ENVIRONMENTAL COMPLIANCE CONSULTANCY

Environmental and Social Impact Assessment Report

Walvis Bay Waterfront Properties Pty Ltd

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Environmental Compliance Consultancy Contact Details:
We welcome any enquiries regarding this document and its content please contact:

Stephan Bezuidenhout
Environmental Consultant & Practitioner
Tel: +264 81 262 7872
Email: stephan@eccenvironmental.com
www.eccenvironmental.com

Jessica Mooney
Environmental & Safety Consultant
Tel: +264 81 653 1214
Email: jessica@eccenvironmental.com
www.eccenvironmental.com

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EXECUTIVE SUMMARY

INTRODUCTION

This Environmental and Social Impact Assessment (ESIA) report presents the findings of an ESIA undertaken for the Walvis Bay Waterfront development proposed by the proponent 'Walvis Bay Waterfront Properties Pty Ltd'. The ESIA and this report have been undertaken in accordance with the requirements of the Environmental Management Act, 2007 (Act No. 7 of 2007) and the Environmental Impact Assessment Regulation, 2007 (No. 30 of 2011) gazetted under the Environmental Management Act, (EMA), 2007 (Act No. 7 of 2007).

The proposed project is a waterfront development in Walvis Bay on the east side of the mouth of the Lagoon. It is a mixture of both marine and land-based developments. The land-based development is proposed to be developed on two adjoining plots of land to the east of popular Esplanade Drive (the road running parallel to the Lagoon). The following will be developed on-shore: two hotels; residential properties; business and conference centre; offices; restaurants; retails space; and outdoor open area. The marine development will utilise land between Esplanade Drive and the coastline (currently the Road Reserve) and will occupy an off-shore area up to and around The Raft Restaurant (Lagoon Water Area). The Marina includes an Access Channel, and Outer Marina with a breakwater and an Inner Marine made of water canals. In addition, the existing sporting facilities on the site will be relocated to two areas in Walvis Bay, these include a swimming pool, tennis and jukskei courts and cricket grounds.

ESIA PROCESS AND PUBLIC PARTICIPATION

The aim of the ESIA was to identify, predict, evaluate and mitigate the potential impacts of the construction, operation and decommissioning of the proposed project. The ESIA report presents the findings of the assessment.

The EIA methodology applied to the ESIA was developed using the International Corporation (IFC) standards and models, in particular Performance Standard 1, 'Assessment and management of environmental and social risks and impacts'; Namibian Draft Procedures and Guidance for EIA and EMP; international and national best practice; and over 25 years of combined EIA experience. The key stages of the ESIA process followed are as follows:

1. Screening: Register with the Directorate of Environmental Affairs (DEA) / Ministry of Environment and Tourism (MET), and identified if the proposed project triggers the EMA, 2007;
2. Scoping: Preparation and distribution of the Background Information Document (BID), identify the scope of the assessment and consultation with stakeholders;
3. Investigation and Baseline Studies;
4. Impact Prediction and Evaluation;
5. Draft ESIA report and Environmental and Social Management Plans (ESMP) and submit for consultation with Interested and Affected Parties (I&APs);
6. Final ESIA report, incorporating I&AP comments and submission to the DEA / MET;
7. DEA / MET Assessment and Decision; and
8. Implement Monitoring and Auditing.

Stage 1, Screening, was completed in August 2016 and Stage 2. The conclusion of Screening was that the proposed project triggered several Listed Activities in the EMA, 2007 and associated Regulations, and a detailed EIA was required.

The Scoping process was undertaken through 2017 which scoped topics to be assessed in the ESIA; identified the study area; established the availability of existing data; and defined the Terms of Reference for specialist studies. During this stage, the BID was developed and issued to I&AP for comment.

The following topics were scoped out of the assessment: soils and geology; terrestrial ecology; and surface water. A transboundary assessment, a health and safety assessment, and fault and accident assessment were also not part of the scope of assessment. The key stages of the proposed project assessed were construction and operations. Due to the uncertainties around decommissioning, this was scoped out of the ESIA, however the Decommissioning ESMP was drafted with specific requirements to be implemented prior to the project entering the decommissioning phase.

The study area for the ESIA was set at 1km from the boundary of the proposed project site for all topics, however was extended for socio-economics and the marine environment. Several data gaps were identified and as a result, surveys and studies were commissioned to fill these gaps including a Bathymetry Survey, Traffic Impact Assessment, Avifauna study, Hydrodynamic Study, Marine Mammal Study, and Sun and Height Study.

The baseline was collected in 2017 through various methods: field surveys; desktop studies; consultation with stakeholders (local authority's environmental specialists); and door-to-door engagement with neighbouring residents. During the baseline studies, experts were consulted with through face-to-face meetings, telephonic and email correspondence. The baseline focuses on environmental and social receptors most sensitive to change or receptors that have a high value of importance.

Consultation was undertaken throughout the design development of the proposed project and the ESIA process to ensure meaningful public and stakeholder participation has occurred in line with the EMA (2007) and associated regulations. Through means such as door to door knocking, postal letters, adverts, posters, public meeting, other face to face meetings, stakeholder meetings and continuous social media updates, the proposed project undertook stakeholder engagement that went over and above the requirements of the EMA (2007).

Through the stakeholder engagement process in 2017, I&APs provided feedback raising their questions, issues or concerns about the project. This feedback influenced the ESIA process and subsequently enhanced the ESIA report. Revision 1 of this ESIA report and associated appendices were formally issued to I&APs on January 15th 2018 for 21 days.

This Final ESIA Report and ESMPs has been prepared in compliance with Section 15(2) of the EIA Regulations 2012 and has been informed by I&AP comments received on the draft report. This report is submitted to DEA / MET, as the competent authority, who will make the final decision on the application for Environmental Clearance.

PROPOSED PROJECT OVERVIEW

The proposed project has been subject to a process of design evolution, informed by both consultation and an iterative environmental assessment. During design development, alternatives considered include site locations; site layout and configuration; and final design.

The proposed project will take approximately 3.5 years to construct, which will be undertaken in a phased approach: Phase 1 will be developed first followed by Phase 2, which will be market driven depending upon demand and minimising the potential economic impacts on the local housing market. Phase 2 will be constructed as soon as possible after Phase 1 to ensure the construction period is not overly extended affecting the neighbouring community.

- **Phase 1** includes the development of the Marina, residential, commercial, retail, and conference center, which is focused on the waterfront and Outer Marina.
- **Phase 2** comprises of residential, hospitality facilities and a portion of the Inner Marina (canal).

Approximately 500 jobs will be created to construct the development; between 60 – 80% of these will be from the local community. Key construction activities are as follows:

- Relocation and demolition of existing facilities;
- Construction of relocated sporting facilities;
- Sit preparation – vegetation clearance, removal of rubble and existing boundaries;
- Re-routing existing services;
- Main construction:
  - Site mobilisation and formation of the construction compound;
  - Minor earthworks including raising low-lying land (at 1.2 above Mean Sea Level) to approximately 2.6m above MSL;
  - Closure of The Esplanade and the Lagoon Promenade at the site, and provision of diversions;
  - Site office and parking located on the Namport side of the proposed project site away from residential areas as far as possible;
  - Construction material will be stored and off-loaded on the Namport side of the project site;
  - Installation of drainage infrastructure;
  - Construction of the Marina (breakwater, Outer Marina and Inner Marina);
  - Construction of buildings (residential, commercial, retail, and conference centre);
  - Construction of the Waterfront promenade, pedestrian routes and open green spaces;
  - Construction of the bridge and new Waterfront Drive;
  - Upgrades to intersections from Waterfront Drive;
  - Reinstatement and plantation of new vegetation (soft landscaping); and
  - Hard landscaping.

Various plant and equipment will be required during the construction phase, including excavators, tipper trucks, graders and compactors, tower crane, dredging and piling equipment, and smaller hand-held items. Traffic to and from the site will follow prescribed routes and scheduled times, and will be managed by banks men and signage.

Road improvements will be undertaken to ensure the conditions and capacity of the local roads can accommodate the anticipated increase in traffic volumes. These upgrades will be limited to within the existing road boundary, with the majority of works being new road markings altering junction layouts, existing roads to be upgraded to dual roads (use of road markings), and installation of traffic signals.

Phase 1 will become operational first, followed by phase 2. Walvis Bay Waterfront Properties (Pty) Ltd will be the management company for the proposed project. The day-to-day operations of the businesses will not be managed by Walvis Bay Waterfront Properties (Pty), for example the operations of a restaurant, but rather by the business owner or appointed managers. Walvis Bay Waterfront Properties (Pty) Ltd will therefore be responsible for the following:

- Care and maintenance of the marina and canal: dredging, flushing of the internal canal and regular monitoring;
- Ensuring compliance with Marina rules and regulations by all occupants (boats);
- Managing rental and levy finances for all occupants of the proposed project;
- Managing the distribution of profits;
- Undertaking regular communications with updates, news or other information to all occupants;
- Undertaking maintenance of utilities and services;
- Undertaking maintenance of open areas; and
- Managing and maintaining residential rental properties, including the serviced apartments.

Approximately 1,800 jobs will be created as a result of operating the proposed project, and further indirect jobs will be created and affect down-stream services in the Walvis Bay area.

The buildings of the proposed project are designed for a life span of 40 plus years. Before and during this time, it is envisaged that care and maintenance, refurbishment and restoration will be applied to extend the buildings life.

The Marina will accommodate berthing for approximately 70 boats. The Outer Marina and Access Channel will require dredging to maintain a safe nautical depth. This will occur approximately every five and two years respectively. The Outer Marina is expected to have a natural circulation and the Inner Marina will be a fixed water level that will be circulated.

THE RECEIVING ENVIRONMENT

Walvis Bay is the third most densely populated town in Namibia and has developed along the coastline of the Walvis Bay area due to the fishing industry and development of the Harbour, and geographical restrictions such as the Dune belt to the east and south and the Lagoon to the south-west. The key features of Walvis Bay are the main Bay area; the Harbour; the Lagoon; the Salt Works, Salt Pans and Evaporation Ponds; and the Peninsular reaching up to Pelican Point.

Walvis Bay is earmarked to become the leading industrial town in Namibia by 2030 due to its strategic location and transport networks. As a result of the current pace of economic development, including the industrial and housing sector, as well as future port expansion, the town is expected to grow substantially.

The proposed project site is located approximately 1.5km south of the town centre (the central business district (CBD)), immediately south of the Namport container terminal on the seafront at the mouth of the Lagoon. The surrounding area around the site is residential to the south, east and north-east; the majority of properties being two stories or less. Vegetation including trees lined streets in the areas. To the north of the site is the Namport container terminal, where containers are stacked around four to five containers high. To the west is the Lagoon.

The key receiving environmental and social features in the study area are the Lagoon, including the water quality and ecology; the Ramsar site and local avian community; marine mammals; local businesses; local residents and community; and the tourism industry.

Local businesses in the area surrounding the site (500m from the site boundary) for the proposed project include: the Protea Pelican Bay Hotel; Various restaurants including Anchors Restaurant, the Boardwalk, Lyon Des Sables Restaurant, Brume sur le port, The Venue and View Café; The Raft Resturant; Various privately owned local Guest Houses and hotels, including the Oyster Box, Langholm hotel, the Courtyard and Loubser’s B&B; The Walvis Bay Yacht Club; Walvis Bay Salt Holdings operates the Saltworks; informal vendors and various tourism service providers.

Residents surrounding the project site currently have views of an open green space with low-level buildings. Some properties have views of the Lagoon. The landscape character is mixed between residential and industrial due to the Namport container terminal to the north. The Seascape character is dominated by the Protea hotel and the Raft Restaurant, residential properties lining the Lagoon waterfront and the Namport South Port in the Harbour area. The mudflats can be seen from the coast on clear days.

The Lagoon is a dominating feature of Walvis Bay, and plays a fundamental feature of the Ramsar site. It is the source of water that supplies the Salt Pans and provides an environment suitable for roosting and feeding for a significant proportion of the birds in the Bay area. It is also used for recreational activities such as kayaking. The attributes that make up and influence the Lagoon’s environment are the wind and currents; tides and waves; water flow; sedimentation and turbidity; temperature and salinity; and decomposition of organic material.

The nutrient-rich waters of the Benguela system provides food for phyto- and zooplankton in the Bay area, which leads to high biological production and large numbers of pelagic fish such as pilchard, anchovy and juvenile horse mackerel, which in turn sustain an abundance of top predators such as whales, dolphins, shark, turtle and seabirds. The soft-bottom fauna (benthic fauna) is abundant (however species poor) and also provides food for the bird and fish populations.

Marine mammals such as Cape-fur seals, various species of whales and dolphins, including the Common, Dusky and Bottlenose Dolphins and the endemic Heavyside's Dolphin are found in the Bay waters. The Bottle-nosed Dolphins and whales are observed around the Peninsula and frequently enter the Lagoon. A large proportion of the Bottlenose population uses the shallow waters of the Lagoon for feeding, socializing and resting on a regular basis.

Walvis Bay holds the largest number of birds than any other wetland in southern Africa, which is predominantly dominated by wading birds. The number of wading birds are highest in the austral summer when all the migrant waders congregate at the coastal wetlands. The winter numbers reflect, mainly, the resident species with a few over-wintering sub adult migrants that do not need to head back to the northern hemisphere. In the Lagoon wading birds, rather than seabirds, predominate (40% of the waders in the area), and approximately 20 bird species regularly occur in numbers greater than 1% of the world's population.

IMPACT ASSESSMENT FINDINGS

Once the baseline was collected, the assessment of impacts commenced. Through the ESIA, a range of potential environmental and social impacts were identified. The ESIA report presents those that are considered as significant or sensitive to the community.

The Raft restaurant will likely be affected the most during the construction works due to the indirect impacts that will affect patrons visiting the restaurant. The construction of the Marina, in particular the breakwater wall will cause noisy and visually intrusive activities next to the restaurant. These impacts will most likely deter patrons from visiting the restaurant, but also affect their visit thereby reducing their stay. Mitigation measures such as a visual screen and technologies have been identified to minimise noise during construction works, however a reduction in revenue could occur during this time. Further engagement with the owners of the Raft Restaurant will continue to identify further mitigation measures or agreements to reduce the level of significance.

During construction, there is potential that tourists and the local community will not use the surrounding local businesses due to disruption and other construction impacts (e.g. noise, increase traffic and thus traffic disruption, and dust). This could result in a loss of revenue to some businesses. This impact however, would be for a short duration during the construction phase, and in the operational phase, local businesses are likely to see an increase in revenue due to an increase in number of people frequenting the area.

A small section of Esplanade road will be permanently closed; however, this is unlikely to impact users as it is the end section of the road and alternative access routes are available. A new road through the proposed project site, Waterfront Drive, will also be developed. Pedestrian access routes will be integrated into the proposed project, allowing access up to the Protea Hotel, and potentially through to the existing waterfront.

The relocation of the sporting facilities will leave the local community without facilities for a short duration of time. However, these facilities will be replaced on a like for like basis elsewhere in the town, will be brand new and modern; an improvement from the existing facilities. A large open green space will be lost through the development of the proposed project, however open spaces have been integrated into the design of the proposed project, and alternative green spaces are available within 2km of the site.

There will likely be adverse impacts on the local residents as a result of construction activities. An increase in noise levels will occur, dust may arise, and there will be a presence of construction traffic. Even with appropriate mitigation, these impacts are likely to be the most cause of concern for local residents, and therefore appropriate community engagement will be undertaken for the duration of the construction works.

The presence of the proposed project would result in a change to the amenity, sense of place, and seascape and landscape characters of the area. Over time, local residents will become accustomed to the new environment, however some may not. The design of the proposed project has taken into consideration a range of factors to ensure the development integrates into the local environment, minimising environmental and social impacts.

Another major concern, as expressed by many I&APs, is the potential impacts on the Lagoon and Ramsar site. Dedicated studies were undertaken, and the overall conclusions are that the proposed project may result in some short term adverse impacts such as suspended solids, however this will not alter the integrity of the Ramsar site or the Lagoon's ecosystems, including the bird life. An increase in small recreational boats will occur, thereby increasing the potential risk of pollution and waste entering the marine environment and potentially disturb marine wild life; however strict marina rules and controls, and access to the Lagoon will not be allowed.

Marine mammals, in particular dolphins may be affected by the construction works and maintenance dredging through increased suspended solids, noise and vibration and impacts on their food sources. It is likely that they will avoid the areas during these short periods and will return due to the protection the Bay and Lagoon provides, and the available food sources. All construction works in the marine environment will be overseen by suitably qualified personnel to ensure marine mammals are not impacted.

Both the construction and operational phase will create jobs, resulting in various beneficial impacts such as an increase in local economic activity, reduction in unemployment and increase in skills and training. House prices are expected to increase as a result of the presence of the proposed project and new bulk infrastructure will be provided, thereby improving the local sewerage and freshwater supply systems.

A summary of the environmental and social impacts, after mitigation, associated with the construction, and operation of the proposed project is presented in Table 1. These impacts are considered to be of significance or sensitive issues to the community.

Continual engagement will be undertaken with the community through the construction and operations of the proposed project. Through feedback and where possible, additional measures may be identified to reduce these impacts.

CUMULATIVE IMPACT ASSESSMENT FINDINGS

A CIA was undertaken to identify intra-project and inter-project impacts:

- **Intra-project cumulative impacts:** Cumulative impacts that occur within the proposed project;
- **Inter-project cumulative impacts:** Cumulative impacts that occur as a result of the proposed project in combination with other projects, which is split into two:
  - Cumulative impacts with existing projects; and
  - Cumulative impacts with future projects.

The CIA considered past, present and realistically defined future projects, which were identified through a desk-based investigation.

INTRA-PROJECT CUMULATIVE IMPACT ASSESSMENT CONCLUSIONS

The findings of the assessment of combined impacts and activities within the proposed project (intra-project cumulative impacts) found that the following receptors are likely to have moderate or major impacts:

- **The Raft Restaurant:** Potential loss of revenue;
- **Local residents and community**: Severance, increased noise and dust, change of residential views and local landscape/seascape character, change to sense of place, and temporary loss of sporting facilities.
- **The Ramsar Site:** Reduced water quality (increased sedimentation), reduced marine flora, changes to bird habitat, reduced food for birds and disturbance to birds (please note that the proposed project is not the responsible development for these potential impacts as discussed in the CIA above); and

- **Marine Mammals:** Potential loss of food source, marine noise levels, other disturbance and human-wild life interaction leading to mammals avoiding the area.

A precautionary assessment approach has been applied; therefore, with the application of best practice and additional mitigation measures, the predicted impacts may be less severe. Key mitigation will be the sequencing and scheduling of construction activities; type of dredging and piling techniques applied; dredging on the outgoing tide, applying soft starts to machinery and equipment; applying dust suppression techniques; and implementing traffic management and calming measures. In addition, a range of monitoring will be undertaken including but not limited to, water quality and noise monitoring.

INTER-PROJECT (EXISTING) CUMULATIVE IMPACT ASSESSMENT CONCLUSIONS

Existing projects and activities that continue to affect shared environmental and social receptors with the proposed project are the Salt Works and associated evaporation ponds; fish factories; diversion weir on the Kuiseb river; Phase 1 of Namport's Container Expansion project; and tourism. The shared environmental and social receptors which are continually being influenced by anthropogenic influences and natural processes, and thus resulting in adverse changes, are the Lagoon's water quality and sedimentation rates, marine flora and fauna, the avian community, and the Ramsar site.

Whilst the proposed project could potentially contribute to the continual adverse changes of each of these receptors through various activities, the contribution is considered to be insignificant, and thus it is unlikely that the proposed project will be the responsible development for the incremental impacts.

INTER-PROJECT (FUTURE) CUMULATIVE IMPACT ASSESSMENT CONCLUSIONS

Through a desk-based review, six future projects were identified that could potentially have an impact on shared environmental or social receptors with the proposed project:

a) Walvis Bay South Port Terminal: Phase 1 of the Namport's Container Expansion project becoming operational;

b) Walvis Bay South Port Terminal: Construction and operation of both phases 2 and 3 of the Namport's Container Expansion project;

c) Namport's Waterfront and Marina;

d) Walvis Bay North Port Terminal;

e) Development of a hotel and casino on erven 4941; and

f) Lovers Hill development.

The following activities were identified that could potentially have an impact on shared environmental or social receptors as the proposed project: Increased population as well as tourists and visitors to the Walvis Bay area; and Increase in activities within the marine environment (tours, recreational boat users, sporting activities and fishing).

Projects c – f were not considered as realistically defined projects in accordance with IFC assessment guidance. A high level qualitative CIA was therefore undertaken which considered these projects in combination with the proposed project. Shared receptors that could potentially be impacted, and thus result in cumulative impacts are the community and the Ramsar site. Local residents surrounding the proposed project site could potentially be impacted by increased traffic volumes, increase in noise levels and a change to the local landscape. The features and attributes of the Ramsar site including the Lagoon environment (a fundamental component), could be impacted from various activities which could alter the water quality and avian life.

The magnitude of change, and nature and severity of impacts caused by the construction and operations of these four projects will determine the level of significance of the cumulative impacts on these receptors. This information is currently unknown; therefore, significance cannot be determined or suitable mitigation.

Phase 1 of the Namport's Container Expansion project is 76% complete and is expected to become operational in 2019. Phases 2 and 3 are unlikely to be constructed before 2025. An EIA was undertaken for the Namport Container Expansion project, and an Environmental Clearance was issued, therefore the Namport project is considered as a realistically defined project. The operations of phase 1, and construction and operations of phases 2 and 3 were assessed in the inter-project CIA.

The inter-project CIA illustrates that the proposed project would likely be responsible for the following incremental impacts that would occur in addition to the Namport project:

- Avian community impacted from noise during operations: Minor cumulative impact;
- Local residents surrounding the proposed project site impacted through increased noise levels: Moderate cumulative impact; and
- Local residents surrounding the proposed project site impacted from change to local views and changes to landscape and seascape character: Moderate cumulative impact.

The increase in noise levels to residents surrounding the proposed project site would be felt during normal working hours which would be generated from Namport traffic, traffic to and from the proposed project (users of the development and staff) and a slight increase from operational activities on the proposed project site (day to day operations). These cumulative impacts are localised and various mitigation measures are in place to manage noise levels, such as designated routes to and from the proposed project site and restricted operating schedule. The proponent will continually monitor the changes to the baseline and there will be an Environmental and Sustainability Manager in place to manage concerns and potentially identify further controls where issues arise.

Walvis Bay has a dynamic environment which is constantly changing. Views, landscape and seascape character and sense of place will continue to change, and people will adapt to these changes. The impacts to local residents are expected to reduce over time as people will be accustomed to the changes to their surroundings.

In addition to the above, it is concluded that the proposed project does not jeopardise the sustainability or integrity of the Lagoon environment and Ramsar site; the potential impacts arising from the proposed project are insignificant compared to other project and activities. It is acknowledged that the Lagoon environment is changing and could further be affected by other projects, therefore further collaborative work needs to be undertaken to ensure the Lagoon is protected holistically due to its value.

The conclusions drawn from the CIA demonstrates that the proposed project may contribute to cumulative impacts, and in particular will result in localised cumulative impacts to receptors adjacent to the proposed project site. In a wider context, both temporally and spatially, the proposed project is unlikely to be the responsible development for significant incremental impacts, as the degree of this contribution to those impacts is considered to be marginal compared to other developments and activities in the area. It should be noted, that the wider cumulative impacts (not local) are expected to occur with or without the development of the proposed project.

RECOMMENDATIONS

Whilst undertaking this ESIA, various observations have been made, and as responsible environmental practitioners and proponent, recommendations have been proposed. These recommendations do not in any way have a bearing on or alter the findings of this ESIA; some may confirm findings or are required as part of the monitoring and management arrangements through the construction and operational phase. The main purpose of these are to illustrate there are environmental and social concerns that are bigger than this project and improvements can be made.

1. **Namibian Town and Regional Development Plans and CIA**

During the review of the Walvis Bay IUSDF, it was recognised there was an opportunity to improve the way in which development plans such as the IUSDF, are prepared. This improvement could include the provision for a comprehensive SEA with a supporting CIA for large-scale development plans in future. This will ensure cumulative impacts on potentially sensitive receptors are understood and determined at a strategic level and not reliant on being assessed on a project-by-project basis.

It is therefore recommended that Strategic CIAs be undertaken in future, for all strategic development plans and when revisions of development plans occur to ensure the environment and social cumulative impacts are understood and considered in the National and Regional development framework and plans.

The IFC assessment guidance which is part of the World Bank states that it is the Government and regional planners that have the ultimate responsibility of this level of CIA.

It is also recommended that any future developments (planned or unplanned in the IUSDF) in Walvis Bay undertake a robust CIA as part of their EIA (similar to that applied and conducted for this CIA in line with IFC standards).

2. **CIA for the Ramsar site**

The draft Wetland Policy for Namibia sets out the threats to Namibia's wetlands, presents goals and objectives, and details the need for partnerships and co-operation for the management and protection of Namibia's wetlands. The SEA for the Coastal area of Erongo and Kunene Regions also recognises there is a weak structure for the protection of Namibia's wetlands. One of the recommendation in this report was: *'MET, the Walvis Bay Municipality and the Coastal Environmental Trust of Namibia should as soon as possible establish a long-term environmental monitoring programme including the biodiversity elements for terrestrial, coastal as well as offshore habitats found in the wetland. A baseline for the monitoring programme should produce diversity gradients in relation to tourism, aquaculture and agriculture and the acquired data should feed into the requirement for improved Environmental Impact Assessments.'*

As part of the above commitments i**t is recommended that a detailed CIA should be undertaken to support the policy and management plans.** The purpose of undertaking a CIA would not only meet the policy goals and objectives, it would take the extra step of defining environmental quality objectives and thresholds for various attributes of the Ramsar site. This will be used to inform the parameters of future development and steer development that interacts with the Ramsar site in a sustainable direction.

ECC recommends that this is completed prior to any future development which is likely to cause significant effects on the Lagoon or other features of Ramsar site (please note, this project is not likely to cause any significant effects on the marine environment, and a detailed CIA has been completed for the project in this report). Therefore, this recommendation should not alter the ability for the regulating authority to issue an environmental clearance certificate for the proposed project. This recommendation is made solely on the basis of improving future EIAs that might not be completed with the same level of attention and assessment that has been applied to this ESIA.

3. **Namport Container Expansion project EIA**

It is recommended that prior to the second and third phases of the Namport project progressing, additional work to strengthen their existing EIA should be undertaken. This should include a robust and detailed CIA. Furthermore, construction of phases 2 and 3 should be dependent on ability to demonstrate compliance with conditions set for Phase 1. This recommendation is made on the basis that the consultant, the proponent and many of the I&AP for this project expressed concern for the lagoon as a result of the Namport construction project. It is apparent that further work is required to address these concerns.

4. Environmental monitoring

In relation to the above recommendations, **it is recommended that collaborative environmental monitoring between the Municipality, Namport, the proposed project proponent and other key stakeholders and developers should be undertaken.**

FINAL REMARKS

Based on the findings of the specialist studies and taking into consideration the overall potential adverse impacts, mitigation measures and the potential beneficial impacts, ECC believes the long-term benefits of the proposed project outweigh the short-term adverse impacts. In addition, the proposed project will contribute to the sustainable development of Walvis Bay, in line with the Walvis Bay IUSDF and National Development Plans.

The implementation of the ESMPs and associated programme of environmental protection as an outcome of the impact assessment process would serve to minimise the impacts and risks associated with the proposed project to an environmental and socially acceptable standard. **An Environmental Clearance Certificate could be issued, on condition that the management and mitigation measures in the ESMP are adhered to.**

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DEFINITIONS AND ABBREVIATIONS

Acronym	Term
ALARP	as low as reasonable practicable
BCLME	Benguela Current Large Marine Ecosystem
BCC	Benguela Current Convention
BID	Background Information Document
CBD	central business district
CIA	Cumulative Impact Assessment
dB(A)	Unit of Measure
ECC	Environmental Compliance Consultancy
DEA	Directorate of Environmental Affairs
EIA	Environmental Impact Assessment
EPZ	Export Processing Zone
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
GDP	Gross Domestic Product
I&APs	Interested and Affected Party
IPPC	Intergovernmental Panel on Climate Change
IUSDF	Integrated Urban Spatial Development Framework
LAT	Lowest Astronomical Tide
MAWF	Ministry of Agriculture, Water and Forestry
MET	Ministry of Environment and Tourism
MFMR	Ministry of Fisheries and Marine Resources
MSL	Mean Sea Level
NDP	National Development Plan
NGOs	Non-Governmental Organisations
NMPCP	National Marine Pollution Contingency Plan
Ramsar	Ramsar Convention
RFFPs	Reasonable foreseeable future projects
SADC	Southern African Development Community
SEA	Strategic Environmental Assessment
SME	Small Medium Enterprises
SWMP	Site Waste Management Plan
UNAM	University of Namibia
WBWF	Walvis Bay Waterfront Properties (Pty) Ltd

1 INTRODUCTION

1.1 PURPOSE OF THIS REPORT

This Environmental and Social Impact Assessment (ESIA) report presents the findings of an ESIA undertaken for the Walvis Bay Waterfront development proposed by the proponent 'Walvis Bay Waterfront Properties Pty Ltd'. This document has been prepared by Environmental Compliance Consultancy (ECC).

ECC's terms of reference for this assessment (see Appendix C) was to strictly address potential environmental and social impacts, whether positive or negative, and their relative significance, and explore alternatives for technical recommendations and identify appropriate mitigation measures for the Walvis Bay Waterfront development.

The ESIA and this report have been undertaken in accordance with the requirements of the Environmental Management Act, 2007 (Act No. 7 of 2007) and the Environmental Impact Assessment Regulation, 2007 (No. 30 of 2011) gazetted under the Environmental Management Act, (EMA), 2007 (Act No. 7 of 2007) (referred to herein as the EIA Regulations).

This ESIA report and appendices including the Environmental and Social Management Plans (ESMP) (Appendix A) are being submitted to the Directorate of Environmental Affairs (DEA) at the Ministry of Environment and Tourism (MET) for review as part of the Environmental Clearance Certificate application and support the decision-making process for the Walvis Bay Waterfront development proposal. The ESIA report and appendices are also being submitted to the Ramsar Convention, MET Conservation division responsible for the Ramsar site, Ministry of Fisheries and Marine Resources, Ministry of Works and Transport and project stakeholders who were consulted with during the ESIA process.

This ESIA report and associated appendices were submitted to the relevant competent authorities, MET and Interested and Affected Parties (I&APs) on Monday 15th January 2018 for public and stakeholder comment. Comments have been considered and incorporated into this ESIA report where they were deemed to be material to the decision-making or enhanced the ESIA and ESIA report. An Addendum report and associated appendices will accompany this ESIA report. The addendum collates all comments received during the I&AP public review period and provides responses from the proponent and ECC for all comments.

1.2 PROPOSED PROJECT

Walvis Bay is a coastal town located in the centre of the Namibian coastline and is home to Namibia's largest commercial port. Over the last decade, Walvis Bay has developed considerably as a result of urbanisation, the tourism industry and the operations of Walvis Bay Harbour. The town is a key tourist destination due to the diverse populations of birds and marine wildlife. The tourism industry and the town's population are expected to double by 2030 (see Chapter 6 for more detail) infrastructure to support this growth is therefore required.

The Walvis Bay Waterfront project (referred to herein as the proposed project) is located on the east side of the mouth of the Lagoon, at the far west end of the town, south of the container terminal (see Figure 1). The proposed project is a mixture of both marine and land-based developments. The land-based development is proposed to be developed on two adjoining plots of land to the east of popular Esplanade Drive (the road running parallel to the Lagoon). This development will include two hotels; residential properties; business and conference centre; offices; restaurants; retails space; and out door open area. The marine development will utilise land between Esplanade Drive and the coastline (currently the Road Reserve) and will occupy an off-shore area up to and around The Raft Restaurant (Lagoon Water Area). The Marina includes an Access Channel, and Outer Marina with a breakwater and an Inner Marine made of water canals. In addition, the existing sporting facilities on the site will be relocated to two areas in

Walvis Bay, these include a swimming pool, tennis and jukskei courts and cricket grounds, as illustrated in Figure 6.

The project aims to maintain Walvis Bay's dominant maritime identity, while simultaneously strengthening the city's character with various urban elements. The main focal point and features of the proposed project is the marina and canal. The marina will cater for the mooring of recreational boats and leisure yachts, and provide an open outdoor feature for tourists and local community.

The proposed project was developed through an analysis of the city's history, structure, character, potentials and challenges in response to the area's development as a new residential and commercial hub with a functional marina. It will create a community and tourism asset that will drive economic development in Walvis Bay and the Erongo Region and will support the town becoming one of the top tourist destinations in Namibia. The development will transform the landscape from its current municipal land into a positive living prescient, capturing the unique character and charm of Walvis Bay. Chapter 4 provides the full description of the proposed project.

Figure 1 - Proposed project site locations [Source: Google Earth, 2018]

1.3 Philosophy and Benefits of the Proposed Project

The proposed project is being developed to become the 'people's waterfront'. The aim of which is to support and facilitate the growth of the local community and economy, and provide facilities, which strengthen community relationships.

The proposed project aims to:

- Establish a world-class waterfront and create a tourism node for Walvis Bay;
- Uplift the currently underutilised municipal land;
- Generate revenue and economic stimulus to the business and tourism industries of Walvis Bay; and
- Provide a multi-purpose, recreational and lifestyle facility for all community members of Walvis Bay, the broader Namibian community, international and domestic tourists.

The project will generate a range of social and commercial benefits, which include but are not limited to the following:

- Providing residential properties which form part of the strategic plan for the management of an increasing population;
- Providing tourism facilities which will attract and retain tourists in Walvis Bay thereby supporting economic growth through increased bed occupancy and additional spending;
- Relocating existing sporting facilities to lower income areas thereby improving the availability of facilities for the less affluent areas;
- Improving local bulk services including water supply, sewerage treatment and electricity;
- Encouraging and supporting local investment;
- Creating direct and indirect employment opportunities;
- Increasing demand for secondary services such as catering and cleaning, thereby providing additional employment opportunities; and
- Increasing property values.

The philosophy and benefits of the proposed project align to the National Policy on Tourism principals (Directorate of Tourism, 2008) by providing an economical, social and environmentally sustainable tourism development, the yields long-term benefits

1.4 Need and Desirability of the Proposed Project

A market study for the Walvis Bay Waterfront Mixed-use Development was commissioned and used to guide the design and composition mix of the development. The findings of this study were separated into four key pillars: residential; office; retail; and hotel. The study analysed the geographical influence of the proposed project, including undertaking a detailed assessment of the background demographics of Namibia, drawing down to the study area of Walvis Bay.

A site evaluation was also conducted, including the site profile, and an evaluation model applied. A Strength, Weakness Opportunity and Threat (SWOT) analysis and an evaluation summary were conducted for each pillar; the key findings per pillar to support the market capability, need and capacity for the proposed project, is set as follows:

RESIDENTIAL

- The Walvis Bay Waterfront propose to construct luxury and ultra-luxury apartments; the study found that there is scope for such residential units but should be phased to not saturate the market. The project has applied the planned the phased approach to the development

- According to market and realtor interviews, there appears to be a high demand for luxury apartments, depending on the location of such developments that is likely to drive the asking price.

OFFICE

- Office demand was assessed and it was determined that the development would require an average market share of 5% from the net effective demand. The study determined that the development would be able to achieve this market share due to the unique position and ability to provide A Grade offices in a prime location
- The majority of businesses are anticipated to be located in Walvis Bay that should make it less difficult to fill the office space with tenants.
- From the site evaluation, the office component rated 70%. The site has the ability to establish a new node and bring tenants closer to the hotel occupants that could make use of services such as tour guides and operators that currently depart from the existing waterfront across the road.

RETAIL

- The retail pillar of the market demand survey found international and local tourism markets as key contributors to income in the region and Walvis Bay.
- A strong market demand for retail was determined in the study; however, it concluded that a selective market strategy be applied to avoid duplication of the existing retail chains as seen in Walvis Bay and Swakopmund. The project aims to engage local and boutique retail and this strategy has been applied in the design of the development.
- There is, however, a difference between the local convenience retail market and the retail orientated towards the tourism market, which is currently more concentrated in Swakopmund. Tourism retail has a much more affluent feel to it and consists of jewellery stores, restaurants, boutique fashion and curious shops.

HOTEL

- The hotel pillar of the study concluded that the demand for hotel beds in Walvis Bay is primarily driven by international holidays and business.
- The two main tourist destinations within the Erongo Region is Walvis Bay and Swakopmund which receive 25% and 30% of all tourism inflow to the region respectively.
- The study area shows, 85% of the mapped accommodation facilities are situated in Swakopmund while Walvis Bay only represented 9% of the supply.

As per the National Policy on Tourism principals (Directorate of Tourism, 2008), the proposed project is market-driven. An assessment of the market potential and viability has been undertaken and used to guide the investment and design of the Walvis Bay Waterfront. The feasibility and bankability of the project have been determined by market demand and is in line with investor due-diligence.

1.5 The Proponent of the Proposed Project

The proponent of the project is Walvis Bay Waterfront Properties (Pty) Ltd, a registered Namibian company (number: 2013/1138). Walvis Bay Waterfront Properties (Pty) Ltd (referred to herein as the proponent) is a joint venture between Afrikuumba (a Namibian registered company) and the Municipality of Walvis Bay. The Company is engaged in all activities relating to the development of the proposed project, including site preparation, construction and operations.

Table 1 - Proponent

Proponent Representative	Proponent Representative
Mr Titus Nakuumba Afrikuumba Partner P O Box 90885 Windhoek, Namibia Tel: + 264 61 400177 Email: titusn@afrikuumba.com.na	Mr Victor Agostinho Walvis Bay Municipality Partner P O Box 90885 Windhoek, Namibia Tel: + 264 61 400177 Email: avictor@walvisbaycc.org.na

1.6 Environmental Consultancy

ECC, a Namibian consultancy (registration number Close Corporation 2013/11401), has undertaken the ESIA and prepared this report on behalf of the proponent. ECC operates exclusively in the environmental, social, health and safety fields for clients across Southern Africa, in both the public and private sectors. ECC is independent to the proponent and has no vested or financial interested in the proposed project.

All compliance and regulatory requirements regarding this ESIA report should be forwarded by email or post to the following address:

Consultant:
Environmental Compliance Consultancy
PO BOX 91193
Klein Windhoek, Namibia
Tel: +264 81 262 7872 or Tel: +264 81 653 1214
Email: info@eccenvironmental.com

The individuals who contributed to the ESIA and this report are provided in Table 2.

Table 2 - ESIA Project Team

Name	Role
Mr Stephanus Bezuidenhout (ECC)	Environmental Practitioner and Consultant ESIA Project Core Team
Ms Jessica Mooney (ECC)	Environmental Practitioner and Consultant ESIA Project Core Team
Ms Rachel Moore	Environmental Practitioner and Consultant ESIA Project Core Team
Dr Amanda Rau	Palaeoceanography and Marine Geologist - Marine Mammals Impact Assessment
Dr Rob Simmons	Ornithologist - Avian Impact Assessment

Name	Role
Dr Hendrik Bergmann	Marine Consultant Senior Coastal Engineer - Hydrodynamic Modelling and Water Exchange Assessment
Mr Hugo Engelbrecht	Traffic Engineer - Traffic Impact Assessment
Dr Peter Tarr (SAIEA)	Independent Peer Reviewer – ESIA Report

1.7 Environmental Requirements

1.7.1. Environmental and Social Impact Assessment

The Environmental Management Act, 2007 stipulates that an Environmental Clearance Certificate is required to undertake Listed Activities under the Act and associated Regulations. Listed activities triggered by the proposed project in accordance with the Environmental Management Act, 2007 and supporting regulations are listed below:

WASTE MANAGEMENT, TREATMENT, HANDLING AND DISPOSAL ACTIVITIES

- 2.3 The import, processing, use and recycling, temporary storage, transit or export of waste;
  - Temporary storage of waste generated by operations of the proposed Waterfront.

LAND USE AND DEVELOPMENT ACTIVITIES

- 5.1(d) The rezoning of land from open space to any other use;
  - The rezoning of erven 4941 and 4939.

TOURISM DEVELOPMENT ACTIVITIES

- 6 The construction of resorts, lodges, hotels or other tourism and hospitality facilities;
  - Construction of two hotels, several restaurants and conference facilities.

WATER RESOURCES DEVELOPMENTS

- 8.10 Reclamation of land from below or above the high-water mark of the sea or associated inland waters;
  - Construction of a marina and other structures below the high-water mark.
- 8.11 Alteration of natural wetland systems;
  - Marina breakwater and retaining wall extending into the Lagoon connecting to the Raft Restaurant.

HAZARDOUS SUBSTANCE TREATMENT, HANDLING AND STORAGE

- 9.1 The manufacturing, storage, handling or processing of a hazardous substance defined in the Hazardous Substances Ordinance, 1974;
  - Temporary storage of diesel during construction.
- 9.2 The storage and handling of a dangerous goods, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 cubic meters at any one location;
  - Temporary storage of diesel during construction (Two 22,000 litre tanks bunded to contain a capacity of 110% of the stored volume);
  - Diesel tanks in standby electricity generators.

INFRASTRUCTURE

- 10.1(a) The construction of bulk supply pipelines;
  - Re-routing of the existing sewerage pipelines.
- 10.1 (e) The construction of any structure below the high-water mark of the sea;
  - The foundations of the marina wall will be constructed below the high-water mark.

OTHER ACTIVITIES

- 11.2 Construction of cemeteries, camping, leisure and recreational sites;
    - Construction of two hotels and relocation / construction of recreation and leisure facilities.

As part of the Environmental Clearance Certificate application, an ESIA has been undertaken to satisfy the requirements of the Environmental Management Act, 2007. This report addresses the requirements and provisions stipulated in the EIA Regulations and presents the findings of comprehensive studies of the existing environment and the potential impacts to the physical and social environments as a result of the proposed project.

1.7.2. Environmental and Social Management Plan

In addition to the ESIA, an ESMP is also required under the Environmental Management Act, 2007. A suite of ESMPs have been developed to provide a management framework for the planning and implementation of construction activities and provides construction standards and operating arrangements so that potential environmental and social impacts of the proposed project are mitigated, prevented and minimised as far as reasonable practicable, and that statutory requirements and other legal obligations are fulfilled.

The ESMPs for the proposed project is a series of three documents, one for each phase of the project:

- Site Preparation and Construction ESMP
- Operations ESMP Operations ESMP
- Decommissioning and Reinstatement ESMP

By having individual ESMPs specific to phases, the application of the plan and the management of environmental risks shall be more effective and easier to implement. All three are contained in Appendix A.

1.8 Objectives of this ESIA Report

This ESIA report has been prepared to present the finding of the ESIA and provide information to Authorities, the public, I&APs and stakeholders to aid in the decision-making process for the proposed project. The main objectives of this ESIA report are therefore:

- To define the scope of the proposed project and the potential interaction of the project activities with the natural and social environment;
- To review, identify and apply applicable national and international legislation, standards and guidelines during the ESIA;
- To provide a description of the receiving environment;
- To provide a description of the proposed project from site preparation to final design and restoration;
- To identify and assess potential environmental and social impacts from the proposed project;
- Identify and describe mitigation measures to prevent, minimise and/or abate/treat the identified potential environmental and social impacts;
- To provide a means by which the mitigation measures will be implemented, and residual impacts managed; through the provisions of an ESMP; and
- To facilitate public consultation throughout the assessment and development of the proposed project.

1.9 Report Structure

The ESIA report is structured as per the contents set out in table 3.

Table 3 - ESIA Report Structure

SECTION	TITLE	CONTENT
-	Executive Summary	Executive summary of the ESIA
-	Acronyms	A list of acronyms used throughout the report
1	Introduction	This chapter introduces the ESIA and provides background information on the proponent
2	Regulatory Framework	This chapter describes the Namibian, international and relevant environmental regulatory framework applicable to the project
3	Approach to the ESIA	Provides the approached undertaken and applied to the ESIA
4	Project Description	Technical description of the project
5	Alternatives & Design Evolution	This chapter considers alterative options for the project that allow the objectives of the project to be met detailing the reasons for the selection and rejection of options
6	Description of the baseline environment	This chapter describes the existing environment through the analysis of the baseline data regarding the existing natural and socio-economic environment
7	Prediction and Evaluation of Impacts Methodology	This chapter presents the methodology applied to the ESIA
8	Assessment Findings and Mitigation	This chapter predicts the potential environmental and social impacts arising from the project, the assessment of impacts including residual impacts This chapter also outlines the proposed management strategies for monitoring commitments to ensure the actual and potential impacts on the environment are minimised to as low as reasonable practicable (ALARP) this informs the ESMP
9	Stakeholder Engagement and Consultation	This chapter outlines the process and details, associated with public participation for the ESIA Questions, issues or concerns raised by stakeholders are tabulated in this Chapter, along with the location of where these questions, issues and concerns are addressed in this ESIA report.
10	Conclusions	Summarises the findings of the ESIA and provides recommendations.
11	References	A list of reference used for this report

The ESIA report has the following supporting appendices:

A Environmental and Social Management Plans
B MET Project Notification
C MET Scope of Assessment
D Stakeholder Engagement Evidence
E Background Information Document
F Bathymetric Survey
G Traffic Impact Assessment
H Avian Impact Assessment

I Hydrodynamic Impact Assessment Study
J Marine Mammal Impact Assessment
K Sun & Height Study
L Method Statement for Sewer Relay
M CVs for ECC Team
N Watermaster Environment Dredger fact sheet

OTHER:

- ADDENDUM 1

2 REGULATORY FRAMEWORK

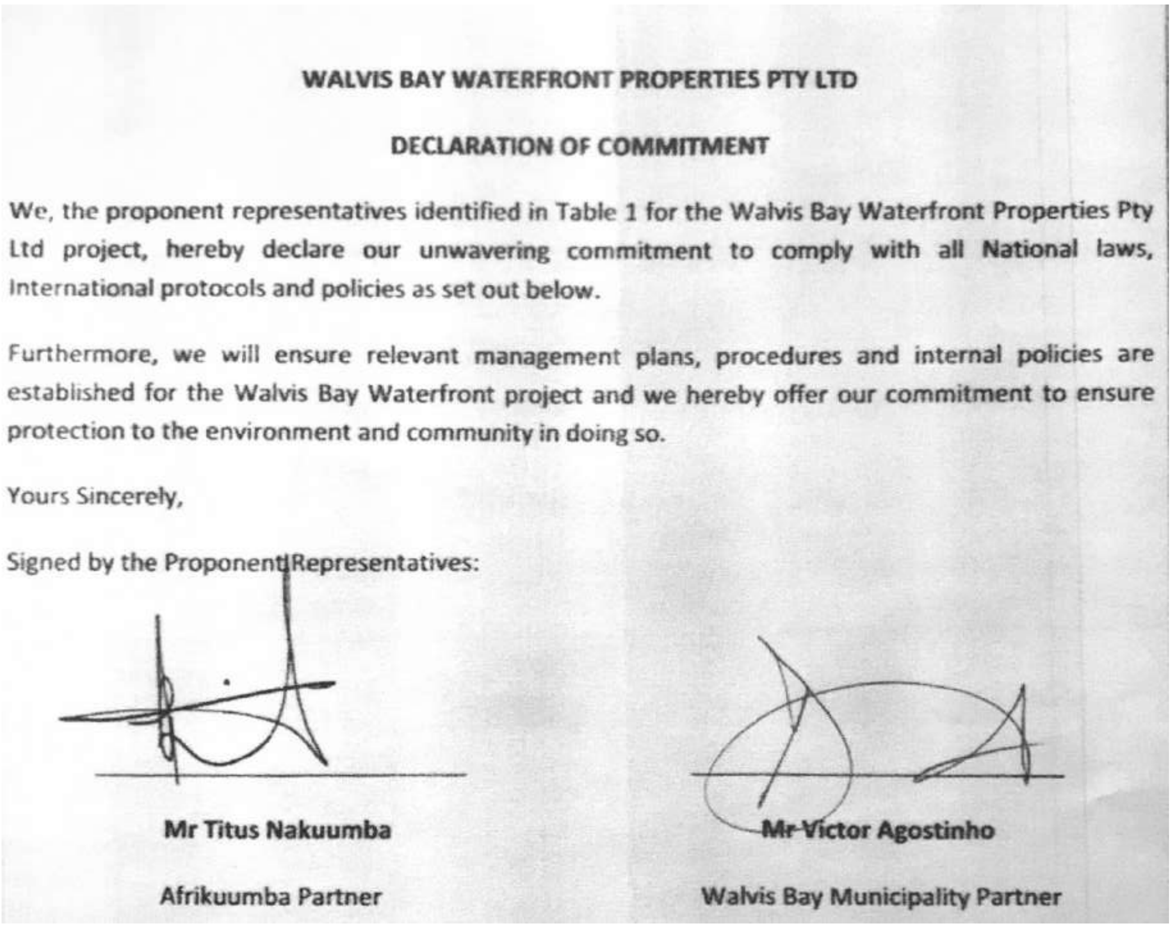
2.1. Introduction and Proponent Declaration of Commitment

The Constitution of the Republic of Namibia, 1990 clearly defines the Country's position in relation to sustainable development and environmental management. The Constitution refers that the State shall actively promote and maintain the welfare of the people by adopting policies aimed at the following:

"Maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future; in particular, the Government shall provide measures against the dumping or recycling of foreign nuclear and toxic waste on Namibian territory."

The Constitution of the Republic of Namibia Article 95 (l)

This section of the report outlines the regulatory framework applicable to the proposed project. The proponent holds their responsibilities and commitments made in line with this framework in the highest regard and provides this statement of commitment to comply with the provisions of the regulatory framework set out below.



WALVIS BAY WATERFRONT PROPERTIES PTY LTD

DECLARATION OF COMMITMENT

We, the proponent representatives identified in Table 1 for the Walvis Bay Waterfront Properties Pty Ltd project, hereby declare our unwavering commitment to comply with all National laws, International protocols and policies as set out below.

Furthermore, we will ensure relevant management plans, procedures and internal policies are established for the Walvis Bay Waterfront project and we hereby offer our commitment to ensure protection to the environment and community in doing so.

Yours Sincerely,

Signed by the Proponent Representatives:

Mr Titus Nakuumba
Afrikuumba Partner

Mr Victor Agostinho
Walvis Bay Municipality Partner

Figure 2 Walvis Bay Waterfront Properties PTY LTD Declaration of Commitment

2.2. INTERNATIONAL CONVENTIONS & AGREEMENTS

International conventions relevant to the proposed project (have to be complied with or have influenced the design) or relate to the scope of the ESIA (have influenced or have been considered in the ESIA process) are summarised in Table 4.

Table 4 – International Protocol, Treaties and Conventions

CONVENTION	SUMMARY	APPLICABILITY TO THE PROJECT
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar) (1971)	The Convention on Wetlands (known as Ramsar Convention) is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Parties to the Convention are required to designate at least one national wetland for inclusion in a 'List of Wetlands of International Importance' and to consider their international responsibilities for conservation, management and wise use of migratory stocks of wildfowl. Namibia ratified the convention and therefore has to ensure that Ramsar declared sites are kept safe from degradation.	The proposed marina portion of the proposed project is partly sited within a Ramsar designated site, and therefore the development proposals, ESIA and ESMP have followed Ramsar guidelines and are in accordance with the Ramsar Site's Integrated Management Plan (Burger L. , 1998).
United Nations Convention on Biological Diversity	Signed by 150 government leaders at the 1992 Rio Earth Summit, the Convention on Biological Diversity is dedicated to promoting sustainable development. Conceived as a practical tool for translating the principles of Agenda 21 into reality, the Convention recognizes that biological diversity is about more than plants, animals and microorganisms and their ecosystems – it is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live.	The convention applies to the proposed project as the project is sited next to an area with international important biological diversity, which is influenced by various natural and anthropogenic processes. The ESIA has considered the local, national and international importance of the local biodiversity.
Additional Protocol to the Abidjan Convention Concerning Cooperation in the Protection and Development of Marine and Coastal	The Additional Protocol to the Abidjan Convention, to which Namibia is a Party, provides a framework for preventing pollution to the marine environment from Land-Based activities. The objective of this Protocol is to prevent, reduce, mitigate and control pollution	The protocol applies to the proposed project as the project may directly or indirectly affect the marine and coastal environment of the Protocol area, including developments that cause physical alteration of the natural habitat or otherwise result in physical alteration and destruction of habitats. The proponent has taken appropriate measures

CONVENTION	SUMMARY	APPLICABILITY TO THE PROJECT
Environment from Land-Based Sources and Activities in the Western, Central and Southern African Region	from land- based sources and activities on their territories or emanating from any other land-based source, including through the atmosphere, to protect and sustain the marine and coastal environment of the Protocol area. Namibia ratified the convention and ensures compliances to the Convention through the incorporation of such in relevant National Legislation.	in accordance with the provisions of the Convention and the Protocol to prevent, reduce, mitigate and control pollution and degradation of the Protocol area. The ESIA and ESMP including the processes followed throughout the assessment are in line with the requirements of the Convention by virtue of the convention being ratified into National Law.
Benguela Current Convention	The Benguela Current Commission is a multi-sectoral inter-governmental, initiative of Angola, Namibia and South Africa. It promotes the vision of the Benguela Current Large Marine Ecosystem (BCLME) sustaining human and ecosystem well-being for generation after generation. In 2013, these countries signed the Benguela Current Convention, a treaty that entrenches the Benguela Current Commission as a permanent inter-governmental organisation.	The convention applies to the proposed project as the project is sited in the BCLME area and may directly or indirectly affect the marine and coastal environment supporting this ecosystem. The mitigation of pollution is a key focus of the convention applicable to the proposed project, in addition to environmental monitoring and management of biodiversity and ecosystem health. The ESMP provides mitigation measures and monitoring arrangements for the proposed project to ensure compliance with the convention.

The following conventions have been identified as potentially being applicable to the proposed project, however it is assumed that they have been ratified into National Statutes, which are discussed in the next section, and therefore not detailed further:

- United Nations Convention on the Law of the Sea of 10 December 1982;
- Convention for the Prevention of Marine Pollution from Land-Based Sources (1974); and
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter 1972.

2.3. National Statutes

Environmental and social national Statutes, which are applicable to the proposed project (have to be complied with or have influenced the design) or have been considered in the assessment and are summarised in Table 5.

Table 5 – National Statutes

NATIONAL REGULATORY REGIME	SUMMARY	APPLICABILITY TO THE PROJECT
Environmental Management Act, 2007 (Act No. 7 of 2007) and	The Act aims to promote sustainable management of the environment and the use of natural resources by establishing principles for decision-making on matters	This ESIA report (and ESMP) documents the findings of the ESIA process undertaken for the proposed project, which will form part of the environmental clearance application. The ESIA

NATIONAL REGULATORY REGIME	SUMMARY	APPLICABILITY TO THE PROJECT
associated regulations, including the Environmental Impact Assessment Regulation, 2007 (No. 30 of 2011)	affecting the environment. It sets the principles of environmental management as well as the functions and powers of the Minister. The Act requires certain activities to obtain an environmental clearance certificate prior to project development. The Act states an EIA may be undertaken and submitted as part of the environmental clearance certificate application. The MET is responsible for the protection and management of Namibia's natural environment. The Department of Environmental Affairs under the MET is responsible for the administration for the EIA process.	and report have been undertaken in line with the requirements under the Act and associated regulations.
Water Act, 1956	This rather out-dated Act that remains in force, provides for the control, conservation and use of water for domestic, agricultural, urban and industrial purposes; to make provision for the control, in certain respects, of the use of sea water for certain purposes; and for the control of certain activities on or in water in certain areas. The Ministry of Agriculture, Water and Forestry (MAWF) Department of Water Affairs is responsible for administration of the Water Act.	The Act stipulates obligations to prevent pollution of water. The ESMP sets out measures to avoid polluting the environment.
Water Resources Management Act, 2013 (No. 11 of 2013)	This Act provides a framework for managing water resources based on the principles of integrated water resource management. It provides for the management, development, protection, conservation, and use of water resources. This Act has not been approved by parliament, however it is best practice to comply with this Act.	The Act sets out obligations in order to avoid water pollution. These have been incorporated into the ESMP to minimise groundwater pollution during construction. A licence may be required under this Act to undertake certain activities within any wetland; however, as the Act is not enforced (but is applied as best practice), no regulations support the Act to stipulate how a licence should be obtained. As it is not possible to obtain a licence due to the fact mentioned above, it is understood that the environmental clearance will provide the relevant permission to this requirement in the absence of the Act being enforced.

NATIONAL REGULATORY REGIME	SUMMARY	APPLICABILITY TO THE PROJECT
		The Ministry of Agriculture, Water and Forestry are stakeholders for this ESIA, therefore consulted throughout.
The Marine Resources Act, 2000 (Act 27 of 2000)	The Marine Resources Act provides for the conservation of the marine ecosystem and the responsible utilisation, conservation, protection and promotion of marine resources on a sustainable basis. It replaces the Sea Fisheries Act 29 of 1992, which in turn replaced the Sea Fisheries Act 58 of 1973. It also replaces the Sea Birds and Seals Protection Act 46 of 1973.	Whilst the construction and operation of the proposed project does not fall under the Act, it is recognised that as an indirect consequence of the use of the development, activities may fall under the Act, therefore the ESMP provides guidelines and requirements under the Act for fishing or harvesting marine resources.
The Namibian Ports Authority Act, 1994 (Act 2 of 1994)	The Act provides for the establishment of the Namibian Ports Authority to undertake the management and control of ports and lighthouses in Namibia, and the provisions of facilities and services related thereto. The Act gives provisions for licence to undertake activities in any port (including entry to a port).	During construction any vessel entering Namport waters will comply with all nautical safety requirements, and will obtain relevant permission or licences where required. During operation, any vessels (recreational boats) using the Marina at the Walvis Bay Waterfront, will pass through the Namport Authority Area and therefore are compelled to comply with Namport regulations and Acts, and will have a licence. Furthermore, the management company (Walvis Bay Waterfront Pty Ltd) will be responsible for ensuring that the approach channel and marina comply with Namport Nautical safety requirements and regulations throughout. The above is stipulated in the ESMP.
Atmospheric Pollution Prevention Ordinance 11 of 1976	The Ordinance provides for the prevention of the pollution of the atmosphere. In terms of Section 5 any person carrying out a "scheduled process" within a "controlled area" has to obtain a registration certificate from the administering authority, in this case the Department of Health.	Schedule two of the Ordinance lists out Scheduled Processes, which includes the handling of Asbestos. An existing building that is to be demolished on the site has been identified to contain asbestos cement roofing material. The removal of this material will be completed by a licenced and registered contractor specialising in asbestos removal.
Hazardous Substance Ordinance 14 of 1974, and associated amendments	The ordinance gives provisions for manufacture, sale, use, disposal and dumping, as well as import and export of hazardous substances listed and categorized in the Act.	Fuel is considered a hazardous substance, and as such the project will register the storage and handling of fuel, and obtain the relevant licence Fuel for the standby generators will be kept on site within the specifications as set out in the Ordinance.
Petroleum Products and Energy Act (Act	The Petroleum Products Regulations under the Act provides obligations for operators	Approximately two 22,000 litre fuel tanks will be on site during construction, therefore the project

NATIONAL REGULATORY REGIME	SUMMARY	APPLICABILITY TO THE PROJECT
13 of 1990) and associated amendments and regulations	storing and dispensing fuel into equipment.	will require a licence and certificate to store and dispense fuel. The Regulations set out certain obligations for the duties, specifications, standards, safety and environment. The ESIA and the ESMP have taken these obligations into consideration in the assessment.
Draft Pollution Control and Waste Management Bill (1999)	The Bill amalgamates a variety of legislative frameworks in Namibia, regulating pollution in different sectors of the economy. The Bill promotes sustainable development; to provide for the prevention and regulation of the discharges of pollution.	Although not enacted, the Bill has been applied to the ESIA to ensure any activities potentially giving rise to air pollution, water pollution, noise emissions and solid waste are minimized as far as reasonable practicable and obligations are adhered to.
Seashore Ordinance 37 of 1958	The ordinance provides for the determination of the actual position of the high-water mark and for matters incidental thereto, including surveying.	In the event that the high-water mark needs to be surveyed, it shall be undertaken in accordance with this ordinance and other relevant Namibian Law. This ordinance has not been used to guide the ESIA process.

The following laws are applicable to the project and will be complied with, however are not applicable to the ESIA nor have they influenced or been considered in the assessment process:

- The Labour Act, 2007 (Act No. 11 of 2007); and
- The Labour Act, 1992: Regulations relating to the health and safety of employees at work.

The proponent will develop a specific Safety Management Plan for the construction and operations of the Waterfront independently to the ESIA that will be in place prior to construction.

2.4. National Policy and Plans

Namibia has a range of policies that set out broad course of actions that are required to achieve Government objectives. Policies that are or have influenced the design, or and relate to the scope of the ESIA (have influenced or have been considered in the ESIA process are set out in Table 6.

Table 6 - National Policies and Plans

POLICY	SUMMARY	APPLICABILITY TO THE PROJECT
5th National Development Plan (NDP) and Vision 2030	Namibia's overall long-term development ambitions are provided in the National Vision 2030, which is implemented by five-yearly national development plans (NDP's). NDP5 is the current development plan. NDP5 incorporates the principals and recommendations contained in the Stockholm Declaration on the Human Environment (1972) and associated Action Plan, and Agenda 21 which merged from the Convention on Biological Diversity, Rio De Janeiro (1992).	The proposed project is a development, which forms part of the bigger picture of achieving economic progression, social transformation and environmental sustainability. During the development of the proposal, the principals of NDP5 have been applied where relevant. The information contained in NDP5 has been used to develop the baseline (e.g. population growth predictions and information on different industry sectors (current and future targets).
Towards a Coastal Policy for Namibia, Green Paper, 2009.	The Green Paper provides an outline of the key findings of a long-term study on the conservation and management of the Namibian coast. It sets out the coastal policy and the vision for the coast, as well as principals, goals and objectives for coastal governance. It also presents the options for institutional and legal arrangements towards implementing the emerging Namibia Coastal Policy options for coastal governance in Namibia. The Green Paper will develop into the Coastal Policy White Paper.	The proposed project has been assessed against the Green Paper to ensure the development does not conflict any future policies. The principles of Integrated Coastal Zone Management have been used as guidance in the ESIA, including applying the precautionary approach; the polluter pays principal and applying transparency.
Namibia's Draft Wetland Policy, 2004	This policy strives to complement existing policy instruments regarding sustainable development and sound natural resource management in Namibia. Its implementation provides a platform for the conservation and wise use of wetlands, thus promoting inter-generational equity regarding wetland resource utilisation. The objectives of the policy are to protect and conserve wetland diversity and ecosystem functioning to support basic human needs, to provide a framework for sustainable use of wetland resources, to promote the integration of wetland management into other sectoral policies, and to recognise and fulfil Namibia's international and regional commitments	The objectives and guiding principles in the Policy have been applied to the ESIA, including openness and transparency providing environmental and socio-economic information / decision making regarding wetlands to the public and stakeholders, and using the tool of environmental assessment to help reduce negative impacts and sustainability.

POLICY	SUMMARY	APPLICABILITY TO THE PROJECT
	concerning shared wetlands and wetlands of international importance.	
The National Environmental Health Policy (2002)	The Policy provides a framework and guidelines to prevent and control environmental health hazards and risks that may adversely affect health and quality of life for all the people in Namibia.	The Policy has been used to influence the design of the proposed project, taking into consideration the policies and objectives. Measures set out in the Policy to avoid and manage hazards such as waste management and air pollution have been considered in the identification of mitigation measures described in this report and the ESMP.
The National Policy on Climate Change for Namibia	The policy lays out a number of principles that aim to guide the process of addressing climate change challenges, while also outlining the roles and responsibilities of the relevant stakeholders to ensure the effective implementation of the policy.	The proposed development considered the effects of climate change in the design, in particular sea level rises. The guiding principals and strategies were reviewed to ensure the proposed project is in accordance with the policy.
National Policy on Tourism for Namibia	Provides a framework for the mobilisation of tourism resources to realise long term national goals defined in Vision 2030 and the more specific targets of the NDP, namely, sustained economic growth, employment creation, reduced inequalities in income, gender as well as between the various regions, reduced poverty and the promotion of economic empowerment.	The policy was reviewed during the preparation of the ESIA process and the evolution of the proposed project design. The proposed project aligns with the policy, in particular, the development provides competitive tourism amenities and services, creating a competitive business environment that is market driven and meets international standards.
National Marine Pollution Contingency Plan	A coordinated and integrated system for preparing and responding to ship-sourced pollution incidents, setting out and defining Namibia's oil and hazardous and noxious substances (HNS or chemicals) pollution preparedness and response system.	The measures set out in the Contingency Plan to prevent marine pollution incidents have been considered and included where applicable in the ESMPs.

2.5. Local Policy and Frameworks

The local polices that have been considered in or influence the design development and the ESIA process are described in Table 7.

Table 7 - Local Policy and Frameworks

POLICY	SUMMARY	APPLICABILITY TO THE PROJECT
Integrated Urban Spatial Development Framework (IUSDF) for Walvis Bay (2014)	The IUSDF reviews the current town plan, population projects and social requirements, and sets out a plan to accommodate the town's development.	The IUSDF identifies and allocates the site for the development of a Waterfront Development. The plan for the development depicts a range of uses and activities and specifically excludes any incompatible industrial or related land use and activities. The proposed project is in accordance with the IUSDF. The framework states that a full EIA will be required for the proposed project, as wells as public consultation and an EMP. The ESIA undertaken for the proposed project and subsequent reports satisfy the requirements. In addition, the environmental recommendations listed throughout the framework have been considered and aligned with.
Walvis Bay Lagoon Integrated Environmental Management Plan (1998)	The Management Plan sets out measures to be implemented to manage the Lagoon and avoid environmental impacts, preserve the ecological integrity as well as promote and encourage sustainable use of the Lagoon.	The measures identified in the Management Plan have been considered during the assessment process and the development of the ESMP.
Local Agenda 21	At the Rio Earth Summit in 1992, the United Nations agreed an action plan in order to achieve sustainable development was required, and thus Local Agenda 21 was formed. Local Agenda is a local-government-led, community-wide, and participatory effort to establish a comprehensive action strategy for environmental protection, economic prosperity and community well-being in the local jurisdiction or area. Walvis Bay Municipality implemented a three-year project in 2001, which aim was to make progress towards the sustainable management of Walvis Bay along the lines of the Local Agenda principals. Progress with this agenda was assessed at the World Summit on Sustainable Development, which took place in Johannesburg, South Africa, in 2002 where it was agreed to move from Agenda to Action 21. The Integrated Environmental	The proposed project is in line with the proposed direction and principals set out in the relevant documents. Various data and information from the studies undertaken as part of the Agenda 21 project has been used to develop this ESIA.

POLICY	SUMMARY	APPLICABILITY TO THE PROJECT
	Policy sets out the directions Walvis Bay Municipality will move towards in the forthcoming years to fulfil its responsibilities in managing the environment of Walvis Bay together with the town's residents and institutions.	

The formation of the Walvis Bay Environmental Action Group in 1996 was formed with the specific purpose of raising public awareness of the environmental issues in the Walvis Bay area. This resulted in the formalization of the Walvis Bay Lagoon Integrated Environmental Management Plan (1998), the town's Structure Plan (1999) and the Local Agenda 21 Project to establish an environmental policy for the town in accordance with the Rio Convention. It is within this framework that the Municipality of Walvis Bay function, plan and develop to ensure sustainable and economic growth while ensuring protection of the environmental assist of Walvis Bay.

2.6. Other

Other strategic documents, which have been used to guide this ESIA, are listed in Table 8.

Table 8 - Other Strategic Documents

POLICY	SUMMARY	APPLICABILITY TO THE PROJECT
Strategic Environmental Assessment for the Coastal Areas of Erongo and Kunene Regions, 2007	This Strategic Environmental Assessment (SEA) was undertaken for the coastal zones of Namibia to support and inform the decision-making processes affecting biodiversity conservation and sustainable coastal development (DHI Water & Environment, 2007). It provides management guidelines on activities to be conducted in the coastal environs of Namibia.	The recommendations in the SEA have been considered during the development of the proposed project. The SEA states that tourism facilities are to "minimise their impact on the environment in terms of both resource utilisation and visual impact," with mechanisms such as EIAs to assure this. New tourism developments, in particular, are to be "designed in such a way that they are unobtrusive, environmentally sympathetic and, as far as possible, enhance rather than detract from the visual impression of the environment." The report presents the findings of an ESIA and the design of the proposed project has applied these requirements. The findings of the SEA for the Walvis Bay area have been applied to this ESIA. Relevant management guidelines have also been used to develop the ESMP. This EIA Report is compliant with the SEA which stipulates EIAs for accommodation and tourist developments.

3 APPROACH TO THE ESIA

3.1 EIA PROCESS

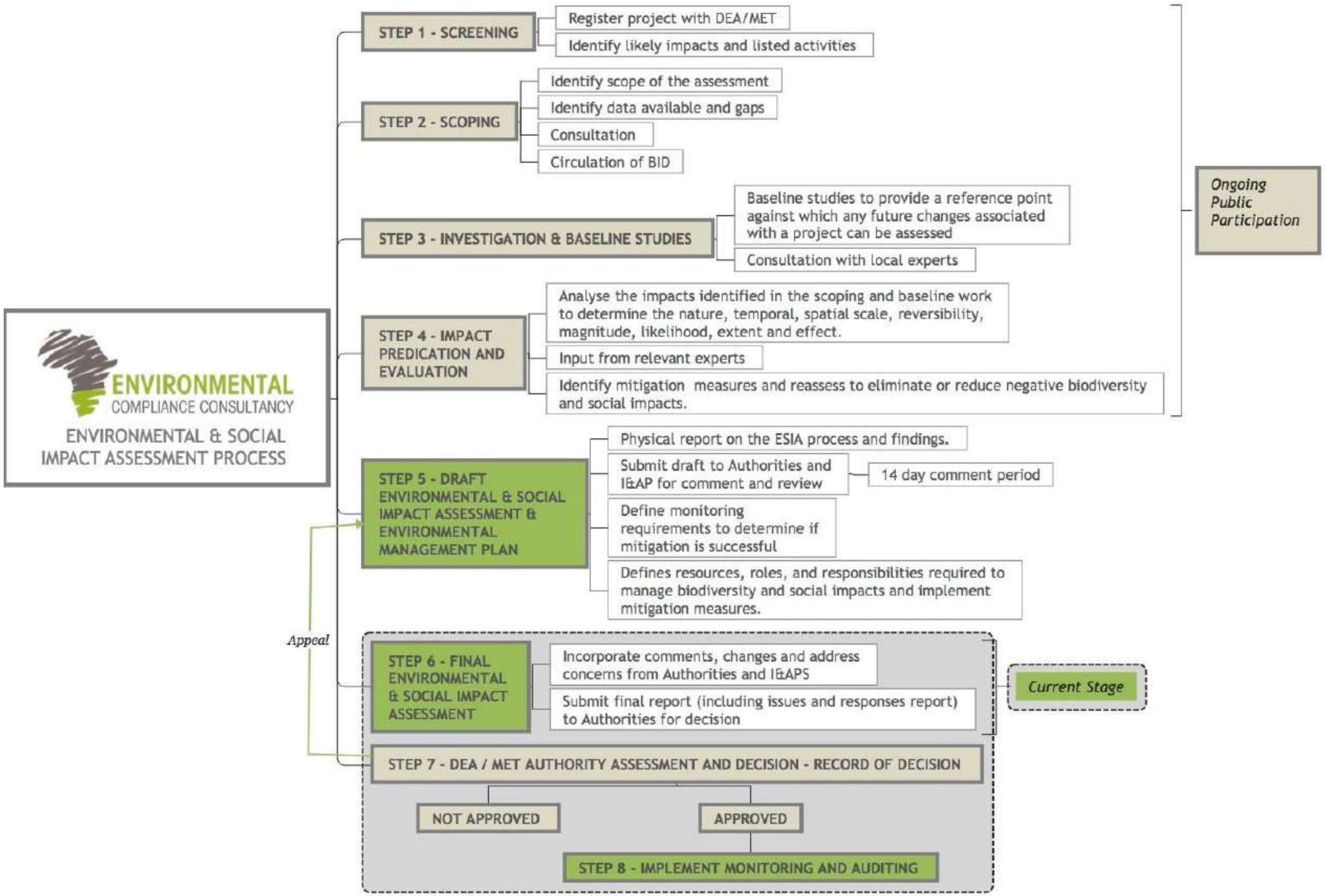
The EIA process in Namibia is governed and controlled by the Environmental Management Act, 2007 and the EIA Regulations No. 30 of 2012, which is administered by the Office of the Environmental Commissioner through the Department of Environmental Affairs of the MET.

An ESIA is the process of identifying, predicting, evaluating and mitigating the potential impacts of a proposed project on the natural and human environment. The aims of the ESIA process and subsequent report are to apply the principles of environmental management to proposed activities; reduce the negative and increase the positive impacts arising from a proposed project; provide an opportunity for the public to consider the environmental and social impacts of a proposed project through meaningful consultation; and to provide a vehicle to present the findings of the assessment process to competent authorities for decision making.

The ESIA process can aid the design development process through incorporating design changes early on into the project planning to avoid or reduce environmental impacts, as well as design aspects such as siting, technology and scale. Mitigation measures and recommendations are identified through collaborative working between the ESIA team and the proponent's team, including engineers, architects and project managers.

The EIA methodology applied to this ESIA has been developed using the International Finance Corporation (IFC) standards and models, in particular Performance Standard 1, 'Assessment and management of environmental and social risks and impacts' (International Finance Corporation, 2017) (International Finance Corporation, 2012); Namibian Draft Procedures and Guidance for EIA and EMP (Republic of Namibia, 2008); international and national best practice; and over 25 years of combined EIA experience. The process flow diagram in Figure 3 provides an overview of the ESIA process followed for the proposed project. The subsequent sections provide further detail of each step and what has been or will be undertaken for each one. Chapter 7 details the assessment methodology.

Figure 3 – ECC ESIA Process Overview



3.2 The Assessment Process Followed by Environmental Compliance Consultancy

This Section describes the process of the ESIA undertaken by ECC, as summarised in Figure 3. Whilst illustrated as a sequential consecutive staged process, some stages may be undertaken in parallel.

Steps 1 – 3 are complete, and where necessary, the findings / conclusions of these stages have been reported in this Chapter or signposted to a separate chapter in this report. Step 4 is the impact prediction and evaluation, and Step 5 is the preparation and completion of the ESIA and ESMP reports. As the main purpose of this report is to present the assessment findings, the assessment method has been detailed in Chapter 7 and findings presented in Chapter 7. Steps 6 onwards are future steps and have been summarised in this chapter.

3.2.1. Limitations, Uncertainties and Assumptions

During the ESIA process several limitations and uncertainties were identified. These are listed in Table 9 and are provided in each Chapter where relevant, along with any assumptions made in order to manage the limitations and uncertainties.

Table 9 – Consolidation of all limitations, uncertainties and assumptions.

CHAPTER	LIMITATION / UNCERTAINTY	ASSUMPTION
4: Project Description	The main limitation of the project description was a final construction schedule.	An indicative construction schedule is provided; however, changes to this are likely during the final stages of the design process. This is not considered as a substantial limitation and will not meaningfully affect the conclusions of the assessment.
5: Alternatives & Design evolution	No new or unique limitations specific to this chapter that have not already been identified elsewhere in the ESIA report.	
6: Environmental Baseline	Lack of specific and local air quality data.	An air quality study was not commissioned for the proposed project due to the nature of the development. Existing qualitative baseline information was brought together to provide an indication of the receiving environment, including developments, traffic and industrial activities in the local area, as well as climatic conditions.
	Lack of specific and local noise data.	A baseline noise survey for Namport Container Expansion project was undertaken in 2009. The baseline derived during this survey has been used in this report as the Namport data was deemed suitable for use. A new survey was not commissioned as it was not deemed necessary due to the short duration of noisy construction works (see chapter 4 for the project description); the nature of the proposed project; and the baseline in the Namport report was considered robust and adequate to use in this assessment. It is recognised that the baseline has changed since the construction and operation of Phase 1 of the Namport port extensions. The projections identified in the Namport report have been incorporated into the baseline and assumptions have been made
	Lack of Zoobenthos data.	Zoobenthos: University of Namibia (UNAM) have undertaken further surveys for zoobenthos to assess the potential effects the Namport container terminal project may have on the marine environment. It was agreed that

CHAPTER	LIMITATION / UNCERTAINTY	ASSUMPTION
		these would be made available to ECC for use in this ESIA and therefore additional surveys were not commissioned. These surveys have not been made available, therefore previous baseline surveys (2012) have been used to describe the baseline environment, with recognition that it is likely that the zoobenthos may have deteriorated as a result of the port extensions; therefore, a precautious approach has been applied, which allows the worst-case scenario for potential effects to be identified
	Lack of Turbidity data.	It is understood, that during the construction and dredging operations for Namport's Container Expansion Project (commenced May 2014) turbidity surveys were undertaken by Namport. This data has been requested on various occasions, however has not yet been made available to ECC for incorporation in the ESIA. Assumptions in the assessment have been applied to address this data gap.
7: Methodology	Topic specific assessment guidance and methodology has not been developed in Namibia (e.g. landscape and visual impact assessment methodology).	A generic assessment methodology was applied to all topics using IFC guidance and professional judgement.
	Guidance for CIA has not been developed in Namibia.	The IFC's guidance document (International Finance Corporation, 2013) has been used for the CIA.
	Namport's Container Expansion project EIA was used for the CIA for the proposed project. A comprehensive CIA in the Namport EIA was absent.	Assessment findings under each assessment has been used to develop the proposed project's CIA.
8: Assessment Findings	The specialist studies were undertaken at an early stage of the development of the proposed project. Some included different design options or early designs.	The environmental and social baseline presented in Chapter 3 has been used in the assessment. It is recognized that the project design had evolved since certain specialist studies were conducted. Some conclusions and recommendations of these studies may no longer be applicable, and therefore have not been included in the ESIA report or where required. Where required, consultation with specialists was undertaken to revise the conclusions and recommendation; these have been captured in this chapter where relevant.
	The project description in Chapter 4 has been applied to the assessment.	Any changes to the design, construction methods etc. may alter the assessment findings. If this occurs, the assessment will need to be revisited and further assessment work may be required
	Lack of specific and local noise data.	Lack of noise monitoring data and assessment modelling, a realistic worst-case scenario has been applied and a qualitative assessment has been undertaken
	The creation of approximately 5,000 jobs during operations could potentially result in the migration of an estimated 9,900 people to Walvis Bay (worst case scenario). The specific requirements of these workers and families are unknown and an assessment would be based	The Walvis Bay IUSDF anticipates and plans for population and development growth in the town, and therefore identified required public services (schools, hospitals, shops, residential areas). It is assumed these services are adequate and suitable for the workers and families of the proposed project. An assessment of pressure and demand of services has therefore not been included in the socio-economic assessment.

CHAPTER	LIMITATION / UNCERTAINTY	ASSUMPTION
	on guesses and assumptions.	
	The CIA has been limited to a desk-based literature review as Namibia does not have a centralised data base that logs all planned or realistically defined projects that are applying for Environmental Clearance	A rapid CIA has been undertaken which includes a limited high level assessment for projects that only have concept plans and a more detailed, yet still high level quantitative assessment for projects that are committed (have environmental clearance).
	Namport's EIA for the Container Expansion project is limited.	The CIA has made assumptions where assessment has not been undertaken or where assessment findings are considered to be questionable, and the precautionary approach has been applied.
	A rapid CIA has been undertaken due to certain limitations.	A rapid CIA is considered to be the most appropriate approach considering the limitations, as set out in the IFC CIA guidance (International Finance Corporation, 2013).

3.2.2. Step 1 – Screening

STATUS: COMPLETE

The first stages in the ESIA process is to register the project with the DEA/MET and undertake a screening exercise to determine whether it is considered as a listed activity under the Environmental Management Act, 2007 and associated Regulations and if significant impacts may arise from the project. The location, scale and duration of project activities will be considered against the receiving environment.

On the 11th August 2016, a meeting was held between the Permanent Secretary of the MET and Urban Dynamics to formally register and provide an introduction to the proposed project. Under section 32 of the Environmental Management Act, 2007, a notification and request for a scope of work for the proposed project was made to the MET following the meeting (see Appendix B). The notification provides the intention of the proponent to develop erven 4941 and remainder of Erf 4939 into the Walvis Bay Waterfront; states the Listed Activities the project triggers; and provides a plan of the proposed project site.

It was concluded that a detailed ESIA was required as the proposed project is considered as a Listed Activity as there may be the potential for significant impacts to occur.

3.2.3. Step 2 – Scoping

STATUS: COMPLETE

3.2.3.1. Scope of Assessment

Where an ESIA is required, the second stage is to scope the assessment. The main aims of this stage is to determine which impacts are likely to be significant (the main focus of the assessment); scope the available data and any gaps which need to be filled; determine the spatial and temporal scope; and identify the assessment methodology.

In response to the Notification Letter, the Office of the Environmental Commissioner in consultation with the Ministry of Fisheries and Marine Resources and the Ministry of Works and Transport, confirmed in writing on the 27th October 2016 (Appendix C), that the level of assessment for the proposed project to be an EIA and provided recommendations on the scope of assessment; as stated previously, this is considered as the Terms of Reference for the ESIA.

Subsequently, scoping of the ESIA was undertaken by the ESIA team. The scope of the assessment was determined through undertaking a preliminary assessment of the proposed project against the receiving environment obtained through a high-level desktop review. Feedback from consultation with MET and stakeholders also informed this process. The following environmental and social topics and sub topics were scoped into the assessment, as there was potential for significant impacts to occur:

- Built environment
- Infrastructure and waste management
- Socio-economics
  - Employment
  - Local businesses
  - Community and recreational facilities
  - Tourism
  - Cultural heritage
- Sense of place
  - Landscape and visual amenity
  - Residential and recreational views
  - Lighting
- Air Quality
  - Dust emissions
  - Aerial pollution (air emissions e.g. oxides of nitrogen; nitrogen dioxide, particulate matter; sulphur dioxide and carbon monoxide
- Noise and vibration
- Climate and meteorology
- Groundwater
- The marine environment
  - Oceanography and hydrodynamics (including tides and currents)
  - Bathymetry
  - Sedimentology and siltation
  - Water quality
  - Marine habitats and species

The following topics were scoped out of the ESIA, as no likely significant impacts are predicted, therefore are not discussed further in this report:

- **Soils and geology:** the surrounding soils and geology are common and have no significant value. The proposed project will require some ground excavation and limited material will be generated on shore. Material generated from marine activities will be reused on site or relocated to an alternative site. The geotechnical aspects are considered as an engineering design consideration.
- **Terrestrial ecology:** The proposed project site is located in an urban and industrialised area with limited terrestrial ecological features within or surrounding the proposed project site.
- **Surface water:** No surface water features are present in the locality of the site. Any site drainage during construction and operation is considered in the marine environment assessment, as this will be the receptor for any discharges.

Transboundary impacts were also scoped out of the assessment as impacts on neighbouring countries (e.g. South Africa, Angola and Botswana) were deemed unlikely due to the nature of the proposed project.

A health and safety assessment has not been undertaken as part of this ESIA. A separate health and safety management plan will be developed by the construction team and reported separately to the relevant authorities.

This will include aspects such as spread of HIV. In addition, the requirement for disaggregation is not applicable to this ESIA.

The lifetime of the proposed project to be assessed includes:

- Construction and relocation of the existing sporting facilities;
- Demolition of the existing facilities; main construction works;
- Site preparation and rerouting existing services;
- Main construction; and
- Operations of all developments.

The scope of assessment for the operations of the proposed project is limited to an extent. Even though the proposed project provides a space for hotels, retail, restaurants, marine activities, residences and other community facilities, the companies that will occupy these spaces and their activities are unknown at this stage. The number of people visiting the proposed project and the behaviour of visitors and users cannot be fully predicted. The ESIA and ESMP have been undertaken taking these discrepancies into consideration. Where possible, measures have been identified to pre-empt potential impacts. The assessment includes likely potential incidents and accidents as a result of the proposed project. A full accidents and fault scenario assessment has not been undertaken.

The buildings of the proposed project are designed for a life span of 40 plus years. Before and during this time, it is envisaged that care and maintenance, refurbishment and restoration will be applied to extend the buildings life. The buildings and the waterfront are designed to be a long-term permanent fixture of the urban landscape. Decommissioning and site restoration of the proposed project is therefore not included within the scope of the assessment, however recommendations for this activity should it be required are included in the Decommissioning ESMP (see Appendix A).

3.2.3.2. Study Area

This ESIA study area has been defined according to the geographic scope of the receiving environment and potential impacts that could arise as a result of the proposed project. A study area of 1 kilometre from the boundary of the proposed project site was applied as a standard for all desk-based studies, see Figure 4. For the following topics, the study area was extended to ensure sensitive receptors were identified and described.

- **Socio-economics:** the boundaries of the town of Walvis Bay; and
- **The marine environment:** the boundaries of the Bay area, including the Lagoon.

Specialist surveys had defined study areas and are discussed in the relevant reports (Appendices F, G, H I and J).

In addition to these study areas, areas where dredged material will be relocated to have also been reviewed and sensitive receptors identified and reported where applicable.

Figure 4 - General Study Area [Source: Google Earth, 2018]

3.2.3.3. AVAILABLE DATA

A desktop review of available baseline data was undertaken during quarter two of 2017. The aim of this activity was to identify what, if any, data is missing to form a robust baseline to be used in the assessment. The review focussed on the environmental and social topics and sub topics that would most likely be significantly affected by the Project. Several data gaps were identified and as a result, surveys and studies were commissioned. These surveys and studies are detailed in the Baseline Chapter (Chapter 6).

3.2.3.4. CONSULTATION

STATUS: COMPLETE AND ONGOING

Public participation and consultation is a requirement stipulated in Section 21 of the Environmental Management Act, 2007 and associated regulations for a project that needs an environmental clearance certificate. Consultation is a compulsory and critical component in the ESIA process in achieving transparent decision-making, and can provide many benefits.

The objectives of the stakeholder engagement process is to:

- Provide information on the project, introduce the overall concept and plan;
- Clarify responsibility and regulating authorities;
- Listen and understand community issues, concerns and questions;
- Explain the process of the ESIA and timeframes; and
- Establish a platform for ongoing consultation.

The proposed project has developed through several years of planning and consultation with stakeholders and the public. Due to the importance of engaging the public in the ESIA process, ECC has taken additional steps to ensure that the stakeholder engagement process reaches a wide range of stakeholders and I&APs, and that the process allows for genuine participation, which would influence the evolution of the design of the proposed project.

Chapter 9 provides a summary of the consultation process, and collates stakeholder comments / questions and ECC's responses. These have been considered and incorporated throughout the ESIA. Appendix D provides the evidence of stakeholder engagement. Appendix E provides the Background Information Document (BID), which was and issued to the general public and stakeholders in June 2017, which presents an overview of the proposed project; the EIA process; the need for the proposed project; and any alternatives considered, with the aim to provide stakeholders an opportunity to register as an I&AP. The BID was the first stage of consultation.

3.2.4. Step 3 – Investigation & Baseline Studies

STATUS: COMPLETE

The next stage of the ESIA process is to undertake baseline studies. A robust baseline is required in order to provide a reference point against which any future changes associated with a project can be assessed and allow suitable mitigation and monitoring to be identified.

The existing environment and social baseline for the proposed project was collected through various methods:

- Field surveys;
- Desk-top studies;
- Consultation with stakeholders (local authority's environmental specialists); and
- Door to door engagement with neighbouring residents.

During the baseline studies, experts were consulted with through face-to-face meetings, telephonic and email correspondence. The baseline focuses on environmental and social receptors most sensitive to change or receptors that have a high value of importance.

The environmental and social baseline is provided in Chapter 6, focussing on the topics that have been scoped into the ESIA, as listed in 3.2.3.1.

3.2.5. Step 4 – Impact Prediction and Evaluation

STATUS: COMPLETE

The key stage of the ESIA process is the impact prediction and evaluation stage. This stage is the process of bringing together project characteristics with the baseline environmental characteristics, and ensuring all potentially significant environmental and social impacts are identified and assessed. The assessment considers all stages of the project's life cycle that is scoped into the assessment (section 3.2.3.1). It is an iterative process that commences at project inception to the final design and project implementation (construction and operations). The impact prediction and evaluation stage was undertaken between January and December 2017, and refined further after feedback from I&APs was obtained through consultation of this ESIA report in January 2018.

The final design of the proposed project has been assessed, as well as alternatives considered during the design process in accordance with the Environmental Management Act, 2007.

Chapter 7 in this report sets out the assessment methodology used to assess the project against the environmental and social baseline that would be affected. Chapter 8 presents the findings of the assessment, focussing on the significant impacts or those considered sensitive to the community.

3.2.6. STEP 5 – DRAFT ESIA REPORT AND ESMP

STATUS: COMPLETE

The ESIA report documents the findings of the assessment process, provides the public with opportunity to comment and continued consultation and forms part of the environmental clearance application. The ESMP provides measures to manage the environmental and social impacts of the proposed project and outlines specific roles and responsibilities to fulfil the plan.

This ESIA report focuses on the significant impacts that may arise from the proposed project as described in Step 4. These impacts are discussed in Chapter 8.

This ESIA report was issued to stakeholders and I&APs for consultation on the 15th January for a period of 21 days, meeting the a mandatory requirement of 14 days as set out in the Environmental Management Act and associated Regulations. The aim of this stage was to ensure all stakeholders and I&APs have the opportunity to provide final comments on the assessment process and findings and register their concerns.

3.2.7. STEP 6 – FINAL ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT, AND ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

STATUS: CURRENT STAGE

All comments received during the I&AP public review period have been collated in an Addendum report (previously referred to as the Consultation report), which will accompany this ESIA report when submitted to the DEA. All comments have been responded to either through providing an explanation or further information in the response table, or sign posting where information exists or new information has been included in the ESIA report or Appendices. Comments have been considered and where they were deemed to be material to the decision making or enhanced the ESIA and ESIA report have been incorporated in to this ESIA report.

The final ESIA report and associated appendices, and the Addendum report are available to all stakeholders on the ECC website www.eccenvironmental.com All I&APs have been informed via email.

The ESIA report, appendices and Addendum are formally submitted to the Office of the Environmental Commissioner, DEA as part of the application for an environmental clearance certificate.

3.2.8. STEP 7 – AUTHORITY ASSESSMENT AND DECISION MAKING

STATUS: FUTURE STAGE

The Environmental Commissioner in consultation with other relevant authorities will assess if the findings of the ESIA presented in the ESIA report and Addendum report are acceptable. If deemed acceptable, the Environmental Commissioner will revert to the proponent with a record of decision and any recommendations.

3.2.9. STEP 8 - MONITORING AND AUDITING

STATUS: FUTURE STAGE

In addition to the ESMP being implemented by the proponent, a monitoring strategy and audit procedure will be determined by the proponent and competent authority. This will ensure key environmental receptors are monitored over time to establish any significant changes from the baseline environmental conditions caused by project activities.

4 PROJECT DESCRIPTION

4.1 INTRODUCTION

This chapter provides a technical description and presents the main features of the proposed project. This chapter includes:

- The geographical limits of the project
- Land ownership and zoning
- A description of the proposed Waterfront
- Major components of the layout
- Construction activities
- Final design and Operations
- Refurbishment and restoration

4.2 SITE AND SURROUNDINGS

4.2.1. ENVIRONMENTAL SURROUNDINGS

Walvis Bay is the third most densely populated town in Namibia and has developed along the coastline of the Walvis Bay area due to the fishing industry and development of the Harbour, and geographical restrictions such as the Dune belt to the east and south and the Lagoon to the south-west. The key features of Walvis Bay are the main Bay area; the Harbour; the Lagoon; the Salt Works, Salt Pans and Evaporation Ponds; and the Peninsular reaching up to Pelican Point.

The proposed project site is located approximately 1.5km south of the town centre (the central business district (CBD)), immediately south of the Namport container terminal on the seafront at the mouth of the Lagoon (see **Figure 5**). The surrounding area is mixed with industrial, commercial and residential uses.

4.2.2. PROPOSED PROJECT SITE

The site allocated for the proposed project as per the 2014 Walvis Bay IUSDF (Walvis Bay Municipality, 2014) is both on land and in the marine environment, as illustrated in Figure 5.

The area of land required to develop the proposed project is the area that borders Atlantic Street to the north, KR Thomas Street to the south and 4th Road to the east. The south end of the proposed site boundary extends past The Esplanade and the Lagoon Promenade to the south. The area within the marine environment is approximately 50 to 80m outwards from the coastline towards The Raft Restaurant, extending just past KR Thomas Street and in front of the Protea Hotel.

The site is approximately 9.5ha; approximately 7ha onshore and 2.5ha offshore. A cricket oval, swimming pool, tennis and jukskei courts currently occupy the site. These sporting facilities will be relocated; the sites are presented in Figure 6. The cricket oval will be relocated to the soccer field in Kuisebmund, a residential area, and the swimming pool, tennis and jukskei courts will be located to the Jan Wilken site, the central sporting stadium in Walvis Bay located in the centre of town.

Figure 5 - Proposed Walvis Bay Waterfront Project Site Location

Figure 6 – Proposed sites for the relocation of sporting facilities

4.3 LAND OWNERSHIP AND ZONING

4.3.1. THE PROPOSED PROJECT SITE OWNERSHIP

The majority of the proposed project area is owned by Walvis Bay Municipality and is located within the Walvis Bay Town Planning scheme on erven 4941 and remainder of Erf 4939 (refer to Figure 7). The area is currently zoned as Private Open Space and is freehold.

The on-shore area of the proposed project site does not extend beyond the Protea Hotel and excludes the Yacht Club and existing restaurants on the water's edge located on Namport land. The Road Reserve between the High-Water mark and the southern site boundary belongs to the Walvis Bay City Council; the Proponent is in the process of procuring a long-term lease over this area. The off-shore area in the Lagoon is under the control of the Government (managed by MET) and owned by the State. All relevant approvals for transfer of ownership will be obtained prior to construction and any surveying of the high-water mark to support this process will be undertaken in accordance with Namibian Law.

The proposed project does not include the Raft Restaurant located in the Lagoon that is privately owned, however an option remains to include this in the proposed project, should an agreement with the operator of The Raft and the land owner be concluded. This is currently under investigation.

Figure 7 – Project Evens

4.3.2. Rezoning

The application for rezoning of erven 4941 and 4939 is currently being undertaken by Urban Dynamics Pty Ltd. Once the rezoning and construction of the proposed project is complete, office space and residential sectional titles will be registered in accordance with the Sectional Title Act, 2 of 2009, then sold in accordance with sales agreement between the owner and the prospective buyer. The Sectional Titles will be incorporated into the rateable area for Walvis Bay Municipality.

4.3.3. Adjacent Areas

The land ownership and zoning of adjacent areas are not expected to be influenced or altered by the proposed project. The two privately owned erven on the corner of Atlantic Street and Esplanade Drive (Erf 4623 and Erf 4940) do not form part of the proposed project site (these ervens are indicated as the grey area in north east corner of erven 4941 seen in Figure 7).

4.4 Project Proposals

4.4.1. Design Philosophy

The proposed project was developed through an analysis of the city's history, structure, character and challenges in response to the area’s development as a new residential and commercial hub with a functional marina. The design philosophy was to maintain Walvis Bay's dominant maritime identity, while simultaneously strengthening the city’s character with various urban elements, such as hotels, restaurants, offices, amphitheatres, public squares and promenades. The core design principal was to create an “urban loop” in the form of a canal boulevard, strengthening the inner street and public spaces to those of the marina front itself. Pedestrians are therefore able to explore the variety of recreational spaces in the new built-environment, thus functioning as a natural extension of the city’s urban context.

By applying this philosophy, the proposed project integrates into the site and provides scenic vistas of the surrounding world-renowned Lagoon and bird life. It will form a hub for both the local community and tourists to enjoy.

4.4.2. Project Components

The proposed project will include the provision of several types of infrastructure and multiple land uses within the proposed site. The following components will constitute the proposed project. Areas have been included where available to provide an indication of land use.

- New community and sporting facilities – swimming pool, tennis and jukskei courts, and cricket grounds;
- Upgrades to bulk services and infrastructure, including sewerage lines and pump station;
- A Marina (Outer and Inner Marina), including:
    - Access channel to enter the Outer Marina;
    - Outer Marina with a breakwater / marina wall;
    - Inner Marina made of water canals for leisure craft moorings;
- Public open outdoor spaces covering approximately 1,600m^2, to be used for community recreation, activities and functions, as well as an area for informal vendors trade goods;
- Hard and soft landscaping, within and around the site;
- An amphitheatre to be used for local and touring artists, schools and the community;
- A multipurpose business and conference centre of more than 2,947m^2, including a plenary hall of approximately 1,450m^2, to encourage business development and provide a multi-functional facility;
- Offices of approximately 8,700m^2 with 400 parking bays;
- A total of 450 Residential units with an area of approximately 10,000m^2 with two car parking bays per unit;

- Approximately 38 Serviced apartments managed by the hotel;
- Two hotels: one four-star hotel, with a gross building area of approximately 10,800m^2, with 108 car parking spaces and 91 rooms; and the one three-star with a building area of approximately 5,800m^2, 80 car parking spaces and 120 rooms;
- Restaurants with a gross leasable area of approximately 2,600m^2;
- Retail space with approximately 23,800m^2 gross leasable area;
- Approximately 1,700 Parking bays in total (at ground level and semi basement, an area of approximately 23,300m^2);
- Internal road and pedestrian access routes; and
- Upgrade of existing road intersections.

The detailed layout plans for the proposed project (refer to Figure 8 and Figure 9) provides the framework of the proposed project and highlights the range of land uses and activities.

Restaurants, retail area and hotels are located on the northern side of the proposed project site, with residential properties to the south. The buildings will be of various heights across the site; with the tallest building (approx. 24m tall) strategically positioned in the middle of the development site to prevent impacts on the surrounding neighbouring properties. The main access point will be from Atlantic Street; main vehicle routes will direct traffic along 5th road and Atlantic Street.

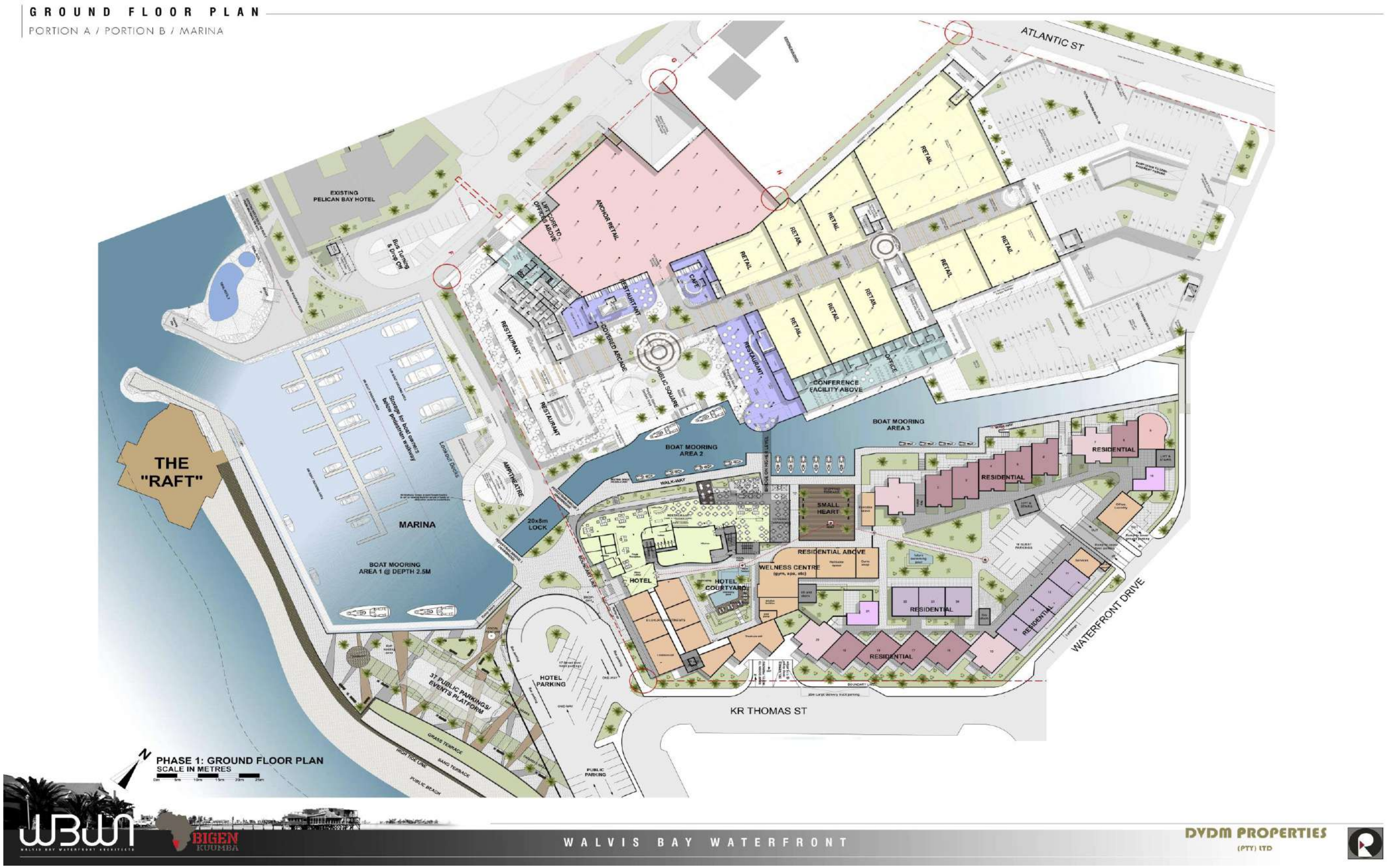


Figure 8 - Walvis Bay Waterfront Detailed Plan

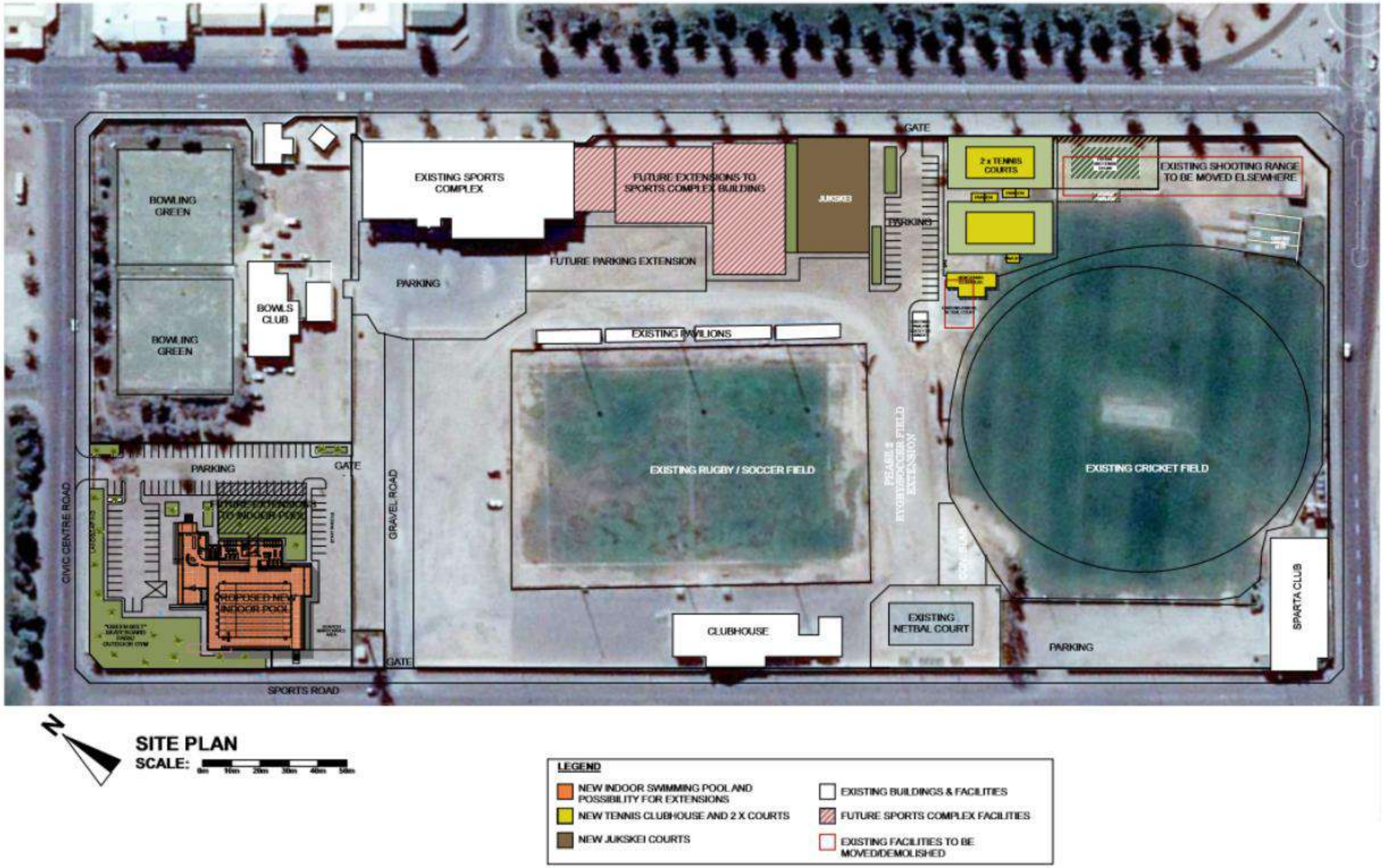


Figure 9 – Proposed Layout for Relocated Sporting Facilities at Jan Wilken Stadium

4.4.3. Enhancement Measures

To enhance the experience for both tourists and the local community, education facilities will be provided, including notice boards along the waterfront presenting local environmental information, Ramsar information, and data obtained during regular monitoring on the marine environment.

The architects have taken the micro-climate and it's harsh weather conditions into account and envisioned a design that would portray elements of both the Namib Desert and the Atlantic Ocean. The following features have been included in the design (embedded design measures):

- Existing palm trees or established vegetation will be removed during site preparation, retained and re-established into the final layout of the proposed project;
- Locally sourced materials such as marble and stone will be used for the construction of buildings;
- Less affluent areas will be provided access to new sporting facilities (cricket grounds); and
- Existing community sporting facilities will be enhanced through the development of new swimming pool, tennis and jukskei courts. The new facilities will be of the same standard (if not higher) of existing facilities.

4.5 Stakeholder Influence through Consultation

As discussed in Chapter 3, consultation provides an opportunity to obtain valuable information from local stakeholders (including the public) that can influence the design development process and achieve a mutually beneficial outcome.

The design development process, which includes the design of the proposed project built components (listed above) and construction methodology, have taken into consideration feedback from consultation with the local community and other stakeholders to ensure desirable planning features and aspects have been incorporated into the proposed project. Appendix D provides the collation of all consultation comments, responses and references which section of this ESIA report the information is contained.

The following considerations have been incorporated into the project design as a result of feedback from the public:

- Pedestrian and visual connections between the Esplanade, The Raft, the Yacht Club and the Protea Hotel to allow free flowing pedestrian movement between these facilities as well as continuous pedestrian access along the Promenade;
- A designated trading space for informal vendors;
- Facilities for people to go to enjoy the restaurant, wine and dine experience;
- An attractive waterfront with diverse activities and functions that will compliment future development plans for Walvis Bay;
- A traffic alternative will be provided for the closure of the Esplanade road near the Raft;
- Access for patrons to the Raft restaurant will be maintained during the construction period (see construction section);
- The use of building materials that will tolerate Walvis Bay' harsh environment; and
- Building heights adjusted and set back into the development to avoid sunlight being blocked onto neighbouring homes.

The design has also taken into consideration proposals within the IUSDF (Walvis Bay Municipality, 2014), including providing connectivity between the proposed project and other potential developments along the Lagoon and Bay area, including the potential Namport waterfront and marina development. This is discussed further in sections 4.10 and 6.11.2.

4.6 Limitations, Uncertainties and Assumptions

The main limitation identified during the production of this ESIA report was a final construction schedule. An indicative construction schedule is provided; however, changes to this are likely during the final stages of the design process. This is not considered as a substantial limitation and will not meaningfully affect the conclusions of the assessment.

4.7 Site Preparation and Construction

4.7.1. Schedule and Sequencing

The duration of the construction stage for the proposed project will be approximately 3.5 years. The development of the proposed project site will be undertaken in a phased approach: Phase 1 will be developed first followed by Phase 2, which will be market driven depending upon demand and minimising the potential economic impacts on the local housing market. Phase 2 will be constructed as soon as possible after Phase 1 to ensure the construction period is not overly extended affecting the neighbouring community.

- **Phase 1** includes the development of the marina, residential, commercial, retail, and conference center, which is focused around the waterfront and outer marina, and covers the majority of erven 4941.
- **Phase 2** comprises of residential, hospitality facilities and a portion of the inner marina (canal) will be constructed on erven R 4939.

The geographical extent of the two Phases are illustrated in Figure 8.

An indicative timeframe of construction activities for each Phase is presented in Table 10, along with an indication of the sequencing of activities; however, some activities may be undertaken in parallel with one another. Further information of each of these activities is presented in the following sections.

Table 10 - Development schedule

	PLANNED ACTION	ESTIMATED STARTING MONTH	ESTIMATED COMPLETION MONTH
Phase 1	Construction and relocation of sports facilities (tennis and jukskei courts and swimming pool)	May 2018	March 2019
	Demolition and site preparation	May 2018	July 2018
	Services realignment and upgrades	July 2018	Feb 2019
	Main construction (hotel, commercial, residential)	September 2018	September2020
	Marina development*	September 2018**	January 2020
	Walvis Bay Waterfront Mall and Marina opening		October 2020
Phase 2	Relocation of cricket oval	January 2020	June 2020
	Demolition and site preparation	January 2020	May 2020
	Main construction	May 2020	August 2021
	Opening of hotel		September 2021
Both	Completion of proposed project		End of 2021

* dredging activities will be undertaken in winter months, from May to August to minimise impacts on sensitive feeding seasons

**marine works will avoid sensitive marine mammal breeding times and should be minimised between June to September

4.7.2. Construction Workforce

Workforce requirements for the proposed project will be similar for both Phases with the exception that Phase 1 will require specialised teams to undertake the marina construction activities. Phase 2 may require some specialists; however, the majority will be required during Phase 1. The estimated workforce is approximately 500 persons who will be contracted on to the project. The role types expected for the proposed project are as follows

- General laborer's, truck and machinery operators, crane operators = 400 people.
- Trade qualified: 50 people.
- Senior contract workers = 25 people. These workers would include project managers, foremen and other contract workers.
- Specialist: 25 people, for example marina construction.

The use of local resources, which includes Namibian workers and contractors, is a pre-agreed principal of the proponent. Between 60 – 80 % of workers will be from the local community. Accommodation will be provided for out of town contractors in a contractor's camp, which will be sited on an area identified by the municipality and would not be on the proposed project site due to limited area. The contractor camp will be a standard camp providing accommodation, food preparation and cleaning facilities. It will be able to accommodate between 200 – 300 workers.

4.7.3. Construction Working Areas

The construction working areas will be limited to the areas illustrated on Figure 7. The marina construction area will encroach into the Walvis Bay Lagoon, occupying approximately 0.014% of the Walvis Bay Wetland Ramsar site (both in the construction phase and operational phase).

4.7.4. Phase 1 Construction Activities

Phase 1 is the western side of the proposed project site, adjacent to the marina. Construction activities occurring in this first phase of works is provided in this section. Phase 2 is discussed in section 4.7.5. Repetition is avoided where similar activities are undertaken, this is highlighted where relevant.

4.7.4.1. Relocation and Demolition of Existing Facilities

Prior to construction commencing, an aesthetically pleasing block-out barrier/fence will be erected around the site boundary to reduce the visibility of the construction site. This barrier/fence will provide public safety and controlled project security for the duration of the project. A demarcated single entry and exit point will be established off Atlantic Street. Traffic management measures will be implemented at this point, for example banksmen and sign posts.

The new sporting facilities construction and demolition of existing facilities will happen simultaneously. The demolition of the existing swimming pool, tennis and jukskei courts will be undertaken at the same time as the construction of the new relocated facilities. The demolition of the cricket clubhouse will also occur in Phase 1 and a temporary cricket club will be provided next to the oval until the relocated cricket club is constructed in Phase 2. This area is needed for the construction of the new road 'Waterfront Drive'. The cricket oval should not be affected by construction works, and will remain a functional during Phase 1 construction.

Key activities associated with demolition of the existing facilities include the following:

- Cleaning out and removal of all redundant equipment;
- Removal of timber roof frames and ceiling boards, metalloid roofing and concrete slabs;
- Removal of asbestos cement roofing;
- Removal of cement foundations of existing buildings;
- Removal of materials such piped services, hard standing, concrete foundations, swimming pool;
- Removal of septic waste; and
- Reclaim materials that can be reclaimed, reused or recycled at the relocated facilities.

Structures will be taken down using a combination of plant, machinery and hand tools. Building demolition waste will include reinforced concrete, concrete, electrical and mechanical services and other miscellaneous building materials. Where appropriate dismantled components and other materials will be stored on site until certain quantities have been collected and can be moved off-site for recycling, reuse or salvage (e.g. timber roof structures and floor boarding). Other waste will be disposed of at the Municipal landfill.

The following best practice environmental safeguards will be implemented during demolition works.

- Water sprays will be used (as required) across work zones and cleared areas to suppress dust,
- During windy months, the direction of prevailing winds will be considered in relation to the impact of dust on surrounding environment, housing, hotel and restaurants, and suitable mitigation methods implemented (e.g. water trucks).

An aesthetically pleasing block-out fence / screen will be erected around The Raft Restaurant to ensure patrons of the Raft are not affected by a construction view. Safe access will be provided at all times for staff and patrons of the Raft.

Prior to construction works of the new swimming pool, tennis and jukskei courts, some minor site preparation works may be required on the Jan Winkle site. The construction of the relocated facilities will take approximately 12 months, and construction activities will include site preparation, laying foundations, erection of buildings and associated infrastructure. Plant and equipment required for the construction of the new facilities will include a standard construction fleet such as trucks, loaders, crane, hand tools and builders. All costs associated with the relocation of the sporting facilities will be carried by Afrikumba and not the municipality. The operations of the facilitates will be the responsibility of the Municipality.

4.7.4.2. Site Preparation

Site preparation will occur concurrently with the demolition of existing buildings and structures. The main aim of this construction stage is to prepare the site for main construction activities, which will include clearance and retention of vegetation (see section 4.4.3), removal of rubble and any existing boundaries (fences, walls, etc.), and minor earthworks.

Suitable drainage at an early stage will be installed around the perimeter and on site to ensure any surface run off is collected, diverted and avoids running on to neighbouring properties.

The Esplanade road will be closed at the beginning of this stage and an alternative route and appropriate signage will be provided.

4.7.4.3. Re-routing Existing Services

The municipal sewerage line and some infrastructure is currently routed through the site. The current sewerage system is unable to cope with the current demand, causing septic tanks to back-flow and blocked toilets in residential dwellings. The system currently carries wastewater from Namport, the Protea Hotel, The Raft Restaurant and surrounding residential areas. The proposed project will increase demand on this services and infrastructure and therefore they will be upgraded as part of the project.

Prior to main construction activities in Phase 1, these services will be re-routed and upgraded thereby providing improvements to the local community and Walvis Bay Municipality.

The realignment of the existing sewer main is a critical task to be completed early in the project. At the start of construction, a sewer deviation line will be installed around the proposed project site on the Raft Restaurant side that will connect to the existing sewer in KR Thomas and 2nd Street. This is to ensure that existing services to all users are accommodated for the full duration of the proposed project. The final route of the services to the Raft Restaurant will be sited along the breakwater wall.

During construction a new sewer line and pump station will be built. The pump station will be located on the southern corner of the proposed project site with the new pump line to be laid parallel to the existing pipeline that connects the municipal sewer into the fairways pump station. The proposed project will not require this service to be commissioned until the project is in the operational phase in 2020; however, it will be commissioned prior to project completion and as early in the construction phase as possible to accommodate and assist the Walvis Bay Municipality with the current sewer flow problems in the area.

All other services, including water and electricity will be constructed as required for the proposed project during construction and connected to the existing networks when required.

All services will be belowground and will be installed following standard construction methodologies for the applicable service.

4.7.4.4. Main Construction

Construction would involve different combinations of the following activities:

- Site mobilisation and formation of the construction compound;
- Minor earthworks including raising low-lying land (at 1.2 above Mean Sea Level (MSL)) to approximately 2.6m above MSL;
- Closure of The Esplanade and the Lagoon Promenade at the site, and provision of diversions;
- Site office and parking located on the Namport side of the proposed project site away from residential areas as far as possible;
- Construction material will be stored and off-loaded on the Namport side of the project site;
- Installation of drainage infrastructure;
- Construction of the marina (more information is provided in section 4.7.4.5);
- Construction of the marina lock/crane system and canal
    - HDPE liner installation for the internal marina canal
    - Cement lining of the canal
- Construction of buildings (residential, commercial, retail, and conference centre):
    - Construction of building foundations

  - Construction of steel frames
  - Construction of walls
  - Construction of roof
  - Installation of cladding
  - Installation of utilities and internal structures and finishing's
  - Connections to services (gas, water and electricity)
  - Final equipment installation and furnishings
- Construction of the Waterfront promenade, pedestrian routes and open green spaces;
- Construction of the bridge and new Waterfront Drive;
- Upgrades to intersections from Waterfront Drive;
- Reinstatement and plantation of new vegetation (soft landscaping); and
- Hard landscaping.

The Raft restaurant will remain intact and will be incorporated into the urban fabric of the Walvis Bay Waterfront; it may be refurbished in future, which will be negotiated and agreed with the operators of The Raft and the Walvis Bay Waterfront.

4.7.4.5. Construction of the Marina

The Marina includes the Access Channel, Outer Marina and Inner Marina (also referred to as the canal). The Outer Marina is the main area of the marina, which includes the marina wall (breakwater), mooring area and access to the inner marina through the use of a crane.

The first stage of the construction works will be to construct the marina wall. This will be constructed from land to a level above high water. Trucks will deliver rocks to the site, which will be placed in the water by excavators and front-end-loaders, to a temporary crest height of +1.25m MSL. The Marina wall will function as a temporary construction platform where further work will be undertaken. See Figure 10 for graphical examples of how the wall will be constructed.

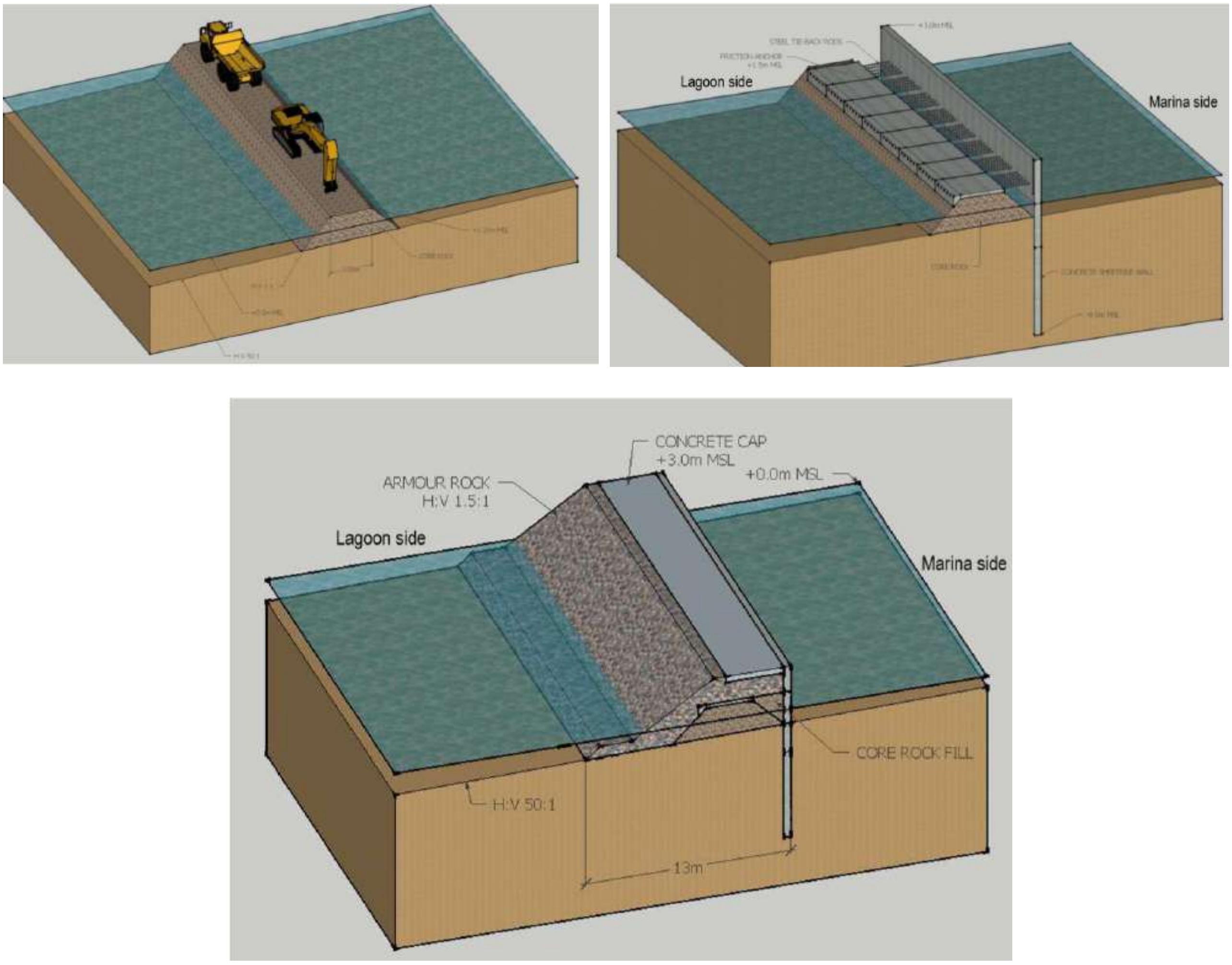


Figure 10 – Proposed construction methods of the marina wall

Construction of the vertical wall on the marina side will most likely be undertaken using vibrating sheet piles from land or from a barge, and lateral stability by means of tiebacks (anchor rods) will be provided. If piling is not suitable when further inspection is carried out, the Marina wall would be constructed using a bund and bringing in rocks on trucks that will be placed and levelled with a Back Actor (a piece of excavating equipment/digger), with concrete coping, either placed in as precast panels or cast in situ.

Vibratory pile driving will take approximately two weeks. The total construction of the breakwater wall will take an estimated timeframe of one month to complete. The final stages of the breakwater wall will be constructed by placing further rock material on the wall using 10-15 tonne dumper trucks for placing rock material, and an excavator will be used to spread the material.

Once the full length of the marina wall is constructed, the entrance to the Marina will be temporary closed using sheetpiles or rock allowing a construction bund to be developed. The natural easterly Lagoon access channel and the Marina Access Channel will then be dredged and pumped into the construction bund. The dredged material will build up in the construction bund, allowing sediments to flow out of the bund through the outgoing tide and back into the Bay area. Overflow pipes will be used where required. The dredged material will be removed by excavators and front-end-loaders which will be on land, directly transferred to trucks and transported to Industrial Zone 14 (discussed more in section 4.7.11), where it will be used as fill material for future development.

Dredging (see next section for more detail) will be conducted using locally available dredging equipment and utilising a gravel dredge pump system (sized between 6-10 inch), utilising a slow, stop start approach, and will occur on the outgoing tide. The rate of backflow will not exceed the rate of pumping. Dredging activities and the construction of the marina wall, which includes piling will be for a short duration, approximately six months, however this may reduce if a different technology is utilised. Mr Alan Louw confirmed (Pers comms on 14th February 2018) dredging on the outgoing tide or into the construction bund, with monitoring would be suitable to ensure potential impacts of dredging are understood and managed. Dr Rob Simmons recommended that dredging should be undertaken in winter months, from May to August (Appendix H); however, the scheduling of the dredging works will be reviewed once a preferred technology has been identified.

Upon completion of these dredging activities, the Outer Marina will then be dredged and excavated to provide a basin. This will be undertaken from land or from the marina wall. Once the required depth is met, the marina wall will then be raised to the specific design level, armour rock and breakwater toe will be installed, and a concrete cap will be constructed, which involves pre-cast and/or in-situ cast concrete cantilever or block units. The temporary sheet piles and/or rock at the entrance will then be removed in order to flood the marina.

The Inner Marina will be constructed in two phases. The western half will be created in Phase 1 and the eastern section in Phase 2. The Inner Marina will be constructed through the use of sheet piles. These would be inserted into the ground creating an enclosed area that would then be excavated. The base would be prepared followed by the dewatering of the basin. The surface of the canal would be prepared, including the installation of any drainage or pumping systems. The floor and sides of the inner marina would be a reinforced concrete structure.

The Phase 1 and Phase 2 sections of the Inner Marina will be constructed independently. During Phase 1, the Inner Marina will be built beyond interface for Phase 2. A wall on the eastern side of the Phase 1 Inner Marina will be created. The second Phase will therefore be built independently of Phase 1. The interface wall will be demolished once the Phase is completed. Any concrete used to construct the Marina will be delivered by an agitator cement truck from Walvis Bay.

