KIMBERLEY EMERGENCY MANAGEMENT DISTRICT

Risk assessment report

'Highlighting potential disaster impacts'

KIMBERLEY
DISTRICT EMERGENCY
MANAGEMENT COMMITTEE

Disclaimer:

The risk assessment results discussed in this report are based explicitly on the credible worst-case hazard scenarios outlined in Section 2 and the views of those who participated in each risk assessment workshop. Risks and impacts other than those discussed here are possible depending on the nature of future hazards.

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SEMC
STATE EMERGENCY MANAGEMENT COMMITTEE

State Risk Project

An Australian Government Initiative

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Executive summary

This document summarises the results of the *State Risk Project* risk assessment workshops in the Kimberley (EM) district. It covers five priority hazards, as identified by the Kimberley District Emergency Management Committee (DEMC): fire (bushfire), cyclone, flood, human epidemic and road crash. The effects of these hazards were measured against five key impact areas (economy, public administration, people, environment and social setting) using 237 specific risks, called risk statements.

Within the larger emergency risk management process, this report sits between the risk analysis and risk evaluation steps as it presents the results of the analysis to stakeholders in order for them to evaluate which risks require treatment (Figure 1).

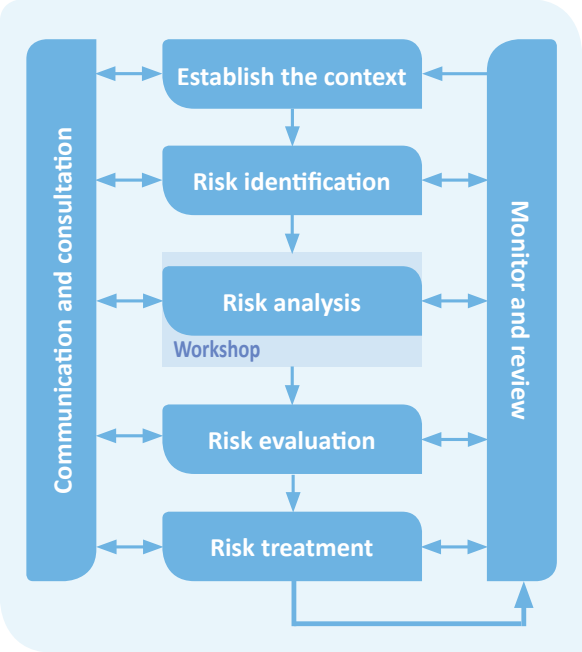

Figure 1: Emergency risk management process.[1]

Twenty-one agencies were represented throughout the workshop series which followed the methodology and criteria outlined in the *Western Australian Emergency Risk Management Guide 2015* and the *National Emergency Risk Assessment Guidelines 2015 (NERAG)*[2]. The risk statements were assessed using a tailored *NERAG* consequence table (Appendix C), which is based on the gross area product ($3.255 billion) and the population (37,673) of the EM district.

The results reveal that 3% of the risks assessed are extreme, 37% are high, 25% are medium, 26% are low and 9% are very low. All of the extreme risks are health related.

Human epidemic poses the greatest risk to the population in the Kimberley. Due to the nature of the event, it would overwhelm the health system with epidemic-related cases, and would impact on those with existing medical conditions. The productivity loss from poor workforce attendance, as a consequence of a human epidemic, was considered the

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[2]*National Emergency Risk Assessment Guidelines* (2015) Australian Government Attorney-General's Department

sole economic risk. Human epidemic is expected to cause tension between public health practices and social or cultural activities.

Cyclone represents another significant hazard; 66% of its risk statements are assessed as high risks. The loss of many buildings, both commercial and residential, from the cyclone scenario (impacting Broome) is expected to cause permanent displacement and a reduction in the quality of life. The destruction of the Broome townsite would severely hamper service provision as it is the primary headquarters for most public agencies in the Kimberley district, although a few services or satellite offices are based in Derby or Kununurra.

Another key area of impact across all hazards is transport. The majority of transport-related risks are assessed as high, from losses incurred by either delays or damage to the physical infrastructure. The disruption of major transport routes also contributes to the highest risks to the community and impact upon essential supplies. The flow of tourists, and the associated economic benefit, is also impeded by disrupted transport routes.

Risk statements assessed as low primarily relate to the environment and the community. Apart from dune erosion, and localised pollutants, environmental impacts are not anticipated to be high. Similarly, many of the social setting risks are assessed as low to very low as the assessed events are not expected to break the social fabric of the community, due to the strong ties to family and land.

The *NERAG* uses a prioritisation system to rank risks for treatment decisions and/or for further investigation. There are no Priority 1 (highest) statements, 6% are Priority 2, 36% are Priority 3, 18% are Priority 4 and 40% are Priority 5 (lowest). Table 1 shows the Priority 2 risk statements in full along with those risk statements with catastrophic consequences. Catastrophic consequence statements are included because if these impacts do occur they could potentially stretch or outstrip the district's resources and therefore should be considered during the treatment phases.

Table 1: Risk statements for the Kimberley district with Priority 2 or catastrophic consequences.

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
Human epidemic	will impact workforce attendance, leading to productivity loss and consequently financial loss.	Economy	Catastrophic	Extreme	Highest	2
Human epidemic	will impact the health of people with other medical conditions due to the demand placed on health services by the epidemic.	People	Catastrophic	Extreme	Highest	2
Human epidemic	will impact remote health services (e.g. remote nursing posts, small country hospitals, clinics) resulting in deaths, injuries or illness directly attributable to the hazard event.	People	Catastrophic	Extreme	Highest	2
Human epidemic	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	Extreme	Highest	2
Human epidemic	will impact the health of people and cause death(s).	People	Catastrophic	Extreme	Highest	2
Human epidemic	will impact health services, affecting their service delivery.	Public administration	Catastrophic	Extreme	Highest	2
Road crash	will impact the health of people and cause death(s).	People	Catastrophic	Extreme	Highest	2
Bushfire	will cause emergency services (e.g. RFDS) to be overwhelmed, resulting in further deaths directly attributable to the hazard event.	People	Major	High	Moderate	2
Human epidemic	will impact small businesses due to low workforce attendance and a reduced number of customers.	Economy	Major	High	Moderate	2
Human epidemic	will impact educational services and their ability to maintain their core services.	Public administration	Major	High	Moderate	2
Human epidemic	will impact suppliers of health service goods (linens, meals, masks etc.) affecting their service delivery.	Public administration	Major	High	High	2
Human epidemic	will impact the health of people and cause deaths, injuries or illness, impacting community wellbeing.	Social setting	Major	High	High	2
Human epidemic	will impact social cohesion due to cultural dimensions.	Social setting	Major	High	Moderate	2

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
Road crash	will impact infrastructure, resulting in costs to the district.	Economy	Major	High	High	2
Road crash	will impact emergency services (e.g. medical transport services such as RFDS) across the district, resulting in deaths, injuries or illness directly attributable to the hazard event.	People	Major	High	High	2
Bushfire	will impact private buildings and contents, resulting in financial losses.	Economy	Catastrophic	High	Highest	3
Cyclone	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	High	Highest	3
Cyclone	will require recovery works to be undertaken by local governments which will impact their ability to maintain core services.	Public Administration	Catastrophic	High	Highest	3
Cyclone	will impact aspects that support the tourism industry (such as access routes, hover craft, float planes, tours, facilities, caravan parks, wineries, orchards, campsites, motels, food and fuel outlets) resulting in recovery costs and financial losses.	Economy	Catastrophic	High	Highest	3
Cyclone	will result in a decrease in tourism to the district such that revenues decline.	Economy	Catastrophic	High	Highest	3
Cyclone	will damage commercial buildings, contents and services, resulting in financial losses.	Economy	Catastrophic	High	Highest	3
Cyclone	will damage private buildings and contents, resulting in financial losses.	Economy	Catastrophic	High	Highest	3
Cyclone	will impact the health of people and cause death(s).	People	Catastrophic	High	Highest	3
Cyclone	will cause disruption to major freight routes, resulting in financial losses.	Economy	Catastrophic	High	High	3
Cyclone	will impact the health of people and cause ongoing health issues from water-borne diseases due to sewerage impacts.	People	Catastrophic	High	Highest	3

1 Introduction

A series of risk assessment workshops were conducted in the Kimberley (EM) district as part of the *State Risk Project*. The project aims to assess the risks posed to the state from all prescribed hazards using a consistent and comprehensive approach. This approach follows the ISO 31000:2009 standard and the methodology outlined in the *National Emergency Risk Assessment Guidelines (NERAG) 2015*. By assessing risks at state, district and local levels, it allows for comparison and the prioritisation of future resource allocation, with an emphasis towards prevention and preparedness activities.

Initially, the highest priority hazards for each district are assessed. The five priority hazards for the Kimberley EM district, as identified by the District Emergency Management Committee (DEMC) are: fire (for this assessment only bushfire was considered and is hereafter referred to as bushfire), cyclone, flood, human epidemic and road crash. All hazards were assessed within a workshop setting (see Table 2 for schedule) and used a credible worst-case hazard scenario. The credible worst-case scenarios were developed by relevant hazard experts and are chosen with the rationale that planning and risk reduction activities for the largest event will address impacts of smaller events, even if the smaller events are more frequent.

During each workshop, presentations were given by relevant experts to provide the hazard context, outline the anticipated district vulnerabilities and impacts and describe the scenario. Following this, as a group, the participants worked through a series of risk statements to estimate the potential consequences of the scenario event. Each risk statement depicts an impact that is likely to eventuate given the scenario (see Table 1 for examples) and is collectively assigned a likelihood, consequence and confidence level using the *NERAG 2015* criteria. Discussion was encouraged among participants allowing the hazards and impacts to be fully evaluated, with decisions based on group consensus. Risk statements are grouped into five impact areas: economy; people; public administration; social setting; and environment with an average of 50 risk statements assessed per hazard.

Data were captured and analysed following the workshop. The results are presented in this report.

Table 2: Location and date of risk assessment workshops.

Hazard	Location of workshop	Date of workshop
Bushfire	Broome	16 September 2015
Cyclone	Broome	1 July 2015
Flood	Broome	1 July 2015
Human epidemic	Broome	4 August 2015
Road crash	Broome	4 August 2015

A range of agencies from across the district were invited to attend the workshops. Agency representation is shown in Table 3.

Table 3: Agencies involved in each risk assessment workshop for the Kimberley district, listed in alphabetical order.

Agency	Hazard				
	Bushfire	Cyclone	Flood	Human epidemic	Road crash
Broome Visitors Centre				x	x
Department of Agriculture & Food WA		x	x		
Department for Child Protection & Family Support	x	x	x	x	x
Department of Environment Regulation				x	x
Department of Fire and Emergency Services	x	x	x	x	x
Department of Fisheries		x	x		
Department of Health		x	x	x	x
Department of Parks and Wildlife	x				
Department of Transport				x	x
Horizon Power	x	x	x		
Kimberley Land Council	x				
Kimberley Ports		x	x		
Main Roads WA		x	x	x	x
Office of Emergency Management (facilitators)	x	x	x	x	x
Royal Flying Doctor Service				x	x
Shire of Broome		x	x		
Shire of Derby, West Kimberley	x				
St John Ambulance		x		x	x
WA Country Health Services				x	x
WA Police		x	x	x	x
Water Corporation	x	x	x	x	x

2 Hazard scenarios

Five hazards were assessed for the Kimberley EM district. Hazard scenarios were developed with the assistance of:

- Bureau of Meteorology Western Australia (BOM)
- Department of Fire and Emergency Services (DFES)
- Main Roads WA
- WA Country Health Services (WACHS)
- WA Police

Bushfire scenario

The bushfire scenario was developed by the BOM and DFES and has approximately a 0.995% chance of occurrence in any given year.

Late in the dry season in the Kimberley district all vegetation is 100% cured. Severe to extreme fire danger occurs over three days. There is an easterly wind-surge in the morning, followed by a strong sea breeze from the west in the afternoon. It is late September/early October with high numbers of tourists still in the area.

Deliberately lit fires (potentially an out-of-control campfire) are ignited along the Great Northern Highway to the east of Broome (Figure 2) and on the Cape Leveque Road/ Dampier Peninsular (Figure 3), 120 km north of Broome. The fires become out of control, initiating major fires. Rates of spread are up to 12 km/hr.

