

# COMMUNITY SURVEY RESULTS SUMMARY REPORT

SEPTEMBER 2015

Townsville Floodplain Management



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# TOWNSVILLE FLOODPLAIN MANAGEMENT STRATEGY COMMUNITY SURVEY

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## **Executive Summary**

A community survey has been conducted as part of the Townsville Floodplain Management Strategy (FMS) to understand community views relevant in guiding the development of the FMS which has:

- determined the community's acceptance of types of floodplain management measures;
- understood the communities resilience to flooding risks; and
- guided weighting of criteria likely to be used for evaluating flood mitigation projects.

The survey was open from early November 2014 to late January 2015 and was accessible online through council's website. Several display stall sessions were conducted to increase participation. A total of 146 responses were received for the survey.

Based on the survey responses about types of floodplain management measures, the floodplain management measures were broken into 3 tiers based on the likely level of support associated with implementing. **Table EX1** outlines the delineation of floodplain management measures.

Tier	Floodplain Management Measures	Description	Implementation Needs
Tier 1	Gradual improvements with replacement of aged infrastructure; Identifying safe evacuation centres; Land use planning to respond to flooding; Flood improvement works incorporated into parkland; and Temporary property protection measures.	Business as usual	Consultation and technical rigour may be required on a case by case basis
Tier 2	Dredging natural watercourses for improved floodwater flow efficiency; Raising existing houses; Changing existing buildings to use waterproof materials; and Buy-back of flood affected properties.	Generally supported	Require rigour in both consultation and technical assessment
Tier 3	Flood improvement works at the expense of natural areas; and Flood improvement works at the expense of private properties.	Controversial	Significant rigour in both consultation and technical assessment if implemented

The survey responses on flooding risk were used to identify a basis for assigning flood risks as acceptable, tolerable or unacceptable. The results were further refined on the basis of workshops with project stakeholders. These results are provided in **Table EX2**.

Flood Risk	Acceptable	Tolerable	Unacceptable
Residential land inundated by flooding			
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood			
Residential buildings inundated by flooding			
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood		#	
Commercial/Industrial land inundated by flooding	1	- I	
5% AEP Flood			#
1 % AEP Flood			
0.2% AEP Flood	#		
Commercial/Industrial buildings inundated by flooding			•
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood		#	
Interruption of water supply due to flooding			
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood		#	
Overflow of sewers due to flooding			
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood			#
Inundation of major roads			
5% AEP Flood			
1 % AEP Flood		#	
0.2% AEP Flood	#		
Emergency Services inundated by flooding			
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood			
Hospitals inundated by flooding	1	1	
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood			
Secondary health facilities inundated by flooding	I		
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood			#

#### Table EX2 – Flood Risk Classifications based on Survey Results

# adopted value/most frequent response but not a clear majority

Guidance on the weighting of the following criteria likely to be used in a Multi–Criteria Analysis for evaluating flood mitigation works was sought:

- Life cycle cost (Impact on Rates) The cost to design, construct, implement, operate, maintain and decommission the flood management measure which will have a direct impact on rates;
- **Impact on natural ecosystem** The impact the flood management measure has on environmental values such as water quality, habitat and biodiversity;
- Flexibility to upgrade design The ability to respond to future requirements such as larger floods, impacts of climate change or storm surge;
- Severity of inundation The combination of depth, velocity and frequency of flooding that remains following the implementation of the flood management measure; and
- Impact on urban amenity The impact the flood management measure has on the urban environment in terms of things like changes to public spaces, changes in road connectivity or changes in adjacent land-uses.

There were no conclusive variations in weightings for evaluation criteria that could be taken from the survey responses. Equal weighting across the evaluation criteria is most reflective of the survey responses.

In addition to the targeted survey questions to directly inform the FMS methodology, respondents were offered the opportunity to provide general comments on floodplain management in Townsville. There were some general themes that could be taken from the individual comments:

- Litter and clearing of drains contributes to issues and management to reduce these issues should continue;
- As much as possible should be done to ensure accuracy of data especially for the purpose of reducing insurance premiums;
- Concern around the location of new and historical development within the floodplain; and
- Inappropriate to have a general rates increase to cover the cost of rectifying specific areas.