4.7.4.6. Dredging Activities

The gravel dredge reclamation system is designed to pump gravel and sediments in soft sea floors. Gravel pump systems employ vortex style pumps between 6 - 10 inches in diameters and are specifically capable of dealing with gravel and other harder material (Keene Engineering, 2018). The gravel dredge system is similar to that applied in the diamond mining application however on a far smaller scale.

Alternative dredging methods are currently being investigated, which may identify utilizing different technologies such as sucker dredgers or environmental dredgers suitable for dredging in shallow waters in sensitive environments. One of the options that has been identified through this review is 'Watermaster' or similar as detailed in Appendix N.

This type of dredging can dredge to a depth of 6.5m and is within the range required for the Outer Marina and Access channel. It is a non-intrusive technique as it does not require permanent footings on the sea floor and is capable to operate in shallow waters with two independent hydraulic pumps; one that operates the suction/vacuum action, the other that operates the cutter blade that feeds the material directly into the suction pump at the head of the dredger. This technology eliminates the need for an agitator pump that rapidly disturbs sediments to allow them to be sucked up with a dredge. Material would be vacuumed through the dredge head into a 220mm suction pipe that would be directed into the construction bunded area and discharged into the bund with a lay flat hose that can be moved around the bund to allow even placement of material.

Due to the technology of the dredge machine there is the ability to control the sediment to a degree; therefore, this option provides the opportunity to dredge on both incoming and outgoing tides on the condition that turbidity thresholds are not exceeded. This option would permit dredged material to be repositioned on the outgoing tide in the Bay area and on the incoming tide material could be directed into the construction bunded area, thereby reducing construction time. This method reduces the amount of potential sediments in the water column and is therefore preferred technology.

Any dredging activities will be monitored through site surveillance by Mr Alan Louw, an extremely knowledgeable local expert on dredging. Mr Louw will be given the authority to stop and start dredging activities to prevent any potential impacts to the Lagoon. Turbidity monitoring will also be undertaken at specific locations in the Lagoon and Bay area.

4.7.4.7. Raft Structure and Integrity

The Raft restaurant is built on wooden piles. The Raft's structure requires an investigation to be able to determine its structural integrity. Visual observations indicate that some of the piles require maintenance and repair. The Marina construction will take place within close proximity to the Raft and therefore there is the potential that construction activities may impact the foundations. Qualified vibratory pile driving operators will be engaged to undertake this task and an assessment on the best approach to prevent harm or damage to the structure will be completed prior and during construction.

A pre-construction survey will be conducted and recorded, including a photographic report. This will be signed off by both the proponent and the owners of the Raft. If necessary, a pre-construction agreement will be drawn up with the owners of the Raft Restaurant.

4.7.5. Phase 2 Construction Activities

This section describes the construction activities for Phase 2. Various activities will be the same as Phase 1, and therefore is not repeated.

4.7.5.1. Relocation and Demolition of Existing Facilities

The cricket clubhouse would have been demolished in Phase 1, and replaced with a temporary facility on the western edge of the oval, until such time as the cricket field is relocated, when a new clubhouse will be constructed at the new location/site. The remaining works for this area in Phase 2 will be to strip the turf and relocate it for reuse on site in Kuiesbmond. This site may require some minor preparatory works prior to receiving the turf. A new cricket club house will be constructed which will take approximately three to six months.

4.7.5.2. Site Preparation and Re-routing Existing Services

The remaining existing services will be re-routed and connected to the re-routed services that occurred in Phase 1 and existing services. The same techniques will be utilised in this Phase.

4.7.5.3. Main Construction

The same construction activities, methods and similar construction plant and equipment for Phase 1 will be required for Phase 2. The construction office compound will be located on the Namport side of Phase 2 and the site will be accessed via Atlantic St.

4.7.6. Construction Lighting

Any lighting required during the construction stage will be to facilitate a safe working environment. Lighting will be downward and away from residential properties, and flood lighting will be minimised. Minimal lighting is envisaged to be required as construction works will be undertaken during daylight hours. The ESMP provides further details on lighting measures.

4.7.7. Traffic and Access Management

During all stages of construction, vehicles will access the site from the north side via Atlantic Street. Construction vehicles will be routed along 5th Road on to Atlantic Street thereby avoiding residential areas, specifically KR Thomas Street and 4th Road. Access to residential properties in the surrounding area and adjacent to the site will be maintained at all times. Waterfront Drive will be commissioned at the end of Phase 1 for public use. This main access route on to Waterfront Drive will be via Atlantic Street.

Traffic management and calming measures will be provided to aid traffic flow for both construction vehicles and public vehicles, control construction vehicles entering and existing the construction site, and maintain safety and minimise disruption on the local community. These measures may include:

- Flags and banks-men
- Signage
- Predetermined and signposted construction traffic routes

The Protea Hotel is currently accessed via Atlantic Street and The Esplanade. The Raft can only be accessed via pedestrian access off the Lagoon Promenade. The Esplanade and Lagoon Promenade will be closed in Phase 1. Access to the Protea Hotel will be via Atlantic Street, which will be appropriately signposted. The Raft will continue to be accessed via the Lagoon Promenade, however pedestrians will not be allowed between the Raft and the Protea Hotel along the Promenade and will be diverted via a slightly longer route. Pedestrian access will be supplied to the Raft as one of the first and critical steps in the marina construction phase.

4.7.8. Vehicle Types and Movements

Based on the schedule and type of activities, it is estimated that the proposed project will involve the following vehicle types:

- Bulk Earthworks
    - Two Excavators
    - Eight 8m^3 Tipper Trucks
    - Two 11 Ton Rollers Compactors
    - One Grader
    - Two Hilux Bakkies
    - One Fuel Trailer
- Building Construction
    - Two Backhoes Loaders
    - Two Skid steer loaders
    - Two Ride on rollers
    - Four Hilux Bakkies
    - Two Tipper Trucks
    - Piling rig and supporting crane
    - Tower cranes
- Hydraulic and pneumatic tools for small tasks;
- Marina Construction
    - Piling rig
    - 10-15 Tonne dump trucks
    - Excavator
    - Roller
- Dredging
    - One six / ten-inch gravel pump
    - Pipes
    - Excavator
    - Trucks for transporting material off site
- Road Upgrades:

- Grader
- Vibratory steel drum roller
- Bitumen sprayer
- Paver
- Roller
- Water truck

During construction, approximately 100,000m^3 (total material 78,000 (off-shore) plus 22,500 (on-shore, from the road reserve area) of material will be generated during dredging activities, which will require transfer off site. This material will be used as fill in the Industrial Zone 14 (see section 4.7.11). The material will be transported off site using trucks, which will require approximately 10,000 truck trips. Ten trucks will move the material over a six-month period, which equates to approximately 50 truck movements to and from the site per day.

These truck movements will be scheduled to avoid sensitive times, such as before 7am and after 6pm, rush hour and school runs. Traffic management measures such as banksmen will be utilised, and designated routes shall be used. Best practice measures will be applied to control dust generation and dispersal, for example dampening techniques, covering the material, and restricted speeds, as set out in the ESMPs (Appendix A).

Materials for construction will be delivered to site upon demand; stockpiling will be avoided where possible.

4.7.9. Road Network Upgrades

A traffic study was undertaken in November 2016 that modelled existing traffic conditions and future predicted flows for the proposed project. Through modelling and analysis, it was identified that some intersections and road sections may not have the required capacity to accommodate predicted traffic flows, therefore minor upgrades would be required

The upgrades will be limited to within the existing road boundary, with the majority of works being new road markings altering junction layouts (see the yellow pins in Figure 11), existing roads to be upgraded to dual roads (use of road markings, see purple and yellow lines in Figure 11), and traffic signals. Some minor works may be required such as the construction of a 6m wide median island along Nangolo Mbumba Drive to ensure safe turns into Esplanade Drive. Traffic calming measures such as speed humps may also be installed on the eastern side of KR Thomas Street and 4th Road to discourage road users accessing the propose project via these roads.

Figure 11 – Potential Road Upgrades

The current road surface conditions are considered to be suitable and do not need to be upgraded. The ESMP (Appendix A) includes monitoring measures to inspect the road surface during construction and operation.

4.7.10. Construction Material

Materials used to construct the proposed development will include the following:

- Locally sourced granite (tiles and/or slabs);
- Natural stone sourced locally;
- Aluminum and stainless steel;
- Roof aluminum sheeting
- Locally sourced cement;
- Timber;
- Locally sourced rocks and cobbles; and
- General construction material.

Materials will be brought to site as and when required, and stockpiling will be minimised.

4.7.11. Material Management: Dredged Material

Approximately 78,000m^3 of material will be dredged removed from off-shore (Outer Marina and Access Channel) and approximately 22,500m^3 will be excavated material from on-shore. This material will require disposal / relocation for reuse for other developments / projects. The disposal options for dredged and excavated material will be determined based on the analysis of the sediments. The identified preferred disposal area for the material is Industrial Zone 14 in an industrial area and would be used for the filling of land for industrial development (see Figure 12).

Figure 12- Industrial Zone 14 for the disposal of material

Industrial Zone 14 is less than 7km from the proposed site. It would be accessed via 5th Road, the D1986 and then the C14. The surrounding site is currently unoccupied and ear-marked for future industrial development by the IUSDF. To the north is Narraville, to the east is open land, to the south is bird sanctuary and to the west is an industrial area and the new mall.

4.7.12. Waste Management: General Construction Waste

The control and management of waste will be undertaken in accordance with the ESMP (Appendix A). A waste management plan will be developed before the start of works and will set out how building materials, and resulting waste, are to be managed. The Waste Management Plan will set out plans for materials, and waste minimisation and management in line with the waste hierarchy (avoid, reduce, reuse, recycle, recover, final disposal), and will include the following details: waste types, quantities, waste handling and disposal companies, and the identified disposal site.

Demolition activities will generate waste including bitumen, concrete, reinforced concrete, swimming pool infrastructure, structural steelwork, concrete and plastic pipework, rock and gravel materials, soil and potentially contaminated soil. These materials will be removed and transported off-site once sufficient volume has been collected, and transferred to an appropriate disposal site. Demolition of buildings and therefore associated waste is anticipated to be approximately 5,500m ^{3} - 7,500m^3. Other general construction waste will include packaging and waste timber or aluminium / steel, excavated material, with the potential for contaminated soil, and vegetation.

Through a site survey of the buildings to be demolished, asbestos has been found in the roof material of one building. The asbestos roof covers an area of approximately 20m^2. Due to the health risks associated with asbestos removal, the specialised task will be undertaken by a qualified asbestos removal contractor. The removal of this contaminated material will produce hazardous waste, which will be disposed of at the hazardous waste disposal site. Other hazardous waste could arise from potential hydrocarbon spills from operating plant and equipment.

Material excavated on-shore during Phase 1 in the location where the part of the Outer and Inner Marina will be located will be approximately 22,500m^3 (road reserve). This material will be tested which will determine the route for reuse (Industrial Zone 14) or disposal (dedicated hazardous waste facility in Walvis Bay).

4.7.13. Site Demobilisation

Upon completion of both Phases, the site will be cleared of all construction vehicles, plant and equipment and the site construction office compound will be removed. The removal will be done in a staged approach, and where plant and equipment are no longer used it will be removed from the site.

4.8 Consultation Feedback: Construction

Consultation feedback that has influenced the construction methodology includes the following:

- A traffic alternative will be provided for the closure of the Esplanade road near The Raft; and
- Access for patrons to the Raft restaurant will be maintained during construction.

4.9 Final Design and Operations

4.9.1. Operational Activities and Management

Walvis Bay Waterfront Properties (Pty) Ltd will be the management company for the proposed project. The day-to-day operations of the businesses will not be managed by Walvis Bay Waterfront Properties (Pty), for example, the operations of a restaurant, but rather by the business owner or appointed managers. Walvis Bay Waterfront Properties (Pty) Ltd will therefore, be responsible for the following:

- Care and maintenance of the marina and canal: dredging, flushing of the internal canal and regular monitoring;
- Ensuring compliance with Marina rules and regulations by all occupants (boats);
- Managing rental and levy finances for all occupants of the proposed project;
- Managing the distribution of profits;
- Undertaking regular communications with updates, news or other information to all occupants;
- Undertaking maintenance of utilities and services;
- Undertaking maintenance of open areas; and
- Managing and maintaining residential rental properties, including the serviced apartments.

4.9.2. Employment Opportunities

To manage the proposed project under Walvis Bay Waterfront Properties (Pty) Ltd, a trained workforce will be required which will include various roles for the standard operating activities associated with a development of this nature. A breakdown of employment is provided in Table 11.

Table 11 –Employment opportunities

EMPLOYMENT TYPE	APPROXIMATE NUMBER OF WORKERS
Waterfront Management Company:	
Management and supervisors (skilled)	15
Unskilled	50
Contract Staff	20
Residential properties:	

EMPLOYMENT TYPE	APPROXIMATE NUMBER OF WORKERS
Supervisors	2
Unskilled	120
Restaurants & Retail:	
Skilled and unskilled	935
Hotel & Serviced Apartments:	
Hotel 1	275
Hotel 2	145
Serviced apartments	45
Conference centre:	
Skilled and unskilled	70
Marina & Boat maintenance:	
Unskilled	35
Offices:	
Mall and Marina	35
Other:	
Other unskilled	55
Total	**1,800**

The above numbers are estimated using the number of hotel rooms, retail and restaurant space and predicted boat numbers. Indirect jobs will be created and affect downstream services in the Walvis Bay area. A conservative multiplier effect of two has been applied to determine potential indirect job opportunities. This has been derived from the professional teams' experience from other waterfront developments around the world, including the Victoria and Alfred Waterfront in Cape Town. It is estimated that between 3,400 and 3,600 indirect jobs will be created, therefore the development will generate between 5,000 and 5,300 jobs.

4.9.3. Traffic

TRAFFIC

Estimates for trip generation were calculated for the proposed project (Appendix G), which were based on the Committee of Transport Officials trip data manual. The expected trips to be generated once the whole development is fully operational are illustrated in Table 12 (applying Scenario 8 in the Traffic Study, Appendix G).

Table 12 – Peak hour expected trips

PEAK HOUR	IN	OUT	TOTAL
Weekday AM	700	302	1,002
Weekday PM	890	1,292	2,182
Saturday Midday	1,057	999	2,055

4.9.4. Access and Parking

A total of 1,700 parking bays will be provided both above ground and at semi-basement level. The number of parking bays was influenced by the recommendations from the Traffic Study (Appendix G) and the Walvis Bay town planning scheme.

Walvis Bay town does not currently have an extensive public transport service; however, the Walvis Bay IUSDF (Walvis Bay Municipality, 2014) details future provisions for a public transport system linking the waterfront with the main town. The proposed project has therefore integrated facilities to cater for a public transport system, including a bus turning circle, bus parking and drop off zones south of the Protea Hotel, and bicycle parking and storage.

The following parking provisions are included in the design:

- Users of the marina area will have access to parking bays adjacent to the marina which is accessed from the Esplanade.
- Parking in the semi-basement for the commercial areas will be accessed off Atlantic Street via Waterfront Drive.
- Parking for retail business is six per 100m^2, which will be both above ground and semi-basement level.
- Parking for residential areas is both above and underground and will be accessed via Waterfront Drive and KR Thomas Street. Residential properties will have two parking spaces per property.
- The hotel next to Atlantic Street will have dedicated parking that will be accessed via Waterfront Drive and KR Thomas St.

Parking bays have been calculated using the Walvis Bay Town Planning Scheme requirement and have been over catered for by the proponent.

The waterfront will be signposted and will route traffic via Atlantic and 5th Street. Pedestrian access to The Raft will be via the breakwater wall, with parking at the end of the marina wall on Esplanade Drive. Parking for The Raft customers is provided within the parking calculations.

4.9.5. Lifespan, Care and Maintenance

The Walvis Bay Waterfront will be a permanent feature of the town of Walvis Bay. Traditional local materials which withstand the harsh coastal conditions will be used so that the buildings are structurally sound in 30-40 years' time, which should not require significant care and maintenance.

The architects have taken the micro-climate and it's harsh weather conditions into account and envisioned a design that would portray elements of both the Namib Desert and the Atlantic Ocean. Low-maintenance, robust materials are proposed for the exterior facades and public areas which will stand the test of time and will be more sustainable in the long run. Passive design and energy efficiency principles combined with the use of appropriate building materials are means in which to achieve a more sustainable development.

4.9.6. Architecture and Landscape Design

The layout of the buildings has been planned to keep in mind the Namibian population who enjoys the outdoors and spend a lot of time utilizing the Lagoons banks throughout the year. This characteristic gives way to propose an open occupation of the ground, and outward facing buildings. Restaurants, cafes, a multi-use auditorium and shops have easy and continuous access to the platform and the central heart.

The public area, which surrounds and connects the site to the Marina has been designed with terraces and subtle level changes, allowing pedestrians ideal places to relax and spend time, whilst the attractive views of the Lagoon and its wildlife are on show.

The final architectural design has been developed to take into consideration the surrounding environment to permit landscape features to be integrated into the design. The contemporary buildings will be made from locally sourced sustainable materials, such as granite, natural stone and cobbles, allowing the integration and blending into the surrounding environment. Granite will be used for floors, arcades, public areas and wall cladding; natural stone will be from the Namib Desert and will be used for building plinths, sea walls, public walkways and wall cladding; and natural hardwood timber structures will be used in public areas, walkways and restaurants. The soft landscaping will have palm trees, aloe trees, olive trees and grassy areas. The design is considered to take into consideration the recommendations set out in the SEA for the Coastal Areas of Erongo and Kunene Regions (DHI Water & Environment, 2007) - *"minimise their impact on the environment in terms of both resource utilisation and visual impact,"* and be *"designed in such a way that they are unobtrusive, environmentally sympathetic and, as far as possible, enhance rather than detract from the visual impression of the environment."*

As much construction material as possible will be obtained locally. Both the building and the Waterfront area are largely covered in naturally sourced stone, preferably from local quarries. The proposed project encourages the use of recycled materials such as the structural steel. Preferring the local industry promotes the local area and diminishes the materials' carbon footprint. Low embodied materials such as timber are largely proposed in the interiors.

The buildings have been set back from the coastline and the surrounding roads. Artistic impressions of the planed waterfront have been provided in Figure 14.

4.9.7. Marina Design

The Marina will accommodate berthing for approximately 70 boats, which has been determined by the design capacity and available space. Berthing will be limited to boats with a maximum draft that the Marina can safely accommodate, which could be between 3m and 5m. Moorings are provided through a series of floating jetties. In the Outer Marina, these will rise and fall with the tide and held in position by means of suitable guide piles or struts.

The Outer Marina and Access Channel have been designed to allow for the vessel draft, Lowest Astronomical Tide (LAT), keel clearance, and allowance for natural siltation. The water level in the Outer Marina is tidal and will thus rise and fall. The depth will be approximately -3.5m deep relative to MSL; therefore, at very low tide the Outer Marina will have a minimum depth of approximately -2.5m. The Outer Marina and Access Channel will require dredging to maintain a safe nautical depth. This will occur approximately every five and two years respectively. The Outer Marina is expected to have a natural circulation, however if required, engineering controls will be implemented to ensure the water is circulated sufficiently to avoid stagnant water and risk of algal blooms.

The Inner Marina will be a fixed water level. The floor of the Inner Marina will be made of impermeable base, i.e. cement and will have a depth of at least -3.5mMSL, and top of walls and gates to around +2.2mMSL. Boat access to the water body will be through the use of a crane. Vessels with a maximum draft of 1.5m will be limited to accessing the Inner Marina.

The environment of the Inner Marina is a closed waterbody, it will be artificial with limited sediments, flora or fauna. To ensure the water quality of the Inner Marina is managed and to reduce negative effects, pumps or oxygenation may be applied, and at certain conditions, water could be drained and the Inner Marina 'flushed'. During these 'flushing' periods, approximately 5,000m^3 (two Olympic swimming pools) of water shall be flushed out into the Bay area. The method and approach to this activity will include measures that avoid impacts on the environment, for example, flushing will only occur on the outgoing tide; and Marina users will be notified early. The final management measures of the Inner Marina shall be determined through the operations phase when real conditions have been realised and the best approach can be established. Chemicals will not be used and the marina will be cleaned every so often to remove build-up of moss and other organisms. These operations will be included in the Operations ESMP (Appendix A).

4.9.8. Marina Operations

Approximately 70 boats are expected to be moored in the Marina. These boats will be of various sizes and will be restricted in size to those the marina has been designed to cater for (as described above); this will include leisure yachts and small recreational boats.

Boat operators using the marina will fall under the management of the proponent and therefore the proponent shall enforce strict rules and regulations for boat operators and users of the marina.

Education and notice boards shall be positioned around the Marina, displaying information regarding the code of conduct, rules and regulations of the Marina and other guidance to ensure impacts on the environment are minimised. This shall include but not limited to:

- No littering;
- No feeding of wild animals;
- Speed limits;
- No-go areas including the Lagoon;
- Compliance to Namport’s nautical safety requirements;
- Compliance to National Water Safety rules and regulations;
- Safety requirements;
- No mooring outside of the Marina;
- Shut down of fish finding and boat sonar equipment when moored; and
- Rules regarding the use and limited use of lights on masks in the Marina.

Boats will only be permitted to use the Access Channel for entry and exit; this will be demarcated by buoys and access will be speed limit restricted.

Outside of the Marina and Access Channel, the proponent will have limited control over the boats users and their activities, however the proponent will reiterate that all users shall adhere to the following:

- Remain within areas approved for boat use and avoid restricted areas, including the Lagoon;
- Boats within the Bay area will fall under the regulations of Namport and all nautical safety requirements must be complied with, including national laws pertaining to boat use.
- A “Code of Conduct” will be drawn up and in place prior to operations setting out the rules and regulations of the Marina use.

4.9.9. Lighting Design

Natural lighting will be optimised in the proposed project which is both sustainable and a major energy-saving measure. A mixture of deep set windows, low glass and frost glazing on the facades provides several impacts: the white appearance; translucent shades and depth impacts; inverts the day-night manifestation of the building; but most importantly, provides positive internal daylight values. The depth plan is relatively narrow, proportioned to the facade height in order to provide sufficient (+300 lumens) natural light to every corner. This is reinforced by square light wells in specific points of the building where the floor plan depth is greater than required, which is also repeated in the parking semi basement floors.

Lighting for the proposed project will be sensitive to the surrounding environment and includes downward facing lights and limited use of floods lights. Interior building lighting (for example the office area) will be fitted with sensors or timed lighting to reduce light pollution at night.

Within the Marina, boats that require lighting will be fitted with small less intrusive lights so not to disorientate birds. Energy efficient lighting will be incorporated into the design. The ESMP provides further details on lighting measures.

4.9.10. Bulk Services

Existing bulk services and infrastructure will be upgraded as part of the proposed project. The new sewerage system will be capable of handling 8,500m^3/day and will be connected to the existing sewerage distribution and wastewater treatment system, existing treatment facilities. The sewer lines will be a class nine PVC pipe, designed for transporting sewer waste, and pipes connecting to the surrounding areas will be a 200mm-diameter pipeline (Appendix L).

Fresh water will be provided through the existing municipality infrastructure, which is sourced from the Kuiseb Aquifer.

Electricity for the proposed project will be supplied by the Meersig Switching Station. The IUSDF allocated a projected electricity load for the proposed project of 1000 (kVA) and 4000 (kVA) for the yacht marina. The infrastructure networks in Walvis Bay have been built and continue to develop in accordance with the Walvis Bay IUSDF; therefore electricity projections for the proposed project have been catered for and accommodated in the Walvis Bay IUSDF.

4.9.11. Energy and Water Use

Building orientation is the single most important passive strategy for minimizing energy requirements. The proposed project organizes mostly elongated north-south volumes with shallow floor plates, leaving relatively neutral large East-West facades. This exposure contains Vertical Signage Facades & Pergola's where needed, a zone which benefits from deflected sunlight. The South facing nodes are designed to host the more public areas such as restaurant, offices and terrace which can benefit from sun exposure. On the opposite side, inward-facing buildings such as the auditorium, and mixed-use facilities are strategically located at the north-east end. Finally, the ground-level restaurants facing the Lagoon have an internal space and a summer external extension with sun-shading and wind protected screens and eaves to allow the visitors maximised connection to views.

Were feasible, renewable energy concepts have been incorporated into the design. The use of solar panels for energy generation is currently being investigated and optioneered, and water pumps embedded in the development will make use of wind power where feasible, which would be generated by small-scale wind circulation pumps inconspicuously incorporated into the design of the proposed project.

It is estimated that approximately 280 kl/day of water will be used across the development. Wherever possible water saving measures will be incorporated into the design, for example, the installation of duel flushing toilets, waterless urinals and further recycling water options will be investigated. Cold seawater will be used where possible to run the air conditioning units across the development, significantly reducing the water and power demand required for cooling buildings.

4.9.12. Drainage Design

The final development will have a permanent surface water drainage system that will consist of buried pipes and chambers, with various networks to cater for effluent water and surface water (rainwater). The design will take into consideration the surrounding properties and businesses, and any surface run-off shall be directed to the central drainage system, thereby avoiding impacts on surrounding areas.

Rainfall on the open car parks will be collected and routed through a surface water drainage system via oil interceptors before joining other rainwater collected from open areas and roofs. Rainwater will be collected across the site and reused within the development for soft landscaping. Should excessive rainwater occur that cannot be used on the site, it will be directed through pipework and discharged at various locations into the marine environment. The location and number of discharge points into the marine environment has been designed to discharge at controlled points at current runoff rates.

The semi-basement (which includes car parking) has an independent drainage system that is designed to ensure there is no interference with the shallow groundwater, this is a critical design consideration to ensure that seepage into the carpark area does not occur resulting in excessive pumping costs for the development.

The drainage system is gravitational and will not require the use of pumps. The system is designed to accommodate a 1 in 100-year event. All pollution preventions measures are specified in the ESMP (Appendix A).

4.9.13. Material and Waste Management

The proposed project will encourage recycling and waste reduction across the site through the use of waste separation bins. Tenants will be responsible for individual waste management within their buildings and shall comply with the Operations ESMP (See Appendix A). Guidance and rules will be provided for all owners and occupants, which will be binding.

A central waste collection point provides recycling and general waste separation facilities. Solid waste will be collected and incorporated into the Municipal Solid Waste Disposal System. Waste that is likely to be generated includes, but is not limited to:

- General household waste (glass, tins, packaging, food, paper) from residential properties, serviced apartments and hotels;
- Packaging from hotels, restaurants and commercial businesses;
- Food waste from hotels and restaurants;
- Hydrocarbon wastes such as oil and grease from fat traps from restaurants and hotels or from the marina;
- Bulk waste, such as redundant equipment, timber, metal etc.; and
- Garden waste.

Hydrocarbon waste is classified as hazardous waste, which includes fatty waste from restaurants and hotels. This will be collected via a standard designed wastewater system that includes the provisions for fat traps strategically located within the channels to prevent waste escaping the waterfront site and entering the Lagoon. The waste collected in these traps will be removed by registered waste removal contractors and disposed of to a suitable and registered disposal site, depending on the nature and quantity of the waste.

Hydrocarbon waste generated from the users of the marina may include small amounts of waste oil or fuel. This material will be collected in a safe and secure waste system designed into the Marina; this will be removed by registered contractors. Other hazardous waste may include paints, paint tins, light bulbs, solvents, corrosion inhibitors and cleaners. Any hazardous waste will be disposed of to a dedicated hazardous waste site in Walvis Bay.

As part of the Operations ESMP (Appendix A), a Waste Management Plan will be produced prior to the operations phase commencing. This will include the following details: waste types, quantities, waste handling and disposal companies, and the identified disposal site.

4.9.14. Material Management: Dredging

As first mentioned in Section 4.9.14, maintenance dredging will be required to maintain safe nautical passage of boats through the Access Channel and into the Outer Marina. This will occur approximately every five and two years respectively. The site where the dredged material will be relocated to has not been finalised due to further information being required before an informed decision can be made, including but not limited to quantity and composition. Five options currently exist which are illustrated in Figure 13 and are discussed further in Section 5.6.

Figure 13 – Potential Sites to move dredged material during operations

4.9.15. Relocated Sporting Facilities

4.1.1.1 Swimming Pool

The swimming pool facility will accommodate a 7-lane, 25m length, indoor heated pool, with supporting facilities including a reception and small office, kiosk, seating / waiting area, ablution facilities and utility services. Provisions will also be made for future expansions to include another pool for diving/kids training pool, a gymnasium, a built-in viewing pavilion and a coffee shop.

4.1.1.2 TENNIS AND JUKSKEI COURTS

Two standard tennis courts with timber stands for spectators and a tennis clubhouse, and new jukskei grounds will be provided at the Jan Wilken site. There will be space for an addition of one tennis court if required in the future.

4.1.1.3 CRICKET OVAL

The new grass cricket oval and cricket pitch will be the same size as the current one on the proposed project site, new practice nets will be provided and a new cricket clubhouse with washing facilities will be provided.

4.9.16. CONSULTATION FEEDBACK: FINAL DESIGN AND OPERATIONS

Consultation feedback (full details in Chapter 9 and Appendix D) that has influenced the final design and operations of the proposed project include the following:

- The use of building materials that will tolerate Walvis Bay' harsh environment;
- Continuous pedestrian access from the Esplanade, through the waterfront, to the Protea hotel and the Yacht club;
- A designated space for informal vendors;
- Public spaces within the waterfront so people can enjoy the waterfront experience without having to spend money;
- A place for community events such as school performances and Galas;
- A business/conference centre;
- A place for people to go to enjoy the restaurant, wine and dine experience;
- An attractive waterfront environment with diverse activities and functions which will complement future development plans of Walvis Bay;
- A traffic alternative for the closure of the Esplanade road near the Raft;
- Adequate parking must be provided;
- Access for patrons to The Raft restaurant must be maintained during construction;
- The use of building materials that will tolerate Walvis Bay' harsh environment;
- Building heights adjusted and set back into the development to avoid blocking sunlight into neighbouring homes.

A series of artist impressions of the proposed project are presented in the following pages for illustrative purposes only, the reader should consider that the images presented might alter in reality as the design evolves.

Figure 14 - Isometric Artistic Impression

Figure 15 - Marina Perspective Artistic Impression

Figure 16 - Hotel and Amphitheatre Perspective Artist Impression

Figure 17 – Marina Perspective

Figure 19 – View from potential offices

Figure 18 – Beach perspective

Figure 20 – Internal Canal

Figure 21 – Birds Eye View of the Marina

4.10 Potential for Additional Development

The IUSDF (Walvis Bay Municipality, 2014) allocates land in and around the town of Walvis Bay for future development. In the area surrounding the proposed project, land available for future development is restricted or has been allocated (see Sections 6.11 and 6.11.2 for more information on current and future development baseline). It is acknowledged that Namport have proposals in place to develop the area into a waterfront, which is currently occupied by restaurants including Anchors and the Yacht Club. Even though not considered as a committed development (see Section 6.11.2 for further information on the current and future developments of Namport), the design of the proposed project has considered the potential development and incorporated features such as pedestrian and cycle access routes, leaving the possibility of providing links and bringing the developments together in a holistic manner and creating a larger marine environment.

5 ALTERNATIVES & DESIGN EVOLUTION

5.1 INTRODUCTION

The proposed project has been subject to a process of design evolution, informed by both consultation and an iterative environmental assessment. As stipulated in the Environmental Management Act, 2007 and associated regulations, alternatives considered should be analysed and presented in the ESIA report. This requirement ensures that during the design evolution and decision-making process, potential environmental impacts, costs, and technical feasibility have been considered, which leads to the best option(s) being identified.

During design evolution of the proposed project, alternatives considered include site locations; site layout and configuration; and final design. In accordance with the EIA regulations, an analysis has also been undertaken to understand the implications of not having the development (non-development).

5.2 NON-DEVELOPMENT

5.2.1. STRATEGIC NON-DEVELOPMENT

Walvis Bay is a growing town and has been earmarked to become the leading industrial town in Namibia. By 2020, the Namibian Government, through the proposals set out in the 5th NDP (National Planning Commission, 2017) intend to increase processing rates in the fishing industry in Walvis Bay by 40%; increase the capacity of Walvis Bay Port by 65%; and increase national tourist numbers by 22%. As predicted by the Namibian Statistics Agency (Namibia Statistics Agency, 2011), the population will continue to increase and is expected to double by 2030. This economical, infrastructure and population growth will place pressure on local services and infrastructure, including available housing and community and tourism facilities.

The 5th NDP (National Planning Commission, 2017) identified that infrastructure and variability to support tourism growth is lacking across Namibia. The Plan therefore sets out objectives to improve infrastructure and diversify products so that tourism targets can be achieved. In Walvis Bay, there are currently no other formal committed developments similar to the proposed project that will support achieving the Government targets.

The proposed project therefore plays an integral part in supporting the growth of Walvis Bay. Without it, the growth of the economy and tourism industry may be limited: tourist numbers and retention will remain as is; new jobs will not be created; and the pressure on housing will continue.

5.2.2. PROPOSED PROJECT SITE NON-DEVELOPMENT

The Walvis Bay IUSDF (Walvis Bay Municipality, 2014), funded by the European Union and undertaken by an independent company, Urban Dynamics, Africa, presents the proposals and plans on how Walvis Bay will grow, allocating land for various development schemes taking into consideration population growth and certain thresholds/requirements (e.g. residential area per person) to identify the required land for certain developments. Marine development has been allocated on the area of land which is currently occupied by Yacht and Angling clubs, Municipality pool, tennis courts and cricket field (see Figure 22).

The southern area is the preferred area for the proposed project; the reasons why are discussed later in this Chapter. A cricket oval, swimming pool, tennis and jukskei courts currently occupy the site. These facilities do not fully optimise the available land; are not in the best condition, in particular, the cricket clubhouse; and are not fully utilised by the community. There is an opportunity to improve these facilities and generate social and economic value to the Walvis Bay area.

Leaving the site in its current state will not support the proposals set out in the IUSDF or bring economic benefits to the area through increased tourist numbers; tourist retention; and employment. New and improved facilities to replace the currently existing ones will not be developed and therefore other communities around Walvis Bay will not benefit.

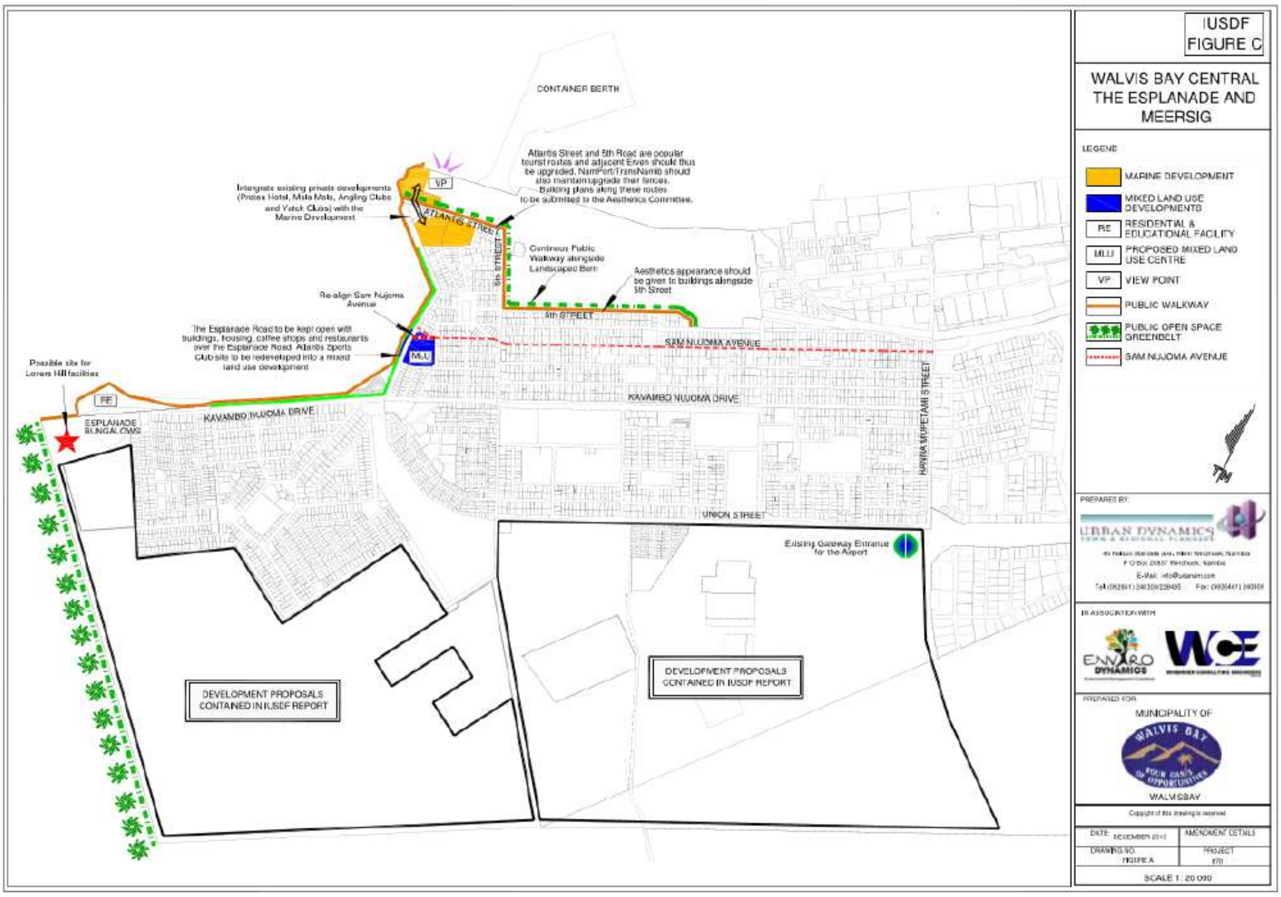


Figure 22 – IUSDF Waterfront Development locations [source IUSDF]

In addition, not proceeding with the proposed project is likely to leave the existing sewerage infrastructure in its currently under designed state, until further capital can be raised or injected into the Municipality. A project such as this one often has positive multiplier knock-on impacts for the surrounding residents and improvements to services such as sewerage and water supply.

5.2.3. Strategic Siting

Although the IUSDF identified areas for a marine development, an independent review has been undertaken to compare other potentially suitable sites/areas and determine whether or not the proposed project site is the optimum site.

Walvis Bay is 30km south of Swakopmund. The coastline between Walvis Bay and Swakopmund is open to the Atlantic Sea with a Dune belt running parallel to the coastline. Small residential areas have developed along this coastline. The development of Walvis Bay town was focussed around the Harbour area and has subsequently grown inland, which has been limited to geographical features such as the Lagoon and dunes. The town is well developed, with only small pockets of undeveloped land. Available land along the coastline is fully optimised in the Harbour area; the Namport Container Expansion project is currently underway to accommodate the lack of available space for port operations, and a second port terminal to the north is earmarked in the IUSDF. The developed Lagoon front is mostly taken up by residential properties and hotels/guesthouses.

Urban development along the coastline is limited to upmarket residential developments, aquaculture, eco-tourism and recreational related developments. Taking into consideration no development zones, conservation areas and other zones areas defined in the IUSDF, several potential areas/sites were identified, as illustrated in Figure 23. A summary of a high-level comparison is presented in Table 13. This has not analysed the environmental impacts but identifies certain features that would influence the decision making and comparison.

Figure 23 – Strategic Siting Site locations

Table 13 – Strategic Site options

SITE/AREA	ADVANTAGES	DISADVANTAGES
SITE A: **IUSDF Marine Development Area (the proposed project site)**	• Identified in the IUSDF for Marine development • In the Bay area, therefore protected from the Atlantic harsh conditions • On the mouth of the Lagoon and not in the Lagoon. • Compliant with the SEA for Coastal Areas of the Erongo and Kunene Region (DHI Water & Environment, 2007) • Provides accessible community facilities to local residents • Provides tourist facilities to those entering and exiting the Port of Walvis Bay	• Utilised site (although under-utilised) • On the periphery of the Ramsar designated site

SITE/AREA	ADVANTAGES	DISADVANTAGES
SITE B: North of the second terminal, south of Aphrodite Beach	• Within the Bay area, therefore protection from the Atlantic Ocean • Compliant with the SEA for coastal areas of the Erongo and Kunene Region (DHI Water & Environment, 2007) • Positioned away from the Lagoon	• No current access • The area between Swakopmund and Walvis Bay is designated as an Important Bird Area (Birdlife International, 2018) (see Section 6.1.2.16 for more information on IBAs) • The area is not close to the Walvis Bay Town and other facilities • Not accessible to local residents (walking or biking distance)
SITE C: Coastal area north of Walvis Bay: Area for upmarket housing and recreational activities, north of Long Beach **SITE D: Coastal area north of Walvis Bay: area for upmarket housing, north of Bird Island, south of Aphrodite Beach**	• Potential areas identified in the IUSDF. • Compliant with the SEA for coastal areas of the Erongo and Kunene Region (DHI Water & Environment, 2007) • Access from the B2 • Positioned away from the Lagoon	• The area between Swakopmund and Walvis Bay is designated as an Important Bird Area (Birdlife International, 2018) • The area is not close to the Walvis Bay Town and other facilities • Not accessible to local residents (walking or biking distance)
SITE E: Unoccupied site halfway down the Esplanade	• On the Lagoon front providing accessible community facilities • In the Bay area, therefore protected from the Atlantic harsh conditions	• In the Lagoon and Ramsar site • Limited boat accessibility • Atlantis sports club to be relocated in order to accommodate the planned mix land use development on the site (IUSDF)
SITE F: End of the Esplanade / South of Lagoon past the existing residential area	• On the Lagoon front providing accessible community facilities • In the Bay area, therefore protected from the Atlantic harsh conditions	• In the Lagoon and Ramsar site • Limited boat accessibility

The review of alternative strategic sites/areas for the proposed project concluded that all potential alternative sites/areas do not perform as well as the areas identified in the IUSDF, the current site.

5.3 Waterfront Alternative Site Locations

As discussed earlier, an area was allocated for marine or waterfront development in the IUSDF (the 'northern area' and 'southern area'); Figure 24 illustrates this area in more detail (Walvis Bay Municipality, 2014). As clearly stated in the IUSDF, the waterfront development was not a new proposal identified by the development framework; it had been earmarked as a potential development site for some time. The project was intended to be a joint venture between the two landowners (Namport and the Municipality), which initiated around 2008. An agreement between the two landowners, therefore a joint venture was never formally established.

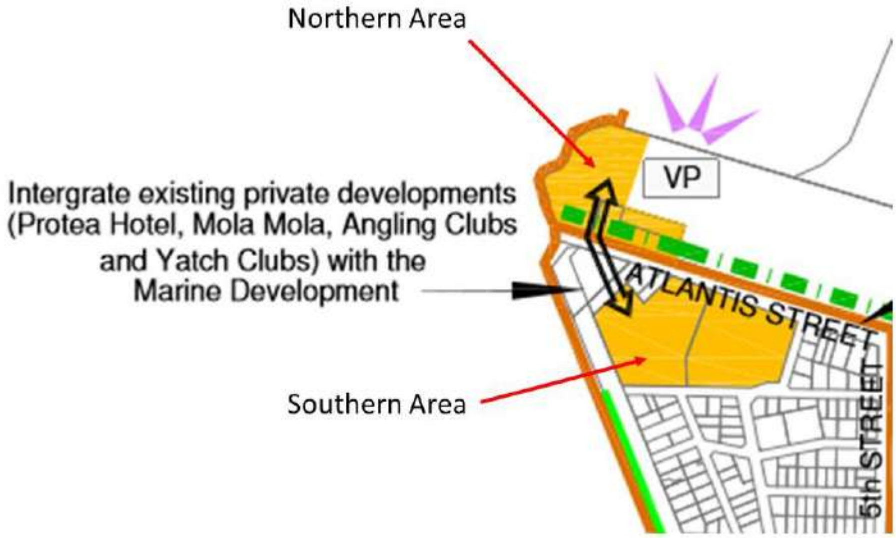


Figure 24 – Northern and Southern areas identified in the IUSDF

5.3.1. Northern Area

As illustrated in the first Namport Annual Report (Namport , 2013), Namport progressed with developing a marine development within their ownership (the 'northern area'). Between 2004 and 2014, feasibility studies followed by preliminary designs were progressed (see Figure 25). Several preliminary designs were drafted, taking into consideration environmental issues, financial feasibility, technical restrictions as well as informal stakeholder feedback. Since then, little progress has been made. Section 6.11.2.2 provides further details on this site.

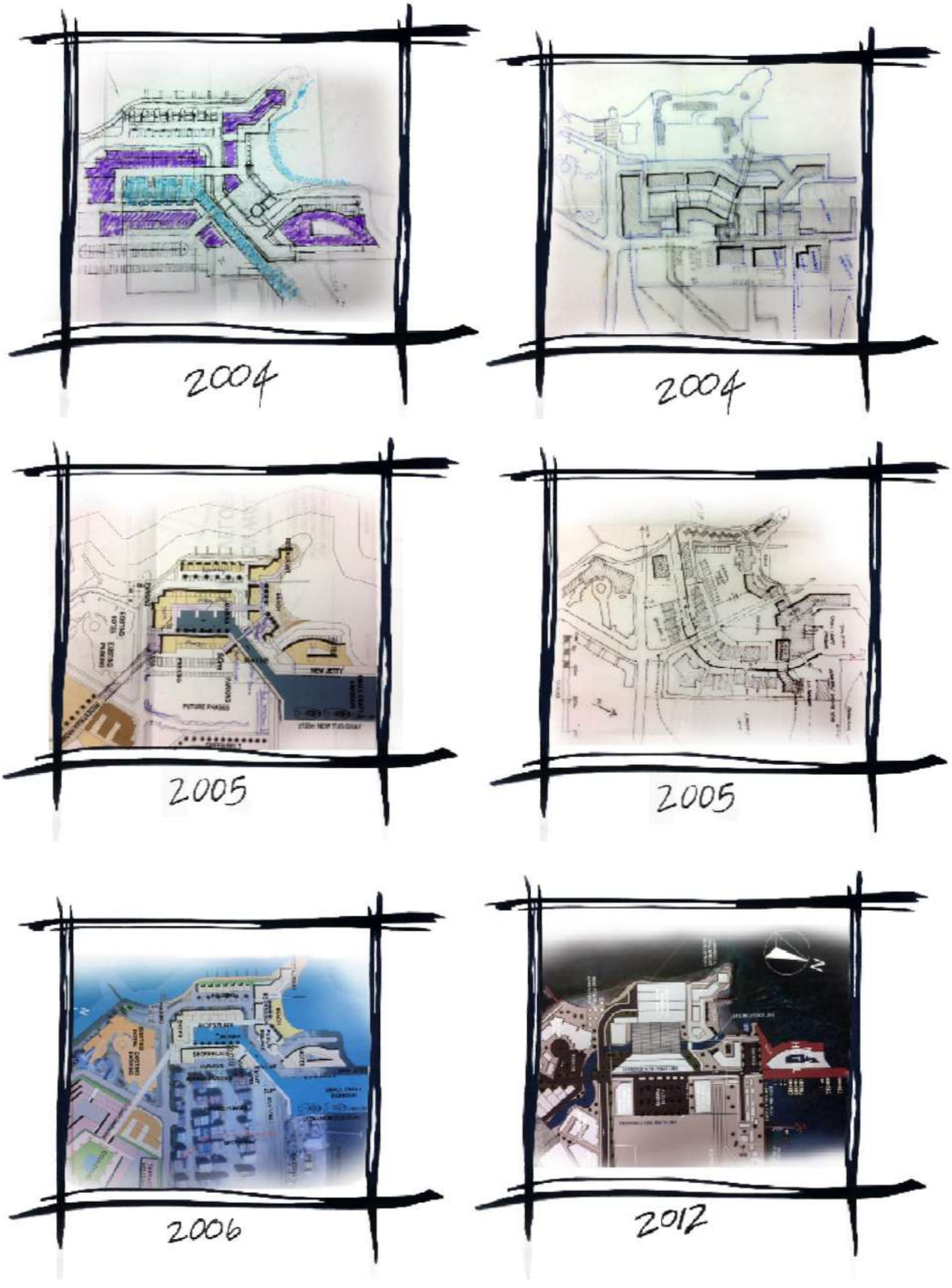


Figure 25 - Alternative Design Considerations for the Northern Area

5.3.2. Southern Area

At around the same time (2008), Afrikuumba approached the Municipality with proposals to develop the area of land owned by the Municipality (termed the 'southern site'). Afrikuumba continued engaging Namport with the proposal to progress both sites simultaneously, however, due to limited responses from Namport, the Municipality and Afrikuumba combined to form a Joint Venture, formally establishing in December 2013 (shares certificate were issued January 2014) to ensure development plans continued. This joint venture established in line with the Local Authorities Act, 1992 as amended, and consultation and feedback from the community on the Public Private Partnership between the Municipality and Afrikuumba was obtained.

Between January 2014 and the end of 2016, various administrative tasks were undertaken to drive the proposed project forwards, for example, property rights and obtaining titles for transfer to the joint venture company, and obtaining minister approval for the development. At the same time, designs evolved taking into consideration lessons learned from the northern area (similar design principals were applied, however, certain elements had to be reconfigured due to the difference in the coastal features). Figure 26 provides examples of alternative layouts.

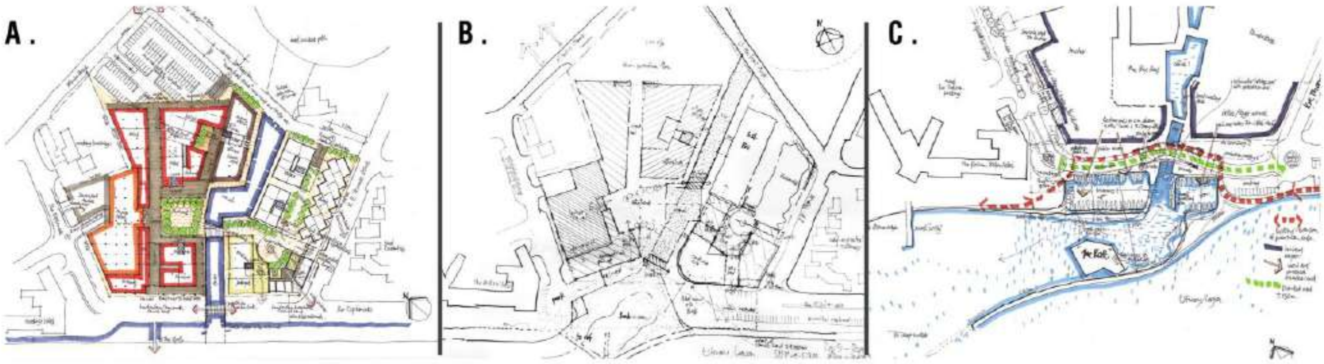


Figure 26 – Alternative arrangements

5.4 Early Designs

During consultation with MFMR, it was identified that the proponent should consider the proposed project without the Marina option. The proponent took onboard this feedback and assessed and considered this option (see Figure 27), however, the findings from this review demonstrated that a waterfront development without a Marina would not warrant the project feasible; it would not technically constitute a marina/waterfront development as it would be set back from the coastline, nor would it provide potential tourist amenities and facilities. This option was therefore not taken further in the design development process.

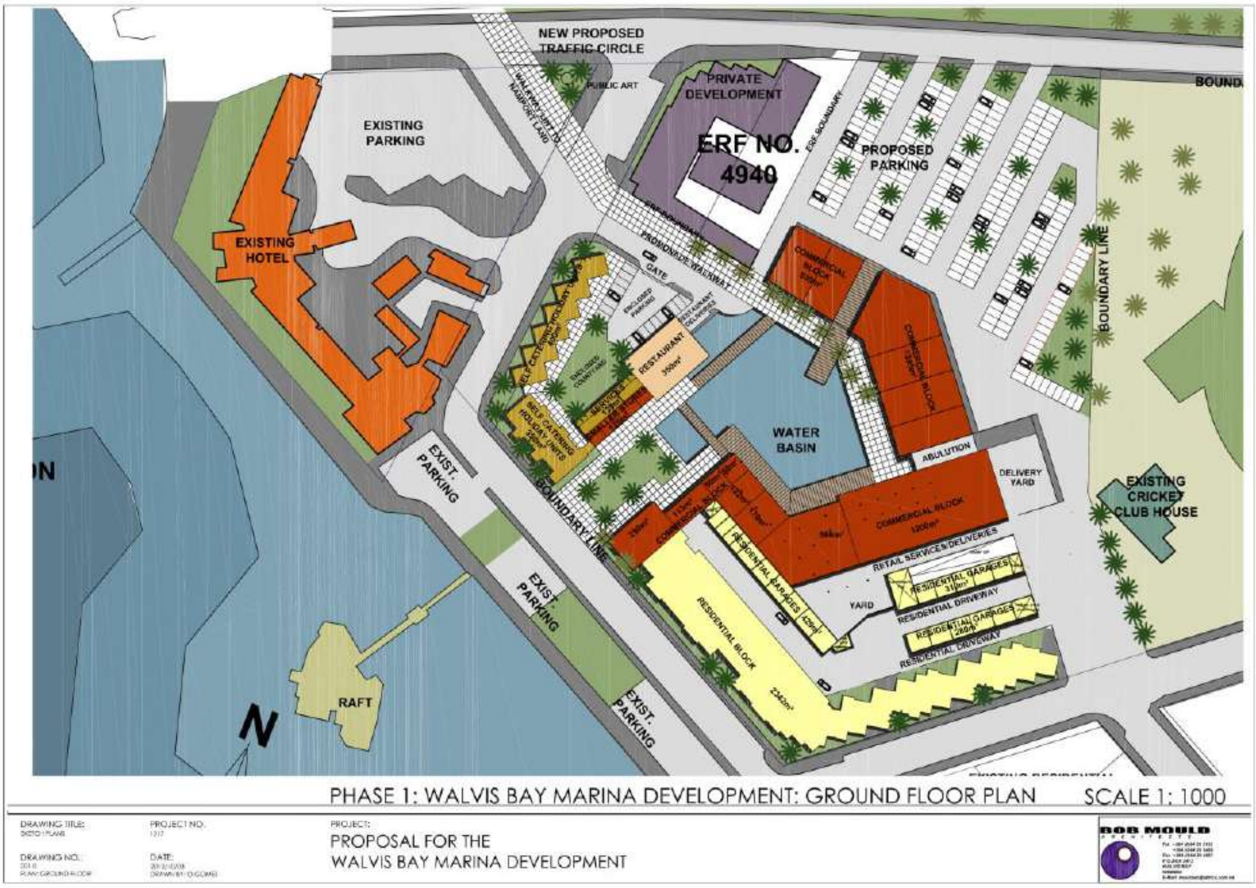


Figure 27 – Design option without marina

5.5 Detailed Design: Proposed Project Site Layout

The preferred proposed project design is a combination of both marine and land-based development components. A series of detailed designs were produced for the different development components to ensure the optimum design was identified. The design process was an iterative process: the ESIA team were commissioning in early 2017 and were directly consulted with at key stages so that designs could be reviewed; several specialists were brought in to ensure certain receptors and issues were considered and boat users were presented with designs to ensure the design was user-friendly. Various design changes were made as a result of feedback and advice provided by the specialists. Each of these components is discussed in this section.

5.4.1. Outer Marina Layout and Orientation

The Outer Marina component is the central component of the proposed project, as this influences the layout and orientation of all other development components. It is not only sensitive to the surrounding environment, but it could also cause the most damage to the environment. Careful consideration of this development component was therefore required, which involved using the hydrodynamic model, specific engagement with the avian specialist and hydrodynamics' specialist.

The key element of designing the Outer Marina was the marina wall. Various options of differing orientation, length and breadth were considered, as seen in Figure 28, which led to alternative layouts of the Outer Marina. Depending on the layout of the Outer Marina, other features such as the number of mooring areas, water locking systems, and internal beaches were also considered.

Figure 28 – Examples of Outer Marina Alternatives Considered

The key environmental issues that were acknowledged during this design stage were the potential impacts on the natural circulation of the Bay and Lagoon waters; reduce flushing impacts and increase sedimentation in the Lagoon leading to impacts on birds and sea mammals; and land taken (including the Ramsar site).

Taking onboard lessons learned through the design evolution of the marina wall and subsequently the Outer Marina, the preferred design remains in keeping with the natural features of the coastline: new land or infrastructure extending into the Lagoon is minimised and the Outer Marina that is not exposed / open to the Lagoon. The preferred option has a marina wall that runs parallel to the coast and is limited in length. The Raft Restaurant is sited on the outside of the marina wall, thereby reducing the total footprint area of the Outer Marine in the Lagoon. The Outer Marina is accessed from the north through a narrow but short access channel. These design elements avoid interference with the main deep-water channel and allow for continued flushing of the Lagoon.

5.4.2. Inner Marina

One of the design principals of the proposed project was to provide a waterfront development and a setting, both coastal and inland, for restaurants, hotels, residential and other facilities. An Inner Marina connecting to the Outer Marina was, therefore, a component considered from the beginning of the design process. It needed to have an integrated locking system so that the water level could be controlled and unaffected by the natural tides.

The design of the Inner Marina, including the locking system, length, and width, evolved through the design process.

Two design options were conceptualized towards determining the most feasible solution for the locked system:

- **Option 1:** Semi-Tidal Water Body. The inner basin is designed to function similarly to a tidal pool, where the minimum design water level is fixed and the maximum water level varies according to the upper tidal cycle. This system would be controlled through means such as a Lock System, which would allow the movement of boats into and out of the Inner Marina.

- **Option 2**: Perched Water Body. The water level of the inner basin is maintained at a fixed design level (level attained by pumping) and circulation is achieved by means of an operational pumping scheme. The Inner Marina would be a closed system, and boats would be moved in and out of the Inner Marina by means of a Davit/Derrick Crane for example.

The preferred option taken forward to detail design was Option 2. Option 2 would be significantly cheaper to operate than Option 1; a constant level would be required to allow boats to use the Inner Marina (tide would vary 2m which is greater than the proposed depth of the Inner Marina); and the Inner Marina would be more visually appealing when full.

5.4.3. Orientation and Layout of Buildings

The configuration of the development has incorporated many alternatives responding to the feedback received by neighbouring residents, for example, retail, restaurants and bars have has been positioned inwards of the development so 'residential' abuts existing 'residential'.

The setting of buildings was also considered including the potential blocking of sunlight on to locale residential properties and the heights of buildings and blending the development with surrounding buildings.

5.6 Operations Detailed Design: Dredging Alternatives

Sediment will accumulate in the base of the Outer Marina and Access Channel over time and therefore maintenance dredging will occur every two and five years respectively to ensure the access remains open and the required depths are maintained. Five potential sites have been identified for the relocation of the dredged material, as illustrated in Figure 29. The preferred location has yet to be identified and will be prior to the completion of the construction phase once more information and data has been obtained, for example, estimated quantity and composition. ECC will support the decision making to ensure the best practicable environmental option is identified and any potential risks or issues appropriately mitigated or managed. A preliminary review of these options is provided in Table 14.

Figure 29 – Potential site options to move the dredged material

Table 14 – Comparison of potential sites for the relocation of dredged material during operations

SITE OPTION	DESCRIPTION	ADVANTAGES	DISADVANTAGES
A: Lagoon Channel into the outgoing tide.	Sediment material could be collected by a floating dredge and discharged via a pipe into the outward flowing tide via the exit channel of the Lagoon. Discharge on the outgoing tide would allow sediments to resettle naturally in the wider bay area with the outward flowing tide.	✓ Cost-effective ✓ Use of natural repositioning of material ✓ Relocates sediment out of the Lagoon and back into the bay area	× Potential impacts to mariculture farmers, monitoring prior must be enforced × To a degree, this method is uncontrolled as the deposition of sediments is dependent on the tidal flow × If poorly managed sediment might end up back in the Lagoon × Not seen as best practice
B: On land on the sand bank west of the Lagoon mouth	Sediment material would be collected by a floating dredge, transported via a floating pipe then discharged on land, west of the mouth of the Lagoon. Once on land a small non-invasive piece of plant will be used to spread the material evenly on the surface.	✓ Cost effective ✓ May provide alternative habitat and food for birds and mammals ✓ Floating pipe non-intrusive method •	× Potential to disturb birds and mammals (seals) using the land × Potential for visual impacts × Introduction of mechanical equipment to a new area of the Lagoon × Not seen as good practice
C: Namport disposal site	Sediment material would be collected by a floating dredge and is transported to the Namport disposal site via barge/boat. Surplus dredge volume would be disposed of at an approved off-shore dumping site (located NNE of Pelican Point) in a manner defined by (Namport, 2006)	✓ Known disposal site ✓ Level of adaption likely to already be in place due to historic disposal ✓ Controlled location for dredged material disposal ✓ Seen as best practice	× Very cost intensive for anticipated small-scale dredging
D: Donkey Bay Area	Sediment material would be collected by a floating dredge and is transported to an area of the Walvis Bay Peninsula via barge/boat.	✓ Suggested site in line with the Climate Change adaptation report to build the area up to prevent a potential breach ✓ Resource for peninsula protections	× Cost prohibitive and small volumes therefore might not have the desired result × May negatively impact visual amenity × May impact birds and mammals
E: On land re-positioning of material	Sediment material would be collected by a floating dredge, transferred to trucks and transported to an onshore site. A site would have to be identified on land that can be used as the catchment area for the pumped sediment	✓ Provides a resource to the town to allow growth and development	× Cost intensive × Lack or limited land available for the onsite collection of material to be dried prior to transport × Increased transport and therefore noise or dust effects × Potential community severance issues

5.7 CONSTRUCTION METHODS

Several options for the design of the Outer Marina Wall were reviewed due to the potentially invasive construction techniques in the marine environment. The avoidance of piling was considered, however, was not deemed appropriate as piling was needed to reduce land take of the design of Marina Wall and optimise available space in the Outer Marina allowing it to be commercially feasible.

Hammer pile driving was considered, however, due to the nature of this technique being loud and potentially causing adverse impacts on marine mammals and other marine life, vibratory pile driving was considered more appropriate and would cause fewer impacts.

5.8 SPORTING FACILITY RELOCATION

The existing sporting facilities will be relocated to other sites in Walvis Bay. The relocation of these facilities has been carefully investigated based on consideration of the IUSDF (National Planning Commission, 2017) and consultation feedback from the public, current users and potential new users (new location). The agreement with the Municipality is that the sports facilities will be of an equal standard, as a minimum, and will be provided at a mutually agreed alternative location(s). Alternative sites for the relocation of the sporting facilities were presented to and discussed with the Walvis Bay Municipality. Sites considered unsuitable have not been included in this report.

Alternatives considered during design development were:

- Non-development: Development of the proposed project with no replacement or relocation of the existing sporting facilities;
- No-relocation: Integrate all or some of the existing facilities into the proposed project;
- Partial relocation: Integrate one or two facilities into the proposed project and relocate others; and
- Relocate all facilities: Relocate all facilities to other sites.

A summary of the decision-making is summarised in Table 15.

Table 15 – Alternatives considered for the sport facilities

OPTION	ADVANTAGES	DISADVANTAGES
Non-Development	Reduced costs (not additional development) Less disruption in other areas (less construction works)	Loss of community facilities, social impacts. Reliance upon and overuse of existing facilities (SPARTA), which will result in over-utilisation. Loss of green space
No relocation	Community does not loose facilities and gains better ones.	Some communities benefit from new facilities which are currently not in close proximity Less land available for tourist, commercial or residential use Less economical
Partial relocation	Community does not loose facilities and gains better ones. Less land take (for the project)	Other communities do not benefit from the new facilities which are currently not in close proximity Less land available for tourist, commercial or residential use Less economical
Full relocation:		
Cricket Pitch: Kuisebmond	Area does not have a cricket field The majority of cricketers are the younger generation; this area has a high population of potential users. Less travelling for users A legacy benefit to a less affluent area	Community loses sporting facilities
Tennis and jukskei courts: Incorporated into Jan Wilken Stadium	New and improved facility, improving a sporting venue	Community loses sporting facilities
Swimming Pool: Incorporated into Jan Wilken Stadium	New and improved facility (indoor heated pool), improving a sporting venue Improved economic return for the Municipality	Community loses sporting facilities Increased price for use of a facility

6 ENVIRONMENTAL AND SOCIAL BASELINE

6.1 Baseline Data Collection

The identification of the existing environmental conditions that may be affected by the proposed project was collated through a number of methods: site walk-overs; field surveys, desk-top studies; consultations with stakeholders (local authorities and environmental specialists); and door to door engagement with neighbouring residents.

The environmental and social topics that may be affected by the proposed project is described in this section. The baseline focuses on receptors which could be affected by the proposed project and is limited to a study area which is discussed in section 3.2.4.

6.2 Field Surveys

6.2.1 Site Walk-Over

A site walk over was undertaken by ECC and the proponent on the 17th February 2017. A summary is provided below:

- The proponent provided an overview of the proposed project and a walk over of the site and surroundings was undertaken;
- The existing facilities were inspected including the pool, cricket field, tennis and juskies courts;
- ECC studied the site and surrounding environment, including walking along the neighbouring streets;
- Key observations included the location and proximity of residential properties to the site; vegetation on the site namely the large palm trees and municipal gardens; and species for relocation were identified.

Site visits were undertaken as part of surveys and assessments:

- 24th May 2017 – Bathymetry Survey
- 11th and 12th June 2017 – Site Walk Over with Dr. Rob Simmons
- 9th November 2017 – Site assessment with Mr. Peter Bridgeford
- 10th November 2017 – Site Assessment with Mr. Alan Louw

Towards the end of the assessment process, a further site visit was undertaken by ECC on the 10th December 2017, the aim of which was to reaffirm the assessment findings and close out any issues.

6.2.2 Bathymetric Survey

A bathymetry survey of the Lagoon was completed by Strydom and Associates Surveyors for ECC in May 2017 to determine the marine floor conditions, access channel and sediment within the area that could be affected by the proposed project. The results of the bathymetry survey are included as Appendix F.

6.2.3 Traffic Impact Assessment

A traffic impact assessment was conducted by Innovative Transport Solutions (ITS) Cape Town. The study undertook a traffic count of certain roads in the locality of the proposed project site and modelled ten scenarios. The model was then used to assess the potential impacts on the surrounding road infrastructure, including future capacity requirements of roads, intersections and junctions. Several mitigation requirements were identified. The study is included in Appendix G.

6.3 Specialist Studies

Specialist studies were commissioned for topics that are considered important to the project due to the potential impacts on certain receptors. These are set out as follows.

6.3.1 Avifauna Study

To understand the potential impacts on the important birdlife of Walvis Bay Lagoon area and potential implications on the Ramsar site, an Avifauna Study was commissioned in 2017. Dr. Rob Simmons, a renowned and respected expert on bird life specifically in the Walvis Bay Lagoon area has been involved in collecting data over the last 30 years. Dr. Simmons collated various data sets to establish a robust baseline and assessed the potential impacts on the avifauna from the construction and operation of the proposed waterfront development. Potential mitigation measures and alternatives were identified, which were recommended to the project designers. This report is included as Appendix H.

6.3.2 Hydrodynamic Study

A hydrodynamic study was undertaken in 2017 by Delta Marine Consultants (DMC) to assess the potential impacts from the proposed marina as part of waterfront development. The study collated bathymetric data from the survey undertaken in 2017, NAMPORT surveys (2009) and the Local Agenda 21 Project (2002). The study applied the same modelling and assessment methodology as that used for the port extension project in Walvis Bay. Modelling was undertaken followed by an assessment of potential impacts. The study is included as Appendix I.

6.3.3 Marine Mammal Study

The proposed project will require construction work within the marine environment, therefore Dr. Amanda J. Rau was commissioned to undertake a Marine Mammal Study to establish a baseline, undertake an assessment of the potential impacts of the proposed project and identify suitable mitigation measures. The baseline was collected through a desk-based study using available information, including data published by the Namibian Dolphin Project, and professional judgement. The study is included as Appendix J.

6.3.4 Sun and Height Study

Sun and height studies were conducted by Bob Mould and Scheffer Architects to investigate the potential impacts the proposed Waterfront buildings may have on the neighbouring residential houses. The results of the sunlight and height studies are included as Appendix K.

6.4 Desk-top Studies and Literature Review

A desk-top study was undertaken to review a range of sources of information, the details of which are provided below. The major sources include several environmental studies conducted for the Walvis Bay area, including impact assessments conducted for the Walvis Bay municipally and Namport.

- Walvis Bay Biodiversity Report (2008) (Walvis Bay, 2008): Provides an overview of the biological components of the areas surrounding and including Walvis Bay.
- Atlas of Namibia (Mendelsohn, 2003): Provides general environmental and social information for Namibia.
- Google Earth: Used to produce figures, understand the town layout, and identify potential social and economic receptors.
- Between the Atlantic and the Namib, An Environmental History of Walvis Bay (Silverman, 2001): Provides an overview of the environment around Walvis Bay and a detailed history from when the town was first colonised.
- Namport EIA Report (Delta Marine Consultants, 2010) and associated specialist studies: An EIA undertaken in 2010 to identify the potential effects from the proposed expansion container terminal.

- Erongo Regional Council Website (Erongo Regional Council, 2017): Information obtained on transport, economy and tourism.
- EIA Report for the Kuiseb Delta and Dune Belt Areas (Risk Based Solutions, 2012): An EIA undertaken in 2012 to identify the carrying capacity of the Kuiseb Delta and Dune Belt Area for community based tourism and other activities.
- Walvis Bay Integrated Urban Spatial Development Framework (Walvis Bay Municipality, 2014): A document which sets out the proposed project strategy for the town.
- NDP (National Planning Commission, 2017): Provides an overview of the proposed target industries to develop Namibia's economy.
- Namibia 2011 Population and Housing Census Report and Namibia Population Projection 2011 – 2041 Report (Namibia Statistics Agency, 2011) (Namibia Statistics Agency, 2011): Provide information on population growth rates and projections for the next 30 years.
- Ministry of Environment and Tourism Tourist Statistical Report 2015 (Ministry of Environment and Tourism, 2015), and National Tourism Investment Profile and Promotion Strategy 2016 – 2026 (Ministry of Environment and Tourism, 2016): Provides statistics on previous tourist numbers and types, and strategy for the growth of the tourism industry.
- Intergovernmental Panel on Climate Change Synthesis Report (Intergovernmental Panel on Climate Change, 2007): Provides information on climate change projections and potential effects.
- Building Climate Resilience, A Handbook for Walvis Bay Municipality (J. Josefsson, 2012): Provides detail on the potential impacts and effects of climate change, and proposals to avoid and mitigate these effects.
- Walvis Bay, Namibia: a key wetland for waders and other coastal birds in southern Africa (Wearne. K and Underhilll L. G, 2005): Holds valuable data and evaluates the status of the complex wetlands and their significance for waders and other coastal birds. The data has been reviewed and reanalysed, combined with data from Sandwich Harbour Data and some sophistical statistics, and published in the journal of Conservation Biology: Declines in Migrant Shorebird Populations from a Winter-Quarter Perspective. 29: 877-887 (Simmons RE, 2015).
- Agenda 21, various reports: A three-year project which began in mid-2001, to set out measures for the town to develop in a sustainable manner in line of Local Agenda 21 principals. Specific studies include a Wind Blown Sand Transport report (Danish International Development Agency , 2003), Hydrodynamic Modelling report (Danish International Development Agency , 2003) and overall Coastal Area Strategy and Action Plan (Municipality of Walvis Bay, 2003).
- Zoobenthos Survey of the Walvis Bay Lagoon (University of Namibia, 2012): Agenda 21 initiated a long term monitoring program, and subsequently a report was prepared for Walvis Bay Municipality setting out the changes in the benthic community of the Lagoon.
- The Ramsar convention website (Ramsar, 2017): information pertaining to the wise use of Rasmar wetlands, institutional documents and Ramsar wetland management plans.
- The Strategic Environmental Assessment (SEA) for the coastal areas of the Erongo and Kunene Regions (DHI Water & Environment, 2007).

6.5 Consultation

Consultation with stakeholders and local experts either telephonically or personally was undertaken during the course of the ESIA process. ECC also conducted a series of community consultations, including door knocking and visiting neighbouring property owners; undertook general community engagements; held a public meeting; met with government agencies and had meetings with major stakeholders to seek feedback on the proposed project. These meetings were undertaken as follows:

- 10th May 2017 - Competent authority, scope confirmation with MET
- 22nd May 2017 – Consultation with Ramsar Convention Switzerland

- 23rd and 24th May 2017 – Neighbour door knocks and face to face
- 24th May 2017 – Stakeholder face to face
- 29th May 2017 – Ramsar Namibia
- 12th June 2017 – Public meeting
- 23rd June 2017 – Ministry of Fisheries and Marine Resources Swakopmund
- 14th August 2017 – Namport meeting
- 7th September 2017 – Namport meeting

The results of the public participation process are presented in Section 9 and have been fed into the ESIA process.

6.6 Limitations, uncertainties and Assumptions

The identification of the receiving environment had several limitations:

- **Air Quality data:** No air quality sampling was undertaken as it was not deemed necessary to commission a survey because of the nature of the proposed project. A similar approach to that presented in Namport's Container Expansion project EIA report was adopted, and data/information used where available.
- **A baseline noise survey** for Namport was undertaken in 2009. The baseline derived during this survey has been used in this report. A new survey was not commissioned as it was not deemed necessary due to the short duration of noisy construction works (see chapter 4 for the project description); the nature of the proposed project; and the baseline in the Namport EIA report (Delta Marine Consultants, 2010) was considered robust and adequate to use in this assessment. It is recognised that the baseline has changed since the construction and operation of Phase 1 of the Namport's Container Expansion project. The projections identified in the Namport report have been incorporated into the baseline and assumptions have been made.
- **Zoobenthos:** University of Namibia (UNAM) have undertaken further surveys for zoobenthos to assess the potential effects the Namport's Container Expansion project is having on the marine environment. It was agreed that these would be made available to ECC for use in this ESIA and therefore additional surveys were not commissioned. These surveys have not been made available, therefore previous baseline surveys (2012) have been used to describe the baseline environment, with recognition that it is likely that the zoobenthos may have deteriorated as a result of the expansions; therefore, a precautious approach has been applied, which allows the worst-case scenario for potential effects to be identified.
- **Turbidity:** It is understood that turbidity surveys were undertaken by Namport during the construction and dredging activity for Namport's Container Expansion project (commenced May 2014). This data has been requested on various occasions, however has not yet been made available to ECC for incorporation in the ESIA. Assumptions in the assessment have been applied to address this data gap.

Where uncertainties exist, a precautious approach has been applied, allowing the worst-case scenario for potential impacts to be identified. Where limitation and uncertainties exist, assumptions have been made and applied during the assessment process. These have been clearly described in the baseline section.

6.7 WALVIS BAY LOCATION

Walvis Bay is a coastal town in the Erongo Region, approximately 400km from the Capital of Namibia, Windhoek. It is sited in the centre of the Namib coastline and covers an area approximately 30km^2. The town established at this location due to the natural deep-water bay.

Figure 30 Location of Walvis Bay {Google Maps}

Walvis Bay lies at the estuary of the Kuiseb River, a linear oasis which forms a sharp boundary between the Namib Naukluft National Park to the south and the gravel plain desert to the east. A Dune Belt flanks Walvis Bay to the east which runs parallel along the coast up to Swakopmund, approximately 30km to the north of Walvis Bay. Figure 31 presents these features.

The area illustrated in Figure 31 is part of the designated Dorob National Park, which was gazetted under the Nature Conservation Ordinances No. 4 of 1975 on 1st December 2010. The National Park is bordered to the north by the Ugab River and the Skeleton Coast Park. The Omaruru River bisects it, while the Swakop River is situated just south of its boundary. The towns of Henties Bay and Swakopmund are found within its boundaries, along with the hamlet of Wlotzkasbaken (Ministry of Environment and Tourism , 2018).

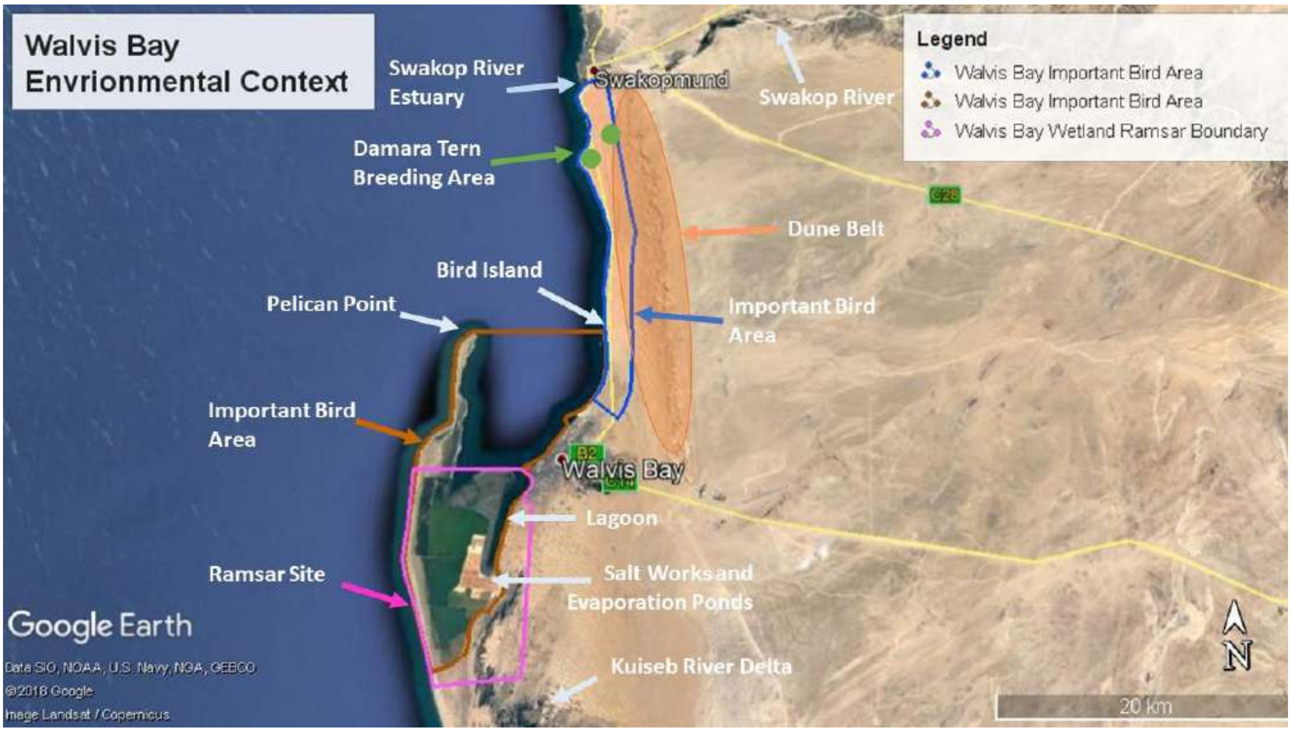


Figure 31 - Walvis Bay Environmental Context

6.8 Built Environment

6.8.1 History of Walvis Bay

Namibia's exploration by Europeans commenced as early as 1485, with the Portuguese visiting the area. Two centuries later, the Dutch East India Company explored the Atlantic coast and landed at Sandwich Bay in 1670. The British arrived in 1786, who surveyed sections of the coast, however it was not until the Dutch Meermin in 1793 proclaimed Dutch sovereignty over Walvis Bay. In 1795 the British took possession of all potential harbour sites along the Namibian coast, claiming Walvis Bay (Dierks, 2017).

In 1877, Walvis Bay and the surrounding territories were annexed, and the acquisition of Walvis Bay to the British was approved. The Germans moved into the area and annexed South West Africa from South Africa. In 1884, whilst remaining under the British, the port became part of the Cape Colony, which in 1920 joined the new Union of South Africa (despite the physical separation from the Union). South Africa seized South West Africa and imposed military rule during World War One. At the end the War, the League of Nations granted South Africa a mandate over the South West African Protectorate. Walvis Bay was subsequently transferred into South West Africa in 1922 (Dierks, 2017), and became independent in 1990.

The town as it is today, started to develop around 1844 with the arrival of the European settlers (Silverman, 2001). The marine resources off the coast were one of the key development drivers for the area; namely fish and whales. In 1914, there were two whaling companies. The First World War drove the whaling industry due to the increased requirement of glycerine, a whale by-product. The port area grew spaciously supporting the fishing and whaling industry, but also the import and export industry, exporting livestock and arms goods (Silverman, 2001).

The first permanent buildings (wooden shacks) were built in the vicinity of the Lagoon. By the 1880s, a grid street pattern had been laid out, and the parcels of land were sold off and developed. The magistrate's court, magistrate's residence, customs office and other residential buildings constituted the town at the turn of the 20th century. Significant development started in 1922 when Walvis Bay became part of South West Africa. A new railway connection to Swakopmund was constructed and the port facilities were extended with the harbour first being dredged (Silverman, 2001).

The port continued to grow as a result of import and export demands, namely oil, and fish and minerals respectively. The fishing industry developed further, and fishing boomed in 1946. Factories rose across the harbour area to accommodate this boom. In the 1960's the Saltworks was established. The population of the town consequently increased, which resulted in the town area doubling. The Central Business District developed south-east of the port area. Residential areas established around the area and moving outwards along the coast in a spatial fashion due to the availability of unoccupied land. Kuisebmond and Narraville developed in 1959 and 1962 respectively. The town expanded spreading into the suburbs which have become part of Walvis Bay town, with Kuisebmond to the north of the Central Business District and Narraville to the south of the B2 (Silverman, 2001).

With the integration of Walvis Bay into South West Africa, the development of infrastructure boomed, connecting road and rail between the port and the rest of the protectorate. The town continues to grow as a result of the fishing, tourism, mining and manufacturing industries.

6.8.2 Walvis Bay Town Plan

The town of Walvis Bay and Walvis Bay Harbour are built on the east side of the Bay in one of the best natural harbours along the barren south-west African coast. The town stretches along the coast, in a north-southerly direction, with the Harbour taking up the majority of the coastline. Walvis Bay Lagoon and Saltworks are located to the south of the Bay (see section 6.9).

The B2 enters the town from the north connecting Walvis Bay to Swakopmund. The C14 joins the B2 from the east of the town, which passes Dune 7. The town is structured in a grid fashion with the central and southern parts of the town having roads running in a north-west to south-east, and south-west to north-east.

The town covers an area approximately 30km^2 which has been zoned into four general areas: Walvis Bay North; Walvis Bay East; Walvis Bay South; and Walvis Bay Central. Each residential area has different demographic and socio-economic characteristics. The lower income residential area is found in Walvis Bay North, which is predominantly resided by labourers. Walvis Bay East is a township, which also has a light industrial zone. Walvis Bay Central has a low-density residential area to the south and predominately contains zones for heavy industries (including the harbour area) and is the Central Business District, which is located immediately adjacent to the harbour. Walvis Bay South is also a low-density residential area for high-income groups. This area features around the Lagoon (Environ Dynamics, 2010).

The shopping and main amenity area of the town are on the north side of the Walvis Bay museum and is predominantly distributed between 12th Road to the east, 9th to the west, 6th Street to the north and Nangolo Mbumba Drive to the south. The town is served by two hospitals, the main hospital being the Welwitschia Hospital located south-eat of the Museum. The police station is to the north-east of the museum, and the train station is to the north of the main amenity area. The Ministry of Finance Ministry of Marine Resources, Ministry of Home Affairs and Immigration and MET have offices in the town centre close to the train station. There are four secondary schools, two in Walvis Bay Central, one in Naraville and one in Kuisebmond, and seven primary schools, three in the central area, one in Naraville and three in Kuisebmond. This provision is currently not compliant with the standards set by the Ministry of Education (Walvis Bay Municipality, 2014).

An industrial area is located between Circumferential and Grand Avenue. The town has a disjointed and fragmented Central Business District (CBD). There are small and localised street shopping facilities and a recently open mall at the town's entrance.

6.9 Development in Walvis Bay and around the Lagoon

The Walvis Bay Peninsula, reaching up to Pelican Point forms the sheltered Bay, providing protection from the Atlantic swells and south-westerly winds and currents (see Figure 32). Within the Bay lies the Harbour area to the east, Walvis Bay Lagoon to the south, and the Saltworks and Saltpans to the far south of the Lagoon.

Figure 32 Walvis Bay and Key Features {Google Maps}

6.9.1 Harbor Area

The Harbour comprises a commercial harbour in the southern section (Namport) and a fishing harbour in the northern portion. The Namport commercial harbour handles containerised and bulk cargo and is bounded on the west and north by the limits of Namport jurisdiction. The fishing harbour is bounded on the east by the shore and fish factories, which supports around 15 fish processing factories and their vessels. In the north-eastern corner is an artificial guano platform for nesting birds.

The Harbor area provides various facilities and operations: servicing of vessels participating in marine exploration and fishing; and serves as the country's main import/export facility. Exported goods are minerals such as uranium, copper, lead, feldspar, salt, beef and canned fish. Imports of general container cargo, motor vehicles, machinery, petroleum and bitumen also pass through the port facilities. Various cruise liners also make Walvis Bay one of their regular port of call.

6.9.2 Namport

Namport is a state-owned enterprise, which manages the commercial Port of Walvis Bay and the Port of Luderitz. The main activities of the Port of Walvis Bay are managing vessel traffic and container cargo handling, undertake vessel repairs, support the fishing industry and manage passenger traffic. Namport's role is to exercise general infrastructural and regulatory functions (dredging and customs), together with nautical safety, navigational and other commercial facilities.

The port of Walvis Bay is split into three defined areas:

- The South Port: The commercial port with a container terminal
- The Fishing port: Accommodates various fish factories and associated activities
- The North Port: Not currently under development

Due to business growth in Namibia's ports, the increase of container ships increasing and throughput of container volumes from landlocked countries, there was a need to expand the port's capacity and services to meet this growth. Namport identified that the container terminal was not capable to support this growth; therefore a new container port facility (referred to as the Namport Container Expansion project) was proposed and approved.

Due to a shortage of land for the expansion, proposals for a new container terminal on reclaimed land inside the port limits was developed, upgrading the port's capacity from moving approximately 37,0000 containers per year (2016) to 1 million containers a year by 2019. The construction of the Container Expansion project was planned in three phases; the first phase commenced in May 2014 (Namport, 2015), which is 76% complete as of January 2018 (Gelderbloem, 2018). Land reclamation is 95% complete with civil works and installation of infrastructure around 65% complete. The Passenger Liner Jetty is 90% complete and the construction of the breakwater wall and marine has just commenced. Phase 1 is expected to be commissioned in 2019 and is currently on target. Phases 2 and 3 have not been scheduled as yet (see Section 6.11.2.1).

6.9.3 The Lagoon

The Lagoon (and Salt Pans) occupy approximately 13% of this Bay area and is 7km long (Delta Marine Consultants, 2010). The mouth of the Lagoon is at the south end of the Bay area, to the south-west of the town (further description on the Lagoon characteristics is provided in Section 6.23.2). Up until the early 1960s, the Lagoon remained unaffected by anthropological changes.

Local development has resulted in a reduction in the area of the Lagoon that traditionally was inundated on a regular or occasional basis. Along the northern and north-eastern perimeter of the Lagoon, residential suburbs and tourism developments occupy land that was formally part of the Lagoon (Delta Marine Consultants, 2010). Section 6.23.3 provides further detail on anthropogenic influences on the Lagoon environment.

6.9.4 The Saltworks

The Saltworks, owned by Walvis Bay Salt Holdings (Pty) Ltd was established in 1964 Lagoon to extract salt from seawater. The Saltworks developed on the south-western bank of the Lagoon as the area provided favourable conditions for the production of salt. Over the years, various evaporation ponds, crystallisers, pre-evaporation ponds and concentration ponds were developed. The last major expansion occurred in 2000.

The Saltworks and pans have been identified as potentially affecting the natural ecological and hydrological processes of the Lagoon, which may have contributed to siltation, and the reduction in size and associated tidal action has led to valid widespread concerns about the ecological sustainability of the Lagoon (see section 6.23) (Walvis Bay Municipality, 2008).

Even though the developments have altered the natural ecological and hydrological features of the Lagoon, the evaporation ponds have resulted in a positive change by providing a habitat for birds, including large numbers of flamingos, which feed off the microscopic crustaceans. The Lagoon and surrounding area were declared a Ramsar site in 1995 due to it ornithological features. Section 6.23.12 provides further information on the Ramsar site.

6.9.5 Other Development and Activities

A range of recreational activities takes place in and around the Lagoon. Sections 6.15.10 and 6.15.8 provide further detail.

The commercial farming of oysters is being undertaken in evaporation ponds in the Saltpans of the Lagoon and within the Namport boundaries of the Aquaculture Production Area 1 (Bay area). Commercial aquaculture and mariculture ventures started in Namibia in the late 1990's, which focuses on mussels and Oysters in the Bay area (Appendix J). At the time of writing, there were no committed plans to extend these mariculture activities.

6.10 Infrastructure and Waste Management

6.10.1 Transport Infrastructure

The Erongo Region is connected by the national road network to the rest of the country via Okahandja, Windhoek, and Otjiwarongo. The primary route is the B2 which connects Walvis Bay and Swakopmund. Two minor roads, the C28 and C14 form secondary routes to Windhoek and other smaller towns (see Figure 33).

The B2 forms part of the Trans Kalahari Highway which facilities trade as the road runs from Walvis Bay, through Botswana to Gauteng in South Africa. The road network links Walvis Bay to the Trans Caprivi Highway and stimulates trade with other Southern African Development Community (SADC) countries such as Zambia and Zimbabwe. The Walvis Bay Corridor Group has put in a great amount of effort to ensure that these corridors assist with exports to other landlocked countries (Environ Dynamics, 2010).

Figure 33 Main transport infrastructure Erongo Source: (Erongo Regional Council, 2017)

Walvis Bay Harbour, located to the south of the town, is one of Africa's most efficient and best equipped ports which can handle more than eight million tonnes of cargo per annum. It is the largest port in Namibia and is at the start and the end of four transport corridors, serving as a transport hub for regional and international trade between SADC countries, Europe, the Americas, and the rest of the world (Erongo Regional Council, 2017).

A national network of railways covering 2,382km connects Walvis Bay and Lüderitz with key destinations in Namibia and South Africa. Much of the containerised traffic at Walvis Bay goes by rail, and the Harbour has its own marshalling yard for maximum operational efficiency. Thousands of tons of bulk minerals from mines in South Africa and Namibia are transported directly to the quayside by rail for export (Risk Based Solutions, 2012).

Approximately 15km south-east of the town is Walvis Bay International Airport, which is the second largest airport in Namibia handling over 20,000 aircraft and over 98,000 passengers in 2015. The airport operates daily flights to Windhoek, Johannesburg and Cape Town. The Airport is primed to become a leader in cargo handling for marine, coastal and mining activities in the area. Major developments at the airport in 2016 have resulted in the airport becoming Namibia's second international airport.

6.10.2 Utilities

The Erongo Region is connected to the well-developed national power grid, which is operated by Namibia Power Corporation (NamPower). Erongo Regional Distributor distributes and maintains the electricity network in the Erongo Region. The bulk power supply to Walvis Bay is distributed through underground supply cables from Paratus Power Station and associated substation (Walvis Bay Municipality, 2014).

NamWater extracts water from the Kuiseb river aquifers, which is pumped to bulk storage (dams) and then distributed across Walvis Bay.

Walvis Bay is one of the few towns in Namibia that enjoys world class telecommunications system, with telephone and internet connections widely available, thanks to recent substantial investment in the telecommunications infrastructure including the installation of optical fibre cable networks and broadband systems. An international satellite links Namibia to worldwide telecommunications services (Risk Based Solutions, 2012).

6.10.3 Waste Management

A waste disposal landfill site and the hazardous waste site was constructed in 1999, 1.5km from the town centre near to the municipal sewerage facility. The landfill has a capacity of 2.8million m^3 with a 30-year lifespan. The existing solid waste landfill has sufficient capacity to cater for the town and town development as per the IUSDF until 2040 (Walvis Bay Municipality, 2014). The site has recycling collection points, which are leased to various businesses to manage recyclable waste. The municipality is responsible for the collection and removal of refuse from all households. Some businesses and industries also use the municipality to collect their waste (Municipality of Walvis Bay, 2005).

The hazardous waste site receives waste from various producers including Rossing Mine, the Gobabeb Research Station and construction companies. The site has a capacity of approximately 18,000m^3. An incinerator is on site for use for final disposal of hazardous waste (Municipality of Walvis Bay, 2005).

Walvis Bay also has a modern liquid waste disposal system which produces treated effluent by means of bio-filter and activated sludge process. A process in which sewerage water is treated and make available for reuse has also been introduced (Municipality of Walvis Bay, 2005).

6.11 Walvis Bay Future Development

6.11.1 Development of the Town

Walvis Bay is earmarked to become the leading industrial town in Namibia by 2030 due to its strategic location and transport networks (Walvis Bay Municipality, 2014). The current pace of economic development, including the industrial and housing sector, as well as future port expansion, long-term planning is a critical requirement, considering the impact such growth would have on roads, water, sewerage and electricity infrastructure in the long run. The town of Walvis Bay is expected to grow substantially to enable it to continue to be the leading industrial town in Namibia (Walvis Bay Municipality, 2014).

The town has grown in a northerly and southerly direction and is expected to grow inland to the east due to geographical and existing physical constraints, making the CBD less central to future residential areas. The Walvis Bay IUSDF (Walvis Bay Municipality, 2014) provides a development plan for the town, taking into consideration the projected population growth (see section 6.15.2) and the anticipated pattern of land use. The following development proposals presented in the IUSDF are expected to be developed or are being developed by 2030:

- Walvis Bay South Port Terminal (Namport's Container Expansion project, phases 2 and 3)
- Namport's Waterfront
- Walvis Bay North Port Terminal
- Development of 90 townships, 44,200 households (39 should be completed by 2018, 19,370);
- Other residential areas around Walvis Bay (Beachfront residential development and Inland Residential Developments)
- Several light industrial areas at various locations around the town;
- Heavy Industrial Area located east of the high dune belt;
- Rooikop Airport behind Dune 7;
- Eight secondary schools, 30 primary schools and 20 day-care centers;
- Additional community centers and clinics;
- Four new police stations, two fire stations and two cemeteries;
- Service centers within residential suburbs (shops, and secondary services);
- Seven new sports fields and eight local parks, all associated with the local service centers;
- Various open spaces which are linked by a dedicated network of pedestrian/cycle corridors;
- Various upgrades to utility services (bulk water supply, sewerage disposal, power supply and solid waste disposal); and
- Various changes, upgrades and new infrastructure for the road network in and around Walvis Bay.

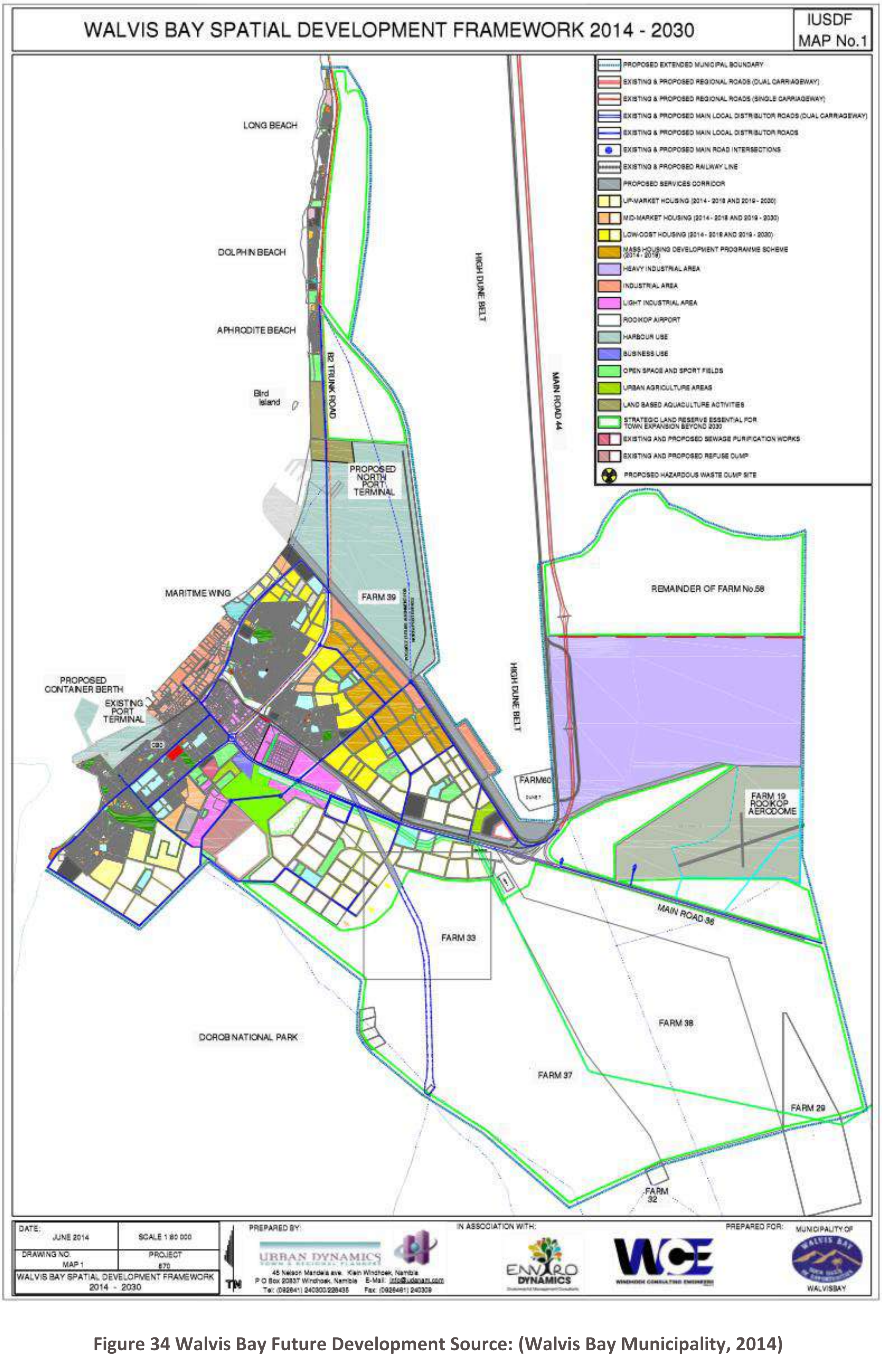


Figure 34 Walvis Bay Future Development Source: (Walvis Bay Municipality, 2014)

As a result of the CBD becoming less central to residential areas, a Regional Shopping Mall has been constructed and eight local service centres are proposed to cater for the residential areas growing towards the east. The road systems will also be upgraded; the D1984 will be upgraded to a dual carriageway and will become the official access to the town using the C14. The B2 will restrict use to passenger vehicles and tourists; and various other diversions and intersections will be built across the town. A strong feature of the plans is the development of open spaces linked by pedestrian and cycle corridors, and the development of waterfront areas (Figure 35), as detailed in the Walvis Bay IUSDF (Walvis Bay Municipality, 2014).

Figure 35 – IUSDF Development areas and surrounding features

6.11.2 Namport's Future Development

6.11.2.1 South Port: Namport Container Expansion Project

As discussed in Section 6.9.2, phase 1 of Namport's Container Expansion project is 76% complete and is scheduled to be commissioned in 2019 (Gelderbloem, 2018). Phases 2 and 3 (see Figure 36) have not formally been scheduled as the requirement for the additional capacity that these extensions shall provide has not been fully examined and committed. Phase 1 shall provide double the current capability, and until it is understood when this capacity is almost utilised, phases 2 and 3 will not be developed. This is expected to be beyond 2025 (Gelderbloem, 2018).

The dredging and land reclamation activities for phase 1 took approximately two and a half years to be almost complete (95% (Gelderbloem, 2018)) (Namport, 2018). The actual total quantity of dredged material is unknown, however the Namport EIA and supporting reports is estimated approximately 4,265,000m^3 of material would be dredged and 33ha of land would be reclaimed (Delta Marine Consultants, 2009). Phases 2 would dredge 8,208,657m^3 (double phase 1) and reclaim 27.5ha of land and phase 3 would dredge 3,508,768m^3 and reclaim 60ha of land (Delta Marine Consultants, 2009)). Based on this, the dredging and land reclamation works could take approximately 8 to 10 years to complete, which does not include installation of port infrastructure and commissioning.

To fully implement phases 2 and 3 of Namport's Container Expansion project, a range of construction activities in the marine environment shall occur over a long period. Available information to provide a comprehensive understanding of these works is limited. The Namport EIA Study (Delta Marine Consultants, 2010) provides some information on the construction and operations of these phases of the project, as well as the findings of the impact assessment. For example, maintenance dredging will be required, which will cover a larger area compared to the current maintenance dredging. It is also assumed that vessel movements and associated marine activities will increase, however the throughput and detailed is not known (Delta Marine Consultants, 2010).

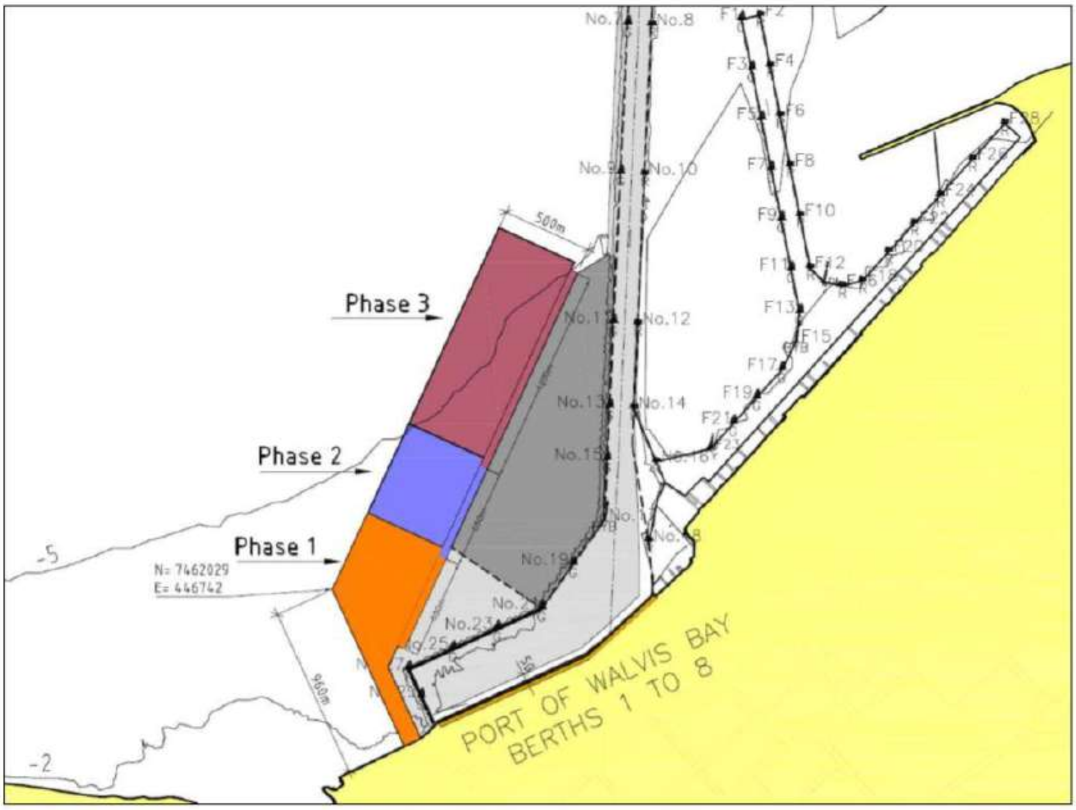


Figure 36 – Namport Container Expansion project (Source: (Delta Marine Consultants, 2010))

6.11.2.2 NAMPORT'S WATERFRONT

As part of the Namport's Container Expansion project (and as discussed initially in Section 5.3), concept proposals have been publicised on for the development of a new waterfront and marina development, with the inclusion of a new Passenger Liner Jetty adjacent to the new Container Terminal (Namport , 2013). The new Passenger Liner Jetty is 90% complete as of January 2018 (Gelderbloem, 2018) and the Marina Breakwater is 30% complete. The completion date for these are unknown.

The area of land around Anchors and the Yacht Club (as illustrated in Figure 35) is partly leased by Namport to private businesses and used by Namport for the storage of containers and handling thereof. This area was identified for development by the Government Parastatal Namport. The proposals were first published and presented in Namport's 2012/2013 Annual Report (Namport , 2013), where Namport reported that the waterfront marina development had entered into feasibility studies and tendering stage. An expression of interest process for seeking private developers was undertaken in 2016, and Namport indicated that the appointment of a developer is envisaged by end of 2019 in the 2014/2015 Annual Report (Namport, 2015). The development of this waterfront cannot be progressed until the first phase of the Namport Container Expansion project is commissioned which will be in 2019 (pers. Comm. Mr. Elzevir Gelderbloem, 19th February 2018).

Indicative outline designs for the designated area and construction approaches were presented in the 2014 – 2015 annual report. The state-owned enterprise, is currently seeking part Government finance to develop this piece of land into a waterfront and marine development. At the time of writing, no formal commitment from Government had been made relating to the allocation of funds for the proposed 'Namport' waterfront.

6.11.2.3 North Port

The 5th NDP sets out four pillars to guide the development of the country, which are broken down in to focus areas. Through these focus areas, targets have been set to aid the progression of development, in particular for the port of Walvis Bay:

- Focus area 2.2.8, Structure Transformation through Value-added Industrialisation sets out targets for tourism;
- Focus area 2.3.3, Expansion and Modernisation of Physical Infrastructure, Transport and Logistics sets out targets for the Port of Walvis Bay; and
- Focus area 2.4, Strengthened Export Capacity and Greater Regional Integration.

To accommodate the targets, the Port of Walvis Bay is set to expand even further. The North Port area has been proposed to be developed to provide additional capacity and capabilities. The North Port has been identified in the IUSDF and Namport has purchased the land from the Municipality. Concept designs have been drafted, however whilst taking these into consideration and the need for the additional capacity to support the growth of Namibia, the time of writing the certainty of this project is considered to be low.

6.12 Description and Current Use of the Proposed Site

The site for the proposed project is located approximately 1.5km south of the town centre (the CBD), immediately south of the existing Namport container terminal on the seafront at the mouth of the Lagoon. The area for the proposed project will utilise both onshore and offshore areas. The land portion covers an area of land currently zoned as Private Open Space covering approximately 7ha, and a Road Reserve (see section 4.3.1 for further detail). The area is bordered Atlantic Street to the north, KR Thomas Street to the south and 4th Road to the east. The south end is the Road Reserve which includes The Esplanade and the Lagoon Promenade. The offshore area takes an area up to and around The Raft Restaurant out into the Lagoon.

The Esplanade runs along the Lagoon past The Raft Restaurant and connects to Atlantic Street by the Protea Hotel. The hotel access is provided off The Esplanade. Atlantic Street runs between the proposed project site and the Namport container terminal, and provides access to several small businesses and facilities, including the Yacht Club, the Boardwalk, Sarah se Gat and Anchors restaurant. KR Thomas St runs between a residential area and the site, connecting The Esplanade to 5th Road, and provides access to side streets, residential properties and guesthouses. 4th Road provides access to residential properties.

5th Road and The Esplanade are the main access routes to the site from the central and northern areas of town and southern town area respectively. Both of which join the main access route in and out of the town from the south.

The Lagoon Promenade is approximately 4km long and runs parallel to the coast and The Esplanade, from the Protea Hotel to Esplanade Park. It is a scenic coastal path for pedestrians and cyclists, and provides areas for tourists to view and photograph flamingos and pelicans. The Promenade passes several restaurants and hotels including The Raft, Oyster Box Guesthouse, and the Flamingo Villas Boutique. The proposed project site is at the north end of the Promenade.

The proposed project area has a range of community facilities: the Walvis Bay Cricket Oval and cricket club, Tennis courts, swimming pool and Jukskei courts (see Figure 37). Local residents use these facilities; the swimming pool has, for many years, hosted school and club sporting days, school sports events, competitions and Navy training exercises are ongoing. The cricket field is currently home to the Junior Coastal Cricket Academy an academy to train aspiring young Namibian cricketers and the development of Cricket in the town of Walvis Bay. The cricket oval periodically hosts cricket tournaments.

The public open space or green area is used by many residents of Walvis Bay for activities such as dog walks, exercise, picnics, a safe place for children to play, and provides an open space for families to be together during holiday periods. The area has established palm trees and other vegetation.

Figure 37 – Existing Community Facilities

The proposed project site is currently occupied by community facilities. These facilities will be relocated to two sites: the cricket oval to a football pitch in Kuisebmosnd; and swimming pool, tennis and jukskei courts to the Jan Wilken Stadium. The locations are presented on Figure 6.

- The **football pitch in Kuisebmosnd** is in a residential area in the northern area of Walvis Bay town. The site comprises the football pitch, tennis courts and other recreational facilities.
- The **Jan Wilken stadium** is located in the centre of the town, east of the CBD in a built-up urban/residential area. The site is adjacent to the Walvis Bay Museum, Welwitschia Hospital, residential properties and a redundant site. The Jan Wilken site is the central sporting grounds in Walvis Bay and currently has a multi-purpose indoor sports facility, a gym and squash courts. Bowling greens, a rugby stadium and field, netball courts, archery practice range and a cricket club with an international sized cricket field are also currently established at the Jan Wilken sports grounds.

6.13 On-Site Contamination and Asbestos

Prior to all three sites being used primarily for recreation, it is believed they were unoccupied, therefore there is limited potential for the ground to be contaminated.

A site survey of all buildings on the proposed project site has been undertaken and samples from have been taken and tested. Asbestos has been found in the roof sheeting of the kiosk, part of the swimming pool facilities. No other facilities are expected to have asbestos in the building materials.

6.14 Existing and Future Traffic and Road Use

6.14.1 Existing

A traffic study was undertaken in November 2016 to model existing traffic conditions around the proposed project site, predict future traffic flows and assess if the local transport network can accommodate the future flows. The full report is contained in Appendix G.

The existing traffic baseline is heavily influenced by the Namport operations and the construction of the Namport Container Expansion project. Construction vehicles access the new Namport extension and construction area from 5th Road and Atlantic Street. The traffic survey recorded up to 300 trucks per day between 06:00 and 18:00 along these roads. In addition to these vehicles, a similar number of trucks delivering salt to Namport for export were also recorded. Based on these surveys, between 10 and 25 trucks were surveyed per hour.

Other road users include local residents commuting to and from work, and the local community and tourists travelling to and from the existing waterfront. Nangolo Mbumba Drive experiences the highest traffic volumes during the peak hours for both weekday and weekends, with 690 vehicles being experienced during morning peak hour, 1,055 during afternoon peak hour and 690 vehicles at weekends. 5th Road experienced the most vehicles in the roads surrounding the site; 130, 220 and 95 respectively (excluding trucks) and The Esplanade Drive experienced the least; 80, 100 and 65 respectively.

The current transport network can accommodate the existing traffic demand.

6.14.2 Future

The traffic study (Appendix G) modelled future traffic volumes for 2022 by applying a 4.7% growth rate for a five-year period, as per the predicted population growth rate documented in the Walvis Bay IUSDF (Walvis Bay Municipality, 2014). The study assumed the second phase of the Namport Container Expansion project would be completed by 2025 and thus traffic generation will continue to be experienced by this project until that date. Recent information obtained from Namport confirms that phase 2 and 3 will not be developed until after 2025, therefore it is assumed that traffic generation will reduce one phase one nears completion. It will however be greater than the volume of traffic experienced prior to the Container Expansion project as there will be an increase in port activities and operations. Traffic will then increase once the construction works of phases 2 and 3 commence.

6.15 SOCIO-ECONOMIC

6.15.1 Governance

Namibia was established in 1990 and is led by a democratically-elected and stable government. The country ranked top fifth out of 54 African countries in the Ibrahim Index of African Governance in 2015 for the indicators including the quality of governance and the government's ability to support human development, sustainable economic opportunity, rule of law and human rights (National Planning Commission, 2017).

As a result of sound governance and stable macroeconomic management, Namibia has experienced rapid socio-economic development. Namibia has achieved the level of 'medium human development' and ranks 125th on the Human Development Index out of 188 countries (National Planning Commission, 2017).

Walvis Bay is the regional capital of the Erongo Region. The Erongo Regional Council is responsible for the planning and development of the region in a sustainable manner for the benefit of its inhabitants by establishing, managing and controlling of settlement areas focusing on core services. The council is accountable for an area of 63,586km^2, about 7.7% of the total area of Namibia (Erongo Regional Council, 2017).

Walvis Bay falls under the jurisdiction of the Walvis Bay Municipality, whose authority stretches up to the Swakop River in the North and to the Kuiseb River in the South. This area is divided by the road between Walvis Bay and Swakopmund, with the dune side under the jurisdiction of the Ministry of Environment and Tourism, and the coastal beach area under the control of the Walvis Bay Municipality (Environ Dynamics, 2010).

6.15.2 Demographic Profile

Namibia is one of the least densely populated countries in the world, with a population of 2.3 million people. Life expectancy is 65 years and expected years of schooling is 11.7 (National Planning Commission, 2017). In the 2011 Census, the population of the Erongo Region was 150,809, a growth rate of 28.6% since 2001. Walvis Bay had a population of 62,096, making it the third densely populated city in the country. The population of Namibia has been growing steadily; the population growth rate between 2001 and 2011 (the two census) was 1.4%, with urban areas growing quicker than rural areas. The highest growth rate in Namibia was recorded in the Erongo region (3.4%). This was mainly influenced by in-migration; more than 40% of residents in these regions were born elsewhere (Namibia Statistics Agency, 2011).

Namibia's population is expected to increase from an estimated 2.11 million in 2011 to 3.44 million by 2041 (63%). It is predicted that urbanisation will continue, with an increase from 43% population in urban areas in 2011 to 67% in 2041. The populations of Khomas and Erongo are projected to increase the most with over a third of Namibia's population to live in these two regions (Namibia Statistics Agency, 2011).

In Walvis Bay, industrial activity and port related activities will continue to grow, along with the migration of skills and unskilled workers. This will contribute to a continual population growth rate in the town. The Walvis Bay IUSDF (Walvis Bay Municipality, 2014) has applied a predicted growth rate of 4.7%, applying historical growth rates and future development growth. Using this, Walvis Bay's population is projected to grow up to around 180,000 by the year 2030 (doubling the population).

The average Namibian household size is 4.4 according to the 2011 Namibia Population and Housing Census (Namibia Statistics Agency, 2011).

6.15.3 HIV / Aids in Namibia

HIV/Aids in Namibia is a critical public health issue and is one of the leading causes of death. Namibia has a generalised HIV epidemic, meaning that there is a high HIV prevalence among the whole population. The epidemic is now starting to stabilise, after a rapid increase from the time that the first case of HIV was reported in 1986 through until a peak in 2002. HIV prevalence in Namibia is not yet measured through a population based survey, instead, HIV-prevalence among pregnant women attending Ante Natal Clinics is used. In 2010, 18.8% of pregnant women were HIV positive, a reduction from the high of 22% in 2002. However, HIV prevalence is unevenly distributed throughout the country, therefore this figure is not a national representation. The overall trend illustrates that HIV prevalence is stabilising rather than increasing (UNICEF, 2011).

Walvis Bay has 17.6% HIV prevalence, which is similar to the national of 17.2%, ranking 16th in Namibia (Ministry of Health and Social Services, 2016).

6.15.4 Employment

The Erongo Region is one of the most affluent regions in Namibia, with the second highest per capita income in Namibia at N$16 819 per annum (Environ Dynamics, 2010). In Walvis Bay, most employment is through the Harbour, fishing industry and the processing of sea salt (Walvis Bay Municipality, 2008).

The labour force participation rate is the proportion of the economically active people in a given population group, which is calculated as the number of economically active people divided by the total population in the same population group. The labour force participation for the country was 64.0%, and 79% for the Erongo Region. The unemployment rate in the Erongo Region was around 30% unemployment, lower than the national rate of 37% (Namibia Statistics Agency, 2011).

6.15.5 Crime

Namibia's crime index is 78.53. In the financial year, March 2008 – February 2009, crimes reported in Namibia amounted to 96,200. In 2009/2010 crimes reported were 90,675 and in 2010/11 to 90,675. More than two-fifths of all reported crimes occurred in Windhoek, where the majority of reported crimes were burglaries, robberies and assaults (Insight Namibia, 2012).

6.15.6 Economic Activities

The Namibian economy has grown on average by 4.6% per year between 2012 and 2016, however, slowed down in 2016 to 0.2% due to a reduction in productivity in the farming industry. The growth rate over the years has not reduced unemployment; in 2016 nearly 18% of the population lived in poverty. A lack of industrialisation and infrastructure has contributed to Namibia's economic imbalance. The 5th Namibian NDP (National Planning Commission, 2017) states that by modernising and industrialising of the major sectors of agriculture, fisheries, manufacturing, mining and tourism, and by providing trading opportunities so that workers can upgrade their skills, Namibia will create jobs in a diverse range of industries which will improve the economy.

Mining is the largest income earner in Namibia followed by tourism, fishing and manufacturing. Agriculture contributes 3.8% to GDP, but supports above 70% of the Namibian population and employs about a third of the working force. In the Walvis Bay area, the economy is driven by four main industries: fishing, tourism, manufacturing and the harbour.

Although the mining industry is a large income earner in the Erongo Region due to several mines being in the area including Rossing Uranium Mine, it is not considerable in Walvis Bay. Having said that, the industry does provide critical upstream, downstream and side stream linkages for the local and national economy, e.g. transport services, power and skills.

6.1.1.1 Fishing Economy

The fishing grounds off the coast of Namibia provide over 20 species of fish, lobsters and crabs which are commercially harvested. Namibia's fishing industry is the country's second biggest export earner of foreign currency after mining. 90% of the national output of fish is exported (Erongo Regional Council, 2017). Over a period of 50 years, the industry has established itself in the world fish market; while contributing approximately 7% to the overall GDP, it also accounts for 25% of foreign exchange earnings (Environ Dynamics, 2010).

The commercial fishing industry is the cornerstone of Walvis Bay's economy; it is the biggest employer as it employs approximately 10,000 people throughout its value chain. Even though the fishing industry is subject to seasonal and stock variation, it continues to play an important role in the economy of Walvis Bay. More than 70% of the industries in Walvis Bay are directly or indirectly dependent on the fishing industry. Investment opportunities are presented in the support and service sectors, including marketing, production and packaging related to the industry (Environ Dynamics, 2010).

6.1.1.2 Tourism Economy

The tourism industry is an important contributor to the generation of foreign exchange earnings, investments, revenue, employment, rural development, poverty reduction and to the growth of the country's economy. Tourism also creates strong direct and peripheral benefits because of its multiplier effect, based on its resilience on a wide spread of supplies and services. Hotels and restaurants, a proxy for the tourism sector grew by an average of 6.6% in the last five years, which contributed about 1.8% to GDP which is estimated to the foreign exchange earnings increased to about N$4,682 billion. The target in the 5th NDP is to increase tourist arrivals from 1.4 million to 1.8 million by 2021/22 and increase employment from 29,000 to 43,000 (National Planning Commission, 2017).

6.1.1.3 Local Manufacturing Economy

Namibia has a small manufacturing sector, amounting to 14.3% of total GDP at 2008 prices. This sector consists mainly of meat processing, processing natural products for export or producing basic consumer goods and fish processing on shore. In an effort to diversify and expand the manufacturing sector in Walvis Bay, while stimulating economic growth, the Export Processing Zone (EPZ) was established in 1996 to provide an attractive package of fiscal incentives for local and foreign investors. The EPZ contributes to the development of the country's manufacturing sector while creating much needed employment opportunities. The main manufacturing activities in Walvis Bay thus take place within the EPZ. The manufactured products include plastic pallets and products, automotive parts for Volkswagen and Audi vehicles, fishing accessories, bathroom fittings, clothing and fishing related accessories. The cutting and polishing of diamonds are also conducted in this area. In addition, the scope for future investors in the EPZ includes the manufacturing of footwear, leather products, electronic equipment and various foodstuffs (Environ Dynamics, 2010).

6.1.1.4 Harbor Operations Economy

Businesses in Namibia's ports are increasing mainly due to the country's economic growth in industries such as mining and fisheries; the lack of other available ports in Namibia or on the western coast of Southern Africa; but also as a result of the economies of SADC countries developing. Import and export activities are increasing, and Walvis Bay is becoming more preferential for a hub to transport goods into SADC countries as ports in South Africa are at least three more days travel when travelling from the west.

As a result of the Harbour and port capabilities increasing, a knock-on effect will occur in the area; other businesses will benefit such as hotels and other service providers.

6.15.7 Local Businesses

The past 4 years have seen a growth in the number of businesses in Walvis Bay, increasing from 2 000 to between 5,000 to 6,000 Small Medium Enterprises (SMEs). The growth in the number of companies is mainly related to the transport sector. This includes companies involved with freight forwarding, truck and ship repairs, and storage facilities; for the latter, the request for warehousing has increased. It is expected that the number of new SMEs will grow rapidly as new business opportunities emerge. The growth can be attributed to the increase in mining activities, the corridor development, and the expansion of Namport's container terminal (Environ Dynamics, 2010).

Local businesses in the area surrounding the site (500m from the site boundary) for the proposed project include:

- The Protea Pelican Bay Hotel is part of the Marriott International group, a leading global lodging company with more than 6,000 properties in 122 countries and territories. The hotel has 48 rooms, a Beauty Spa and dining facilities;
- Various restaurants: Anchors Restaurant, the Boardwalk, Lyon Des Sables Restaurant, Brume sur le port, The Venue and View Café;
- The Raft, a privately-owned business and is located the end of a jetty in the Meersig Lagoon. The Raft is an iconic feature of Walvis Bay as it is made out of solid wood timbers from the original Namibian Walvis Bay jetty. It is one of the few buildings remaining in Walvis Bay that retain the character and design of the stilt buildings of the 1960 era designed for floods. The restaurant area overlooks Meersig Lagoon where birdlife and marine life can be viewed. The Raft attracts local and international visitors. The Raft requires frequent maintenance and up kept due to the harsh coastal conditions it faces.

- Various privately owned local Guest Houses and hotels, including the Oyster Box, Langholm hotel, the Courtyard and Loubser's B&B.
- Tourism providers include Catamaran Charters and Sandwich Harbour 4x4;
- The Walvis Bay Yacht Club (WBYC), located to the south of the Harbour. Established in 1961 and offers a range of activities from dolphin cruises, sailing, canoeing, windsurfing, kite-surfing, power-boating, training and all other related and associated sporting disciplines. Private boats and yachts are either anchored in the bay area or launched at the available slipways (the slipway is located approximately 400m from the proposed project site). The WBYC has a restaurant which also caters for functions such as weddings and seminars, seating up to 90 people (Walvis Bay Yacht Club, 2017);
- Walvis Bay Salt Holdings operates the Saltworks which processes 24 million tons of seawater each year to produce more than 650,000 tons of high quality salt. The majority of the salt produced by Walvis Bay Salt Refiners is used by the chlor-alkali industry for the production of chlorine and caustic soda. In addition, the salt is used as a fodder supplement for cattle and also refined for human consumption. Bulk consignments of salt are shipped to other countries, mainly South Africa. Walvis Bay Salt Refiners is also a commercial producer of high-quality oysters supplied to customers throughout southern Africa. The plankton-rich seawater is an ideal food source for the oysters (Environ Dynamics, 2010); and
- Informal Vendors: The car park area near the restaurant Anchors has become an area for informal vendors to market their goods to tourists frequenting the area. It is not a formalised area and as such makeshift shelters and shop have been built.

6.15.8 Tourism in Walvis Bay

Tourists are attracted to the Walvis Bay area for the bird life, the Saltworks and pink evaporation ponds, marine life, Dune 7 and surrounding sand dunes. Desert tours, sightseeing trips, tours to Dune 7, dune-boarding, quad biking, 4X4 Off-road recreational driving, paragliding, scenic flights, and filming and photography are all available in Walvis Bay. There are currently eight marine tour operators and two kayaking operators. It is estimated that 600 tourists go on dolphin tours daily, departing from the yacht club area (Risk Based Solutions, 2012).

A local museum in the Civic Centre and the Rhenish mission church (located on 5th Road and Thomas Morris St, 1.5km from the proposed project site) established in 1880 are also tourist attractions. A variety of hospitality establishments such as hotels, lodges, guesthouses cater for tourists and holidaymakers. A hotel is located at Pelican Point that is accessible by 4x4 vehicles. Paaltjies beach on the sandspit is a popular local spot for shore anglers. Angling, from small craft or from the beach, is a major form of recreation throughout the coastal reaches of the Walvis Bay area.

The Dune belt area is the only coastal dune area that is easily accessible to the public provides multiple tourism use practices. The area also contains a diversity of biophysical features and attractive landscape. Land-based and nature-based tourism activities are also available.

The Lagoon is one of the key tourist features of the area and various activities are centred around it. Sailing, wind-surfing and kite-boarding are popular activities on the Lagoon. Wind conditions on the outer Lagoon make this one of the world's best locations for wind- and kite-surf speed sailing.

Capitalising on this resource, many guesthouses have been established around the Lagoon, offering a view of the rich bird life against the backdrop of sunsets. The number of guesthouses in Walvis Bay has grown since 1995; along with the Protea Hotels they have an average occupancy rate of between 70-80%. This is due to the increase in business tourism, as the increased economic activities in Walvis Bay drawing business to this area. Often, teams working at the ship and rig repair yard reside at these guesthouses and hotels for long periods of time of up to two months or more. Furthermore, February and March see an influx of fishermen to the area as they use Walvis Bay as their basis for angling excursions (Environ Dynamics, 2010).

