Cruise Berthing Terminal for Cayman Islands

Final EIA Terms of Reference

December 2013

Government of the Cayman Islands

Mott MacDonald

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George Town Grand Cayman

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Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
P1	11/10/2013	Claire Hollingworth/ Isobel Stanley	Jamie Ledingham/Laura Mair		First Draft
A	11/11/2013	Claire Hollingworth	Jamie Ledingham	Isobel Stanley/ David Donald	Final Draft
B	04/12/2013	Claire Hollingworth	Isobel Stanley	Isobel Stanley	Final for Comments
C	10/12/2013	Claire Hollingworth	Isobel Stanley	David Donald	Final

Contents

1 Introduction

1.1 Project Background

Grand Cayman is the largest of the three Cayman Islands, situated to the west of Jamaica and south of Cuba. George Town is the capital of Grand Cayman and it sits within the George Town District. The George Town District has a current population of 30,202 residents[1]. The island is a favourite destination of cruise ships in the Caribbean and attracts just over 1.5 million visitors per year[1]. This is projected to increase to 2.2 million by 2015.

It is the Government's policy to enhance the existing facilities for cruise passengers visiting the Cayman Islands. The Cabinet Policy Guidance (Appendix A) has identified that the proposed Cruise Berthing Facility is to be sited in downtown George Town with a secondary facility at Spotts Landing.

George Town harbour has the only port facility on the island, and consists of a Cargo Terminal and a Cruise Facility, which serves as the embarkation point for tender services from the cruise ships. Cruise ships currently anchor at one of four offshore deep-water anchorages, and passengers must take a tender service between the ship and the tender jetty at the George Town terminal.

Our Client (Cayman Islands Government (CIG)) commissioned Price Waterhouse Coopers (PwC) to prepare an Outline Business Case (OBC) for improvements to cruise berthing facilities at the specified George Town Harbour location. Mott MacDonald Limited (MML) were commissioned by PwC to carry out the port planning exercise and preliminary cost estimate in support of this OBC for this location.

As a result of the OBC, the feasibility of providing two cruise ship piers at George Town is being considered and this will provide passengers with direct access to the shore. The OBC was approved by the Cabinet and presented for comment at a Stakeholder Meeting on 31st October 2013. This was followed by a Public Engagement Meeting for review of the OBC on the 5th November.

MML has been appointed to compile this Terms of Reference (ToR) for an Environmental Impact Assessment (EIA) for the proposed Cruise Berthing Facility in George Town.

[1] The Cayman Islands' Compendium of Statistics, 2012, published June 2013, The Economics and Statistics Office, Ministry of Finance and Economic Development.

1.2 The Proposed Development

The proposed development is a concept design identified through the Outline Business Case, which may be modified based on the proponents' design submissions and constraints identified through the EIA process. The proposed new cruise berthing facility consists of two piers orientated south-east to north-west. Each pier will accommodate one berth either side, providing a total of four new berths. The orientation of the piers has been selected in order to minimise the dredging quantities and to avoid construction in deep waters, while at the same time maintaining a good alignment to the prevailing wind and wave conditions.

The piers have been located in such a way as to avoid dredging for the turning circle which is in deep waters in front of the piers in order to allow easy berthing / unberthing manoeuvres.

There are four existing anchor points at the location of the cruise facility. These are currently used by the cruise ships when calling at the port. As a result of the construction of the new cruise berthing facility, two anchor points will be made redundant. If the number of ships calling at Grand Cayman on a given day is higher than four, the ships in excess will use the two remaining anchor points.

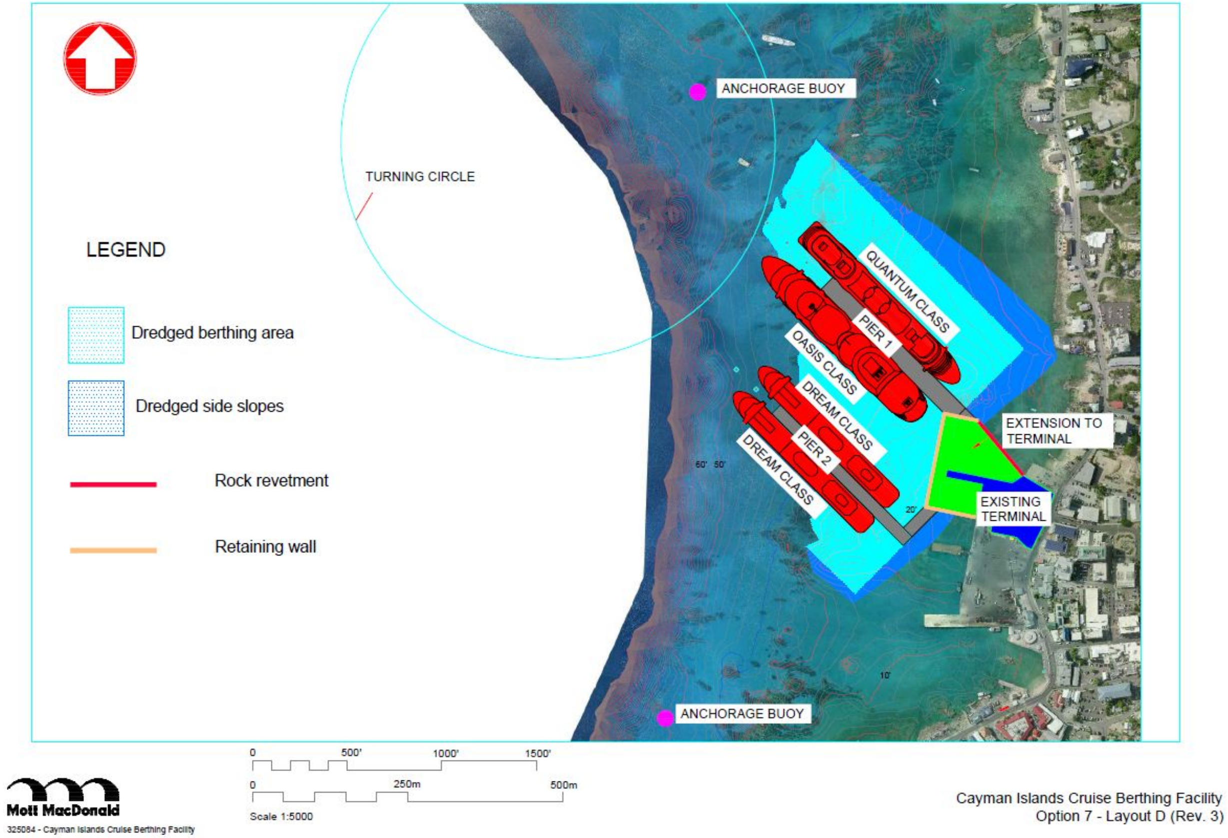
Local tender operators have stated that, should the new facility become operational, they will cease their current tendering services. As such, each cruise ship anchored off shore will operate their own tendering services should the berths be fully utilised

The new facility will not encroach into the existing cargo terminal and consequently, cargo operations will not be affected. Also, the location and orientation of the new piers minimises the potential navigational impact on access to the cargo terminal.

An additional onshore area will be created through reclamation adjacent to the existing cruise facility to allow for the increase in the numbers of passengers disembarking at the same time. Reclamation along the shoreline has been avoided.

The layout of the proposed facility is shown in Figure 1.1.

Figure 1.1: Proposed Option



Source: MM

1.2.1 Construction

The berthing pockets for the proposed development will be dredged to a depth of 36 ft (11 m) to allow berthing of the Oasis Class of cruise ship which is likely to be the largest vessel to visit the Island. The design draught for the Oasis Class ship is 30 ft which leaves 6 ft underkeel clearance (20%). This clearance is sufficient for this ship under the berthing conditions at the new facility.

It is anticipated that the form of construction to be adopted for the piers will be a suspended deck. This would consist of a reinforced concrete suspended deck supported on tubular steel piles driven into the underlying bedrock. Placing reinforced concrete inside the tubular piles is not envisaged, but this will be determined during the design stage.

The deck will be constructed through placement of pre-cast beam and plank units on the piled foundation, with an in-situ concrete topping.

For the concept design, the elevation of the pier has been assumed to be +10 ft (3.0 m) CD (chart datum) and the piers will be 984 ft (300 m) long by 98 ft (30 m) wide.

The amount of dredging envisaged will be approximately 820,000 yds^3 (626,000 m^3). This volume is based on the bathymetric information provided by the client and a dredge depth of 36 ft. It is proposed that part of the dredging material will be used for reclamation of the area that will accommodate the new onshore facilities. It is proposed that the excess dredging will be either disposed of offshore or sold locally. This will depend entirely on the requisite permissions being granted. Based on currently available geotechnical information it is envisaged that dredging operations will be undertaken using a Cutter Suction Dredger (CSD). Other dredging techniques were considered including backhoe and dipper dredgers however they were not thought to be as suited to the hard material identified in this location. Also their production rate is significantly lower than the CSD.). If the rock is found to be too hard to be dredged by a CSD, drilling and blasting may be required. This will be determined once more geotechnical information is collected however the impact of blasting has still been included in this ToR.

In order to support the reclamation, a series of retaining walls and revetments will be constructed. The retaining walls will comprise steel sheetpiles driven into the ground. The revetments will comprise rock armour and under layer.

It is proposed that most of the construction materials will be imported into the island through the cargo terminal.

In order to reduce the wave height and the overtopping, the need for any revetments on the west side of the new onshore terminal will be considered during the outline design stage informed by the results of the wave modelling study.

1.2.2 Operation

Cargo operations take place during the night and cruise operations take place during the day. It is intended that this mode of operation will continue after construction of the new cruise terminal. The new cruise terminal has been planned so as to not encroach on the cargo terminal.

New facilities to accommodate the increased number of passengers disembarking at the same time following the construction of the new facility will be built on the reclaimed land. It is envisaged that part of the reclaimed land will be allocated to parking spaces for buses and taxis, which currently park on the grounds of the cargo terminal. Relocation of the cargo terminal is not envisaged at this stage.

Given that the new cruise facility provides four berths and that two out of the four existing anchor points will be made redundant, if the number of ships calling at Grand Cayman on a given day is higher than four, the ships in excess will use the two remaining anchor points. If more than six ships call at the same time, the additional ships will remain on engine offshore. The ships at the anchor points and the ships on engine will be tendered by tender boats and these will berth at the existing facilities south of the cargo terminal

The use of tugs to assist berthing operations of the cruise ships is not envisaged.

Given that the new piers will not be sheltered from wave and wind action, during bad weather conditions the cruise ships will not be able to berth. In this event existing arrangements will apply, where the ships will be redirected to an area located in the south of the island (Spotts Landing), which provides better shelter, and the passengers will be disembarked by tender boats to an existing pier. The tender boats will need to be independently run by the cruise ship operators as existing tender operators have stated that they will cease their current service with the introduction of the new berthing facility.

1.3 Environmental Scoping

This ToR describes the potential environmental effects associated with the proposed development, and identifies the scope of work required for the preparation of the EIA. The study included the following tasks:

- collation of existing environmental information by searching available databases and literature and information provided by the Government of the Cayman Islands;
- identification of potentially significant environmental effects under a range of specialist fields; and
- determination of the requirements for appropriate EIA methodologies.

Additionally, its purpose is to invite, through a transparent process, further comments on the proposed scheme (Section 1.4). The scope of this report and of the further comments will then define the requirements for a potential EIA for the scheme.

1.4 Consultation

The stakeholder engagement, consultation and disclosure guidelines of the Equator Principles[2] and the International Finance Corporation (IFC)[3] of the World Bank (WB) Group, are being used to inform best practice guidance for this project. This approach considers stakeholder engagement as an on-going process with requirements for information disclosure, consultation and engagement throughout all project phases, from the EIA through to construction and operation. Meaningful consultation should be undertaken about a project's environmental and socio-economic aspects with relevant stakeholders in order to take their views into account. The extent and degree of engagement required by the consultation process should be commensurate with the project's risks and adverse impacts, and with concerns raised by stakeholders. In accordance with this approach and to promote compliance with best practice, it is recommended that a Stakeholder Engagement Plan (SEP) is developed at the outset of the EIA process.

The purpose of an SEP document would be to:

- Identify, analyse and prioritise key potential stakeholder groups;

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[2] The Equator Principles (EPs) is a risk management framework, adopted by financial institutions, for determining, assessing and managing environmental and social risk in projects and is primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making. The EPs defer to the IFC's Policy and Performance Standards on Social and Environmental Sustainability as best practice (see below).

[3] As laid out in the IFC's Policy and Performance Standards on Social and Environmental Sustainability (PS), 2012; most notably specified in IFC PS1 Assessment and Management of Environmental and Social Risks and Impacts.

- Provide a strategy and timetable for disclosing information to and consulting with each of the identified stakeholder groups during the EIA, construction and operational phases of the project;
- Outline a grievance mechanism that would be used for receiving, recording and addressing complaints during construction and operation; and
- Describe resources and responsibilities for implementing stakeholder engagement activities.

Typically, for projects such as this with potentially significant adverse impacts, consultation during the EIA phase will occur at two stages:

1. ToR disclosure and consultation meeting: to present the preliminary prediction of impacts and the methodology for the full EIA, and to take on board stakeholder concerns prior to finalising the EIA methodology; and
2. Draft EIA disclosure and consultation meeting: to disclose the findings of the draft EIA and address stakeholder concerns, prior to finalisation of the EIA.

As part of the disclosure process, public notification would typically be given in the press and media, and non-technical summary documentation for the EIA would be made available at public places that are readily accessible to project affected peoples and local non-governmental organisations (NGOs).

1.4.1 Initial Stakeholder Consultation

Early discussions with stakeholders were held to ascertain the reaction to the possible development of the berthing terminal. A meeting was held on the 2nd July 2013 in the offices of the CIG where representatives of CIG, the Port Authority and representatives of the consultancy organisations were in attendance.

In addition to the above, a number of representatives of businesses potentially affected by the construction of the new cruise berthing facility attended the meeting including:

- The operator of the tender boat business;
- Local retailing businesses;
- Hoteliers; and
- Chamber of Commerce.

The retailing businesses stressed that the question was not if a new cruise berthing facility was needed, but how soon they can have it. In their opinion, the new facility will attract more ships, more passengers including more affluent passengers (Oasis class) who will leave the ship and go to visit the island. Therefore they believe this will be good for the retailing business.

The owner of the tender boats business was opposed to the new piers. He mentioned environmental reasons for this. The development of the new piers will likely have a negative impact on his business.

Some of the people attending the meeting shared their concerns about the environmental impact of the new facility; in particular, the potential damage to the existing coral reef. Also, they were concerned about the impact of the new facility on the tourist business in the port area (diving mainly).

They were also concerned about the potential impact of the dredging on the stability of the Seven Mile Beach.

Additional meetings were held with the cruise line representatives, specifically Carnival and Royal Caribbean. From their perspective, berthing is needed for two main reasons one being passenger experience and the other safety.

With respect to passenger experience, the cruise lines have told us that passengers dislike tendering because of:

- the extra time required for getting on/off ship (so less time for shore activities)
- the need for queuing (both for getting on and off ship);
- the diminished flexibility (when there is a large volume of passengers, passengers are assigned a time when they can go ashore, they're not free to go when they want); and
- less convenience, especially for younger and older passengers (for example, difficulty of getting a stroller onto the tender).

With respect to safety, although the tender service in Cayman is considered to be of world class standard by the cruise lines, there is always a greater risk for passengers when getting to shore on a tender as opposed to simply walking off the ship at berth.

Some stakeholders would like the Oasis Class cruise ships to call at the Cayman Islands, which is not possible without a berthing facility. There is a very strong commercial reason to want a berth as it would give an additional destination to call on with large vessels.

Other companies are for berthing but do not seem to be as ready to pay more for it (compared to the current cost of tendering). Perhaps, a reflection of their smaller ships and of the lower price point at which they operate.

None of the cruise lines want to see their competitive position deteriorate. While they are all willing to come to Cayman today despite the lack of berthing (because Cayman is viewed, by cruise lines and their passengers, as a very safe, friendly and interesting destination), none of them feel disadvantaged since all ships must tender.

Should limited berthing capacity be put in place, some cruise lines said they may no longer call on Cayman if they could not use the pier while other ships are using the pier. Tendering for all is alright, berthing for all is better but berthing for some and tendering for the rest is a problem.

