeks swollen and communication with Gympie cut off; mail coach at the Durramboy Lagoon washed away and three horses drowned.
14-20 July 1876	Very heavy gales (14th), SS *City of Brisbane* attempted to enter Moreton Bay without success. Another ship narrowly escaped shipwreck in the Bay. Exceedingly furious gales on the coast between Brisbane and Sydney (18th to 20th). Heavy rain and floods (14th) Myall Creek bridge at Dalby almost destroyed and part of the railway near Gowrie swept away. High seas on the coast with heavy gales. Several lives lost in different places, also large numbers of stock and sheep. Disastrous floods and loss of life at Grafton.
3 June 1878	Unprecedented heavy gales very general on the southern coast.
15 May 1879	Very heavy gale along South-East coast of Queensland with some casualties. Very heavy rain on the coast (9th). Coffer dam at the Brisbane dry docks destroyed. Three men drowned while attempting to cross the Thomson River.
24-27 Jun 1879	Thunderstorm (24th) developed into winter cyclone (25th) with much roof damage in Brisbane. Winter cyclone in southern Queensland (27th) with great damage.
27 Aug 1879	Catholic Church at Charters Towers blown down (27th). Very severe and unprecedented floods in parts of the colony (27th), in Dalby many were forced to leave their houses. The Brisbane River was more than 8 feet above the high water mark. The floods reached their highest mark on the 30th. The Victoria baths were washed down the Brisbane River; thirty tons of Yengarie sugar were destroyed at Bundaberg Wharf.
8-11 Oct 1888	Winter cyclone moving eastward across Coral Sea. South-east gales and heavy seas in South-East Queensland and north and central coasts of NSW. Very heavy rain on the coast.
17-19 Jul 1889	Winter cyclone near Rockhampton (17th), Brisbane (18th) then moved east. Gales and heavy seas on north and central coasts of NSW.
8 Jun 1891	Hurricane at Brisbane did considerable damage. Floods Brisbane and Gympie. Gales northern NSW coast.
10-12 Jun 1893	Winter cyclone moved south-east from Central Queensland coast and then east. Gales and very heavy rain on South-East Queensland coast and north coast NSW.
26 Jul 1897	The schooner *Heroine*, a wooden vessel of 122 tons and with 130 tons of coal on board, was driven ashore at North Kirra near the mouth of Coolangatta Creek. On the 25th the schooner was at anchor off Tweed Heads and on the morning of the 26th heavy seas were breaking over her and staving in the hatches. The Captain had to slip her cables and the vessel was driven ashore. The captain and crew landed safely. Also on the 26th, the ketch *Candidate* was driven ashore at Byron Bay at the height of the gale. The captain and crew were landed by means of ropes.
23-24 Jun 1912	Very severe east to north-east gales along sub tropical coast of Queensland. Shipping delayed. Masters of vessels reported that night of 24th was the worst they had encountered.
15-16 Aug 1912	A depression off South-East coast of Queensland produced gales and high seas south of

Date of Event	Impact
	Sandy Cape.
24-25 Jun 1914	Winter cyclone off north coast. Gales between Mackay and Rockhampton.
21-23 Sep 1914	Winter cyclone on north coast. Gales east of Brisbane.
8-10 Oct 1914	Winter cyclone passing down off coast caused gales and torrential rains. Wrecked two ships off south coast.
23-28 Sep 1916	Winter cyclone passed from interior east-south-east out to sea producing very heavy rain and gales along south-east coast.
28 Jul 1919	Winter cyclone passed southwards between New Caledonia and Queensland. Ships driven on Barrier Reef south-east of Mackay.
22-24 July 1921	Winter cyclone from north-east struck northern NSW coast causing gales and shipping disruptions before recurving to south-east. Disastrous floods in South-East Queensland and northern NSW. Goondiwindi, Warwick and Roma flooded. Several houses washed away and 2 men drowned at Texas. A man drowned at Inglewood. Heavy stock and crop losses and damage to roads and bridges.
2-6 Oct 1921	A winter cyclone passed southwards between New Caledonia and Queensland, producing severe gales.
18-23 Jun 1925	Winter cyclone crossed central coast at Port Clinton on 19th. Some damage to buildings at Yeppoon and Taranganba Station. It recurved over Gayndah and Double Island Point.
17-20 May 1926	Cyclone passed just east of Double Island Point on 17th and moved south-east to Norfolk Island while intensifying. SS *Wanganella* adrift for a week and *Eastern Moon* in similar difficulties. Local flooding in Burnett, Dawson and Balonne Rivers.
29-30 Nov 1927	Winter cyclone off Sandy Cape moving south. Heavy weather along south coast.
15-17 Jun 1929	Winter cyclone recurved to south-east off Central Coast with gales reported. Local flooding in the Fitzroy River.
29-30 Jun 1929	Winter cyclone recurved to south-east just to north-east of Cape Moreton with gales and heavy rain. Much damage at Sandgate. Flooding in the Pine and Nerang Rivers.
7 July 1931	Winter cyclone developed South-East Queensland and moved towards the south-east. High winds in Brisbane.
10-11 Jul 1933	Winter cyclone recurved over Broadsound and Rockhampton towards the south-east. Floods in Central Queensland.
1-2 Sep 1934	Winter cyclone passed to east of Brisbane. SS *Montoro* damaged.
7-10 July 1935	Winter cyclone recurved over Shoalwater Bay and moved towards south-east. Gales. SS *Maheno* driven ashore on Fraser Island. Heavy rain in Central Queensland.
30 May 1941	Winter cyclone crossed coast near Town of 1770 and then moved back out to sea. Gales Central Coast 30th and 31st. Local heavy rain and hail.
14-16 Jun 1948	Complex cyclonic system moved from Double Island Point to Coolangatta and then seawards. Gale force winds. Flooding on South Coast and Condamine.
15-26 Jun 1950	The event began on the 15th/16th when a low developed east of Newcastle. A second low developed near Ballina on the 19th and at Rathmines Meteorology Office south-east wind gusts to 61 knots were recorded. On the 23rd, a winter cyclone moved westward towards the Gold Coast and then turned slowly back out to sea and down the NSW coast. Wind over 50 knots in Moreton Bay and northern NSW where 10 to 15 m waves reported. Houses were unroofed at Cleveland, Southport and Coolangatta. 40 launches at Southport were damaged or destroyed. 24 hour rainfall totals to 368 mm

Date of Event	Impact
	(Springbrook). Extensive damage in South-East Queensland due to flooding and 2 lives were lost. Winds to hurricane force and waves to 15 m off the NSW coast. For the 24 hours to 9am 24th Dorrigo recorded 636 mm of rain. Serious flooding in northern NSW rivers and the Clarence River forced a new path to the sea. Grafton, Kempsey and Maitland badly affected with large scale evacuations (estimated 9000) and 4 lives lost. Navy ship *Fair Wind* lost with crew of 17. 648 ton freighter *Bangalow* driven ashore at Coffs Harbour. Tornado at Cudgen wrecked 4 homes and damaged others. At Grafton 3000 people were made homeless with 6 houses washed away. At Maitland 3200 were made homeless. Aerial surveys from Newcastle to Queensland revealed hundreds of blocks swept clear of homes. Millions of pounds (1950) damage to NSW train and tram tracks. Cronulla surf club collapsed into sea and extensive damage to other foreshore installations along the NSW coast. When rain cleared southward from the Maitland area, westerly gales caused wave damage to submerged houses in an inland sea south and east of Maitland. Several houses and flats collapsed in the Sydney area by foundations being undermined by heavy rain. 300 families were evacuated in the Hunter Region. Similar evacuations in the Woy Woy-Tuggerah area. Main roads out of Sydney were cut by landslides and flooded bridges. Five lives were lost.
16 Nov 1950	Low crossed coast near Brisbane and caused considerable structural damage with one life lost.
8-9 Jun 1951	Winter cyclone crossed coast Coffs Harbour and then moved over Darling Downs. Heavy rain.
29 Aug 1953	Winter cyclone made landfall at Rockhampton and then moved back out to sea. Gusts to 50 knots recorded at Rockhampton.
11-13 Jul 1954	Complex cyclonic system crossed coast near Bundaberg and then recurved towards south-east. Winds to hurricane force left a trail of damage along the coast south from Bundaberg. Woman killed at Nambour when shed was lifted by wind and hurled into her. Houses, shops, jetties and boats were badly damaged. 200 people were left homeless, hundreds of small craft were wrecked. Many houses unroofed including 50 at Caloundra. Hurricane force winds in Moreton Bay with widespread property and boat damage at Redcliffe, Sandgate and Wynnum. The Dutch naval sloop *Snellius* reported waves to 21 m off the South Coast.
8-12 Jun 1958	Large intense winter cyclone passed to east of South Coast. Waves over 10m were reported off the South Coast out to a distance of 640 km. The schooner *Venturer* was wrecked near Lady Musgrave Island. Other ships sustained damage. Floods cut roads in South-East Queensland. There was severe beach erosion along the coast.
24-26 May 1960	Small deep low developed off the South Coast on the 25th north of a vigorous high in the Tasman Sea- 457 mm of rain fell in 3.5 hours at Cawarral (near Rockhampton)- Flash flood damage to crops and communications - extensive sea damage to Gold Coast Beaches and interruptions to shipping.
5-7 Jun 1961	Deep complex low developed with centre east of Brisbane and another near Lord Howe Island. Gales and large seas along south coast caused the harbours to be closed.
6- 7 October 1961	1040 hPa high near Tasmania and an upper low forced a deep trough or small low to move off the Central Coast. A house was blown down at Rosedale. Heavy flooding in the Curtis River. And heavy damage to roads. Crop and stock losses. 356 mm of rain was recorded in 9 hours at Wonbah (near Mt Perry.)
9-11 Jul 1962	Winter cyclone developed north-east of Fraser Island and moved past Gold Coast. 60 to 70 knot winds reported from Tweed Heads to Yamba in the 24 hours to 9am 11th. Local flash floods Brisbane to Gold Coast. Fruit trees damaged buildings flattened at Sunnybank. Small boats wrecked, buildings flattened, extensive beach erosion and

Date of Event	Impact
	roads damaged Gold Coast. Radio mast wrecked at Lytton. Widespread flooding in Nerang, Albert and Logan Rivers. In NSW small craft lost or damaged at North Coast harbours. Bad floods in Murwillumbah, Lismore, Bellingen and Grafton with many evacuations and people drowned. At 1am on the 9th, 2 waterspouts came ashore at Port Macquarie and left a trail of destruction. 3 men were killed when a two-story building they were erecting was wrecked. 30 house were damaged. Largest 24 hour rain totals 265mm in Springbrook and 227mm in Lismore.
7-8 May 1963	Small winter cyclone developed near Tewantin and then moved south-eastwards out to sea. Gales brought down trees and power lines. Big tides and heavy rain caused severe local flooding at Redcliffe, Wynnum, the Sunshine Coast and the Gold Coast. There was waist deep water in Sutton Street, Redcliffe and other streets were under 5 feet of water. Families were evacuated at Lota. A landslide cut the Pacific Highway at Kirra. The Casino-to-Tenterfield road was washed away west of Casino, leaving a 1000 foot sheer drop. Lismore had a major flood with water entering the city. Grafton then flooded with 700 families evacuated from their homes.
25-28 June 1965	Winter cyclone developed off Sunshine Coast and moved out to New Caledonia. Maximum average winds 44 knots at Double Island Point. Ship reported southerly winds averaging 60 knots east of Fraser Island as winter cyclone intensified while moving seawards. Heavy-to-flood falls in Mary River catchment and in Moreton Bay. Maximum 24 hour rainfall registration of 242 mm at Tewantin.
18-21 Jul 1965	Winter cyclone developed east of Brisbane, moved up to Fraser Island, turned southwards over Brisbane, down to Yamba and then seawards. Wind gusts to 60 knots recorded at the Bureau in Brisbane. There was much damage to small structures in the metropolitan area and 3 houses were unroofed. Trees were uprooted, plate glass windows smashed and telephone and power lines downed. Along the Bay, many small craft were damaged. There was much crop damage in surrounding areas. Fallen trees and floods blocked roads. 24 hour rain totals in Brisbane were up to 236mm on the 20th. 510mm fell in 24 hrs at Springbrook. The upper trough associated with the development of the winter cyclone brought snow into the tropics for the first time on record. Scattered falls were reported on the 19th from the Central Highlands through the northern Warrego to the Darling Downs and Maranoa. Further north, snow fell west of Mackay at Dalrymple Heights and Blue Mountain. Sleet was observed at Nebo and Clermont and on the 20th Thangool reported snow.
9-13 Jun 1966	Winter cyclone developed near Fraser Island and then moved south and passed to the east of Brisbane and the Gold Coast. Average winds to fifty knots along the southern Queensland coast. 24 hour rainfall totals:- 388mm Springbrook; 213mm Caboolture; 197mm Beenleigh and 163mm Brisbane Airport.
8-13 Jun 1967	Winter cyclone developed near Willis Island and moved down to Bundaberg on the 10th, passed over Fraser Island and then moved into Moreton Bay on the 11th before moving over Gold Coast and then out to sea on the 13th. Cape Moreton reported gales from 9am on the 9th to 9am on the 11th, with the strongest winds (gusts to 80 knots) at 6pm on the 10th. Very heavy rain fell on the 11th to 12th. Bureau in Brisbane recorded 282mm in 24 hours to 9am on the 12th. 140mm fell in the 3 hours to 10pm on the 11th. Springbrook recorded 636 mm in 24 hours to 9am on the 12th, including 276mm in 6 hours to 3am on the 12th. A woman was killed when her car overturned into Mary River at Gympie. A youth was killed in an intersection crash in blinding rain at Clayfield. Two men were rescued from flooded vehicles at Doboy Creek and Wickham Street in Fortitude Valley. Five hundred people were evacuated from flooded homes, fourteen