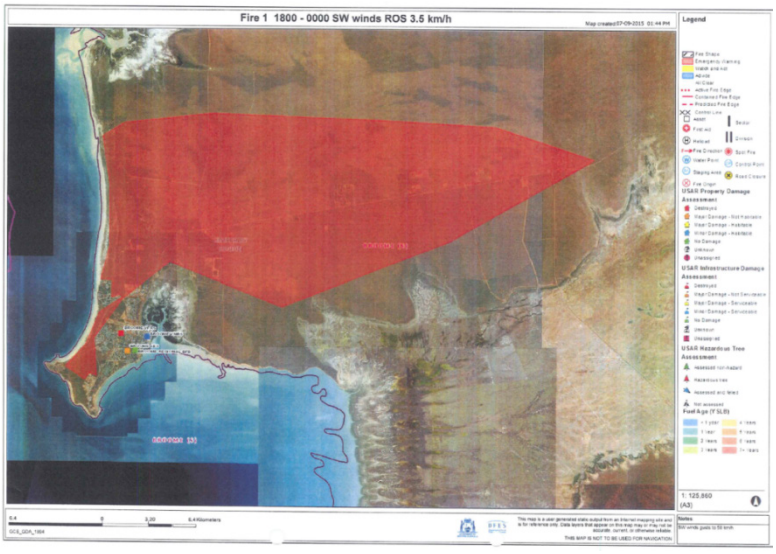

Figure 2: Fire shape 1 - Broome bushfire scenario.

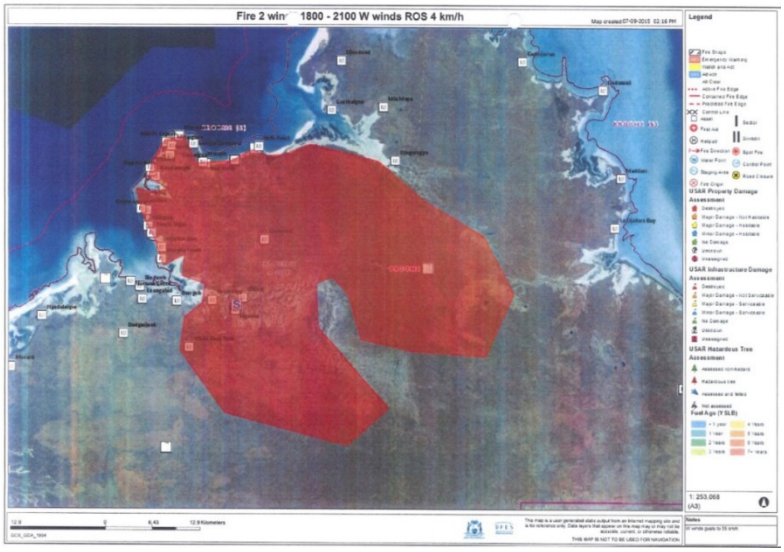

Figure 3: Fire shape 2 - Cape Leveque Road/Dampier Peninsular bushfire scenario.

Cyclone scenario

The cyclone scenario was developed by the BOM and has approximately a 0.1% chance of occurrence in any given year.

A tropical low develops north of the coast around 17 April and begins to track slightly south-west and then south, at which point it becomes a Category 1 tropical cyclone (Figure 4). In the early hours of the morning on 19 April the tropical cyclone tracks east, gaining momentum and increasing to a Category 3 and then a Category 4. By the time it reaches just south of Broome in the very early hours of 20 April it is a Category 5 tropical cyclone.

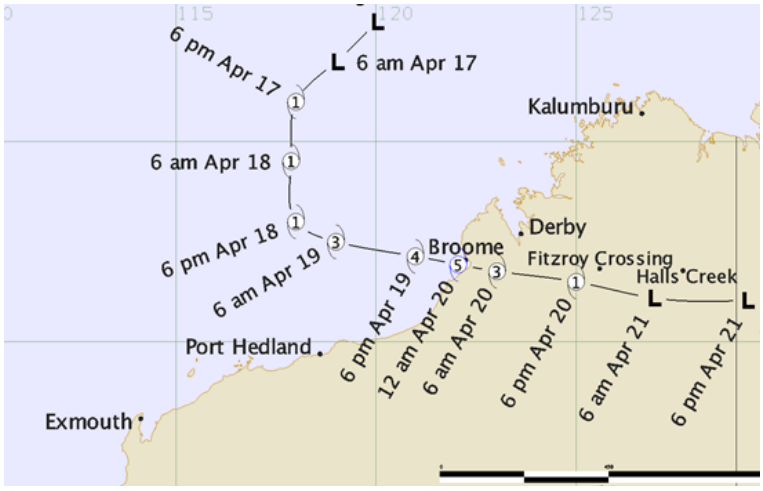

Figure 4: Cyclone track map across the Kimberley for the cyclone hazard scenario.

The Category 5 cyclone makes landfall a couple of kilometres south of Broome (Figure 4). Broome is exposed to 'eye-wall' winds with average wind speeds of 200 km/hr with gusts of up to 275 km/hr. The cyclone is a tight system; 50-60 km in diameter of very strong, destructive winds. The cyclone is travelling at a speed of 20 km/hr and continues to track inland.

Along with the cyclone, there is 200-400 mm of rainfall over a 48-hour period. The greatest rainfall is concentrated in Broome and the Dampier Peninsula, with areas such as Fitzroy Crossing, Halls Creek and Wyndham receiving between 100 and 300 mm of rainfall. The cyclone also drives a storm surge of 7.5 m on top of a high spring tide which results in a storm tide of 12 m above mean sea level (Figure 5).

The cyclone occurs during the April school holidays during a spring tide (10 m).

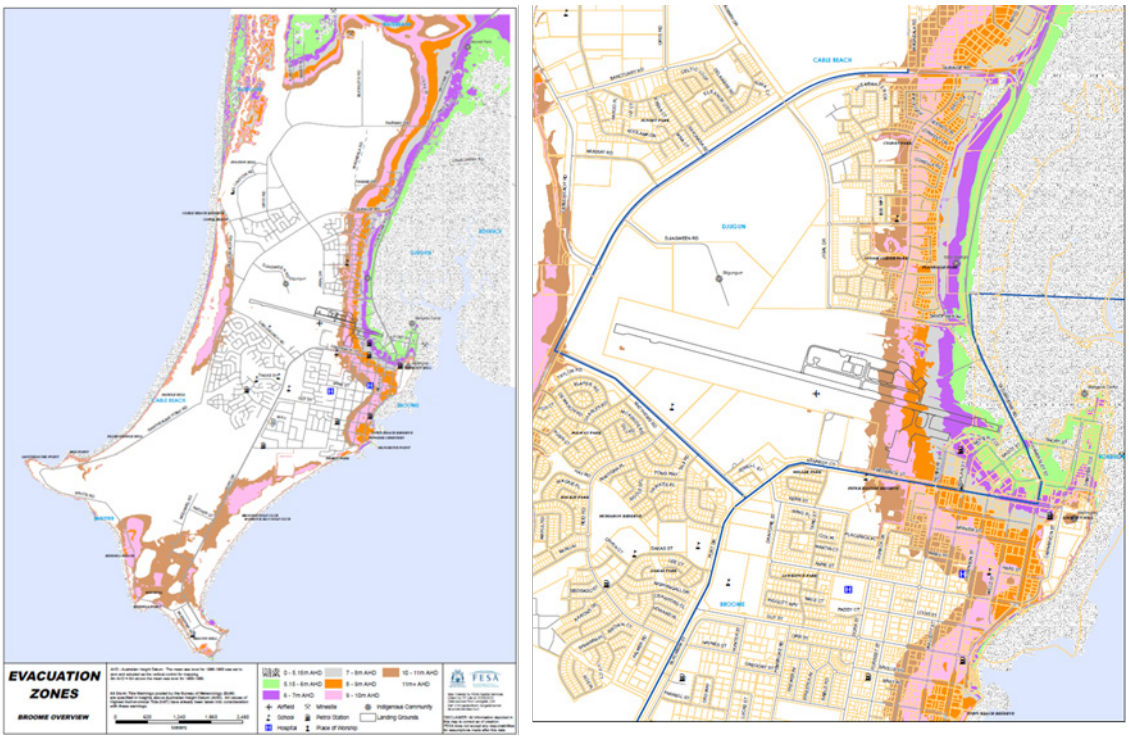

Figure 5: Storm surge inundation map for Broome for the cyclone hazard scenario.

Flood scenario

The flood scenario was developed by the BOM and has approximately a 0.499% chance of occurrence in any given year.

During the northern wet season (summer) a monsoonal low passes across the Kimberley district resulting in heavy rainfall. Approximately 400 mm of rain falls over three days, with 250 mm in one day (Figure 6). Significant stream rises and major flooding is expected across the district (Figure 7).

This event is considered to be an extreme event and is exacerbated by above average rainfall for the preceding months and due to wet catchments from rainfall a few days prior.

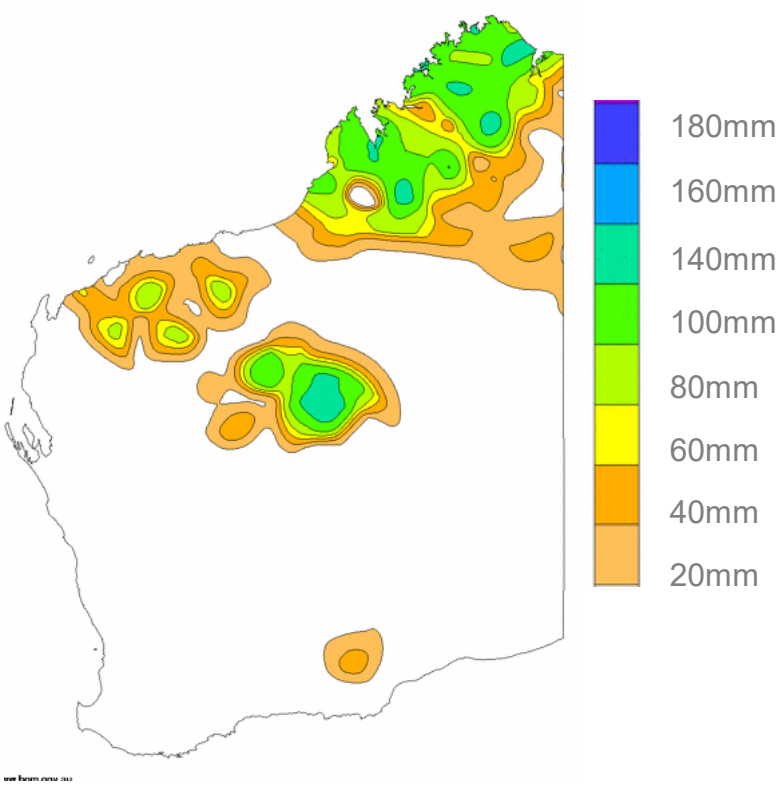

Figure 6: Rainfall levels (mm) on Day 3 at 9 am following the monsoonal low for the flood hazard scenario.

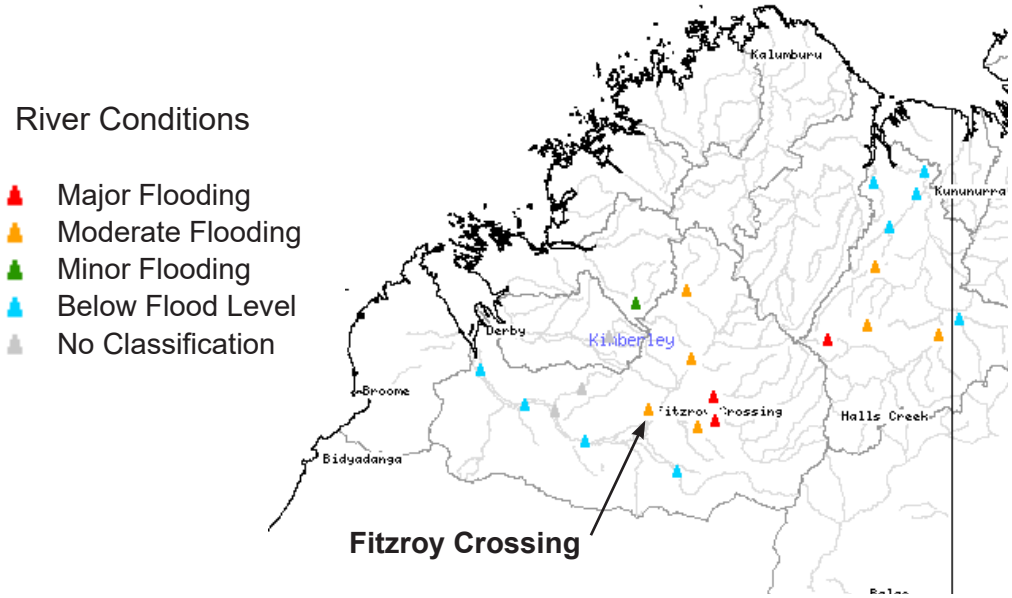

Figure 7: Flood level timeline for Fitzroy Crossing River following the monsoonal low for the flood hazard scenario.