On the 24th July a Public Sector Stakeholder Meeting was held with the Steering Group and the National Roads Authority (NRA). The NRA confirmed that even if a new berthing facility were not to be built, they require road improvements to aid with the level of dock traffic occurring. They stated that without road improvements and new by-passes they could not advise any pedestrianisation down town. They finally highlighted that such road improvements would require funding.

No further feedback has been provided from public stakeholders since the meeting.

1.4.2 Consultation Meeting on the Draft ToR

1.4.2.1 Private Stakeholder Consultation

A consultation meeting allowing invited stakeholders to comment on the Draft ToR for the EIA was held on the 20th November at the Government Administration Building; 19 attendees were present. MML gave an overview of the Draft ToR for the EIA which was followed by an opportunity for stakeholders to pose questions to MML, CIG and the Department of Environment (DoE).

Minutes from the meeting are provided in Appendix B.

1.4.2.2 Public Stakeholder Consultation

An evening Public Consultation Meeting was held at Mary Miller Hall, Prospect. The meeting was open to all members of the public; 116 attendees were present. The register of attendees is included in

Appendix C though as registration was optional not all 116 attendees are identified. The Meeting Minutes are included in Appendix D.

All attendees were invited to complete a Questionnaire for the Consultation on the Terms of Reference for the EIA for the OBC Option with a submission deadline of 2nd December 2013.

12 responses were received including independent letters in addition to the standard Questionnaire; a summary of the comments received has been included in Appendix E. This version of the ToR document has been amended to address and/or incorporate a number points highlighted through the consultation process.

1.5 Climate Change

Climate change has become a key environmental issue over the past decade. Concerns have increased about the potential effects it may have on sustainable development, but also the impact of development itself on the rate of climate change.

New coastal infrastructure can lead to changes in Greenhouse Gas (GHG) emissions within the system it operates. These include scheme-owned emissions, where activities of the scheme lead to new sources of emissions; and indirect emissions, where the activities of the scheme cause existing sources of emissions to change. This potential for change makes it important to consider climate change mitigation measures that can reduce impacts and enhance the benefits as much as possible.

Coastal infrastructure assets are also already vulnerable to the climate. Climate change is expected to exacerbate this vulnerability with significant implications for assets, particularly those with long operational lifetimes. This makes proposed coastal infrastructure sensitive not only to the existing climate at the time of their construction, but also to climate variations over the decades of their use.

Decisions made now will shape the design, development and operation of infrastructure systems potentially extending into the end of the century. Action is therefore needed to design, manage and adapt new infrastructure, such as the Cayman Islands Cruise Berthing Facility, to make it more efficient, robust and resilient to future climate conditions.

The EIA process has an important role in ensuring that future developments respond to the issue of climate change as well as ensuring that their impacts do not exacerbate its effect on the environment, society or the economy. This scoping study will support the EIA process by mainstreaming consideration of climate change issues throughout the assessment process, specifically in relation to:

- **Climate Change Mitigation** - identifying the priority GHG emissions from the scheme with the committed mitigation and exploring the potential benefits and risks associated with GHG emissions that are emerging from other assessments being undertaken, as well as additional risks and opportunities; and
- **Climate Change Adaptation** - appraising the climate resilience of the proposed development and its impact on the wider environment's vulnerability and capacity to adapt to climate risks. Where necessary making recommendations to improve resilience through adaptation measures.

1.6 Report Structure

This introductory section briefly describes background information including an initial description of the proposed scheme, the approach to proposed consultation and to climate change assessment within the EIA.

Section 2 presents the requirements of the ES with regards to the analysis of alternatives undertaken.

Section 3 details the potential impacts associated with the scheme, with regard to a range of environmental and socio-economic considerations. For each of the areas investigated, the following aspects are described:

- A brief description of the baseline data/information that is currently available on that environmental consideration;
- the applicable standards that will be used as a basis for the assessment;
- description of the likely impacts of the construction and operational phases of the development; and
- description of the methodology to be applied in approaching the EIA, including details of specialist studies and further consultation requirements.

The environmental and socio-economic considerations included within this report are as follows:

- Natural Hazard Assessment;
- Geology and Soils;
- Coastal Processes;
- Sediment Transport and Water Quality;
- Stormwater;
- Air Quality;
- Noise and Vibration;
- Terrestrial Ecology;
- Aquatic Ecology;
- Cultural Heritage;
- Traffic and Pedestrian;
- Cruise and Cargo Operations (including waste handling);
- Socio-economic Assessment;
- Business District – Impact Evaluation; and
- Land and Visual Impact Assessment.

Section 4 outlines the approach to assessing the cumulative impact of the potential effects of other developments on the Cayman Islands in combination with the proposed development.

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2 Analysis of Alternatives

2.1 Introduction

The OBC was developed to analyse identified options for improvements to cruise berthing facilities at George Town Harbour and to identify a preferred option. Detailed information on the options can be found in the OBC Report submitted to the Client. An EIA will be required to ensure environmental impacts of the preferred option are minimised and these measures will be described in an Environmental Statement (ES). The ES will provide a summary of the various alternatives considered in the OBC.

2.2 Methodology

The ES will include:

- Discussion of the alternative concepts that have been considered for the development of cruise facilities, both within George Town and at other locations in Grand Cayman. This should include:
  - Overview of the historical alternative options considered by the client, including at other locations within Grand Cayman
  - Summary of the outcome of previous alternative options considered by the client which led to the identified George Town Harbour location for the proposed Berthing Terminal
  - Discussion of the options considered in the OBC at George Town Harbour
  - Discussion of the layouts considered for a one pier and a two pier option in the OBC
- An EIA is specific to a location and will be commissioned for the preferred option from the OBC.

  Inclusion of a 'Do Nothing' alternative which will discuss the current conditions which would remain the same if no improvements were made.

3 EIA Considerations

3.1 Introduction

An EIA is a process through which any environmental or socio-economic impacts of a project are identified. An ES is the subsequent document prepared to inform stakeholders and the public about the project detailing the process and results of the EIA. It should not be an overly technical document and technical matters should be included in appendices to the main report.

The description of the project needs to provide detail about the project during construction and operational phases, sufficient for the environmental and socio-economic impacts to be identified and mitigation measures developed. The issues discussed in this section have been developed around the ToR provided by the CIG.

3.2 Natural Hazard Assessment

3.2.1 Introduction

The Cayman Islands are vulnerable to a number of natural hazards, primarily hurricanes and tropical storms. These natural hazards will have significant implications for infrastructure assets, particularly those with long operational lifetimes such as the proposed Cayman Islands Cruise Berthing Facility. These hazards will be compounded due to the effects of climate change during the 21st Century.

During this Century the Cayman Islands will experience changes in climate that will affect the frequency and severity of climate induced natural hazards, due to:

- Increasing temperatures;
- Changes in amount and seasonality of precipitation;
- Changes in the magnitude and frequency of extreme events, especially hurricanes; and
- Sea level rise.

This not only makes assets sensitive to the climate at the time of construction, but also to climate and weather extremes over the lifetime of their use. Action is, therefore, required to ensure new infrastructure assets are more efficient, robust and resilient to changes in climatic conditions, through considered planning and design. The EIA process has an important role in ensuring that future developments respond to the issue of climate change and that their impacts do not exacerbate the effects on the environment, society or the economy.

To inform the EIA of the Cayman Islands Cruise Berthing Facility, Mott MacDonald has scoped the impact of natural hazards and project resilience. The scoping of GHG emissions associated with the scheme and climate change mitigation is considered separately in the Air Quality Assessment (Section 3.7).

3.2.2 Applicable Standards

Climate Resilience and EIA – The European Commission has produced guidance on integrating climate change into Environmental Impact Assessment. It represents the shift in thinking from the traditional assessment of environmental impact to take account of long term risks. A more risk based approach is required to take account of the uncertainty associated with climate change. In line with proposed changes to the European EIA Directive, climate change issues will be addressed in project screening, scoping and the detailed assessment stage. This includes including climate resilience and climate change adaptation, specifically climate impacts including the impacts of climate change on the project and the contribution of the project to wider resilience.

Achieving a Low Carbon, Climate Resilient Economy (2011) - The Cayman Islands' Draft climate change policy aims to facilitate the transition to a climate-resilient, low-carbon economy through a number of interventions to be implemented over a five year period following the policy's enactment. This is supported by the development of regional climate projections for 2011 to 2099 using the PRECIS (Providing REgional Climates for Impact Studies) regional climate model based on the Met Office Hadley Centre's regional climate modelling system.[4]

3.2.3 Baseline Conditions

3.2.3.1 Temperature extremes

Average temperature in the Cayman Islands is 81°F (27°C), with the hottest month (July) averaging 84°F (29°C). The highest recently recorded temperature extreme in the Cayman Island was 100°F (38°C) recorded in September 2009. The lowest recently recorded temperature extreme was 63°F (17°C) recorded in January 2010. The region is experiencing increasing incidents associated with higher average and extreme temperature events as average temperatures increase at

[4] http://www.metoffice.gov.uk/precis/

around 33°F (0.5°C) per decade from 1971 to 2004. Over the last 100 years the Caribbean Sea has also warmed by around 35°F (1.5°C).

3.2.3.2 Precipitation extremes

Annual total rainfall averages 4.7 ft (1,432.8 mm) per annum with October typically the wettest month with an average of 0.7 ft (217.17 mm) (1971 to 2000) although heavy rainfall is often experienced in November. March is the driest month with an average of 0.1 ft (34 mm). Recent precipitation records show that the Cayman Islands has experienced a number of drought periods over the last 55 years (1958, 1960, 2003 and 2004) all occurring during the regular dry season. Observational trends have shown a decrease in total precipitation, but an increase in rainfall intensity resulting in an increasing in flood and drought events.

3.2.3.3 Wind

The prevailing wind direction is south-easterly from May through October and north-easterly from December to April. Winter cold fronts bring cooler temperatures, stronger winds and rough sea swells. This weather phenomenon is known locally as a 'Nor-wester'.[5] Nor'westers occur suddenly and can be severe, with sustained wind speeds of up to 40 knots (60 knots gust). These Nor'westers are typically accompanied by storms and rain for up to 72 hours after onset. They can occur up to once a week in unfavourable weather conditions.

Nor'westers greatly affect the west coasts of the Cayman Islands, specifically George Town Harbour and Seven Mile Beach. As the storms move in from the west, the existing port becomes flooded, making berths untenable and ceasing port operations.

3.2.3.4 Hurricanes/Tropical Storms and Storm Surges

Over the last 30 years the primary risk from natural disasters in the Cayman Islands is from tropical storms and hurricanes. Tropical low pressure systems, of which the most severe are hurricanes with sustained wind speeds of over 74 mph (119 km/h) and agitated sea state, are typically experienced during the summer (June to November). Storm surges from hurricanes and tropical storm activity can raise the

[5] Hurlston-McKenzie, Lisa-Ann. Climate Change Issues for Cayman Islands: Towards a Climate Change Policy. http://www.doe.ky/wp-content/uploads/2010/11/Green%20Paper%20Technical%20Report%20consultation%20draft%20November%202010.pdf

water table of an area which may exacerbate flooding if the high water table impacts on the efficiency of the drainage system. Large Caribbean hurricanes (e g Mitch, 1998) can provide storm surges that damage docks and coastal structures from 100s of miles away (Natural Disasters Assessment Consulting Group, 2009).

The Cayman Islands has experienced 74 tropical storms and hurricane over the last 156 years (1852-2008), with 9 major storms (Category three or higher). Major storms have devastating socio-economic impacts. For example, in September 2004, Hurricane Ivan caused sustained winds of up to 155 mph (249 km/h), producing storm surges of 9.8 ft (3 m) and wave heights of greater than 26 ft (7.9 m) that flooded large coastal areas and deposited large amounts of sediment onshore. Two people were killed and it caused $3.4 Billion in damage. In 2008, Hurricane Paloma hit Cayman Brac and Little Cayman with 140 mph (225 km/h) winds, resulting in extensive property damage, some injuries, but no deaths.[6] The region has also experienced a number of recent significant hurricanes that did not make landfall, although caused significant damage.[7]

3.2.3.5 Sea Level Rise (SLR)

Mean Relative Sea Level Rise (SLR) in the Caribbean is 0.4 in (10 mm) a decade. Projected continued SLR will further exacerbate other climate impacts, such as extreme coastal high water levels [8], although there is significant uncertainty regarding projections.

[6] Hazard Management Cayman Islands. “Historical Hurricanes 1751-2008”. http://www.caymanprepared.gov.ky/pls/portal/docs/PAGE/HMCHOME/RESOURCES/BROCHURES/196853%20PAST%20HURRICANES.PDF

[7] In 2007, Hurricane Dean tracked past the Grand Cayman with waves exceeding 7ft and wind gusts of 57mph but did not make landfall. In 2001 Hurricane Michelle passed 130 miles away but the waves caused significant damage

[8] IPCC, 2012: Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance

Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea,

K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups

I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and

New York, NY, USA, pp. 1-19.

3.2.3.6 Earthquakes and Tsunami

The Cayman Islands sits in an active seismic zone on a transformational plate boundary between the North American and Caribbean tectonic plates known as the Oriente Fracture Zone. The active fault line runs along the south-east coast of Cuba to an area just west of Cayman, roughly following the northern edge of the Cayman Trough. The region surrounding the Cayman Islands has a high earthquake hazard rating[9] [10] and there have been a number of powerful earthquakes recorded along the Oriente Fracture Zone. Higher magnitude earthquakes are limited to a magnitude of 7 on the Richter scale, although it is not unusual for minor tremors to be recorded. In December 2004 Grand Cayman experienced an earthquake of 6.8 in magnitude. Despite the magnitude, this event did not cause significant damage to critical infrastructure, homes or businesses.

Tsunamis are also a significant risk for the Cayman Islands. The main sources of tsunamis in the Caribbean are earthquakes (generated at the boundaries of the Caribbean Plate or within the Plate), submarine landslides, volcanoes, and large earthquakes which occur far away and generate a large tsunami which reaches the Caribbean. In the past 500 years, there have been 10 confirmed earthquake generated tsunamis in the Caribbean Basin, which killed an estimated 350 people in total.[11] Tsunamis can devastate coastlines, causing widespread property damage and loss of life.[12] The tsunami risk to the Caribbean is however uncertain. The movement of the Oriente Fracture Zone is typically transcurrent, which creates horizontal stress. Vertical stress is the usually the mechanism for tsunami generation.

3.2.4 Potential Impacts

The following tables summarise the potential impacts on the scheme from natural hazard risks and the potential for the scheme to affect the vulnerability of the key receptors to natural hazards and their resilience. These issues are explored further in each receptor chapter.

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[9] The Global Seismic Hazard Map produced by the Global Hazard Assessment Program (GSHAP)

[10] A peak ground acceleration of up to 4.0m/s^2, based on a 10% probability of exceedance in 50 years.

[11] University of West Indies Seismic Research Unit

[12] http://www.caymanprepared.gov.ky/portal/page?_pageid=3701,6816355&_dad=portal&_schema=PORTAL

Table 3.1: Potential Construction Impacts

Receptor	Risks posed by current climate variability and climate change and other natural hazards	Potential impacts
Construction Impacts	Climatic extremes[13] and adverse conditions	Emergency planning and exacerbation of impacts, such as dust generation

Table 3.2: Potential Operational Impacts

Receptor	Risks posed by current climate variability and climate change and other natural hazards	Potential impacts
Coastal Engineering	Climatic extremes, Sea Level Rise (SLR) and wave action	Long term resilient design implications, structural damage from extreme events and sediment transport
Cruise & Cargo (Operation)	Climatic extremes, SLR and earthquakes	Operational impacts from extreme events
Traffic & Pedestrian	Climatic extremes and earthquakes	Exposure to extreme events and damage to supporting infrastructure
Infrastructure	Climatic extremes, SLR, earthquakes, salt corrosion, and wave action	Long term resilient design implications, structural damage from extremes and operational loss
Biological Assessment	Climatic extremes, SLR and increasing temperatures.	Exacerbation of marine, coastal and terrestrial habitats vulnerability to risks and/or a reduction in resilience
Water & Sediment Quality	Climatic extremes, SLR, changes in temperature and precipitation patterns	Exacerbation of the current species and environments vulnerability to risks and/or reduction in resilience
Air Quality	Increasing temperatures	Exacerbation of the wider environments vulnerability to risks and/or reduction in resilience
Noise & Vibration	No significant resilience issues	n/a
Socio-Economic Assessment	Climatic extremes, SLR, and earthquakes	Emergency planning and exacerbation of impacts
Business District	Climatic extremes, SLR, and earthquakes	Exacerbation of impacts
Cultural Heritage	No significant resilience issues	n/a

3.2.5 Methodology

To inform the EIA of the Cayman Islands Cruise Berthing Facility, the consultants will undertake a Climate Change Risk Assessment (CCRA). This assessment will also include non-climate induced natural hazards such as earthquakes. This is important as many of the measures that

[13] Including precipitation, temperature and wind extremes and hurricanes and tropical storms.

could build resilience to earthquakes could also build climate resilience. This CCRA process will:

- Evaluate current and long term changes in risks and opportunities associated with natural hazards, considering:
- Risks to the berthing facility project
- Impact of the berthing facility project on the vulnerability of the wider environment and its resilience or capacity to adapt to risks
- Identify and appraise the schemes resilience
- Outline recommendations for improving scheme resilience over its operational lifetime

Aiming to mainstream resilience into the EIA process, the outputs of the CCRA will inform the development relevant chapters of the EIA.