Date of Event	Impact
	people were rescued by boat. Fifteen cars were swept into Enoggera Creek and the occupants either escaped or were rescued. A car plunged into a washout at Chapel Hill. Hundreds of homes and shops in Fortitude Valley, Ashgrove, Moorooka, Hemmant, Breakfast Creek, Newstead, New Farm, Woolloongabba, Stones Corner, Greenslopes, Coorparoo, Fairfield, Annerley, Milton, Toowong, Newmarket, Windsor and Albion had water pouring through them. The floods wrecked three yachts in Breakfast Creek. Caravans were washed away from the Newmarket Caravan Park. Landslides cut Brisbane rail services and there was much damage to roads and bridges. On the Gold Coast, water entered the ground floors of structures in Cavill Avenue. The worst hit areas were the canal estates west of Broadbeach, where hundreds of houses were isolated. Fifty families were evacuated from homes on the Gold Coast. At Southport, houses were washed away or undermined. Many boats were set adrift by the gales and were badly damaged. Huge seas added to the severe beach erosion left over from the summer cyclones. Over the border in NSW, there were two deaths. 400 people were evacuated from their homes in Grafton and sixty families were evacuated from homes in the Kyogle region.
21-22 Jun 1967	Winter cyclone moved from Willis Island down to Fraser Island and then turned towards the south-east and passed over Lord Howe Island. Average winds to 40 knots along the southern Queensland coast. Rainfall in Brisbane to 60mm produced minor flooding.
26-28 Jun 1967	Winter cyclone developed just to the east of Brisbane (26th) and moved slowly north to the east of Double Island Point (27th) and then turned slowly towards the south-east. Hurricane force winds were reported from Cape Moreton from 9am 26th to 3pm 27th. A man was killed when his car crashed into a creek at Nerang in bad weather on the night of the 26th. Some houses and buildings were unroofed at Burleigh and Surfers Paradise. At Mudgeeraba, a building was blown off its stumps and wrecked. Boats were swept from their moorings. Two houses at Mermaid Beach were lost to the sea (26th). Large sections of the Esplanade at Surfers Paradise were lost to the sea and lanes and streets collapsed at Palm Beach (26th). The swimming pool from the Beach Lodge resort was lost to the sea at Surfers Paradise. By the 28th, the Esplanade at Main Beach fell into the sea and 5 houses were wrecked at Nobby's and Palm Beach. Many houses were badly damaged by the sea along the Gold Coast, however a volunteer army of 5000 people placed around 100,000 sandbags along the foreshore, helping to prevent many houses being lost to the sea. Wreckage of the prawn trawler *Sydney J* was found at Tewantin with no trace of the owner-skipper who was believed to have drowned.
5-8 Jul 1973	Winter cyclone developed east of Mackay (5th) and moved down just seawards of the Sunshine Coast by the 7th. It then moved back up north to the east of Yeppoon. Four people drowned on the evening of the 7th; two near Nambour when the car went into a creek and two near Yandina after their car became stranded. Average winds of 40 to 55 knots were reported along the South Coast from 8 am 5th until 10pm 8th. A ship reported average winds of 60 knots off Stradbroke Island at 3pm 6th while another ship reported winds of 74 knots off the Gold Coast at 3pm 7th. Trees and power line were brought down throughout South-East Queensland causing widespread blackouts. Some houses were unroofed at Kingaroy and near Warwick. The South Nobby wave recording station on the Gold Coast reported significant wave heights to 5.2 m and maximum wave heights to 8.7 metres. The 1600 ton cargo ship *Cherry Venture* was driven ashore 1.5 km south of Double Island Point on the afternoon of the 8th, after foundering in 'forty foot waves'. Twenty four hour rainfall totals recorded 9am 6th included: 384mm Nambour; 349mm Woodford; 340mm Mapleton; 335mm Maleny

Date of Event	Impact
	and 328mm Springbrook. Many roads in South-East Queensland were cut by floods. and in Gympie, 6 feet of water was over Mary Street on the night of the 6th. The Mary River at Gympie peaked at 19.6 m at 2am on the 9th with houses, shops and factories under 2 m of water.
29-30 Jul 1979	Winter cyclone developed to the north-east of Fraser Island, moved down just to the east of Brisbane and then turned eastwards out to sea. Gales along the Gold Coast. The Brisbane wave recording station (7 km east of Point Lookout) recorded significant (peak) wave heights of 4.7m (8.7m) on the 30th of July.
6-9 May 1980	Winter cyclone developed near Fraser Island, moved east and then turned back and crossed the coast to the north of Brisbane. Average winds along the south coast to 45 knots. The Brisbane wave recording station recorded significant (peak) wave heights of 5.2m (8.1m) on the 8th of May. Six houses at Labrador (Gold Coast) were flooded by 1 m of water (6th). Floods cut roads in Brisbane and power lines were brought down causing blackouts in some suburbs (6th). Vehicle swept off road by floods in the Gold Coast hinterland, though the driver escaped injury (8th). Roads flooded in the Waterford-Marsden area (9th).
21-22 May 1981	Major low pressure system developed near Mount Isa and moved down to north-western NSW. Small secondary winter cyclone developed on the coast near Cairns and ran right down the east coast with gale force winds. Extensive sugar cane damage Cairns to Home Hill. 16 homes damaged at Darling Heights (Toowoomba). Two small yachts wrecked. Local flooding from Rockhampton to Proserpine. Two boys drowned at Rockhampton and one near fatality at Proserpine when motor vehicles were washed off creek crossings. The Brisbane wave recording station recorded significant (peak) wave heights of 3.8m (5.2m) on the 22nd of May.
3-5 Jun 1983	Small low formed north-east of Cape Moreton while major low developed near New Caledonia with a central pressure of 1000 hPa (4th) and north of a large 1040 hPa high. Storm force winds South Coast 3pm 3rd to 9pm 4th with gusts to 70 knots at Cape Byron. The Brisbane wave recording station recorded significant (peak) wave heights of 5.3m (10.0m) on the 8th of May.
20-23 Jun 1983	A winter cyclone developed in the Coral Sea and moved down through Hervey Bay across the Sunshine Coast and back out to sea. Maximum sustained winds of 60 knots were reported from a ship east-north-east of Noosa. Gusts to 56 knots were recorded at the Brisbane City Bureau (22nd). 350 mm of rain was recorded in the 24 hours to 9am 22nd at Nambour including 229mm in 4 hours. A boy was drowned at Pomona after being sucked into a flooded drain. A man was killed at Gatton when a tree fell on him. In Brisbane, winds brought down trees and powerlines and landslides closed the Southeast Freeway and Settlement Road. Brisbane creeks were flooded. On the Sunshine Coast, many centres were isolated as floods and landslides cut roads. Trees and power lines were down and 15 yachts were damaged at Mooloolaba . Eleven caravans were washed away and destroyed by floodwaters at Yandina Caravan Park. In Nambour, shops were flooded including a Mercedes dealership where cars were washed away. Floodwaters inundated houses and shops in the lower parts of Mary Street , Gympie. On the Gold Coast trees and power lines were blown down and tiles were lifted off roofs. A boat was sunk in one of the canals and many roads were blocked by floods, downed trees and landslides. There was widespread crop damage in South-East Queensland. Eleven houses were evacuated at Roma. Major flooding occurred at Dalby with 13 houses evacuated. There was severe beach erosion along the South Coast and the Brisbane wave recording station recorded significant (peak) wave heights of 5.1m (7.1m) on the 22nd of Jun.

Date of Event	Impact
8-10 Jul 1985	A 1009 hPa low developed on the Sunshine Coast by 3pm 8th and moved south while intensifying to a 1001 hPa low over southern suburbs of Brisbane at 3am 9th. Maximum sustained 38 knots north-east winds at Cape Moreton and 50 knots east-north-east winds with gusts to 65 knots at Cape Byron. Caloundra recorded 239 mm of rain in 24 hours. At 9am 9th the low was 1001 hPa and just to the north of Yamba, after which it deepened and moved to the south-east. Lord Howe Island at 3pm 9th had 40 knot winds from east-south-east with gusts to 54 knots.
7-9 Apr 1984	Tropical cyclone *Lance* underwent rapid extra-tropical transition near and east of Brisbane. Sustained winds reached 60 knots with damage to boats on the western side of offshore Islands in storm force westerlies. On the Gold Coast many houses lost roofing while wind drove rain into high rise buildings and there were huge seas. The Brisbane wave recording station recorded significant (peak) wave heights of 5.1m (8.8m) on 9 Apr.
2-3 Sep 1985	A large low pressure area developed in the Tasman Sea with the main 990 hPa centre east of Sydney on the 2nd. It then moved south-east and deepened below 988 hPa. On the 2nd, westerly wind gusts uprooted trees, damaged buildings and crops and blacked out 9000 homes in Brisbane. The maximum wind gust recorded in Brisbane was 97 km/h (52 knots) at 11.12 am on the 2nd. Waves to 3 m high were reported on Moreton Bay.
9-10 May 1987	Small low on the Gold Coast with large 1037 hPa high in the Tasman Sea. 345mm of rain in the 24 hours to 9am 10th at Springbrook with flash flooding on the Gold Coast. Road collapsed at Bundall. A woman was drowned when the motor cycle she was a pillion passenger on ran into a metre of water at Nerang. A man was drowned when swept away by floodwaters at Tallebudgera Caravan Park. A man was missing believed drowned by a flash flood on his Mullumbimby property. There was one other death (source Lucinda Coates, BoM Melbourne). Many other people were rescued from floodwaters and hundreds of houses were flooded. Three boats sank at Southport.
4-7 Apr 1988	Small low moved out to sea from Sunshine Coast, then up to Fraser Island, back to Gympie, out to sea again and then back overland west of Brisbane. In Springbrook, the measured rainfall was: 24 hours to 9am 4th, 228mm; to 9am 5th, 246mm; to 9am 6th, 302mm. 161 mm at Dayboro in 24 hr to 9am 6th, causing flash floods. In South-East Queensland flooding closed schools, swept people off bridges, uprooted trees, caused landslides and closed roads and highways. Landslides blocked the Western Freeway and roads at Samford. Floods isolated people at Cecil Plains for a week. Ipswich SES had more than 200 calls for help. 400 residents were stranded in their homes at Kholo. Sandbagging was required to save homes at Tarragindi and Logan. The crop damage in the Lockyer Valley and Darling Downs reached $20 million (1988$). Floods also cut roads and isolated communities in north-east NSW. Gold Coast wave recording station recorded significant wave heights to 4.28 m on 5 Apr.
10-11 Apr 1988	Small low developed south-east of Fraser Island and moved onto Sunshine Coast. 24 hour rainfalls :- Springbrook 215mm to 9am 11th and 337mm to 9am 12th; Cooroy 239mm to 9am 11th; Eumundi 203mm to 9am 11th. Gales were reported from Double Island Point to Yamba. Wind gusts to 50 knots at the Gold Coast uprooted trees, flipped small craft, and ripped bigger boats from their moorings. SES repaired roofs, cleared trees from houses and sandbagged houses on Gold Coast. Crop damage expected to reach $100 million in South-East Queensland from the series of lows. Communities continued to be isolated by floods in South-East Queensland. Huge seas on Gold Coast with 1 m waves on Broadwater. Brisbane wave recording station recorded significant wave heights to 4.1 m on 11 Apr.

Date of Event	Impact
14-16 Sep 1988	A low developed 100 km east of Cape Moreton and then moved slowly out to sea. Gales affected the Gold and Sunshine Coasts and the North Coast of NSW. Large swells hit the Gold Coast and northern NSW. Brisbane wave recording station recorded significant wave heights to 4.62m on 15 Sept.
14-18 Dec 1988	A tropical low developed near Willis Island and initially moved towards the south-south-east before turning south and then south-west before crossing the coast south of Gladstone. Gales were reported from near the low and along the Sunshine Coast. Central business area of Gladstone badly flooded. One metre of water swept through shops in Goondoon Street on the 18th. There were four deaths from road accidents over South-East Queensland in bad weather on the 18th. Brisbane wave recording station recorded significant wave heights to 4.98m on the 18th of December.
24-26 Apr 1989	Tropical low developed near Yeppoon on the 24th,moved down the coast over the Sunshine Coast on the evening of the 25th and east of the Gold Coast on the morning of the 26th. Gale to storm force winds on the Sunshine Coast with 15 houses suffering roof damage and 5 houses damaged by falling trees. One person was drowned at a creek crossing on the Gold Coast and another was electrocuted on the Sunshine Coast. Heavy rains caused widespread flooding. At the high tide early on the 26th, some roads in Brisbane were under a metre of water. Landslides blocked city streets, walls collapsed and power lines were brought down. Flooding occurred at Gympie and several houses on the Sunshine coast were flooded. Large seas caused severe beach erosion along the Sunshine and Gold Coasts. The Brisbane wave recording station recorded significant wave heights to 6.11 m on the 25th of April.
21 -22 Feb 1992	Monsoon low crossed the coast near Rockhampton as it formed a secondary centre near Maryborough. Very heavy flood rains South-East Queensland. A motorist lost his life when he attempted to cross a barricaded crossing on the Stanley River. 225 homes were inundated by depths up to 800 mm in the Maroochy system. There was a flash flood component to this flooding. 30 to 40 houses and 110 business premises were flooded at Gympie. There was flash flooding at Bundaberg and on the Cherwell River near Howard where 60 houses and caravans were inundated and around 20 people evacuated.
14-16 Feb 1995	Low developed off the central coast and deepened to 997 hPa early on the 15th before making landfall on the Sunshine Coast. Winds to storm force south of the centre. Flash floods occurred at Hervey Bay though fortunately at low tide. The Brisbane wave recording station recorded significant wave heights to 6.42 m on the 15th.
14-17 Feb 1996	A tropical low developed near New Caledonia and moved past Brisbane and brought storm force southerly winds to waters off the Gold Coast. A storm surge brought some flooding up the Brisbane River at Newstead. A storm surge of 0.59m was measured at the Gold Coast Seaway. The luxury vessel *Queen Elizabeth II,* travelling from Brisbane to Sydney, was battered by average winds of 26 ms^{-1} and very short and very steep 10 m waves just off the northern New South Wales coastal town of Yamba around 1900 UTC 15 February 1996, resulting in injuries to passengers. The Brisbane wave recording station recorded significant wave heights to 6.19 m on the 15th.
1-5 May 1996	Low developed east of Townsville and intensified as it moved down to waters just off Brisbane. Wind, sea and flood damage South-East Queensland - 3 drowned in small craft and in rivers. Boy swept down drain - 1 traffic accident death - 16 houses were damaged by wind at Tamborine and there was wind damage on the Gold Coast. Landslides blocked roads and fallen trees brought down power lines. The maximum wind gust of 65 knots was recorded at Cape Moreton AWS. Storm tides flooded the Sandgate foreshore at Flinders Parade. The Gold Coast Seaway was 0.51m above the