Human epidemic scenario

The human epidemic scenario was developed by WACHS and has approximately a 4.35% chance of occurrence in any given year.

Two cases of severe respiratory illness were admitted to Fitzroy Crossing Hospital (which does not have specific infection control or isolation facilities) and a family connection advised of a third case. The patients are transferred to Broome Hospital. The first patient is recovering, the second is deteriorating and the third died. A fourth patient, a Chinese national, who was attending the Garnduwa Festival (September-October) was diagnosed with severe pneumonia and died a day later. Post-mortem pathology confirmed H5N1R5-alpha influenza virus, a novel avian influenza virus. There are a number of other cases reported and hospitalisations in the district. There are at least 105 people known to have had contact with infected people, 68 of whom have been contacted and quarantined.

Other contributing factors at the time: fever clinics are available at Broome and Fitzroy Crossing Hospitals but not Kununurra; the regional pharmacist is missing; a machine used to assess influenza is broken; no capacity in the Dampier Peninsula for contact identification; communications are down in Looma; and the Kununurra Hospital Infection Control Coordinator (ICC) is on jury duty and there is no back-up ICC.

Road crash scenario

The road crash scenario was developed by Main Roads WA and the WA Police and has approximately a 4.7% chance of occurrence in any given year.

During the peak tourist season in the Kimberley (July-August), a head-on collision between a road train carrying fuel and a tourist bus occurs on the Willare Bridge (Figure 8). The truck was damaged and fuel spilled from the cracked tank into the river, requiring a clean-up operation. Fuel ignites causing a fire at the back of the truck and damages the bridge. The tourist bus did not ignite but went off the bridge into the river below. Issues are experienced getting equipment to the correct side of the bridge due to its remote location. No alternate road is available for traffic.

Figure 8: Location of Willare Bridge for the road crash scenario.

3 Assessed risk statements

A total of 237 risk statements were assessed across five priority hazards: bushfire (56); cyclone (53); flood (52); human epidemic (45); and road crash (31).

Table 4 shows the number of risk statements for each hazard, separated into the five impact areas (economy, public administration, people, environment and social setting).

The statements were generated to cover all foreseen impacts of the scenario events across the five impact areas.

The risk statements were assessed using the tailored *NERAG* consequence table for the Kimberley EM district found in Appendix C. The consequence levels are based on the gross area product ($3.255 billion) and the population (37,673) of the EM district.

Table 4: Number of risk statements assessed for each hazard in the Kimberley district.

Hazard	Impact area				
	Economy	Public administration	People	Environment	Social setting
Bushfire	13	18	4	5	16
Cyclone	16	15	3	5	14
Flood	14	15	4	5	14
Human epidemic	8	14	5	0	18
Road crash	9	8	4	3	7

4 Kimberley EM district risk profile

The risk profile for the Kimberley district for the five assessed hazards is shown in Figure 10 (following page). This diagram shows the percentage of risk statements for each hazard as they sit on the *NERAG 2015* risk matrix. The matrix is used to categorise risk statements by their likelihood, consequence and risk level. The bar graph below (Figure 9) combines the data and categorises it by hazard and risk level.

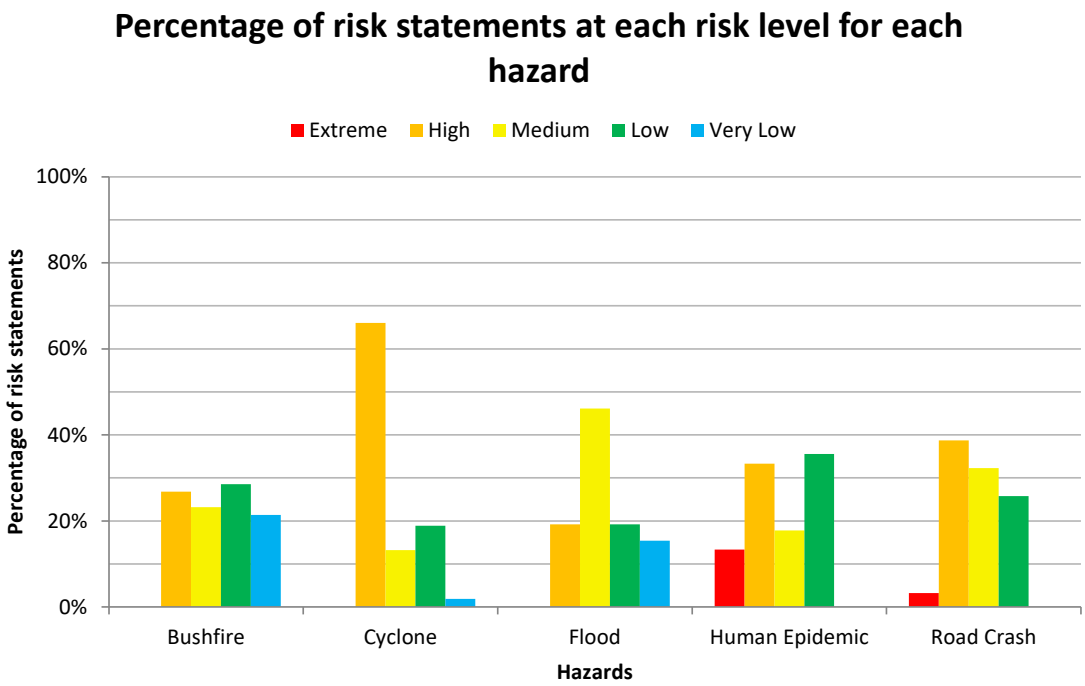

Figure 9: Percentage of risk statements at each risk level for each hazard. Note each hazard sums to 100%.

Of the 237 statements assessed for all five hazards, 3% are extreme risks, 37% are high, 25% are medium, 26% are low and 9% are very low risks. Individual hazard risk assessment summaries can be found in Appendix A.

Figure 9 and Figure 10 show that there are a number of risks for the Kimberley that are assessed as extreme. These predominantly stem from the human epidemic and road crash hazard scenarios and relate to impacts on people, the economy and public administration (see Figure 11). These are the greatest risks for the district as they are likely to occur more often and with higher consequences than other risk statements.

Figure 10 shows that the assessed risks range from very low to extreme, with the greatest proportion (37%) of the risk statements for the five hazards being assessed as high risks to the district. As a hazard, cyclone stands out as having the greatest proportion of high risk statements (66%) among those assessed (Figure 9).

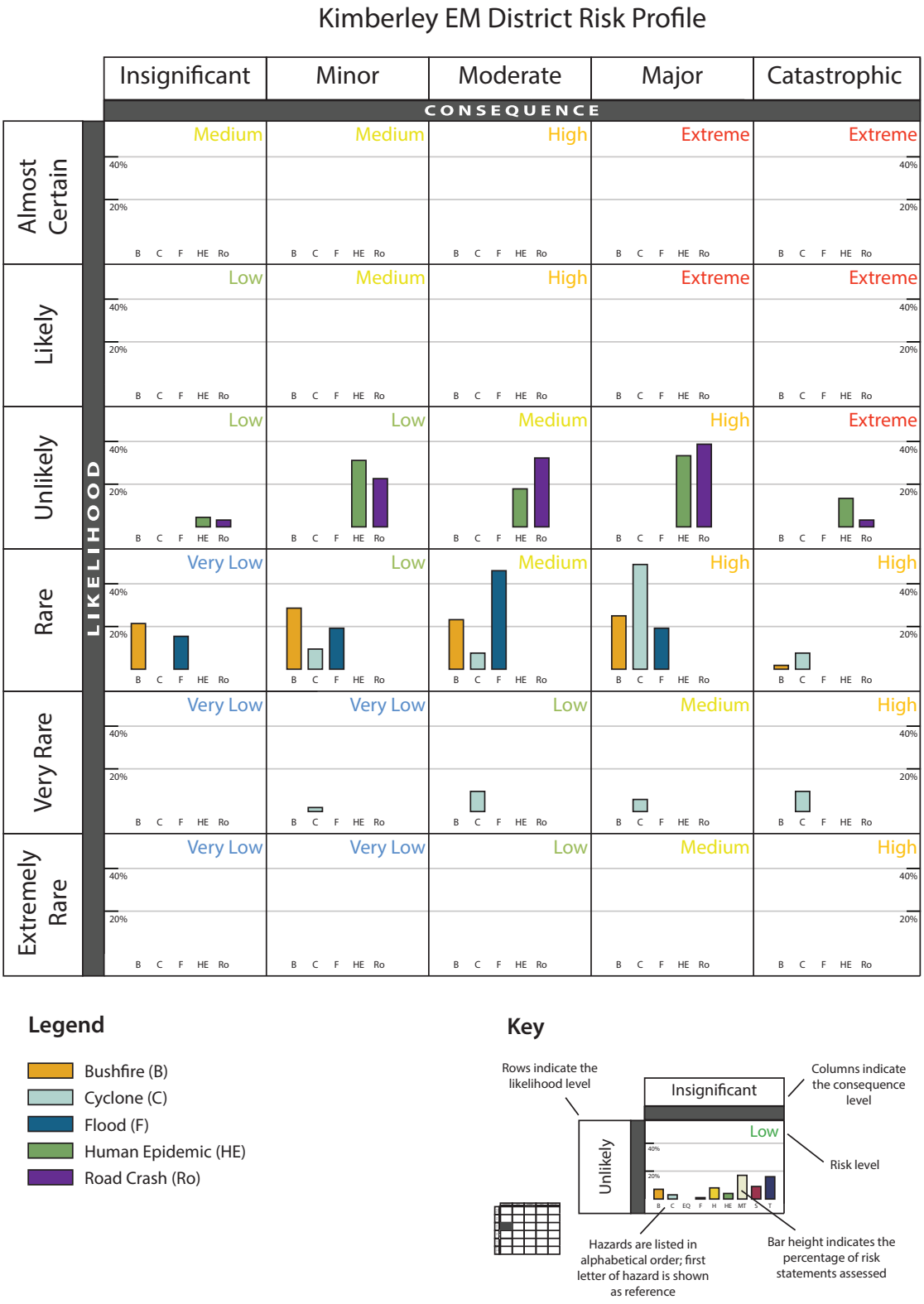

Figure 10: Percentage of risk statements for each hazard assessed in the Kimberley EM district, categorised by their likelihood, consequence and risk level.

As illustrated in Figure 10, there are several risk statements (7%) that have been assessed as having catastrophic consequences. Flood is the only hazard which was assessed to not produce catastrophic consequences. Major consequences were assessed to result from 34% of the risk statements. It should be noted that the consequence levels are based on the gross area product ($3.255 billion) and the population (37,673) of the Kimberley EM district (see Appendix C for the Kimberley consequence table). The likelihood of the hazards range between very rare to unlikely, with the human epidemic and road crash more likely (4.35 - 4.7% chance of occurring in any given year) than the natural hazards assessed (bushfire, cyclone and flood) which have between 0.1% and 0.995% chance of occurring in any given year.

Figure 11 shows the percentage of all risk statements at each risk level for the five different impact areas. The majority of the risk statements assessed as extreme are in the people impact area and relate to the hazards (human epidemic and road crash) impacting people's health causing death and/or injury. Most of the high risk statements are within the economy, public administration and people impact categories due to the high impact the hazards have on the population, the day-to-day activities of governing agencies and financial activities within the district. The majority of the low and very low risks are within the social setting and environment categories.

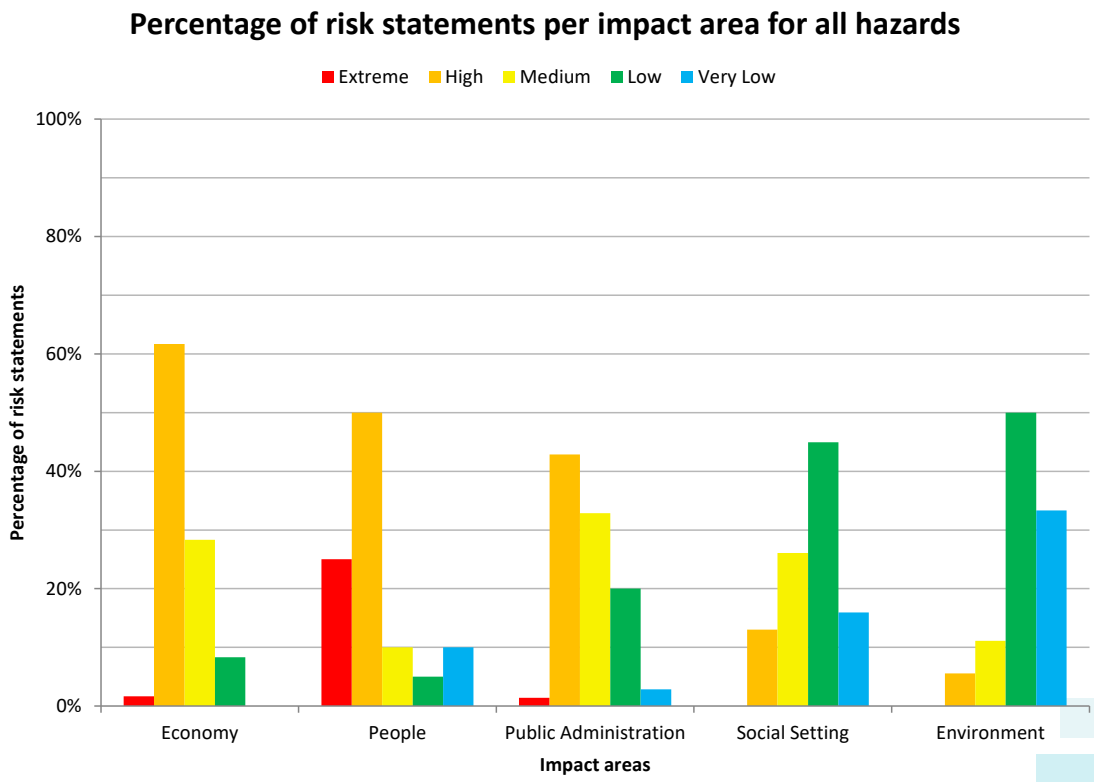

Figure 11: Percentage of risk statements per risk level, by impact area for all hazards. Note: each impact area sums to 100%.