FMS Floodplain Management Strategy

## 1.0 Overview

### 1.1 Purpose

A community survey has been conducted as part of the Townsville Floodplain Management Strategy (FMS) to understand community views relevant in guiding the development of the FMS. In particular the survey has sought:

- an appreciation of the community's acceptance of types of floodplain management measures;
- an understanding of the communities resilience to flooding risks; and
- guidance towards weighting of criteria likely to be used for evaluating flood mitigation projects.

### 1.2 Conducting the Survey

The survey was conducted via an online form-site page on council's website as well as series of stall displays during the period the survey was open. The survey opened November 2<sup>nd</sup>, 2014 and closed on the 25<sup>th</sup> of January, 2015. The stall displays were:

- November 2<sup>nd</sup> at council's Cyclone Sunday event;
- January 15<sup>th</sup> at Stockland Shopping Centre;
- January 16<sup>th</sup> at Stockland Shopping Centre;
- January 21<sup>st</sup> at Willows Shopping Centre; and
- January 22<sup>nd</sup> at Willows Shopping Centre.

The display stalls were generally staffed by a customer service officer and a project engineer. The stalls included iPads to allow respondents to complete the survey directly into the online data base, as well as information sheets about the online flood mapping service and the floor level survey project. Respondents completing the survey on the day at the stalls went into the draw for a \$100 shopping voucher. The stall setup is shown in **Figure 1**.



Figure 1 – Display stall set-up Willows Shopping Centre

## 1.3 Survey Response

The paper-based version of the survey input form is provided in **Appendix A**.

A total of 146 responses were received from the survey. Of the respondents, 113 identified as owning their own home, 29 identified as renting and 10 did not provide an indication of their home ownership status. The respondents were spread across Townsville suburbs as outlined in **Table 1**.

#### Table 1 – Respondents by Suburb

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Suburb	Respondents	Suburb	Respondents
Aitkenvale	8	Julago	1
Alice River	3	Kelso	12
Alligator Creek	1	Kirwan	21
Annandale	8	Mount Louisa	6
Belgian Gardens	2	Mount Low	3
Black River	2	Mundingburra	2
Bohle	1	Mysterton	1
Bohle Plains	1	North Ward	2
Burdell	6	Oak Valley	1
Bushland Beach	2	Pallarenda	1
Condon	3	Pimlico	3
Cranbrook	5	Railway Estate	2
Cunguna		hasinassen	
Currajong	2	Rosslea	2
Deeragun	1	Saunders Beach	1
Douglas	1	Shaw	1
Garbutt	3	South Townsville	1
Gulliver	4	Thuringowa Central	4
Heatley	1	West End	1
Hermit Park	9	Wulguru	4
Hermit Park	9	Not answered	3
Idalia	5		

## 2.0 Floodplain Management Measures

## 2.1 Survey Input

Question 3 of the survey asks respondents to provide yes or no answers to whether they find particular floodplain management measures acceptable for existing risk on the Townsville floodplain. The floodplain measures were:

- land use planning to respond to flooding (i.e. retaining natural low lying areas for floodplain, and creating density on higher ground to accommodate growth);
- buy-back of flood affected properties;
- flood improvement works at the expense of natural areas;
- flood improvement works incorporated into parkland;
- flood improvement works at the expense of private properties;
- dredging natural watercourses for improved floodwater flow efficiency;
- raising existing houses (only possible with stump houses);
- changing existing buildings to use waterproof materials;
- temporary property protection measures (e.g. sand-bagging);
- identifying safe evacuation centres; and
- gradual improvements with replacement of aged infrastructure.

#### 2.2 Results

Results are provided overleaf in Figure 2 as a bar chart.



Figure 2 – Survey Response: Acceptable Floodplain Management Measures

### 2.3 Discussion

Floodplain management measures that had more negative responses than positive were:

- flood improvement works at the expense of natural areas; and
- flood improvement works at the expense of private properties.

These measures are likely to be highly controversial and will require significant rigour in both consultation and technical assessment if implemented.

