Department of **Transport**

Coastal Management

Local Coastal Hazard Assessment

Generic Scope

Contents

User Guidance Notes

This standard scope of works has been developed for a responsible management authority and/or proponent where existing development is at risk of being affected by coastal hazards within 25 years. The aim of a local coastal hazard assessment is to predict in detail and quantify the coastal exposure to erosion and inundation. The assessment is limited to a relatively small area or a site where active short-term (<25 years) adaptation and management are required or likely to be required.

Where applicable, it is expected that this study will draw on existing coastal monitoring information and the outcomes of existing Coastal Hazard Risk Management and Adaptation Planning (CHRMAP).

This standard scope is only a guide and should be tailored to meet the individual needs of the user.

Additional Information

This scope of works document should be read in conjunction with the following documents:

- WA Coastal Zone Strategy
  https://www.planning.wa.gov.au/10223.aspx
- State Coastal Planning Policy (SPP 2.6)
  https://www.planning.wa.gov.au/dop_pub_pdf/SPP2.6_Policy.pdf
- SPP 2.6 Guidelines
  https://www.planning.wa.gov.au/dop_pub_pdf/State_Planning_Policy_No__2_6_State_Coastal_Planning_Policy_Guidelines.pdf
- CHRMAP Guidelines
  https://www.planning.wa.gov.au/dop_pub_pdf/CHRMAP_Guidelines.pdf

Is a local scale assessment right for you?

Coastal hazard assessment can be undertaken at a variety of scales, dependent on their purpose and the level of definition required. In Western Australia the three scales typically considered in planning are regional, district and local. These scales exist on a spectrum and are not separated by exact boundaries. The selection of a scale is usually driven by the size of the study area and timescales of hazard management. Descriptive information about the three scales and their component features is illustrated in Figure 1 and presented in Table 1. Local scale assessments focus on relatively small areas and shorter-timeframes (<25 years) and are for coastal management purposes. A local scale assessment usually needs to be supported by more extensive/detailed data collection and analysis, which allows for a higher resolution assessment.

A coastal hazard assessment undertaken at a local scale is frequently used to:

1. provide a quantified understanding of the critical coastal processes that shape the beaches and coastline
2. predict the erosion and inundation extents using the available best coastal engineering tools over small areas and short time periods
3. inform short-term (<25 years) implementation of adaptation options and management actions
4. understand present day emergency/reactive management requirements
5. support the refinement of adaptation options at an individual asset scale
6. refine short-term (<25 years) trigger points for adaptation

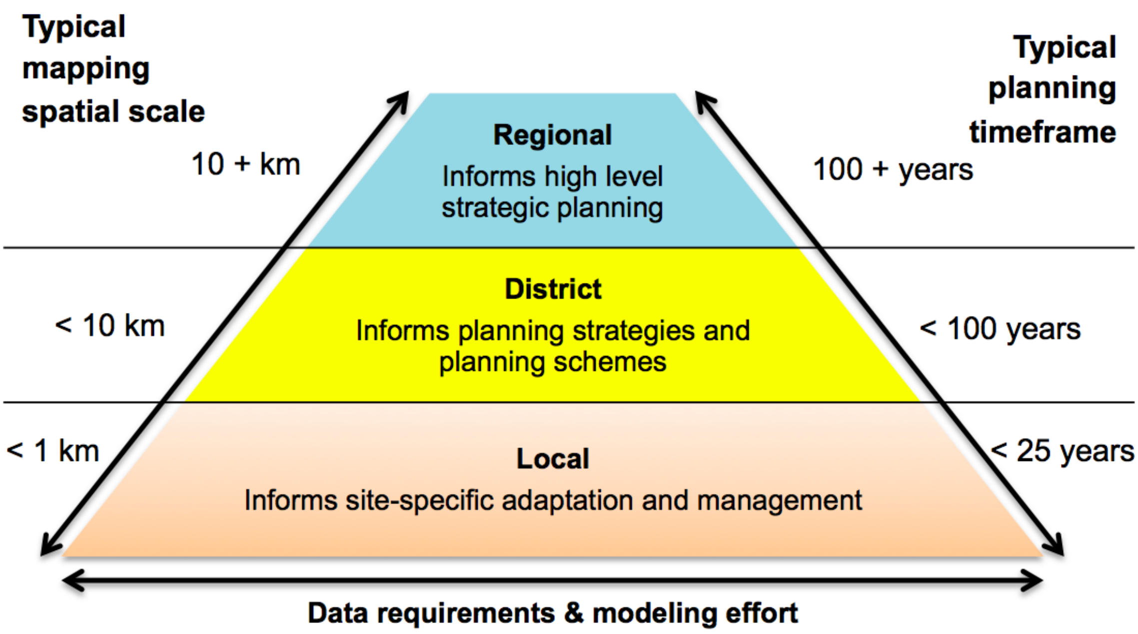

Figure 1. Coastal Hazard Assessment Scales (Adapted from Barnes 2017)

Do I have enough data for a local coastal hazard assessment?

This consultancy scope of work is for a local scale coastal hazard assessment. Mapping at the local scale has increased data and modelling requirements relative to larger scales. Access to sufficient data is essential for the success of the study. The typical datasets requirements for local scale assessment can be found in Table 1.

If insufficient data is available to undertake this assessment it will be necessary to first prepare and undertake a Coastal Monitoring Action Plan (CMAP). Where some monitoring data is available and you are unsure what further data may be required, an option is to only undertake Task 1 (review of available information & knowledge summary) and Task 2 (develop conceptual model of driving coastal processes) of this consultancy scope of works in order to gain a better understanding of the study area, available data/information and critical processes. This should help identify any critical data gaps and inform monitoring requirements.

How does a local coastal hazard study link with a CHRMAP?

A local coastal hazard assessment is typically undertaken for areas with assets that are likely to be impacted by erosion and/or inundation and where management action or adaptation is required within the 25 years' timeframe.

The SPP 2.6 methodology, which includes storm erosion from a potential 1 in 100 year storm event (S1), historical erosion trends (S2), sea level rise of 0.9 m by 2110 (S3) and a safety factor of 0.2 m per year is considered necessary and reasonable in identifying appropriate coastal process allowances for 100 year planning purposes. This method, however, is not ideal where a high-resolution engineering assessment of the most likely shoreline position is required for the purpose of developing practical coastal adaptation options and management within the shorter 25 years timeframe.

This scope of works is focused on the short-term (<25 years). If a local hazard assessment is being undertaken for a proposed development or to form part of a CHRMAP the scope of works will need to be expanded to align with the aim/objectives/purpose of the CHRMAP and include a 100 year timeframe undertaken in accordance with the requirements of SPP 2.6.