6.15.9 Tourism Growth

Tourism (and eco-tourism) is the fastest-growing industry in Walvis Bay. The main limiting factor to tourism is infrastructure, which is echoed in the 5th NDP; some tourist spots lack infrastructure which is hampering growth, which needs to be actioned over the next five years to reach these targets (National Planning Commission, 2017).

Tourism is a thriving industry in Namibia and has been increasing over the years: in 2015 a total of 1,387,773 tourists arrived in Namibia, which was a 5.1% growth rate from 2014. This growth rate was lower than the year before, which was a 12% increase between 2013 and 2014 (Ministry of Environment and Tourism, 2015).

Whilst statistics for 2015 to 2016 / 2016 to 2017 have not been released, it has been reported that 2016 experienced one of the best results over the last decade, with tourism accommodation properties (bed spaces) recording an average of 60% occupancy across the country (The Economist, 2017).

The Government has recognised and prioritised tourism development in various legislative and policy documents, setting out the approach to growing the tourism industry into the most competitive tourism destination in Africa. To influence development, the Government has set targets of increasing tourist arrivals by 8% from 2016 to 2020, with a yield (per tourist) of a 50% increase. To support this growth target, nine subsectors/products have been identified (Ministry of Environment and Tourism, 2016):

- Wildlife tourism;
- Trophy hunting tourism;
- Coastal tourism;
- Community based tourism;
- Cruise tourism;
- Circuit development/route development model;
- Luxury affordability;
- Meetings, incentives, conference and event tourism, and
- Medical and retail tourism.

6.15.10 Community and Recreational Facilities

The town has a range of community and recreational facilities which are distributed around the town. These facilities include Hospitals, primary schools, high schools, higher education (university), recreational facilities, cricket grounds, tennis courts, swimming pools, open spaces, Walvis Bay Museum, hotels, lodges, guest houses, camping and caravan parks.

The proposed project site is currently occupied with green spaces, the Walvis Bay Cricket Oval and cricket club, Tennis courts, swimming pool and Jukskei courts. South of Paul Vincent Street is an open green space, approximately 300m from the boundary of the proposed site. Approximately 1.7km is the Sparta field sports facilities, which has a clubhouse, cricket oval, soccer field and rugby pitch. Open green spaces are dotted along the Lagoon coastline between the Promenade, a wide pedestrian seafront path, and the Esplanade.

A small boat ramp for launching motor boats into the Bay is located approx. 200 m from the proposed project site, as part of the Yacht Club.

6.15.11 Cultural Heritage

On the coast of Namibia, dense local concentrations of archaeological sites are associated with some of the larger river mouths. Open coastline environments are generally poor in archaeological sites, as are the mouths of smaller rivers. The river courses, although mainly dry, had in the past sufficient water beneath the surface to sustain small human groups. River environments also have edible plants and wild game, and these, combined with littoral and marine foods, offer a more stable subsistence base than any area in the immediate hinterland. The combination of such resources in the vicinity of the Kuiseb Delta led to humans using the area and therefore has the largest concentration of archaeological sites on a coastline over 2,000 km in length (Risk Based Solutions, 2012).

Archaeological sites and remains around Walvis Bay have been recorded. To the north of Walvis Bay, there is a minor group of sites associated with the mouth of the extinct Tumas River. To the south, there are two important archaeological localities, Frederiksdam and Sandwich Harbour. There is little historic value in the surrounding area of the proposed site; the area with archaeological and historic importance is in the lower Kuiseb River between Gobabeb and Rooibank which is associated with a narrow strip of thinly scattered sites close to the course of the river itself. The overall picture of archaeological sites is therefore of a distribution that is confined to the lower Kuiseb until it flares out among the Walvis Bay dunefields, particularly in the area nearest to the Lagoon (Risk Based Solutions, 2012).

Walvis Bay has various places of worship, the closest one to the proposed site being the Baptist Church on the corner of 5th Road and Peter Dixon street, approximately 1km south-east. No other archaeological or heritage sites are within or surrounding the proposed project site.

6.15.12 Air Quality

Sensitive receptors surrounding the proposed project area are as follows and illustrated in Figure 38:

- 47 Residents in properties and guest houses, particularly those adjacent to the site on Kr Thomas Street and 4th Road;
- Residents in properties and guest houses along vehicle access routes during construction: Atlantic Street, 5th Road and the D1986;
- Residents in properties and guest houses along vehicle access routes during operation, which will be predominately Atlantic Street, KR Thomas Street, 5th Road and the D1986;
- Visitors and workers at the Protea Pelican Bay Hotel; and
- Users of the Lagoon Promenade.

Figure 38 – Sensitive receptors to air quality

The main complaint over the years has been the unpleasant odour from the fish processing industry. The prevailing southerly winds that blow northerly to north-westerly help to dissipate any pollution (Delta Marine Consultants, 2010).

The local air quality has been derived from a desk-based study and observations from the site visit. The following sources have been identified through the desk-based study:

- Walvis Bay does not have heavy industries that could be the source of substantial amounts of harmful emissions and pollutants, for example sulphur dioxide, nitrogen oxide and mercury;
- The fish processing industry and the sewerage treatment facility result in foul odours which tend to spread north due to the predominant southerly winds;
- The fishing processing plants, Namport's existing operations and certain shipping activities undertake fuel combustion which can lead to carbon dioxide, sulphur dioxide, nitrogen oxide and particulates;
- Vehicle exhausts in and around the town; and

- Construction works of Namport Container Expansion project are likely to be a source of increased dust from land-based transport movements and construction activities, and small quantities of pollutants such as nitrogen oxides, carbon monoxide, volatile organic compounds, sulphur oxides and particulate matters generated as a result of increased shipping and road traffic.

The atmospheric dispersion potential in Walvis Bay is expected to be effective for a lot of the time due to the frequent moderate to strong winds (see Section 6.17), and the high daytime temperatures. Poor dispersion conditions are most likely to occur at night when low temperatures coincide with light or calm winds. The poorest dispersion conditions are likely to occur between May and November when the lowest nighttime temperatures occur (Walvis Bay Municipality, 2014).

The number of these sources is considered to be small and atmospheric dispersion is generally good, therefore ambient air quality is regarded as generally good.

6.15.13 Noise and Vibration

Sensitive receptors surrounding the proposed project area are the same as for Air Quality, in addition to ecological receptors in the marine environment including mammals, cetaceans and fish.

A noise survey was undertaken in 2009 for the Namport Container Expansion project. A summary of the ambient noise levels around the proposed site is summarised in Table 16. The main source of noise emissions was road traffic (Safetech, 2009).

Table 16 Summary of baseline noise results

Noise monitoring Location	Morning peak $L_{Req.T}$ dB(A)	Afternoon peak $L_{Req.T}$ dB(A)	Night time $L_{Req.T}$ dB(A)
Atlantic Street next to Protea Hotel Close to the Harbour and community facilities	42.1	68.3	64.3
Corner of Atlantic Street and 5th Road Residential Area	45.9	66.6	59.6
Corner of 5th Road and JH De Waard Street Residential Area	46.8	71.2	59.1
Corner of 5th Road and 5th Street Residential Area	52.6	70.9	58.2

The South African regulatory and guidance reports provide typical levels of noise in various types of districts. The South African National Standards (SANS) 10103:2008 (SANS 10103:2008) provides typical rating levels for noise in various types of districts, as described in Table 17.

Table 17 Typical rating levels for noise in various types of districts. [Source: (Safetech, 2009)]

Type of District	Equivalent Continuous Rating Level, LReq.T for Noise					
	Outdoors (dB(A))			Indoors, with open windows (dB(A))		
	Day-night	Daytime	Night-time	Day-night	Daytime	Night-time
Rural Districts	45	45	35	35	35	25
Suburban districts with little road traffic	50	50	40	40	40	30
Urban districts	55	55	45	45	45	35
Urban districts with one or more of the following: Workshops; business premises and main roads	60	60	50	50	50	40
Central business districts	65	65	55	55	55	45
Industrial districts	70	70	60	60	60	50

During the afternoon (between the hours of 16.00 and 16.45), noise levels in the area surrounding the proposed site are the loudest and exceed the recommended levels for urban areas (see Table 17) and on two sites, exceed recommended levels for industrial districts.

It is acknowledged that since the noise monitoring was undertaken, the construction and operation of the first phase of the port expansion project has been undertaken, and therefore it is likely that noise levels will exceed this original baseline as a result of an increase in traffic from operational activities. Noise emissions currently originate from the moving of containers, both during the day and at night hours, and the movement of construction vehicles along Atlantic Street. The trucks used to transport the salt from the Salt Works also contribute to the noise levels along 5th Road.

It is unlikely that noisy construction activities at the Harbour will be heard at the sensitive receptors around the site due to the distance, wind direction and structures between source and receptors. The baseline is therefore influenced by traffic along the roads travelling to and from the Harbour and the existing waterfront. It is assumed that an increase in traffic to and from the Harbour has occurred since the completion of the first phases of the Namport Container Expansion project. Therefore, the baseline along Atlantic Street and 5th Road is likely to be greater than those recorded in Table 16. Noise levels along KR Thomas Street and other residential roads are anticipated to be lower and probably no more than 55dB(A), the outdoor levels to be used as a guideline for a mixed urban district.

6.16 LANDSCAPE AND VISUAL AMENITY

6.16.1 Local Landscape

Walvis Bay is situated on the Namib Desert coast at the confluence of the Southern Atlantic Ocean, the Namib Sand Sea, the gravel plains of the central Namib Desert and the Delta of the ephemeral Kuiseb River. The Walvis Bay area is characterised by this complex and dynamic environment; the Dune Belt, the Bay area, the Lagoon and the Northern Namib Dune sea providing key features of the landscape. The landscape has changed over the years due to natural and man-induced processes and will continue to do so as a result of population increase and town development.

The rolling hills and dunes surrounding the town are no higher than 100m and the town area lies approximately 6m above sea level (Date and Time Info, 2017). The site for the proposed project is relatively flat, with an elevation of approximately 1mMSL.

The town is relatively flat with the buildings no higher than three stories. The Harbour area dominates the landscape with large vessels, cranes and other infrastructure, and stacked containers.

The surrounding area around the site is residential to the south, east and north-east; the majority of properties being two stories or less. Vegetation including trees line the streets in areas. To the north of the site is the Namport container terminal, where containers are stacked around four to five containers high. During the preparation of this ESIA report, six port container cranes were delivered by sea and are to be established on the new phase 1 Namport Container Expansion area (Gelderbloem, 2018). These cranes are approximately 125m and therefore will alter the landscape and seascape character of the area, which will be visible from the proposed project site and surrounding residential properties.

The Raft is a dominating feature in the seascape and the Protea hotel and other smaller developments contribute to the seascape character. From the Raft and coastline, the tidal flats can be seen a low tide.

6.16.2 Residential Views

Residential properties along KR Thomas Street and 4th Road overlook the proposed project site (see Figure 39), which is currently a green space with recreational facilities. Some properties are multi story and have views onto the proposed project site. Properties along Esplanade overlook the Lagoon.

Figure 39 -View across the cricket oval from KR Thomas Street / 4th Road

6.16.3 Lighting

Artificial lights illuminate the area at night. Streetlights come on just prior to sunset and remain on until sunrise (see Figure 40).

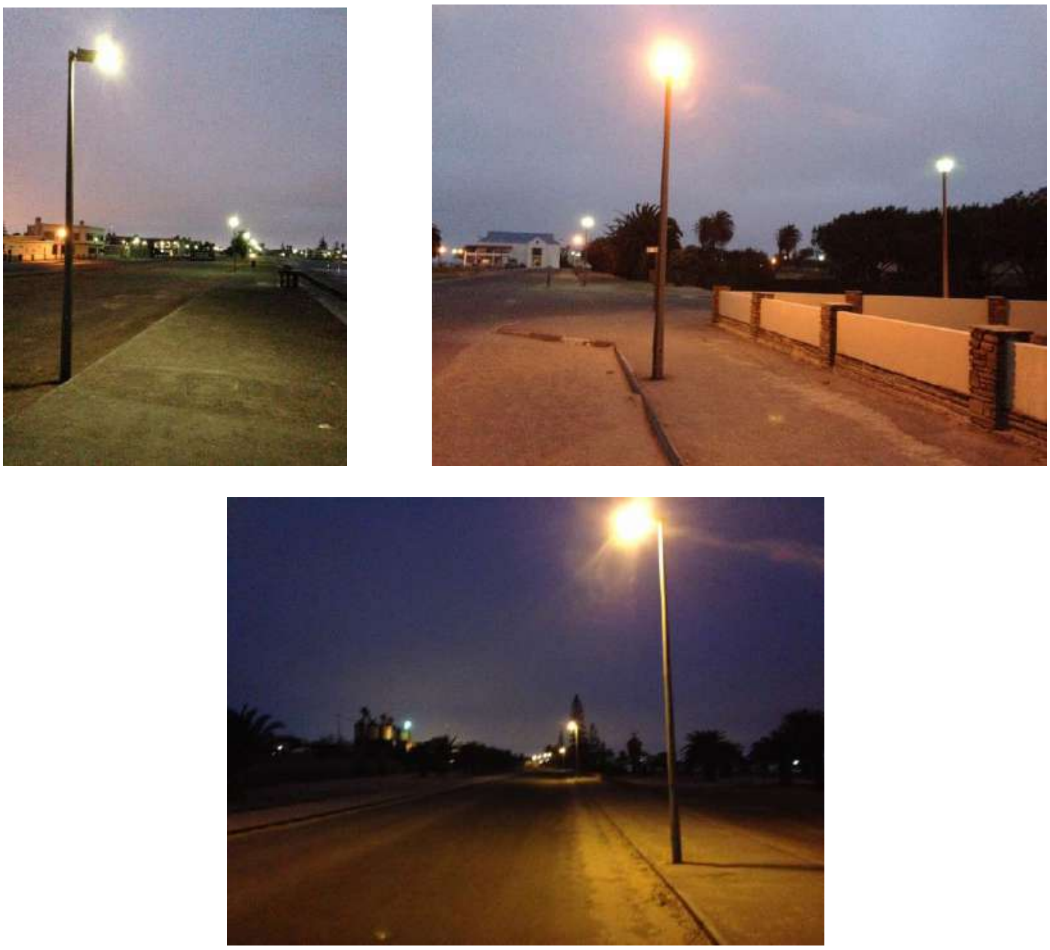


Figure 40 – Examples of street lights around the proposed project site

Facilities on the site are illuminated by tall floodlights (see Figure 41). Namport is very brightly lit and can be seen from a distance (see Figure 42).

Figure 41 – Existing Facilities on the proposed project site at night

Figure 42 – Namport lighting at night

6.17 Climate and Meteorology

The climate of Walvis Bay is driven by a combination of atmospheric and marine conditions, namely the South Atlantic Anticyclone or high-pressure system, the northward-flowing cold Benguela Current and the divergence of the south-east trade winds along the coast.

The general weather changes from cool, foggy, windy and hyper-arid conditions along the coast. Extremely low rainfall (8 mm/yr), characteristic of the harsh desert environment, is moderated by coastal fog that creeps as far as 70km inland and contributes 35 - 45mm of precipitation per year to the coastal area (Enviro Dynaics, 2012; Uushona and Makuti, 2008; Heather-Clarke, 1996).

There are on average 150 foggy days per annum in the Walvis Bay-Swakopmund region, mostly between April and August. The fog attracts and accumulates pollutants. Although the winds are typically strong and hence disperse air pollution, sea breezes present in the lower atmosphere tend to blow pollution back landwards. Stable air conditions result in temperature inversions in the lower atmosphere and pollutant dispersal is limited to the coastal belt. These factors exacerbate the odour pollution problems experienced in Walvis Bay town (Preston-Whyte and Tyson, 1988; Heather-Clarke, 1996).

The Benguela coastal region is characterised by hot, dry adiabatic "berg" winds blown in off the western escarpment when high-pressure cells form over the subcontinent in winter. These winds are locally intensified by topographic features such as river valleys, blowing in excess of 50 km/h and causing severe sandstorms that considerably reduce visibility both at sea and on land.

Satellite imagery reveals that the berg winds transport significant quantities of terrigenous material far out to sea (Figure 43). Although berg wind conditions occur only intermittently, they last for up to a week at a time. The winds strongly affect the local temperatures, which are often above 30°C during "East wind" periods. The warm air associated with Berg winds flows over the cold marine boundary layer after passing over the coast. Land-sea breezes blow along coastal areas adjacent to interior coastal plains, resulting in a strong diurnal rotary wind component (Stuut, 2001; Jury et al, 1985). This dynamic wind regime influences most biotic and abiotic processes within the Walvis Bay area by changing sedimentation rates, upwelled nutrient flux and primary production within the system.

Figure 43 - Dust and Hydrogen Sulphide (green) along the Namibian coast (Source: NASA, 2010)

The windiest month in Walvis Bay is July, followed by January and December. The prevailing wind directions for these months are illustrated in Figure 44 and Figure 45. Data gathered over a six-year period by Iowa State University, illustrates the general prevailing wind through the year is from the south-west-west (Iowa State University, 2018).

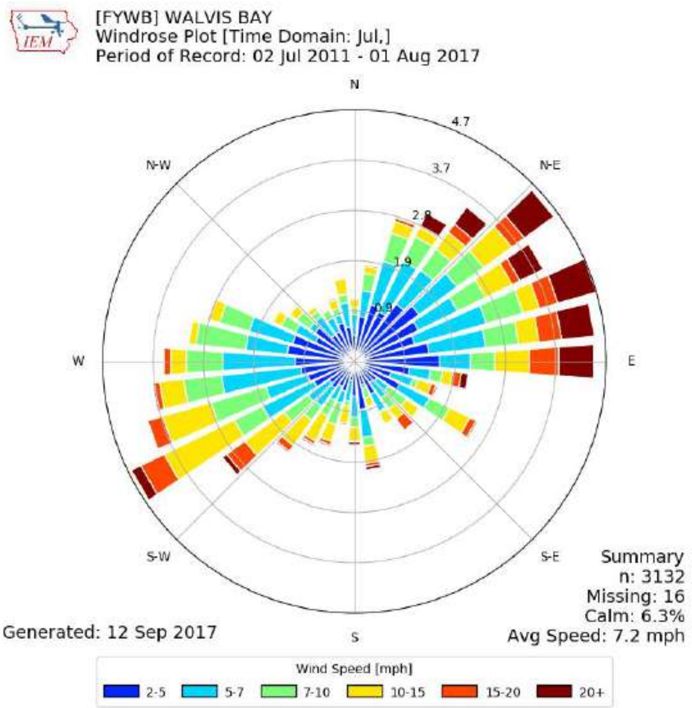


Figure 44 – July prevailing wind direction, Walvis Bay (Source: (Iowa State University, 2018))

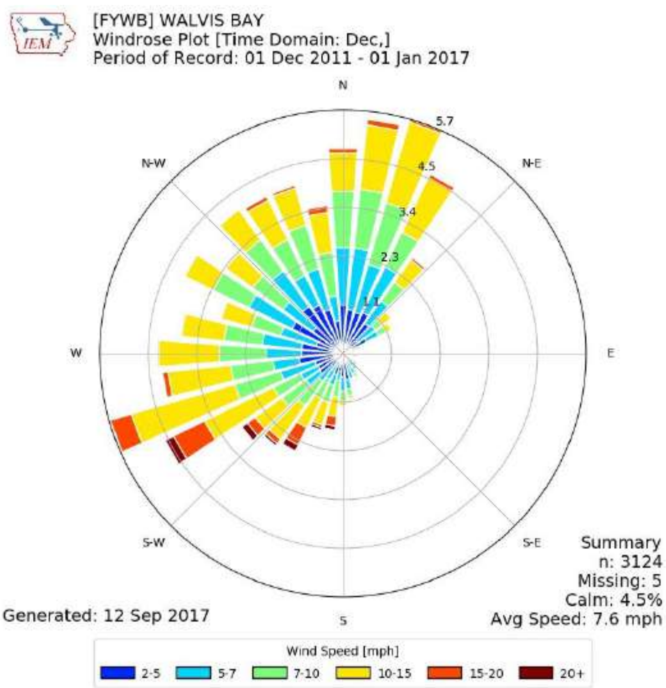


Figure 45 – December Prevailing wind direction, Walvis Bay (Source: (Iowa State University, 2018))

The average maximum temperatures in Walvis Bay are between 24°C in March - April and 19°C in September. Average minimum temperatures fall between 16.5°C in February and 9.1°C in August. Extreme hot events are experienced during some summers (December – February) when temperatures exceed 25°C.

6.18 Climate Change

Warming of the climate system is evident from observation of increases in average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level (Intergovernmental Panel on Climate Change, 2007).

Sea levels have risen between 1993 and 2006 by 3.3+/- 0.4mm/yr and are expected to continue for centuries due to the timescales associated with climate processes and feedbacks. Projections of sea level rise by the Intergovernmental Panel on Climate Change (IPCC) show that the rise of global average sea level by 2100 will be in the range from 0.18 to 0.59 m depending on the emissions scenario (Intergovernmental Panel on Climate Change, 2007).

Southern Africa is estimated to have a temperature increase of between 1^{o}C and 3^{o}C by 2050, mean sea surface temperatures are anticipated to increase between 1.5^{o}C and 6^{o}C by 2100, and a 10 to 20 percent decline in rainfall is anticipated by 2070. Climate change projections for Walvis Bay include a 0.2m rise in sea level and an increase in storm surge events (J. Josefsson, 2012).

6.19 Groundwater

Walvis Bay lies on a small zone with a productive porous aquifer, the Kuiseb aquifer, which is considered as one of the most productive aquifers in Namibia. The underground water from this aquifer is of good quality, with less than 1,000 mg/l of dissolved solids (Mendelsohn, 2003).

Walvis Bay obtains fresh water from the Central Namib Water supply scheme based in Swakopmund. The scheme is run by NamWater and draws groundwater from borefields in the Omaruru and Kuiseb rivers (Christelis et al., 2011).

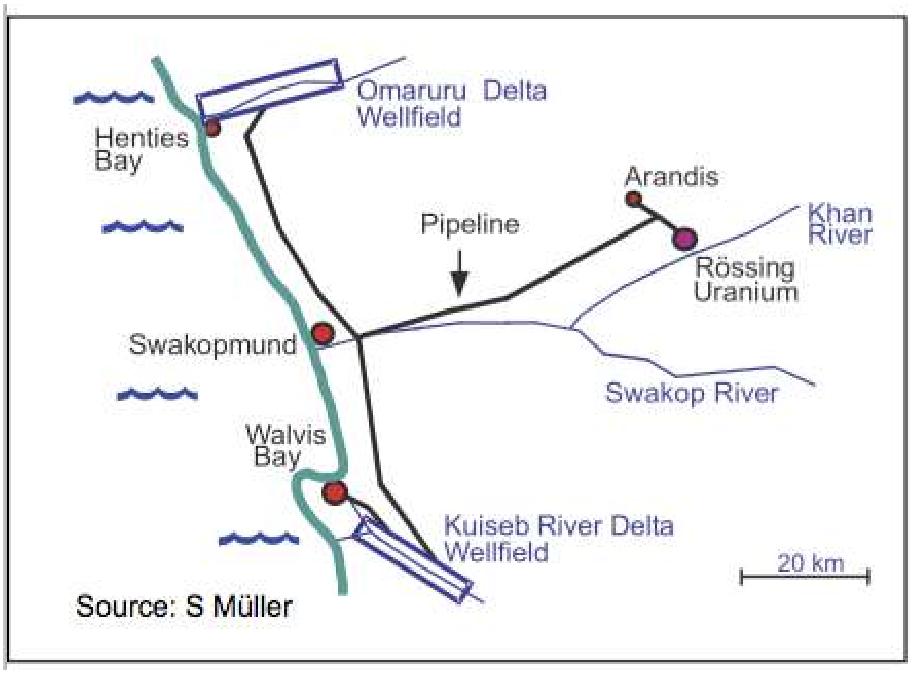


Figure 46 – Wellfields and pipeline networks of the coastal area. Image courtesy of **(Christelis et al., 2011)**

The alluvial aquifer in the lower part of the Kuiseb River at Rooibank has been used since 1923 to supply water to Walvis Bay. In 1966, the Rooibank B Area was developed and in 1992 an additional wellfield at Dorop South, closer to the coast, came into operation. Another wellfield was established at Swartbank upstream of Rooibank in 1974 to supply Swakopmund and Rössing Mine. In addition to 53 boreholes in the Kuiseb wellfields, there is one large-diameter, horizontal filter well (Fehlmann well) (Christelis et al., 2011).

The alluvium in the Kuiseb River is 15-20m thick. Its relatively high permeability allows high pumping rates and quick recharge in case of floods. The IUSDF (Walvis Bay Municipality, 2014) estimates that the sustainable yield for the Kuiseb River is 7.2 million m^3/annum, although indications suggest that this is high. Pressure on this water source is increasing as a result of urbanisation and population growth. It is estimated that by 2030, approximately 13.8 million m^3/annum will be required.

6.20 Local Groundwater

The water table on the proposed project site was encountered during the geotechnical investigation (GEOSTRADA , 2016) at an average depth of 1.3m throughout the site. The groundwater is expected to be saline and not extracted for local use.

6.21 Flooding

The Kuiseb River, when flooded reaches the sea approximately every 10 years. During these events, flooding in areas around Walvis Bay occurs as a result of a tributary which enters the town from the south-east. In 1961, a flood barrier was built at Rooibank to contain the river and prevent flooding via the route, and has proven effective in 1963 and 2011. Potential remains for flood water to reach the Lagoon via the southern tributary, however in the past this has been dissipated by the porosity of the delta, which soaks up the flood and prevents the break-out to sea (Namibian Ports Authority, 2013).

6.22 Site Geology

The geotechnical survey (GEOSTRADA , 2016) conducted to investigate the underlying geology, concludes that the entire site comprises of the same stratigraphy: from surface to a depth between 0.15 and 0.6m consist of a layer of imported material, which is pale yellowish orange, medium dense to dense consistency, coarse sand and gravel. From an average depth of 0.3m to and average depth of 1.3m is transported sand (windblown).

6.23 The Marine Environment

This section describes the environmental features that directly interact with the marine environment, which includes the subtidal area (below low-tide mark), inter-tidal area (foreshore and seashore) and coastal zone (areas of land which border the marine environment).

6.23.1 Walvis Bay and Surroundings

The coastline of central Namibia is dominated by sandy beaches, with rocky habitats being represented only by occasional small rocky outcrops. Biogeographically the central Namibian marine and coastal environment fall into the warm-temperate Namib Province, which extends northwards from Lüderitz into southern Angola. The wind-induced upwelling characterising the Namibian coastline is the principal physical process which shapes the marine ecology of the central Benguela region. The harsh aridity of the Namib coastline contrasts with the rich productive marine environment offshore (Delta Marine Consultants, 2010).

The Walvis Bay area is one of only three, west to north facing embayments in Namibia that provide significant wave shelter from the South Atlantic swell, the others being Lüderitz and Swakopmund. This natural marine shelter along with freshwater from the Kuiseb River and Kuiseb Delta to the south of the Bay resulted in seafarers settling in the area of Walvis Bay. American, British, Dutch and French whaling fleets also used the area for hunting whales in the surrounding waters, which contributed to the development of the town.

The key marine features of the Bay are, the deep-water bay and Harbour area to the east of the Bay; Walvis Bay Peninsula reaching up to Pelican Point; Walvis Bay Lagoon to the south; the Saltworks and Saltpans to the far south of the Lagoon (see Figure 32) and the intertidal areas (including the mudflats). The Lagoon, Salt Pans, the southern half of Pelican Point and the adjacent intertidal areas from the Walvis Bay Ramsar site.

6.23.2 The Lagoon

The Walvis Bay Lagoon play a fundamental feature of the Ramsar Site; it is the source of water which supplies the Salt Pans and provides an environment suitable for roosting and feeding for a significant proportion of the birds in the Bay area. The Lagoon can be divided into three zones (Danish International Development Agency , 2003):

- **Mouth:** The hydrodynamics of this area is dominated by the wave and tidal currents with little likely wind-blown intrusion of sand. This is the only access point into the Lagoon for marine mammals such as dolphins.
- **Central section:** The section of the Lagoon with the apparent wind-blown intrusion of sand extending approximately 50m from the dune field along the eastern shore.
- **Southern zone:** The flow and circulation in this area is limited and is therefore characterised by higher water temperatures and salinity, and is largely anoxic. The Kuiseb River mud is present, deposited during major floods. There is also a high organic load of fine detritus in the bottom sediments at the southern end of the Lagoon. This organic material is partly transported into the Lagoon from the Bay, and partly generated by biologic activity in the Lagoon.

Further detail regarding the Lagoon environment is discussed in the next sections.

6.23.3 Anthropogenic Influences in The Bay Area

As discussed throughout this report, the Bay area has been developed substantially over the years and various activities and operations occur within the marine environment as a result. In brief, the following existing developments and activities influence the marine environment:

- **Salt Works:** The Salt Works is made up of various evaporation and concentration ponds, as described in Section 6.9.4. The Salt Works have profoundly changed the functioning and ecology of the Lagoon area, particularly in the southern end. Land reclamation and the construction of physical barriers to the tidal dynamics have resulted in decreased circulation and accompanied siltation and lowering of water clarity and quality with increased temperatures and salinity. Some of the natural wetland and Lagoon area has been reclaimed for use as evaporation ponds. Access roads have been built which cut off tidal circulation to the southern extremity of the Lagoon (Appendix J).

- **Fishing Industry / Factories:** The activities associated with the fishing industry been active in the in the harbor area for over 50 years and will continue to operate and potentially grow. The fish processing plants in Walvis Bay draw process water from the bay and also discharge effluent into it. However, because of the frequently anoxic status of the receiving waters, the discharge of high BOD waste has become problematic. While it is advantageous for these factories to discharge into the Bay it is clear that the effluent is compounding the already oxygen-stressed condition of the Bay, particularly along its eastern shore (OLRAC, 2009).
- **Namport Operations**: Namport has been operating since the early 1900's, and during this time considerable development and various changes to the natural environment has occurred, including but not limited to:
  - In 2000, the harbour was deepened (Delta Marine Consultants, 2010); and
  - Annual maintenance dredging is undertaken for the entrance channel, turning circle and tanker basin. Over 2,000,000m^3 of material is dredged from the sea floor (Namport, 2006), which is removed and transferred to one of three off-shore sites in the Bay area (Appendix J). These dredging operations have led to an increase in suspended solids in the Bay area.
- **Namport Container Terminal Expansion project**: As discussed in Section 6.9.2, phase 1 of the Container Terminal Expansion project is almost complete after two and a half years of construction works. Direct and indirect influences include, but are not limited to:
  - Bottlenose dolphins were observed to move north during the phase 1 of the Namport Expansion Project (see Section 6.1.2.14);
  - The construction of phase 1 has led to an increase in suspended solids in the Lagoon which has directly impacted the bird population (see Section 6.1.2.15); and
  - Due to the type and location of the new port structure, the refreshment rates in the Lagoon may have reduced. Studies undertaken to date are not consistent and some uncertainty remains, however it is considered likely (Namibian Ports Authority, 2013).
- **Tourism**: Tourism is one of the fastest growing industries in Walvis Bay and is predicted to grow nationally (see Section 6.15.9). The Bay area and in particular the Lagoon attract tourists for the bird and marine life. In addition, recreational activities in the Lagoon area include fishing, kayaking, sailing, wind-surfing and kite-boarding. The direct and indirect impacts of tourism activities include but are not limited to pollution and waste, noise, human-animal interaction, increased water activities, and disturbing and injuring mammals.
- **Fishing**: Fishing in the Bay area is a popular recreational activity. There is potential that over-fishing and collection of bait species are contributing to the changes in the fish community structure and structure of the benthic and sessile organisms (respectively) in the Bay area (Appendix J).
- **Mariculture**: Two sites in the Bay area are being used for mariculture. Impacts from aquaculture and mariculture include pollution and the introduction of alien species. These farms also close off spaces previously accessible to wild marine life, possibly impacting habitat and feeding and breeding patterns. Bottlenose Dolphins have also been seen swimming between the lines of oyster farms and there is a danger of injury or death resulting from entanglement (Appendix J).
- **Town Development and expansion of residential areas along the Lagoon waterfront:** Development along the coastline has altered wave action which contributes to marine sediment.
- **Kuiseb river**: A diversion weir was constructed at Rooibank in the 1960's to contain the river and prevent flooding Walvis Bay. This has altered the natural flow of the river (when flooded). This has resulted in a reduction in the size of the Lagoon, exacerbated the sedimentation process and reduced nutrients being brought into the Lagoon from inland.

6.23.4 Oceanography and Hydrodynamics

Continental shelf circulation off Namibia is a result of the interaction of three gyral systems: the South Atlantic Subtropical Gyre, the Sub-Antarctic Gyre and the Subequatorial Gyre. The Benguela Current is regarded as the eastern boundary current of the South Atlantic Gyre. North of Walvis Bay, the current moves offshore away from the coast. The speed of the Benguela Current varies between 10 and 30 cm/s depending on the location off the coast and wind direction and speed. Appendix J provides further information about the ocean systems around Walvis Bay and Appendix 1 provides further information regarding the flow dynamic modelling.

6.1.1.5 Wind and Currents

The dominant wind direction in autumn, winter and spring is from the south-west. During autumn, gentle winds from the south also occur as do strong north-easterly "Berg winds" (see Section 6.17). In summer the prevailing winds are from the north-west to south-west with the latter predominating (Delta Marine Consultants, 2010). Wind roses are presented in Section 6.17.

The northward-flowing Benguela Current and its associated upwelling results in nutrient-rich water being flushed into the Bay and the Lagoon. Water circulation in the Bay takes place mainly in the upper layer and depends on the direction of the wind. The dominant south-westerly winds create a clockwise water flow in the Bay during the morning, which travels southwards past the Harbour, and reverses later towards the north (see Figure 47). At Pelican Point the current is generally northward for the whole day. Bottom waters enter the Bay area at Pelican Point and surface layers exit at the same point.

Current speeds are found to be fairly constant with depth and are generally found to be very low, rarely exceeding 10 cm/s. This is consistent with the relatively small volume of the tidal prism, and also indicates only a small wind-driven circulation. An exception is at Pelican Point, which is subject to a highly three-dimensional current field due to the local bathymetry and the wave induced longshore current on the ocean side of Pelican Point (Danish International Development Agency , 2003).

The fastest current speeds in the Lagoon mouth area are focussed in the deep channels where they reach 1m/s, whereas over the shallow sandbanks the current speeds are below 0.3m/s, and in the more subtle channel reaches are 0.4-0.5m/s (Namibian Ports Authority, 2013).

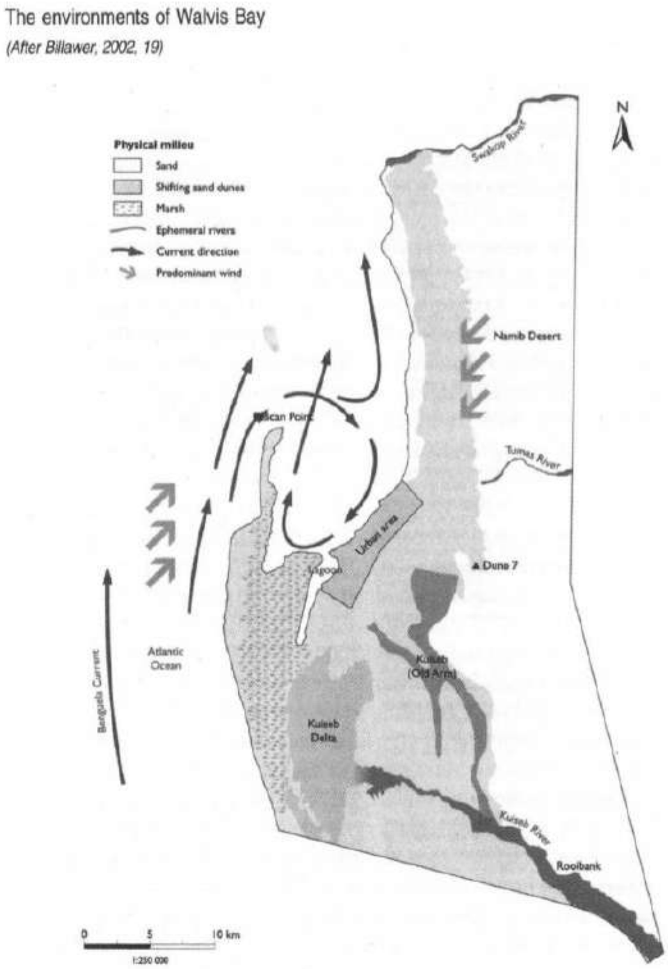


Figure 47 - The currents around Walvis Bay Source: (Silverman, 2001)

Since the development of the first phase of the Namport Container Expansion project, the refreshment rates of the Lagoon have altered slightly compared to rates prior to the development; however, a direct comparison study and use of real data of the flow before and after the development has not been undertaken. This assumption has been derived from comparing modelling outputs in the Namport EIA Hydrological Study (Delta Marine Consultants, 2009) and the hydrological modelling undertaken for the proposed development (Appendix I).

6.1.1.6 Tides and Waves

Tides along the Namibia shelf are semi-diurnal with an average tidal range of between 0.5 and 1.3m and up to 1.6m range between mean spring lows and mean spring high tides. The mean spring tidal range for Walvis Bay is 1.42m (0.27m – 1.69m), while the mean neap tide is 0.62m (0.67m – 1.29m). Variations in the absolute water level as a result of strong winds and big waves can, however, occur adjacent to the shoreline, resulting in differences of up to 0.5 m from the tidal predictions (Environ Dynamics, 2010). (CSIR, 2009).

Although the mouth of the Lagoon is protected from the south-westerly waves by Pelican Point, waves occur in the shallow zone. The waves and the wave set-up progressively decrease in magnitude southwards in the shadow zone. This results in a southwards-setting longshore current in the harbour (Delta Marine Consultants, 2010). The Lagoon is becoming shallower due to siltation, which is arising due to various influences (see Section 6.23.6).

The Bay and Lagoon are flushed twice daily with nutrient-rich water from the open ocean. There is a relatively large degree of mixing of Lagoon and Bay water, however, due to its shallowness and dynamic nature, the water temperature and salinity within the Lagoon vary across special and temporal scales (Appendix J). The refreshment rates in the Lagoon may have reduced since the development of the first phase of the Namport Container Expansion project; studies undertaken to date are not consistent and some uncertainty remains, however it is considered likely and therefore assumed for the purpose of this report (Namibian Ports Authority, 2013).

6.1.1.7 Flow Conditions at the Lagoon Mouth

The flow pattern in the immediate vicinity of the Raft Restaurant is slightly deflected both during ebb and flood (see Figure 49). During ebb flow, an eddy is formed on the shallows just south of the Raft restaurant. The main ebb flow is conducted through the eastern tidal channel. The (artificial/dredged) western channel is inactive. In contrast, the flood flow is distributed over the entire entrance section.

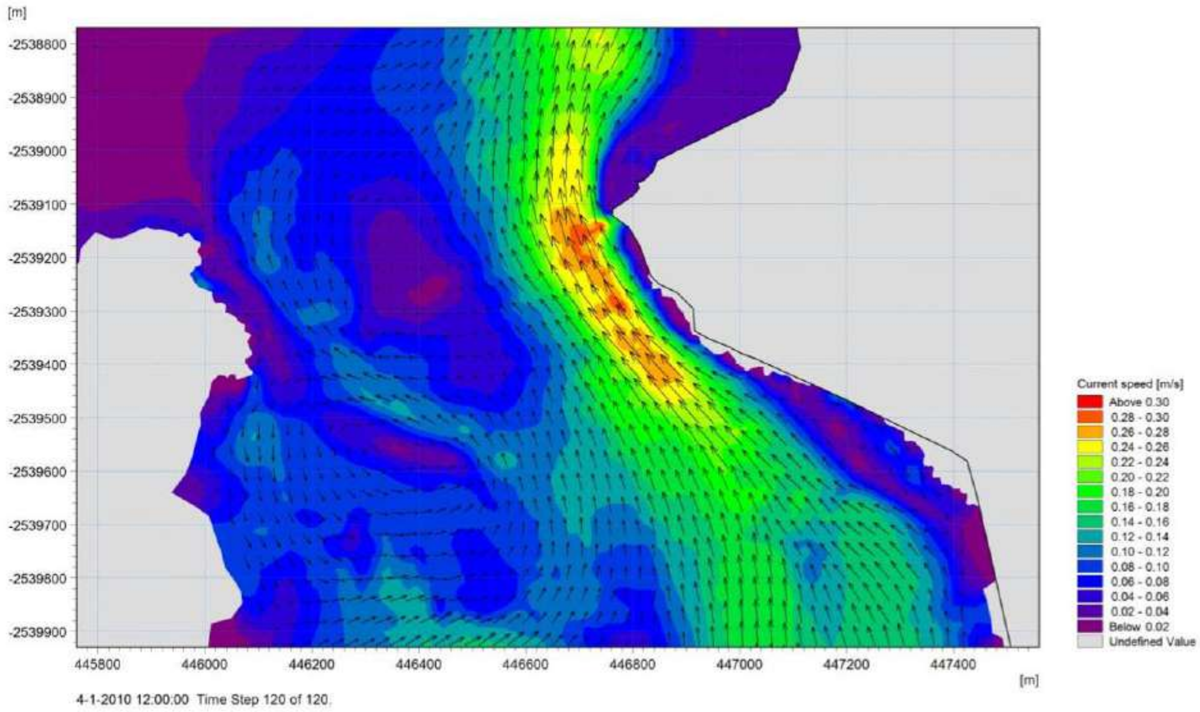


Figure 48 – Typical ebb current pattern (Appendix I)

6.1.2 Bathymetry

A prominent berm on the upper beach stretches along much of the coastline surrounding Walvis Bay. From the berm, the beach slopes gently to the low water mark. At around 1-2m deep, the slope flattens, and the sandbank is replaced by gently sloping, low relief rocky seabed, which extends approximately 400m offshore to about the 5m isobath (depth contour). Seaward of the 10m depth contour, the seabed is dominated by a gently sloping flat featureless sandy area (Delta Marine Consultants, 2010).

In Walvis Bay, the water depth ranges from -20 m chart datum (CD) at Pelican Point to approximately -2.5 m CD at the entrance to the Lagoon during high tide (Danish International Development Agency , 2003) (see Figure 49). The Bathymetric survey carried out in June 2017 provides detailed bathymetric for the areas of the Lagoon entrance and around the proposed project site (see Figure 50).

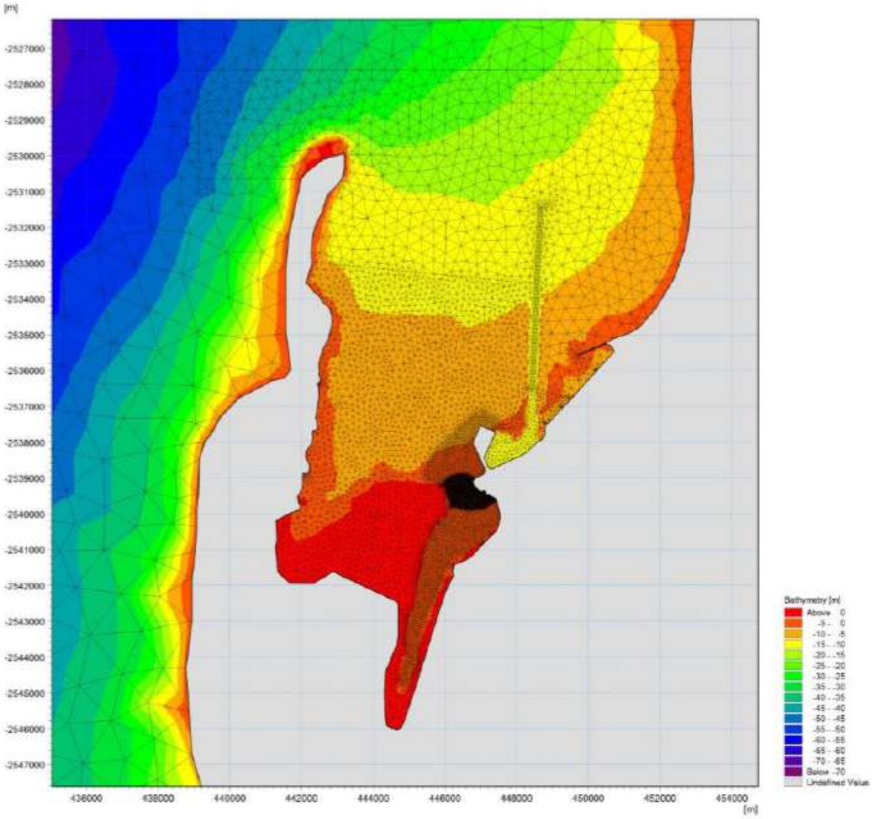


Figure 49 - Walvis Bay Bathymetry (m)

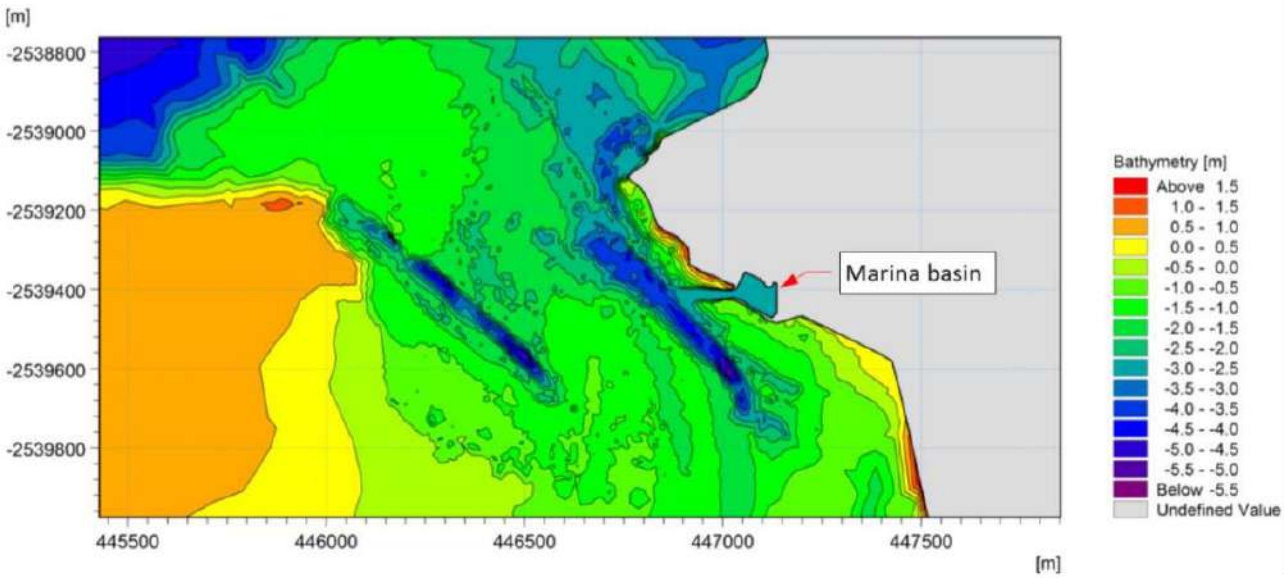


Figure 50 - Sea bed levels (MSL) around the proposed waterfront development

The southern and eastern boundaries of the Lagoon area have been radically modified by the development of saltpans and associated building of roads. Within the saltpans, there is no diurnal fluctuation in water levels. Fluctuations in water levels within a pan are relatively small; there is great variation in salinity between pans as the water is pumped from one evaporation pan to the next (Simmons RE, 2015).

The bathymetry in the Lagoon entrance is considered most relevant for the flow conditions and water exchange between Lagoon and Bay, which is relevant to the proposed project. The western channel (as seen as the left dark blue in Figure 50) is ineffective for tidal flushing and is likely to fill-in over time, whereas the eastern channel is self-scouring and not currently under threat (Namibian Ports Authority, 2013).

The Lagoon bathymetry has not altered significantly between 1987 and 2013; where shallowing has occurred, it is most likely as a result of the deposition of organic matter (see section 6.23.6). The steepening of the flood tide front due to shoaling is reported as a probable cause for the transport of the material to the south within the Lagoon. The organic material is light and more readily transported than sand. Once at the south of the Lagoon, the very weak tidal flushing in that area is unable to remove this material and settling occurs (Namibian Ports Authority, 2013).

6.23.5 Geomorphology and Coastal Dynamics

The coastal area in the Walvis Bay area, including Sandwich Harbour, is an extremely dynamic and changing coastline due to wave action, currents and the wind.

6.1.2.1 Walvis Bay

The Walvis Bay Peninsula has had little anthropogenic change, however, is geomorphically dynamic. South of Donkey Bay, the coast is impacted by high energy, long period swells from the southwest causing huge quantities of sediment to be transported along the beach to the north, resulting in longshore deposition of sediment causing the Peninsula to change in shape and extend in length over the years (Simmons RE, 2015) (Namibian Ports Authority, 2013). The Peninsular is narrowest at Donkey Bay, which is at risk for a breach to occur, severing the northern part of the Pelican Point peninsula from the mainland. If a breach occurs, it is assumed that it will close within a short period of time due to the high sedimentation rate in that area (Walvis Bay Municipality, 2008). Appendix J provides further information on coastal sedimentation.

The mouth of the Lagoon has not significantly altered since 1987 and is considered to be stable with no trend of bed level changes. The eastern channel has slightly shifted to the east in 2012 and 2013. The Lagoon sandspit (the mouth area) has undergone some changes over the years, which appear to be naturally driven by wave and sediment supply from the west (see Section 6.1.2), which accumulates at the Lagoon entrance. The sandspit has grown over the years, but the growth rate has slowed down between 2007 and 2013 and seems to stabilise (Namibian Ports Authority, 2013).

6.1.2.2 Sandwich Harbour

Whilst outside the study area, it is important to document an example of the dynamics of coastline in an area that has had had minimal anthropogenic influence. During the 1970s the northern section of Sandwich Harbour was an extensive system of tidal mudflats, which drained brackish and freshwater pools. At its widest point, the beach was about one kilometre from the base of the dunes. Twenty years later, 1992, the sea has pushed back the beach towards the dunes, covering large portions of the vegetation with a blanket of wave-washed sand. Only a narrow channel still drains the pools at the far (southern) end. By 1997 the beach has closed against the dunes in the south and no tidal flow is possible. The vegetation is dying from increased salinity and the beach broadens as it moves closer to the dunes (Jenkins, 2015).

Figure 51 – Costal changes of Sandwich Harbour between the 1970s and 1997 (Source: (Jenkins, 2015) & Google Earth)

In more recent years, changes are also evident, illustrating the constantly changing coastline of the Walvis Bay area.

Figure 52 – Changes to Sandwich Harbour in the last eight years

6.23.6 Sedimentation and Siltation

Sedimentation and siltation in the Bay area occur as a result of natural processes and anthropogenic influences. The sediment transport inside the Bay is driven by wind generated and tidal currents. The sand transport might be further influenced by waves (Delta Marine Consultants, 2009). The next four sections provide further details on sedimentation and siltation.

6.1.2.3 Natural Influences

The movement of sediment within the central Namibian coastal region involves a dynamic interaction between land and marine components. The complex nature of the sedimentary environment within present-day Walvis Bay is a result of both fluvial and marine deposition over the past 6,000 years, as well as being impacted by the high productivity of the Benguela Current.

Due to the Benguela current, the background levels of suspended matter in the Bay area is considerable. Currents entering and flowing from the Lagoon carry sediments that are deposited, mainly at the mouth of the Lagoon. The natural shoaling processes of the tidal wave within the Lagoon causes the net inward transport of particulate organic matter, resulting in muddy sediments in the inner Lagoon, with high concentrations of organic matter and nutrients (Danish International Development Agency , 2003).

Modelling undertaken through the Agenda 21 studies (Danish International Development Agency , 2003) illustrates that it is likely that suspended solids enter the Lagoon from the Bay occurs during situations with a northerly wind. On land, the prevailing south-westerly winds drive sand northwards onto barchanoid dunes which flank the eastern side of the Lagoon. This sand at a rate in the order of 5,000m^3/yr, reaches the Lagoon which contributes to sedimentation, a small amount when compared to the tidal prism of the Lagoon, which is 4.3 million m^3 (Danish International Development Agency , 2003) (Namibian Ports Authority, 2013).

The natural flow of the southern arm of the Kuiseb river has been altered over time through the build-up of dunes and anthropogenic changes. This has resulted in a reduction in the size of the Lagoon and exacerbated the sedimentation process (Silverman, 2001).

6.1.2.4 Human Activities and Sedimentation

The Bay area has seen various development and human activities over the years: the growth of the town and the expansion of residential areas along the eastern shores and construction of hard structures of the harbour reduce wave action which contributes to a reduction in marine sedimentation; the Saltworks established in the 1960's, has resulted in a reduction the tidal sweep, possibly contributing to siltation; and each year, Namport dredge the Harbour entrance channel (see Figure 49), turning circle and tanker basin, resulting in excess of 2,000,000m^3 of sediment (Namport, 2006) which is dumped at one of three sites within the Bay area.

6.1.2.5 Decaying Organic Matter

In addition to meteorological, hydrological and human influences, natural sedimentation occurs as a result of the rich nutrient Benguela Current. Phytoplankton that takes up the nutrients provided by the Current is grazed by the zooplankton. Due to the large quantities of phytoplankton, a large proportion is not grazed and settles on the seafloor. These settled particles metabolise in the sediment causing an accumulation of anaerobically decaying phytoplankton at depths around 3 – 4m. This rich organic sediment has a high oxygen demand and is usually anoxic (depleted of dissolved oxygen). As a result of further decay, toxic hydrogen sulphide is released into the sediment (see Section 6.23.10 for sulphur eruptions), which bubbles into the water column and turns it anoxic (Appendix J).

6.1.2.6 THE LAGOON AND SEDIMENTATION

The combination of these natural and anthropogenic changes results in the Lagoon accumulating sediments. The studies undertaken for Agenda 21 (Danish International Development Agency , 2003), document that over the past 14 years, sedimentation has mostly occurred in the tidal channels. This is however not solely as a result of wind-blown transport as the wind-blown transport only affects the Lagoon edge. There is a high organic load in the bottom sediments at the southern end of the Lagoon that does not appear to have a wind-blown source. This organic material is partly transported into the Lagoon from the Bay, and partly generated by biologic activity in the Lagoon. These deposits might partly result from the stronger flood tide flows in comparison with the ebb tide flows.

The development of the first phase of Namport's Container Expansion project is believed to have resulted in an increase in sedimentation in the Lagoon (see Figure 53). This increase is resulting in indirect impacts, namely on bird number in the Lagoon (Appendix H) (see Section 6.1.2.15 for further information). This change could be one of the factors negatively affecting the local flora and fauna and illustrates how the Lagoon is susceptible to changes in the Bay, either human or natural influences.

It should be noted, that this event presented in Figure 53 is unrelated to a potential naturally occurring sulphur eruption.

Figure 53 – Google Earth images (august 2014 and January 2015) indicating conditions after the development of the phase 1 of the Namport Container Expansion project (Source: Appendix H)

6.23.7 MARINE SEDIMENTS

Coarse and medium sands are found near the mouth of the Lagoon, with fine, muddy sediments at the central and southern end. The inter-tidal flats have increased, and sub-tidal areas have decreased, due to progressive siltation. The harbour has a soft substrate/mud sediment bottom with depths up to 15m (Walvis Bay Municipality, 2008).

A thick, pungent, dark green diatomaceous ooze overlies fine to medium sand that has accumulated in sheltered parts of the Bay at depths below -3 to -4 m. Integrated sedimentary components of silt, diatomaceous muds, aeolian and marine sand trap organic-rich material containing naturally high concentrations of heavy metals. The organic-rich sediments have a high oxygen demand and can become anoxic. See Appendix J for further details.

The Lagoon sediment is high in organic matter, which may lead to higher levels of a number of environmental contaminants. Chemicals like phthalic anhydride, phenol, methylphenols, and indole are found in Lagoon sediments

(Delta Marine Consultants, 2010). Concentrations of heavy metals were detected within the Bay and Port area sediments, especially in and around the fish processing factories (Municipality of Walvis Bay, 2003). The concentrations of metals in the sediment of the Bay area are generally of the same order of magnitude as other harbours around the world. Cadmium levels are elevated; its toxicity is inversely related to salinity, and in an anoxic environment like Walvis Bay, its potential impact is reduced. See Appendix J for further details.

In the Lagoon, samples of marine sediments have been analysed (Namport, 2006) and results show that concentrations of heavy metal were found to be below the threshold effects limits (TEL), the limit where adverse biological effect usually or always occur. Sediment samples in the Lagoon also confirmed that sediments are below the 'effect range low' (ERL), the value of contaminants with an unlikely occurrence of biological effects. Both of these threshold values (ERL and TEL) have been recommended as quality limits by BCLME.

The concentrations of metals in sediments found in the Bay area and Lagoon are illustrated below. A graph illustrating concentrations of cadmium in sediment from the Lagoon and Bay area compared with threshold values adopted by BCLME is illustrated in Figure 55.

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Table 3-6 Concentration of metal in sediment samples mg/kg dw and for TBT mg/kg ww (COWI, 2003a, BCLME)

	As	Hg	Cd	Pb	Mn	Cu	TBT
Port Berth 8	9.81	0.25	6.46	195.16	105.06	119.42	0.04
Port Berth 7	7.85	0.33	5.85	117.42	109.83	54.84	<0.02
Port Berth 5	5.43	0.33	1.75	74.86	81.56	71.69	-
Port Berth 2	3.71	0.32	1.69	31.02	66.03	45.34	0.07
Fishing Port Outside Etosha	5.28	0.49	5.21	228.61	154.45	54.77	<0.02
Lagoon Line 3 Channel	2.76	0.28	0.44	9.36	37.59	9.02	<0.02
Lagoon Line 3 Middle	3.29	0.27	0.41	8.34	46.43	7.65	<0.02
Lagoon Line 3 Dry	1.45	0.25	0.16	4.83	44.50	4.88	-
Lagoon Line 5 Channel	2.57	0.33	0.29	2.26	19.62	2.51	<0.02
Lagoon Line 5 Middle	2.91	0.29	0.32	4.80	31.12	4.88	-
Lagoon Line 5 Dry	9.05	0.12	1.82	42.79	137.41	41.56	-
Bay 6 m	6.48	0.26	6.09	87.13	116.69	46.86	<0.02
Bay 11 m	8.38	0.35	9.50	9.61	59.16	16.00	<0.02
Fishing Port inside breakwater	6.76	0.29	4.86	45.41	114.40	35.71	-
Fishing Port Middle	8.39	0.33	5.39	69.51	107.47	60.08	<0.02
Fishing Port South	6.01	0.34	4.44	32.65	94.28	25.66	-
At Syncrolift	3.80	0.22	2.02	28.01	64.29	47.55	<0.02
At Oil pier	4.29	0.29	2.37	21.49	75.70	16.53	<0.02
Average	5.5	0,30	3.28	56.29	81.42	36.94	-
ERL (BCLME recommended guide-line values)	8.2	0.15	1.2	46.7	-	34	0.005
TEL (BCLME recommended guide-line values)	7.24	0.13	0.68	30.2	-	18.7	-

Figure 54 – Concentrations of metal in sediment samples (Source: (Namport, 2006))

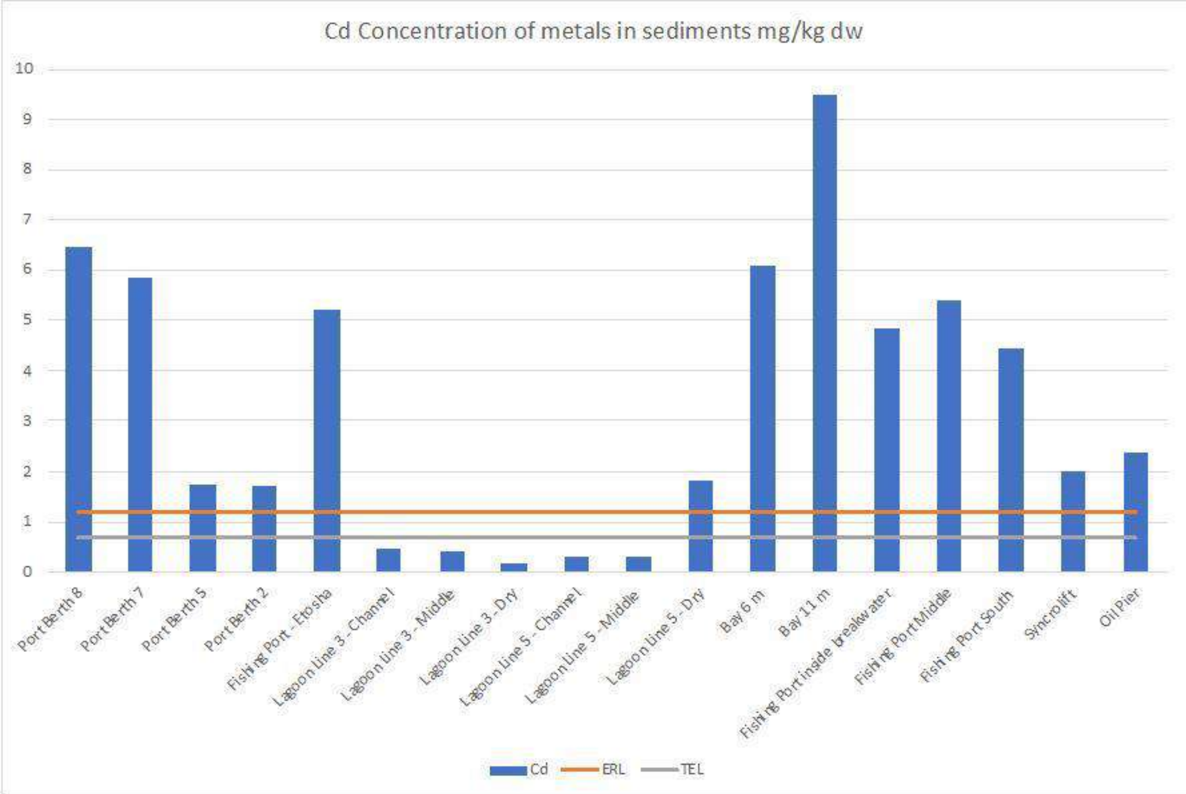

Figure 55 –Cadmium levels in sediments from the Lagoon and Bay area

6.23.8 WATER QUALITY

6.1.2.7 TURBIDITY

Turbidity is a unit of measure to determine concentrations of suspended solids (Section 6.23.6) and organic matter (see Section 6.1.2.5) in water, which is used as an indicator of water quality.

Water transparency deteriorates (i.e. increased turbidity) from Pelican Point towards the Bay, into the Harbour and further into the Lagoon. The suspended matter at Pelican Point is approximately 5mg/l and rises to 60mg/l in the southern part of the Lagoon (Delta Marine Consultants, 2010).

At Pelican Point the turbidity values are relatively high in the lower part of the water column. This indicates re-suspension of fine bed sediments, probably organic detritus (small particles of dead organic material), due to local wave and current conditions (Danish International Development Agency , 2003).

As part of the normal Namport operations, dredging of the entrance channel, turning circle and tanker basin is undertaken annually. Over 2,000,000m^3 of material is dredged from the sea floor, which is removed and transferred to one of three off-shore sites in the Bay area (Namport, 2006).

6.1.2.8 TEMPERATURE AND SALINITY

Lowest temperatures (approximately 12ºC) are found in the western, deep waters at Pelican Point, and highest temperatures (approximately 17ºC) at the shallow east coast and the mouth of the Lagoon. The temperature increase is due to the heating effect of solar radiation and the counter clockwise circulation in the Bay (Danish International Development Agency , 2003).

Variations of vertical salinity profiles in the Bay are very small. The Practical Salinity Unit (PSU) ranges between 34.8 and 35.5, with most values between the 35.1 and 35.3 range. A clear freshwater influence is found at the breakwater in the centre of the Bay on the east side and Bird Rock to the north-east side of the Bay, indicating an outflow of freshwater in the Harbour region. There is also no indication for outflow of high saline water from the Lagoon or for salinity stratification in the deeper areas of the Bay (Danish International Development Agency , 2003).

Due to its shallowness and dynamic nature, the Lagoon's temperature and salinity differ in different parts of the Lagoon and at different times. The limited flushing waters and organic loading in the southern section result in extreme conditions; surface heating and evaporation yield temperatures as high as 30°C and salinity values of 46 ppt in the southern-most tip of the Lagoon (University of Namibia, 2012). Bay water is found at the mouth, so salinity levels are much lower (Appendix J).

6.1.2.9 Pollution

The water quality of the harbour depends somewhat on the seasonally changing activity of the fish processing industry due to the discharge of organically polluted seawater and freshwater (Delta Marine Consultants, 2010). Pollution from fish factory effluent and commercial activities within the Harbour and surrounding area are thought to have reduced marine invertebrate biodiversity significantly. Effluent and waste discharges from the fish processing industry can require high oxygen for neutralisation, which diminishes oxygen levels in the water. This forces mobile fauna to migrate away and causes the death of sessile and sediment-dwelling organisms. In these oxygen-poor conditions, microbial communities such as anaerobic sulphate-reducing species take over and cause more emissions of sulphide (Delta Marine Consultants, 2010).

The biological and chemical oxygen demand is high in the Harbour area due to organic matter discharged from the fishing industries. Delta Marine Consultants, 2010 report that the average fish factory effluent is 1.7 times higher in chemical oxygen demand (COD) than the influent sea water. Measurements show that fish processing industry contributes about 700 mg COD/l against a maximum discharge limit of 75 mg COD/l permitted in the Water Act of 1956.

The biological oxygen demand (BOD) reduces further away from the Harbour breakwater and the effects of dissolved oxygen concentration in the Lagoon are small. However, during periods of high production, some impact can be expected due to spills from the fishing industry (Danish International Development Agency , 2003).

In the framework of the Local Agenda 21 Project, water quality samples were taken at 9 different stations, of which five stations were in the Bay area, one at the Lagoon entrance and three in the Lagoon. One of the main conclusions of the study is that the environmental conditions of the Lagoon do not appear to be governed by emissions of pollution from the town of Walvis Bay, the fishing industry or the harbour. It is, however, found that the water plume from the harbour vicinity reaches the Lagoon. The impact of the pollution load from man-made sources on the ecological and biological conditions in the Lagoon cannot be distinguished from the impact of the natural high load of nutrients and organic matter (Delta Marine Consultants, 2009).

6.1.2.10 Heavy Metals and Tributyltin

Heavy metals can become resuspended in the water column, however usually resettle very quickly (approximately five hours). Therefore Section 6.23.7 provides details on heavy metals.

TBT is commonly used in antifouling paints on the hulls of ships to prevent the attachment of molluscs, algae and other organisms. However, as a result of its persistent toxicity to sealife, TBT is being phased out in many countries, including Namibia. There are no approved guidelines for detection limits for TBT in Namibia. The Namport Container Expansion project EIA undertook a comparison of available data from the Bay area with the BCLME Guideline Values drawing extensively on the American Environmental Protection Agency's Ambient aquatic life water quality criteria for TBT. Concentrations of TBT in the water column at twelve different locations in Walvis Bay were higher than the

BCLME guideline values (Municipality of Walvis Bay, 2003). Concentrations have ranged from < 2.5 µg/l to 290 µg/l, with values exceeding guidelines around Berths 1 and 8 and Donkey Bay. TBT below 20 µg/l is considered low; however, analysis of concentrations below the detection limits might still be three times higher than the recommended guideline values. (Delta Marine Consultants, 2010)

6.23.9 Harmful Algal Blooms

Harmful algal blooms (also known as red tides) occur in Walvis Bay as a result of changes in the marine environment, for example through reduced circulation, increased sea temperature and/or changes in nutrients from pollution events. These blooms usually occur in the summer and autumn and can cause low oxygen events which can lead to catastrophic effects on the marine community; in 2008 a *Ceratium fura* bloom result in the largest rock lobster walkout in Namibian recorded history. Appendix J provides further information.

6.23.10 Hydrogen Sulphide Eruptions

Sulphur eruptions are associated with aerobic decomposition of organic material within the sediments, which results in the generation of methane, sulphur dioxide and hydrogen sulphide gasses that become trapped within the layers of organic-rich, anoxic mud. Over time, the pressure exerted by the expansion of these gasses in the sediment, causes the gas to erupt into the water column. These events strip the surrounding water column of dissolved oxygen, resulting in mass mortality of the local marine community. These events are common in Walvis Bay, however as these are natural, recurrent events, the local biota has adapted to the toxicity levels and the associated hypoxic water conditions (Appendix J provides further information).

6.23.11 Marine Habitats and Species

The Benguela Current is one of the most productive ocean areas in the world, however the marine environment carries relatively low biodiversity in all the major marine habitats due to the extremely variable nature of the marine environment at a range of temporal and spatial scales (Appendix J).

The nutrient-rich waters of the Benguela system provide food for phyto- and zooplankton which leads to high biological production and large numbers of pelagic fish such as pilchard, anchovy and juvenile horse mackerel, which in turn sustain an abundance of top predators such as whales, dolphins, shark, turtle and seabirds. The soft-bottom fauna (benthic fauna) is abundant (however species poor (see Section 6.1.2.5) and also provides food for the bird and fish populations.

6.1.2.11 Benthic Fauna

Because of the low oxygen concentration in the sediment (see Section 6.1.2.5), benthic fauna in the Bay area is species-poor. The limited suite of species found are adapted to conditions of low oxygen concentration, and the biomass is dominated by few opportunistic species. The Bay and Lagoon are flushed (6.1.1.6), however this is limited and results in the sediment surface being devoid of other bacterial life below several meters and the biodiversity being reduced to a few species that can tolerate recurrent anoxic conditions (low oxygen concentrations) or can recover fast after oxygen problems. Appendix J provides further information on low oxygen events.

6.1.2.12 Zooplankton

The high production of phytoplankton in the Lagoon is based upon nutrients generated as well as imported into the Lagoon by the tides and currents. Zooplankton finds a plentiful food supply from the phytoplankton, detritus and bacteria in the water and are encouraged by high nutrient levels, warm temperatures and calm water (Walvis Bay Municipality, 2008).

Within the Salt Pans, plankton species include several species of the salt-tolerant unicellular green algae such as Dunaliella species; Rhodobacteria and Halobacteria (which produces the dark reddish colour of the brine water) are common residents of the evaporation ponds. In addition, a variety of cyano-bacteria (blue-green algae) such as Anabeana, Microcystis; and the brine shrimp (Artemia) are also found. B-carotene originally from Dunaliella and passed on to brine shrimp, who feed on Dunaliella, is responsible for the pink pigment in flamingos (Walvis Bay Municipality, 2008).

The red colour from the Halobacteria is important in the operation of the ponds as more colour in the water increases the heat absorption of sunlight, increasing the temperature of the water and also the evaporation rate. In addition, the red colour from the Halobacteria is found in the blue-green algae on which both the Lesser and Greater Flamingos feed (Walvis Bay Municipality, 2008).

The maintenance of the physical structure of the salt pans currently facilitates the continued existence of benthic and planktonic animals and plants and the birds that feed on them (Walvis Bay Municipality, 2008).

6.1.2.13 Zoobenthos

Zoobenthos are animals that live on, in or near the seabed and are good indicators for the status of marine ecosystems, which can play an important role in both structuring the habitat and as prey for commercially valuable species. A survey conducted in 2012 recorded 18 species from seven phyla of marine benthic invertebrate organisms, which varies considerably from previous surveys; a decrease in the number of species is being encountered. The Polychaeta are the predominant Zoobenthos in the Lagoon and wetland area, which can be associated with their tolerance to high levels of pollution. Crustaceac and Cnidaria are also relatively abundant and present in the samples, with fewer species of Echinoderms, Bivalvia, Spincula and Newmertins. Species richness is greatest in the mouth of the Lagoon, and declines the further into the Lagoon, which could be attributed to the restriction of water reaching that part of the Lagoon. The far south of the Lagoon had no benthic life (University of Namibia, 2012).

6.1.2.14 Mammals, Fish & Invertebrates

Marine mammals found in Namibian waters, including the Bay area include cetaceans and seals: a colony of Cape fur seals (Arctocephalus pusillus) is resident on the Peninsula; eight species of baleen whales including Southern Right, Bryde's and Humpback have been seen in Namibian waters; and 23 species of dolphin and toothed whales have been recorded, the most common being the Common, Dusky and Bottlenose Dolphins and the endemic Heavyside's Dolphin (considered as vulnerable due to its limited distribution). Appendix J provides further details on the marine mammals in the Bay area.

Bottle-nosed Dolphins (*Tursiops truncatus*) and whales are observed around the Peninsula and frequently enter the Lagoon. A large proportion of the Bottlenose population uses the shallow waters of the Lagoon for feeding, socializing and resting on a regular basis and this area appears to be a biologically significant area for this population (pers. comm Dr. Simon Elwen NDP 2017). Due to the shallow nature of the Lagoon and the tidal range, dolphins have been known to become stranded in the Lagoon by the outgoing tide. Two stranding events have occurred in recent years: a mature humpback whale on the 14th March 2009 and a mass stranding of 19 bottlenose dolphins in the inner Lagoon on the 16th March 2009 (Simmons RE, 2015) (Elwn, SH and Leeney, EH, 2009).

According to feedback from the Namibian Dolphin Project, the Bottlenose dolphin population inhabiting Walvis Bay numbers is approximately 100 individuals, making it one of the smallest populations of any mammal in southern Africa. This population has been stable (pers comm. Amanda Rau, 15th February 2018), however the population is affected by human activities within its range including marine tourism activities, activities associated with the Namport Container Expansion project, prey depletion and desalination plants amongst others (Appendix J). This pod of dolphins was reported to move north during the two and half years of construction works associated with the phase 1 Namport Container Expansion project (pers com. Amanda Amanda Rau, 15th February 2018).

The Walvis Bay Peninsula is sandy with no vegetation and supports sandy shore animals such as sand hoppers and white mussels, as well as many terrestrial insects. A few marine salt and sand tolerant plant species are scattered on the inland side of the Peninsula. The harbour wall offers rare surfaces for the attachment of indigenous sessile marine animals such as mussels, barnacles, tube worms, sea squirts and lace-animals. However, pollution from fish factory effluent within the harbour is thought to have reduced marine invertebrate biodiversity significantly (Simmons RE, 2015).

The Lagoon is characterised by two main habitats: extensive shallow, sandy shores that are regularly covered and exposed by tidal action and the sub-tidal deeper (up to 5 m) waters of the southern harbour area. The larger invertebrate fauna in the Lagoon is typical of the Southern African west coast with a high density but low diversity. Distribution of fauna are determined by the varied habitat as well as variations in oxygen levels. Coastal fish species are said to have been caught in great numbers in the Lagoon in the past. Presently large schools of small mullet and springer and some skates and rays are found (Simmons RE, 2015).

Crowned crabs are abundant at the mouth and high densities of bivalves and tubeworms are supported at the mouth and northern reaches of the Lagoon. The middle sub-tidal area supports the greatest species diversity and density of invertebrates in the Lagoon. The southern third of the Lagoon is nearly devoid of bottom-dwelling invertebrates, presumably because of anoxia. The inter-tidal flats support a limited fauna of invertebrates, dominated by small polychaete worms (Simmons RE, 2015).

The evaporation ponds in the Lagoon are used for commercial farming of oysters. Activities associated with the oyster farming has resulted in affecting some marine mammals including whales and bottlenose dolphins.

6.1.2.15 Marine Bird life

As a result of high productivity of the sea life and plankton due to the nutrient-rich Benguela current, wetland areas and available roosting sites, a unique and abundant birdlife is present in Walvis Bay. The bird life is the primary interest of the wetland (and the primary reason for the Ramsar designation – see Section 6.23.12) and provides great conservation value, locally and internationally, as well as economic value from tourism. Walvis Bay holds the largest number of birds than any other wetland in southern Africa, which is predominantly dominated by wading birds. The number of wading birds are highest in the austral summer when all the migrant waders congregate at the coastal wetlands. The winter numbers reflect, mainly, the resident species with a few over-wintering sub adult migrants that do not need to head back to the northern hemisphere (Appendix H).

There are four main waterbird habitats within the Walvis Bay wetland complex: the sandy shoreline (including the Peninsula), intertidal mudflats, shallow sheltered water, and constructed saltpans. The most important feature of the area is the mudflats which are exposed at low tide, providing several sandbars serving as roosting sites for a diverse range of wetland birds, including migrant waders and resident species.

The Peninsular provides a suitable ground for numerous terns to roost, and various seabirds colonise the area; the bird count in summer months average out at approximately 150,000 individuals. In the Lagoon wading birds, rather than seabirds, predominate (40% of the waders in the area), and approximately 20 bird species regularly occur in numbers greater than 1% of the world's population.

The salt pans support up to half various species of bird, where they feed in the shallow pans that have a steady artificial influx of particles and nutrient-rich water that fuels the benthic and pelagic food-chain. The pans are also good habitat for rarer waterbirds such as the Rednecked Phalarope (*Phalaropus lobatus*), Common Redshark (*Tringa totanus*), Eurasian Curlew (*Numenius arquata*) and Bairds Sandpiper (*Calidris bairdii*) (Walvis Bay Municipality, 2008).

The broad groups of birds found in the Bay area are Terns, Gulls, Cormorants, Pelicans, Sandpipers, Plovers, Grebes, Flamingos and other species. The most numerous species are lesser and greater flamingos, with sometimes more than 40,000 individuals. Eleven endangered species have been observed in the area (IUCN Red List) and 9 of the 25 species are Namibian threatened Red Data species (see Appendix H); one of these species, the Chestnut-banded

Plover present almost half of the world's population. The Bay supports a range of migratory birds which breed elsewhere (northern hemisphere and Africa), however when rains fail, Intra-African migrants will breed at Walvis Bay. Resident wetland birds e.g. pelicans and Damara Terns are present all year and breed along the Namib coast (Appendix H).

The open desert landscape and the presence of predators, mainly Black-backed Jackals and Kelp Gulls (*Larus dominicanus*), combine to limit opportunities for ground-nesting birds to breed at Walvis Bay. The wetland therefore serves mainly as a dry-season and drought refuge for intra-African migrants and as a non-breeding area for Palearctic migrants (Appendix H).

Thirty years of twice-yearly bird counts have been undertaken. A summary of the trends found are as follows:

- Significant population declines have occurred since the early 1990s in four of the 12 long-distance migrants investigated (Turnstone, Ringed Plover, Red Knot, Little Stint);
- In contrast, resident or short-distance migrant wader populations all exhibited stable or increasing population levels relative to the early 1990s;
- Population levels increased for White-fronted Plover (Charadrius marginatus), Chestnut-banded Plover, Black-winged Stilt (Himantopus himantopus), Pied Avocet (Recurvirostra avosetta), and Greater Flamingo (Phoenicopterus ruber) relative to the early 1990s;
- The most abundant waders in these wetlands, Curlew Sandpiper and Sanderling (Calidris alba), had stable populations, although both populations may have had slightly higher levels from 2005 to 2006. Both species showed a marked drop in winter counts, especially in 2009 and 2010.

Overall migrant birds have been declining in abundance, while resident and intra-African migrant are stable, or increasing, at Walvis Bay over 30 years. Overall, despite the declines exhibited by some long-distance (Palearctic) migrants, and the stability or increases in resident species, no differences between Walvis Bay and Sandwich Harbour were found (Simmons et al, 2015). This suggests that Walvis Bay showed no adverse effects of the harbour facilities of the time or the potential dangers of pollution from bilge water, or oils. However, this is not true of the Lagoon (see below).

The Lagoon is estimated to hold around 40% of the total number of waders found in the wetland (Ramsar site), therefore is very important to the avian community in Walvis Bay. The counts taken since the mid-1990s illustrate various changes to the bird community. The two key findings identified are:

i) The Chestnut-banded Plover and Lesser Flamingo increased in numbers. These species prefer saline saltpans, which may suggest conditions are becoming more saline; and
ii) For the majority of comparisons, the species in the Lagoon showed declining numbers; and overall abundance dropped by 42% in the 20 years since the mid-1990s. Given that long term trends (Simmons et al. 2015) show only four of the 12 long-distance migrants and none of the resident species have declined overall in the Walvis Bay wetland in the last 30 years, these declines in the Lagoon cannot be explained by broad-scale declines.

The conclusion drawn from the Avian Study (Appendix H) is that changes to the Lagoon environment itself are the cause of these avian declines. The changes to the Lagoon can be associated with both natural and anthropogenic influences, namely the long-term impact from the flow of the Kuiseb River being diverted; and the construction activities of the Namport Container Expansion project. The decrease in the average number of wetland birds using the Lagoon was recorded immediately after the Namport Container Expansion project: the average numbers dropped from 21,078 to 17,406, a decline of 17% in four years (two years before the project and 2 years after). The long-term decline in wader numbers of approximately 42% over a 20-year period, gives an average rate of decline of approximately 2.1% per year. This does not prove that the Namport Container Expansion project caused the decline of birds using the Lagoon, but the fact that it is associated temporally with it, and doubled the rate of decline over a short period, strongly suggests the two are linked.

The reduction in bird numbers can be attributed to sedimentation, salination, pollution and/or disturbance. An increase in sediment (see Section 6.23.6) may decrease feeding opportunities, decreasing the likelihood that wading birds will use the area.

6.1.2.16 Important Bird Area

In addition to the Ramsar site which is also an Important Bird Area (IBA) (Birdlife International, 2018), the 30km section of coastline from Walvis Bay to Swakopmund is designated as an IBA, an internationally recognised area by Birdlife International (Birdlife International, 2018) (see Figure 31). This area has up to 770 birds per kilometre of shore line, which is the highest linear count of birds anywhere in Southern Africa. The importance of this coastline for birds is largely due to the high productivity especially on the rocky shores and the sheltering effect of the Pelican Point Peninsula (Walvis Bay Municipality, 2008).

Approximately 9km north of Walvis Bay is an artificial guano platform a for nesting birds from which the guano is harvested annually (Walvis Bay Municipality, 2008).

6.23.12 Walvis Bay Ramsar Site

The Walvis Bay Ramsar Site was designated on 19th June 1995, as the wetland was considered of international importance due to its ornithological significance (detailed above). The site is considered as one of the most important coastal wetlands in Southern Africa for its birdlife, which supports up to 250,000 individual birds at peak times during the summer season.

The wetland site consists of the natural areas of Walvis Bay Lagoon, Pelican Point (southern half) and the adjacent intertidal areas. It also includes the Walvis Bay Salt Works, including the artificially flooded evaporation ponds, and the area to the south which occasionally floods (Ramsar, 2017) (see Figure 56). The only terrestrial vegetation in the wetland is the extensive riverine vegetation in the Kuiseb Delta and in the Kuiseb ephemeral river.

The site is approximately 4,000ha (40km^2) and the most important characteristic of the site is the mudflats exposed at low tide which provides a feeding area for various bird species, the qualifying feature. The Walvis Bay Ramsar site and Sandwich Harbour Ramsar site located approximately 55km south of Walvis Bay, are Namibia's most important coastal wetlands which support eight endangered species and individually support more waterbirds than any other coastal wetland area in Southern Africa (Delta Marine Consultants, 2010). Appendix H and J provide more info on the Ramsar Site and environmental interfaces.

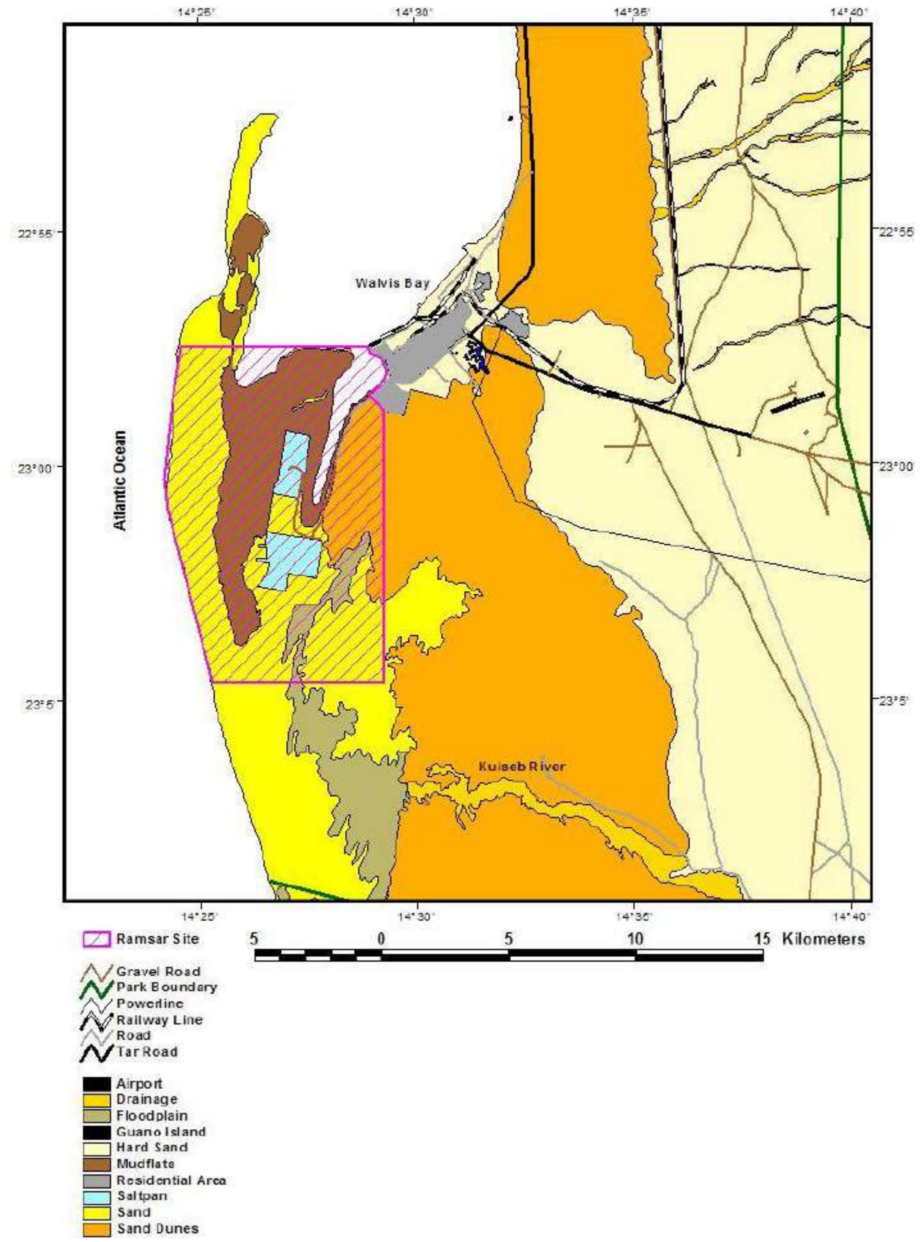

Figure 56 - Walvis Bay Ramsar Site [Source: (Ramsar, 2017)]

Various environmental interactions and processes contribute to the diverse and dynamic site. The bird life is supported and made up of distinct attributes including the mudflats exposed at low tide, the numerous sandbars, water quality and hydrodynamics, and marine ecology. Changes to the environmental characteristics of Bay area and in particular the Lagoon such as sedimentation, recharge and flow rate, and chemical composition could impact the environmental conditions thereby impacts the attributes of the site. This, in turn, can indirectly affect the bird populations, and thus jeopardise the loss of the international designation and potentially impacting the local tourism industry and other ecological services.

Current threats to the Ramsar Site includes the development along the edge of the Lagoon, which could affect bird populations; natural siltation; natural geomorphological changes to the coastline; the fishing industry; tourism activities; pollution; and development within the marine environment, namely the Namport Container Expansion project.

6.24 Future Baseline

As described in previous sections, the development of the Bay area and receiving environment have seen various changes over the years as a result of both anthropogenic influences, and natural processes and systems. These changes will continue to change, thereby the baseline of the social and environmental baseline described in the earlier sections is likely to change within the timeframe and lifetime of the proposed project.

This Section provides a high-level description of the predicted and potential future changes of sensitive environmental and social features and attributes (the Future Baseline). The described future baseline is focussed on the area surrounding the proposed project site and the direct receiving environment. The existing baseline, trends identified through studies, assumptions and professional judgment have been used to develop this high-level summary.

The purpose of this summary is to provide an understanding that the environmental and social baseline will continue changing in the absence of the proposed project. This summary is a prediction and is focussed, and does not provide an assessment of these changes. As part of an ESIA, it is important to understand the future baseline and apply this to the assessment to identify likely future significant impacts, particularly in the CIA (International Finance Corporation, 2013).

6.24.1 Town Development

As a result of economic growth in Namibia driving development, the town of Walvis Bay will continue to develop as set out in the IUSDF (Municipality Walvis Bay, 2014) and summarised in Section 6.11.1. The major infrastructure projects in the area are the development of the South Port (the Namport Container Expansion project) and the North Port. As a result of the increased capacity and subsequent increase in operations, there will be significant downstream developments and knock-on effects. There will be a requirement for local services, amenities and facilities, and housing for example, which will all contributing to the town's growth as well as altering the environmental and social baseline, for example an increase in vehicles on the road and other modes of transport is very likely, thereby altering the noise levels and potential local air quality.

In addition to industrial growth, tourist arrivals are set to increase from 1.4 million to 1.8 million by 2021/22 and increase employment from 29,000 to 43,000, as per the 5th NDP. This will result in various direct and indirect changes to the environment and society in Walvis Bay and the Lagoon area, including but not limited to an increase in local businesses and other service providers (restaurants, hotels, downstream providers); an increase in tourism activity providers and associated operations; an increase in recreational activities (e.g. fishing, boating and tours); an increase in noise levels; a potential reduction in unemployment; and further development and infrastructure to support the growth.

Committed development in the area surrounding of the proposed project site are the second and third phases of the Namport Container Expansion project (see Section 6.11.2 for further information). There is potential for other development in the local area, for example the Namport waterfront development; the development Lovers Hill facilities (both of these identified in the IUSDF); and the development of the adjacent property on the north-western corner of erven 4941 (Namib Times, 12th January 2018). With an increase in tourism, activities in the surrounding marine environment are also likely to increase, as well as traffic on the local roads and number of visitors to the Lagoon area.

6.24.2 The Lagoon Environment

The Lagoon is a valuable environmental and social receptor: it forms a fundamental component of the Ramsar site; it draws tourists to the area for the bird life; is used recreationally by visitors and local residents; supports several businesses namely the Salt Works and maricultural; supports an important avian community; and provides an area for marine mammals to feed and rest.

The Lagoon environment is a complex system composed of various attributes that come together to form a unique ecosystem. The key attributes and influences are: the flow and tidal flushings (currents and tides) into and out of the

Lagoon and around the Bay area; sedimentation; water quality (BOD, COD, salinity and temperature); nutrient levels and supporting phyto- and zooplankton. The key attributes that are likely to continue to change are discussed in the following sections.

6.24.3 The Lagoon: Water Flow & Refreshment Rate

The hydrodynamic modelling undertaken for the Namport Container Extension project modelled flow and current conditions as well as refreshment rates for the existing baseline and future baseline, which includes the completion of all three phases of the Namport Container Terminal. The model demonstrated that there would be a change to the current patterns, in particular in the southern part of the Bay as well as the currents in and out of the Lagoon. The Lagoon refreshment rates could be reduced by 10 – 15% under certain conditions, in addition to the port basin refreshment rates, and the infrastructure will reduce water exchange between the port basin and the Lagoon (the natural clockwise circulation) (Delta Marine Consultants, 2009).

The completion date of all three phases of the Namport Container Extension project is unknown at this stage, however it can be assumed they will not commence until 2025; at least four years after the proposed project is completed. The changes to the currents and refreshment rates will therefore not occur until the proposed project is operational.

It should be noted at this stage, that the hydrodynamic modelling undertaken for the proposed project (Appendix I) only modelled the first phase of Namport's Container Extension project, which was almost complete at the time of modelling. Phases 2 and 3 were not modelled as the presence of the marina would not impact the hydrodynamics of the Bay and Lagoon (Pers Comm Hendrick Bergmann, DMC, 13th December 2017).

The change to the currents and reduction in the refreshment rate would result in indirect changes to other attributes that make up the Lagoon's ecosystem.

6.24.4 The Lagoon: Water Quality

Due to the potential changes to the hydrodynamics of the Bay area and thus the Lagoon, the water quality in the Lagoon is also likely to change. The temperature and salinity could increase across the Lagoon due to reduced flushing; pollution may increase due to increased activities in the marine environment and may not effectively be flushed out of the Lagoon; and harmful algal blooms and hydrogen sulphide eruptions may worsen due to reduced circulation and increase in temperature.

6.24.5 Sedimentation and the Lagoon

6.24.5.1 Continual Sedimentation

As discussed in Section 6.23.6, various natural and anthropogenic influences contribute to sedimentation in the Lagoon. With regards to natural processes, it is assumed sediment will continue to be transported into the Lagoon at the current rates from the surrounding dunes by south-westerly winds and from the Bay through the natural flushing and hydrological processes, as well as through continued biological activity. Based on the Lagoon profiles measured over the last 14 years and considering likely survey inaccuracies, it has been calculated that the Lagoon is accreting at a rate in the order of 5,000m^3/yr (Danish International Development Agency , 2003). In addition, it is also assumed that historical changes continue to have an influence (Salt Works and changes to the Kuiseb river) as well as current operations (Namport maintenance dredging) further exacerbating the sedimentation of the Lagoon.

6.24.5.2 Construction of Namport's Container Expansion

As discussed in Section 6.11.2, the second and third phases of Namport's Container Expansion project is still to be undertaken. Namport's Hydrological Study (Delta Marine Consultants, 2009) estimated that the dredged material during phase 1 to be 4,265,256m^3, 8,208,657m^3 for phase 2 and 3,508,768m^3 for phase 3. The dredging works in phase 1 took approximately two and a half years, therefore it can be assumed that dredging works during phases 2 and 3 could take eight years. These dredging activities are very likely to contribute to increasing sedimentation in the

Bay area and the Lagoon, which would cause changes to the Lagoon's environment thereby having knock on impacts to dependent receptors, namely birds.

The construction of the first phase of the Namport Container Expansion project has been observed to increase suspended solids and result in sedimentation in the Bay and Lagoon. As stated in the Limitations Section (3.2.1), turbidity monitoring data (organic matter and sediment) was requested from Namport the period between 2014 and 2016, however was not made available for inclusion in the ESIA and this ESIA report; it is currently unknown if Namport undertook data collection throughout the duration of the construction works of phase 1. It is therefore assumed based on visual observations and modelling outputs from the Namport Hydrodynamic Report, that sedimentation increased during this time, entered and settled in the Lagoon. The extent is unknown, however indirect impacts on the avian life across the Lagoon have been recorded (see Section 6.1.2.15).

In the absence of data, the Namport hydrological study is relied upon (Delta Marine Consultants, 2009). The study modelled dredging plume simulations for phase 1 construction works (phases 2 and 3 were not modelled). During construction, the sediment plume would spread in front of the entrance of the Lagoon (the mouth), from where the sediment plume enters the Lagoon during the subsequent flood tide. It was predicted that the concentration of suspended sediment in the Lagoon would locally rise to 0.5-1.0kg/m^3. This is higher than the commonly accepted value of 0.15kg/m^3, however the report concludes that the Lagoon would only be exposed to these high sediment loads for a very short duration, shorter than 1 week during the initial construction activities (the duration of these activities was not provided). The Lagoon would continue to be exposed to sediments throughout the construction phase, however would reduce progressively through the phase and would be below 0.15kg/m^3 for the remainder of the construction works.

The settlement of these sediments was also modelled. After three days, most of the sediment would settle in the deeper part in front of the Lagoon entrance (the mouth), and a small amount would settle in the Lagoon (mainly along on the banks). The total sediment load on the Lagoon was calculated to be in the order of 200 ton.

Whilst the modelling outputs present an indication of the sedimentation in the Lagoon as a result of constructing phase 1, the actual conditions and changes to the Lagoon have not been recorded and additional modelling undertaken with these results. It can therefore only be assumed that similar sedimentation will occur for phases 2 and 3, which may be worse for phase 2 due to the amount of material to be dredged; 8,208,657m^3, twice the amount for phase 1. However, the slight reduction in the currents in the Bay from phase 1, which will reduce further as phases 2 and 3 are constructed, may influence the spread of sedimentation into the Lagoon.

6.24.5.3 OPERATIONS OF NAMPORT'S CONTAINER EXPANSION

The hydrodynamic modelling undertaken as part of the EIA for the Namport Container Extension project also modelled and analysed sediment transportation in the marine environment once all three phases are completed. The study concluded that the port development will have an influence on the sedimentation and erosion rates in the Lagoon, resulting in the bathymetry of the Lagoon altering. Accretion and erosion for both the Lagoon and tidal flats were identified; the average rates increased slightly from the baseline with the most noticeable difference occurring on the tidal flats (Delta Marine Consultants, 2009):

- **Lagoon:** The size of accretion and erosion areas, and the average accretion and erosion rates are almost unchanged (reduced by less than 5%).
- **Tidal flat:** The erosion area is slightly enlarged, the accretion area is reduced in size (by about 15%). The average accretion rates are somewhat reduced (by about 30%), the erosion rates are also slightly reduced (by about 10%.

The following morphological changes in the Lagoon were identified through the modelling and are predicted to occur once all three phases are completed:

- The bed level will be slightly lowered along the western banks of the Lagoon;

- Smaller patches with local erosion or sedimentation are expected in the northern part of the Lagoon; and
- Some sedimentation is expected at the eastern banks of the entrance to the Lagoon.

6.24.5.4 Future Sedimentation in the Lagoon

Taking into consideration the sources of sedimentation outlined above, it is likely that the Lagoon will continue to be exposed to increased suspended solids and sedimentation through both anthropogenic and natural processes, which may be further exacerbated through a reduced flow rate due to the structure of the completed Namport Container terminal. Collectively, this would result in further changes to the Lagoon's environment and ecology, and thereby affect dependent features (e.g. birds).

It is highly likely that human activities are speeding up the siltation of the Lagoon.

6.24.6 Bathymetry, Geomorphology and Coastal Dynamics

As documented in Section 6.23.5, the coastal area around Walvis Bay is a highly dynamic coast that constantly changes due to natural processes such as wave action, currents and sediment supply (see Figure 51 and Figure 52). In the Bay area and Lagoon, the eastern channel in the mouth of the Lagoon slightly shifted to the east in 2012 and 2013; and the Lagoon sandspit has grown over the years but has slowed down between 2007 and 2013 and seems to be stabilising. Natural changes are expected to continue; however, these changes are unknown due to the influence of anthropogenic activities.

The development of Namport Container Expansion project (all three phases), may contribute to the changes of the coastline. There is potential for the new development to accelerate coastal erosion and accretion due to the changes in the circulation of the Bay and the refreshment rates of the Lagoon (see Section 6.24.3). The depth of the Lagoon and the characteristics of the seafloor are likely to change as a result of this.

6.24.7 Marine Mammals

The most sensitive marine mammals (receptor) in the local environment are the Cetacea. As discussed in Section 6.1.2.15 various species are found in the Walvis Bay area including eight species of baleen whales and 23 species of dolphin. Despite the increase in commercial activity within Namibia's Economic Exclusion Zone, visual observations suggest that whale and dolphin populations have been increasing in the last decade. The population of Bottlenose dolphin has been stable as well as the Heaviside's population (pers comm. Amanda Rau, 15th February 2018). During phase 1 of Namport's Container Extension project, the Bottlenose Dolphin moved away from the Bay and Lagoon area to Langstrand (Long Beach). The reasons for this move for example was it their food relocated, or they moved due to disturbance is unknown. It can be assumed however, that through the construction of phases 2 and 3, the Dolphins will relocate again.

Due to the hydrological changes in the Bay area and the Lagoon (see above), there is potential for anoxic conditions to spread from the southern area of the Lagoon towards the centre. This could increase the area that is devoid of bottom-dwelling invertebrates, which could potentially cause secondary impacts to the supporting ecosystem, e.g. reduce fish stock and bird life.

In addition to the construction of the Namport Container Extension project, other activities will increase in the area: the operations of extended port shall increase, thereby increasing number of vessels in the Bay area; tourism is expected to increase thereby increasing the number of recreational activities in the marine environment; and fishing is likely to increase (to name a few). These can all directly and indirectly alter the marine environment that Cetacea use. There is therefore potential for Cetacea to move away from the area and use areas with fewer anthropogenic influences, e.g. Sandwich Harbour.

6.24.8 Bird Life & Ramsar Site

The Lagoon which forms a fundamental component of the Ramsar site is estimated to hold around 40% of the total number of waders found in the wetland (Ramsar site), therefore the Lagoon environment is very important to the avian community in Walvis Bay and Southern Africa. Any changes to the Lagoon's dynamics or supporting attributes could affect the avian wildlife (as discussed in Section 6.24.2).

As part of the Avian Impact study (Appendix H), the impacts on bird numbers in the Lagoon as a result of phase 1 of the Namport Container Extension project were investigated. A decrease in the average number of wetland birds (using 35 years of data) using the Lagoon was recorded immediately after the Container Expansion project and an increase in bird numbers was recorded in bird counts taken in early 2018. The study concluded that an increase in sedimentation in the Lagoon has occurred since the construction of phase 1 which could be one of the leading factors that have negatively affected the local flora and fauna of the Lagoon.

It is expected that the diversity of the bird population and numbers of individuals will change in the future due to the historical and current anthropogenic and natural systems and direct and indirect changes to the Lagoon environment. It has however, been documented that certain activities have exacerbated the situation, namely phase 1 of the Namport Container Extension project. It is therefore expected that phases 2 and 3 are likely to affect the Lagoon's environment (discussed in the preceding sections) to a similar degree due to the predicted extended construction schedule (see Section 6.11.2).

Taking into consideration the potential future changes to the Lagoon environment, the qualifying features of the Ramsar site may be affected. The changes to the bird populations will also alter the number and type of tourists of visit the area, which may indirectly alter tourism service providers and the local economy.

7 PREDICTION AND EVALUATION OF IMPACTS METHODOLOGY

7.1 INTRODUCTION

Chapter 3 provides an overview of the ESIA process detail each of the steps undertaken to date, the current one, and future ones. Prediction and evaluation of impacts, Step 4, is the key step in the ESIA process. This chapter outlines the method followed to predict and evaluate the impacts arising from the proposed project. The findings of the assessment are presented in Chapter 8.

This chapter provides the following:

- Details on the assessment guidance used to develop the methodology;
- Lists the limitations, uncertainties and assumptions with regards to the assessment methodology;
- Details how impacts were predicted and evaluated, and how the level of significance was derived;
- Details how mitigation was applied in the assessment and how additional mitigation was identified; and
- Details the CIA method.

7.2 ASSESSMENT GUIDANCE

The principal documents used to inform the assessment method are:

- International Finance Corporation standards and models, in particular Performance Standard 1, 'Assessment and management of environmental and social risks and impacts' (International Finance Corporation, 2017) (International Finance Corporation, 2012);
- International Finance Corporation Cumulative Impact Assessment (CIA) and Management Good Practice Handbook (International Finance Corporation, 2013)
- Namibian Draft Procedures and Guidance for EIA and EMP (Republic of Namibia, 2008);
- International and national best practice;

7.3 LIMITATIONS, UNCERTAINTIES AND ASSUMPTIONS

The following limitations and uncertainties associated with the assessment methodology were observed:

- Topic specific assessment guidance has not been developed in Namibia. A generic assessment methodology was applied to all topics using IFC guidance and professional judgement;
- Guidance for CIA has not been developed in Namibia, and a single accepted state of global practice has been established. The IFC's guidance document (International Finance Corporation, 2013) has been used for the CIA; and
- Due to professional judgement being applied, it has been difficult to indicate the degree of confidence for the assessment findings.

7.4 DETERMINATION OF SIGNIFICANCE

The evaluation and prediction of environmental and social impacts require the assessment of the project characteristics against the baseline of environmental and social characteristics, and ensuring all potentially significant impacts are identified and assessed.

The significance of an impact was determined by taking into consideration the combination of the sensitivity and importance/value of environmental and social receptors that may be affected by the proposed project, the nature and characteristics of the impact, and the magnitude of potential change. The magnitude of change (the impact) is the identifiable changes to the existing environment which may be direct or indirect; temporary/short term, long-term or permanent; and either beneficial or adverse. These are described as follows and thresholds provided in Table 19 to Table 20.

- The **sensitivity and value of a receptor** is determined by identifying how sensitive and vulnerable a receptor is to change, and the importance of the receptor (internationally, nationally, regionally and locally).
- The **nature and characteristics of the impact** is determined through consideration of the frequency, duration, reversibility and probability and the impact occurring.
- The **magnitude of change** measures the scale or extent of the change from the baseline condition, irrespective of the value. The magnitude of change may alter over time, therefore temporal variation is considered (short- term, medium-term; long-term, reversible, reversible or permanent)

Table 18 - Sensitivity and Value of Receptor

SENSITIVITY AND VALUE	DESCRIPTION
High	Of value, importance or rarity on an international and national scale, and with very limited potential for substitution; and/or very sensitive to change, or has little capacity to accommodate a change.
Medium	Of value, importance or rarity on a regional scale, and with limited potential for substitution; and/or moderate sensitivity to change, or moderate capacity to accommodate a change.
Low	Of value, importance or rarity on a local scale; and/or not particularly sensitive to change, or has considerable capacity to accommodate a change.

Table 19 - Nature of Impact

NATURE	DESCRIPTION
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct	Impacts causing an impact through direct interaction between a planned project activity and the receiving environment/receptors.
Indirect	Impacts that result from other activities that are encouraged to happen as a result / consequence of the Project. Associated with the project and may occur at a later time or wider area
Extent / Geographic Scale	
On-site	Impacts that are limited to the boundaries of the proposed project site
Local	Impacts that occur in the local area of influence, including around the proposed site and within the wider community
Regional	Impacts that affect a receptor that is regionally important by virtue of scale, designation, quality or rarity.
National	Impacts that affect a receptor that is nationally important by virtue of scale, designation, quality or rarity.
International	Impacts that affect a receptor that is internationally important by virtue of scale, designation, quality or rarity.
Duration	
Short-term	Impacts that are likely to last for the duration of the activity causing the impact and are recoverable
Medium-term	Impacts that are likely to continue after the activity causing the impact and are recoverable

Long-term	Impacts that are likely to last far beyond the end of the activity causing the damage but are recoverable over time
Reversibility	
Permanent /Irreversible	Impacts which are not reversible and are permanent
Temporary / Reversible	Impacts are reversible and recoverable in the future
Likelihood	
Certain	The impact is likely to occur
Likely	The impact is likely to occur under most circumstances
Unlikely	The impact is unlikely to occur

Table 20 - Magnitude of Change

MAGNITUDE OF CHANGE	DESCRIPTION
Major	Loss of resource, and quality and integrity of resource; severe damage to key characteristics, features or elements; or Large scale or major improvement of resources quality; extensive restoration or enhancement; major improvement of attribute quality.
Moderate	Loss of resource, but not adversely affecting its integrity; partial loss of/damage to key characteristics, features or elements; or A benefit to, or addition of, key characteristics, features or elements; improvements of attribute quality.
Minor	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (or maybe more) key characteristic, feature or element; or A minor benefit to, or addition of, one (or maybe more) key characteristic, feature or element; some beneficial effect on attribute quality or a reduced risk of a negative effect occurring.
Negligible	Very minor loss or detrimental alteration to one (or maybe more) characteristic, feature or element; or Very minor benefit to, or positive addition of, one (or maybe more) characteristic, feature or element.

The level of certainty has also been applied to the assessment to demonstrate how certain the assessment conclusions are and where there is potential for misinterpretation or a requirement to identify further mitigation measures, thereby adopting a precautionary approach. Where there is a low degree of certainty, monitoring and management measures can be implemented to determine if the impacts are worse than predicted and support the identification of additional mitigation measures through the lifetime of the proposed project.

Table 21 – Level of certainty

LEVEL OF CERTAINTY	DESCRIPTION
High	Likely changes are well understood. Design/information/data used to determine impacts is very comprehensive. Interactions are well understood and documented. Predictions are modelled, and maps based on interpretations are supported by a large volume of data. Design/information/data has very comprehensive spatial coverage or resolution.
Medium	Likely changes are understood. Design/information/data used to determine impacts include a moderate level of detail. Interactions are understood with some documented evidence. Predictions are modelled but not yet validated and/or calibrated. Mapped outputs are supported by a moderate spatial coverage or resolution.
Low	Interactions are currently poorly understood and not documented. Predictions are not modelled, and the assessment is based on expert interpretation using little or no quantitative data. The design is not fully developed, or information has poor spatial coverage or resolution.

The significance of impacts has been derived using professional judgment and applying the identified thresholds for receptor sensitivity and magnitude of change (as discussed above), and guided by the matrix presented in Figure 57. The matrix is applicable for impacts that are either positive or negative. The distinction and description of significance and whether the impact is positive or negative is provided in Table 22.

Figure 57 – Guide to significance ratings

Magnitude of Change

Sensitivity	Negligible	Minor	Moderate	Major
High	Minor (3)	Moderate (6)	Major (9)	Major (12)
Medium	Low (2)	Minor (4)	Moderate (6)	Major (8)
Low	Low (1)	Low (2)	Minor (3)	Moderate (4)

Significance is not defined in the Namibian EIA Regulations, however the Draft Procedure and Guidance for EIA and EMP states that the significance of a predicted impact depends upon its context and intensity. Accordingly, definitions for each level of significance has been provided in Table 22. These definitions were used to check the conclusions of the assessment of receptor sensitivity, nature of impact and magnitude of impact was appropriate.

Table 22 – Significance Description

SIGNIFICANCE OF IMPACT	DESCRIPTION
Major (negative)	Impacts are considered to be key factors in the decision-making process that may have an impact of major significance, or large magnitude impacts occur to highly valued/sensitive resource/receptors. Impacts are expected to be permanent and non- reversible on a national scale and/or have international significance or result in a legislative non- compliance. Factors key to the decision-making.
Moderate (negative)	Impacts are considered within acceptable limits and standards. Impacts are long term, but reversible and/or have regional significance. These are generally (but not exclusively) associated with sites and features of national importance and resources/features that are unique and which, if lost, cannot be replaced or relocated. Factors likely to be key to the decision-making.
Minor (negative)	Impacts are considered to be important factors but are unlikely to be key to the decision-making. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value. Impacts are considered to be short term, reversible and/or localized in extent.
Low (negative)	Impacts are considered to be local factors that are unlikely to be critical to decision-making.
Low – Major (Beneficial)	Impacts are considered to be beneficial to the environment and society:

To ensure the beneficial impacts are brought out in the assessment, green has been applied to ensure the different type of impact is clear. The description for each level of significance presented in Table 22 was also followed when determining the level of significance of a beneficial impact.

The significance of impacts has been derived using professional judgment and applying the identified thresholds for receptor sensitivity and magnitude of change, as well as the definition of significance. It most instances, moderate and major adverse impacts are considered as significant, and however there may be some instances where impacts are lower than this, but are considered to be significant. The following thresholds were therefore used to double check the assessment of significance had been applied appropriately; a significant impact would meet at least one of the following criteria:

- It exceeds widely recognized levels of acceptable change;
- It threatens or enhances the viability or integrity of a receptor or receptor group of concern; and
- It is likely to be material to the ultimate decision about whether or not the environmental clearance certificate is granted.

7.5 Environmental Mitigation

Mitigation comprises a hierarchy of measures ranging from preventative environmental impacts by avoidance, to measures that provide opportunities for environmental enhancement. The mitigation hierarchy is: avoidance;

reduction at source; reduction at receptor level; repairing and correcting; compensation; remediation; and enhancement.

Mitigation measures can be split into three distinct categories, broadly defined as:

1. Actions undertaken by the ESIA process that influence the design process, through implementing design measures that would entirely avoid or eliminate an impact, or modifying the design through the inclusion of environmental features to reduce the magnitude of change. These are considered as embedded mitigation.
2. Standard construction practices and other best practice measures for avoiding and minimizing environmental impacts. These are considered as good practice measures.
3. Specified additional measures or follow-up action to be implemented to further reduce adverse impacts that remain after the incorporation of embedded mitigation. These are considered as additional mitigation.

The ESIA is an iterative process whereby the outcomes of the environmental assessments inform the design. Considerable mitigation has been built into the design of the proposed project as potentially significant adverse environmental impacts have been identified and design changes have been identified to overcome or reduce them. The ESMP (Appendix A) provides the good practice measures and specified additional measures or follow-up action.

Embedded mitigation and good practice mitigation have been taken into account in the assessment. Additional mitigation measures have been identified when the significance of impact requires it and causes the impact to be further reduced. Where additional mitigation has been identified, a final assessment of the significance of impacts (residual impacts) was carried out taking into consideration the additional mitigation.

7.5.1. Cumulative Impacts

The EIA Regulations clearly states that cumulative impacts should be considered as part of the EIA for a proposed project. Good practice requires that, as a minimum, cumulative impacts are assessed during the ESIA process.

Cumulative impacts can arise when a single resource or receptor is affected by more than one impacts from the proposed project. For example, a local resident could be affected by noise from construction vehicles and dust from ground excavation during the construction stage. In isolation, the impacts of noise and dust may be insignificant, however when combined, the impacts on the local resident may result in a significant impact. **This is termed 'Intra-Project Cumulative Impacts'.**

Cumulative impacts may also arise as a result of the combination of two or more projects. A receptor could be impacted by similar types of impact from different developments or a receptor could be impacted by different types of impact from different developments. This could occur at the same time or at different times. **This is termed Inter-Project Cumulative Impacts**. An example of this is as follows; noise generated during the construction stage of the proposed project may not cause a significant effect in isolation; however, a sensitive receptor (e.g. local resident) may be significantly impacted when noise from the proposed project is combined with noise generated from other projects. These projects could be future projects or existing projects which may have ongoing influences on the environment in the future and are expected to interact with the same environmental and social receptors as the proposed project (International Finance Corporation, 2013).

In addition to considering other projects, it is important to consider natural stressors such as droughts and natural dynamic systems and potential future changes within the lifetime of the proposed project.

Cumulative impacts have a wide temporal and spatial scope, and are not restricted to a local area nor need to happen at the same time. It is therefore, crucial to identify a suitable study and assessment area, as well as a timeframe to assess. Cumulative impacts can also be vast and complicated; therefore it is important to focus on the significant impacts.

7.5.2. Cumulative Impact Assessment Method

The IFC, the private sector arm of the World Bank Group, is committed to ensuring that the costs of economic development do not fall disproportionately on those who are poor or vulnerable. This commitment is implemented through the January 1, 2012, IFC Policy on Environmental and Social Sustainability and its corresponding, comprehensive set of eight Performance Standards that define IFC clients' responsibilities for managing their environmental and social impacts and risks (International Finance Corporation, 2012). Performance Standard 1, *Assessment and Management of Environmental and Social Risks and Impacts* recognizes that because of the increasing significance of system wide risk factors such as climate change, water availability, decline of species biodiversity, degradation of ecosystem services, and modification of socioeconomic and population dynamics, among others, cumulative impact assessment and management (CIA) is an essential framework for risk management.

Performance Standard 1 defines the project area of influence to encompass *"cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned, or reasonably defined developments at the time the risks and impact identification process is conducted."* Performance Standard 1 offers some context to limit the cumulative impacts to be addressed to *"those impacts generally recognized as important on the basis of scientific concerns and/or concerns from Affected Communities"*.

The CIA has been undertaken by applying the IFC Good Practice Handbook for CIA and Management (International Finance Corporation, 2013). Through a review of this guidance, a rapid CIA has been applied due to certain limitations. A rapid CIA takes into consideration the challenges associated with a good CIA process, which includes lack of basic baseline data, uncertainty associated with anticipated development, limited government capacity, and absence of strategic regional, sectoral or integrated resource planning schemes.

The six-step rapid CIA process has been followed:

- Step 1: Scoping - determine spatial and temporal boundaries
- Step 2: Scoping - identify valued environmental and social receptors and identify reasonably foreseeable developments
- Step 3: Determine present condition of valued environmental and social receptors (the baseline)
- Step 4: Assessment of cumulative impacts and evaluation of the significance of the cumulative impacts
- Step 5: Identification of mitigation measures to avoid or reduce cumulative impacts

The following information has been applied to the assessment in line with the above steps and IFC Guidance:

- The spatial and temporal boundaries of the CIA are the extent of Walvis Bay town boundaries and the duration of the construction and operation phases of the proposed project (up to 40 years into the future);
- Valued environmental and social receptors that may be affected are those presented in Chapter 6. No additional ones have been identified through this CIA;
- A review of existing and reasonable anticipated and/or planned developments has been undertaken which is based on the information presented in Sections 6.9, 6.10 and 6.11.
- The predicted future conditions of sensitive and common environmental and social receptors (section 6.24) have been taken into consideration in the assessment;
- The assessment findings presented in Chapter 8 have been applied to the CIA in combination with professional judgment and published environmental assessment reports; and
- A review of mitigation and monitoring measures have been undertaken, with any additional ones identified.

8 ASSESSMENT FINDINGS AND MITIGATION

8.1 INTRODUCTION

This chapter presents the findings of the ESIA for the proposed project as per the ESIA process, scope and methodology set out in Chapter 3 and Chapter 7. A range of potential impacts have been identified that may arise as a result of the proposed project. The aim of this ESIA report is to focus on the significant impacts that may arise as a result of the proposed project. This chapter therefore only considers the significant impacts and those that have specific interest to the community and stakeholders. A summary of impacts that are not considered significant is discussed in section 8.3.

Impacts that are considered significant or are those of interest to the community and stakeholders are as follows:

- Socio-economic: Tourism
- Socio-economic: Employment
- Socio-economic: Local Businesses
- Socio-economic: House Prices
- Socio-economic: Community Severance
- Socio-economic: Community Bulk Services
- Socio-economic: Community Facilities
- Socio-economic: Noise Impacts
- Socio-economic: Air Quality Impacts
- Socio-economic: Sense of Place
- The Marine Environment: Water Flow
- The Marine Environment: Water Quality
- The Marine Environment: Birds
- The Marine Environment: Mammals
- Relocation of Sporting Facilities
- Cumulative Impacts

For each potential significant or sensitive impact, a summary is provided which includes the activity that would cause an impact; the potential impacts; embedded or best practice mitigation (stated where required / available); the sensitivity of receptor that would be impacted; the severity, duration and probability of impacts; the significance of impacts before mitigation and after mitigation measures are applied.

8.2 LIMITATIONS, UNCERTAINTIES AND ASSUMPTIONS

The following assumptions and uncertainties identified during the assessment process include:

- The environmental and social baseline presented in Chapter 3 has been used in the assessment. It is recognized that the project design had evolved since certain specialist studies were conducted. Some conclusions and recommendations of these studies may no longer be applicable, and therefore have not been included in the ESIA report or where required. Where required, consultation with specialists was undertaken to revise the conclusions and recommendation; these have been captured in this chapter where relevant;
- The project description in Chapter 4 has been applied to the assessment. Any changes to the design, construction methods etc. may alter the assessment findings. If this occurs, the assessment will need to be revisited and further assessment work may be required;
- Lack of noise monitoring data and assessment modeling, a realistic worst-case scenario has been applied and a qualitative assessment has been undertaken; and

- The Walvis Bay IUSDF anticipates and plans for population and development growth in the town, and therefore identified required public services (schools, hospitals, shops, residential areas). It is assumed these services are adequate and suitable for the workers and families of the proposed project. An assessment of pressure and demand for services has therefore not been included in the socio-economic assessment.
- Namibia does not have a centralized database that logs all planned or realistically defined projects that are applying for Environmental Clearance are logged and this available for people /consultants to refer to in order to determine or obtain all potential projects in a given area, the assessment of potential combined impacts is limited to known projects through a detailed literature review.
- The EIA report prepared for the Namport Container Expansion project has been used to undertake the CIA for reasonable defined projects. This has several limitations which are brought out in the assessment.
- A rapid CIA has been undertaken due to the uncertainty associated with the anticipated development and lack of or limited quantitative information.

8.3 Impacts Not Considered as Significant

As a result of an iterative design development process, mitigation has been incorporated and embedded into the design, thereby designing out environmental and social impacts or reducing the potential impact so that it is not significant. Best practice has also played a role in avoiding or reducing potential impacts. The ESMP provides best practice measures, management and monitoring for all impacts.

Impacts that have been assessed as not being significant are summarised in Table 23 and not discussed further.

Table 23 – Summary of impacts not assessed as being significant

ENVIRONMENT / SOCIAL TOPIC	POTENTIAL IMPACT	SUMMARY OF ASSESSMENT FINDINGS
Cultural heritage	There is potential to uncover heritage remains during construction activities.	Findings are unlikely. By applying good construction practice measures and following measures detailed in the ESMP in the event of finding remains, the potential impact is not considered significant.
Air Quality	The operations of the proposed project may discharge air pollution.	During operations, minimal activities will discharge aerial emissions and pollutants (carbon dioxide, sulphur dioxide and particulate matter) to the atmosphere that would alter the baseline conditions. Best practice measures for Marina operations will be implemented as detailed in the ESMP. Dust have been included in the assessment due to the risk during construction.
Climate change – adaptation	The potential for climate change impacts to impact the proposed project, for example, sea level rise and storm surges	The proposed project will not be significantly impacted by the impacts of climate change as the design has considered storm surges, sea level rises and localised flooding. The design has been adapted considering these issues, such as height about sea level and buildings set back from the coastline. Embedded design measures are discussed in the project description.

Climate change – cause / contribute to	The proposed project contributing to climate change through the discharge of greenhouse gas emissions	The proposed project is considered as a relatively small development and will be constructed within approximately 3.5 years. The operations of the proposed project will not emit greenhouse gases apart from carbon dioxide indirectly through the generation of electricity. The proposed project will implement energy efficiency technologies where possible and will be built considering energy efficiency, for example double glazing. Best practice measures such as avoiding the idling of vehicles are included in the ESMP.
Groundwater	Potential to impact the groundwater through pollution or abstraction during construction and operation. Potential to alter the hydrodynamics of the flow of the groundwater.	Best practice construction methods will be applied and are detailed in the ESMP. These will avoid pollution of the groundwater. The Inner Marina has an impermeable base, and will be constructed with inert materials and cement. It is unlikely that the hydrodynamics of the groundwater is likely to be significantly affected as a result of the proposed project, due to its size and nature of groundwater.

8.4 Socio-economic Environment: Economic

The term socio-economic impact assessment embraces both social impacts and economic impacts. Economic impacts include issues such as employment, changes in economic activity such as tourism, and increased expenditure. The significant economic impacts or impacts that have specific interest to the community and stakeholders are summarised in Figure 58 and discussed in more detail in this section.

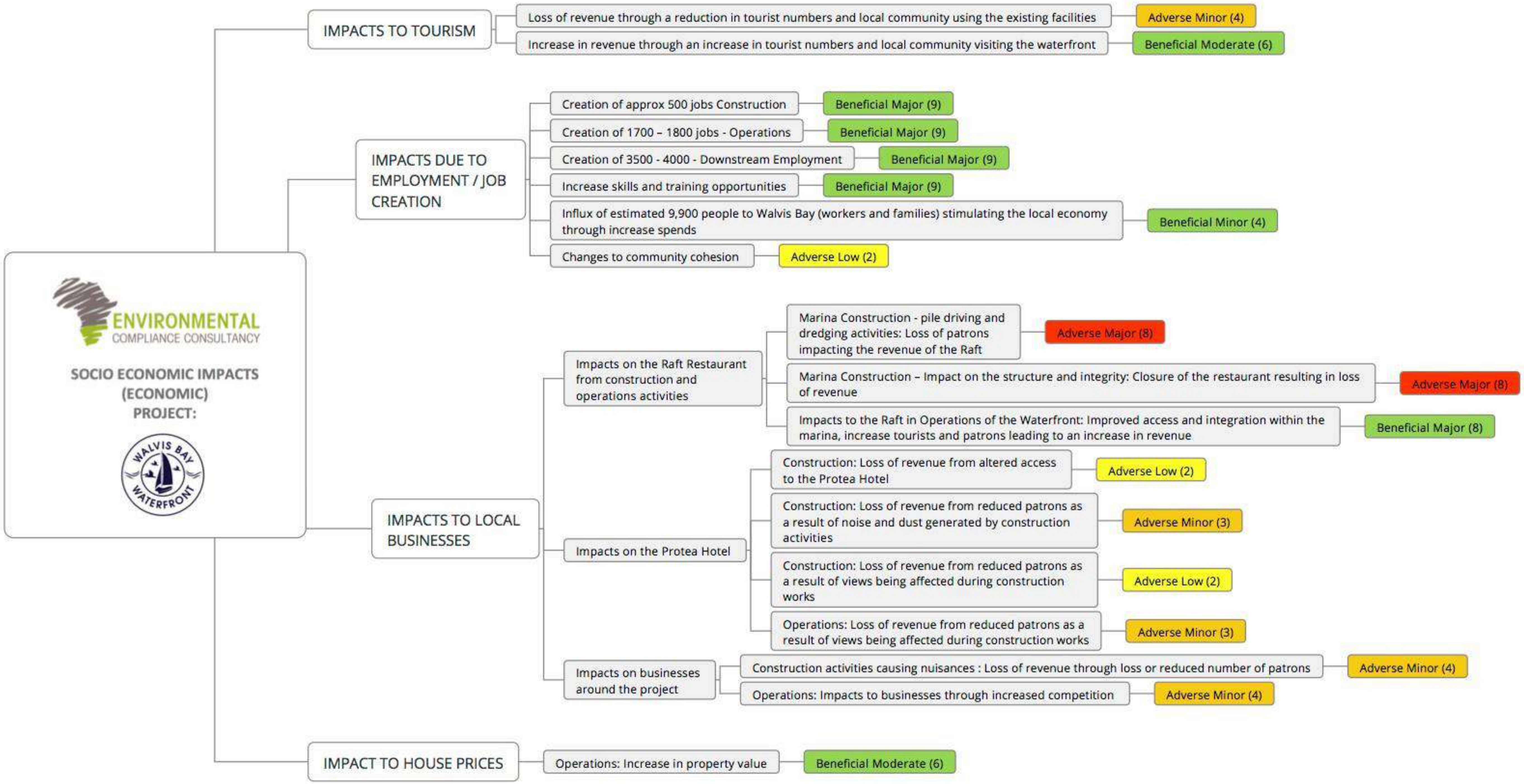

Figure 58 – Economic Impacts

8.4.1. Tourism

Tourism is an important industry in Walvis Bay and supports the local economy. Tourists visit the area for the birdlife, marine life and adventure activities such as quad biking in the dunes. Various tourism related receptors are in close proximity to the proposed project site, including The Raft Restaurant, the Yacht Club, the Protea Hotel, shops, restaurants and tourism operators along the existing marina, as well as the Lagoon and Bay which supports an important ecosystem for tourism and recreational related activities. The impacts on tourism as a result of the proposed project is detailed in this section.

