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NATURAL HAZARD RISK:
Cities Project Perth

Good decisions need good data—the Cities Project Perth report will give decision makers high-quality information about natural hazard risk.

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Is the land I want to buy in Perth likely to be flooded? Will my office building withstand storms or earthquakes? How much of the Perth coastline will erode in the next 50 years? Until the Cities Project Perth report, very little information was available to local councils, engineers or administrators to help answer such basic questions.

Cities Project Perth has created and analysed an enormous amount of data on sudden-onset natural hazards in the most rigorous natural hazard risk assessment ever undertaken for the Perth region. The report is now the primary resource for emergency managers, risk managers, land use planners and other officials responsible for reducing natural hazard risk in the most densely populated area of Western Australia (WA).

Permanent urban settlements in WA began with European settlement in 1829, but scientific data has been collected for a much shorter period. Records of events over such a short time are not a reliable guide to future impacts from natural disasters. Cities Project Perth examined past events, gathered new data, and developed predictive models to provide scenarios for rare but probable high-impact events not seen in the historical record. The completion of this body of research enables us to make some very well-informed estimates.

Increased knowledge highlights risk

The study provides new information about important risks to Perth and the surrounding areas. The results show that Perth could experience an extremely rare earthquake, a highly damaging cool season storm, or higher flood levels than previously modelled or experienced.

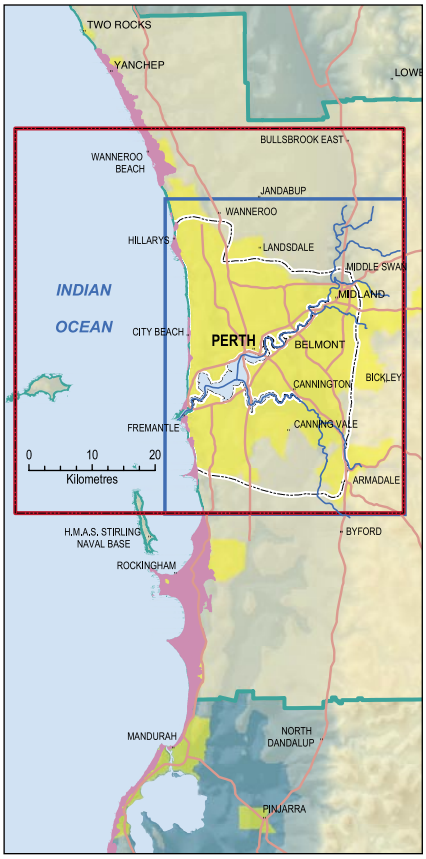
The earthquake source zone east of Perth is larger than previously thought, placing more wheatbelt communities at higher risk. While wheatbelt earthquakes occur some distance from Perth, they have caused significant insurance losses in the city. This new knowledge will be included in the next revision of the earthquake loadings standard for Australian buildings.

The report estimates that potential losses from earthquakes in WA are considerably higher than historical losses, partly because most residences are unreinforced double brick, which is vulnerable to earthquake damage. The rare but high-impact nature of earthquake risk in the Perth region indicates that the most effective means of mitigation are appropriate building design and construction standards, combined with adequate insurance.

Cool season storms and tropical cyclones, often accompanied by bushfires, have historically caused the highest natural-hazard insurance losses in southwest WA. The report indicates that these storms will continue to pose a threat to the region.

Wind hazard is highest for coastal areas, including the lower reaches of the Swan River, and the region running north–south along the top of Darling Scarp, where historical losses have occurred. New wind-hazard maps produced by the project collate essential information that could be used to improve building construction and design guidelines. By highlighting the areas exposed to greater risk, the maps are also a valuable guide for emergency managers.

A model was developed for assessing flood hazard, providing new information on flooding in the Swan–Canning river system. Eight flood scenarios identify flood-prone areas, providing information on area and depth of inundation and flow velocity, and how these may change during a flood event. This information may contribute to better land use planning, appropriate development controls for the future, and improved emergency response and recovery planning.



Cities Project Perth Urban Setting

- *Towns or Localities*
- *Flood Hazard Study Area Streams*
- *Main Streams*
- *Major Roads*
- *Wind Hazard Study Area*
- *Coastal Erosion Susceptibility Study Areas (near urban areas)*
- *Flood Hazard Study Area*
- *Builtup Area (Greater Perth)*
- *Building Database Study Area for Earthquake Risk Assessment and Damage Cost Model*
- *Area of Social Vulnerability Research*

▲ **Figure 1.** Study area—greater metropolitan Perth.