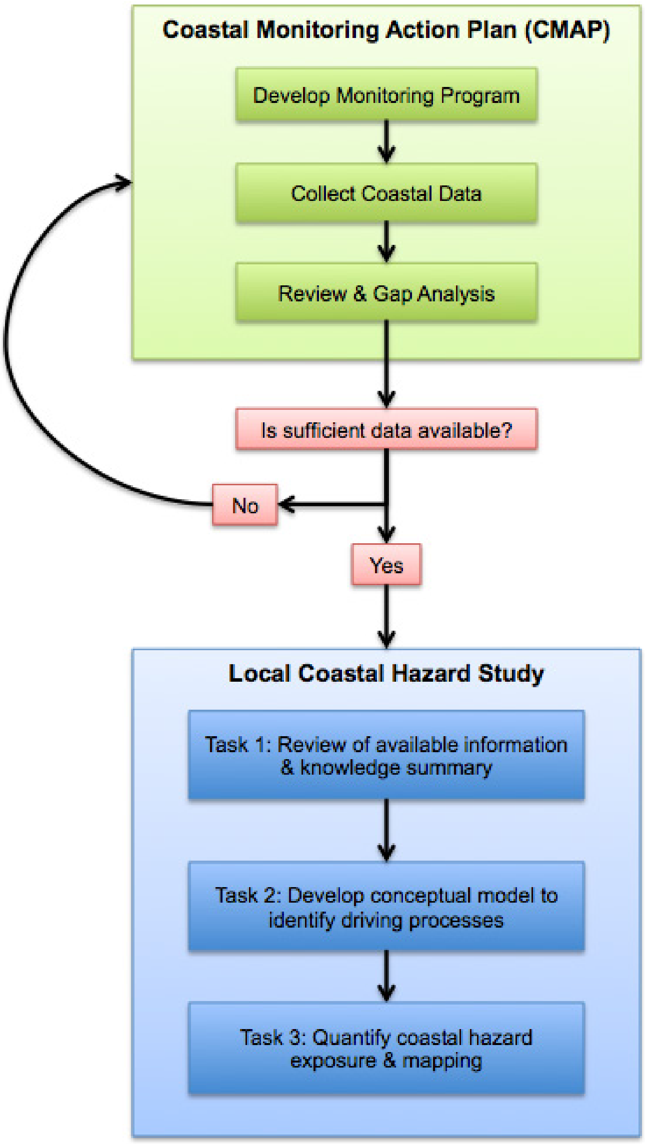

Figure 2. Links between CMAP and local coastal hazard assessment

Table 1. Coastal Hazard Assessment Scales (Adapted from Barnes 2017)

Assessment scale	Typical study area size and features	Typical datasets requirements	Typical scope and methods used	Examples of hazard assessment scale
Regional	Large area (typically > 10 km) – study area would cover a primary sediment cell or relevant local government area, whichever is larger. Mapping resolution approximately hundreds of metres.	Large scale datasets collected for multiple-purpose use. E.g. terrestrial topography, nautical charts, regional geology maps, off-shore wave buoys, regional tide gauges	Representative analysis for study area at a small number of sites for some variables. Produces mapping for high-level strategic planning. Existing analysis utilised where available. Simplistic numerical modelling e.g. 2D cross-shore erosion models.	Peron Naturalise Partnership (PNP) coastal vulnerability and flexible adaptation options project; Shire of Broome Coastal Vulnerability Study.
District	Medium area (typically 1 to 10 km) – study area would usually cover multiple suburbs, a small local government authority or section of a large local government authority. Mapping resolution approximately tens of metres.	Datasets for regional assessments as well as specific local area datasets. E.g. periodic beach survey, local waves/ water level/current recordings (AWAC or ADCP), local wind recordings, Lidar, photo monitoring.	Produces mapping of vulnerable areas for localised planning strategies, changes to planning schemes etc. Increased resolution of analysis compared to regional assessments – perhaps the same number of sites for a much smaller length of coast. New analysis of available data undertaken. Increased metocean condition and sediment transport modelling, e.g. planform shoreline evolution modelling.	Shire of Broome Townsite CHRMAP project, Shire of Esperance Coastal Hazard Adaptation Study.
Local	Small area (typically < 1 km) – study area would cover several streets up to a suburb scale – a particular beach, tertiary sediment cell, individual lot for development, local erosion hotspot. Mapping resolution of metres.	Datasets for district assessments as well as highly-detailed local datasets. E.g. repeated hydrographic survey and metocean data collection at the study area, local geotechnical assessment.	Mapping to inform site-specific adaption options, often for existing key assets. High-resolution of all key datasets for the study area, often with different methods. Detailed numerical modelling, calibrated and validated, with results actively compared to empirical findings. Detail sufficient for subsequent option selection and potentially preliminary design of options.	Quinns Beach Long-term Coastal Management Project, Yanchep SLSC CHRMAP project.

Consultants Brief

Project Title

Date

Formatting Key

Within this scope of works document the following colour coding has been used to distinguish between text:

black text – content that is recommended to be used as-is

[red text in square brackets] – guidance notes for the user, to be deleted prior to seeking quotes/tenders

blue text in italics – example text to be edited by the user prior to seeking quotes/tenders

Introduction

Aim

[One or two sentences explaining the overall project aim.]

To complete a **local coastal hazard** assessment for the study area, in order to predict the potential exposure to coastal hazards for different likelihoods at a local scale over the next 25 years.

Objectives

[Bullet points outlining what the work is being undertaken for.]

The objectives of this study are to:

- understand the critical coastal processes shaping the study area
- quantify the influence of coastal features, existing structures and previous management actions
- develop a site specific, quantified sediment transport conceptual model and sediment budget for the study area
- predict how the coastline may change for each project timeframe using the best available information.
- understand the likelihood of assets within the coastal zone being exposed to coastal hazards at each project timeframe
- prepare hazard maps for different likelihood scenarios at each project timeframe.

Purpose

[A few sentences which explain why the assessment is needed.]

The purpose of this study is to:

- inform short-term (<25 years) risk management and adaptation planning of the shoreline
- inform short-term (<25 years) management of the shoreline
- assist in the refinement of adaption options and management actions
- inform present day emergency/reactive management
- inform short-term (<25 years) adaptation/management triggers and monitoring requirements.

Outcomes

[A few sentences which explain the results of the work – what will be produced.]

A coastal hazard assessment using the best available information provides a conceptual model of coastal sediment transport pathways, and quantified sediment transport budget, as well as predicted coastline responses to different coastal process scenarios within the study area. Coastal hazard maps depicting the current and future extent of land exposed to erosion and inundation. An accompanying report summarising the method, findings, recommendations and other relevant information.