Floodplain management measures that had over 80% positive response were:

- gradual improvements with replacement of aged infrastructure;
- identifying safe evacuation centres;
- land use planning to respond to flooding;
- flood improvement works incorporated into parkland; and
- temporary property protection measures.

These measures are essentially "business as usual" for existing floodplain management in Townsville and are widely supported. While far less controversial than flood improvement works at the expense of private properties or natural areas, consultation and technical rigour will be required where appropriate.

Floodplain management measures that had net positive responses, however with a significant proportion (>20%) of negative responses in increasing order of negative responses are:

- dredging natural watercourses for improved floodwater flow efficiency;
- raising existing houses;
- changing existing buildings to use waterproof materials; and
- buy-back of flood affected properties.

These measures have general positive support but are likely to be controversial in implementing. They will require rigour in both consultation and technical assessment in implementation.

## 2.4 Recommendations

It is recommended that floodplain management measures are categorised into Tiers as outlined in **Table 2**.

Tier	Floodplain Management Measures	Description	Implementation Needs
Tier 1	Gradual improvements with replacement of aged infrastructure; Identifying safe evacuation centres; Land use planning to respond to flooding; Flood improvement works incorporated into parkland; and Temporary property protection measures*.	Business as usual	Consultation and technical rigour may be required on a case by case basis
Tier 2	Dredging natural watercourses for improved floodwater flow efficiency; Raising existing houses*; Changing existing buildings to use waterproof materials*; and Buy-back of flood affected properties.	Generally supported	Require rigour in both consultation and technical assessment
Tier 3	Flood improvement works at the expense of natural areas; and Flood improvement works at the expense of private properties.	Controversial	Significant rigour in both consultation and technical assessment if implemented

Table 2 - Floodplain Management Measure Tiers

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\*to be carried out by the owner of the house.

## 3.0 Resilience to Flooding Risks

### 3.1 Survey Input

Question 4 of the survey asks respondents to identify whether particular flood risks are acceptable, tolerable or unacceptable. These classifications were defined as:

- Acceptable Risk a flood risk that can be lived with;
- Tolerable Risk a flood risk that can be lived with but it can be cost-effectively reduced, should be; and
- Unacceptable Risk individuals and society will not accept this flood risk and measures must be undertaken to reduce risks to at least a tolerable level.

Remembering that risk is the product of probability and consequence, the risks were proposed to respondents used the following series of probabilities:

- High likelihood 5% annual chance;
- Medium likelihood 1% annual chance; and
- Low likelihood 0.2% annual chance.

The series of consequences that respondents were asked to consider were:

- residential land being inundated;
- residential buildings being inundated;
- commercial/industrial land being inundated;
- commercial/industrial buildings being inundated;
- interruption of water supply due to flooding;
- overflows of sewer due to flooding;
- major roads being inundated;
- emergency services being inundated;
- hospitals being inundated; and
- secondary health facilities being inundated.

#### 3.2 Results

Results are provided in Figures 3 to 12.

Figure 3 - Survey Response: Flood risk classification for inundation of residential land



Figure 4 - Survey Response: Flood risk classification for inundation of residential buildings





Figure 5 - Survey Response: Flood risk classification for inundation of commercial/industrial land

Figure 6 - Survey Response: Flood risk classification for inundation of commercial/industrial buildings





Figure 7 - Survey Response: Flood risk classification for interruption of water supply due to flooding

Figure 8 - Survey Response: Flood risk classification overflow of the sewer due to flooding





Figure 9 - Survey Response: Flood risk classification for inundation of major roads

Figure 10 - Survey Response: Flood risk classification for inundation of emergency services





Figure 11 - Survey Response: Flood risk classification for inundation of hospitals

Figure 11 - Survey Response: Flood risk classification for inundation of secondary health facilities



### 3.3 Discussion

#### Residential Areas (Figures 3 and 4)

The responses of the classification of flood risk relating to residential land and buildings follows the flood immunity objectives sought through the Townsville City Plan in that:

- Inundation of land is unacceptable in the 5% AEP flood, tolerable in the 1% AEP and acceptable in the 0.2% AEP flood; and
- Inundation of buildings is unacceptable up to the 1% AEP flood.