Common themes from extreme and high risk statements

ECONOMY 	• Damage to private and commercial buildings and contents resulting in asset loss. • Damage and disruption of power, transportation, sewerage and potable water networks incurring financial costs. • Impacts to tourism and those services which support tourism, such that revenues decline. • Loss of production and revenue for agriculture and aquaculture. • Impact to workforce attendance such that productivity decreases (*extreme risk for human epidemic*).
PEOPLE 	• Emergency events cause injuries/illnesses (*catastrophic consequence for cyclone and human epidemic*). • Emergency events cause deaths (*catastrophic consequence for cyclone and human epidemic*). • Ongoing health issues from water-borne diseases due to sewerage impacts (*catastrophic consequence for cyclone*). • Impact on health of people with other medical conditions due to increased health service demand (*extreme risk for human epidemic*).
PUBLIC ADMINISTRATION 	• Require response and recovery works by state agencies and local governments, affecting their ability to provide core services. • Increased demand for emergency, WA health and home-based services, reducing their service provision and delivery (*extreme risk for human epidemic*). • Damage to power, water, transport, sewerage and communication infrastructure, impacting their ability to provide core services. • Disruption to corporation staff in remote Aboriginal communities.
SOCIAL SETTING 	• Community wellbeing affected by deaths/injuries and residential building damage. • Displacement of people and disruption of social services. • Decrease in day-to-day function of facilities for vulnerable people. • Isolation of towns affecting their ability to function as a district community.
ENVIRONMENT 	• Inundation and erosion of sandy coastlines and dune systems.

5 Analysis of risk profile

In order to understand any potential relationships, the assessed risks have been grouped into categories to determine common themes or if certain areas and sectors are at higher risk.

In the following tables, risk statements are represented by showing the hazard name under the assigned risk level. Where a number follows the hazard name, more than one statement from that hazard fits into that category and risk level. There may also be more than one statement for a hazard in a category. For example, statements addressing horticulture, crops and agriculture infrastructure would all appear in the impacts to agriculture and pastoral activities category. Risk statements were written for each hazard to address anticipated impacts; therefore, there are categories where not all hazards appear.

Risks to economy

Sixty economy statements were assessed across the five hazards (Table 5). The statements address impacts to a significant industry or the decline in economic activity across the EM district (see Appendix C for criteria).

Table 5: Impacts to economy by hazard and risk level. Note: H Epidemic = human epidemic.

Category	Risk level				
	Extreme	**High**	**Medium**	**Low**	**Very Low**
Disruption to transport routes		Cyclone Flood Road Crash	Bushfire		
Health services		H Epidemic			
Impacts to agricultural and pastoral activities		Bushfire Flood Road Crash	Bushfire (2) Cyclone Flood	Cyclone	
Impacts to aviation		Cyclone	Flood Road Crash		
Impacts to bridges or their approaches		Flood Road Crash	Cyclone		
Impacts to commercial activities		H Epidemic (3)			
Impacts to commercial buildings, contents and services		Bushfire Cyclone Flood			

Category	Risk level				
	Extreme	High	Medium	Low	Very Low
Impacts to communication infrastructure			Bushfire	Cyclone Flood	
Impacts to marine infrastructure and industry		Cyclone (2)			
Impacts to power supply infrastructure		Bushfire	Cyclone Flood		
Impacts to private buildings and contents		Bushfire Cyclone Flood			
Impacts to sewerage systems		Cyclone Flood	Bushfire		
Impacts to tourism		Bushfire (2) Cyclone (2) H Epidemic Road Crash	Flood	Flood Road Crash	
Impacts to transport infrastructure		Cyclone Flood			
Impacts to water supply infrastructure		Cyclone Flood	Bushfire		
Response and recovery activities		Bushfire	Road Crash (2)		
Workforce productivity losses	H Epidemic	H Epidemic (2)	Road Crash		

The sole extreme economic risk relates to the productivity loss arising from poor workforce attendance as a consequence of a human epidemic. Small numbers of employees in organisations within the Kimberley mean that the loss of one or two individuals may result in the cessation of all activities, as there is no one available to assume the position's responsibilities. The free movement of workers is also impinged by human epidemic as the public health aspect seeks to limit transmission through limited personal contact; this also results in a decline in commercial retail activities.

In general, the high economic risks relate to building and infrastructure damage from the flood, cyclone and bushfire scenarios. The ubiquitous nature of the events and high costs of repairs contribute to the anticipated losses.

Due to its nature, economic impacts from road crash relate to the disruption of transport routes blocking freight, including livestock transport, and also tourists from moving about the area. The potential reputational damage, and resultant drop in tourist numbers, was assessed to be a low risk.

Risks to people

Twenty risk statements assessed the impact to people across the five hazards. These statements addressed deaths, injuries or illnesses, further deaths or illnesses/injuries as a result of the event's impact on emergency services (primarily medical transport) and on health services. The risk posed to each of these elements by the assessed hazards is shown in Table 6.

Table 6: Impacts to people by hazard and risk level. Note: H Epidemic = human epidemic.

Category	Risk level				
	Extreme	**High**	**Medium**	**Low**	**Very Low**
Deaths	H Epidemic Road Crash	Bushfire Cyclone			Flood
Disease outbreak		Cyclone	Flood		
Emergency services		Bushfire H Epidemic Road Crash			
Health services	H Epidemic			Road Crash	Bushfire
Impacts to general health	H Epidemic	Flood			
Injuries or illnesses	H Epidemic	Bushfire Cyclone Road Crash	Flood		

It is clear that human epidemic poses the greatest risk in the Kimberley to its population. Due to the nature of the event, it would overwhelm the health system with epidemic cases resulting in those with other medical conditions being impacted. The epidemic and road crash scenarios are assessed to result in multiple fatalities (>4), with fewer resulting from a bushfire or cyclone. Conversely, flood was assessed to pose a very low risk of death, though there is a high risk to the health of remote Aboriginal communities and a medium risk to illnesses being exacerbated by isolation due to floods.

Cyclone and flood events could result in subsequent water-borne disease outbreaks. Cyclone was assessed as a high risk due to the anticipated impact on the sewerage system in Broome, while flood was assessed as a medium risk due to widespread stagnant waters.

Risks to public administration

Seventy statements were assessed across the five hazards that addressed public administration impacts (Table 7). These pertain to the continuity of an agency's core services. For example, at medium risk or higher, either a significant reduction in services would occur or external assistance from outside the EM district would be required to maintain service levels (see Appendix C for criteria).

Table 7: Impacts to public administration by hazard and risk level. Note: H Epidemic = human epidemic.

Category	Risk level				
	Extreme	**High**	**Medium**	**Low**	**Very Low**
Administration of Aboriginal communities		Cyclone	Flood	Road Crash	
Availability of essential supplies				Bushfire	
Demand on public facilities		Cyclone	Flood	Bushfire	
Disruption of educational services		H Epidemic			
Disruption to aviation services		Cyclone		Flood Road Crash	Bushfire
Disruption to supply of natural gas				Bushfire	
Emergency services		Bushfire Cyclone (3) H Epidemic (2) Road Crash (2)	Bushfire Flood H Epidemic	Flood (2) Road Crash	Bushfire
Government services		Cyclone	Bushfire Flood H Epidemic (4)	Bushfire (2) H Epidemic	
Health services	H Epidemic	Bushfire Cyclone H Epidemic Road Crash	Flood H Epidemic	H Epidemic	

Category	Risk level				
	Extreme	**High**	**Medium**	**Low**	**Very Low**
Home care services		Cyclone	Bushfire Flood		
Impacts to communication service delivery		Bushfire Cyclone		Flood	
Impacts to port and marina services		Cyclone			
Impacts to power supply service delivery		Bushfire Cyclone Road Crash	Flood		
Impacts to sewerage service delivery		Flood	Bushfire		
Impacts to water supply service delivery		Cyclone	Bushfire Flood		
Public information			H Epidemic		
Response and recovery activities		Bushfire Cyclone (2) Road Crash	Bushfire Flood (2)		

The highest risk to public administration is from human epidemic, resulting in an increased demand (surge) on health services, limiting their ability to provide their core services. All hazards will cause an increased demand (surge) on health services and impact their service provision, but human epidemic is assessed to be an extreme risk due to the widespread nature of the event, the small number of primary health clinics across the district, the remoteness of individuals, and the itinerant nature of a portion of the population.

Emergency services face similar issues in trying to provide for the increased demand in services with limited staff numbers. High risks are related to this surge in required services such that their other core services are impacted, while medium risks are in response to delayed services due to damaged transportation networks and low staff numbers during an epidemic.

All cyclone statements have been assessed as high risks for the public administration sector. The destruction of the Broome townsite would severely hamper service provision as it is the primary headquarters for most agencies in the Kimberley district, though a few services or satellite offices are based in Derby or Kununurra.

The common occurrence of flooding in the district has meant that, despite the scale of the flood scenario, the risks it poses were not assessed to be high as the community is aware of the hazard and their lifestyle and processes are well adapted to floods.

Power supply infrastructure, especially above ground equipment, is at high risk of being impacted by widespread, intense hazards such as cyclone and bushfire, whereas flooding is likely to be less intense and therefore cause less damage. The disruption to road networks from road crash will also affect the power supply as power generation in most of the Kimberley is from gas or diesel.

Risks to social setting

Sixty-nine risk statements assessed the impact to the social setting across the five hazards (Table 8). The social setting focuses on the community wellbeing, community services and culturally important activities and objects (see Appendix C for criteria).

Table 8: Impacts to social setting by hazard and risk level. Note: H Epidemic = human epidemic.

Category	Risk level				
	Extreme	**High**	**Medium**	**Low**	**Very Low**
Availability of essential supplies		Cyclone	Flood (2) Road Crash	Bushfire (2) Flood H Epidemic (2)	
Breakdown of social networks		H Epidemic		H Epidemic (2)	Bushfire
Community services and events		H Epidemic		Cyclone H Epidemic (2)	
Culturally significant facilities and customs					Bushfire (3)
Death/injury of animals				Cyclone	Bushfire Flood
Displacement or isolation of Aboriginal communities			Cyclone Flood (2) Road Crash	Cyclone Bushfire	
Displacement or isolation of communities		Cyclone Road Crash	Flood (2)	Bushfire Cyclone H Epidemic (2)	
Educational facilities			Cyclone	H Epidemic	Bushfire Flood

Category	Risk level				
	Extreme	High	Medium	Low	Very Low
Facilities for vulnerable people		Cyclone	Flood	Bushfire H Epidemic Road Crash	
Impacts to people's health affecting wellbeing		Cyclone H Epidemic	Flood	H Epidemic	Bushfire
Impacts to tourism			Bushfire Road Crash	Cyclone	
Loss of income			Cyclone Road Crash	H Epidemic	Bushfire Flood
Psychological and emotional stress				H Epidemic Road Crash	
Residential building damage		Cyclone		Bushfire Flood	
Social service providers			Cyclone H Epidemic	Bushfire Flood H Epidemic	

Cyclone poses the greatest risks to community services. The loss of many buildings, both commercial and residential, is expected to cause permanent displacement and a reduction in the quality of life.

Similarly, compared to other categories, many of the social setting statements are assessed as low to very low risks (61%), as the potential events are not expected to break the social fabric of the community. Strong cultural ties to the area for some mean they will stay in the district regardless of such events. At the same time, there is also a transient population (e.g. government workers) that would typically stay for only a few years. Such a dynamic community may cope better with changes brought on by these events.