Project Background

[Client to summarise the following information about the project to help inform the context of the hazard assessment:

- key issues of concern - e.g. concerns about particular assets, previous or current problems associated with coastal erosion or inundation
- other key drivers of the project e.g. development plans for the foreshore
- local community's relationship with the coast: concerns, reactions, coastal values, main users and uses
- historical information about data collection and monitoring; and active management such as sand nourishment and construction of protection structures]

Example text:

The study area has a history of coastal management activities including the construction of beach groynes and regular sand nourishment. The City works to address the impacts of both coastal erosion and inundation through ongoing data collection and analysis, specialist investigations and active management.

The City is particularly concerned about the key assets of the skate park and recreational centre located in close proximity to the beach. These assets are highly valued by the community and draw users from a broad area. The local community commonly use the beach for active recreation (swimming, walking etc.) but the foreshore parks are also very popular with people who want to be near the beach and ocean, but are happy to appreciate it from a distance.

In 2011 winter storms caused significant erosion leading to the construction of a seawall and the establishment of a monitoring program which includes wave and current measurements since 2013. The City is also actively engaged with the community and has been undertaking photo-monitoring at key locations since 2015.

The City is adopting a risk management and adaptation planning approach to deal with the adverse impacts of coastal hazards and requires coastal hazard maps as part of the CHRMAP process. Comprehensive local understanding of both the present and future impacts of coastal hazards will assist with planning and management of the study area in the present and into the future.

Study Area

[Client to write a few paragraphs for this section, providing notes on important aspects of the study area. Client to include the following information about the study area:

extent of coast – including length, names of end points, aerial photo depicting study area

significant natural coastal features/assets including large bays, points, inlets, cliffs, sand banks, reefs]

The study area is described below and should be considered in the context of any available sediment cell and coastal compartment information from the Department of Transport (DoT). The hierarchy of cells and compartments assists with coastal planning and management as they are natural management units. This scope shall focus on the study area identified but also consider the coastal processes within the context of the sediment cell/ coastal compartment frameworks.

- Available sediment cell/ coastal compartment reports

  http://www.transport.wa.gov.au/imarine/coastal-erosion-and-stability.asp

If the study area has discrete sections of coast which behave differently to each other it may be necessary to split these into coastal sectors for the purposes of this consultancy.

Example text:

The City manages approximately XX kms of ocean coastline which is the subject of this consultancy project. Figure XX depicts the study area.

Insert Study Area Figure

Figure XX. Study Area

Hazard assessment timeframes

[The selection of appropriate timeframes is critical to the success of the project. Different coastal land uses and development have differing objectives and timeframes of interest. Day-to-day managers of facilities may focus on the next several years, whilst planning may have a focus from several decades out to 100 + years. Engineering design for coastal management and maritime infrastructure is often in between these timeframes, looking at design life of a few years to a few decades (after Eliot 2016).

Timeframes should be selected to inform management requirements and be tailored to the individual user's requirements. For a local hazard assessment, it is recommended 25 years be selected as the maximum timeframe. This is considered the reasonable maximum for which higher resolution predictions can be made using numerical modelling. It is also the timeframe commonly selected for the design of coastal protection structures.]

Note, it is mandatory to consider longer-term planning (100 years) in preparing a CHRMAP in accordance with the requirements of SPP 2.6, this has not been included as part of this scope.]

The purpose of this local coastal hazard assessment is to focus on the changes to the coast which are expected to occur in the short-term (<25 years) to inform the short-term implementation of adaptation options and management actions. Proposed timeframes are presented in Table 2.

Example text:

The present-day timeframe is considered very useful to set the context of the other timeframes and is immediately useful for day to day coastal management tasks. The 25 year timeframe has been selected as it aligns with the typical design life of coastal management structures. The 5 year and 10 year timeframes were selected to provide information between the other timeframes, with a focus on providing more information at shorter timeframes for management purposes.

Table 2. Timeframes for Coastal Hazard Assessment

Timeframe	Year
Present day	*2018*
Present day plus 5 years	*2023*
Present day plus 10 years	*2028*
Present day plus 25 years	*2043*

Tasks

[The tasks within this section focus on the evaluation of the exposure to the coastal hazards of erosion and inundation. If other site-specific hazards exist (e.g. sand dune migration, instability of a tidal creek entrance, coastal cliff stability and risk of rock falls) these should be added in as secondary/additional concerns on a case by case basis if they are relevant to the study area.]

The following tasks are required to complete a coastal hazard assessment in order to identify the potential coastal hazard exposure within the study area. The term coastal hazard refers to the consequences of coastal processes that affect the environment and safety of people. Potential coastal hazards include erosion, accretion and inundation. Coastal erosion and coastal inundation are the two key hazards to be considered in this scope.

- Task 1: Review of available information & knowledge summary (includes field inspection)
- Task 2: Develop conceptual model of driving coastal processes
- Task 3: Quantify coastal hazard exposure and mapping

Task 1: Review of available information & knowledge summary

[In most locations there is already a significant amount of data and information available to help inform a local hazard assessment. Where possible these should be listed in this section and referenced in appendixes. Recommended appendixes are included at the end of this document.]

It is expected that this study will take into consideration and build on previous data collection and studies/reports covering the study area. Recommended datasets and information to be considered are listed in Appendix 1. Key datasets and reports specific to the study area are identified in Appendices 2 and 3. This may not be an extensive list and it is expected that the Consultant will undertake a thorough search of available data and information. If datasets/information are not available online contact the custodian directly for access.

Level of detail required

[Detail the level of analysis and reporting required for this Task.]

The level of review and analysis shall be sufficient to inform the subsequent Tasks 2 and 3. The review should be focused on the most relevant data and information. Relevant datasets and information shall be briefly summarised to describe content, relevance to the current study and any missing information or critical knowledge gaps.

Where critical knowledge gaps are identified that may affect the success of the project the Consultant shall detail the additional work required to fill these gaps.

Field inspection

[A field inspection/site-visit is included to ensure the Consultant visits the study area and to provide a snapshot of its features, current condition and behaviour. It provides an opportunity for the Client and Consultant to meet and discuss any anecdotal information which may not be easily available/understood by reading reports and reviewing data etc.]

A field inspection/site-visit shall be undertaken to complement the desktop review, improve familiarity with the site and to assist in the characterisation of the local coastal processes. The information acquired is expected to help inform the identification of sections of the coast which show similar behaviour and provide a snap-shot of the current status of the coastal system. If the study area has discrete sections of coast which behave differently to each other it may be necessary to split these into coastal sectors for the purposes of this consultancy.