3.3 Geology and Soils

3.3.1 Baseline

Several geotechnical investigations have been completed in the region over a period of 17 years. The available ground investigation reports have been used to develop an overview of the typical stratigraphic conditions across the study area.

The Cayman Islands are outcrops of the Cayman Ridge, a submarine mountain range, whose spreading centre is still active; hence they are situated within a tectonically active area (Jones, 1994). The island is located on a separate fault block that has been elevated above the general level of the Cayman Ridge. The Island has a granodiorite base, followed by a cap of basalt and topped by 1422 yds (1300 m) of tertiary carbonates – limestones and dolostones. However due to the terrain, less than 22 yds (20 m) is above sea level (Jones, 2013). The carbonate rocks were formed as a result of successive deposition and erosion cycles which occurred over the last 30 million years, related to sea level rise: highstands initiated deposition; and lowstands led to the exposure and weathering of previously deposited carbonates (Jones, 1994).

The coastline consists of lithified Ironshore Formation limestones lying unconformably over the central limestone and dolostone core. These were deposited at various periods during the Pleistocene (Pemberton and Jones, 1988). This rock is a soft to hard coralline limestone interspersed with hard lenses, coral ledge and pockets of calcareous sand. The formation has been divided into units A-F in response to

Pleistocene Highstands, but the unconformities between these units are subtle and often difficult to recognise.

Overlying this, the superficial deposits consist of carbonate sand overlaying layers of sand and gravel consisting of coral and limestone fragments. These calcareous sand/ soils are more susceptible to particle breakage and there is an increased susceptibility of the grains to crushing. The sediments are to a depth of between -84 ft (26 m) and -89 ft (27 m) CD. However these are in a narrow insular shelf because the extent of the reef forming Grand Cayman is reached approximately 1,200 ft (366 m) offshore of George Town. Hence the water depths after this increase rapidly as the bathymetric relief declines quickly.

Grand Cayman shallow lagoons are sinks for sediments derived from the reefs. Sediment circulations are thought to be driven largely by wind by the unidirectional trade winds in addition to reef overtopping. During storms the processes are amplified with greater carrying capacity of waves and currents and wider area affected. Surge currents from waves breaking on reefs are important for sediment transport of sandy materials. Coarse sediments can also be transported to the back-reef areas. The south eastern part of Grand Cayman (close to George Town) has a deep foreshore reef shelf where sediments are stored and then transported to the deep island slope (Brunt and Davies, 1994). This supports theories of significant offshore transport in this area. The area is characterised by reef buttresses which are separated by wide sediment floored channels. These channels act as avenues where which sediments can be transported to off shelf areas (ibid). Sediment transport is considered in detail in Section 3.5.

There are no existing geo-conservation programmes within the Cayman Islands (Stanley, 2009)

3.3.1.1 Weathering

When these rocks are exposed to rainwater, minerals will slowly dissolve both at the surface and below the surface due to a large presence of calcium carbonate within the limestone rocks and the high porosity and low topography funnelling water below the surface. As a result fractures within the rock have been widened by dissolution, and there are a large number of subsurface caves which are a result of the associated Karstic terrain.

3.3.2 Potential Impacts

Potential impacts from the proposals are likely to include:

Dredging and Extraction

- The dredging of material for the berthing facilities may result in the mobilisation of sediment into the water column leading to temporary increased turbidity (considered again in detail in Section 3.5). It has been noted that “in the presence of coralline limestone, the cutter head invariably generates considerable fines in the 10 micron range that are difficult to settle” (Sciortino, 2010).
- The stratification of the bedrock, especially the presence of hard lenses may cause problems for the cutting equipment.
- Potential de-watering impacts during the extraction process (considered again in detail in Section 3.5).

Construction

- Steel piles for the suspended deck are to be bored into the bedrock; however the presence of subsurface caves and voids within the limestone has been noted. If the stability of these caves is compromised this may develop into local collapses.
- The superficial materials are susceptible to breakage and crushing which may lead to temporary increased turbidity levels.
- The release of sediments in the dredging process will lead to alterations in the superficial material.

Operation

- The dredging of the area will lead to permanent changes to the erosion regime within the harbour area.
- If piles are drilled into the bedrock they may weaken the bedrock, and lead to the development of localised failures.
- Increased ship operations may lead to disruption of the seabed.

3.3.3 Methodology

Further ground investigation studies will be required to assess the density of materials and stratigraphy and the presence of localised faults or voids. These studies will be completed to inform the outline design on which the environmental assessment will be based and any mitigation to be recommended.

3.4 Coastal Processes

3.4.1 Introduction

This section of the ToR will outline applicable standards and present an assessment of the baseline coastal conditions and potential impacts of the Cruise Berthing Facility at George Town harbour on the Grand Cayman Island. It will focus on hydrodynamics and wave energy which drive wider coastal erosion processes and morphological changes. A separate assessment of sediment movement and water quality is considered in Section 3.5 of this ToR. This section will outline the proposed methodology of how the significance of the impacts will be considered during the development of a full EIA.

3.4.2 Applicable Standards

Currently, construction of works within the coastal zone (new structures), are governed under a submission of an application to the Ministry of Financial Services, Commerce and Environment.

In the absence of formal guidance, it is recommended that the following best practice guidance is utilised: '*Coastal Process Modelling for offshore wind farm environmental impact assessment; best practice guide'* by Lambkin *et al*, (2009). Whilst this guidance is more focussed on offshore wind farms in the UK, many of the key issues in terms of data analysis, numerical modelling and defining 'thresholds' are likely to be similar.

3.4.3 Baseline Conditions

3.4.3.1 Hydrodynamics and wave energy

The area of George Town where the new berthing facilities will be constructed is a microtidal environment with a tidal range of 8 in (20 cm). Data on the wave climate around George Town originates from a number of sources which are summarised below.

A wave hindcast model (Moffatt and Nichol, 1999) based on information provided by the Public Works Department of the Cayman Islands presents the directional distribution of wave heights. Data indicates that waves from the northwest dominate.

In 2008, Halcrow Inc. (now CH2M Hill) undertook a data acquisition campaign in the project area, using Acoustic Doppler Current Profilers to measure directional waves and currents. The data is broadly in alignment with the results of the wave hindcast carried out by Moffatt and Nichol. However, there was a greater frequency of waves recorded originating from a south-westerly direction than were predicted by the Moffatt and Nichol study.

The UK Admiralty Pilot indicates that westerly equatorial currents predominate along the northern coast of Grand Cayman. However, George Town harbour is protected from these currents by the mainland. Direct measurements of local currents have been recorded by both Halcrow Inc and the Department of the Environment of the Cayman Islands Government (DoE). The results of the measurements show a directional trend generally parallel with the western coastline of Grand Cayman, with a tidal flow oscillating between northerly and southerly directions. The northerly flows were recorded as being more predominant than southerly flows, and local directional variation was apparent due to variations in local bathymetry. Current flows are generally relatively weak (i.e. <1 ft/s (30 cm/s)) (ibid).

Seven Mile beach is located north of George Town and is a popular tourist destination. Seven Mile beach has been experiencing problems with erosion and these erosion issues have been outlined by the Cayman Island Beach Review and Assessment Committee (BRAC, 2003) in a Strategic Beach Management Plan report. This report provided information on the current status of Seven Mile beach, erosion problems, establishment of strategic beach management plan and beach management strategies.

Recent weather patterns, such as a series of tropical storms which have passed mostly to the south and west of the Cayman Islands, have contributed to the erosion on the southern section of Seven Mile beach.

3.4.4 Potential Impacts

The potential predicted impacts on hydrodynamics and wave energy and resulting coastal erosion processes from the construction and operation of the proposed berthing facility are outlined briefly in the table below and should be assessed in terms of their significance as part of the EIA.

Table 3.3: Potential Impacts

Issue	Construction Impacts	Operational Impacts
Hydrodynamics and wave energy leading to changes in coastal erosion processes	Temporary impacts on water levels and flows within the harbour area from construction activities and from dredging. This may lead to mobilisation of material in the short term. Temporary disruption to the harbour bed as a result of works such as excavation, dredging and piling, may cause changes in hydrodynamics and wave breaking patterns. This may lead to short term mobilisation of material. Potential for localised scour on existing structures and increased/reduced erosion of the main shipping area. Temporary storage/stockpiling of materials may alter drainage patterns and locally increased flood or coastal erosion risks	Permanent changes to water levels, flows and flow directions and sediment deposition and erosion regimes within the intertidal harbour/tidal areas could occur following the completion of the berthing facilities and dredging activities. Presence of berthing facilities and cruise ships could lead to wave overtopping and impact on level of flood risk. The implementation of the berthing facilities could provide direct protection/sheltering to areas along the George Town shoreline from the strongest waves. Potential reduction in littoral drift relating to the new facilities and impacts on coastal processes beyond the harbour.

3.4.5 Methodology

The EIA should consider direct, indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the project.

In order to assess potential impacts the required baseline data will be reviewed and additional surveys undertaken to address any identified gaps. The baseline data will be supplemented by:

- A site walkover to verify the existing coastal and flood defence structures and their conditions.
- Collection of additional detail topographic/beach level data.
- Interview of locals to identify local flooding or coastal erosion issues.

Further data on waves and currents within George Town Bay will need to be collected to supplement existing data from Halcrow (2008).

Bathymetric surveys were carried out during 1999 and around all three Cayman Islands in 2005/2006 however, these may not be of sufficient resolution. The existing bathymetric data shall be confirmed as part of the EIA and if significant changes are identified a new survey will be required to inform the EIA.

The larger scale coastal process model will be developed to model the impact of the development on the wider coastal geomorphology. It will include 2D hydrodynamic, wave and sediment aspects which could lead to morphological changes in the local area surrounding George Town Harbour. This larger scale coastal model will produce the boundary conditions used to drive a smaller localised hydrodynamic model of sediment dispersion processes and water quality in the harbour.

The localised hydrodynamic model will be developed as part of the sediment transport and water quality assessment considered separately in section 3.5.

A Flood and Coastal Erosion Risk Assessment shall be undertaken. The assessment shall include:

- Analysis of current and potential long term changes in flood and coastal erosion as a result of sea level rise, (the results of the modelling can help determine the most vulnerable areas at risk of flooding and erosion in George Town Bay);
- Flood and coastal erosion risks to the scheme;
- Impact of the scheme on the flood and coastal risk vulnerability of the area and its resilience or capacity to adapt to risks; and
- Identify and appraise the schemes resilience and provide recommendations for increasing resilience.

Guidelines relating to coastal impacts do not exist in the Cayman Islands so consequently, it may be difficult to use predictive analysis to fully determine the nature, magnitude, extent and significance of the impacts. Relevant applicable best practice guidance as highlighted earlier in this section will be used however this may need to be supplemented by professional judgement.

A description of measures proposed for mitigating the anticipated adverse impacts will need to be considered. The Coastal and Marine Environment Site Guide (CIRIA, 2003) provides practical guidance on how to control impacts potentially arising from construction works for managers, engineers and supervisors on working in the coastal and marine environments.

In addition a proposed programme of monitoring the environmental impacts on the coastal processes (wave energy) of the berthing facility will need to be outlined. This could include monitoring of flow speed measurements in and around the area during construction works and operation in relation to the baseline measurements.

It is acknowledged that the increased depth of water resulting from the dredging will increase wave height. The modelling identified in this section will consider this impact in more detail. The outcome of the assessment will then inform the engineering design and identify if there is a need for any revetment or coastal protection structures to dissipate wave energy. Also the drainage system and surfacing of the new onshore terminal shall be designed to re-direct the overtopping water towards the sea and minimise flooding of the adjacent roads and buildings.

3.4.6 Consideration of Climate Change

Consideration of sea level rise and increased frequency/strength of storms will be essential to ensuring that the development does not significantly impact water levels or make the coastline more vulnerable to wave activity. The key impact of increased sea level will be to increase overall water depths with potential increased tidal currents and wave propagation within George Town Harbour. In addition it could alter the coastal processes and littoral drift which could impact on sediment deposition and erosion.

3.5 Sediment Transport and Water Quality

3.5.1 Introduction

Construction and operation of the proposed Cayman Island Berthing Facility has the potential to have impacts on the water quality and sediment transport in the development area because the structures will affect flow patterns. The development may create new issues or exacerbate current sediment transport and water quality issues. This document identifies the likely risks and recommends an approach for assessing their impacts and developing mitigation measures.

The impacts on water quality and sediment transport shall be assessed using modelling of the baseline conditions and development scenario under average and atypical conditions. An overview of the modelling approach, data requirements and analysis is described below.

3.5.2 Applicable Standards

There are no specific standards for water quality and sediment requirements in the Cayman Islands. Therefore, consultation with the Department of Environment, Water Authority, DEH and Port Authority will be required to assess the applicable standards that should be applied in this area. The Department of Environment has previously collected water quality samples in George Town Harbour. Samples collected as part of this study should complement these samples.

The assessment should also consider international standards such as the UK's Environmental Quality Standards, the US's Environmental Protection Agency's Water Quality Standards for Marine Waters and Canada's Environmental Quality Guidelines. The Environmental Quality Standards are only applicable in the water column and there is no equivalent for sediments used in the UK.

3.5.3 Baseline Conditions

3.5.3.1 Bathymetry

A coral reef runs parallel to the George Town shoreline, approximately 500 ft (152 m) offshore. The reef is generally continuous, with the exception of a break of approximately 500 ft (152 m) to the west of the existing cargo terminal.

Water depths between the shoreline and the reef generally range from 5 to 25 ft (1.5 to 7.6 m). The 40 ft (12.2 m) contour is located beyond the coral reef, approximately 900 ft (274 m) to the west of the existing wharf. The water depths then increase rapidly as the extent of the reef forming Grand Cayman is revealed, located approximately 1,200 ft (366 m) offshore.

3.5.3.2 Currents

Westerly equatorial currents prevail along the northern coast of Grand Cayman but George Town is protected from these by the mainland. Direct measurements of local currents have previously been recorded by the Cayman Islands Government in 2006 to 2007. The results of the measurements show a directional trend generally parallel with western coastline of Grand Cayman, with a tidal flow oscillating between northerly and southerly directions. The northerly flows were recorded as being predominant over southerly flows and local directional variation was apparent which is probably caused by local bathymetry. Current flows are relatively weak due to the small tidal range.

3.5.3.3 Sediment Transport

The presence of the sandy plain and coral sediment along this coast will mean the sediment that could be affected by the development is likely to be composed of sands and finer sediments. Finer sediment will enter the water column in suspension more readily than larger particle sizes creating sediment transport and water quality issues such as increased turbidity. Strong wave and current conditions during northwesters leads to a circulation causing dispersion and transport of sediments in a southerly direction along Seven Mile Beach. Conversely, during hurricanes and tropical storms, waves and currents can cause an opposite circulation with erosion of southern Seven Mile Beach (Draft TORs for EIA, 2011).

However, within the vicinity of the proposed development site Moffatt and Nichol (1999) concluded that "*little to no sand movement occurs due to the minimal wave energy under typical daily wave conditions*". They attribute this to minimal wave velocities that extend to the bottom during typical wave conditions.

Events such as hurricanes and the northwesters will increase currents and wave activity leading to increased sediment transport. This will result in increased turbidity, changes in oxygen levels, decrease in light levels and increases the risk of contaminated sediments being disturbed.