Date of Event	Impact
	predicted high tide on the 2nd, which was 0.18 m above HAT. The Brisbane wave recording station recorded significant wave heights to 6.9 m on the 2nd.
4-5 Feb 1999	A low developed east of Fraser Island and moved south. Highest peak and highest significant waves on the Southport wave rider buoy on the 4th were 6.7 m and 3.5 m. Two men were lost when a 8.1 m fishing boat was wrecked by a large wave on Breaksea Spit north Fraser Island early on the 6th.
8-10 February 1999	Small low developed near Double Island Point. In the lead up rains, a girl drowned at Samford on the 6th. A man and a woman in a campervan were swept into creek at Kennilworth when bank collapsed on afternoon of the 8th; the man drowned. On the 8th at the Sunshine Coast, flooding and landslides closed dozens of roads. Wind blew power lines down causing blackouts and several houses had roof damage. SES sandbagged homes against flash flooding in Nambour, Palmwoods, Coolum, Mudjimba and Pacific Paradise. Landslides affected the Obi Range Road between Mapleton and Kennilworth, Jimna Creek Road, Cedar Pocket Road and Tin Can Bay Road. Kilcoy was isolated by floodwaters. At Brookfield a schoolgirl was rescued from Mogill Creek. In Fortitude Valley a landslide closed off Ivory Street. The road to Bribie Island was cut. SES volunteers attended wind and flood damage operations in the Laidley and Gatton area. Fallen trees cut several roads. Double Island Point automatic weather station (AWS) recorded a gust of 63 knots at 0047 UTC 8th, while the AWS at Cape Moreton registered a gust of 56 knots at 0119 UTC 8th. A peak wave height of 8 m was measured on the waverider buoy off Main Beach Southport at 1300 UTC 8th. On the 9th, top 24 hour rainfall totals to 9am were Maleny 404 mm, Mary Cairncross 370mm, Nambour 332 mm. In Brisbane, Strathpine recorded 182 mm. A boy was drowned when he was swept into a stormwater drain at Palmwoods. Another boy was rescued after being swept from a park in Nambour. A man was drowned when he was swept over a weir while boogie-boarding in the Caboolture River and a man was trapped by the rapidly rising South Pine River at Albany Creek and drowned. North of Brisbane 160 roads were cut, with the Bruce Highway being the worse affected by cuts in several key locations. 17 800 houses were without power in South-East Queensland. A man drowned in a creek on the Gold Coast. On the 10th, the body of a man was found in a creek just outside Conondale. The Mary River at Gympie peaked at 21.95 m (The highest level this century). 150 business and 20 houses were inundated.
20 May 1999	A disturbed area formed well off the Queensland coast during the third week of May. By 1800 UTC 20 May 1999 the low was about 225 nautical miles north-west of the northern tip of New Caledonia. The system moved on a fairly straight southerly track for the next five days, passing about 300 nautical miles west of Noumea, New Caledonia. The system continued slowly southward until the 25th, when it accelerated rapidly south-south-eastward, passing west of the southern tip of New Zealand's South Island and near Auckland Island around 0600 UTC on 26 May. During 25 May the storm had intensified, had central convection and extensive peripheral cloud banding, and looked more like a tropical cyclone than at any previous time. On 23 May the storm also exhibited an eye-like feature. The storm had a significant impact on the Australian coast between 25°S and 32°S although its closest approach was about 400 nautical miles off the coast. There were two helicopter rescues to stricken yachts just off Brisbane and two more near Port Macquarie. Swells with wave heights to 10 m were reported. Numerous ships reported winds well above gale force, and there were a couple reporting winds in excess of 50 knots: ELMQ 23/0600Z 150/50 knots near 26.3° S, 159.6°E ---- 23/1200Z 140/54 knots near 26.3°S, 154.0°E The storm passed about 50 nautical miles east of Lord Howe Island around 1200 UTC on 24 May. That

Date of Event	Impact
	station reported peak winds of 41 knots with a gust to 57 knots at 24/1355 UTC. However the anemometer is obstructed for south-west winds. An anemometer on runway 10 recorded a maximum gust of 81 knots from the south-west during the afternoon of the 24th. The mean wind was 62 knots. Boats in the Lagoon with anemometers recorded gusts to 85 knots. Boats in the Lagoon were washed ashore. Three lodges were damaged and one was unroofed. There was widespread tree damage. 24 hour rainfall to 9am 25th at Lord Howe was 150.0mm. Secretary Island (located in the south-west of South Island) experienced gusts to 78 knots as the storm brushed by New Zealand. Invercargill reported 60 knot winds at 2100 m and 84 knots at 3050 m. Finally, as the system moved rapidly south-south-eastward on 26 May, it passed over a drifting buoy near 52.5°S,169.0°E which reported a minimum pressure of 975.2 hPa at 1249 UTC.

Appendix F: Impacts of Severe storms On South-East Queensland

Date of event	Impact
February 1871	Capt C.B Whish diary 'the soil (at Caboolture) which is being plowed up looks beautiful, friable and moist and the oldest canes are growing away well since the hail storm'. (Caboolture Historical Society, 1973)
10 August 1916	Extensive hail storms in the Sunshine Coast hinterland from Melany to Palmwoods. Bald Knob (near Melany) 'left like a snow capped mountain for three days'. (Caboolture Historical Society, 1977)
17 April 1956	Hail and wind damaged crops and buildings in Brisbane. Many people in Brisbane injured by flying glass and large hailstones associated with wind gusts to 56 knots.
10 December 1956	30 houses were unroofed and a cottage blown off its stumps at Redcliffe –100 000 pounds (1956 value) damage -3000 poultry killed by hail. Crops damaged at Strathpine. 20 houses were unroofed at Booval and 5 people were injured by hail.
3 February 1957	73 knot gust at Amberley. Radio station 4IP's radio transmitter damaged. Power disrupted in Ipswich. Lightning struck a house at Oxley causing a small fire, fireballs were reported.
14 March 1957	Thunderstorm hit Brisbane between 4pm and 5pm. Church, golf clubhouse and ten houses unroofed in north and north-west suburbs- trees uprooted and power lines down causing protracted blackouts. The centre of the storm passed over Enoggera, Windsor and Nundah. 57 knot wind gusts were recorded by the Bureau of Meteorology.
12 December 1958	Storm damaged houses and gardens in Brisbane. Hail 6.3 cm in diameter shattered many windows and ruined gardens. Power lines down with prolonged blackouts. Lightning damaged a house at Oxford Park. Rainfall of 13.4 mm in 5 minutes was recorded, causing flooding in the city area. Water entered business premises in Fortitude Valley with considerable damage to stock. Roads were also flooded. 3.8 cm hail at Kallangur smashed fibro roofs, destroyed crops and killed poultry.
17 December 1958	Hail storm hit Brisbane. Houses were unroofed, roads and bridges flooded and power lines brought down. Wind tore the roof off a house at Chelmer and hurled it 65 m. Other roofs were shattered by flying debris at Indooroopilly. Water several feet deep swept through a flat at Paddington. Two houses were unroofed at Windsor with interiors ruined. Another two houses at Ashgrove lost their roofs. Two houses were struck by lightning. Flash flooding caused much damage through the city and suburbs. 17 mm of rain in 5 minutes and then 44 mm in 30 minutes were recorded at the Bureau's observation site in the City, while 69 mm in 45 minutes was recorded at Bardon.
28 December 1958	Storm over the southern suburbs of Brisbane unroofed 15 homes, a factory, school, prison block and Rocklea show buildings. Gusts to 61 knots were recorded at Archerfield, 50 knots in the city and 48 knots at Eagle Farm. 25 m wood and steel roofs were hurled 100 m and awnings were torn from many shops. Lightning strikes were reported in 10 suburbs. Roads were flooded and Bureau of Meteorology recorded 15 mm in 5 minutes. Widespread power blackouts resulted.
3 January 1959	Storms in Brisbane produced local flooding in Northern suburbs. 14 homes were flooded at Booval.
3 February 1960	Lightning struck and burnt down a house at Indooroopilly. Wind damage was reported at Coorparoo, Loamside and Fordlane. South side suburbs were blacked out and trunk-line circuits were out. 115 mm of rain in 1 hour was recorded at Deagon.
27 November	Storms in Brisbane. Houses unroofed at Rosalie and Auchenflower, trees were

Date of event	Impact
1960	uprooted along Coronation Drive blocking the road. Many windows were broken by hail, especially in northern and western suburbs. Flash floods occurred in City streets.
25 February 1961	Storms with flash floods in the Bundamba Creek. A car was swept off culvert with 2 people killed. A man was struck by lightning. Lightning shattered a 12 m tree at Bald Hills.
17 November 1961	127 mm of rainfall in 75 minutes was recorded in Upper Brookfield. Roads and bridges were washed away and farmland damaged.
21 November 1961	75 mm of rainfall in 45 minutes was recorded at Redland Bay. Crops were damaged and more than 15 cm of topsoil was washed away. Rainfall caused local flooding.
18 December 1961	Storm in Brisbane. Flash flood across the northern suburbs with Kedron Brook 1.8 m over Sandgate Road. Widespread power blackouts.
October 1962	Storm produced 81 knot wind gusts at Amberley, causing power blackouts and structural damage to buildings at Brisbane and Ipswich.
17 November 1962	Two men drowned in Moreton Bay when a trawler capsized off Redcliffe during a storm. The roof was blown off the new school at Scarborough. In Brisbane, buildings were damaged by 60 knot winds, unroofing some in the Windsor and Redbank areas.
7 December 1962	Winds caused extensive damage to houses and buildings at Brisbane. Power and telephone lines were brought down. Heavy hail and rain resulted in flash floods. The worst affected suburbs included Wynnum, Manly, Hawthorne and Morningside. The Manly Baths were wrecked and the Manly Memorial Hall unroofed. At least 50 homes were seriously damaged at Morningside and Hawthorne. A waterspout sank a small craft in the Brisbane River.
11 December 1962	Wind damage to houses in Kenmore, Indooroopilly, Corinda, Sherwood, Oxley, Inala, Acacia Ridge, and Eight Mile Plains. Hail at Oxley was as large as 4 cm in diameter. A funnel cloud was sighted. Fallen trees blocked the Pacific Highway at Slacks Creek.
31 October 1963	Very heavy hail recorded in Brisbane. Hail drifts 1.2 m deep were observed at Woolloongabba. Hail blocked drains and caused water damage to property and household belongings. Severe winds caused roof damage to buildings in East Brisbane and Highgate Hill, and widespread power blackouts.
2 January 1964	Wind gusts to 66 knots recorded at Amberley. Houses were unroofed, buildings damaged and power lines down in Ipswich.
3 January 1964	Storm with severe winds and hail caused property damage at Ipswich. Maximum wind gusts of 62 knots were recorded at Amberley.
29 December 1964	Very large hail (to 185 grams in weight) caused widespread damage to buildings, windows, gardens and crops at Petrie, Kallangur and Lawnton. Hail and rain caused local flooding in eastern parts of Brisbane.
26 January 1965	Storms with hail caused serious wind and water damage to properties in the Brisbane area. The heaviest rain fell in a narrow swathe from Kenmore through South Brisbane and the City and across to Nundah. Severe wind damage was reported from West End to Eagle Farm including Hawthorne and Morningside. Houses and buildings were unroofed or damaged, trees uprooted or snapped and power lines downed. Water from hail-blocked drains entered houses and buildings. Rail traffic halted when water caused signals to fail. Extensive power losses occurred across the area. Details: in Hamilton, sheds and buildings damaged, 2 ships torn from moorings, full 200 litre drums and 1 tonne gangway blown along by the wind. Around Hawthorne and Morningside, 20 houses unroofed and buildings damaged. At Wooloongabba Cricket Ground buildings damaged, homes and buildings damaged at New Farm, West End, Hendra, Newstead and Fortitude Valley. Wind gusts to 59 knots were recorded.

Date of event	Impact
18 December 1965	Thunderstorm caused severe damage to properties at Kenmore, Toowong, Ashgrove, Bardon, and Enoggera. 20 houses were unroofed, trees were uprooted or snapped off, power lines were brought down. Gusts to 44 knots were recorded.
19 December 1967	Storms cut a swathe several kilometres wide from Coopers Plains to Chermside. Around 3000 insurance claims (mostly hail) were made. Hail to cricket ball size was reported. One house had 123 holes in its roof and some cars were penetrated by hail.
20 January 1970	A 27 km wide front of hail and wind damage passed through the southern suburbs. Almost all houses in the Slacks Creek-Rochedale area were damaged with 70 badly damaged. 60 houses were damaged at Wynnum, many unroofed. Widespread damage occurred across the city. SES reports indicate 5 houses were unroofed, 2000 houses damaged and 100 houses were declared structurally unsafe.
20 February 1970	Insurance records show a significant loss this day with a 75 knot gust recorded at Brisbane Airport.
27 December 1972	Wind damage occurred from Oxley through to Sunnybank. Tents were flattened on North Stradbroke Island. 5000 houses damaged throughout southeast Queensland.
14 January 1973	Wind and rain damage occurred from Redbank through Darra to Tingalpa and Gumdale. 15 houses were unroofed and 1000 damaged.
4 November 1973	Severe thunderstorm with a tornado moved from Brookfield to Eight Mile Plains, causing extensive damage along its path. The tornado track was 51 km long and 100 m to 230 m wide. 500 houses were unroofed, 1390 damaged and 500 declared structurally unsafe.
30 November 1976	Thirty buildings were damaged by wind in Brisbane's northern suburbs. Twelve houses were unroofed at Ipswich. Wind gusts to 49 knots were recorded in the city and to 62 knots at the Airport.
16 December 1977	Damaging storm path from Yeronga to Nundah with severe wind gusts. 150 houses were damaged with 50 declared structurally unsafe.
26 March 1978	A severe hailstorm with up to orange and cricket ball size affected the Mudgeeraba region inland from the Gold Coast, destroying a poultry farm. Hail lay up to 0.5 m deep on the ground. Damage was also reported at the Sunshine Coast, where 4 houses were unroofed at Bli Bli and one at Nambour.
7 November 1978	Egg-size hail damage and some wind damage from Wacol across to Sunnybank. 16 houses were unroofed and 1000 damaged.
13 December 1978	25 homes damaged in Ipswich and the western suburbs.
14 December 1978	Extensive hail damage (egg size) from Albany Creek to Brackenridge and Bald Hills. 40 houses were damaged.
23 March 1979	Wind and hail damage occurred in the Ipswich area. A 60 knot wind gust was recorded at Amberley. Caravans and 22 homes were damaged.
27 April 1979	Extensive hail damage Alderley, Dorrington, Enoggera and Newmarket with egg-size hail. Thirty-six houses suffered roof damage caused by severe winds. Damage also occurred at Stafford, Grange, Bardon and Northgate.
20 November 1979	Thunderstorm with severe winds and large hail caused major property damage. 700 insurance claims were made. 10 houses were unroofed, 500 suffered damage and 5 were declared structurally unsafe. The major suburbs affected included Woodridge, Mount Gravatt, New Farm, Camp Hill, Carina, Wynnum, Capalaba, and Beenleigh.
21 November 1979	One house was destroyed and 30 damaged at Kallangur, Lawnton , Petrie and Brackenridge.