The Client shall be invited to attend the inspection and may be able to provide further details on key coastal issues, observations and site history etc. The inspection shall include the following:

1. complete walk-through and photography of study area and compilation of detailed field notes.
2. inspection of key coastal features (including erosion scarps, inundation debris marks and indications of accretion if available) to identify their stability and processes which influence it. This information will help determine sectors for hazard assessment, inform development of a conceptual model of coastal processes, identify driving features, and assist in classifying the coastal type.
3. high-level inspection of existing coastal structures, noting their locations, dimensions, condition, construction material and remaining life. Any observable, or potential, influences of structures on local coastal processes and the adjacent coastline shall be recorded (e.g. indicators of sediment transport magnitude and direction).
4. summary of any significant rock cliffs or outcrops which may influence local sediment transport. Basic GPS mapping of rock should be undertaken to compare to desktop review, and/or to inform subsequent data collection.

Review of geotechnical data

[The presence of rock can be an important factor for determining the exposure to coastal hazards on a local scale. However, many areas lack accurate information about the location and characteristics of rock (both exposed cliffs, rock outcrops, and as substrate below sand dunes). For geotechnical data to be able to be incorporated into, and affect, a coastal hazard assessment it needs to be of sufficient detail to determine the characteristics of the rock feature(s) - in particular its continuity and elevation.]

For geotechnical data to be able to be incorporated into, and affect, a coastal hazard assessment it needs to be of sufficient detail to determine the characteristics of the rock feature(s) - in particular its continuity and elevation, in accordance with SPP2.6. The location and nature of rock observed during the field inspection should be reviewed against any existing geotechnical data/information available for the coast in the study in order to determine the influence of rock within the study area.

Additional data gathering [Provisional]

[It is important that appropriate searching of metadata has been undertaken to ensure duplication of data is not undertaken. Where possible this work should be undertaken by the Client before issuing the scope of works or included in this scope of works, so that any specific requirements for data collection can be included here. For example, where a shoreline is identified as rocky, however, limited geotechnical information exists it may be beneficial to add in the collection of geotechnical information as part of this scope. Recommended work for a rocky coast is included in Appendix 4.]

Following review of the available data and information if critical data does not exist it may be necessary to collect data as part of this scope of works. It is important that appropriate searching of metadata has been undertaken to ensure duplicate data is not collected.

Should critical data gaps be identified, a costed proposal (provisional item to accompany Project Execution Plan) is to be submitted to the Client to fill the gap. The proposal should identify how increased confidence (from improved data) could result in different mapping outputs, and summarise the risks/benefits/financial justification for the proposed scope.

Task 2: Develop conceptual model of key coastal processes

[The information from the field inspection and review of existing information should lead to the identification of the most important features and processes that need to be taken into consideration in the erosion and inundation assessment. Requires consideration of geomorphology.]

Based on the review of available information and field inspection (Task 1) the Consultant shall develop a conceptual model of the key coastal processes shaping the study area. The key purpose of the conceptual model will be to:

- provide a general understanding of the coastal processes within the study area
- identify the sediment transport sources, sinks, pathways, budget, and their seasonal and inter-annual variation in the study area
- inform the selection of appropriate numerical models for use in Task 3
- inform the selection of appropriate modelling scenarios to represent different likelihoods in Task 3

The conceptual model shall be presented as a figure (see example Figure 3) with an accompanying written description. The conceptual model shall detail the sediment sources, sinks and transport pathways, taking into consideration the following elements:

1. local geology and geomorphology of the study area
2. identification of existing coastal landforms and summary of their relative stability, typical behaviour and influence from local geomorphology or external processes. Landforms may include:
    a. sandbanks, reefs, points, spits, bays, entrances and channels (including estuaries and inlets), islands
    b. sand dunes
    c. foreshores created from dredge spoil
    d. naturally variable landforms such as cuspate forelands
    e. variable sediment transport factors likely to influence the shoreline position
    f. coastal cliff stability and risk of rock falls
3. existing indicators of historical, modern and potential future behaviour (e.g. erosion, accretion, inundation)
4. review and discussion of sediment cell and coastal compartment mapping and reporting (if available for the study area)
5. detailed consideration of both alongshore and cross-shore processes
6. short-term storm erosion due to storm events
7. longer-term movement of sediment within, into and out of the study area including:
    a. quantitative sediment budget
    b. consideration of storm events and seasonal/annual variability in metocean weather and water levels
    c. short to moderate term beach realignment (rotation)
    d. longshore sediment transport gradients and their influence on erosion trends
    e. identification of underlying recession or accretion trends due to sediment deficit or surplus
    f. erosion due to influence of artificial structures
    g. local instability due to present landforms
    h. instability due to external processes (e.g. sediment supply)

8. any current or previous management actions (e.g. seawall, groyne, sand bypassing or nourishment)
9. identification of artificial structures that cannot withstand erosion (e.g. informal seawalls that may not tolerate erosion)
10. projected response of recession due to projected long-term water level variability (e.g. inter-annual tidal cycles and projected sea level rise)

The conceptual model shall identify the main parameters/processes likely to cause coastal erosion and inundation for the study area (by sector if appropriate). The relative importance and sensitivity of these processes shall be determined, and presented, so that the most important processes can be focussed on when quantifying the hazard exposure for the study area in Task 3 below.