3.5.3.4 Water Quality

The EIA will need to identify and assess all of the existing potential pollution sources that will affect water quality. These will include the existing impact from commercial shipping, commercial cruise ship activities, private and commercial boating, storm water outfalls and physical disturbances by divers. The Department of Environment has previously taken water quality samples in George Town Harbour. These will need to be collected and analysed to define the baseline water quality conditions and supplemented with further water quality data collection to establish baseline conditions.

3.5.4 Potential Impacts

There are a range of potential impacts that the proposed development could have on sediment transport and water quality issues. The EIA should assess the impacts that could occur during construction and operation.

Construction

- Dredging – During construction dredging will be required and will result in increased suspended sediment and sediment transport. This will result in increased turbidity, changes in water quality (light, oxygen levels and chemistry) which will have implications on the ecology and potentially smothering of the coral reef. Sediment entering the water column also has the potential to be contaminated. Sediment analysis will be conducted to assess the most appropriate dredging technique to reduce these impacts; different types of dredging were considered by Moffatt and Nichol (1999). The phasing of construction and the timing of dredging throughout the year should also be considered to mitigate the impacts. Dredging may also have impacts on the supply of sediment to other areas in particular Seven Mile Beach and has the potential to affect local currents.
- Discharges - During construction discharge of water from de-watering excavations may be required and will need to be considered in relation to sediment movement and increased turbidity.
- Pollution – this can be caused by spillages or discharges from vessels or construction materials on shore. These risks can be mitigated against through a robust environmental management plan for the construction of the berthing facilities. A phased construction may also reduce the impacts of potential pollution events.
- Structures – temporary structures or large vessels required during the construction will have an effect on the local flow patterns which can in turn affect water quality especially if “dead” zones are created where there is little or no flow movement to disperse sediment, chemicals, effluent or warmer water. Hydrodynamic water quality modelling is required to simulate the impacts of these structures on water quality. The modelling can be used to test scenarios and identify a construction approach to minimise the impacts.

Operation

- Pollution – Similarly during the construction phase there are risks associated with discharges from vessels, bilge pumping, propeller wash, refuelling and storage of fuel, spillage and storm damage. All of these have the potential to create sediment or water quality issues at the berthing facility. Procedures should be put in place (regulated by the Port Authority) to minimise these risks but there will always be a possibility that they will occur therefore the implications of these should be assessed as part of the EIA. The EIA should consider whether an increase in ship traffic close to shore will significantly increase the risks of pollution.
- Structures – Again, this is a similar potential impact to that described above for the constructions phase. However, during operation the impacts will be longer term and may vary seasonally with changes in the prevailing currents and wave conditions. The hydrodynamic water quality modelling should consider both the construction and operation phases to assess the impact of the structures on flow patterns and dispersion.
- Extreme weather events – Events such as hurricanes and the northwesters will increase currents and wave activity leading to increased sediment transport. This will result in increased turbidity, changes in oxygen levels, decrease in light levels and increases the risk of contaminated sediments being disturbed. Extreme weather events are predicted to increase in severity and frequency in the future with climate change. Therefore, these extreme weather conditions should be considered by the hydrodynamic water quality modelling as well as average daily conditions.
- Cruise Operation and Maintenance – The operation of large cruise vessels will create turbulence and increase the turbidity of the water. During the operational stage there may also be a requirement for some maintenance dredging. The impact of this will be the same as during the construction phase.
- Impact on other developments – At this stage it is not known whether there are any other developments such as power stations and sewage outfalls within the vicinity of the site that rely on the baseline current movements to disperse effluent or warmer water. The EIA will need to identify any of these types of development and assess whether the proposed berthing facility will have an adverse impact on these developments.

3.5.5 Methodology

To inform the EIA, it is recommended that a sediment and water quality modelling study is undertaken. Modelling will allow the impacts of the proposed development during construction and operation to be assessed and mitigation measures to be identified and tested. The larger scale coastal process model and this smaller scale hydrodynamic modelling should be developed in parallel to ensure consistency where possible.

The modelling will require a large amount of data to be collected, some of which may be available from third parties. The data requirements are likely to include:

- Bathymetric and sediment data – there is existing information available on the distribution, layer thickness and characteristics of sediments in the project vicinity and reports on the sediment transport patterns along the western coast of Grand Cayman. Bathymetric surveys were carried out during the 1999 study and around all three Cayman Islands in 2005/2006 however, these may not be of sufficient resolution for the detailed assessment required.
- Chemical characteristics of sediment that will be dredged, grain size, main inorganic pollutants, likely heavy metals and synthetic organic pollutants.
- Water quality – salinity, temperature, turbidity, dissolved oxygen, concentration of chemical parameters (PAHs, nutrients, chlorophyll "A", BOD, suspended solids etc.). The Department of Environment has previously collected water quality samples.
- Current and wave data – some wave data has been collected in August 2007 – April 2008 (Halcrow) and current data from September 2006 – January 2007 (Government data).

The model should be calibrated and verified against observed data. The data required for calibration and verification will include:

- Concurrent measurements of water level, current velocity, temperature and salinity and potentially other water quality parameters at a number of locations to be determined during a range of conditions.
- Accurate climatic data for the dates of observation including air temperature, wind speed and direction.

3.5.6 Consideration of Climate Change

The impacts of climate change have been discussed in Section 1.5. Higher average water temperatures, sea-level rise and increased storminess are likely to result in changes in water quality and sediment transport in the future. For example, higher average water temperatures will decrease oxygen solubility in water, thus reducing oxygen levels available for ecology. More intense and frequent storms will result in greater wave and current energy available for sediment transport and increase turbidity of the water. The EIA should consider both the present day (typical and atypical) and climate change conditions.

3.6 Stormwater

3.6.1 Introduction

The stormwater drainage plan will assess the stormwater drainage impacts associated with construction and operational phases of the proposed project.

This section provides a high level overview of what will be included within the stormwater drainage chapter and how the assessment will be undertaken. It provides a brief indication of the baseline conditions, identifies likely impacts and the methodology that will be used for the assessment.

3.6.2 Applicable Standards

Two relevant standards have been identified in relation to the development's stormwater drainage system:

- *Stormwater Management Guidelines*[14] provides national guidance on the formation of **Stormwater Master Plans** and primarily focuses on management of stormwater volume
- *Environmental, Health and Safety Guidelines, General EHS Guidelines: Environment. Waste water and ambient water Quality*[15] provides supplementary international guidance on water quality

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[14] *Stormwater Management Guidelines* (Cayman Islands Planning Department & NRA, 2008) http://caymanroads.com/index.php?option=com_deeppockets&task=catShow&id=17&Itemid=26

[15] *Environmental, Health and Safety Guidelines* (International Finance Corporation, 2007) www.ifc.org/ehsguidelines

3.6.3 Baseline condition

George Town, Grand Cayman has sub-humid tropical climate with notable seasonal variation in rainfall. The year can be broadly divided into wet season from May to November and winter dry season from December to April. The heaviest rains typically occur in October although the island is subject to intense tropical storms and hurricanes which are accompanied by very intense rainfall.[16]

The proposed Cruise Berthing Facility is currently neighboured by existing infrastructure, businesses and residential properties. The existing drainage provision for these properties is unknown.

3.6.4 Potential Impacts

The stormwater assessment will assess the potential for the development to increase stormwater flooding at existing properties and infrastructure in addition to stormwater issues which may arise within the development site. Key drainage impacts may include:

- Inadequate drainage of the development leading to flood damage or interruption to operation
- An increase in stormwater discharge leading to increased flooding of neighbouring properties
- A reduction in water quality due to the discharge of pollutants
- Damage to existing drainage infrastructure and subsequent flooding of neighbouring properties or infrastructure
- Blockage of existing overland drainage routes or the diversion of additional flooding towards existing properties

3.6.5 Methodology

In compliance with *Stormwater Management Guidelines* a **Stormwater Master Plan** will be developed for the Berthing Facility. This will demonstrate that development is able to operate effectively during intense rainfall events and that it does not increase flood risk to surrounding properties or infrastructure.

The development of the plan will require the following baseline data:

- Existing topographic mapping of the wider George Town area;

[16] Brunt M and Davies J, *The Cayman Islands: Natural History and Biography,* 51-60. 1994

- Existing drainage infrastructure mapping from the National Roads Authority (NRA);
- Existing drainage infrastructure mapping from the Port Authority;
- Access to local rainfall record.

The required baseline data will be reviewed and additional surveys undertaken to address any identified gaps. This baseline data will be supplemented by:
- A site walkover to verify the existing drainage network and potential surface water flow paths;
- Collection of additional detail topographic data;
- Interview of local businesses/residents to identify local flooding issues and any otherwise unidentified drainage infrastructure.

The **Stormwater Master Plan** will be developed following appropriate drainage modelling to address the following areas:
- Identification of an appropriate location to discharge stormwater from the site;
- A review of the recommended design rainfall intensity using available local rainfall data and the outcomes of the climate change study to ensure it is adequately conservative for this development;
- Design of drainage infrastructure with adequate capacity to safely convey the design rainfall intensity;
- Provision of safe overland stormwater flow routes to minimise impact during design exceedence events;
- Design of mitigation measures to ensure the adequate attenuation of stormwater prior to discharge ;
- Design of mitigation measures to maintain good water quality in the discharged water;
- Identification of, along with any necessary mitigation measures, existing drainage infrastructure or overland flow routes which may be affected by the development.

Consideration will be given to the inclusion of water conservation measures that may assist in lowering the imported fresh water requirements for the Cruise Berthing Facility.

3.6.6 Consideration of Climate Change

Detailed consideration will be given to ensuring that the development's stormwater drainage system is resilient to the effect of climate change. The key impacts of climate change on the development's stormwater drainage system are likely to include an increase in both the design rainfall intensity and the sea level at the discharge point. Using the latest climate change science appropriate uplift factors may be identified for these and any other key drainage design parameters.

3.7 Air Quality and Greenhouse Gases Emissions

3.7.1 Air Quality

The proposed development has the potential to generate emissions of air pollutants during both construction and operation. Key pollutants of concern are nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and particulates (including ‘PM_{10}’).

3.7.1.1 Applicable Standards

The Cayman Islands has not adopted numerical standards for ambient air quality. There are a range of standards applied in countries such as the United Kingdom and the United States. Those that apply to the UK (for England) are presented in Table 3.4.

Table 3.4: UK Ambient Air Quality Standards

Pollutant	Averaging period	Air Quality Objective	
		Concentration	Allowance
Nitrogen Dioxide (NO_2)	1-hour	200 µg.m^{-3}	18 per calendar year
	Annual	40 µg.m^{-3}	-
Sulphur dioxide (SO_2)	15 minute	266 µg.m^{-3}	35 per calendar year
	1 hour	350 µg.m^{-3}	24 per calendar year
	24 hour	125 µg.m^{-3}	3 per calendar year
Particulates (PM_{10})	24-hour	50 µg.m^{-3}	35 per calendar year
	Annual	40 µg.m^{-3}	-
Particulates ($PM_{2.5}$)	Annual	25 µg.m^{-3}	-

Emissions from vessels are regulated under The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations, 2012. These regulations set provisions for the types of vessels that may use national waters, and specifically sets emission standards for vessels. This includes limits on the rate at which pollutants may be emitted as well as the quality of the fuel that must be used. The Regulations consider emissions of NO_x, SO_2 and ozone (O_3) depleting substances.

Public Health Law (2002 revision) sets out powers in respect of nuisance from pollution. This Law provides provisions that apply to any *"furnace, chimney, fireplace, bonfire or other place from which is emitted smoke or other unconsumed combustible matter…*[and]*…any vehicle or vessel, in such a condition as to be prejudicial to health or a nuisance"*.

A nuisance is defined *"as any act, omission, or thing occasioning or likely to occasion injury, annoyance, offence, harm, danger or damage to the sense of sight, smell or hearing, or which is or is likely to be dangerous or injurious to person or property*". Under this Law, the Chief Environmental Health Officer can serve Notices requiring abatement of any source of pollution deemed to be a nuisance, with powers extending to the potential closing of activities that do not comply with such Notices.

3.7.1.2 Baseline environment

Air quality monitoring is not routinely undertaken on the Cayman Islands, and no data is currently publicly available on existing levels of air pollutants. There are a limited number of stationary sources of pollutants on the Island, and transportation is likely to be the biggest contributor to local ambient air quality. Based on a desk based review of the study area and emission sources present it is unlikely that pollutant levels are above standards for the protection of health.

3.7.1.3 Sensitive receptors

The berthing facility will be located on the western coast of George Town. In the immediate area, there is the existing cruise terminal. On Harbour Road immediately opposite the proposed location, there is a mix of commercial and leisure use with hotels and some residential dwellings.

Roads that serve to bring passengers to and from the cruise terminal could potentially affect local traffic flows and this would mean there may be some affected residential receptors along any key routes that might serve the terminal.

3.7.1.4 Potential impacts

During construction, there are four key potential sources of emissions:

- From use of vessels to undertake dredging and deliver construction materials;

- From the use of road vehicles to deliver construction materials and workers to the site;
- Use of construction plant such as excavators, cranes and drilling equipment; and
- Particulates from the construction activities themselves due to the movement and storage of loose materials.

During operation, there are two key potential sources of emissions:

- From approaching and stationary docked vessels (which idle at the berthing facility leading to intermittent emissions); and
- From increased road traffic serving the berthing facility and vehicles remaining idle due to increased congestion.

With respect to operational emissions, the proposals may change the way that cruise ships use their main and auxiliary power facilities, and will bring emissions closer to receptors on the Island.

No consideration is required of emissions from dock-side power generation facilities as none are planned.

3.7.1.5 Assessment methodology

Due to the lack of existing ambient air quality monitoring data available within the study area, a three month diffusion tube survey for NO_2 and SO_2 shall be carried out. A maximum of ten monitoring locations shall be used representing sensitive receptors, roadside locations, shipping/industrial areas and 'background' locations (i.e. away from the immediate influence of any local emission sources). Diffusion tube monitoring results are subject to an uncertainty of around 20% and can only provide data on longer term (minimum of 1 month) concentrations. However, given the nature of the study area and likely impacts of the proposals this approach is considered to be appropriate and proportionate.

Construction phase effects will focus on potential impacts from dust generating activities which is likely to be the key air quality issue of concern. The assessment will identify specific activities which have the potential to cause dust emissions, and the degree of that potential. Mitigation measures will then be identified consistent with best practice to mitigate these risks.

The assessment of operation phase effects will first involve a review of the expected change in nature, and location of emissions of NO_2, SO_2

and PM_{10} from shipping as a result of the proposals i.e. how much closer emission sources are likely to be to sensitive receptors, whether vessels are likely to use their main or auxiliary power facilities more or less etc.

If, following this review, the change is concluded to be likely to cause significant air quality effects; dispersion modelling will be carried out to quantify the effects. The model will be used to predict concentrations of key pollutants at sensitive receptors 'with' and 'without' the proposals and to determine whether exceedences of ambient air quality objectives are likely to occur.

3.7.2 Greenhouse Gas Emissions

The proposed development has the potential to generate emissions of greenhouse gases (GHG) during both construction and operation. The main GHG is considered to be CO_2.

3.7.2.1 Applicable Standards

The Cayman Islands is a signatory to the UN Framework Convention on Climate Change (the 'Kyoto Protocol') through the ratification of the Protocol of the United Kingdom (clarified in 2007). The Kyoto Protocol committed the UK to a reduction in GHG emissions of 4.3% by 2012 compared to 1990 levels. An amendment to the Kyoto Protocol was negotiated in 2012 (the Doha Agreement) which extended the commitments to reduce emissions in the period 2012 to 2020. Although not ratified at the time of writing, the Doha Agreement would commit the UK to a reduction in GHG emissions of 20% below 1990 levels by 2020.

The Cayman Islands published a Draft National Climate Change Policy in 2011. The policy has a number of goals, which include:
- Reducing GHG emissions in line with national targets
- Setting a national GHG reduction target
- Encouraging energy conservation and renewable energy
- Create and maintain a more environmentally responsible tourism industry
- Develop and adopt an energy code and supporting legislation to increase energy efficiency across all sectors.

A draft National Energy Plan was published in 2013 which outlines a number of goals relating to energy and climate change. The Plan sets out a development trajectory to 2030 which balances the goals of meeting energy demand, maintaining energy security and reducing emissions of GHG. The Plan aims to reduce emissions by 3.5 million tCO_2 over the life of the plan compared to business as usual, stated as a 19% reduction. In the Plan the GHG target would serve to maintain emissions at a level comparable to 2012 up to 2030 while meeting the other objectives.