The responses around inundation of residential buildings in the 0.2% AEP are inconclusive. While the single largest classification for this flood risk is acceptable, the sum of the tolerable and unacceptable classification responses far exceeds the number of number of classifications as acceptable. If a single classification had to be chosen on the basis of these results it would probably be tolerable.

#### Commercial Areas (Figures 5 and 6)

The responses of the classification of flood risk relating to commercial/industrial land and buildings are less conclusive than the classifications of residential areas. In particular:

- there is no clear majority for the classification of land being inundated in the 5% AEP flood (unacceptable was the most frequent classification);
- there is no clear majority for the classification of land being inundated in the 0.2% AEP flood (acceptable was the most frequent classification); and
- there is no clear majority for the classification of buildings being inundated in the 0.2% AEP flood (tolerable was the most frequent classification);

Based on the responses, the following classifications are conclusive:

- floors inundated in the 5% AEP flood is unacceptable; and
- land inundated in the 1% AEP flood is tolerable.

#### Interruption to water supply (Figure 7)

Response on the interruption to water supply due to flooding were conclusive in that a majority of respondents classify it as unacceptable for the supply to be interrupted up to the 1% AEP flood. The results on the 0.2% flood had marginally more respondents classifying it unacceptable than other classifications.

Having the water supply uninterrupted up to the 1% AEP flood is consistent with current design guidelines used by council for flood immunity of water reticulation infrastructure. The requirement in the Townsville City Plan for flood immunity of Water Treatment Plants is 0.5% AEP.

#### **Overflow of Sewer Systems (Figure 8)**

Response on the overflow of sewers due to flooding where conclusive in that a majority of respondents classify it as unacceptable for overflows up to the 1% AEP flood. The results on the 0.2% AEP flood had more respondents classifying it unacceptable than other classifications. Subsequent review of the survey by project team suggested that the definition of the flood risk relating to sewer overflows was not clear. Overflow of sewers into buildings is worse than the overflows into streets or open drains though the survey made no distinction between the two. It is suggested that the results of this question be treated with caution given this limitation.

Preventing the sewer from overflowing up to the 1% AEP flood is consistent with current design guidelines used by council for flood immunity of sewer reticulation infrastructure. In older areas of the city, the frequency of sewer overflows exceeds the design guidelines or the expectations of the survey respondents.

#### Major Roads (Figure 9)

The only conclusive outcome from the responses on the flood risk for major roads is that inundation of major roads in the 5% AEP flood is unacceptable. Inundation of major roads in the 1% and 0.2% AEP floods has tolerable and acceptable marginally ahead respectively.

The responses are aligned with the Townsville City Plan which calls for 2% AEP flood immunity of roads with a hierarchy equal to or higher than major collector.

#### **Emergency Services (Figure 10)**

Responses on emergency services were conclusive that emergency services should be free from flooding up to the 0.2% AEP flood. This is consistent with the requirement under the Townsville City Plan for immunity up to the 0.2% AEP flood.

#### Hospitals (Figure 11)

Responses on hospitals were conclusive that hospitals should be free from flooding up to the 0.2% AEP flood. This is consistent with the requirement under the Townsville City Plan for immunity up to the 0.2% AEP flood.

#### Secondary Health Facilities (Figure 12)

Responses on secondary health facilities were conclusive that these facilities should be free from flooding up to the 1% AEP flood. The results on the 0.2% AEP flood had more respondents classifying it unacceptable than other classifications.

The responses are aligned with the Townsville City Plan which calls for 1% AEP flood immunity of building floor levels.

## 3.4 Recommendations

The flood risk classifications obtained from the community survey outline in **Table 3**. These flood risk classification should be considered by the project stakeholders in adopting a flood risk classification criteria for the project.