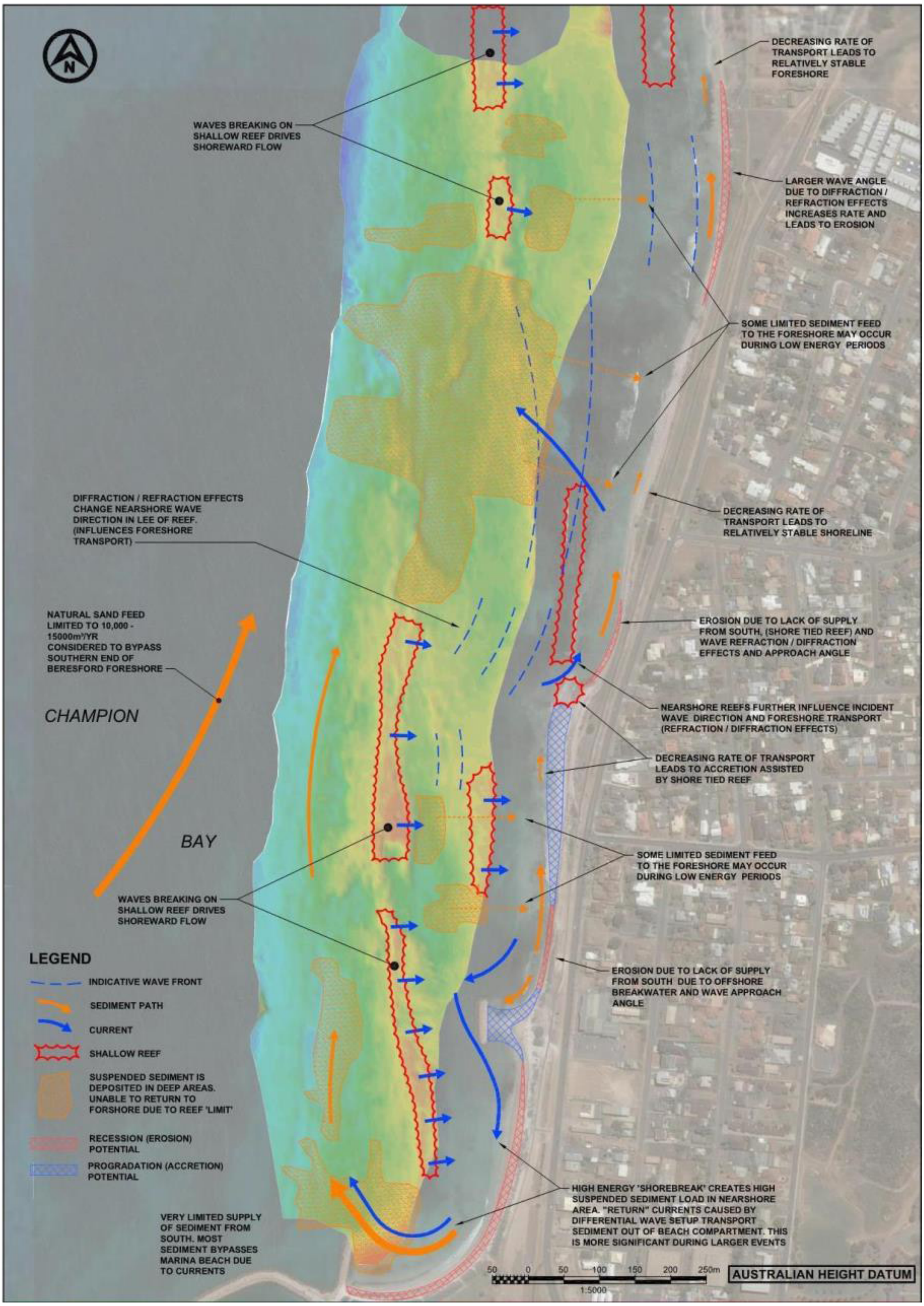

Figure 3. Example figure - conceptual model of driving processes (RHDHV 2016)

Hold Point

Prior to undertaking Task 3 the Consultant will update the Project Execution Plan, detailing the recommended methodology for Task 3 including numerical model selection and scenario selection, see Deliverables. Client approval of the Project Execution Plan is required prior to the commencement of Task 3.

Task 3: Quantify coastal hazard exposure and mapping

[The purpose of this Task is to understand the current local exposure to erosion and inundation and how they may change over time]

The purpose of this task is to predict the changes in the shoreline for a range of likelihood scenarios at each of the project timeframes *(present day, 5 years, 10 years and 25 years).*

Existing Controls

[It is necessary to state what assumptions should be made around existing coastal controls (e.g. artificial coastal protection structures like groynes and seawalls, and; ongoing management actions like sand nourishment or excavation). Should these be assumed to continue as-is for the short-term. In particular this applies to existing coastal protection structures. It should be assumed they will be maintained to their current condition or allowed to deteriorate.]

The modelling undertaken within this section must incorporate the influence of any existing coastal protection structures and management within the study area. Any assumptions made about the structures shall be clearly presented within the reporting.

Example text:

Existing coastal protection structures shall be assumed to be maintained to their existing condition over the assessment period. Any routine active management currently undertaken (e.g. sand nourishment, sand bypassing/backpassing) can be assumed to continue unless there are reasons to suspect a significant change to the current management approach.

Assessment Likelihoods

[A suggested likelihood scale, based on AS 5334-2013 (Standards Australia, 2013) "Climate change adaptation for settlements and infrastructure – a risk based approach" is provided. It is important for the Client to review the suggested scale and make sure it is consistent with any existing risk management frameworks for their organisation.

If this hazard assessment is to be used to support a CHRMAP the selection of likelihood scales and descriptions for hazard assessment needs to be carefully considered as it will drive the outputs for the rest of CHRMAP process.

For simplicity it is recommended that the risk scale be limited to three levels - "likely", "possible" and "unlikely"]

The Consultant shall recommend modelling scenarios consistent with the likelihood scale of AS 5334-2013 "*Climate change adaptation for settlements and infrastructure – a risk based approach*", (Standards Australia, 2013) presented in Table 3. For simplicity, it is suggested this be limited to the three levels of likelihood - "likely", "possible" and "unlikely", which are to be determined for each of the project timeframes.

Selection of the likelihood scenarios shall be based on the work undertaken in Tasks 1 and 2 and represent the uncertainty associated with the critical driving parameters identified in the conceptual process model. The scenario selection may include a combination of critical driving parameters. Scenario selection shall be undertaken by the Consultant with the justification clearly presented in the reporting. Appropriate data analysis and hindcasting shall be undertaken of available datasets as required to inform scenario selection.

Examples of critical driving parameters which may influence the exposure to coastal hazards are:

- inter-annual variation in storm intensity and number of storms
- changes in wave energy transferring over reef structures
- changes in onshore sediment feeds
- inter-annual variation in mean wave direction
- inter-annual variation in mean sea level

Table 3. Descriptive hazard likelihood ratings (after Standards Australia, 2013)

Rating	Descriptor	Recurrent or event risks	Long term risks	Notes
Likely	May arise about once per year	Has happened at least once in the past year and in each of the previous 5 years or May arise about once per year	Has a 60–90% chance of occurring in the identified time period if the risk is not mitigated	Represents an approach with low conservatism. E.g. using a year of metocean data which has lower than average water levels and wave heights to drive a sediment transport model.
Possible	Maybe a couple of times in a generation	Has happened during the past 5 years but not in every year or May arise once in 25 years	Has a 40–60% chance of occurring in the identified time period if the risk is not mitigated	Represents best estimate prediction of hazards.
Unlikely	Maybe once in a generation	May have occurred once in the last 5 years or May arise once in 25 to 50 years	Has a 10–30% chance of occurring in the future if the risk is not mitigated	Represents a conservative approach. E.g. using a year of metocean data which has higher than average water levels and wave heights to drive a sediment transport model.

Model Selection

[The model selection will be dependent on the outcomes of Task 2 and the key coastal processes shaping the study area. As these will be unknown at the time of tendering/quoting, it will be necessary for the Consultant to propose a range of modelling capabilities.]

The Client is seeking the use of best practice modelling techniques most suited to representing the modelling scenarios developed for the project. It is acknowledged that there are a wide variety of models available which may be used to predict the exposure to coastal hazards. Preference will be given to process based numerical models over empirical models. (Although it may be useful to compare the results from numerical models with empirical methods.)

