

# Guideline

## State Coastal Management Plan

### Mitigating the Adverse Impacts of Storm Tide Inundation

*The purpose of this Guideline is to provide advice and information on interpreting and implementing the 'Coastal hazards' policy 2.2.4 of the State Coastal Management Plan – Queensland's Coastal Policy State Coastal Plan.*

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## Mitigating the Adverse Impacts of Storm Tide Inundation

### 1 PURPOSE OF THE GUIDELINE

- 1.1 The purpose of this Guideline is to provide advice and information on interpreting and implementing the 'Coastal hazards' policy (policy 2.2.4) of the *State Coastal Management Plan – Queensland's Coastal Policy* (State Coastal Plan).
- 1.2 The State Coastal Plan is a statutory instrument under the *Coastal Protection and Management Act 1995* and has the effect of a State Planning Policy under the *Integrated Planning Act 1997* (IPA).
- 1.3 Principle 2D and policy 2.2.4 'Coastal hazards' of the State Coastal Plan apply specifically to areas on the coast and express the State's interest in minimising the potential adverse impacts from coastal hazards on people, property, economic activity and the environment.
- 1.4 Storm tide is a coastal hazard that can cause dangerous levels of inundation to coastal areas, over and above the risks associated with overland flooding from high rainfall.
- 1.5 This Guideline aims to ensure that storm tide inundation is adequately considered when decisions are made about development, particularly in the making or amending of local government planning schemes, the assessment of development applications, and when land is designated for community infrastructure under the *Integrated Planning Act 1997* (IPA).

### 2 SCOPE OF THE GUIDELINE

- 2.1 The State Coastal Plan establishes the policy framework for decision makers regarding matters to do with storm tide inundation. The relevant coastal management outcome, principles and policies relating to storm tide inundation from the State Coastal Plan have been reproduced below.
- 2.2 Section 2.2 of the State Coastal Plan describes the desired coastal management outcome for physical coastal processes. Direction on how to achieve this management outcome is provided through State Coastal Plan principles 2C, 2D and 2E.

#### 2.2 Physical Coastal Processes

##### Coastal Management Outcome

The coast is managed to allow for natural fluctuations to occur, including any that occur as a result of climate change and sea level rise, and provide protection for life and property.

##### Principles

- 2C The consequences of physical coastal processes are recognised and such processes generally are allowed to occur naturally.
- 2D Risks associated with all relevant hazards including storm tide inundation and cyclone effects are minimised.

- 2E The natural topography and physical features of coastal dune systems which provide adjacent areas with protection from inland erosion are to be protected and managed on an ecologically sustainable basis.

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- 2.3 State Coastal Plan policy 2.2.4 'Coastal hazards' addresses coastal hazards as a sub-set of physical coastal processes.

### **Policy 2.2.4 Coastal hazards**

*This policy seeks to achieve the following 'Physical coastal processes' principles: 2C, 2D and 2E.*

#### **Policy context**

Coastal hazards include events such as storm tides, cyclone effects and related inundation. Storm tides (the combined effect on coastal water levels of a storm surge and the normally occurring astronomical tide) that cause dangerous levels of inundation are not rare events in Queensland. These events can place human life and property on the coast at risk over and above the risks associated with overland flooding events from high rainfall in the catchment.

#### **Policy**

When determining new areas for urban land uses on the coast, an evaluation is to be carried out to identify the level of potential risk to life and property from coastal hazards. This evaluation should be based on mapping of storm tide hazard areas in addition to considering the impact of physical coastal processes, including any impacts from potential sea level rise.

Development in areas on the coast identified as having a risk of being affected by coastal hazards needs to be carefully considered and wherever possible, be retained undeveloped. Where areas vulnerable to storm tide inundation have been developed, further development in these areas needs to address:

- \* its vulnerability to sea level rise and storm tide inundation; and
- \* the proposed access to and protection of evacuation routes.

In such areas, local government should have in place counter-disaster plans to address these coastal hazards.

- 2.4 This Guideline does not address:

- counter-disaster planning and operations. This is dealt with by the *Disaster Management Act 2003*; or
- emergency response mapping to interpret storm tide warnings issued by the Bureau of Meteorology; or
- coastal cliff erosion. This is classified as a landslide hazard and is addressed in the State Planning Policy and the associated Guideline for Mitigating the Adverse Impacts of Flood, Bushfire and Landslide; or
- areas vulnerable to beach erosion or encroachment from tidal waters (not including storm events). This is addressed in State Coastal Plan Policy 2.2.2 *Erosion Prone Areas*.

- 2.5 This Guideline has been prepared to be consistent with the State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* and its supporting SPP 1/03 Guideline. It is not intended to be a complete technical guide to the assessment and management of storm tide inundation.

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### ***Other considerations***

- 2.6** The scope of State Coastal Plan policy 2.2.4 'Coastal hazards' is limited to avoiding and minimising (in order of preference) the risks to life and property from storm tide inundation. Therefore, the relationship with other policies needs consideration. Additionally, achieving the policy outcomes for 2.2.4 may need to be balanced against other policies such as those in a planning scheme.
- 2.7** State Coastal Plan policy 2.2.4 'Coastal hazards' should not be used as an automatic justification for overriding other policy considerations in the State Coastal Plan, planning scheme or other State instruments. Development applications need to be assessed on their merits against all relevant considerations specified in the Integrated Development Assessment System (IDAS). Similarly, planning scheme proposals need a broad, balanced assessment to determine what is appropriate in the public interest. In many cases, a development proposal that achieves the policy outcomes of 2.2.4 but which has serious conflicts with another State Coastal Plan policy, local planning instrument or another State instrument, may be considered inappropriate.
- 2.8** Nothing in the State Coastal Plan restricts a local government, assessment manager or designator from addressing the planning for and management of the risks associated with storm tide more stringently or in more detail than required by the State Coastal Plan and this Guideline.

### 3 APPLICATION OF STATE COASTAL PLAN POLICY 2.2.4 'COASTAL HAZARDS'

#### Effect of the State Coastal Plan

3.1 Under the *Integrated Planning Act 1997* (IPA), the State Coastal Plan has the following effect.

#### ***Development assessment***

3.2 This Guideline is not to be used when assessing development applications for building work assessable only against the *Standard Building Regulation*. The State Coastal Plan policy 2.2.4 'Coastal hazards' applies to assessable development<sup>1</sup> in the following ways:

(i) IPA Planning Schemes

*Where an IPA planning scheme is in force and it does not appropriately reflect State Coastal Plan policy 2.2.4*

- the assessment manager must have regard to the State Coastal Plan policy 2.2.4 when assessing both code assessable and impact assessable development applications under the IDAS.

(ii) Transitional Planning Schemes

*Where a transitional planning scheme is in force—*

- the assessment manager must have regard to State Coastal Plan policy 2.2.4 when assessing development applications requiring development approval under a planning scheme.

(iii) Schedule 8 of IPA

*For assessable development not addressed by a planning scheme and subject to assessment under the Integrated Planning Regulation,*

- the assessment manager must have regard to State Coastal Plan policy 2.2.4 when assessing relevant development proposals. For example, in areas under the jurisdiction of Aboriginal and Torres Strait Islander local governments where planning schemes are unlikely to be prepared, the policy 2.2.4 applies only to development that is assessable against Schedule 8 of the IPA.

#### ***Making or amending planning schemes***

3.3 State Coastal Plan policy 2.2.4 is to be appropriately reflected in planning schemes to ensure that the State's interests in mitigating the adverse impacts of storm tide inundation are interpreted in the local context when planning for future development and making decisions on development applications.

3.4 Policy 2.2.4 is appropriately reflected when the planning scheme seeks the same outcomes as the Policy and all aspects of the planning scheme are consistent with Policy 2.2.4 and this Guideline to an extent

<sup>1</sup> Assessable development is defined in the IPA as:

- (a) development specified in Schedule 8, Part 1; or
- (b) for a planning scheme area – development that is not specified in Schedule 8, Part 1 but is declared under the planning scheme for the area to be assessable development.

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that satisfies the Minister for Local Government and Planning (acting for the State Government on the advice of the Environmental Protection Agency (EPA) and the Department of Local Government and Planning (DLGP)).

### ***Land designated for community infrastructure***

- 3.5** Under the IPA, the State Coastal Plan policy 2.2.4 must be considered when designating land for certain types of community infrastructure listed in A1.2 of Appendix 1.

### ***Development to which State Coastal Plan policy 2.2.4 applies***

- 3.6** The State Coastal Plan policy 2.2.4 applies to development described in Appendix 1 of this Guideline. It should be noted that this policy applies to the development listed in Appendix 1 of this Guideline only where the development is proposed within a *natural hazard management area (storm tide)*. However, this policy applies for the types of community infrastructure listed in A1.2 of Appendix 1 of this Guideline.
- 3.7** The EPA in its role as a concurrence agency in the assessment of relevant development on land within the Coastal Management District or a coastal building line, including building works on land subject to a Coastal Building Line, must have regard to State Coastal Plan policy 2.2.4.

### ***Areas to which State Coastal Plan policy 2.2.4 applies***

- 3.8** State Coastal Plan policy 2.2.4 applies to the local government areas listed in Table 1 as defined on 1 March 2004.

### **Other considerations**

- 3.9** Decision makers must consider other relevant principles and policies in the State Coastal Plan when making decisions about planning and development on the coast. The management outcomes, principles and policies of the State Coastal Plan are not to be read in isolation, but as an integrated package.

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**TABLE 1: List of Local government authorities with coastline**

Local Government Councils		Deed of Grant in Trust Communities	Island Councils
Aurukun	Hinchinbrook	Doomadgee	Badu Island
Bowen	Isis	Inginoo	Bamaga Island
Brisbane	Johnstone	Kowanyama	Boigu Island
Broadsound	Livingstone	Lockhart River	Dauan Island
<i>Bundaberg *</i>	<i>Logan *</i>	Mapoon	Erub Island
Burdekin	Mackay	Napranum	Hammond Island
Burke	Maroochy	New Mapoon	Iama Island
Burnett	Maryborough	Palm Island	Kubin Island
Caboolture	Miriam Vale	Pompuraaw	Mabuiag Island
Cairns	Mornington	Umagico	Mer Island
Calliope	Noosa	Yarrabah	Poruma Island
Caloundra	Pine Rivers		Saibai Island
Cardwell	Redcliffe		Seisia Island
Carpentaria	Redland		St Pauls Island
Cook	<i>Rockhampton *</i>		Ugar Island
Cooloola	Sarina		Warraber Island
Douglas	Thuringowa		York Island
Fitzroy	Tiaro		
Gladstone	Torres		
Gold Coast	Townsville		
Hervey Bay	Whitsunday		

\* These local governments do not adjoin the coastline but are located on tidal waterways and are close to the coastline

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### 4 THE NEED TO MITIGATE THE ADVERSE IMPACTS OF STORM TIDE INUNDATION

#### ***Storm tide inundation – A physical coastal process***

- 4.1 The State Coastal Plan identifies the State's interest in recognising the consequences of physical coastal processes and the need for such processes to generally be allowed to occur naturally.
- 4.2 Storm tide inundation and extreme wave conditions are the coastal hazards with the greatest potential for loss or harm to the community and environment. Storm tide inundation becomes a natural disaster when severe disruption occurs to a community, requiring assistance from various levels of government. Mitigation means measures taken to reduce the severity of, or eliminate the risk from disasters. Mitigation is usually thought of in terms of prevention and community preparedness.