Flood Risk	Acceptable	Tolerable	Unacceptable
Residential land inundated by flooding	I		
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood			
Residential buildings inundated by flooding			
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood		#	
Commercial/Industrial land inundated by flooding	I		
5% AEP Flood			#
1 % AEP Flood			
0.2% AEP Flood	#		
Commercial/Industrial buildings inundated by flooding			
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood		#	
Interruption of water supply due to flooding	1		
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood		#	
Overflow of sewers due to flooding	L		•
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood			#
Inundation of major roads			
5% AEP Flood			
1 % AEP Flood		#	
0.2% AEP Flood	#		
Emergency Services inundated by flooding		-	·
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood			
Hospitals inundated by flooding			
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood			
Secondary health facilities inundated by flooding			
5% AEP Flood			
1 % AEP Flood			
0.2% AEP Flood			#

Table 3 – Flood Risk	Classifications	based on	Survey	Results
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# adopted value/most frequent response but not a clear majority

## 4.0 Evaluation Criteria Weighting

## 4.1 Survey Input

Question 5 of the survey asks respondents to assess the importance of criteria likely to be used in a Multi–Criteria Analysis of any flood mitigation works from the project. The criteria assessed were:

- Life cycle cost (Impact on Rates) The cost to design, construct, implement, operate, maintain and decommission the flood management measure which will have a direct impact on rates;
- **Impact on natural ecosystem** The impact the flood management measure has on environmental values such as water quality, habitat and biodiversity;
- Flexibility to upgrade design The ability to respond to future requirements such as larger floods, impacts of climate change or storm surge;
- Severity of inundation The combination of depth, velocity and frequency of flooding that remains following the implementation of the flood management measure; and
- Impact on urban amenity The impact the flood management measure has on the urban environment in terms of things like changes to public spaces, changes in road connectivity or changes in adjacent land-uses.

Respondents were asked to identify which was more important of a subset pair of the above issues or whether they were equally important. The process was repeated for all combinations of sub-set pairs.

#### 4.2 Results

The survey results of the pairwise comparison of evaluation criteria are provided in **Tables 4 to 13**.

Pair 1		
Impact on Rates	37	
Impact on natural ecosystem	30	
Equally important	72	
Blank	7	

Table 4 – Survey Response: Pairwise comparison – Impact on Rates and Impact on Natural Ecosystem

#### Table 5 - Survey Response: Pairwise comparison - Impact on Rates and Impact on Flexibility to upgrade design

Pair 2			
Impact on Rates	31		
Flexibility to upgrade design	38		
Equally important	69		
Blank	8		

Table 6 –Survey Response: Pairwise comparison –Flexibility to upgrade design and Impact on Natural Ecosystem

Pair 3		
Flexibility to upgrade design	32	
Impact on natural ecosystem	32	
Equally important	73	
Blank	9	

#### Table 7 – Survey Response: Pairwise comparison – Impact on Rates and Severity of Inundation

Pair 4		
Impact on Rates	19	
Severity of inundation	56	
Equally Important	64	
Blank	7	

#### Table 8-Survey Response: Pairwise comparison -Flexibility to upgrade design and Severity of Inundation

Pair 5		
Flexibility to upgrade design	24	
Severity of inundation	42	
Equally Important	73	
Blank	7	

#### Table 9–Survey Response: Pairwise comparison –Impact on Natural Ecosystem and Severity of Inundation

Pair 6		
Impact on natural ecosystem	28	
Severity of inundation	40	
Equally Important	72	
Blank	6	

Pair 7		
Impact on Rates	40	
Impact on urban amenity	37	
Equally Important	61	
Blank	8	

#### Table 11-Survey Response: Pairwise comparison - Flexibility to upgrade design and Impact on Urban Amenity

Pair 8		
Flexibility to upgrade design	40	
Impact on urban amenity	24	
Equally Important	73	
Blank	9	

#### Table 12-Survey Response: Pairwise comparison - Impact on Natural Ecosystem and Impact on Urban Amenity

Pair 9		
Impact on natural ecosystem	41	
Impact on urban amenity	34	
Equally Important	61	
Blank	10	

#### Table 13-Survey Response: Pairwise comparison - Severity of Inundation and Impact on Urban Amenity

Pair 10		
Severity of inundation	44	
Impact on urban amenity	18	
Equally Important	74	
Blank	10	

### 4.3 Discussion

The results show that for all pairwise comparisons the "Equally Important" assignment was the most frequent response. This would suggest that based on community survey results, all five criteria should be weighted equally.