As the modelling scenarios are yet to be determined the Consultant shall propose a range of models capable of representing the following processes within their response to this Scope:

- waves
- hydrodynamics/currents
- sediment transport (long shore and cross shore)
- inundation (including wave run-up and overtopping)

Commonly used process-based numerical models include:

- Delft3D (https://www.deltares.nl/en/software/delft3d-4-suite/) coupled with the wave model SWAN (http://www.swan.tudelft.nl/)
- UNIBEST (https://www.deltares.nl/en/software/unibest-cl/)
- SBEACH (http://www.veritechinc.com/products/cedas/cedas-details)
- XBeach (http://oss.deltares.nl/web/xbeach/)
- Mike21 (https://www.mikepoweredbydhi.com/products/mike-21

Model Calibration

[It is very important for calibration and validation to be undertaken by the Consultant using local data. This is a key feature of this scale of assessment to improve the confidence of the results.]

All models shall be calibrated and validated to locally recorded datasets. Reporting should include calibration information with validation examples. The resolution of all models shall be appropriate to represent all key features and processes within the study area.

Model Outcomes

The outcomes of the numerical modelling study should include:

- Simulated cross shore and longshore sediment transport and shoreline evolution during storm conditions and over typical summer and winter weather patterns, and; the identification of sediment sources, sinks, pathways and vulnerable areas for focus in subsequent stages of the study
- Simulated extreme events to identify design metocean conditions for the study area.

The Consultant shall provide details of the proposed modelling package(s) necessary to achieve the desired outcomes within their response to this Scope.

Mapping of modelling results

[A description of the hazard characteristics expected to be produced from the method is provided to guide preparation of hazard maps. Further detail around the expected format of the maps is provided in the "Deliverables" section.]

Model results shall be presented as maps clearly showing the extent and magnitude of the erosion and inundation hazard for each timeframe and likelihood scenario. Maps shall be included within the report and also be provided in digital formats.

Best estimates of shoreline position shall be presented for each timeframe and likelihood scenario considered. For each map the details of what the shoreline represents shall be clearly explained (e.g. mean sea level or a defined high-water mark).

The inundation hazard shall be presented from a perspective of public safety and infrastructure risk and depict hazard areas defined by:

1. spatial extent
2. depth – including discussion on relative hazard e.g. high hazard areas having depths greater than 1m, and medium hazard areas having depths less than 1m etc. (after Local Government Association of Queensland and the Department of Environment and Heritage Protection, 2016)
3. duration
4. velocity
5. "depth x velocity" tolerability shall be identified for public safety and infrastructure, e.g. D x V > 1 m2/s poses a significant threat to adults, while D x V > 2 m2/s poses a significant threat to buildings and infrastructure (after Local Government Association of Queensland and the Department of Environment and Heritage Protection, 2016)

Refinement of conceptual model

[It is important that the Consultant provides updated reporting and summarises what is understood about the study area after the completion of the detailed study and modelling. This information, along with the hazard maps, is the key result of undertaking a local coastal hazard assessment.]

Following the application of modelling, and associated comparisons, interpretation and mapping of results it is expected that the Consultant will have gained an advanced understanding of the study area. This may identify subtle differences in the system which where not included in, or differ from, the conceptual model prepared for Task 2. The conceptual model developed in Task 2 shall be updated as required to reflect any improvements in the understanding of the behaviour of the study area. In particular, any new information about the quantities of the sediment budget shall be presented.

Monitoring requirements

Based on the results from the modelling the Consultant shall recommend any ongoing monitoring requirements to inform future short-term (<25 years) management.

Deliverables

Project execution plan

[Succinct plan to be provided soon after project award which clarifies the methodology and details milestones, tasks, deliverables and timeframes associated with project components.]

Within one week of project commencement the Consultant shall prepare a project execution plan. The purpose of the project execution plan shall be to confirm the common understanding of the scope, agreement on the details of the methodology, project schedule and milestones. The project execution plan shall include:

- project methodology
- project schedule indicating key milestones

Updated project execution plan

[Provides an opportunity for the Consultant and Client to confirm the scope and deliverables after the Consultant has had time to review desktop information and critical coastal processes (Tasks 1 and 2). It will only be at this stage that the methodology can be finalised, as previous tasks are needed to inform conceptual model and ensure driving process are being captured in method.]

Following completion of Task 2 the Consultant shall revise and re-submit the project execution plan covering the remaining stage of the project. The plan shall further clarify the Consultant's methodology following identification of the driving processes for the study area and shall provide updated details on timeframes, milestones, tasks and deliverables associated with all components of the project. It is recommended that DoT be consulted in the development of the modelling scenarios.

This plan should be brief and submitted following completion of Task 2. The plan will:

1. identify the need for any additional data collection
2. recommended methodology for Task 3 including numerical model selection and scenario selection
3. identify any changes to method proposed in tender/quote
4. identify any proposed changes to the project schedule to account for refinement to the methodology or additional data collection

Reports

[Description of report style and content required, along with more detail around the expectations of the presentation/discussion of the technical content. Report is to include appendices of relevant technical info i.e. PSD test results, model reports etc.]

A single technical report shall be produced which summarises the method undertaken and key findings. Although reference will be made to previous projects, all relevant figures, data, discussion and conclusions shall be incorporated in the report. The reports shall be of a professional standard.

The report shall address the scope and objectives and include, but may not be limited to, the following:

1. summary of historical information and studies undertaken to date
2. summary and analysis of relevant coastal zone data
3. summary of coastal processes based on existing information and data
4. conceptual model of driving processes
5. description of numerical modelling packages used

6. model calibration and validation plots and full details illustrating that the model can - represent existing conditions to an acceptable level; reproduce historical extreme events, and; represent long-term change to the study area's geomorphology over the required scenarios
7. summary of coastal process information identified by numerical modelling, as a refined conceptual model
8. summary of methods used to analyse data and inform mapping inputs - with justifications provided.
9. coastal hazard maps for hazard assessment timeframes and likelihoods
10. recommendations for changes to management and/or monitoring approach
11. list of references
12. electronic submission of draft and final reports in MS Word and PDF format

Draft versions of the report shall be submitted for review by the Client. The final version must address Client comments.

Hazard Maps

[Paragraph describing the resolution, scale, datums and features of maps required, and the need for PDFs and map/drawing format - need to provide shape files, or similar, of key deliverables such as hazard lines/areas.]

The coastal hazard maps shall be created in high resolution format at an appropriate scale and show cadastre, street names, scale, legend, north point and aerial imagery. Mapping information is to be provided in standard geospatial output formats such as .shp, .kml or .kmz files. The inundation maps should include the information on flood depth over the submerged land area and maximum current velocity over the land. The coastal hazard maps shall be submitted as an Appendix separate to the report in PDF format.

Other Data generated

[Client to add any specific data format requirements]

A copy of all data produced during the project shall be supplied to the Client in standard formats. All model input and output data are to be provided to the Client in native form.