#### ***Role of land use planning***

- 4.3 Effective land use planning can limit, and over time, reduce the impacts of natural disasters.
- 4.4 The State Coastal Plan policy 2.2.4 guides decisions regarding the planning for, and assessment of, development on the coast to avoid or minimise the following risks associated with storm tide inundation, including:
- injury or loss of life;
  - loss of, or damage to, property;
  - interference to ongoing natural coastal processes; and
  - future need for property protection works for new development in vulnerable areas.

#### ***Costs associated with storm tide inundation***

- 4.5 As described in State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*, the financial costs of natural disasters have been rising over recent times and are primarily due to increased development in hazard prone areas and the increased value of property and infrastructure in these areas. This is particularly relevant to development on the coast that is often of high economic value and potentially exposed to a significant risk of damage.
- 4.6 There are other costs associated with storm tide inundation, both measurable and immeasurable, that adversely affect the interests of the State, regions and local communities. These other costs may involve both monetary and human costs including loss of life, injury, emotional suffering, loss of memorabilia, reduced quality of life, reduced productivity, weakened economy, loss of employment, associated loss of business and primary producers, increased costs of insurance and degraded environment. It is widely recognized that the human costs of natural disasters, while difficult to estimate in economic terms, are substantial and are therefore important when considering the benefits of mitigation measures.

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### ***Climate change***

- 4.7** The *Queensland Greenhouse Policy Framework* acknowledges growing scientific consensus that the enhanced greenhouse effect is changing the world's climate and that Queensland will be vulnerable to the effects of climate change. Predicted changes are likely to include reductions in annual rainfall, but increases in rainfall intensity; coastal erosion; sea level rise; and damage to transport infrastructure and low-lying human settlements. These changes would have significant impacts on the nature and extent of coastal hazards and, where practicable, should be considered when developing hazard mitigation strategies.
- 4.8** A significant number of existing coastal communities are potentially affected by storm tide inundation and the level of risk may increase substantially in the future as a result of global sea level rise. State Coastal Plan policy *2.2.1 Adaptation to Climate Change*, provides direction for addressing potential impacts of climate change when undertaking planning for the coast.

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### 5 THE POLICY APPROACH

- 5.1** The intention of the State Coastal Plan policy 2.2.4 is that, coastal areas vulnerable to inundation by storm tide should be identified through a comprehensive and detailed natural hazard assessment study.
- 5.2** The State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* (SPP 1/03) establishes the concept of 'natural hazard management areas'. This Guideline establishes a 'natural hazard management area (storm tide)'.
- 5.3** Where areas vulnerable to storm tide inundation have already been developed, new development must address vulnerability to storm tide inundation and the proposed access and protection of evacuation routes. In particular, new development should take into account the effects of a major storm tide event on:
- the risk of injury or loss of life in the event that forecasting and evacuation procedures are not completely successful;
  - the potential additional burden on counter disaster operations; and
  - the potential overall costs to the community of property damage from wave impacts.
- 5.4** The principal mechanisms for achieving implementation of State Coastal Plan principle 2D and policy 2.2.4, and thereby reducing the risks associated with storm tide inundation on the Queensland coast, are:
- the identification of 'natural hazard management areas (storm tide)' and
  - the provision of relevant outcome statements with respect to managing development in vulnerable areas.

#### ***Identification of 'natural hazard management areas (storm tide)'***

- 5.5** The 'natural hazard management area (storm tide)' is the area of coast inundated by the Defined Storm Tide Event (DSTE), i.e. storm tide level adopted by local government for managing development in a particular locality. Appendix 2 provides the recommended approach to determine a 'natural hazard management area (storm tide)'.
- 5.6** The default Defined Storm Tide Event (DSTE) level is HAT + 1.5 m. The 1.5 m above HAT is based on the most recent state-wide averaged storm tide statistics with an allowance for storm surge, wave setup, and future sea level rise. Refer to James Cook University (2004) - *Queensland Climate Change and Community Vulnerability to Tropical Cyclones, Ocean Hazards Assessment - "The Frequency of Surge Plus Tide During Tropical Cyclones for Selected Open Coast Locations Along the Queensland East Coast" and "Tropical Cyclone-Induced Water Levels and Waves: Hervey Bay and Sunshine Coast"*.  
<http://mmu.jcu.edu.au/atlas/atlas.shtml>

## 6 DEVELOPMENT OUTCOMES AND DEVELOPMENT ASSESSMENT

### Introduction

- 6.1** When development applications are assessed against State Coastal Plan Policy 2.2.4, or land is designated for community infrastructure, regard must be had to Outcomes 1 to 3 from the State Planning Policy 1/03 as shown below, except where only assessable against the State Building Regulation 1993.
- 6.2** The assessment manager needs certain information to be able to assess development applications for consistency with SPP 1/03 Outcomes 1 to 3. If the requisite information is not provided with an application, the development should be subject to an information request under the IDAS. Figure 1 depicts the process for achieving SPP 1/03 Outcomes 1 to 3, and the following subsections provide guidance on the implementation of each of the steps.

**Outcome 1:** Within a natural hazard management area (storm tide), development to which State Coastal Plan policy 2.2.4 applies is compatible with the nature of the storm tide hazard, except where:

- the development proposal is a development commitment; or
- there is an overriding need for the development in the public interest, and no other site is suitable and reasonably available for the proposal.

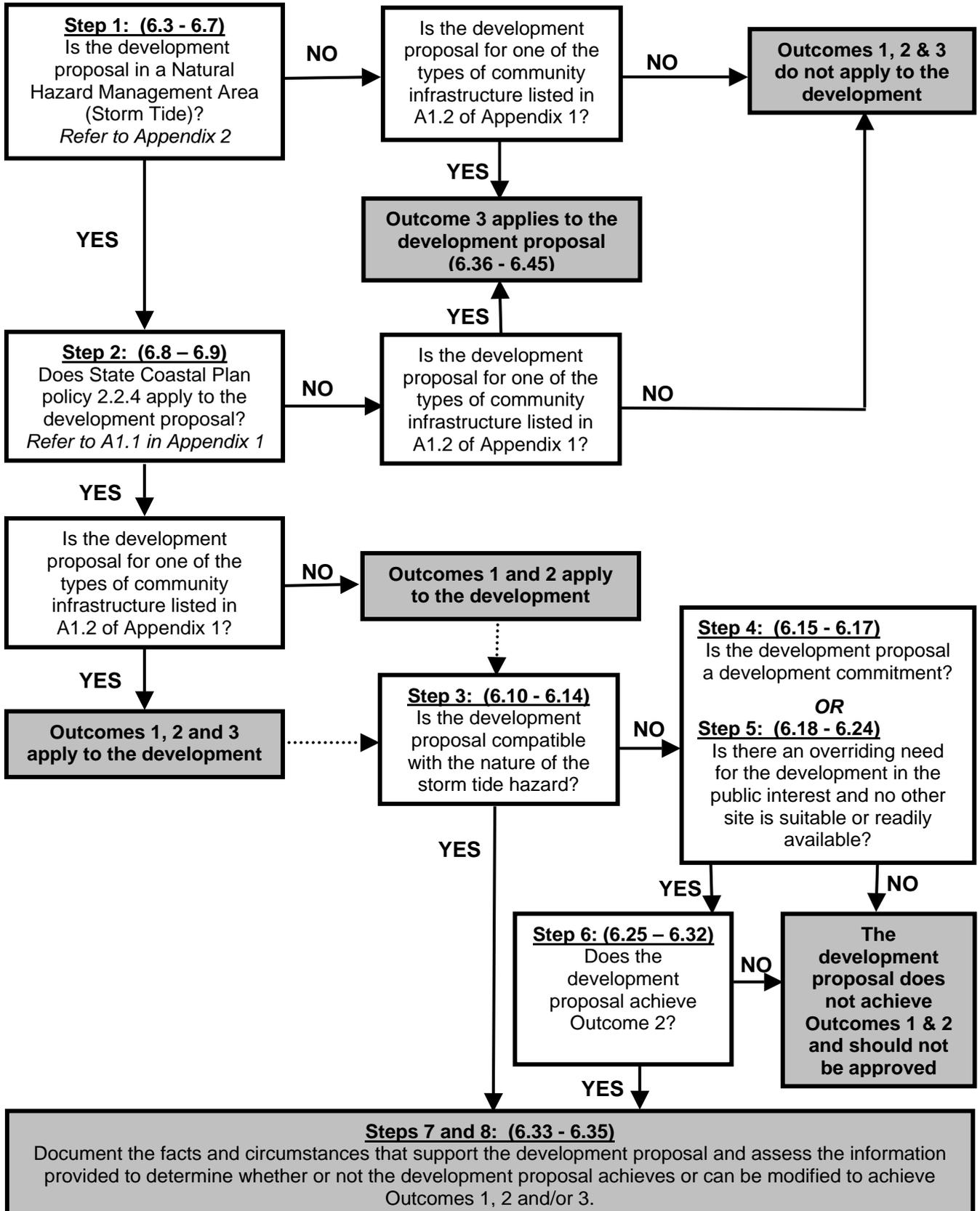
**Outcome 2:** Development that is not compatible with the nature of the storm tide inundation hazard but is otherwise consistent with Outcome 1:

- minimises as far as practicable the adverse impacts from storm tide inundation; and
- does not result in an unacceptable risk to people or property.

**Outcome 3:** Wherever practicable, community infrastructure to which State Coastal Plan Policy 2.2.4 applies is located and designed to function effectively during and immediately after a storm tide inundation event commensurate with a specified level of risk.

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**Figure 1: Achieving Outcomes 1, 2 and 3**



**Achieving Outcomes 1 and 2**

***Development in a natural hazard management area (storm tide)***

**Outcome 1:** Within a natural hazard management area (storm tide), development to which State Coastal Plan policy 2.2.4 applies is compatible with the nature of the storm tide hazard, except where:

- the development proposal is a development commitment; or
- there is an overriding need for the development in the public interest, and no other site is suitable and reasonably available for the proposal.