Date of event	Impact
20 December 1979	Wind gusts of 64 knots were recorded at Amberley. Hail and wind damage occurred in Ipswich and 36 homes were damaged at Peak Crossing.
20 January 1980	Hail to golf ball size occurred over a wide area from Tennyson through to Sandgate. 63 knot wind gusts were recorded at Brisbane airport. Homes at Saint Lucia, Alderley, Chermside, Geebung, Strathpine and Sandgate were damaged.
28 February 1980	36 homes suffered roof damage at Beenleigh.
22 November 1980	Widespread wind and hail damage with 67 knot wind gusts reported at Brisbane Airport. Area affected was from Sunnybank to Wynnum. Most damage to housing was at Murarrie where 46 homes were unroofed. Other wind damage at Cannon Hill and Nudgee and flashfloods at Greenslopes and Browns Plains.
16 December 1980	900 homes were seriously damaged by hail at Brighton. A tornado was sighted at Hayes Inlet. 4000 tarpaulins were needed to secure damaged homes. 860 homes were unroofed, 1600 damaged and 100 declared structurally unsafe. Another supercell passed from Ipswich to Coopers Plains unroofing 70 homes and damaging another 150. 25 light aircraft were destroyed at Archerfield.
29 November 1981	A severe Z6 cell passed over Beaudesert causing considerable wind and hail damage. Golf ball sized hail caused a dozen injuries and 70 homes were unroofed or suffered major damage. The cell continued northwards across the city and reformed but passed out to sea without further severe effects.
7 December 1982	Severe wind and hail damage at Beenleigh with 180 houses damaged and one death. 53 knot wind gust recorded at Wickham Terrace.
8 September 1983	A tornado was suspected of causing damage in the Lamington National Park area and associated storms caused damage along the south coast region. Sections of walking track south of O'Reilly's took four months to clear of felled 2000 year-old Antarctic Beech and cedars.
6 October 1983	Severe damage occurred in the Cotton Tree caravan park in Maroochydore causing seven injuries and one death. A tornado was suspected of clearing a 50 m wide strip that destroyed 13 caravans and damaged six others.
3 November 1983	On a day of considerable regional thunderstorm activity, one severe storm affected the Gold Coast region and damaged 16 houses at Ashmore.
4 January 1984	Severe wind and hail damage was reported in the Laidley-Gatton area to farm buildings and also crops.
6 January 1985	Severe wind and hail in the Manly area with 2 deaths. 10 houses were unroofed and 200 damaged.
18 January 1985	Major Brisbane hailstorm (south-west and north-east suburbs) with wind gusts to 101 knots recorded at Brisbane Airport and hail up to cricket ball size. 2000 houses were unroofed, another 20 000 suffered damaged and 12 were declared structurally unsafe. The damage path was 8 to 12 km wide from Jamboree Heights to Banyo. Major damage occurred at Jamboree Heights, Corinda, Sherwood, Graceville area and a region bounded by Windsor, Chermside, Banyo, Eagle Farm and Hamilton.
13 October 1985	Hail to the size of oranges damaged 40 houses in the northwest Brisbane suburbs.
9 March 1985	Tornado reported at Daisy Hill. Extensive property damage occurred at Ipswich and through the southern suburbs of Brisbane. 1000 homes suffered damage.
13 October 1985	Hail from a Z5 (50 dBZ reflectivity) cell ranging up to orange and tennis ball size caused damage to 40 houses in the north western suburbs.
19 October 1987	Hail damage occurred in the Ipswich area and wind damage occurred in the Clayfield-Kedron-Stafford area. 40 houses were unroofed, 220 others were damaged and 2 were declared structurally unsafe.

Date of event	Impact
24 November 1987	Hail and wind damage with wind gusts to 87 knots recorded at the Tennyson Power House (40 m elevation). Damage occurred in the Ipswich and Goodna areas. 270 houses were unroofed with 820 others damaged.
24 December 1989	A tornado was sighted at Redcliffe. Wind damage also occurred in the Brisbane area. A yacht at the Newport Marina recorded wind gusts in excess of 100 knots. 500 homes were unroofed, another 1000 were damaged and 12 were declared structurally unsafe.
2 November 1990	Hail damaged 27 homes in the Booval area and 12 homes were damaged by hail and wind at Albany Creek.
30 November 1991	Hail and wind caused damage to areas in the southern suburbs of Brisbane. A possible tornado sighting at Sunnybank. 5 houses were unroofed and 20 others damaged.
29 November 1992	This was a day of quite considerable thunderstorm activity in South-East Queensland with five major severe storm cells affecting the regions south from Bundaberg to the Gold Coast. Brisbane experienced golf ball sized hail across the SE suburbs from a Z4 cell but no severe winds, with damage mainly to motor vehicles. This storm notably interrupted the Australia - West Indies Test Match at Woolloongabba and was nationally telecast. Maroochydore had severe winds and hail up to cricket ball size from a Z5 supercell that caused significant property and vehicle damage. Numerous light aircraft were damaged. West of Maryborough, near Oakhurst, an estimated F3 tornado from a Z6 supercell cut a path 30 km long and between 150 to 250 m wide through mainly forest country. Accompanying hail was at least golf ball size. Further north at Bucca near Gin Gin, another Z6 supercell spawned an estimated F4 tornado with a 10 km path. It destroyed nine homes and lead to about twenty cattle having to be destroyed because of their injuries. The width of this tornado was estimated as between 20 to 60 m on the ground. The owner of one of the demolished houses reported that, together with most items, “the fridge is still missing...”. Hail ranged from cricket ball to grapefruit size.
26 December 1992	Roofs were torn off houses in the Brighton, Brackenridge area. At least 50 houses were also damaged at Albany Creek, Sandgate and Redcliffe.
6 January 1993	A storm swept through Ipswich and the western suburbs of Brisbane and damaged 29 houses, four of them extensively. SES received 100 calls for assistance.
4 November 1994	Areas from Mount Tamborine through Helensvale were affected by golf ball sized hail that damaged every car in the Movie World car park.
29 January 1995	Storm hit Brisbane late at night and damaged 100 homes (most properties suffered roof damage, broken windows or fallen trees on houses). The Rialto theatre lost its roof. Wind gusts to 55 knots were recorded at Brisbane Airport.
5 November 1995	Wind storm in Brisbane with SES responding to 60 calls for help throughout the Brisbane suburbs.
6 November 1995	Thunderstorms caused extensive hail damage at Bellbowrie with hail to softball size observed. 30 houses were unroofed and 300 others damaged. Approx $60 million losses.
19 November 1995	Severe but very localised wind damage in Caboolture resulted in several homes being destroyed and many more damaged.
16 December 1995	A line of thunderstorms moved rapidly through the Gold Coast and southern suburbs of Brisbane ahead of a surface trough. The storms, moving at about 90 km/h, produced severe wind gusts between Beaudesert, Beenleigh and then out through Redland Bay and over Moreton Bay.
18 December 1995	A phenomenal day of severe thunderstorm activity with three lines of severe storms through the South-East region alone. Severe storms also occurred in the Wide Bay - Burnett and Capricornia districts. The first line of storms passed through Brisbane,

Date of event	Impact
	followed by a second line in which a severe cell affected Maroochydore producing wind and hail. The third line produced a severe cell over the Caboolture-Morayfield area
10 December 1996	Thunderstorm caused widespread wind and hail damage. SES Brisbane responded to 51 tasks at Mansfield, Mt Gravatt, Inala, Woolloongabba, Nathan, Forest Lake, Durack, Holland Park, Salisbury Tarragindi, Pinkenba, mainly for hail damage and water intrusion. 9 other tasks were also attended to in Pine Rivers, Redcliffe and Caboolture. Wind gusts to 69 knots were recorded at Brisbane Airport and 56 knots at Archerfield. 10 aircraft were damaged by hail at Archerfield.
31 March 1997	Thunderstorm caused hail damage in the Chermside area. The Chermside shopping centre suffered severe hail damage. 40 houses in the Brisbane suburbs sustained roof damage. There was also widespread damage in the Caboolture shire. Approx $10 million insurance losses.
28 January 1998	Thunderstorms with intense rainfalls caused flashfloods in the Sunnybank and Rocklea areas. 20 homes were flooded. Calamvale recorded 154mm.
10 April 1998	Severe wind and hail storm at Ipswich with SES responding to 132 calls for help. Wind gusts to 63 knots were recorded at Amberley. 3 people were killed when they came in contact with fallen power lines. The Beenleigh Ambulance received 50 calls due to injuries from slamming doors and windows in the wind.
13 October 1998	Wind damage in Fortitude Valley, Bowen Hills, Breakfast Creek, Albion, Clayfield, Ascot, Nundah, Toombul, Greenslopes and Coorparoo. A school was unroofed at Wynnum and many large trees were uprooted along the Wynnum-Manly foreshore. Wind gusts to 64 knots were recorded at the Brisbane Airport and an anemometer was held at 70 knots maximum deflection for 3 minutes at the Manly Coast Guard. A yacht at Manly recorded a wind gust of 85 knots. Department of Civil Engineering (University of Queensland) study indicated winds of 90 knots damaged house at Hendra. Hail to 5 cm in diameter was observed at Cannon Hill. Insurance claims $23 million.
18 November 1998	Wind partially unroofed 6 houses at Toowoomba, with the Toowoomba Airport anemometer recording a gust of 60 knots. Approximately 37 000 houses lost power, chiefly in the towns of Laidley, Gatton and Esk. Houses in the Brisbane suburbs of Chapel Hill and Kenmore had roofs damaged by falling branches. Brisbane airport recorded a maximum wind gust of 49 knots.
24 November 1998	Widespread storms across South-East Queensland with power supply company Energex stating that almost 100 000 homes lost power. Ipswich SES controller reported that they attended about 50 homes and businesses damaged by storms, with rain causing additional damage. Hail to golf ball size was reported at Rosewood and Marburg. A brick duplex was destroyed at Caloundra, where a tornado was reported. Eight other houses were also damaged in the Caloundra area.
5 December 1998	Hail larger than golf ball-size was reported from the Ivory Rock conference centre near Peak Crossing (south of Ipswich). Roofs and 30 cars suffered hail damage. Hail to golf ball size was also reported from Manly West and Algester.
16 December 1998	Thunderstorm with large hail moved north across the Brisbane city area and eastern suburbs. A Toyota dealership reported 600 vehicles sustaining damage between $2,000 and $8,000 each. Suncorp, Queensland's major insurer, reported more than 1500 vehicle claims, with total damage estimated as between $10 million and $12 million. The Insurance Council of Australia named the worst hit suburbs as Clayfield, Windsor, Wilston, Albion, Northgate and Wavell Heights with an estimated total damage bill of $76 million. There were many reports of hail, the largest reported diameter was 10 cm

Date of event	Impact
	at Bracken Ridge. Additional storms caused damage in the Ipswich area and in the Gold Coast hinterland.
11 January 1999	Ipswich SES controller about 9.00 pm reported 75 callouts to businesses and homes damaged by thunderstorm gusts during the evening. Sixty homes and the Brisbane Court House and Tivoli Sewage works were damaged. Approximately 12 000 homes lost power. Maximum wind gusts of 37 knots were reported at Amberley RAAF base. Damage to caravans at North Ipswich
4 October 1999	Power lines brought down in the suburbs of Booval and Bundamba about 5.15 pm, disrupting traffic. Energex representative reported that about 3100 homes lost power, chiefly in the Bundamba and Booval area. Bundamba creek rose 1.5 m in 30 minutes, flooding also at River View. Fallen tree damaged house in Pine Mountain. Severe flooding occurred in Durack and Inala. Roads also flooded near Helensvale at about 7pm.
14 October 1999	Two early morning storms (occurring at 7.30am and 8.15am) 8 km south-east of Nanango, with rainfall recordings of 65mm and 105mm during that timespan. Also some light to medium hail.
20 October 1999	Heavy rain recorded at Brisbane airport. 47mm between 12.25 am and 1.00 am , and approximately 24mm between 3.15 am and 4.00 am. Wind at Brisbane Airport 12:30 am recorded gusts of 37 knots. Anecdotal reports of hail and fallen trees in suburbs south of the airport.
7 November 1999	Between 4:00 and 8:00 am golf ball size hail at Chapel Hill and Zillmere. 2cm and golf ball size hail reported from Caboolture. 2cm hail reported from Indooroopilly. 1cm size hail reported from Samford, The Gap, Banyo, Wavell Heights and Northgate.
23 November 1999	Broad rotation under cell in the Beenleigh area, at about 5.30 pm reported by David Bernard (meteorologist). Report from G McNutt (meteorologist) of 'violent' winds at Woolloongabba, with 'building shaking'.
10 December 1999	Storm chasers reported a swathe of property and tree damage stretching from just south of Boonah to Redland Bay, due to strong winds associated with a thunderstorm. Storm spotter and newspaper reports of large hail - 5 cm at Brunswick Heads (NSW); 2-3 cm at Stephens (Gold Coast); golf ball size at Park Ridge, Shailer Park and other areas south of Brisbane in 2 separate cells.
30 December 1999	The towns of Palmwoods, Chevallum, Forest Glen and Nambour (the Sunshine Coast hinterland) experienced building, crop and tree damage; mostly wind damage, but some hail damage to fruit. Energex representative stated 20 000 homes lost power due to fallen power lines.
5 January 2000	Pea to marble size hail; 'very strong wind gusts'; minor flooding; reported by storm spotter at Wellington Point. Courier Mail newspaper report of 7 houses damaged in the suburb of Capalaba, and 2 houses damaged in Birkdale, and 2 houses damaged in Wellington Point. Damage to trees was also reported. A funnel cloud was reported from Annerley at 5:15 pm, looking towards Cleveland.

APPENDIX G: MODIFIED MERCALLI (MM) SCALE OF EARTHQUAKE INTENSITY (after Dowrick, 1996)

MM I *People*
Not felt except by a very few people under exceptionally favourable circumstances.

MM II *People*
Felt by persons at rest, on upper floors or favourably placed.

MM III *People*
Felt indoors; hanging objects may swing, vibrations may be similar to passing of light trucks, duration may be estimated, may not be recognised as an earthquake.

MM IV *People*
Generally noticed indoors but not outside. Light sleepers may be awakened. Vibration may be likened to the passing of heavy traffic, or to the jolt of a heavy object falling or striking the building.

Fittings
Doors and windows rattle. Glassware and crockery rattle. Liquids in open vessels may be slightly disturbed. Standing motorcars may rock.

Structures
Walls and frame of building are heard to creak, and partitions and suspended ceilings in commercial buildings may be heard to creak.

MM V *People*
Generally felt outside, and by almost everyone indoors. Most sleepers awakened. A few people alarmed.

Fittings
Small unstable objects are displaced or upset. Some glassware and crockery may be broken. Hanging pictures knock against the wall. Open doors may swing. Cupboard doors secured by magnetic catches may open. Pendulum clocks stop, start, or change rate.

Structures
Some windows Type I cracked. A few earthenware toilet fixtures cracked.

MM VI *People*
Felt by all. People and animals alarmed. Many run outside. Difficulty experienced in walking steadily.

Fittings
Objects fall from shelves. Pictures fall from walls. Some furniture moved on smooth floors, some unsecured free-standing fireplaces moved. Glassware and crockery broken. Very unstable furniture overturned. Small church and school bells ring. Appliances move on bench or table tops. Filing cabinets or “easy glide” drawers may open (or shut).