Meetings, Presentations and Project Management

[Bullet points of minimum meetings and project management requirements have been included]

As a minimum, the Consultant shall allow for the following meetings, presentations and project management:

1. project initiation meeting at Client's office within first week following project award. The date of the field inspection shall be decided and project execution plan shall be provided
2. progress meeting at Client's office to present the draft completion of Tasks 1 and 2, and updated project execution plan with the recommended methodology for Task 3
3. progress meeting at Client's office to present draft completion of Task 3
4. final presentation at Client's office; and submission of final draft report and mapping
5. project progress phone calls – fortnightly
6. project progress emails – fortnightly (alternate weeks to phone calls)
7. other meetings anticipated by the Consultant

Timeframes

Timeline

[Prompt for Client to describe best estimate timeline.]

It is anticipated this Scope shall be completed in *XX weeks* - from the date of award to the submission of final deliverables.

Milestones

[Include table for Client to edit with key project milestones identified.]

Table 4 below lists proposed project milestones. These shall be confirmed with the Consultant during project planning and the initiation meeting.

Table 4. Project milestones and estimated timing.

Milestone	Timing
Project Initiation	
Submission of project execution plan	*Week 1*
Project initiation meeting	*XX*
Task 1	*XX*
Task 2	*XX*
Progress meeting to present draft Task 1 & 2 reporting & updated project execution plan	*XX*
HOLD POINT: approval to proceed based on updated project execution plan	
Task 3	*XX*
Progress meeting to present draft Task 3 reporting	*XX*
Presentation meeting and submission of draft final report & mapping	
Final Report Submission	*XX*

Selection Criteria

[Example criteria and sub-criteria have been provided as a starting point for drafting selection criteria.]

Please provide a response which addresses the following selection criteria:

Example text:

1. *DEMONSTRATED UNDERSTANDING OF PROJECT SCOPE AND PROPOSED APPROACH AND METHODOLOGY*
    a. *provide a detailed proposed methodology for completing the scope and undertaking the main tasks*
    b. *provide details of the specific techniques and proposed modelling package/s and scenarios to be used to complete the scope*
    c. *outline your appreciation and understanding of the project, including key research areas and deliverables*
    d. *demonstrated knowledge of the oceanography, geology and geomorphology at the study area*
    e. *identify and provide the risks and challenges associated with the scope and how they will be overcome and the key outcomes expected from the project*
    f. *provide a detailed program of work including milestones, timeframes and details of the nominated personnel. Provide a Gantt chart to indicate critical dates for the delivery of each stage of the project*

1. *EXPERIENCE AND CAPABILITY OF THE ORGANISATION*
    a. *provide recent relevant examples of projects similar to the requirements of this contract including previous experience with coastal processes assessments, numerical modelling (specifically sediment transport modelling) and design of coastal structures*
    b. *describe your experience in undertaking similar or related projects*
    c. *provide details of any significant issues that arose during the delivery of the project(s) and how these were managed*
    d. *demonstrate competency and proven track record of achieving successful outcomes within an agreed timeframe on tasks related to the project*
    e. *provide some brief background information about yourself covering company history, company size, current client list, professional associations*
    f. *references - identify organisations, contact names and telephone numbers for which contracts of a similar nature are being carried out or have been successfully completed. These references may be used to verify claims of relevant experience and performance. You should ensure that your nominated referees are willing to provide information*

2. *EXPERIENCE AND CAPABILITY OF NOMINATED PERSONNEL*
    a. *identify all personnel nominated including any back-up personnel and their role/s to undertake the scope*
    b. *provide details of the relevant skills, knowledge and experience of the key personnel proposed to work on the project, with particular emphasis on experience of relevance to this project*
    c. *provide current copies of the nominated personnel's CV's*

References

1. Evocoast (2018). Local Coastal Hazard Assessment – Generic Scope. Prepared by Evocoast through Advisian for Department of Transport Western Australia.
2. Standards Australia 2013. AS 5334-2013 - Climate change adaptation for settlements and infrastructure - A risk based approach. ISBN 978 1 74342 480 3, Sydney, NSW.
3. RHDHV (2016) Prepared by Royal HaskoningDHV for the City of Greater Geraldton, https://www.cgg.wa.gov.au/Profiles/cgg/Assets/ClientData/Documents/Infrastructure/ChampionBayCoastalProcesses.jpg (accessed 1-Dec-2017)
4. Barnes, M. 2017: How to Choose an Appropriate Coastal Hazard Mapping Spatial Scale. Report prepared by BMT WBM for CoastAdapt. National Climate Change Adaptation Research Facility, Gold Coast.
5. Eliot, M., 2016: Coastal sediments, beaches and other soft shores. CoastAdapt Information Manual 8, National Climate Change Adaptation Research Facility, Gold Coast.
6. Local Government Association of Queensland and the Department of Environment and Heritage Protection, 2016. Developing a Coastal Hazard Adaptation Strategy: Minimum Standards and Guideline for Queensland Local Governments.

Document Title: Local Coastal Hazard Assessment – Generic Scope
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Author: Karl Ilich
Reviewer: Charlie Bicknell
Approver: Charlie Bicknell

Appendix 1 - Recommended datasets and information

[List of recommended datasets and information provided as guidance to help inform the Client and Consultant about what additional data/information is likely to be required for the hazard assessment. If any are not available a separate monitoring or data gathering project could be undertaken before issuing this coastal hazard assessment scope. Alternatively, it may be possible to detail specific data gathering tasks as part of this hazard assessment scope – see "Data gathering" listed as a provisional item. This scope also requires consultants to familiarise themselves with the available data and consider the need for any additional data gathering.]

Table A-1 below provides further detail on recommended datasets for local coastal hazard assessment (after Barnes 2017). Initial metadata searches should be undertaken using the SLIP Marine Map at https://maps.slip.wa.gov.au/Marine/app. A number of datasets and studies are held by the Department of Transport and the Department of Planning Lands & Heritage (DPLH). For further information on the available data and studies please visit:

- https://maps.slip.wa.gov.au/Marine/app
- https://www.transport.wa.gov.au/imarine/coastal-data-and-charts.asp
- http://www.transport.wa.gov.au/imarine/coastal-erosion-and-stability.asp
- https://www.planning.wa.gov.au/674.aspx

Please note many DoT oceanographic data sets may be accessed using the self-service system following the links:

- https://s3-ap-southeast-2.amazonaws.com/transport.wa/Tide_Packet/TideStations.kml
- https://s3-ap-southeast-2.amazonaws.com/transport.wa/WAVERIDER_DEPLOYMENTS/WaveStations.kml

Copy the links above to a web browser other than the default Windows Internet Explorer - Firefox and Chrome should be fine. A KML file will be automatically downloaded after you hit 'Enter', and then you can double click the file to open in Google Earth. Please ensure you have Google Earth installed on your computer. Links within the KML file can be used to directly download metadata and data files.