***(Step 1) Is the proposed development within a natural hazard management area (storm tide) ?***

- 6.3** Outcome 1 applies to development in a natural hazard management area (storm tide). It is first necessary to identify whether the development proposal is located within a natural hazard management area (storm tide) and, if so, the severity of hazard that applies.
- 6.4** Information should be sought from local government on natural hazard management areas (storm tide) or areas previously affected by storm tide inundation.
- 6.5** Appendix 2 outlines study approaches for defining natural hazard management areas (storm tide). Where local government has not adopted a Defined Storm Tide Event (DSTE) for the management of development in a particular locality, but a study has been undertaken to identify areas at risk from storm tide inundation, development applications should be assessed against State Coastal Plan policy 2.2.4 and this Guideline using the available information.
- 6.6** The applicant should determine whether any part of the development site is located within a natural hazard management area (storm tide). Where part of the subject site is included in a natural hazard management area (storm tide), but the development proposal does not adversely impact on the area, the application should include sufficient information to demonstrate this. In such circumstances, the assessment manager may determine that further consideration of State Coastal Plan policy 2.2.4 is not required. These instances will be assessed on a case-by-case basis and are at the discretion of the assessment manager.
- 6.7** If the subject site is not located in a natural hazard management area (storm tide), or the assessment manager determines that the proposal is not likely to impact on a natural hazard management area (storm tide), no further consideration of State Coastal Plan policy 2.2.4 is required in relation to Outcome 1.

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### ***(Step 2) Does State Coastal Plan policy 2.2.4 apply to the development ?***

- 6.8** For land located within a natural hazard management area (storm tide), State Coastal Plan policy 2.2.4 and this Guideline applies to the following types of development (refer to A1.1 of Appendix 1) which include material **changes of use** and **reconfigurations of a lot** that:
- a)** Increase the number of people living or working in the natural hazard management area (e.g. residential development, shopping centres, tourist facilities, industrial or commercial uses) except where the premises are only occupied on a short-term or intermittent basis (e.g. by construction/maintenance workers); **or**
  - b)** involve institutional uses where evacuating people may be particularly difficult (e.g. hospitals, educational establishments, child care, aged care, nursing homes and high security correctional centres); **or**
  - c)** involve the manufacture or storage of hazardous materials in bulk; **or**
  - d)** involve building<sup>2</sup> or other work that involves any physical alteration to land within the high hazard zone as an intrinsic element of the development proposal.
- 6.9** If the development proposal does not include any of the actions or activities identified above, Outcomes 1 and 2 do not apply. (Outcome 3 is relevant to specified types of community infrastructure).

### ***(Step 3) Is the development compatible with the nature of the storm tide hazard ?***

- 6.10** Development within a natural hazard management area (storm tide) should be tailored to the nature of the storm tide hazard on the subject site. Appendix 3 sets out the specific outcomes that development proposals should achieve in order to be compatible with the nature of the storm tide hazard, and to comply with Outcome 1. Appendix 4 of this Guideline includes solutions for each of the specific outcomes that can be used to help determine whether or not a development proposal is compatible with the nature of the storm tide hazard.
- 6.11** The development application should demonstrate the achievement of the relevant specific outcomes in Appendix 3. A storm tide hazard assessment study may need to be provided to demonstrate compatibility.
- 6.12** Areas on the coast within the high storm tide hazard zone (refer to A2.33) are to be retained undeveloped, wherever possible. In particular, building work within existing undeveloped areas in a high storm tide hazard zone is not considered to be compatible with the nature of the hazard.

<sup>2</sup> Excludes building work that is assessable only against the Standard Building Regulation 1993, but includes building work on land seaward of a Coastal Building Line under the *Coastal Protection and Management Act 1995*

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- 6.13** Development that is not compatible with the nature of the storm tide hazard can still achieve Outcome 1 if it:
- meets one or both of the exceptions listed in Outcome 1; **and**
  - achieves Outcome 2.

- 6.14** The exceptions listed for Outcome 1 relate to development commitments and overriding need in the public interest. Advice on interpreting these exceptions is provided in Steps 4 and 5, respectively.

### ***(Step 4) Is the development proposal a development commitment ?***

- 6.15** Development that is incompatible with the nature of the storm tide hazard may be approved where it is a development commitment.
- 6.16** Where required, the development application should demonstrate that the development proposal is a development commitment based on an assessment of the development proposal for consistency with the overall outcomes (and/or intent) of the relevant zone (or equivalent), the associated development assessment tables and any applicable codes. The assessment manager should confirm that the development proposal is a development commitment.
- 6.17** A development application that is consistent with these planning scheme measures is a development commitment and therefore achieves Outcome 1 of this Guideline. However, the development proposal will still be required to achieved Outcome 2 in order to be consistent with State Coastal Plan Principle 2D.

### ***(Step 5) Can overriding need be demonstrated ?***

- 6.18** Development that is incompatible with the nature of the storm tide hazard can be approved on the grounds of overriding need in the public interest. However, such development is also required to achieve Outcome 2. Determining such overriding need will necessarily depend on the circumstances of the particular development proposal. This section of the Guideline sets out the main principles for evaluating an overriding need in the public interest.
- 6.19** Firstly the degree of net environmental, economic and/or social benefits to the community should be established and, secondly, if there are net community benefits, the likelihood of suitable alternative sites being generally available should be assessed.

#### ***a) Assessing net benefits to the community***

- 6.20** The overall environmental, economic and social benefits of a proposed incompatible development located within a natural hazard management area (storm tide) should be weighed against the consequences of the storm tide hazard on the proposed development.
- 6.21** To be in the public interest, the proposed incompatible development should:

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- serve an essential community need (e.g. a health-care facility), significantly improve the community's access to services (e.g. a community centre or other facility that reduces travel times for a significant proportion of the community); or
- provide significant long-term economic benefit (e.g. a major new employment opportunity, or an industry with synergies with existing activities in the area); or
- provide significant environmental benefits (e.g. where other alternative sites would result in adverse impacts upon important habitat areas).

**6.22** For public benefit to be 'overriding', it must outweigh the adverse impacts from the development's exposure to the hazard of storm tide inundation. These impacts include:

- the increased risk to life, property and/or the environment;
- the increased demand for emergency services; and
- the potential risk of increased community pressure for storm tide hazard remediation works.

**6.23** Any increased risk to human lives needs to be given significant weight in determining overriding need.

### ***b) Assessing alternative sites***

**6.24** A broad assessment of specific alternative sites should be undertaken as follows:

1. Identify the site requirements of the proposed development, including location needs, physical site characteristics, access and servicing.
2. Identify sites or general locations that meet those site requirements and are situated:
  - outside the natural hazard management area (storm tide); or
  - within the natural hazard management area (storm tide) but with a lower severity of hazard.
3. Evaluate identified sites/locations in terms of their consistency with the planning scheme (or adjoining planning scheme if suitable sites can be identified in an adjoining local government area).
4. Consider in general terms whether land ownership of any preferred alternative site(s) is likely to present a major obstacle to assembling an appropriate parcel of land for the proposed development.

[**NB:** The fact that the applicant owns, or has an option on the site that is the subject of the development application and that it is consequently available for the proposed development, does not in itself justify an 'overriding need'.]

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### ***(Step 6) Does the development proposal achieve Outcome 2 ?***

**Outcome 2:** Development that is not compatible with the nature of the storm tide inundation hazard but is otherwise consistent with Outcome 1:

- minimises as far as practicable the adverse impacts from storm tide inundation; and
- does not result in an unacceptable risk to people or property.

- 6.25** Outcome 2 applies to development that is not compatible with the nature of the storm tide hazard (refer to Step 3 above), but satisfies either of the exceptions in Outcome 1 (refer to Steps 4 and 5 above).
- 6.26** Development achieves Outcome 2 when it is brought as near as possible to the level required to comply with the Specific Outcomes for compatibility with Outcome 1 (See Appendix 4), and the development would not result in unacceptable risk to people or property.
- 6.27** There will be some circumstances where a development proposal that minimises the adverse impacts of storm tide inundation as far as possible, should not be approved because it would still result in an unacceptable risk to people, property or the environment. Storm tide inundation can be difficult to manage within individual sites, and on-site mitigation measures may be inadequate to reduce the level of risk associated with a development proposal to an acceptable level. Also, the development may adversely impact on the level of storm tide inundation elsewhere in the locality.
- 6.28** An unacceptable risk may be thought of as one where an informed community would decide not to accept the consequences and likelihood of a particular risk. The key characteristic of unacceptable risk is that it is determined by the community rather than an individual or particular group within the community. The best way to determine a community's risk threshold is through a natural disaster risk assessment study using the process outlined in Appendix 1 of the SPP 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* Guideline.
- 6.29** Where such a structured, community-based assessment of unacceptable risk is not available, it will be the responsibility of the assessment manager to determine whether a particular development proposal would result in an unacceptable level of risk.
- 6.30** As noted above, unacceptable risk will vary between communities and over time. However, there are certain minimum requirements that development proposals must achieve to meet the test of 'unacceptable risk'. These minimum requirements are achievement of Specific Outcomes 1 and 4 in Appendix 4.
- 6.31** It should be noted that local governments and other assessment managers may impose more stringent requirements based on the severity of the storm tide inundation hazard in the vicinity of the development site, and the characteristics of the development proposal. Appendix 4 provides more information including possible solutions on how to achieve these outcomes.
- 6.32** Where suitable measures to achieve Outcome 2 have not been included in the development proposal, the assessment manager should negotiate suitable measures with the applicant or include them as

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reasonable or relevant conditions of development approval. The Solutions in Appendix 4 of this Guideline provide guidance as to the types of measures that may be required to achieve Outcome 2.

**The Solutions in Appendix 4 of this Guideline provide guidance as to the types of measures that may be required to achieve Outcome 2.**

### ***(Step 7) Document the facts***

**6.33** Applicants preparing development applications involving land that is contained within a natural hazard management area (storm tide) should consider including the following information as part of the development application:

- plans illustrating the location of the proposed development and the relationship between the proposed development and the natural hazard management area (storm tide); and
- a report outlining either how the proposed development achieves the relevant Outcomes, including where necessary how it meets the requirements set out in Steps 4, 5 and 6 above.

### ***(Step 8) Role of the assessment manager***

**6.34** To comply with the requirements in relation to Outcomes 1 and 2, the role of the assessment manager is to:

- determine whether the application contains sufficient information, and issue an information request if more information is required;
- assess the application against the State Coastal Plan policy 2.2.4 and planning scheme; and
- impose reasonable or relevant conditions to achieve Outcomes 1 and 2 if the application is to be approved.

**6.35** The assessment manager should not approve development applications that do not achieve Outcomes 1 and 2 of the Guideline.