Structures
Slight damage to Buildings Type I. Some stucco or cement plaster falls. Windows Type I broken. Damage to a few weak domestic chimneys, some may fall.

Environment
Trees and bushes shake, or are heard to rustle. Loose material may be dislodged from sloping ground, e.g. existing slides, talus slopes, shingle slides.

MM VII *People*
General alarm. Difficulty experienced in standing. Noticed by drivers of motorcars who may stop.

Fittings
Large bells ring. Furniture moves on smooth floors, may move on carpeted floors. Substantial damage to fragile contents of buildings.

Structures
Unreinforced stone and brick walls cracked. Buildings Type I cracked with some minor masonry falls. A few instances of damage to Buildings Type II. Unbraced parapets, unbraced brick gables, and architectural ornaments fall. Roofing tiles, especially ridge tiles, may be dislodged. Many unreinforced chimneys damaged, often falling from roof-line. Water tanks Type I burst. A few instances of damage to brick veneers and plaster or cement-based linings. Unrestrained water cylinders (Water Tanks Type II) may move and leak. Some windows Type II cracked. Suspended ceilings damaged.

Environment
Water made turbid by stirred up mud. Small slides such as falls of sand and gravel banks, and small rock-falls from steep slopes and cuttings. Instances of settlement of unconsolidated or wet, or weak soils. Some fine cracks appear in sloping ground. A few instances of liquefaction (i.e. small water and sand ejections).

MM VIII *People*
Alarm may approach panic. Steering of motor cars greatly affected.

Structures
Buildings Type I, heavily damaged, some collapse. Buildings Type II damaged, some with partial collapse. Buildings Type III damaged in some cases. A few instances of damage to Structures Type IV. Monuments and pre-1976 elevated tanks and factory stacks twisted or brought down. Some pre-1965 infill masonry panels damaged. A few post-1980 brick veneers damaged. Decayed timber piles of houses damaged. Houses not secured to foundation may move. Most unreinforced domestic chimneys damaged, some below roof-line, many brought down.

Environment
Cracks appear on steep slopes and in wet ground. Small to moderate slides in roadside cuttings and unsupported excavations. Small water and sand ejections and localised lateral spreading adjacent to streams, canals, lakes, etc.

MM IX *Structures*

Many buildings Type I destroyed. Buildings Type II heavily damaged, some collapse. Buildings Type III damaged, some with partial collapse. Structures Type IV damaged in some cases, some with flexible frames seriously damaged. Damage or permanent distortion to some Structures Type V. Houses not secured to foundations shifted off. Brick veneers fall and expose frames.

Environment
Cracking of the ground conspicuous. Landsliding general on steep slopes. Liquefaction effects intensified and more widespread, with large lateral spreading and flow sliding adjacent to streams, canals, lakes, etc.

MM X *Structures*
Most Buildings Type I destroyed. Many Buildings Type II destroyed. Buildings Type III heavily damaged, some collapse. Structures Type IV damaged, some with partial collapse. Structures Type V moderately damaged, but few partial collapses. A few instances of damage to Structures Type VI. Some well-built timber buildings moderately damaged (excluding damage from falling chimneys). Dams, dykes, and embankments seriously damaged. Railway lines slightly bent. Cement and asphalt roads and pavements badly cracked or thrown into waves.

Environment
Landsliding very widespread in susceptible terrain, with very large rock masses displaced on steep slopes. Landslide dams may be formed. Liquefaction effects widespread and severe.

MM XI *Structures*
Most Buildings Type II destroyed. Many Buildings Type III destroyed. Structures Type IV heavily damaged, some collapse. Structures Type V damaged, some with partial collapse. Structures Type VI suffer minor damage, a few moderately damaged.

MM XII *Structures*
Most Buildings Type III destroyed. Many Structures Type IV destroyed. Structures Type V heavily damaged, some with partial collapse. Structures Type VI moderately damaged.

Construction types

Buildings Type I Buildings with low standard of workmanship, poor mortar, or constructed of weak materials like mud brick or rammed earth. Soft storey structures (e.g. shops) made of masonry, weak reinforced concrete, or composite materials (e.g. some walls timber, some brick) not well tied together. Masonry buildings otherwise conforming to Buildings Type I–III, but also having heavy unreinforced masonry towers. (Buildings constructed entirely of timber must be of extremely low quality to be Type I).

Buildings Type II Buildings of ordinary workmanship, with mortar of average quality. No extreme weakness, such as inadequate bonding of the corners, but neither designed nor reinforced to resist lateral forces. Such buildings not having heavy unreinforced masonry towers.

Buildings Type III Reinforced masonry or concrete buildings of good workmanship and with sound mortar, but not formally designed in detail to resist earthquake forces.

Structures Type IV Buildings and bridges designed and built to resist earthquakes to normal use standards, i.e. no special collapse or damage limiting measures taken (mid 1930s to c. 1970 for concrete and to c. 1980 for other materials).

Structures Type V Buildings and bridges designed and built to resist earthquakes to normal use standards, i.e. no special damage limiting measures taken, other than code requirements, dating from since c. 1970 for concrete and c. 1980 for other materials.

Structures Type VI Structures dating from c. 1980 with well defined foundation behaviour, which have been especially designed for minimal damage, e.g. seismically isolated emergency facilities, some structures with dangerous or high (value) contents, or new generation low damage structures.

Windows
Type I – Large display windows, especially shop windows.
Type II – Ordinary sash or casement windows.

Water tanks
Type I – External, stand mounted, corrugated iron water tanks.
Type II – domestic hot-water cylinders unrestrained except by supply and delivery pipes.

APPENDIX H: IMPACT OF FLOODING IN SOUTH-EAST QUEENSLAND

Given in the following pages are details of known floods in the Brisbane River Basin, including Ipswich and the surrounding districts, extracted from:

- *The Romance of the Bremer*, Margery Brier-Mills, Historical Society of Ipswich, 1982. (Ref 1)
- *The early floods of the Brisbane-Bremer River system, 1823-1867*, Murdoch Wales (in association with Geoffrey Cossins and Robert Broughton), Brisbane City Council, 1976 (Ref 2).
- *Caboolture country*, Caboolture Historical Society, 1973 (Ref 3).
- *By many campfires*, Caboolture Historical Society, 1977 (Ref 4).
- *From spear and musket: 1879-1979*, Caboolture Shire Council, 1979 (Ref 5).
- *Results of rainfall observations made in Queensland,* Bureau of Meteorology, 1940.
- Monthly Weather Reviews & various data, Bureau of Meteorology.

Date of event	Impact
Early 1820's	John Oxley, early explorer, mentioned evidence of an inundation which he discovered on 19 September 1824 in an area north of the junction of the Bremer with the Brisbane: "the starboard bank an elevated flat of rich land, declining to a point where had evidently by its sandy shore and pebbly surface, been at some time washed by an inundation; a flood would be too weak an expression to use for a collection of water rising to the full height (full fifty feet) which the appearance of the shore here renders possible." (Ref 2)
1825	Major Edmund Lockyer mentioned the evidence of a large flood while in the area of today's Mount Crosby pumping station - "marks of drift grass and pieces of wood washed up on the sides of the banks and up into the branches of the trees, marked the flood to rise here of one hundred feet". Lockyer's descendant, Nicholas Lockyer, in 1919 made the following remarks: "the official record of the flood level of the river on the 4th February 1893 at the Pumping Station, the site of which is within a mile of Lockyer's camp, was 94 feet 10.5 inches. His remarks would seem to suggest that between Oxley's visit in September 1824 and his [Major Edmund Lockyer] own in September 1825, the river had experienced a flood as great as that subsequently experienced in February 1893." (Ref 2) Note that the early records refer to heights taken at the Ipswich Pumping Station. This was on the Brisbane River (not the Bremer river) near Kholo.
March 1836	Brisbane: Commandant of the Moreton Bay Settlement, Captain Foster Fyans, wrote that "we had constant rain from the 8th to the 12th March, and I am happy to say, notwithstanding the river rose about 12 feet, we sustained no injury or consequence, and those many parts of the cornfields were flooded". Murdoch Wales comments that this was in fact only three feet lower in the central city area than the 1974 flood. (Ref 2.)
1839	As reported by the *Moreton Bay Courier*, 30 May 1857, Ref.2, regarding the 1857 flood: "the river began to rise on Tuesday morning (at Ipswich) more rapidly than usual, and on Thursday afternoon it had attained the maximum height of between 35 and 40 feet above the level, being 14 feet less, we believe, than when it rose in the great flood of 1839 when, according to the statement of one who resided here at the time (probably one of the Thorn household), the river overflowed its banks to the extent of 54 feet completely filling all the gullies leading from the Bremer to what are today the main streets of the town, and inundating the country to the eastward of the Main Range

Date of event	Impact
	for many miles." Ref 2 also refers to a letter by McConnel of "Cressbrook" near Toogoolawah in which it was said that the 1839 flood was three feet four inches higher than the 1864 flood of twelve feet six inches. Cossins suggests that with a major flood at both Cressbrook and Ipswich, Brisbane must have experienced a flood also. (Ref 2.)
1841	Ipswich flood "55 feet above the ordinary height of the Bremer". (From *Queensland Times,* Ref 1) "The water rose 70 feet at Ipswich and no such flood again seen until the 1893 trouble. In the floods of 1857, 1863, 1864, 1870 the water rose 45 feet to 50 feet in Ipswich. The 1887 flood is said to have risen 50 feet in Ipswich which is 5 feet above 1864 and 1870. The flood of May 1857 was the outcome of 6 weeks long continued rather than heavy rain. That of 1863 was February autumn one 15.14 inches of rain fell in 16 days. In March 1864 an equinoctial gale brought the floods. The night of the 18th was terrific. A hurricane blew. The river rose 50 feet in 12 hours at Ipswich. The deluge of March 1870 consisted of 24.25 inches of rain in a little over 4 days; 8.20 inches being the maximum fall in 12 hours." (From *Australian Pioneers and Reminiscence,* Nehemiah Bartley, Ref 1.)
14/1/1841	Brisbane: Highest flood in Brisbane's recorded history (to 2000). In 1896, JB Henderson, the Government Hydraulics Engineer in an address to Parliament reported that he found by examination of earlier plans that the 1841 flood was [7 centimetres] higher than the flood of 5th February 1893. (Ref 2)
9/6/1843	Brisbane: A flood of 2.76 metres AHD. (Ref 2)
10/1/1844	Heavy floods experienced at Ipswich on 10th January 1844 (HA Hunt, 1913).(Ref 2) Flood peak at Brisbane about 4 feet less than the record 1841 flood.
17/12/1845	Heavy floods experienced at Ipswich on 17th December 1845 (HA Hunt, 1913). (Ref 2)
11-14/4/1852	Heavy floods at Brisbane and Ipswich. Ipswich: "We are informed by a person of credit that the Bremer roses 24 or 25 foot." (From *Moreton Bay Courier*, Ref 1.) Possibly peaked Tuesday 13 April of Wednesday 14 April following the Easter weekend.
19-20/5/1857	Great floods at Ipswich and Brisbane; river at Ipswich rose 45 feet, and at Brisbane 12 feet.
May 1857	Ipswich: "In the inundation in the autumn of 1857 the Bremer rose about 40 feet." (From *Queensland Times*, Ref 1.) "At Mr Flemings extensive establishments, it appears that the water rose 51 feet above its usual level, reaching to the second pane of the window of his new flour mill." (From *Moreton Bay Courier*, Ref 1.) Ipswich: As reported by the *Moreton Bay Courier*, 30 May 1857, (Ref.2), regarding the 1857 flood : "the river began to rise on Tuesday morning (at Ipswich) more rapidly than usual, and on Thursday afternoon it had attained the maximum height of between 35 and 40 feet above the level, being 14 feet less, we believe, than when it rose in the great flood of 1839 when, according to the statement of one who resided here at the time (probably one of the Thorn household), the river overflowed its banks to the extent of 54 feet completely filling all the gullies leading from the Bremer to what are today the main streets of the town, and inundating the country to the eastward of the Main Range for many miles." Brisbane: "The following morning the wharves were completely inundated with the water rising over the banks to flood the lower portions of both North and South Brisbane. Frogs' Hollow [along a stream, beginning near the corner of Albert and Elizabeth Street and extending northwards to the St Stephen's Cathedral site before making its way to the river near Edward Street] was badly affected and the residents of

Date of event	Impact
	between twenty and thirty houses had to be evacuated." (Ref 2) From a correspondent of the *Brisbane Courier*, 29th June 1907: "The flood of 1857 was the result of eight weeks' continuous, but not heavy, rain. There had been a strong fresh in the river for several weeks, and during a portion of this time all vehicular traffic between North and South Brisbane was suspended as the horse-punt at Russell Street was unable to cross on account of the strong current. At Ipswich the river rose 45 feet, and waterside stores were submerged to the roof; in the Brisbane reaches, however, the flood waters did not rise more than 7 feet above ordinary springs. Rowing boats were plying in Margaret, Mary, and Charlotte streets, but except near Edward and George streets there were few house in the streets named. There were only a couple of houses in Albert Street between Charlotte and Alice Streets, and the whole of the low-lying ground from Elizabeth Street to the river was a muddy lake. At South Brisbane one could stand on a hill at Cordelia Street near Boundary Street and see an unbroken sheet of water stretching from Melbourne Street to Tribune Street. Stanley Street was submerged from Walmsley Street to within 1000 yards of the present dry dock. A good deal of the land at Hill-end was submerged, as was also the land on the opposite side of the river, now known as St. Lucia, and which was then a dense vine scrub. Most of the scrub lands at Oxley were also under water, as was Montague-road from the Stanley-street to the present West-end Reserve".
7/10/1858	Flood at Ipswich.
12/10/1858	Ipswich: "Nothing but the absence of a fresh in the Brisbane River prevented the most calamitous consequences in Ipswich, as the water rose even opposite Woodend some six feet higher than during the flood of May 1857." (From the *North Australian*, Ref 1.)
26/1/1863	Ipswich: Brisbane River bank high, Bremer River rose 4 or 5 feet, Brisbane Road almost impassable.
30/1/1863	Ipswich: Bremer River still rising and the Brisbane River a banker.
2/2/1863	Ipswich: Bremer River rapidly failing. At the height of the flood a shed on the river bank was about 15 feet under water.
15 & 16/2/1863	Severe floods at Brisbane, Ipswich and places elsewhere.
17/2/1863	Brisbane: Great deal of damage done by floods; road to Ipswich impassable; Oxley Creek residents flooded out; hundreds of acres of land under water; machinery at the mill affected, work stopped; Frog's Hollow under water; telegraphic communication with Sydney interrupted. River 40 feet above ordinary level.
18-20/2/1863	Ipswich: Heavy rain fell incessantly from the 12th to the 15th, and caused the highest flood, except that of 1841, on record. Stores along the wharves swept away; roads and creeks impassable; ferry house and several small buildings on the banks of gullies and other low lying positions inundated; creek at One-Mile Bridge a roaring torrent, telegraph posts submerged; Rosewood township partly under water; Nelson Plains one sheet of water. "The 1863 flood was 12 ft. lower than the 1841 flood, as on the Sunday night, when the water was at its highest, it was estimated to be 43 feet above the usual level of the river." (From *Queensland Times*, Ref 1.)
20 & 21/2/1863	The greater portion of the lowlands between Laidley and Ipswich one sea of water.
17-18/3/1863	Flood in Queen Street Brisbane from Wheat Creek; very heavy fall of rain; shops and dwellings flooded. The *Courier* reported "all Queen Street was in a state of consternation last evening consequent upon a sudden flood which deluged the back premises, yards, and basement stories of nearly all the houses on the west side of Queen Street from Albert Street to Edward Street. It would appear that the current was so strong that it smashed windows, burst in bolted doors, and carried gates from their