The high risks from human epidemic relate to community activities being cancelled and impacts to social cohesion. For instance, it was identified during the workshop that issues could arise with people being unable to attend funerals.

Risks to environment

Eighteen environmental risk statements were assessed across four of the hazards (Table 9). These statements address impacts to ecosystems, species and landscapes (see Appendix C for criteria). No environment statements were assessed for human epidemic as risks to the ecosystem or species were not foreseen at the time of the workshop.

Table 9: Impacts to environment by hazard and risk level. Note: H Epidemic = human epidemic.

Category	Risk level				
	Extreme	**High**	**Medium**	**Low**	**Very Low**
Coastal erosion		Cyclone			
Contamination from toxic substances				Bushfire	
Debris or pollutants entering the riverine or marine environment			Road Crash (2)	Bushfire Cyclone Flood	
Flora and fauna				Bushfire (2) Cyclone Road Crash	Bushfire Flood (3)
Salt contamination				Cyclone	
Soil erosion					Cyclone Flood

The risks posed to the environment from natural hazard events are low or very low, as these are natural processes and the landscape has and will be shaped by these events. The exception to this is the high risk posed by a cyclone causing ocean surges and wave activity, resulting in marine inundation and erosion of sandy coastlines/dune systems. While the process is natural, inundation and erosion near towns (e.g. Broome) cause land instability and would result in significant efforts to restore the natural environment for land stabilisation and recreational purposes (and perhaps equally for economic reasons by way of tourism).

The contamination of riverways from pollutants (e.g. fuel) and debris from road crashes results in a medium risk rating, due to the cost of remediation efforts.

Risks by theme

Risk statements were assessed across the five impact areas (economy, public administration, people, social setting and environment) following the NERAG consequence criteria. However, some risks crosscut multiple impact areas. By combining them into themes, common risks are highlighted for different sectors and actors.

The eleven themes identified for the Kimberley EM district are: Aboriginal communities and cultural activities; buildings; community; education; environment; government; health; industry/commercial; tourism; transport; and utilities. The environment category is not shown here as the data are the same as that represented in Table 9.

The colour coding in these table follows the impact areas: pink – economy; orange – public administration; blue – people; purple – social setting; green – environment.

Aboriginal communities and cultural activities

Table 10 shows the risks that directly address Aboriginal communities and cultural activities.

Table 10: Risks related to Aboriginal communities and cultural activities. Note: H Epidemic = human epidemic.

Aboriginal communities and cultural activities					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Administration of Aboriginal communities		Cyclone	Flood	Road Crash	
Culturally significant facilities and customs					Bushfire
Displacement or isolation of Aboriginal communities			Cyclone Flood (2) Road Crash	Cyclone Bushfire	

Buildings

The majority of risks to buildings (Table 11) are ranked as high risks and are caused by natural hazard events.

Table 11: Risks related to buildings. Note: H Epidemic = human epidemic.

Buildings					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Demand on public facilities		Cyclone	Flood	Bushfire	
Impacts to commercial buildings, contents and services		Bushfire Cyclone Flood			
Impacts to private buildings and contents		Bushfire Cyclone Flood			
Residential building damage		Cyclone		Bushfire Flood	

Community

Table 12 shows the risks to the community. The highest risks to community pertain to the disruption of essential supplies, resulting either from blocked transport routes, isolation of towns or damage incurred by buildings that would normally receive goods. Human epidemic is expected to cause issues related to the tension between public health practices (isolation or limited contact) and the desire to attend large gatherings (e.g. funerals).

Table 12: Risks related to the community. Note: H Epidemic = human epidemic.

Community					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Availability of essential supplies				Bushfire	
Availability of essential supplies		Cyclone	Flood (2) Road Crash	Bushfire (2) Flood H Epidemic (2)	
Breakdown of social networks		H Epidemic		H Epidemic (2)	Bushfire

Community					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Community services and events		H Epidemic		Cyclone H Epidemic (2)	
Culturally significant facilities and customs					Bushfire (2)
Death/injury of animals				Cyclone	Bushfire Flood
Displacement or isolation of communities		Cyclone Road Crash	Flood (2)	Bushfire Cyclone H Epidemic (2)	
Facilities for vulnerable people		Cyclone	Flood	Bushfire H Epidemic Road Crash	
Home care services		Cyclone	Bushfire Flood		
Psychological and emotional stress				H Epidemic Road Crash	
Social service providers			Cyclone H Epidemic	Bushfire Flood H Epidemic	

Education

The highest risks to education relate to the Department of Education's ability to maintain services during a human epidemic (Table 13). The confidence level of this assessment was rated as moderate, automatically raising the risk level. Further investigations of the matter could thus refine the risk rating.

Table 13: Risks related to education. Note: H Epidemic = human epidemic.

Education					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Disruption of educational services		H Epidemic			
Educational facilities			Cyclone	H Epidemic	Bushfire Flood

Government

The higher risks for government activities are for response and recovery activities (Table 14). The lower risks pertain to the disruption of normal government services. The high risk statements from cyclone are due to the main office headquarters being destroyed or damaged.

Table 14: Risks related to government activities. Note: H Epidemic = human epidemic.

Government activities					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Emergency services		Bushfire			
Government services		Cyclone	Bushfire Flood H Epidemic (4)	Bushfire (2) H Epidemic	
Public information			H Epidemic		
Response and recovery activities		Bushfire	Road crash (2)		
Response and recovery activities		Bushfire Cyclone (2) Road Crash	Bushfire Flood (2)		

Health

The risks related to health are by far the greatest risks for the Kimberley (Table 15); all extreme risk statements are health related.

Table 15: Risks related to health. Note: H Epidemic = human epidemic.

Health					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Deaths	H Epidemic Road Crash	Bushfire Cyclone			Flood
Disease outbreak		Cyclone	Flood		
Emergency services		Bushfire H Epidemic Road Crash			

Health					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Emergency services		Cyclone (2) H Epidemic (2) Road Crash	Flood H Epidemic	Flood Road Crash	Bushfire
Health services		H Epidemic			
Health services	H Epidemic			Road Crash	Bushfire
Health services	H Epidemic	Bushfire Cyclone H Epidemic Road Crash	Flood H Epidemic	H Epidemic	
Impacts to general health	H Epidemic	Flood			
Impacts to people's health		Cyclone H Epidemic	Flood	H Epidemic	Bushfire
Injuries or illnesses	H Epidemic	Bushfire Cyclone Road Crash	Flood		
Loss of income				H Epidemic	
Workforce productivity losses	H Epidemic	H Epidemic (2)			

Industry/commercial

Cyclone has the greatest impact to industry activities (Table 16). Agriculture and pastoral activities are impacted by four of the hazards. The disruption of transport routes and the loss of livestock or agricultural equipment are the primary causes.

Table 16: Risks related to industry. Note: H Epidemic = human epidemic.

Industry					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Impacts to agricultural and pastoral activities		Bushfire Flood Road Crash	Bushfire (2) Cyclone Flood	Cyclone	
Impacts to commercial activities		H Epidemic (3)			

Industry					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Impacts to marine infrastructure and industry		Cyclone (2)			
Impacts to port and marina services		Cyclone			
Workforce productivity losses			Road Crash		

Tourism

The risks posed to tourism are assessed as high for economic reasons (Table 17). The flow on effect of the decrease in tourism impacts the community through loss of income.

Table 17: Risks related to tourism. Note: H Epidemic = human epidemic.

Tourism					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Impacts to tourism		Bushfire (2) Cyclone (2) H Epidemic Road Crash	Flood	Flood Road Crash	
Impacts to tourism			Bushfire Road Crash	Cyclone	
Loss of income			Cyclone Road Crash		Bushfire Flood

Transport

The majority of transport-related risks are high risks, due to losses incurred by either delays or damage to the physical infrastructure (Table 18).

Table 18: Risks related to transport. Note: H Epidemic = human epidemic.

Transport					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Disruption to aviation services		Cyclone		Flood Road Crash	Bushfire
Disruption to transport routes		Cyclone Flood Road Crash	Bushfire		
Emergency services		Cyclone Road Crash	Bushfire	Flood	
Impacts to aviation		Cyclone	Flood Road Crash		
Impacts to bridges or their approaches		Flood Road Crash	Cyclone		
Impacts to transport infrastructure		Cyclone Flood			

Utilities

All of the risks related to utilities are a result of natural events, with the exception of potential power supply issues from fuel supply delivery delays during a road crash event (Table 19). Economic and service delivery risks are similar for most utilities, suggesting that damage to assets is the likely cause of service disruptions.

Table 19: Risks related to utilities. Note: H Epidemic = human epidemic.

Utilities					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Disruption to supply of natural gas				Bushfire	
Impacts to communication infrastructure			Bushfire	Cyclone Flood	
Impacts to communication service delivery		Bushfire Cyclone		Flood	
Impacts to power supply infrastructure		Bushfire	Cyclone Flood		
Impacts to power supply service delivery		Bushfire Cyclone Road Crash	Flood		
Impacts to sewerage systems		Cyclone Flood	Bushfire		
Impacts to sewerage service delivery		Flood	Bushfire		
Impacts to water supply infrastructure		Cyclone Flood	Bushfire		
Impacts to water supply service delivery		Cyclone	Bushfire Flood		

6 Risk evaluation

The next step in the risk management process is to evaluate the risks, determining whether the identified risks are acceptable or require treatment (Figure 12).

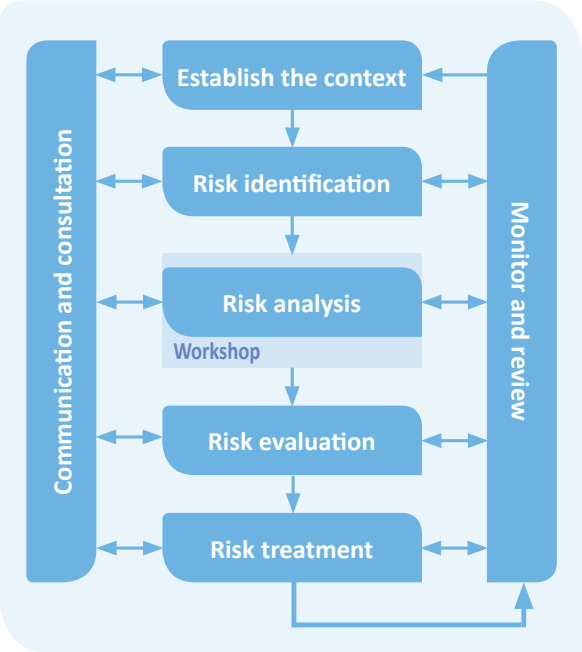

Figure 12: Emergency risk management process.[3]

The *NERAG* uses a prioritisation system to rank risks for treatment decisions and/or for further investigation. *NERAG* priority is based on the risk level and confidence associated with each assessed risk. Priority ranges from 1 (highest priority) to 5 (lowest priority). The following prioritisation of risks is a helpful tool to focus attention on the more significant risks. However, the determination of whether a risk is acceptable or should be treated has governance, financial and societal implications and is best administered by the appropriate level(s) of government.

Figure 13 shows that most (40%) of the Kimberley risk statements are classified as Priority 5, meaning that these are low priority and require monitoring and review during the next risk assessment phase. There is also a high percentage (36%) of Priority 3 risk statements which need further investigation and/or development of treatment plans.

There are no Priority 1 risk statements for the Kimberley district, however, 6% of the statements are categorised as Priority 2, meaning they need further investigation and/or treatment. Because of their high priority, these risk statements should be addressed first by the relevant agencies.

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Table 20 contains the Priority 2 risk statements in full and those risk statements with catastrophic consequences. Catastrophic consequence statements are included because if these impacts do occur they could potentially stretch or outstrip the district's resources and therefore should be considered during the treatment phases.