The southwest WA coastline is susceptible to erosion caused by long-term sea level rise. Modelling suggests that the shoreline of Swanbourne Beach could recede by as much as 130 metres over the next century—significantly more than earlier estimates. Fortunately, the Swanbourne seafront doesn't have many buildings. Further investigations in developing areas such as the Bunbury to Mandurah coastline, which are potentially susceptible, would improve our understanding of future impacts from sea level rise.

Tsunamis generated by earthquakes in the subduction zone offshore of Indonesia could endanger Northwest Shelf oil and gas infrastructure (a considerable part of the WA economy). Tsunami research initiated by the WA Government and Geoscience Australia will shed further light on the tsunami hazard along the state's coastline. This research will prioritise areas of coastline to be monitored by the Australian Tsunami Warning System.

On a brighter note, Australian Bureau of Statistics data indicates that WA has a strong community network, which will greatly assist long-term recovery from a natural disaster.

Guarding against complacency

With this new level of risk assessment, it is reassuring that Perth has so far enjoyed a relatively benign environment. In the city's short history, no truly catastrophic natural events have affected it—in the past hundred years, no natural disaster has killed more than five people or caused insurance losses worth more than $100 million.

Other cities and regions in Australia have not been so fortunate. Darwin was flattened by cyclone Tracy in 1974; the Brisbane–Ipswich–Gold Coast region was flooded in 1974; Brisbane was buffeted by storms again in 1985; and Newcastle suffered the 1989 earthquake. Fires have been catastrophic in Hobart (1967), South Australia and Victoria (Ash Wednesday, 1983), and Canberra (2003).

The Cities Project Perth report provides a perspective by comparing the cost of natural disasters and transport accidents in the Perth region. Aircraft crashes have killed a significant number—29 people died in the 1950 crash of a DC-4 near York, 100 kilometres east of Perth—and shipwrecks off the WA coast were regular events in the nineteenth century, causing great loss of life and incurring high economic cost.

Events like the Indian Ocean tsunami and Hurricane Katrina in the United States show that we need to plan for unexpected, rare and extreme disasters, as well as the more likely lesser ones.

Risks of environmental impact and economic loss are rising due to a higher population and denser settlement in the Perth region, but recent losses of life in natural hazard events have been much fewer than in the early days of the Swan River settlement. Improved warning systems and better emergency management response, land planning and building codes have reduced life-threatening risk. Reduced risk, however, is not 'no risk'. The report makes recommendations for action and for gathering further information to improve the models and enable more accurate projections.

Although estimates of the cost of potential natural disasters are important inputs for decision makers responsible for allocating expenditure on risk reduction, such estimates are difficult to achieve. Apart from loss of human life, estimates of loss are traditionally based almost entirely on total insurance claims. Available data suggests annualised losses of approximately $15 million from natural hazards in southwest WA, but this figure is considered an underestimate.

A collaborative approach

Cities Project Perth is the latest in a series of studies of Australian cities. The studies took a unique, all-hazards approach to understanding risk by incorporating measures of vulnerability, resilience and probability of occurrence.

Before the project began, discussions were held with government agencies in WA to define the needs of the research, as described in the final project brief:

The goal of [the] Cities Project is to ascertain the vulnerability of Australian urban communities to the effects of geological and meteorological hazards (collectively referred to as geohazards), thereby providing emergency managers and planners with information and decision support tools that will aid in the mitigation of geohazards. The objective of the WA Cities Project is to improve the methodology, develop decision support tools and generate information to assist in the mitigation of geohazards.

Figure 2. Coastal erosion on Perth's beaches (photo courtesy of *The West Australian*).

A unique feature of this project is the partnership developed between Geoscience Australia and a range of organisations. There was extensive cross-jurisdictional collaboration between national, state and local government agencies. Cities Project Perth participants were Geoscience Australia, the Fire and Emergency Services Authority of Western Australia (FESA), the Bureau of Meteorology (BoM), the Western Australian Land Information System (WALIS), and the Western Australian departments of Planning and Infrastructure (DPI), Environment (DoE), and Land Information (DLI). Local government has also been a key partner of Geoscience Australia's cities projects. Several local governments, including the cities of Perth, Wanneroo, Joondalup and Swan directly contributed data or advice on hazards and community vulnerability.