### Achieving Outcome 3

**Outcome 3: Wherever practicable, community infrastructure to which State Coastal Plan Policy 2.2.4 applies is located and designed to function effectively during and immediately after a storm tide inundation event commensurate with a specified level of risk.**

- 6.36** Outcome 3 applies to certain types of community infrastructure located anywhere within the coastal zone of the local governments listed in Table 1. These types of community infrastructure provide services vital to the well being of the community. It would be unrealistic to locate and design this community infrastructure to withstand any storm tide inundation event, so Appendix 5 sets out appropriate risk levels for differing types of community infrastructure and provides advice on assessing community infrastructure proposals against Outcome 3.
- 6.37** The State Coastal Plan policy 2.2.4 and this Guideline apply to the following types of community infrastructure (refer to A1.2 of Appendix 1):
- police and emergency services facilities including emergency shelters;
  - hospitals and associated institutions;
  - facilities for the storage of valuable records or items of cultural or historic significance;
  - state-controlled roads;
  - railway lines, stations and associated facilities;
  - aeronautical facilities;
  - works of an electricity entity under the Electrical Safety Act 2002; and
  - water cycle management infrastructure.
- 6.38** Valuable cultural or historical records are irreplaceable and they should not be exposed to undue risk from the natural hazard of storm tide inundation. The other types of community infrastructure listed above provide important emergency response or recovery roles, or provide transportation, communication links or service networks that are important to the safety, health and well being of the community.
- 6.39** Outcome 3 requires that, **wherever practicable**, these types of community infrastructure are located and designed to ensure resilience during and after a storm tide event up to and including the specified level of risk. This requirement applies regardless of which of the following mechanisms is used for the community infrastructure proposal:
- a development application under IDAS;
  - allocation of land in a planning scheme; or
  - designation of land for community infrastructure under section 2.6.7 of the IPA.
- 6.40** Appendix 5 of this Guideline contains Specific Outcomes against which a community infrastructure proposal must be assessed to determine achievement of Outcome 3.

## Mitigating the Adverse Impacts of Storm Tide Inundation

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- 6.41** There may be instances where the development proposal should proceed but it is not practicable to achieve the Specific Outcomes in Appendix 5 of this Guideline. For example, it may not be possible to achieve the level of immunity from storm tide inundation recommended in Appendix 5 because of other relevant considerations. These could include locational requirements such as the need to provide acceptable levels of service (e.g. response times) within service catchments and the need to balance competing demands for services and facilities throughout the coastal zone with available resource allocations.
- 6.42** Therefore, the assessment of community infrastructure proposals will need to be undertaken on the basis of the circumstances associated with individual proposals, and will involve the consideration of the following matters:
- the role and function of the infrastructure including during a storm tide event;
  - the potential impacts on the community should the infrastructure be operationally impaired by a storm tide hazard;
  - the cost and benefits of mitigation measures (including alternative locations) and the consequences of not requiring mitigation measures;
  - taking the foregoing into account, together with the resources and priorities of the responsible public sector entity, the level of protection from and resilience to storm tide inundation that is considered appropriate for the infrastructure; and
  - the requirements about works or the use of the land considered necessary to provide the appropriate level of protection from, and resilience to, the adverse impacts of storm tide inundation. These could include location, siting and design measures.
- 6.43** As a simple example, it would not be practicable to require a fire or police station to locate outside a natural hazard management area (storm tide) if this increases emergency response times and results in an overall increase in community risk. Similarly because network infrastructure (such as roads and electricity distribution networks) join fixed points (e.g. towns) there may be no alternative to traversing areas subject to storm tide hazard. As a result it will often not be practicable or cost-effective to achieve optimum levels of immunity from storm tide inundation for network infrastructure.
- 6.44** The responsibility for determining compliance with Outcome 3 will rest with either the assessment manager or the community infrastructure designator depending on which of the mechanisms outlined in paragraph 6.39 is used.
- 6.45** Certain types of community infrastructure proposals located in a natural hazard management area (storm tide) should achieve Outcomes 1, 2 and 3 (refer to A1.2 of Appendix 1).

## Mitigating the Adverse Impacts of Storm Tide Inundation

### 7 MAKING AND AMENDING PLANNING SCHEMES

- 7.1 In order to achieve Outcomes 4 to 6 of the Guideline, planning schemes should identify particular information and contain appropriate planning strategies and development assessment measures.

#### Achieving Outcome 4

**Outcome 4: Natural hazard management areas (storm tide) are identified in the planning scheme.**

- 7.2 State Coastal Plan policy 2.2.4 requires that when allocating new areas for urban development, local governments must assess the potential risk to life and property from the natural hazard of storm tide inundation.
- 7.3 A natural hazard management area (storm tide) should be identified through a comprehensive and detailed storm tide hazard assessment study, that also takes account of impacts from other physical coastal processes (e.g. erosion and sea level rise). This assessment should include mapping the natural hazard management area (storm tide) and may include the assessment of relative levels of severity. Appendix 2 provides advice on appropriate study approaches for defining a natural hazard management area (storm tide).
- 7.4 In assessing risks from storm tide inundation, the scope of studies will vary between local governments, and sometimes between different locations within the same local government area. The variation in study scope will depend on:
- the size and distribution of the population;
  - the degree of risk to people, property, the environment and economic activity, posed by development in areas affected by storm tide inundation;
  - the availability or difficulty of obtaining and analysing information; and
  - the capacity and resources of the local government.
- 7.5 The scope of studies to be undertaken will be determined by the local government in consultation with relevant state government departments during the process of making or amending planning schemes. The natural hazard management area (storm tide) should be clearly identified in the planning scheme through the use of techniques such as overlays, consistent with the approach and terminology suggested for planning schemes in the *IPA Plan Making Guideline 1/02* published by DLGP. The most appropriate presentation will depend on the structure and format of the particular planning scheme.
- 7.6 A natural hazard management area (storm tide) is based on a Defined Storm Tide Event (DSTE). Identifying the areas affected by a DSTE may require a specific storm tide assessment study for each locality or catchment area. It may not be cost-effective and practicable to conduct these studies for areas that are not subject to significant development pressures, especially in small and/or low-growth local governments. However, at a minimum, the natural hazard management area (storm tide) overlay should address all areas identified in the planning scheme as existing or proposed urban development, including rural residential.

## Mitigating the Adverse Impacts of Storm Tide Inundation

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### Achieving Outcome 5

**Outcome 5: The planning scheme contains planning strategies that aim to:**

- **ensure that development in the natural hazard management area (storm tide) is compatible with the severity of the storm tide hazard;**
- **minimise the impacts from storm tide hazard on existing developed areas;**
- **prevent development from materially increasing the extent or the severity of storm tide inundation;**
- **ensure that the growth of new urban areas occurs on land that is not affected by storm tide inundation.**

- 7.7** The planning scheme's land use strategies should give preference to future land uses that would achieve Outcomes 1-3. Public safety should be the main consideration in seeking to achieve these outcomes, with planning strategies devised to achieve optimum levels of safety within the planning scheme area.
- 7.8** Uses involving the actions or activities listed in Appendix 1 of this Guideline need to be considered when developing the land use strategy. When allocating land uses in the natural hazard management area (storm tide), planning schemes should give preference to those uses that are less susceptible to the risk posed by storm tide inundation and impose development requirements that lessen the risk of the hazard. Appendix 2 provides further advice on land uses that may be appropriate to various levels of severity of storm tide hazard.
- 7.9** In general, land use strategies that achieve Outcome 5 and State Coastal Plan Principle 2D would:
- not increase the number of people living, working or congregating in the natural hazard management area (storm tide); and
  - avoid the establishment or intensification of other uses or works that are likely to increase the adverse impacts of the storm tide inundation hazard.
- 7.10** In particular, uses such as residential development that are likely to materially increase the risks to life or personal property should be discouraged in the high storm tide hazard severity zone, unless the planning scheme includes clear mechanisms aimed at ensuring that appropriate levels of safety will be achieved through the development assessment process.
- 7.11** Where there are existing development commitments (for example, in areas of existing development), strategies that provide for lower risks from storm tide inundation without adversely affecting the development commitment could be considered. Strategies for achieving this could include:
- encouraging alternative uses that are less susceptible to the hazard; and
  - mechanisms for encouraging a high proportion of the total development onto those parts of the area that are least affected by the hazard.
- 7.12** Planning strategies should also seek to ensure development does not occur in a manner that is likely to result in an increase in the extent or severity of the storm tide inundation hazard. This element of planning applies both within and outside the natural hazard management area (storm tide).

## Mitigating the Adverse Impacts of Storm Tide Inundation

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- 7.13** Uses that would not detrimentally impede the flow of storm tide water and wave action should be encouraged in the high storm tide hazard zone. Suitable uses may include conservation areas, parks and low impact recreational uses.

### **Achieving Outcome 6**

**Outcome 6: The planning scheme measures:**

- a. include a code(s) designed to achieve development outcomes consistent with section 6; and**
- b. ensure that development to which State Coastal Plan policy 2.2.4 applies is assessable or self-assessable against that planning scheme code(s).**

**The planning scheme, or planning scheme policy(s), specifies the information expected to be submitted with development applications subject to the code(s)**

- 7.14** Detailed planning scheme measures should be prepared generally in accordance with the approach and terminology suggested for planning schemes in the *IPA Plan Making Guideline 1/02* published by DLGP.
- 7.15** The code may take the form of a specific storm tide inundation code or be incorporated into broader codes as appropriate.
- 7.16** Appendix 4 provides examples of Solutions that achieve the Specific Outcomes in Appendix 3 concerning compatible development within the natural hazard management area (storm tide). Appendix 5 provides similar information for the types of community infrastructure to which policy 2.2.4 applies. The Specific Outcomes and Solutions, suitably adapted to reflect local knowledge and conditions, could be used as a basis for the preparation of codes.
- 7.17** Planning scheme preparation will also involve the identification of appropriate levels of assessment for development within the natural hazard management area (storm tide). This could involve different levels of assessment for areas of different hazard severity and/or the linking of assessment levels to specific types of development such as those contained in Appendix 1 of this Guideline. Overlay mapping may be used to identify particular areas to be subject to assessment in relation to the management of storm tide inundation.

## Mitigating the Adverse Impacts of Storm Tide Inundation

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### 8 ROLES AND RESPONSIBILITIES

#### *Applicant/developer*

- 8.1 The applicant identifies the location of the natural hazard management area (storm tide) on the subject site and the severity of the hazard, demonstrates that the proposal achieves the relevant desired outcomes and incorporates appropriate management techniques into the development proposal.
- 8.2 The developer implements reasonable and relevant conditions of approval placed on the development approval.

#### *Local government/assessment manager*

- 8.3 Assessment managers have regard to State Coastal Plan policy 2.2.4 during development assessment. Assessment managers should impose reasonable or relevant conditions on development approvals to minimise risk from storm tide inundation and, should not approve development applications that are unable to achieve Outcomes 1 to 3 of this Guideline.
- 8.4 Local Governments appropriately reflect State Coastal Plan policy 2.2.4 in planning schemes by identifying the natural hazard management area (storm tide) and including suitable strategies and detailed measures to achieve the Outcomes.