The loss or increase of tourist numbers may have an impact on the revenue of local businesses that support the industry. This section provides an overarching assessment of impacts arising from fluctuations in tourist numbers. Specific impacts to individual business receptors are included in section 8.4.4.

8.4.2. Tourism Industry: Construction

During the construction stage, there will be an increase in traffic on the local roads around the proposed project site resulting in potentially increased journey times and increased noise, and noise and dust will be generated from the movement and operation of construction vehicles. Tourists frequenting the facilities on existing waterfront may choose not to use these facilities due to this disruption; may stay for shorter periods of time; or may not visit the facilities again. Spending would reduce, potentially affecting local vendors and other tourism activity providers, and other downstream receptors which rely on the tourism industry.

These construction activities may have a direct impact on the tourism industry, however it is considered that the nature of the impact is short term and reversible. The tourism market in Walvis Bay is of low sensitivity in this instance: tourists will not be deterred from visiting Walvis Bay, but potentially from the existing waterfront and other facilities in the area. Alternatives and substitutions are available in the town; therefore; the magnitude of change is considered minor as the change of the baseline is expected to be small. Measures such as a site boundary fence, traffic management and calming measures (banksmen and signposts for any diversions) and specific scheduling of specific activities to minimise noise impacts on local receptors would be implemented. Construction vehicles, in particular, heavy vehicles, will avoid travelling on roads at peak times, for example school runs, evenings and weekends. Taking into consideration these mitigation measures, the significance of impact on the tourism industry is considered to be minor.

It is also acknowledged that tourists come to the area for the marine and bird life. There is potential for construction activities to cause indirect impacts to the flora and fauna of the marine environment (see Sections 8.7 and 8.8 for the findings of this impact). For example, an increase in suspended sediments and reduction in water quality could result in marina mammals not frequenting the area, and an increase in noise could disturb bird life, causing them not to roost along the local shoreline. This is considered as a cumulative impact and therefore discussed in Section 8.9.1.

8.1.1.1 Tourism Industry: Operations

The proposed project will provide waterfront facilities in which people live, work and play; and will create a community and tourism asset that will drive economic development in Walvis Bay and the Erongo Region. The proposed project will attract and retain visitors in Walvis Bay, which will result in local spends thereby supporting the local and wider economy. Local accommodation, restaurants, shops and retail and tourist/recreational activities will all benefit, and revenue will increase.

The direct and indirect impacts of visitor spending benefit the community and economy long term. This impact is considered irreversible, as the proposed project will become a tourist node and permanent feature of the urban landscape. The overall significance of the impacts on the tourism economy is therefore considered to have a moderately beneficial impact.

There is concern that the marine environment which is one of the main tourist attractions could be affected by the proposed project through increased sedimentation and noisy activities. Impacts on the marine environment have been assessed and presented in Sections 8.6, 8.7 and 8.8.

8.1.1.2 Summary of Impacts on the Tourism Industry

Table 24 – Impact assessment for revenue and tourism

Activity	Receptor/s	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction activities - general	− Local tourism industry − The Raft − Protea Hotel − Businesses around the sites	Loss of revenue through a reduction in tourist numbers and local community using the existing facilities	Adverse Direct Local Short Term Irreversible	Medium	Minor	Adverse Minor (4)
Operations	− Local tourism industry − Users of the Development − The Raft − Protea Hotel − Businesses around the sites	Increase in revenue through an increase in tourist numbers and local community visiting the waterfront	Beneficial Direct Regional Long Term Irreversible	Medium	Moderate	Beneficial Moderate (6)

8.4.3. Employment

Whilst Namibia has a high unemployment rate, the Erongo Region is one of the highest employment rates in Namibia. In Walvis Bay, the majority of employment is through Harbour operations, the fishing industry and the processing of sea salt. The value and sensitivity of employment is considered to be high as it is of importance to the country.

8.1.1.3 Direct Employment: Construction

Approximately 500 jobs will be generated during the construction phase. The proponent will employ Namibians wherever possible and feasible to fulfil the roles. Construction works will take approximately three and a half years to complete, therefore the beneficial impact of creating 500 temporary jobs will result in a medium-term impact with a moderate magnitude of change. A moderate beneficial impact on the community and economy is therefore expected.

8.1.1.4 Direct Employment: Operation

Approximately 1700 - 1800 jobs will be created in the operational stage as a direct result of the project, with an anticipated additional 3500 - 4000 jobs generated as downstream opportunities. As above, the proponent will employ Namibians wherever possible and feasible. The magnitude of change during operation is considered as moderate, but having long term impacts thereby resulting in a major beneficial impact on the community and economy.

8.1.1.5 Indirect Employment Impacts

Various indirect impacts will arise as a result of job creation, including an increase in skills, increase in population, increase in economic activity and changes to community cohesion.

With increase job creation, indirect benefits will be brought to the area: worker skills will improve, and training opportunities will arise, thereby bringing long-term benefits to the area and local communities. A large proportion of the Namibian population is unskilled working in the agricultural industry. Through skills improvements and training, workers, who are highly sensitive to potential improvements will see long-term benefits, thereby resulting in a major beneficial impact.

Coupled with job creation is the potential migration of workers and their families to the town of Walvis Bay. The average Namibian household size is 4.4 according to the 2011 Namibia Population and Housing Census (Namibia Statistics Agency, 2011). The creation of approximately 5,000 jobs during operations could potentially result in the migration of an estimated 9,900 people to Walvis Bay (worst case scenario), assuming 65% of workers are already living in Walvis Bay. This influx of people to the town will put pressure on the existing services, such as water, waste, sewerage and community facilities and services, such as schools and hospitals.

The Walvis Bay Municipality has catered for the town's expansions and expected population growth, which is detailed in the Walvis Bay IUSDF (Walvis Bay Municipality, 2014). Areas where workers would relocate to are the expanding and developing land in the Kuisebmond and Narraville areas. The Walvis Bay IUSDF identifies community services and facilities required to support population increase, such as hospitals, schools and police services (see Section 6.11.1). Some of these improvements have been undertaken and others continue to be supplied. The demand for these services and extra pressure on existing ones has therefore not be considered in the assessment as it is assumed that have been appropriately catered for through the provisions set out in the IUSDF.

The impacts arising from the influx of workers and their families to Walvis Bay is considered beneficial as it stimulates the economy as an indirect impact. The sensitivity of the economy is considered to be medium as economic development is an important regional issue. The magnitude of change will be minor as local spends from the families of workers will attribute to the economy, but is unlikely to result in medium scale improvements.

Another potential impact as a result of the influx of workers and their families is the potential impacts on community cohesion. The demographics of the workers that will fill the unskilled roles during the construction and operations of the proposed project, is diverse. The community where workers would live are accustomed to change and the inflow and outflow of migratory workers, which is attributed to the seasonal and variable fishing industry in Walvis Bay. Diverse communities in Walvis Bay are used to change and therefore are not considered as sensitive, however there is potential that there may be a reduction in community safety and cohesion as a result of the influx of workers to the area.

The magnitude of change is anticipated to be negligible, therefore the impacts on community cohesion such as culture impacts, increase in crime or community disputes are unlikely to result in an adverse significant impact.

8.1.1.6 Summary of Employment Impacts

Table 25 – Impacts on employment and influx of people to Walvis Bay.

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction works - general	– Community – Job seekers – Local economy	Creation of 500 jobs	Beneficial Direct Regional Short Term Reversible	High	Moderate	Beneficial Major (9)
Operations of the proposed project	– Community – Job seekers – Local economy	Creation of 1700 – 1800 jobs	Beneficial Direct Regional Long Term Reversible	High	Moderate	Beneficial Major (9)
Downstream job creation	– Community – Job seekers – Local economy	Creation of 3,500 – 4,000	Beneficial Indirect Local	High	Moderate	Beneficial Major (9)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
			Long Term Reversible			
Job creation	− Community	Increase skills and training opportunities	Beneficial Indirect Local Long Term Reversible	High	Moderate	Beneficial Major (9)
Influx of workers & families	− Community − Local economy	Influx of estimated 9,900 people to Walvis Bay (workers and families) stimulating the local economy through increase spends	Beneficial Direct Local Long Term Reversible	Medium	Minor	Beneficial Minor (4)
Influx of workers & families	− Community	Changes to community cohesion	Adverse Direct Local Long Term Reversible	Low	Negligible	Adverse Low (1)

8.4.4. Local Businesses

The Raft Restaurant and Protea Hotel are immediately adjacent to the proposed project site boundary, and other businesses such as the Yacht Club, Anchors Restaurant, the Boardwalk, Lyon Des Sables Restaurant, Brume sur le port, The Venue and View Café occupy the existing waterfront. Impacts on these businesses have been assessed, and the findings are presented in this section.

8.1.1.7 The Raft Restaurant: Construction

The Raft Restaurant is positioned in the Lagoon approximately 40m from the shoreline. The Restaurant will become part of the Marina and be accessed via the marina wall. Patrons visit the restaurant for meals at lunchtime and dinner. Key features of the restaurant are the sea views and the marine environment surrounding the building which is visited by dolphins and other marine life.

During construction, activities in the marine environment have the potential to impact The Raft Restaurant through a reduction in patrons leading to a loss of revenue. The Raft Restaurant is privately owned and is considered as being of medium sensitivity with moderate capacity to accommodate change. The construction of the breakwater wall will take approximately one month to construct, and vibratory pilling will be required for construction. This noisy activity will take approximately two weeks. Once the breakwater wall has been constructed, the marina access channel will be dredged, which will require substantial pipework to pump the sediment into the marina area for transport onshore. These noisy and visually intrusive activities, as well as the overall view of the construction landscape, will deter patrons from visiting the restaurant, but also affect their visit thereby reducing their stay (and spends) and discourage from visiting again.

A visual screen will be erected to reduce views into the construction working area. A partial loss of from The Raft will be experienced, however the seaward views will not be affected. The vibratory piling techniques employed during construction were identified as they are the least noisy. Access will be provided at all times either via the existing boardwalk or via the new marina wall once constructed. Taking into consideration these design measures, the magnitude of change on the Raft is considered to be moderate due to the potential loss of patrons during this short term, temporary construction activity. The significance of impact is therefore considered to be of major adverse.

8.1.1.8 The Raft Restaurant: Structure and Integrity

The Raft Restaurant is built on wooden piles in the marine environment. The integrity of the structure has not been fully determined and further investigation will be undertaken prior to construction activities commences. Through visual observations, some of the piles require maintenance and repair. Due to the current condition, there is a risk that the structures and foundations could be impacted by construction works, in particular activities that emit vibrations such as piling and other construction works in close proximity to The Raft.

Qualified vibratory pile driving operators will be engaged to undertake the piling activities and an assessment on the best approach to prevent harm or damage to the structure will be completed prior to and during construction activities. A pre-construction survey will be conducted and recorded, including a photographic report. This will be signed off by both the proponent and the owners of the Raft. If necessary, a pre-construction agreement will be drawn up with the owners of the Raft Restaurant. Downtime would be minimised as far as possible.

In the event that measures are required to protect the structure prior to construction or construction activities impact the integrity of the structure, the business may be temporarily closing down due to safety requirements, and would not reopen until works have been undertaken to protect or repair the damage. The Raft is considered as a medium sensitivity receptor as it has a moderate capacity to accommodate change. If closed down for a short-term temporary period, the magnitude of change would be major due to the loss of revenue to the business owner. A major adverse impact would therefore occur. The certainty of this impact is low due to the lack of a detailed structure investigation.

8.1.1.9 The Raft Restaurant: Operation

The final design of the marina integrates The Raft into the design. The Raft will be accessed along the marina wall and will remain as a predominant position and feature in the overall waterfront. The access route will be slightly longer than the existing route, however the safety, security and lighting of the new access route would be an improvement from the current arrangements. The walkway will be used by patrons, but also tourists who want to view the Marina. In addition, parking bays provided as part of the proposed project will be an improvement of the current parking arrangements.

The proposed project will create community and tourism facilities, which will attract and retain tourists in Walvis Bay. As a result, an increase in potential patrons will frequent the Raft Restaurant thereby resulting in increased revenue. The Raft Restaurant is a medium sensitivity receptor. With this long-term positive improvement, the magnitude of change is considered to be major, thereby the significance of impact has been assessed as major beneficial.

Considering the potential short-term temporary impacts during construction and the long-term positive benefits during operation, the overall impact on the Raft Restaurant is considered to be beneficial.

8.1.1.10 Summary of Impacts on the Raft Restaurant

Table 26 – Impacts on the Raft

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Marina Construction - pile driving and dredging activities	– The Raft	Loss of patrons impacting the revenue of the Raft	Adverse Indirect Local Short Term Temporary and Reversible	Medium	Major	Adverse Major (8)
Marina Construction – Impact on	– The Raft	Closing of the restaurant resulting in loss of revenue	Adverse Indirect Local	Medium	Major	Adverse Major (8)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
the structure and integrity			Short Term Temporary and Reversible			
Operations	– The Raft	Improved access and integration within the marina, increase tourists and patrons leading to an increase in revenue	Beneficial Indirect Local Long Term Irreversible	Medium	Major	Beneficial Major (8)

ADDITIONAL MITIGATION

Whilst the impact during construction has been assessed to be of major significance, the nature of the impact will be of short duration and the long-term beneficial impacts would most likely outweigh the adverse impacts. Additional mitigation measures to reduce this impact further have not been identified, however, the proponent is currently in discussions with the business owners of The Raft where further measures may be identified to manage the impacts identified.

8.1.1.11 PROTEA HOTEL: ACCESS

The Protea hotel is located opposite the proposed project site on the north-east corner and is accessed via Atlantic Street and The Esplanade. During construction, the Esplanade will be stopped up and will not be available to access the hotel. This will a permanent change to the road network, however as the main vehicle access route to the hotel is considered as via Atlantic Street (as per signposts), the sensitivity of hotel access and users is considered to be low as there is an alternative option which will remain open throughout construction. The magnitude of change is minor; even though the road will be permanently lost and thus the baseline changed, regular users accessing the hotel will adapt quickly. There also may be a reduction in passing traffic, thereby bringing benefits to the hotel through less traffic and associated noise emissions. The significance of the potential impact is therefore considered as low.

8.1.1.12 PROTEA HOTEL: CONSTRUCTION

The hotel is designed to allow rooms to have views of the Lagoon. Several rooms face the south overlooking into the Lagoon and the Raft Restaurant. The views of some rooms will therefore overlook the off-shore construction area. The dining room also has views over the Lagoon and from this angle, it will be possible to see the construction site. This can be mitigated through the layout of the dining room and restrict views out of the windows through the arrangement of the dining room and temporary screening measures. The main views that would be affected would be from the bedrooms, which would have limited screening options, however the view of the construction area would occupy a small proportion of the view into the Lagoon.

The hotel is directly opposite the proposed project site and it is anticipated that construction activities will impact the patrons of the hotel. Earth movements and general construction activities will cause dust to arise and potentially be blown off site. Noise will be generated from the operation of construction plant and equipment, and an increase in construction traffic will be felt in the vicinity of the site. These nuisances could reduce the number of patrons frequenting the hotel or nights spent in the hotel, thereby reducing spends and overall revenue for the hotel.

The findings of the noise assessment is documented in section 8.5.4, which includes impacts on patrons and staff of the hotel. The findings of the dust assessment 8.1.1.33. This economic assessment focuses on the indirect impacts resulting from a potential loss of trade and revenue.

Construction works will not be undertaken at night and noisy activities will be restricted to certain times of the day. The access route into the proposed project site will be off Atlantic Street and not opposite the Protea Hotel, construction traffic will therefore not pass the hotel. The block-out fence surrounding the construction site will help contain dust, dust suppression techniques will be applied where required and a suitable drainage system during construction will be installed to minimise any surface run-off entering neighbouring properties. Best practice construction measures will also be implemented.

The Protea Hotel is part of the Marriott International Group, and therefore is considered as a being of low value and low sensitivity as it will be able to accommodate change. The impacts associated with the views into the Lagoon are considered to have a minor magnitude of change as some of the characteristics of the view would alter for a short duration and would be temporary in nature. It is considered that the change in view would not deter patrons from using the hotel, therefore the significance of this impact is assessed to be low adverse.

The impacts associated with construction noise and dust has been assessed as having a moderate magnitude of change, which is concluded after applying the mitigation measures, including scheduling of noisy activities outside of sensitive times (early morning, evenings and weekends) and no night time working. The hotel and all other local receptors would be provided with an early warning for any noisy construction works. The magnitude of change has been derived as it is envisaged that some patrons may complain and may not frequent the hotel during the construction period, and therefore some revenue will be lost as a result. The overall significance of the impact is minor.

8.1.1.13 Protea Hotel: Operation

The proposed project will have two new hotels offering a total of 211 rooms and other facilities, which will result in direct competition for the Protea Hotel. As per the National Policy on Tourism (Directorate of Tourism, 2008), competitive tourism business that enhances the country's ability to compete internationally is needed in the country. The increased competition and the other facilities of the proposed project will generate improved services and choice for the consumer in a free market. The hotel is considered as a low sensitive receptor and the change to the baseline of businesses in the area is considered to be moderate as there is potential for the integrity of the Protea Hotel to be affected. However, the proposed development will encourage tourist visiting and staying at the waterfront, therefore the potential impact of increased competition may be lessened due to the potential increase in users. Therefore, the potential environmental impact has been assessed at as being moderately adverse.

8.1.1.14 Summary of Impacts on the Protea Hotel

Table 27 – Impacts on the Protea Hotel

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction – general activities	− Protea Hotel	Loss of revenue from altered access to the Protea Hotel	Adverse Indirect Local Short Term Irreversible	Low	Minor	Adverse Low (2)
Construction – general activities	− Protea Hotel	Loss of revenue from reduced patrons as a result of noise and dust generated by construction activities	Adverse Indirect Local Short Term Irreversible	Low	Moderate	Adverse Minor (3)
Marina construction – general activities	− Protea Hotel	Loss of revenue from reduced patrons as a result of views being affected during construction works	Adverse Indirect Local Short Term	Low	Minor	Adverse Low (2)

			Temporary Reversible			
Operations	− Protea Hotel	Increased competition, leading to reduced revenue	Adverse Indirect Local Short Term Temporary Reversible	Low	Moderate	Adverse Minor (3)

8.1.1.15 Other Businesses

Other businesses surrounding the proposed project site may be affected during the construction and operational phases of the project. The Raft and the Protea Hotel which are directly opposite the site have been discussed previously. Other businesses that may be affected have been grouped together as it is likely that they will have similar impacts.

CONSTRUCTION

During construction, increased traffic and other construction nuisances (dust and noise) will arise. Access to the existing Waterfront will maintain, although it will be disrupted due to the Esplanade closing and due to construction traffic using the main route (Atlantic Street) potentially causing disruption to journey times. The construction of the Namport Container Extension project has been undertaken for the last few years, and some construction traffic has been routed along the existing waterfront, therefore the area is used to these higher and fluctuating levels. However, the potential remains for some local diners and tourists being discouraged from visiting the existing waterfront due to an increase in traffic and associated noise levels, and ease of access to these facilitates (journey times and stress levels). Patrons may use alternative restaurants and venues away from the construction site and surrounding area. Revenue may therefore be lost through a loss of patrons or less time (and thus spends) spent dining and drinking. The local restaurants are locally owned and therefore are considered as medium sensitive receptors. Any disruption would be of a medium duration during the construction phase but would be limited to specific times, e.g. construction works between 7am and 6pm. Access would remain at all times and any impacts are likely to be temporary, therefore the magnitude of change would be minor, resulting in an impact of minor adverse.

Local hotels and B&Bs in the area are considered to be medium sensitive receptors as they are also locally owned companies and could be sensitive to change. These receptors may also be affected during construction; however, construction traffic and activities will be limited to certain times and areas, therefore the normal operations of accommodation providers are unlikely to be affected and customers are unlikely to be deterred from using the facilities, thereby representing a minor magnitude of change and a minor adverse impact.

OPERATIONS

As a result of the proposed project, various restaurants, shops and two hotels will be introduced to the area, thereby generating competition. The philosophy being the proposed project is to create the peoples Waterfront that supports local businesses (see Section 1.4). The concept is to prevent a carbon copy large retail chain environment and have a mix of local and international brands. The increased competition may place pressure on the existing businesses, which may experience disruption and a loss of patrons and customers. However, taking into consideration the potential increase in tourists visiting the area, the diversity of potential businesses, and the probability that impacts will be experienced in the first six months due to locals trying the new venues and then moving back, the nature of impact may be both positive and negative, resulting in a minor magnitude of change. Accordingly, the impacts on local businesses and revenue is expected to be adverse minor.

8.1.1.16 Summary of Impacts on Other Businesses

Table 28 - Impacts to businesses around the development

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction activities causing nuisances	− Businesses around the sites	Loss of revenue through loss or reduced number of patrons	Adverse Indirect Local Short Term Reversible	Medium	Minor	Adverse Minor (4)
Operations	− Businesses around the sites	Impacts to businesses through increased competition	Adverse Indirect Local Long term Reversible	Medium	Minor	Adverse Minor (4)

8.4.5. House Prices

The proposed project will alter the local area and integrate new facilities such as a marina, two new hotels, restaurants, shops and other amenities. Through public consultation, concerns have been raised regarding how the proposed project could impact the value of properties surrounding the proposed project site.

The possible impacts on property values surrounding the development can be related to several international case studies (Oliva, 2006). Case studies have shown that house prices can be affected by waterfront developments in a beneficial way. Evidence supports that property values increase in close proximity to a Waterfront development, decreasing the further you move away from the waterfront (see Figure 59). The overall impact associated with property values is considered to have a beneficial direct long-term impact on private property owners, who are considered to be a medium sensitive receptor as the finance associated with houses have limited potential for substitution.

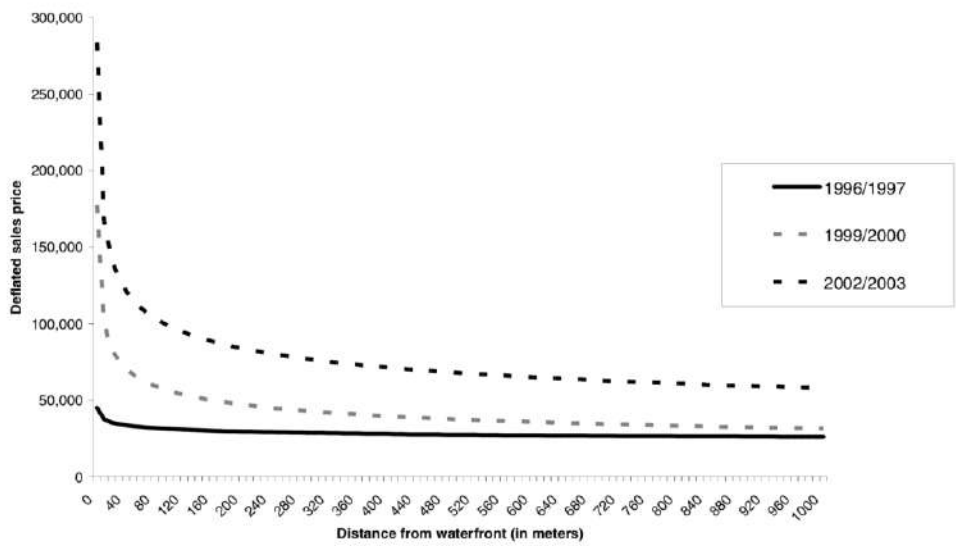

Figure 59 – House prices surrounding the waterfront (Oliva, 2006)

8.1.1.17 Summary of Impacts on House Prices

Table 29 - Impacts to housing prices

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Operations	− Private property owner	Increase in property value	Beneficial Indirect Local Permanent Irreversible	Medium	Moderate	Beneficial Moderate (6)

8.5 Socio-Economic Environment: Social

Social impacts include the consequences to local populations in terms of ways in which people live, work and interact. The significant social impacts or impacts that have specific interest to the community and stakeholders are summarised in Figure 60 and discussed in more detail in this section.

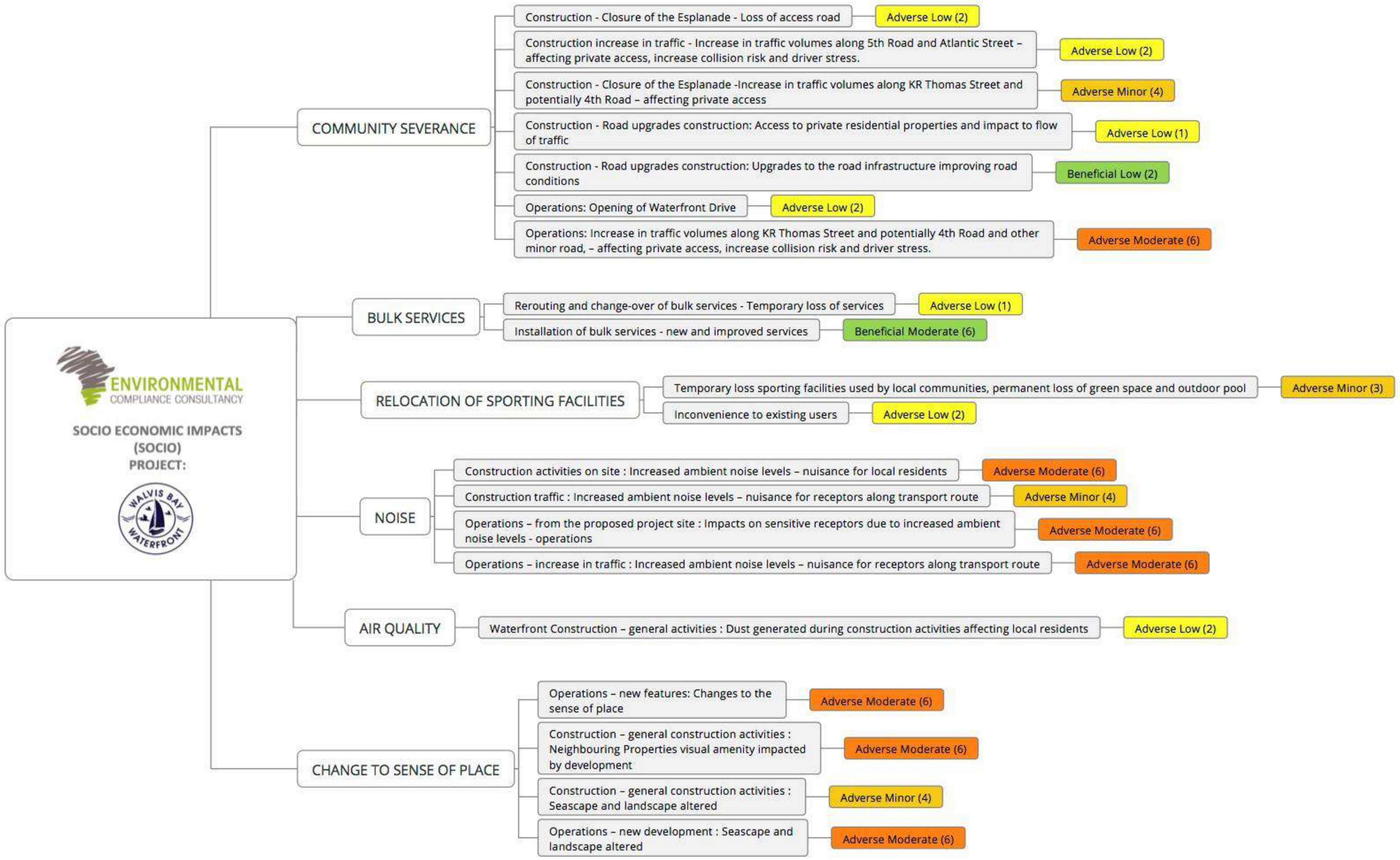

Figure 60 – Social Impacts

8.5.1. Community Severance

During construction, there will be an increase in construction traffic and The Esplanade will be closed, diverting traffic along KR Thomas Street up to 5th Road or along Waterfront Drive once completed. There is potential for local residents and the community to suffer from severance as a result of disrupted access in and out of private residential properties, increased traffic movements leading to increased journey times and access to the town's facilities, and changes to normal traffic flows (increasing traffic on streets where it would not usually flow).

8.1.1.18 Community Severance during Construction

An increase in traffic (construction vehicles delivering workers, plant and material, and removing waste and marine material) will be felt along 5th Road and Atlantic Street, which would affect access into and out of private residential properties along these roads and potentially increase the potential risk of accidents and driver stress. These roads are already main vehicle access routes to the existing Waterfront, Namport Expansion terminal and port, and therefore experience high levels of traffic. The Transport Impact Assessment (Appendix G) recorded up to 300 trucks along 5th Road at the Namport access between 06:00 and 18:00 during a normal weekday, and a similar number of truck trips delivering salt to the harbour.

The sensitivity of residents along these routes is considered to be low, as people are used to high levels of traffic and are not particularly sensitive to change as a result. The construction traffic associated with the proposed project is also predicted to be significantly less then what the local community has been exposed to during recent activities associated with Namport.

The volumes of construction traffic will not be constant through the construction works; the number of vehicles used will based on the construction activities and site requirements. Construction traffic shall follow a defined route to and from the site, and traffic will be managed and controlled through the use of banksmen. The duration of the impact from construction vehicles will be limited to the construction phase, therefore is short-term and temporary. The magnitude of change is therefore determined to be minor as the number of vehicles is expected to increase slightly from the current baseline. The significance of impact is therefore assessed to be adverse low.

The Esplanade will be closed early on in the construction schedule and diversions will be put in place to divert traffic up KR Thomas Street to 5th Road. The section of road that is lost will be replaced with the Waterfront Drive, however this will not be available until towards the end of Phase 1 construction works. The users of the road are considered as the receptor. The sensitivity of the receptors is considered to be low and the magnitude of change is minor (as per the assessment in the Protea Hotel assessment), as there is a partial loss of a resource, however is not considered to adversely affect the integrity of the traffic infrastructure and alternatives are available. Even though the loss of the section of road is permanent, the impacts are considered short term as local road users will become accustomed to the diversions. The significance of impact is therefore considered as low.

An increase in traffic along KR Thomas Street and possibly 4th Road may result in disruption to access to properties during construction. Residents along this route are not use to high volumes of traffic, and therefore are considered to be medium sensitive receptors. Construction traffic will not access the proposed project site via these roads; normal vehicles will be diverted along these routes. With a lack of traffic data for the Esplanade, it is assumed that the magnitude of change could be moderate as there would be a noticeable difference from the baseline and a loss of resource. The duration of the impact would be felt most during construction, but may continue into operations, therefore the impact could be long-term and permanent. Whilst minor disruption is expected, the degree of severance is considered to be low as access would not be severely hindered or restricted, resulting in a minor magnitude impact and a minor adverse impact.

8.1.1.19 Community Severance during Road Upgrades

The Transport Impact Assessment (Appendix G) was undertaken to investigate the expected transport impacts from the proposed project. The assessment concluded that certain road sections and intersections may not have the required capacity to accommodate predicted future traffic flows during the operational phase therefore there is an increased risk of accidents, driver stress and road deterioration. To mitigate this issue, upgrades were recommended, which are described in section 4.7.9.

The works required to upgrade the road sections and intersections will be limited to the existing road boundary and will be a short duration. The changes will be permanent, but will provide improvements to the existing baseline. During construction, temporary closures of lanes may be required, reducing roads from a dual carriage way to a single carriage way or a single carriageway to one lane with appropriate road signals or diversions. It is not anticipated that access to properties will be impacted and the works will not alter the flow of traffic. It is therefore considered that the significance of impact during construction is adverse low and during operations is beneficial low.

8.1.1.20 Community Severance during Operations

The Esplanade by the Protea Hotel will be permanently closed, and an alternative route will be via the new Waterfront Drive. The loss of The Esplanade has been assessed above in construction, and therefore will not be repeated here. The addition of the new Waterfront Drive will provide an alternative route and alter the baseline again. Road users (considered as low sensitive receptors) will become familiar with the new road layout therefore the nature of impact is considered to be short-term impact but a permanent change. The magnitude of change is therefore considered to be minor, and brings both positives and negative impacts, with an overall significance rating of low adverse.

During operations, traffic movements in the area will increase due to journeys to and from the proposed project site. The main vehicle access route to the proposed project site will be clearly signposted along 5th Road and Atlantic Street, and other roads leading to these streets. It is inevitable that some traffic movements will use the Esplanade and KR Thomas Street, with potential knock on impacts to 4th Road, 3rd Road and 2nd Road. As with the construction assessment, the impacts will be most felt along KR Thomas Street, and possibly 4th Road and other minor roads in the area. The increased traffic volumes may disrupt access to properties along these roads as well as increase driver stress and the potential for accidents. As per above, the residents along these routes are not use to high volumes of traffic, and therefore are considered to be medium sensitive receptors.

The indirect impacts will affect the local community over the long-term which are considered irreversible in nature. The local community will however gradually become accustomed to the change in the baseline, therefore the magnitude of change is considered to be medium. Traffic calming measures are also integrated into the road upgrades; therefore a moderate adverse impact is therefore predicted.

8.1.1.21 Summary Community Severance Impacts

Table 30 - Impacts on community severance

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction – The Esplanade stopped up	– Community – Residents	Loss of access road	Adverse Indirect Local Short Term Irreversible	Low	Minor	Adverse Low (2)
Construction – increase in traffic	– Community – Residents	Increase in traffic volumes along 5th Road and Atlantic Street – affecting private access, increase collision risk and driver stress.	Adverse Indirect Local Short Term Irreversible	Low	Minor	Adverse Low (2)
Construction – closure of The Esplanade	– Community – Residents	Change of traffic flow, increase in traffic volumes along KR Thomas Street and potentially 4th Road – affecting private access	Adverse Indirect Local Short Term Irreversible	Medium	Minor	Adverse Minor (4)
Road upgrades - construction	– Community – Residents	Access to private residential properties and impact to flow of traffic	Adverse Indirect Local Short Term Temporary	Low	Low	Adverse Low (1)
Road upgrades - operation	– Community – Residents – Users of the proposed project	Upgrades to the road infrastructure improving road conditions	Beneficial Indirect Local Short Term Permanent	Low	Minor	Beneficial Low (2)
Operations – Opening of Waterfront Drive	– Community – Residents – Users of the proposed project	New Waterfront Drive	Adverse Indirect Local Short-term Permanent	Low	Minor	Adverse Low (2)
Operations	– Community – Residents	Increase in traffic volumes along KR Thomas Street and potentially 4th Road and other minor road, – affecting private access, increase collision risk and driver stress.	Adverse Indirect Local Medium-Term Irreversible	Medium	Moderate	Adverse Moderate (6)

8.5.2. Impacts on Community: Bulk Services

The proposed project site has existing infrastructure running through it, which will need to be rerouted. As a result of the proposed project, demands on bulk services will increase, therefore the infrastructure will not only be rerouted, but also upgraded. These bulk services include sewerage, water, power and utilities. The sewerage line in particular has severe deficiencies and cannot accommodate the current demand. A new and upgraded sewerage line and pump station will be constructed to cater for the increased volume.

8.1.1.22 Bulk Services: Construction

Some service users may be subjected to temporary interruptions when the services are changed over to the new system during the testing phase. This period should be no more than 24 hours and adequate notice and information would be supplied to all service users prior to any service interruption. Peak times, such as weekends would be avoided.

The sensitivity of the receptor is considered medium due to the importance and the provisions of adequate waste services, and limited potential for substitution. Users are used to a deficient system, therefore a temporary short-term loss of services which will be scheduled appropriately with prior notice provided, is considered to result in a minor magnitude of change. It is therefore anticipated that the impacts will be adverse low.

8.1.1.23 Bulk Services: Operation

Once the new system has been swapped to, the local users will have an upgraded system which has been designed to accommodate the proposed project, local community and potential future growth in the area. These improvements and benefits felt by the users have been assessed to be of a moderate magnitude of change. The significance of the impact is therefore considered to have a moderately beneficial effect on the users.

8.1.1.24 Summary of Impacts on Community Bulk Services

Table 31 – Potential impacts associated with bulk services

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Rerouting and change-over of bulk services	− Service users	Temporary loss of services	Adverse Direct Local Short term Temporary Reversible	Medium	Low	Adverse Low (1)
Installation of new bulk services	− Service users	New and improved services	Beneficial Direct Local Long Term Irreversible	Medium	Moderate	Beneficial Moderate (6)

8.5.3. Community Facilities

The proposed project site is currently occupied by a cricket oval and cricket clubhouse, swimming pool, tennis and jukskei courts, and green open spaces with established palm trees and other vegetation. The proposed project will be developed on the whole site and these facilities will be relocated and their areas replaced with hotels, restaurants, commercial business and residential properties. Open areas are designed and integrated throughout the development, however the current sporting facilities will no longer exist on the site. The cricket oval and cricket clubhouse will be relocated to Kuisebmond and the swimming pool, tennis and jukskei courts will be relocated to Jan Wilken Stadium. The area surrounding the proposed project site has green spaces, including a playground less than 300m away.

The impacts on the sites used to relocate the sporting facilities are discussed in Section 1.10. The impacts of a temporary loss and relocation of local sporting facilities away from the site is discussed in this section.

8.1.1.25 Loss of Sporting Facilities: Construction

During the Phase 1 construction, the swimming pool, tennis and jukskei courts will be demolished and new facilities will be relocated. There will be a period of time where these facilities will not be available for use. The cricket clubhouse will also be demolished to enable construction works, however a temporary facility will be replaced on site. In Phase 2, the cricket oval and cricket club will be relocated to Kuisebmond.

Whilst these facilities are temporarily lost, other facilities at Jan Wilken and Sparta can be used, as well as other open green spaces in and around the area: approximately 3,500m^2 of open space is available along the esplanade within 1km of the site, as well as a playground 300m south of the proposed project site between 2nd and 3rd Road. An increase in users of these other facilities may be felt, however this will be short term and temporary.

A temporary loss in sporting facilities will potentially result in a moderate adverse impact. There will be a temporary loss of sporting facilities (swimming pool, tennis and jukskei courts, and cricket oval) and a complete loss of the outdoor swimming pool and green areas, which are all considered to be of medium sensitivity because of their importance to the town and local community and have limited potential for substitution during. The most significant impact will be the loss of the outdoor swimming pool and associated green areas and open spaces where people braai and congregate. This will not be directly replaced; however, alternatives are available and open spaces have been integrated into the final design on the proposed development.

8.1.1.26 Available Sporting Facilities: Operations

The relocated sporting facilities will be sited at two sites; Jan Wilken and a site in Kuisebmond. These sites are approximately 2.3km and 5.3km away respectively. An alternative cricket pitch, tennis and jukskei courts are approximately 1.3kmaway at Sparta; however, an alternative swimming pool is not available. Some users of the existing sporting facilities on the proposed project site may have to travel further to use these alternative facilities. This could result in an inconvenience to these people, which are considered to be low sensitive as people have the capacity to change. The change to the existing baseline will be permanent and could result in an adverse impact of a minor magnitude of change. The impact has therefore been assessed to be low adverse.

8.1.1.27 Summary of Impacts on Community

Table 32 – Potential impacts associated with the Community

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Proposed development – land use	– Community – Residents	Temporary loss sporting facilities used by local communities, permanent loss of green space and outdoor pool	Adverse Direct Local Temporary Irreversible	Low	Moderate	Adverse Minor (3)
Relocated sporting facilities	– Community – Residents	Inconvenience to existing users	Adverse Direct Local Permanent Irreversible	Low	Minor	Adverse Low (2)

8.5.4. Noise Impacts

The proposed project site is adjacent to a residential area, the coastline and an industrial area. Noise levels will increase as a result of the construction and operational activities at the proposed project site.

Noise impacts on marine mammals are assessed and presented in section 8.6 and therefore has not been discussed in this section.

8.1.1.28 Noise Impacts on Receptors from Construction Site Activities

Noise levels are expected to increase as a result of construction activities. The main sources of noise will be from:

- Construction vehicles moving on site;
- Demolition activities;
- Earthwork activities;
- Piling activities;
- Construction of marina wall – movement of rocks; and
- General construction activities such as drilling and loading and unloading material.

Noise data from the Namport Expansion Terminal Project EIA has been used to define the baseline, along with a number of assumptions and the use of SANS 10103:2008. It is assumed that the noise baseline along Atlantic Street is between 66.6aB(A) and 68.3dB(A) during afternoon peak times, and less during morning and nighttime peak times. Noise levels along KR Thomas Street and 4th Road are approximately 55dB(A), increasing towards Atlantic Street and 5th Road.

Human receptors opposite the proposed development site are those that are most likely to be affected by the construction works. Receptors within 200m of the proposed project site boundary are also likely to experience disruption from noise, however noise will reduce the further away from site the receptor is. Receptors further away are likely to only hear noisy activities which will be limited to short periods and during specific times. The impacts on receptors directly opposite the site on the Esplanade, KR Thomas Street and 4th Road have been assessed as these impacts will be the worse.

The South African noise control regulations describe disturbing noise as any noise that exceeds the ambient noise by more than 7dB. Noise levels will vary depending upon the type, duration and frequency of equipment used, the location on site and climate conditions, in particular wind and rain. It is predicted that noise generated from general construction activities will increase the baseline levels by more than 7dB(A) for the majority of the construction works. Noisy activities may see an increase of potentially double this value, however this would be for short durations of times.

Receptors (residents and hotel guests) along the Esplanade, KR Thomas Street and 4th Road are within 30m of the site with no structures to attenuate the noise. Receptors are considered to be medium sensitive as they sensitive to change. Receptors are located along quiet roads compared to the surrounding roads and the majority of the area is residential.

Noisy activities would be scheduled around sensitive times and between 7am and 6pm during weekdays. Notice will be provided to local residents and receptors prior to undertaking noisy activities. The site would also have a boundary fence made of material to reduce noise, dust and visual impacts of the site (e.g. hoarding), which would provide some noise attenuation. However, with these mitigation measures, the nature of the impact will be adverse and short-term. The change to the baseline conditions will be temporary; however, will have a major magnitude of change. The impacts of construction noise on local receptors has therefore been assessed as being of moderate adverse.

8.1.1.29 Noise Impacts on Receptors from Construction Traffic

During the construction stage, there will be an increase in construction traffic on the local roads approaching and around the proposed project site. During the construction of the marina, there will be approximately 50 truck movements per day to and from the site over a six-month period. After this period, the number of vehicles is likely to be less than this number, and will be needed to deliver and remove plant, equipment and waste.

It is predicted that there will be around six truck movements per hour along designated routes to Industrial Zone 14. Local residents and other noise sensitive receptors such as schools and churches, may see a small increase in noise levels as a result of this intermittent short-term activity. This change in baseline is expected to be small; the nature of Walvis Bay is industrial, and there are regular trucks and high levels of traffic on the roads as a result of industrial activities like the Salt Works and Namport operations. Therefore, it has been assessed that a minor adverse impact may occur as a result of increasing noise levels during construction.

8.1.1.30 Noise Impacts on Receptors from Operations

The final design has considered local residents by designing the anticipated noisier components of the development on the north side of the site (e.g. commercial and car parking) and residential properties to the south and east of the site, opposite residential properties. There is still potential for the current noise levels to increase as a result of the proposed project, from sources such as increase people visiting the area, increase in residents in the area and addition of commercial (retail) properties.

This increase will be long term for the duration of the operations of the proposed project, and shall result in negative impacts to sensitive receptors including local residents, customers of the Raft and the Protea hotel. The change to the baseline is considered to be of moderate magnitude, as there will be measurable change to the current baseline. The local residents are sensitive to change; however, they should become accustomed to the change in the environment, and therefore are considered as being medium sensitivity. The proponent would hold quarterly forums to ensure all comments, concerns or complaints are recorded and appropriate actions are taken to minimise impacts on the community. With mitigation measures, the significance of impacts is considered to be moderate.

8.1.1.31 Noise Impacts on Receptors from Traffic During Operations

The volume of traffic on roads is likely to increase as a result of the proposed project. It is anticipated that at peak times (see Table 12) there is potential for over 1,000 vehicles per hour to enter the site, a major magnitude of change (increase) from the baseline. Although local residents and other sensitive receptors along the main vehicle routes to and from the Namport Container Terminal and the Salt Works are used to high traffic levels and thus noise levels, this increase will be a noticeable change. The minor roads around the proposed project site are also likely to experience increased levels of traffic and thus noise. This increase in traffic would result in an increase in noise and thus adversely impact sensitive receptors. This impact is considered to be of moderate significance.

8.1.1.32 Summary of Noise Impacts on Receptors

Table 33 - Impacts to the community due to increased ambient noise levels

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction activities on site	− Community − Residents	Increased ambient noise levels – nuisance for local residents	Adverse Direct Local Short Term Reversible	Medium	Moderate	Adverse Moderate (6)
Construction Traffic	− Community − Residents	Increased ambient noise levels – nuisance for receptors along transport route	Adverse Direct Local Short Term Reversible	Medium	Minor	Adverse Minor (4)
Operations – from the proposed project site	− Community − Businesses − Residents	Impacts on sensitive receptors due to increased ambient noise levels - operations	Adverse Indirect Local Permanent Irreversible	Medium	Moderate	Adverse Moderate (6)
Operations – increase in traffic	− Community − Businesses − Residents	Increased ambient noise levels – nuisance for receptors along transport route	Adverse Indirect Local Permanent Irreversible	Medium	Moderate	Adverse Moderate (6)

8.5.5. Air Quality

The proposed project site is sandwiched between a residential area, the coast and an industrial area. There are limited industrial activities in Walvis Bay that adversely affect the local air quality, which is considered to be good. Operating plant and equipment will result in emissions from the combustion of fuel, releasing pollutants into the air, the most concerning ones being nitrogen dioxide and particulate matter. It is very unlikely that the existing local air quality will be impacted by the emissions during the construction works, and therefore is not discussed further.

Dust will be generated from construction activities and may impact the local air quality.

8.1.1.33 Dust Impacts on Sensitive Receptors

Dust will be generated from the proposed project site during the construction activities through vehicle movements, demolition activities, site levelling, road construction and short-term stockpiling of dredged or fill material. Dust may become airborne and settle on surrounding properties. It is considered both a nuisance problem and health issue.

The potential dust generated in the proposed project location will generally be coarse consisting of sand and fill material, with limited potential to become airborne. The prevailing wind direction is south-west-west (Iowa State University, 2018), therefore any dust becoming airborne is likely to be carried away from sensitive receptors.

Local receptors are the same as those considered in the noise assessment, and a similar zone of influence is applicable to dust impacts (200m). Dust can potentially cause health issues, and to a lesser impact, can accumulate on properties and become a nuisance. Local receptors are used to sand and dust issues due to the surrounding environment and strong winds, therefore are considered to have low sensitivity.

The construction works are short-term and temporary. The construction site will have a solid fence (hoarding) around the site thereby limiting the potential for dust to be transported off site and good construction methods will be implemented to minimise dust arising and becoming airborne, such as minimising dust works during high winds. Where required, water would be sprayed on surfaces and stockpiles to reduce air borne dust and construction vehicles will have speed restrictions (on and off site). Specific activities would avoid high wind periods, and stockpiles would be avoided on site.

The transportation of dredged material from the proposed project site to Industrial Zone 16 will be undertaken along specific routes, which would be cleaned of sediments if required. The material will be covered to avoid dispersion and in the event of very windy events, transportation shall be ceased. Appendix A provides further measures to avoid and minimise dust impacts.

The magnitude of change is therefore considered to be minor as there will be some measurable change to the receptors. The significance of impact is predicted to be low, however it is recognised that the nuisance is of concern to local residents, therefore suitable mitigation has been identified.

8.1.1.34 Summary of Impacts on Air Quality

Table 34 - Impacts to community due to dust generated during construction

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Waterfront Construction – general activities	− Community − Residents	Dust generated during construction activities affecting local residents properties (nuisance) and potentially health	Adverse Direct Local Short Term Reversible	Low	Minor	Adverse Low (2)

8.5.6. Sense of Place

The proposed project site is located next to a residential area to the south and east, an industrial area to the north (harbour area), and the Lagoon to the west. Residential properties along KR Thomas Street and 4th Road over-look the proposed project site, as does the Protea Hotel on the north-west side of the site. The proposed site is currently occupied by sporting facilities and green open spaces with established palm trees and other vegetation.

The assessment for sense of place analysed the potential impacts from the changes to the character of the landscape, residential amenity (residential views and light – noise has been assessed in the noise assessment) and changes to the existing sense of place. This assessment does not consider the impacts of a loss of community facilities, this has been assessed and presented in section 8.5.3.

8.1.1.35 Changes to Existing Sense of Place: Operations

Although a perceived convenience, the sense of place experienced by the local community may be impacted through the development of the proposed project. A sense of place can be defined in many ways; it can be defined as characteristics that a geographical area has, the perception held by people of a place or a place that has certain characteristics that fosters a sense of authentic human attachment and belonging.

The proposed site is a community site which contributes to the characteristics of the area. A new development in the area that will take away this characteristic and introduces a different characteristic may alter the sense of place for local residents and the community. This change can be perceived both positively and negatively and varies from person to person. Assuming the worse-case scenario is that the change to sense of place is considered negative, the potential impact could affect the receptor (local residents and community) directly for the long term, however people adapt and over time will be accustomed to these changes, therefore it is considered as a temporary change.

The magnitude of change to the receptor compared to the current baseline is considered major due to the changes to key features and characteristics of the environment. The significance of the impact is therefore assessed to have a moderately adverse impact on the receptor.

8.5.7. Residential Amenity: Construction

Residential properties that line KR Thomas Street and 4th Road, and potentially some that are located on adjacent roads have views into the proposed project site, and some have unobstructed views looking towards the Lagoon. Not all properties will have views onto the site and the Lagoon as many have high security walls or are less than two stories. The existing lights in the area are downward facing street lights as well as some lighting seen from the Namport Harbour.

During construction, the proposed project site will change from a community site into a construction area, with large plant and equipment, and some lighting for health and safety reasons. Construction works will not occur during the night; therefore, lighting will be limited to daylight hours. The construction period is considered as short-term; however, the views of the existing community site will be lost permanently. A visual screen will be placed around the site, which will mitigate most of the views into the area, however properties which are two stories or higher may still see into the site. Where lights are required, downward facing lights will be used.

Due to the magnitude of change from the baseline being moderate and the receptors considered as being highly sensitive, the significance of impact has been predicted to be adverse moderate.

8.5.8. Residential Amenity: Operation

The proposed project will introduce a completely different view for residents surrounding the site; rather than a green open area with low buildings, a more built-up area with buildings ranging from two stories high to seven. Residents along KR Thomas Street and 4Th Road will have views overlooking the residential zone of the proposed project. Views into the Lagoon from properties along 4th Road will be obstructed as a result of the development.

Buildings developed on the perimeter of the site will set back into the development to prevent blocking the sun and creating shade into neighbouring houses. Street lights will be replaced on a like for like basis as existing arrangements, and any lighting around the marina will be directed away from residential properties.

The change in residential amenity (view and light conditions) is considered to be a moderate magnitude of change from the baseline; the change is permanent and localised, however the impacts felt by the receptor will reduce over time as people become accustomed to their surroundings. The area would not be rendered as an unattractive place to live; therefore the impact has been assessed as being adverse moderate significance.

8.1.1.36 Landscape and Seascape Character

The area where the proposed project site is located is dominated by the Lagoon, residential area and Namport Container Terminal. Vegetation such as palm trees and other trees and vegetation enhances the area, particularly along The Esplanade road running parallel to the Lagoon and along KR Thomas Street. Residential properties are no greater than three/four stories high, and the container terminal stacks containers no higher than five. The Raft Restaurant plays an important feature in the seascape character as does the shallow Lagoon and coastline.

The proposed project will utilize an area which currently occupies sporting facilities, and will alter both the local landscape and seascape character of the area due to the integration of commercial and additional tourist facilities. The landscape and seascape character of the area is valuable to the local community and therefore considered to be a medium sensitive receptor.

Construction activities will result in the removal and relocation of the existing facilities, turning the area into a construction site. The area will be fenced off with a block-out structure, thereby minimizing impacts on the surrounding area. The construction phase will be short-term, however will alter both the local landscape and seascape character considerably. The magnitude of change is minor as most of the impact will be felt during operations. The impact during construction is therefore predicted to be as adverse minor.

The loss of open green space and integration of built development, change to the seascape and coastline. These features along with consultation feedback, have influenced the design. Open spaces are incorporated into the design as well as an inner marina; vegetation will be retained and reestablished around the site; building material will be sourced locally allowing the buildings to blend in with existing buildings and the natural environment; and the design, position and setting of the buildings have taken into consideration sunlight and residential views. Lighting will be designed to minimize spill on to adjacent properties and downward lighting will be used where possible.

During operation the magnitude of change from the existing baseline is considered to be both positive and negative: the landscape and seascape character will change considerably, however the area surrounding the site is already built up. The seascape will have the most impact as there are limited developments that border the Lagoon front and marine buoys will be required permanently to mark the approach channel. The development will integrate features along the shoreline including the Raft and the Protea hotel. The change will permanently alter the character of the landscape and seascape; however, it will be localised. The magnitude of change is therefore considered to be moderate and the potential impact to be adverse moderate.

8.1.1.37 Summary of Impacts on Sense of Place

Table 35 - Impacts to community due to changes in sense of place

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Operations – new features	– Community – Businesses – Residents	Changes to the sense of place	Adverse Direct Local Long-Term Temporary	Medium	Major	Adverse Moderate (6)
Construction – general construction activities	– Community – Businesses – Residents	Neighbouring Properties visual amenity impacted by development	Adverse Direct Local Permanent Irreversible	Medium	Moderate	Adverse Moderate (6)
Construction – general activities	– Community – Businesses – Residents	Seascape and landscape character altered	Adverse Direct Local Short term Temporary	Medium	Minor	Adverse Minor (4)
Operations – new development	– Community – Businesses – Residents	Seascape and landscape altered	Adverse Direct Local Long-term Permanent Irreversible	Medium	Moderate	Adverse Moderate (6)

8.1.1.38 Additional Mitigation

To ensure the proposed project site integrates with the local surroundings and that any soft landscaping (vegetation) has successfully established, management and maintenance measures will be required. Details of the measures are contained in the Operations ESMP, Appendix A.

8.6 The Marine Environment: Hydrodynamics & Water Quality

Impacts on the hydrodynamics and water quality of the marine environment has been assessed and reported in this section. The significant hydrodynamics and water quality impacts or impacts that have specific interest to the community and stakeholders are summarised in Figure 61.

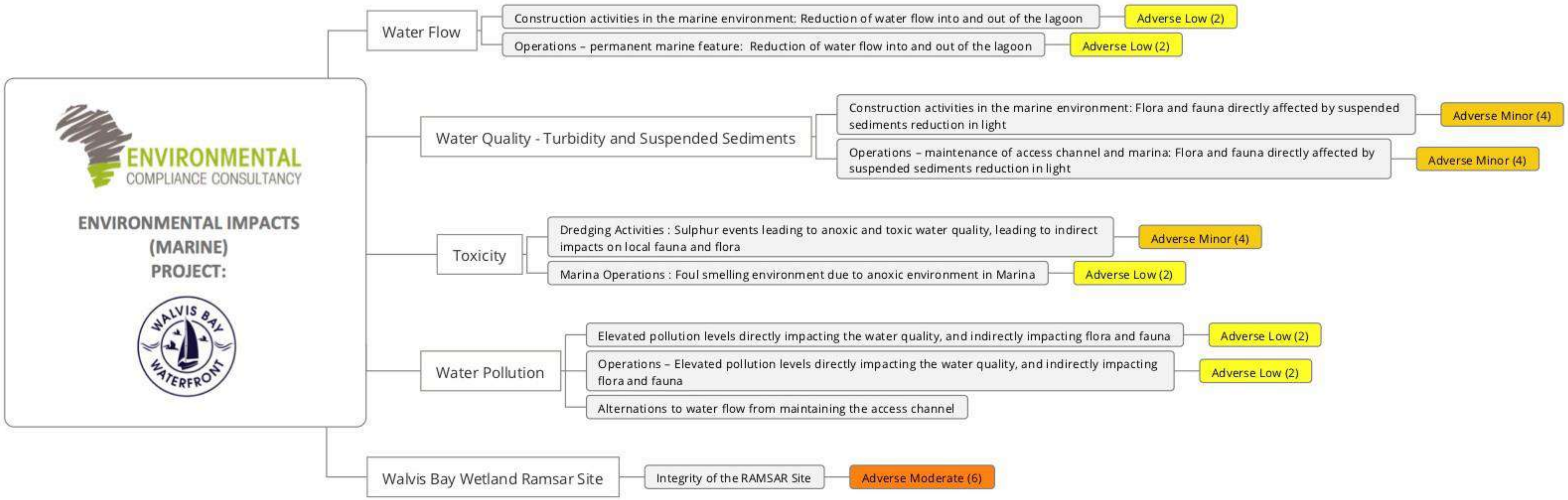

Figure 61 – Hydrodynamics and water quality impacts

8.6.1. The Lagoon

The proposed development includes a new marina that will be constructed on the coastline, immediately south of the mouth of the Lagoon. The Lagoon forms part of an area that is designated as the Walvis Bay Wetland Ramsar site. Tourism and recreational activities are undertaken in the Lagoon and Bay area. The hydrodynamics of the Lagoon are fundamental to Lagoon's environment and associated ecosystems, in particular the water quality and flow of water (currents and tides) are fundamental to the functions of the Lagoon. The Lagoon directly interacts with the wetlands, and therefore supports vast populations of resident and migratory birds of various species (approximately 40% of the total number of waders in the wetland are found in the Lagoon). The Esplanade along the eastern shore of the Lagoon affords visitors and locals the opportunity to view flamingos, pelicans, waders and other coastal birds from close range.

The dynamics of the Lagoon and supporting features are therefore considered as national value and has moderate sensitivity to change due to the potential direct and indirect impacts; thus classified as medium sensitivity and value as per Table 18. This sensitivity is applied to the following sections which investigates how the water quality of the Lagoon could be affected, focussing on water flow, turbidity (suspended solids), pollution and toxicity levels.

Significant indirect impacts as a result of the change of water quality are discussed separately: the impacts on birds and marine mammals is discussed in sections 8.7 and 8.8 respectively. As stated above, the Lagoon forms part of the Ramsar site, which is considered as an individual receptor due to its international importance. The impacts on the Ramsar site are discussed in section 8.6.7. The assessment presented in this section considers the combined impacts on the various attributes that combine to form the complex Lagoon ecosystem. This then feeds into the assessment on the Ramsar site the Lagoon forms an important feature of this international valued site.

8.6.2. Water Flow: Construction

During construction, various plant and equipment will be within the marine environment to enable the construction of the marina, which will be limited to a designated working area to minimise potential impacts on the marine environment. The Marina wall will be one of the first construction activities which will form a new solid structure in the Lagoon. The presence of this structure has been assessed and presented in section 8.6.3.

No other solid structure will be present in the marine environment during construction, therefore it is unlikely that the natural flow into and out of the Lagoon will be affected. Therefore, the potential impacts are predicted to be low as the potential magnitude of change is expected to be negligible.

8.6.3. Water Flow: Operations

The design of the marina has been developed through an iterative process as described in section 5.4.1. Through this process, several potential impacts to the marine environment have been designed out, in particular the potential impact on the flow of water into and out of the Lagoon. The layout of the Marina wall and the orientation of the Access Channel have taken into consideration the main natural tidal channel and flow of water into and out of the Lagoon, the currents and natural siltation.

The Marina wall will extend approximately 40 to 50m into the Lagoon and therefore there is potential for the natural flow into and out of the Lagoon to be affected and thus a hydrodynamic study was conducted. The hydrodynamic study report (Appendix I) concluded that the flow velocities at the Lagoon mouth and the refreshment rate of the Lagoon may slightly be affected by the presence of the Marina – see Figure 62 and Figure 63. The flow velocities are expected to deviate by a maximum of 3mm/s, which is considered to be a negligible magnitude of change.

During neap and spring tide conditions all discharge parameters (average, max flood, max ebb) across the indicator line at the Lagoon entrance show negligible differences between the existing situation and the situation with proposed project. The deviations are generally below 0.3% with one outlier (scenario 1 max ebb velocity). Changes in flow direction as derived from the modelling are mostly below 0.5 degrees, with one maximum difference of 2.5 degrees. These changes are also considered to be minor, therefore resulting in a low significant adverse impact.

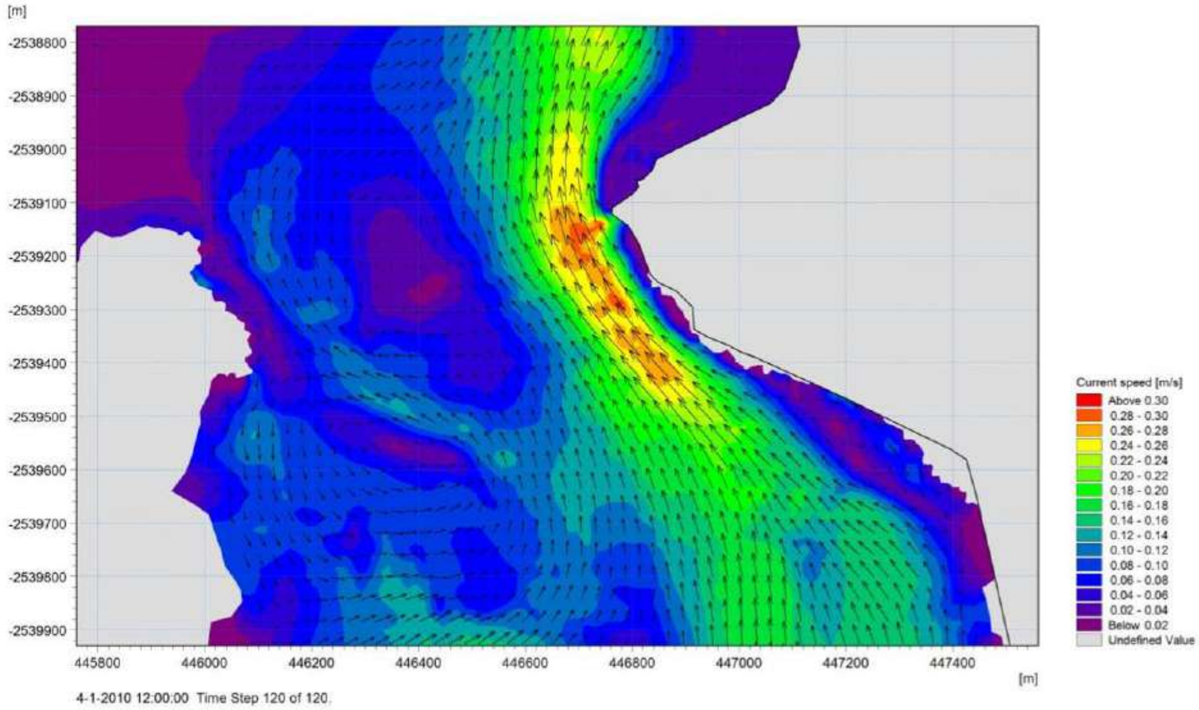

Figure 62 – Typical existing ebb current pattern (Appendix I)

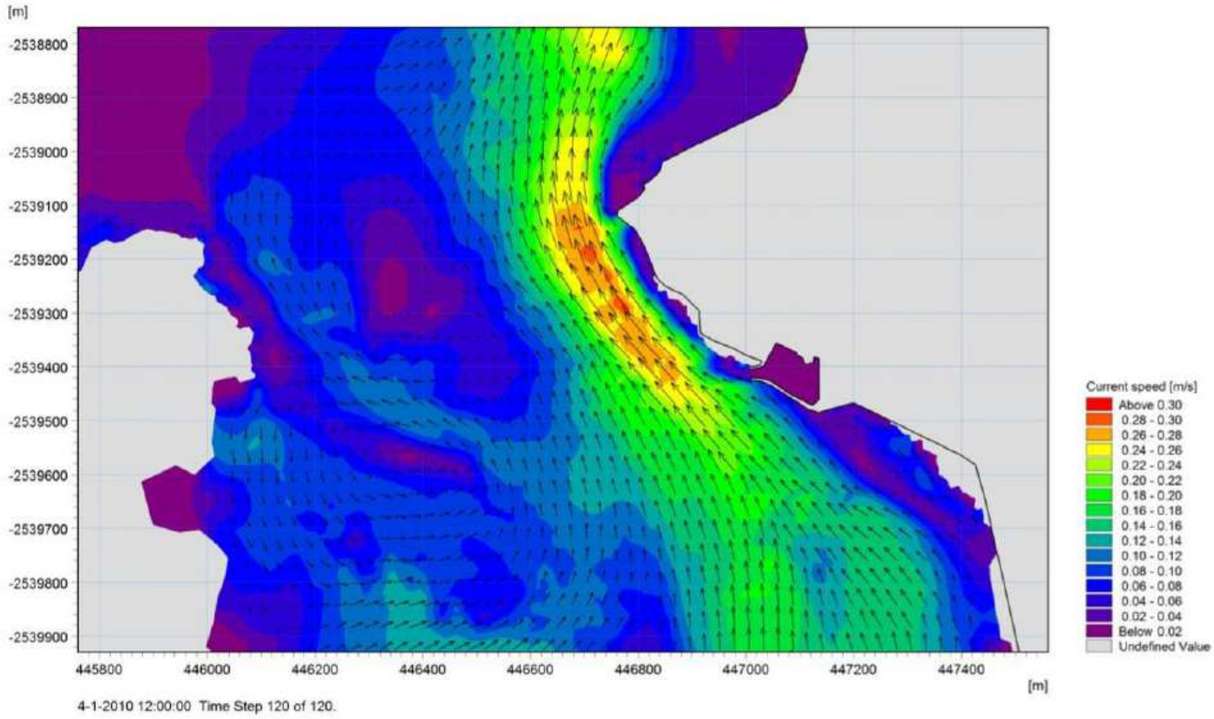

Figure 63 – Typical ebb current pattern with proposed development

8.6.4. Water Quality: Turbidity & Suspended Sediments

The sea floor of the harbor has a soft substrate/mud sediment bottom, and the mouth of the Lagoon is composed of coarse and medium sands. Due to the anoxic conditions of the Bay and Lagoon, the biodiversity is limited to a few species that can tolerate the environment (see Section 6.23.11).

8.1.1.39 Suspended Sediments: Construction

Construction activities will be undertaken in the marine environment to enable the construction of the marina wall and the deepening of the Lagoon access channel and the Marina Access Channel. Associated construction activities such as piling, offloading of rocks and dredging will have the potential to disturb and increase suspended sediments in the Lagoon and Bay area. A gravel dredge pump system and vibratory piling techniques will be applied; however, alternatives are currently being investigated, including a more environmentally friendly dredger (Watermaster) as discussed in Section 4.7.4.6. The most appropriate techniques shall be identified to minimise suspended solids.

If utilised, the Watermaster would minimise suspended solids entering the water column, therefore by applying the precautionary principal, the worst-case scenario has been applied to the assessment. The gravel dredge reclamation system has been assessed which involves undertaking dredging activities on the outgoing tide. With either dredging option, a closed bund would be built and used during the construction process. Mr Alan Louw would monitor all dredging activities and turbidity monitoring will be undertaken in specific areas in the Lagoon. Environmental thresholds will be set (see Section 0 and the ESMPs) and should these be exceeded during dredging, a silt curtain will be deployed. Sequencing and scheduling of dredging activities have also been designed to take into consideration the potential impacts from suspended sediments. Further detail of mitigation measures are detailed in the ESMPs (Appendix A).

It is however possible that some sediments will become suspended during these activities, leading to suspended sediments into the water column. The release of potentially contaminated sediments and the impacts is discussed in sections 8.6.5 and 8.6.6. Increase suspended sediments can affect filter feeding organisms, such as shellfish, through clogging and damaging feeding and breathing equipment. Similarly, young fish can be damaged if suspended sediments become trapped in their gills and increased fatalities of young fish have been observed in heavily turbid water. Adult fish are likely to move away from or avoid areas of high suspended solids, such as dredging sites, unless food supplies are increased as a result of increases in organic material. This could have an indirect impact on the avian community, see Section 8.7.5. A reduction in light can occur affecting seaweeds and plants, and temporarily reducing productivity and growth rates, and the settlement of sediments can result in the smothering or blanketing of sub tidal communities and/or adjacent intertidal communities. Sedimentation can result in smothering habitats in the area or downstream, which may be food sources for marine fauna.

The turbidity of the Bay area is considered to be relatively high due to the natural hydrodynamics from the Bay area, but also as a result of existing dredging operations associated with Namport. The Bay is flushed twice daily through water circulation, with the Lagoon being refreshed through these currents. The existing eastern natural channel into the Lagoon has the highest current rates. The Hydrodynamic Study (Appendix I) states that infrequent short-term dredging with appropriate environmental management, is unlikely to result in an impact to the water quality through increased sedimentation, thus no change to the baseline is expected to occur.

Taking into consideration the above: the nature of the activity; the potential change to the baseline; and the mitigation measures, the magnitude of change is considered to be minor, and the overall significance of impact has been assessed to have a minor adverse.

8.1.1.40 Suspended Sediments: Operations

During operations, there will be a requirement to dredge the Access Channel approximately every two years and the Outer Marina every 5 years to maintain depth and safe nautical access, as well as reduce decomposing flora and fauna in the marine environment. The duration of dredging operations will be short term and temporary, and will occur in specific localised areas. As stated above, the Hydrodynamic Study (Appendix I) states that infrequent short-term dredging is unlikely to result in an impact to the water quality through increased sedimentation. If any impact occurs, it will be localised and only last for the duration of the dredging activities, and mitigation measures (see Section 8.6.4) therefore a low adverse impact is therefore predicted.

8.6.5. Toxicity: Construction & Operations

The sediment on the Lagoon and Bay floor is rich organic sediment which is usually anoxic due to the depletion of dissolved oxygen and has a number of environmental pollutant contaminants. Aerobic decomposition of organic material within the sediments results in the generation of methane, sulphur dioxide and hydrogen sulphide gasses that become trapped within the layers of organic-rich, anoxic mud. The disruption of sediments can lead to a sulphur eruption as a result of the accumulation and release of these gases, which leads to reduced dissolved oxygen resulting in mass mortality of the local marine community, and potentially indirectly impacting local birds.

Construction activities in the marine environment, in particular dredging, can lead to the disruption of sediments and therefore a sulphur eruption, as well as the release of environmental pollutants resulting in the water becoming anoxic and toxic. Dredging and other construction activities in the marine environment will be short term and methods and equipment have been chosen to minimise impact to the marine environment (see section 8.6.4). The potential changes to the baseline (anoxic and toxic conditions) will be temporary and localised, and would unlikely lead to indirect impacts on local fauna and flora great than a minor magnitude of change. The level of significance has been assessed to be of minor adverse on marine flora and fauna, and the Lagoon ecology.

These sulphur events could also result in foul smells being emitted indirectly impacting the local community. These events have been assessed as having a low adverse impact on the local community due to the duration of activities and the events already being a common occurrence in Walvis Bay.

During operations, there is limited opportunity for considerable sulphur eruptions to occur and impact the marine environment or the local community. The Marina Access Channel will be dredged every two years and the Outer Marina every five years, thereby regularly releasing organic material and trapped gases, and reducing the natural build up. There may be a beneficial impact as a result of these dredging activities as fewer episodes may occur naturally.

8.6.6. Water Pollution: Construction & Operations

As a result of activities in the Bay area, including the Harbour and fishing industry, there is potential for existing elevated pollutants (heavy metals and organic compounds) to be present in the marine sediments. There is therefore potential to disrupt these pollutants during dredging activities (construction and operation), impact the local water quality and potentially spread pollutants into the Lagoon. The proposed project will not contribute to these pollutant levels.

Elevated pollutants have the potential to indirectly impact the flora and fauna of the Lagoon, as well as downstream users such as the Salt Works. There have been no reports of significant long-term impact related to the regular maintenance dredging undertaken by Namport in Walvis Bay Harbour (Appendix J and see limitations).

Pers comms with Mr Alan Louw 14th February 2018 confirmed that is it widely known in the Walvis Bay community that heavy metals are found in the sediments of the port area, however heavy metals are not found in the sediments in the Lagoon. Sediments analysed by Namport in 2006 also confirms this; the Lagoon area, including the channel has less than 1mg/kg of cadmium concentration, which is below the BCLME TEL. Whilst this data is 12 years old, it is considered unlikely that dredging activities within the Lagoon will mobilise heavy metals, however, to further mitigate this potential risk, dredging operations will have specific mitigation measures, depending on the preferred technology identified and utilised, for example dredging operations will only occur on the outgoing tide and at certain times of the year (see section 8.6.4). Turbidity monitoring will be undertaken throughout, Mr Alan Louw will oversee all dredging works and a bund will be established to control the movement of sedimentation. It should also be noted that if heavy metals become suspended, they are likely to settle within approximately five hours, and in combination with the outgoing tide, they would be swept into the Bay and not the Lagoon. It is therefore considered, that the risk of causing a significant impact due to suspension and spread of heavy metals is low and the environmental impact is considered to be of low significance.

During operations, there is potential for boat users of the Marina to lose oil or fuel, thereby resulting in a localised adverse impact. Potential spills and incidents will be avoided through regular maintenance of boats and refuelling will be undertaken in controlled areas. The likelihood of a large spill occurring as a result of the Marina operations is considered to be low. A loss could result in a medium-term change to the environment, and could cause indirect impacts to marine mammals, flora and fauna, as well as the Saltworks' operations. The significance of impact has therefore been predicted as being low adverse.

The proposed development site will have a drainage system which will incorporates oil interceptors and fat traps. Surface water runoff and any waste effluent will be filtered prior to discharge to the marine environment, therefore it is unlikely that significant impacts will arise.

8.6.7. Lagoon & Ramsar Site

Walvis Bay Wetland Ramsar site covers the Lagoon, Pelican point and the Saltworks. The most important features and main reasons for the designation of the area are the mudflats exposed at low tide, the various sandbars and the diverse population and significant individual number of birds.

The Bay area plays a fundamental role in maintaining the environmental conditions that support the mudflats and bird life within the Ramsar site. Changes to the characteristics and attributes of the Lagoon such as sedimentation, recharge and flow rate, water quality and chemical composition could impact the environmental conditions resulting in indirect adverse impacts to the ecological features and bird populations, and thus jeopardise the loss of the international designation and potentially impacting the local tourism industry and other ecological services.

Due to its international designation and regional economic value, the Ramsar site is a highly valued site, however it has the capacity to accommodate change as illustrated through the constantly altering environment as a result of both natural and human influences (as discussed in the baseline chapter).

Taking into consideration the potential impacts assessed and presented in sections 8.6.2 to 8.6.6, there is potential for the water quality of the Lagoon to be affected by construction works, thereby affecting the dynamics of the Ramsar Site. In summary, the key issues are as follows:

- **Water flow:** The natural flow is unlikely to change as a result of the presence of the Marina – flow velocities are expected to deviate by a maximum of 3mm/s, however the Lagoon Access Channel will be dredged, thereby the flow may improve from baseline conditions.
- **Turbidity and suspended solids:** Suspended solids may arise due to dredging activities, however with the application of the construction methodology (use of bund, operate on outgoing tides) and type of dredging technology, suspended solids are expected to be minimal during the 6 months of marine construction works and to short duration of maintenance dredging. Sedimentation can cause indirect impacts to the marine environment.
- **Toxicity:** During dredging, there is a risk of disturbing rich organic sediments in an anoxic environment, leading to sulphur eruption, leading to the water becoming toxic. These potential impacts would be temporary and localised and would not worsen the existing conditions.
- **Pollution:** It is very unlikely that existing pollution, namely heavy metals will be disturbed and spread into the Lagoon or impact the water quality.

- **Pollution:** There is potential for an increase in pollution entering the environment as a result of additional vessels and boats operating in the marine environment.

In addition to these, there is potential for to disturb birds through the temporary loss of a small area of habitat during construction; noises from construction activities and operations; changes to food sources due to increased sedimentation; and the introduction of new buildings and lights potentially resulting in injury, mortality or changes to available food.

Taking into consideration these potential impacts that may affect certain attributes of the Ramsar site, the nature of the activities and mitigation measures that will be applied, the risk of affecting the integrity and qualifying features of the Ramsar site, namely the bird populations, is expected to be low. The magnitude of change is therefore considered to be minor and the potential impact assessed to be moderate adverse, which is driven mainly by the international value of the site.

8.6.8. Summary of Impacts on Water Quality

Table 36 - Impacts on water quality

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction activities in the marine environment	– Water Flow, the Lagoon	Reduction of water flow into and out of the Lagoon	Adverse Direct Local Short Term Reversible	Medium	Negligible	Adverse Low (2)
Operations – permanent marine feature	– Water Flow, the Lagoon	Reduction of water flow into and out of the Lagoon	Adverse Direct Local Long Term Permanent	Medium	Negligible	Adverse Low (2)
Construction activities in the marine environment	– Water Quality: suspended sediments, the Lagoon	Flora and fauna directly affected by suspended sediments, leading to a reduction in light	Adverse Indirect Local Short Term Reversible	Medium	Minor	Adverse Minor (4)
Operations – maintenance of access channel and marina	– Water Quality: suspended sediments, the Lagoon	Flora and fauna directly affected by suspended sediments, leading to a reduction in light	Adverse Indirect Local Short Term Reversible	Medium	Negligible	Adverse Low (2)
Construction –dredging activities	– Marine flora and fauna, the Lagoon	Sulphur events leading to anoxic and toxic water quality, leading to indirect impacts on local fauna and flora	Adverse Direct and indirect Local Short-term Temporary	Medium	Minor	Adverse Minor (4)
Marina operations	– Local community	Foul smelling environment due to anoxic environment in Marina	Adverse Indirect Local Temporary Reversible	Low	Minor	Adverse Low (2)
Construction - Dredging activities	– Marine flora and fauna – Saltworks	Elevated pollution levels (heavy metals) directly impacting the water quality, and indirectly impacting flora and fauna	Direct and indirect Local Short-term Temporary	Low	Negligible	Adverse Low (2)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Operation – boat activities	− Marine flora and fauna	Elevated pollution levels directly impacting the water quality, and indirectly impacting flora and fauna	Direct and indirect Local Short-term Temporary	Medium	Negligible	Adverse Low (2)
Construction and operation	− Ramsar Site (and Lagoon)	Integrity of the Ramsar Site through reduced water quality (increase sedimentation, flow,) and indirect impact on bird populations.	Direct and indirect International Short-term Temporary	High	Minor	Adverse Moderate (6)

8.6.9. Public Feedback on the Impacts to The Lagoon and Ramsar Site

During the review process of this ESIA report in January 2018, I&APs raised their concerns regarding the Lagoon's ecosystem and potential impacts as a result of the proposed project. This section in addition to Section 4.7.4.6, provides further information on the mitigation methods for the dredging operations.

The Lagoon is the most important feature of the Ramsar site; it supports 40% of the waders that reside in the Ramsar site; and is hydrologically linked to the mudflats and Salt Pans / Evaporation Ponds. Over the last few years, the Lagoon environment has changed, which has been documented in the decline in bird numbers (Appendix H) and observed by the local community. It is therefore imperative that the proposed project does not contribute to adverse changes.

Activities in the marine environment, namely dredging and piling are the most concern as these can potentially result in direct and indirect impacts to the Lagoon. As discussed, various mitigation is embedded in the construction design and construction activities, various additional mitigation shall be applied as well as monitoring. In summary, these are:

- **Construction design:** A bund will be provided as soon as reasonably practicable to support the dredging operations and minimise suspended sediments.
- **Choice of technology:** A gravel dredge pump system which uses a sucking technique has been identified as the preferred option. A review is currently being undertaken to ensure this is the correct technology. During this review the Watermaster (Appendix N) was identified, which utilises a special technique specifically for shallow water which minimises suspending solids entering the water column.
- **Scheduling:** The time of year when dredging will be undertaken will consider the findings of this assessment. Dr. Rob Simmons recommended that dredging should be undertaken in winter months, from May to August…
- **Scheduling:** The dredging works will be scheduled so that other similar marine activities in the southern area of the Bay are not undertaken at the same time.
- **Scheduling:** Depending on the preferred technology, dredging will occur on the outgoing tide at all times, or when turbidity thresholds within the Lagoon cannot be achieved.
- **Thresholds and monitoring:** A monitoring plan shall be developed, setting out turbidity thresholds (see below) and monitoring arrangements for turbidity and heavy metal before, during and after dredging activities.
- **Thresholds and monitoring:** If thresholds are exceeded, a silt curtain shall be deployed.
- **Dredged material:** All material dredged during construction shall be relocated at on-shore sites approved by the Namibian authorities and according to the conditions stipulated in the approvals for sites.

The aim of the pre-construction monitoring plan, as set out in the Construction ESMP (Appendix A) is to:

- Further develop the baseline records of existing turbidity conditions in the Lagoon;
- Set out turbidity and heavy metal monitoring arrangements;
- Set out turbidity thresholds; and
- Including a measure to determine organic matter vs. suspended solids.

Threshold values for suspended sediments concentrations will be applied during the dredging monitoring programme to ensure that the potential impacts to the Lagoon are mitigated. The threshold values have been determined using the environmental thresholds of bivalve molluscs and fish, and combine biological effects data and values based on a background, reference signal (Gosling, 2003) (Namport, 2006). This approach sets response parameters of background suspended sediment concentrations exceed the threshold limit. The Australian New Zealand Environmental and Conservation Council (useful guide to marine water quality) recommends that the 80th percentile of at least 10 observations of background values should constitute the new guideline value for the lowest limit (Delta Marine Consultants, 2010).

Suspended sediment concentrations for the upper portion of the water column will therefore be measured as Total Suspended Solids (TSS) in units of mg/l. By adopting this approach, the following environmental thresholds for turbidity levels have been adopted which is consistent with Namport's thresholds (Delta Marine Consultants, 2010):

- < 20 mg/l or 80th percentile of background levels – desirable low risk scenario.
- 20 – 80 mg/l for continuous periods of three days or longer - lower threshold of possible adverse ecological effects.
- 80 – 100 mg/l for more than six hours - probable adverse effects, mitigation measures must be considered.
- 150 mg/l - proven negative impacts, cease dredge operations.

Monitoring locations will be suitability placed in the Lagoon area to detect potential impacts associated with dredging activities, for example a monitoring location in the centre of the Lagoon below the dredging activity would confirm the effectiveness of dredging mitigation measures (i.e. to ensure that suspended solids from dredging activities are settling out in the Bay area on the outgoing tide). Should monitoring indicate that the impacts of dredging are being mitigated successfully and if no impacts are detected due to the dredging measures employed, the option to allowing dredging into the construction bund on both the incoming and outgoing tide could be investigated given the fact that material will be pumped into a construction bund.

Samples to detect heavy metal concentrations in sediments will be collected before and after dredging. Samples collected before dredging will be compared to the historic sediment samples and heavy metal results for the Lagoon area, thereby providing a more robust baseline (COWI, 2003 a, BCLME). Sediment samples collected after dredging will be used to compare results and check the effectiveness of mitigation measures.

Pers comms with Mr Rodney Braby (currently at the BCME and previously nine years at NACOMA (the Namibian Coast Conservation Management Project)) on the 13th February 2018 confirmed that independent threshold effect limits (e.g for sediment or water quality) specific for the Lagoon are not in place as the Lagoon is dependent on the waterbody of the wider Bay area; therefore the threshold effects limits that are applied to the Bay area are used for the Lagoon and the proponent should comply to these threshold limits as set out above.

8.7 The Marine Environment: Avian

Impacts on the birds has been assessed and reported in this section. Significant impacts or impacts that have specific interest to the community and stakeholders are summarised in Figure 64 . An Avian Assessment was undertaken by the specialist Birds and Bats, which is presented in Appendix H.

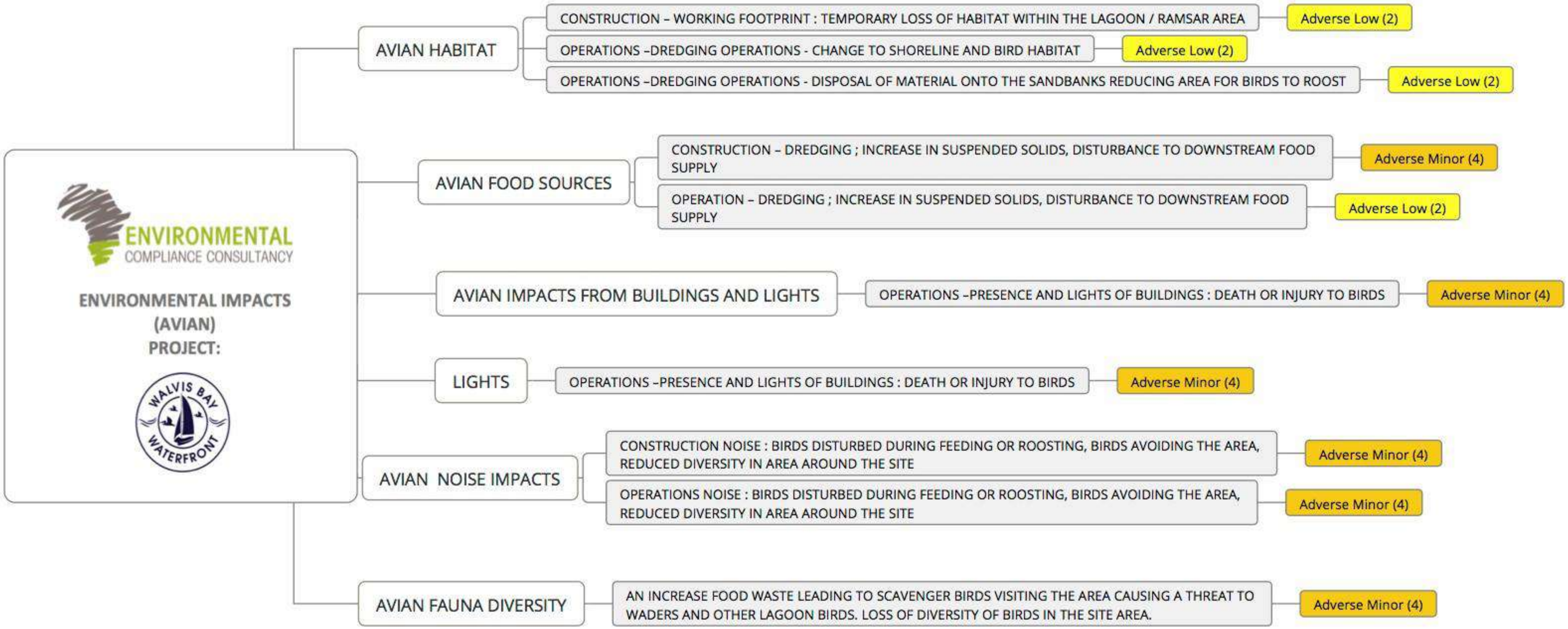

Figure 64 – Avian Impacts

8.7.1. The Lagoon and Ramsar Site

As discussed in Section 8.6.1, the Lagoon and Bay area provides a sanctuary for a number important and listed bird species. The Lagoon and surrounding area form the Walvis Bay Wetland Ramsar site, which is designated primarily for the bird life. The impacts on the Ramsar characteristics that make the unique wetland area, in particular, the water quality, have been assessed in Section 8.6.7. The conclusion was that there is potential for moderate adverse impacts to occur on the Ramsar site during the construction as a result of the changes to sedimentation, recharge and flow rate, and chemical composition, which would have an indirect impact on birds, the qualifying Ramsar feature. Whilst the main assessment for the Ramsar site was discussed earlier, the indirect impacts that could impacts the bird life and thus jeopardies the integrity of Ramsar site, are discussed in this section.

As a result of the diverse populations of birds being the primary interest of the wetland, the principal reason for the Ramsar designation and also the fact that they attract considerable number of tourists to the area, the sensitivity of birds is considered to be medium; they are of regional value but have the capacity to accommodate change.

8.7.2. Avian Monitoring Program

Twice-year (summer and winter) bird counts have been undertaken for the last 30 years, led by Mr. Peter Bridgeford, an international avian specialist in conjunction with a number of NGOs, interested groups, private businesses, Walvis Bay Municipality, environmental organisations and the MET. The Avian Study (Appendix H) was prepared by Dr. Rob Simmons, a specialised ornithologist. Dr. Simmons reviewed and analysed the bird count data and provided the findings of his review which included the potential influences on the bird populations in the Bay area.

Mr. Bridgeford continues to undertake twice-year bird counts, which is publicly available and shall be shared with ECC and the Walvis Bay Municipality. Appendix H recommends that further studies and monitoring is required. This is not because there is a lack of data for assessment purposes, but because the trends in the avian community should be continually monitored so that they can be more understood, which can be used to understand what impacts the numbers and diversity, e.g. natural processes or anthropogenic influences.

As set out in the ESMPs, the proposed project's Environmental Management team shall be encouraged to participate in the bird counts. This data shall be used for various reasons, in particular to monitor bird populations and diversity, and identify impacts that are affecting the bird life and suitable mitigation measures to minimise effects.

8.7.3. Avian Habitat: Construction

There are four main waterbird habitats within the Walvis Bay wetland complex: the sandy shoreline (including the Peninsula), intertidal mudflats, shallow sheltered water, and constructed saltpans. The most important feature of the area is the mudflats which are exposed at low tide, providing several sandbars serving as roosting sites for a diverse range of wetland birds.

The proposed project will occupy a small part of the north-east corner of the Ramsar site; approximately 0.014% (0.54 hectares). During construction, the sandy shore of the coastline within the proposed project site footprint will be temporarily unavailable for use by birds, and the surrounding coastline may also be affected due to other nuisances such as noise and general construction activities.

The temporary loss of the small area of habitat for birds will be limited to the marina construction period (6-8 months). The loss of this area will only affect a few individuals and not populations. This short-term adverse impact is considered to be indirect and will have a negligible magnitude of change. This area is not considered an important area for feeding or roosting compared to the inner Lagoon area, nor has anything unique been identified in this area in relation to bird habitat. The impact is considered therefore considered to be low.

8.7.4. Avian Habitat: Operation

The proposed project will result in additional land being created within the Lagoon and Ramsar site (approximately 0.30 additional hectares), which will result in 0.84 hectares of the Ramsar site being occupied by the proposed project. This altered habitat could be used by for birds, mainly for roosting; however, it would not provide a significant change to the overall availability of suitable areas/habitats for roosting or feeding. This long term permanent change is therefore considered to have a low impact.

During operations, maintenance dredging of the Access Channel and Outer Marina will be required, approximately every two and five years, respectively. If the material is of suitable quality, the material may be disposed of in the marine environment (see Section 5.6). The identified areas are not a bird breeding or feeding area, however the sandbank area is where birds are known to roost. If moved to the sandbanks, there is potential to disturb birds roosting in the area. The change would be for a short temporary duration, and the impacts would be felt by individuals and not populations, who have other areas to roost. The magnitude of change of disposing material in the marine environment, and for example on the sandbanks is therefore considered to be negligible and overall impact considered to be adverse low.

8.7.5. Avian Food Sources: Construction

Section 8.6.4 details the findings of the water quality assessment and suspended solids. Suspended solids will arise from construction activities which could result in smothering habitats downstream on incoming tides. An increase in sediments may decrease feeding opportunities, decreasing the likelihood that wading birds will use the area(see section 8.1.1.39). If food source of birds is affected, birds may find alternative locations to feed away from the Bay area, thereby altering the special characteristics and ecology of the Ramsar site and Lagoon area.

Avian declines of 42% in the Lagoon have been recorded over the past 20 years which has had an average rate of decline of approximately 2.1% per year, which can be seen in 11 of the 14 waders using the Lagoon. This decline worsened during and after the Namport Container Expansion project for four years at approximately 8.4% per year (see Section 6.1.2.15). This decline does not prove that the project causes the decline, however the two could be linked. It can therefore be assumed that sedimentation, salination, pollution and/or disturbance from the Namport construction works are key impacts causing effects. As per Section 8.1.1.39, An environmental dredger or gravel dredge pump system and vibratory piling techniques will be applied during construction and various mitigation measures will be adopted including the use of a bund, the overseeing by Mr Alan Louw, the scheduling and sequencing of works will consider local sensitive receptors (e.g. preference is to undertake works in the winter months) and turbidity monitoring will be undertaken throughout construction works. Further detail o mitigation measures are detailed in the ESMPs (Appendix A).

The potential impact from dredging (construction and operational) and thus increase suspended solids, on downstream food supplies of birds will be localised and short-term in nature. Birds will be able to utilise alternative food supplies; however, this could risk temporarily moving to a different area. The magnitude of change is considered minor due to the dynamic nature of the Lagoon and past experiences or exposure in relation to dredging, therefore the overall significance is considered minor and unlikely.

8.7.6. Avian Food Sources: Operation

Dredging will be required during operations to maintain safe nautical passage of the Access Channel and the Outer Marina. This will occur every two and five years respectively. These operations will be infrequent, of a short duration and result in localised suspended solids (as discussed in Section 8.1.1.40). The potential impact would be low adverse, potentially impacting fish populations (see section 8.1.1.39) and indirectly food sources for birds. Birds may be impacted; however, this is considered unlikely due to the nature of effects, would be able to avoid the localised area during these periods and find food sources elsewhere in the Lagoon or Bay area.

8.7.7. Avian Impacts from Buildings and Lights: Operations

The proposed project will incorporate new buildings into the landscape and seascape of the local area. This new infrastructure should not impact the flight paths or movement of birds during the day, however at night, when buildings have lights on, there is potential for birds to collide with the buildings, thus resulting in mortality or injury.

The heights of the buildings have been designed taking into consideration advise from Dr. Rob Simmons, who confirmed that bird flight paths can be adjusted to avoid collisions, therefore a seven-story building should not result in impacting bird flight paths. There are no other tall structures adjacent to the area, therefore ample room for birds to fly around the buildings. However, at night some of the buildings will be lit, which could disorientate or distract birds. A second impact of lights is the potential attraction of bugs, leading to birds feeding off them and subsequently colliding with buildings.

Lights will be minimised where possible, downward facing lights shall be sued where appropriate and sensor lights in office and communal areas that will go off when the space is not in use. However, even with these mitigation measures there will be a noticeable change in nighttime lighting in the area, particularly for birds. Tall masts or buildings with bright lights attract and kill more birds than any other anthropogenic source, excluding domestic cats (Loss et al 2014). Therefore, there is potential for the lights from proposed project to affect night-flying birds and migrants.

Birds will become accustomed to the change in landscape during daytime hours, and would only be impacted for a very short time. However, there is potential for the presence and lighting of the buildings to result in long-term changes. The design team and the ESIA team have incorporated recommendations from Dr. Rob Simmons into the lighting plans and strategy for the development to reduce potential impacts to birds from the proposed project. The adverse impact of lights is considered to be long-term and irreversible. The magnitude of change from the baseline environment is considered minor due to the presence of existing tall lighting structures on the project site and surrounding Namport area. The overall impact is therefore assessed to be minor adverse.

8.7.8. Avian Noise Impacts: Construction

During construction, various plant and equipment will increase noise levels in the local vicinity of the proposed project site and marine environment. Sudden noise can cause birds that are feeding to take flight, reducing energy intake and relocate to less productive areas away from sources of noise.

The main construction activities have been planned to avoid the summer months when the long-distance migrants are present. Furthermore, noisy activities have been designed out where possible; blasting will not be undertaken, and the vibratory pile driving will be employed.

Whilst some birds may feed along the coastline close to the proposed project site, the main feeding areas are further in the Lagoon, therefore only a few individuals would be affected by potentially noisy construction activities. Birds would most likely avoid the area for the duration of the construction works and find alternative feeding grounds in the Lagoon and Bay area. The change would be short-term and therefore the magnitude is considered to be minor. The overall impact is considered to be adverse minor.

8.7.9. Avian Noise Impacts: Operations

The proposed project may result in an increase in noise both on-shore and off-shore during operations: increase in watercraft traffic in and out of marina; increased road traffic around the development; and an increase in people and associated activities. This increase in noise levels, particularly in the marine area may dissuade sensitive species of birds from roosting or feeding in the local area, thereby reducing the diversity of birds around the proposed project site.

Strict controls over the users of the marina will include one point of entry and exit from the Lagoon and limitations to where motorized boats are permitted in Lagoon and Bay area. The magnitude of this potential change is considered adverse minor; the change to the existing baseline is expected to be small and infrequent, however will be a permanent change to the local area. The marine area around the proposed project site is not a unique feeding area and other area are available within the Lagoon. The receptor has a medium sensitivity resulting in an overall minor impact.

8.7.10. Avian Fauna Diversity: Operations

The proposed project will accommodate restaurants and other catering facilities. From the operation of these facilities, scrap food will be produced, which would increase the potential for scavenger birds to visit the area. An increasing number of scavenger birds can dissuade other species of birds, resulting in a decrease of waders and other wetland birds in and around the area of the proposed project.

A dedicated waste disposal area will be within the proposed project, which will have dedicated enclosed sorting facilities. Operations across the development and dedicated staff will maintain areas and collect waste to reduce attracting scavenger birds. There will however still be potential for this impact to occur, however, through good housekeeping measures, it will be reduced as much as possible. The adverse impact could be long-term and have a minor magnitude of change, thereby resulting in a minor adverse impact.

8.7.11. Summary of Impacts on Marine Birds

Table 37 - Impacts on Avian Fauna

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction – working footprint	– Avian Fauna, roosting / feeding ground	Temporary loss of habitat within the Lagoon / Ramsar area	Adverse Direct Local Short Term Reversible	Medium	Negligible	Adverse Low (2)
Operations – dredging operations	– Avian Fauna, roosting / feeding ground	Change to shoreline and bird habitat	Adverse Direct Local Permanent Irreversible	Medium	Negligible	Adverse Low (2)
Operations – dredging operations	– Avian Fauna, roosting / feeding ground	Disposal of material onto the sandbanks reducing area for birds to roost	Adverse Direct Infrequent Local Short Term Reversible	Medium	Negligible	Adverse Low (2)
Construction – dredging	– Avian Fauna, food sources	Increase in suspended solids, disturbance to downstream food supply	Adverse Indirect Local Short Term Reversible	Medium	Minor	Adverse Minor (4)
Operation – dredging	– Avian Fauna, food sources	Increase in suspended solids, disturbance to downstream food supply	Adverse Indirect Local Infrequent Short Term Reversible	Medium	Minor	Adverse Low (2)
Operations – presence and lights of	– Avian Fauna	Death or injury to birds	Adverse Direct Local	Medium	Minor	Adverse Minor (4)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
buildings			Long Term Irreversible			
Construction– noise	– Avian Fauna	Birds disturbed during feeding or roosting, birds avoiding the area, reduced diversity in area around the site	Adverse Direct Local Long Term Partly Reversible	Medium	Minor	Adverse Minor (4)
Operation - noise	– Avian Fauna	Birds disturbed during feeding or roosting, birds avoiding the area, reduced diversity in area around the site	Adverse Direct Local Long Term Partly Reversible	Medium	Minor	Adverse Minor (4)
Waterfront operations	– Avian Fauna	An increase food waste leading to scavenger birds visiting the area causing a threat to waders and other Lagoon birds. Loss of diversity of birds in the site area.	Adverse Direct Local Long Term Reversible	Medium	Minor	Adverse Minor (4)

8.8 THE MARINE ENVIRONMENT: MARINE MAMMALS

The marine environment in the Bay area provides a home for or is frequented by a range of marine mammals including seals, whales and dolphins. The significant hydrodynamics and water quality impacts or impacts that have specific interest to the community and stakeholders are summarised in Figure 65.

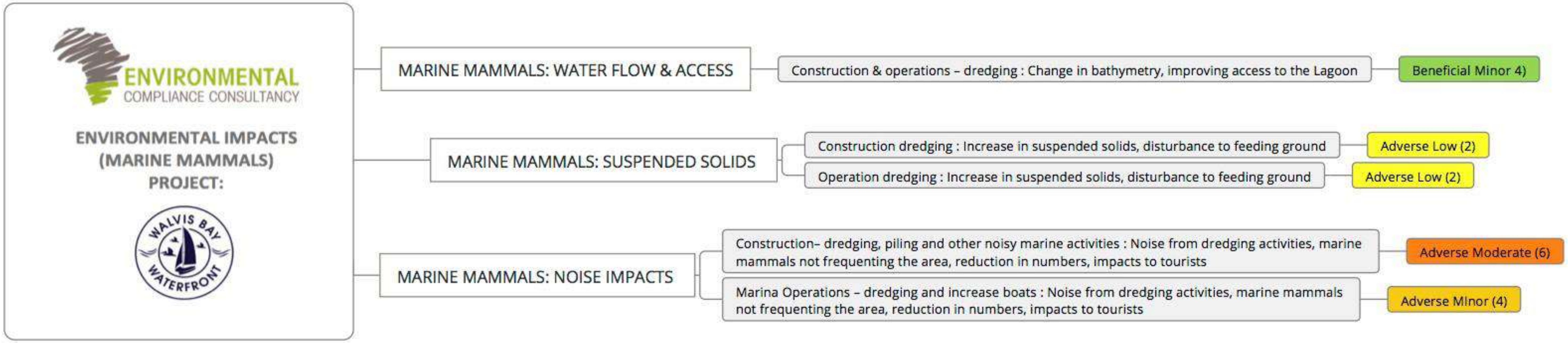

Figure 65 – Significant Marine Impacts

8.8.1. Marine Mammals

Impacts on marine mammals associated with the proposed project include access to the Lagoon, underwater noise impacts, reduced prey availability, disturbances from construction and shipping activities, contamination of the water column and resultant bioaccumulation of toxins, injury from litter, stress from increased human activity and habituation to human presence.

Through consultation with the Namibian Dolphin Project and Dr. Amanda J. Rau, a marine specialist (Marine Mammals Study is found in Appendix J), it has been identified that the cetacean species most likely to be impacted by construction activities of this project is the common bottlenose dolphin (Tursiops truncatus). A large proportion of the population of bottlenose dolphins that inhabit the Bay area use the shallow waters of the Lagoon for feeding, socialising and resting on a regular basis. Whales do not tend to enter the bay and it is predicted that seals will not be significantly affected by the proposed project. Therefore, bottlenose dolphins have been used to undertake the assessment of impacts on marine mammals as they represent the worst case.

Given the small size of the population of Bottlenose dolphins in the Bay area, any deaths or injuries to individuals could potentially have implications for the local population. Bottlenose dolphins are not threatened internationally and are not internationally protected. Due to their local importance and attraction for tourists, Bottlenose dolphins are considered as medium value and sensitivity, and are sensitive to change with limited substitution in the region.

8.8.2. Marine Mammals: Water Flow & Access

As discussed previously, the natural Lagoon eastern channel will be dredged in order to allow a safe nautical passage for boats in and out of the marina. This natural channel is used by dolphins and fish entering and exiting the Lagoon, who are of value to the area for the tourism industry. Whilst the dredging of this access channel during construction and operation will result in negative impacts through suspended sediments (see section 8.8.3), long-term benefits may also be achieved: access to the Lagoon by marine species may become easier as a result in the change in bathymetry, and the flow of water through the channel may increase, thereby improving the biodiversity and number of individuals visiting the Lagoon. It could however potentially increase the risk of larger numbers of dolphins becoming stranded at low tide. Taking into consideration the benefits and negatives, this change could result in an indirect long-term and localised beneficial impact, and therefore is considered to be a minor magnitude of change. The significance of the impact is predicted to be minor beneficial.

8.8.3. Marine Mammals: Suspended Solids during Construction

Section 8.1.1.39 details the activities that would lead to solids becoming suspended and the potential direct impacts. Whilst suspended solids will not directly adversely affect marine mammals as they are able to navigate through turbid waters, prey fish (food source of mammals such as dolphins) may be affected through abundance and distribution within the Lagoon and Bay area. The potential impact of a dredge plume will be localised and short-term. Marine mammals can compensate through relocation to an alternative feeding ground or switching prey species. The magnitude of change on marine mammals is therefore considered to be negligible and overall impact assessed to be adverse low.

A potential secondary impact could arise through loss of dolphin sightings in the Lagoon area, however this will be for a short-duration (weeks) and specific to construction activities that would result in suspended solids (piling and dredging). Therefore, the impact to tourists would be negligible and not discussed further.

8.8.4. Marine Mammals: Suspended Solids during Operation

Dredging activities will occur every two years and will be of a short duration. During these activities, dolphins will avoid the area, but will not be permanently affected and are expected to return once the activities are complete. Activities during operations are unlikely to cause a significant impact on dolphins.

8.8.5. Marine Mammals: Noise Impacts during Construction

Construction activities in the marine environment will result in underwater noise that can affect marine mammals. The key noisy activities are:

- The construction of the marina wall including stone dumping and piling;
- The dredging of the natural Lagoon channel and the Marina Access Channel; and
- The dredging of the outer marina.

Dr. Simon Elwen of The Namibian Dolphin Project has observed through monitoring of the recent construction projects in Walvis Bay, that Dolphins tend to avoid noisy activities rather than being attracted to them. The Marine Mammal Study (see Appendix J) also confirms these observations: evidence shows that dolphins can avoid noisy marine activities by up to distances of 20km and will remain distant from the noise sources for 4 to 48 hours. Behavioural changes may also occur, such as non-directional movement to directional movements, however behaviour returns to baseline levels within 4 hours of noisy activities.

Large amounts of noise produced at the mouth of the Lagoon, may act to chase animals further into, or trap them in the Lagoon, potentially resulting in them stranding on a dropping tide (pers. comm Dr. Simon Elwen NDP 2017).

The construction noise associated with stone dropping, pile driving and dredging will be of a limited duration. The pile driving activities will last for approximately two weeks, the dredging of the access channel will take approximately three months. The whole marina will be completed in approximately six months. The construction sequencing and construction methods have been designed to avoid and minimise underwater noise. Noisy activities will occur simultaneously (i.e. dredging and pile driving) to reduce the duration and occurrence of noise. The use of the vibratory piling driving method for the marina construction will significantly reduce the time and exposure of increased noise to the marine environment; furthermore, the amplitude of sound produced is significantly reduced.

Increased levels of anthropogenic noise can cause marine mammals to avoid areas they would normally inhabit, sometimes permanently. Additional noise provokes changes in diving and foraging behaviour, leading to greater energy expenditure and potential loss of feeding opportunities, and may limit communication and the detection of biologically important sound sources.

Monitoring of the animal movements before construction commences, during and after construction will ensure that the activities are timed in such a manner to avoid impacting marine animals. The proposed project will engage the Namibian Dolphin Project to conduct Hydrophone monitoring prior to and during construction activities to determine the dolphin movements and impacts on dolphins as a result of the project. Furthermore, an independent Marine Mammal Observer (MMO) from the Namibian Dolphin Project will be appointed to observe and identify if animals are present before and during works. The MMO will have the authority to stop construction activities if dolphins are within the predetermined safe zone.

Mr. Alan Louw (a local specialist in marine dredging activities) will also be engaged to oversee dredging activities to ensure sedimentation in the water column is limited. This activity will be managed according to feedback from both experts and will be dependent on animal behaviour for example monitoring may indicate that dredging rates could increase to reduce noise exposure or dredging rates might have to decrease due to siltation.

Noisy activities are not expected to present any long-term adverse impacts to any of the mammals in the Bay area. Short-term impacts may include avoidance behaviour and reduction in prey species that could move away. However, the varied diet of seals and cetaceans, and their ability to forage some distance away from their usual habitats will negate any temporary reduction in prey availability. This impact would be temporary and short-term and would not cause any feeding stress. The magnitude of change is considered to be moderate thereby resulting in an adverse moderate significant impact.

In addition to the mitigation measures discussed above, the following mitigation measures are to be considered as recommended by the mammal study (Appendix J):

- No piling during the seasons with the highest abundance of sensitive species (June and September);
- Using "soft starts" and ramping-up procedures to allow mammals to move away;
- Monitoring noise levels. If they exceed 30 kPa at a distance of 1m to 2m from the pilings noise reduction methods should be considered such as mantling or installing silt or bubble curtains; and
- Establishing specified safe distance zones (500 m for Cape Fur Seals and 2 km for dolphins) and delaying or ceasing piling operations if a mammal is within these zones.

8.8.6. Marine Mammals: Noise Impacts during Operation

During operations, dredging of the marina access channel and outer marina will be required approximately every two and five years respectively. The number of boats in the marine environment is also likely to increase, however this will be limited to the number of mooring spots in the marina (70). Potential underwater noise during the operations is expected to increase from the current baseline, however only by a small amount and for intermittent durations in localised areas; the magnitude of change is expected to be minor. It is unlikely that marine mammals will completely avoid the Lagoon and Bay area as a result of these changes. The potential impact to marine mammals is therefore predicted to be minor adverse.

8.8.7. Marine Mammals: Toxicity & Pollution

As discussed in section 8.6.6, there is unlikely potential for toxins, including heavy metals and organic compounds to be resuspended into the water column during dredging and piling activities in the construction phase and through maintenance dredging. Marine mammals accumulate high levels of contaminants, irrespective of whether they are exposed to construction or dredging activities, as they are highly mobile creatures feeding at high trophic levels and have a large proportion of lipid-rich blubber which readily accumulates toxins. Pollution can impact the health of individual marine mammals and have longer-lasting, population-level impacts such as reproductive complications, developmental defects, strandings and other mortality events.

It is anticipated that marine mammals will avoid the area during the piling and dredging operations due to the noise, vibration and affected feeding grounds through suspended sediments. However, when they return, they may feed off prey fish which have been exposed to toxins. It is not expected that the levels of toxins will be present in the Lagoon area; as stated in section 6.23.7 metals in sediments are found in the Harbour and Bay area, however not in the Lagoon. Therefore, potential issues with the dredged material and toxicity levels are considered to have negligible magnitude of change and the overall significance is predicted to be low adverse.

8.8.8. Marine Mammals: Human-Mammal Interactions

During the construction and operation of the proposed project, there will be an increase in marine traffic, in particular during the operational phase. The Port of Walvis Bay is Namibia's largest harbour and accommodates a range of vessels, both within the Harbour and moored off-shore. Large sea-going vessels entering and exiting the Port of Walvis Bay do so under pilotage and follow the designated channel at low speed. Consequently, cetaceans become habituated to this pattern and will likely avoid ships. Smaller craft do not need to use the dredged approach channel and behave more randomly. They are thus more likely to have encounters with marine mammals. An increase in the number of small craft can consequently raise the risk of mammal strikes. Dolphins are usually easily able to avoid vessels and generally can co-exist comfortably with both ships and smaller craft. Nevertheless, careless and reckless handling of high-speed craft in the presence of dolphins could result in injury through propeller strikes (Appendix J).

The current numbers of small crafts and the addition of the boats that would use the Marina are considered not to cause major distress to the resident dolphin population and marine mammals in the Bay area. However, there is still a risk of cetaceans being disturbed or injured.

Marine mammals become habituated to vessel movement, therefore the Marina Access Channel shall be clearly demarcated for the entry and exits of boats, allowing mammals to be accustomed to the route. Speed limits will be set and enforced, and a Code of Conduct shall be drawn up and be circulated regularly and strictly enforced. Notice boards around the Marina will display the Code of Conduct as well as rules to abide by for example, no littering and no feeding of wild animals.

The potential impacts to marine mammals will be adverse and localised. They will occur throughout the operational phase, and therefore are considered to be long term. The magnitude of change is considered to be minor, and therefore the overall impact is considered to be of minor significance.

8.8.9. Summary of Impacts on Marine Mammals

Table 38 - Impacts on Marine Mammals

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction & operations – dredging	– Marine mammals	Change in bathymetry, improving access to the Lagoon	Beneficial Direct Local Long-term Irreversible	Medium	Minor	Beneficial Minor (4)
Construction– dredging	– Marine Mammals – Prey Fish	Increase in suspended solids, disturbance to feeding ground	Adverse Indirect Local Short Term Reversible	Medium	Negligible	Adverse Low (2)
Operation - dredging	– Marine Mammals – Prey Fish	Increase in suspended solids, disturbance to feeding ground	Adverse Direct Local Temporary Reversible	Medium	Moderate	Adverse Low (2)
Construction– dredging, piling and other noisy marine activities	– Marine Mammals	Noise from dredging activities, marine mammals not frequenting the area, reduction in numbers, impacts to tourists	Adverse Indirect Local Short Term Reversible	Medium	Moderate	Adverse Moderate (6)
Marina Operations – dredging and increase boats	– Marine Mammals – Prey Fish	Noise from dredging activities, marine mammals not frequenting the area, reduction in numbers, impacts to tourists	Adverse Indirect Local Medium term / intermittent Reversible	Medium	Minor	Adverse Minor (4)
Construction and Operations – marine traffic	– Marine Mammals	Direct interactions with humans, increased noise, risk of injury, disturbance	Adverse Indirect and direct Local Long term Reversible	Medium	Minor	Adverse Minor (4)

8.9 CUMULATIVE IMPACT ASSESSMENT

This section presents the CIA, which has been undertaken in line with the methodology summarised in 7.5.2. A rapid CIA has been undertaken, and therefore the assessment is a relatively high-level qualitative assessment. The CIA covers the following:

- **Intra-project cumulative impacts:** Cumulative impacts that occur within the proposed project;
- **Inter-project cumulative impacts:** Cumulative impacts that occur as a result of the proposed project in combination with other projects, which is split into two:
  - Cumulative impacts with existing projects; and
  - Cumulative impacts with future projects.

8.9.1. INTRA-PROJECT CUMULATIVE IMPACTS ASSESSMENT

The proposed project may result in a receptor or resource being affected by more than one impact arising from same activity and the impacts will act together to result in a combined effect. Whilst this type of CIA is not considered in the IFC assessment guidance, it is an internationally widely accepted method to ensure potential combined impacts of a development are understood and mitigated, which may be missed from the 'general' assessment.

An example of an intra-project cumulative impact within the proposed project is as follows:

During the construction phase, there will be noisy activities such as ground excavation which could generate dust. A site boundary fence will be erected, plant and machinery will be distributed across the site, and construction traffic will access the site via the local roads. If all of these activities were undertaken at the same time, a local resident living opposite the site would be exposed to an increase in noise levels, dust may deposit on their property, views from their house will be altered from an open green space to a construction site and severance may be caused due increased traffic obscuring their normal route to town or access to their house.

The cumulative impacts that may arise as a result of the proposed project are provided in Table 39 and Table 40. The impacts in the second column ('Impacts') are those presented in Sections 8.4 to 8.8, which includes embedded and best practice mitigation. The significance of the potential cumulative impacts (third column) has been identified using the assessment methodology presented in Chapter 7 and the Significance Matrix as well as professional judgment. These impacts include embedded and best practice mitigation that has already been identified in the assessment. Mitigation that has been identified through the assessment is listed in the last column to demonstrate the measures the project is taking to minimize the impacts as much as possible. Any additional mitigation is discussed after the tables.

Table 39 – Intra-project cumulative impacts within the proposed project – construction

RECEPTOR	IMPACTS			SIGNIFICANCE	IMPACT MANAGEMENT
Tourism Industry	**Activity & impact:** Increased traffic and general construction activities both resulting in increased noise levels and generation of dust. Increased traffic causing disruption to access or increased journey times. **Impact:** Tourists avoid existing waterfront area resulting in reduced spends and thus a reduction in the tourism industry. **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Dredging activities and other marine and land-based construction works causing increased localised suspended solids, dust generation, noise and increase levels of pollution, resulting in the temporary loss of marine wild life. **Impact:** Reduced number of tourists or increase in complaints resulting in reduced spends in the area and affecting the tourism industry. **MINOR ADVERSE SIGNIFICANCE**		Minor	Site boundary fence, traffic management and calming measures, scheduling of noisy construction activities, dredging on outgoing tide, type of dredging technique, dust suppression techniques
The Raft Restaurant	**Activity & impact:** Construction of the Marina (piling, dredging, construction of the marina wall) leading to increase dust, noise and vibration, visual impacts (loss of visual amenity) and temporary loss of marine wild life. **Effect:** Loss of customers and thus revenue **MAJOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Construction of the Marina leading to vibrations. Potential measures to protect/strengthen the structure of the building (dependent upon review by specialist). **Effect:** Restaurant closed for a period of time, resulting in loss of revenue. **MAJOR ADVERSE SIGNIFICANCE**		Major	Visual screen, vibratory piling techniques, continual access, scheduling of activities.
Protea Hotel	**Activity & impact:** Construction of the Marina – closure of the Esplanade. **Effect:** Loss of an access route to the hotel and thus disturbance to patrons. **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Construction activities on the proposed project site (on and off-shore). Views from the hotel on to the Lagoon impacted. **Effect:** Loss or reduced clients / patrons and reduced revenue. **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Construction activities on the proposed project site (on and off-shore). Noise and dust generated. **Effect:** Patrons affected by nuisances resulting in complaints, loss or reduced clients and thus reduced revenue. **MINOR ADVERSE SIGNIFICANCE**	Minor	Continual access via Atlantic Street, Site boundary fence, traffic management and calming measures, scheduling of noisy construction activities, scheduling of construction activities, site drainage, suitable site drainage.

RECEPTOR	IMPACTS		SIGNIFICANCE	IMPACT MANAGEMENT
Local Businesses (B&Bs, lodges, restaurants & shops)	**Activity & impact:** Construction of the Marina – closure of the Esplanade, increased construction traffic on the local roads (reduce journey time and disruption). Loss of tourists and patrons to the area. **Effect:** Loss of revenue. **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** General construction works on the proposed project site, increasing noise levels in the area. **Effect:** Loss of patrons, increased complaints and thus loss of revenue. **MINOR ADVERSE SIGNIFICANCE**	Minor	Scheduling of construction traffic and traffic management and calming measures. Scheduling of construction activities.

RECEPTOR	IMPACTS				SIGNIFICANCE	IMPACT MANAGEMENT
Local Residents opposite the proposed project site	**Activity & impact:** Closure of the Esplanade, resulting in traffic flows altering. **Effect:** Local residents will be disturbed from the change in traffic flows and road users will be diverted. Severance to local residents – disruption to accessing properties, in particular those along KR Thomas Street and possibly 4^{th} Road. **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Increase in construction traffic and changes to the local flow. **Effect:** Increase in risk of accidents and driver stress. **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Construction activities on site, including ground excavation leaving to dusts. **Effect:** Dusts becoming airborne and transported to neighboring properties (nuisance & health issue). **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Construction vehicles and general construction activities on site, increasing noise levels. **Effect:** Sensitive receptors (local residents) will be disturbed. **MODERATE ADVERSE SIGNIFICANCE**	Moderate	Restricted hours, traffic management and calming measures, defined routes to and from site, road upgrades to accommodate and mitigate increased traffic levels, site boundary fence, scheduling of noisy construction activities, notice to residents prior to noisy activities, dust suppression techniques, avoid certain activities during high winds (minimise dusts), covering of material during transportation, scheduling of relocating facilities, downward lighting.
	Activity & impact: Construction traffic, increasing noise levels. **Effect:** Sensitive receptors (local residents) will be disturbed and amenity affected. **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** General construction site and visible plant, equipment, lights and earth movements. Change of a community open space to a construction site. **Effect:** Residents views general residential amenity will be affected. **MODERATE ADVERSE SIGNIFICANCE**	**Activity & impact:** General construction site and visible plant, equipment, lights and earth movements. Change of a community open space to a construction site. **Effect:** Landscape and seascape of the local area will alter. Loss of green open space **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Change of a community open space with sporting facilities to a construction site. Relocation of sporting facilities. **Effect:** Temporary loss sporting facilities used by local communities, permanent loss of green space and outdoor pool. Inconvenience to existing users due to facilities relocated to a site further away. **MINOR ADVERSE SIGNIFICANCE**		

RECEPTOR	IMPACTS			SIGNIFICANCE	IMPACT MANAGEMENT
Local Residents further away from the proposed project site and along transport routes	**Activity & impact:** Closure of the Esplanade, resulting in traffic flows altering. **Effect:** Local community will be disturbed from the change in traffic flows and road users will be diverted. **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Increase in construction traffic along designated routes and changes to the local flow. **Effect:** Increase in risk of accidents and driver stress. **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Increase in construction traffic along designated routes. Increased noise and potential ease of access to properties. **Effect:** Sensitive receptors (local residents) will be disturbed due to increase in noise. Community severance due to increase traffic and access to private properties. **MODERATE ADVERSE SIGNIFICANCE**	Moderate	Restricted hours, traffic management and calming measures, defined routes to and from site, road upgrades to accommodate and mitigate increased traffic levels, site boundary fence, scheduling of noisy construction activities, notice to residents prior to noisy activities, dust suppression techniques, avoid certain activities during high winds (minimise dusts), covering of material during transportation, scheduling of relocating facilities, downward lighting.
	Activity & impact: Traffic diversions or increased journeys as a result of construction of road upgrades. **Effect:** Increase community severance, journey times and potential stress. **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** General construction site and visible plant, equipment, lights and earth movements. Change of a community open space to a construction site. **Effect:** Landscape and seascape of the local area will alter. Loss of green open space **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Change of a community open space with sporting facilities to a construction site. Relocation of sporting facilities. **Effect:** Temporary loss sporting facilities used by local communities, permanent loss of green space and outdoor pool. Inconvenience to existing users due to facilities relocated to a site further away. **MINOR ADVERSE SIGNIFICANCE**		

RECEPTOR	IMPACTS		SIGNIFICANCE	IMPACT MANAGEMENT
Water Quality	**Activity & impact:** Dredging and piling construction activities, leading to suspended solids in the water column. **Effect:** Increased turbidity. Affect filter feeding organisms, fish (fatalities and disturbance), indirect impacts to marine mammals and birds. Reduction in light affecting seaweeds and plans. Settlement of sediments smothering plants. **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Dredging and piling construction activities, disturbing sediments and trapped gasses leading to a sulphur eruption. **Effect:** Reduced dissolved oxygen reducing water quality, resulting in mortality of the local marine community, indirectly impacting local birds. **MINOR ADVERSE SIGNIFICANCE**	Minor	Most appropriate dredger (sucking system) and piling (vibratory), removal of dredged material from marine environment, undertaking activities on outgoing tide, turbidity monitoring, use of a bund, silt curtain, sequencing and scheduling, well maintained and serviced equipment, all dredging over seen by suitable qualified person.

RECEPTOR	IMPACTS				SIGNIFICANCE	IMPACT MANAGEMENT
Walvis Bay Ramsar Site	**Activity & impact:** Dredging and piling construction activities, leading to suspended solids in the water column. **Effect:** Increased turbidity. Affect filter feeding organisms, fish (fatalities and disturbance – move away from area), indirect impacts to the birds (reducing their food). Reduction in light affecting seaweeds and plans. Settlement of sediments smothering plants. **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Dredging and piling construction activities, disturbing sediments and trapped gasses leading to a sulphur eruption. **Effect:** Reduced dissolved oxygen reducing water quality, resulting in mortality of the local marine community, indirectly impacting local birds. **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Construction activities in the Ramsar site and temporary land take (occupies 0.014%) **Effect:** Temporary loss of habitat and changes to the shoreline, birds affected **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Construction noise **Effect:** Disturbance to birds and marine mammals. Avoidance of the area. **MINOR ADVERSE SIGNIFICANCE**	Moderate	Most appropriate dredger (sucking system) and piling (vibratory), removal of dredged material from marine environment, undertaking activities on outgoing tide, turbidity monitoring, use of a bund, silt curtain, sequencing and scheduling, soft starts or equipment in marine environment, well maintained and serviced equipment, all dredging over seen by suitable qualified person, continual twice-yearly bird monitoring.