Nevertheless, a review of the weightings ignoring the equally important scores was completed. The pairwise analysis was completed where the most popular criteria from the pair was given a score of 2, the least popular was scored 0.5 and if the number of responses for a pair were equal then the score was given as 1. On the basis of this assessment, the weights for the five criteria are provided below in **Table 14**:



Criteria	Weighting
Life cycle cost (impact on rates)	19%
Impact on natural ecosystem	17%
Flexibility to upgrade design	22%
Severity of inundation	32%
Impact on urban amenity	11%

Given that equally important always scored highest, the weightings above are not conclusive.

### 4.4 Recommendations

There are no conclusive variations in weightings for evaluation criteria that can be taken from the survey responses. Equal weighting across the evaluation criteria is most reflective of the survey responses.

## 5.0 General Survey Comments

In addition to the targeted survey questions to directly inform the FMS methodology, respondents were offered the opportunity to provide general comments on floodplain management in Townsville. There were some general themes that could be taken from the individual comments:

- Litter and clearing of drains contributes to issues and management to reduce these issues should continue;
- As much as possible should be done to ensure accuracy of data especially for the purpose of reducing insurance premiums;
- Concern around the location of new and historical development within the floodplain; and
- Inappropriate to have a general rates increase to cover the cost of rectifying specific areas.



# Appendix A – Community Survey Form



Townsville City Council is developing the Townsville Floodplain Management Strategy to build community resilience to flooding by guiding land use planning, development controls, emergency management, community programs and future infrastructure investment.

Council recognises that flood hazard is a risk for the community as a whole and it is appropriate that the community guide the strategy to ensure community needs are addressed. The community survey is the first step in ensuring the community's needs are identified so that they can be incorporated in the strategy. Information gathered from the survey will:

» assist with the review and understanding of Townsville's flood hazard;

» help identify options for managing Townsville's flood risk;

Are you a permanent Townsville resident?

» guide analysis of options for managing Townsville's flood risk; and

» shape council's response to flood and storm tide emergencies.

 $\bigcirc$  YES  $\bigcirc$  NO

If yes, please state your street and suburb



Q1

Do you:

○ OWN YOUR OWN HOME ○ RENT

#### FLOODPLAIN MANAGEMENT

Your responses will directly shape the analysis used in preparing the floodplain management strategy. While potential options for managing flooding or funding may be outlined below, there may be substantial work or impediments to implementing these measures. Council is seeking to understand the community views, prior to determining what specific measures may be feasible.

#### Q3

# Please indicate which of the following you see as acceptable floodplain management measures for existing flood risk in Townsville:

» Land use planning to respond to flooding (i.e. retaining natural low lying areas

for floodplain, and creating density on higher ground to accommodate growth)	$\bigcirc$ YES $\bigcirc$ NO
» Buy-back of flood affected properties	○ YES ○ NO
» Flood improvement works at the expense of natural areas	○ YES ○ NO
» Flood improvement works incorporated into parkland	○ YES ○ NO
» Flood improvement works at the expense of private properties	○ YES ○ NO
» Dredging natural watercourses for improved floodwater flow efficiency	○ YES ○ NO
» Raising existing houses (only possible with stump houses)	○ YES ○ NO
» Changing existing buildings to use waterproof materials	○ YES ○ NO
» Temporary property protection measures (e.g. sand-bagging)	○ YES ○ NO
» Identifying safe evacuation centres	○ YES ○ NO
» Gradual improvements with replacement of aged infrastructure	⊖ YES ⊖ NO

Vulnerability to flooding is often assessed based on categorising risks as either:

- » Acceptable Risk a flood risk that can be lived;
- » *Tolerable Risk* a flood risk that can be lived with but if can be cost-effectively reduced, should be; or
- » **Unacceptable Risk** individuals and society will not accept this flood risk and measures must be undertaken to reduce risks to at least a tolerable level.

Risks are the product of the probability and consequence of an event. For the purpose of the Floodplain Management Strategy probabilities will be taken as:

» High likelihood – 5% annual chance;

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» Medium likelihood – 1% annual chance; or

» Low likelihood – 0.2% annual chance.