Date of event	Impact
	hinges."
23/4/1863	Brisbane: The late rain caused floods over the low-lying ground at Milton and in Fortitude Valley.
25/4/1863	Ipswich: Bremer River rose 15 feet; water within a few inches of the One-Mile bridge; rain ceased; no further rise.
3/12/1863	Ipswich: Continuous rain; flood at Three Mile Bridge; western road impassable.
5/2/1864	Ipswich: Owing to heavy rains communication with the interior cut off and the Warwick mailman forced to return to Ipswich; creek at Fassifern bank to bank; Bremer River rising rapidly.
8/2/1864	From *Courier* files 8-13/2/1864: "The weather has been very tempestuous and rainy during the early part of the week, and the Bremer and Brisbane Rivers rose above their usual flood-tide levels. Very slight inconvenience was felt in Brisbane from the overflow, the proprietors of warehouses on the waterside having taken timely precautions to prevent damage to property by removing their goods. At Ipswich, however, the ferry house was submerged, and the gauging shed was considerably damaged and several of the wharves were flooded. Stream traffic between the two towns was temporarily suspended. Man drowned whilst attempting to cross the river at Ipswich."
17-19/3/1864	Flood and gale at Brisbane and Ipswich (from the *Courier* files 19-22/3/1 864). On Saturday night (19th March) the river began to rise, and it was evident that a flood was impending. The telegraph posts at the One-Mile Creek Bridge, Ipswich, which had been raised 20 feet higher than they were at the flood of 1863, were swept away, although they had been let into the ground to a depth of 9 feet and supported by struts. The water at Brisbane rose throughout the whole of Sunday, and at 4 o'clock in the afternoon Albert Street, from Alice Street to Charlotte Street was impassable, and many of the residents of Frog's Hollow had to abandon their tenements. Raff's Wharf was 5 feet under water, as also were Harris's, Forrest's and Town's. The water went up Russell Street as far as Mr Kincheial's store. At the 3 Miles Scrub the water rose 25 feet above the ordinary level. At Milton much damage was done, and the whole of the cemeteries were under water.
21/3/1864	The flood was at its highest at Ipswich at 1am on Monday, the 21st March, when it was flush with the stone wall at the end of East Street. At this point, the water remained stationery for two hours, when it began to fall slowly. (from *Queensland Times*, 16 Apr 1864, Ref 1.)
23-30/3/1864	From the *Courier* files: Flood damage at Oxley Creek. A large amount of property has been destroyed at Oxley Creek by the late floods. All the farmers on the Brisbane side of the Creek were compelled to leave their houses, and camp on the high ground in the neighbourhood of Cooper's Plains. On the opposite side very few were driven out. McDonald's Hotel was submerged to the eaves, and a sheet of water extended from the new sawmills, situated near the junction of the creek with the river, to the high land at the back of Cooper's Plains, a distance of nearly 7 miles. River rose 18 feet above the level reached during the flood that occurred about a fortnight ago, and 10 feet above that of the flood of March 1863.
23/3/1864	Brisbane: The greatest amount of damage by recent floods occurred at South Brisbane, Frog's Hollow, and Fortitude Valley. For many miles along the banks of the river farmers were flooded out, and crops, furniture and in some cases their habitations swept away. Stone jetty at Cleveland completely swept away during a gale on the 18th. Ipswich: Ipswich surrounded by impassable rivers and creeks immense damage caused. At Gatton the creek rose 1 5 feet higher than ever known before.

Date of event	Impact
2/4/1864	Brisbane: Two hundred teams stuck up on the road between Ipswich and Toowoomba. Highways throughout interior in impassable state after heavy rains; distressing accounts of destruction received from the northern and interior districts; several lives lost.
5-10/8/1864	Ipswich: Heavy and almost continuous rain; river rose; wharfs many feet under water; One-Mile bridge impassable rifle butts under water.
22/9/1865	Brisbane: Some damage done to the dam in course of erection at the Enoggera Creek waterworks by a heavy fall of rain.
27/10/1866	A terrific storm occurred at Brisbane; town flooded and some buildings unroofed.
10-12/12/1866	Brisbane: Almost incessant rain since 2 am on the 10th inst.; creeks and watercourses overflowed; lower parts of South Brisbane flooded to a considerable extent. A.S.N.Co's wharf covered; a foot of water in the shed. Total rainfall from 2 a.m. Sunday 9th to 9 pm Wednesday 12th, 5.75 inches. At 9 am on l1th inst. the water was within 3 feet of the by-wash at Enoggera Reservoir and rising at the rate of 4 inches per hour. At 1.30 am 12th the depth of the overflow was 9 inches. By 5 pm the 11th all the wharfs at Ipswich on the southern bank were several feet under water, while there were 3 or 4 feet of water in the sheds; water almost level with the top of the Railway Wharf at North Ipswich, and 10 feet above its ordinary level at high water.
1/2/1867	Brisbane: The recent heavy rain caused floods on low and excavated land and basement floors of buildings in several portions of the town. Ipswich: At about 12.30 pm the Bremer River had risen 20 feet at the Ipswich wharfs and was still rising; the One-Mile Creek Bridge at Little Ipswich was submerged the railway at Walloon flooded and traffic suspended. The embankments upon the line, 4 miles from Gatton, were washed away. A man and a team of horses were drowned while trying to cross the creek at Helidon.
2/2/1867	Serious floods at Brisbane, Ipswich and in parts of the country.
21/4/1867	Severe flood and gale at Brisbane and Ipswich; loss of life occurred; houses unroofed; damage done to new Victoria Bridge works.
26-28/4/1867	Brisbane: During most of the week ending 27th April, the weather was very unsettled, and on Friday the 26th rain commenced to fall steadily and continued with but little intermission all day on Saturday. Soon after midnight on Saturday the rain which had been falling in heavy showers accompanied by squalls of wind, commenced to descend in torrents. The rain continued to fall incessantly until daylight. In consequence of this heavy rain the river rose, and never within the last twenty years have the indications of a flood shown themselves within so short a period. The river at high water on Sunday was on a level with the highest spring tides, although the present are dead neaps. Between 8 and 9 o'clock at night, which would have been about half ebb, the water had fallen 2 feet. The two lowest wharfs in the town were covered. A strong current was running down the river all Sunday, carrying with it large quantities of drift timber in single logs and rafts as well as other debris evidently washed off the bank. The temporary bridge linking north and south Brisbane acted as a dam and collapsed on the evening of 29 April as a result of the debris piling up against it.
22/1/1868	Floods throughout the country especially the southern parts. Bremer River rose 9 feet, wharves submerged; flood anticipated.
23/1/1868	Ipswich floods subsiding, weather clearing up.
27/4/1868	Ipswich: Heavy rains. Slight fresh in the Bremer last week and on the 27th the river continued to rise with great rapidity. Shortly after noon it was flush with the wharves and towards evening there were several feet of water in the sheds. The railway line was also damaged.

Date of event	Impact
31/1/1870	Brisbane: Creeks between Brisbane and Gympie swollen; after the Glass House mountain stage was reached the driver of the Gympie coach found it necessary to swim across the creeks with the mails.
7-11/3/1870	Great rains. On the 7th there was a fresh in the river; the Upper Brisbane showed signs of flood, the water being within a foot of top of breakwater. Much of low-lying country at Eagle Farm Flats was flooded and Breakfast Creek Road below the Waterloo Inn was covered to a depth of several inches. On the 8th the river rose considerably, at 2 pm it was 6 feet above high water mark. At Enoggera Reservoir the water was 1'7" below bywash on the 5th, 9" above on the 6th and 4'10" above bywash on 1lth. All creeks in district flooded. The water covered Bowen Bridge and extended as far as foot of the hill beyond the hospital. At Caboolture on 8th the river rose 15 feet above ordinary high water level. On the 9th the river at Ipswich was 20 feet above high water level and at Brisbane on the same date from 3 to 4 feet deep on wharf and in wool pressing and produce stores. In Stanley Street, Town's Wharf was completely hidden by water which appeared to be half-way up posts on the wharf sheds. The Bremer at Ipswich subsided after reaching within a few feet of last great flood.
10/3/1870	Goodna: Flood waters surrounding the post office and still rising; wires submerged at the creek. Glengallan Creek very much flooded.
12/3/1870	Oxley: Fields along the banks of Oxley Creek partially devastated by floods. Ipswich: "The flood of 1864 was fully five feet higher than the present one which reached its greatest altitude during Wednesday night." (from *Queensland Times*, 12 Mar 1870, Ref 1.)
14/3/1870	Ipswich: Incessant rain; river again rose considerably.
9/4/1870	Brisbane: Heavy rains. On the 15th the Bremer rose at Ipswich until the water was 2 feet above the wharves. On the 16th the Bremer was 20 feet above the ordinary level and still rising; only the roofs of the wharf sheds visible. On the 18th rain ceased; the Brisbane River was swollen considerably.
14-18/7/1870	Heavy rains. On the 15th the Bremer rose at Ipswich until the water was 2 feet above the wharves. On the 16th the Bremer was 20 feet above ordinary level and still rising; only the roofs of the wharf sheds visible. On the 18th rain ceased; the Brisbane River was swollen considerably.
17/11/1870	Ipswich: Perfect deluge of rain in the evening and during the greater part of the night; the Bremer rose almost to the top of the sheds at the company's wharf; One-Mile Creek high. Brisbane: Heavy rain on evening of 17th over the whole of southern portion of the colony; lower parts of the town flooded; creek overflowed its banks and flooded cellars of the houses in Queen Street. Rainfall for 24 hours ending 9 am on 18th 3.66 inches; heaviest fall since floods in early part of the year.
24/2/1871	Oxley: Heaviest thunderstorm of year; creeks and roads flooded.
22/12/1872	Bremer River rose rapidly; 3 feet of water in the A.S.N. Co's sheds at Ipswich in a few hours time.
30/12/1872	Several of the cellars in Queen Street, Brisbane flooded through stoppage of the creek. Almost all rivers up country flooded during last week by heavy rains.
28/2/1873	The Bremer and other rivers much swollen owing to the continued rains; overflow at Enoggera reservoir about 14 inches above the by-wash.
1/3/1873	The Bremer rose to within a few inches of the A.S.N.Co's receiving shed at Ipswich.

Date of event	Impact
17-19/6/1873	Heavy flood at Brisbane. At Ipswich one of the greatest floods experienced since 1864 occurred, and the Bremer rose 40 feet above ordinary level; eight persons and over 6,000 sheep drowned at Cecil Plains. Floods also general up country; great damage at places.
24/6/1873	The highest point reached by the flood at the Port Office in Brisbane was 3 feet 10 inches above the highest spring tides and 5 feet lower than the flood in 1864.
31/12/1873	Flood at Ipswich.
16-23/2/1875	Floods in the Kenilworth district required stock to be rescued (Ref 3).
30/8/1879	The floods reached the highest mark. Victoria Baths washed down the Brisbane River.
20/10/1882	Enoggera Reservoir in flood.
11/1882	C.B. Whish reported that 'the late floods in the Caboolture River' had washed away the northern approaches to the Caboolture bridge (Ref 3).
19-22/1/1887	Very heavy rain over Moreton and East Darling Downs divisions. Creeks in flood and low-lying ground submerged at Cryna (Beaudesert) and Fassifern. Goodna township flooded; houses under water. "The rain commenced on Wednesday January 19. During the 24 hours to 9am on Friday 21st, 2.63 inches was recorded. Between 9am and 4.30pm on the same day 6.83 inches was recorded." (from *Queensland Times*, 22 Jan 1887, Ref 1). 'James Hipwood, Mayor of Brisbane, requested the (Caboolture Divisional) board to advise immediate information as to the urgent wants for food and clothing through floods in the division.' (Ref 5)
22/1/1887	Railway traffic on the Southern and Western Railway suspended on account of floods. Bowen Bridge, Brisbane 5 feet under water at 5 pm, washed away at 6.30 pm.
23/1/1887	Very high flood at Brisbane. Several lives lost by drowning and a great deal of property damaged.
25/1/1887	The steamer *Barrabool* ran aground in Brisbane River and two sailors were drowned by the flood waters.
13/8/1887	Heavy rains flooded the low-lying ground in neighbourhood of Brisbane.
17/7/1889	Low lying suburbs of Brisbane flooded owing to the heavy rains; river rose to within a few inches of the flood mark of January 1887.
19/7/1889	Floods in most of the Queensland rivers south of Bundaberg. Five vessels adrift in Brisbane River. The Brisbane wharves and part of Ipswich submerged.
25/1/1890	Brisbane: Water in the river 3'4" above the height reached by the King tides; several of the wharves flooded.
10/3/1890	Floods in the Brisbane River.
11/3/1890	Owing to floods all telegraphic and postal business interrupted. Brisbane River 18' above the level of the 1887 flood.
12/3/1890	Ipswich: Height of flood above spring tides 58.48 feet; measured at high water at Bremer railway bridge.
13/3/1890	Floods subsided.
28/3/1890	Ipswich: Height of flood above spring tides 35.85 feet; measured at high water at Bremer railway bridge.
11/6/1891	Traffic on Indooroopilly ferry interrupted owing to strong fresh in the Brisbane River.
3/2/1893	Lower part of Brisbane submerged, and water still on the rise; the *Elamang* and the gunboat *Paluma* were carried by the flood into the Botanical Gardens, and the *Natone* on to the Eagle Farm flats.