DoT recommends that you download the KML using the link above every time you want to obtain data. Once the KML is downloaded, it is static. However, DoT add new data and update the KML file regularly. Updates will only be visible on the newer KML file.

If datasets/information are not available online contact the custodian directly for access.

Table A-1. Recommended datasets and information, and notes on relevant sources and custodians.

Item	Sources / Custodians
Regional scale coastal geology (e.g. geological maps)	Geological Survey of Western Australia
Detailed coastal geology and local geotechnical survey data and mapping (e.g. site investigation reports) and any associated datasets (such as boreholes, cone penetrometer test results, or data obtained from Multi-channel Analysis of Surface Waves (MASW) and/or Seismic Refraction methods)	Variable – no specific source
Sediment cell classification	DoT
Tidal recording Time series of water levels Local tidal plane and water level information	DoT
Local sea level rise projections	DoT
Design water level statistics	Variable – no specific source
Regional wave recordings	DoT
Local wave and current recordings	DoT
Design wave statistics	Variable – no specific source
Local wind and atmospheric pressure recordings	Bureau of Meteorology
Topographic land survey (e.g. LiDAR)	Landgate
Historical and present day regional bathymetry, and detailed nearshore bathymetry	DoT
Historical and present-day beach profile and survey data	DoT and Client
Aerial photography	Landgate
Photogrammetry analysis of shoreline and vegetation lines	DoT
Beach sediment sample and analysis	Variable – no specific source
Lower river water level and stream flow recordings	Department of Water
Design details (drawings, technical reports etc.) of the existing asset(s), coastal structures or proposed development	DoT and Client
Previous management actions (e.g. summary information about coastal works, modifications, sand nourishment. This information should be summarised as a coastal works timeline.)	Client
Design Storms for Western Australian Coastal Planning Tropical Cyclones (2018)	DoT https://www.transport.wa.gov.au/mediaFiles/marine/MAC_R_DesignStormsWACoastal-PlanTropCyclones.pdf

Appendix 2 - Data

[Example table for Client to complete to inform Consultant about key datasets they are aware of for the study area.]

Table A-2 below summarises key datasets for the study area. The list is not extensive and should be reviewed by the Consultant.

Table A-2. Available datasets for the study area.

Dataset	Custodian	Notes
Example text: *Offshore wave data – Rottnest*	*Example text:* *DoT*	*Example text:* *In approximately 50m water depth.* *Directional data available since September 2004.*
XX	*XX*	*XX*

Appendix 3 – Information and studies

[Example table for Client to complete to inform Consultant about key information/studies they are aware of for the study area.]

Table A-3 below summarises key information and reports for the study area. The list is not extensive and should be reviewed by the Consultant.

Table A-3. Available information and studies for the study area.

Study	Description and Relevance
Example text: *2015* *Coastal Sediment Cells for the Vlamingh Region between Cape Naturaliste and Moore River, Western Australia* *Prepared by Seashore Engineering Pty Ltd and Geological Survey of Western Australia for the Department of Transport*	*Example text:* *Study Area: Coast from Cape Naturaliste to Moore River* *Scope: To define sediment cell boundaries.* *Comments: Provides spatial context for coastal processes studies. Does not extend into the Peel Harvey Estuary.* *Application to CHRMAP: Supporting information for a coastal hazard assessment and identification of shoreline management units.*
XX	*XX*

Appendix 4 – Collection of geotechnical data/information

[Where it is determined that the influence of rock is a key control on coastal processes, or is suspected to be, additional specialist geotechnical work is likely to be required. This Appendix summarises recommended work for a rocky coast, where the extent of rock is clear and the focus is on the characteristics of the rock to help estimate its future behaviour; and a mixed coast where the extent of rock is unclear and data collection is required to determine it.]

Detailed data collection of geotechnical/geophysical information is affordable along small sections of coast (i.e. hundreds of metres to a few kilometres) at locations where the presence of rock is observed or suspected, and is likely to significantly influence the local coastal processes.

Where there are large areas of exposed rock and the coastal behaviour is likely to be dominated by its presence (e.g. limestone coastal cliffs and granite headlands or significant rock outcrops) it is recommended that a geotechnical assessment of the shoreline stability is undertaken by a geotechnical engineer, engineering geologist or coastal geomorphologist. The geotechnical assessment shall include:

1. detailed visual inspection of the rock by a geotechnical engineer, engineering geologist or coastal geomorphologist.
2. accurate mapping of the location of continuous rock and/or rocky outcrops. Mapping could use the existing datasets such as LiDAR and aerial photography if available and be confirmed by field survey and inspection by a coastal or geotechnical specialist. The mapping should differentiate between offshore outcrops, shoreline outcrops and on-shore outcrops.
3. a summary of the geologic profile of the study area including likely future behaviour.
4. characterisation of the following information about the rock:
    a. slope elevation
    b. slope angle
    c. durability
    d. consistency
    e. angle of bedding layers
    f. thickness of bedding layers
5. categorisation of the rocky coast by geometry and geology, presented with chainage and a rating of susceptibility to erosion.
6. classification of the coast into three categories:
    a. sections where future coastal erosion is not likely to be affected by the presence of rock. Coastal hazard mapping should assume the coast is sandy.
    b. sections where the presence of rock is likely to significantly affect coastal processes. Coastal hazard mapping shall incorporate the expected influence of the rock.
    c. sections where the coast is completely rocky (e.g. continuous cliff). Coastal hazard mapping shall only use predictions of the behaviour of the rock. The landward limit of the extent of coastal slope/

Where there is reason to assume significant buried rock is present, but the extent is unclear, it is recommended detailed data collection is undertaken. Typical data collection would include Cone Penetrometer Tests (CPT) combined with Multi-channel Analysis of Surface Waves (MASW) and/or Seismic Refraction, summarised below:

1. Cone Penetrometer Testing (CPT) – a standard geotechnical test for evaluating soil compaction. Provides approximate compaction rates of material and can complement the non-invasive methods.
2. Multi-channel Analysis of Surface Waves (MASW) – measurement of variations in the seismic S-wave velocity of the subsurface, a direct indicator of the ground strength and compaction of the material.
3. Seismic Refraction – an alternative to MASW. Seismic refraction can be applied in areas where MASW is not appropriate - such as in highly vegetated dunes.

Contact

Department of Transport
1 Essex St, Fremantle WA 6160
Phone: (08) 9435 7500
Fax: (08) 9435 7800
www.transport.wa.gov.au

Email: coastalmanagement@transport.wa.gov.au
Phone: Ellena Bromwell on (08) 9435 7796

DOT 14845701