International standards for energy efficiency in ships were introduced in 2011 via changes to the MARPOL agreement. The Energy Efficiency Design Index was introduced to reduce overall energy use in vessels based on travel per capacity mile. Over time, the applicable standards will tighten to reduce overall emissions. Although primarily aimed at vessels involved in shipping goods, eventually all vessels will be covered. New guidelines were also published on developing Ship Energy Efficiency Management Plans which provide a means of measuring fuel efficiency gains due to changes in operational regimes. These Plans are mandatory for all ships.

3.7.2.2 Baseline

Reporting on GHG emissions for the Cayman Islands is undertaken by the United Kingdom as part of its GHG emissions inventory. Information on Cayman Islands activity is provided to the inventory by the Department of Environment.

The latest data on GHG emissions from the Cayman Islands was published in 2013 and covers emissions from 1990 to 2011 as part of the UK's reporting under the Kyoto Protocol. A summary of these emissions is presented in Table 3.5. Under the UNFCCC reporting method, emissions from international travel are not directly attributed to individual nations and therefore do not form part of any agreed targets placed on individual signatories. Nonetheless, emissions associated with international travel as they relate to the Cayman Islands have been presented in Table 3.5.

Table 3.5: Summary of Largest Emission Sources from the Cayman Islands, based on UNFCCC methodology

Source	2011 emissions (MtCO2)	Change 2002 to 2011
Total	0.72	+28%
Power stations	0.43	+41%
Domestic transport	0.18	-5%
Waste management	0.04	+22%
Refrigerants - business	0.06	+121%

Table 3.6: Summary of other emissions sources (non-UNFCCC reporting, international emissions)

Source	2011 emissions (MtCO2)	Change 2002 to 2011
International bunkers – aviation	0.07	Negligible
International bunkers - shipping	0.12	+7%

The principle sources of GHG emissions on the Cayman Islands arise from power production and transport. There is a general trend of emissions increasing across most emission sources over the past ten years. Transport from shipping from international movements represents around 13% of emissions attributable to the Cayman Islands, while domestic transport (which includes emissions from all travel on the Island, plus trips by air and sea to the United Kingdom) is the second most important source of GHG emissions.

3.7.2.3 Sensitive receptors

GHG emissions do not have a direct effect on receptors, although they do influence overall changes in climate over a prolonged period. Therefore the receptor can be considered to be the Cayman Islands as a whole.

3.7.2.4 Potential Impacts

The proposed development has the potential to generate emissions of greenhouse gases (GHG) during both construction and operation. The main GHG is considered to be CO_2.

In construction, there are three potential sources of GHG emissions:

- From use of vessels to undertake dredging and deliver construction materials to the project site;
- From the use of road vehicles to deliver construction materials and construction workers to the site; and
- Use of construction plant such as excavators, cranes and drilling equipment.

In the operational phase, there are two key potential sources of emissions:

- Changes in the way that cruise ships (and support vessels) use their main and auxiliary power facilities (compared to the use associated with the existing offshore deep-water anchorages); and
- From increased road traffic serving the berthing facility and vehicles remaining idle due to increased congestion.

3.7.2.5 Methodology

Emissions from the use of the facility will be quantified based on project information where it is available.

Emissions for each source will be quantified by taking the activity data for each source considered in the assessment (for example fuel use, number of traffic movements) and multiplying by emission factors from datasets such as the UKs DECC/Defra emission factors, the Greenhouse Gas Protocol, the International Maritime Organisation and those of other reputable bodies.

Total emissions will be quantified where possible for the baseline and the project case. The change in emissions between the existing scenario and the project scenario will be compared to the level of national emissions. If a relevant operational metric can be determined (for example change in emissions per passenger or per berthing) for both the baseline and project case, this will also be considered in the assessment.

The significance of any change in emissions will also be considered in relation to:

- The extent to which measures are put in to place to minimise the emissions over a business as usual approach, for example whether vessels exceed any applicable emission standards;
- The extent to which the project considers national policy and/or targets for reducing emissions;
- Whether the project has included sufficient management plans to monitor and manage emissions.

Any further mitigation for the construction and operational phase will be proposed where necessary.

3.8 Noise and Vibration

3.8.1 Introduction

The project is expected to generate noise and vibration impacts during construction and operation, which may result in effects on onshore and marine receptors. This chapter identifies the impacts and sets out how these will be assessed within the EIA process.

3.8.2 Applicable Standards

3.8.2.1 International Finance Corporation

The World Bank Group (WB) has developed a thorough programme of pollution prevention and management techniques in order to ensure that projects funded by the organisation are environmentally and socially responsible. The International Finance Corporation (IFC), a member of the WB, has produced Environmental, Health and Safety (EHS) General Guidelines that apply to investment projects in various industry sectors. The respective limit values are detailed in Table 3.7.

Table 3.7: World Bank Group/IFC Guideline Noise Values

Specific Environment	Noise Level Leq,1 hour dB(A) free field	
	Daytime (07:00-22:00)	Night-time (22:00-07:00)
Residential, educational or institutional	55	45
Industrial or commercial	70	70

The EHS Guidelines require that noise impacts should not exceed the limit values presented in Table 3.7 or result in a maximum increase in background levels of 3 dB(A) at the nearest sensitive receptor location off site.

3.8.2.2 World Health Organization

The World Health Organization (WHO) provides broad guidance on noise levels required to protect individuals from harmful levels of noise within a range of environments, which is described in '*Guidelines for Community Noise*' (1999). This is an important reference which includes guideline noise values that are founded on the results of scientific research into the effects of noise on the population. This forms the basis of standards for noise used worldwide, including those described above. The specific values that are considered appropriate to the project are given in Table 3.8.

Table 3.8: WHO guideline noise values relevant to the Project

Specific environment	Critical health effect(s)	Guideline noise value
Outdoor living areas	Serious annoyance – daytime and evening	55 Leq,16 hours dB(A)
Dwellings – outside bedrooms (window open)	Sleep disturbance – night-time	45 Leq,8 hours dB(A)

Specific environment	Critical health effect(s)	Guideline noise value
Industrial, commercial, shopping and traffic areas, indoors and outdoors	Hearing impairment	70 Leq,24 hours dB(A)

3.8.2.3 British Standard 5228 – Code of Practice for Noise and Vibration Control

WHO and IFC Guidelines are not specific but generally apply to the permanent, operational noise impacts of a development. Generally, it is accepted that noise impacts generated during the construction of a development project are inherently higher than the impacts arising under operation. Consequently, higher noise levels during construction are usually tolerated in the knowledge that the impacts are temporary.

The British Standard 5228 '*Code of Practice for Noise and Vibration Control on Construction and Open Sites*' (2009) provides comprehensive guidance on construction noise and vibration including details of typical noise levels associated with various items of plant or activities, prediction methods and measures and procedures that have been found to be most effective in reducing impacts. The guidance forms the basis for the majority of construction noise assessments in the United Kingdom and is widely recognised internationally. It has been adopted for this assessment.

3.8.2.4 Underwater Noise

Criteria for the onset of behavioural and physiological effects in cetaceans (marine mammals) due to underwater noise have been published by various sources including the US National Marine Fisheries Service (NMFS), the National Oceanographic and Atmospheric Administration (NOAA), the High Energy Seismic Survey (HESS) Team and Southall et al. These are summarised in Table 3.9.

Table 3.9: Impact criteria for marine mammals

Exposure limit	Effect	Study
230 dB re 1µPa (Peak)	PTS auditory injury onset in cetaceans	Southall et al (2007)
224 dB re 1µPa (Peak)	TTS onset in cetaceans	Southall et al (2007)
198 dB re.1µPa2s SEL M-Weighted	PTS auditory injury onset in cetaceans	Southall et al (2007)
183 dB re.1µPa2s SEL M-Weighted	TTS onset in cetaceans	Southall et al (2007)
215 dB re.1µPa2s SEL	PTS auditory injury	NOAA (2006)
195 dB re.1µPa2s SEL	TTS auditory injury	NOAA (2006)

Exposure limit	Effect	Study
180 dB re 1µPa (RMS)	Auditory injury criteria – cetaceans	NMFS (1995)
160 dB re 1µPa (RMS)	Behavioural disturbance, level B harassment	NMFS (1995)
140 dB re 1µPa (RMS)	Low level disturbance	HESS (1997)

Source: Kongsberg Maritime Ltd Document 37399 – FR1

In the case of fish, avoidance behaviour is seen at levels relative to the hearing threshold of the species.

The above criteria will be used, along with other relevant research findings, depending on the detail of information available on the sources of noise associated with the project.

3.8.3 Baseline Conditions

A desk study review of mapping and aerial photography indicates that the onshore receptors in the immediate vicinity of the proposed berthing facility include:

- Residential: private residential and hotels;
- Commercial: restaurants, banks, retail, offices;
- Institutional: public library, hospital.

Key onshore receptors will be identified and a description of the baseline noise climate will be developed based on existing information and supplemented by additional survey work where necessary. The availability of existing baseline data will be investigated through consultation with the Department of Environmental Health for the Cayman Islands which has the responsibility for the control of statutory nuisance, and development control which includes the control of noise pollution.

Marine receptors include:

- Fauna such as fish and mammals; and
- Recreational divers and swimmers.

Temporary noise impacts during the construction phase of the project generated by piling, blasting and dredging activities might be audible for most marine mammals and fish over considerable distances up to several kilometres from the source, depending on conditions. The project will permanently introduce intermittent noise impacts from the propulsion systems of cruise liners into the area of the proposed berthing facility. Existing activities within the marine environment such as cargo vessels accessing George Town Harbour affect the underwater noise climate.

3.8.4 Potential Impacts

Noise and vibration impacts during the construction phase are expected to arise due to:

- Dredging of berth pockets with a cutter suction dredger and the disposal of dredging material;
- Blasting to clear obstructions in the seabed;
- Tubular piling for deck supports and sheet piling for retaining structures;
- Construction of the deck, retaining walls and revetments; and
- Delivery of materials.

Noise and vibration during the operational phase are expected to arise due to:

- Cruise and cargo ships accessing the berthing facilities (typically daytime for cruise ships and night-time for cargo ships); and
- Additional movement of road traffic (taxis, service vehicles) on new or modified access roads or parking areas.

3.8.5 Methodology

The purpose of the noise and vibration assessment will be to determine the significance of effects at receptors due to the expected magnitudes of impacts associated with the project. The significance of effect is dependent on both the sensitivity of the receptor and the magnitude of impact at the receptor. The criteria for sensitivity of receptor, magnitude of impact and significance of effect are set out below.

3.8.5.1 Sensitivity of Receptor

Sensitivity criteria for the assessment of noise impacts affecting sensitive receptors are assigned in Table 3.10.

Table 3.10: Construction noise receptor sensitivity criteria

Sensitivity	Type of receptor
High	Residential area, hospitals, schools, colleges or universities, places of worship, designated environmental areas including marine environments, nature areas, high value amenity areas, cemeteries.
Medium	Offices, recreational areas, agricultural land.
Low	Public open spaces, industrial areas, car parks.

Sensitivity	Type of receptor
Negligible	Derelict land.

3.8.5.2 Magnitude of Impact

Outline criteria for the assessment of noise impacts at high sensitivity onshore receptors are set out in Table 3.11. The criteria will be refined within the ES to take account of the duration of impact, type of receptor (less sensitive types such as commercial etc), and of conditions where baseline noise levels already exceed the noise criteria.

Table 3.11: Outline approach to assess magnitude of noise impacts at onshore receptors

Magnitude of Impact	Definition	Level of impact exceeds criterion	Criteria for noise impact Leq dB(A) free field for high sensitivity receptors
Major	Significant change in conditions	More than 5.0 dB	Construction phase Daytime 65 dB(A) Night-time 45 dB(A) Operational phase Daytime 55 dB(A) Night-time 45 dB(A)
Moderate	Material but non-significant change in conditions	3.0 dB to 5.0 dB	
Minor	Perceptible but restricted change in conditions	1.0 to 2.9 dB	
Negligible	Potentially perceptible but non-significant change in conditions	0 to 0.9 dB	

Noise and vibration impacts on receptors within the marine environment will be assessed based on the level of detail available and with reference to reported effects resulting from similar activities (e.g. cutter suction dredging and the type of piling methods to be used).

3.8.5.3 Significance of Effect

The significance will be determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected, as depicted in the significance matrix shown in Table 3.12.

Only impacts of moderate or greater significance will be considered to be significant. If the impact is negative then the effect is adverse; if the impact is positive then the effect is beneficial. Professional judgement will be used to vary the predicted effect where appropriate. For example, an impact of major magnitude on a highly sensitive receptor may not be of critical significance if it is considered unlikely to occur.

Table 3.12: Matrix to determine significance of effects

				Sensitivity of receptor
Magnitude of Impact	High	Medium	Low	Negligible
Major	Critical	Major	Moderate	Negligible
Moderate	Major	Major	Moderate	Negligible
Minor	Moderate	Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

3.8.6 Consideration of Climate Change

Climate change may have direct and indirect influences on noise within the study area. For example, increases in ambient temperatures would have a direct influence on the mechanism of sound propagation because it results in a reduction in the attenuation of sound due to air absorption, as well as other factors such as temperature inversions. An indirect influence on noise may arise where increases in ambient temperatures results in occupiers opening windows of dwellings more frequently to increase natural ventilation. Consequently, this would increase the ingress of noise from external sources into living areas which may become a source of disturbance. Similarly, the more widespread use of air-conditioning as temperatures increase also introduces sources of noise from building services.

It is not possible to establish robust relationships between these climate-sensitive factors and any corresponding changes in noise levels, or attribute sensitivities to specific aspects of the project. Furthermore, the influence of climate change is not expected to make a significant change to the assessment of impacts compared with the other aspects of the project design (e.g. the proximity of berthing facility to receptors). It is concluded that Climate Change is not expected to have any significant influence on the potential effects of the project in terms of noise and vibration.

3.9 Terrestrial Ecology

3.9.1 Introduction

This section of the report presents the context of EIA with respect to the natural environment associated with the project with particular reference, but not limited to the construction phase of the project. Herein the “natural environment” includes terrestrial biodiversity (habitats and species) and their associated ecosystem services.

3.9.2 Applicable Standards

The assessment will follow the International Finance Corporation (IFC) Performance Standards (PS) that forms the basis for the Equator Principles, the leading industry standard on sustainability in project finance. These performance standards provide guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts. Of relevance are PS1 'Assessment and Management of Environmental and Social Risks and Impacts' and PS6 'Biodiversity Conservation and Sustainable Management of Living Natural Resources'. Compliance with the performance standards will address compliance with national laws, regulations and permits that pertain to environmental issues whilst also meeting international industry best practice.

National legislation, policy and plans for which the assessment takes into account, includes:

- Animals Law (2011 Revision);
- National Trust for the Cayman Islands Law 1987 (as amended);
- Environment Charter - Cayman Islands;
- National Environmental Policy, 2002;
- The Cayman Islands Constitution Order 2009, Schedule 2, Part 1, Bill of Rights, Freedoms and Responsibilities Paragraph 18 – Protection of the Environment;
- Draft National Conservation Law 2009;
- The National Biodiversity Action Plan 2009; and
- Marine Park Regulations and Marine Conservation Law (2007 Revision).

3.9.3 Baseline Conditions

In accordance with PS1 the baseline conditions will be established in the area likely to be affected by:

- The project and the activities and facilities that are directly owned, operated or managed by the proponent of the project (including by contractors) and that are a component of the project;
- Impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or
- Indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent.

The assessment of critical habitats (CHA) is an IFC requirement relevant to Environmental, Social and Health Impact Assessments

(ESHIAs) (IFC, 2012). The baseline biodiversity information required to undertake the assessment will be collated in order to undertake the CHA and will include but may not be limited to:

- Habitats protected by national law, international convention or listed on the National Biodiversity Action Plan; and
- Species protected by national law, international convention or listed on the National Biodiversity Action Plan.

3.9.4 Potential Impacts

Impacts throughout the project's lifecycle acting alone or in-combination with other existing or proposed plans or projects will be assessed within the ES, including:

- Temporary and permanent habitat loss and fragmentation;
- Disturbance to habitats and species (e.g. noise and artificial lighting);
- Potential changes to supporting processes on which habitats within the project area rely;
- Accidental pollution events; and
- Potential introduction of new invasive non-native species or the enhancement of existing invasive non-native species.