Date of event	Impact
4/2/1893	Disastrous floods in the Brisbane River; 8 feet of water in Edward Street at the *Courier* building. Numbers of houses at Ipswich and Brisbane washed down the rivers. Seven men drowned through the flooding of the Eclipse Colliery at North Ipswich. Telegraphic and railway communication in the north and west interrupted.
5/2/1893	The Indooroopilly railway bridge washed away by the flood. Heaviest floods known in Brisbane and suburbs.
6/2/1893	The lower part of South Brisbane completely submerged. The flood rose 23'9" above the mean spring tides and 10 feet above flood mark of 1890; north end of the Victoria Bridge destroyed.
7/2/1893	Flood waters subsiding. Sydney mail train flood bound at Goodna, unable to either proceed or return.
13/2/1893	Second flood for the year in the Brisbane River.
16/2/1893	More rain in the south east districts; another rise in the Brisbane; further floods predicted.
17/2/1893	A third flood occurred in the Brisbane River for the year.
18/2/1893	The *Elamang* floated off from the Botanical Gardens. Business at a standstill in Brisbane. Ipswich and other towns. Several deaths by drowning reported.
19/2/1893	The gunboat *Paluma* safely floated off the Gardens, and the *Natone* off Eagle Farm flats. Another span of the Indooroopilly railway bridge carried away. The third flood reached its maximum height at 12 noon, viz. 10 inches below the first flood.
21/2/1893	Flood waters subsiding.
11/6/1893	Flood waters of the Brisbane River still rising.
10/6/1893	A fresh in the Brisbane River.
12/6/1893	Flood at Brisbane reached a height of 10 feet 10 inches above low water or 1'4" above the level of the flood of 1887; water stationary at 10 am.
(nd) 1898	'Mr Inigo Jones reported flood damage to a culvert at Coochin Bridge' (Ref 5).
28/2/1907	Brisbane: Considerable rise in the Brisbane after the recent heavy rains; immense quantities of water hyacinth washed down to the city reaches of the river.
15/3/1908	At Brisbane the river rose to 14'8 1/2" above low water springs. Serious flood at Rosewood.
March 1908	Esk: Heaviest rain and floods since 1903. All traffic practically suspended for many days. Extraordinary season. Goodna: River Height at 2 pm 15th 38'4". Harrisville creeks all bankers 13th to 17th and all low lying lands flooded. Ipswich: Bremer River in flood rose to 48'. Laidley: Excessive rains throughout district from 14th to 17th cause local floods and washaways and some damage to crops. Pinkenba floods in river, and half of Pinkenba under flood for three days. Redbank: Flood covering all low lying lands. Rocklea: Owing to heavy rains on 14th and 15th, flood prevailed in this district but did not reach quite as high as 1903 flood.
March 1910	Crohamhurst River constantly in flood. Esk: River 12' over normal. Goodna: Slight fresh during month. Cedar Pocket: Creek in a continual fresh. Harrisville: Warrill Creek in flood twice.
13/1/1911	Floods at Rosewood.
2/1913	Stanley River and creeks in the Woodford area in flood (Ref 4).

Date of event	Impact
3/1914	Mary river in flood below Conondale (Ref 4).
5-10/2/1915	Two men drowned in Stanley River at Woodford.
1-4/2/1916	Local heavy flooding in Brisbane district.
11/4/1916	Stanley River flooded.
1-10/2/1922	A heavy fresh in Brisbane River.
4/2/1924	Low-lying areas of Brisbane submerged; boy drowned at Zillmere.
11/2/1924	Flooding in Lockyer district.
16-18/3/1925	The Stanley, Caboolture, Pine, Logan and Albert Rivers flooded.
18-22/6/1925	Most south coast rivers and creeks rose considerably. Flood in Stanley River. Railway line washaways and damage to bridges and roads.
1-8/1/1926	Local heavy flooding coastal districts south from Mackay and in sub-tropical interior. Numerous line washaways and several bridges damaged. Boy drowned at Ipswich.
16-31/12/1926	Flood in Stanley River disorganized traffic between Woodford and Kilcoy. Loss of stock in Brisbane River Valley.
January 1927	Local flooding during first half of month notably in Brisbane on 4th when low-lying parts under water.
15-31/1/1927	Stanley and Upper Brisbane Rivers flooded; strong fresh only in lower reaches of Brisbane but many metropolitan suburban districts submerged. Low-lying parts of Ipswich under water.
5-14/3/1927	Stanley flooded and railway line damaged between Woodford and Kilcoy.
& 24-26/3/1927	The Murrumba and Wivenhoe Bridges (Upper Brisbane) covered. Crops damaged.
1-2/4/1927	Minor flooding in several south-eastern rivers, chiefly the Stanley, Burnett, and Mary. Numerous bridges submerged; dislocation of traffic and damage to roads and railway tracks.
1-4/10/1927	Heavy local flooding in south-eastern districts, including low-lying parts of metropolis. Many bridges submerged and some damaged.
13-22/2/1928	Floods in Stanley and Upper Brisbane very high but in metropolitan reaches of latter only moderate fresh experienced.
18-21/4/1928	Only a big fresh in lower reaches of Brisbane River, but many of the low-lying parts of the metropolitan suburbs were inundated and the damage to city streets, bridges etc. was estimated at £50,000. Lad was drowned at Graceville.
18-21/4/1929	Stanley and Upper Brisbane Rivers flooded but a strong fresh only in city reaches of the Brisbane.
2-10/2/1930	Some bridges over Stanley River submerged.
2-8/2/1931	Brisbane experienced its first flood for 23 years. Most city wharves submerged and water reached almost to Stanley Street, South Brisbane. More serious inundations in parts of suburbs, notably the Milton, Oxley, Rocklea, Fairfield and Sherwood districts. Bridges and roads in Greater Brisbane area damaged to extent of about £25,000. TC entered the Coral Sea near Cooktown and moved southward to Hervey Bay. Initially serious flooding occurred in north Queensland with one drowning. As the system moved south towards Hervey Bay, major floods developed over south-east Queensland with 1300 homes inundated in Brisbane on the 5th February. Two people drowned. A storm surge of 0.76 m was recorded on the Moreton Bay tide gauge. Most of the flooding in Brisbane was in Breakfast Creek where 1056 houses were flooded (396 above floor level). Around midday on the 5th February, before the heavy rain in the creek catchment, high tide level at the mouth of Breakfast Creek was 1.1 m above ordinary high water spring levels. The subsequent flood levels above Bowen Bridge exceeded the February 1893 flood levels.

Date of event	Impact
	Ipswich: "From a maximum height of 47ft 6 ins about 3 o'clock on Saturday morning (February 7) the Bremer early this morning had dropped to 16ft 6 ins." (from *Queensland Times*, Mon 9 Feb 1931, Ref 1)
6/3/1931	Low lying parts of Brisbane inundated.
2/1931	The Caboolture Shire territory suffered the biggest flood ever recorded. The Waraba Creek bridge was washed away and extensive flood damage was suffered in many placed (Ref 5)
9/12/1931	Low lying suburbs of the metropolitan area were submerged. Much damage to roads and bridges, cost of repairs to latter estimated at between £2,000 and £3,000.
15-31/1/1935	Laidley Creek reached its highest level for 40 years.
4/4/1933	Man drowned in Stanley River. Low lying part of metropolis inundated and some damage to property particularly in Nundah district where several fences washed away.
11/12/1933	Some flooding of creeks in the metropolitan area; a lad drowned in Ekibin Creek.
30 & 31/1/1934	Disorganization of traffic in coastal districts south from Maryborough.
20-23/2/1934	Low-lying suburbs of Brisbane again submerged.
1-4/4/1934	Flooding in many streams between Brisbane and Gympie, submerging bridges and roads, and seriously dislocating transport services.
12/4/1934	Further flooding between Gympie and Brisbane.
21/12/1934	Some flooding of creeks and inundations of low-lying parts in the metropolitan area.
17/10/1935	Low-lying parts of Brisbane suburbs flooded, especially in Wynnum district where roads damaged to extent of about £10,000.
10/3/1937	Local flooding between Brisbane and Coolangatta.
15-20/3/1937	Low-lying parts of Brisbane and Ipswich inundated. Floods at Harrisville highest since 1911.
19-21/1/1938	Local flooding in Moreton section of South Coast division, chiefly Stanley River. Low-lying parts of Brisbane inundated.
31/1/1938	Low-lying suburbs of Brisbane submerged.
23-27/5/1938	Kilcoy isolated for few days; low-lying parts of Brisbane submerged on two occasions.
11-17/3/1939	Extensive flooding of low-lying suburbs of Brisbane.
April 1939	Local flooding in Esk district.
5/7/1939	Some flooding in Stanley River and the adjacent reaches of the Brisbane River.
Dec 1943	At 0900 on the 30th a small cyclonic centre was indicated a little to the north of Cape Moreton. The formation of this depression was responsible for flood rains from 28th to 30th. The rain spell lasted approximately 36 hours, but fortunately eased by Monday 31st when the centre, filling in, was located 250 kilometres to the north-east of Lismore. Much flooding of low lying areas in South Moreton districts with rapid rises in creeks and main streams on 29th and 30th, but no excessive heights were reached on the Brisbane River. Local reports for 30th included Stanley River at Villeneuve - over railway bridge, Caboolture River at Caboolture Post Office — traffic bridge submerged, Pine River at Dayboro — main street under water.
January 1946	On 23rd rain stations west and south of Brisbane reported 75 to 125mm and up to 165mm (Kalbar and Laidley). These falls caused local flooding, mainly in Lockyer Creek, but main streams in the Moreton and Port Curtis districts were not affected.

Date of event	Impact
April 1946	The rainfall accompanying the offshore cyclonic depression from 2nd to 5th caused moderate rises in the Mary and Stanley rivers where local flooding occurred. At Murrumba, where the Brisbane River rose over the traffic bridge on 6th, conditions were indicative of the temporary traffic dislocation which occurred in these areas.
January 1947	Flooding was particularly heavy in the Logan and Albert river basins, the highest since 1887 and 1893. At Slacks Creek, floodwaters reached telephone wires. On 25th the Logan River peaked at Dulbolla and Beaudesert and the Albert River peaked at Bromfleet and Lumeah. The following peaks were reported from the lower tributaries of the Brisbane River. Warrill Creek at Harrisville on 25th, highest since 1893, and Bremer River at Ipswich on 26th, highest since 1931.
26/1/1947	Ipswich: Bremer River in major flood, highest since 1931.
January 1951	Flooding was most severe over the South Coast Moreton where 500 to 750mm seven day rainfall totals caused strong rises in the Mary and Brisbane river systems and in other smaller coastal streams. All transport services were disrupted and low level flooding caused considerable property damage and covered all roads from Brisbane to a depth of a metre or more. Many houses were evacuated particularly in the Maroochy River districts where flooding was very severe. One life was lost at Currumundi Lake near Caloundra.
31/1/1951	Ipswich: Bremer River peaked just below major flood height, two households evacuated, widespread disruptions to traffic. Brisbane-Ipswich road closed at Woogaroo Creek. Brisbane: Brisbane River in flood, severe disruptions to road traffic, most roads out of Brisbane closed due to inundation from flooding caused by metropolitan and adjacent stream.
1/2/1951	Brisbane: Brisbane River in flood between Brisbane and Ipswich backing up creeks, flooding of low lying areas extensive. Oxley Creek 5' over Oxley road.
2/2/1951	Brisbane River flood threat did not eventuate; rain and flooding easing.
March 1955	Serious flooding was also reported in the upper Brisbane River, as well as the small coastal streams north of Brisbane, namely the Pine and Maroochy rivers, as a result of 125 to 375mm rains on 27th. Flood heights in the Brisbane River were generally the highest since 1931, resulting in moderate flooding in the lower Brisbane catchment on 29th and 30th. One life was lost. The Port Office gauge at Brisbane peaked at 3am on 30th, resulting in flooding of some low lying suburbs.
29/3/1955	Ipswich: Bremer River in major flood, severe disruption to traffic, widespread inundation of low lying areas; highest flood since 1947.
30/3/1955	Brisbane: Brisbane River in minor flood, some inundation of low lying areas. Great quantities of debris in river.
18/2/1959	Brisbane River in flood Brisbane Valley Highway cut at Wivenhoe.
Nov 1959	Laidley: Local severe flooding resulted in 1 metre of water in some streets of Laidley, flooding business premises. Hundreds of acres of small crops were inundated in the Lockyer Valley with damage proving very costly. Marburg: Heavy flood run-off damaged three bridges, destroyed a garage and covered the western highway to in excess of 1 metre of water.
May 1960	Further heavy rain, 125 to 150mm in 48 hours, brought about flash flooding in the upper Stanley River on 26th.
February 1961	Flash flooding in the Bundamba Creek at Booval on 25th swept a car off a culvert, killing two people.

Date of event	Impact
November 1961	On 17th intense one hour 75 to 125 rains in the Upper Brookfield area led to flash floods which caused destruction of roads and bridges. In the Brisbane Metropolitan area heavy rains on the 20th caused local flash flooding in many suburbs, the worst hit areas being Mount Gravatt and Sandgate. The Brisbane Valley Highway was cut between Esk and Toogoolawah, due to flash flooding of Gallanani Creek, and rail traffic was slowed because of erosion. Heavy rain in the Bremer catchment on 17th, followed by further falls in the next few days, caused a rise in the river, submerging the bridge at Rosewood for some days. Freshes in other tributaries of the Brisbane River resulted in a slight rise in the main river in its lower reaches.
March 1963	From 13th to 18th heavy rain in south-east districts produced 250mm totals with some totals up to 500mm. Local flooding and traffic disabilities were reported in the Mary and Brisbane rivers as well as the shorter Moreton streams. The Stanley River at Peachester reported peak flows as did the Brisbane River at Murrumba and Wivenhoe Bridge.
March 1967	On 18th falls of up to 150mm associated with Cyclone *Elaine* were recorded in the south-eastern corner of the State. Minor flooding and traffic disabilities occurred as a small flood moved down the Brisbane River, while the Logan River peaked at Macleans Bridge on 19th.
12/6/1967	Ipswich: Bremer River, in major flood but below 1955 levels. Brisbane: No flooding from Brisbane River itself but widespread severe local flooding from metropolitan creeks with damage estimated in the excess of $1million. Traffic at a standstill; rail traffic halted on some suburban lines. 500 people evacuated from low lying areas. Rainfalls averaging 200 to 250mm in the South Coast Moreton district during the week ending 14th resulted in moderate flooding in the Brisbane and Mary rivers and adjacent coastal streams. The Brisbane River peaked at Vernor on 12th, the highest recorded since 1955, and the Mary River peaked at Gympie on 11th, the highest since 1963. Worst flooding was in the Nerang River, which peaked at Numinbah Valley early on 12th, highest since 1954, and flooded some residential areas on the Gold Coast. Traffic disabilities occurred throughout the Moreton district, but were worst in coastal areas south of Brisbane. Serious local flooding in Brisbane itself on the night of 11th.
January 1968	Seven day totals of over 750mm were common in the headwaters of the Mary River, while slightly lower totals were recorded in the headwaters of neighbouring coastal streams and in the headwaters of the Stanley River. The Mary River peaked at Gympie on 10th, and all coastal roads from Brisbane to the north of Bundaberg were impassable to traffic for a few days as the flood peak moved downstream. Many people in Gympie and other centres downstream were forced to evacuate their homes as flood waters approached, and at least one life was lost. Slightly lower rainfalls in the Brisbane River sub-catchments other than the Stanley were sufficient to cause minor to moderate flooding in parts of the Brisbane Valley, while moderate falls on the border ranges produced only minor flooding in coastal streams south of Brisbane.
14/1/1968	Ipswich: Bremer River in moderate flood; Moogerah Dam spills for the first time since construction, widespread traffic disabilities throughout catchment, most roads cut in low areas or by washouts.
15/1/1968	Brisbane: Brisbane River in minor flood causing some inundation of low river front reaches in the metropolitan area in conjunction with high tides and heavy local runoff.