#### *Queensland Environmental Protection Agency (EPA)*

- 8.5 The EPA in their role as a concurrence agency in the assessment of relevant development on land within the Coastal Management District and/or subject to a Coastal Building Line, must have regard to State Coastal Plan policy 2.2.4. The EPA should impose reasonable or relevant conditions on development approvals to minimise the risk of storm tide inundation, and should not recommend an approval of development applications that are unable to achieve Outcomes 1 to 3 of this Guideline.
- 8.6 The EPA reviews draft planning schemes to ensure that the State Coastal Plan has been appropriately reflected to achieve the State's interest in respect of storm tide inundation and conveys this advice to DLGP.
- 8.7 The EPA provides advice on interpretation and implementation of the State Coastal Plan and should be consulted by local governments about integrating the State Coastal Plan, including the specific requirements in this Guideline, into planning schemes.

#### *Queensland Department of Local Government, Planning, Sport, and Recreation (DLGPSR)*

- 8.8 The DLGPSR, in conjunction with other State Agencies, reviews planning schemes and amendments to ensure that the State Coastal Plan has been appropriately reflected into planning schemes.

## Mitigating the Adverse Impacts of Storm Tide Inundation

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### ***Minister designating and/or developing community infrastructure***

- 8.9** The designator has regard to the State Coastal Plan to ensure the policy direction of the State Coastal Plan, including the specific requirements of this Guideline, is achieved in relation to the specified types of community infrastructure.

### ***Community***

- 8.10** The community has a role in providing input into disaster risk management studies, the preparation of planning schemes and comment in relation to development applications.

## Mitigating the Adverse Impacts of Storm Tide Inundation

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### 9 GLOSSARY

**Annual Exceedence Probability (AEP):** The likelihood of occurrence of a storm tide event of a given height or higher in any one year; usually expressed as a percentage. For example, if a 2m storm tide water level has an AEP of 5 percent, it means that there is a 5 percent risk (i.e. probability of 0.05 or a likelihood of 1 in 20) of a 2m storm tide or higher occurring in any one year. The AEP of a storm tide event gives no indication of when another of that height will occur next.

**Australian Height Datum (AHD):** Australian Height Datum (AHD) is the datum (adopted by the National Mapping Council of Australia) to which all vertical control for mapping is to be referred.

**Climate change:** A change of climate, which is attributed directly or indirectly to human activity which alters the composition of the global atmospheres, and is in addition to natural climate variability observed over comparable time periods.

**Coastal hazards:** For the purposes of this Guideline, a coastal hazard is defined as a natural hazard occurring exclusively on the coast. Coastal hazards include storm tide inundation, beach erosion, coastline recession, coastal cliff erosion and sand drift. Coastal hazards in Queensland are often related to severe storm events such as tropical cyclones. These events produce storm surges and high wave conditions, along with extreme winds and high rates of rainfall.

**Coastal processes:** Natural processes of the coast including: sediment transport; fluctuations in the location and form of the foreshore, dune systems and associated ecosystems; tides; changes in sea level and coastal hazards; ecological processes (e.g. migration of plant and animal species); and the natural water cycle (e.g. coastal wetlands' role in nutrient filtration and flood mitigation).

**Coastal zone:** coastal waters and all areas to the landward side of coastal waters in which there are physical features, ecological or natural processes or human activities that affect, or potentially affect, the coast or coastal resources (s 11 *Coastal Protection and Management Act 1995*).

**Defined Storm Tide Event (DSTE):** The storm tide level adopted by a local government for the management of a particular locality.

**Development commitment:** includes any of the following:

- Development with a valid development approval;
- Development clearly consistent with the relevant zone (or equivalent) in a planning scheme (but not including a designation in a forward planning document such as a strategic plan or development control plan under a transitional planning scheme);
- A subdivision or other reconfiguration of allotment boundaries consistent with the requirements of the relevant planning scheme; or
- Development consistent with a designation for community infrastructure.

**Emergency rescue area:** A predetermined area from which people can be safely rescued in the event of an emergency. An emergency rescue area should comprise a Final Approach and Take Off Area (FATO) with a minimum diameter of 30m that is level and free from obstacles likely to interfere with the manoeuvring of a helicopter with a total length of up to 15m. The FATO should be located above the DSTE or the Recommended Storm Tide Event Level (RSTEL) that applies to the particular development and should be provided with an adjoining Obstacle Limitation Area (OLA) in accordance with the requirements set out in the *Guidelines for the establishment and use of helicopter landing sites*, CAAP

## Mitigating the Adverse Impacts of Storm Tide Inundation

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92-2(1), Air Services Australia, Civil Aviation Safety Authority Australia (CASA). When not required for emergency rescue purposes area may be used for other purposes such as parking or recreation.

**Hazardous materials in bulk:** Hazardous materials as defined in the *Dangerous Goods Safety Management Act 2001* (except that radioactive substances and infectious substances<sup>3</sup> are excluded for the purposes of this State Coastal Plan Guideline) in quantities that:

- would be equivalent to or exceed the minimum quantities set out to determine a Large Dangerous Goods Location in the *Dangerous Goods Safety Management Regulation*; or
- would require a licence for a magazine for the storage of an explosive under the *Explosives Regulation 1955*.

**Highest Astronomical Tide (HAT):** The highest water level that can be predicted to occur under average meteorological conditions and any combination of astronomical conditions.

**High water mark:** The ordinary high water mark at spring tides (see also mean high water springs) (schedule 2 of the *Coastal Protection and Management Act 1995*)

**IDAS:** Integrated Development Assessment System (IDAS) is a framework that establishes a common statutory system under Chapter 3 of the *Integrated Planning Act 1997* for making, assessing and deciding development applications, regardless of the nature of development, its location in Queensland or the authority administering the regulatory control.

**Natural Hazard Management Area (storm tide):** An area that has been defined for the management of storm tide hazard, but may not reflect the full extent of the area that may be affected by storm tide inundation (e.g. land above the Defined Storm Tide Event may become inundated during a larger event.)

**Recommended Storm Tide Event Level (RSTEL):** The storm tide event level identified in Appendix 5 of this guideline that is recommended for particular types of community infrastructure.

**Safe refuge:** A room or area specially designed and constructed to provide protection for people during a natural hazard event.

**Storm surge:** A storm surge is a localized increase in ocean water levels caused by high winds and reduced atmospheric pressures associated with a storm event. Very severe tropical cyclones can generate surges of up to 6 metres in height and affect large sections of coastline.

**Storm tide:** The effect on coastal water of a storm surge combined with the normally occurring astronomical tide, including wave setup.

**Unacceptable risk:** A situation where people or property are exposed to a predictable hazard event that may result in serious injury, loss of life, failure of community infrastructure, or property damage that would make a dwelling unfit for habitation.

<sup>3</sup> Radioactive substances are appropriately managed under the *Radiation Safety Act 1999*, and facilities dealing with infectious substances are subject to Australian Standards and the Office of Gene Technology.

## Mitigating the Adverse Impacts of Storm Tide Inundation

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**Vegetation clearing:** Removing or cutting down, ringbarking, pushing over, poisoning or in any way destroying a tree, shrub or other plant (other than grass), but does not include:

- Lopping, pruning or mowing for maintenance purposes;
- Work associated with management practices for the conduct of an agricultural or forestry use;
  - ❖ Clearing for essential management including:
    - ❖ To establish or maintain a firebreak to protect a building, property boundary or paddock;
    - ❖ To ensure the safety of people or property from hazardous vegetation;
    - ❖ To maintain an existing fence, stockyard, shed, road or other built infrastructure; or
    - ❖ To maintain a garden or orchard.

**Wave setup:** An increase in the mean water level towards the shoreline caused by wave action. It can be very important during storm events as it results in a further increase in water level above the tide and surge levels.

**APPENDIX 1: DEVELOPMENT TO WHICH STATE COASTAL PLAN POLICY 2.2.4  
'COASTAL HAZARDS' APPLIES**

**A1.1** In a natural hazard management area (storm tide) including **material changes of use** and **reconfigurations of a lot** that:

1. increase the number of people living or working in the natural hazard management area (e.g. residential development, shopping centres, tourist facilities, industrial or commercial uses) except where the premises are only occupied on a short-term or intermittent basis (e.g. by construction/maintenance workers); **or**
2. involve institutional uses where evacuating people may be particularly difficult (e.g. hospitals, educational establishments, child care, aged care, nursing homes and high security correctional centres); **or**
3. involve the manufacture or storage of hazardous materials in bulk ; **or**
4. involve building or other work that involves any physical alteration to land within high hazard areas as an intrinsic element of the development proposal.

**AND**

**A1.2** Throughout the Queensland coastal zone to the following types of **community infrastructure** that provide services vital to the well-being of the community:

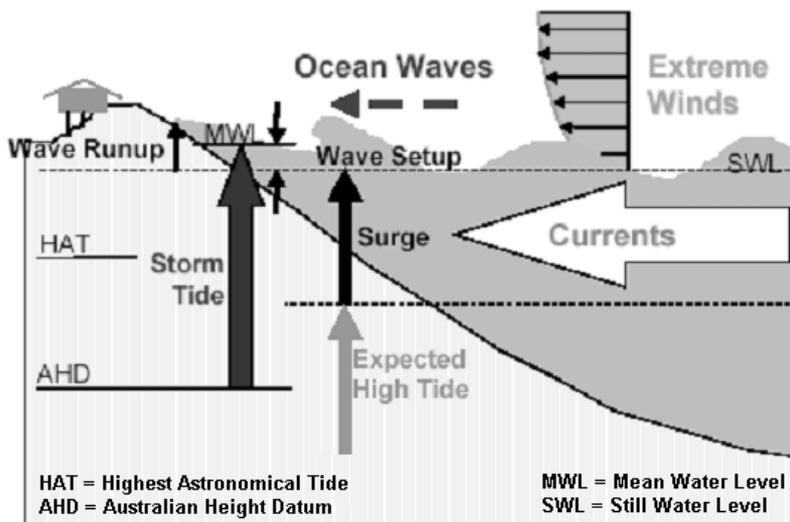
1. police and emergency services facilities including emergency shelters;
2. hospitals and associated institutions;
3. facilities for the storage of valuable records or items of cultural or historic significance<sup>4</sup>
4. state-controlled roads;
5. railway lines, stations and associated facilities;
6. aeronautical facilities;
7. works of an electricity entity under the Electrical Safety Act 2002; and
8. water cycle management infrastructure.

<sup>4</sup> Including facilities for the storage of public records under the *Public Records Act 2002*.

**APPENDIX 2: DEFINING A NATURAL HAZARD MANAGEMENT AREA (STORM TIDE)**

**Key characteristics of storm tide inundation in Queensland**

**A2.1** A storm tide is the effect on coastal water of a storm surge combined with the normally occurring astronomical tide, including wave setup.