RECEPTOR	IMPACTS				SIGNIFICANCE	IMPACT MANAGEMENT
Marine Birds	**Activity & impact:** Dredging and piling construction activities, leading to suspended solids in the water column. **Effect:** Increased turbidity. Affect filter feeding organisms, fish (fatalities and disturbance – move away from area), indirect impacts to the birds (reducing their food). **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Dredging and piling construction activities, disturbing sediments and trapped gasses leading to a sulphur eruption. **Effect:** Reduced dissolved oxygen reducing water quality, resulting in mortality of the local marine community, indirectly impacting local birds. **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Construction activities in the Lagoon area **Effect:** Temporary loss of habitat (roosting area) and changes to the shoreline, birds affected **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Construction noise **Effect:** Disturbance to birds and marine mammals. Avoidance of the area. **MINOR ADVERSE SIGNIFICANCE**	Minor	Most appropriate dredger (sucking system) and piling (vibratory), removal of dredged material from marine environment, undertaking activities on outgoing tide, turbidity monitoring, use of a bund, silt curtain, sequencing and scheduling, soft starts or equipment in marine environment well maintained and serviced equipment, all dredging over seen by suitable qualified person, continual twice-yearly bird monitoring.

RECEPTOR	IMPACTS			SIGNIFICANCE	IMPACT MANAGEMENT
Marine Mammals	**Activity & impact:** Dredging and piling construction activities, leading to suspended solids in the water column. **Effect:** Prey fish (food source) may avoid area reducing food availability for marine mammals. **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Construction or the Marina – noisy activities **Effect:** Marine mammals could avoid area due to increased marine noise. Changes to diving and foraging behavior, loss of feeding opportunities. **MODERATE ADVERSE SIGNIFICANCE**	**Activity & impact:** Increase in marine traffic. **Effect:** Human – mammal interaction leading to disturbance and potential mammal strikes from small crafts. **MINOR ADVERSE SIGNIFICANCE**	Moderate	Most appropriate dredger (sucking system) and piling (vibratory), removal of dredged material from marine environment, undertaking activities on outgoing tide, turbidity monitoring, use of a bund, silt curtain, sequencing and scheduling, soft starts or equipment in marine environment, well maintained and serviced equipment, all dredging over seen by suitable qualified person, continual monitoring before, during and after construction.

Table 40 – Intra-project cumulative impacts within the proposed project – operation

RECEPTOR	IMPACTS				POTENTIAL CUMULATIVE IMPACT	IMPACT MANAGEMENT
Local Residents surrounding the proposed project site and local community	**Activity & impact:** Closure of the Esplanade and new Waterfront Drive **Impact:** Change of flow patterns and potential severance to local residents. **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Increased traffic movements **Impact:** Severance to local residents, increase driver stress, accidents and journey times. **MODERATE ADVERSE SIGNIFICANCE**	**Activity & impact:** Relocation of sporting facilities **Impact:** Facilities moved further away, increased travel times and access. **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Increase background noise from proposed project site **Impact:** Local resident's amenity affected. **MODERATE ADVERSE SIGNIFICANCE**	Moderate	Traffic calming measures and road upgrades, design of the development, soft landscaping, new sewerage services, new and upgraded facilities,
	Activity & impact: Increase background noise from increased traffic **Impact:** Local resident's amenity affected. **MODERATE ADVERSE SIGNIFICANCE**	**Activity & impact:** New structures in a residential / industrial and coastline area **Impact:** Local resident's sense of place will alter. **MODERATE ADVERSE SIGNIFICANCE**	**Activity & impact:** New structures in a residential / industrial and coastline area **Impact:** Local resident's amenity affected (views and lighting) **MODERATE ADVERSE SIGNIFICANCE**	**Activity & impact:** New structures in a residential / industrial and coastline area **Impact:** Changes to the local landscape and seascape character **MODERATE ADVERSE SIGNIFICANCE**		

RECEPTOR	IMPACTS		POTENTIAL CUMULATIVE IMPACT	IMPACT MANAGEMENT
Water Quality	**Activity & impact:** Maintenance dredging leading to suspended solids in the water column. **Effect:** Increased turbidity. Affect filter feeding organisms, fish (fatalities and disturbance), indirect impacts to marine mammals and birds. Reduction in light affecting seaweeds and plans. Settlement of sediments smothering plants. **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Increased boats and marine traffic **Effect:** Pollution entering the water and affect water quality, and indirectly impacting flora and fauna **LOW ADVERSE SIGNIFICANCE**	Low	Water quality monitoring, maintenance dredging over seen by suitable qualified person, undertaken on outgoing tide, well maintained and serviced marine vessels and boats, refuelling in designated areas, appropriate drainage system across site, rules and environmental awareness displayed throughout development.

RECEPTOR	IMPACTS				POTENTIAL CUMULATIVE IMPACT	IMPACT MANAGEMENT
Marine Birds	**Activity & impact:** Maintenance dredging, leading to suspended solids in the water column. **Effect:** Increased turbidity. Affect filter feeding organisms, fish (fatalities and disturbance – move away from area), indirect impacts to the birds (reducing their food). **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Increased noise levels in the marine environment and on land. **Effect:** Disruption to behaviors **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Integration of new buildings and lights **Effect:** Bird flight paths will be affected, light may distract or disorientate birds at night, and bugs (food) may also be attracted by the lights, causing indirect impacts to birds. **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Operations of the development including waste management and food scrap **Effect:** Increase scavenger birds, dissuade other species of birds **MINOR ADVERSE SIGNIFICANCE**	Minor	Continual twice yearly bird monitoring, water quality monitoring, maintenance dredging over seen by suitable qualified person, undertaken on outgoing tide, appropriate waste management system throughout development (bins and disposal area & good housekeeping), downward lighting, design of the development (height of buildings), rules and environmental awareness displayed throughout development.

RECEPTOR	IMPACTS			POTENTIAL CUMULATIVE IMPACT	IMPACT MANAGEMENT
Marine Mammals	**Activity & impact:** Dredging and piling construction activities, leading to suspended solids in the water column. **Effect:** Prey fish (food source) may avoid area reducing food availability for marine mammals. **LOW ADVERSE SIGNIFICANCE**	**Activity & impact:** Noisy activities from increased boats in marina and dredging activities **Effect:** Marine mammals could avoid area due to increased marine noise. Changes to diving and foraging behavior, loss of feeding opportunities. **MINOR ADVERSE SIGNIFICANCE**	**Activity & impact:** Increase in marine traffic and human – mammal interaction **Effect:** Disturbance and potential mammal strikes from small crafts. **MINOR ADVERSE SIGNIFICANCE**	Minor	Continual twice-yearly bird monitoring, water quality monitoring, maintenance dredging over seen by suitable qualified person, undertaken on outgoing tide, appropriate waste management system throughout development (bins and disposal area good housekeeping), downward lighting, design of the development (height of buildings), rules and environmental awareness displayed throughout development.

During construction, the Raft Restaurant is likely to have major impacts. Whilst the nature of the impacts will be for a short duration and the business will likely see long term benefits when the proposed project becomes operational, the proponent and the management of the Raft will work together to identify further mitigation impacts that would reduce the significance of impact during construction.

The local residents and community are likely to be moderately impacted as a result of the combined impacts of the proposed project. The construction phase is expected to last for 3.5 years which will be undertaken in phases. During construction, an Environmental and Social Manager will be available to consult with and direct and concerns or complaints. The Environmental and Social Manager will work with the community to manage impacts from the proposed project during both construction and operation.

The predicted significance of cumulative impacts to the Ramsar site during construction is driven by the value of the site (High) and applying a precautionary approach. The proponent is committed to avoiding impacts on this international designated site and will implement a water-monitoring programme that will support the avoidance of adverse impacts that would affect the features and attributes of the site, e.g. water quality. All construction personnel will be briefed about the environmental sensitives of the local area and protection measures prior to construction works commencing and the Environmental and Social Manager will work closely with local environmental groups such as local bird groups, Namibia Dolphin Project and MFMR.

Marine mammals may also be moderately adversely impacted due to the combined impacts arising from the construction of the proposed project; however, a cautious assessment approach has been applied; the activities that cause the most impact are of a short duration and a local small area, therefore these impacts may be less severe than assessed. The Environmental and Social Manager will work with Namibian Dolphin Project to ensure construction works are not significantly adversely impacting marine mammals, and if there is evidence of significant impacts during certain activities, works will cease and measures to minimise impacts will be implemented.

During operations, the assessment has identified that there is potential to cause moderate impacts on the local residents and community. The majority of these impacts are surrounding the changes to the local developed environment and the perception of the impact from person to person. Humans are adaptable and therefore the severity of these impacts will reduce over time as residents become accustomed to their new surroundings. Environmental monitoring will be undertaken through the construction and operational phases of the proposed project. These are included in the relevant ESMPs (Appendix A). The monitoring programme will support the identification of further mitigation if thresholds are breached.

8.9.2. Inter-Project Cumulative Impact Assessment

As defined in Section 7.5.2, IFC assessment guidance (International Finance Corporation, 2012) states that a CIA should assess impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned, or reasonably defined developments at the time the risks and impact identification process is conducted. This section assesses existing and then reasonably defined developments.

Namibia does not have a centralised database that logs all existing and future potential projects applying for an Environmental Clearance, therefore information is not easily available for people /consultants to allow them to determine or obtain all potential projects in a given area. The assessment of potential combined impacts is therefore limited to known existing and future projects through a detailed literature review.

8.9.2.1. Inter-Project CIA: Existing Projects

Existing projects and activities that continue to affect shared environmental and social receptors with the proposed project, i.e. projects that continue to adversely alter the baseline without the proposed project, are detailed in this section. These developments and activities are all likely to be placing pressure on the Lagoon environment (the receptor which all projects interact with), in addition to the natural processes, as discussed in Section 6.23. The CIA is presented in

Table 41, which presents impacts arising from activities undertaken during the construction and operations of the proposed project; other projects and activities that would contribute and potentially worsen these impacts; the combined impacts; with additional mitigation identified and a brief concluding statement. The additional mitigation measures included in the table are further measures than those already identified in the assessment presented in the previous sections.

The assessment throughout Chapter 8 provides further information on the proposed project's impact (e.g. nature of impact and value of receptor). Additional combined impacts have been included in Table 41 as the potential impacts become potentially greater when combined with other projects.

- **Salt Works:**

The Salt Works have profoundly changed the functioning and ecology of the Lagoon area, particularly in the southern end; decreased circulation and accompanied siltation and lowering of water clarity and quality with increased temperatures and salinity. It is assumed that these changes to the Lagoon and wetland area have established and do not continue to directly contribute to the siltation of the Lagoon. Therefore, is not assessed further.

Some of the natural wetland and Lagoon areas has been reclaimed for use as evaporation ponds. These evaporation ponds are maintained and during maintenance activities there is potential to disturb birds within the Ramsar site. This has been considered in the assessment – see Table 41.

Conversely, the potential impacts on the Salt Works from the potential disturbance and resettlement of pollutants (e.g. heavy metals) in the marine sediments from dredging activities are unlikely to occur, as discussed in Section 8.6.6. This is therefore not assessed further.

- **Fish Factories:**

The operations of the fish factories discharge high BOD liquid waste effluent into the marine environment. This waste effluent is compounding the already oxygen-stressed condition of the Bay, particularly along its eastern shore (OLRAC, 2009). The proposed project will not discharge liquid waste effluent into the marine environment. Therefore, there is no potential for combined impacts to occur as a result effluent discharges from the proposed project and the fish factories. There is potential however for these discharges to contribute to the continual combined adverse impacts on the Lagoon's water quality and indirectly impacting the ecology of the Lagoon and Ramsar site. These have been assessed and are presented in Table 41.

- **Diversion weir on the Kuiseb river:**

In the 1960's the Kuiseb river was diverted which alters the natural flow during flood events. This has resulted in a reduction in the size of the Lagoon and more importantly, the natural process of nutrients being brought into the Lagoon from inland has stopped. The discontinuation of this source of nutrients continues to have an adverse impact on the Lagoon environment and dependent features, namely birds (as described in Appendix H). There is potential that this river diversion in combination with a reduced flow into and out of the Lagoon may reduce nutrients even more, therefore this potential impact has been considered in the assessment and presented in Table 41.

- **Namport Operations and the phase 1 Container Expansion:**

Annual maintenance dredging is undertaken for the entrance channel, turning circle and tanker basin for the South Port. This activity is likely to generate suspended solids which will enter the water column, however the likelihood of suspended solids being transported into the Lagoon is low (Namport, 2006). Since (Namport, 2006) was issued, the first phase of the Namport Container Expansion project has been constructed. This is a solid structure in the marine environment that will reduce the suspended solids spreading from the area during maintenance dredging (Delta Marine Consultants, 2010). Whilst this impact is unlikely, there is local concern around sedimentation and the siltation of the Lagoon, therefore it has been considered in the assessment.

An additional impact could be the increase in sulphur events due to disturbing sediment on the ocean floor and the subsequent release of gases. However, the same areas in the Namport boundaries are dredged each year, therefore is assumed that the buildup of gasses is minimized and limits sulphur events. This impact has therefore not been considered further, as it is unlikely that in combination impacts will occur with the proposed project's dredging activities.

The use of marine vessels and boats to undertake these activities increase noise levels and the risk of potential pollution in the marine environment, therefore continually adversely affect the marine wildlife and water quality. This potential impact in combination with the proposed project has been considered.

- **Tourism:**

Tourism activities in particular activities in the marine environment and along the coastline, can result in human-wildlife interactions; disturbance to resting / feeding birds and mammals; feeding wildlife and altering behaviors; and potentially increase pollution (e.g. oil, fuel, rubbish). The proposed project will undertake activities (namely dredging) in the marine environment during construction and there will be an increase in recreational boats using the Marina and surrounding area (not the Lagoon) during the operational phase, therefore an increase in number of boating activities in the Bay area. There is potential for these combined impacts to continually adversely affect marine life, therefore this has been considered in the assessment and presented in Table 41.

8.9.2.2. Assessment of existing inter-project cumulative impacts

The shared environmental and social receptors which are continually being influenced by anthropogenic influences and natural processes, and thus resulting in adverse changes, are the Lagoon's water quality and sedimentation rates, marine flora and fauna, the avian community, and the Ramsar site.

Table 41 sets out the findings of the assessment of combined impacts of existing projects and activities that continue to affect shared environmental and social receptors with the proposed project. The aims of this assessment are to identify what impacts could be significantly worsened as a result of the construction and operation of the proposed development when considering other existing project impacts; identify if the proposed project is considered to be the responsible project for tipping the impact into being significant; and identify further mitigation that can be implemented to further reduce these impacts.

The impacts of the other projects have been derived from undertaking a desk-top study through investigating how the baseline has changed over the years and is expected to change (trends), which has included a review of specialist studies undertaken to-date, as well as the application of professional judgement. The assessment methodology in Chapter 7 and the significance matrix have been applied.

Table 41 – Inter-project and existing project's cumulative impacts

RECEPTOR	PROPOSED PROJECT ACTIVITY	PROPOSED PROJECT POTENTIAL IMPACT	SIGNIFICANCE	OTHER PROJECTS	SIGNIFICANCE OF COMBINED IMPACT	SIGNIFICANCE OF COMBINED IMPACT AFTER ADDITIONAL MITIGATION	ADDITIONAL MITIGATION AND CONCLUSION
Water Quality of the Lagoon: Nutrients	Presence of the Marina infrastructure (operations)	The flow into and out of the Lagoon may alter slightly; the magnitude of change is considered to be minor.	Adverse Low	• Continual impacts resulting from the diversion of the Kuiseb river (loss of nutrients entering the Lagoon)	Adverse Low	Adverse Low	The presence of the Marina is will not affect the flow of nutrients entering the Lagoon. The diversion of the Kuiseb river is considered to be the responsible project for this issue.
Water Quality of the Lagoon: suspended sediments	Construction activities in the marine environment (dredging, piling)	Flora and fauna directly affected by suspended sediments, leading to a reduction in light. Short duration, localised area, negligible change to the baseline, minor change to the baseline.	Adverse Minor	• Namport annual maintenance dredging and suspended solids being transported to the Lagoon (deemed unlikely) • Natural siltation and sedimentation	Adverse Minor	Adverse Minor	In the event that dredging activities occur simultaneously, there is potential for a cumulative short-term impact in the Bay area (not the Lagoon). It is unlikely that a combine impact on the Lagoon will occur. If undertaken at different times, the severity may be reduced, but the impacts duration will be longer. Monitoring of the Bay area and Lagoon should be undertaken to monitor turbidity and if thresholds are breached, further mitigation measures such as a silt curtain should be deployed. (see recommendations in Chapter 10)
Water Quality: suspended sediments	Maintenance dredging of Access Channel and Outer Marina (operations)	Flora and fauna directly affected by suspended sediments, leading to a reduction in light. Short duration, localised area, negligible change to the baseline.	Adverse Low	• Namport annual maintenance dredging and suspended solids being transported to the Lagoon (deemed unlikely) • Natural siltation and sedimentation	Adverse Low	Adverse Low	

RECEPTOR	PROPOSED PROJECT ACTIVITY	PROPOSED PROJECT POTENTIAL IMPACT	SIGNIFICANCE	OTHER PROJECTS	SIGNIFICANCE OF COMBINED IMPACT	SIGNIFICANCE OF COMBINED IMPACT AFTER ADDITIONAL MITIGATION	ADDITIONAL MITIGATION AND CONCLUSION
Marine flora and fauna Local community	Construction activities in the marine environment (dredging, piling)	Potential sulphur events leading to anoxic and toxic water quality, leading to indirect impacts on local fauna and flora	Adverse Minor	• Namport annual maintenance dredging and suspended solids being transported to the Lagoon (deemed unlikely) • Natural disturbance (e.g. storms)	Adverse Minor	Adverse Minor	The Namport dredging operations occur in the same location each year, therefore the proposed project will not contribute more to this combined impact. This impact would be short term and localised. The dredging operations will occur in different areas therefore the likelihood for the two projects to affect the same receptor is unlikely. The proposed project will not generate sulphur eruptions due to the nature of the sediments in the lagoon area and also considering the dredging method to be used
Marine flora and fauna	Increased boat activity during both construction and operations	Elevated pollution levels (various sources) directly impacting the water quality, and indirectly impacting flora and fauna.	Adverse Low	• Namport annual maintenance dredging and other activities • Increase tourism numbers and thus marine activities / boats in the water • Increase in vessels due to the operations of phase 1 Namport Container Expansion project.	Adverse Low	Adverse Low	The addition of 70 boats in the water will increase potential pollution risk and may contribute to the cumulative impact; however, in comparison to the current situation, the magnitude of change of these additional boat numbers is low. The proposed project is not considered to be the responsible development for this issue and it is unlikely that the situation will be significantly worsened.

RECEPTOR	PROPOSED PROJECT ACTIVITY	PROPOSED PROJECT POTENTIAL IMPACT	SIGNIFICANCE	OTHER PROJECTS	SIGNIFICANCE OF COMBINED IMPACT	SIGNIFICANCE OF COMBINED IMPACT AFTER ADDITIONAL MITIGATION	ADDITIONAL MITIGATION AND CONCLUSION
Ramsar Site	Construction and operation	Potential threats to the integrity of the RAMSAR Site through reduced water quality and indirect impact on bird populations. Even though the proposed project would likely result in minor change to the baseline and the nature of the impacts would be miner, a moderate adverse impact is predicted due to the nature and importance of this receptor (considered to be of high value in accordance with the EIA methodology in Chapter 7).	Adverse Moderate	• Natural siltation and sedimentation • Increase tourism numbers and thus marine activities and land-based activities • Maintenance activities in the Salt Works and Evaporation Ponds – disturb birds • Fishing Industry – discharges of high BOD liquid effluents which contribute to poor water quality in the Bay and Lagoon, indirectly impact the ecosystem	Adverse Moderate	Adverse Moderate	The current other projects and activities have an influence on the Ramsar site and the proposed project is expected to contribute to these impacts. Whilst the nature and severity of impacts from all projects (including the proposed project) is considered to be minor (insignificant), the international importance of this site (high value/sensitivity) results in the impacts being moderately adverse. No further mitigation for the proposed project has been identified during this assessment however associated recommendations have been made (see recommendations in Chapter 10)
Avian Fauna	Construction and operational noise	Birds disturbed during feeding or roosting, birds avoiding the area, reduced diversity in area around the site. Minor change to the baseline due to short term, localised activities.	Adverse Minor	• Maintenance activities in the Salt Works and Evaporation Ponds • Increase tourism numbers and thus marine activities and land-based activities • Increase noise levels from the first phase of Namport's Container Expansion project (increased land based	Adverse Minor	Adverse Minor	Whilst noise levels are increasing in the proposed project site area, the majority of the birds are found further in the Lagoon and Salt Works. In addition, the contribution of the proposed project to the noise levels that may affect birds will be for a short duration, therefore the proposed project is unlikely to significantly worsen the potential impacts.

RECEPTOR	PROPOSED PROJECT ACTIVITY	PROPOSED PROJECT POTENTIAL IMPACT	SIGNIFICANCE	OTHER PROJECTS	SIGNIFICANCE OF COMBINED IMPACT	SIGNIFICANCE OF COMBINED IMPACT AFTER ADDITIONAL MITIGATION	ADDITIONAL MITIGATION AND CONCLUSION
				and off-shore activities)			
Marine Mammals & Prey Fish	Construction and maintenance dredging – suspended solids, noise and other disturbances	Increase in suspended solids could disturb feeding ground of marine mammals and prey fish, and underwater noise generated from dredging activities could both result in marine mammals not frequenting the area and indirectly impacting the tourism industry. The predicted magnitude of change is negligible due to the duration of dredging activities and the mobility of the dolphins, however due to the local value of these marine mammals (medium), the impacts are considered to be moderate significance.	Adverse Moderate	• Namport annual maintenance dredging and suspended solids in the Bay area • Natural disturbance (e.g. storms)	Adverse Moderate	Adverse Moderate	In the event that dredging activities occur simultaneously, there is potential for a cumulative short-term impact in the Bay area (from noise and suspended solids). If undertaken at different times, the severity may be reduced, but the combined impacts will last longer. Monitoring of the Bay area and Lagoon should be undertaken to monitor turbidity and if thresholds are breached, further mitigation measures such as a silt curtain could be deployed. (See recommendations in Chapter 10)

The findings of the CIA for the proposed project in combination with existing projects that will continue to adversely influence the future baseline, demonstrates that the proposed project will marginally contribute to these continual changes; however, the contribution to these changes from the proposed project are considered to be insignificant and it is unlikely that the proposed project will be the responsible development of the incremental changes.

8.9.2.3. Inter-Project CIA: Planned or Realistically Defined Projects

The first stage of assessing the inter-project cumulative impacts of planned or reasonably defined projects that could potentially have an impact on shared environmental or social receptors as the proposed project, is to identify those projects.

As part of economic development and working towards the targets set out in the 5th NDP (National Planning Commission, 2017), Walvis Bay is expected to see significant growth through the direct and indirect modernising and industrialising of the major sectors of agriculture, fisheries, manufacturing, mining and tourism. The key future growth and development plans set out in the 5th NDP for the next four years that will affect Walvis Bay include:

- *'Namibia to be the key fisheries and processing hub in the South East Atlantic Ocean through increasing the volume of fish handled, canned or processed in Walvis Bay cumulatively by 40%';*
- *'Namibia has an integrated mining industry value chain doubling the share of valued added mining exports from 2015';*
- *'Namibia has a diversified and competitive tourism sector increasing the number of tourists' arrival from 1.4 million to 1.8 million';*
- *'Namibia has a sustainable transport system supporting a world-class logistics hub connecting SADC to international market'; and*
- *'Namibia has diversified and increased exports of manufactured goods from 44% to 60%'.*

To accommodate the plans set out in the 5th NDP, various developments will be required. These can be as a direct need, e.g. the development of the Walvis Bay Port or as an indirect consequence, e.g. residential properties to accommodate an increase in population growth as a result of industrial growth. The growth of the town of Walvis Bay will be substantial over the next 12 years and beyond (the IUSDF sets out plans up to 2030), which will include various types of developments as set out in Section 6.11.1.

As discussed in Section 6.24, the environment in Walvis Bay, in particular the Lagoon and surrounding the proposed project site is not a static environment; it is constantly changing as a result of historical and existing anthropogenic and natural influences. In particular, the following future developments have the potential to cause environmental and social impacts that are likely to result in incremental impacts, on areas or resources used by or directly impacted by the proposed project:

a. Walvis Bay South Port Terminal: Phase 1 of the Namport's Container Expansion project becoming operational;
b. Walvis Bay South Port Terminal: Construction and operation of both phases 2 and 3 of the Namport's Container Expansion project;
c. Namport's Waterfront and Marina;
d. Walvis Bay North Port Terminal;
e. Development of a hotel and casino on erven 4941; and
f. Lovers Hill development.

In addition to these proposals there may be other developments such as improvements to infrastructure (sewerage, bulk water, electrical transmission system, roads and paths), however these are unknown. Various activities that may not necessarily be developments, could also contribute to altering or affecting the environment and society. These include, but are not limited to:

- Increased population as well as tourists and visitors to the Walvis Bay area; and
- Increase in activities within the marine environment (tours, recreational boat users, sporting activities and fishing).

The actual impacts as a result of the construction, operations and decommissioning of projects c to f listed above are unknown. Concept plans may exist for the waterfront and marina, and the North Port; however, no data, design, construction methodology, scheduling of the project or information on how the development would operate is publicly available. In line with IFC Assessment Guidance these developments are not considered as realistically defined projects in (see Section 3.2) (International Finance Corporation, 2013). A high level qualitative assessment has therefore been undertaken to identify potential impacts on key receptors to provide an indication of the likely impacts.

Phases 2 and 3 of the Namport's Container Expansion project is considered as a realistically defined and committed development as an Environmental Clearance Certificate has been obtained. The EIA undertaken for the Namport project has been reviewed and where available, assessment findings used to identify the potential cumulative impacts. Several limitations of the Namport EIA were identified during this review, which limits the scope and conclusions of this CIA, in particular, a schedule of construction works of phases 2 and 3 is not provided; the sedimentation plume modelling for the construction works of phases 2 and 3 was not undertaken; the number of marine and road vehicles were not provided for the Namport operations phase; and a comprehensive CIA was not undertaken. These limitations are highlighted where applicable.

8.9.2.4. FUTURE BASELINE

Due to the local environment, in particular, the Lagoon environment being a dynamic and shifting environment, it is important to consider potential changes to the baseline when undertaking the CIA. The changing environment is expected to occur as a result of both historic, existing and future anthropogenic influences and natural processes (see Section 6.24. In particular, throughout this ESIA report, the following aspects of the current baseline have been noted as changing and resulting in a noticeable shifting baseline, which is expected to continue to change. These changes have considered the future growth of the town to a degree.

- Natural sedimentation in the Lagoon.
- Water quality in the Bay and the Lagoon.
- Flow into and out of the Lagoon.
- Geomorphological changes through wave action, currents and sediment supply.
- Changes in avian populations, diversity and numbers.
- Movements of marine mammals.

Whilst considering the development of the realistically defined projects and the dynamic local environment, it is expected that the baseline environment, in particular, the changes listed above, will continue to alter without the development of the proposed project, meaning the proposed project is unlikely to significantly alter the predicted changes of the future baseline. The assessment findings documented in the previous section assessed the magnitude of change that the proposed project would cause as the predicted changing environment without the future realistically define projects. The next section considers the future baseline, the proposed project and the potential future developments and activities.

8.9.2.5. Assessment of Impacts: Qualitative Assessment

Whilst the projects c to f listed above (Namport's waterfront and marina; Walvis Bay North Port Terminal; development of a hotel and casino on erven 4941; and Lovers Hill development) have limited available information and thus a robust assessment cannot be undertaken (nature of impacts and magnitude of change cannot be determined), it is important to recognise that the combined impacts of the development of the waterfront area (proposed project and existing waterfront area) could result in negative and beneficial impacts.

The findings of the proposed project impact assessment (presented in Sections 8.4 to 8.8) concluded that the following receptors would likely be moderately to majorly adversely impacted during construction and operations, and therefore additional impacts to these receptors from other development or activities (such as the projects c – f listed above as well as the activities) could contribute to these impacts and further worsen them, potentially making them significant.

- **The Raft:** potential loss of patrons leading to loss of revenue during construction phase;
- **The community:** community severance from increased traffic, disturbance from noise, dust, change to sense of place, change in seascape and landscape character, and localised visual impacts;
- **Integrity of Ramsar:** impacts on the attributes that make up the Ramsar site (e.g. Lagoon water quality and Lagoon ecology and avian life); and
- **Marine mammals:** disturbance during construction phase.

The combined inter-project impacts on these receptors cannot however be easily quantified mainly due to the lack of other project scheduling information (e.g. when construction would start, how long it would take, when operations commence); the construction of projects c to f listed previously could occur at the same time, or they could occur at different times. It is considered likely that the construction of the proposed project would not coincide with the construction of any of these projects, therefore the combined impacts would occur during the operations of the proposed project and the construction and then operations of the other projects. The increase in tourist numbers and population, and increase in marine activities will continue gradually, however the impacts are more likely to be seen during the operational phase of the proposed project.

The magnitude of change, and nature and severity of impacts caused by the construction and operations of projects c - f will determine the level of significance of the cumulative impacts on these receptors. This information is currently unknown; therefore, significance cannot be determined or suitable mitigation. Recommendations have been proposed as a result of the findings of this ESIA, which are detail in Chapter 10.

The construction of the projects c- f are unlikely to require activities to be undertaken in the marine environment (based on early concept designs). The Namport container terminal project includes a marina breakwater; however, this is included in the phase 1 Namport Container expansion project and is currently (at the time of writing) being constructed. Therefore, inter-project cumulative impacts on the water quality and the Lagoon environment during construction is unlikely to be significant.

Whilst the operations of the proposed project are unlikely to result in significant impacts in the marine environment, it is recognised that there is potential for inter-project cumulative impacts on the marine environment, in particular the Lagoon environment which forms an integral component of the Ramsar site. Impacts could arise due to increased tourism and visitors to the area. One of the key issues is human-wildlife interactions due to an increase in marine based tourism activities, potentially resulting in a disturbance, injury and mortality to birds and marine mammals. At this stage, these impacts can also not be quantified, but it is recognised as a risk and thus a recommendation has been presented (see Chapter 10).

8.9.2.6. Assessment of Impacts: Namport Container Expansion Project

Phase 1 of the Namport's Container Expansion project is 76% complete and is expected to become operational in 2019. Phases 2 and 3 are unlikely to be constructed before 2025. The operations of phase 1, and construction and operations of phases 2 and 3 are included in the CIA.

An EIA was undertaken for the Namport Container Expansion project (Delta Marine Consultants, 2010), therefore data, information and an impact assessment is available for use in the CIA. As stated earlier, this information is limited in areas.

The methodology between the Namport EIA and the proposed project ESIA differ, in particular with the definition of duration and significance. Whilst a comparison exercise is not intended here, or an evaluation of the assessment methodology and thresholds applied, it is important to recognise these differences, as it will have an influence on the CIA. The key differences that influence the CIA are summarized in Table 42.

Table 42 – EIA Methodology differences

METHODOLOGY	PROPOSED PROJECT ESIA	NAMPORT EIA
Duration	Three thresholds: • Short-term • Medium-term • Long-term Permanent and temporary are considered as reversibility. An impact could for example be a short-term permanent impact, i.e. the change is permanent but effects short-term.	Five thresholds: • Temporary (less than 1 year) • Short term (1 to 6 years) • Medium term (6 to 15 years) • Long term (the impact will cease after the operational life of the activity) • Permanent
Significance	Four levels of adverse significance: • Major • Moderate • Minor • Low	Three levels of adverse significance: • High • Medium • Low to very low

Whilst there is a difference in the Significance ratings, the definitions are similarly aligned. Therefore, the duration ratings (and reversibility) are the key differences.

The Namport Container Expansion project EIA report concludes that *'no impacts of high significance as a consequence of the proposed terminal expansion were identified…'*. Whilst applying the methodology, this conclusion may be correct, however an example of where different methodology can alter the findings is as follows.

Section 5.3.1.1.1 of the Namport EIA report states the following *'…it is considered extremely unlikely that any sediment arising from dredging, deposited in the lagoon, will be detectable and the significance of this impact will be low to very low.'* This predicted impact includes impacts on the marine ecology. The assessment concludes that the impacts would be short-term. Studies undertaken as part of this ESIA (Appendix H) have concluded that potential changes to the avian community of the Lagoon have significantly altered in numbers before, during and after the Namport phase 1 construction works. This impact is as a result of increased the sedimentation in the Lagoon which can be attributed to the Namport construction activities. Approximately one year after the Namport marine construction works, the number of birds started to recover, however it is currently unknown if these impacts will be completely reversed or the duration in which the impact will last for. A short-term impact defined in Namport's EIA is *'The timeframe during which the impact will be experienced (1 to 6 years)'*, therefore the assessment findings is considered appropriate if a full recovery of the impact is achieved within 6 years.

It should be noted at this stage that the indirect impacts on the avian community in the Lagoon (and thus the integrity of the Ramsar site) from sedimentation was not thoroughly assessed in the Namport EIA. Only Lagoon refreshment rates and the indirect impacts on the avian community were assessed.

If the methodology in this ESIA report were to be applied, a medium-term impact and temporary reversibility would have been applied *'Impacts that are likely to continue after the activity causing the impact and are recoverable'*, thereby making the overall magnitude of change as moderate and the significance of impact as moderate adverse; higher than the Namport conclusions due to differing methodology.

Taking into consideration these differences, the thresholds defined in this ESIA impact assessment methodology (see Chapter 7) have been applied to the CIA when assigning a level of significance, in addition, the precautionary principle has been applied where there are uncertainties. The level of significance from both assessments is after mitigation has been applied.

The following have also been considered in the inter-project CIA:

- The second and third phases of the Namport Container Expansion project will not be constructed prior to 2025 (Gelderbloem, 2018), therefore the proposed project will be in the operational phase when these activities commence.
- Operational impacts of the proposed project and construction and operations of the 2nd and 3rd phases have been considered in this inter-project CIA.
- The operational activities and associated impacts of phase 1 have been considered.
- It is believed that the assessment presented in Namport's EIA is focused on phase 1 in places, and therefore broad assumptions have been applied where impacts associated with phases 2 and 3 are lacking, using the assessment findings concluded from phase 1. Some data for phase 1 is limited, for example the number of road and marine traffic.
- The combined impacts of operating all three phases have been considered, however this is based on assumptions due to lack of information in the Namport EIA.
- The significance of the inter-project cumulative impacts has applied the methodology and significance matrix presented in Chapter 7.

The inter-project CIA is presented in Table 43. The first column presents the receptor that could be affected; column two presents the activities that would cause the impacts; the third column presents the significance of the impact on the receptor that was identified in this ESIA (Sections 8.4 to 8.8); column 4 presents the significance of the impact on the receptor that was identified in the Namport EIA report; column 5 presents information of these impacts and the likely responsible project for the combined impact; and the sixth column presents the significance of the inter-project cumulative impacts (combined impacts) on each receptor as result of the proposed project and Namport's project.

To summarise, inter-project cumulative impacts have been derived using the following simple equation:

IMPACTS FROM PROJECT 1 ACTIVITIES + IMPACTS FROM PROJECT 2 ACTIVITIES = COMBINED IMPACT ON THE SAME RECEPTOR

Various recommendations have been identified during this assessment and are listed at the end of the Chapter.

Table 43 – Inter-project cumulative impacts of the proposed project and Namport Container Expansion project

RECEPTOR	ACTIVITY	PROPOSED PROJECT	NAMPORT	COMBINED IMPACT	SIGNIFICANCE	IMPACT ASSESSMENT
Water Quality: Refreshment rates in the Lagoon	Operations of Namport phases 1, 2 and 3	Low	Low	**THE WALVIS BAY WATERFRONT PROJECT** The proposed project was assessed as having negligible impacts on the flow into and out of the Lagoon. **NAMPORT PROJECT** The Lagoon refreshment rate was modelled to reduce by 10-15% under certain conditions when all three phases of the port extension is built. This is likely to result in a long-term impact on the Lagoon environment, that is unlikely to be irreversible. **COMBINED** The proposed project is considered not to significantly worsen the predicted impacts on the Lagoon's refreshment rates, and it is the combined impacts of phases 1, 2 and 3 that are likely the main contributors to this overall cumulative impact.	Moderate	**THE WALVIS BAY WATERFRONT PROJECT** No mitigation measures were identified for the proposed project due to the negligible impacts.
The Lagoon, Water Quality: Heavy Metals and other pollution	Construction of phase 2 or 3 Disturbance of heavy metals	Negligible	Low	**THE WALVIS BAY WATERFRONT PROJECT** Maintenance dredging for the proposed project will occur in specific areas every two and five years. There are limited heavy metals found in the Lagoon area, therefore limited impact. The proposed project will not discharge waste effluent to the marine environment. **NAMPORT PROJECT** During the construction of phases 2 and 3, there is potential to mobilise harmful elements and compounds. The assessment concludes that limited pollutants were unlikely to be found in the dredged material, therefore limited impacts. Actual findings / real data collected during from phase 1 should be available, which should be reviewed and considered when reviewing the cumulative impacts of phases 2 and 3 – see Chapter 10 for recommendations.	Low	**THE WALVIS BAY WATERFRONT PROJECT** No mitigation measures were identified for the proposed project due to the negligible impacts.

RECEPTOR	ACTIVITY	PROPOSED PROJECT	NAMPORT	COMBINED IMPACT	SIGNIFICANCE	IMPACT ASSESSMENT
				COMBINED The combined impacts of disturbing heavy metals and spreading contamination is not considered significant.		
The Lagoon, Water Quality: Sedimentation	Construction of phase 2 or 3	Minor	Low	**THE WALVIS BAY WATERFRONT PROJECT** The proposed project will minimise suspended solids through mitigated dredging operations and best available technology. Due to the duration and occurrence (every 2 and 5 years), localised nature and dredging techniques, the impacts has been assessed as minor. The indirect impacts would be on marine mammals, the bird life, fish and phytoplankton, which is assessed to be minor significance. **NAMPORT PROJECT** The Namport project is likely to cause increased siltation and sedimentation during construction works. The Namport assessment considered *'it to be extremely unlikely that any sediment suspended during dredging that might be deposited in the Lagoon will be detectable, nor would it have an impact on marine ecology'* (including birds). Through the impacts assessment process undertaken for the proposed project, it was found that considerable amounts of sedimentation had entered the Lagoon during the construction period which caused a considerable change to the avian community. Namport's construction activities are most likely a key contributor to this – see Appendix H. Therefore, it is assumed that similar sedimentation in the Lagoon will occur during phases 2 and 3. It is possible that sedimentation load and rates may differ due to the new structure of phase 1, which has altered the currents in the Bay. However due to this uncertainty, the	Moderate	**THE WALVIS BAY WATERFRONT PROJECT** Most appropriate dredger (sucking system/Watermaster), undertaking activities on outgoing tide, turbidity monitoring, use of a bund, silt curtain, sequencing and scheduling, all dredging over seen by suitable qualified person. **NAMPORT PROJECT** It is understood that Namport undertook water monitoring during the first phase of construction. Recommendation No. 3 in Section 10.3.4 includes a recommendation for Namport to review this data and undertake an assessment prior to phases 2 and 3.

RECEPTOR	ACTIVITY	PROPOSED PROJECT	NAMPORT	COMBINED IMPACT	SIGNIFICANCE	IMPACT ASSESSMENT
				significance of cumulative impacts is considered to be moderate. **COMBINED** Whilst the proposed project may marginally contribute to sedimentation (if mitigation measures are not applied) in the Lagoon, it is believed that it would not be considered as the responsible development for the incremental impacts and it is unlikely to significantly worsen the impact to the Lagoon. To reduce impacts, the scheduling of dredging for both projects should be considered – it may be best to undertake these at different times to ensure the magnitude of change is kept to a minimum. Water quality monitoring should also be undertaken collaboratively; this has been included as a recommendation in Chapter 10.		

RECEPTOR	ACTIVITY	PROPOSED PROJECT	NAMPORT	COMBINED IMPACT	SIGNIFICANCE	IMPACT ASSESSMENT
The Lagoon: & Ramsar Site	Construction and Operations	Moderate	No assessment	**THE WALVIS BAY WATERFRONT PROJECT** The impacts on the Lagoon and other areas that make up the Ramsar site can combine and result in impacts on the qualifying features of the Ramsar site. Whilst the project is likely to result in minor changes to certain attributes and will contribute to the cumulative impacts on the Ramsar site, the proposed project is not considered to be the responsible development for this issue and it is unlikely that the situation will be significantly worsened. **NAMPORT PROJECT** The lack of a holistic assessment for the potential impacts specifically on the Ramsar site in the Namport EIA limits this assessment. The Lagoon refreshment rate and potential impacts on benthic fauna and bird populations was assessed, which concluded low adverse impacts, not significant. This is only one impact that could affect the receptor. **COMBINED** It is assumed, that Namport will likely be the main contributor to the incremental impacts and potential significant impacts on this receptor, due to siltation and sedimentation witnessed and indirect impacts recorded during construction works; increase risk in pollution events during both construction and operation; changes to the Bay's current pattern and the Lagoon's refreshment rate; and changes to natural sediment transport. Due to these uncertainties as well as the uncertainties of the magnitude of change and the duration of these changes, a significance of major adverse impacts has been derived due to the international value of the site as well as the local and national important.	Major	**THE WALVIS BAY WATERFRONT PROJECT** Most appropriate dredger (sucking system), turbidity monitoring, use of a bund, silt curtain, sequencing and scheduling, well maintained and serviced equipment, all dredging over seen by suitable qualified person. **NAMPORT PROJECT** It is understood that Namport undertook water monitoring during the first phase of construction. Recommendation No. 3 in Section 10.3.4 includes a recommendation for Namport to review this data and undertake an assessment prior to phases 2 and 3. **COMBINED** Section 10.3.4 includes a recommendation (No. 2) for a CIA to be undertaken for the Ramsar site so that environmental quality objectives and thresholds can be defined which can be used in future EIAs, especially projects that have the potential to cause significant impacts . A detailed CIA has been undertaken for this project that determined this project would not significantly alter the baseline even in combination with other existing projects. To avoid the scale of work conducted in this ESIA for the CIA, and to improve the quality of EIAs in the region, a holist CIA is recommended but is not required for this project, as it has already been completed.

RECEPTOR	ACTIVITY	PROPOSED PROJECT	NAMPORT	COMBINED IMPACT	SIGNIFICANCE	IMPACT ASSESSMENT
Water Quality: Pollution	Construction and operations	Low	Not assessed	There is risk for pollution such as oil and fuel to enter the marine environment as a result of boats in the water for both projects. The Namport EIA has not undertaken an assessment on the potential impact from an increase in marine traffic, both from the construction and operations of each phase. **COMBINED** Due to the lack of data, it is assumed that the individual projects result in a low impact, however the impact worsens when the projects are combined. This combined impact has been assessed as minor.	Minor	**COMBINED** Well maintained and serviced equipment, Code of Conduct, designated refuelling area. Inner marina provides contaminant area. Spill response booms to be housed on site in the event of a spill. Rubbish collection points built into the design
Avian community: impacts from noise	Construction and operations	Minor	Not assessed	**THE WALVIS BAY WATERFRONT PROJECT** The noise from the proposed project site during operations is likely to be a small change to the current environment. There is potential to impact birds, however this impact will be localised. **NAMPORT PROJECT** The construction noise from Namport is assessed as being of low significance to local residents, therefore it can be assumed a similar impact to birds due to the added distance from the Lagoon area. **COMBINED** The combined impacts are assumed to be minor whilst taking a precautionary approach. The proposed project would likely be the responsible development for the incremental impacts on bird life in the Lagoon due to noise as it is in closer proximity to the site and marine activities are also likely to contribute. The Namport activities would contribute to these noise levels.	Minor	**THE WALVIS BAY WATERFRONT PROJECT** Continual twice-yearly bird monitoring

RECEPTOR	ACTIVITY	PROPOSED PROJECT	NAMPORT	COMBINED IMPACT	SIGNIFICANCE	IMPACT ASSESSMENT
Marine mammals: impacts from construction noise, marine traffic noise and human-wildlife interactions	Construction of phase 2 or 3	Minor	Not assessed	**THE WALVIS BAY WATERFRONT PROJECT** Due to the local importance of dolphins, the potential adverse impact is considered to be minor, even though the magnitude of change is expected to be limited (background noise, increase in small crafts and boats). During maintenance dredging, the dolphins are likely to avoid the area for the very short duration. **NAMPORT PROJECT** During the construction of phase 1, dolphins avoided the area during dredging works. It is assumed the same thing would occur for the construction of phases 2 and 3 which could take approximately 8 years of construction, with long periods of dredging activities. In addition, the increase in marine vessels and traffic will also likely contribute to marine noise and potentially interact with marine mammals. **COMBINED** The potential cumulative impacts are likely to result in a moderate adverse impact – they are considered to be long-term impacts but will have some regional importance due to the possibility of dolphins staying away from the areas for long durations, thereby affecting the ecology of the area and the tourism industry. The proposed project will contribute to this cumulative impact, however is it not considered to be the responsible development for the incremental impacts.	Moderate	**COMBINED** Continual engagement with the Namibian Dolphin Project. **COMBINED** Section 10.3.4 includes a recommendation (No. 3) for a CIA to be undertaken for the future development of Walvis Bay. The findings of the assessment should illustrate the future carrying capacity of the receptors in the area and suitable development plans and mitigation measures. A detailed CIA has been undertaken for this project that determined this project would not significantly alter the baseline even in combination with other existing projects. To avoid the scale of work conducted in this ESIA for the CIA, and to improve the quality of EIAs in the region, a holist CIA is recommended but is not required for this project, as it has already been completed.

RECEPTOR	ACTIVITY	PROPOSED PROJECT	NAMPORT	COMBINED IMPACT	SIGNIFICANCE	IMPACT ASSESSMENT
Marine mammals: impacts from operational noise, marine traffic	Operations of phases 1, 2 and 3	Minor	Low	**THE WALVIS BAY WATERFRONT PROJECT** Due to the local importance of dolphins, the potential adverse impact is considered to be minor, even though the magnitude of change is expected to be limited (background noise, increase in small crafts and boats). During maintenance dredging, the dolphins are likely to avoid the area for the very short duration. **NAMPORT PROJECT** In addition to the above, increased ship and vessel traffic will occur as a result of the activities and operation of phases 1, 2 and 3, which is likely to increase marine noise and human-wildlife interactions. The Bay area will likely become more congested and dolphins are more likely to avoid the area, be disturbed or injured. **COMBINED** Combined impacts are therefore likely, however the proposed projects is not considered to be the responsible development for this incremental impact.	Minor	**COMBINED** Continual engagement with the Namibian Dolphin Project. **COMBINED** Section 10.3.4 includes a recommendation (No. 1) for a CIA to be undertaken for future development of Walvis Bay. The findings of the assessment should illustrate the future carrying capacity of the receptors in the area and suitable development plans and mitigation measures. A detailed CIA has been undertaken for this project that determined this project would not significantly alter the baseline even in combination with other existing projects. To avoid the scale of work conducted in this ESIA for the CIA, and to improve the quality of EIAs in the region, a holist CIA is recommended but is not required for this project, as it has already been completed.
Local residents surrounding the proposed project site: noise levels increasing from noise	Construction of phase 2 or 3	Moderate	Low	**THE WALVIS BAY WATERFRONT PROJECT** The local residents surrounding the proposed project site are likely to experience an increase in noise levels due to the operations of the development, and residents along the major access route to the site are also likely to see an increase in noise due to increased traffic levels. **NAMPORT PROJECT** These residents would also be exposed to an increase in noise levels as a result the construction activities of phases 2 and 3, construction traffic, operational activities and operational traffic.	Moderate	**THE WALVIS BAY WATERFRONT PROJECT** Continual communications through the Environmental and Social Manager, monitoring programme implemented as per ESMPs. **COMBINED** Recommendation 4 in Section 10.3.4 of this report includes noise monitoring to be undertaken in collaboration between several stakeholders. This will provide a baseline which can be used in the

RECEPTOR	ACTIVITY	PROPOSED PROJECT	NAMPORT	COMBINED IMPACT	SIGNIFICANCE	IMPACT ASSESSMENT
				COMBINED The proposed project is predicted to be the responsible development that contributes to the majority of the cumulative impacts on the residents surrounding the proposed project site. The Residents on the main vehicle access routes by Namport site and the proposed project site are the responsibility of both developments.		proposed Strategic CIA (Recommendation 1) and other EIAs to ensure the town is developed sustainable. A detailed CIA has been undertaken for this project that determined this project would not significantly alter the baseline even in combination with other existing projects. To avoid the scale of work conducted in this ESIA for the CIA, and to improve the quality of EIAs in the region, a holist CIA is recommended but is not required for this project, as it has already been completed.
Community severance: Construction Traffic	Construction of phase 2 or 3	Moderate	Low	It is noted that the difference between assessment findings is quite different. The Namport assessment focussed on the capacity of the road, impact to pavement infrastructure, safety and accident risk. The traffic assessment for the proposed project focussed on the receptors that would be affected; the severance the community would experience as a result of increased traffic volumes. In addition, a traffic study reviewed the capacity of the local road infrastructure and recommended upgrades which are part of the project, to ensure future capacity is accommodated. This included traffic predictions for phases 2 and 3. **COMBINED** The cumulative impacts are expected to be the responsibility of both developments. A recommendation has been made that considers this impact due to the potential additional contributors that may worsen this impact – see Chapter 10.	Moderate	**THE WALVIS BAY WATERFRONT PROJECT** Continual communications through the Environmental and Social Manager, monitoring programme implemented as per ESMPs. **COMBINED** Section 10.3.4 includes a recommendation (No. 1) for a CIA to be undertaken for future development of Walvis Bay. The findings of the assessment should illustrate the future carrying capacity of the receptors in the area and suitable development plans and mitigation measures. A detailed CIA has been undertaken for this project that determined this project would not significantly alter the baseline even in combination with other existing projects. To avoid the scale of work conducted in this ESIA for the CIA, and to improve the
Community severance: Operations Traffic	Operations of phases 1, 2 and 3	Moderate	Low		Moderate	

RECEPTOR	ACTIVITY	PROPOSED PROJECT	NAMPORT	COMBINED IMPACT	SIGNIFICANCE	IMPACT ASSESSMENT
						quality of EIAs in the region, a holist CIA is recommended but is not required for this project, as it has already been completed.
Local economy: increased workers and families to Walvis Bay:	Construction and Operations of phases 1, 2 or 3	Major	Medium	**COMBINED** The combined impacts of the projects will result in a beneficial impact to the local and regional economy as a result of employment and local spends.	Major Benefit	N/A
Local communities: increased workers and families to Walvis Bay	Construction and Operations of phases 1, 2 or 3	Low	Low	**THE WALVIS BAY WATERFRONT PROJECT** The increase in people moving to Walvis Bay as a result of these project due to job creation would result in adverse cumulative impacts on the pressure local services and social cohesion. The demand and pressure on local services has been considered in the Walvis Bay IUSDF, which sets out provisions to accommodate an increasing population. **NAMPORT PROJECT** The conclusions found from the Namport EIA is that the existing services would accommodate the workforce. **COMBINED** Combined impacts on the local communities as a result of social cohesion is likely and would be the responsibility of both developments.	Minor	**COMBINED** Section 10.3.4 includes a recommendation (No. 1) for a CIA to be undertaken for future development of Walvis Bay. The findings of the assessment should illustrate the future carrying capacity of the receptors in the area and suitable development plans and mitigation measures. A detailed CIA has been undertaken for this project that determined this project would not significantly alter the baseline even in combination with other existing projects. To avoid the scale of work conducted in this ESIA for the CIA, and to improve the quality of EIAs in the region, a holist CIA is recommended but is not required for this project, as it has already been completed.
Landscape and seascape character, local resident views and sense of place	Operations of phases 1, 2 or 3	Moderate	Low	**THE WALVIS BAY WATERFRONT PROJECT** The proposed project is likely to alter local resident views, alter the seascape and landscape character of the local area, as well as change the sense of place. The existing Namport terminal and phase 1 are not currently visible from the proposed project site or surrounding residential properties, and does not	Moderate	**THE WALVIS BAY WATERFRONT PROJECT** Design of development has set-back buildings to minimise impacts on local residents and used local resources to construct the buildings (blend into natural environment). Maintenance of soft landscaping.

RECEPTOR	ACTIVITY	PROPOSED PROJECT	NAMPORT	COMBINED IMPACT	SIGNIFICANCE	IMPACT ASSESSMENT
				contribute to the same seascape character (i.e. cannot be easily viewed in the same viewpoint from sea unless quite far out where the proposed project site is less visible). **NAMPORT PROJECT** The Namport EIA did not consider the six 125m cranes that are currently being installed for the phase 1 (Gelderbloem, 2018). These will be seen from outside of the town limits and will most likely be visible from the proposed project site and surrounding residential properties, thereby contributing to and altering the local views, and landscape and seascape character. This impact was not addressed in the Namport EIA, therefore it is assumed that phase 2 and 3 will include similar infrastructure. Therefore, the overall character of the coastline and views from the town will continue to change, and thus cumulative visual impacts will occur. **COMBINED** The proposed project will be responsible for the adverse changes to the local landscape and seascape character, local residential views and sense of place, and Namport will contribute to this cumulative impact, however will not make it significantly worse. This is a long term, local and direct impact. However, people adapt and will become accustomed to the change in landscape and seascape character.		**COMBINED** Section 10.3.4 includes a recommendation (No. 1) for a CIA to be undertaken for future development of Walvis Bay. The findings of the assessment should illustrate the future carrying capacity of the receptors in the area and suitable development plans and mitigation measures. A detailed CIA has been undertaken for this project that determined this project would not significantly alter the baseline even in combination with other existing projects. To avoid the scale of work conducted in this ESIA for the CIA, and to improve the quality of EIAs in the region, a holist CIA is recommended but is not required for this project, as it has already been completed.

The inter-project CIA illustrates that the proposed project would likely be responsible for the following incremental impacts:

- Avian community impacted from noise during operations: Minor cumulative impact;
- Local residents surrounding the proposed project site impacted through increased noise levels: Moderate cumulative impact; and
- Local residents surrounding the proposed project site impacted from change to local views and changes to landscape and seascape character: Moderate cumulative impact.

The potential impacts to the avian community are of both local and international concern. Twice yearly monitoring is undertaken to collect data on number of individuals and species present in the Lagoon and surrounding area. This monitoring will continue and shall be used to monitor the potential impacts arising from the proposed project. A recommendation in Chapter 10 has been made to support the protection of this sensitive and valued receptor.

The increase in noise levels to the local residents would be felt during normal working hours as a result of the Namport traffic, traffic to and from the proposed development and a slight increase from operational activities on the proposed project site. The environmental and social baseline will have changed considerably in the area since Namport undertook their EIA study, and therefore background noise levels may have increased. Several recommendations have been made and documented in Chapter 10 to mitigate impacts from noise on local residents.

Walvis Bay has a dynamic environment, which is constantly changing. Views, landscape and seascape character and sense of place will continue to change, and people will adapt to these changes. The impacts to local residents are expected to reduce over time as people will be accustomed to the changes to their surroundings.

In addition to the above, it is concluded that the proposed project does not jeopardise the sustainability or integrity of the Lagoon environment and Ramsar site; the potential impacts arising from the proposed project are insignificant compared to other project and activities. It is acknowledged that the Lagoon environment is changing and could further be affected by other projects, therefore further collaborative work needs to be undertaken to ensure the Lagoon is protected holistically due to its value. A recommendation detailed below has been included.

8.9.2.7. Conclusions of the CIA

The CIA has assessed the following:

- **Intra-project cumulative impacts:** Cumulative impacts that occur within the proposed project;
- **Inter-project cumulative impacts:** Cumulative impacts that occur as a result of the proposed project in combination with other projects, which is split in to two:
  - Cumulative impacts with existing projects; and
  - Cumulative impacts with future projects.

The conclusions drawn from the CIA demonstrates that the proposed project may contribute to some cumulative impacts, in particular will result in localised cumulative impacts to receptors adjacent to the proposed project site. In a wider context, both temporally and spatially, **the proposed project is unlikely to be the responsible development for significant incremental impacts**, as the degree of this contribution to those impacts is considered to be marginal compared to other developments and activities in the area. It should be noted, that the wider cumulative impacts (not local) are expected to occur without the development of the proposed project.

Various recommendations in Chapter 10 have been identified as a result of the ESIA and CIA. As responsible practitioners and as a responsible proponent, these recommendations have been made so that the Government and the Walvis Bay Municipality can take action to manage and minimise current and future impacts to sensitive receptors in Walvis Bay.

9 STAKEHOLDER ENGAGEMENT AND CONSULTATION

9.1 INTRODUCTION

Stakeholder engagement forms an important component of the environmental and social assessment process and is defined in the EIA Regulations (2012) as a *"process in which potential interested and affected parties are given an opportunity to comment on, or raise issues relevant to, specific matters".*

The proposed project has developed through several years of planning and consultation with stakeholders and the public.

9.2 EARLY STAKEHOLDER ENGAGEMENT

Consultation started prior to commencing the official stakeholder engagement process commissioned as part of this ESIA study. This included:

- Consultation through the development of the Walvis Bay IUSDF and associated plans;
- General plans and presentations made to neighboring residents and key stakeholders;
- Presentations to council and stakeholders;
- Social media engagements and interactions; and
- The stakeholder engagement process as part of this ESIA.

9.3 STAKEHOLDER IDENTIFICATION

The first stage of consultation involved identifying I&APs. This stage was undertaken between February and May 2017, and involved the following activities:

- Identification of I&APs in proximity to the proposed project site;
- Consultation with the MET to identify the competent authority;
- Consultation and engagement with Walvis Bay Municipality;
- Collection of all addresses for neighbouring properties from the municipality;
- Review of other potentially interested parties including businesses and environmental organisations; and
- Desk-based review to identify Non-Governmental Organisations (NGOs) and other non-statutory stakeholders.

An I&AP database has been developed for the proposed project which contains contact details and potential relationship to the proposed project (see Appendix D).

Throughout this ESIA, stakeholder engagement has been undertaken through face-to-face interviews with neighbouring property owners; meetings; social media engagements; newspapers articles; and written letters to key stakeholders including the Ramsar convention in Switzerland and Namibian Government Ministries.

9.4 COMMUNICATION METHODS

Once the initial list of I&APs was identified, a robust public participation process was undertaken, the aims of which was to identify sensitive environmental and social receptors (either perceived or actual); identify local concerns; present the proposals, encourage feedback and receive any other comments.

Communication with stakeholders was facilitated through the following means:

- ECC door knocked and conducted face-to-face meetings with the neighbours surrounding the development and key stakeholders 23rd – 24th May 2017 (Appendix D);

- A notification letter was sent via registered mail to the neighbors of the proposed development 6th July 2017 (Appendix D);
- Adverts were placed on ECC social media pages and three newspapers in accordance with the Environmental Management Act, 2007; notifying people how to register for the proposed project and inviting the public to the public meeting. This reached over 15,700 people, 100% post engagements were from Namibia;
- ECC held a public meeting on the 12th June 2017 to discuss the details of the project, it was extremely well attended with over 100 seats occupied (minutes and attendance register Appendix D);
- Additional face to face follow up meetings with stakeholders including Ministry of Fisheries and Marine Resources in Swakopmund, Namport, neighboring property businesses including The Raft, The Protea Hotel, the small businesses and tour operators on the Namport foreshore, consultation with the Walvis Bay Yacht club and ongoing consultation with potential project stakeholders occurred through the process;
- Public advertisements regarding the project were placed in three newspapers (Appendix D);
- Site notice erected (Appendix D);
- I&AP registration and compilation of the stakeholder database for the project. The I&AP registration form was also available on a web-based platform to allow a wider range of people to register and participate as an I&AP (Appendix D);
- Through the I&AP registration form, written formal comments were received from Sarah Goldsack (the Raft Restaurant) and Mike Yates (Appendix D);
- Meetings with Namport (Appendix D);
- Consultation with Ramsar (Appendix D); and
- Ministry engagements (Appendix D).

9.5 Stakeholder Notification

A BID was prepared and issued to the general public and stakeholders in June 2017 (see Appendix D). Although not a legal requirement, a BID is considered best practice. The purpose of the BID was to present an overview of the proposed project; the EIA process; the need for the proposed project; and any alternatives considered, with the aim to provide stakeholders an opportunity to register as an I&AP. The BID was the first stage of consultation, and as a result the register of I&APs was developed along with initial comments, questions and concerns (see Appendix D).

9.6 Social Media Engagement

The social media landscape is an important and powerful platform to incorporate important components of stakeholder engagement of the ESIA process and the overall proposed project, including publishing, sharing, discussing and networking. Social media has been used as a tool for stakeholder consultation, as it allows:

1. Communicating and providing stakeholders with opportunities to directly inform decision makers and receive immediate feedback.
2. Enabling efficient and cost-effective large-scale public participation.
3. Allowing greater adaptability during the stakeholder consultation process.
4. Providing broader participation by targeting interested and affected public, particularly youth.
5. Enhancing credibility by demonstrating open, fair and rigorous process.
6. Showing greater transparency by providing open and immediate access to information.

Advertisements for the public meeting posted on ECC social media page reached over 15,000 people with 100% audience engagement from Namibia (see Figure 66 and Figure 67).

Figure 66 – ECC Social Media Notifications of Public Meeting

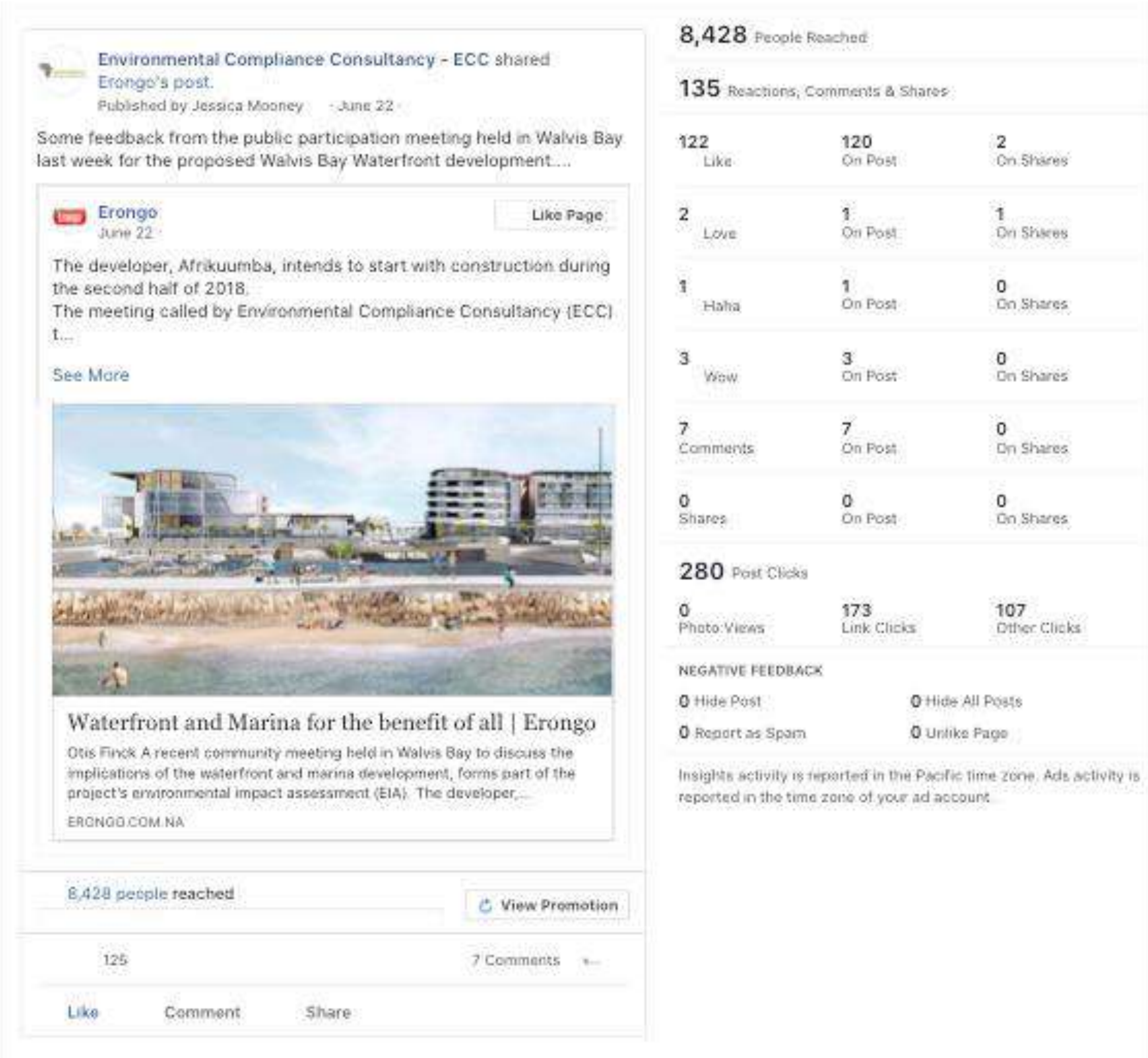

Figure 67 – ECC Social Media Feedback

The proposed project utilises Facebook as the key platform for social media engagement recognising the high proportion of Namibians using Facebook as a daily source of information. The proposed project's Facebook page has over 22,000 followers and is a practical, focused, participative and transparent platform for information gathering and sharing.

Where genuine participation was required to ensure the proposed project meets the community expectations and the project design incorporates the community needs, voting polls were established on Facebook. Opportunities to comment on preliminary designs and initial plans were invited, feedback and invitations seeking input were regularly maintained, resulting in a project that has strong community and stakeholder involvement.

The recreational sporting facilities and the relocation of these were identified as a key and critically important issue to the community. Several questions were posed to the community to better understand the community needs and desires in relation to the sporting facilities. An example of how social media has been used to engage the public is presented in Figure 68.

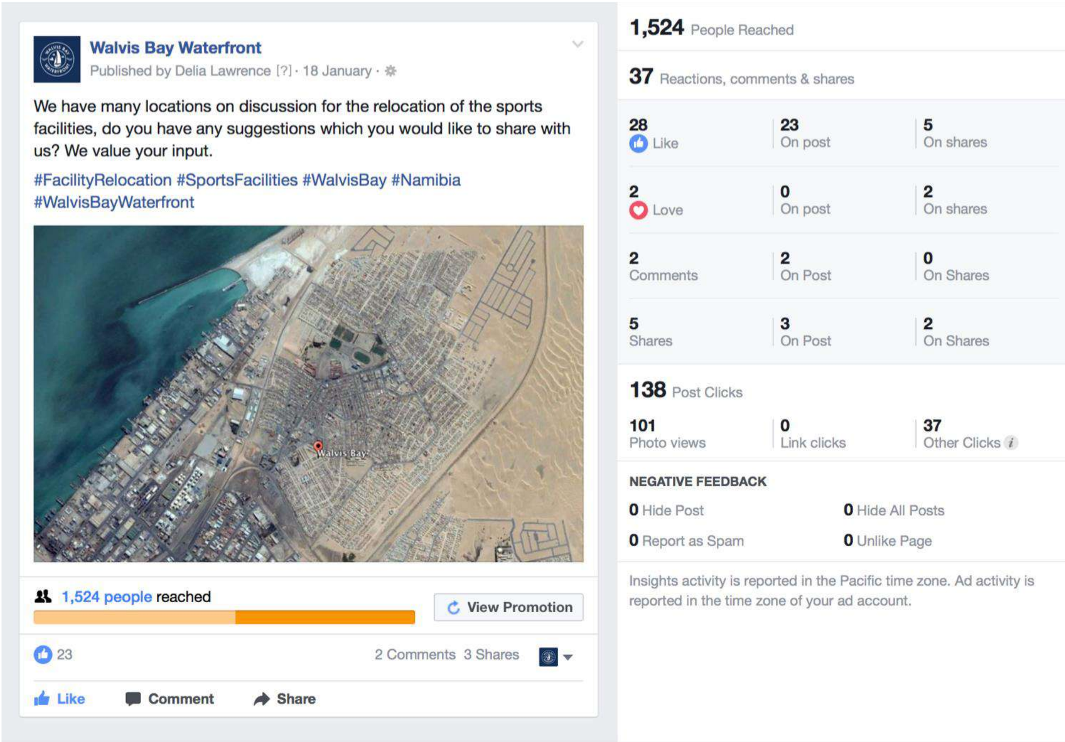

Figure 68 – Proponent seeking community input on relation of sports facilities

A series of questions and posts are presented in Figure 69 to Figure 72 in relation to the relocation of the swimming pool, to demonstrate the level of community engagement and feedback undertaken, and in turn the proponent's responses and inclusions in the proponents plans.

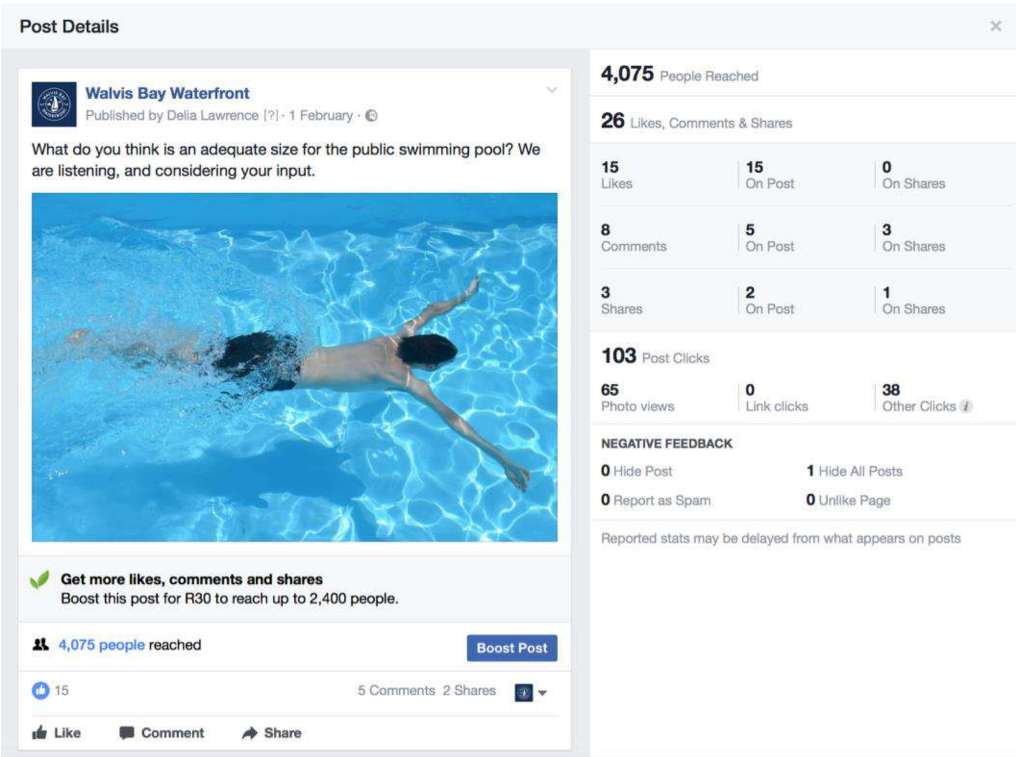

Figure 69 – Proponent seeking community input on size of swimming pool

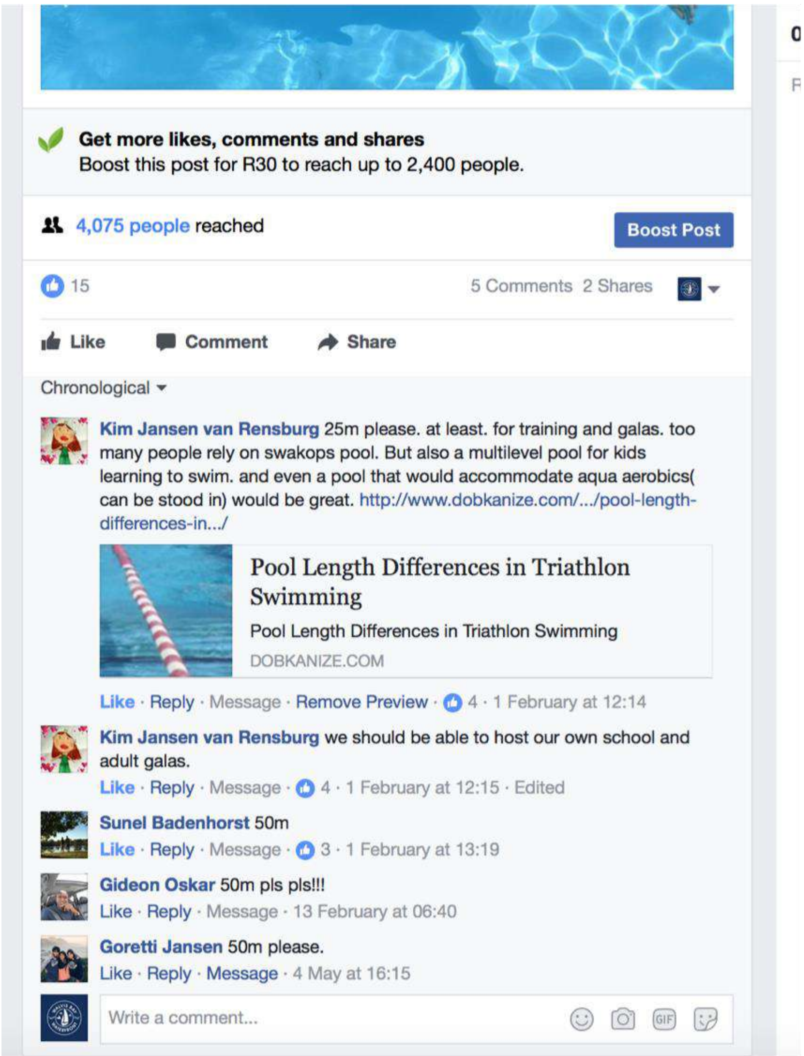

Figure 70 –Community feedback on size of swimming pool

Figure 71 – Proponent seeking community input on swimming pool design

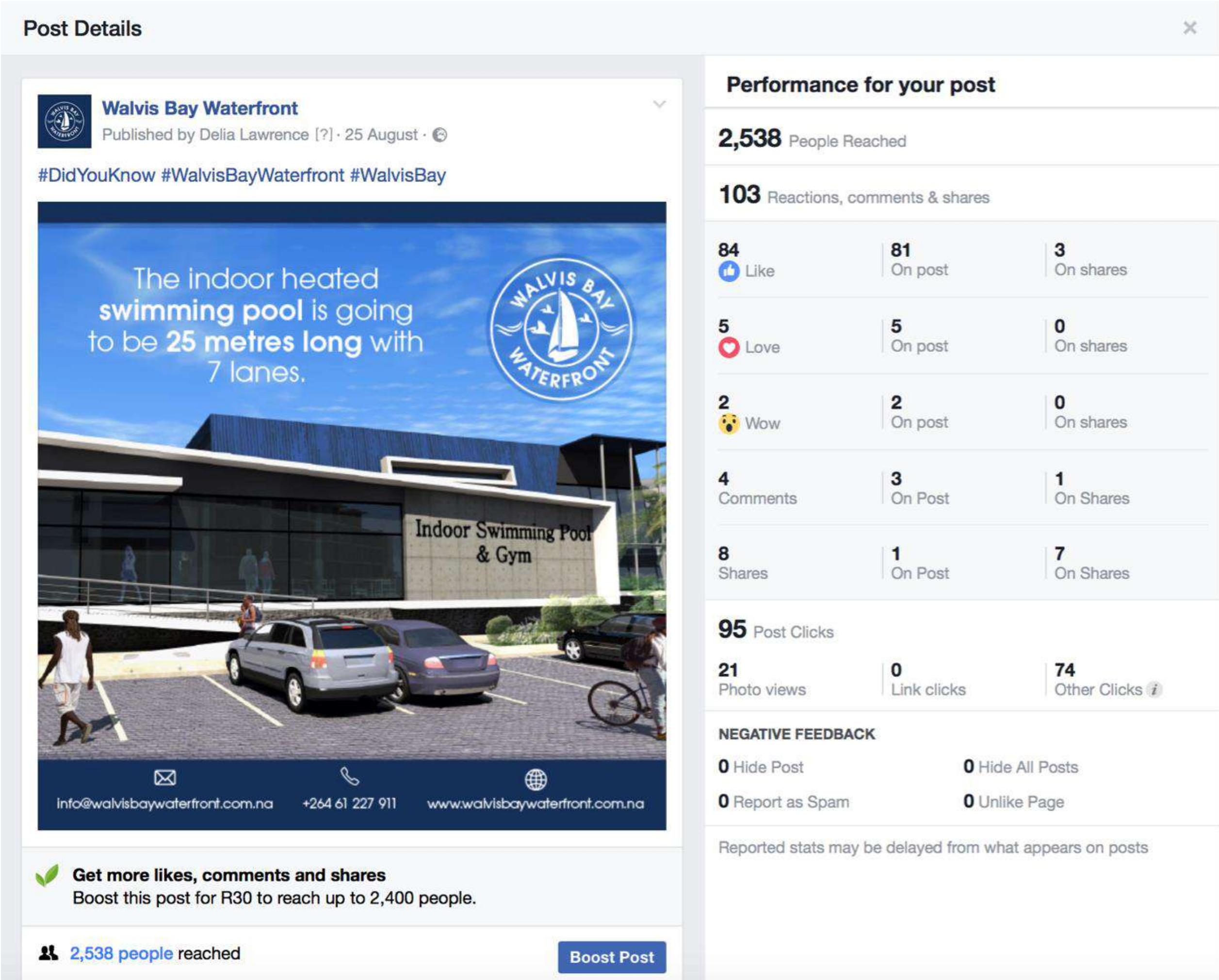

Figure 72 – Proponent response and plans incorporated community feedback

9.7 Public Meeting

A public meeting was held in Walvis Bay in order to discuss the environment and social impact assessment process, aims and objectives. The minutes of the meeting are in Appendix D.

9.8 Consultation Feedback 2017

Appendix D includes a register of all written questions, issues or concerns raised by stakeholders in 2017, through the stakeholder engagement process discussed in the previous sections. This feedback influenced the design of the proposed project (see Sections 4.5, 4.8 and 4.9.16), the ESIA process and subsequently enhanced the ESIA report. The last column in the register presents the location of where each I&AP question, issue or concern was addressed within the first revision of ESIA report.

9.9 CONSULTATION FEEDBACK 2018

This ESIA report was formally submitted to the relevant competent authorities, MET and I&APs on Monday 15th January 2018 for public and stakeholder comment. Comments received were collated in a register that is included in the accompanying Addendum Report. Each comment has been responded to, and where they were deemed to be material to the decision making or enhanced the ESIA, amendments were made to this ESIA report, with cross references in the collated register. Where substantial changes were made due to feedback, amended or new sections have been highlighted in the Addendum Report.

This ESIA report has been revised and the second revision has been issued to the MET and relevant competent stakeholders and I&APs to accompany the application for an Environmental Clearance Certificate.

9.10 FUTURE STAKEHOLDER ENGAGEMENT

To ensure the proposed project avoids and minimises environmental and social impacts during the construction and operations phase, continual engagement with the community and stakeholders will occur. This will be undertaken through the following forms:

- Advertising and community notices;
- Door to door knocking;
- Letter dropping and newsletters;
- Quarterly forums; and
- The Environmental and Social Manager managing a complaint's register, who will receive, respond to and action any complaints.

10 CONCLUSION

10.1 Introduction

This ESIA report presents the findings of an ESIA undertaken for the Walvis Bay Waterfront development proposed by the proponent 'Walvis Bay Waterfront Properties Pty Ltd'. The ESIA and this report have been undertaken in accordance with the requirements of the Environmental Management Act, 2007 (Act No. 7 of 2007) and the Environmental Impact Assessment Regulation, 2007 (No. 30 of 2011) gazetted under the Environmental Management Act, (EMA), 2007 (Act No. 7 of 2007).

Through the ESIA, a range of potential environmental and social impacts have been identified that may arise as a result of the construction, operation and decommissioning of a waterfront development, located on the Lagoon coastline in Walvis Bay. A range of mitigation and monitoring measures and arrangements have been identified to ensure the impacts are avoided or minimised as low as reasonably practicable.

Consultation has been undertaken throughout the design development of the proposed project and the ESIA process to ensure meaningful public and stakeholder participation has occurred in line with the EMA (2007) and associated regulations. Through means such as door to door knocking, postal letters, adverts, posters, public meeting, other face to face meetings, stakeholder meetings and continuous social media updates, the proposed project undertook stakeholder engagement that went over and above the requirements of the EMA (2007).

Through the stakeholder engagement process in 2017, I&APs provided feedback raising their questions, issues or concerns about the project. This feedback influenced the ESIA process and subsequently enhanced the ESIA report. Revision 1 of this ESIA report and associated appendices were formally issued to I&APs on January 15th 2018 for 21 days. All comments received from I&APs were collated in a register, and where comments were deemed to be material to the decision-making or enhanced the ESIA, amendments were made to this ESIA report and associated appendices.

10.2 Assessment Findings

A summary of the findings is presented below and Table 44 provides a summary of the environmental and social issues that result in a moderate or major adverse impact, which are considered important factors in the decision making.

The Raft restaurant will likely be affected the most during the construction works due to the indirect impacts that will affect patrons visiting the restaurant. The construction of the Marina, in particular the breakwater wall will cause noisy and visually intrusive activities next to the restaurant. These impacts will most likely deter patrons from visiting the restaurant, but also affect their visit thereby reducing their stay. Mitigation measures such as a visual screen and technologies have been identified to minimise noise during construction works, however a reduction in revenue could occur during this time. Further engagement with the owners of the Raft Restaurant will continue to identify further mitigation measures or agreements to reduce the level of significance.

During construction, there is potential that tourists and the local community will not use the surrounding local businesses due to disruption and other construction impacts (e.g. noise, increase traffic and thus traffic disruption, and dust). This could result in a loss of revenue to some businesses. This impact however, would be for a short duration during the construction phase, and in the operational phase, local businesses are likely to see an increase in revenue due to an increase in the number of people frequenting the area.

A small section of Esplanade road will be permanently closed; however, this is unlikely to impact users as it is the end section of the road and alternative access routes are available. A new road through the proposed project site, Waterfront Drive, will also be developed. Pedestrian access routes will be integrated into the proposed project, allowing access up to the Protea Hotel, and potentially through to the existing waterfront.

The relocation of the sporting facilities will leave the local community without facilities for a short duration of time. However, these facilities will be replaced on a like for like basis elsewhere in the town, will be brand new and modern; an improvement from the existing facilities. A large open green space will be lost through the development of the proposed project, however open spaces have been integrated into the design of the proposed project, and alternative green spaces are available within 2km of the site.

There will likely be adverse impacts on the local residents as a result of construction activities. An increase in noise levels will occur, dust may arise, and there will be a presence of construction traffic. Even with appropriate mitigation, these impacts are likely to be the most cause of concern for local residents, and therefore appropriate community engagement will be undertaken for the duration of the construction works.

The presence of the proposed project would result in a change to the amenity, sense of place, and seascape and landscape characters of the area. Over time, local residents will become accustomed to the new environment, however some may not. The design of the proposed project has taken into consideration a range of factors to ensure the development integrates into the local environment, minimising environmental and social impacts.

Another concern, as expressed by many I&APs, is the potential impacts on the Lagoon and Ramsar site. Dedicated studies were undertaken, and the overall conclusions are that the proposed project may result in some short-term adverse impacts such as suspended solids, however this will not alter the integrity of the Ramsar site or the Lagoon's ecosystems, including the bird life. An increase in small recreational boats will occur, thereby increasing the potential risk of pollution and waste entering the marine environment and potentially disturb marine wild life; however strict marina rules and controls, and access to the Lagoon will not be allowed.

Marine mammals, in particular dolphins may be affected by the construction works and maintenance dredging through increased suspended solids, noise and vibration and impacts on their food sources. It is likely that they will avoid the areas during these short periods and will return due to the protection the Bay and Lagoon provides, and the available food sources. All construction works in the marine environment will be overseen by suitably qualified personnel to ensure marine mammals are not impacted.

Both the construction and operational phase will create a significant number of jobs (5000), resulting in various beneficial impacts such as increase in local economic activity, reduction in unemployment and increase in skills and training. House prices are expected to increase as a result of the presence of the proposed project and new bulk infrastructure will be provided, thereby improving the local sewerage and freshwater supply systems.

A summary of the environmental and social impacts, after mitigation, associated with the construction and operation of the proposed project is presented in

Table 44 and Table 45. These impacts are considered to be of significance or sensitive issues to the community, both beneficial and adverse.

Continual engagement will be undertaken with the community through the construction and operations of the proposed project. Through feedback and where possible, additional measures may be identified to reduce impacts.

Table 44 – Summary of the key adverse environmental and social issues

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact	Impact Management
Marina Construction - pile driving and dredging activities	– The Raft	Loss of patrons impacting the revenue of the Raft	Adverse Indirect Local Short Term Temporary and Reversible	Medium	Major	Adverse Major	Visual screen, type of technology: dredging and vibratory piling techniques, continual access, scheduling of activities.
Marina Construction – Impact on the structure and integrity	– The Raft	Closing of the restaurant resulting in loss of revenue	Adverse Indirect Local Short Term Temporary and Reversible	Medium	Major	Adverse Major	
Operations – increase in traffic	– Community – Residents	Change to traffic flows - increase in traffic volumes along KR Thomas Street and potentially 4th Road and other minor road, – affecting private access, increase collision risk and driver stress.	Adverse Indirect Local Medium-Term Irreversible	Medium	Moderate	Adverse Moderate	Traffic calming measures. Continual environmental monitoring.
Construction activities on site	– Community – Residents	Increased ambient noise levels – nuisance for local residents and sensitive receptors	Adverse Direct Local Short Term Reversible	Medium	Moderate	Adverse Moderate	Restricted hours, traffic management and calming measures, site boundary fence, scheduling of noisy construction activities, notice to residents prior to noisy activities.
Operations – activities on the proposed project site	– Community – Businesses – Residents	Impacts on sensitive receptors due to increased ambient noise levels - operations	Adverse Indirect Local Permanent Irreversible	Medium	Moderate	Adverse Moderate	Continual environmental monitoring.
Operations – increase in traffic	– Community – Businesses – Residents	Increased ambient noise levels – nuisance for sensitive receptors along transport route	Adverse Indirect Local Permanent Irreversible	Medium	Moderate	Adverse Moderate	Traffic calming measures and road upgrades. Continual environmental monitoring.

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact	Impact Management
Operations – new features	– Community – Businesses – Residents	Changes to the sense of place	Adverse Direct Local Long-Term Temporary	Medium	Major	Adverse Moderate	Design of the development – use of locally sourced natural material, integration of soft and hard landscaping, open green areas, buildings set back from the road.
Construction – general construction activities	– Community – Businesses – Residents	Neighbouring properties visual amenity (residential views) impacted by the construction site	Adverse Direct Local Permanent Irreversible	Medium	Moderate	Adverse Moderate	Site boundary fence, downward lighting.
Operations – new development	– Community – Businesses – Residents	Seascape and landscape altered due to new development.	Adverse Direct Local Long-term Permanent Irreversible	Medium	Moderate	Adverse Moderate	Design of the development – use of locally sourced natural material, integration of soft and hard landscaping, open green areas, buildings set back from the road.
Construction and operation	– RAMSAR Site	Integrity of the RAMSAR Site through reduced water quality of the Lagoon (increase sedimentation) and indirect impact on fish and bird populations.	Direct and indirect International Short-term Temporary Reversible	High	Minor	Adverse Moderate	Most appropriate dredger (sucking system) and piling (vibratory), removal of dredged material from marine environment, undertaking activities on outgoing tide, turbidity monitoring, use of a bund, silt curtain, sequencing and scheduling, soft starts or equipment in marine environment, well maintained and serviced equipment, all dredging over seen by suitable qualified person, continual twice-yearly bird monitoring and water quality monitoring.
Construction– dredging, piling and other noisy marine activities	– Marine Mammals	Noise from dredging activities, marine mammals not frequenting the area, reduction in numbers, impacts to tourists	Adverse Indirect Local Short Term Temporary Reversible	Medium	Moderate	Adverse Moderate	Scheduling of noisy construction activities, type of technology: dredging and vibratory piling techniques. Continual environmental monitoring.

Table 45 – Summary of the key beneficial environmental and social issues

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Operations	– Local tourism industry – Users of the Development – The Raft – Protea Hotel – Businesses around the sites	Increase in revenue through an increase in tourist numbers and local community visiting the waterfront	Beneficial Direct Regional Long Term Irreversible	Medium	Moderate	Beneficial Moderate
Construction works - general	– Community – Job seekers – Local economy	Creation of 500 jobs	Beneficial Direct Regional Short Term Reversible	High	Moderate	Beneficial Major
Operations of the proposed project	– Community – Job seekers – Local economy	Creation of 1700 – 1800 jobs	Beneficial Direct Regional Long Term Reversible	High	Moderate	Beneficial Major
Downstream job creation	– Community – Job seekers Local economy	Creation of 3,500 – 4,000	Beneficial Indirect Local Long Term Reversible	High	Moderate	Beneficial Major
Job creation	Community	Increase skills and training opportunities	Beneficial Indirect Local Long Term Reversible	High	Moderate	Beneficial Major
Operations	The Raft	Improved access and integration within the marina, increase tourists and patrons leading to an increase in revenue	Beneficial Indirect Local Long Term Irreversible	Medium	Major	Beneficial Major
Operations	Private property owner	Increase in property value	Beneficial Indirect Local Permanent Irreversible	Medium	Moderate	Beneficial Moderate
Installation of new bulk services	Service users	New and improved services	Beneficial Direct Local Long Term Irreversible	Medium	Moderate	Beneficial Moderate

10.3 Cumulative Impact Assessment Findings

A CIA was undertaken to identify intra-project and inter-project impacts:

- **Intra-project cumulative impacts:** Cumulative impacts that occur within the proposed project;
- **Inter-project cumulative impacts:** Cumulative impacts that occur as a result of the proposed project in combination with other projects, which is split in to two:
  - Cumulative impacts with existing projects; and
  - Cumulative impacts with future projects.

The CIA considered past, present and realistically defined future projects, which were identified through a desk-based investigation.

10.3.1 Intra-project Cumulative Impact Assessment Conclusions

The findings of the assessment of combined impacts and activities within the proposed project (intra-project cumulative impacts) found that the following receptors are likely to have moderate or major impacts:

- **The Raft Restaurant:** Potential loss of revenue;
- **Local residents and community**: Severance, increased noise and dust, change of residential views and local landscape/seascape character, change to sense of place, and temporary loss of sporting facilities.
- **The Ramsar Site:** Reduced water quality (increased sedimentation), reduced marine flora, changes to bird habitat, reduced food for birds and disturbance to birds (please note that the proposed project is not the responsible development for these potential impacts as discussed in the CIA above); and
- **Marine Mammals:** Potential loss of food source, marine noise levels, other disturbance and human-wild life interaction leading to mammals avoiding the area.

A precautionary assessment approach has been applied; therefore, with the application of best practice and additional mitigation measures, the predicted impacts may be less severe. Key mitigation will be the sequencing and scheduling of construction activities; type of dredging and piling techniques applied; dredging on the outgoing tide, applying soft starts to machinery and equipment; applying dust suppression techniques; and implementing traffic management and calming measures. In addition, a range of monitoring will be undertaken including but not limited to, water quality and noise monitoring. All mitigation measures and monitoring programme are detailed in the ESMPs in Appendix A.

10.3.2 Inter-project (Existing) Cumulative Impact Assessment Conclusions

Existing projects and activities that continue to affect shared environmental and social receptors with the proposed project are the Salt Works and associated evaporation ponds; fish factories; diversion weir on the Kuiseb river; Phase 1 of Namport's Container Expansion project; and tourism. The shared environmental and social receptors which are continually being influenced by anthropogenic influences and natural processes, and thus resulting in adverse changes, are the Lagoon's water quality and sedimentation rates, marine flora and fauna, the avian community, and the Ramsar site.

Whilst the proposed project could potentially contribute to the continual adverse changes of each of these receptors through various activities, the contribution is considered to be insignificant, and thus it is unlikely that the proposed project will be the responsible development for the incremental impacts.

10.3.3 Inter-project (Future) Cumulative Impact Assessment Conclusions

Through a desk-based review, six future projects were identified that could potentially have an impact on shared environmental or social receptors with the proposed project:

a. Walvis Bay South Port Terminal: Phase 1 of the Namport's Container Expansion project becoming operational;

b. Walvis Bay South Port Terminal: Construction and operation of both phases 2 and 3 of the Namport's Container Expansion project;

c. Namport's Waterfront and Marina;

d. Walvis Bay North Port Terminal;

e. Development of a hotel and casino on erven 4941; and

f. Lovers Hill development.

The following activities were identified that could potentially have an impact on shared environmental or social receptors as the proposed project: Increased population as well as tourists and visitors to the Walvis Bay area; and Increase in activities within the marine environment (tours, recreational boat users, sporting activities and fishing).

Projects c – f were not considered as realistically defined projects in accordance with IFC assessment guidance. A high level qualitative CIA was therefore undertaken which considered these projects in combination with the proposed project. Shared receptors that could potentially be impacted, and thus result in cumulative impacts are the community and the Ramsar site. Local residents surrounding the proposed project site could potentially be impacted by increased traffic volumes, increase in noise levels and a change to the local landscape. The features and attributes of the Ramsar site including the Lagoon environment (a fundamental component), could be impacted from various activities which could alter the water quality and avian life.

The magnitude of change, and nature and severity of impacts caused by the construction and operations of these four projects will determine the level of significance of the cumulative impacts on these receptors. This information is currently unknown; therefore, significance cannot be determined or suitable mitigation.

Phase 1 of the Namport's Container Expansion project is 76% complete and is expected to become operational in 2019. Phases 2 and 3 are unlikely to be constructed before 2025. An EIA was undertaken for the Namport Container Expansion project, and an Environmental Clearance was issued, therefore the Namport project is considered as a realistically defined project. The operations of phase 1, and construction and operations of phases 2 and 3 were assessed in the inter-project CIA.

The inter-project CIA illustrates that the proposed project would likely be responsible for the following incremental impacts:

- Avian community impacted from noise during operations: Minor cumulative impact;
- Local residents surrounding the proposed project site impacted through increased noise levels: Moderate cumulative impact; and
- Local residents surrounding the proposed project site impacted from change to local views and changes to landscape and seascape character: Moderate cumulative impact.

The increase in noise levels to residents surrounding the proposed project site would be felt during normal working hours which would be generated from Namport traffic, traffic to and from the proposed project (users of the development and staff) and a slight increase from operational activities on the proposed project site (day to day operations). These cumulative impacts are localised and various mitigation measures are in place to manage noise levels, such as designated routes to and from the proposed project site. The proponent will continually monitor the changes to the baseline and there will be an Environmental and Sustainability Manager in place to manage concerns and potentially identify further controls where issues arise.

By the time phases 2 and 3 are constructed, the environmental and social baseline will have changed considerably in the area since Namport undertook their EIA study. Background noise levels are likely to increase as a result of the proposed project, and other contributors to the baseline noise may have altered their noise levels. Potential mitigation measures that Namport may implement to reduce noise levels are therefore unknown. Several recommendations associated with the Namport EIA have been made and listed in the following section.

Walvis Bay has a dynamic environment, which is constantly changing. Views, landscape and seascape character and sense of place will continue to change, and people will adapt to these changes. The impacts to local residents are expected to reduce over time, as people will be accustomed to the changes to their surroundings.

In addition to the above, it is concluded that the proposed project does not jeopardise the sustainability or integrity of the Lagoon environment and Ramsar site; the potential impacts arising from the proposed project are insignificant compared to other project and activities. It is acknowledged that the Lagoon environment is changing and could further be affected by other projects, therefore further collaborative work needs to be undertaken to ensure the Lagoon is protected holistically due to its value. A recommendation detailed below has been included.

The conclusions drawn from the CIA demonstrates that the proposed project may contribute to cumulative impacts, and in particular will result in localised cumulative impacts to receptors adjacent to the proposed project site. In a wider context, both temporally and spatially, the proposed project is unlikely to be the responsible development for significant incremental impacts, as the degree of this contribution to those impacts is considered to be marginal compared to other developments and activities in the area. It should be noted, that the wider cumulative impacts (not local) are expected to occur with or without the development of the proposed project.

10.3.4 Recommendations

Whilst undertaking this ESIA, various observations have been made, and as responsible environmental practitioners and proponent, recommendations have been proposed. These recommendations do not in any way have a bearing on or alter the findings of this ESIA; some may confirm findings or are required as part of the monitoring and management arrangements through the construction and operational phase. The main purpose of these are to illustrate there are environmental and social concerns that are bigger than this project and improvements can be made.

1. **Namibian Town and Regional Development Plans and CIA**

During the review of the Walvis Bay IUSDF, it was recognised there was an opportunity to improve the way in which development plans such as the IUSDF, are prepared. This improvement could include the provision for a comprehensive SEA with a supporting CIA for large-scale development plans in future. This will ensure cumulative impacts on potentially sensitive receptors are understood and determined at a strategic level and not reliant on being assessed on a project-by-project basis.

It is therefore recommended that Strategic CIAs be undertaken in future, for all strategic development plans and when revisions of development plans occur to ensure the environment and social cumulative impacts are understood and considered in the National and Regional development framework and plans.

The IFC assessment guidance (International Finance Corporation, 2013), which is part of the World Bank states that it is the Government and regional planners that have the ultimate responsibility of this level of CIA.

It is also recommended that any future developments (planned or unplanned in the IUSDF) in Walvis Bay undertake a robust CIA as part of their EIA (similar to that applied and conducted for this CIA in line with IFC standards).

2. CIA for the Ramsar site

The draft Wetland Policy for Namibia (Ministry of Environment and Tourism , 2004) sets out the threats to Namibia's wetlands, presents goals and objectives, and details the need for partnerships and co-operation for the management and protection of Namibia's wetlands. The SEA for the Coastal area of Erongo and Kunene Regions (DHI Water & Environment, 2007) also recognises there is a weak structure for the protection of Namibia's wetlands. One of the recommendation in this report was: *'MET, the Walvis Bay Municipality and the Coastal Environmental Trust of Namibia should as soon as possible establish a long-term environmental monitoring programme including the biodiversity elements for terrestrial, coastal as well as offshore habitats found in the wetland. A baseline for the monitoring programme should produce diversity gradients in relation to tourism, aquaculture and agriculture and the acquired data should feed into the requirement for improved Environmental Impact Assessments.'*

As part of the above commitments it is recommended that a detailed CIA should be undertaken to support the policy and management plans. The purpose of undertaking a CIA would not only meet the policy goals and objectives, it would take the extra step of defining environmental quality objectives and thresholds for various attributes of the Ramsar site. This will be used to inform the parameters of future development and steer development that interacts with the Ramsar site in a sustainable direction.

ECC recommends that this is completed prior to any future development which is likely to cause significant effects on the Lagoon or other features of Ramsar site (please note, this project is not likely to cause any significant effects on the marine environment, and a detailed CIA has been completed for the project in this report). Therefore, this recommendation should not alter the ability for the regulating authority to issue an environmental clearance certificate for the proposed project. This recommendation is made solely on the basis of improving future EIAs that might not be completed with the same level of attention and assessment that has been applied to this ESIA.

3. Namport Container Expansion project EIA

During the ESIA process and in particular during the CIA, it was recognised that various impacts are associated with the Namport project, some impacts were not expected, and some impacts are considered to be more significant that what was predicted. The lack of sediment plume modelling for the construction of phases 2 and 3, as well as the lack of a CIA in the Namport EIA limited the CIA undertaken in this EISA, however it is acknowledged that the Namport EIA was undertaken prior to the EIA Regulations (2012).

The baseline data collected for the Namport EIA was undertaken prior to 2012. By the time phases 2 and 3 commence construction (not before 2025 when phase 1 reaches capacity), the baseline data will be more than 13 years old. During this period the baseline could have changed considerably, including the development of the proposed project. In addition, Namport's operations and activities that are undertaken within the marine environment and on-land have altered considerably over the years.

One of the recommendations in the Namport EIA was to undertake monitoring of the suspended sediment concentrations during dredging and reclamation. This data has not been made available for the ESIA undertaken for the proposed project, however it is assumed it will be made available in the future and therefore it should be used for future assessments for other projects, in particular phases 2 and 3 of the Namport Container Expansion project.

Based on the above points, it is therefore recommended that prior to the second and third phases of the Namport project progressing, additional work to strengthen their existing EIA should be undertaken. This should include a robust and detailed CIA. Furthermore, construction of phases 2 and 3 should be dependent on ability to demonstrate compliance with conditions set for Phase 1. This recommendation is made on the basis that the consultant, the proponent and many of the I&AP for this project expressed concern for the lagoon as a result of the Namport construction project. It is apparent that further work is required to address these concerns.

4. Environmental monitoring

In relation to the above recommendations, **it is recommended that collaborative environmental monitoring between the Municipality, Namport, the proposed project proponent and other key stakeholders and developers should be undertaken.**

10.4 Final Remarks

Taking into consideration the potential adverse impacts, mitigation measures and the potential beneficial impacts, ECC believes the benefits of the proposed project outweigh any potential negatives, and the proposed project will contribute to the sustainable development of Walvis Bay, in line with the Walvis Bay IUSDF and relevant National development plans.

The implementation of the ESMPs and associated programme of environmental protection as an outcome of the impact assessment process would serve to minimise the impacts and risks associated with the proposed project to an environmental and socially acceptable standard. **An Environmental Clearance Certificate could be issued, on condition that the management and mitigation measures in the ESMP are adhered to.**

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APPENDIX A: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLANS

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STRYDOM & ASSOCIATES
LAND SURVEYORS

Haus Hartmann
22 Robert Mugabe Avenue
C/O of Burg & Ballot Streets
P.O. Box 40716
Ausspannplatz
Namibia
Tel: (061) 400418 & 256 033
Fax: (061) - 269 178
Cell: 081-127 1320
sasurv@iafrica.com.na
herman@sasurv.com

BATHYMETRIC SURVEY REPORT

Purpose of Survey

A Bathymetric survey, performed between 23rd and 25th May 2017, of the Walvis Bay Lagoon, encompassing "The Raft" restaurant and extending to the land boundary edge of The Esplanade, in order to obtain a bathymetric seabed profile and ranging depth elevations in support of the proposed waterfront development.

Survey

The survey was based on a real-time GPS calibration using a number of benchmarks in the area. Navigation around the survey area was accomplished by the skipper using a handheld GPS navigator while the actual survey was done with Leica 1230 GPS Differential Global Positioning Systems (DGPS).

Survey Vessel

The vessel utilized in this survey was a rubber Dinghy, provided by B4 Diving. This vessel was further outfitted with our protruding board/wooden clamp (to reduce vibration) to which the transducer and GPS antennae were attached. Cruising speed of the vessel was limited to an average ±8km/h or ±4m/2sec.

Sounding Device

The sounding device utilized was a Hi-Target Echo sounder HD 370. Soundings were recorded at a 2 second interval by integrating the Leica 1230 with the HD 370 to receive the NMEA output from the HD 370. Driven by the Leica 1230, positions were stored every 2 seconds as XYZ coordinates translating into a 5m grid with the sounding data attached as an annotation string. A data set of ±13 600 points were recorded over the survey area.

Quality Control

With the echo sounder / GPS recording continuously at a 2 second interval, a number of subsequent soundings were taken in close proximity to previous soundings, thus comparing soundings from different days or a few hours apart for roughly the same locality, there was a difference within the range of ±5cm.

Bathymetric Results and Deliverables

The survey drawing, raw XYZ survey data, drawing file (.dwg or .dxf), the DTM (Digital Terrain Model), as well as this report, are attached to the email bearing the project subject.

Depth elevations were processed in connection to the Walvis Bay Benchmarks and thus reduced to Mean Sea Level. The heights obtained during the survey ranged from the highest elevation reading, -0.245m, to the lowest elevation reading, -6.088m.

The results show distinct depressions along the East of the survey area that runs parallel to the shoreline of The Esplanade, averaging -4.50m in depth and south-west of the survey area, close to the sand bank, averaging -3.50m in depth. These depressions indicate the gullies that exist in the area. There are also a number of small depressions in the area, most likely caused by eddies. The bathymetric profile of the area does not indicate any sudden dips in depth that could indicate sudden ridges; however it gives the indication of a relatively even profile ranging between -1.00m and -2.00m below Mean Sea Level (MSL) closer to the shoreline.

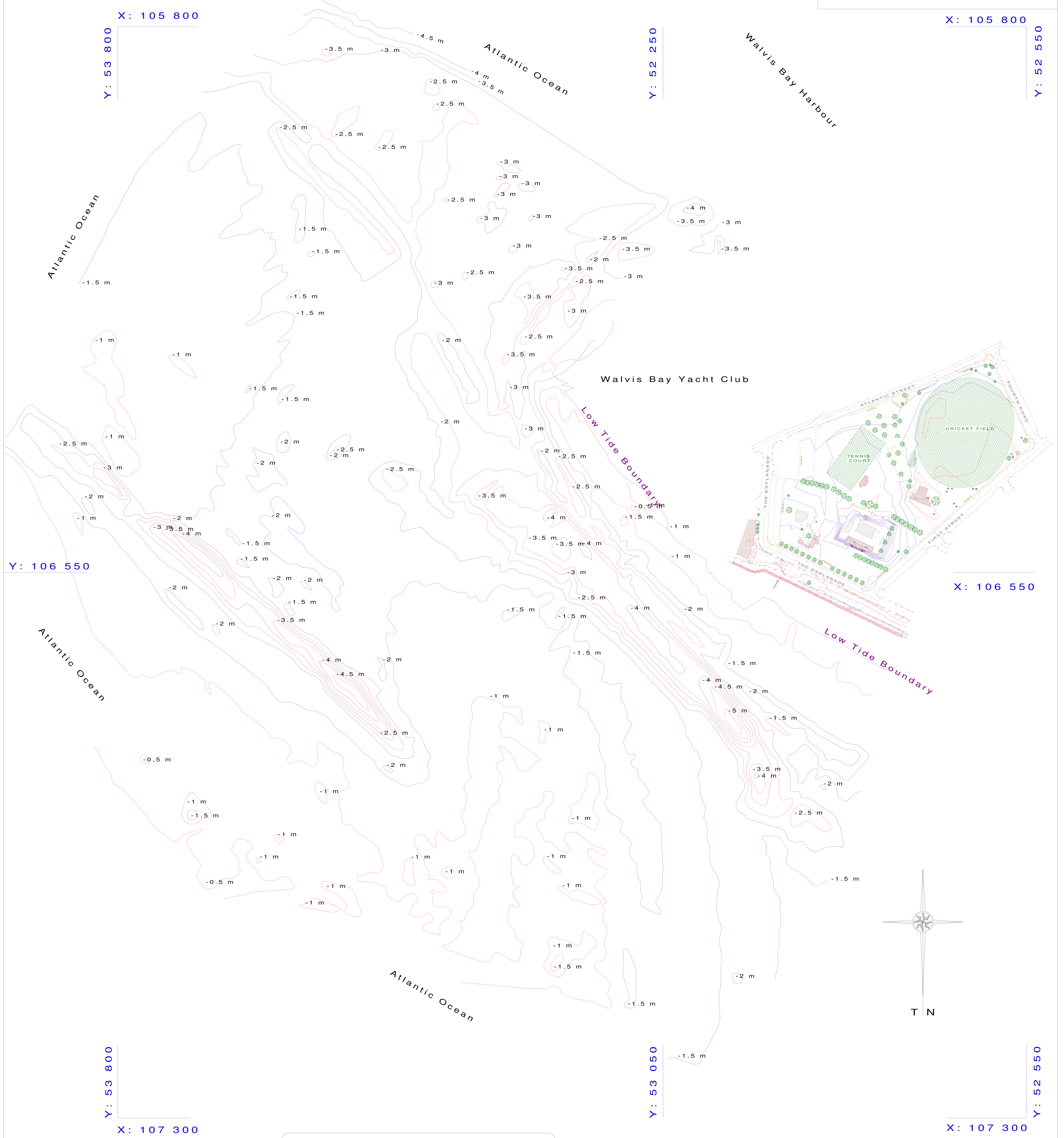
H.L. Strydom **May 2017**

Land Surveyor Date

STRYDOM & ASSOCIATES

Land Surveyors
P.O. Box 40716
Ausspannplatz
Windhoek
Tel.: (061) 260 380 / 256 033
Fax.: (061) 269 178
E-mail: herman@sasurv.com
Cel.: 081 127 1320 / 081 129 0913

Client: B-4 Eng & Diving (OPS)
PO Box 11757
Namibia
Swakopmund
Fax: +264 64 886 15501
Cell: +264 81 129 2015
email:bres@b4diving.com



LEGEND

- Low Tide Boundary
- Lamp Post
- Manhole
- Cadastral Boundary
- Contours and Contour Lines

PROJECT:	
Bathymetric Survey of Walvis Bay Lagoon	
Surveyed	K.C. Onwudinjo
Drawn	K.C. Onwudinjo
Date	May/2017
Scale	1 : 2000
Drawing No.	WALLAG.dxf

Transport Impact Assessment

Walvis Bay Waterfront Development

Walvis Bay, Namibia

March 2018- Final

5th Floor

Imperial Terraces

Carl Cronje Drive

Tyger Waterfront

Bellville, 7530

(021) 914 6211 (T)

e-mail: mail@itsglobal.co.za

SUMMARY SHEET

Report Type	Transport Impact Assessment
Title	Walvis Bay Waterfront Development
Location	Walvis Bay, Namibia
Client	Walvis Bay Waterfront Properties (Pty) Ltd
Reference Number	ITS 3791
Project Team	Hugo Engelbrecht Theodore Neels
Contact Details	Tel: 021 914 6211 or mail@itsglobal.co.za
Date	March 2018
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1 Background and Purpose

This report summarises an investigation of the expected transport impacts from the Walvis Bay Waterfront development planned on Erf 4941 and Remainder of Erf 4939. The purpose of the study is to identify constraints within the surrounding road network and to recommend appropriate mitigation measures.

2 Study Area Description

This proposed development will be fronting onto the Meersig Lagoon within Walvis Bay, with Esplanade Street to the west, Atlantic Street to the north, KR Thomas Street to the south and 4th Road to the east. This development is planned in three phases and it will include retail, office, hotel and residential land uses.

As part of this development, a new water canal is planned from the Meersig Lagoon into the site, which will be used by boats. This will necessitate the closure of a section of Esplanade Street, between KR Thomas Street and the Protea Hotel. However, a new road will be constructed (referred to a Waterfront Drive) between KR Thomas Street and Atlantic Street. See **Figure 1** for a Locality Plan.

3 Existing / Proposed Land Uses

The site is currently utilised as a recreational and sports area with facilities for cricket, swimming and tennis. The proposed development will be a mixed-use development including the following total land uses. See **Figure 2** for the Site Development Plan.

TOTAL	**Land Use**	**Extend**
	Retail	10 000m^2
	Offices	7 400m^2
	Conference Facility	1 000 seats
	Restaurants	3 750m^2
	Residential Apartments	402 units
	Hotel	260 units

The development will be constructed in three phases, with the full retail, offices, conference facility and restaurant component as listed above, included into Phases 1A. Phase 1B and 2 will include only residential and hotel related land uses as summarised below:

Phase 1B	Residential Apartments	120 units
	Hotel	140 units
Phase 2	Residential Apartments	282 units
	Hotel	120 units

Additional retail and office extent scenarios were investigated in this transport study, as summarised below:

Land Use	**Phase 1A** Extent	Scenario 8 **Total** Extent	Scenario 9 **Total** Extent
Retail	10 000m^2	*25 000m^2*	*35 000m^2*
Offices	7 400m^2	*15 000m^2*	*20 000m^2*

These retail and offices extents were evaluated to determine the sensitivity of the surrounding road network to accommodate additional development bulk.

4 Existing Access

There are two existing accesses to this site. The one is from Esplanade Drive, which gives access to a swimming pool area. The other is from Atlantic Street, which gives access to the tennis courts and cricket field. Neither of these existing accesses will form part of the proposed future Walvis Bay Waterfront development. Refer to **Section 15** of this report, for a discussion on future development accesses.

5 Surrounding Roads

See **Figure 1** for the location of these roads, relative to the development. The major roads in the site vicinity include the following:

Atlantic Street: A Class 5 industrial road with one lane per direction.

Esplanade Drive**:** A Class 5 residential street with one lane per direction.

KR Thomas Street: A Class 5 residential street with one lane per direction.

5th Road: A Class 4 Road, which is wide enough for two lanes per direction. There are on-street parking along one side of the road and sidewalks along both sides of the road.

Sam Nujoma Avenue: A Class 4 road with one lane per direction and sidewalks along both sides of the road.

Nangolo Mbumba: A Class 3 road with two-lanes per direction and sidewalks along both sides of the road.

6 Analysis Hours

The Walvis Bay Waterfront development will include retail, offices, conference facilities, restaurants, hotels and apartments. Residential related land uses typically generate more trips during weekday AM and weekday PM peak periods, whereas retail related land uses mostly generate vehicle trips during Friday PM and Saturday midday peak periods. For this reason, the following peak periods were surveyed and included in this evaluation:

- Weekday AM peak hour (Surveyed peak hour 06:30 – 07:30)
- Weekday PM peak hour (Surveyed peak hour 17:00 – 18:00)
- Saturday midday peak hour (Surveyed peak hour 11:00 – 12:00)

7 Scenarios Analysed

The following scenarios were included in the analyses of this development evaluation:

- **Scenario 1:** 2017 Existing Traffic - Based on existing counted traffic volumes
- **Scenario 2**: 2022 Background Traffic Conditions - Existing counted traffic volumes adjusted with a growth rate of 4.7% over five years
- **Scenario 3**: 2022 Total Traffic Conditions – Phase 1A Commercial Component (2022 Background Traffic plus the Phase 1A development trips
- **Scenario 4**: 2022 Total Traffic Conditions – Phase 1B plus 2 Residential Component (2022 Background Traffic plus the Phase 1B plus Phase 2 development trips)
- **Scenario 5**: 2022 Total Traffic Conditions – Full Phase 1A+B and 2 development (2022 Background Traffic plus Phase 1A+B and 2 of the Walvis Bay Waterfront trips)
- **Scenario 6**: 2022 Total Traffic Conditions – Phase 1A+B and 2 (Scenario 5) Traffic with the Esplanade Link between Atlantic Street and KR Thomas Street removed
- **Scenario 7**: 2022 Total Traffic Conditions – Phase 1A+B and 2 (Scenario 6) Traffic with the additional Namport Extension development trips
- **Scenario 8**: 2022 Total Traffic Conditions – Full Development (Scenario 5) Traffic with total 25 000m^2 of retail and 15 000m^2 of offices
- **Scenario 9**: 2022 Total Traffic Conditions – Full Development (Scenario 5) Traffic with total 35 000m^2 of retail and 20 000m^2 of offices
- **Scenario 10**: 2022 Total Traffic Conditions – Full Development (Scenario 9) Traffic with the Namport Extension development trips

8 Study Intersections

The following intersections were included in the analyses of this development evaluation:

- **Int. 1**: Esplanade Drive / Atlantic Street……………………………………Priority Stop Control
- **Int. 2**: Esplanade Drive / Protea Hotel………………………………………Priority Stop Control
- **Int. 3**: Esplanade Drive / KR Thomas Street……………………………….Priority Stop Control
- **Int. 4**: Atlantic Street / Future Waterfront Drive………………………….Future Intersection
- **Int. 5**: Future Waterfront Drive / KR Thomas Street…………………….Future Intersection
- **Int. 6**: KR Thomas Street / 5th Street……………………………………Priority Stop Controlled
- **Int. 7**: 5th Street / Sam Nujoma Avenue…………………………………Priority Stop Controlled
- **Int. 8**: Nangolo Mbumba Drive / 5th Street…………………………………………….Traffic Signal
- **Int. 9**: Nangolo Mbumba Drive / Esplanade Drive…………………Priority Stop Controlled

See **Figure 3** for the location, geometry and control of the above listed study intersections.

9 Namport Construction Traffic

The traffic counts for this investigation were done in November 2016, when the construction works of the Namport new container terminal was under way. Based on these surveys, up to 300 trucks were surveyed along 5th Road at the Namport access, between 06:00 and 18:00 during a normal weekday. It should be noted that roughly a similar number of truck trips were surveyed, delivering salt to the Namport harbour for export, per day.

Based on these surveys, between 10 and 25 construction trucks were surveyed per hour. Hence, it is expected that a similar number of truck trips could be subtracted along 5th Road, when the construction of the Namport new container terminal is complete.

10 2017 Existing Traffic Conditions (Scenario 1)

Peak period traffic counts of the study intersections were done on Wednesday, 9 November 2016, Thursday 10 November 2016 and Saturday 12 November 2016. The peak hour traffic volumes are illustrated on **Figure 4**. The total two-way link volumes along these study roads are summarised in **Table 1** below:

***Table 1**: Existing Link Volumes along study roads*

Road Name	AM Peak Hour	PM Peak Hour	Saturday
Nangolo Mbumba	960 vehicles	1 055 vehicles	690 vehicles
Sam Nujoma	285 vehicles	550 vehicles	325 vehicles
5th Road (at KR Thomas)	130 vehicles	220 vehicles	95 vehicles
Atlantic Street	115 vehicles	165 vehicles	95 vehicles
The Esplanade Drive	80 vehicles	100 vehicles	65 vehicles

Based on the summary above, Nangolo Mbumba Drive experiences the highest traffic volumes during the peak hours. Sam Nujoma Drive also experiences relatively high traffic volumes during the weekday PM peak hour, whilst all other study roads experience relatively low traffic volumes during the different peak hours.

The Existing Traffic operations are based on existing intersection geometries, controls and traffic volumes as illustrated in **Figure 3**. These analyses were confirmed with on-site observations. The capacity analyses results are illustrated in **Figure 4A-C**. Based on the Existing Traffic capacity analyses results, the following can be concluded:

All study intersections currently operate at acceptable Levels-Of-Service (LOS) during all the peak periods. The current transport network can accommodate the existing traffic demand. Hence, no upgrades are required for the Existing Traffic conditions, *from an intersection capacity point-of-view.*

11 2022 Background Traffic Conditions (Scenario 2)

The 2022 Background Traffic volumes were calculated by adjusting the existing counted traffic volumes with a 4.7 percent growth rate over a five-year period.

Based on the Walvis Bay Council's Integrated Urban Spatial Development Framework (IUSDF), the expected population growth in Walvis Bay will more than double from 2012 to 2030, with an average annual growth rate of 4.7%. This growth rate was used to adjust the existing traffic volumes to determine the future 2022 Background Traffic Volumes.

The Background Traffic analyses were based on existing intersection lane configurations and control. Based on the Background Traffic capacity analyses results, the following can be concluded:

All study intersections will continue to operate at acceptable Level-of-service (LOS) during all peak periods. The current transport network can accommodate the background traffic demand. Hence, no road upgrades are required for the Background Traffic conditions, *from an intersection capacity point-of-view.* See **Figure 5A-5C** for the 2022 Background Traffic conditions.

12 Trip Generation

The trip generation rates used for this development were obtained from the Committee of Transport Officials (COTO, 2013) trip data manual, as follows:

Phase 1A - Land Use (Code)	**a.m. peak**	**p.m. peak**	**Saturday Peak**
Retail (COTO 820)	1.53/100m^2	8.69/100 m^2	11.5/100m^2
Restaurant (COTO150)	0.75/100m^2	11.8/100m^2	11.0/100m^2
Conference Centre (COTO 780)	0.50/Seat	0.50/Seat	0.25/Seat
Offices (COTO 710)	2.10/100m^2	2.10/100m^2	0.45/100m^2

Phase 1B & 2 - Land Use (Code)	**a.m. peak**	**p.m. peak**	**Saturday Peak**
Hotel (COTO 310)	0.50/Room	0.50/Room	0.70/Room
Residential – Apartments (COTO 220)	0.65/Unit	0.65/Room	0.35/Room

The Walvis Bay Waterfront development will generate mainly private vehicle trips. Trips were adjusted for passer-by, internal and public transport trips. According to the Walvis Bay Transport Masterplan, dated November 2015, currently public transport such as busses and taxis could account for around 16% of vehicle trips in Walvis Bay.

The Transport Masterplan also indicate two upgrades to the public Transport system i.e. introduction of direct busses and better public transport stop/station facilities. These upgrades are expected to increase the public transport modal share.

See **Table 2, 4 & 6** for the expected trip generation rates for the respective phases of the proposed Walvis Bay Waterfront development.

13 Development Trips

Based on the above-mentioned trip generation rates, the Full Phase 1A+B and 2 Walvis Bay Waterfront development is expected to generate the following new peak hour vehicle trips:

Peak Hour	In	Out	Total
Weekday AM	573	263	837
Weekday PM	659	1 000	1 659
Saturday midday	766	710	1 476

See **Table 3, 5 & 7** for the expected development trips of each respective phase of the proposed development.

13.1 Development Trips - Scenario 8

The development is expected to generate the following total peak hour vehicle trips for Scenario 8, with the total 25 000m^2 retail and 15 000m^2 offices land uses, as well as the other land uses associated with Phase 1A+B and 2:

Peak Hour	In	Out	Total
Weekday AM	700	302	1 002
Weekday PM	890	1 292	2 182
Saturday midday	1057	999	2 055

13.2 Development Trips - Scenario 9

The development is expected to generate the following total peak hour vehicle trips for Scenario 9, with the total 35 000m^2 retail and 20 000m^2 offices land uses, as well as the other land uses associated with Phase 1A+B and 2:

Peak Hour	In	Out	Total
Weekday AM	780	326	1 107
Weekday PM	1 029	1 472	2 501
Saturday midday	1 231	1 171	2 402

14 Trip Distribution

The following macro-level trip distribution was used for development:

- 30% of trips to/from the east along Nangolo Mbumba Drive
- 5% of trips to/from the adjacent residential area
- 25% of trips to/from the east along Sam Nujoma Avenue
- 30% of trips to/from the south along 5th Road
- 10% of trips to/from the west along Nangolo Mbumba Drive

Refer to **Figures 6, 7** and **8** for the expected development trips and the distribution thereof.

15 Development Accesses

Several new accesses are planned as part of the Walvis Bay Waterfront development (Refer to **Figure 9**). The accesses to **Phase 1A** (commercial component) are summarised below:

- *Access E* – from Waterfront Drive, located 140 meters north of KR Thomas Street and 65 meters south of Atlantic Street. This will be an access to a parking area.
- *Access I* – from Waterfront Dive, located 155 meters north of KR Thomas Street and 50 meters south of Atlantic Street. This will be an access to a service yard.
- *Access J* – from Waterfront Drive, 180 meters north of KR Thomas Street and 25 meters south of Atlantic Street. This will be an access to a parking area.
- *Access K* – from Atlantic Street, 50 meters west of the future Waterfront Drive and 120 meters east of Esplanade Drive. This will be an access to a parking area.
- *Access L* – along Atlantic Street, 90 meters west of Waterfront Drive and 80 meters east of Esplanade Drive. This will be an access to a retail delivery yard.
- *Access M* – from Esplanade Street, 60 meters south of Atlantic Street. This will be the main delivery yard to the retail component of the development.

Accesses to **Phase 1B** (residential/hotel component) are summarised below:

- *Access A* – from KR Thomas Street, 35 meters northeast of Esplanade Drive and 75 meters south-west of 2nd Road / Waterfront Drive. This will be the access to the hotel.
- *Access B* – from Waterfront Drive, 60 meters north of KR Thomas Street and 145 meters south of Atlantic Street. This will be the access residential units.

Accesses to **Phase 2** (residential/hotel component) are summarised below:

- *Access C* – from KR Thomas Street at the 3rd Road intersection. This is will be an access to the apartments and indoor swimming pool area.
- *Access D* – from Waterfront Drive, 80 meters north of KR Thomas Street and 125 meters south of Atlantic Street. This will be an alternative access to the apartments, visitor parking and indoor swimming pool area.
- *Access F* – from Waterfront Drive, 180 meters north of KR Thomas Street and 25 meters south of Atlantic Street, directly opposite access J. This will be the main access to the hotel.
- *Access G* – from Atlantic Street, 50 meters east of Waterfront Drive and 110 meters west of 4th Road. This will be a service yard access to the hotel.
- *Access H* – from Atlantic Street, 90 meters east of Waterfront Drive and 70 meters west of 4th Road. This will be an entrance to the apartments parking area.

Since all accesses are proposed from lower order roads, it should be acceptable.

16 2022 Total Traffic Conditions (Scenario 3) – with Phase 1A

The 2022 Total Traffic volumes were calculated by adding the expected Phase 1A (commercial component) development trips to the 2022 Background Traffic volumes. The existing intersection geometries were used for this Total Traffic Conditions analyses.

Based on these analyses results, it can be concluded that most study intersections will continue to operate at an acceptable Level-Of-Service (LOS). However, the Sam Nujoma Avenue / 5th Road intersection will experience unacceptable LOS F operations during all peak periods.

The recommended upgrade at the Sam Nujoma Avenue / 5th Road intersection, are discussed in **Section 18** of the report. Refer to **Figure 10A-C** for the expected 2022 Total Traffic Conditions (for Scenario 3).

17 2022 Total Traffic Conditions (Scenario 4) – with Phase 1B and 2

The 2022 Total Traffic (Scenario 4) volumes were calculated by adding the expected hotel and apartment land use development trips (for Phase 1B plus Phase 2) to the 2022 Background traffic (Scenario 2) volumes. The expected development trips generated by the proposed residential / hotel component of the development will be significantly less than the trips that could be generated by the commercial component. The existing intersection geometries and controls were used for the 2022 Total Traffic (Scenario 4) analyses.