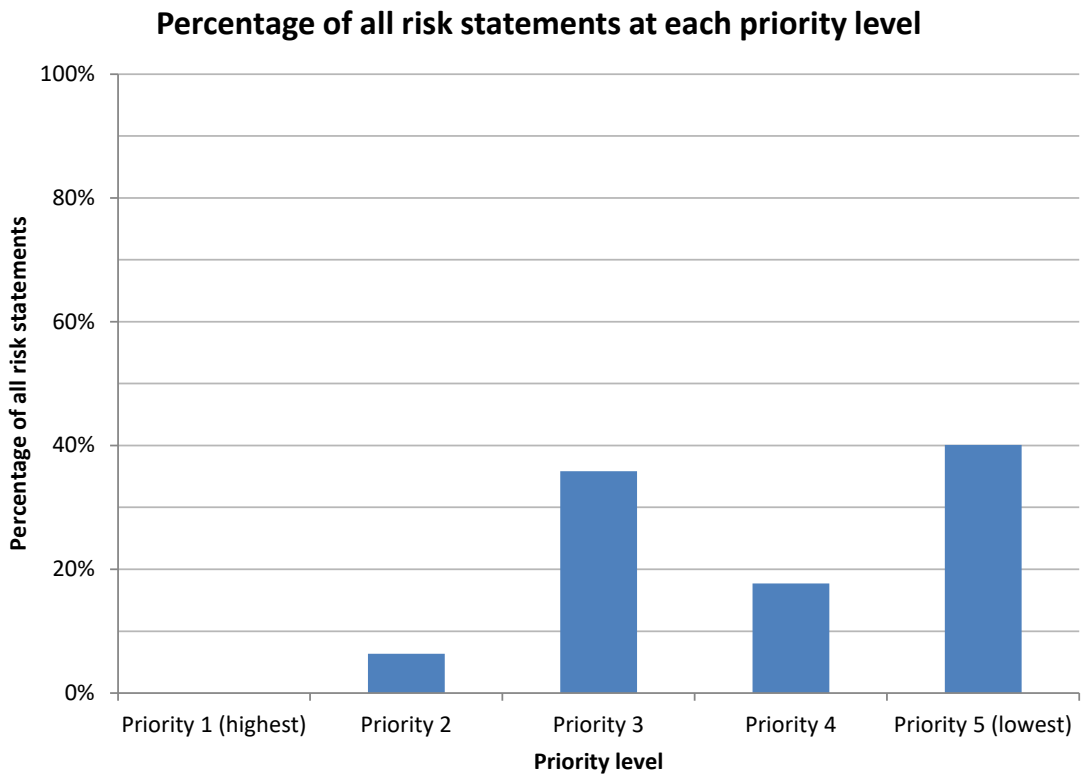


Figure 13: Percentage of all risk statements at each priority level. Priority 1 – highest; Priority 2 – high; Priority 3 – medium; Priority 4 – low; Priority 5 – lowest.

Table 20: Risk statements for the Kimberley district with Priority 2 or catastrophic consequences.

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
Human epidemic	will impact workforce attendance, leading to productivity loss and consequently financial loss.	Economy	Catastrophic	Extreme	Highest	2
Human epidemic	will impact the health of people with other medical conditions due to the demand placed on health services by the epidemic.	People	Catastrophic	Extreme	Highest	2
Human epidemic	will impact remote health services (e.g. remote nursing posts, small country hospitals, clinics) resulting in deaths, injuries or illness directly attributable to the hazard event.	People	Catastrophic	Extreme	Highest	2
Human epidemic	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	Extreme	Highest	2
Human epidemic	will impact the health of people and cause death(s).	People	Catastrophic	Extreme	Highest	2
Human epidemic	will impact health services, affecting their service delivery.	Public administration	Catastrophic	Extreme	Highest	2
Road crash	will impact the health of people and cause death(s).	People	Catastrophic	Extreme	Highest	2
Bushfire	will cause emergency services (e.g. RFDS) to be overwhelmed, resulting in further deaths directly attributable to the hazard event.	People	Major	High	Moderate	2
Human epidemic	will impact small businesses due to low workforce attendance and a reduced number of customers.	Economy	Major	High	Moderate	2
Human epidemic	will impact educational services and their ability to maintain their core services.	Public administration	Major	High	Moderate	2
Human epidemic	will impact suppliers of health service goods (linens, meals, masks etc.) affecting their service delivery.	Public administration	Major	High	High	2
Human epidemic	will impact the health of people and cause deaths, injuries or illness, impacting community wellbeing.	Social setting	Major	High	High	2

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
Human epidemic	will impact social cohesion due to cultural dimensions.	Social setting	Major	High	Moderate	2
Road crash	will impact infrastructure, resulting in costs to the district.	Economy	Major	High	High	2
Road crash	will impact emergency services (e.g. medical transport services such as RFDS) across the district, resulting in deaths, injuries or illness directly attributable to the hazard event.	People	Major	High	High	2
Bushfire	will impact private buildings and contents, resulting in financial losses.	Economy	Catastrophic	High	Highest	3
Cyclone	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	High	Highest	3
Cyclone	will require recovery works to be undertaken by local governments which will impact their ability to maintain core services.	Public Administration	Catastrophic	High	Highest	3
Cyclone	will impact aspects that support the tourism industry (such as access routes, hover craft, float planes, tours, facilities, caravan parks, wineries, orchards, campsites, motels, food and fuel outlets) resulting in recovery costs and financial losses.	Economy	Catastrophic	High	Highest	3
Cyclone	will result in a decrease in tourism to the district such that revenues decline.	Economy	Catastrophic	High	Highest	3
Cyclone	will damage commercial buildings, contents and services, resulting in financial losses.	Economy	Catastrophic	High	Highest	3
Cyclone	will damage private buildings and contents, resulting in financial losses.	Economy	Catastrophic	High	Highest	3
Cyclone	will impact the health of people and cause death(s).	People	Catastrophic	High	Highest	3
Cyclone	will cause disruption to major freight routes, resulting in financial losses.	Economy	Catastrophic	High	High	3
Cyclone	will impact the health of people and cause ongoing health issues from water-borne diseases due to sewerage impacts.	People	Catastrophic	High	Highest	3

7 Future actions

A preliminary treatment discussion was held on 4 February 2016 in Broome with relevant agencies to review the risk assessment results and begin the conversation concerning risk tolerability and potential treatment strategies.

Appendix A: Individual hazard risk assessment summaries

This appendix contains a summary of the assessed risks for each of the hazards, separated into the five impact categories.

Bushfire

This section summarises the risk to the Kimberley EM district from the bushfire scenario. The percentage of risk statements at each risk level for the scenario is shown in Figure 14.

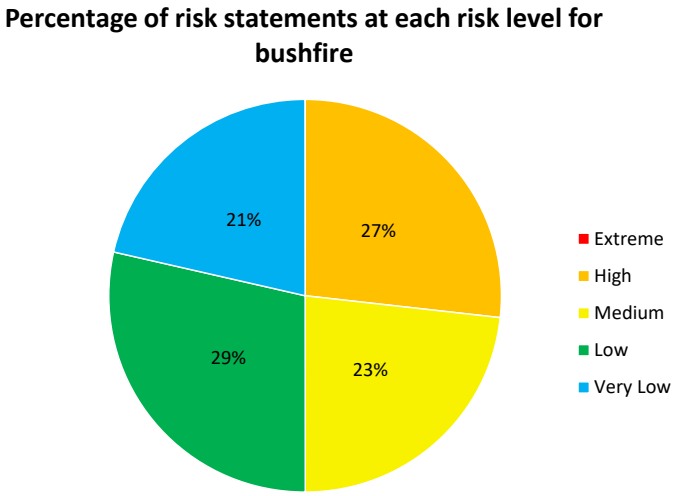
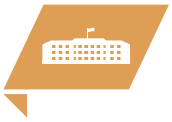


Figure 14: Percentage of risk statements at each risk level for bushfire.

Bushfire risk assessment	
ECONOMY	**Extreme risks** Nil. **High risks** Statements involved the impact to the tourism industry and aspects that support the tourism industry (e.g. caravan parks, places of interest), building damage and the costs resulting from damage to power infrastructure and recovery activities. **Medium risks** Risk statements associated with impacts to infrastructure including communications, water, sewerage systems and horticulture infrastructure were all assessed as medium risks. Livestock deaths and disruption to main road transport routes were also assessed as medium risks. **Low and Very Low risks** Nil.

Bushfire risk assessment	
PEOPLE 	**Extreme risks** Nil. **High risks** Deaths, serious injuries or illness were assessed as high risks with the potential for major consequences such that at least 4 fatalities, 4 critical injuries or 38 serious injuries would occur. Risk statements addressing the possibility of additional deaths due to non-attendance or delayed attendance to non-fire related emergencies was also assessed as a high risk, mainly due to the remoteness of the region and accessibility issues. **Medium risks** Nil. **Low risks** Nil. **Very Low risks** The possibility of additional deaths due to the overwhelming of health services (e.g. ICU units, hospitals, clinics, remote nursing posts) was assessed as a very low risk.
PUBLIC ADMINISTRATION 	**Extreme risks** Nil. **High risks** High risk statements in the public administration impact area relate to the increased demand on emergency and health services, power supply and communications affecting these agencies' ability to maintain core services. The requirement of local governments to undertake recovery works was also assessed as a high risk. **Medium risks** Statements related to the impacts to water and sewage systems were assessed as medium risks. Impacts to the ability for state agencies at a district level to maintain their core services, as well as the impact to home-based services and potential social unrest, were also medium risks. **Low risks** Statements related to the impact to natural gas supply, backlog in government services, and disruption to the resupply of essential supplies were assessed as low risks. **Very Low risks** Impacts to emergency services buildings, affecting their ability to maintain core services, and the impact to aviation services were very low risks.

Bushfire risk assessment		
SOCIAL SETTING		**Extreme and High risks** Nil. **Medium risks** The only medium risk in the social setting impact area considered the impact to community wellbeing as a result of an impact on tourism in the region, as tourism is a high earner for a number of people in the district. **Low risks** Impacts to community wellbeing as a result of damage to infrastructure and buildings (private and commercial) were assessed as low risk. In addition, the evacuation of the community, including indigenous communities, to areas away from their homes was also ranked as a low risk. **Very Low risks** Statements addressing loss of income, breakdown of support networks, loss of heritage sites (including cultural sites) and disruption to the provision of education were all assessed as very low risk.
ENVIRONMENT		**Extreme, High and Medium risks** Nil. **Low and Very Low risks** Risk statements related to the environment impact area were all assessed as low or very low risk. These statements included the impacts of the bushfires on wildlife and plants as well as the potential for pollutant runoff and the incursion of invasive weeds.

Cyclone

This section summarises the risk to the Kimberley EM district from the cyclone scenario. The percentage of risk statements at each risk level for the scenario is shown in Figure 15.

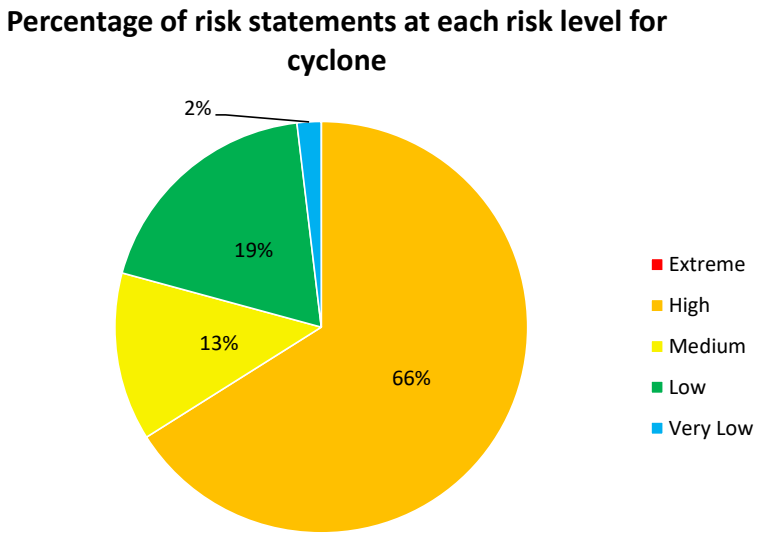
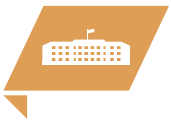


Figure 15: Percentage of risk statements at each risk level for cyclone.

Cyclone risk assessment		
ECONOMY		**Extreme risks** Nil. **High risks** Impact to private and commercial buildings and contents incurring costs presented a high risk to the district for the economy impact area. Also assessed as high risk were the impacts to infrastructure in the region such as sewerage, potable water supply and marine activities. Impacts to transport routes were considered a high economic risk both for the costs required to reconstruct and also due to the knock-on effect of disruption to major freight routes in and out of the region. In addition, high risks were identified which included impacts to the aviation sector, tourism and aspects that support the tourism industry and also the aquaculture industry, particularly pearling and fisheries which are prominent activities in the district. **Medium risks** The impacts to agricultural infrastructure resulting in financial losses were considered a medium risk, as was damage to power infrastructure and bridges and their approaches. **Low risks** The impact to communications and livestock (through death/injury) were the only low risks. **Very Low risks** Nil.
PEOPLE		**Extreme risks** Nil. **High risks** Risk statements regarding the potential for deaths and serious injury/ illness were ranked as high risks. Of concern was the impact of people with ongoing health issues from water-borne diseases due to sewerage impacts, which was considered a high risk. **Medium, Low and Very Low risks** Nil.
PUBLIC ADMINISTRATION		**Extreme risks** Nil. **High risks** All 15 of the public administration risk statements were ranked as high risks. These statements centred on statements involving an increased demand on emergency services, health services, home-based services, public facilities, government services (e.g. Centrelink) and disruption to staff working with Aboriginal communities. Risk statements regarding damage and disruption to infrastructure (transport, communication, power, water supply, aviation and marine) were ranked as high risk and will require response and recovery activities by local government and state agencies at a district level, impacting their ability to maintain their core services. **Medium, Low and Very Low risks** Nil.