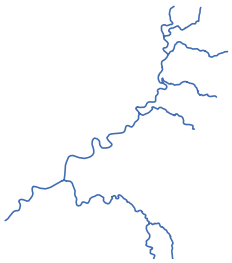


Figure 3. Fremantle Railway Bridge destroyed by the July 1926 floods (photo courtesy of The Battye Library 54902P).

FESA offered Geoscience Australia office space and resources in the project, and greatly assisted research and stakeholder interaction. BoM contributed expert meteorological input to the project and provided data from its automatic weather stations for the severe wind analysis.

DPI gave expert advice on the implications for planning policy of the risks exposed by the project. DPI's close relationship with the WA Planning Commission has effectively transmitted results from the project into WA planning policy.

WALIS and DLI are playing leading coordination roles in ensuring that the Cities Project Perth databases will continue to be maintained, improved and made available to users through the WA Shared Land Information Platform (SLIP). DLI provided many spatial databases to the project at its beginning, including 'Lands' GIS coverages and extracts from the WA Valuer-General's database, laying the foundation for the spatial analysis of community safety.

Close collaboration with DoE enabled the development of a new model for assessing flood hazard, and expansion of the mapping to include the more extreme flood events. DoE has taken ownership of the model and will use it when the department reviews flooding in the Swan River system after the next major flood.

This pooling of expertise and resources developed more than a dozen databases, models and maps which are not only the backbone of this study but can assist further investigation. While the original information applies to Perth, the models and processes are also applicable worldwide. For example, the building cost models provide cost per square metre estimates for replacing Perth's built environment after earthquake damage, and can be applied to other hazards.

The project is attracting considerable interest in Australia and internationally. It recently won an Emergency Management Australia Safer Communities Award in WA and was recognised at the 2005 Australian Safer Communities Awards ceremony held at Parliament House on December 1. The Project, as well as two other Geoscience Australia projects, received a 'Highly Commended' award in the Pre-Disaster Category (National Significance).