Based on these capacity analyses results, all study intersections will continue to operate acceptably during the 2022 Total Traffic (Scenario 4) conditions. Refer to **Figure 11** for the results of the 2022 Total Traffic (Scenario 4) scenario.

18 2022 Total Traffic Conditions (Scenario 5) – with Phase 1A+B and 2

The 2022 Total Traffic (Scenario 5) volumes were calculated by adding the expected full development (Phase 1A, 1B and 2) trips to the 2022 Background Traffic volumes. Based on these analyses, most study intersection will continue to operate acceptably, however the following intersections will experience capacity constraints:

KR Thomas Street / Waterfront Drive (Int. 5): The geometry used in the analyses was one lane per direction on all approaches with stop control on the Waterfront Drive and 2nd Road approaches of the intersection. Based on the analysis it is expected that this intersection will operate at unacceptable LOS E, delays greater than 36 seconds and with only 11 percent spare capacity during the p.m. peak hour.

Proposed Mitigation: The following upgrades are recommended at this intersection:

- *The Waterfront Drive approach should consist of a dedicated right-turn lane (15 meters min.) and a shared through and left-turn lane.*

- *The KR Thomas Street (Eastbound approach) should consist of a dedicated left-turn lane (15 meters min.), and a shared through and right-turn lane.*
- *The KR Thomas Street (Westbound approach) should consist of a dedicated right-turn lane (15 meters min.) and a shared through and left-turn lane.*

5th Road / KR Thomas Street (Int. 6): This intersection will operate at unacceptable LOS F during the p.m. peak hour. Long delays and queues will be experienced along the KR Thomas approach of the intersection.

Proposed Mitigation: It is recommended to change the intersection control to a signal, when warranted. This will improve operations at this intersection to acceptable LOS B during the peak periods. It is also recommended that the road markings along 5th Road be upgraded to two-lanes per direction, since sufficient road space is available to accommodate these road markings within the existing road surface space.

Sam Nujoma Avenue / 5th Road (Int. 7): This intersection will operate at unacceptable LOS F with long delays of more than 50 seconds expected on the Sam Nujoma Avenue approaches of this intersection, during all peak hours.

Proposed Mitigation: It is recommended to change the control of the intersection to a two-phased traffic signal, when warranted. This will improve operations at this intersection to acceptable LOS A / B during the peak periods. It is also recommended that the road markings along 5th Road be upgraded to two-lanes per direction, since sufficient road space is available to accommodate these road markings within the existing road surface space.

Refer to **Figure 12** for the 2022 Total Traffic conditions (Scenario 5) as well as **Figure 13** for the operations after the implementation of the upgrades as discussed above. The cross section of 5th Road is shown schematically on **Figure 17**.

19 2022 Total Traffic Conditions (Scenario 6) – with Esplanade Closure

As part of the Waterfront development, a new water canal is planned from the Meersig Lagoon into the site, which will be used by boats. This will necessitate the closure of a section of Esplanade Street, between KR Thomas Street and the Protea Hotel. However, a new road will be constructed (referred to a Waterfront Drive) between KR Thomas Street and Atlantic Street to accommodate the expected redistributed trips.

The 2022 Total Traffic Scenario 6 volumes are based on Scenario 5 traffic volumes; however the traffic volumes were adjusted/redistributed to simulate the expected Esplanade Street closure. Refer to **Figure 2** for the Site Development Plan.

Only the intersections in relative close proximity of this planned road closure were evaluated, since the impact on the intersection further away should remain relatively similar as evaluated in Scenario 5. Based on these analyses, it can be concluded that the intersections surrounding the development will continue to operate at acceptable LOS, with the road upgrades as proposed in Scenario 5. Hence, no additional upgrades are proposed for this Scenario. Refer to **Figure 14A-C** for the operations and results as well as **Figure 14D** for the geometries that were used in this evaluation.

20 2022 Total Traffic Conditions (Scenario 7) – with Namport Expansion

A high-level vehicle trip generation was calculated for the planned Namport Waterfront development, based on information provided on **Figure 15**.

The 2022 Total Traffic (Scenario 7) volumes were calculated by adding this expected Namport Waterfront development trips to the 2022 Total Traffic (Scenario 5) trips. The geometries discussed under the 2022 Total Traffic Conditions Scenario 5 upgrades, were used in this scenario. Based on these capacity analyses results the following can be concluded. Refer to **Figures 16A to 16C** for the operation results.

Most study intersections will continue to operate at acceptable LOS, however the following intersections will experience capacity constraints:

Nangolo Mbumba Drive/ 5th Road (Int. 8): will operate at unacceptable LOS E during the p.m. peak hour and at capacity during the p.m. and Saturday peak hours.

Proposed Mitigation: It is recommended that the traffic signal at this intersection be upgraded from a two-phase to a four-phase signal, with protected right-turn movements on all approaches as well as overlapping left-turn movements.

Esplanade Drive / Nangolo Mbumba Drive (Int. 9): This intersection will operate at unacceptable LOS F, due to long delays expected on the southbound approach.

Proposed Mitigation: it is recommended that a median island be constructed along Nangolo Mbumba Drive and that the Esplanade Street approach be remarked to accommodate separate left-and right-turn lanes. The median island should be minimum 6-meters wide to enable the side road traffic to cross Nangolo Mbumba Drive in two stages.

Refer to **Figure 16D** for a schematic layout of the proposed upgrades and the resultant improved operations.

21 2022 Total Traffic (Scenario 8) - 25 000m^2 Retail and 15 000m^2 Offices

The 2022 Total Traffic (Scenario 8) volumes were calculated based on the 2022 Total Traffic (Scenario 5) volumes, with an adjustment for the additional retail (total 25 000m^2 GLA) and office (total 15 000m^2 GLA) land uses. Refer to **Figures 18A** to **18C** for the 2022 Total Traffic (Scenario 8) traffic operations.

Based on these capacity analyses results, the following upgrades are recommended, over and above the road upgrades proposed in Scenarios 5 to 7:

Atlantic Street / Future Waterfront Drive (Int. 4): will operate at unacceptable LOS F, long delays, and at capacity during the p.m. peak hour

Proposed Mitigation: The following upgrades would be required to mitigate the expected p.m. peak hour traffic:

- Install a traffic signal when warranted
- Construct separate left- and right turn lanes on the northbound approach. The left-turn lane should have a minimum storage lane length of 15m.
- Construct a dedicated westbound left-turn lane with a min. storage length of 45m.
- Construct a dedicated eastbound right-turn lane with a min. storage length of 15m.

Nangolo Mbumba Drive / 5th Road (Int. 8): will operate over capacity.

Proposed Mitigation: Construct a southbound dedicated left-turn lane with a minimum storage length of 36m. Based on initial investigations, it might be possible to provide this southbound left-turn lane within the existing road reserve space. However, truck movements will be restricted. The heavy vehicle demand through this intersection is notable and this upgrade should take cognisance of heavy vehicle movements. Hence, additional road reserve space will most likely be required to accommodate this proposed road upgrade, as part of these additional retail and office land uses.

It is recommended that Atlantic Street be dualled between Waterfront Drive and 5th Road and that 5th Road be dualled from Atlantic Street to Sam Nujoma Avenue. Traffic should also be discouraged from using KR Thomas Street, by means of possible traffic calming measures. These measures should encourage the Waterfront Development traffic to rather use 5th Road and Atlantic road instead of KR Thomas Street.

The intersection upgrades proposed for Scenarios 5, 6 and 7 would be sufficient to accommodate the 2022 Total Traffic (Scenario 8) trips at all other study intersections.

Refer to **Figure 18** and **Figure 19** for the 2022 Total Traffic Conditions (Scenario 8) and 2022 Total Traffic Conditions (Scenario 8) with upgrades.

22 2022 Total Traffic (Scenario 9) - 35 000m^2 Retail and 20 000m^2 Offices

The 2022 Total Traffic (Scenario 9) volumes were calculated based on the 2022 Total Traffic (Scenario 5) volumes, with an adjustment for the additional retail (total 35 000m^2 GLA) and office (total 20 000m^2 GLA) land uses.

Based on these capacity analyses results, no additional upgrades would be required over and above the upgrades discussed in Scenarios 5 to 8 of this report. Refer to **Figure 20** for the 2022 Total Traffic Conditions (Scenario 9) operations.

23 2022 Total Traffic (Scenario 10) with Namport Expansion

The 2022 Total Traffic (Scenario 10) volumes were calculated by adding the Namport development trips to the 2022 Total Traffic (Scenario 9) volumes. The geometries and controls used are in this scenario is based on the upgrades recommended in Scenario 5 to 8 of this report.

Based on these capacity analysis results, most study intersections will continue to operate acceptable. However the following intersection will require further improvements:

Sam Nujoma Avenue / 5th Road intersection: will operate over capacity.

Proposed Mitigation: The following upgrades are recommended:

- Construct a southbound dedicated left-turn lane with a min. storage length of 65m.
- Change the westbound approach to a dedicated right-turn lane and a shared through and left-turn lane. The right-turn lane should have a storage lane length of 120m.

The proposed road upgrade on the westbound approach could be accommodated within the existing road reserve space. However, insufficient road reserve space is currently available to accommodate the recommended southbound left-turn lane. Hence, additional road reserve space will be required to accommodate this proposed road upgrade, as part of these additional retail and office land uses.

Refer to **Figure 21** for the analysis results of 2022 Total Traffic Conditions (Scenario 10).

24 Public Transport

Based on the Site Development the following public transport facilities will be provided:

- Bus drop-off zone in Esplanade Street at the Phase 1B Hotel. The bus drop-off zone will accommodate bus-turning movements.
- Bus parking bays would be provided on both sides of Esplanade Street opposite the Protea Hotel and next to the proposed retail development.
- A dedicated taxi parking area (with 17 taxis bays) would be provided in front of the Protea Hotel in Esplanade Street.

Refer to **Figure 22** for the locations of these public transport facilities.

25 Pedestrians

The following pedestrian facilities will be provided as part of this development:

- Sidewalks along all site frontages.
- 3x Pedestrian bridges linking Phase 1A with Phase 1B.

It is proposed that pedestrian movements be highlighted by means of surfacing and road markings were movements would be in conflict with vehicles. This would highlight the conflict zone to both motorists and pedestrians. Walkways should also be highlighted by means of signage. Refer to **Figure 22** for the locations of these pedestrian facilities.

26 Parking

The recommended parking rates and number of parking bays required for each phase of the development are as follows:

Phase 1A - Commercial Component:

Land Use	**Rate**	**Extent**	**Parking Required**
Retail	6 bays / 100m^2	10 000m^2	600 parking bays
Restaurant	4 bays / 100m^2	3 750m^2	150 parking bays
Office	4 bays / 100m^2	7 400m^2	296 parking bays
Conference Centre	10 bays / 100m^2	1700m^2	170 parking bays
Total parking required (Phase 1A)			**1 216 parking bays**

Phase 1B – Hotel and Apartments:

Land Use	**Rate**	**Extent**	**Parking Required**
Hotel	0.72 bays / bedroom	140 rooms	101 parking bays + 20 bays
Residential	2 bays / unit	120 units	240 parking bays
Total parking required (Phase 1B)			**361 parking bays**

Phase 2 – Hotel and Apartments:

Land Use	**Rate**	**Extend**	**Parking Required**
Hotel	0.72 bays / bedroom	120 rooms	87 parking bays + 20 bays
Residential	2 bays / unit	282 units	564 parking bays
Total parking required (Phase 2)			**671 parking bays**

The number of parking bays that will be provided per phase and/or land use, should be checked during the Site Development Plan approval stage., based on the summary above.

27 Visitor Guidance Signs

It is recommended that road signs be provided to guide visitors to/from the Waterfront development, along 5th Road and Atlantic Street. It is also recommended that road upgrades are focussed along these roads. This should assist to mitigate the impact along the other residential streets, near this development.

28 Conclusions and Recommendations

This report summarises an investigation of the expected transport impacts from the Walvis Bay Waterfront development, planned on Erf 4941 and Remainder of Erf 4939. The development is planned in three phases namely Phase 1A, Phase 1B and Phase 2. Two additional development bulk scenarios were investigated (namely Scenario 8 and 9). The land use and extent of each scenario is summarised as follows:

Land Use	Phase 1A+B plus Phase 2	Scenario 8	Scenario 9
Retail	10 000m^2	25 000m^2	35 000m^2
Offices	7 400m^2	15 000m^2	20 000m^2
Conference Facility	1 000 seats	1 000 seats	1 000 seats
Restaurants	3 750m^2	3 750m^2	3 750m^2
Residential Apartments	402 units	402 units	402 units
Hotel	260 units	260 units	260 units

Based on the findings of this investigation, the following can be concluded:

2017 Existing Traffic (Scenario 1): All intersections currently operate acceptably.

2022 Background Traffic (Scenario 2): All study intersections will continue to operate acceptably. Hence, no upgrades are proposed from an intersection capacity point of view.

Development Trips: The Full (Phase 1A+B plus 2) development is expected to generate 837 weekday AM-, 1 659 weekday PM- and 1 476 Saturday peak hour vehicle trips. Scenario 8 will generate 2 180 weekday PM- and 2 055 Saturday peak hour vehicle trips and Scenario 9 will generate 2 500 weekday PM- and 2 400 Saturday peak hour vehicle trips.

Vehicular Access: Refer to **Section 15** and **Figure 9** for the accesses proposed per phase.

2022 Total Traffic (Scenario 3): The following upgrades are recommended:

- Intersection 7: 5th Road / Sam Nujoma Road
  - Provide a two-phase traffic signal, when warranted.

2022 Total Traffic (Scenario 4): All study intersections will continue to operate acceptably. Hence, no upgrades are proposed from an intersection capacity point of view.

2022 Total Traffic (Scenario 5): The following upgrades are recommended:

- Intersection 5: KR Thomas Street / Waterfront Drive
  - Provide a dedicated eastbound left-turn lane (15 meters min.),
  - Provide a dedicated westbound right-turn lane (15 meters min.)
  - Provide a dedicated southbound right-turn (15 meters min.)

- Intersection 6: 5th Road / KR Thomas Street
  - Provide a two-phase traffic signal, when warranted.
  - Upgrade road markings along 5th Road to two-lanes per direction, within the existing road surface.
- Intersection 7: 5th Road / Sam Nujoma Road
  - Provide a two-phased traffic signal (as recommended in Scenario 3)

2022 Total Traffic (Scenario 6): All study intersections will continue to operate acceptably. Hence, no upgrades are proposed from an intersection capacity point of view.

2022 Total Traffic (Scenario 7): The following upgrades are recommended:

- Intersection 8: 5th Road / Nangolo Mbumba Drive
  - Provide protected right-turn (traffic signal) phases on all movements, plus left-turn overlap phases.
- Intersection 9: Esplanade Drive / Nangolo Mbumba Drive
  - Provide separate left- and right-turn lanes on Esplanade approach.
  - Provide a 6-meter wide median island along Nangolo Mbumba Drive.

2022 Total Traffic (Scenario 8): The following upgrades are recommended:

- Atlantic Street / Future Waterfront Drive (Int. 4):
  - Install a traffic signal, when warranted
  - Construct separate left and right turn lanes on the northbound approach. The left-turn lane should have a minimum storage lane length of 15m.
  - Construct a dedicated westbound left-turn lane (min. storage length of 45m)
  - Construct a dedicated eastbound right-turn lane (min. storage length of 15m)
- Nangolo Mbumba Drive / 5th Road (Int. 8)
  - Provide a southbound dedicated left-turn lane with a minimum storage lane length of 36m. *Additional road reserve space* will most likely be required to accommodate this proposed road upgrade. This must be determined by means of a detailed survey and geometric design of this intersection upgrade.
- Atlantic Street should be dualled between Waterfront Drive and 5th Road. In addition, 5th Road should be dualled from Atlantic Street to Sam Nujoma Avenue. Traffic should also be discouraged from using KR Thomas Street, by means of possible traffic calming measures.

2022 Total Traffic (Scenario 9): No additional upgrades are proposed for this scenario, over and above the upgrades discussed in Scenario 5 to Scenario 8.

2022 Total Traffic (Scenario 10): The following upgrades are recommended:

- Sam Nujoma Avenue / 5th Road (Int. 7)
  - Construct a southbound dedicated left-turn lane. Insufficient road reserve space is available to accommodate this recommended road upgrade. Hence, *additional road reserve space* will be required to accommodate this southbound left-turn lane.

- Change the westbound approach to a dedicated right-turn lane and a shared through and left-turn lane. The right-turn lane should have a minimum storage lane length of 120m.

Public Transport: The following public transport facilities should be provided:

- Bus drop-off zone in Esplanade Street at the Phase 1B Hotel. The bus drop-off zone will accommodate bus-turning movements.
- Bus parking bays on both sides of Esplanade Street, opposite the Protea Hotel and next to the proposed retail development.
- A dedicated taxi parking area for 17 taxis, in front of the Protea Hotel.

Pedestrian Walkways: The following pedestrian facilities should be provided:

- Sidewalks along all site frontages.
- Defined pedestrian routes on site.
- 3x Pedestrian bridges linking Phase 1A with Phase 1B.

Parking: to be provided according to the rates as indicated in **Section 23** of this report.

Visitor Guidance Signs: It is recommended that road signs be provided to guide visitors to/from the Waterfront development, along 5th Road and Atlantic Street.

Based on this evaluation, it is evident that this development can be accommodated acceptably, provided that the road upgrades as discussed in this report are in place. Hence, it is recommended that this development be considered for approval, from a transport point of view, with these proposed road upgrades as conditions of approval.

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Figure 22: Public Transport and Pedestrian Facilities

Atlantic Ocean
Namport New Container Terminal on Reclaimed Land
Walvis Bay Railway Station
Sam Nujoma
18th Road
To Swakopmunt
B2
M36
To Walvis Bay Airport
Walvis Bay
Gertrude Rikumba
Kadanga Hilukilwa
Namport
Existing Namport Waterfront
Atlantic Street
KR Thomas
5th Road
5th Street
Sam Nujoma
Yacht Club
Richard Dryer
Nangolo Mbumba
The Raft
D1986
Proposed Development
Meersig Lagoon
Esplanade
D1986
SCHEMATIC

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	LOCALITY PLAN *ZOOMED-IN VIEW*	1B

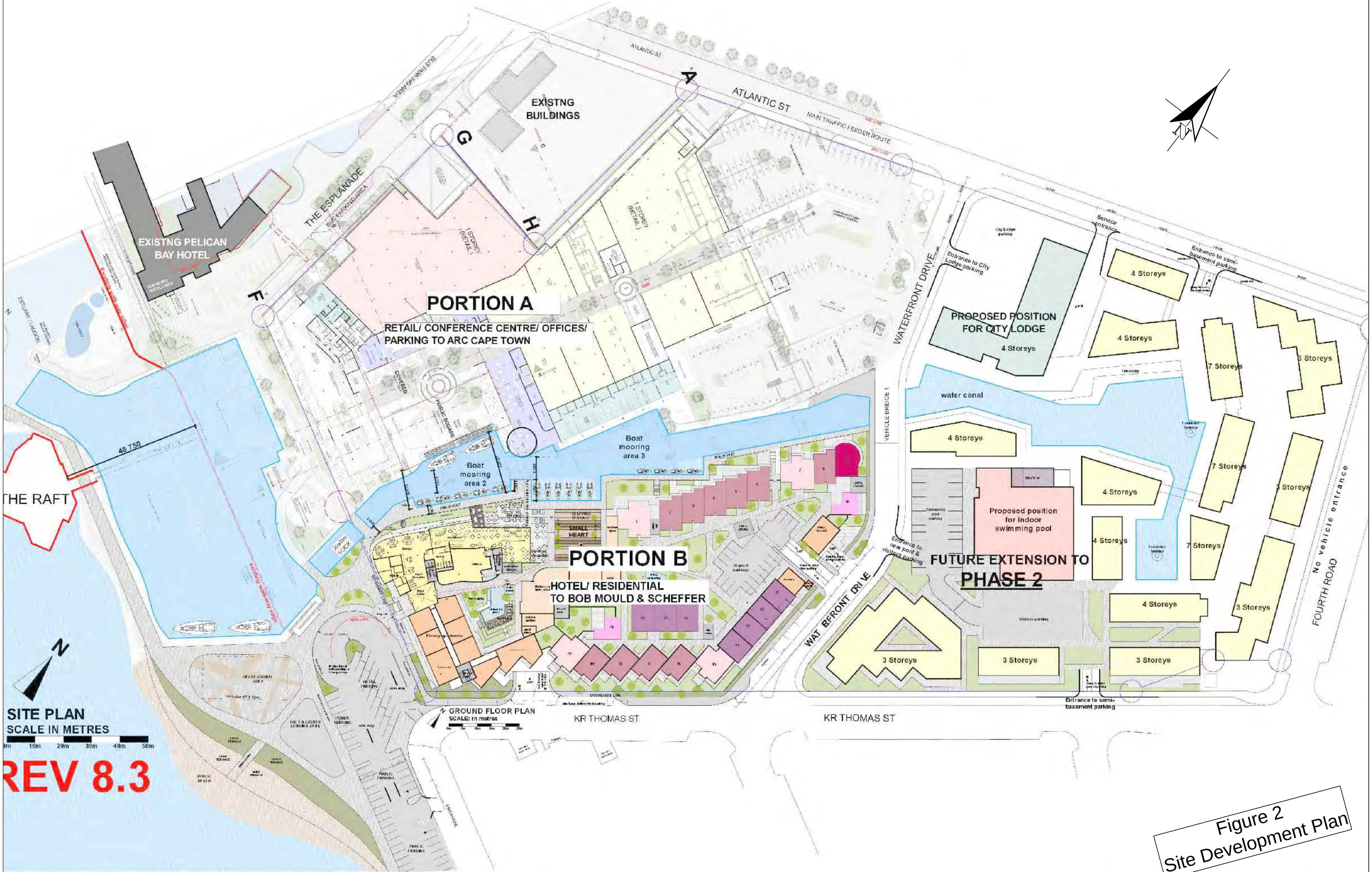
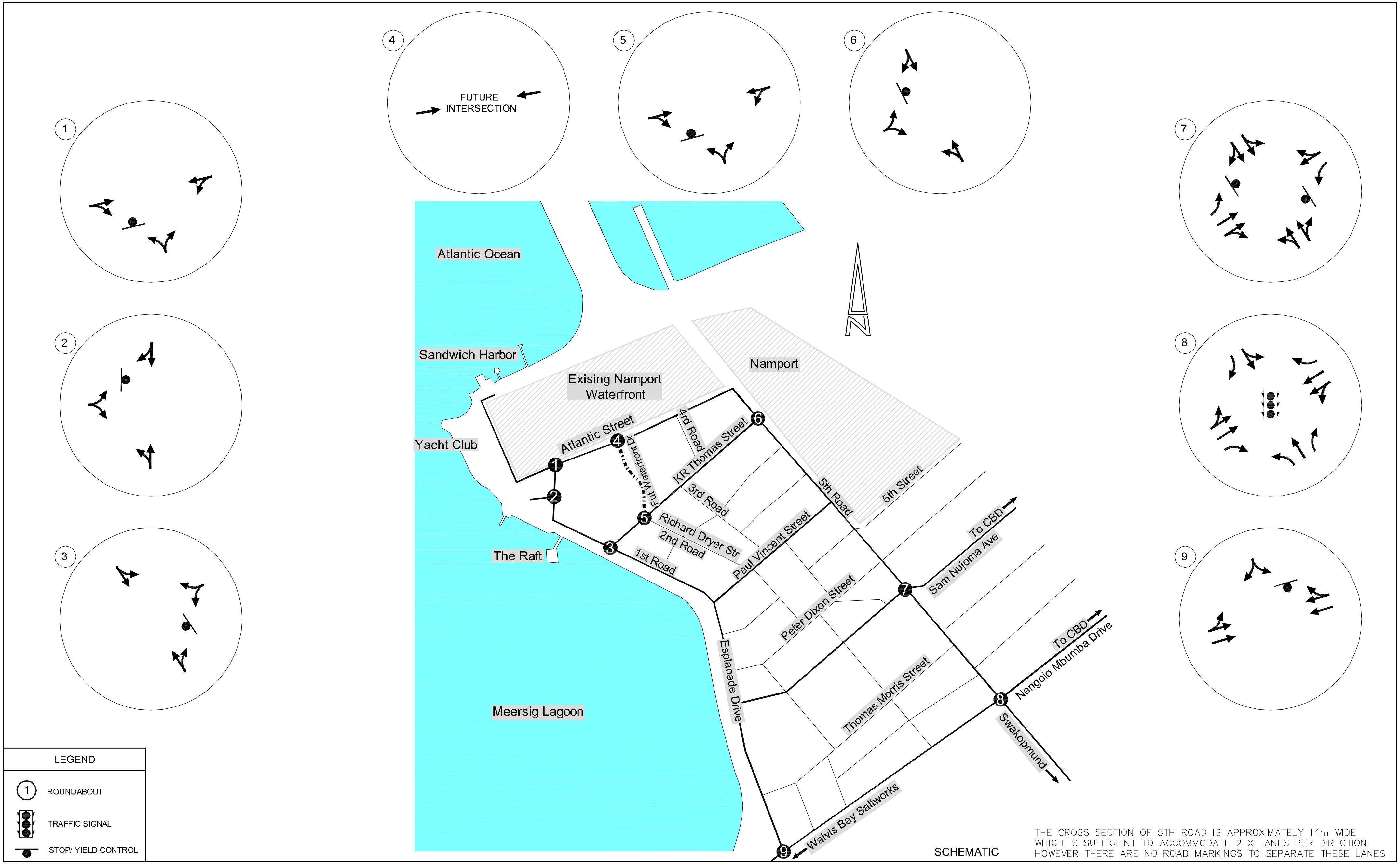
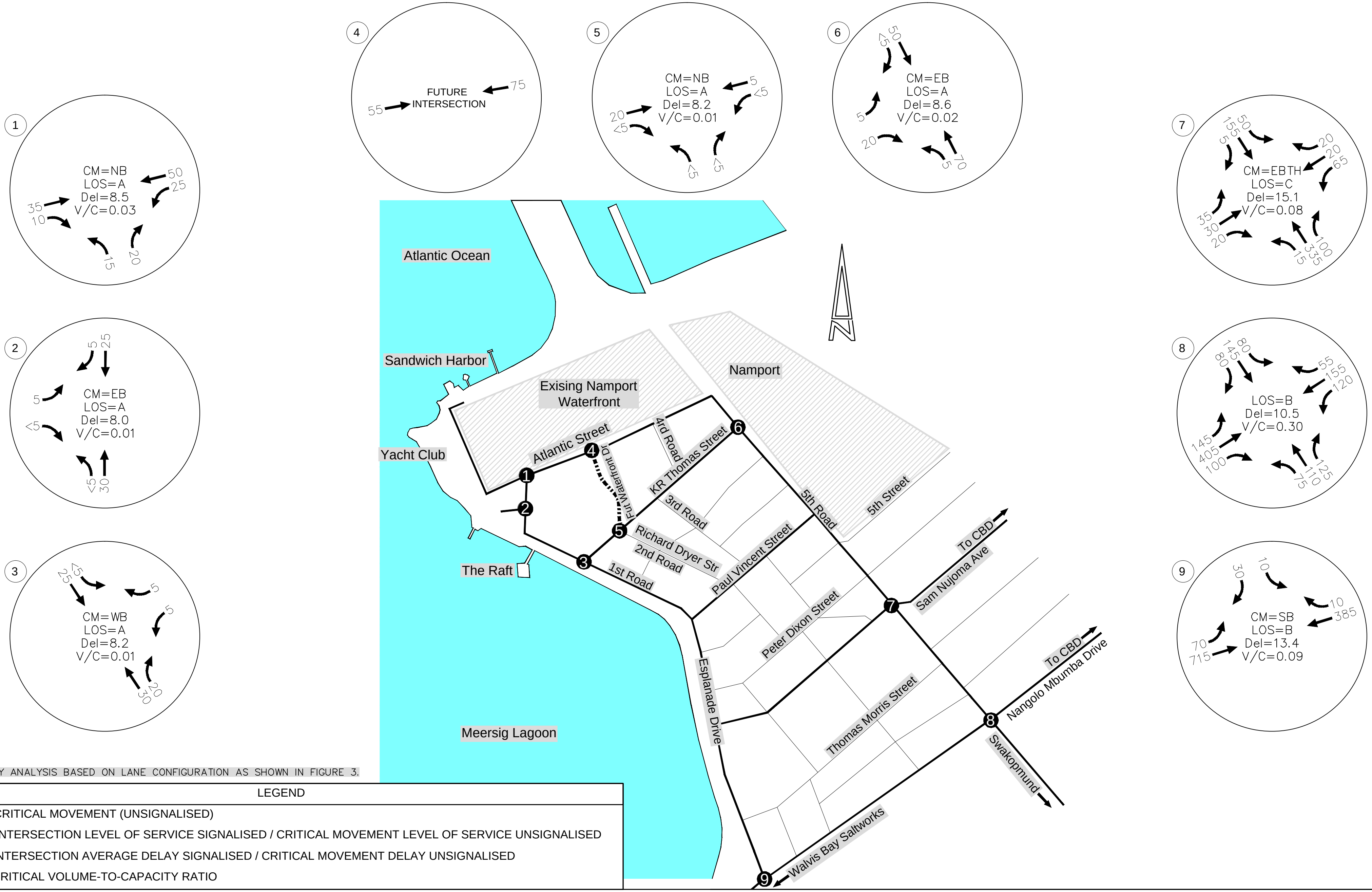


Figure 2
Site Development Plan

REVISION | NOTE: CONTRACTOR TO CHECK ALL DIMENSIONS ON SITE | DESIGNED: | DATE: | JOB NAME: | CLIENT:



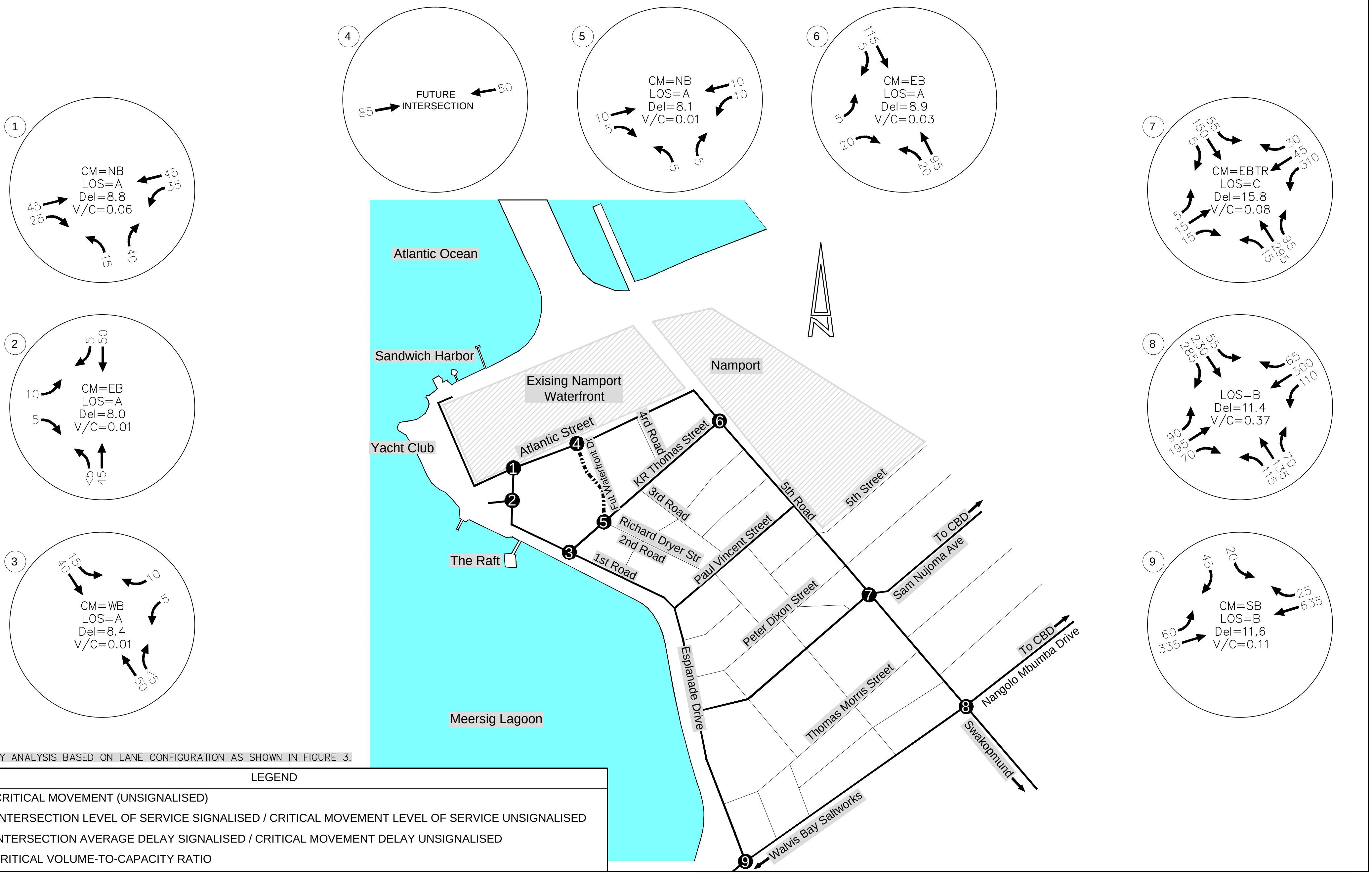
PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2017 EXISTING LANE CONFIGURATION	3



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2017 EXISTING TRAFFIC CONDITIONS *(SCENARIO 1)* A.M. PEAK HOUR	4A



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

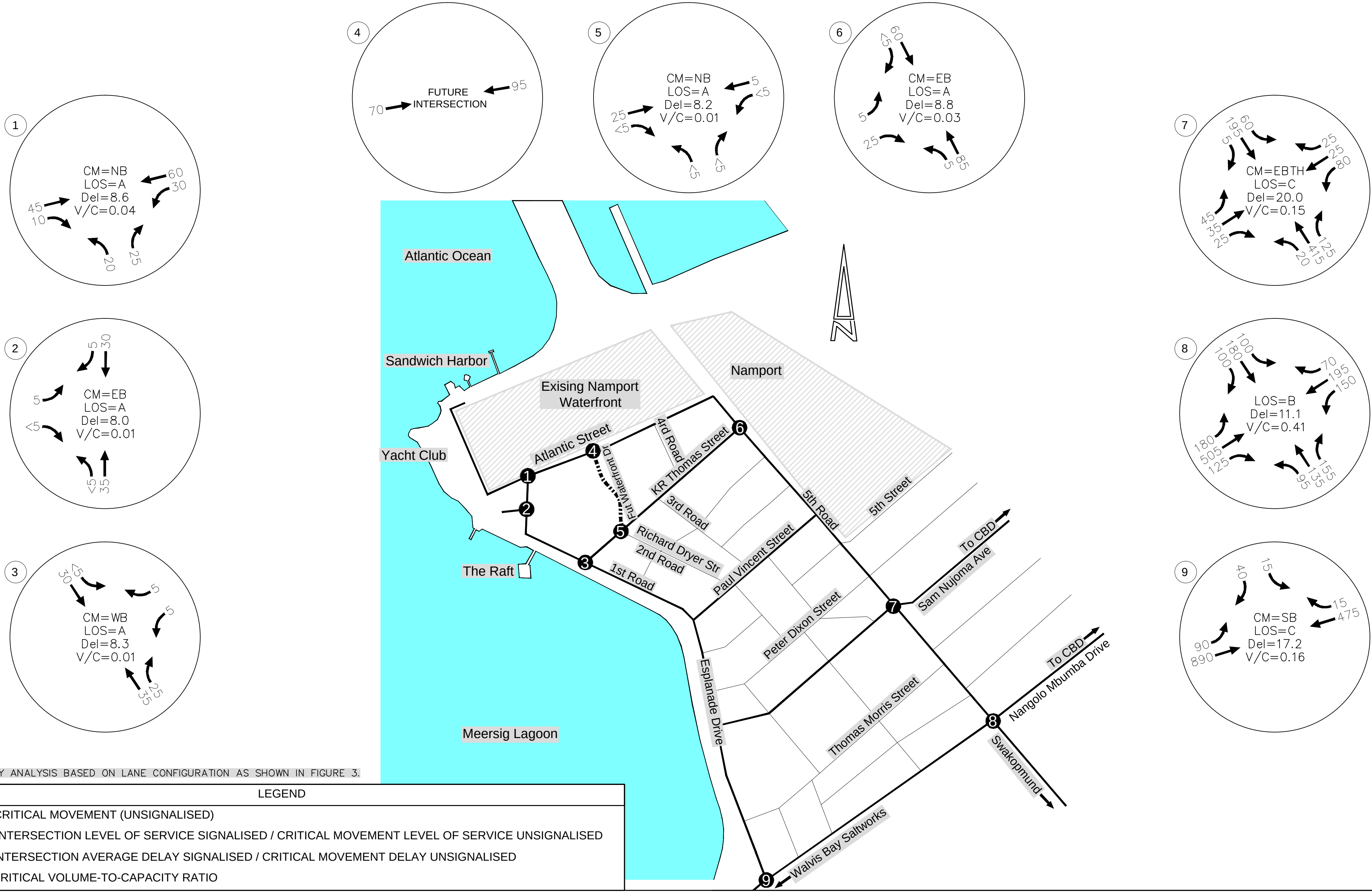
LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2017 EXISTING TRAFFIC CONDITIONS (*SCENARIO 1*) P.M. PEAK HOUR	4B

NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2017 EXISTING TRAFFIC CONDITIONS (*SCENARIO 1*) SATURDAY PEAK HOUR	4C



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

its

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 BACKGROUND TRAFFIC CONDITIONS (*SCENARIO 2*) A.M. PEAK HOUR	5A

NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND

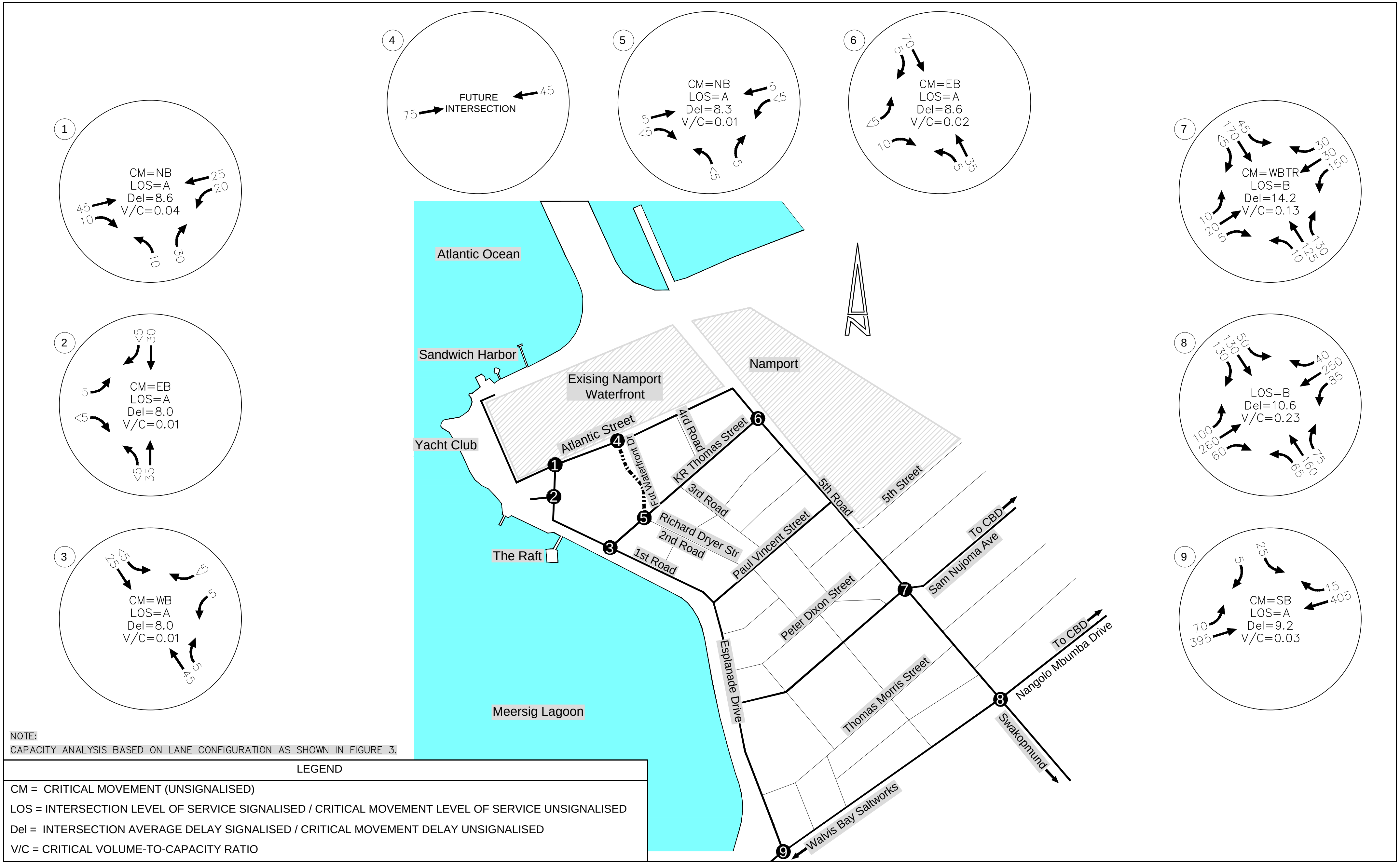
CM = CRITICAL MOVEMENT (UNSIGNALISED)

LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

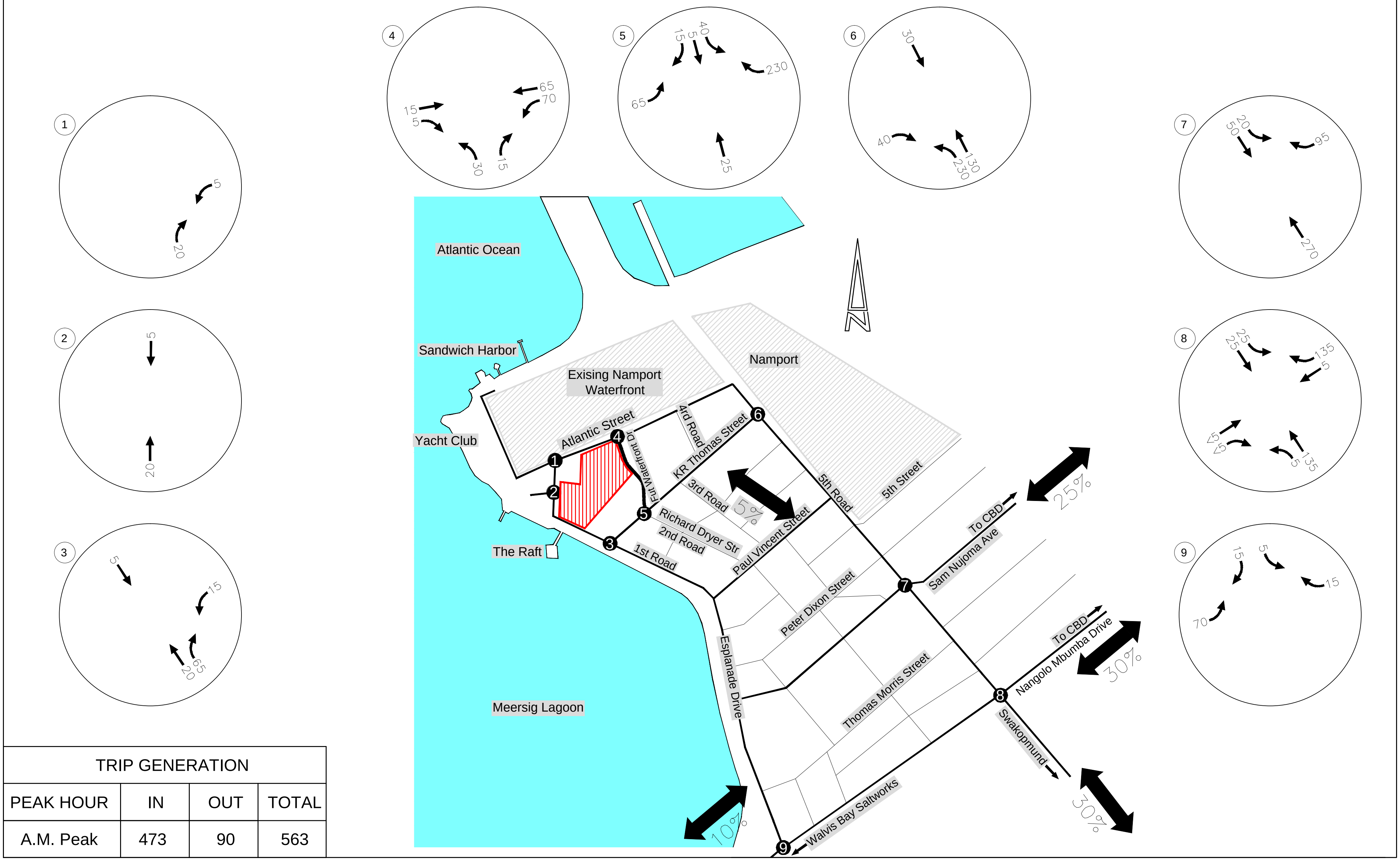
PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 BACKGROUND TRAFFIC CONDITIONS (*SCENARIO* 2) P.M. PEAK HOUR	5B



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

its	PROJECT: WALVIS BAY WATERFRONT DEVELOPMENT	FIGURE: 2022 BACKGROUND TRAFFIC CONDITIONS (*SCENARIO 2*) SATURDAY PEAK HOUR	NUMBER: 5C



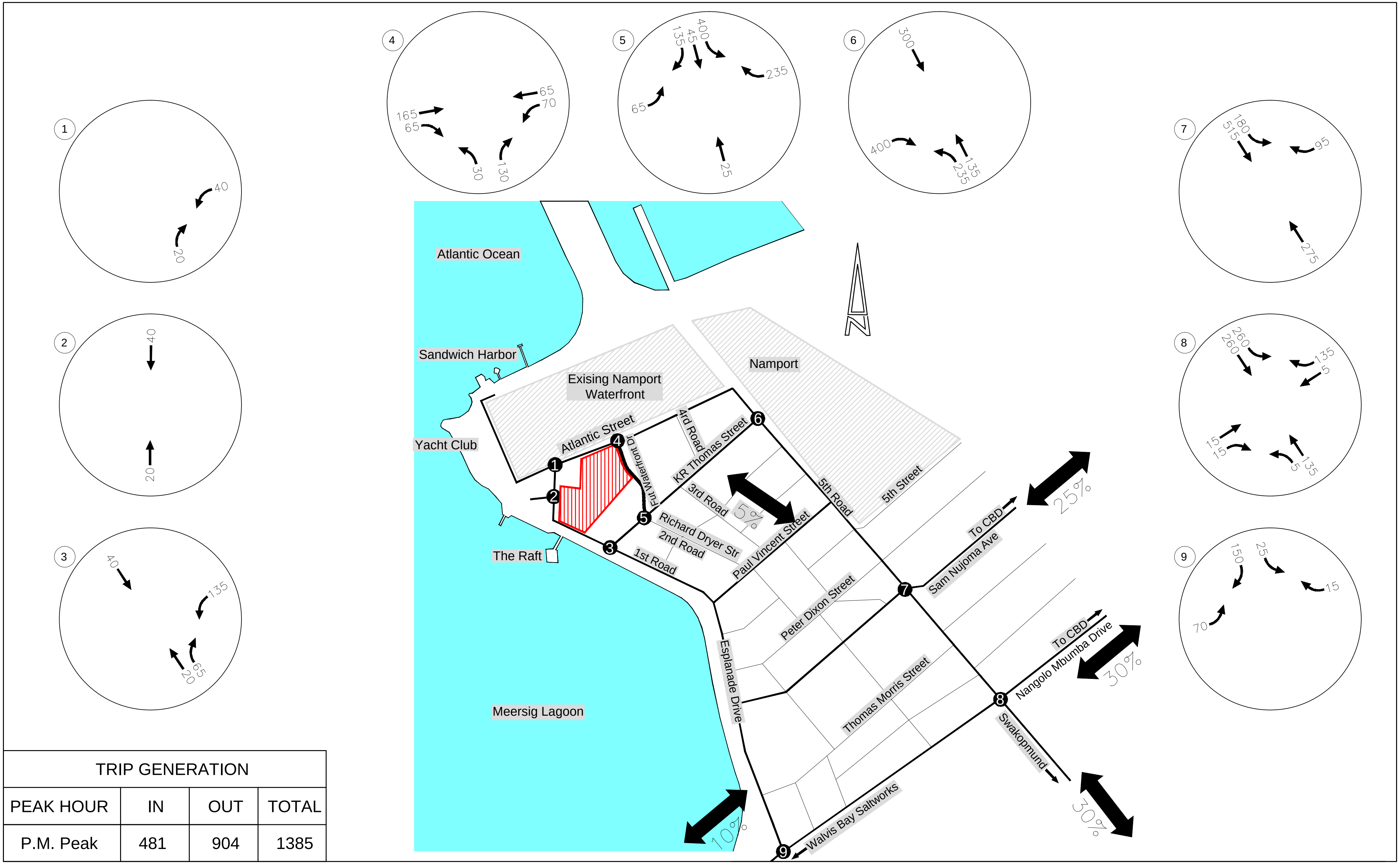
TRIP GENERATION			
PEAK HOUR	IN	OUT	TOTAL
A.M. Peak	473	90	563

its

PROJECT: WALVIS BAY WATERFRONT DEVELOPMENT

FIGURE: 2022 EXPECTED DEVELOPMENT TRIPS (PHASE 1A)
RETAIL COMPONENT ONLY
A.M. PEAK HOUR

NUMBER: 6A



TRIP GENERATION			
PEAK HOUR	IN	OUT	TOTAL
P.M. Peak	481	904	1385

PROJECT:

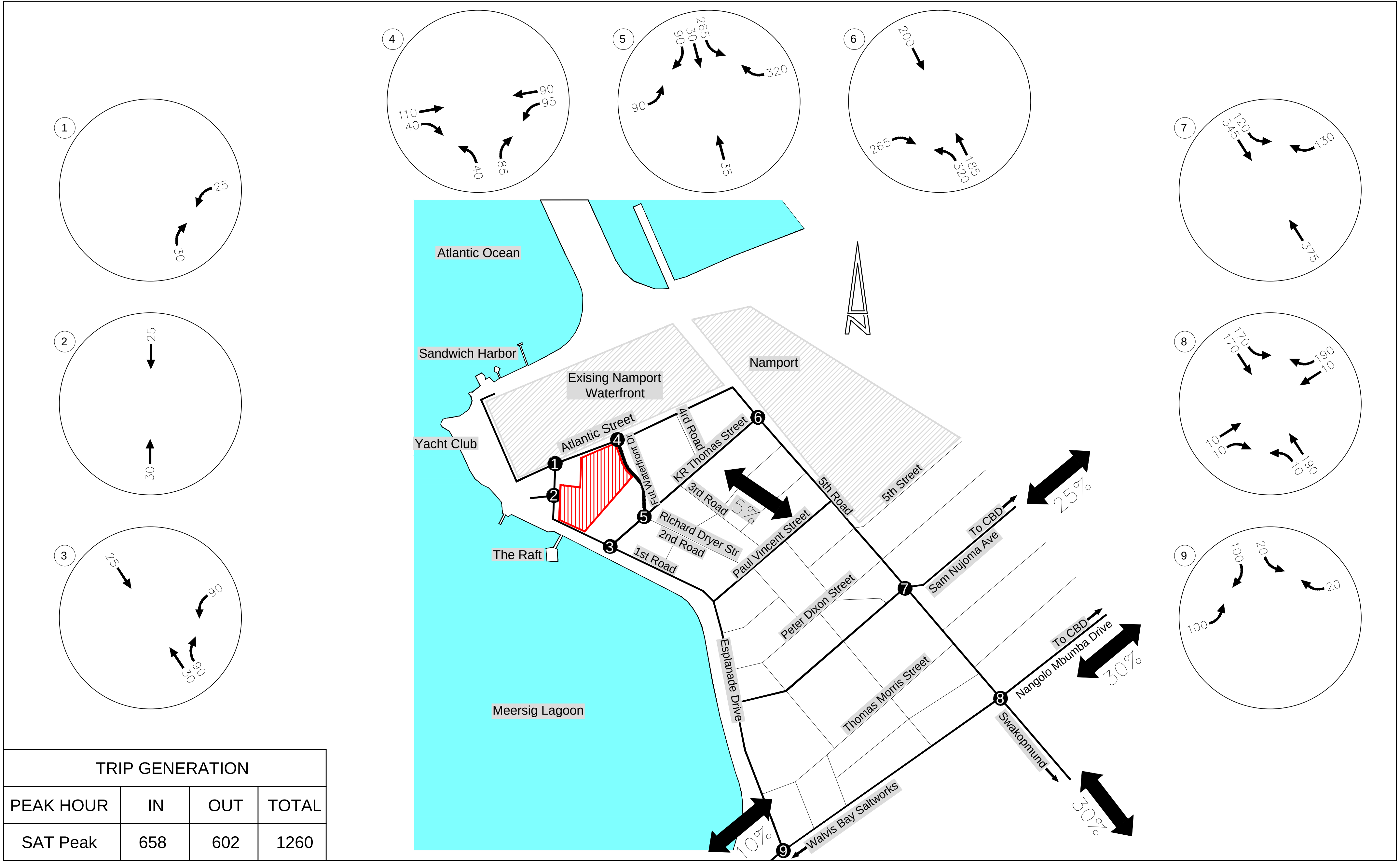
WALVIS BAY WATERFRONT DEVELOPMENT

FIGURE:

2022 EXPECTED DEVELOPMENT TRIPS (PHASE 1A)
RETAIL COMPONENT ONLY
P.M. PEAK HOUR

NUMBER:

6B



TRIP GENERATION			
PEAK HOUR	IN	OUT	TOTAL
SAT Peak	658	602	1260

its

PROJECT:

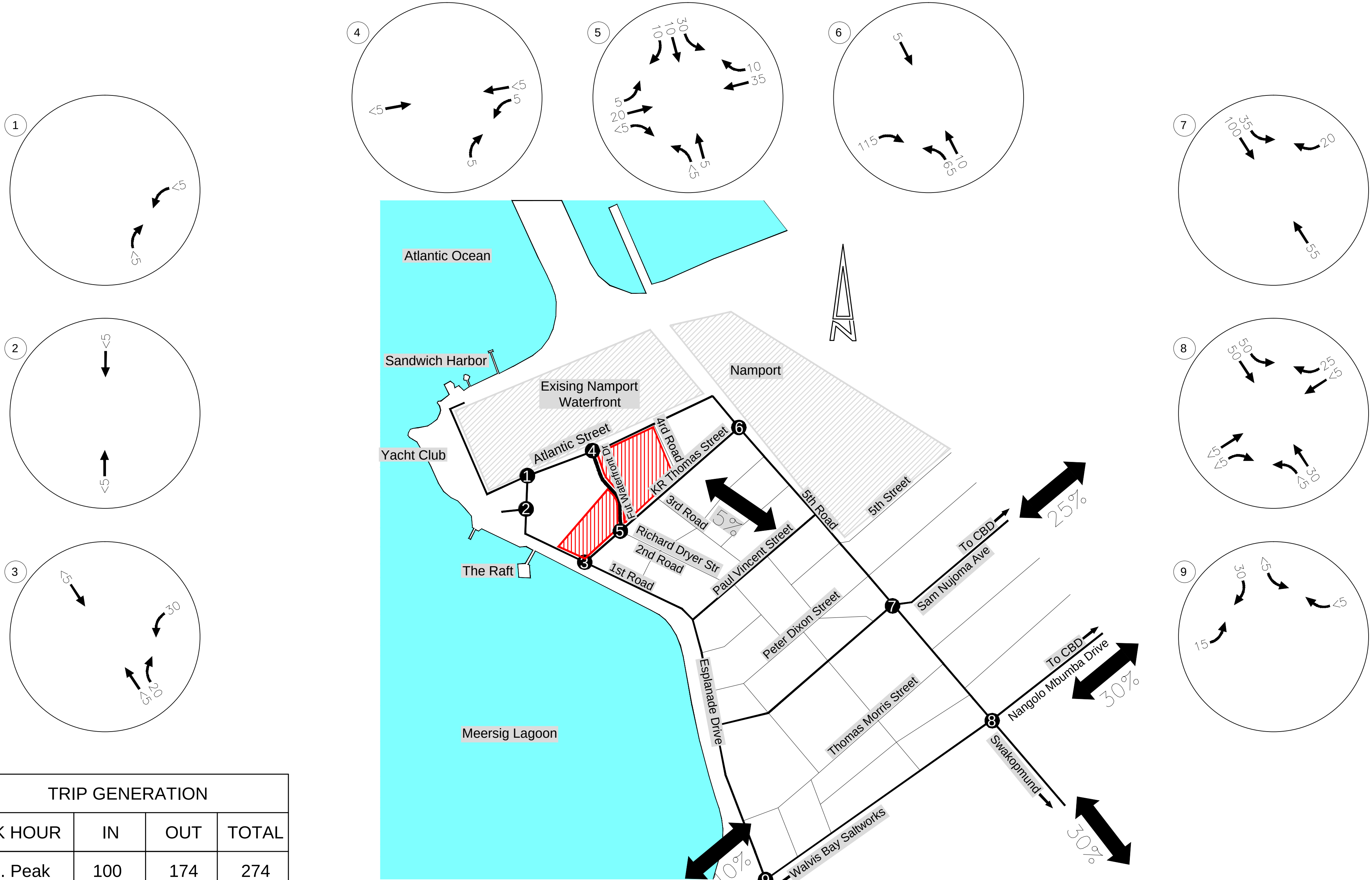
WALVIS BAY WATERFRONT DEVELOPMENT

FIGURE:

2020 EXPECTED DEVELOPMENT TRIPS (PHASE 1A)
RETAIL COMPONENT ONLY
SATURDAY PEAK HOUR

NUMBER:

6C



TRIP GENERATION			
PEAK HOUR	IN	OUT	TOTAL
A.M. Peak	100	174	274

its

PROJECT:

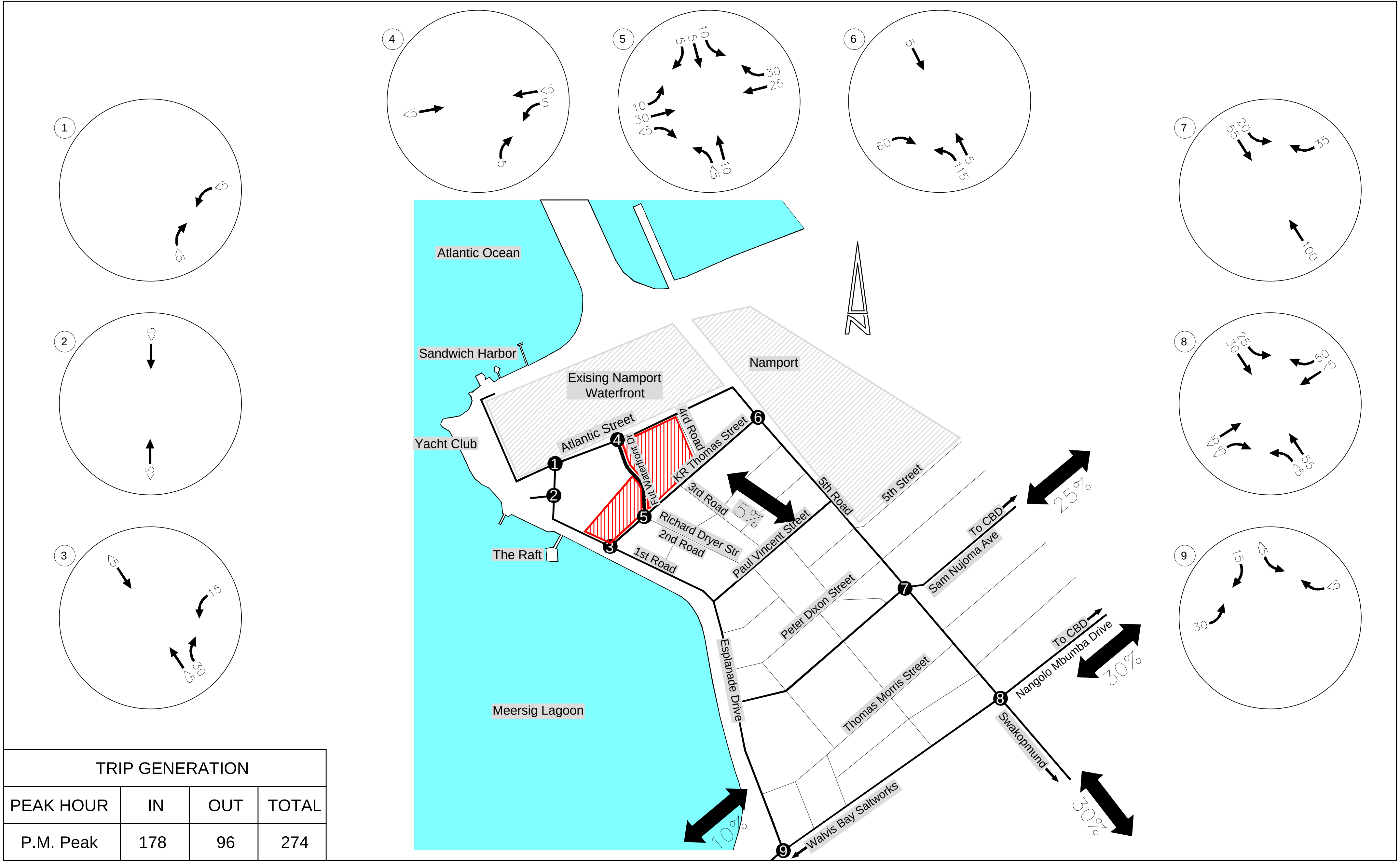
WALVIS BAY WATERFRONT DEVELOPMENT

FIGURE:

2022 EXPECTED DEVELOPMENT TRIPS (PHASE 1B & PHASE 2)
HOTEL AND RESIDENTIAL COMPONENTS ONLY
A.M. PEAK HOUR

NUMBER:

7A



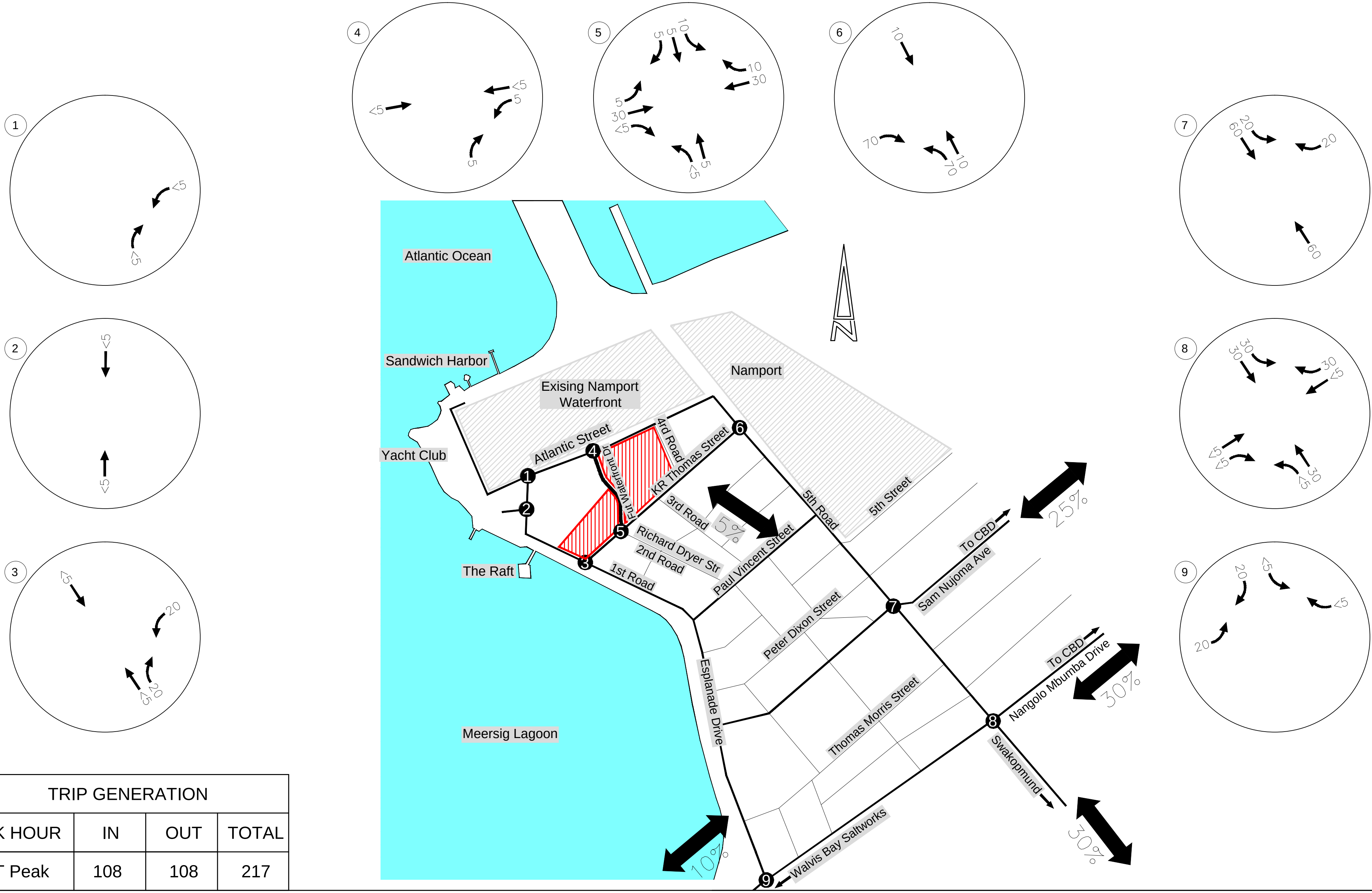
TRIP GENERATION			
PEAK HOUR	IN	OUT	TOTAL
P.M. Peak	178	96	274

its

PROJECT: WALVIS BAY WATERFRONT DEVELOPMENT

FIGURE: 2022 EXPECTED DEVELOPMENT TRIPS (PHASE 1B & PHASE 2) HOTEL & RESIDENTIAL COMPONENTS ONLY P.M. PEAK HOUR

NUMBER: 7B



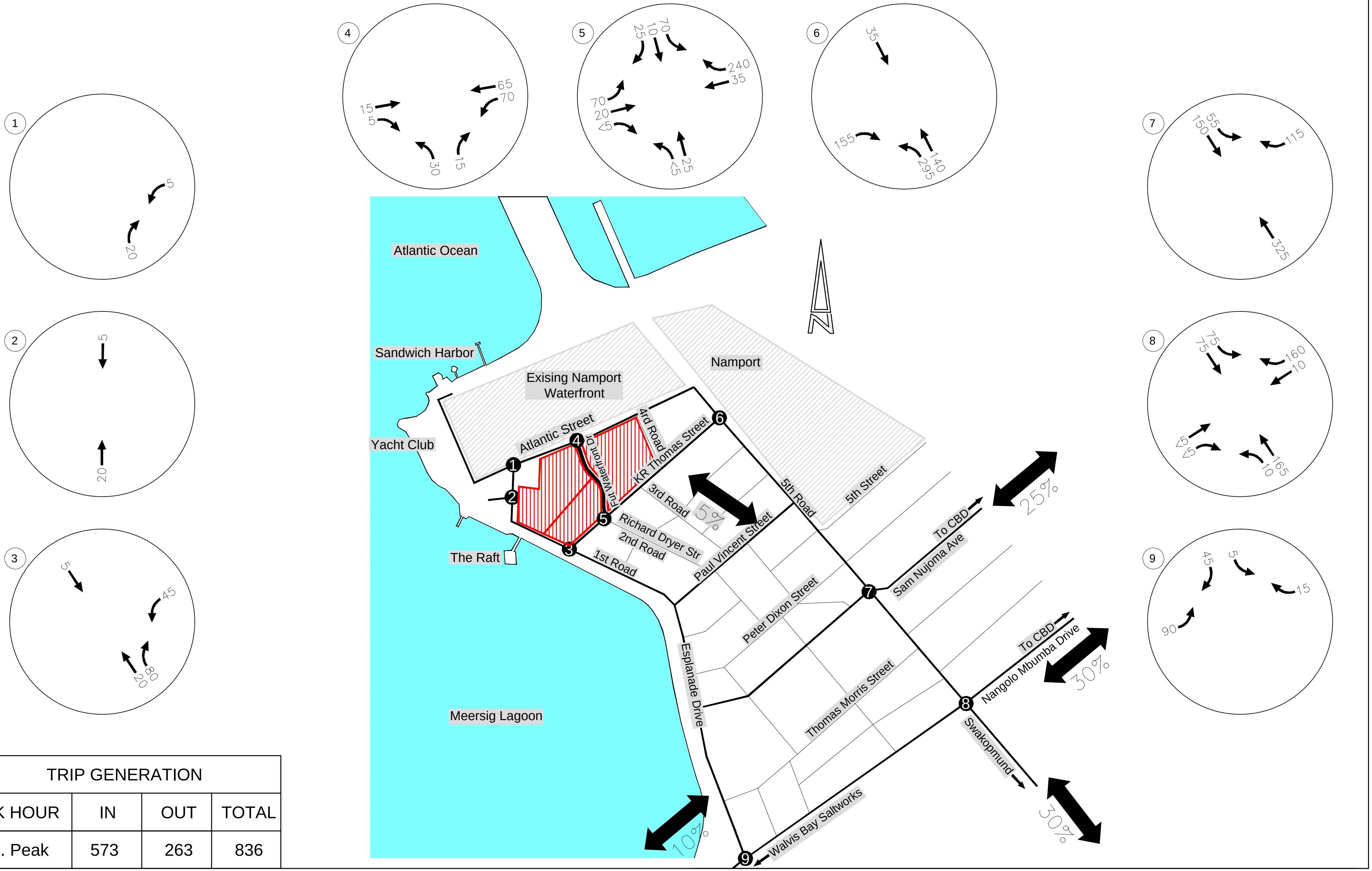
TRIP GENERATION			
PEAK HOUR	IN	OUT	TOTAL
SAT Peak	108	108	217

its

PROJECT: WALVIS BAY WATERFRONT DEVELOPMENT

FIGURE: 2022 EXPECTED DEVELOPMENT TRIPS (PHASE 1B & PHASE 2)
HOTEL AND RESIDENTIAL COMPONENT ONLY
SATURDAY PEAK HOUR

NUMBER: 7C



TRIP GENERATION			
PEAK HOUR	IN	OUT	TOTAL
A.M. Peak	573	263	836

PROJECT:

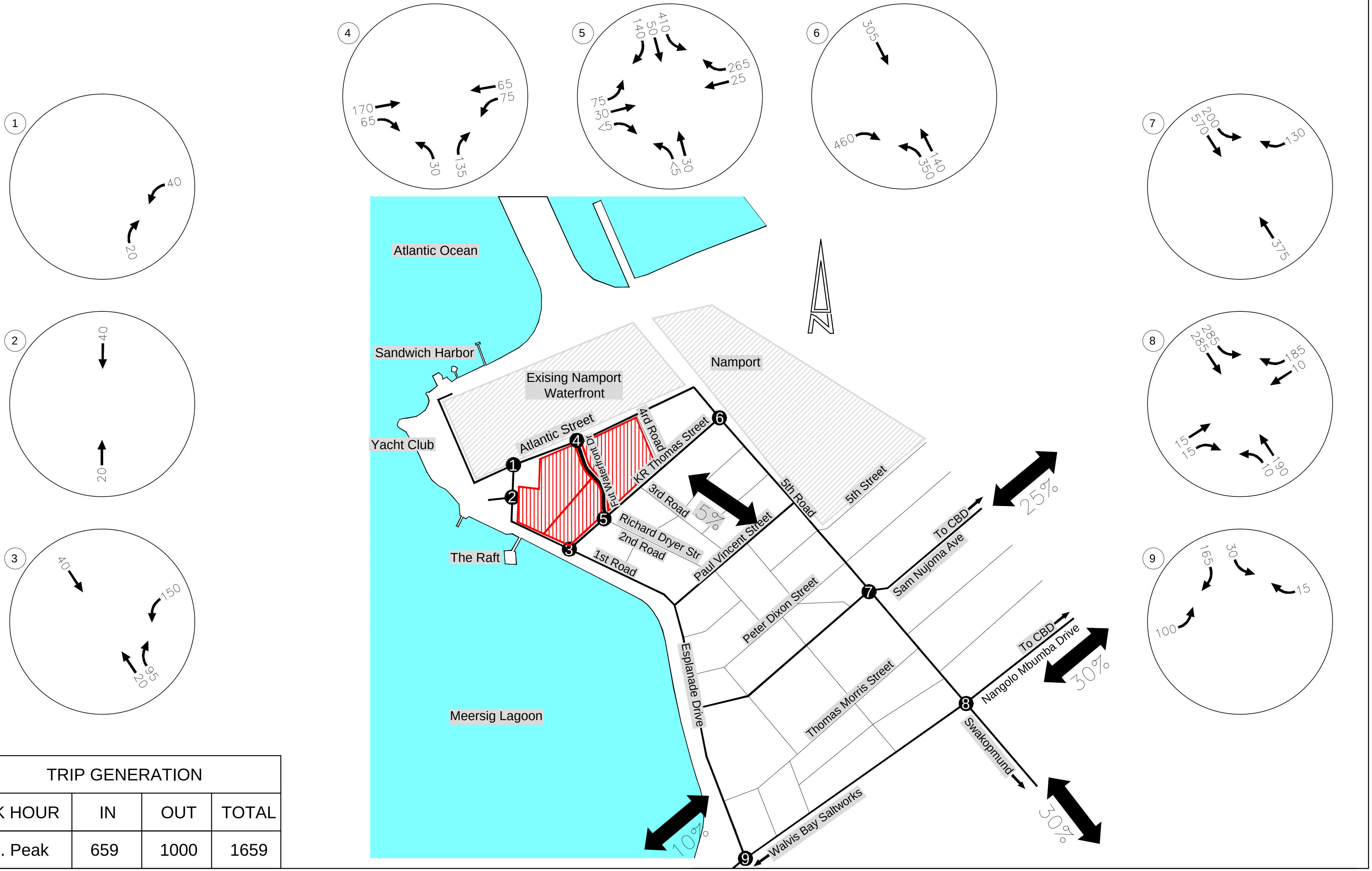
WALVIS BAY WATERFRONT DEVELOPMENT

FIGURE:

2022 EXPECTED DEVELOPMENT TRIPS
FULL DEVELOPMENT
A.M. PEAK HOUR

NUMBER:

8A



TRIP GENERATION			
PEAK HOUR	IN	OUT	TOTAL
P.M. Peak	659	1000	1659

its

PROJECT:

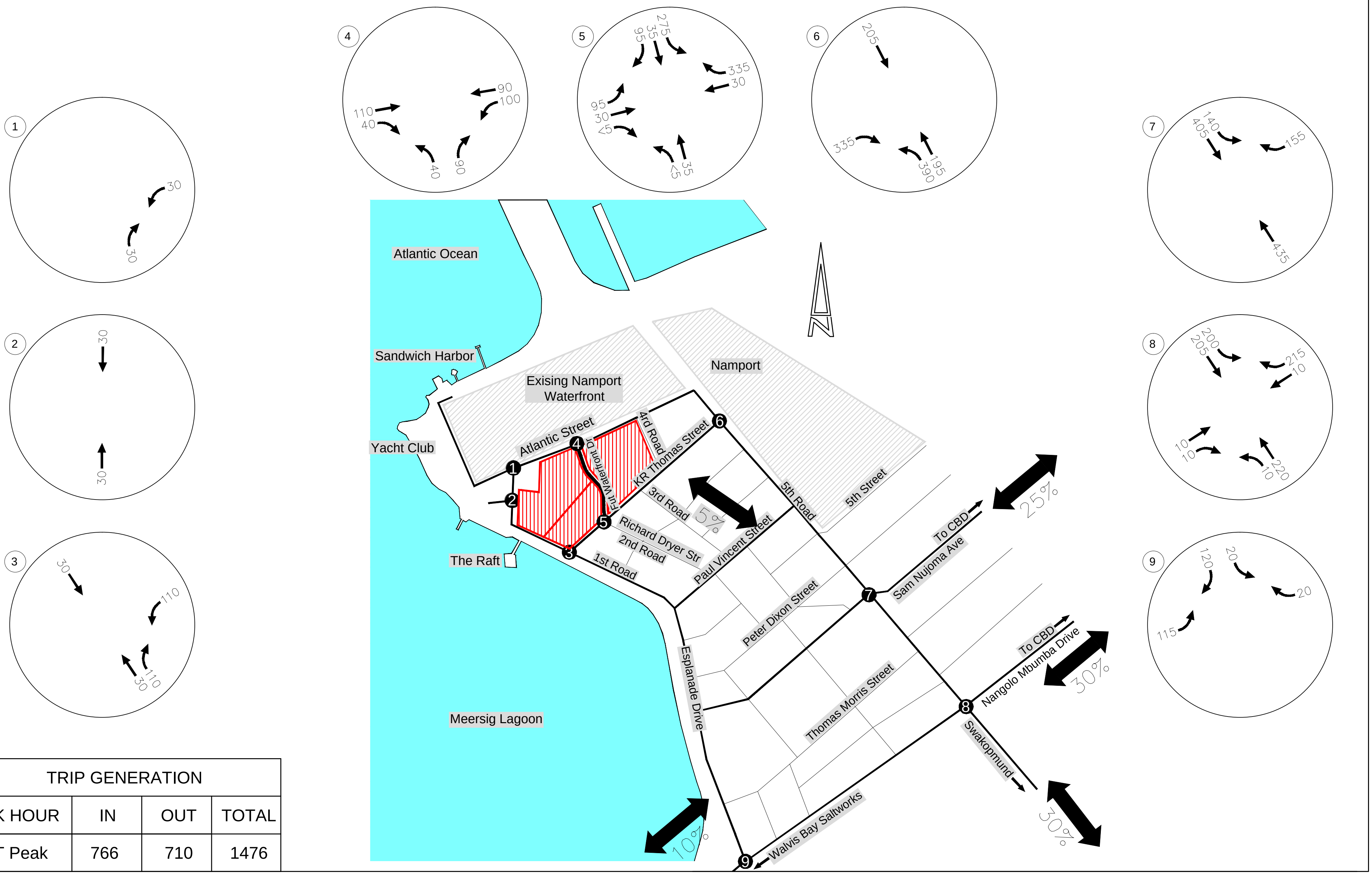
WALVIS BAY WATERFRONT DEVELOPMENT

FIGURE:

2022 EXPECTED DEVELOPMENT TRIPS
FULL DEVELOPMENT
P.M. PEAK HOUR

NUMBER:

8B



TRIP GENERATION			
PEAK HOUR	IN	OUT	TOTAL
SAT Peak	766	710	1476

its

PROJECT:

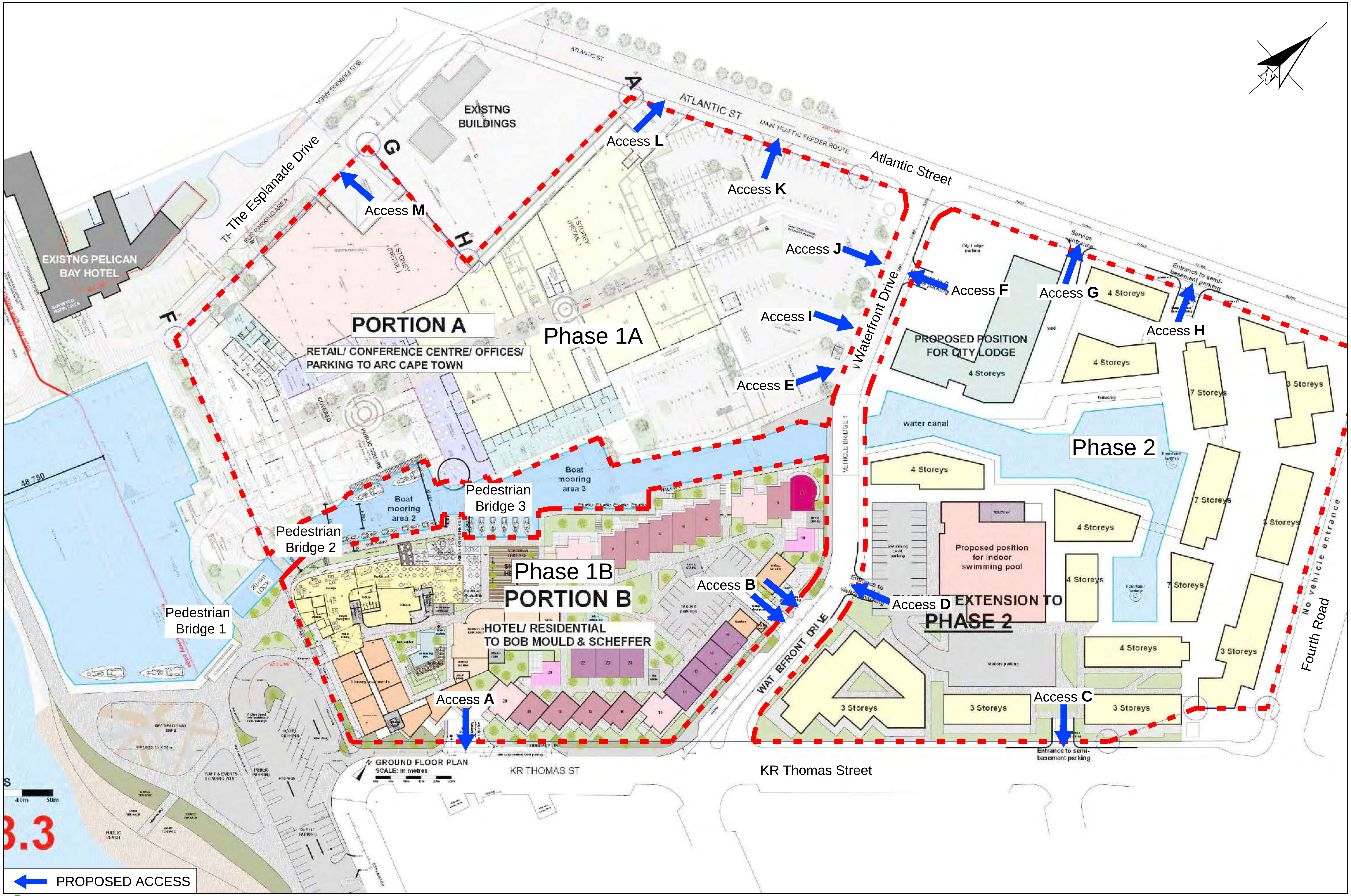
WALVIS BAY WATERFRONT DEVELOPMENT

FIGURE:

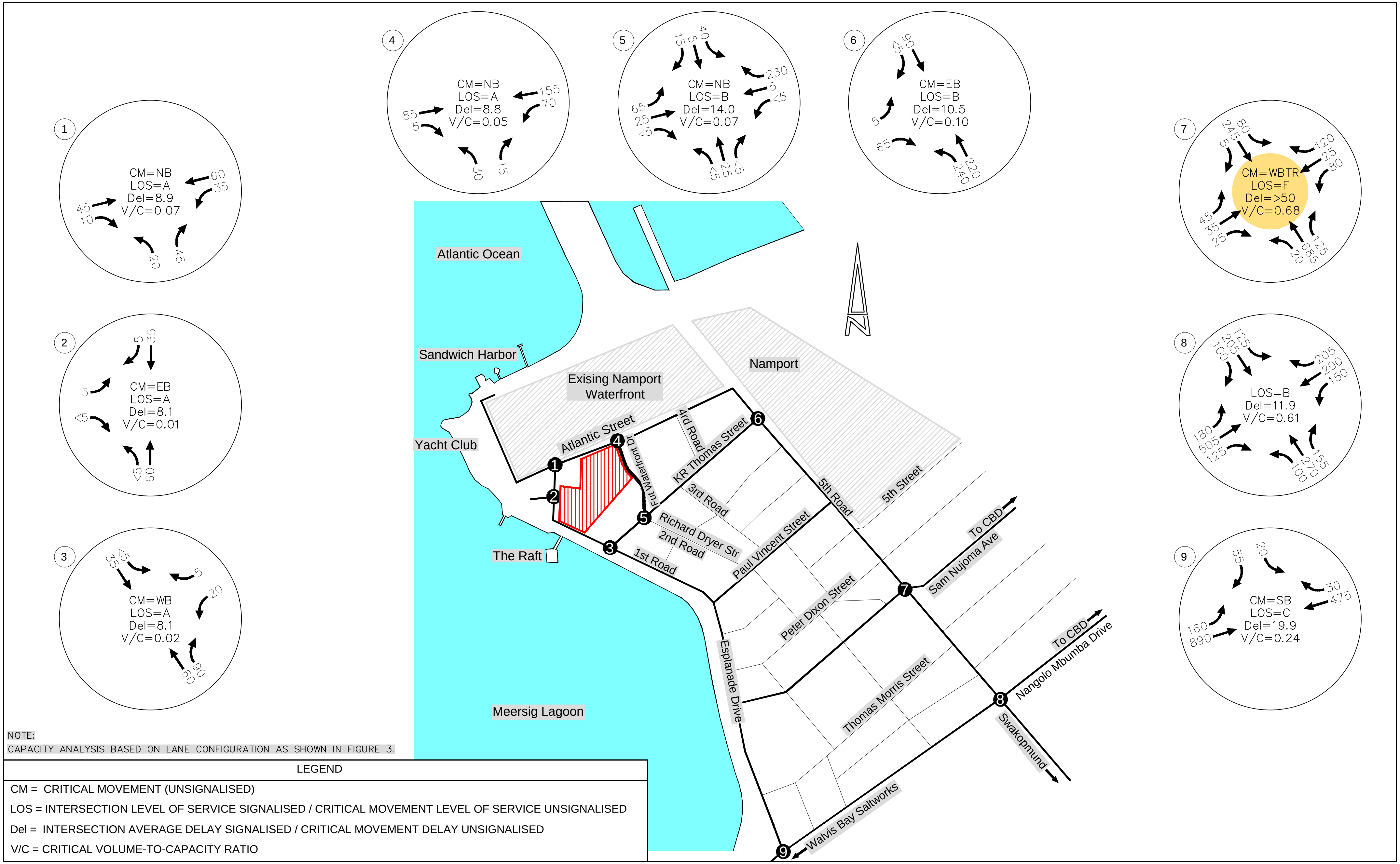
2022 EXPECTED DEVELOPMENT TRIPS
FULL DEVELOPMENT
SATURDAY PEAK HOUR

NUMBER:

8C



PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	PROPOSED DEVELOPMENT ACCESS	9



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND

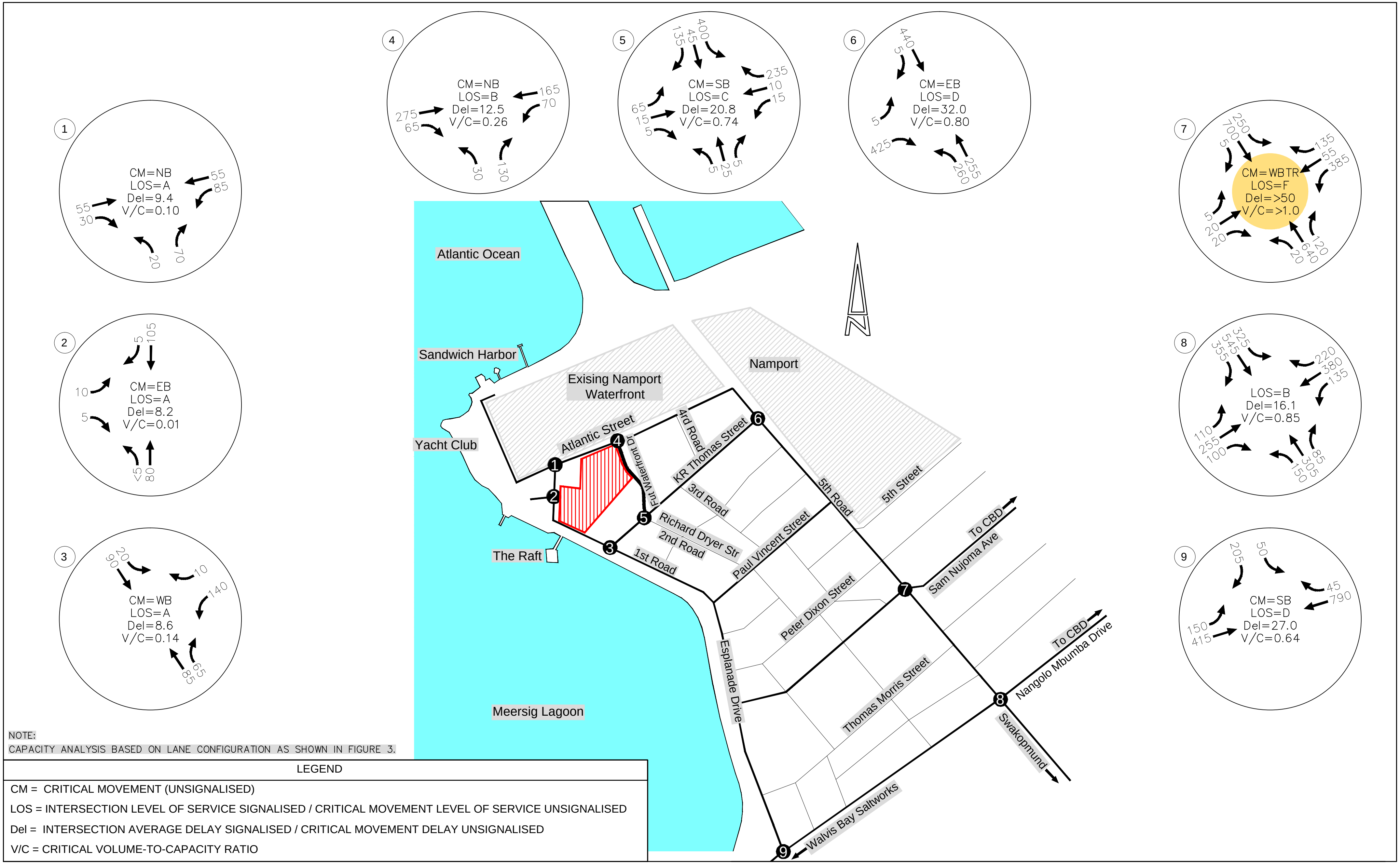
CM = CRITICAL MOVEMENT (UNSIGNALISED)

LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

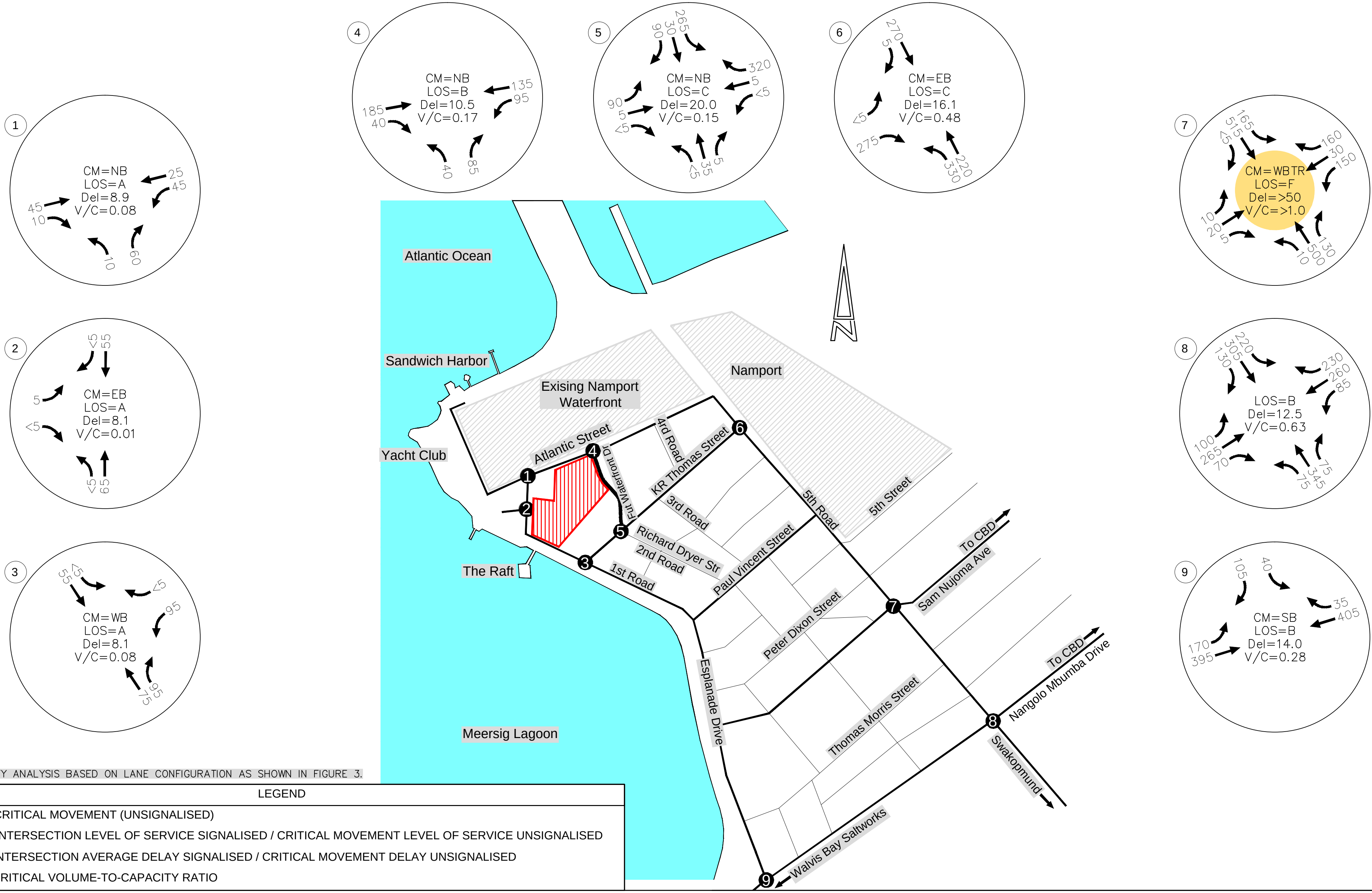
PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO* 3) PHASE 1A RETAIL COMPONENT ONLY A.M. PEAK HOUR	10A



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

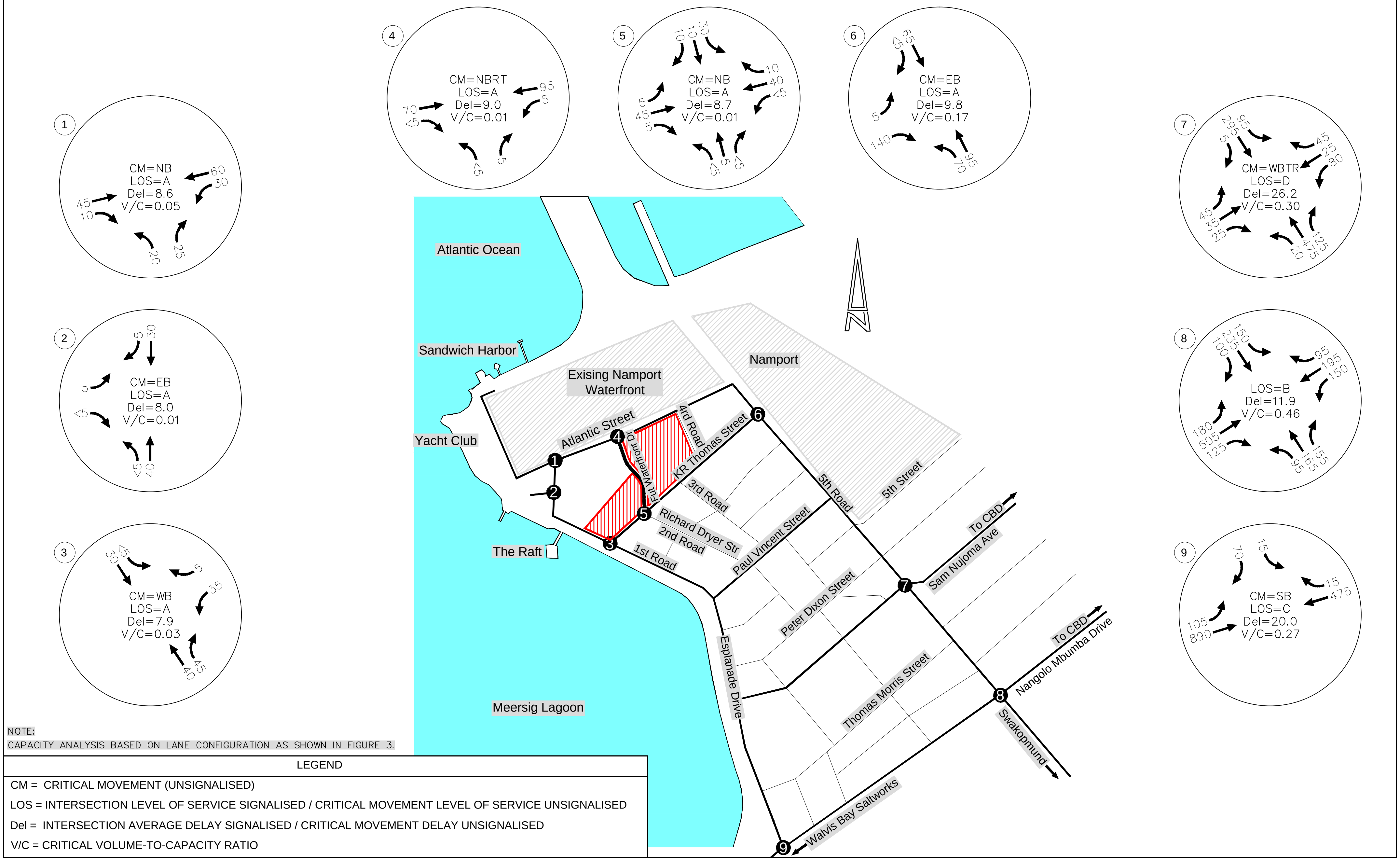
PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO* 3) PHASE 1A RETAIL COMPONENT ONLY P.M. PEAK HOUR	10B



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO* 3) PHASE 1A RETAIL COMPONENT ONLY SATURDAY PEAK HOUR	10C



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND

CM = CRITICAL MOVEMENT (UNSIGNALISED)

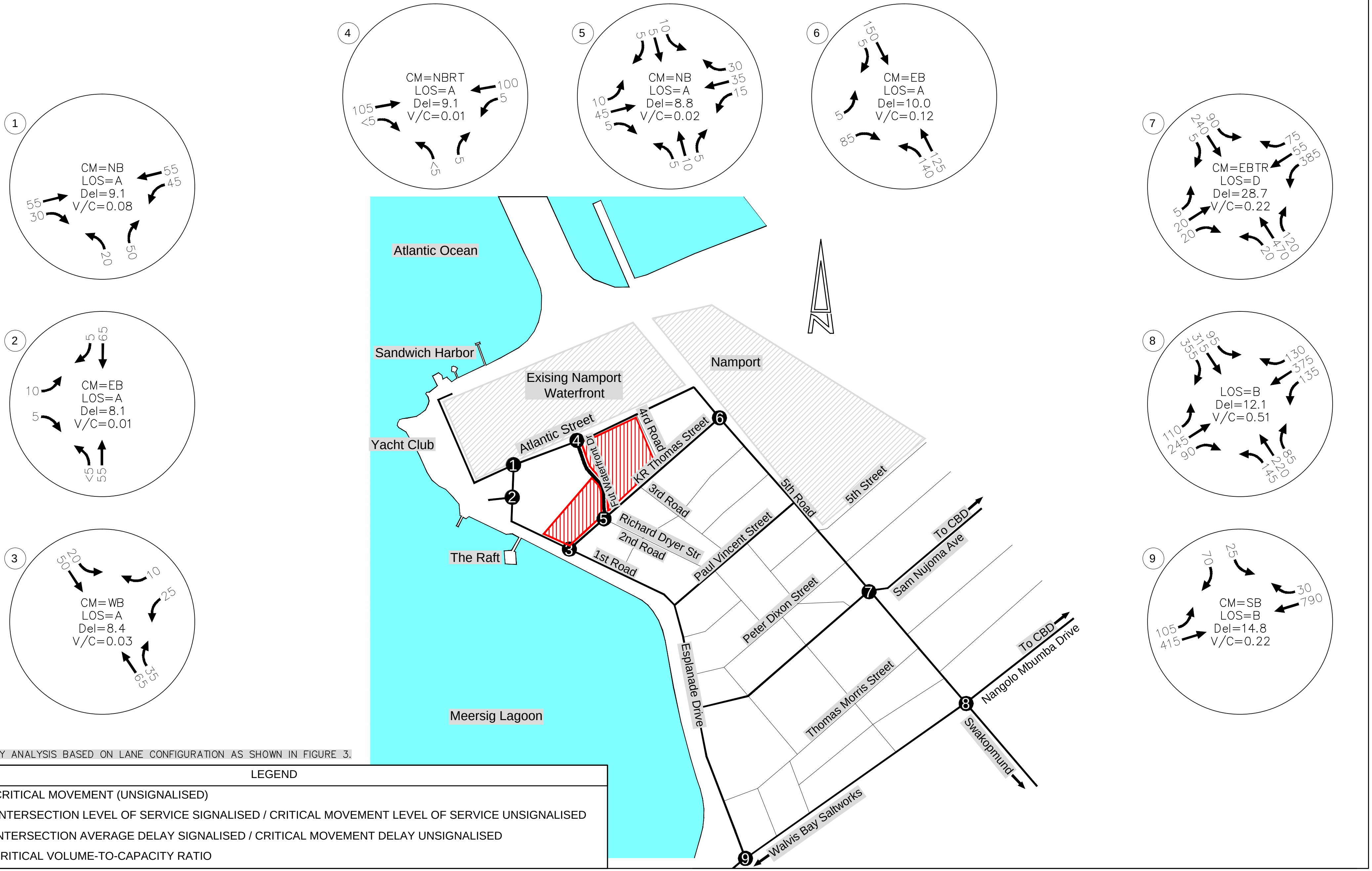
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

its

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 4*) PHASE 1B, PHASE 2 HOTEL & RESIDENTIAL COMPONENTS ONLY A.M. PEAK HOUR	11A

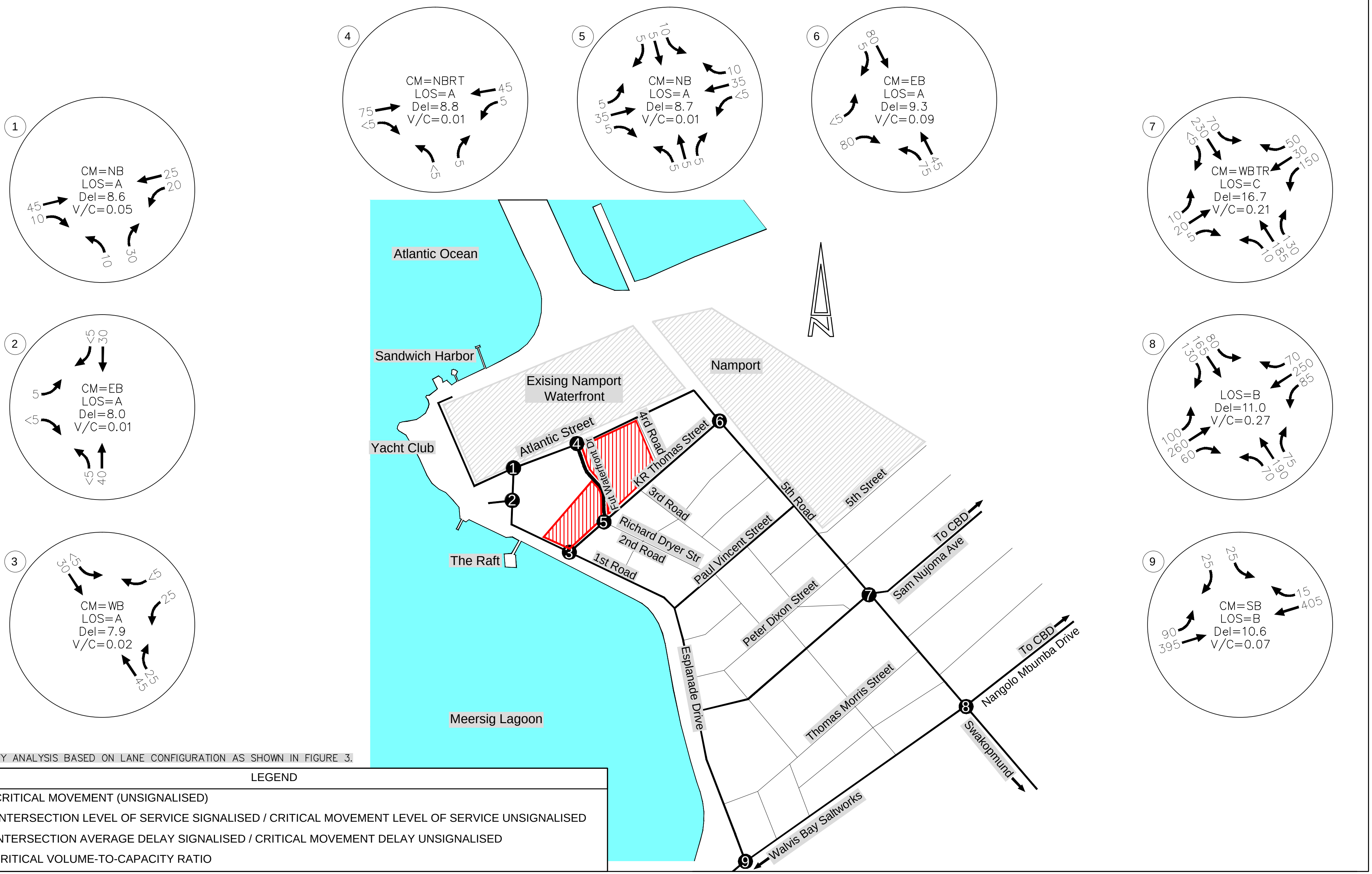


NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

its

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 4*) PHASE 1B & PHASE 2 HOTEL & RESIDENTIAL COMPONENTS ONLY P.M. PEAK HOUR	11B



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND

CM = CRITICAL MOVEMENT (UNSIGNALISED)

LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

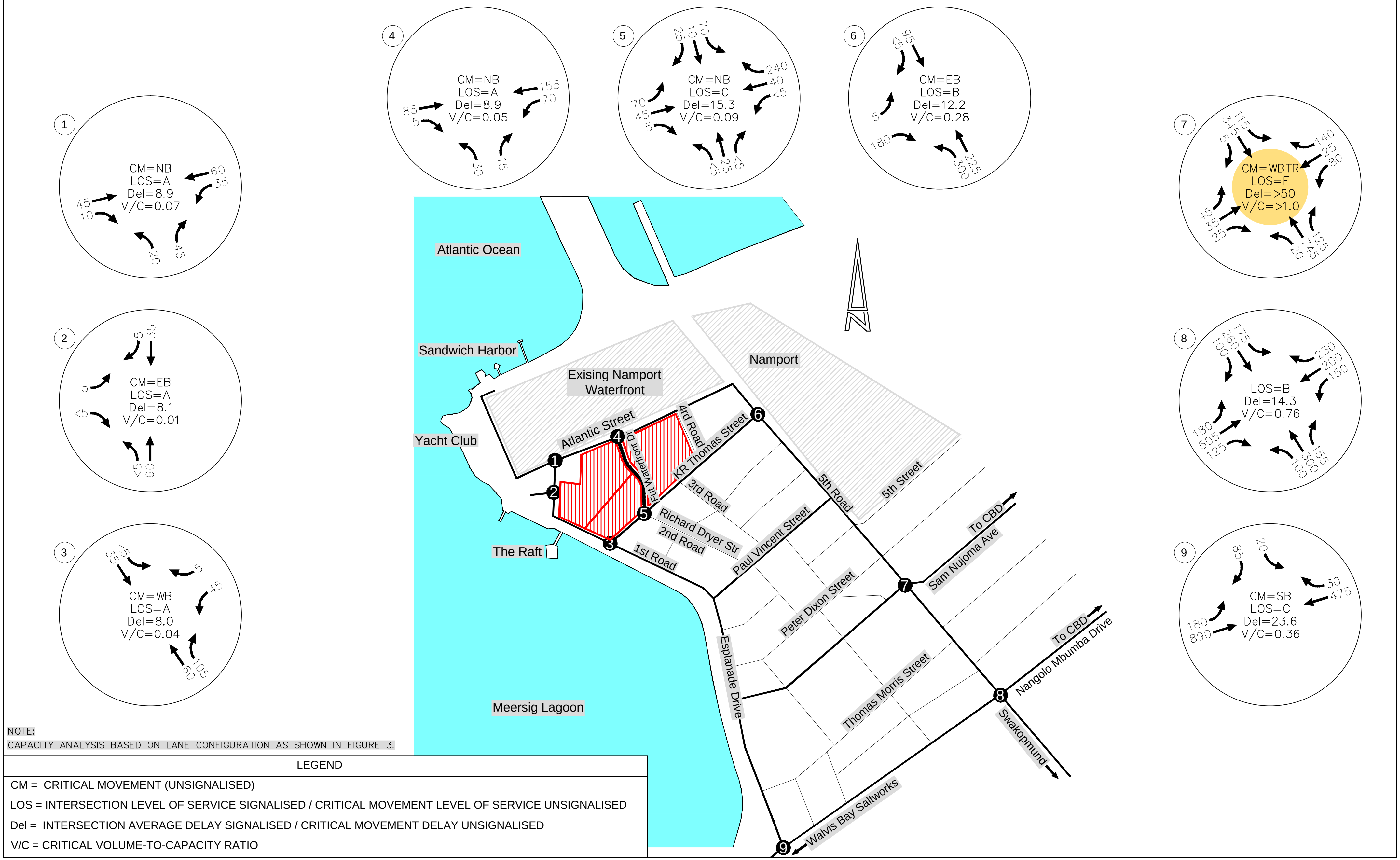
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

its

PROJECT: WALVIS BAY WATERFRONT DEVELOPMENT

FIGURE: 2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 4*) PHASE 1B & PHASE 2 HOTEL & RESIDENTIAL COMPONENTS ONLY SATURDAY PEAK HOUR

NUMBER: 11C



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND

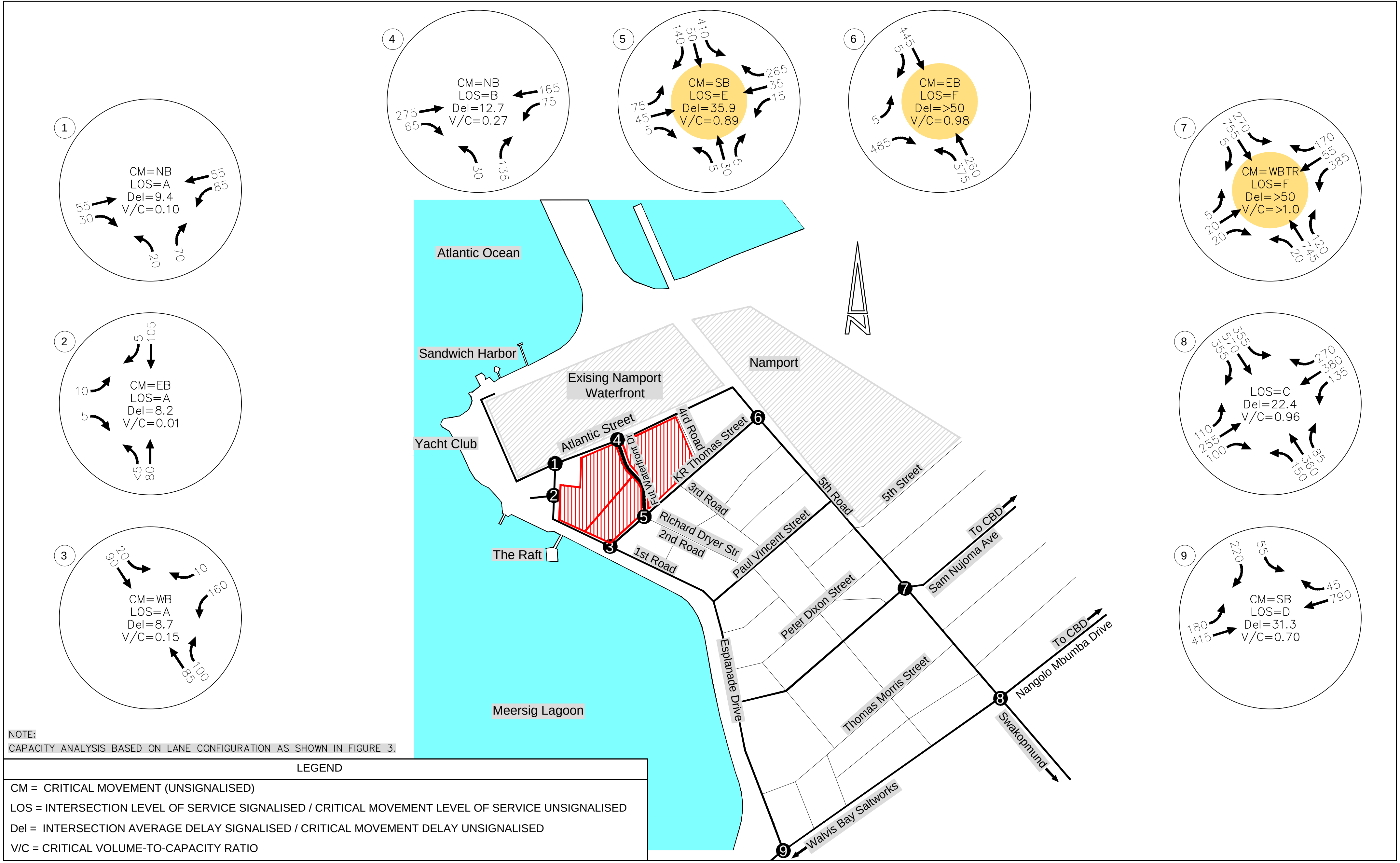
CM = CRITICAL MOVEMENT (UNSIGNALISED)

LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 5*) FULL DEVELOPMENT A.M. PEAK HOUR	12A



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

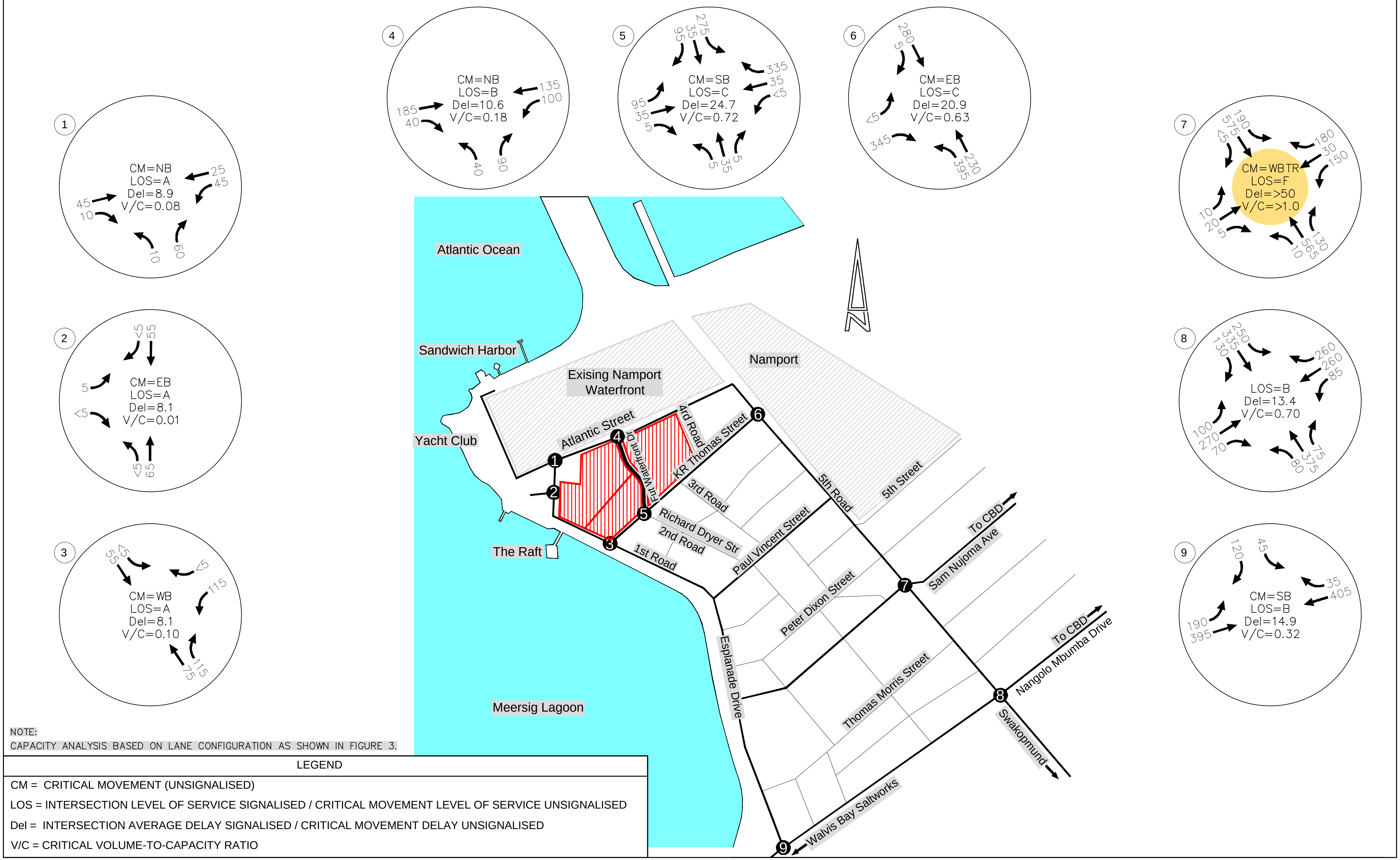
LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

its

PROJECT: WALVIS BAY WATERFRONT DEVELOPMENT

FIGURE: 2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 5*)
FULL DEVELOPMENT
P.M. PEAK HOUR

NUMBER: 12B

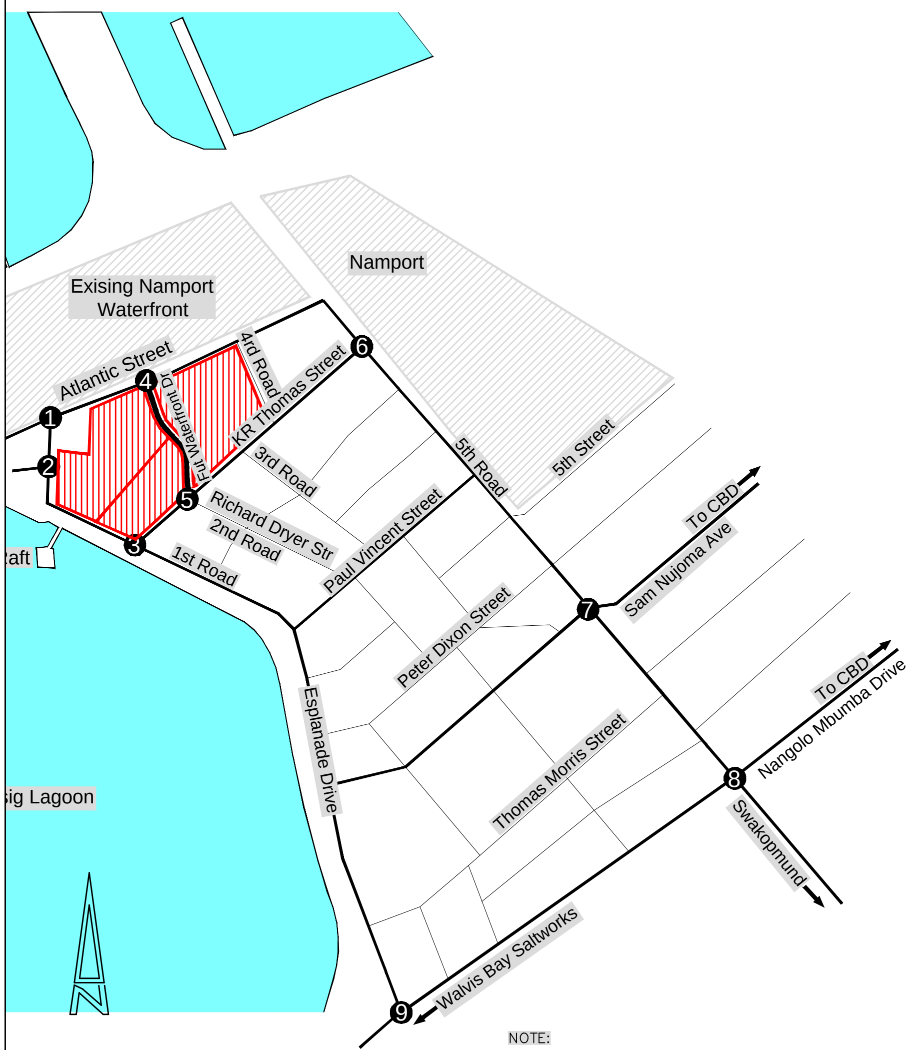


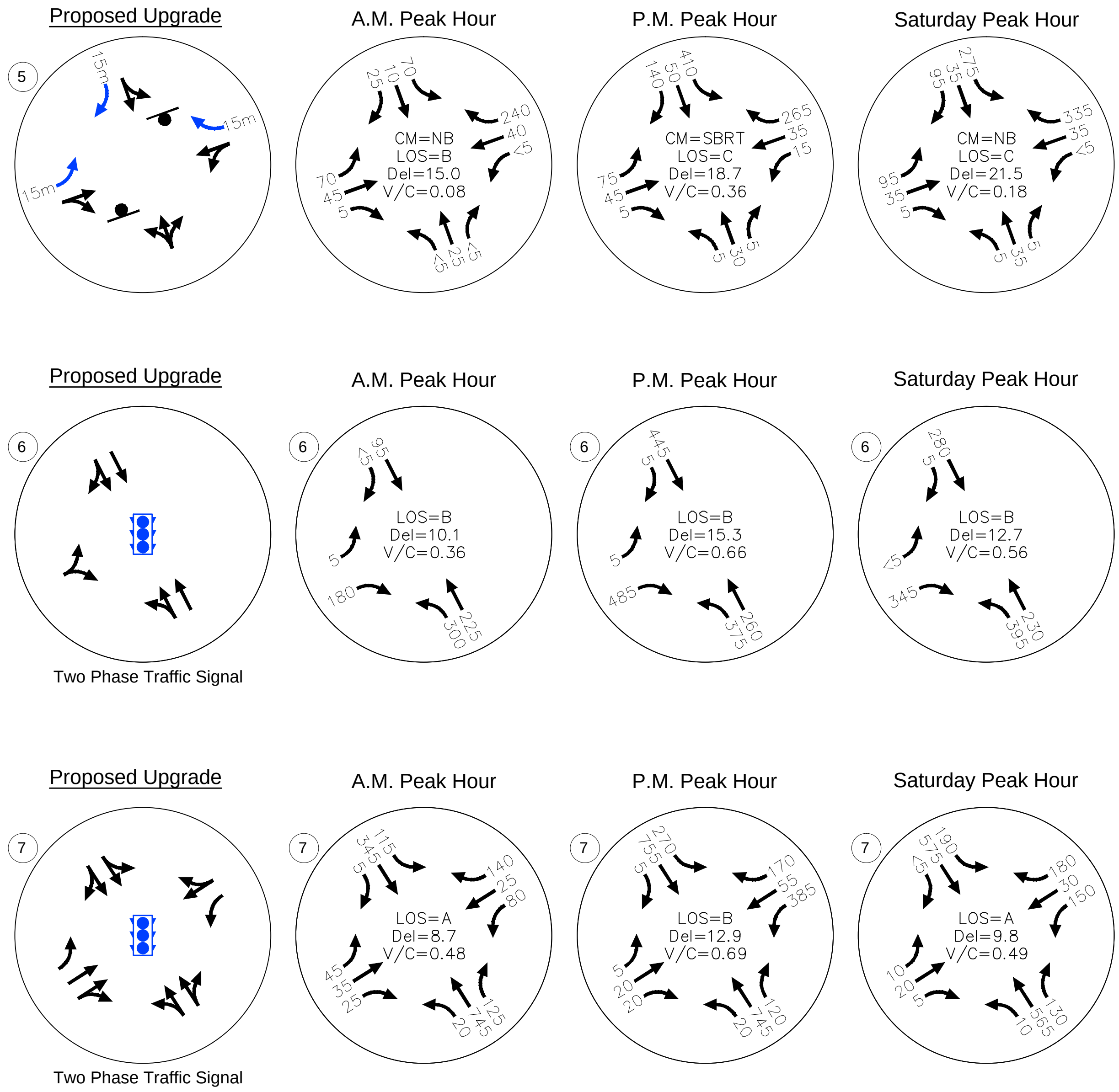
NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (SCENARIO 5) FULL DEVELOPMENT SATURDAY PEAK HOUR	12C

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO





NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN THIS FIGURE

its

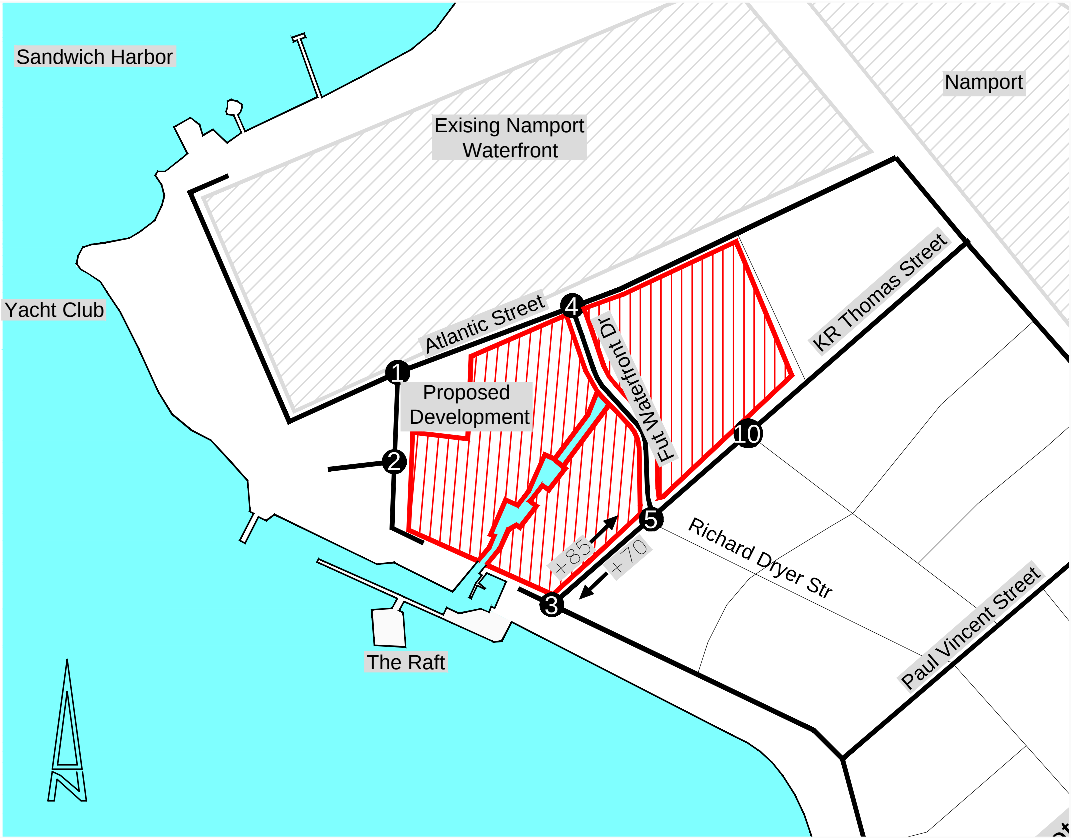
PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 5*) WITH UPGRADES	13

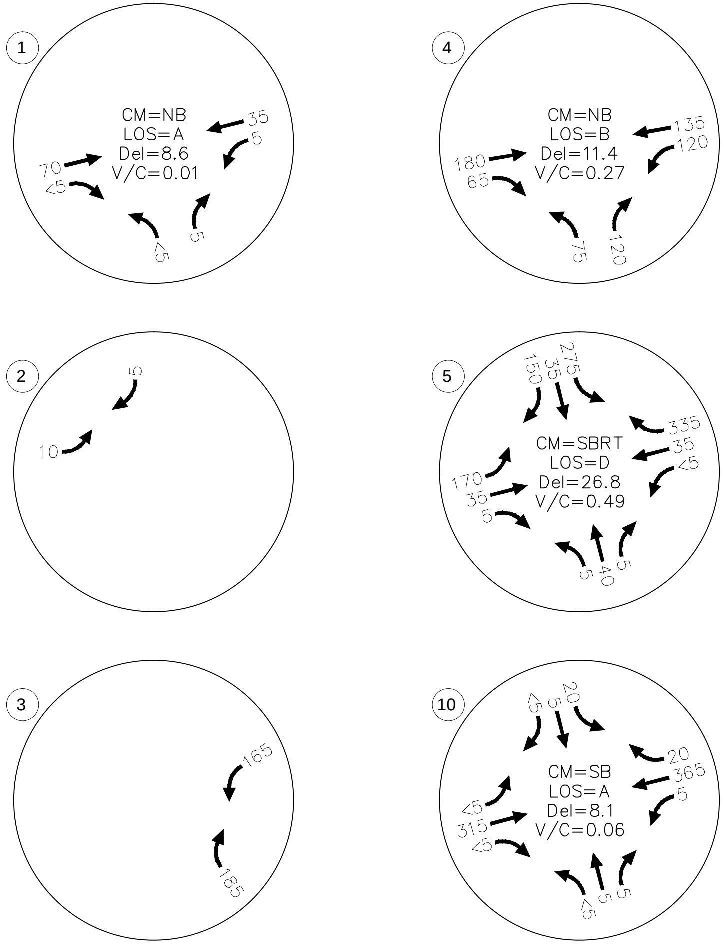
LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 6*) FULL DEVELOPMENT - WITH MARINA BOAT CANAL A.M. PEAK HOUR	14A

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 6*) FULL DEVELOPMENT - WITH MARINA BOAT CANAL P.M. PEAK HOUR	14B





LEGEND

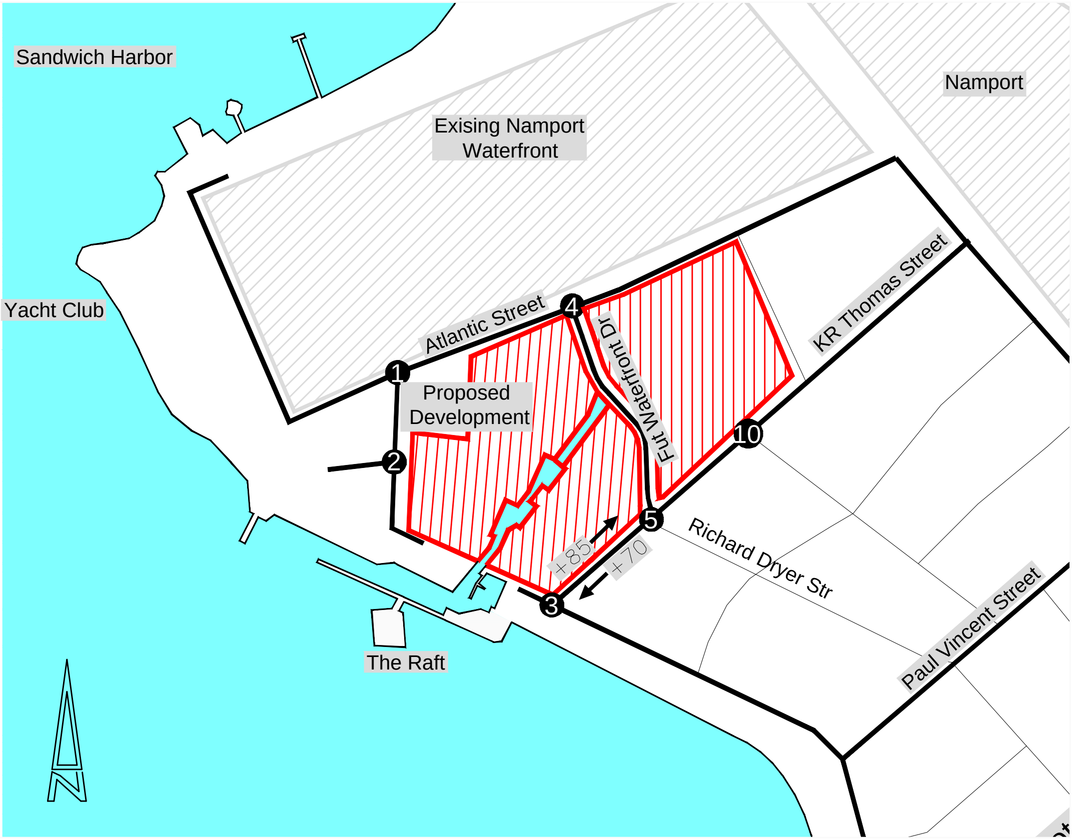
CM = CRITICAL MOVEMENT (UNSIGNALISED)

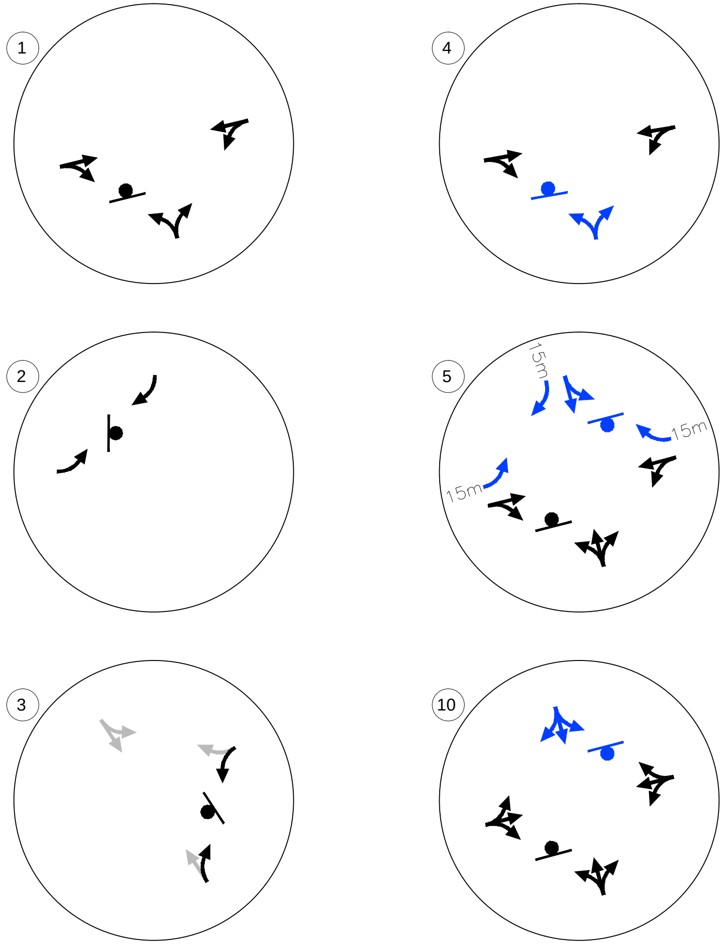
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT: WALVIS BAY WATERFRONT DEVELOPMENT	FIGURE: 2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 6*) FULL DEVELOPMENT - WITH MARINA BOAT CANAL SATURDAY PEAK HOUR	NUMBER: 14C





LEGEND

CM = CRITICAL MOVEMENT (UNSIGNALISED)

LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL LANE CONFIGURATION (*SCENARIO 6*) FULL DEVELOPMENT - WITH MARINA BOAT CANAL PROPOSED GEOMETRY	14D

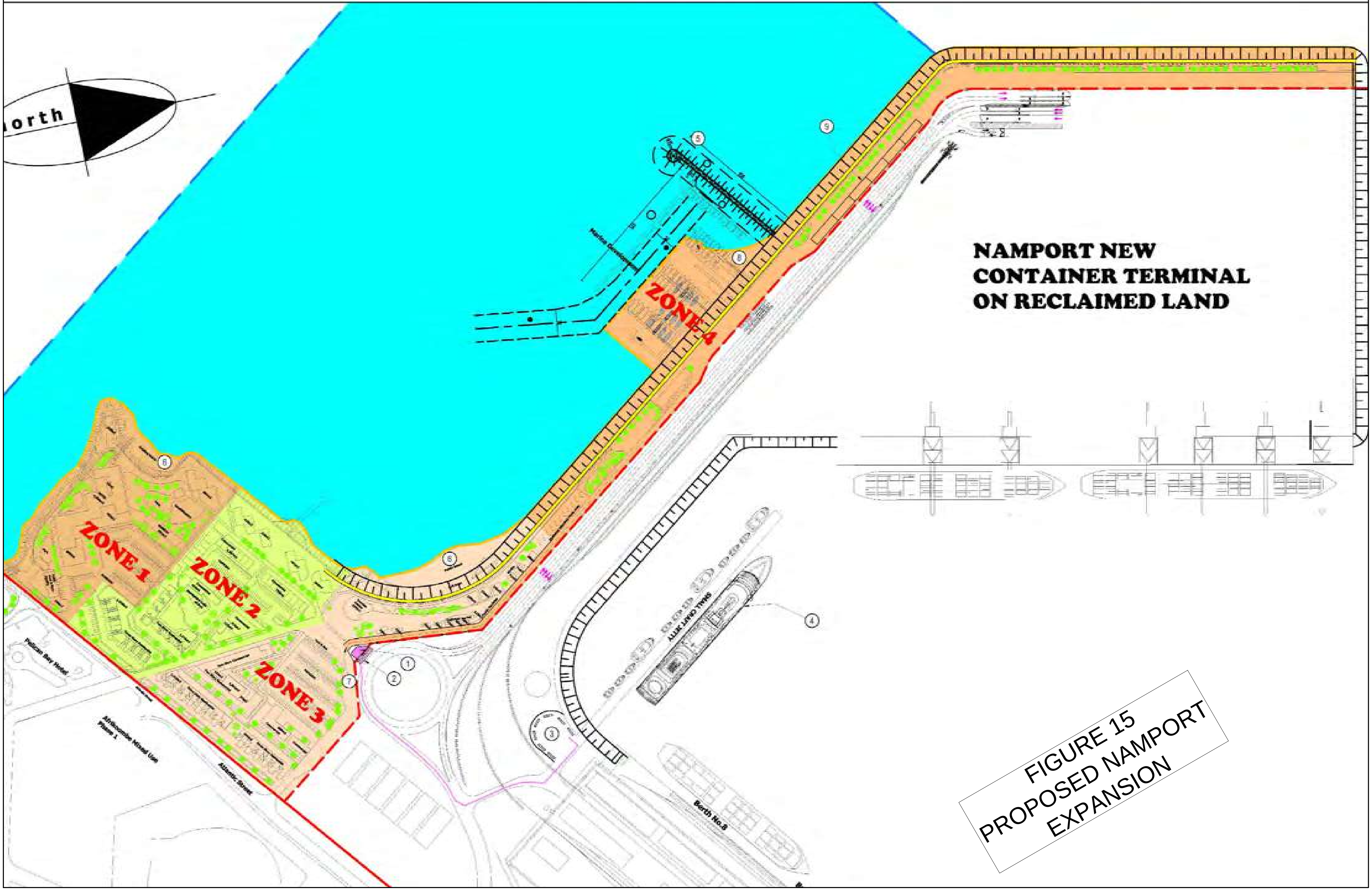
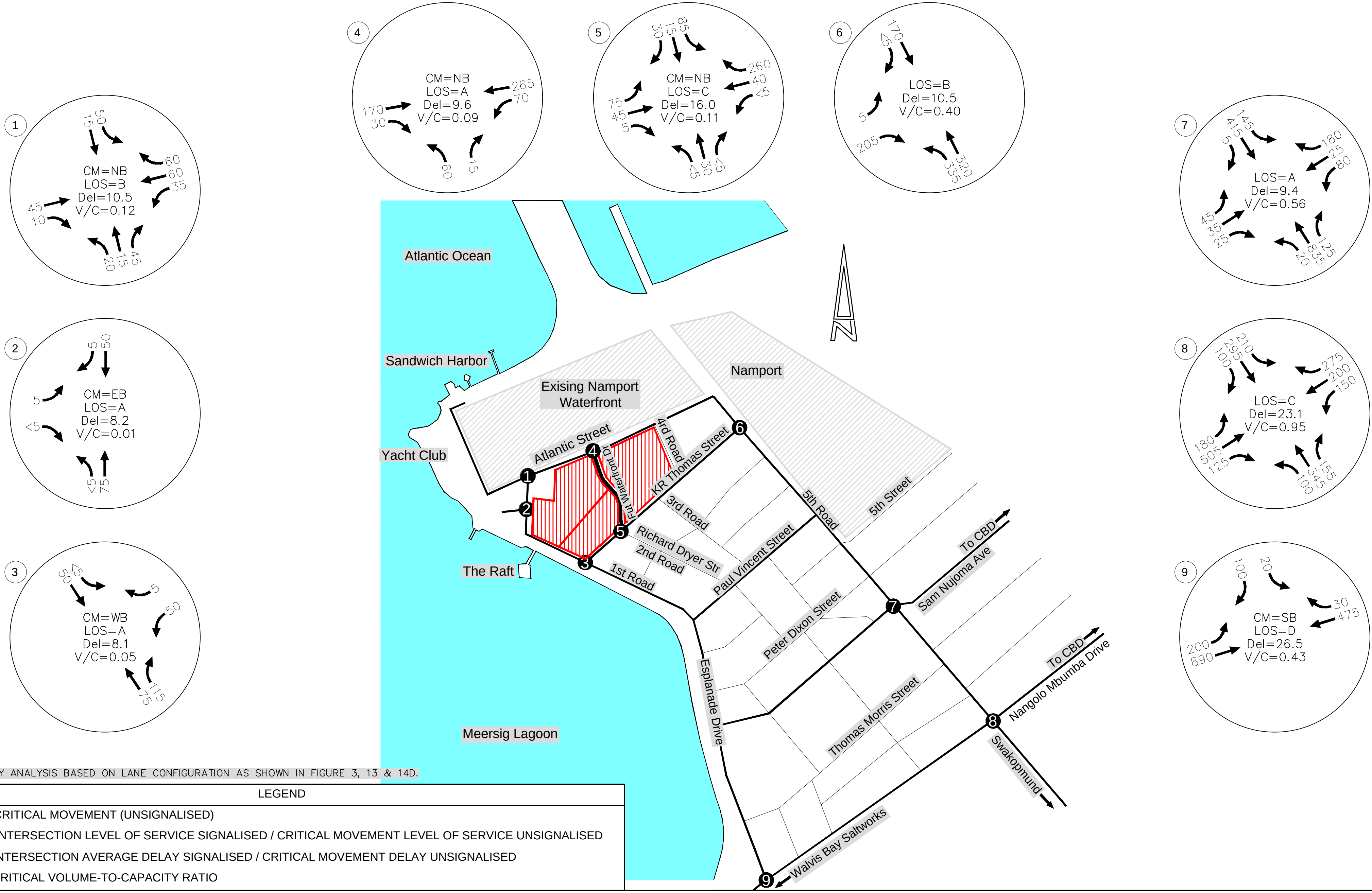


FIGURE 15
PROPOSED NAMPORT
EXPANSION



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3, 13 & 14D.