Date of event	Impact
October 1970	On Saturday 24th there was flash flooding in the Brisbane City metropolitan area in Kedron Brook and Enoggera Creek resulting in damage to furniture and fittings in private homes. Several people were drowned.
4/2/1971	Moderate to major flooding in the Bremer caused inundation of low lying parts of Ipswich. Widespread disruptions to traffic throughout the catchment area considerable damage to roads and bridges.
February 1972	During the second and third weeks of the month, major flooding occurred in the upper and middle reaches of the Mary, upper Brisbane and Stanley rivers in association with heavy rainfall from Cyclone *Daisy*. Flooding, with traffic disabilities, also occurred in Sunshine Coast streams and the Pine and Nerang rivers. Severe local flooding occurred in Brisbane City metropolitan creeks on the morning of Saturday 12th, following general falls of 175mm to 225mm in the 24 hour period.
April 1972	During the first week of the month heavy rains in south-east Queensland, associated with Cyclone *Emily*, caused moderate flooding in the Mary, Stanley and upper Brisbane rivers. Flooding also occurred in the Kolan and Curtis Coast streams, the Burnett, Albert, Logan, Nerang and Pine Rivers, and Sunshine Coast streams. There was widespread traffic disruptions in the above catchments as Easter holiday traffic returned to Brisbane. On the night of Sunday 2nd to Monday 3rd, heavy rain in Brisbane City metropolitan creek catchments caused major flooding in suburban areas, resulting in much damage to property and household furniture.
July 1973	During the period 6th to 10th, heavy rain in south-east Queensland caused moderate to major flooding to the coastal strip between Brisbane and Bundaberg. Several lives were lost. Minor flooding occurred in the Brisbane City metropolitan creeks, in particular Enoggera-Breakfast creeks and Kedron Brook, and also in the Nerang River. Major flooding also occurred in the upper Brisbane River and Stanley River, but flooding was not significant in the lower reaches.
27 & 28/1/1974	Ipswich: Bremer River reached the highest levels this century and the highest since 1893. Flood damage through the Ipswich City area was devastating, some 2,000 homes and properties were affected, many being totally destroyed, countless others were affected, many beyond repair and business, property and damage to services running into millions of dollars. Two people were drowned or killed as a result of the flooding during this period.
25-29/1/1974	Brisbane: The Brisbane River also reached the highest level this century and the highest level since 1893. Similarly to Ipswich, the lower flood prone areas suffered extreme damage; 14 lives were lost, some 8,000 householders were affected, many totally destroyed, others damaged to the tune of thousands of dollars as a result of inundation and battering from both strong currents and water borne debris. Business houses and industry generally suffered countless millions of dollars in losses due to damage to premises, stock and loss of business. Estimated damage approximately $200 million in 1974 money values.
November 1974	On 27th moderate flooding downstream from Harrisville and Rosewood in the Bremer River.
January1976	Between 20th and 23rd, stream rises and some flooding occurred in the south-east quarter, including the Brisbane and Mary rivers, from heavy rain associated with Cyclone *David*. Laidley Creek recorded a major flood in this period with flood waters entering the town of Laidley.

Date of event	Impact
February 1976	By mid month, major flooding was occurring in most streams in the Brisbane Valley, the Albert and Logan Rivers, the Macintyre, Moonie and Weir Rivers, the Condamine, Balonne, Bulloo and Paroo rivers, the Warrego, Thomson and Barcoo rivers, and Cooper Creek, plus Diamantina and Georgina rivers and Eyre Creek . Major flooding in these rivers was caused by the low pressure system formally Cyclone *Alan*.
May 1980	Most streams in the Nerang, Albert and Logan Rivers and Brisbane City metropolitan creeks reached minor flood levels on 7th and 8th. Traffic disabilities occurred through the area, especially along Oxley Creek. No damage reports were received.
November 1981	Local to minor flooding occurred in the Bremer River from 2nd to 4th and local flooding with traffic disabilities for Brisbane City metropolitan creeks on 3rd.
January 1982	Widespread moderate to heavy rainfall in the Moreton South Coast district caused local flooding in the Brisbane City metropolitan area on 21st. Minor to moderate flooding occurred in the Mary River from 21st to 25th, the coastal streams from Brisbane to Noosa on 21st, the Bremer and Warrill creeks on 21st and 22nd and the Stanley River and upper Brisbane River from 21st to 23rd.
May 1982	Moderate to heavy early morning rain in the Brisbane City metropolitan area on 30th, caused local flooding and traffic disabilities in some flood prone suburbs.
May 1983	On the afternoon of 28th moderate flooding occurred in the Bremer River with minor flooding at Ipswich the next day.
April 1984	Stream rises and local flooding were reported from Brisbane metropolitan area and the Macintyre and Dumaresq river systems on 8th due to heavy rainfall in the southeast corner. Gale force winds and heavy rainfall on 8th caused widespread electrical failures, local flooding and traffic disabilities and property damage in the Brisbane metropolitan area and the Gold Coast. Twelve people were rescued from disabled yachts in Moreton Bay and coastal waters of the Moreton Coast.
August 1985	During the evening of the 17th, thunderstorms in the Brisbane metropolitan area caused local flash flooding.
October 1985	Flooding in low lying areas of metropolitan Brisbane due to heavy rain during the morning of the 27th.
February 1988	A severe thunderstorm over Cooyar Creek catchment on the evening of Friday 12th caused the highest flood since European settlement in the township of Cooyar. Several houses and buildings were washed away and two lives were lost.
June 1988	Widespread moderate with local heavy rain on the 3rd and 4th in the South Coast districts caused moderate flooding in Warrill Creek near Amberley on the 5th
July 1988	A man drowned when his car was swept away in a flooded creek in one of the southern Brisbane suburbs.
April 1989	During the first few days of the month, the Albert and Logan rivers experienced moderate flooding, and local to minor flooding occurred in creeks in the greater Brisbane area during the same period. A renewed heavy rain period commenced in southeast Queensland on 25th causing major flooding to re-occur at Gympie on the Mary River, and in the upper Brisbane River, the Albert and Logan rivers to the south of Brisbane and other coastal streams between Maryborough and the New South Wales border. Severe local flooding also occurred in the Brisbane metropolitan area overnight on Tuesday 25th.
May 1989	Very heavy rain re-developed in the south-eastern districts during the 16th and 17th. Minor to moderate flooding was recorded in the Albert and Logan rivers, and also in the Bremer River and Warrill Creek.

Date of event	Impact
February 1990	Moderate to heavy rainfall in the Brisbane Metropolitan /Sunshine Coast area on the 24th produced flooding in low lying areas of Brisbane and parts of the southern Sunshine Coast. Flooding became more extensive the next day, causing traffic disabilities.
February 1991	On the night of Thursday 7th very heavy rain of around 200mm fell over areas of the Logan system and Warrill Creek catchments to the south of Brisbane. Three people drowned at flooded road crossings during the flash flooding that followed. Extensive damage occurred to rural properties, fencing and crops in the Boonah, Rathdowney and Kalbar areas and a school at Kooralbyn was destroyed. Flooding subsequently developed in the Logan River and record flood levels were recorded at several locations. Flooding of low lying properties, roads and bridges accompanied the flood peak. Several houses were flooded in the suburbs of Logan City in the Waterford area during the weekend of 9th and 10th.
December 1991	Severe flooding of some coastal streams occurred in south east Queensland from Thursday 12th to Saturday 14th. Areas of major flooding along the Bremer River, Bundamba and Warrill Creeks caused significant property loss and damage. In the Bundamba Creek area, forty two people were rescued from flooded homes.
February 1992	Major flooding in the upper reaches of the Stanley River occurred during Saturday 22nd and one motorist was drowned attempting to drive across a flooded river crossing.
March 1992	Major flooding occurred in the upper reaches of the Brisbane and Stanley rivers. No reports of damage were received. Minor flooding occurred in some of the Brisbane Metropolitan Creeks causing minor traffic problems.
February 1995	Rainfall around the Sunshine Coast during the middle of February caused moderate flooding in the Mary and Upper Stanley rivers to 17th.
November 1995	Moderate flooding occurred in the upper reaches of the Bremer River and Warrill Creek from the 20th to 21st but only small rises resulted in the lower reaches of the Bremer.
May 1996	Brisbane River basin: Heavy rainfalls and flooding were reported throughout the Brisbane catchment during the first week of May with widespread 7 day rainfall totals of up to 600mm. A tidal surge caused by the low pressure system and gale force winds caused higher than normal tides in the Brisbane River which also contributed to flooding in low lying areas. Runoff from the first peak in the Bremer River combined with the tidal surge and local runoff in the Brisbane City reaches caused higher than normal tides at the Port Office during Saturday 4th and Sunday 5th. The observed high tide at the Port Office on Saturday 4th at 2255 was 1.99 metres AHD (0.61 metres above the predicted tide). On Sunday 5th the high tide at 2338 was 1.94 metres AHD (0.57 metres above the predicted tide). Minor flood level at the Port Office is 1.70 metres. At Lowood the Brisbane River started to rise as floodwaters from Lockyer Creek moved downstream causing a minor flood peak of 12.26 metres at about 2100 on Sunday 5th. Downstream at the Mt Crosby Weir the flood peaked at 14.10 metres at 1200 on Sunday 5th. These floodwaters combined with runoff from the Bremer River produced a Moggill peak of about 7.10 metres AHD at about 0300 on Monday 6th. The effect at the Port Office was a height of 1.60 metres AHD (0.79 metres above predicted tide) at 1200 on Monday 6th and 1.74 metres AHD (0.40 metres above predicted tide) at the next high tide just after midnight. Flood levels at gauges on the Brisbane River downstream of Lowood during this event were the highest recorded since January 1974. They were, however, well under flood levels recorded during January 1974. For example in 1974 the height at Mt Crosby was 26.74 metres, the height at Moggill was 19.93 metres and the Port Office reached 5.45 metres AHD. During this event, inflow

Date of event	Impact
	from the Stanley River and tributaries caused the storage level in Somerset Dam to rise from about 54% to just over Full Supply Level. Moderate flooding in the Upper Brisbane River caused the storage level in Wivenhoe Dam to rise from 57% to nearly 90%of Full Supply Level. During this flood event there were no releases from Wivenhoe Dam or Somerset Dam. Laidley Creek suffered major flooding with a major flood peak of 9.00 metres at Mulgowie on Friday 3rd. At the Showground Weir site a major flood peak of 8.25 metres was also reached on Friday 3rd. Further rainfalls in the catchment during Saturday 4th caused a second major flood peak of 9.09 metres at Mulgowie on Sunday 5th. The Showground Weir peak reached 8.25 metres. Combined runoff from the Lockyer Creek and tributaries as well as runoff from Laidley Creek caused river rises on Lockyer Creek at Glenore Grove during Thursday 2nd with major flooding commencing on Friday 3rd. A peak of 13.62 metres was recorded at Glenore Grove at 0900 on Friday 3rd. Flood levels started to recede slowly at Glenore Grove during Friday afternoon and Saturday morning but started to rise again as further rainfall fell upstream and a second major flood peak of 14.30 metres was reached at 0900 on Sunday the 5th. The flood level at Glenore Grove remained above major flood height from early Friday morning till late on Sunday night. The peak of 14.30 metres is the highest flood peak at Glenore Grove since January 1974 when it reached 14.94 metres. Downstream at Lyons Bridge the flood peaked at 16.44 metres at 0900 on Sunday 5th. This was 0.10 metres below the peak of the January 1974 flood. Flooding in the Lockyer Creek catchment caused extensive crop damage. Evacuations were carried out around Laidley and in the Glenore Grove area. The Warrego Highway was cut near Glenore Grove. Numerous other roads were cut during this flood event isolating farm communities. Bremer River and Warrill Creek: With the onset of the heavier rainfall on the 1st and 2nd, runoff started in the Bremer River and Warrill Creek in the early morning of Thursday 2nd. The Bremer River at Rosewood and Walloon continued to rise during Thursday and peaked at a moderate flood height on Thursday afternoon. Renewed heavy rainfall in the area that night and during Friday the 3rd caused renewed rises in the Rosewood and Walloon areas and a major flood peak of 6.20 metres was recorded at Rosewood at noon on Friday 3rd. Downstream at Walloon a major flood peak of 8.20 metres was also recorded at noon. This peak is the highest recorded at Walloon since the floods of January 1974 when the peak at Walloon was 8.70 metres. On Warrill Creek a major flood peak of 6.75 metres was reported at Amberley at about 2100 on Friday 3rd . This peak was about 3.4 metres below the January 1974 peak. Upstream at Harrisville and Kalbar major flooding was also occurring during Friday. The combined runoff from Walloon and Amberley as well as Purga Creek runoff caused a moderate flood peak of 11.31 metres at the David Trumpy Bridge in Ipswich at 2100 on Friday 3rd. This is well below the January 1974 flood level in Ipswich of 20.70 metres. It is also below the last significant flood event during December 1991 when there was a flood peak of 13.10 metres at Ipswich. Further rainfall was reported in the catchment on the afternoon of Saturday 4th and morning of Sunday 5th with the heaviest falls in the Rosewood to Walloon area. The subsequent moderate flood peak at Ipswich was 9.85 metres at 2300 on Sunday 5th. The floodwaters in the Ipswich area during this second peak were significantly affected by backwater flooding in the Brisbane River.

Date of event	Impact
February 1999	Significant river rises in the Stanley and Brisbane rivers and tributaries above Wivenhoe Dam resulted from heavy rainfall on 8th. Moderate flooding developed in the Stanley River and major flooding in the Brisbane River above Wivenhoe Dam. Releases from Wivenhoe Dam commenced on the 9th causing closures of low level crossings along the Brisbane River downstream of Wivenhoe Dam, with minor flooding between Wivenhoe Dam and Mount Crosby. The same rainfall system caused rapid rises with moderate flooding in Lockyer Creek, Warrill Creek and the Bremer River. The Bremer River at Ipswich peaked just below the minor flood height on the evening of the 9th.