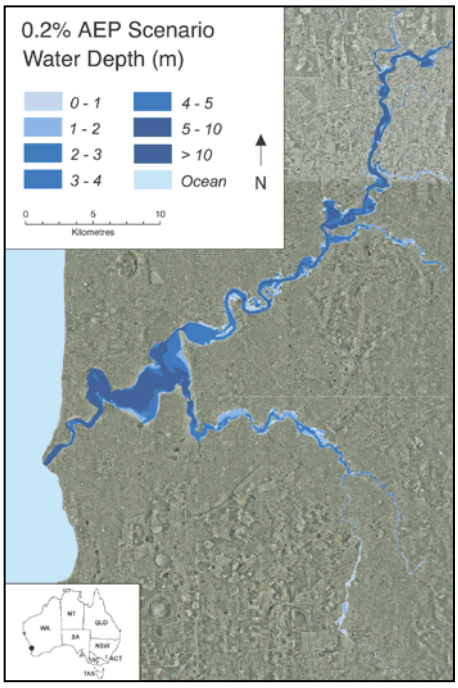
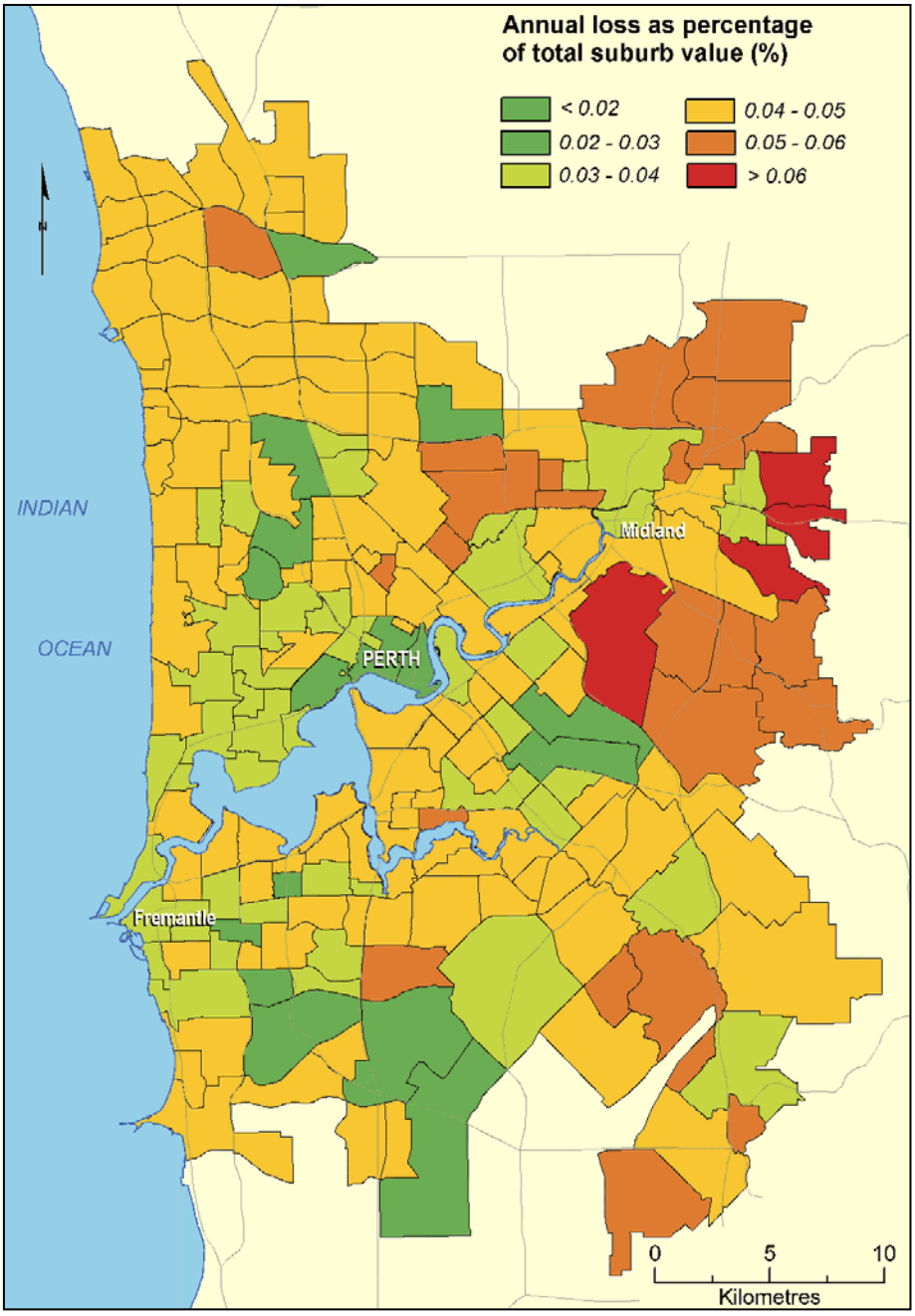


Figure 4. Flood inundation mapping for the 0.2% annual excedance probabilities (AEP) scenario showing maximum water depth contours.

Figure 5. Maximum non-directional wind speeds with a 1 in 500 likelihood of being exceeded in any one year at any particular location (return period of 500 years). Wind speeds are expressed as 3-second maximum gusts in units of metres per second.



▲ **Figure 6.** Annualised earthquake losses at suburb level in the Perth study region. Losses are expressed in terms of total value of buildings and their contents.

The report (approximately 350 pages) can be downloaded from Geoscience Australia's website at www.ga.gov.au/urban/projects/nrap/perth.jsp. Previous Cities Project reports can also be downloaded from www.ga.gov.au/urban/projects/nrap/index.jsp.

A summary brochure and the comprehensive report on CD are also available for cost of postage from Geoscience Australia's Sales Centre at www.ga.gov.au/sales, or email (mapsales@ga.gov.au).

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Acknowledgment

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Further information on collaborators and partners may be found on their websites, at the following links:	
State/local government	**Website**
Fire and Emergency Services Authority of Western Australia (FESA)	www.fesa.wa.gov.au
Bureau of Meteorology	www.bom.gov.au
Western Australian Department for Planning and Infrastructure (DPI)	www.dpi.wa.gov.au
Western Australian Department of Environment (DoE)	www.environment.wa.gov.au
Western Australian Department of Land Information (DLI)	www.dli.wa.gov.au
Western Australian Land Information System (WALIS)	www.walis.wa.gov.au
City of Perth	www.cityofperth.wa.gov.au
City of Wanneroo	www.wanneroo.wa.gov.au
City of Joondalup	www.joondalup.wa.gov.au
City of Swan	www.swan.wa.gov.au