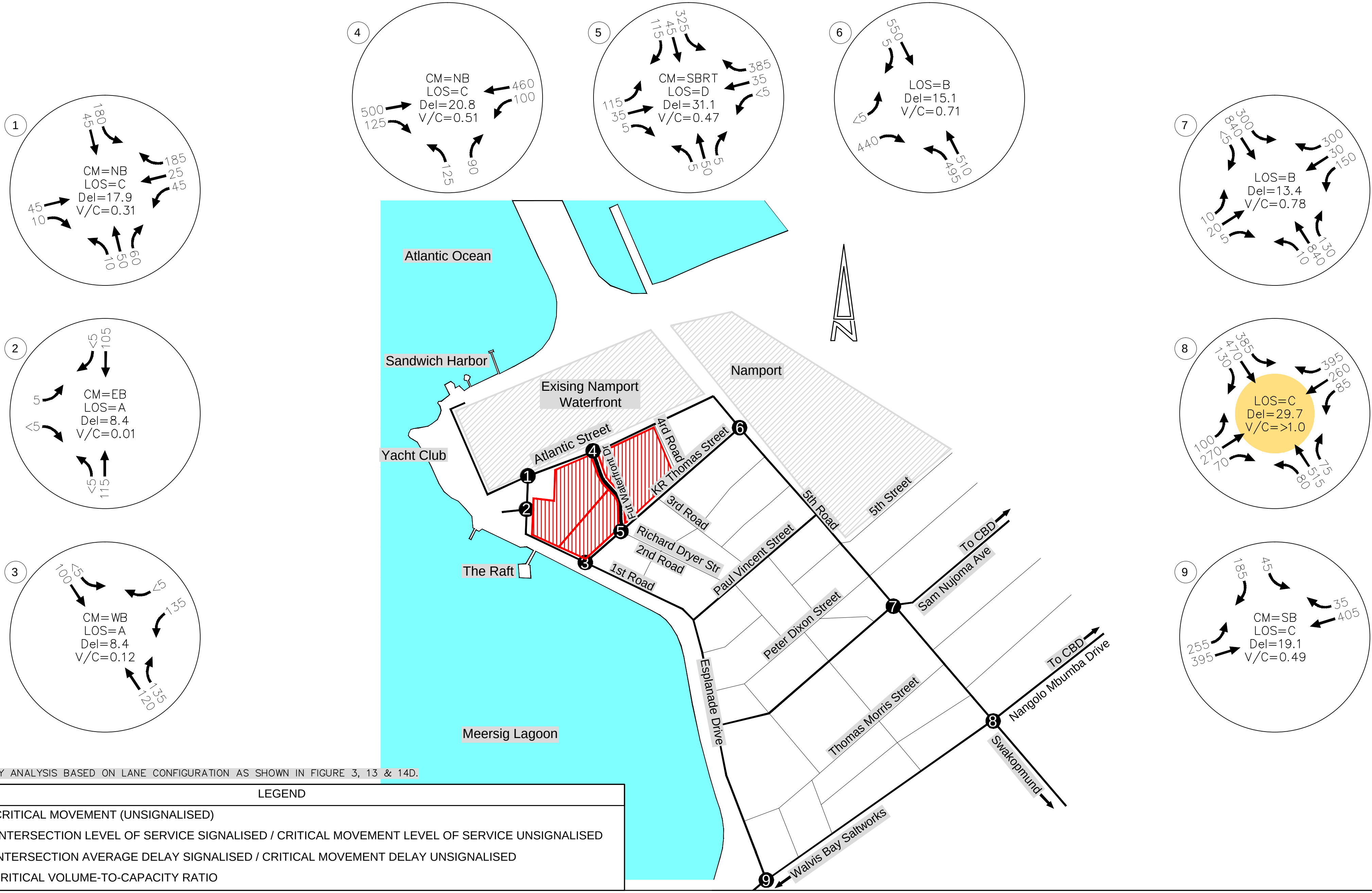
LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 7*) WALVIS BAY WATERFRONT WITH NAMPORT DEVELOPMENT A.M. PEAK HOUR	16A

NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3, 13 & 14D.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 7*) WALVIS BAY WATERFRONT WITH NAMPORT DEVELOPMENT P.M. PEAK HOUR	16B



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 3, 13 & 14D.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

its

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 7*) WALVIS BAY WATERFRONT WITH NAMPORT DEVELOPMENT SATURDAY PEAK HOUR	16C

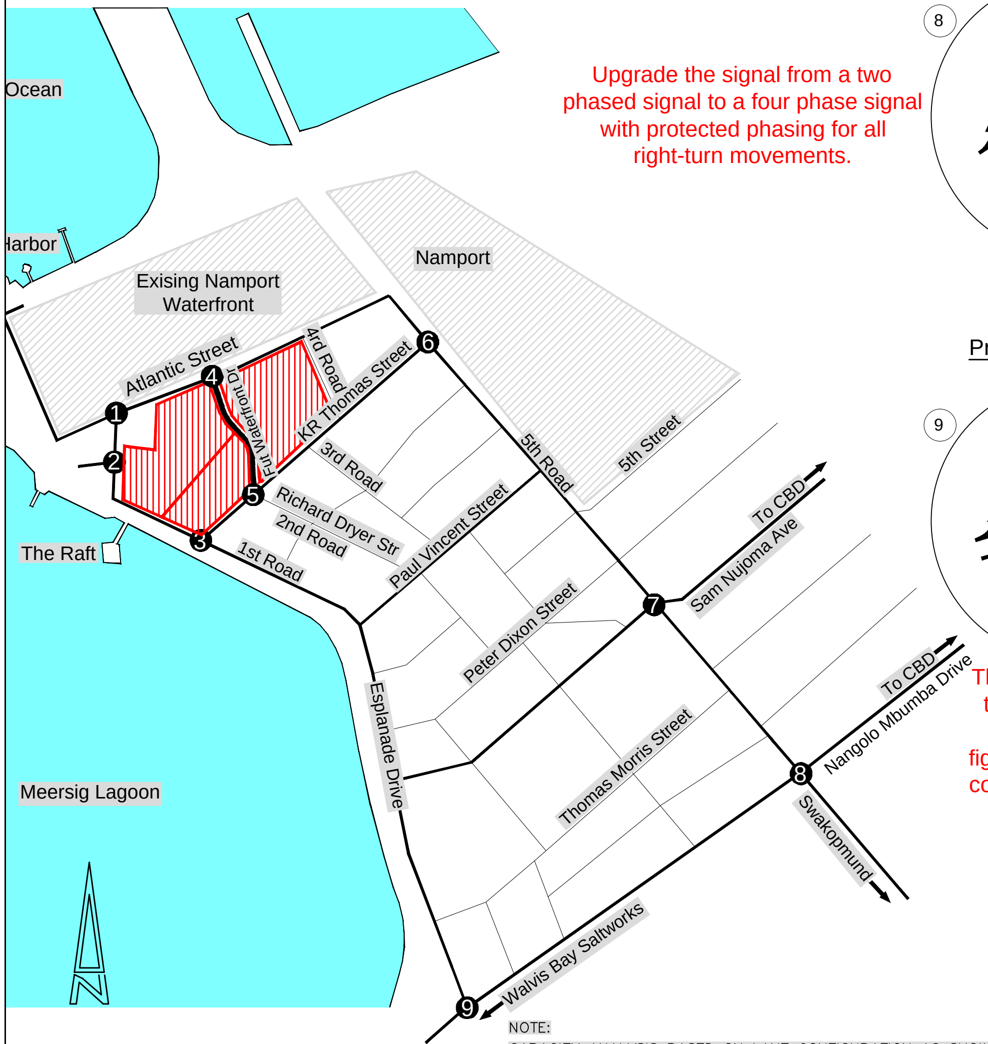
LEGEND

CM = CRITICAL MOVEMENT (UNSIGNALISED)

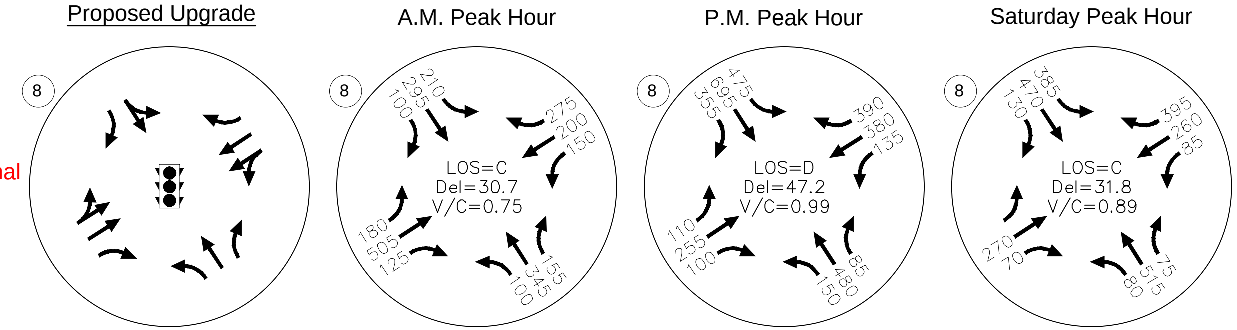
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

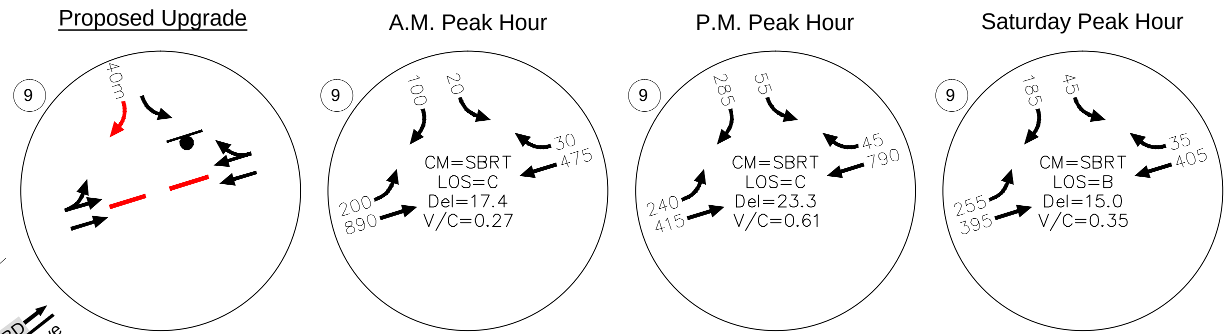
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO



Upgrade the signal from a two phased signal to a four phase signal with protected phasing for all right-turn movements.



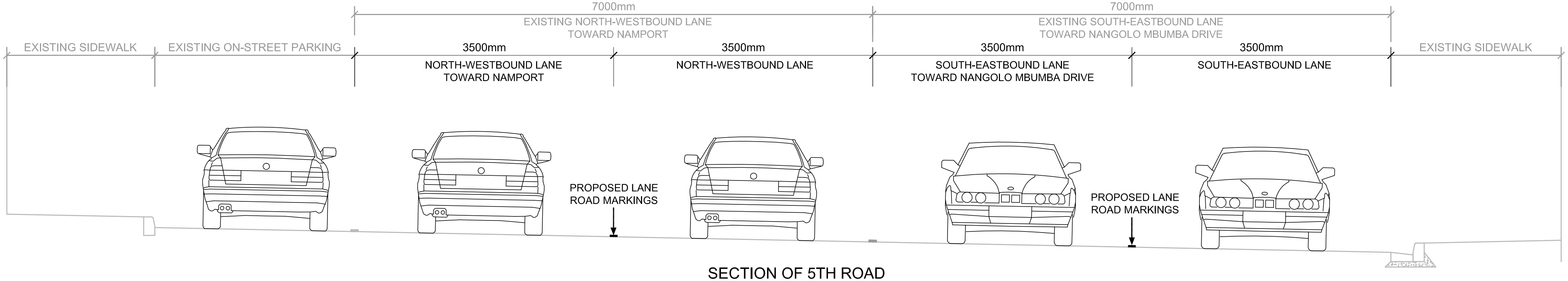


The Esplanade Approach to the intersection is already used as illustrated in this figure. A median island to be constructed min 6m in width.

NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN THIS FIGURE

its

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC CONDITIONS (*SCENARIO 7*) WALVIS BAY WATERFRONT WITH NAMPORT DEVELOPMENT PROPOSED UPGRADES	16D



SECTION OF 5TH ROAD

SCHEMATIC

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	5TH ROAD - EXISTING AND PROPOSED CROSS SECTION	17

NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS ILLUSTRATED ON FIGURE 13, 14D AND FIGURE 16D

LEGEND

CM = CRITICAL MOVEMENT (UNSIGNALISED)

LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

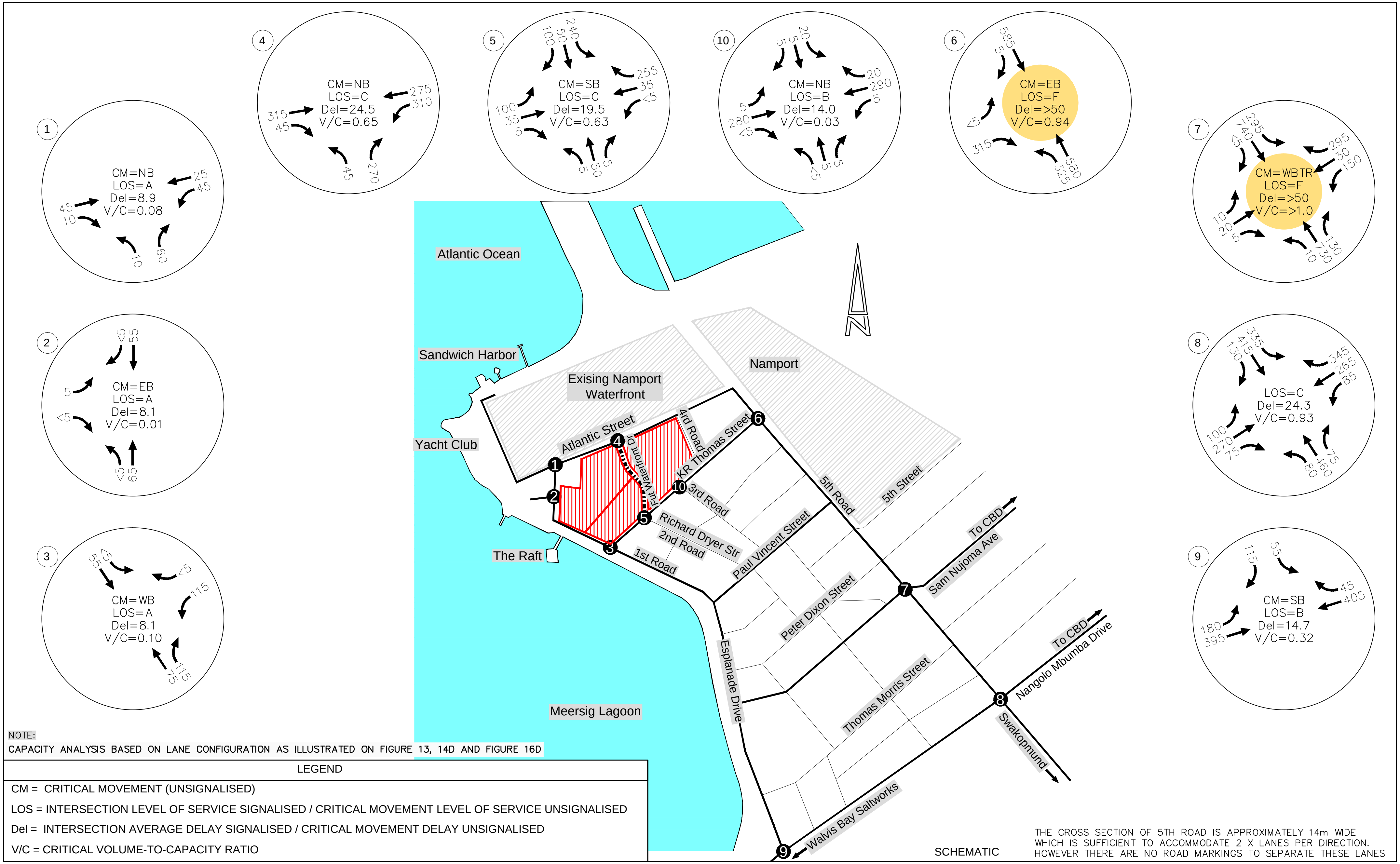
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 8) FULL WATERFRONT DEVELOPMENT + 15 000m² RETAIL AND 7 600m² OFFICE SPACE A.M. PEAK HOUR	18A

NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS ILLUSTRATED ON FIGURE 13, 14D AND FIGURE 16D

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

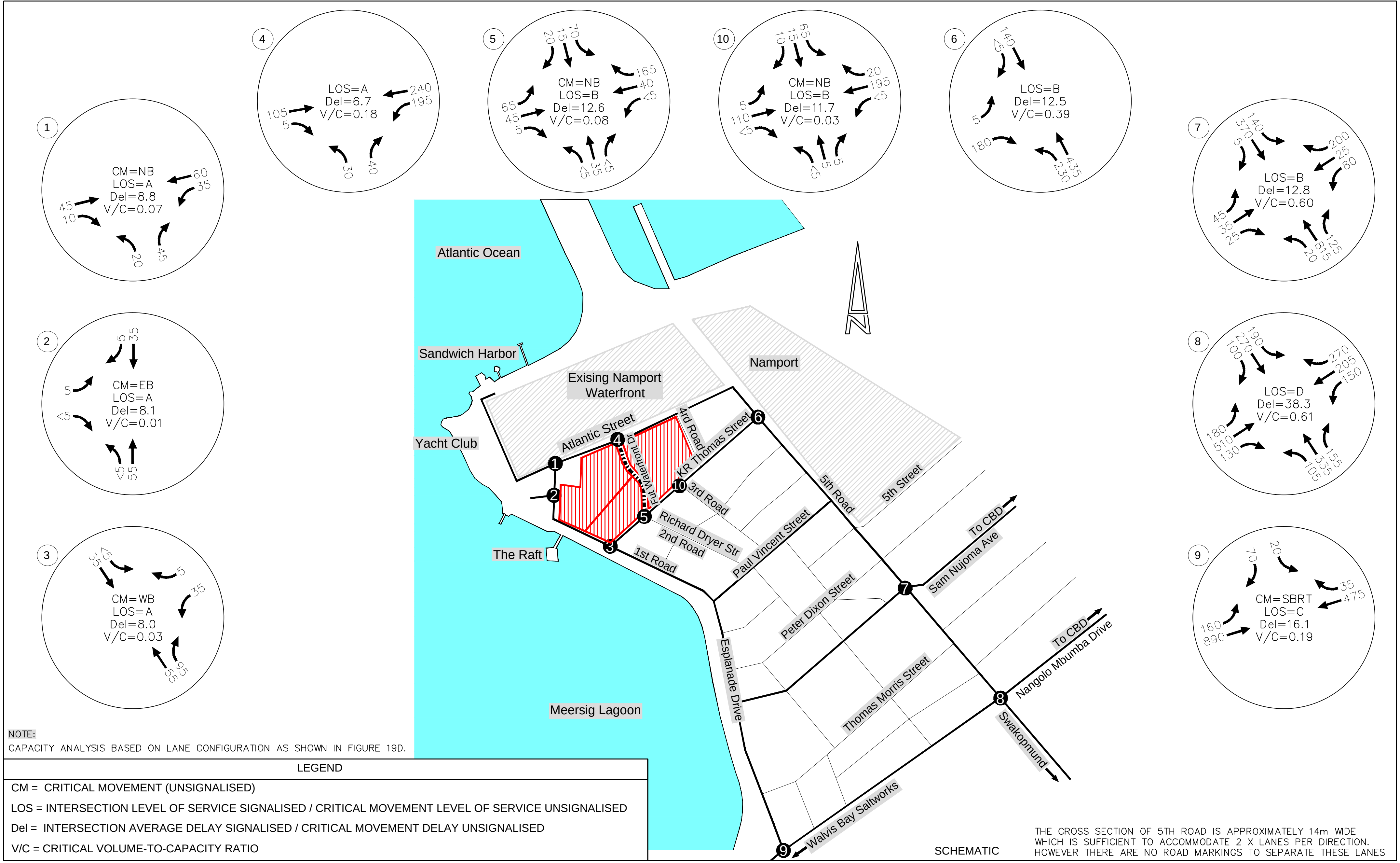
PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 8) FULL WATERFRONT DEVELOPMENT + 15 000m² RETAIL AND 7 600m² OFFICE SPACE P.M. PEAK HOUR	18B



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS ILLUSTRATED ON FIGURE 13, 14D AND FIGURE 16D

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 8) FULL WATERFRONT DEVELOPMENT + 15 000m² RETAIL AND 7 600m² OFFICE SPACE SATURDAY PEAK HOUR	18C



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 19D.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 8) - *WITH UPGRADES* FULL WATERFRONT DEVELOPMENT + 15 000m² RETAIL AND 7 600m² OFFICE SPACE A.M. PEAK HOUR	19A

NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 19D.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 8) - *WITH UPGRADES* FULL WATERFRONT DEVELOPMENT + 15 000m² RETAIL AND 7 600m² OFFICE SPACE P.M. PEAK HOUR	19B

NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 19D.

LEGEND

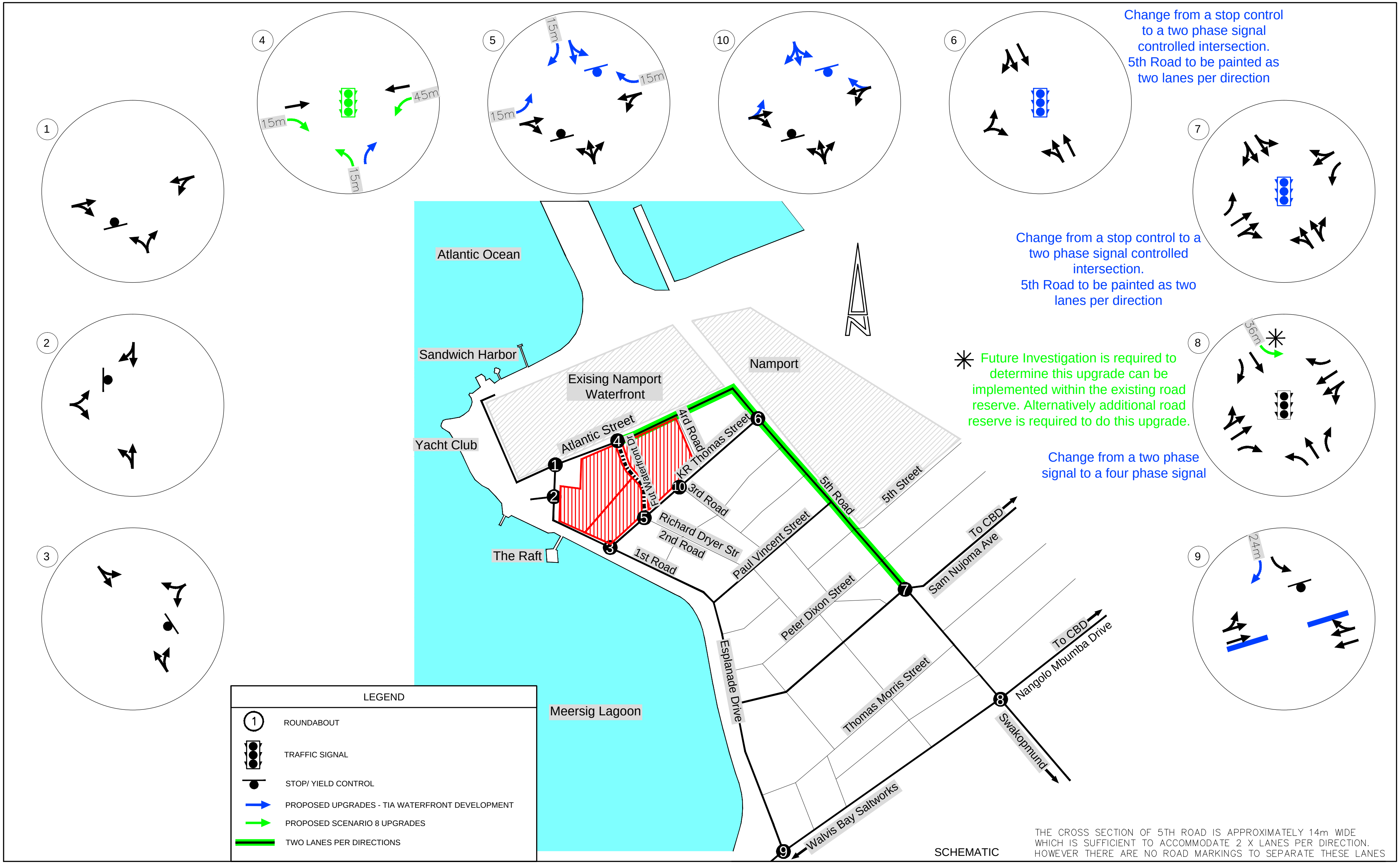
CM = CRITICAL MOVEMENT (UNSIGNALISED)

LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

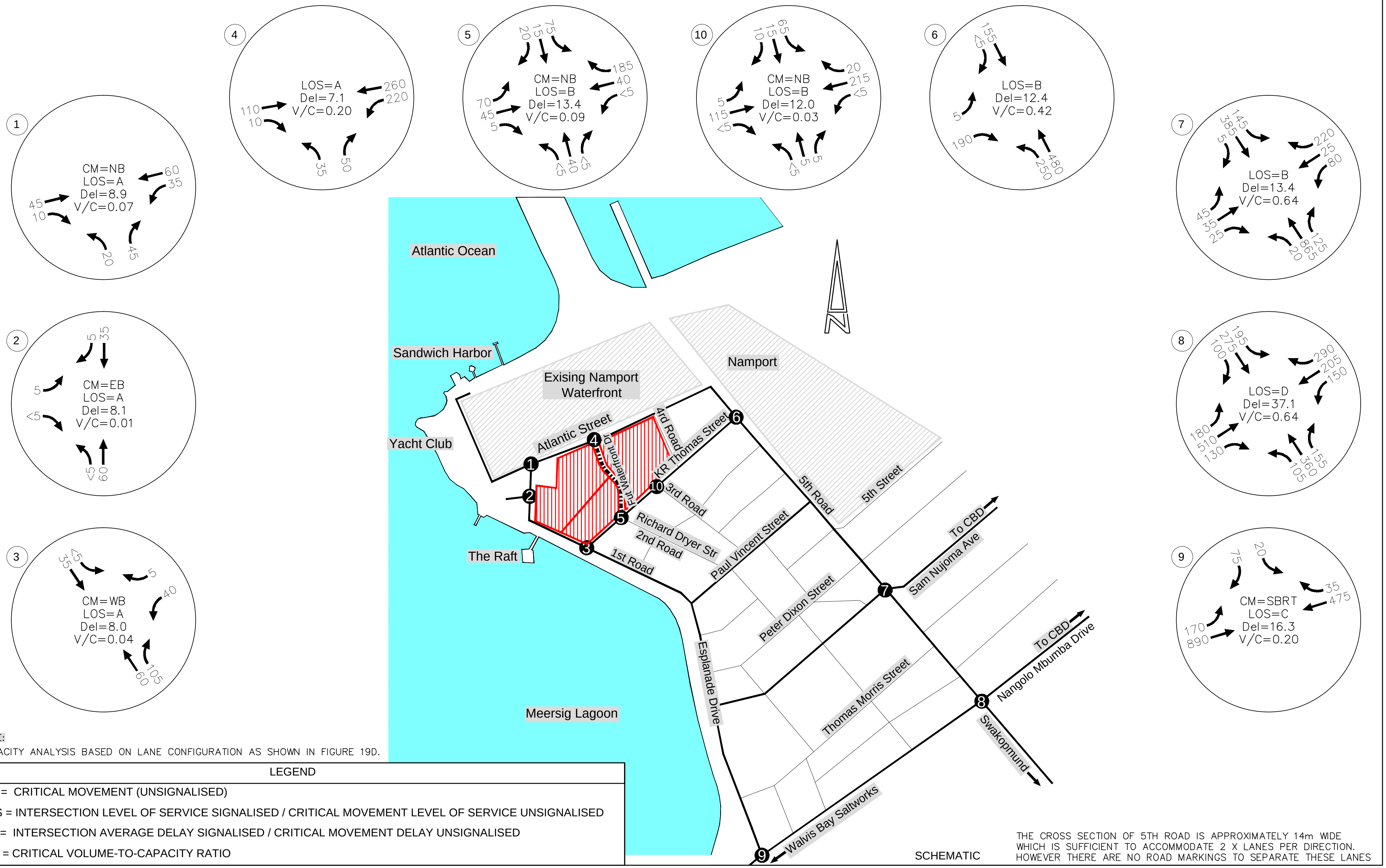
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 8) - *WITH UPGRADES* FULL WATERFRONT DEVELOPMENT + 15 000m² RETAIL AND 7 600m² OFFICE SPACE SATURDAY PEAK HOUR	19C



its

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 8) PROPOSED GEOMETRY	19D



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 19D.

LEGEND

CM = CRITICAL MOVEMENT (UNSIGNALISED)

LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

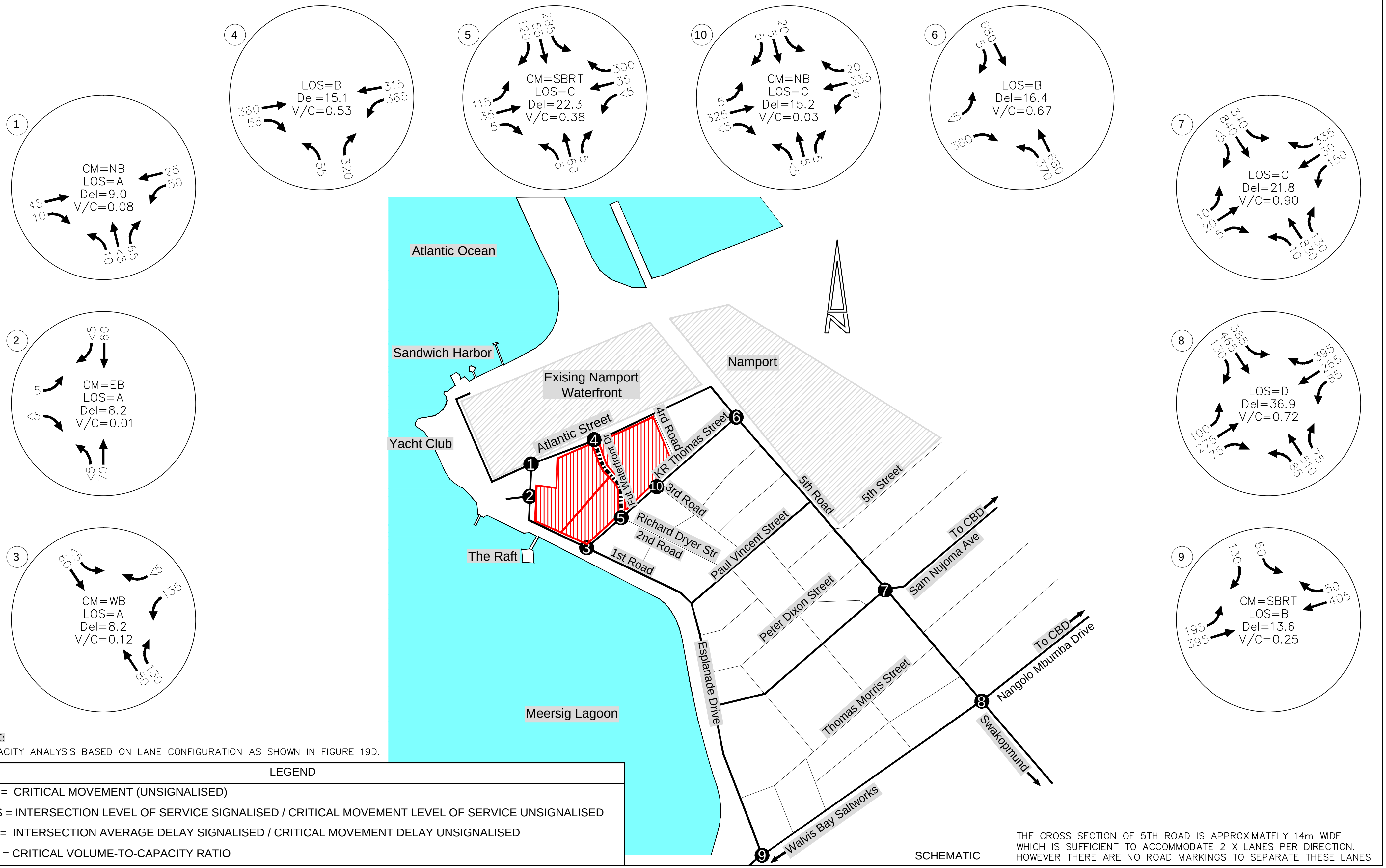
PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 9) FULL WATERFRONT DEVELOPMENT + 25 000m² RETAIL AND 12 600m² OFFICE SPACE - A.M. PEAK HOUR	20A

NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 19D.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

THE CROSS SECTION OF 5TH ROAD IS APPROXIMATELY 14m WIDE WHICH IS SUFFICIENT TO ACCOMMODATE 2 X LANES PER DIRECTION. HOWEVER THERE ARE NO ROAD MARKINGS TO SEPARATE THESE LANES

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 9) FULL WATERFRONT DEVELOPMENT + 25 000m² RETAIL AND 12 600m² OFFICE SPACE - P.M. PEAK HOUR	20B



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 19D.

LEGEND

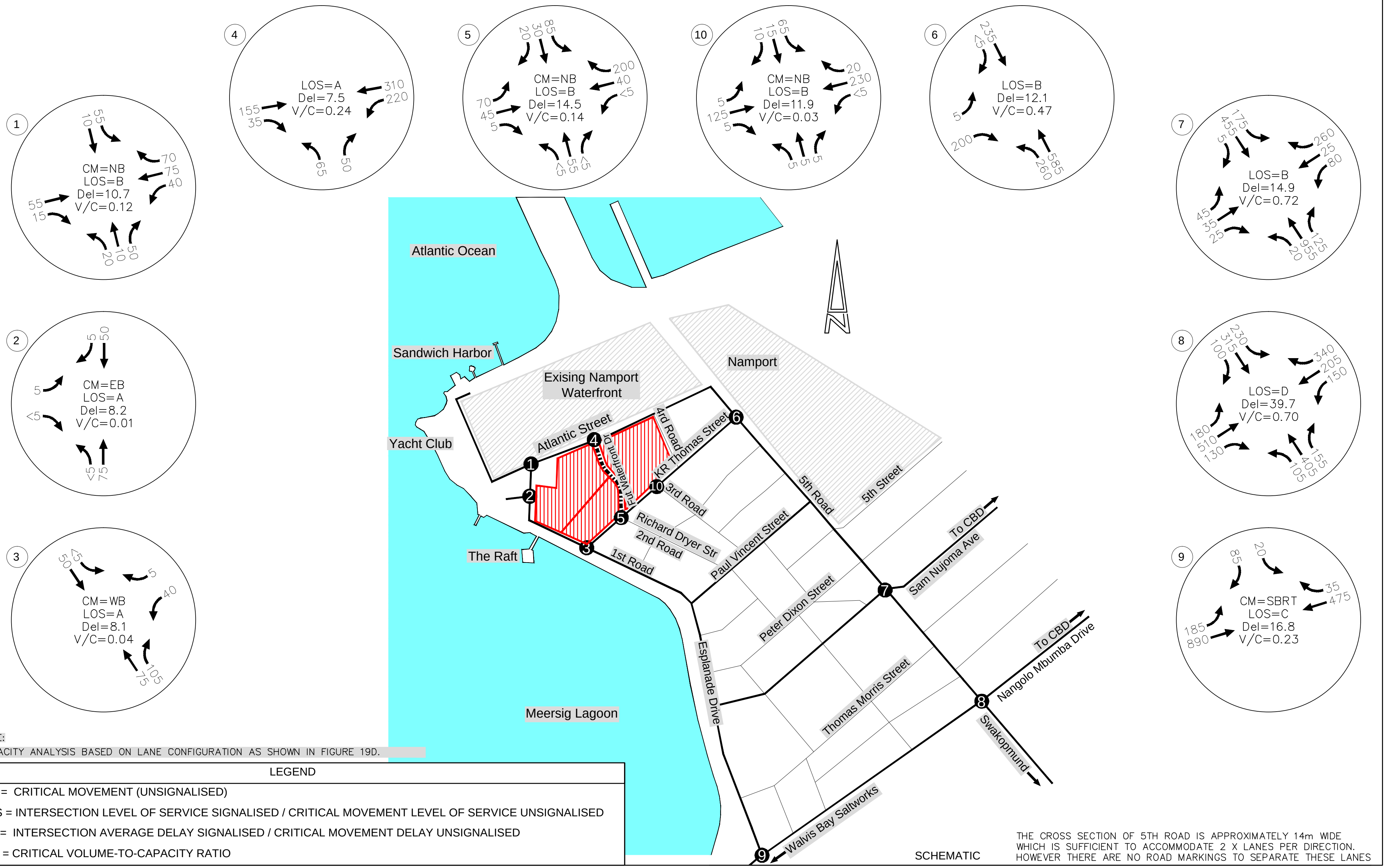
CM = CRITICAL MOVEMENT (UNSIGNALISED)

LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 9) FULL WATERFRONT DEVELOPMENT + 25 000m² RETAIL AND 12 600m² OFFICE SPACE - SATURDAY PEAK HOUR	20C



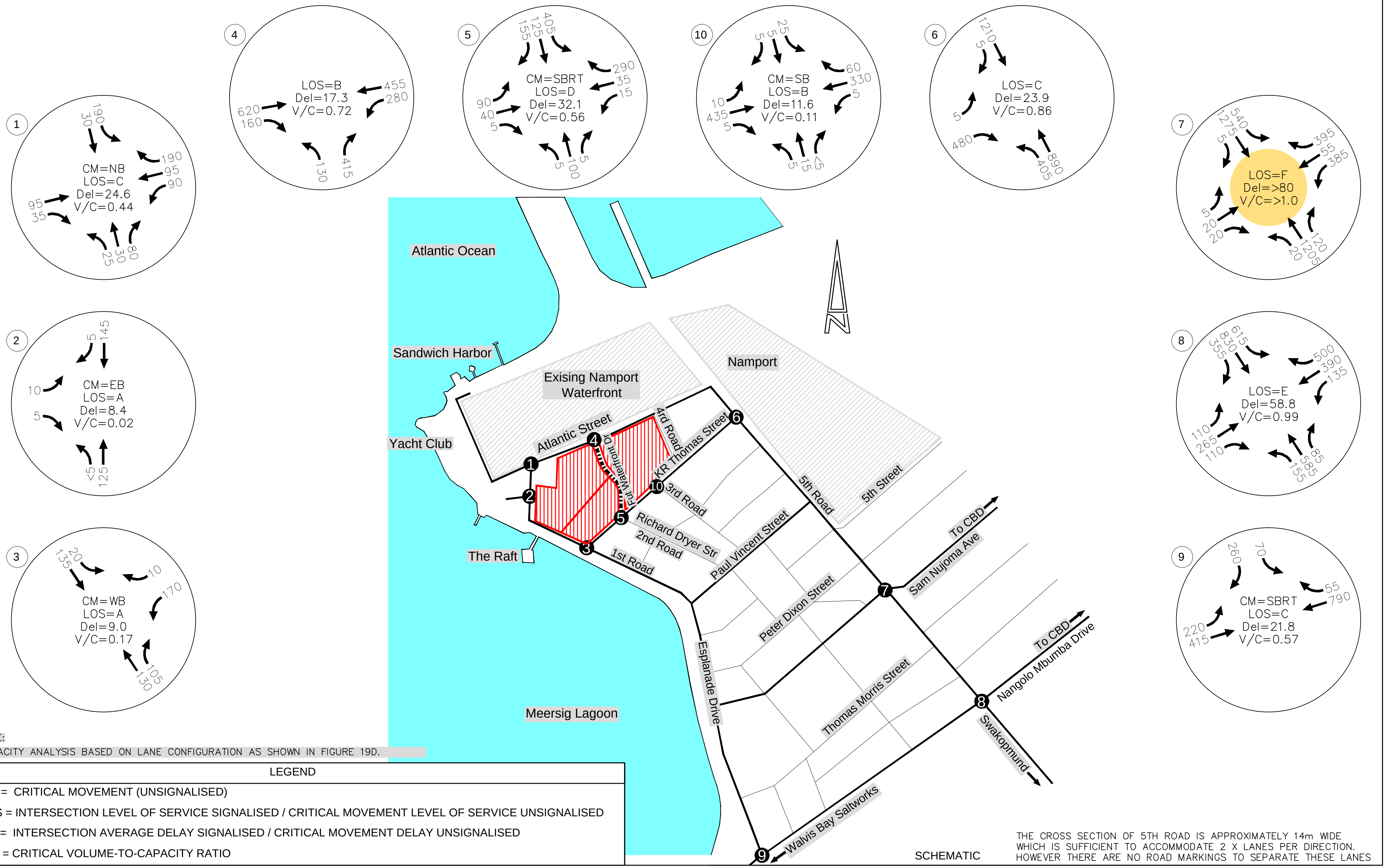
NOTE:

CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 19D.

LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALISED)
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

its

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 10) FULL WATERFRONT DEVELOPMENT + 25 000m² RETAIL AND 12 600m² OFFICE SPACE WITH NAMPORT DEVELOPMENT TRIPS - A.M. PEAK HOUR	21A



NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 19D.

LEGEND

CM = CRITICAL MOVEMENT (UNSIGNALISED)

LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 10) FULL WATERFRONT DEVELOPMENT + 25 000m² RETAIL AND 12 600m² OFFICE SPACE WITH NAMPORT DEVELOPMENT TRIPS - P.M. PEAK HOUR	21B

NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN IN FIGURE 19D.

LEGEND

CM = CRITICAL MOVEMENT (UNSIGNALISED)

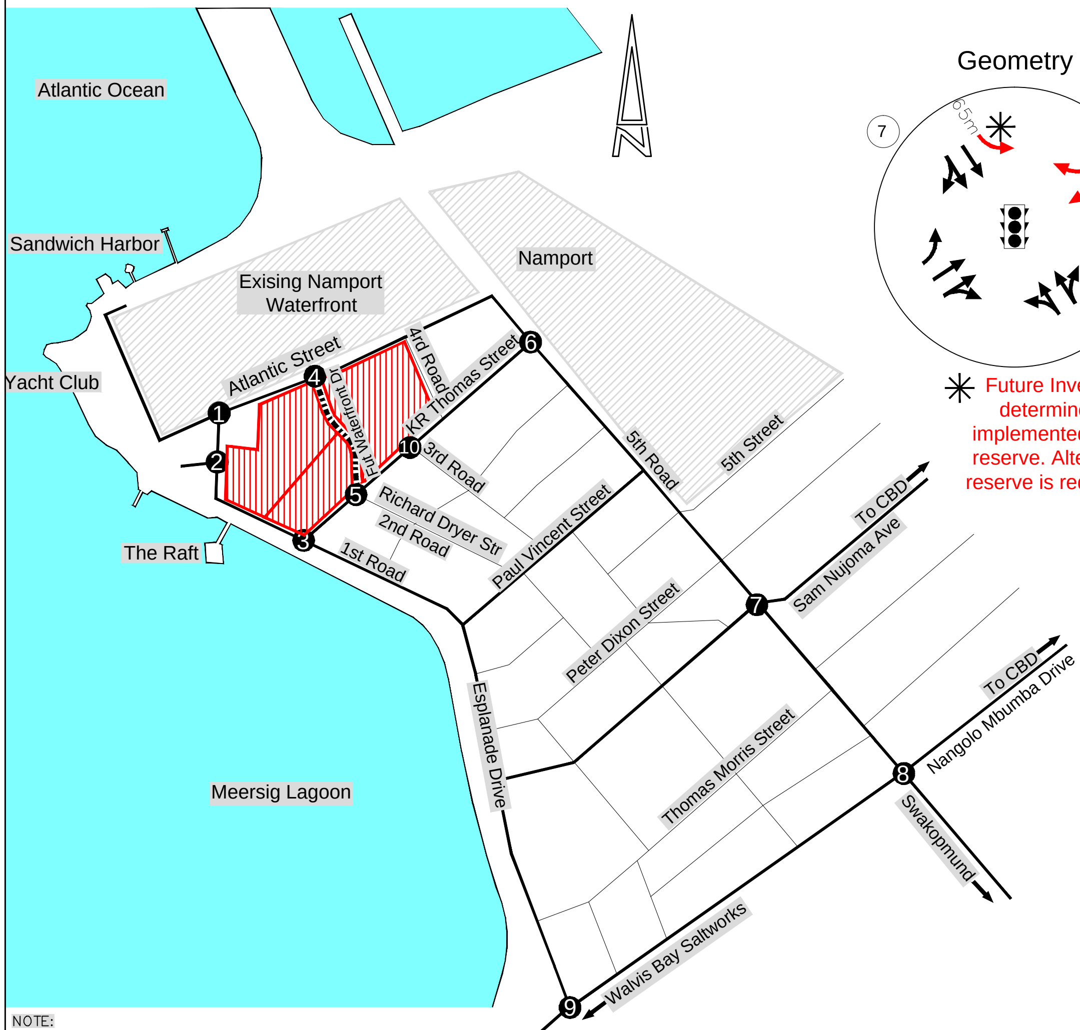
LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

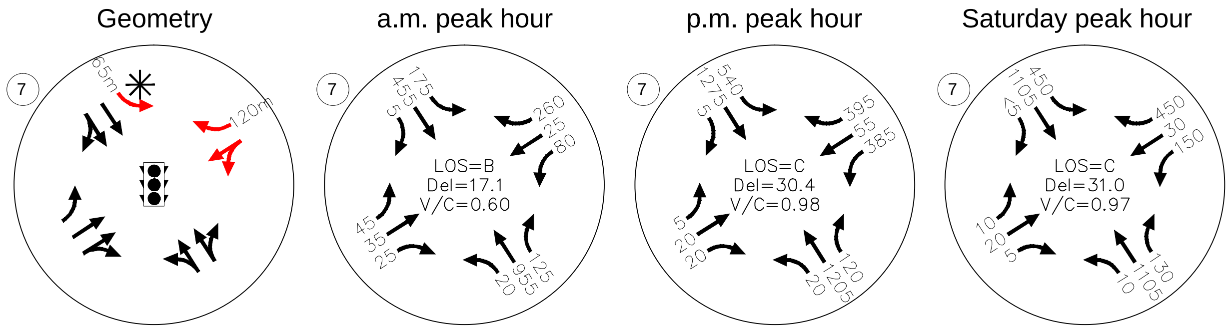
Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

its

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 10) FULL WATERFRONT DEVELOPMENT + 25 000m² RETAIL AND 12 600m² OFFICE SPACE WITH NAMPORT DEVELOPMENT TRIPS - SATERDAY PEAK HOUR	21C





✳ Future Investigation is required to determine this upgrade can be implemented within the existing road reserve. Alternatively additional road reserve is required to do this upgrade.

NOTE:
CAPACITY ANALYSIS BASED ON LANE CONFIGURATION AS SHOWN on this figure .

LEGEND

CM = CRITICAL MOVEMENT (UNSIGNALISED)

LOS = INTERSECTION LEVEL OF SERVICE SIGNALISED / CRITICAL MOVEMENT LEVEL OF SERVICE UNSIGNALISED

Del = INTERSECTION AVERAGE DELAY SIGNALISED / CRITICAL MOVEMENT DELAY UNSIGNALISED

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

→ PROPOSED SCENARIO 3 UPGRADES

SCHEMATIC

THE CROSS SECTION OF 5TH ROAD IS APPROXIMATELY 14m WIDE WHICH IS SUFFICIENT TO ACCOMMODATE 2 X LANES PER DIRECTION. HOWEVER THERE ARE NO ROAD MARKINGS TO SEPARATE THESE LANES

PROJECT:	FIGURE:	NUMBER:
WALVIS BAY WATERFRONT DEVELOPMENT	2022 TOTAL TRAFFIC (SCENARIO 10) PROPOSED GEOMETRY AND OPERATIONS	21D

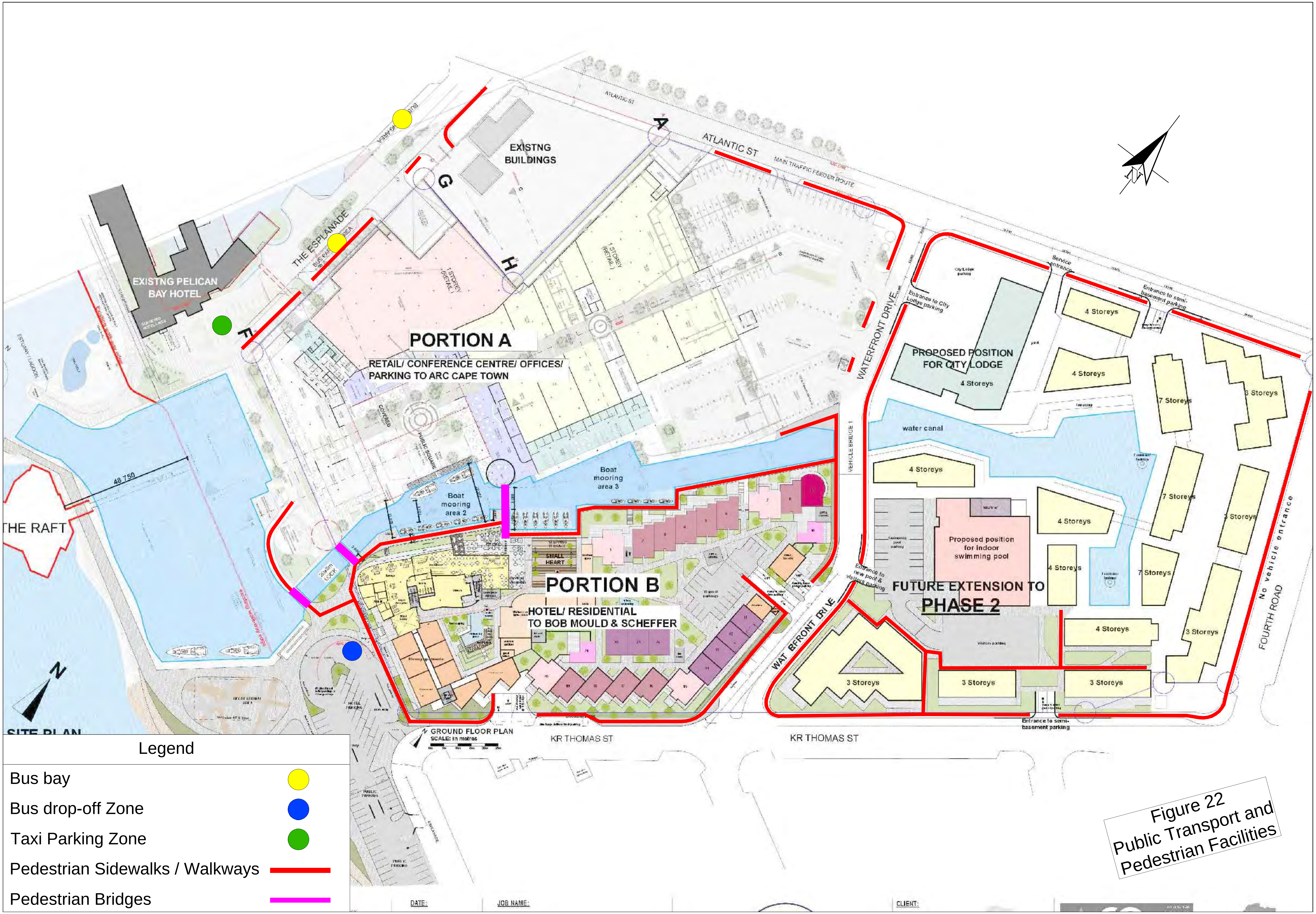


Figure 22
Public Transport and Pedestrian Facilities

Annexure B - Tables

Table 2: Trip Generation Rates – Phase 1A

Land Use	Units	Source	Size	Weekday AM Peak Hour					Public Transport
				Rate	In	Out	Internal	Pass-by	
Retail	m^2	COTO 820	10 000	1,53	65%	35%	15%	0%	20%
Restaurant	m^2	COTO 150	3 750	0,75	70%	30%	10%	0%	20%
Conference Centre	seats	COTO 780	1 000	0,50	90%	10%	10%	0%	20%
Office	m^2	COTO 710	7 400	2,10	85%	15%	20%	0%	20%
Land Use	**Units**	**Source**	**Size**	**Weekday PM Peak Hour**					**Public Transport**
				Rate	**In**	**Out**	**Internal**	**Pass-by**	
Retail	m^2	COTO 820	10 000	8,69	50%	50%	10%	10%	20%
Restaurant	m^2	COTO 150	3 750	11,80	40%	60%	10%	0%	20%
Conference Centre	seats	COTO 780	1 000	0,50	10%	90%	5%	0%	20%
Office	m^2	COTO 710	7 405	2,10	20%	80%	15%	0%	20%
Land Use	**Units**	**Source**	**Size**	**Saturday Lunch Peak Hour**					**Public Transport**
				Rate	**In**	**Out**	**Internal**	**Pass-by**	
Retail	m^2	COTO 820	10 000	11,50	50%	50%	10%	10%	20%
Restaurant	m^2	COTO 150	3 750	11,00	60%	40%	15%	0%	20%
Conference Centre	seats	COTO 780	1 000	0,25	50%	50%	10%	0%	20%
Office	m^2	COTO 710	7 405	0,45	55%	45%	10%	0%	20%

Table 3: Expected Development Trips – Phase 1A

Land Use	Trip type	Weekday AM			Weekday PM			Saturday Lunch		
		In	Out	Total	In	Out	Total	In	Out	Total
Retail	Driveway Trips	100	54	153	434	434	869	575	575	1150
Restaurant		20	8	28	177	266	443	248	165	413
Conference Centre		450	50	500	50	450	500	125	125	250
Office		132	23	155	31	124	156	18	15	33
Total		701	135	837	693	1274	1967	966	880	1846
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Retail	Driveway Trips minus public transport	70	38	107	304	304	608	403	403	805
Restaurant		14	6	20	124	186	310	173	116	289
Conference Centre		315	35	350	35	315	350	88	88	175
Office		92	16	109	22	87	109	13	10	23
Total		491	95	586	485	892	1377	676	616	1292
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Retail	Internal Trips	15	8	23	43	43	87	58	58	115
Restaurant		2	1	3	18	27	44	37	25	62
Conference Centre		45	5	50	3	23	25	13	13	25
Office		26	5	31	5	19	23	2	1	3
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Retail	Pass-by Trips	0	0	0	4	4	9	6	6	12
Restaurant		0	0	0	0	0	0	0	0	0
Conference Centre		0	0	0	0	0	0	0	0	0
Office		0	0	0	0	0	0	0	0	0
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Retail	Public Transport trips	10	5	15	43	43	87	58	58	115
Restaurant		2	1	3	18	27	44	25	17	41
Conference Centre		45	5	50	5	45	50	13	13	25
Office		13	2	16	3	12	16	2	1	3
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Retail	Net New Trips	65	35	100	300	300	600	397	397	794
Restaurant		14	6	20	124	186	310	161	107	268
Conference Centre		315	35	350	38	338	375	88	88	175
Office		79	14	93	20	81	101	13	10	23
TOTAL TRIPS		473	90	563	481	904	1385	658	602	1260

Table 4: Trip Generation Rates – Phase 1B

Land Use	Units	Source	Size	Weekday AM Peak Hour					Public Transport
				Rate	In	Out	Internal	Pass-by	
Hotel	Rooms	COTO310	140	0,50	60%	40%	10%	0%	15%
Residential (Flats)	Units	COTO220	120	0,65	25%	75%	10%	0%	15%
Land Use	**Units**	**Source**	**Size**	**Weekday PM Peak Hour**					**Public Transport**
				Rate	**In**	**Out**	**Internal**	**Pass-by**	
Hotel	Rooms	COTO310	140	0,50	55%	45%	10%	0%	15%
Residential (Flats)	Units	COTO220	120	0,65	70%	30%	10%	0%	15%
Land Use	**Units**	**Source**	**Size**	**Saturday Lunch Peak Hour**					**Public Transport**
				Rate	**In**	**Out**	**Internal**	**Pass-by**	
Hotel	Rooms	COTO310	140	0,70	50%	50%	10%	0%	15%
Residential (Flats)	Units	COTO220	120	0,35	50%	50%	10%	0%	15%

Table 5: Expected Development Trips – Phase 1B

Land Use	Trip type	Weekday AM			Weekday PM			Saturday Lunch		
		In	Out	Total	In	Out	Total	In	Out	Total
Hotel	Driveway Trips	42	28	70	39	32	70	49	49	98
Residential (Flats)		20	59	78	55	23	78	21	21	42
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Hotel	Driveway Trips minus public transport	29	20	49	27	22	49	34	34	69
Residential (Flats)		14	41	55	38	16	55	15	15	29
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Hotel	Internal Trips	4	3	7	4	3	7	5	5	10
Residential (Flats)		2	6	8	5	2	8	2	2	4
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Hotel	Public transport trips	4	3	7	4	3	7	5	5	10
Residential (Flats)		2	6	8	5	2	8	2	2	4
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Hotel	Net New Trips	29	20	49	27	22	49	34	34	69
Residential (Flats)		14	41	55	38	16	55	15	15	29
TOTAL TRIPS		43	61	104	65	38	104	49	49	98

Table 6: Trip Generation Rates – Phase 2

Land Use	**Units**	**Source**	**Size**	**Weekday AM Peak Hour**					**Public Transport**
				Rate	**In**	**Out**	**Internal**	**Pass-by**	
Hotel	Rooms	COTO310	120	0,50	60%	40%	10%	0%	15%
Residential (Flats)	Units	COTO220	282	0,65	25%	75%	10%	0%	15%
Land Use	**Units**	**Source**	**Size**	**Weekday PM Peak Hour**					**Public Transport**
				Rate	**In**	**Out**	**Internal**	**Pass-by**	
Hotel	Rooms	COTO310	120	0,50	55%	45%	10%	0%	15%
Residential (Flats)	Units	COTO220	282	0,65	70%	30%	10%	0%	15%
Land Use	**Units**	**Source**	**Size**	**Saturday Lunch Peak Hour**					**Public Transport**
				Rate	**In**	**Out**	**Internal**	**Pass-by**	
Hotel	Rooms	COTO310	120	0,70	50%	50%	15%	0%	15%
Residential (Flats)	Units	COTO220	282	0,35	50%	50%	15%	0%	15%

Table 7: Expected Development Trips – Phase 2

Land Use	Trip type	Weekday AM			Weekday PM			Saturday Lunch		
		In	Out	Total	In	Out	Total	In	Out	Total
Hotel	Driveway Trips	36	24	60	33	27	60	42	42	84
Residential (Flats)		46	137	183	128	55	183	49	49	99
Total		82	161	243	161	82	243	91	91	183
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Hotel	Driveway Trips minus public transport	25	17	42	23	19	42	29	29	59
Residential (Flats)		32	96	128	90	38	128	35	35	69
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Hotel	Internal Trips	4	2	6	3	3	6	6	6	13
Residential (Flats)		5	14	18	13	5	18	7	7	15
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Hotel	Public transport trips	4	2	6	3	3	6	4	4	8
Residential (Flats)		5	14	18	13	5	18	5	5	10
Land Use	**Trip type**	**Weekday AM**			**Weekday PM**			**Saturday Lunch**		
		In	**Out**	**Total**	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Hotel	Net New Trips	25	17	42	23	19	42	27	27	55
Residential (Flats)		32	96	128	90	38	128	32	32	64
TOTAL TRIPS		57	113	170	113	57	170	59	59	119

Annexure C - Photographs

Photo 1: North-Westbound View along 5th Road approaching KR Thomas Str

Photo 2: North-Eastbound View along KR Thomas at 5th Road intersection

Photo 3: South-Eastbound View along 5th Road at KR Thomas Street

Photo 4: North-Westbound View along 5th Road approaching Atlantic Street

Photo 5: North-Eastbound View along Sam Nujoma Ave approaching 5th Rd

Photo 6: South-Eastbound View along 5th Road at Sam Nujoma Ave

Photo 7: South-Westbound View along Sam Nujoma at 5th Road

Photo 8: North-Westbound View along 5th Road approaching Sam Nujoma

 Photo 9: North-Eastbound View along Nangolo Mbumba Dr at 5th Rd	 Photo 10: South-Eastbound View along 5th Road at Nangolo Mbumba Dr
 Photo 11: South-Westbound View along Nangolo Mbumba Dr at 5th Road	 Photo 12: North-Westbound View along 5th Road at Nangolo Mbumba

Photo 13: North-Eastbound View along Nangolo Mbumba at Esplanade Str

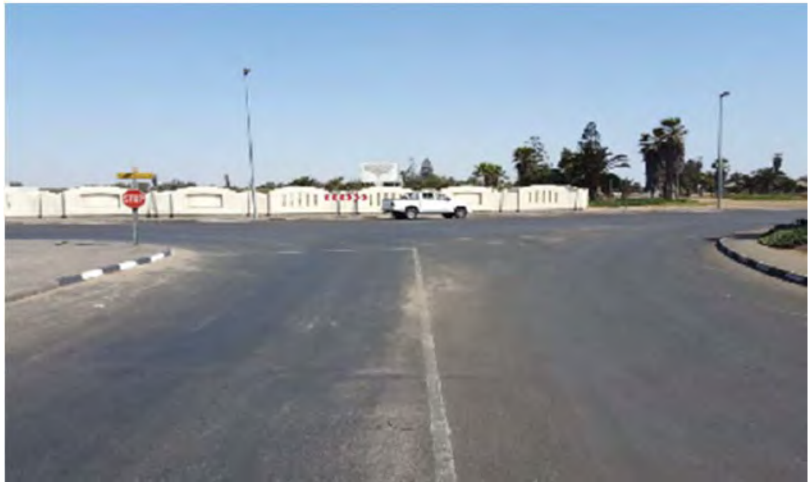
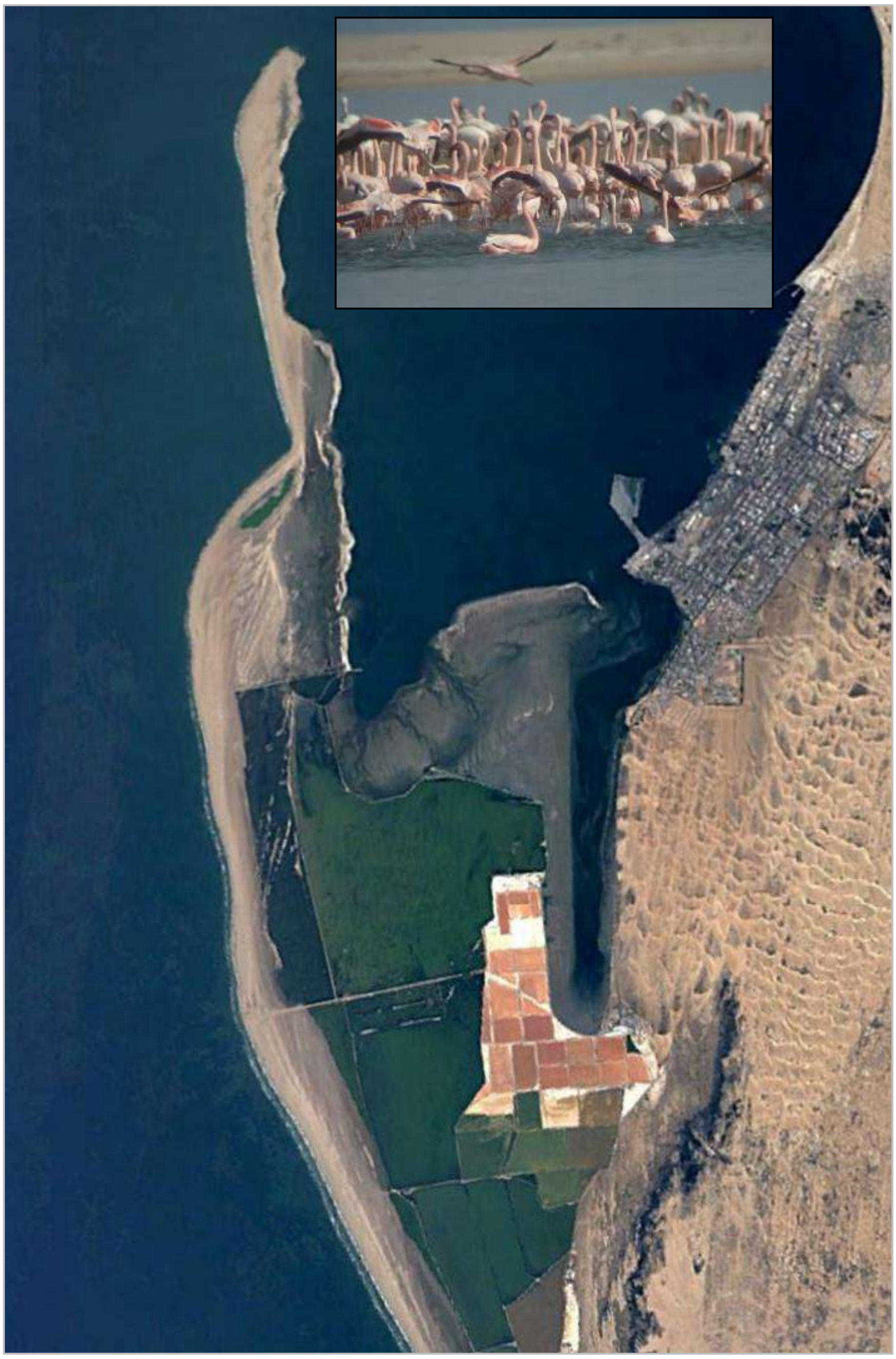


Photo 14: South-Eastbound View along Esplanade Str at Nangolo Mbumba

Photo 15: South-Westbound View along Nangolo Mbumba at Esplanade Str

WALVIS BAY – WATERFRONT DEVELOPMENT:

POTENTIAL EFFECTS ON BIRDS OF THE RAMSAR SITE



Prepared for: ENVIRONMENTAL COMPLIANCE CONSULTANCY

Prepared by: BIRDS & BATS UNLIMITED Environmental Consultants www.birds-and-bats-unlimited.com

1 INTRODUCTION

The Walvis Bay waterfront and marina is a new development proposed by Walvis Bay Waterfront (Pty) Ltd in 2017, on the edge of the mouth of the Walvis Bay lagoon. Walvis Bay is a natural embayment on the edge of the Namib Desert that is a wetland, internationally renowned for its diversity and abundance of coastal birds. It holds the single largest accumulation of coastal birds in southern Africa, as well as large numbers of cetaceans (Williams 1983, Wearne and Underhill 2005). As such it was proclaimed a Ramsar Wetland of International Importance in 1995, and is also ranked internationally as an Important Bird (IBA) by Birdlife International (Simmons et al. 1998).

The study of the impacts on the avifauna is triggered under Namibia's Environmental Management Act of 2007 (EMA) and the EIA specifically addresses the effects that the new marina and waterfront development will have on the avifauna of Walvis Bay. The report also provides mitigation measures and alternatives where these are deemed necessary to avoid high impacts.

The development is not large, relative to other on-going construction in the Walvis Bay environs, but it may impact on the mouth leading into the lagoon. The lagoon is already under pressure from wind-blown sediment from the east and increasing organic material accreting in the southern sections.

This report focusses on the effects that the marina itself will have on the prolific birdlife of the area, both within the immediate environs around the marina and waterfront (e.g. noise, light pollution), and "downstream" in the lagoon where sedimentation is a challenge to the long-term future of the lagoon.

Thirty years of twice-yearly bird counts are available from the 1980s to determine long-term avian trends (Wearne and Underhill 2005, Simmons et al. 2015). We also use the fact that the new Walvis Bay container port, under construction since January 2015, may reduce water flow and increase sedimentation in the lagoon. If this affects the birds using the lagoon we should detect a decrease in avian abundance or species diversity in a before-and-after comparison either side of January 2015. This is a report of our findings.

Overall migrant birds have been declining in abundance, while resident and intra-African migrant are stable, or increasing, at Walvis Bay over 30 years.

Depending on the configuration of the protective breakwater for the marina mouth, the flow of the main channel may be intersected, increasing sedimentation down-stream.

1.1 Consultant's Declaration of Independence

Birds & Bats Unlimited are independent consultants to Environmental Compliance Consultancy (Pty) Ltd. They have no business - financial, personal or other interest in the activity, application or appeal other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of the specialists performing such work.

1.2 Qualifications of Specialist Consultant

Birds & Bats Unlimited Environmental Consultants (http://www.birds-and-bats-unlimited.com/), were approached to undertake the specialist avifaunal assessment for the proposed Walvis Bay waterfront and marina and its potential effects on the Ramsar site. Dr Rob Simmons is an ornithologist, with 35 years' experience in avian research and impact assessment work. He was Namibia's state ornithologist for 14 years heading up the research and conservation on wetland and endemic birds, culminating in the first Namibian Red Data book on birds in 2015. He has published over 100 peer-reviewed papers and 2 books, (see http://www.fitzpatrick.uct.ac.za/fitz/staff/research/simmons for details). More than 64 projects and assessments over 23 habitats have been undertaken throughout Namibia, South Africa and Lesotho. He also undertakes long-term research on threatened species (raptors, flamingos and terns) and predators (cats) at the FitzPatrick Institute, UCT.

Marlei Martins, co-director of Birds & Bats Unlimited, has over 6 years' consultancy experience in avian wind farm impacts as well as 20 years in environmental issues and rehabilitation. She has been employed by several consultancy companies throughout South Africa because of her expertise in this field. She has published papers on her observations including a new species of raptor to South Africa (http://www.birds-and-bats-unlimited.com/).

2 TERMS OF REFERENCE

The desk-top study and research includes the following components (as sent by Jessica Mooney of Environmental Compliance Consultancy, 16 March 2017)

- An overview of birds likely to be encountered in the Walvis Bay area including Palaearctic migrant birds;
- A discussion of the potential environmental impact of the construction of the proposed waterfront on said birds, along with suggested mitigation measures;

- The potential environmental impact of prospective daily operational activities associated with the completed waterfront development on said birds, along with suggested mitigation measures;
- MET requests that the study addresses the impacts of lights on the birds in the lagoon and provide alternatives;
- Impacts to the food sources for bird life (e.g. plant life, algae, fish etc.);
- The potential environmental impacts of the waterfront on the RAMSAR site, and
- Any other impacts that may be identified that should be included.

2.1 NEED FOR PROPOSED AVIAN ASSESSMENT

Birds are known to be impacted directly and indirectly by developments, particularly those around wetlands that are often centers of biological diversity in Namibia (Breen 1991, Barnard 1998). Walvis Bay, the focus of this report, is internationally recognized for its birdlife, and is a proclaimed Ramsar site, and an important bird area (IBA). As such, the development of a waterfront marina triggers an Environmental Impact Assessment under the EMA of 2007, to determine the impacts of the development on the avifauna of the Ramsar site. The Environmental Management Act (2007) promulgated in December 2007 falls under the jurisdiction of the Directorate of Environmental Affairs (DEA), in the Ministry of the Environment and Tourism. Its objectives are to (i) ensure that the significant effects of activities on the environment are considered carefully and timeously; (ii) ensure that there are opportunities for timeous participation by interested and affected parties throughout the assessment process; and (iii) ensure that findings are taken into account before any decision is made in respect of activities.

3 BACKGROUND TO WALVIS BAY AS A BIRD-RICH WETLAND

Walvis Bay is a natural embayment of approximately 70 km^2 in extent on the arid Namib desert coast that holds hundreds of thousands of wetland birds in summer and winter. It vies with Sandwich Harbour (55 km south) as the single-most important wetland in southern Africa in terms of avian biomass and diversity (Williams 1987, Simmons et al. 1998, Wearne and Underhill 2005). The reasons for this can be traced to one of the world's strongest upwelling cells (Sakko 1998) that bring nutrient-rich waters into the protected bay twice a day. The entire central coast benefits from these upwellings (at their most powerful in Lüderitz) because of on-shore winds at certain times of year, and the long-shore Benguela currents that bring the nutrient-rich water from the south (Simmons 1997, Molloy and

Reinikainen 2003). This increases primary productivity in these areas and supports a rich and abundant avian birdlife dominated by wading birds.

Consequently, Walvis Bay is a Ramsar site - a Wetland of International Importance – as well as one of 21 Important Bird Area (IBAs) (Simmons et al. 1998). Namibia acceded to the Ramsar Convention in 1995 and has registered 4 sites of International Importance: Walvis Bay; Sandwich Harbour; Etosha Pan and the Cuvelai Drainage; and the Orange River mouth (jointly with South Africa). The mission of the Ramsar Convention is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world" (http://www.ramsar.org/about/the-ramsar-convention-and-its-mission)

The importance of Walvis Bay as a destination for large numbers of migrant waders and resident species has been recognised since formal counts were undertaken in 1977 (Underhill & Whitelaw 1977). The bay holds substantial proportions of southern Africa's waders (i.e. Charadriidae waders, flamingos, and oystercatchers [Williams 1987, Simmons et al. 1998, Wearne and Underhill 2005]). Peak counts up to 150 000 birds (below) comprise 50% intra-African migrants, 45% Palearctic migrants and 5% residents (Noli-Peard and Williams 1991).

Migrant birds join the resident waders in August, to reach a peak in abundance from September to February in the austral summer, and start to move north in March to April (Hockey et al. 2005). Thus, Walvis Bay acts as a reservoir and destination for both Palearctic migrant waders (e.g. Curlew Sandpipers *Calidris ferruginea*, Red Knot *Calidris canutus,* Little Stint *Calidris minuta)* as well as intra-African migrants (e.g. Greater *Phoenicopterus ruber* and Lesser Flamingo *Phoenicopterus minor* and Chestnut-banded Plover *Charadrius pallidus*).

Counts have been undertaken for over 30 years at the wetland (Bridgeford 2013), and several papers and popular articles have highlighted the trends and compared them with adjacent wetlands. We sourced these and present the results here.

3.1 How does Walvis Bay rank in terms of waders relative to other southern African wetlands?

Walvis Bay and Sandwich Harbour occur as the top two wetlands in southern Africa in terms overall abundance of wading birds. The figures in Table 1 give the maximum numbers of birds at any one time for southern Africa's top 10 wetlands (in terms of avian abundance). They indicate that Walvis Bay has almost 10-fold as many birds at the maxima than any other wetland - other than Sandwich Harbour. These figures are swollen by massive numbers of Common and Black Terns at certain times numbering in the hundreds of thousands. A more accurate assessment, therefore, is the average numbers of waders over the entire period (Table 2).

Table 1. Top 10 coastal wetlands in southern Africa according to maximum counts of wading birds.

Wetland site	Maximum numbers (species richness) of waders	Reference
Walvis Bay Lagoon, Namibia	242,920 (51)	Wearne and Underhill (2005)
Sandwich Harbour, Namibia	401,806 (50)	Simmons et al. (2015)
Langebaan Lagoon, South Africa	38,901	Taylor *et al*. 1999
Swartkops River Estuary, South Africa	14,730	Taylor *et al*. 1999
Voëlvlei, Mossel Bay, South Africa	12,021	Taylor *et al*. 1999
Berg River Estuary, South Africa	11,614	Taylor *et al*. 1999
Baia dos Tigres, Angola	11,000 (25)	Simmons et al. 2006
Lake St Lucia, KZN	9,594	Taylor et al. 1999
Rietvlei, Cape Town	6,130	Taylor *et al*. 1999
Cunene River mouth Angola/Namibia	5,197	Anderson et al. 2001

The median number of wading birds found at Walvis Bay over a 30-year period was higher than at Sandwich Harbour (Table 2). This indicates that Walvis Bay - more consistently - holds larger numbers of birds than any other wetland in southern Africa. The numbers are highest in the austral summer when all the migrant waders congregate at the coastal wetlands. The winter numbers reflect, mainly, the resident species with a few over-wintering subadult migrants that do not head back to the northern hemisphere (Williams 1986).

Table 2. Median numbers of wading birds at Walvis Bay and Sandwich Harbour, summer and winter.

Wetland site	Median numbers of waders Summer : Winter	Number of counts and Reference
Walvis Bay Lagoon	155, 862 : 81, 854	N = 31, 31 (Wearne and Underhill 2005; Simmons et al. 2015)
Sandwich Harbour	96,146 : 52,386	N = 23, 24 (Simmons et al. 2015)

Red Data species and global proportions of each wader species

Biological value is not only measured in total numbers of species but also their significance in a global sense. For Ramsar qualification, a wetland must support 1% or more of the global flyway numbers of each species. Walvis Bay qualifies under these criteria for no less than 25 wetland species (Table 3) that reach or exceed 1% of the African flyway population in the terms of numbers on site (Wetlands International 2017).

Table 3. All wetland species in Walvis Bay that exceed the 1% population flyway threshold (Wetlands International 2017) for inclusion in the Ramsar criteria (after Wearne and Underhill 2005). Namibian Red Data species in red (Simmons et al. 2015).

Species	Maximum count (w= winter, s = summer)	1% threshold of flyway population	Palearctic Migrant (PM) Intra-African Migrant (I-AM) Resident (R)
Black-necked Grebe	13,129 (w)	150	I-AM
White Pelican	637 (s)	200	I-AM
White-breasted Cormorant	593 (w)	120	R
Cape Cormorant	10 850 (s)	2200	R
Greater Flamingo	43,679 (w)	750	I-AM
Lesser Flamingo	43,420 (w)	600	I-AM
Cape Teal	1,813 (s)	1,750	R
African Black Oystercatcher	184 (w)	55	R
Black-winged Stilt	768 (w)	230	I-AM
Pied Avocet	4,102 (w)	190	I-AM
Grey Plover	2,598 (s)	2,500	PM
Ringed Plover	4,545 (s)	1,900	PM
White-fronted Plover	3,108 (w)	180	R
Chestnut-banded Plover	8,428 (s)*	110	I-AM
Ruddy Turnstone	1,883 (s)	1,000	PM
Sanderling	15,169 (s)	1,200	PM
Little Stint	11,592 (s)	10,000	PM
Curlew Sandpiper	44,257 (s)	3,300	PM
Kelp Gull	5,053 (w)	700	R
Hartlaub's Gull	2,020 (s)	300	R
Black Tern	61,015 (s)	4,000	PM
Caspian Tern	116 (w)	15	I-AM
Swift Tern	811 (s)	200	I-AM
Sandwich Tern	1807 (s)	1,700	PM
Common Tern	93,617 (s)	6,400	PM
25 Species			**9 Palearctic migrants** **9 Intra-African migrants** **7 Residents**

* 47% of the world population

Red Data species

Of the 25 species that occur at Walvis Bay and exceed the 1% African fly-way population, 36% (9 of 25) species are threatened Red Data species (Table 3). Indeed, for one of these species, the Chestnut-banded Plover, the maximum numbers at Walvis Bay represent almost half (47%) of the world population (17 800) which includes the East African subspecies *C. p. venestus* (Simmons et al. 2007). For the southern African race (*C. p. pallidus*) alone the maximum Walvis Bay count represents 73% of the 11,500 birds estimated (Simmons et al. 2007).

Several other Red Data avian species also occur within the confines of Walvis Bay but in relatively small numbers. These include Damara Terns *Sterna balaenarum,* and Eurasian Curlew *Nemenius arquata.*

Long-term trends

To determine what influence any development has, in the short-term, on wetland bird numbers we need to understand the long-term population trends for all wader species. This has been undertaken for all main wader species over a 31-year period at Walvis Bay (Simmons et al. 2015) and the following trends were found:

- Significant **population declines** have occurred since the early 1990s in four of the 12 **long-distance migrants i**nvestigated (Turnstone, Ringed Plover, Red Knot, Little Stint);
- The most serious declines were for Little Stint and Ringed Plover, both with approximately 60–90% population declines;
- In contrast, **resident or short-distance migrant** wader populations all exhibited **stable or increasing** population levels relative to the early 1990s;
- Population levels increased for White-fronted Plover (*Charadrius marginatus*), Chestnut-banded Plover, Black-winged Stilt (*Himantopus himantopus*), Pied Avocet (*Recurvirostra avosetta*), and Greater Flamingo (*Phoenicopterus ruber*) relative to the early 1990s;
- The most abundant waders in these wetlands, Curlew Sandpiper and Sanderling (*Calidris alba*), had stable populations, although both populations may have had slightly higher levels from 2005 to 2006. Both species showed a marked drop in winter counts, especially in 2009 and 2010.

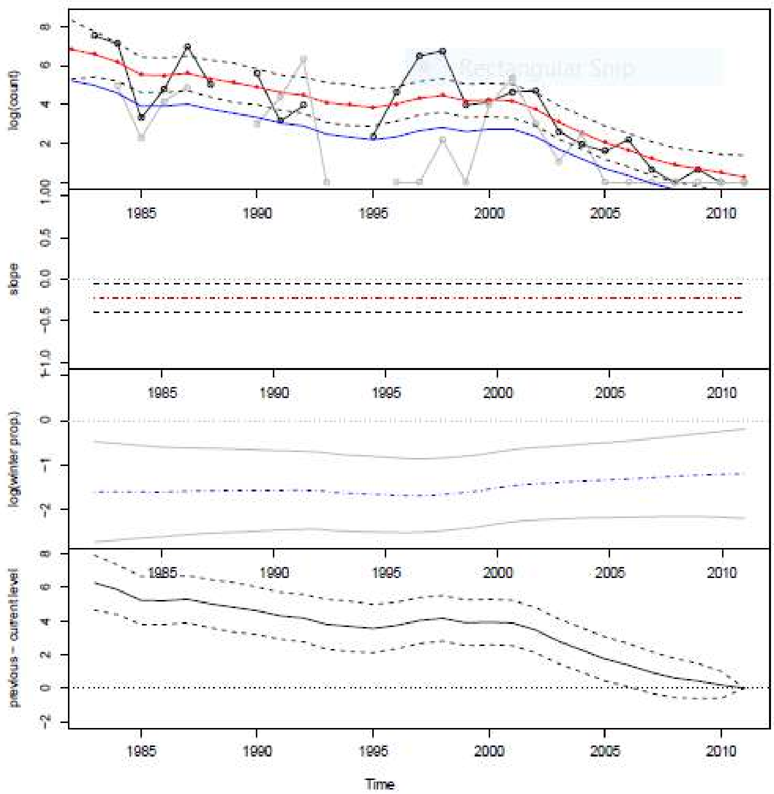


Figure 1: An example of long-term (31 year) population declines in long-distance migrants at Walvis Bay: **Red Knot.**

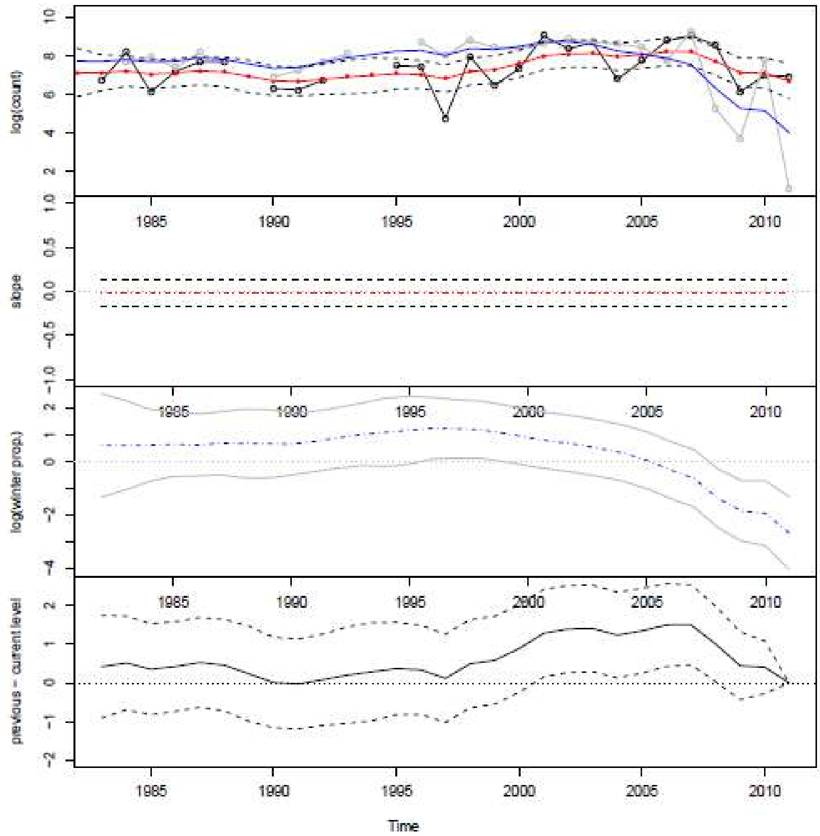


Figure 2: An example of long-term (31 year) population stability for a Red Data, short-distance migrant at Walvis Bay: **Chestnut-banded Plover**

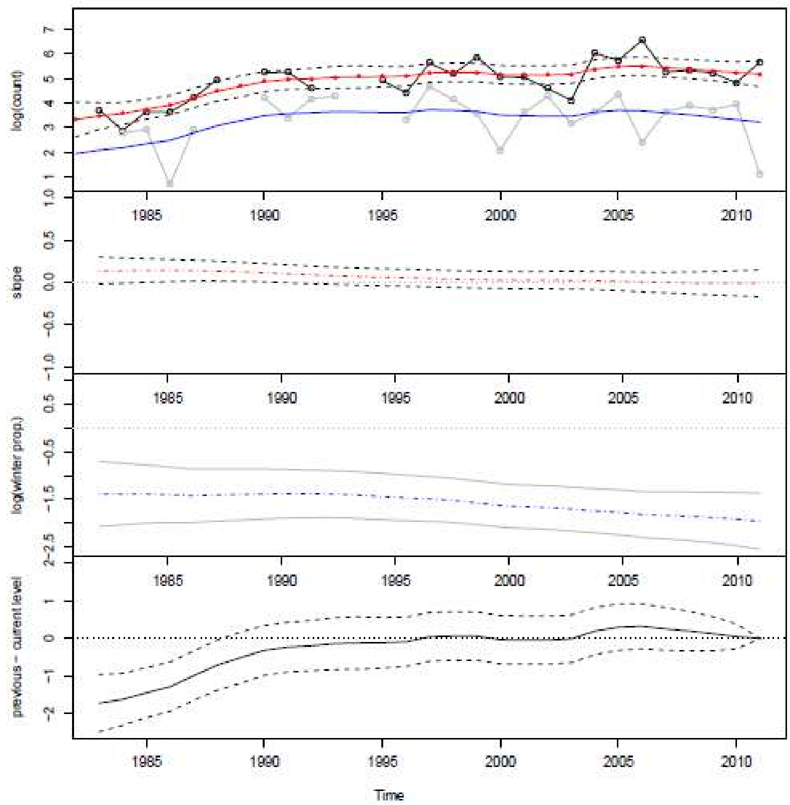


Figure 3: An example of long-term (31 year) population increase for a resident wader at Walvis Bay: **Common Greenshank**

Overall, despite the declines exhibited by some long-distance (Palearctic) migrants, and the stability or increases in resident species, we found no differences between Walvis Bay and Sandwich Harbour (Simmons et al, 2015). This suggests that Walvis Bay showed no adverse effects of the harbour facilities of the time or the potential dangers of pollution from bilge water, or oils. However, this is not true of the lagoon (below).

3.2 How important is the Lagoon: proportions and declines in birds using the lagoon?

Given that the most likely effects of the waterfront and marina will be on the birds of the lagoon, we need to determine what proportions, and which species, the lagoon supports of all Walvis Bay birds.

According to Williams (1997) the lagoon holds about 40% of the total number of waders found in the Walvis Bay wetland (Table 4). The maximum number of waders using the lagoon over this period was about 20 000. Given that the lagoon represents a biologically active area of 9 km^2 in a wetland (including salt works) of ~70km^2, the lagoon is approximately 13% of the total area (Figure 4). That it holds 40% of the waders indicates its high importance to the avian community in Walvis Bay.

For individual species, the proportion using the lagoon varied from 72% for Bar-tailed Godwits to 16% for Lesser Flamingos in the 1990s (Table 4).

Table 4: The maximum numbers (and proportions) of waders, terns and flamingos using the lagoon in the late 1990s (Williams 1997) vs 2013-2017 (this study).

Species (max all of Walvis Bay, 1997)	**Proportion of birds in Lagoon (max counts)** **1990s**	**2013-2017**
Curlew Sandpiper (24 600)	9 600 (39%)	5 246 (decrease)
Little Stint (6 336)	2 406 (38%)	368 (decrease)
Sanderling (10 500)	4 100 (39%)	1 849 (decrease)
Chestnut-b Plover (6 953)	1 234 (18%)	3 027 (increase)
Grey Plover (3 440)	1 100 (32%)	775 (decrease)
Red Knot (1 850)	1 000 (54%)	3 (decrease)
Bar-tailed Godwit (903)	650 (72%)	888 (increase)
All waders (50 000)	**~20 000 (40%)**	**11 674 (42% decrease)**
Terns+Gulls		
Sandwich Tern (920)	397 (43%)	372 (decrease)
Common Tern (19 880)	5 963 (30%)	1 507 (decrease)
Damara Tern (392)	177 (45%)	79 (decrease)
Caspian Tern (129)	64 (50%)	58 (decrease)
Hartlaub's Gull (1145)	812 (71%)	324 (decrease)
Flamingos:		
Greater Flamingo (25 166)	13 003 (52%)	12 085 (decrease)
Lesser Flamingo (35 126)	5 759 (16%)	13 028 (increase)

We re-assessed the maximum numbers of waders using the lagoon (employing the same counting methods as Williams) from data provided by P Bridgeford, national coordinator for the Walvis Bay wetland count. We also took maximum count for each species and summed the maximums to derive the total number of birds. The data period from the last 4 years (February 2013 – February 2017) covered all winter (July) and summer (January) counts.

We found:

- Over the last 4 years the maximum number of waders using the lagoon was 11 674 (Table 4);
- That represents a decrease of ~42% in waders using the lagoon in the 20-year period from the mid-1990s to 2015 (mid-point of 2013-2017 counts);
- The 11 674-lagoon count represents just 12% of the present day maximum total of 100 835 waders recorded at Walvis Bay (Wearne and Underhill 2005);
- 11 of the 14-species recorded declined in maximum numbers in the lagoon;
- One species, the Red Knot, virtually disappeared from the lagoon (3 birds counted) having supported almost 1 000 birds 20 years before;
- One species of flamingo (Greater) declined and the other (Lesser) increased in their use of the lagoon (Table 4);
- Of the five Red Data species found in significant numbers in the lagoon, two species (Chestnut-banded Plover, Lesser Flamingo) showed increasing numbers, while three species exhibited declines;
- Two species that prefer saline saltpans (Chestnut-banded Plover and Lesser Flamingo : Turpie 2005, Simmons 2005) both increased in number in the lagoon, suggesting that conditions there are becoming more saline.

Thus, for the majority of comparisons, the species in the lagoon showed declining numbers; and overall abundance has dropped 42% in the 20 years since the mid-1990s (Table 4). Given that long-term trends (Simmons et al. 2015) show only four of the 12 long-distance migrants and none of the resident species have declined overall in the Walvis Bay wetland in the last 30 years, these declines in the lagoon cannot be explained by broad-scale declines. We, thus, conclude that it is the lagoon environment itself that is the cause of these avian declines.

Figure 4: The ~70 km^2 extent of the biologically active Walvis Bay wetland (red polygon) in relation to the lagoon (green polygon) of ~9km^2. The lagoon held about 40% of the waders at Walvis Bay in 1997, despite comprising just 13% of the entire wetland.

3.3 What is causing avian declines in the lagoon environment?

To determine what the reasons might be for the declines in the lagoon we asked: Are the declines associated with the port expansion? We suggest that the expansion of the container port might reduce the flow or amplitude of water into the lagoon and, thereby, increase sedimentation in the lagoon. More sediment may decrease feeding opportunities, decreasing the likelihood that wading birds will use the area. A prediction of this scenario is that a decline in bird numbers should be seen after the port expansion began construction in January 2015 (Google Earth images in Figure 5a and b).

Figure 5a: Google Earth images indicating Walvis Bay and lagoon prior to port expansion in August 2014 (left) and after expansion in January 2015 (right).

We found, as expected, a decrease in the average number of wetland birds using the lagoon immediately after port expansion (Figure 6). The average numbers dropped from 21 078 to 17 406 birds, a decline of 17% in 4 years. The long-term decline in wader numbers of ~42% over a 20-year period (1997 – 2017), reported above, gives an average rate of decline of approximately 2.1% per year.

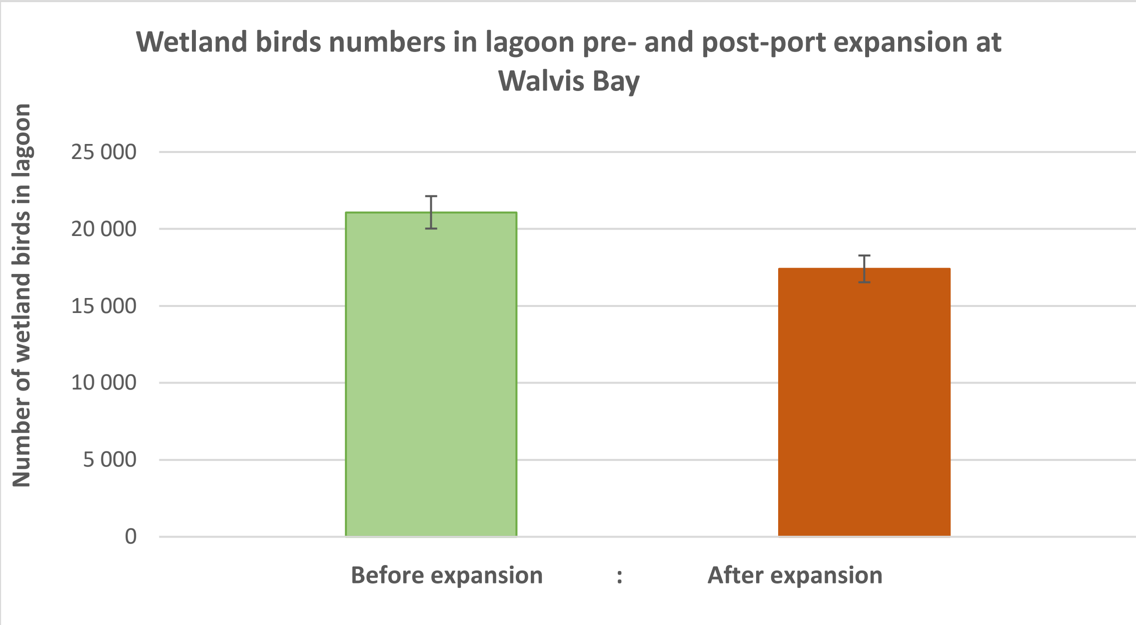


Figure 6: Average numbers of wetland birds recorded in the Walvis Bay lagoon 2 years before and 2 years after the port expansion (January 2015). Winter and summer counts from 2013-2014 (before) were compared to winter and summer counts from 2015-2016 (after).

Therefore, the decline in average numbers of 17% in 4 years before and after the port expansion is double that expected over the same time of (4y x 2.1% =) 8.4%.

This does not prove that the port expansion caused the decline of birds using the lagoon, but the fact that it is associated temporally with it, and doubled the rate of decline over a short period, strongly suggests the two are linked.

This suggests that any additional impacts (such as sedimentation, salinization, pollution or disturbance) caused by the construction of the Walvis Bay waterfront must be strictly minimised to reduce any additional impacts.

4 POTENTIAL IMPACT TO WALVIS BAY BIRDS FROM DEVELOPMENT

Key environmental issues

The main environmental impacts previously associated with developments in Walvis Bay include the following (summarised from Environmental Evaluation Unit [1999] and Namport Walvis Bay EIA study [2009]).

- **Environmental impact of the construction:**
  - Construction may include blasting, dredging,
  - noise of construction.

- **Environmental impact of prospective daily operational activities**
  - The waterfront shops and human activity,
  - Marina itself, noise, lights, pollution, increased water craft traffic.

- **Impacts of lights on the birds in the lagoon and alternatives;**
  - Bright lights are known to attract some night-flying birds and migrants,
  - Collisions with high-rise buildings or tall masts with bright lights.

- **Downstream impacts on avian food sources**
  - Sedimentation from dredging can smother avian foraging habitats,
  - Decreased water flow through lagoon can reduce tidal flushing,
  - Decreased tidal flushing will reduce the invertebrate fauna (Currie 1997),
  - Pollution (e.g. fish or engine oils) introduced to the lagoon (Currie 1997).

We have ranked these in terms of their potential impacts on the abundant birdlife in the lagoon in (Table 5). We have also provided mitigations.

Table 5: Key environmental issues, implications and mitigations arising from the development of the Walvis Bay waterfront and marina on the birds of the Ramsar site.

Potential impact	Reason for impact	Mitigation	Comment/significance
Construction phase: ➢ **Blasting causing disturbance to feeding or breeding birds**	Sudden noise of **blasting** causes feeding birds to fly = reduced energy intake and relocate to less productive areas away from source of noise.	**Main construction** should avoid the main concentration of birds that occur chiefly in the summer months when the long-distance migrants are present.	The best months for any blasting and dredging are in winter from May to August
➢ **Dredging operations**	**Dredging** operations release sediments and organic material that may smother habitats downstream on incoming tides, adding to the already sediment-rich and over-loaded southern sections of the lagoon.	Dredging should avoid incoming tides which will add sediment down-stream into the lagoon, further smothering the feeding areas of the bird life.	Out-going neap tides are best to avoid sediment. Research and monitoring of sediments must be ongoing and close down dredging activities if sediment loads are found to increase beyond acceptable levels.
➢ **Spillage of building materials, especially pollutants**	**Spillage** of construction materials including cement, oils and heavy metals	Strict guidelines to be followed for all waste products from the buildings	This is ranked as low-medium impact with low-medium significance with medium-term effects. With mitigation can be reduces to low/acceptable levels.
Environmental impact of prospective daily operational activities: ➢ **Waterfront and shops**	**Noise, lights and restaurant food** may act as a source of distraction/attraction to different species**.**	**Strictly control the entry and exit** of motorized craft (jet skis and motor boats) in the lagoon area. Only limited numbers of un-motorised craft should be allowed into the lagoon.	Likely to be low during daytime hours **Waste-disposal depots** could be created in the marina and marina “sheriffs” could ensure that all waste is disposed of responsibly.
➢ **Marina traffic**	**Increase watercraft traffic** in and out of marina may dissuade sensitive species of birds. Increased pollution such as bilge water and plastics are likely from the marina if motorised craft dominate the marina.	Control elimination of waste, both human and industrial from the marina. Plastic and oil dumped or spilt in the marina will make it into the lagoon, adding to the environmental stress (high sediment, high salinity, high organic load) in the lagoon.	This is ranked as medium impact with medium significance with long-term effects. With mitigation can be reduced to acceptable levels.
Impacts of lights on the birds in the lagoon and alternatives ➢ collisions with high-rise buildings or tall masts with bright lights	**Tall masts or buildings with bright lights** attract and kill more birds in North America than any other anthropogenic source bar domestic cats (Loss et al 2014).	**Avoid high masts with constant lights. Avoid high buildings with lights on at night.** If lighting required by law, use flashing lights of colours other than white. Avoid the use of flood lights. Lights should be downward pointing, of lowest	This is ranked as medium impact with medium significance with long-term effects. With mitigation can be reduced to acceptable (low) levels.

➢ nocturnal migrants disorientated by bright lights	**Bright lights attract nocturnal species** and disorientate and kill migrant species that fly into the lights	illumination and be directed away from the lagoon. Flamingos migrate at night and increased use of the lagoon by Lesser Flamingos may mean greater likelihood of disorientated birds. Thus, flood lights and lights on tall buildings should be avoided entirely.	
Downstream impacts on avian food sources: ➢ Sedimentation ➢ Decreased tidal flushing ➢ Decreased invertebrate fauna, ➢ Increased salinity (Currie 1997) ➢ Pollution (e.g. fish or engine oils) introduced to the lagoon (Currie 1997)	**Sedimentation** from dredging can smother avian foraging habitats in the lagoon forcing birds to move elsewhere **Decreased tidal flushing** will decrease invertebrate fauna and may lead to biological “dead zones” un-used by birds or fish. Decreased flushing and increased sedimentation appears to have led to an accelerated decrease in bird numbers: (i) 17% decrease in bird numbers since the port expansion in January 2015 (ii) increased salinity as evidenced by increasing numbers of two saline-loving species (Chestnut-banded Plover and Lesser Flamingo). **Pollution from fish oils, or industrial** contaminants can kill invertebrates and birds directly, and this can threaten the two Red Data species that are increasingly using the more saline conditions of the lagoon	**The marina should not impede the flow** of water in the main channel in any way. **The lagoon-side wall protecting the marina** should be constructed on the north-side of the Raft restaurant, parallel with the coastline. Ideally it should not restrain the flow of water in any way. This is best undertaken with pilings supporting the wall, and no solid construction (i.e. not filled). This could also be achieved by a bridge opening at the south-eastern end allowing the water to flow through and on towards the lagoon. A wall that does not project out into the main lagoon channel at all is the preferred option to decrease the impact of the marina on further sedimentation and reduction of tidal flushing. Long-term the lagoon is likely to silt up and become too saline for most species to feed. Thus, remedial action is required now as the port expansion and the waterfront/marina are developed.	Sedimentation is obvious from the Raft restaurant from Google images and this in combination with the port expansion appears to already be reducing bird numbers. So, this is a high priority to get right. This is ranked as high impact with high significance with long-term effects. With mitigation, this can be reduced to medium levels, that will require research to determine the long term effects. Remedial action may be required to avoid the long-term sedimentation, increased salinization and dying of this biologically and internationally renowned wetland.

		Dredging new channels into the lagoon to increase tidal flushing may be required for the long-term sustainability of the ecosystem. **Pollution control and cleaning** and emptying of bilge water, oils and rubbish needs strict control.	

5 CONCLUSIONS

From previous surveys and research, it is obvious that Walvis Bay is a thriving destination and feeding hub for thousands of long-distance migrant birds from as far as Russia and Eurasia. However, the lagoon, which 20 years ago was, area-for-area, the most productive single element of the Ramsar wetland (supporting 40% of the wader population in 13% of the area) is now ecologically compromised. The lagoon currently only supports 12% of the migrant wader population, and 11 of the 14 species using it have declined in the last 20 years.

That this is probably the result of ongoing anthropogenic activities around the lagoon is evidenced by the accelerated (17%) decrease in birds using the lagoon immediately after the port expansion was started in January 2015.

Surveys of the lagoon and its rate of sedimentation indicate that most of the sediments are wind-borne from the dune fields to the east (Ward 1997, Engelhard and Sell 2013). Aeolian sedimentation from other directions seems to be reduced (captured) by the presence of the salt works to the west and south-west of the lagoon and Walvis Bay town, and the bay to the north. According to Engelhard and Sell 2013) the flooded pans to the east of the lagoon capture sediment blown in from the east (particularly with berg winds). As a result, the pans have reduced in size from 190 ha to 50 ha over a 12 year period (2001 to 2013). Once filled, more sand will penetrate the lagoon. At the same time sedimentation and a layer of 20-50 cm of "oil-like black substance" was found in the southern end of the lagoon (Engelhard and Sell 2013). According to the authors they believe this to be sediments and organic matter brought in from the bay on the high tide, but not taken out by the ebb tide. While it was not stated in their report, this suggests a low-oxygen anaerobic matter and this may correspond to the biologically "dead zones" reported in the surveys UNam report (Unam 2013).

We therefore, concur with the conclusion of Currie (1997, p8) who stated that "*the most critical factor regarding the biota is to maintain tidal flux: the lagoon must provide the physical basis to support its biota"*

Previously the CSIR and Unam (Tjipute and Skuuluka 2006) reported that "*the upper [southern] reaches of the lagoon support insignificant populations of benthic fauna. The surface sediments were anoxic consisting of a silty mud with a high content of organic material. The strong southerly winds reduce the tidal penetration, particularly at neap tides, resulting in elevated temperatures and high salinities which may exceed the tolerance limits of the benthic species occurring in the lagoon*" (Namport 2010).

Currie (1997) reported that the invertebrate animals are distributed into zones according to distance from the mouth. The middle subtidal reaches of the lagoon support the greatest species diversity and density including bivalves and tube worms.

According to Namport (2010) the origin of the organic material transported into the lagoon from the bay seem to partly originate from waste or spill from the fish factories in the harbour. Therefore, waste from the harbour and fish industry should be highly regulated and reduced, to avoid creating more biologically dead zones at the southern end of the lagoon.

Each of these suggest that high organic loads, high salinity and low tidal flushing at the southern end of the lagoon are leading to areas of lower biological activity and "*insignificant populations of benthic fauna*" (Currie 1997).

Further sedimentation or deposition of organic material in these areas will result in reduced proportions of wading birds and will, probably, result in the long-term death of the lagoon that once supported 40% of the migrant waders (Williams 1997).

Further developments therefore, that impede the flow of water into the lagoon, reducing the tidal flushing and increasing salinity and increase pollutants, should be avoided.

The waterfront and marina, thus, present significant challenges to the developers to mitigate any effects of reduced tidal flow or amplitude and to avoid strong lighting, and particularly pollutants such as oil, human waste, plastics and chemicals that may enter the lagoon. All of these may continue to accelerate the present decline seen in wetland bird numbers using the lagoon.