3.9.5 Methodology

In accordance with PS6 the EIA process will assess significance of project impacts on all levels of biodiversity, taking into account differing values attached to biodiversity by specific stakeholders. The impact magnitude (Table 3.13) and the biodiversity value (Table 3.14) of each feature will be combined to determine the likely effect of each impact (Table 3.15). The effects marked with an asterisk (*) are considered to be ecologically significant.

Table 3.13: Impact Magnitude Criteria

Magnitude	
Major	The proposal may adversely affect the site/population/habitat such that its respective conservation status is not sustainable.
Moderate	The site/population/habitat integrity will not be adversely affected but the effect on the site/population/habitat is likely to be significant in terms of its national or international conservation objectives. If it cannot be clearly evidenced that the proposal will not adversely affect integrity then the impact should be assessed as major.
Minor	Neither of the above applies but some minor impact is evident, e.g. changes in behaviour or phenology.
Negligible	No observable impact.

Magnitude	
Beneficial	Impacts which provide a net biodiversity gain overall.

Table 3.14: Biodiversity Value Criteria

Conservation Value	Criteria
Very High	Regularly occurring species listed on the IUCN Red List as Endangered or Critically Endangered and the habitats integral to their persistence. Qualifying features of a site of international conservation importance e.g. Ramsar site, Important or Endemic Bird Area (IBA/EBA), Important Plant Area (IPA), Key Biodiversity Area (KBA).
High	Regularly occurring species listed on the IUCN Red List as Vulnerable or Data Deficient. Regularly occurring species /habitats that contribute to the integrity of a site of international conservation importance. Regularly occurring species/habitats listed as endangered on an international/regional convention for which the Cayman Islands are a party. National Red Data Book (or equivalent national list) species/habitats or qualifying features of a site of national conservation importance. Local population of a species exceeding 1% of the respective national population.
Medium	Regularly occurring species listed on the IUCN Red List as Near Threatened. Regularly occurring species/habitats listed on an international/regional convention (for which Morocco is a party) as being in unfavourable conservation status and requiring conservation action to achieve favourable status. Regularly occurring species/habitats that contribute to the integrity of a site of national conservation importance. Regionally important habitat or population of a regularly occurring species in terms of size or distribution.
Low	Regularly occurring species listed on the IUCN Red List as Least Concern with locally important population in terms of size or distribution. Habitats of local importance in terms of size or distribution.
Negligible	Regularly occurring species listed on the IUCN Red List as Least Concern with a population of negligible conservation importance in terms of size and distribution. Habitats of negligible conservation importance in terms of size or distribution.

Table 3.15: Significance Matrix

Magnitude of Impact	Biodiversity Value of Receptors				
	Negligible	Low	Medium	High	Very High
Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Minor	Negligible	Minor	Minor	Minor	Moderate*
Moderate	Negligible	Minor	Moderate*	Moderate*	Major*
Major	Negligible	Minor	Moderate*	Major*	Major*

In accordance with PS6 if adverse impacts are unavoidable, the project proponent will aim to maintain the biodiversity value and functionality using the mitigation hierarchy that includes biodiversity offsets, which may be considered only after appropriate avoidance, minimisation and restoration measures have been applied. Mitigation measures will be identified following the assessment of impacts and through consultation with key stakeholders.

The described methodology will be used to assess impacts from the project on the terrestrial environment.

3.9.6 Consideration of Climate Change

In accordance with PS1 and PS6 the risks and impacts identification process will consider the relevant risks associated with a changing climate and the adaptation opportunities.

3.10 Marine Ecology

3.10.1 Introduction

This section deals with the potential impacts of the proposed port extension on the marine environment. It includes the specific standards and methods to be followed as well as a brief description of the key marine habitats and species that can be potentially affected by the project.

3.10.2 Applicable Standards

The key standards (International and National) needed to be considered were detailed in Section 3.9.2 of this report.

3.10.3 Baseline Conditions

3.10.3.1 Coral Reefs and Associated Benthic Habitats

The Cayman Islands are surrounded by fringing reefs which include a variety of reef structures, including ‘spur-and-groove’ formations, fringing reefs and patch reefs. Over the past decades the coral communities surrounding the Cayman Islands have been decreasing, suffering from habitat degradation due to a number of different causes (coastal development, habitat loss, overfishing and destructive fishing activities) (Cottam, 2011). Two corals that were once remarkably abundant are now rare in Cayman and have been listed by the US Endangered Species Act (May 6, 2006). The corals are the Staghorn coral (*Acropora cervicornis*) and the Elkhorn coral (*Acropora palmata*) (Manfrino, 2008).

Seagrasses along with coral reefs and mangroves, constitute the three major coastal interface communities in the Cayman Islands however it is noted that these communities are not present within the project area.

3.10.3.2 Fish

The Cayman Islands support a rich fish biodiversity and a few fish species are included in the National Biodiversity Action Plan (NBAP). The fish species/groups included in the NBAP are:

- Nassau Grouper Epinephelus striatus;
- Sharks; and
- Southern Stingrays.

Also included in the NBAP is the invasive species red lionfish *Pterois volitans*.

The main threats to fish communities are considered to be fishing, changes in water quality and loss of coral which support fish communities.

3.10.3.3 Other Marine Organisms

Marine turtles are protected under the Marine Conservation Law. There are seven living species of marine turtles. Four species have been recorded in the Cayman Islands:

- Green Chelonia mydas,
- Loggerhead Caretta caretta,
- Leatherback Dermochelys coriacea, and
- Hawksbill Eretmochelys imbricata.

Currently turtle population in the Cayman Islands are affected directly and indirectly through:

- Legal and illegal take;
- Incidental and accidental capture and mortality;
- Marine debris;
- Habitat loss and degradation; and
- Disease.

(NBAP, 2013, http://www.doe.ky, accessed on September 2013)

In the Cayman Islands, cetaceans are found offshore, usually in small pods. The distribution of regional cetacean species is likely to be limited to the pelagic environment and therefore cetacean occurrences in the Cayman Islands are brief and rare (Department of Environment, http://www.doe.ky accessed in September 2013).

3.10.4 Potential Impacts

Potential impacts from the proposed development on the marine environment include:

- During construction:
  - Permanent and temporary habitat loss and habitat degradation;
  - Changes in water quality due to dredging activities, including increased turbidity surrounding the development area resulting in smothering effects on the benthos;
  - Changes to sea bed characteristics due to sediment deposition and potential indirect impacts on habitats and benthic species;
  - Disruption to the benthic habitat due to potential releasing of contaminants into the marine environment;
  - Disturbance due to noise, vibration and artificial lighting causing avoidance and, in more serious cases, permanent physiological changes; and
  - Accidental pollution events.
- During operation:
  - Habitat degradation resulting from increased shipping leading to physical disturbance;
  - Physical damage due to ship movements and anchoring;
  - Changes to water quality due to ship maintenance activities;
  - Impacts due to the change in cruise size using the port;
  - Accidental pollution events; and
  - Potential introduction of new invasive non-native species or the enhancement of existing invasive non-native species.

The impact assessment will look at each of the potential effects on the potential receptors as detailed in baseline conditions. In addition, the footprint of the port and proposed extension lies within a Marine Park and therefore impacts on the protected area will also be considered. The impacts on diving sites located near the port will also be addressed.

3.10.5 Methodology

The impact assessment for this EIA follows the revised International Finance Corporation (IFC) Performance Standard 6 (PS6) (International Finance Corporation, 2012) guidance on biodiversity conservation and sustainable management of living natural resources. In this chapter the methodology will follow the steps and methods described in Section 3.9.5 of this report and therefore it is not described here.

3.10.6 Consideration of Climate Change

As part of the impact assessment and in accordance with PS1, the relevant risks associated with a changing climate will be considered as well as any adaptation opportunities. In particular the potential effects on coral communities will be considered in light of changes in water temperature and cumulative effects due to the proposed development.

3.11 Cultural Heritage

3.11.1 Introduction

This section sets out the methodology for the assessment of effects of the proposed Cayman Islands Berthing Facility on Cultural Heritage. The heritage resource includes both designated features protected by legislation and features of national or local archaeological, historical or architectural interest and value. Within the remit of the scheme this resource incorporates both marine and terrestrial heritage assets, including buried archaeology and historic buildings and sites.

3.11.2 Definition

Cultural Heritage is understood to mean the remains of monuments (architectural works, sculptures and paintings, and dwellings), groups of buildings (and their place in the landscape, or their setting), and sites (Information from UNESCO; Convention concerning the Protection of the World Cultural and Natural Heritage 1972).

Cultural heritage may be threatened by construction work that involves extensive ground work which may damage or remove in-situ remains or affect the landscape within which a feature or site may be located. Inappropriate development can affect the likelihood of the preservation of archaeological remains in situ and can create adverse impacts on the setting of national and locally important buildings, by removing important associations through the changing of visual reference points.

Underwater cultural heritage refers to archaeological remains or deposits which are in an underwater environment. It includes submerged sites and structures, wreck-sites and wreckage and their archaeological and natural context (Information from the ICOMOS International Charter on the Protection of the Underwater Cultural Heritage (1996) – that was developed by the International Committee on the Underwater Cultural Heritage, ICUCH).

Underwater cultural heritage may be threatened by construction work that alters the shore and seabed or alters the flow of current, sediment and pollutants. Underwater cultural heritage may also be threatened by insensitive exploitation of living and non-living resources. Furthermore, inappropriate forms of access and the incremental impact of removing "souvenirs" can have a deleterious effect.

3.11.3 Assessment methodology

The assessment to be presented within the ES will describe the baseline archaeological resource within the study area (both off shore and on the immediate onshore environments) and consider the potential for previously unrecorded remains within the proposed development footprint. It will describe how the proposals will impact on the Cultural Heritage resource and assess the significance and severity of the effects arising from both the construction and operational impacts.

Mitigation measures will be recommended where appropriate. The assessment will conclude with the significance of the residual effects taking into account this mitigation. Indirect, cumulative impacts and secondary effects will also be assessed and the assessment will draw on the conclusions from other disciplines notably, Biological Assessments, Socio-Economic Assessments and Noise and Vibration.

Consultation and dialogue with Dr M.E Leshikar-Denton, and other statutory and non-statutory consultees who have an interest in the protection, conservation and management of the archaeology and cultural heritage resource will be maintained throughout the duration of the assessment.

3.11.4 Applicable Standards

Legislative standards and guidance used during the assessment will include:

- **The International Charter on the Protection and Management of Underwater Cultural Heritage (International Council on Monuments and Sites (ICOMOS) 1996):** This best practice document sets out a series of 15 articles which state the preferred methodology for any underwater archaeological investigation, and includes the requirements for reporting and dissemination of results of projects (Articles 12-14).
- **Convention on the Protection of the Underwater Cultural Heritage 2001 (UNESCO):** Specifically relevant to the scheme are policies 1-10 found within Article 2, which deal with the management and dissemination of underwater cultural heritage.
- **The Abandoned Wreck Law (1997):** states that all shipwrecks which have remained on the seabed within the Cayman Island territory for more than 50 years are contained within the legislation. Artefacts are 'vested in Her Majesty in right of Her Government of the Islands'.
- **The National Environmental Policy, Cayman Island Department of Environment (May 2002):** sets out the Department of Environment's aims and objectives for obtaining the maximum benefit from development opportunities while ensuring the conservation of the natural environment and resources.

3.11.5 Baseline Conditions

The method for determining and appraising baseline conditions will involve both desk study and baseline survey. The assessment will be undertaken in accordance with the published standards and guidance set out in the following:

- The Assessment and Management of Environmental and Social Risks and Impacts; PS1 and PS8 (Cultural Heritage). The International Finance Corporation, 2011.
- The Protection of the underwater heritage: technical handbooks for museums and monuments 4. UNESCO, 1981.

Consultation during the assessment process will be maintained with the following organisations and individuals:

- Dr M. Leshikar-Denton (Museum Director of the Cayman Islands National Museum)

- The Environment Assessment Officer, Cayman Islands Department of Environment (DoE)

Information relating to the historic environment will be obtained from the following organisations:

- Cayman Islands National Museum
- The National Trust for the Cayman Islands
- The Cayman Islands National Archive

The information sources consulted would include:

- The National Shipwreck Inventory
- The Historic Buildings and Sites Inventory (HBSI)
- The Historic Preservation Awards (HPA)
- The Maritime Heritage Trail (Colour posters/ brochures)
- published and unpublished sources (documentary material, archaeological studies, fieldwork reports, local histories);
- cartographic information
- relevant geotechnical data

3.11.6 Potential Impacts

3.11.6.1 Construction

Construction impacts on Cultural heritage assets and underwater archaeological remains are likely to arise as a result of the following activities:

- Reclamation of land for new terminal;
- dredging of the seabed within the development footprint;
- construction of new piers for docking;
- modification of existing infrastructure;
- visual intrusion and disruption on surrounding heritage assets during construction;
- creation of increased noise / dust during construction;
- diversion or alteration of existing services; and
- installation of new services.

These activities could lead to the following effects on the historic resource:

- Total or partial loss/damage of shipwrecks of known and unknown vessels that could potentially date from the sixteenth century to the present day;
- total or partial loss/damage of ship borne artefacts;
- total or partial loss/damage of unknown military aircraft and vessels lost during WWI and WWII conflicts;

- total or partial loss/damage of unknown or undefined archaeological remains, including artefacts;
- total or partial loss/damage to unknown archaeological sites within the area;
- effects on buildings within the area that are statutorily listed (Fort George);
- structural damage to historic buildings due to proximity of excavation, demolition works, vibration etc.;
- severance or loss of features such that the physical or visual integrity of a site is compromised and the ability to understand and appreciate the remaining elements is diminished;
- temporary alteration and/or visual intrusion into the historic setting/character of a designated site or undesignated site of national significance;
- temporary effects on the access to, and amenity of, designated sites or undesignated sites of national significance; and
- opportunity to investigate and record archaeological remains and buildings of architectural or historic interest within proximity to development.

There may also be cumulative effects from the accumulation of different effects on the same resource, or accumulation of impacts on the same type of receptor.

3.11.6.2 Operational

Effects from the operational phase of the scheme may arise as a result of the adverse or beneficial impacts upon the special architectural or historic interest of a designated site (or undesignated site of national importance) and its setting, character or appearance. This is of relevance to the Cayman Island cruise Berthing Facility Scheme in particular due to its close proximity to known shipwrecks of the Cali and Balboa as well as the close proximity to Fort George, Elmslie Memorial Church, Historical buildings and features adjacent to Heroes Square, the George Town Post Office, and the National Museum (housed in the Old Courts Building).

Impacts can arise as a result of:

- physical and visual changes arising from new or modified infrastructure including the new piers and terminal;
- the scale, mass, design or form of a new development and its relationship to the designated resource;
- increased maritime traffic as a result of increased docking opportunities within the harbour;

- changes in pollution levels; and
- changes in noise levels.

These changes could lead to the following effects on the historic resource:
- increased visual intrusion both to and from buildings of national importance;
- alteration to the historic setting/character of a designated site or undesignated site of national significance;
- increase or decrease in traffic, noise, vibration, dust or pollution such that the amenity or physical fabric of a nationally important site is either adversely affected or improved;
- opportunities to enhance the character and setting of a designated site or undesignated site of national significance; and
- opportunities for heritage related education and tourism.

3.11.7 Methodology

The assessment will be divided into the following key stages:
- A desk-based assessment including consultation of relevant record data sources held at the National Archive and The National Museum (including the inventory of known offshore archaeological sites and on- shore sites of archaeological significance, such as designated buildings of historical importance);
- consultation of relevant remote sensing data, including procurement and study of any magnetometer survey data sources of the area within the proposal;
- assessment of potential impacts, and
- reporting.

The principal sources to be consulted in the baseline assessment will include:
- The Cayman Islands National Museum
- The National Trust for the Cayman Islands
- The Cayman Islands National Archive

These data sources will form the basis for a desk-based assessment of the recorded wrecks, submerged landscapes, coastal sites, archaeological sites of national importance, historical buildings, and other relevant features which contribute to the Cultural Heritage of the area and will be directly impacted on by the proposal. In addition, any geophysical data obtained for the area to be used for the proposed development, will be reviewed by appropriately qualified archaeologists, specialising in marine archaeological assessments. The data will be reviewed for any anomalies potentially relating to sea bed marine heritage features.

A data search for designated and undesignated heritage assets will be carried out within a study area of 0.6 mi (1 km) from the centre of the development proposal. Data sources will include Heritage databases (including inventories of known archaeological sites and wreck sites) cartographic sources and published and unpublished reports.