**Storm tide = astronomical tide + storm surge + wave setup**  
(Queensland Climate Change and Community Vulnerability to Tropical Cyclones: Ocean Hazards Assessment - Stage 1, 2001)

- A2.2** The actual level reached by a storm tide is dependant on the height and the relative timing of the local astronomical tide. In some situations, a storm surge will coincide with low tide conditions and the resultant storm tide may be a minor hazard only. However, there is potential for very dangerous flooding of low-lying coastal land across a large proportion of the Queensland coast that can affect communities.
- A2.3** Storm tide inundation is likely to occur when the total water level exceeds the Highest Astronomical Tide (HAT). The mechanism of inundation includes the breaching of dunes or coastal protection structures and overbank flows from watercourses and/or storm water drains.
- A2.4** The inundation effects of a storm tide are exacerbated by wave overtopping and localised intense rainfall which can cause coincident freshwater flooding. Breaking waves and wave “run-up” can also contribute to the storm tide level and the overall hazard at exposed coastal locations. Damage to infrastructure and/or beach erosion, including loss of private property, can be caused by wave action and extreme water levels associated with severe events.
- A2.5** The peak storm surge of a coast-crossing tropical cyclone occurs close to the edge of the cyclone “eye” near to the time of landfall. The surge appears as a very fast rising tide that is usually accompanied by high wind speeds.

## Mitigating the Adverse Impacts of Storm Tide Inundation

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### What is a natural hazard management area (storm tide)?

- A2.6** The intent of State Coastal Plan policy 2.2.4 'Coastal hazards' is that the natural hazard management area for storm tide inundation should be evaluated through a hazard assessment study, that includes the mapping of storm tide hazard areas. Outcome 4 of this Guideline articulates the intent of policy 2.2.4 and requires identification of a natural hazard management area (storm tide) when planning schemes are made or amended.
- A2.7** A natural hazard management area (storm tide) is the area of the coast inundated by the Defined Storm Tide Event DSTE i.e. the storm tide level adopted by local government for management of a particular locality. Consistent with the State Planning Policy 1/03: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*, the preferred basis for determining the natural hazard management area (storm tide) is the 1 percent Annual Exceedence Probability (AEP) event (including appropriate allowances for future sea level rise and wave setup effects). However, it may be more appropriate to adopt a different DSTE depending on the circumstances of particular localities. In the absence of any other information, a default DSTE is defined in Section 5.6
- A2.8** The management of storm tide risk is distinctly different to the management of flooding primarily because storm tide inundation occurs during the peak of a storm at the same time a severe wind hazard is also occurring and an evacuation response is unlikely possible. It therefore could be argued that the preferred basis for determining the DSTE should be a less frequent event than the 1 percent AEP event, which is commonly adopted for flood risk management. Local governments should consider defining a natural hazard management area (storm tide) based on a DSTE corresponding to an event with a lower probability (ie. more extreme) than the 1 percent AEP. In each case, the determination of the DSTE should be based on a rational appraisal of the impacts of storm tide inundation and the social and economic benefits of development.
- A2.9** Within the natural hazard management area (storm tide), low and high hazard severity zones should also be defined. The intent of defining the high hazard zone is to recognise the increased threat to public safety and the potential for loss or damage to property and structures caused by wave impacts and/or high velocity flows. The high hazard zone is where a significant discharge of water and/or dangerous breaking waves occur during the DSTE. Determination of the high hazard zone requires considerable detailed information on the predicted characteristics and likely effects of a storm tide inundation event within a particular locality. Further guidance to enable the delineation of the various levels of hazard severity is provided in later sections.

### Methodology for determining natural hazard management area (storm tide)

- A2.10** Based on the principles set out in *Floodplain Management in Australia: Best Practice Principles and Guidelines*, *SCARM Report 73*, *CSIRO Publishing* (the SCARM Report), the natural hazard management area (storm tide) should be determined in conjunction with the development of a comprehensive management plan. However some elements of the recommended approach of the SCARM report are not relevant to the management of storm tide inundation.
- A2.11** Steps 1 – 4 outlined below comprise the recommended study approach for determining a natural hazard management area (storm tide).

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### **Step 1: Establishment of an advisory committee**

- A2.12** An advisory committee should be established to assist local governments to develop and implement a plan for the management of the area potentially affected by storm tide. The committee should comprise a balanced mix of elected, administrative and community representatives.
- A2.13** Local government should carefully consider how it consults with the community, the need for, the composition of and the terms of reference for a committee.

### **Step 2: Carrying out a storm tide hazard study**

- A2.14** The objective of a storm tide hazard study is to define the nature and extent (i.e severity) of the storm tide hazard across all potentially affected areas.
- A2.15** To determine the nature of the storm tide hazard, a storm tide hazard study would generally comprise the following two components (i) assessment of extreme coastal water levels; and (ii) hydraulic analysis. It is noted that the two components may be inter-related. It is common practice to consider the two separately, however there may be some advantages in the integration of the modelling of coastal hydrodynamics and the overland flooding.

#### **i) Assessment of Extreme Coastal Water Levels**

- A2.16** Historical records of storm tide events for a particular locality are generally either non-existent or very limited. Accordingly a statistical description of water levels utilising extreme value analysis of recorded data is generally not possible.
- A2.17** The assessment normally requires the simulation of the storm tide climate through numerical modelling techniques. This modelling is a specialist task and incorporates the following:
- a representation of tropical cyclone wind fields;
  - simulation of the coastal hydrodynamics forced by the storm including storm surge and wind waves;
  - simulation of nearshore processes, particularly the generation of wave setup;
  - the variation of the normal astronomical tide;
  - the random occurrence of storm events over an extended period of time in accordance with the storm climatology of the region. Assessment of the storm climatology should consider all available data sources; and
  - a statistical analysis of extreme coastal water levels.
- A2.18** A detailed discussion of aspects of this type of numerical modelling study is provided by Systems Engineering Australia, 2001: *Queensland climate change and community vulnerability to tropical cyclones, Ocean hazards assessment – Stage 1* (Report prepared for the Dept of Natural Resources and Mines, the Department of Emergency Services, the Environmental Protection Agency, and the Australian Bureau of Meteorology, Queensland).  
<http://www.longpaddock.qld.gov.au/ClimateChanges/pub/OceanHazardsMenu.html>
- A2.19** In open coast areas, the effect of wave setup should be incorporated into the assessment. Depending on its relative importance and the resources available to the study, this may be done by:
- wave and wave setup modelling added into the storm tide climate modelling as outlined above; or

## Mitigating the Adverse Impacts of Storm Tide Inundation

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- adding a constant value allowance.

**A2.20** Wave runup and overtopping can also potentially contribute to flooding effects and property damage. It is possible that, where extreme wave conditions are generated, considerable coastal flooding could occur without a storm tide actually exceeding the height of the frontal dune or barrier. US Federal Emergency Management Agency Guideline (April 2003) provides guidance on the consideration of wave runup and overtopping. ([www.fema.gov/pdf/fhm/frm\\_gsad.pdf](http://www.fema.gov/pdf/fhm/frm_gsad.pdf))

**A2.21** For planning purposes, an allowance for future sea level rise should be included in the determination of the DSTE. In addition it may be appropriate to consider climate change effects on the future storm climatology. Little is known about the likely effects of Greenhouse climate change on the frequency and intensity of extreme storm events. It is prudent to adopt some appropriate assumptions, such as:

- a southward latitude shift in the tropical cyclone climate;
- an increased frequency of events; and/or
- an increase in the maximum potential intensity (MPI) tropical cyclone for the region.

**A2.22** A number of existing studies are available to enable reasonable estimation of appropriate levels for many affected localities.

**A2.23** Outcomes of this phase of the study would include:

- storm tide statistics for a series of locations within the study area;
- an estimate of the joint probability of extreme waves and storm tide water levels. At the very least the study should estimate a design near-shore wave height condition for the DSTE; and
- the relative contribution to the total water level from Greenhouse climate change and wave setup components.
- an estimate of wave runup in the study area for design purposes.

### **ii) Hydraulic Analysis**

**A2.24** Storm tide inundation is expected to occur in two modes:

- foreshore inundation (i.e. breaching of the frontal dune, overtopping of protection structures); and
- overbank flows from tidal watercourses.

### ***Numerical modelling***

**A2.25** Assessment requires a good understanding of the hydraulic behaviour of the overland flow. This in turn requires detailed knowledge of the local topography and potential flow paths. Assessment (numerical modelling) should take into account:

- the effects of blockages and roughness elements e.g. houses, vegetation, fencing;
- the propagation of waves across inundated land;
- local storm water flows;
- allowance for dune breach and erosion processes; and
- additional discharge due to wave overtopping.

**A2.26** As a starting point, accurate topographic information within critical coastal areas should be collected. This should allow mapping of local contours to a resolution of 0.25m, or better, and include tidally connected watercourses.

## Mitigating the Adverse Impacts of Storm Tide Inundation

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**A2.27** The modelling would examine a range of events from the DSTE, or lower, through to the Probable Maximum Storm Tide Event. Outcomes of the modelling should include:

- the extent of inundation;
- flow velocities and depths of inundation through the study area; and
- information on breaking wave heights in areas close to the open coast.

### ***Alternatives to numerical modelling***

**A2.28** Some local governments may not be able to justify the effort and expense of a fully detailed storm tide inundation study. A simplified approach may provide a reasonable approximation for planning purposes.

**A2.29** Storm tide statistics for a particular locality can be interpolated from published study data. These include Harper (1999)<sup>5</sup> and James Cook University (2004)<sup>6</sup>. These sources also provide estimates for appropriate wave setup values however generally lack detailed information on wave conditions expected in conjunction with the DSTE.

**A2.30** As a first approximation, the area of inundation expected during a storm tide event can be determined from topographic data by simply assuming a horizontal water level from the coast. For example a 4m AHD storm tide would inundate all land to the 4m contour. Care should be taken to ensure that all areas below the selected level would actually flood – some low lying regions may not be directly connected to the storm tide, either from the coast or tidal waterways.

### **Extent or severity of storm tide hazard**

**A2.31** Determining the extent or severity of storm tide hazard is of considerable significance to the appropriateness or otherwise of various land uses. Careful consideration of land use in relation to the expected severity of the hazard maximises the benefits of coastal land and minimises the risks to people and property. The degree of storm tide hazard varies across the affected area in response to the following factors:

- depths of inundation;
- flow velocities; and
- wave heights.

**A2.32** The SCARM report presents a table outlining appropriate land uses across a floodplain in accordance with the severity of a flood hazard. The degree of the flood hazard is determined from an analysis of the effects of flow depth and velocity, particularly relating to the damage potential to structures and the ability of people and vehicles to move through the floodwaters to reach safety. The SCARM report also indicates that overland flooding caused by heavy rainfall can occur at the same time as storm tide

<sup>5</sup> Harper B.A. (1999) Storm tide threat in Queensland: History, prediction and relative risks. Conservation Technical Report No. 10, *Dept of Environment and Heritage*, Jan, ISSN 1037-4701.