Cyclone risk assessment		
SOCIAL SETTING		**Extreme risks** Nil. **High risks** Risk statements regarding the impact on community wellbeing due to building (private and commercial) damage, deaths, injuries and supply disruption of commercial products were all ranked as high risks. Displacement and evacuation of people away from their homes and impacts to the day-to-day functionality of facilities for vulnerable people (elderly, disabled, childcare) were also assessed as high risks. **Medium risks** Medium risk statements concerned the displacement and evacuation of indigenous groups to places with families not aligned to their culture, reduced functionality of educational facilities and reduction of income. **Low risks** The displacement/injury of animals, decreases in tourism, impacts to community buildings and isolation of towns in the district affecting the community wellbeing were ranked as low risks. **Very Low risks** Nil.
ENVIRONMENT		**Extreme risks** Nil. **High risks** Ocean surges and wave activity resulting in marine inundation and erosion of sandy coastlines/dune systems was the only high risk identified for the environment. **Medium risks** Nil. **Low risks** All remaining statements concerning the health of wildlife and flora in the district, spread of airborne salt and pollutant runoff were assessed as low risks. **Very Low risks** Soil erosion was assessed as a very low risk.

Flood

This section summarises the risk to the Kimberley from the flood scenario. The percentage of risk statements at each risk level for the scenario is shown in Figure 16.

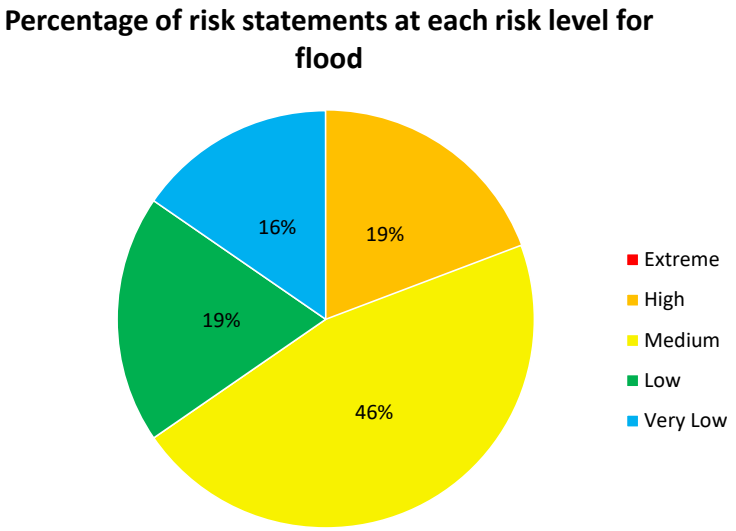
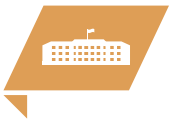


Figure 16: Percentage of risk statements at each risk level for flood.

Flood risk assessment	
ECONOMY	**Extreme risks** Nil. **High risks** Impact to private and commercial buildings and contents, incurring costs presented a high risk to the district. Also assessed as high risk were the impacts to infrastructure in the region, including infrastructure associated with communications, sewerage and potable water supply. Impacts to transport routes (including bridges) were considered a high economic risk, both for the costs required to reconstruct and also due to the knock-on effect of disruption to major freight routes in and out of the region. In addition, damage to horticulture and agriculture infrastructure were assessed as high risks. **Medium risks** Impacts to power infrastructure, the aviation sector and livestock (through death/injury) were considered medium risk. The risk to aspects that support the tourism industry (e.g. caravan parks, campsites, motels, places of interest) was also considered medium risk. **Low risks** A resultant decline in tourism was considered low risk, as it was suggested that they would have enough time to recover before the next tourism season. Damage to communication infrastructure was also considered low risk. **Very Low risks** Nil.

Flood risk assessment	
PEOPLE 	**Extreme risks** Nil. **High risks** A high risk in the people impact area was the potential impact to the health of remote Aboriginal communities. **Medium risks** Statements discussing the potential for serious injury/illness, including the impact to health of people due to stagnant water and waterborne diseases, were ranked as a medium risk with illnesses being exacerbated by the isolation. **Low risks** Nil. **Very Low risks** Death to persons was considered a very low risk.
PUBLIC ADMINISTRATION 	**Extreme risks** Nil. **High risks** The only high risk to public administration is from the impact to sewerage systems and the ability to maintain sewage services due to the inundation of pump stations and increased demand at treatment plants. **Medium risks** Medium risks are centred on statements involving the increased demand on emergency services, health services and public facilities. Response and recovery activities required by local government and state agencies at a district level, impacting their ability to maintain their core services were also considered medium risk, as was the impact to power and water supply infrastructure, reducing available services. In addition, disruption to services including home-based services, government services (e.g. Centrelink, court systems) and to staff of remote Aboriginal community corporations was considered medium risk. **Low risks** All remaining public administration statements which concern disruption to transportation, communications and aviation were considered low risk. **Very Low risks** Nil.

Flood risk assessment		
SOCIAL SETTING		**Extreme and High risks** Nil. **Medium risks** Medium risk statements for social setting addressed the impact to the health of residents, isolation of remote communities, evacuation of people away from their homes and evacuation of indigenous groups to places with families not aligned to their culture. In addition, damage to the road network, resulting in a lack of availability of essential goods and services, as well as resupply efforts required for remote communities, were considered medium risk. **Low risks** Low risks to community wellbeing concerned damage to residential and commercial buildings and contents and the impact to existing social service providers (Lions, Rotary, Salvation Army, Red Cross). **Very Low risks** Displacement of animals, reduction of day-to-day function of educational facilities and the loss of income were ranked as very low risks.
ENVIRONMENT		**Extreme, High and Medium risks** Nil. **Low risks** The potential for debris and pollutants to flow into marine, riverine and estuarine environments, causing contamination was considered low risk. **Very Low risks** All remaining statements concerning the health of wildlife and flora in the district and soil erosion were considered very low risk.

Human epidemic

This section summarises the risk to the Kimberley EM district from the human epidemic scenario. The percentage of risk statements at each risk level for the scenario is shown in Figure 17.

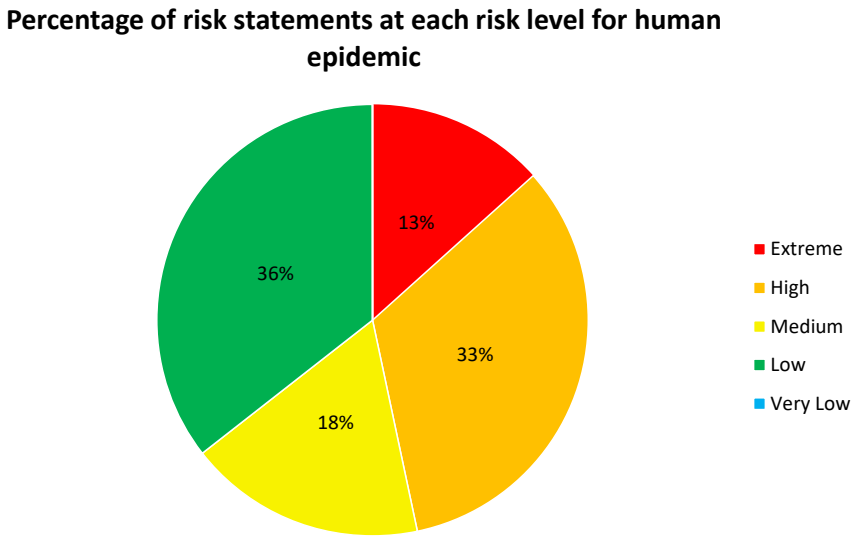


Figure 17: Percentage of risk statements at each risk level for human epidemic.

Human epidemic risk assessment	
ECONOMY	**Extreme risks** There was one extreme risk statement in the economy impact area; this relates to impacts to the workforce attendance leading to a loss of productivity and subsequent financial losses. **High risks** The remaining seven economy risk statements are all categorised as high risk. These relate to the impact on major events (entertainment), decrease in tourism and reduction of commercial spending; all leading to financial losses. Other aspects causing financial losses for the district are an increased demand on medical resources, disruption to small business and a reduction in mining due to transport issues or illness of fly-in fly-out workers. **Medium, Low and Very Low risks** Nil.
PEOPLE	**Extreme risks** There were four people risk statements which were ranked as extreme risks. These statements concern the human epidemic impacting the health of people causing death, injury/illness, impacting remote health services leading to subsequent deaths/illness and impacting people with other medical conditions due to increased demand placed on health services. **High risks** Impacts to emergency services (e.g. Royal Flying Doctor Service) across the district resulting in additional deaths/illness were ranked as a high risk. **Medium, Low and Very Low risks** Nil.

Human epidemic risk assessment

PUBLIC ADMINISTRATION

Extreme risks

There was one extreme risk statement in the public administration impact area which relates to the impact on health services affecting their service delivery.

High risks

High public administration risks concern the impact to health service suppliers, educational services and medical transportation (ambulance and RFDS).

Medium risks

Seven public administration risk statements were classified as medium risks. These include impacts to workforce attendance (government, WA Police, prisons), pathological services, government service provision (disability services, licensing), emergency services (excluding ambulances) and performance of agencies involved in issuing public information.

Low risks

The impact to private general practice (GP) services and to Centrelink services were ranked as low risks.

Very Low risks

Nil.

SOCIAL SETTING

Extreme risks

Nil.

High risks

The impact on community wellbeing due to deaths and injuries/illnesses was ranked as a high risk. Other high risks were impacts to community activities (e.g. sports, clubs) and impacts to the social cohesion due to cultural dimensions.

Medium risks

One risk statement was classified as a medium risk and concerned the impact to social service providers (e.g. Salvation Army, Lions and other volunteer organisations).

Low risks

The remaining 14 social setting risk statements were ranked as low risks. These statements include impacts to the workforce attendance, reluctance to go to places (e.g. visit places of worship, visit public places, attend work), the supply chain of basic needs, isolation of people in their homes or quarantine facilities and a breakdown of community social networks.

Very Low

Nil.

ENVIRONMENT

There were no environment risk statements assessed as it is unlikely that human epidemic would directly impact the environment.

Road crash

This section summarises the risk to the Kimberley EM district from the road crash scenario. The percentage of risk statements at each risk level for the scenario is shown in Figure 18.

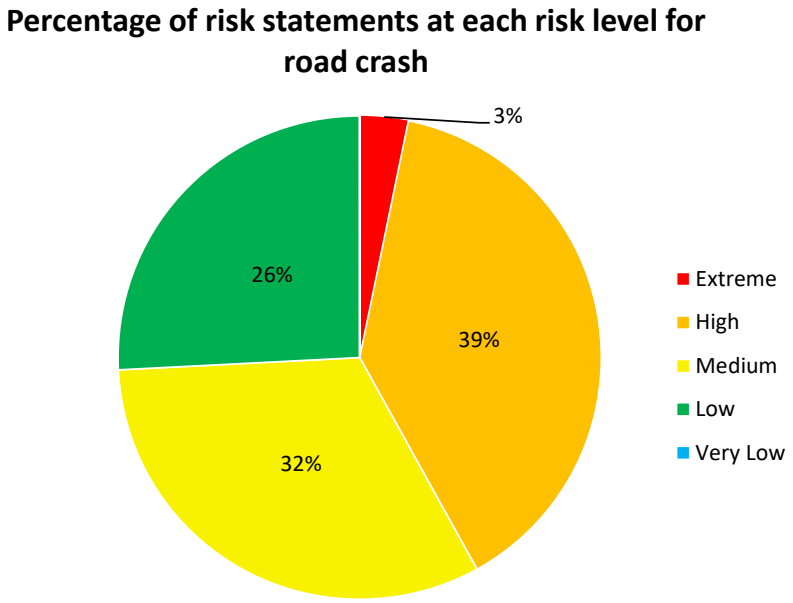
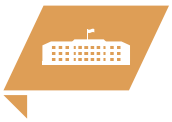


Figure 18: Percentage of risk statements at each risk level for road crash.

Road crash risk assessment	
ECONOMY	**Extreme risks** Nil. **High risks** Damage to the road bridge, incurring costs to the district, disruption to major freight routes, impacts to livestock movements and a decrease in the number of tourists travelling in the district, were all ranked as high risks. **Medium risks** Medium risks to the economy include impacts to the mobility of workers who used the road, impacts to the aviation services due to reduction in fuel deliveries which will initiate emergency response services incurring costs to the district. **Low risks** The only low risk was from reputational damage to the district, resulting in financial losses. **Very Low risks** Nil.