Based on the findings of the desk-based assessment and the impact assessment, a series of recommendations will be proposed to mitigate any significant impacts of the proposed development upon the archaeological and Historic Environment resource.

3.11.7.1 Importance of receptor

The importance and sensitivity of archaeology and cultural heritage receptors will be based on Table 3.16 below. Assessment of importance is based on a combination of designated status and professional judgement.

It is also recognised that occasionally sites can have a lower or higher than normal sensitivity within a local context. It is also recognised that assessment of sensitivity also needs to take into account the component of the site that is being affected and the ability of the site to absorb change without compromising the understanding or appreciation of the resource.

Table 3.16: Assessment of importance of archaeological resources and receptors

Importance Scale	Example of Receptor
High	Archaeological assets of high quality and importance; buildings, monuments, sites or landscapes that can be shown to have particularly important qualities in their fabric or historical association
Medium	Sites of high archaeological resource value as identified through baseline research; buildings, monuments, sites or landscapes that can be shown to have important qualities in their fabric or historical association
Low	Buildings, monuments, sites or landscapes of local importance and of modest quality; Locally important historic or archaeological sites, sites with a local value for education or cultural appreciation; Sites so badly damaged that too little remains to justify inclusion into a higher grade; The receptor is tolerant of change without detriment to its character

3.11.7.2 Magnitude of Effects

The magnitude of effect will be determined as the predicted change to the existing baseline environment during construction and operation of the scheme. The effect of this impact refers to the consequence of the change on the receptor, or particular value or sensitivity.

Table 3.17: Relationship between magnitude of impact and effect

Magnitude of Impact	Effects
High	Significant change to baseline conditions, or causing breaches of legislation or statutory objectives. Change such that the asset is totally altered or destroyed. Comprehensive change to setting affecting the assets significance.
Moderate	Moderate change to baseline conditions. Change such that the value (significance) of the asset is affected. Changes such that the setting of the asset is noticeably different.
Low	Slight change to baseline conditions. Change such that the value (significance) of the asset is slightly affected. Changes to the setting of the asset that have slight impact on significance.
Negligible	No discernible change to baseline conditions. The development does not change the asset or its setting.

3.11.7.3 Level of Significance

Table 3.18: Level of Significance

Magnitude	Low Importance	Medium Importance	High Importance
High	Low	Moderate	Major
Moderate	Low	Moderate	Major
Low	Low	Low	Moderate
Negligible	Negligible	Negligible	Low

The level of significance is given in the above table. Major and moderate effects are considered to be significant. The assessment will also consider cumulative effects, where several types of effect act on the same resources and/or receptors. In some cases it may be that several “slight” effects may, individually, be not significant but acting together may produce a significant effect on a sensitive historic resource.

3.11.7.4 Mitigation and Significant Residual Effects

Where effects are identified as significant, mitigation measures for archaeology and cultural heritage will be incorporated at various stages during the design, construction and operation of the development. The main stages would be as follows:

- during the design stage to avoid or minimise impacts and associated effects;
- during the design stage to incorporate beneficial measures; and
- in advance of and during construction to reduce any negative effects.

Within the assessment and throughout the duration of the scheme, mitigation measures will be considered in the following hierarchy:

- first, avoid adverse effects as far as possible by use of preventative measures including scheme design;
- second, minimise or reduce adverse effects to 'as low as practicable' levels; and
- third, remedy or compensate for adverse effects which are unavoidable.

The ES will conclude with an assessment of residual effects associated with the scheme.

3.11.8 Consideration of Climate Change

Climate change may have direct and indirect influences on heritage assets within the study area. For example, higher rainfall intensities could increase the rate of deterioration of a historic building, particularly if there is a corresponding change in pH levels in the rain. Similarly, with regard to underwater archaeology, an increase in sedimentary movement associated with tropical storms is likely to affect both the visibility and accessibility of wrecks.

It is not possible to establish robust relationships between these climate-sensitive factors and any corresponding effects of the project. Furthermore, the influence of climate change is not expected to make a significant change to the assessment of impacts compared with the other aspects of the project design (e.g. the direct loss of heritage assets due to the construction of the berthing facility). It is concluded that Climate Change is not expected to have any significant influence on the potential effects of the project in terms of Cultural Heritage.

3.12 Traffic and Pedestrian

3.12.1 Approach and methodology

In order to provide robust inputs to meet the requirements of the EIA, it will be necessary to assess the traffic and pedestrian impacts and related environmental effects for both the construction and operational phases.

It is therefore proposed that a Transport Assessment (TA) is undertaken in order to inform the operational assessments of the EIA. In the preparation of the TA, baseline data will be obtained which will be used at the EIA stage to provide a platform on which to assess the significance of environmental effects.

3.12.2 Transport Assessment

The TA will consider the impact of the development on all transport modes, set out proposals to minimise these impacts and promote measures to encourage sustainable transport. Such measures may include: incentives to encourage greater levels of walking, cycling and use of public transport; public transport improvements including better provision of information; initiatives to encourage workers and cruise passengers to choose sustainable modes; and encouraging staff to car share. The assessment will also consider the impacts of construction works (including construction staff movements) on the following;

- Public Transport Delay – journey time changes due to congestion or diversions;
- Disruption at interchanges – impact on bus, taxi or tour operator interchange; and
- Parking and loading – loss of designated public or private car parking or loading spaces.

The TA will be an iterative process, undertaken in consultation with the client, authorities and relevant stakeholders. The option to develop an accompanying framework travel plan will be discussed with the client.

An extensive baseline data gathering stage shall be undertaken which will underpin the TA. Some of the data gathered, (which will also inform the EIA assessments) will include:
- Typical baseline traffic flows on links and junctions in the area (existing or new traffic surveys)
- Percentage of HGV's on the network
- Overview of parking, loading and servicing arrangements
- Public bus and tour bus schedules, capacities and loadings
- Personal trips generated from the existing site and modal distribution

- Pedestrian and cycling facilities and movement counts
- Identification of trip attractors
- Personal injury accident records

In the context of the new berthing facility, some of the specific issues for the TA to address will include the following:

- Processing and efficient onward movement of large numbers of cruise ship passengers in short time periods both for the construction and operational phase. Depending on the complexity and degree of construction or operational impacts on passenger movements, the assessment may include an evaluation using pedestrian movement simulation modelling.
- Mitigation of transport impacts from a substantial uplift in visitor numbers in the centre of George Town;
- Consideration of requirements for alternative tendering services during the construction phase (location, operational prerequisites etc.); and
- Impact on the existing cargo terminal operations and other marine traffic.

The scope of the Traffic Assessment and methodology to be adopted is set out in Appendix F. The TA shall be included as an annex to the ES.

3.12.3 Traffic and Pedestrian EIA inputs

The traffic and pedestrian inputs to the EIA will be informed by the TA assessment and baseline data capture exercise and will assess both the construction and operational impacts of the development. The magnitude and significance of any environmental traffic and pedestrian effects will be determined and any mitigation identified.

The EIA assessment process will adopt the established methodology as outlined in Guidelines for the Environmental Assessment of Road Traffic (Institute of Environmental Assessment, 1993). The assessment will also be undertaken in consultation with the client and agreement on the following aspects will be sought:

- Identification of sensitive areas / affected parties
- Forecast traffic levels and characteristics
- Time period(s) suitable for assessment (e.g. AM peak)
- Year of Assessment (year of construction and year of opening)
- Ceiling figure for maximum number of passengers
- Geographical boundaries of the assessment

The screening process to define the geographical scope of the EIA study will be based upon the established guidance which recommends that detailed environmental impact studies will only be triggered where road links experience a change in traffic of greater than 30% for all vehicles (or HGV's) or more than 10% where the links pass sensitive areas.

Traffic and pedestrian construction and operational impacts to be assessed will include:

- Visual effects – impacts from construction vehicles will be noted and effects described;
- Driver severance and delay – at junctions or links subject to traffic flow increases which are either approaching capacity, or are over capacity (or delays resulting from traffic diversions);
- Pedestrian severance and delay – at locations where physical obstructions or increases in traffic flows in excess of 30% are forecast to result in an increase in severance;
- Pedestrian amenity / intimidation – at junctions or links subject to substantial increases in traffic flow in conjunction with any changes in footway widths or crossing facilities. The presence of sensitive user groups will also be considered;
- Accidents and safety – links and junctions (for which data is available) with existing accident rates in excess of national averages which may be subject to an increase in traffic flows; and
- Hazardous and dangerous loads – consideration of estimated number and composition of loads and assessment of accident risk if considered significant.

Identified significant effects (both adverse and beneficial) will be assessed against significance criteria as set out in the established guidelines and further categorised as 'slight', 'moderate' or 'substantial' as appropriate. The temporal aspects of any impacts will also be considered when determining the significance of effects. Any departures from the guidelines will be agreed with the client and will be clearly stated within the ES. Mitigation will also be developed in consultation with the client and will adopt the hierarchical principles of prevention, reduction and offsetting.

3.12.4 Inputs to other EIA Topics

It is assumed that the assessment of topics such as noise, vibration, air quality, ecology, heritage, conservation areas and climate change will be undertaken by other discipline teams. The traffic team will supply existing and forecast data and analysis, relating to peak and average flows, Annual Average Daily Traffic (AADT) flows and traffic speeds, to inform these assessments.

3.12.5 Consideration of Climate Change

The growth in global tourism is closely linked to climate change. In addition, the burning of fossil fuels such as petroleum is the largest man-made contributor to the increase in atmospheric CO_2.

The traffic and pedestrian chapter of the ES will acknowledge that changes in traffic and transport patterns have the potential to impact upon climate change. The study will identify appropriate mitigation to help avoid, reduce or eliminate the generation of greenhouse gas emissions during the construction and operation phases of the proposed development.

For the construction phase, this is likely to include: controls on vehicle types; use of designated construction vehicle routes; controls on delivery hours; and construction worker travel plans. For the operational phase, this is likely to include the promotion of sustainable modes such as walking, cycling, car sharing and greater use of public transport.

3.13 Cruise and Cargo Operation

3.13.1 Introduction

This section sets out the methodology for assessing the effects on the cruise and cargo operations resulting from the proposed cruise berthing facility.

Key issues include:

- Interface between cruise and cargo operations
- Effects on maritime stakeholders including reduction in tendering demand
- Effects of regular vessels manoeuvres close to shore
- Additional infrastructure/resources required to support ships at berth
- Changes in port security requirements

This section will by default overlap into more specific sections of the EIA such as traffic but will be discussed here for completeness.

3.13.2 Applicable Standards

No requirements were identified specific to the Cayman Islands. It is therefore proposed that this section of the EIA should be prepared with reference to the following standards:

- The International Ship and Port Facility Security Code ISPS - *Port Security*
- International Convention for the Prevention of Pollution from Ships (MARPOL) - *Pollution*
- The UK Department for Environment Food & Rural Affairs 'Marine Policy Statement', 2011
- The UK Marine and Coastal Access Act, 2009
- The UK Department for Transport 'A Project Appraisal Framework for Ports', 2003

3.13.3 Baseline Conditions

3.13.3.1 Cruise Operations

There are currently 4 dedicated offshore anchorages for cruise ships. In 2012, there were 525 cruise ship calls, totalling 1.5 million passengers; however this follows a general decreasing trend in passenger numbers from a peak in 2006, with 802 calls totalling over 1.9 million passengers. Vessels call at George Town all year round, with the busiest months between November and April. George Town is currently served by all of the major cruise lines, including Carnival, Celebrity Cruises, Holland America Line, Princess Cruises, Royal Caribbean and Norwegian Cruise Line. The cruise terminal operates from 6am to 6pm.

By 2014 it is projected that around 1.8 million passengers will be visiting the Cayman Islands and will rise again to 2.2 million by 2015.

3.13.3.2 Cargo Operations

The cargo terminal handles general cargo (break bulk), containerised cargo, liquid cargo (fuel) and bulk cargoes, including cement and aggregates. The majority of cargo comes from Florida (~70%), Cuba (~15%) and Jamaica (~5%). In 2012, 60 different vessels were trading at the cargo terminal, totalling 486 calls, with a total of 217,000 tons (220,000 tonnes) of domestic cargo handled. The cargo port can cater for vessels up to 400 ft (122 m) overall length, with a maximum draught of 16.5 ft (5 m). Cargo lines currently serving George Town are;

Thompson/Tropical Shipping, Seaboard Marine, West Indian Marine and Seafreight Ltd. The cargo terminal operates from 6pm to 6am.

3.13.4 Potential Impacts

The potential predicted impacts on cruise and cargo operations as a result of the construction and operation of the proposed berthing facility improvements are outlined briefly, and should be assessed in terms of their significance as part of the EIA.

3.13.4.1 Construction Impacts

- Disturbance to shipping
- Requirement for temporary navigation aids
- Potential increase in construction materials through the port
- Likely increase in wastes from construction

3.13.4.2 Operational Impacts

- Accidental Damage
  - Accidental damages such as fuel leaks, uncontrolled explosions etc could occur as a result of the cruise ships. Such incidents should be captured in a Disaster Management Plan with appropriate mitigation identified. A Disaster Management Plan should be held by all cruise ships using the Harbour.
- Port security
  - Increased vessel operations/passenger numbers may lead to increased security risks/requirements in the vicinity of the port.
- Interference with cargo operations
  - Increase cruise operations may reduce the available capacity for cargo operations.
  - Extended cruise terminal operational hours may interfere with cargo handling.
  - Increased cruise traffic may affect the sea space available for cargo traffic.
- Increased passenger numbers
  - Improved shore accessibility is likely to increase number of passengers disembarking and visiting George Town/Grand Cayman and demand on island infrastructure.
  - Provision of permanent berthing is likely to attract more/larger cruise ships, with a corresponding increase in visitor numbers.

- Increased demand for island resources
    - Cruise vessels may require island resources (water/electricity/fuel) while at the berth, increasing demands on local supply.
- Effect of nearshore berthing
    - Increased near-shore vessel manoeuvres may cause seabed scour, resulting in increased water turbidity, damage to coral, and a decrease in marine life.
    - Cruise ships near-shore for extended periods could increase the risk of pollution, e.g. hydraulic line breaks, greywater discharge, debris/waste blowing overboard, and oil spills.
    - Potential requirement for waste handling provision from ships.
    - Vicinity of cruise ships to shoreline may increase noise and disturbance to local residents.
    - Provision of permanent moorings may enable vessels to berth in worse weather conditions, reducing weather related 'no-call' days.
- Effects on maritime stakeholders
    - A direct shore connection may lead to a reduction in demand for tender services, potentially driving local tender providers out of business.
    - Provision of permanent moorings may lead to increased demand for waterside port services, such as pilot boats and line handlers.
    - Increased passenger numbers may increase demand for recreational activities including water sports and shore-based excursions however;
    - Increased cruise operations may lead to disruption of water sports businesses at George Town Harbour.

3.13.5 Methodology

The EIA will assess the significance of the potential impacts resulting from the construction and operation of the proposed cruise berthing facility. The steps required are outlined below

1. Collect, review and analyse existing data

- Obtain data from the Port Authority for cruise vessel calls, passengers coming ashore, number of tender and tourist boats in operation
- Obtain passenger queuing data for departures/arrivals for shore excursions and queuing for departure tendering

- Obtain data on the available shore excursions and their capacities to accommodate tourists
- Obtain data on the existing demands for water, waste disposal, electricity and fuel from the port and cruise operations

2. Identify existing conditions

- Determine hours of operation of cruise and cargo terminals and any interference between them
- Analyse data to identify peak conditions for vessel calls, passengers on shore, vessels at berth and cargo/product coming through the port
- Assess existing tender capacity and facilities
- Assess accessibility/convenience for passengers embarking/disembarking from cruise ships
- Assess port security functions and future requirements
- Assess impacts to public rights of way in the vicinity of the new facility

3. Assess effects on cruise and cargo operations of the proposed berthing facilities

Construction

- Assess temporary requirements for alternative cruise tendering processes
- Assess temporary requirements for alternative cargo handling/storage processes
- Assess effects on navigation/ marine accessibility to port during dredging operations/marine piling

Operation

- Evaluate impacts to internal and external operations of the port
- Determine potential for interference between the cruise and cargo operations
- Evaluate how/if the port will reduce weather related no call days or can be used as a safe refuge during storms.