<sup>6</sup> James Cook University (2004) - *Queensland Climate Change and Community Vulnerability to Tropical Cyclones, Ocean Hazards Assessment - "The Frequency of Surge Plus Tide During Tropical Cyclones for Selected Open Coast Locations Along the Queensland East Coast" and "Tropical Cyclone-Induced Water Levels and Waves: Hervey Bay and Sunshine Coast"*. (<http://mmu.jcu.edu.au/atlas/atlas.shtml>)

## Mitigating the Adverse Impacts of Storm Tide Inundation

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inundation. Consequently, it may also be appropriate to undertake an assessment of the joint probability of overland flooding and storm tide inundation in order to determine the resultant flood severity.

**Mitigating the Adverse Impacts of Storm Tide Inundation**

**A2.33** The approach given in the SCARM report is not entirely appropriate to the assessment of storm tide hazard, as it is unlikely that people or vehicles would be attempting evacuation during the peak storm conditions. The severity level for a storm tide hazard should instead focus on the effects of high flow velocities and breaking waves on the stability of structures. Suggested storm tide hazard severity zones are defined as follows:

- **Low** – The inundation depth is less than 1m with wave heights less than 0.9m, and the product of depth x velocity is less than 0.3m<sup>2</sup>/s.
- **High** – Most residential structures will incur moderate to severe damage. The inundation depth is 1m or more with breaking waves of 0.9m or higher, and/or peak flows with a product of depth x velocity of 0.3m<sup>2</sup>/s or greater.

**A2.34** Table A2.1 shows appropriate land uses for the various levels of storm tide hazard severity.

**Table A2.1 Appropriate land uses for storm tide hazard severity**

Severity level	
High	Low
<ul style="list-style-type: none"> <li>▪ Conservation</li> <li>▪ Open Space</li> <li>▪ Recreation</li> <li>▪ Rural*</li> </ul>	<ul style="list-style-type: none"> <li>▪ Conservation</li> <li>▪ Open Space</li> <li>▪ Recreation</li> <li>▪ Rural</li> <li>▪ Residential*</li> <li>▪ Caravan parks*</li> <li>▪ Commercial*</li> <li>▪ Industrial*</li> <li>▪ Clubs*</li> <li>▪ Schools*</li> <li>▪ Public institutions</li> <li>▪ Local government</li> <li>▪ Police</li> </ul>
<p>* with special controls, such as those presented in Appendix 4 of this Guideline.</p>	

**Note 1:** *Some high impact rural uses such as intensive animal husbandry (e.g. feed lots and poultry farms) involve the provision of structures and storage of materials and chemicals which could present a hazard in times of storm tide inundation and may only be acceptable subject to special controls.*

**Note 2:** *Not all forms of recreation or open space are suitable for location in the natural hazard management area (storm tide). Appropriate land assessment and planning should be undertaken.*

**Source:** *Adapted from Figure 1, Floodplain Management in Australia, Best Practice Principles and Guidelines, Standing Committee Agriculture and Resource Management (SCARM), Report No. 73.*

## Mitigating the Adverse Impacts of Storm Tide Inundation

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### **Step3: Carrying out a Storm Tide Management Study and preparation of a Storm Tide Management Plan**

- A2.35** A storm tide management study is analogous to the concept of a floodplain management study described by the SCARM report. The purpose is to use storm tide hazard information and information on current and potential future land uses in the affected areas to determine:
- the impacts for existing land uses in the affected area;
  - how those impacts can be managed; and
  - how best to manage future development.
- A2.36** A storm tide management study is the preferred method to determine the DSTE(s) within a local government area. Following the sourcing of adequate storm tide hazard information (as discussed above) the storm tide management study would comprise the following steps:
- damage assessment for a range of storm tide events;
  - community (people) vulnerability assessment;
  - economic impact assessment (if considered significant enough to separate from damage assessment);
  - assessment of development scenarios;
  - assessment of storm tide mitigation scenarios;
  - recommend a storm tide mitigation program; and
  - determine a DSTE(s) based on an acceptable level of risk.
- A2.37** In many instances this logical progression may not be appropriate because of overriding local preconditions. For example, there may be a pre-existing DSTE or development may be constrained in some areas by other factors.
- A2.38** Having undertaken a storm tide management study an appropriate DSTE can be determined for each locality in the affected area. The key issues to be considered include:
- potential economic and social impacts of a range of storm tide events;
  - community desires and expectations;
  - environmental values of the coastal zone;
  - consistency with adopted DSTEs in adjoining localities;
  - emergency response requirements eg. requirements for evacuation routes, refuges, recovery measures; and
  - management and mitigation measures.
- A2.39** An important outcome from a storm tide management study is the determination of the extent of the High hazard severity zone (the “wave zone”) during the DSTE. Given the results of a detailed storm tide hazard study, the wave zone can be determined from the adoption of appropriate hydrodynamic criteria. The suggested criteria (as discussed above) is an inundation depth of 1m or more with breaking waves of 0.9m or higher and/or peak flows with a product of depth x velocity of 0.3 m<sup>2</sup>/s or greater.
- A2.40** In many cases detailed information on storm wave conditions and wave propagation across affected areas may not be available. In these cases, as a first approximation, the extent of the wave zone can be estimated as the area in which the depth of inundation at the DSTE exceeds 1m and is directly adjacent to the open coast. A consideration of potential dune breach and erosion processes, including potential failure of existing coastal protection structures, should also be taken into account.

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**A2.41** Following on from the storm tide management study, a storm tide management plan would develop a local storm tide management policy and hydrodynamic assessment criteria. In any given locality the factors that affect storm tide risk and the way it is managed will differ. Factors such as the existing level of risk, the opportunity to influence development due to growth, the availability of detailed storm tide hazard information, environmental considerations and community aspirations will all influence the amount of work required to formulate an appropriate storm tide management plan.

### ***Alternatives to storm tide management plans***

**A2.42** *Limited potential for growth in areas at risk of storm tide inundation:*

Where the potential for new development in low lying coastal areas is small, the effort and expense of a comprehensive storm tide management planning process may not be justified. Nonetheless, development controls that adequately deal with potential storm tide risks need to be in place. In this case a natural hazard management area (storm tide) and a DSTE based on readily available storm tide statistics without a detailed hydraulic study could be justified. Similarly, the approximate method for the determination of the wave zone outlined above could be adopted.

**A2.43** *Existing knowledge of community aspirations:*

There may be circumstances where a community has clearly indicated the level of storm tide risk they will accept and this has been communicated to the local government. In this case, extensive community consultation aimed at determining acceptable risk may not be required. Caution must be exercised here because:

- it is unlikely that the “community view” will be totally unanimous and hence a number of people may feel disenfranchised by a simple acceptance of the (believed) current majority view;
- community acceptance is often predicated on the level of appreciation of storm tide impacts and the extent to which individuals understand and accept how an event will actually affect them.
- the current community view of risk acceptance will have resulted from the level of available storm tide hazard information and the experience of that community.

**A2.44** A severe storm tide event has not occurred in Queensland for many decades and a very large proportion of coastal residents have never experienced the landfall of a severe tropical cyclone of Category 3 or higher.

### **Step 4: Adoption and implementation of the storm tide management plan**

**A2.45** The storm tide management plan should set out the results of studies, links to counter disaster plans and include recommended planning responses. The development of appropriate planning scheme outcomes and measures for flooding is one result of the adoption of the storm tide management plan.

**APPENDIX 3: DEVELOPMENT COMPATABILITY IN A NATURAL HAZARD MANAGEMENT AREA (STORM TIDE)**

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**Specific outcomes for the natural hazard of storm tide inundation**

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1. Development maintains the safety of people on the development site from storm tide inundation up to and including the Defined Storm Tide Event.
  2. Development does not increase the severity of the storm tide hazard on adjacent properties.
  3. Development minimises the potential damage from storm tide inundation to property on the development site. In particular, building work within existing undeveloped areas of high storm tide hazard area is not considered to be compatible with the nature of the hazard.
  4. Public safety and the environment are not adversely affected by the detrimental impacts of storm tide inundation on hazardous materials manufactured or stored in bulk.
  5. Essential services infrastructure (e.g. on-site electricity, gas, water supply, sewerage and telecommunications) maintains its function during a Defined Storm Tide Event.
  6. Physical coastal processes are protected from development impacts and are generally allowed to occur naturally.
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## APPENDIX 4: DEVSING DETAILED MEASURES TO ACHIEVE OUTCOME 1

- A4.1** The following material is not intended to be incorporated directly into a planning scheme, but should be used to help devise appropriate detailed measures for achieving Outcome 1, and integrating those measures with other provisions of the planning scheme. Where the Guideline has not been appropriately reflected in a planning scheme, this appendix should be used to assist in interpreting the State Coastal Plan Policy 2.2.4 in development assessment.
- A4.2** This appendix refers to scheme measures in terms of overlays and associated assessment criteria, and is consistent with the approach and terminology suggested for planning schemes in the IPA Plan Making Guideline 1/02 published by the Department of Local Government and Planning.
- A4.3** The natural hazard management areas (storm tide) relevant to the particular local government should be mapped on overlays.
- A4.4** Depending on the circumstances in a particular local government area and the organisation of the scheme provisions, there are different ways to incorporate the overlay provisions for storm tide issues in a planning scheme. For example:
- both the triggers for assessment and the assessment criteria may be dealt with **separately** through overlay assessment tables and associated assessment criteria; **or**
  - both the triggers for assessment and the assessment criteria may be **integrated** within one or more zone tables and their associated assessment criteria; **or**
  - the **triggers for assessment may be integrated** with the assessment tables for one or more zones, but the **assessment criteria are located separately**.
- A4.5** The table below sets out the following information:
- **Column 1: Development the scheme should make assessable or self-assessable**  
Appendix 1 of this Guideline describes the types of development that should be made assessable or self-assessable by the planning scheme. Local governments can decide which of these assessment categories should be applied to particular types of development. Whether development is made assessable or self-assessable depends on whether it is possible to identify all relevant assessment criteria in a precise way that does not require any interpretation or discretion. If that is possible, self-assessable is the appropriate assessment category.
  - **Column 2: Specific Outcomes**  
These specific outcomes are used for assessing the compatibility of development in natural hazard management areas.
  - **Column 3: Solutions**  
These solutions provide the basis for a local government to devise solutions and acceptable solutions for the planning scheme code(s) in the context of the planning scheme area. A solution can be made an acceptable solution when it can be refined in a way that results in precise criteria requiring no exercise of discretion to determine whether a development proposal complies.
  - **Column 4: Comments**  
This column provides advice about:
    - interpreting the assessment criteria;
    - what information is likely to be required to enable an adequate assessment; and
    - information about, or cross references to, other relevant matters.