Road crash risk assessment		
PEOPLE		**Extreme risks** Impacts to the health of people causing deaths is categorised as an extreme risk with catastrophic consequences, such that there are at least four deaths. This is the only extreme risk for the road crash scenario. **High risks** Impacts to the health of people causing injuries and/or serious illnesses, and impacts to medical transport services resulting in death/injuries directly attributed to the road crash, were ranked as high risks. **Medium risks** Nil. **Low risks** The only low risk was related to the impact on remote health services resulting in deaths/injuries directly attributed to the road crash. **Very Low risks** Nil.
PUBLIC ADMINISTRATION		**Extreme risks** Nil. **High risks** Response works undertaken by state agencies at a district level affecting their core services and increased demand on emergency services and health services (including remote nursing posts and smaller hospitals), were all ranked as high risks. Interdependencies between different agencies and services were highlighted in two risk statements where impacts to power infrastructure were caused by a lack of fuel supply and the damage to the road network prevents/delays emergency services providing assistance. These two risk statements were also ranked as high risks. **Medium risks** Nil. **Low risks** The remoteness of the event may affect the ability for agencies to manage and respond; however, this was ranked as a low risk. Impacts to staff of remote Aboriginal communities impacting their ability to provide support, and impacts to the aviation sector due to fuel supply issues, were also categorised as low risks. **Very Low risks** Nil.

Road crash risk assessment		
SOCIAL SETTING		**High risks** The only high risk in the social setting was related to the isolation of towns in the district, affecting their ability to function as a district community. **Medium risks** Loss of income, limited availability of commercial products, isolation of Aboriginal communities and the decline in tourism in the district were all ranked as medium risks. **Low risks** Two risk statements concerning the impact of day-to-day functionality of facilities for vulnerable people (aged care, childcare) and the resulting psychological and emotional stress for victims/emergency personnel were assessed as low risk. **Very Low risks** Nil.
ENVIRONMENT		**Extreme and High risks** Nil. **Medium risks** Two environment risk statements, concerning contamination of the river and ecosystem by pollutants and the impact of the health of wildlife, were classified as medium risks. **Low risks** Impacts to the flora in the area were ranked as a low risk. **Very Low risks** Nil.

Appendix B: District profile

The Kimberley district (Figure 19) is a remote and sparsely populated area with extensive pristine areas covering 424,517 km^2. The Kimberley has a sub-tropical climate characterised by a dry and a wet season.

The population is approximately 37,673 and is culturally rich with approximately half being Aboriginal, representing at least 60 different language groups. The Shires of Broome, Halls Creek, Derby-West Kimberley and Wyndham-East Kimberley are the four local governments that operate within the district.

The district economy is diverse and includes: tourism, agriculture (pastoral), fishing (aquaculture), mining, energy, construction and retail. The gross regional product is approximately $3.255 billion annually.

The Kimberley experiences a diverse range of events throughout the region from both man-made and natural hazards. Priority hazards (as identified by the Kimberley DEMC) are: bushfire, cyclone, flood, human epidemic and road crash.

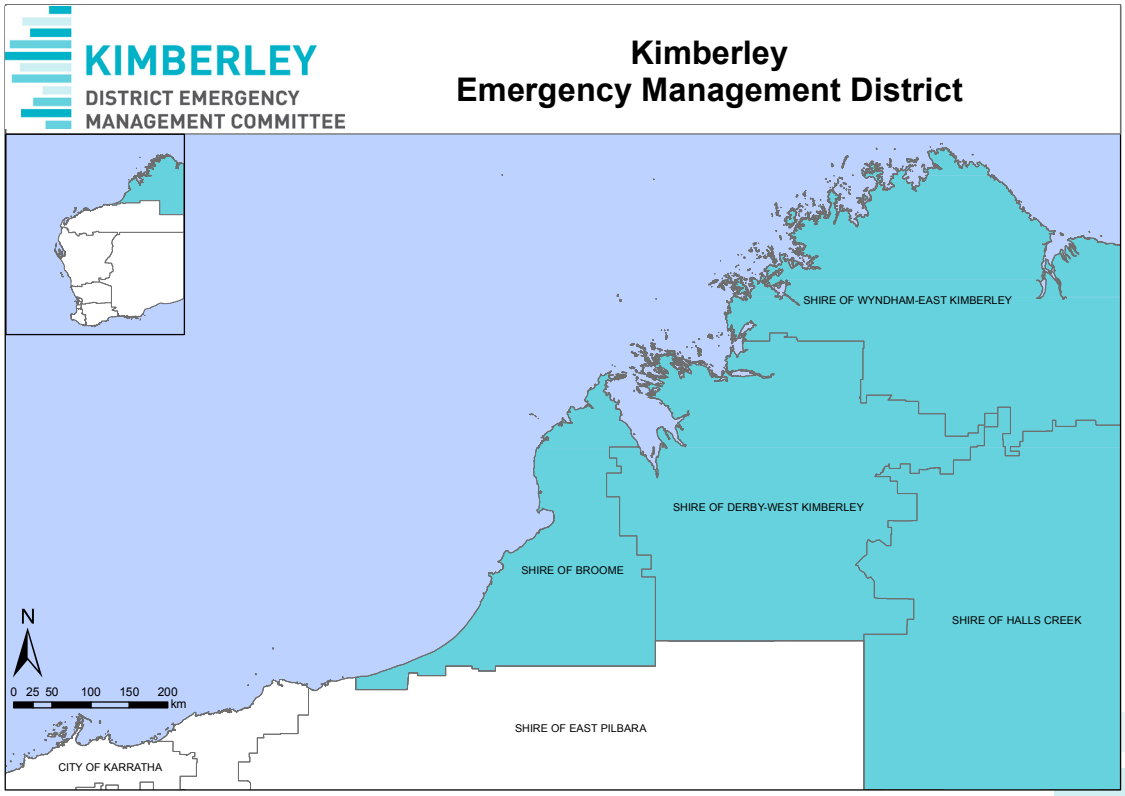


Figure 19: Kimberley EM district map.

Appendix C: Kimberley EM district consequence table

(based on population: 37,673; gross area product: $3.255 billion)

	Insignificant	Minor	Moderate	Major	Catastrophic
People*					
Mortality	Not Applicable.	At least 1 death.	At least 1 death.	At least 1 death.	At least 4 deaths.
Injuries / Illness	1 serious injury or any minor injuries.	1 person critically injured with long-term or permanent incapacitation or 1 person seriously injured.	1 person critically injured with long-term or permanent incapacitation or 1 person seriously injured.	1 person critically injured with long-term or permanent incapacitation or more than 4 serious injuries.	More than 4 critical injuries with long-term or permanent incapacitation or more than 38 serious injuries.
Economy					
Loss in economic activity and/or asset value	Decline of economic activity and/or loss of asset value less than $130,200.	Decline of economic activity and/or loss of asset value between $130,200 and $1,302,000	Decline of economic activity and/or loss of asset value between $1,302,000 and $13,020,000	Decline of economic activity and/or loss of asset value between $13,020,000 and $130,200,000.	Decline of economic activity and/or loss of asset value greater than $130,200,000.
Impact on important industry	Inconsequential business sector disruption.	Significant industry or business sector is impacted by the emergency event, resulting in short-term (i.e. less than one year) profit reductions.	Significant industry or business sector is significantly impacted by the emergency event, resulting in medium-term (i.e. more than one year) profit reductions.	Significant structural adjustment required by identified industry to respond and recover from emergency event.	Failure of a significant industry or sector.
Environment					
Loss of species and/or landscapes	No damage to ecosystems at any level.	Significant loss or impairment of an ecosystem or species recognised at the local and regional levels. and/or Minor damage to ecosystems and species recognised at the state, local or regional level	Minor damage to ecosystems and species recognised at the national level. and/or Significant loss or impairment of an ecosystem or species recognised at the state level and/or Severe damage to or loss of ecosystems and species recognised at the local/regional level.	Permanent destruction of an ecosystem or species recognised at the local/regional level. and/or Severe damage to or loss of an ecosystem or species recognised at the state level. and/or Significant loss or impairment of an ecosystem or species recognised at the national level.	Permanent destruction of an ecosystem or species recognised at the national or state level. and/or Severe damage to or loss of an ecosystem or species recognised at the national level.
Loss of environmental value	Inconsequential damage to environmental values of interest.	Minor damage to environmental values of interest.	Significant damage to environmental values of interest.	Severe damage to environmental values of interest.	Permanent destruction of environmental values of interest.
Public Administration					
Governance Functions	Governing bodies' delivery of core functions is unaffected or within normal parameters.	Governing bodies encounter limited reduction in delivery of core functions.	Governing bodies encounter significant reduction in the delivery of core functions. and/or Governing bodies are required to divert some available resources to deliver core functions or seek external assistance to deliver some of their core functions.	Governing bodies encounter severe reduction in the delivery of core functions. and/or Governing bodies are required to divert a significant amount of available resources to deliver core functions or seek external assistance to deliver the majority of their core functions.	Governing bodies are unable to deliver their core functions.
Social Setting					
Community wellbeing	• Community social fabric is disrupted • Existing resources sufficient to return the community to normal function • No permanent dispersal.	• Community social fabric is damaged • Some external resources required to return the community to normal function • No permanent dispersal.	• Community social fabric is broken • Significant external resources required to return the community to normal function • Some permanent dispersal.	• Community social fabric is significantly broken • Extraordinary external resources are required to return the community to functioning effectively • Significant permanent dispersal.	• Community social fabric is irreparably broken • Community ceases to function effectively, breaks down • Community disperses in its entirety
Community Services	Inconsequential / short term impacts.	Isolated / temporary reductions.	Ongoing reductions.	Reduced quality of life.	Community unable to support itself.
Culturally important objects	Minor damage to objects of cultural significance.	Damage to objects of identified cultural significance.	Damage or localised widespread damage to objects of identified cultural significance.	Widespread damage or localised permanent loss of objects of identified cultural significance.	Widespread and permanent loss of objects of identified cultural significance.
Culturally important activities	Minor delay to a culturally important community event.	Delay to or reduced scope of a culturally important community event.	Delay to a major culturally important community event.	Temporary cancellation or significant delay to a major culturally important community event.	Permanent cancellation of a major culturally important community activity.

*Criteria for people have been rounded up to the nearest whole person.

Appendix D: Glossary and risk matrix

Annual Exceedance Probability (AEP)	The probability of an emergency event of a given size or larger occurring in any given year, expressed as a percentage.
AS/NZS ISO 31000:2009	International standard for risk management which forms the basis of the Emergency Risk Management process.
Consequence	Impact(s) of an event on the five key areas: environment, economy, people, social setting and public administration.
Emergency	The occurrence or imminent occurrence of a hazard which is of such a nature or magnitude that it requires a significant and coordinated response.
Emergency Risk Management (ERM)	A systematic process which contributes to the wellbeing of communities and the environment. The process considers the likely effects of hazardous events and the controls by which they can be minimised.
Hazard	Source of potential harm or a situation with a potential to cause loss.
Impact	To have a noticeable or marked effect on.
Level of risk (risk level)	Magnitude of a risk or a combination of risks, expressed in terms of the combination of consequences and their likelihood.
Likelihood	Chance of something happening. It is used as a general descriptor of probability and may be expressed qualitatively or quantitatively.
Recovery	The support of emergency affected communities in the reconstruction and restoration of physical infrastructure, the environment and community, psychological and economic wellbeing.
Response	The combatting of the effects of an emergency, provision of emergency assistance for casualties, reduction of further damage, and help to speed recovery.
Risk	The combination of the probability of an event and its negative consequences.

The matrix[5] below calculates risk levels based on the consequence and likelihood levels assigned to a risk statement. Please note the likelihood of a statement in this report is determined by multiplying the scenario probability (AEP) by the probability of the risk statement occurring (as determined in workshops).

	Consequence level				
Likelihood	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost Certain (63% per year or more)	Medium	Medium	High	Extreme	Extreme
Likely (10% to <63% per year)	Low	Medium	High	Extreme	Extreme
Unlikely (1% to <10% per year)	Low	Low	Medium	High	Extreme
Rare (0.1% to <1% per year)	Very low	Low	Medium	High	High
Very Rare (0.01% to <0.1% per year)	Very low	Very low	Low	Medium	High
Extremely rare (<0.01% per year)	Very low	Very low	Low	Medium	High

[5] from the *National Emergency Risk Assessment Guidelines* (2015) Australian Government Attorney-General's Department

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State Risk Project

An Australian Government Initiative