Please indicate whether the following flood risks are acceptable, tolerable or unacceptable:	ACCEPTABLE	TOLERABLE
» High likelihood of residential land being inundated	0	0
» Medium likelihood of residential land being inundated	0	0
» Low likelihood of residential land being inundated	0	0
» High likelihood of residential floors being inundated	0	0
» Medium likelihood of residential floors being inundated	0	Ο
» Low likelihood of residential floors being inundated	0	0
» High likelihood of commercial/industrial land being inundated	0	0
» Medium likelihood of commercial/industrial land being inundated	Ο	Ο
» Low likelihood of commercial/industrial land being inundated	0	0
» High likelihood of commercial/industrial floors being inundated	0	0
» Medium likelihood of commercial/industrial floors being inundated	0	0
» Low likelihood of commercial/industrial floors being inundated	0	0
» High likelihood of major roads being inundated	0	0
» Medium likelihood of major roads being inundated	0	0
» Low likelihood of major roads being inundated	0	0
» High likelihood of interruption in the water supply due to flooding	0	0
» Medium likelihood of interruption in the water supply due to flooding	0	0
» Low likelihood of interruption in the water supply due to flooding	0	0
» High likelihood of overflow of sewer system due to flooding	0	0
» Medium likelihood of overflow of sewer system due to flooding	0	0
» Low likelihood of overflow of sewer system due to flooding	0	0
» High likelihood of Hospital being inundated	0	0
» Medium likelihood of Hospital being inundated	0	0
» Low likelihood of Hospital being inundated	0	0
» High likelihood of secondary health facility being inundated	0	0
» Medium likelihood of secondary health facility being inundated	0	Ο
» Low likelihood of secondary health facility being inundated	0	0
» High likelihood of emergency services (police/fire/ambulance) being inundated	0	0
» Medium likelihood of emergency services (police/fire/ambulance) being inundated	0	Ο
» Low likelihood of emergency services (police/fire/ambulance) being inundated	0	0

#### FLOOD MANAGEMENT OPTIONS – DETERMINING CRITERIA FOR ASSESSMENT

Q5

An important part of developing the Townsville Floodplain Management Strategy will be to assess the relative merits of flood management options. Each option will be evaluated against the criteria below:

*Life cycle cost (Impact on Rates)* – The cost to design, construct, implement, operate, maintain and decommission the flood management measure which will have a direct impact on rates.

*Impact on natural ecosystem* – The impact the flood management measure has on environmental values such as water quality, habitat and biodiversity.

*Flexibility to upgrade design* – The ability to respond to future requirements such as larger floods, impacts of climate change or storm surge.

*Severity of inundation* – The combination of depth, velocity and frequency of flooding that remains following the implementation of the flood management measure.

*Impact on urban amenity* – The impact the flood management measure has on the urban environment in terms of things like changes to public spaces, changes in road connectivity or changes in adjacent land-uses.

To assist in determining the relative importance of each criteria, for each question, please identify which of the pair of issues is more important to you, or whether they are equally important:

» O Life cycle cost (Impact on Rates)	$\bigcirc$ Impact on natural ecosystem	$\bigcirc$ Equally important
» $\bigcirc$ Flexibility to upgrade design	$\bigcirc$ Life cycle cost (Impact on Rates)	○ Equally important
» O Impact on natural ecosystem	○ Flexibility to upgrade design	○ Equally important
» O Severity of inundation	○ Life cycle cost (Impact on Rates)	○ Equally important
» O Severity of inundation	○ Flexibility to upgrade design	○ Equally important
» O Impact on natural ecosystem	○ Severity of inundation	○ Equally important
» O Impact on urban amenity	○ Life cycle cost (Impact on Rates)	○ Equally important
» O Impact on urban amenity	○ Flexibility to upgrade design	○ Equally important
» O Impact on natural ecosystem	$\bigcirc$ Impact on urban amenity	○ Equally important
» $\bigcirc$ Severity of inundation	$\bigcirc$ Impact on urban amenity	$\bigcirc$ Equally important

If you have any additional comments or suggestions regarding the Townsville Floodplain Management Strategy please refer to the form overleaf.

Thank you for your time. Your answers are a valuable contribution in the development of the Townsville Floodplain Management Strategy.

## ADDITIONAL COMMENTS