**APPENDIX 4: DEVISING DETAILED MEASURES TO ACHIEVE OUTCOME 1**

Type of development made assessable or self-assessable	Specific Outcomes	Solutions	Comments [if applicable]
<p><b>Material changes of use and associated reconfigurations of a lot that:</b></p> <ul style="list-style-type: none"> <li>▪ increase the number of people living or working in the natural hazard management area (e.g. residential development, shopping centres, tourist facilities, industrial or commercial uses) except where the premises are occupied on a short-term or intermittent basis (e.g. by construction/maintenance workers, certain agricultural and forestry workers); <b>or</b></li> <li>▪ involve institutional uses where evacuating people may be particularly difficult (e.g. hospitals, education establishments, child care, aged care, nursing homes and high security correctional centres); <b>or</b></li> <li>▪ involve the manufacture or storage of hazardous materials in bulk; <b>or</b></li> <li>▪ would involve the building or other work that involves any physical alteration to land (other than the placement of topsoil not exceeding 100mm in depth) within high hazard zone as an intrinsic element of the</li> </ul>	<p><b>1.</b> Development maintains the safety of people on the development site from all storm tide inundation up to and including the DSTE.</p>	<p><b>1.1</b> Development is sited on land that would not be subject to inundation during the DSTE <b>OR</b></p> <p><b>1.2</b> There is no increase in the number of people living or working on the site, except where the premises are occupied on a short-term or intermittent basis (e.g. by construction/maintenance workers, certain agricultural and forestry workers) <b>OR</b></p> <p><b>1.3 For residential development:</b></p> <ul style="list-style-type: none"> <li><b>a)</b> dwellings are sited so that the floors of all habitable rooms can be located above the DSTE level and are not located within high hazard zone; <b>and</b></li> <li><b>b)</b> development would not significantly affect counter-disaster operations.</li> </ul> <p><b>OR</b></p> <p><b>1.4 For non-residential development and development involving temporary or moveable residential structures (e.g. caravan parks and camping grounds):</b></p> <ul style="list-style-type: none"> <li><b>a)</b> temporary residential structures are not located within high hazard zone; <b>and</b></li> <li><b>b)</b> buildings are located and</li> </ul>	<p><b>Note for 1.1:</b> If the development proposal complies with this Solution no further assessment is required in relation to storm tide hazard</p> <p><b>Note for 1.1 and 1.3:</b> A storm tide assessment report may be necessary to demonstrate compliance to the satisfaction of the assessment manager (or designator). The assessment report should include an assessment of the development proposal against these outcomes and solutions, and may require a specific hydraulic investigation undertaken by suitably qualified professional engineer.</p> <p><b>Note for 1.3 a):</b> The definition of habitable rooms is in the Building Code of Australia. Designing dwellings to achieve this requirement may have siting and height implications addressed by separate codes in the planning scheme.</p> <p><b>Note for 1.3 b) and 1.4 c):</b> This solution may include provision for a safe refuge for all people within the development site. Safe refuge is defined in Section 9 Glossary.</p> <p><b>Note for 1.4 b):</b> Local governments may also specify a freeboard level for non-habitable parts of a building, but that</p>

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intrinsic element of the development proposal.		<p>designed so that floor levels (except areas used for car parking) are at or above the DSTE level; <b>and</b></p> <p>c) development would not significantly affect counter-disaster operations.</p>	habitable parts of a building, but that level should not exceed that required for habitable rooms.
Type of development made assessable or self-assessable	Specific Outcomes	Solutions	Comments [if applicable]
	<p><b>2.</b> Development does not increase the severity of the storm tide hazard on adjacent properties</p>	<p><b>2.1</b> Works do not involve any physical alteration to the high hazard zone, including vegetation clearing.</p> <p style="text-align: center;"><b>OR</b></p> <p><b>2.2</b> The proposed works do not change the storm tide inundation characteristics at the DSTE outside the subject site in ways that result in:</p> <ul style="list-style-type: none"> <li>▪ acceleration of flows; <b>or</b></li> <li>▪ increase of local water levels; <b>or</b></li> <li>▪ increase of breaking wave heights</li> </ul>	<p><b>Note for 2.1:</b> See Section 9 Glossary for a definition of vegetation clearing.</p>

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Type of development made assessable or self-assessable	Specific Outcomes	Solutions	Comments [if applicable]
	<p><b>3.</b> Development minimises the potential damage from storm tide inundation to property on the development site. In particular, building work within existing undeveloped areas in the high storm tide hazard zone is not considered to be compatible with the nature of the hazard.</p>	<p><b>3.1</b> Development involving building work on undeveloped land is not sited within the high storm tide hazard zone. <b>AND</b> <b>3.2</b> Dwellings are sited so that the floors of all habitable rooms can be located above the DSTE level. <b>AND</b> <b>3.3</b> Building work is designed and constructed to resist hydrostatic and hydrodynamic forces as a result of inundation by the DSTE <b>AND</b> <b>3.4</b> Moveable residential structures are registered and maintained for road use.</p>	<p><b>Note for Specific Outcome 3:</b> No minimum floor levels are being <b>required</b> for commercial and industrial development. There may be commercial considerations that justify the “commercial risk” associated with the potential damage to property. Such commercial risk considerations are best addressed through a comprehensive storm tide management plan. Local governments may specify minimum floor levels for non-habitable rooms where this is considered appropriate to the storm tide characteristics of the locality. However, the freeboard levels should not exceed those for habitable rooms.</p> <p><b>Note for 3.1:</b> The definition of habitable rooms is in the Building Code of Australia. Designing dwellings to achieve this requirement may have siting and height implications addressed by separate codes in the planning scheme.</p>
	<p><b>4.</b> Public safety and the environment are not adversely affected by the detrimental impacts of storm tide inundation on hazardous materials manufactured or stored in bulk.</p>	<p><b>4.1</b> The manufacture or storage in bulk of hazardous materials takes place above the DSTE level. <b>OR</b> <b>4.2</b> Structures used for the manufacture or storage of hazardous materials in bulk are not located within the high hazard zone and are designed to prevent the intrusion of floodwaters.</p>	<p><b>Note for 4:</b> “Hazardous materials in bulk” is defined in Section 9 - Glossary of this Guideline</p>

Type of development made assessable or self-assessable	Specific Outcomes	Solutions	Comments [if applicable]
	<p><b>5.</b> Essential services infrastructure (e.g. on-site electricity, gas, water supply, sewerage &amp; telecommunications) maintains its function during a DSTE.</p>	<p><b>5.1</b> Any components of the infrastructure that are likely to fail to function or may result in contamination when inundated by flood water (e.g. electrical switchgear and motors, water supply pipeline air valves) are:</p> <ul style="list-style-type: none"> <li><b>a)</b> located above the DSTE; or</li> <li><b>b)</b> designed and constructed to exclude floodwater intrusion/infiltration</li> </ul> <p style="text-align: center;"><b>AND</b></p> <p><b>5.2</b> Infrastructure is designed and constructed to resist hydrostatic and hydrodynamic forces as a result of inundation by the DSTE</p>	
	<p><b>6.</b> Physical coastal processes are protected from development impacts and are generally allowed to occur naturally.</p>	<p><b>6.1</b> Development does not impact upon physical coastal processes (for all conditions up to the DSTE) in ways that result in:</p> <ul style="list-style-type: none"> <li>▪ erosion of adjacent coastal areas; or</li> <li>▪ interference with the flow of water within a tidal waterway; or</li> <li>▪ alteration of existing hydrological flows; or</li> <li>▪ adverse conditions for existing coastal vegetation.</li> </ul>	

**APPENDIX 5: DEVISING DETAILED MEASURES TO ACHIEVE OUTCOME 3**

Specific Outcomes	Solutions	Comments [if applicable]	
<p>1. The community infrastructure is able to function effectively during and immediately after Storm Tide Events.</p>	<p><b>1.1</b> Community infrastructure development is not located in an area that has been identified by storm tide hazard mapping as being below the Recommended Storm Tide Event Level (RSTEL) specified for that community infrastructure in the following table:</p>	<p><b>Note for 1.1:</b> For localities where there is insufficient flood information to identify one or more of the RSTELs, a local government may instead nominate required freeboard heights above a known flood level (for example the DSTE) that are estimated to provide an approximately equivalent level of flood immunity to that achieved by the RSTELs.</p> <p><b>Notes for Recommended Storm Tide Event Levels:</b> For sewage treatment plants, the RSTEL applies only to electrical and other equipment that, if damaged by floodwater or debris, would prevent the plant from functioning. This equipment should either be protected from damage or designed to withstand inundation. Also some police and emergency services facilities (e.g. water police and search and rescue operations) are dependent on direct water access. The RSTELs do not apply to these aspects but other operational areas should be located above the RSTEL wherever practicable.</p> <p><b>reference 1*</b> : Design Guidelines for Australian Public Cyclone Shelters Report August 2002 posted at <a href="http://www.ema.gov.au/">http://www.ema.gov.au/</a></p>	
	<b>Recommended Storm Tide Event Levels for Community Infrastructure</b>		
	<b>Type of Community Infrastructure</b> <b>Recommended Storm Tide Event Level</b>		
	Emergency services		0.2% AEP
	Emergency shelters		see reference 1*
	Police facilities		0.5% AEP
	Hospitals and associated facilities		0.2% AEP
	Stores of valuable records or items of historic or cultural significance (e.g. galleries and libraries).		0.5% AEP
	<ul style="list-style-type: none"> <li>▪ State controlled roads</li> <li>▪ Works of an electricity entity not otherwise listed in this table</li> <li>▪ Railway lines, stations and associated facilities</li> <li>▪ Aeronautical facilities</li> <li>▪ Communication network facilities</li> </ul>		<p>No specific recommended storm tide event level but development proponents should ensure that the infrastructure is optimally located and designed to achieve suitable levels of service, having regard to the processes and policies of the administering government agency.</p>
	Power stations		0.2% AEP
	Major switch yards		0.2% AEP
	Substations		0.5% AEP
	Sewerage treatment plants		DSTE
Water treatment plants	0.5% AEP		

Specific Outcomes	Solutions	Comments [if applicable]
	<p style="text-align: center;"><b>OR</b></p> <p><b>1.2</b> The community infrastructure is located below the RSTEL but can function effectively during and immediately after the RSTE.</p> <p style="text-align: center;"><b>AND</b></p> <p><b>1.3</b> Essential community infrastructure (emergency services and shelters, police facilities and hospitals, and associated facilities) has an emergency rescue area above the RSTEL</p>	<p><b>Note for 1.2:</b> The development proposal would need to include a comprehensive report demonstrating that this solution would be achieved to the satisfaction of the assessment manager or designator.</p> <p><b>Note for 1.3:</b> Emergency rescue area is defined in Section 9 - Glossary of this Guideline.</p>