4. Assess effects of proposed nearshore berthing and operations

- Evaluate potential for propeller scour and possible mitigation measures
- Assess potential for pollution from ships (hydraulic line breaks, greywater discharge, debris/waste blowing overboard, oil spills) and potential for dispersion of spills due to tidal/current conditions
- Evaluate potential for disturbance to local residents from noise/light from cruise ship

5. Identify effects on maritime stakeholders

- Evaluate the anticipated increase in the number of cruise passengers along with other types of tourism and any interaction between the modes
- Identify expected impacts to water sport activities and use of recreational areas at the project location
- Evaluate growth of waterside support services (e.g. pilot/repair) that will be required due to berthing of cruise ships
- Evaluate potential ship calls and estimate the number of ships berthed/anchored to determine an estimate of the number of passengers requiring tendering and compare with existing number of tendered passengers

6. Define requirement for island based resources

- Evaluate change in operational cruise ship requirements and how this will affect demand for island based resources (e.g. water, waste disposal, electricity).

7. Define effects on island infrastructure

- Determine the sensitivity of cruise and cargo operations to existing island infrastructure
- Determine the magnitude of peak demand due to the improved berthing facilities and impact on island infrastructure
- Describe and discuss potential changes in cruise ship operations due to the MARPOL convention
- Describe current requirements (and potential changes) under the MARPOL regulations for prevention and control of pollution from ships, due to, oil, sewage, garbage, and air
- Assess the requirement for port reception facilities to ensure compliance with the MARPOL regulations

3.14 Socio-Economic Assessment

3.14.1 Introduction

The socio-economic impact assessment (SIA) will involve the process of identifying, assessing and managing positive and negative effects of the project interventions, and any socioeconomic change processes invoked by those interventions. The SIA approach that will be followed is guided by the concepts of the International Association for Impact Assessment (IAIA), which considers social impacts as changes to one or more of the following: people’s way of life, their community, culture, environment, health, wellbeing, and personal and community property rights.

3.14.2 Applicable Standards

The project will be required to follow the social laws of the Cayman Islands', which are largely based on English common law, with local statutes. Key laws relevant to socioeconomic issues include:

- Labour Law, 2011 Revision (G23/2011 s5)
- Land Acquisition Law, 1997 Revision (G21/1997 s6)
- Tourism Law, 2002 Revision, G13/2002 s12)
- Trade Union Law, 1998 Revision (G7/1998 s8)
- Workmen's Compensation Law, 1996 Revision (G26/1996 s6)

In addition to national law, the SIA approach will aim to promote compliance with international best practice, typically embodied by the Equator Principles[17] and the International Finance Corporation (IFC[18]) Policy and Performance Standards on Social and Environmental Sustainability (PS). Efforts will be made to promote compliance with the following PS, that are relevant to the SIA and the project:

- PS1: Assessment and management of environmental and social risks and impacts
- PS2: Labour and working conditions[19]
- PS4: Community health, safety and security
- PS5: Land acquisition and involuntary resettlement
- PS8: Cultural heritage

PS7: Indigenous peoples (IPs), is thought at this stage to be scoped out of further assessment as it is thought that none of the potentially project- affected peoples meet the international definition of IPs.

The World Bank Group's Occupational and Community Health and Safety Guidelines for Ports, Harbours, and Terminals will also be used as key guidance.

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[17] The Equator Principles (EPs) is a risk management framework, adopted by financial institutions, for determining, assessing and managing environmental and social risk in projects and is primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making. The EPs defer to the IFC's Policy and Performance Standards on Social and Environmental Sustainability as best practice (see below).

[18] The IFC is the private sector lending instrument of the World Bank Group.

19 Which are based on the Core Labour Standards of the International Labour Organisation (ILO).

3.14.3 Baseline Conditions

The Cayman Islands has a total population of 56,732 people, most of whom reside on Grand Cayman. The capital city of Grand Cayman, George Town, is located in the George Town District where the project is to be located and has a population of 30,202 people. The population of the Cayman Island's is young compared to most developed countries, with 85.3% of the population below the age of 55.

The Cayman Islands is a flourishing offshore financial centre, with 93,712 companies registered in the islands as of 2012[20]. In order of contribution to the Gross Domestic Product (GDP), the most important industries are tourism, banking, insurance and finance, construction and furniture. In 2008 1.9 million tourists visited the Cayman Islands, and in 2011 accommodation and restaurants alone accounted for 5%of GDP. In terms of employment, 21% of the labour force is occupied within the services sector, primarily in tourism, and there is 6.2% unemployment.

There is controversy over the rapid increase in cruise tourists and day visitors over the last ten years, which is considered by key stakeholders including the Ministry and Department of Tourism, as a potential contributing factor to the reduction in 'stay-over' visitors. It is thought that stay-over visitors, who stay a number of nights and contribute more significantly to the economy than day visitors, are being put off by the day visit crowds[21]. The high number of day visitors also contributes to pressure on infrastructure, in particular congestion on roads and key attractions, such as Seven Mile Beach.[22]

During the stakeholder consultation an issue concerning passenger safety during tendering was raised. No statistics are available to include in this report.

3.14.4 Potential Impacts

Table 3.19 below summarises the preliminary key socioeconomic impacts and issues preliminarily identified for further analysis as part of the EIA.

[20] The Cayman Islands' Compendium of Statistics, 2012, published June 2013, The Economics and Statistics Office, Ministry of Finance and Economic Development.

[21] The Tourism Company (2013), Tourism Policy and Management Plan for the Cayman Islands

[22] The Tourism Company, Revised National Tourism Management Plan 2009-2013

Table 3.19: Potential Socio-economic Impacts and Issues

	Potential Adverse Impacts	Potential Beneficial Impacts
Potential Direct Impacts	Community disturbance from noise and vibrations, visual impacts, waves, etc. Population changes: in particular resulting from the increase in number of day visitors puts pressure on local infrastructure and services. Potential involuntary resettlement of homes and businesses.[23]	Local construction employment and business impacts: construction phase jobs and local procurement could benefit the local economy. Boost to tourism economy: increase in cruise-related tourism injection of foreign exchange into local economy.
Potential Indirect Impacts	Tourism economy: increase in day-visitor may deter stay-over visitors and harm local small scale tourism service providers The number of tourists may reach a level that overwhelms the current facilities and negatively impacts on the cruise visitor experience The presence of increased numbers of visitors may negatively impact the condition of natural tourism attractions Creation and operation of berthing facilities may negatively impact water sports operations in the vicinity of the project. Local fisheries: including impacts to small scale artisanal fishermen whose livelihoods could be affected by wave impacts, loss of fish landing spots or disruption to marine ecology. Archaeological and cultural assets, in particular the two wrecks of Balboa and Cali as well as Fort George Changes to culture and cohesiveness of the community, for example behavioural changes resulting from increased number of tourists. Potential climate change exacerbation resulting in increased vulnerability of coastal residence to erosion and tropical storms, and the related impoverishment risks.	Secondary supply chain impacts: providing 'spin-off' jobs and business opportunities for workers and entrepreneurs.

During the initial site visits, a number of local businesses were noted in or immediately adjacent to the harbour. Therefore, consideration of the socioeconomic impacts of the cruise berthing terminal on these stakeholders and on local fishermen will be an important aspect of the EIA.

[23] Resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use (Source: IFC PS5).

3.14.5 Methodology

Baseline information will be collected from secondary data sources including but not limited to: local population census data, government planning documents, international financial institutions' statistics, non-governmental organisations (NGOs) and business reports. Primary data sources will include consultation with key stakeholders, including local community and business representatives and NGOs. Relevant socio-economic indicator data will be gathered including information on income sources and livelihoods, and access to employment and business opportunities, as well as social services such as education and health.

This information will be evaluated and used to identify potential impacts and attribute significance to them. Significance will be determined through the use of clearly-defined qualitative criteria considering:

- Sensitivity of socioeconomic receptors (individuals or social or economic groups), determined by their vulnerability to socio-economic shocks or ability to take advantage of opportunities; vis-à-vis
- Magnitude of impacts, determined by effect on receptors, well-being, which refers to the financial, physical and emotional conditions of people or groups.

The assessment will specifically consider impacts on gender relations, and any vulnerable groups identified.

Mitigation measures will be identified for the construction and operational phases, which will seek to minimise potential negative impacts and enhance positive impacts of the project, where possible. These will include but not be limited to:

- Measures to maximise local employment and procurement business benefits.
- Sector-specific construction phase measures to minimise community health, safety, security and disturbance from aspects like noise, dust and vibrations.
- Measures to maximise the likelihood that resettlement affected people's quality of life and livelihood will be equal to or better than the pre-project conditions.
- Enhancement measures, such as provision of training to construction phase employees and local community investment measures.

Social mitigation, management and monitoring provisions will be developed for inclusion in the ESMMP.

3.14.6 Consideration of Climate Change

Consideration will be given to how this project will impact on climate change, and vice versa. The most obvious socioeconomic climate change issue relates to the high risk of natural disasters such as hurricanes, and the impact on local communities and economies in terms of vulnerability, resilience and well-being.

The Cayman Islands are susceptible to hurricanes, primarily from July to November. Due to its tropical location, the Cayman Islands are directly hit or brushed every 2.23 years[24]. In September 2004, Grand Cayman was hit by its worst hurricane in 86 years (Hurricane Ivan), which flooded many areas of the island and damaged more than 80% of dwellings. Hurricane Ivan has a devastating impact on the islands tourism sector[25]. If not mitigated appropriately, potential increased carbon emissions as a result in the project, could contribute to climate change impacts, thus contributing to the increased incidents of tropical storms such as Hurricane Ivan, and the related socioeconomic consequences.

The project could also place development pressure on coastal areas that are already vulnerable to climate change impacts such as rising sea levels and tropical storms. This could exacerbate coastal erosion impacts, which in turn could increase the vulnerability of coastal inhabitants to personal injury, as well as loss of residences, assets and livelihoods.

These climate change issues, and their relationship with socioeconomic issues, mitigation and management, in particular tourism and emergency preparedness and planning, will be considered within the socioeconomic assessment, mitigation and management planning.

3.15 Business District – Impact Evaluation

As discussed previously an Outline Business Case (OBC) has been carried out to recommend the preferred option for the cruise berth layout to the CIG. The OBC will provide the base information for the

[24] Thompson, K. (2010), Caribbean Islands: The Land and the People

[25] The Tourism Company, Revised National Tourism Management Plan 2009-2013

identification of impacts both positive and negative on the business community. Economic impact is a significant issue in consideration of the social impacts of the proposed development and will be captured within the socioeconomic chapter of the ES as outlined and discussed in Section 3.14 above.

3.16 Landscape and Visual Impact Assessment (LVIA)

3.16.1 Introduction

The purpose of this section is to summarise the approach for assessing the potential impacts on landscape character and visual amenity in relation to the project.

3.16.2 Applicable Standards

The assessment would make reference to the World Bank/IFC guidelines and requirements which would then be refined in accordance with guidance contained within the publication *Guidelines for Landscape and Visual Impact Assessment (2013),* prepared by the UK Landscape Institute and the Institute of Environmental Management and Assessment.

3.16.3 Baseline Conditions

The proposed development is located at the Cargo Terminal and a Cruise Facility in George Town, Grand Cayman. George Town is the largest town on the Grand Cayman Island, located on the western coast of the island. The Caymans' landscape is composed mostly of low-lying limestone and dolostone rocks, derived from ancient seabed sediments resulting in flat coastal landscape with no distinctive high points. The immediate surroundings of the harbour consist of the large detached properties, often relatively high, both commercial and residential in nature, with large car parks and wide street surrounding the buildings. The harbour is located within a shallow indentation in the coastline.

There are no landscape related designations identified close to the proposed location.

3.16.3.1 Scoping of Landscape and Visual Issues

Spatial Scope for Landscape and Visual Assessment

The zone of visual influence (ZVI) is defined as the area of potential visibility to or from a proposed development. The coastal location of the project would result in the proposed development being visible along the coastline approximately 1.2 mi (2 km) to the south and north of the harbour, defined by the shallow indentation of the coastline. To the north and south, the coastline swings away from the harbour and faces away from the proposed development. The extent of the ZVI inland to the east has been defined as an area of approximately 0.6 mi (1 km) due to the low lying topography. The views of the land-based receptors towards the sea are likely to be changed by the berthing cruise ships. The large vessels are likely to temporarily obscure views of the open water to the west and break the horizontal skyline of the sea in the background.

Non land-based receptors of the offshore environment would include fisherman from fishing boats, workers and passengers on commercial shipping, including container, cargo and passenger ships, and leisure sailors, located relatively close to the harbour. It is likely that the new terminal building would also break the skyline.

3.16.4 Methodology

A review of mapping and topographical data, aerial photographs, information from statutory agencies, and other relevant reports and data would be undertaken in order to develop an understanding of the characteristics and features of the site and its surroundings. The baseline data available from previous studies would be reviewed to inform evaluation of the existing landscape character and its sensitivity to change in the form of new development. Similarly, visual amenity would be assessed with reference to key views within the study area. This would include considering the visual amenity of the residential and commercial properties and leisure facilities in close vicinity to the harbour.

The landscape and visual impacts of the project would be identified taking into consideration all mitigation measures developed throughout the scheme design process to avoid or reduce potential adverse effects. Impacts would be identified and described for both the construction and operational phases of the scheme. The cumulative landscape and visual effects of the proposed development combined with other proposed local developments would also be considered in the report, if required. Potential effects would be shown on photomontages which would illustrate the proposed development during its operational phase.

3.16.5 Potential Impacts

3.16.5.1 Temporary Landscape and Visual Impacts

The landscape and visual impacts may arise from:

- the construction of the berthing facility including dredging of the sea bed to accommodate the suspended deck and driving steel piles into the underlying bedrock and consequently construction of the proposed berthing piers;
- incorporation of the dredging material to reclaim the area for construction of the new onshore facilities;
- the construction of the new cruise terminal;
- the presence of temporary construction compounds and presence of plant and associated equipment both on- and offshore;
- change in noise levels due to the construction activities affecting the local tranquillity levels; and
- temporary change in colour of coastal water as result of the construction activities.

3.16.5.2 Operational Landscape and Visual Impacts

The landscape and operational impacts may arise from the operational phase of the new berthing facility including the new piers with berthing vessels and new onshore terminal facilities. The effects are likely to include:

- the presence of the new two piers;
- the presence of the berthing vessels including Oasis cruise vessel class (the world's largest passenger ships) in a close vicinity to the harbour and the town;
- the presence of the new terminal and associated facilities including a car park for buses and taxis;
- possible overshadowing of the closely located properties by the berthing vessels; and
- interrupted views of the harbour from shoreline properties.

3.16.6 Consideration of Climate change

The relevant risks and any adaptation opportunities associated with climate change will be considered as part of the landscape and visual impact assessment. The potential effects on the landscape character and visual amenity will be taken into account in light of predicted changes in rising sea levels and frequency and severance of tropical storms and hurricanes.

These climate change issues and their impacts on landscape and visual amenity will be included in the assessment together with the mitigation and management measures.

4 Cumulative Impacts

Cumulative impacts will require discussion and assessment within the EIA.

At present we are aware that a coastal works application was submitted to the Ministry of Environment on 29 April 2013 for the construction of two cruise berthing piers and associated dredging. The DoE reviewed the application (along with other consultees) and advised the Ministry that the application was premature in the context of Government's preparation of the OBC for the future of George Town harbor. The application was not determined by Cabinet.

However, the applicant of the above application has now amended the proposal and is seeking a coastal works licence for the construction of a cargo, mega yacht and tall ship berthing pier and land reclamation area.

There appears to be no other consented or pending proposals which could have an impact on the EIA for the preferred option from the OBC but this matter will be determined during compilation of the ES.

5 Summary and Recommendations

The TOR defines the scope of the work and studies to be carried out in the EIA. It is clear from an examination of the detailed specialist inputs that there have been no recommendations to scope out any of the topics. Consequently all of the topics identified below will be taken forward in the investigations and reported in the ES.

- Natural Hazard Assessment;
- Geology and Soils;
- Coastal Processes;
- Sediment Transport and Water Quality;
- Stormwater;
- Air Quality;
- Noise and Vibration;
- Terrestrial Ecology;
- Aquatic Ecology;
- Cultural Heritage;
- Traffic and Pedestrian;
- Cruise and Cargo Operations (including waste handling);
- Socio-economic Assessment;
- Business District – Impact Evaluation; and
- Land and Visual Impact Assessment.

This ToR has been submitted to the CIG for comment and subsequently amended where required. The ToR was made available for public consultation and input prior to commencement of the EIA for the chosen pier development option.

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