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APPENDIX 1: Raw data for lagoon-side birds 2013-2016. Red Data species in **red** (data as per Peter Bridgeford)

WALVIS BAY BIRDS	**Jul-16**	**Jan-16**	**Jul-15**	**Feb-15**	**Jul-14**	**Feb-14**	**Jul-13**	**Feb-13**
	74 772	***95 280***	***56 448***	***148 475***	***95 386***	***109 044***	***103 106***	***118 850***
		40						
	LAGOON ONLY							
Avocet	407	69	367	2	**589**	9	227	441
Coot Red-knobbed					**1**			
Cormorant Bank								
Cormorant Cape	155	269	57	1	79	331	248	**346**
Cormorant Crowned					1			
Cormorant White-breasted	26	10	23	8	3	10	**37**	10
Curlew		**2**						
Egret Cattle	**10**				8		7	
Egret Little	2	7		2	11	13	9	**18**
Flamingo Greater	10240	4512	9209	5603	5189	4184	**12085**	6847
Flamingo Lesser	**13028**	1946	2017	295	2096	1546	8024	
Flamingo Unidentified					5200			
Godwit Bar-tailed		1133		106	2	**888**	62	215
Godwit Black-tailed								
Goose Egyptian					1			
Grebe Black-necked					3		5	**8**
Grebe Little								
Grebe Great-crested								
Greenshank	8	53	16	2	15	28	15	**80**
Gull Grey-headed						1	**3**	2
Gull Hartlaub's	183	114	122	268	126	**324**	133	226
Gull Kelp	307	172	760	268	98	258	493	**816**
Heron Grey	14	19	46	17	5	19	21	**62**
Knot Red								**3**
Oystercatcher African Black		34	3	21	8	8	7	**36**
Pelican White	267	86	62	277	188	**445**	102	217
Plover Blacksmith	20		11		13		**32**	
Plover Caspian								
Plover Chestnut-banded	48	32	**3027**	944	1411	608	400	1466
Plover Common Ringed		50	2	6		**20**		2
Plover Golden			1					
Plover Grey	4	74	156	**775**	8	507	53	681
Plover Kittlitz's		6						
Plover Mongolian								
Plover Ringed								
Plover Sand								
Plover Three-banded			5		2		**7**	1
Plover White-fronted	54	98	176	38	**1435**	94	132	404
Ruff		1	7	1		20		**21**
Sanderling		1466		**1849**	10	377	6	210
Sandpiper Broadbilled								
Sandpiper Common					2			**4**
Sandpiper Curlew	6	125	99	1228	842	1512	166	**5246**

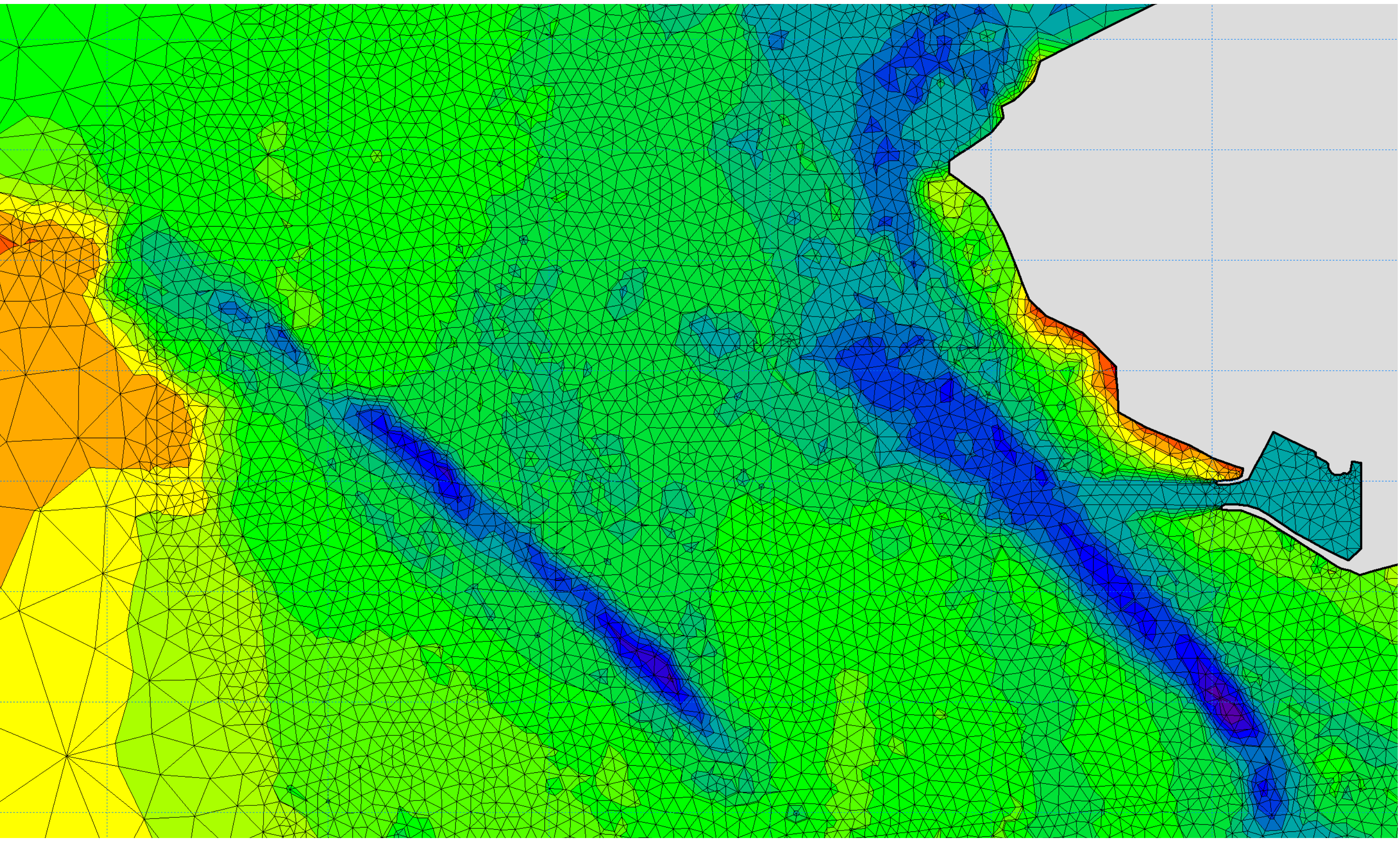
Sandpiper Marsh								
Sandpiper Terek								
Shoveler Cape			**14**					
Stilt Black-winged	5	2	28		3		8	**34**
Stint Little		4	1	9	5	**368**	33	138
Teal Cape	46		100	14	25		27	**212**
Tern Black						**65**		
Tern Caspian	53	36	27	25	11		46	**58**
Tern Common	8	**1507**		117	30	735	5	122
Tern Damara		2		60				**79**
Tern Sandwich		33		1	1			**372**
Tern Swift	41	46	25	8	22	4	25	**295**
Tern Unidentified	200	200		524		230		**2862**
Turnstone	30	142	2	21	27	155	11	**525**
Unidentified large waders			2	10				
Unidentified medium waders		**300**					190	
Unidentified small waders	98	290	951	1652	850	3054	457	**5000**
Whimbrel	3	24	7	22	5	11	11	**16**
Totals	**25 263**	**12 864**	**17 323**	**14 174**	**18 325**	**15 824**	**23 087**	**27 075**
	winter	summer	winter	summer	**winter**	**summer**	**winter**	**summer**
	After naval base				**Before naval base**			

Ave for last 4 years 19 242

Max wader counts **(bold)** over last 4 years **11 674**

EIA Walvis Bay Waterfront

Hydrodynamic study



1 September 2017
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Delta Marine Consultants

004330 EIA Walvis Bay Waterfront

Hydrodynamic study

Report number: 004330-rap-u-0001

Client

Environmental Compliance Consultancy CC
PO Box 91193
Klein Windhoek
Namibia

Author

Name: H. Bergmann
Direct line: +31 627 169 314
E-mail: h.bergmann@dmc.nl
Address: H.J. Nederhorststraat 1, 2801 SC Gouda, The Netherlands
P.O. Box 268, 2800 AG Gouda, The Netherlands
Telephone +31182590610 / www.dmc.nl / dmc@dmc.nl

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Summary

A new yacht marina breakwater is planned in context with the waterfront development at Walvis Bay lagoon. The potential effect of the marina breakwater on the hydrodynamic conditions in the lagoon has been investigated.

The flow conditions at the lagoon entrance and in the lagoon have been numerically modelled for various environmental conditions by the software package Mike 21 FM. The modelling results have been analysed for the present situation (Base Case) and the situation after marina construction.

Based on the numerical modelling the following has been derived with respect to the potential effects of the envisaged marina:

1. Water levels changes in the lagoon are expected to remain in general below 1mm. During spring tides and strong winds the minimum water level may decrease further by 5-10mm compared to the present situation (Base Case).
2. Flow velocities at the lagoon entrance are affected to minor extent by the marina construction (maximum deviation below 3mm/s) when compared to the Base Case. During neap and spring tide conditions the discharge across the indicator line at the lagoon entrance show negligible differences (generally below 0.3%) between Base Case and situation with marina development. Changes in flow direction as derived from the modelling are mostly below 0.5 degrees, with one maximum difference of 2.5 degrees.
3. The relative refreshment after marina implementation is determined 1-2% less compared to the Base Case. At the entrance cross-section, the immediate vicinity to the initial tracer boundary between bay (zero tracer) and lagoon (100% tracer) is unfavourable as it may result in larger uncertainties in calculated refreshment rates.

The envisaged marina breakwater appears to have little or virtually no impact on the flow conditions at the lagoon entrance and the water refreshment rate in the lagoon. The potential environmental implications require assessment by the relevant experts.

1 General

A new waterfront development is planned at Walvis Bay, Namibia. The waterfront shall be situated close to the Lagoon entrance, adjacent to the existing Pelican Bay Hotel and the Raft Restaurant.

In context with the EIA for the waterfront development, DMC has been requested by Environmental Compliance Consultancy (EEC), Windhoek, to carry out a hydrodynamic modelling study to assess potential negative effects caused by the envisaged marina. It was agreed that the study shall be based on a similar approach as applied on the study for the new container terminal at Walvis Bay in 2009. The study shall focus on potential effects of the new marina on the flow conditions and water exchange in the lagoon. No morphological study is included. Potential morphological effects are expected small and of local nature. An indication of potential effects (if any) shall be derived from the changed current pattern in the lagoon.

The starting points of the study are summarized as follows:

1. Methodology and general assumptions as for the EIA in context with the New Container Terminal in 2009
2. Hydrodynamic Modelling to be carried out on Phase 1 Container terminal footprint (construction works close to completion)
3. Bathymetry data in particular of the lagoon entrance will be provided by Client
4. Layout and geometry of marina and marine structures including access channel for the planned waterfront shall be provided by Client
5. The inner channel of the new waterfront development (separated by a lock structure) is excluded from the model
6. The flow conditions and water exchange between Lagoon and Bay will be assessed for the present situation (Base Case) and after construction of the new marina. In addition to the lagoon entrance up to two trajectory lines will be analysed in the lagoon.
7. Wave conditions in the lagoon are benign and will be neglected for the hydrodynamic modelling.
8. Modelling of plume emissions during dredging and disposal or potential emissions from the marina appear to be avoidable by suitable environmental management plans and are not investigated.

The planned development (see artist impression in Figure 1-1) is located inside Walvis Bay Lagoon close to the outlet to the bay (refer to Figure 1-2). The entire lagoon forms part of an important Ramsar site. The footprint and location of the envisaged marina are shown in Figure 1-3.

The design dredging depth in the marina and access channel has been set at -3mCD (email of 24.05.2017). The approach channel has been assumed in continuation of the breakwater arms and runs in east west direction towards the natural tidal channel (channel width 20m, channel length approx. 75m, see Figure 1-3).

Figure 1-1: Artist impression of Walvis Bay waterfront and marina

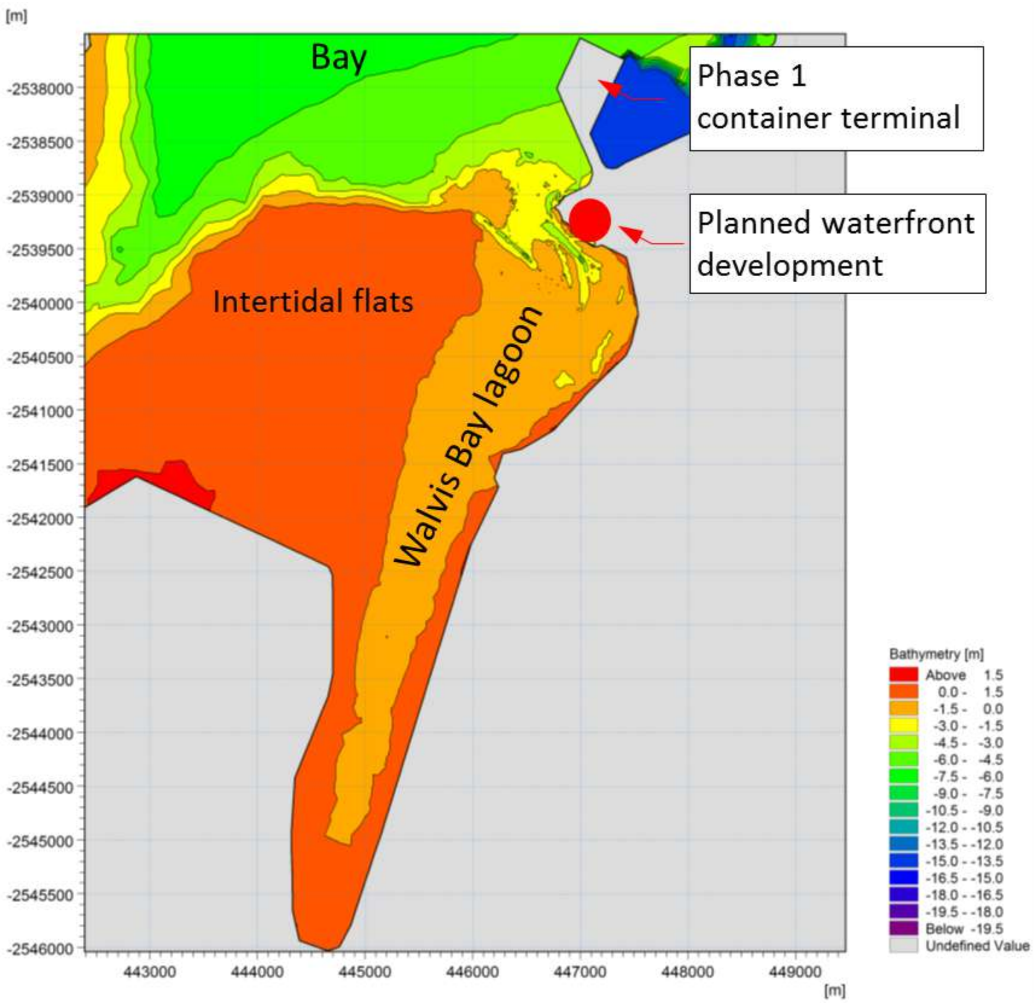


Figure 1-2: Location of the planned waterfront development, Walvis Bay (seabed levels refer to MSL)

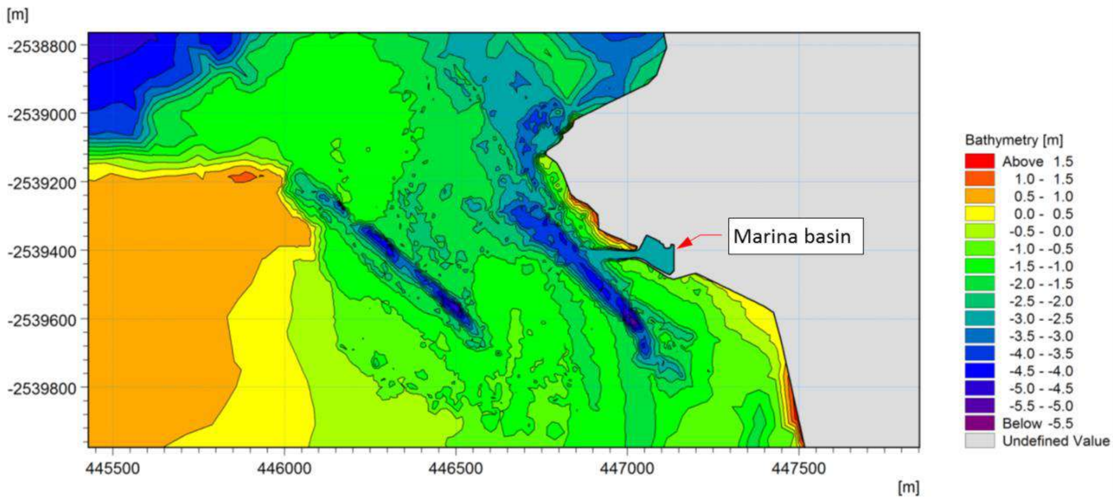


Figure 1-3: Waterfront marina (sea bed levels refer to MSL)

A new bathymetric survey was carried out in June 2017, covering the area of the lagoon entrance and the vicinity of the waterfront (coverage about the area shown in Figure 1-3) to ensure an appropriate basis for the hydrodynamic modelling and for detailed design of the marina infrastructure.

The potential effect of the new marina on currents and water levels at the lagoon entrance and the water exchange between lagoon and bay has been assessed by comparison of the future situation with the situation before implementation. The present situation (Base Case) includes phase 1 of the new container terminal being currently under construction.

2 References

[1] DMC and CSIR: EIA Study for Extension of the Walvis Bay Container Terminal. Volumes I – VI, Final Report, December 2009.
[2] Geoff Toms: Additional Baseline Study Walvis Bay Lagoon Mouth Area (For Namport), December 2013

3 Modelling of flow conditions and water exchange

All modelling has been carried out with the numerical modelling software package Mike 21 FM (flexible mesh) of Danish Hydraulic Institute. For details refer to [1].

3.1 Bathymetry

The bathymetry applied for the modelling have been retrieved from different sources:

- Admiralty charts
- Large scale bathymetric survey of Bay and Lagoon, performed by the Local Agenda 21 Project (DHI/COWI 2002, [1])
- NAMPORT surveys 2009
- Surveys carried out for the project in June 2017

Besides the new data obtained in 2017, survey data including the larger scale bathymetry have been applied as in the in the EIA study for the container terminal (Namport, 2009, [1]).

Admiralty charts are used for the large scale regional bathymetry which has been extracted from MIKE21 C-Map (world-wide electronic chart database from Jeppenson). In addition the comprehensive bathymetric survey performed within the Local Agenda 21 Project (2001-2004) has been used for the Bay and the Lagoon. Port areas, access channel and areas close to the lagoon entrance have been surveyed by Namport in 2009.

The bathymetry in the lagoon entrance is considered most relevant for the flow conditions and water exchange between Lagoon and Bay. The new bathymetry revealed significant changes compared to the situation in 2009, therefore the old data have been discarded and replaced by the new data in that area. In particular the deepening of the eastern tidal channel has been also confirmed in [2]. Morphological changes outside this area are expected less distinct and/or less relevant for the hydrodynamic processes in the lagoon.

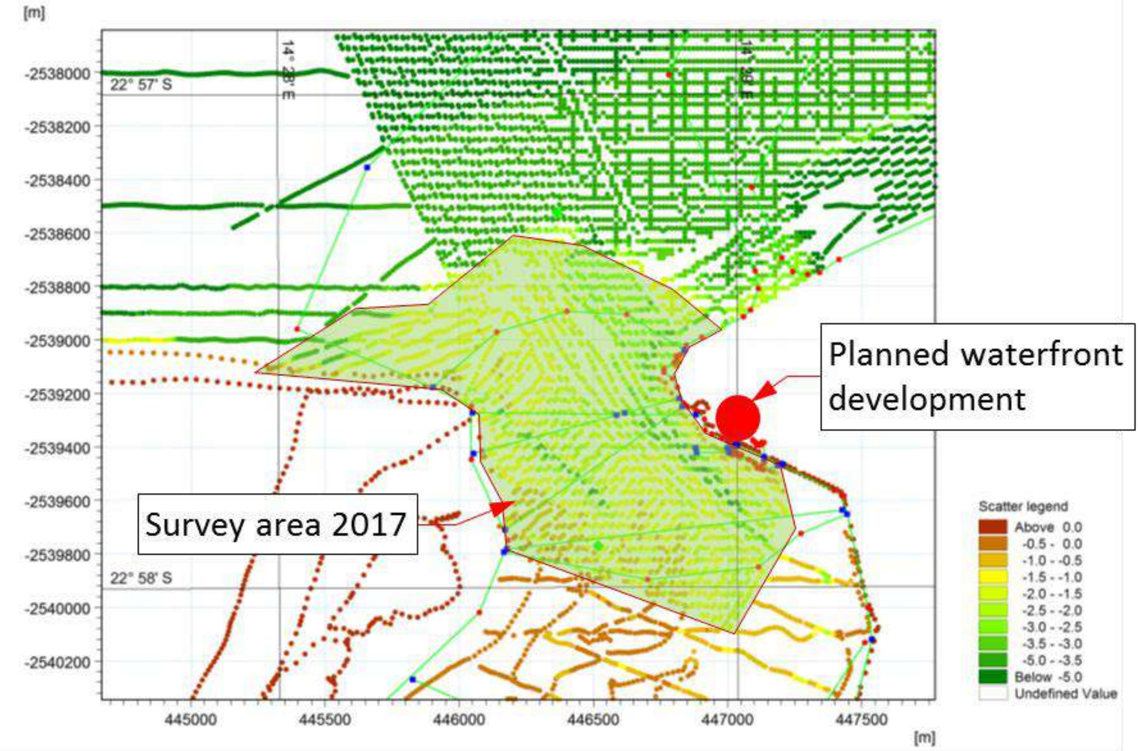


Figure 3-1 Coverage of June 2017 bathymetric survey

When implementing the June 2017 survey data into the numerical model it was found difficult to transform the data set into the correct model projection. The finally decided projection transformation parameters were checked visually as overlay of a referenced google earth image and survey points data in the Mike 21 software (see Annex D). It is recommended to double check the survey data reference and to assess the effect of potential deviations.

3.2 Model grid

The modelling has been carried out based on a flexible mesh which allows to set the grid resolution according to the importance of model areas. The highest grid resolution has been applied in the lagoon entrance and close to the envisaged marina (about 10m node distance, see dark hatched area in Figure 3-2). The tidal flats west of the lagoon as well as the most southern part of the lagoon itself fall dry during low water levels.

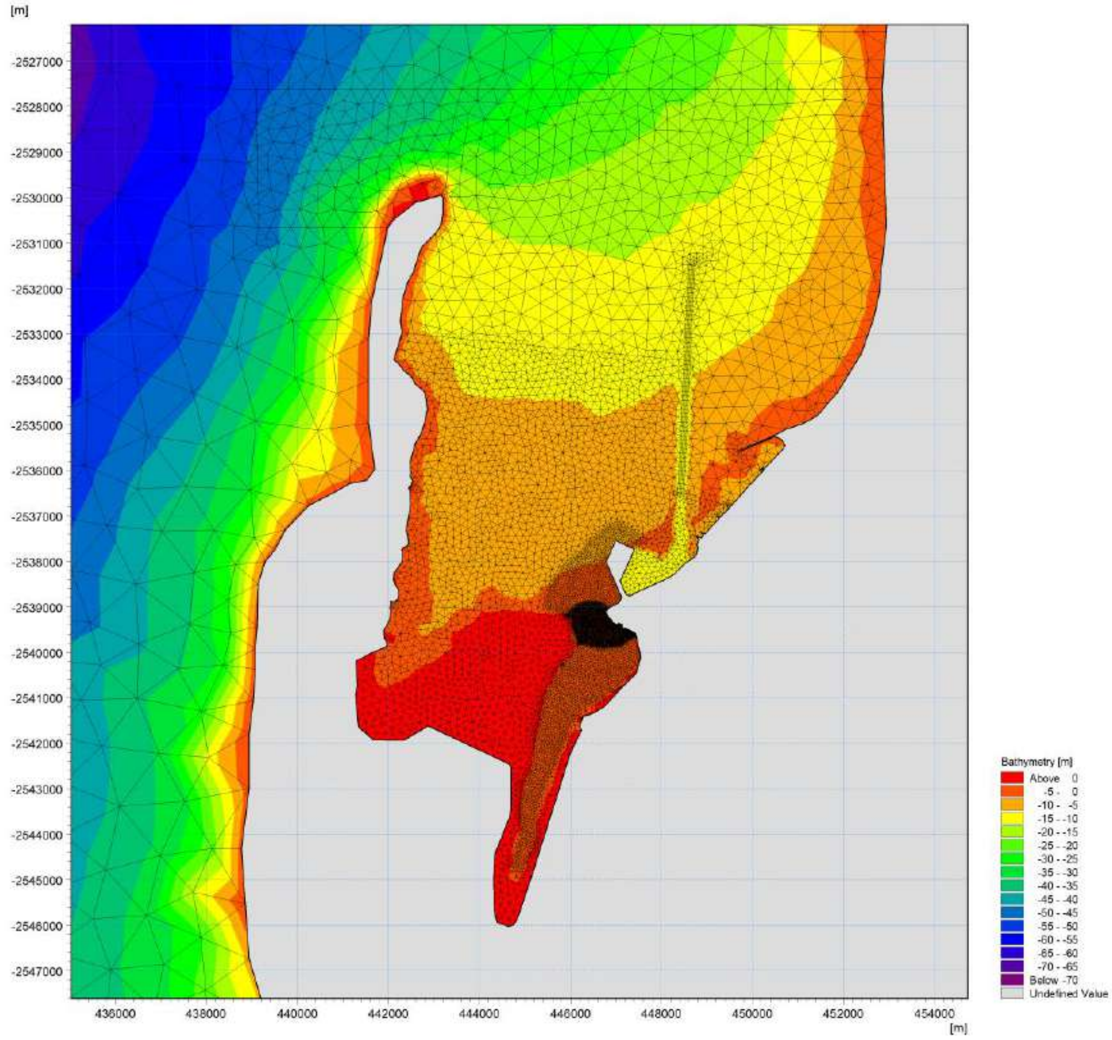


Figure 3-2: Model grid applied for the numerical calculations

3.3 Model output

In addition to spatial output information, e.g. to describe flow pattern and tracer movements, several output points and cross-sections have been defined to characterize the potential effect of the marina on the hydrodynamic conditions.

3.3.1 Output points

Characteristic water levels have been assessed for three different locations

1. Just north of the lagoon entrance (bay side)
2. Just south of the lagoon entrance (lagoon side)
3. Central area of the lagoon

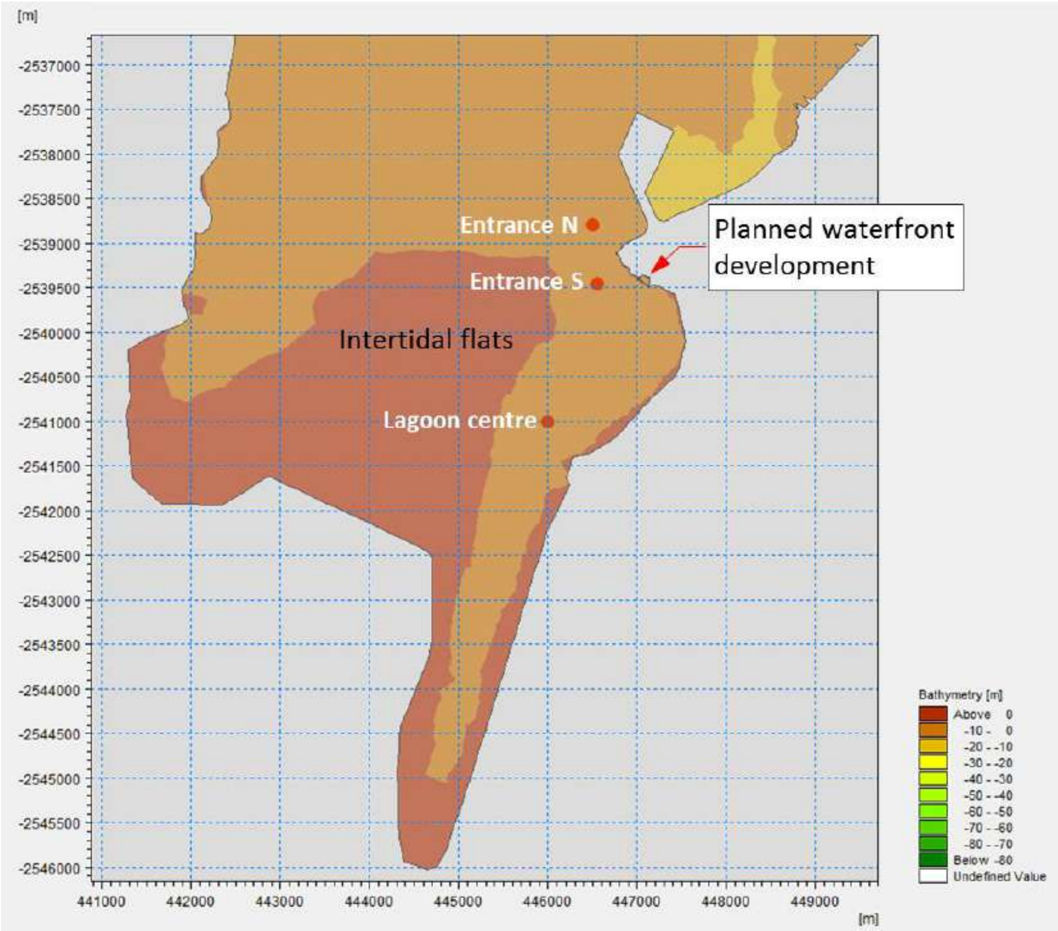


Figure 3-3: Location of output points used

3.3.2 Indicator cross-sections

Three indicator cross-sections have been specified to numerically monitor hydraulic characteristics and asses the water refreshment rates (refer to Figure 3-4):

1. Lagoon entrance (alignment adopted from Line Y in the baseline report - refer to **Error! Reference source not found.**)
2. Line 2 (approx. as in [1])
3. Line 3 (approx. as in [1])

At the lagoon entrance flow velocities, discharges and flow directions have been determined for flood and ebb situations for the scenarios summarized in Table 3-1.

Water refreshment in the lagoon has been analysed based on all three indicator lines.

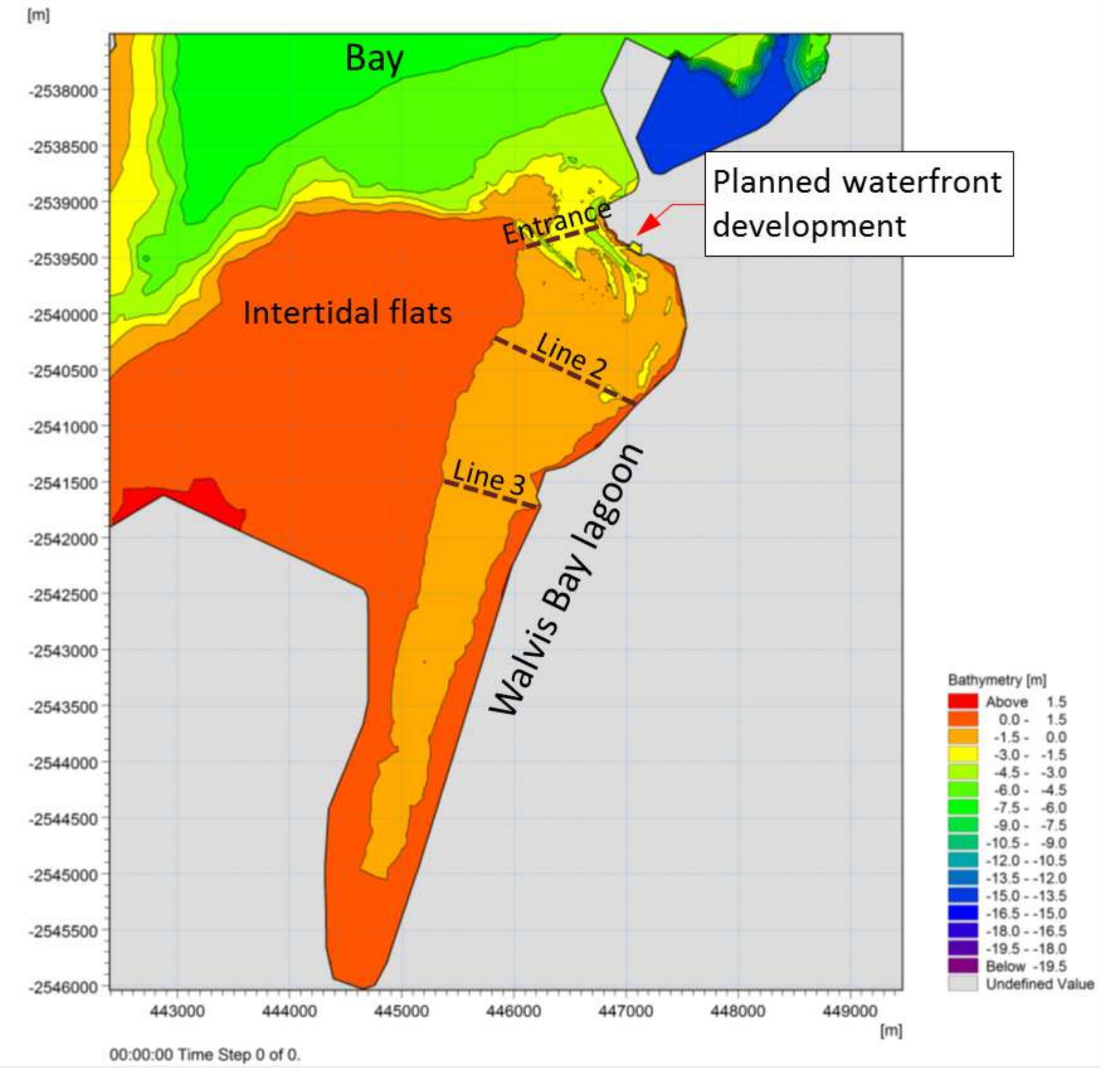


Figure 3-4: Chosen indicator cross sections

3.4 Model scenarios

3.4.1 Flow conditions at the lagoon entrance

The main task of the modelling is to assess whether the new marina will have impact on the hydrodynamic conditions in the lagoon. Interference between flow pattern and structures is expected to be more evident when investigating rather harsh boundary conditions. The modelling of the current pattern at the lagoon entrance has therefore been done with rather distinct wind conditions, as applied during the 2009 EIA modelling ([1]). The tested conditions are based on historical storm events, as selected from offshore NOAA time series (for details refer to [1]). Besides conditions with relatively strong winds also a scenario with neap tide without wind is modelled to assess the effects under smallest flow velocities. An overview of the scenarios is given in Table 3-1.

Table 3-1: Extreme environmental conditions to assess effects on flow conditions

	Water levels	Wind speed	Wind direction
Scenario 1	Neap tide	14 m/s	S (180 ºN)
Scenario 2	Neap tide	10 m/s	NNW (347.5 ºN)
Scenario 3	Neap tide	10 m/s	NE (67.5 ºN)
Scenario 4	Neap tide	0 m/s	No Wind
Scenario 5	Spring tide	14 m/s	S (180 ºN)
Scenario 6	Spring tide	10 m/s	NNW (347.5 ºN)
Scenario 7	Spring tide	10 m/s	NE (67.5 ºN)

3.4.2 Water refreshment in the lagoon

Water refreshment rates have been determined for the Lagoon which indicates the fraction of water volume inside the lagoon (or a certain part of the lagoon) which is replaced by water from outside the lagoon over a defined period of time. For that the water volume in the Lagoon has been marked with a numerical tracer. The refreshment is determined by the mixing of the "marked" water from inside the Lagoon with ambient water from outside the lagoon.

Prevailing (operational) wind and wave conditions, combined with neap and spring tides are used to determine the refreshment rates in the lagoon as well as potential impacts of the new marina. Operational conditions, as specified in Table 3-2, cover about 99% of the range of typical environmental conditions at Walvis Bay.

The modelling has been performed with wind and tidal forcing. Waves have been rated of insignificant influence on current pattern in the lagoon [1] and have been ignored.

The water exchange has been modelled over 4 tidal cycles (of 12.5 hours). The first tidal cycle has been applied as "warm-up" period to provide realistic starting conditions of (spatially variable) water levels and current velocities throughout the modelling area. The water volume in the Lagoon has been marked after the first tidal cycle. The time varying concentration of tracer along the indicator cross sections has been determined after the second and after the third tidal cycle. The refreshment rate, R in this study is defined as $R = (C_2 - C_3) / C_2$ (with averaged tracer concentration after 2 tidal cycles, C_2 and after 3 tidal cycles, C_3).

Table 3-2: Operational conditions for modelling of water refreshment

	Exceedance probability	Tide	Wind speed	Wind direction
Run 1	1%	Neap	13	195
Run 2	10%	Neap	11	195
Run 3	50%	Neap	9	195
Run 4	50%	Neap	9	225
Run 5	50%	Neap	9	315
Run 6	50%	Neap	0	-
Run 7	1%	Spring	13	195
Run 8	10%	Spring	11	195
Run 9	50%	Spring	9	195
Run 10	50%	Spring	9	225
Run 11	50%	Spring	9	315
Run 12	50%	Spring	0	-

4 Modelling results

4.1 Water levels

The water levels evaluated for the chosen output locations (Figure 3-3) over one tidal cycle (12.5 hours) are summarized in Table 4-2 (Base case) and Table 4-2 (marina case). The effect of the wind on water levels is evident. With strong southern winds the water is pushed out of the lagoon average water levels are getting negative and minimum water levels are further decreased.

The effect of the new marina on water levels at the lagoon is concluded insignificant (white cells in Table 4-2 show less than 0.5mm deviation between Base Case and situation with marina). Maximum deviation rarely exceeds 1mm, with exception of average and minimum water levels at the lagoon centre during spring tides and strong winds (scenario 5-7, last row in Table 4-2) which have been found to deviate by up to 8mm.

Table 4-1: Water levels determined for output locations (base case)

Base Case	Average water level			Maximum water level			Minimum water level		
	Entrance north	Entrance south	Centre Lagoon	Entrance north	Entrance south	Centre Lagoon	Entrance north	Entrance south	Centre Lagoon
Scen. 1	-0.069	-0.093	-0.209	0.176	0.162	0.095	-0.361	-0.389	-0.520
Scen. 2	0.007	0.009	0.018	0.244	0.246	0.260	-0.289	-0.288	-0.285
Scen. 3	-0.002	-0.002	0.003	0.230	0.232	0.250	-0.295	-0.295	-0.293
Scen. 4	0.000	-0.001	0.000	0.238	0.239	0.243	-0.293	-0.293	-0.297
Scen. 5	-0.061	-0.088	-0.077	0.818	0.802	0.755	-0.974	-1.003	-0.736
Scen. 6	0.014	0.018	0.118	0.880	0.887	0.909	-0.901	-0.893	-0.543
Scen. 7	0.005	0.006	0.105	0.873	0.878	0.897	-0.911	-0.905	-0.558

Table 4-2: Water levels determined for output locations (marina case)

Marina Case	Average water level			Maximum water level			Minimum water level		
	Entrance north	Entrance south	Centre Lagoon	Entrance north	Entrance south	Centre Lagoon	Entrance north	Entrance south	Centre Lagoon
Scen. 1	-0.069	-0.093	-0.209	0.176	0.162	0.095	-0.361	-0.389	-0.520
Scen. 2	0.007	0.009	0.018	0.244	0.246	0.260	-0.289	-0.288	-0.285
Scen. 3	-0.002	-0.002	0.003	0.230	0.232	0.250	-0.295	-0.295	-0.294
Scen. 4	0.000	-0.001	0.000	0.238	0.239	0.243	-0.293	-0.293	-0.297
Scen. 5	-0.061	-0.088	-0.080	0.818	0.802	0.755	-0.974	-1.004	-0.744
Scen. 6	0.014	0.018	0.115	0.880	0.887	0.909	-0.901	-0.893	-0.548
Scen. 7	0.005	0.006	0.103	0.874	0.879	0.898	-0.911	-0.906	-0.563

up to 1mm *1-3mm* *above 5mm* *(deviations from present situation)*

4.2 Flow conditions at lagoon entrance

The effect of the envisaged marina on flow conditions at the lagoon entrance is shown in Figure 4-1 to Figure 4-4. The flow pattern at the entrance for the Base Case and the situation with marina appear very similar. The flow pattern in the immediate vicinity of the marina breakwater is slightly deflected both during ebb and flood. During ebb flow for the Base Case and the situation with marina an eddy is formed on the shallows just south of the Raft restaurant (i.e. south of the envisaged marina). The main ebb flow is conducted through the eastern tidal channel. The (artificial/dredged) western channel is inactive. In contrast the flood flow is distributed over the entire entrance section.

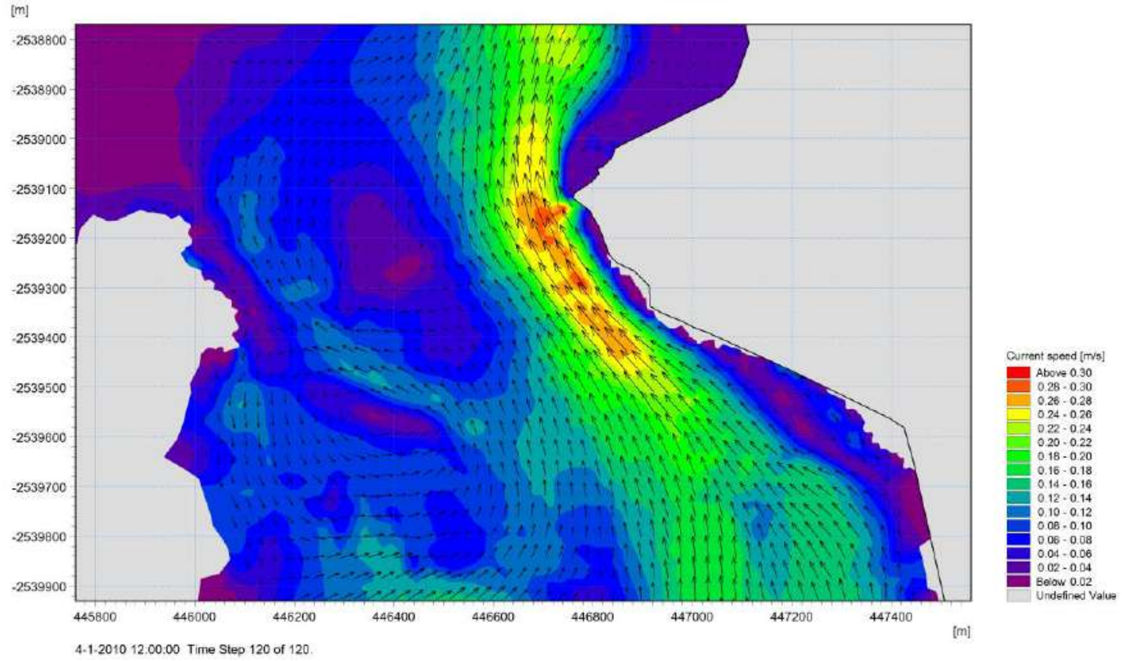


Figure 4-1: Typical ebb current pattern scenario 2, Base Case

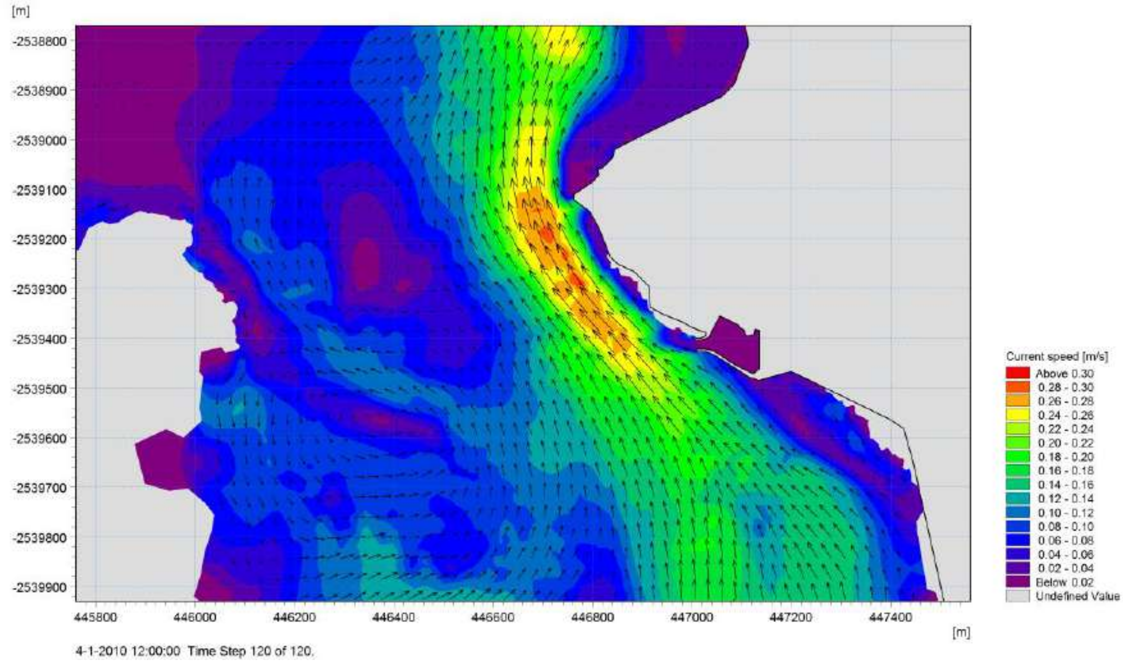


Figure 4-2: Typical ebb current pattern scenario 2, with Marina

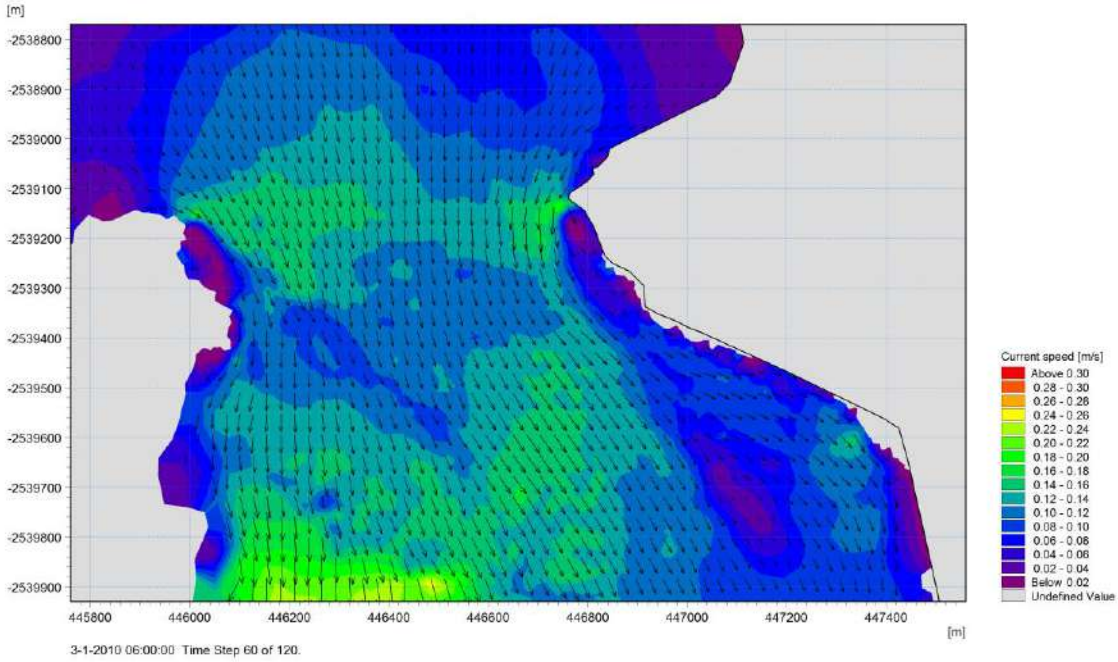


Figure 4-3: Typical flood current pattern scenario 2, Base Case

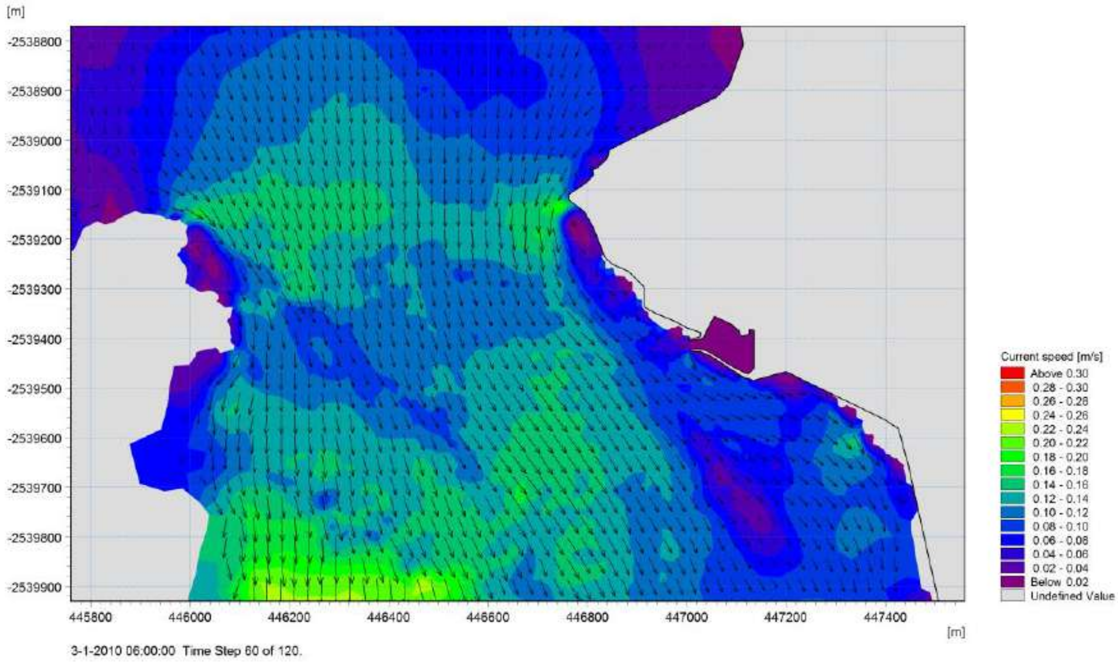


Figure 4-4: Typical flood current pattern scenario 2, with Marina

Flow velocities and discharge rates are given in Table 4-3. The maximum values given in Table 4-3 are maximum values in time of the average over the entire indicator cross section. It is evident that the flow velocities at the lagoon entrance are affected to minor extent by the marina construction (maximum deviation below 3mm/s, see Annex B) when compared to the Base Case.

During neap and spring tide conditions all discharge parameters (average, max flood, max ebb) across the indicator line at the lagoon entrance show negligible differences between Base Case and situation with marina development. The deviations are generally below 0.3% with one outlier (scenario 1 max ebb velocity). Changes in flow direction as derived from the modelling are mostly below 0.5 degrees, with one maximum difference of 2.5 degrees.

Table 4-3: Flow conditions at the Lagoon entrance (refer to scenarios in Table 3-1)

	Average flow velocity [m/s]	Max flow velocity Flood [m/s]	Max flow velocity Ebb [m/s]	Average Q across [m³/s]	Max Q across Flood [m³/s]	Max Q across Ebb [m³/s]	Mean flow direction Flood [degree]	Mean flow direction Ebb [degree]
Scenario 1 Neap tide wind from S								
Base Case	0.18	0.21	0.21	78.83	157.16	129.67	218.88	306.91
Waterfront	**0.18**	**0.22**	**0.21**	**78.74**	**157.03**	**127.98**	**219.56**	**309.36**
Scenario 2 Neap tide wind from NNW								
Base Case	0.07	0.11	0.11	99.22	181.77	157.64	163.85	323.67
Waterfront	**0.07**	**0.11**	**0.11**	**99.40**	**181.58**	**157.67**	**163.93**	**322.84**
Scenario 3 Neap tide wind from NE								
Base Case	0.07	0.10	0.09	95.91	176.99	150.26	167.97	335.85
Waterfront	**0.07**	**0.10**	**0.09**	**95.97**	**176.90**	**150.65**	**167.60**	**335.44**
Scenario 4 Neap tide no wind								
Base Case	0.06	0.10	0.10	96.62	169.00	158.23	166.05	330.82
Waterfront	**0.06**	**0.10**	**0.10**	**96.82**	**169.14**	**158.86**	**166.13**	**331.47**
Scenario 5 Spring tide wind from S								
Base Case	0.25	0.36	0.32	272.97	650.76	547.14	173.98	337.86
Waterfront	**0.25**	**0.35**	**0.32**	**273.42**	**652.24**	**545.61**	**174.92**	**337.33**
Scenario 6 Spring tide wind from NNW								
Base Case	0.21	0.36	0.33	352.02	717.45	682.37	169.02	331.70
Waterfront	**0.21**	**0.37**	**0.33**	**353.11**	**717.65**	**678.10**	**168.56**	**331.96**
Scenario 7 Spring tide from wind NE								
Base Case	0.20	0.37	0.33	345.15	724.30	665.87	169.39	333.02
Waterfront	**0.20**	**0.37**	**0.33**	**346.02**	**723.32**	**661.36**	**169.47**	**333.35**

When comparing the results with earlier analyses done ([1]) it is evident that flow velocities in the present Base Case are in general decreased whereas at the same time characteristic discharges through the lagoon entrance are determined larger, i.e. the flow capacity of the present entrance cross-section is enhanced. This might be associated to some extent to a more refined modelling set-up, however the main influence is expected to be caused by the changed seabed morphology.

This is confirmed when comparing the cross-sections at the lagoon entrance used in both studies. The flow cross-section based on the survey of June 2017 is about 50% larger than determined from the base data applied in the 2009 study. In addition the eastern tidal channel is presently much more distinct and deepened, as has been also found in [2] (see Annex E). The evident changes in flow cross-section have also substantial effects on the water exchange between lagoon and bay.

4.3 Water refreshment in the lagoon

The water refreshment in the lagoon has been determined for the situation with the new marina breakwater and has been compared with the Base Case. The refreshment rates have been analysed for both situations at the three indicator lines in the lagoon (Figure 3-4) . Water refreshment rates are expressed as percentage of the Base Case refreshment rate.

The refreshment rates are summarized in Table 4-4 and Table 4-5. The first block of columns show the percentage of water being refreshed after one tidal cycle (about 12.5 hours). The centre block provides the extrapolated time in hours estimated to completely replace the water at the respective location by water from the Bay. The last block summarizes the refreshment rate compared to the Base Case.

Table 4-4: Refreshment rates during neap tide

	Refreshment percentage per tide			Refreshment time in hours			Relative refreshment to BC		
	Entrance	Location 2	Location 3	Entrance	Location 2	Location 3	Entrance	Location 2	Location 3
	Run 1 - 13m/s S			Run 1 - 13m/s S			Run 1 - 13m/s S		
Base Case	36.1%	37.6%	25.2%	58	55	89	100%	100%	100%
Waterfront	32.4%	37.6%	25.2%	66	55	89	87%	100%	100%
	Run 2 – 11 m/s S			Run 2 – 11 m/s S			Run 2 – 11 m/s S		
Base Case	48.9%	33.4%	21.4%	38	63	107	100%	100%	100%
Waterfront	46.4%	33.2%	21.6%	41	64	106	93%	99%	101%
	Run 3 – 9m/s S			Run 3 – 9m/s S			Run 3 – 9m/s S		
Base Case	55.9%	28.0%	16.4%	32	79	144	100%	100%	100%
Phase 1	55.7%	28.0%	16.3%	32	79	145	99%	100%	99%
	Run 4 – 9m/s SW			Run 4 – 9m/s SW			Run 4 – 9m/s SW		
Base Case	35.3%	20.6%	11.2%	59	112	217	100%	100%	100%
Waterfront	34.3%	20.3%	10.7%	62	114	229	96%	98%	95%
	Run 5 – 9/ms NW			Run 5 – 9/ms NW			Run 5 – 9/ms NW		
Base Case	57.9%	36.6%	16.2%	30	57	146	100%	100%	100%
Waterfront	57.5%	37.4%	16.0%	30	55	148	99%	103%	99%
	Run 6 - No Wind			Run 6 - No Wind			Run 6 - No Wind		
Base Case	13.6%	7.8%	0.2%	176	316	12048	100%	100%	100%
Waterfront	12.4%	7.9%	0.2%	196	314	11714	90%	101%	103%

Table 4-5: Refreshment rates during spring tide

	Refreshment percentage per tide			Refreshment time in hours			Relative refreshment to BC		
	Entrance	Location 2	Location 3	Entrance	Location 2	Location 3	Entrance	Location 2	Location 3
	Run 7 - 13m/s S			Run 7 - 13m/s S			Run 7 - 13m/s S		
Base Case	63.6%	49.9%	34.0%	26	37	62	100%	100%	100%
Waterfront	63.0%	49.6%	32.8%	26	38	65	98%	99%	96%
	Run 8 – 11m/s S			Run 8 – 11m/s S			Run 8 – 11m/s S		
Base Case	60.7%	48.1%	32.6%	28	39	65	100%	100%	100%
Waterfront	59.7%	47.5%	32.4%	28	40	66	98%	98%	99%
	Run 9 – 9m/s S			Run 9 – 9m/s S			Run 9 – 9m/s S		
Base Case	61.4%	48.6%	32.2%	27	39	66	100%	100%	100%
Phase 1	60.3%	47.7%	31.8%	28	40	67	97%	97%	99%
	Run 10 – 9m/s SW			Run 10 – 9m/s SW			Run 10 – 9m/s SW		
Base Case	68.3%	53.5%	36.3%	22	34	57	100%	100%	100%
Waterfront	68.2%	54.4%	36.6%	23	33	57	100%	103%	101%
	Run 11 – 9m/s NW			Run 11 – 9m/s NW			Run 11 – 9m/s NW		
Base Case	81.3%	70.2%	46.3%	15	21	41	100%	100%	100%
Waterfront	81.3%	70.3%	46.8%	15	21	41	100%	100%	102%
	Run 12 - No Wind			Run 12 - No Wind			Run 12 - No Wind		
Base Case	53.1%	45.4%	27.6%	34	43	80	100%	100%	100%
Waterfront	52.4%	44.7%	27.7%	35	44	80	98%	98%	101%

The absolute refreshment between first and second tidal cycle varies for the Base Case between 0% - 58% during neap tide and between 28% - 81% during spring tide. During spring tide the tidal prism is increasing significantly, consequently a larger portion of water is exchanged between lagoon and bay. In addition to the tidal characteristics also the wind conditions appear to play an important role for the refreshment of the lagoon water.

For most scenarios the relative refreshment is determined 1-2% less compared to the Base case. During neap conditions (Table 4-4) it is obvious that largest deviations occur at the entrance cross-section which is situated in immediate vicinity to the initial tracer boundary between bay (zero tracer) and lagoon (100% tracer). It has been concluded that this may influence the calculated refreshment rates at that location.

In situations with generally low water refreshment (small absolute refreshment rates, run 6) deviations in relative refreshment increase and should be weighed together with the absolute rates.

In Annex C the modelled tracer movement (advection and dispersion) is shown for various time steps (each step 0.5 hours) for Run 9 (wind 9m/s from S, spring tide) both for the Base Case and the situation after marina construction.

5 Summary and conclusions

A new yacht marina breakwater is planned in context with the waterfront development at Walvis Bay lagoon. The potential effect of the marina breakwater on the hydrodynamic conditions in the lagoon has been investigated.

The flow conditions at the lagoon entrance and in the lagoon have been numerically modelled for various environmental conditions by the software package Mike 21 FM. The modelling results have been analysed for the present situation and the situation after marina construction.

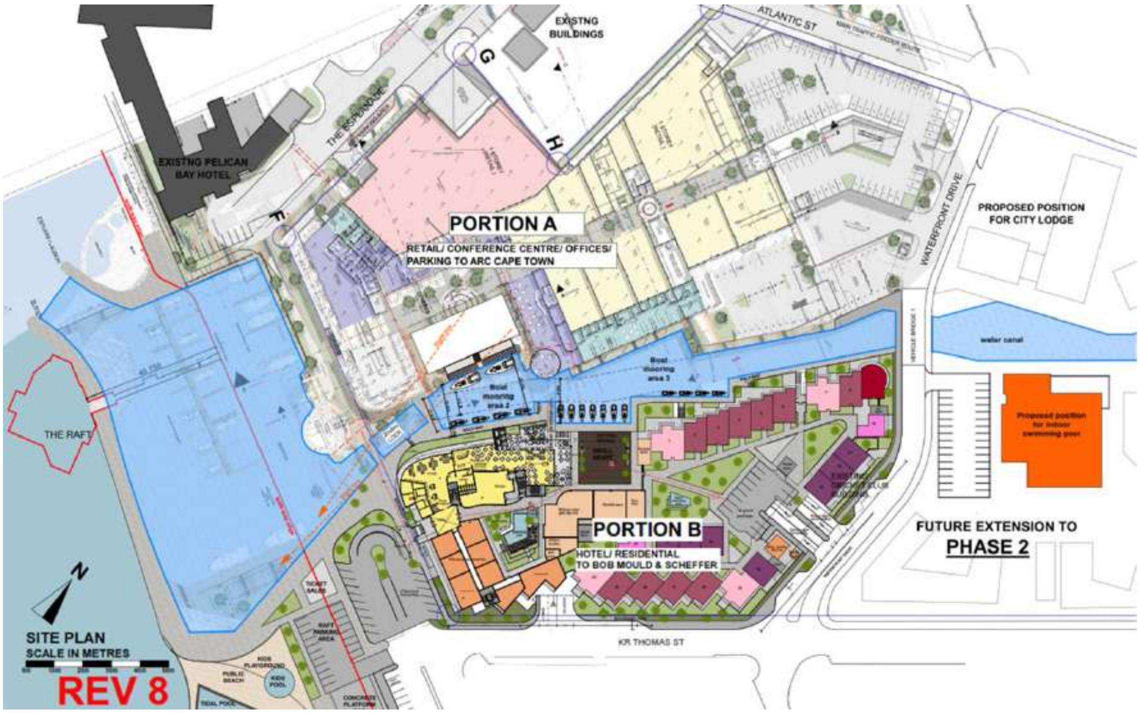
Based on the numerical modelling the following has been derived with respect to the potential effects of the envisaged marina:

1. Water levels changes in the lagoon are expected to remain in general below 1mm. During spring tides and strong winds the minimum water level may decrease further by 5-10mm compared to the present situation (Base Case).
2. Flow velocities at the lagoon entrance are affected to minor extent by the marina construction (maximum deviation below 3mm/s) when compared to the Base Case. During neap and spring tide conditions the discharge across the indicator line at the lagoon entrance show negligible differences (generally below 0.3%) between Base Case and situation with marina development. Changes in flow direction as derived from the modelling are mostly below 0.5 degrees, with one maximum difference of 2.5 degrees.
3. The relative refreshment after marina implementation is determined 1-2% less compared to the present situation (Base case). At the entrance cross-section, the immediate vicinity to the initial tracer boundary between bay (zero tracer) and lagoon (100% tracer) is unfavourable as it may influence the calculated refreshment rates.

It shall be noted that the given results are suitable for comparison of the situations before and after marina construction. For verification of the absolute values determined in the numerical model, further measurement campaigns and monitoring would be required.

The envisaged marina breakwater appears to have little or virtually no impact on the flow conditions at the lagoon entrance and the water refreshment rate in the lagoon. The potential environmental conclusions require assessment by the relevant experts.

ANNEX A – Waterfront Site plan



ANNEX B – Flow conditions at lagoon entrance

Table B 1: Changes in flow characteristics at lagoon entrance due to marina construction

	Average flow velocity [m/s]	Max flow velocity Flood [m/s]	Max flow velocity Ebb [m/s]	Average Q across [m³/s]	Max Q across Flood [m³/s]	Max Q across Ebb [m³/s]	Mean flow direction Flood [degree]	Mean flow direction Ebb [degree]
Scenario 1 Neap tide wind from S								
absolute	0.00	0.00	0.00	-0.08	-0.13	-1.69	0.68	2.45
relative	1.2%	0.8%	1.3%	-0.1%	-0.1%	-1.3%	-	-
Scenario 2 Neap tide wind from NNW								
absolute	0.00	0.00	0.00	0.19	-0.19	0.03	0.08	-0.83
relative	0.0%	-0.1%	-1.3%	0.2%	-0.1%	0.0%	-	-
Scenario 3 Neap tide wind from NE								
absolute	0.00	0.00	0.00	0.07	-0.09	0.38	-0.38	-0.41
relative	0.8%	-0.1%	-2.0%	0.1%	0.0%	0.3%	-	-
Scenario 4 Neap tide no wind								
absolute	0.00	0.00	0.00	0.20	0.14	0.63	0.08	0.65
relative	0.4%	0.6%	-1.0%	0.2%	0.1%	0.4%	-	-
Scenario 5 Spring tide wind from S								
absolute	0.00	0.00	0.00	0.45	1.48	-1.53	0.94	-0.53
relative	0.5%	-0.7%	0.0%	0.2%	0.2%	-0.3%	-	-
Scenario 6 Spring tide wind from NNW								
absolute	0.00	0.00	0.00	1.08	0.20	-4.27	-0.46	0.26
relative	0.5%	0.5%	0.4%	0.3%	0.0%	-0.6%	-	-
Scenario 7 Spring tide from wind NE								
absolute	0.00	0.00	0.00	0.87	-0.99	-4.51	0.07	0.33
relative	0.2%	0.6%	0.2%	0.3%	-0.1%	-0.7%	-	-

ANNEX C – Refreshment - tracer movement

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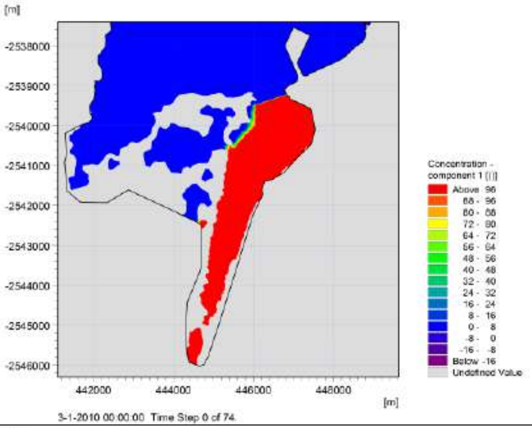
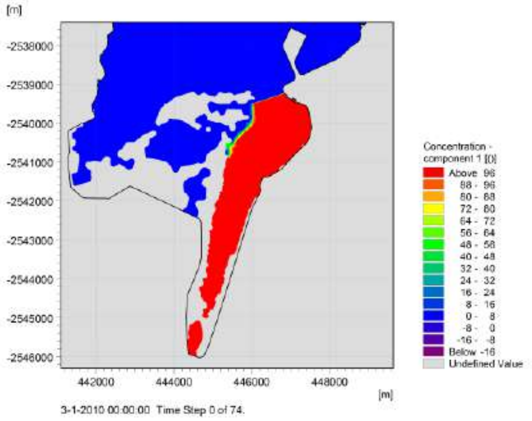
<tr><td>0</td><td>
</td><td>
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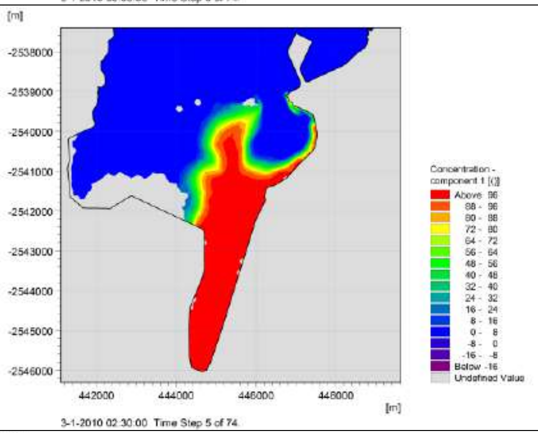
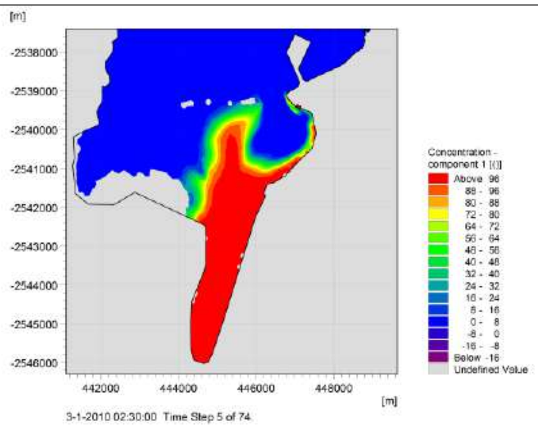
<tr><td>5</td><td>
</td><td>
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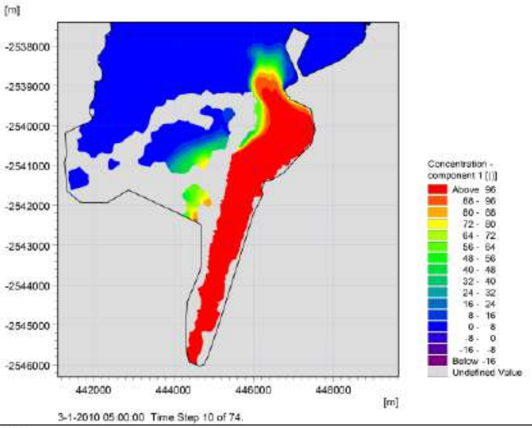
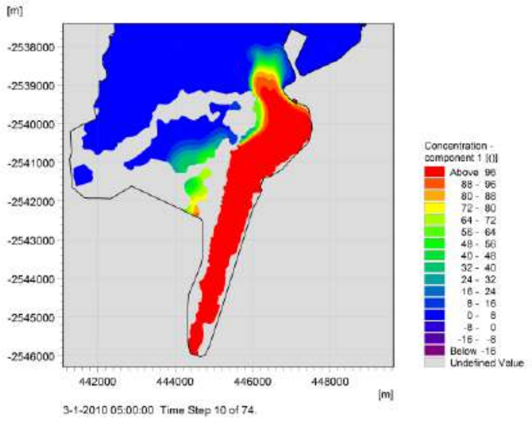
<tr><td>10</td><td>
</td><td>
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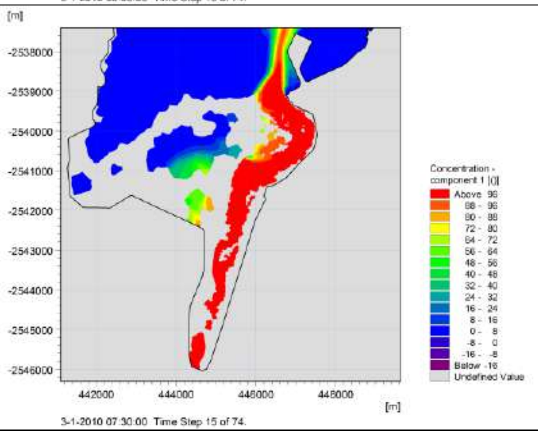
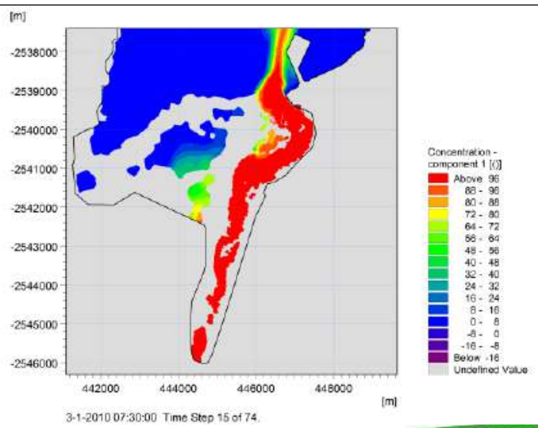
<tr><td>15</td><td>
</td><td>
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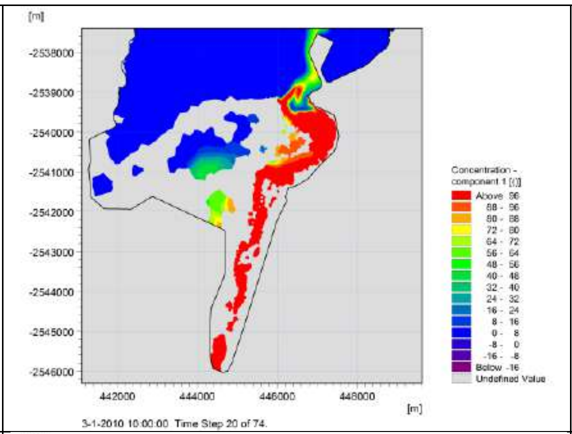
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80 - 88
72 - 80
64 - 72
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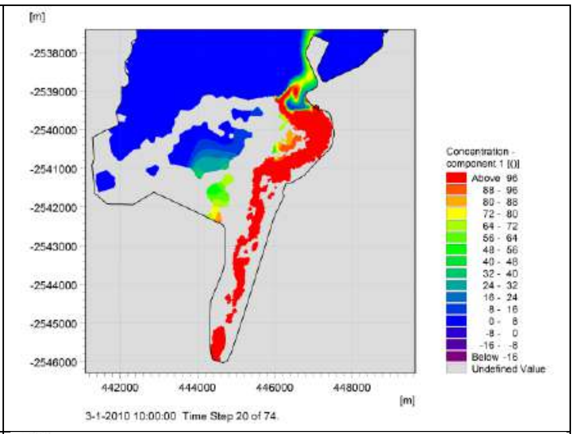
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-2546000
442000
444000
446000
448000
[m]
Concentration - component 1 [()]
Above 96
88 - 96
80 - 88
72 - 80
64 - 72
56 - 64
48 - 56
40 - 48
32 - 40
24 - 32
16 - 24
8 - 16
0 - 8
-8 - 0
-16 - -8
Below -16
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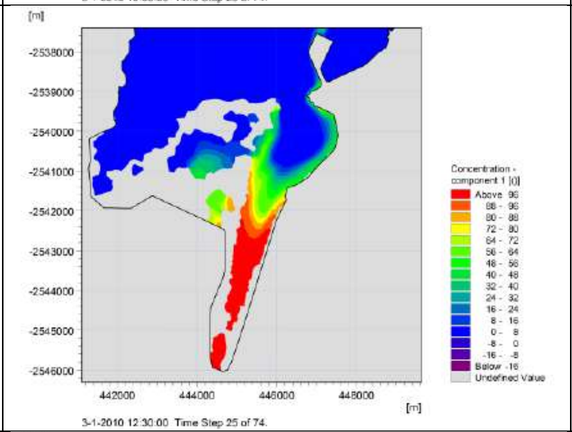
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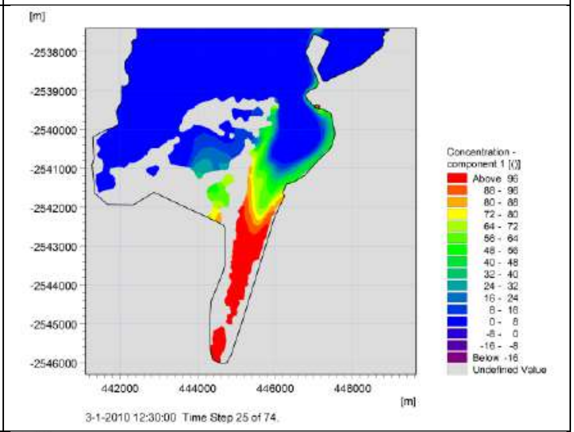
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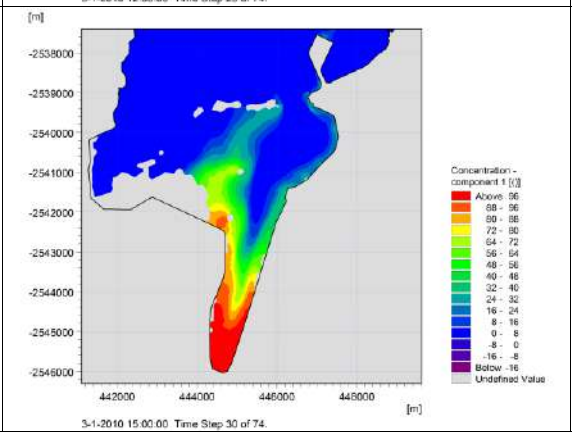
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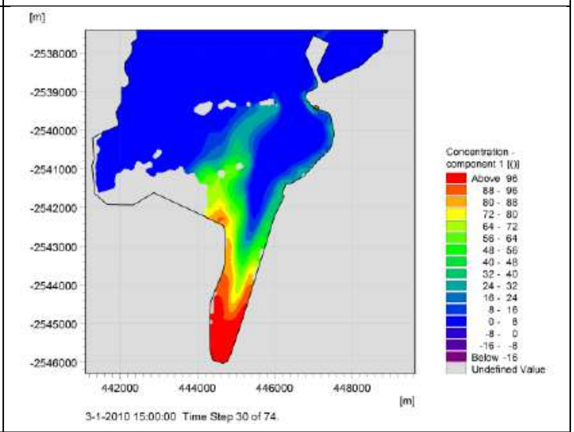
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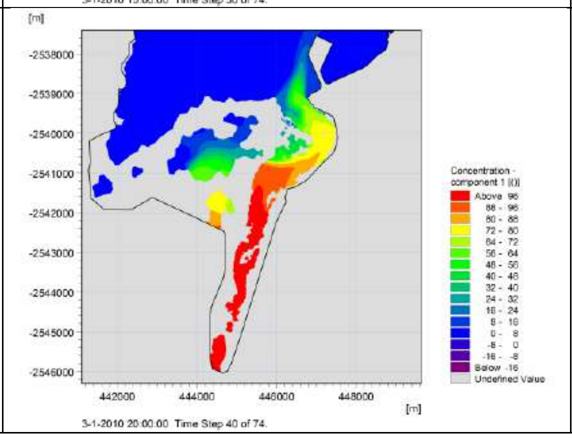
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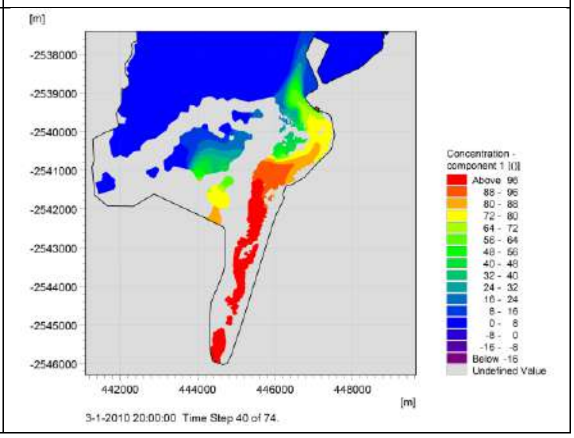
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ANNEX D – Survey data 2017 fit

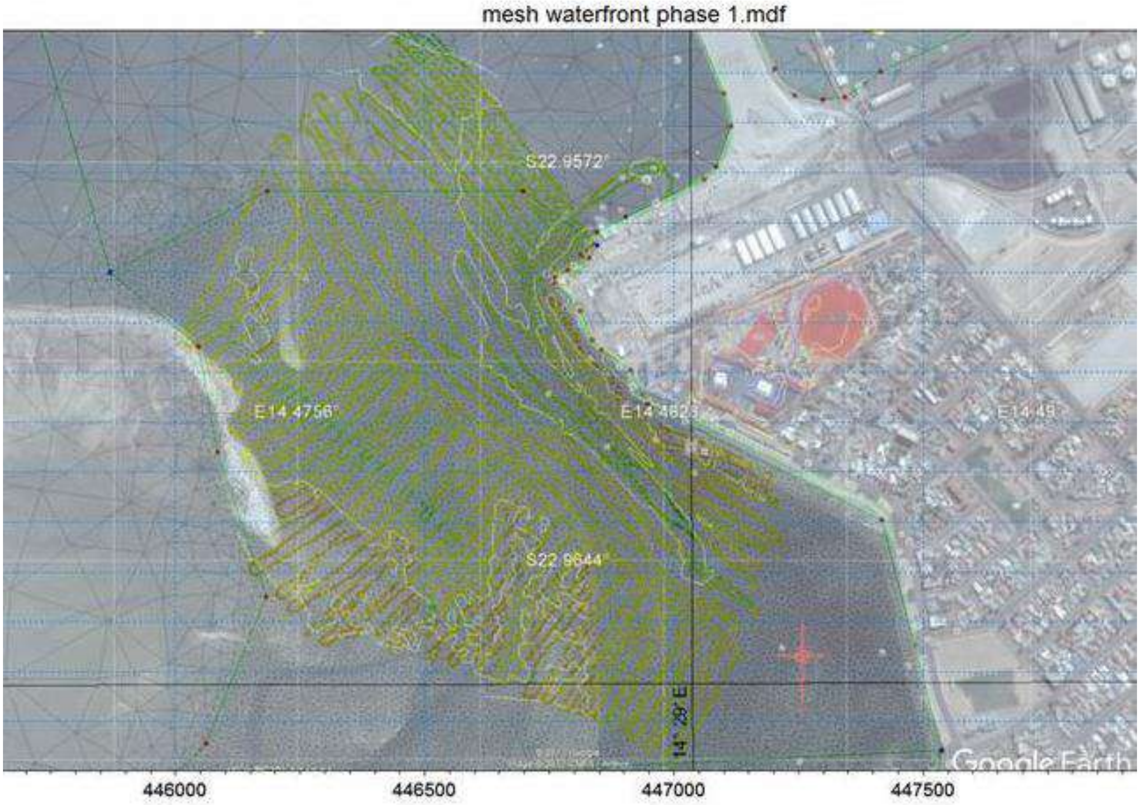

Figure D 1: Fit of June 2017 data into Mike 21 model

ANNEX E – Previous bathymetric surveys at lagoon entrance

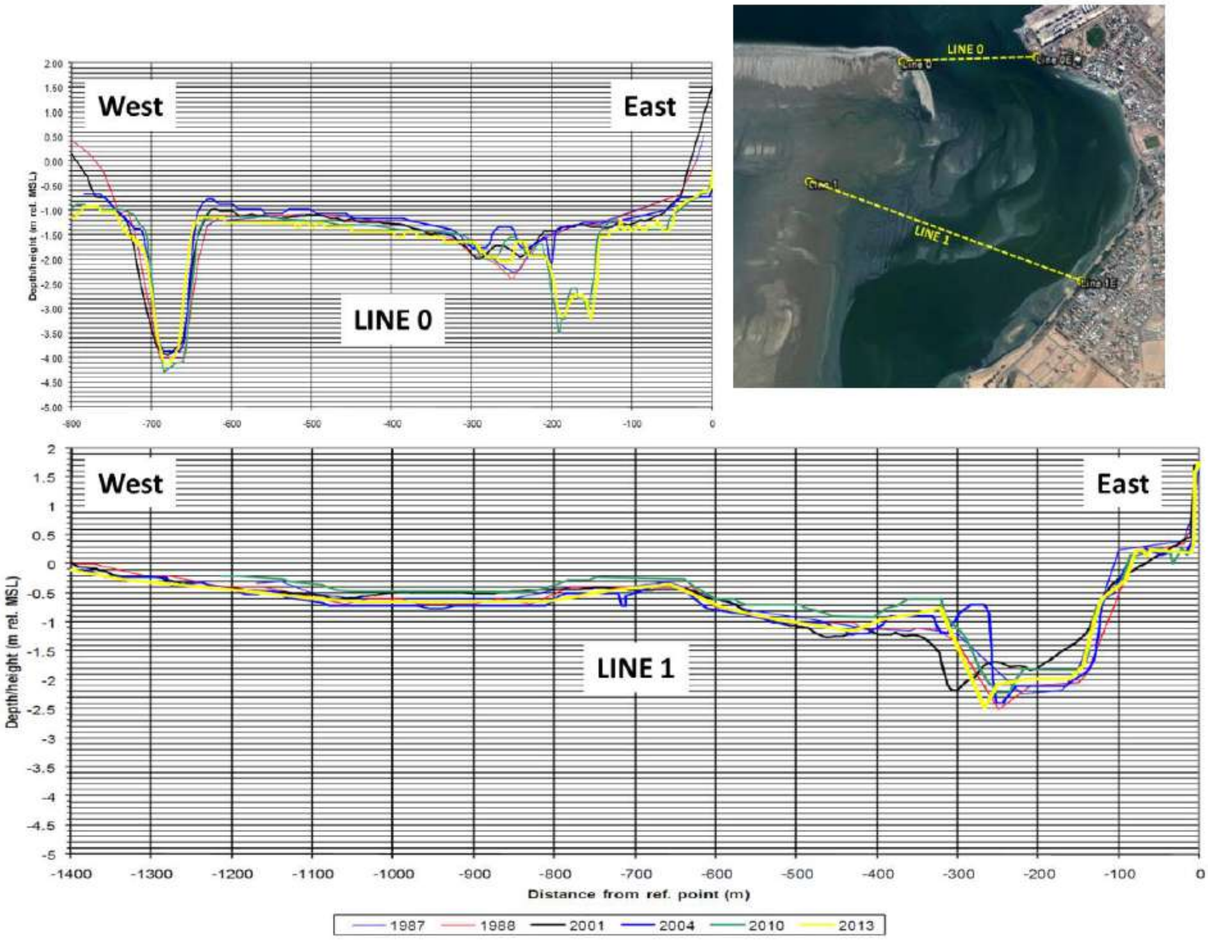

Figure E 1: Deepening of the eastern tidal channel at the lagoon entrance after 2010 (upper left). African Geomatics surveys (2013) adopted from [2]

OVERVIEW OF POTENTIAL IMPACTS ON MARINE MAMMALS IN THE WALVIS BAY AREA WITH RESPECT TO THE PROPOSED WATERFRONT DEVELOPMENT

Dr A.J. Rau PhD (UCT)

March 2017

Statement of Qualification of the Author

Dr Amanda J. Rau was awarded the degree of Doctor of Philosophy (PhD) in Palaeoceanography from the University of Cape Town in 2002. From 2003-2004 she held the position of Post-doctoral Fellow in the Oceanography Department, University of Cape Town.

She completed an MSc in Applied Marine Geoscience at the University of Natal, Durban (1995), with a research focus on the driving forces behind fluctuations in Namibian pilchard and anchovy populations.

Dr Rau has inter-disciplinary qualifications, with most of her research relating to environmental change, both natural and anthropogenically-driven. Dr Rau has worked as a marine geo-science contractor for over 10 years, working on numerous projects in the fields of marine diamond mining, naval research (IMT) and pipeline surveys (SIEP; Kudu gas field). Dr Rau has been involved in environmental issues relating to the Benguela Current Large Marine Ecosystem since 1993 (SFRI), including scientific and environmental collaboration between the mining and living resources industries, and also between neighbouring countries (BCLME, BENEFIT). She has been on working groups at the Sea Fisheries Research Institute, Cape Town (Climate Change Working Group 1993-1994), the Benguela Ecology Programme (BEP, 1993-1994), Quaternary Research Group, UCT (1998-2004), the Lüderitz Cell and Orange River Cone (LUCORC, 2000-2001), BENEFIT (2005) and conservation planning (BCLME 2006). Dr Rau has also lectured, trained and supervised students and employees at various levels in industry and at tertiary education facilities (UCT, NUST). Dr Rau has authored numerous reports related to the potential environmental impact of marine exploration and development.

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GLOSSARY

ABF	Angola-Benguela Front
Audiogram	A graph that shows audible threshold (softest sounds detected) at different frequencies (or pitches)
BCLME	Benguela Current Large Marine Ecosystem
CD	chart datum
CH_4	Methane
dB	decibel - a unit used to measure the intensity or the “loudness of a sound. Used to measure the amplitude of the sound pressure wave of a sound
ENSO	El Niño Southern Oscillation
Frequency	The number of pressure waves that pass a reference point in one second. Measured in Hertz (Hz) or cycles per second. Higher frequency is perceived as a higher pitched sound
HAB	harmful algal bloom
H_2S	Hydrogen Sulphide
Hearing threshold	The sound pressure level that is just audible to a subject under quiet conditions
Hz	Hertz – pressure wave cycles per second
LOW	low oxygen water
Masking	Temporary reduction in ability to detect biologically relevant sounds
Mysticetes	Baleen whales
NBR	Northern Benguela Region
Odontocetes	Toothed whales and dolphins
Otariids	Fur Seals and Sea Lions (eared, clawless seals)
Pinnipeds	Odobenidae (Walrus), Otariidae (sea lions and fur seals) and Phocidae (true seals)
Phocid	True seals (earless, clawed seals)
ppt	parts per thousand
PTS	permanent threshold shift (hearing damage)
SAA	South Atlantic Anticyclone
SBR	Southern Benguela Region
SEL	Sound Exposure Level - the overall acoustic energy impinging on a receiver per unit area within 1 second (dB re 1 μPa^2-s.)
SL or SPL *#	Sound Levels or Sound Pressure Levels - measured in decibels (dB) and referenced to a standard pressure at a standard distance. Reference pressure level for underwater acoustics is 1 micropascal at a reference distance of 1 m (1 µPa@1m). Reference level in air is 20µPa @ 1m. *#
SO_2	Sulphur Dioxide
SST	sea-surface temperatures
Threshold shifts	an animal’s ability to hear at a particular frequency
TTS	temporary threshold shift
µPa	micropascal - a measure of pressure. In air 1,000,000 µPa = 1 Pa ≡ 94 dB

*# To compare noise levels in water to noise levels in air, one must subtract 26 dB from the noise level referenced in water. For example, a supertanker radiating noise at 190 dB (re 1µPa @ 1m) has an equivalent noise level in air of about 128 dB (re 20µPa @ 1m).

EXECUTIVE SUMMARY

The Walvis Bay Waterfront Development (Pty) Ltd intends to develop an area stretching from the current position of *The Raft* Restaurant northwards towards the present Yacht Club. The construction will encompass a breakwater, a connecting canal and a basin. Construction activities will comprise dumping of breakwater material, dredging (and possibly blasting) and piling. There will be increased marine traffic to and from the development site during construction as well as afterwards, with the construction of a new marina. The new facilities are aimed at increasing tourism and recreation in Walvis Bay. The potential positive economic spin-off of the proposed waterfront development must be weighed against any possible negative environmental impact.

The nutrient-rich waters of the adjacent coastline and the Benguela Current region support a variety of top predators, including marine mammals. Of consequence to this report are those that inhabit the nearshore areas that may be directly affected by construction activities, or by increased marine vessel traffic, specifically dredgers, small motorised craft and eco-tourism cruises. All marine mammals are protected within Namibian waters. The purpose of this report is to identify potential impacts of the development on the resident and temporary inhabitants of the Walvis Bay region, as well as on the migratory species and transient visitors.

The key environmental concerns are the resident and commonly seen mammal populations. There is a non-breeding population of Cape Fur Seals at Pelican Point. The largest resident dolphin populations are Heaviside's Dolphins (~500 animals), Bottlenose Dolphins (~100 individuals) and Dusky Dolphins (Namibian Dolphin Project, 2016). Killer Whales have been seen at increasingly regular intervals within the bay over the last decade. Humpback Whales migrating along the Namibian coast are seen in peak numbers in June-July and also in September. Other cetaceans seen periodically within the vicinity of Walvis Bay are Risso's, Rough-toothed and Southern Right-whale Dolphins. Leatherback Turtles have been sighted by tourists on marine cruises off Swakopmund between October and April, and in Walvis Bay in February and March (Namibian Dolphin Project, 2016). It is hoped that Southern Right Whales will return to historical breeding grounds around Walvis Bay in the near future.

The area being considered for development is neither pristine nor undeveloped. Although the Walvis Bay lagoon and wetlands have been declared a Ramsar site and are of global environmental significance, there are numerous commercial enterprises in and around the wetlands, including saltpans and a salt works, an upmarket hotel at Pelican Point near the entrance to the lagoon, and popular fishing spots on the sandspit protecting the bay near the lagoon mouth. Walvis Bay is Namibia's largest harbour and port with passenger amenities, cargo loading quays, storage and transport services, dry-dock facilities, and commercial fish processing factories. The protected waters of the bay itself provide ample

offshore anchorage. The lagoon is used for commercial mariculture farms and also for tourism and recreational activities such as wind- and kite-surfing and kayaking. Marine tours take visitors into the lagoon and out to Pelican Point to view seals and dolphins close up. Recreational fishing spots are found on the sandspit at the seaward end of the wetlands, within the lagoon and around the northern shores of the bay. There is 4 x 4 access, via the salt works, through the wetlands to Paaltjies Beach and Pelican Point. The wetlands are popular with birdwatchers, as they host vast populations of resident and migratory birds of a variety of species. The esplanade along the eastern shore of the lagoon affords visitors and locals the opportunity to view flamingos, pelicans, waders and other coastal birds from close range. It is a popular route for joggers and dog-walkers. The marine mammals have been exposed to harbour development with the expansion of the container basin, periodic maintenance dredging, regular sea-going traffic and repeated close contact with humans as a consequence of marine tourism cruises. None-the-less, the new development will add an extra dimension of disturbance and potential threat to the mammals sharing the bay waters.

Despite the increase in commercial activity within Namibia’s EEZ, visual observations suggest that whale and dolphin populations have been increasing in the last decade. Baleen whales use migratory corridors along the coast or off the continental shelf during their annual migrations between summer Antarctic feeding grounds and breeding grounds in coastal tropical and subtropical waters. There is documented evidence that Southern Right Whales are returning to historical breeding grounds in southern Namibia, and it is hoped that they will venture further north into the Walvis Bay region. Toothed whales have been seen migrating through the cold Benguela system.

The Benguela (Heaviside’s) Dolphin is a resident species endemic to the nearshore waters of the Benguela region. This dolphin is commonly seen between Cape Point (34º20’S) and northern Namibia (17º30’S), concentrated in shallower waters, inshore of the 100 m isobath. There is a resident population of some 500 individuals in Walvis Bay. The larger form of the Bottlenose Dolphin (Common Bottlenose *Tursiops truncatus*), resides in waters less than 10 m deep in the extreme inshore region of northern Namibia, while a slightly smaller form is seen throughout deeper (> 500 m) southern African offshore waters. A pod of ~100 Common Bottlenose Dolphins lives in Walvis Bay. The Dusky Dolphin is a year-round resident of BCLME coastal waters. Sightings are reported generally close to shore within the 50 m isobath, although some individuals have been reported as far out as the 500 m isobath. Risso’s Dolphins are the third most frequently seen dolphin in the Northern Benguela Region, usually in deep waters off the Namibian coastline. Common Dolphins avoid the cooler inshore waters of the BCLME region, but have been recorded as regular inhabitants of pelagic Namibian waters. The Long-beaked Common Dolphin *(Delphinus capensis)* is a popular attraction on a dolphin cruises around Walvis Bay and Swakopmund because it is very gregarious and highly vocal and can be seen in large schools. Rough-toothed Dolphins have been seen from Walvis Bay northwards to Möwe Bay in deep, warmer waters. They have been observed in the company of Pilot Whales and offshore Bottlenose Dolphins. According to vessels operating within Namibian waters, dolphin numbers have been increasing in the last decade.

The Cape Fur Seal is a common resident of the BCLME with numerous breeding sites on the mainland and on nearshore islands and reefs. A colony of some 5000 seals that haul-out at Pelican Point is visited frequently by tourists.

Any construction of harbour and quay facilities will impact on the natural environment. Hydrological changes are brought about by the construction of quays and breakwaters and the implementation of dredging programs and dumping of dredged material. Runoff from quays and walkways can pollute the water. Increased organic loading can result from additional sewage outflow or dumping of garbage. Explosive devices and pile driving can cause physical trauma, hearing loss and behavioural change in marine fauna. Dredging to deepen approach channels and basins can result in loss of food sources, turbidity and resuspension of sediments that may contain toxic compounds. Imprudent disposal of waste products and rubbish can lead to entanglement, injury and death in mammals and turtles. Increased tourism and numbers of recreational vessels can lead to masking of biologically important sounds. There is an increased risk of vessel-animal and human-animal interactions and these pose a risk to both the animals and to humans.

Effects on marine mammals associated with the proposed development project include underwater noise impacts, reduced prey availability, disturbances from construction and shipping activities, collisions between marine mammals and vessels, contamination of the water column and resultant bioaccumulation of toxins, injury from litter, stress from increased human activity and habituation to human presence. The significance level of each impact can be reduced through the implementation of mitigation measures.

Underwater noise

Marine mammals (cetaceans and pinnipeds) use sound for communication, orientation, predator avoidance and foraging. Underwater noise has the potential to affect or interfere with these critical activities. The effects range from subtle changes in behaviour to temporary or permanent hearing loss. The response of a marine mammal to an anthropogenic sound will depend on the frequency, duration and energy (amplitude) of the sound, as well as the distance of the animal from the sound source and whether the noise is perceived to be approaching or moving away.

In extreme cases and at very high received SPLs received close to the source, very intense sounds (e.g. underwater explosions) can result in internal injuries that might lead to death.

Masking is the term used to describe a temporary reduction in ability to detect biologically relevant sounds as a result of a loud noise or strong SPL. Masking can shorten the range over which sounds can be detected and across which conspecifics are able to communicate (e.g. mother and calf). However, most mammals communicate across a range of frequencies, so it is highly improbable a construction noise will mask the full range of frequencies used by one specific species. *Threshold shifts* refer to an animal's ability to hear at a particular frequency. Temporary threshold shift (TTS) refers to an animal's inability to hear a particular frequency for a transitory period of hours to days. Permanent threshold shift (PTS) represents a permanent loss of hearing at a particular frequency. *Behavioural disturbances* are reflected by noticeable changes in activity and demeanour in direct response to a sound source (e.g. directional swimming, jumping out of the water, avoidance or reduced acoustic response).

The frequency of sounds generated by marine mammals range from the 10 Hz low-frequency calls of Humpback Whales to the > 200 kHz ultrasonic clicks of offshore dolphins and Harbour Porpoises. The hearing systems of animals are not equally sensitive to all frequencies. The marine mammals of concern in this report, that may be found within the Walvis Bay area, are low-frequency mysticetes (Humpback and Southern Right Whales) that have a vocalisation and hearing range of 7 Hz to 22 kHz, mid-frequency cetaceans (Orcas, Bottlenose, Dusky, Common and Risso's Dolphins) with ranges of 100 Hz to 160 kHz and Cape Fur Seals. There are no auditory records for Cape Fur Seals, so data for similar species (Northern and New Zealand Fur Seals and Australian and California Sea Lions) are used. Seals and sea lions produce sounds that range in frequency from approximately 125 Hz to 40 kHz.

The main sources of underwater noise from the proposed development can include blasting, ramming or impact (strike) pile driving during construction, dredging and operating noise from construction vessels and increased small craft after completion of the waterfront.

Blasting is one of the most powerful sources of underwater sound, but the energy impact is very short-lived. Cape Fur Seals appear to have a high tolerance for underwater sounds. Their habituation to "seal bombs" suggests that they are fairly resistant to loud noise pulses. After an initial startle reaction, it has been noted that individuals quickly reverted back to normal behaviour. Blasting is unlikely to significantly impact the behaviour of Cape Fur Seals or impair their hearing at distances greater than 700 m (Brough et al., 2014; Thompson et al., 2000).

Mid-frequency cetaceans are more sensitive and need to be further (~2 km) removed from the sound source to avoid suffering TTS (NOAA, 2015; Finneran et al., 2002). Behavioural responses can be expected at far as 5 – 10 km away.

Low-frequency Humpback Whales are the most sensitive to blasting noise and will be highly impacted if in close range. There is evidence to suggest some level of disorientation or impairment after blasting events at < 2 km (Madsen and Møhl B., 2000; Todd et al., 1996). However, as Humpbacks are only transient migrants past Walvis Bay, and if the timing of the blasting can be scheduled not to coincide with peak observation periods (June, July and September), the impact level of blasting on the baleen whales is considered to be of very low significance.

While blasting can severely injure turtles at close range, research indicates that masking or behavioural disturbance is unlikely at distances greater that 1 km. This is because magnetic signals are turtles' main navigational tools, rather than sound signals (Lohmann et al., 2001; McCauley et al., 2000).

Acoustic harassment devices have been used successfully used against Ringed Seals and Harbour Porpoises. Effective avoidance zones using pingers have been reported at distances of 200 to 500 m (OSPAR, 2009). It might be necessary to deploy several pingers at different distances from the construction site to keep mammals outside of potential TSS zones.

Pile-driving is undertaken in harbour and offshore construction. Impact pile drivers have much lower peak pressures and far longer rise times than explosives. Source levels vary depending on the diameter of the pile and the method of pile driving: impact or vibro-piling. The frequency spectrum for pile driving ranges from less than 20 Hz to more than 20 kHz with most energy around 100 - 200 Hz (Dahl et al., 2015; AFTT, 2012; Bailey et al., 2010; OSPAR, 2009). Consequently, it is expected that pile driving noise would significantly mask Humpback Whale vocalisations. However, as Humpback Whales are transient migrants through the NBR, and do not come into the bay itself, it is expected that any pile driving operations will have minimal impact on this species. Also, they feed only opportunistically during migration, so displacement of prey species such as anchovy and sardine, is of small consequence.

Mid-frequency dolphins (Bottlenose, Dusky, Common, Risso's) and Killer Whales have less sensitive hearing below 1 kHz. PTS and TTS will occur within 5-10 and 10-20 m, respectively, of the pile-driving process. Masking of vocalisations and echolocation in Bottlenose Dolphins as a result of pile driving is deemed unlikely beyond 100 m (Bailey et al., 2010; David, 2006). Bottlenose Dolphins and Harbour Porpoises have shown avoidance of wind farm construction areas during active piling periods for distances of 20 km. They remained distant from the noise source for 4 to78 hours (Bailey et al., 2010; Brandt et al., 2011; Tougaard et al., 2005; 2003). Additionally, porpoises exhibited significant behavioural changes from non-directional movement (presumably associated with feeding) to directional movement on days with active pile driving operations. Nevertheless, all behaviour returned to baseline levels within 4 hours of cessation of ramming, suggesting no long-term effects (Tougaard et al., 2005; 2003a; b).

Cape Fur Seals vocalise at low frequencies (~ 100 Hz), so their detection of biologically important sounds may be impaired by increased low spectrum noise. However, Bailey et al. (2010) found that PTS is likely only within 20 m of piling at peak source levels of 212 dB re 1 µPa. TTS is possible at 40 m. Masking was deemed unlikely beyond a distance of 100 m, based on a SEL of 166dB re1 µPa2-S. Brough et al. (2014) suggested a precautionary exclusion zone of 700 m to preclude physical injury to New Zealand Fur Seals resulting from pile driving noise. Edren et al. (2004) observed a reduction in numbers of Harbour Seals hauling out at sandbanks 4–10 km away from the piling operations. The avoidance behaviour was very short-term as seal haul-out returned to base level numbers, accompanied by normal behaviour, on days when no ramming was undertaken.

Legislation in several European countries is aimed at limiting piling impacts on marine mammals and reducing avoidance distances to less than 8 km (Dahl et al., 2015). A precautionary approach, based on these regulations and other data, would involve:

- no piling during the seasons with the highest abundance of sensitive species (For this project that would be during the peak Humpback migration in June and September)
- using “soft starts” and ramping-up procedures to allow animals to move away (seals and odontocetes are known to move out of range before SEL reach damaging intensities)
- monitoring noise levels. If they exceed 30 kPa at a distance of 1 m to 2 m from the pilings noise reduction methods should be considered such as hydraulic pile driving or vibratory hammers rather than impact pile driving, mantling orinstalling silt or bubble curtains
- establishing specified safe distance zones (500 m for Cape Fur Seals and 2 km for dolphins) and delaying or ceasing piling operations if a mammal is within these zones.

(Todd et al., 2015; Brough et al., 2014; Bailey et al., 2010; OSPAR, 2009; Marine Mammal Commission, 2008; Würsig et al., 2000).

No mitigation measures other than “soft starts” are deemed necessary with respect to the presence of turtles, as scientific evidence suggests that turtles will move away from the noise source (McCauley et al., 2000; Bartol et al., 1999).

Madsen et al. (2006) determined that pile driving would not have significant masking implications across the entire spectrum of frequency ranges used by Harbour Porpoises, Bottlenose Dolphins, North Atlantic Right Whales or Harbour Seals. Cape Fur Seals have shown a strong resilience to noise impacts from other marine sources in Namibian waters. They purposely approach operational marine survey, mining and fishing vessels regardless of the use of deterrents. Thus, piling activities are not expected to present any long-term detrimental impacts to any of the mammals in Walvis Bay, as long as they are sufficiently removed from direct exposure to the sound source.

Short-term impacts of piling on marine mammals may include avoidance behaviour and reduction in prey species that could move away or otherwise suffer negative consequences. However, the varied diet of seals and cetaceans and their ability to forage some distance away from their usual habitats will negate any temporary reduction in prey availability.

The long-term impact of impulsive noise on turtle migration and feeding is considered to be of low significance, since turtles make use of magnetic cues rather than acoustics for navigation (Lohmann et al., 2001).

Dredging emits continuous broadband sound, mostly in the lower frequencies with bandwidths between 20 Hz and 1 kHz. These sounds primarily fall within the lower frequency ranges of baleen whales, at which toothed whales and dolphins are less sensitive (Robinson et al., 2011; Richardson et al., 1995). Damage to the auditory systems of low-frequency marine mammal is unlikely, but masking and behavioural changes are possible, owing to the increased (and continuous) ambient noise in the low-frequency spectra.

Behavioural responses of baleen whales vary according to the type of construction activity and dredge method, but there is generally some avoidance response. The numbers of Bottlenose Dolphins in established foraging areas in Aberdeen Harbour declined as dredging intensity increased (Todd et al., 2015).

Research suggests that the impact of dredging sounds on pinnipeds is limited. New Zealand Fur Seals, Australian Sea Lions and Hawaiian Monk Seals showed no disturbance reactions, despite the relative closeness of the dredging to popular haul-outs (Todd et al., 2015; EPA, 2007). In some cases pinnipeds and dolphins were actually attracted to areas of active dredging (Anderwald et al., 2013 cited by Todd et al., 2015), possibly because of increased prey numbers as a result of seabed disturbance.

It can be concluded that most effects of construction involve short, perhaps medium-term, behavioural reactions and masking of low-frequency calls in baleen whales and seals. Temporary hearing loss is possible if receivers stay for extended periods near the dredger, but auditory injury is unlikely. It is unlikely that construction noise will interfere significantly with the sonar or hearing ability of mid-frequency cetaceans.
While the preferred prey species of resident mammals may be temporarily displaced through stress and avoidance of the construction noise, this would be of limited duration in time and space and should not cause any feeding stress.

The overall impacts of construction noise and disruption on marine mammals within Walvis Bay may be moderate to high initially, but can be moderated in the medium term. No long-term, significant population-level negative effects are expected as a result of noise associated with this development.

Increased marine traffic:

There will likely be more vessels entering the lagoon area (dredge and construction) during the construction phase of this project than at any time previously. This will create more disturbance within a confined space. Heiler et al. (2016) identified an upward shift of up to 1.99 kHz in the vocalisations of Bottlenose Dolphins in the presence of one or more small boats in Walvis Bay. It is likely that construction, transport and dredge vessels will illicit similar responses, though the significance thereof is undetermined.

In terms of direct effects on marine mammals, collisions are possible, but improbable, given that the marine mammals within Walvis Bay are accustomed to the passage of sea-going vessels in and out of the harbour, as well as to the smaller marine tour boats. Operating dredgers are either stationary or moving at slow speeds and the marine mammals in the bay are highly mobile, so collisions are improbable. Non-the-less, the probability of collisions can be lessened if:

- vessels use predetermined shipping lanes and navigation routes to and from the construction site
- vessels maintain a constant course and constant speed where practical, except in an emergency
- crews of vessels involved in construction activities remain vigilant to the presence of marine mammals in the area
- vessels maintain a distance of 100 m from any marine mammal (if marine mammals deliberately approach within 100 m, vessel speed should be reduced and, if possible, cautiously manoeuvred away from the animal, vessel speed may be resumed once a mammal has moved at least 100 m from the vessel)

The fact that there has only been one case of a small-boat propeller injury suggests that, on the whole, tour operations are not a threat to swimming dolphins. However, an increase in the number of vessels may result in more “jostling” for prime positions, with associated increase in risk of mammal-vessel collision. People need to be educated with respect to approaching and feeding marine mammals. The practise of feeding Cape Fur Seals and encouraging them to board boats should be stopped as they will be unable to distinguish between a tour boat and a small fishing or recreational vessel.

The considerable increase in marine traffic approaching the lagoon will have significant impact on all wildlife life for the duration of the construction. Initially, and in the short term, a high level of disruption to cetaceans and seals is probable, but the significance and level of intensity will moderate with time as the mammals become habituated. Cape Fur Seals will probably habituate faster than the cetaceans in the bay. Long-term impacts of small craft in the bay will be dependent on regulations and enforcement thereof.

Turbidity, water contamination, pollution and litter

Dredging operations, during construction and subsequently, for maintenance purposes, will release sediments into the water column, causing turbidity and remobilizing compounds. Sediment plumes are generally localized and marine mammals often navigate through turbid waters, so significant impacts from turbidity are improbable. Heaviside's, Dusky and Bottlenose Dolphins are highly mobile and would readily avoid turbid water. They also have the ability to use sonar, so that they do not have to rely solely on vision. Sight is not essential to pinnipeds' survival or ability to forage and hence the level of turbidity is inconsequential (Dehnhardt et al., 2001; McConnell et al., 1999). Turbidity has the potential to impact fish abundance and distribution within the lagoon. However, additional food sources are available in the rest of the bay. These highly mobile animals can relocate to more favourable feeding areas or increase time spent foraging for the periods when dredge plumes are present. This may impact the local population densities somewhat in the short term, but is likely to be of low significance in the long term.

Entrainment, habitat degradation, noise, contaminant remobilization, suspended sediments, and sedimentation can affect benthic, epibenthic and infaunal communities, which may impact marine mammals indirectly through changes to prey species. Marine mammals can compensate for small-scale changes in prey abundance by switching prey species or moving to alternative foraging grounds. Dredging could have positive impacts, such as increasing prey availability and species diversity due to a temporary augmentation of nutrients and primary productivity (Todd et al., 2015; Bailey et al., 2010).

The level of the impact of remobilising contaminants within dredged material will be determined by the sediment composition and the distance of the dump site from known breeding and feeding grounds and haul-out sites. If the sediments contain a high degree of toxins that can become bioavailable, the impact of dredging and dredge spoil dumping can be very high in the long term. However, a properly designed and managed dredging programme can have a low impact on the mammal population. There are no reports of significant long-term impact related to the regular maintenance dredging in Walvis Bay Harbour and it is assumed that the sediments in the proposed construction area will be of similar composition.

Stormwater runoff, particularly during the construction phase of the development, may cause water pollution and reduce water clarity if adequate stormwater treatment systems are not established. Mitigation measures can include introducing systems to minimise contamination of runoff and stormwater, introducing and enforcing no dumping policies for construction material and rubbish and placing containment net fences around active construction sites to minimise wind-blown dust and debris. Appropriate design and management can reduce the risks of intense impacts (both long- and short-term) to moderate levels of significance.

Contaminants can be introduced into the marine system through inadequate disposal of construction materials, rubbish generation and accidental oil and chemical spills from construction vessels and machinery. Short term impacts of high intensity and significance can result from oils spills, but can be lessened by quick response and following preset clean-up procedures.

Marine mammals are susceptible to bioaccumulation because they feed at high trophic levels and have a large proportion of lipid-rich blubber which readily accumulates toxins. High contaminant levels have been linked to depressed immune systems and endocrine disruption (Todd et al., 2015; Brough et al., 2014; Bailey et al., 2010; Marine Mammal Commission, 2008). The inshore distribution and movement of the resident dolphin species is a factor of concern. Pollution can impact the health of individual marine mammals and have longer-lasting, population-level impacts such as reproductive complications, developmental defects, strandings and other mortality events. Solid surfaces (walkways, jetties) near and around residences and businesses will facilitate the addition of pollutants into the lagoon waters due to suspension in rainwater run-off and cleaning water that is washed into the waterways. Toxins may also accumulate in the bottom sediments and may be resuspended into the water column by storms and maintenance dredging, and subsequently be taken up by marine mammals. Policies to eliminate the addition of pollutants (cleaning chemicals, rubbish, and effluent) into the waters of the lagoon and bay and control waste disposal must be established and enforced.

Marine mammals accumulate high levels of contaminants, irrespective of whether they are exposed to construction and dredging activity, as they are highly mobile creatures and come into contact with contaminants throughout their entire range. Any cumulative effects are only possible to calculate with known baseline levels of toxins in the marine mammals that already inhabit the Walvis Bay area. Dolphins and seals have some of the highest concentrations of organochlorides for any marine animal owing to their fairly regular contact with humans, the close proximity of their habitat, their large coastal distribution and high trophic level. However, the potential impact of toxin accumulation in dolphins as a result of increased exposure to chemical waste is considered high in the long term.

A further point of concern is an increase in non-biodegradable pollution that will result from an increase in tourism and general human activities in and around the waterfront. Non-biodegradable litter and discarded fishing gear pose a serious threat to seabirds and marine animals, such as seals and turtles. Stringent controls and penalties for littering need to be imposed. The impact on seal and turtle injury and mortality due to entanglement or garbage consumption is considered to be highly significant, both in the short and long term.

The level of impact of the completed development is dependent upon what control measures are instigated to combat pollution. High levels of chemical pollution and non-biodegradable waste can potentially cause irreparable harm.

Increased human activity

The Walvis Bay Lagoon is explored by boat and kayak. Wind surfing and kite-boarding are popular on the leeward side of Pelican Point. The shoreline is popular for walking with locals and tourists alike. Recreational fishing occurs at Paaltjies Beach on the sandspit and elsewhere in the bay. There are daily boat tours to Pelican Point and into the bay. Pelican Point can be accessed overland via the wetlands and salt pans. There is a potential for increased activity on a daily basis as a result of the development attracting more visitors as well as local residents, particularly when the accommodation phases are complete. With increased numbers of people comes associated increased disturbance of all nature wildlife in the immediate area, as well as a higher likelihood of human-animal interaction. There is the potential for degradation of the sandspit if numbers are not controlled. Overfishing and removal of bait species can impact top predators in the entire Walvis Bay area.

Dolphins can experience stress from increased human activity, particularly when breeding and nursing. Larger numbers of marine tour boats can influence the vocalization parameters of dolphins and such changes could have a long-term impact if they reduce the communication range of whistles or increase energy expenditure (Heiler et al., 2016). Frequent contact between humans and dolphins, achieved through the regular tourist cruises, can have unknown long-term negative impacts on dolphin health (at population level) owing to the nearness of the interactions. Captive dolphins are susceptible to human illnesses and the dolphin populations in the bay may be similarly exposed through daily contact. Stress and discomfort will make them vulnerable to infection.

Cape Fur Seals are known to become habituated to human presence, particularly if the if humans are providing food. As with all encounters with wild animals, there is potential for injury – both to the animal and to humans. The fact that they will come out of the water represents a greater threat. These are strong animals and encounters will, more often than not, favour the seals. The feeding of seals by the public, tour operators and workers in local business and restaurants will only encourage scavenging and enhance the risk of animal-human conflicts. An apparently easy source of food will persuade more seals to frequent the lagoon area and approach people, both in the water and out of it. Cape Fur Seals are known to predate seabirds in times of prey shortage (Kemper et al., 2007). Becoming accustomed to "easy meals" may encourage predatory behaviour, and this can lead to potential declines in local seabird populations.

The impact of increased human presence can be mitigated by implementing and enforcing regulations and controlling numbers. Discarding of rubbish and fishing gear should be rigorously controlled and penalties should be imposed (e.g. fines or banning from the area). Approach distances to mammals on land and in the water must be applied. Regulations regarding type and amount of fish and bait removal must be enforced.

The safeguarding and preservation of the natural status quo depends on controlling the number of recreational users and tourist visitors to the lagoon and bay areas and relies upon the enforcement of regulations. Poor management and regulatory control can have a significantly high, long-term effect on the natural integrity of the entire bay area. However, the impacts can be moderated through education, regulation and sound management.

Tourism can have substantial positive impacts for Walvis Bay in that it generates employment and foreign exchange. A conscientiously constructed and well managed waterfront can be economically beneficial and if there is a strong environmental component to the management, the long-term negative impacts will be low.

1. INTRODUCTION

DVDM Properties (Pty) Ltd intends to develop a recreational and business waterfront area in Walvis Bay on the northern end of the Walvis Bay lagoon. The development will include a shallow small-craft harbour and tidal marina, restaurants and tourism-related businesses, hotels and residential apartments. The Walvis Bay Waterfront Development (Pty) Ltd intends to develop an area stretching from the current position of *The Raft* Restaurant northwards towards the present Yacht Club. The construction will encompass a breakwater, a connecting canal and a basin that will be at least 3 m below lowest astronomical tide (DVDM Properties, 2016).

Figure 1: Aerial View of Walvis Bay showing from west (left) Pelican Point peninsula, wetlands, salt pans, lagoon and town. (Source: Uushona and Makuti, 2008.)

Walvis Bay is situated on the west coast of Namibia, midway between its southern and northern borders. It is situated at the mouth of the Kuiseb River at the northern extent of the Namib Desert. The cold, nutrient-rich, upwelled waters of the Benguela Current run northwards along the coastline. An active, northwards-extending sandspit protects a natural, deep-water anchorage against the rough seas of the South Atlantic Ocean. An automatic lighthouse and a luxury hotel are built on the tip of the 18 km-long sandspit at Pelican Point (Figs. 1 & 2). The southern part of the bay comprises a 7 km-long lagoon and some 10 km^2 of coastal wetlands. (Enviro Dynaics, 2012; Namport, 2010; CSIR, 2009; Uushona and Makuti, 2008).

The Walvis Bay wetlands, comprising the eastern half of Pelican Point and its adjacent inter-tidal areas, the salt works south of the town, the naturally flooded areas to the south of the salt works, Walvis Bay lagoon and a second lagoon area near the sewage works, represent one of the most important coastal wetlands in southern Africa. It hosts some 200 000 migrant and 170 000 resident birds throughout the year (Enviro Dynaics, 2012; Uushona and Makuti, 2008). The wetlands surrounding the lagoon have been declared a Ramsar Site. Namibia acceded to the Convention on Wetlands of International Importance (Ramsar Convention, 1971) on 23 December 1995 (Ramsar, 2017). It is an environmentally sensitive area that has been afforded some measure of protection status.

The town of Walvis Bay (Figs. 1 & 2) is built adjacent to one of the best natural harbours along the barren south-west African coast. It has both a deep-water bay and a tidal lagoon. The harbour area is protected from the brunt of the south-westerly winds and currents by the Pelican Point peninsula. The harbour area (Fig. 2) is under the control of Namport and the commercial fishing industries.

The Benguela Current Large Marine Ecosystem (BCLME) is one of the most biologically productive systems in the world's oceans. The nutrient-rich waters support large numbers of pelagic fish such as pilchard, anchovy and juvenile horse mackerel, which in turn sustain an abundance of top predators such as whales, dolphins, sharks, turtles and seabirds, as well as a fishing industry that supports many local Namibians and contributes significantly to the country's GDP.

Within Walvis Bay, eco-tourism, with particular emphasis on marine animal viewing cruises, plays a significant role in the local economy. There is an oyster-farming mariculture industry within the lagoon (Fig. 2).

As the ocean is not our natural habitat, all human activity has an impact on the marine environment to varying degrees. There are always potential environmental impacts associated with any marine and /or coastal project. Coastal ecosystems are extremely fragile and can easily be disturbed by anthropogenic activities. It is important to prioritise the safeguarding of ecosystems and general coastal environments. The purpose of any Scoping Report and EIA is to identify potential negative impacts of the proposed project, determine the significance and consequences of such impacts, and prompt the initiation of mitigation measures to nullify or diminish potentially negative impacts to acceptable risk levels.

This report is a desktop review of marine mammals that occur within the Walvis Bay area. It identifies any potentially negative impacts of the development on these mammals, during both the construction phase and the subsequent operational phase, and suggests mitigation measures.

2. ENVIRONMENTAL AND SOCIO-ECONOMIC SETTING

2.1 LOCATION AND GENERAL DESCRIPTION

Walvis Bay, situated in the middle of Namibia's S-N trending Atlantic coastline, is one of only three west to north-facing embayments that provide significant wave shelter from the South Atlantic swell, the others being Lüderitz and Swakopmund. Thus, it was one of the first settled areas for seafarers. Another draw-card was the presence of fresh water at the mouth of the Kuiseb River. This bay was once a favourite hunting ground for American, British, Dutch and French whaling fleets, owing to the abundance of baleen whales in the surrounding waters.

Being located at the northern extreme of the Namib Desert, Walvis Bay lies within an ever-changing sedimentary environment. The bay itself is bounded to the west by the dynamic Pelican Point peninsula – an 18 km-long, north-westward extending sandspit that is growing at approximately 17 m per annum (Namport, 2010). There is an extensive wetland area to the south and a 7 km-long north-north-eastward oriented lagoon inshore of the spit. The town and harbour are situated on the northward side of the lagoon.

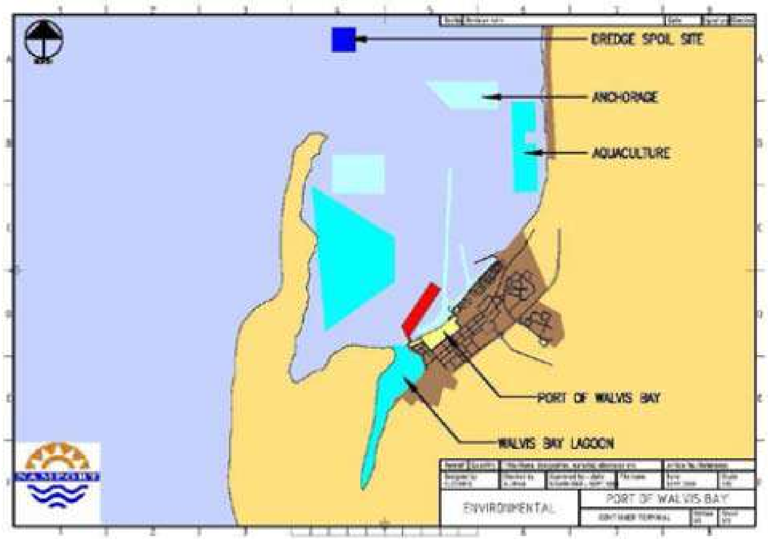

Figure 2: Locality Map. Walvis Bay (Source: OLRAC, 2009).

2.2 CLIMATE

The climate of Walvis Bay is driven by a combination of atmospheric and marine conditions, namely the South Atlantic Anticyclone or high pressure system (SAA), the northward-flowing cold Benguela Current and the divergence of the south-east trade winds along the coast. Walvis Bay falls within a "cool desert" region of Namibia. The general weather changes from cool, foggy, windy and hyper-arid conditions along the coast, to dry and hot in the interior beyond the Great Escarpment. Extremely low rainfall (8 mm / yr), characteristic of the harsh desert environment, is moderated by coastal fog that creeps as far as 70 km inland and contributes 35 - 45 mm of precipitation per year to the coastal area (Enviro Dynaics, 2012; Uushona and Makuti, 2008; Heather-Clarke, 1996). There are on average 150 foggy days per annum in the Walvis Bay-Swakopmund region, mostly between April and August.

The fog attracts and accumulates pollutants. Although the winds are typically strong and hence disperse air pollution, sea breezes present in the lower atmosphere tend to blow pollution back landwards. Stable air conditions result in temperature inversions in the lower atmosphere and pollutant dispersal is limited to the coastal belt. These factors exacerbate the odour pollution problems experienced in Walvis Bay town (Preston-Whyte and Tyson, 1988; Heather-Clarke, 1996).

The curved anticyclonic flow associated with the SAA is steered along the coast by the internal thermal barrier created by the desert conditions of the coastal plain and the orography of the continental escarpment (Nelson and Hutchings, 1983). Coast-parallel, upwelling-favourable winds continue as far as southern Angola, but north of 15°S they weaken and are directed more offshore.

The Benguela coastal region is characterised by hot, dry adiabatic "*berg*" winds blown in off the western escarpment when high pressure cells form over the subcontinent in winter. These winds are locally intensified by topographic features such as river valleys, blowing in excess of 50 km/h and causing severe sandstorms that considerably reduce visibility both at sea and on land. Satellite imagery reveals that they transport significant quantities of terrigenous material far out to sea (Fig. 3). Although *berg* wind conditions occur only intermittently, when they do, they last for up to a week at a time. *Berg* winds strongly affect the local temperatures, which are often above 30°C during "East wind" periods. The warm air associated with *Berg* winds flows over the cold marine boundary layer after passing over the coast. Land-sea breezes blow along coastal areas adjacent to interior coastal plains, resulting in a strong diurnal rotary wind component (Stuut, 2001; Jury *et al*, 1985). This dynamic wind regime influences most biotic and abiotic processes within the Walvis Bay area by changing sedimentation rates, upwelled nutrient flux and primary production within the system.

Figure 3: Dust and Hydrogen Sulphide (green) along the Namibian coast. (Source: NASA, 2010)

Over the Northern Benguela region (NBR), the effects of distinct inter-annual variations associated with the El Niño Southern Oscillation (ENSO) are registered in changes in sea-surface temperatures (SST) and the strength of the longshore, upwelling-inducing winds which weaken during the low phase (El Niño) and strengthen during the high phase (La Niña). This has a modulating effect on the coastal and interior rainfall. (Rau, 2002; Stuut, 2001; Shannon and Nelson, 1996). The almost decadal poleward intrusions of nutrient-poor, oxygen-deficient, warm, saline tropical surface waters along the Angolan-Namibian coastline are often concurrent with heavy rains and temporal proximity to the Pacific El Niño, as well as anomalous sea surface temperatures, salinity levels, winds and mean sea levels (Shannon and Agenbag, 1990; Brundrit *et al.*, 1987). These Benguela Niños (Shannon *et al.,* 1986) seem to be responses to broader global or ocean-wide signals and the relative effect and importance of the driving systems may vary locally.

2.3 MARINE ENVIRONMENT

2.3.1 Benguela Current Region

Continental shelf circulation off Namibia is a result of the interaction of three gyral systems: the South Atlantic subtropical gyre, the sub-Antarctic gyre and the sub-equatorial gyre. The Benguela Current is regarded as the eastern boundary current of the South Atlantic Gyre (Shannon and Nelson, 1996). North of Walvis Bay, the current moves offshore away from the coast (Fig. 4). The speed of the Benguela Current varies between 10 and 30 cm/s depending on the location off the coast and wind direction and speed (O'Toole, 2009).

The De Decker Counter-current flows southward nearer the coast at depths greater than 30 metres (De Decker, 1970; Nelson, 1989). The poleward undercurrent flows with varying strength and varying degrees of seasonal dependence. It is identified by its low oxygen content. The Angola-Benguela Front (ABF) marks the northern boundary of the Benguela region. This surface frontal zone is most intense within 250 km of the coast and can be traced westward as far as 0°. The ABF is most marked

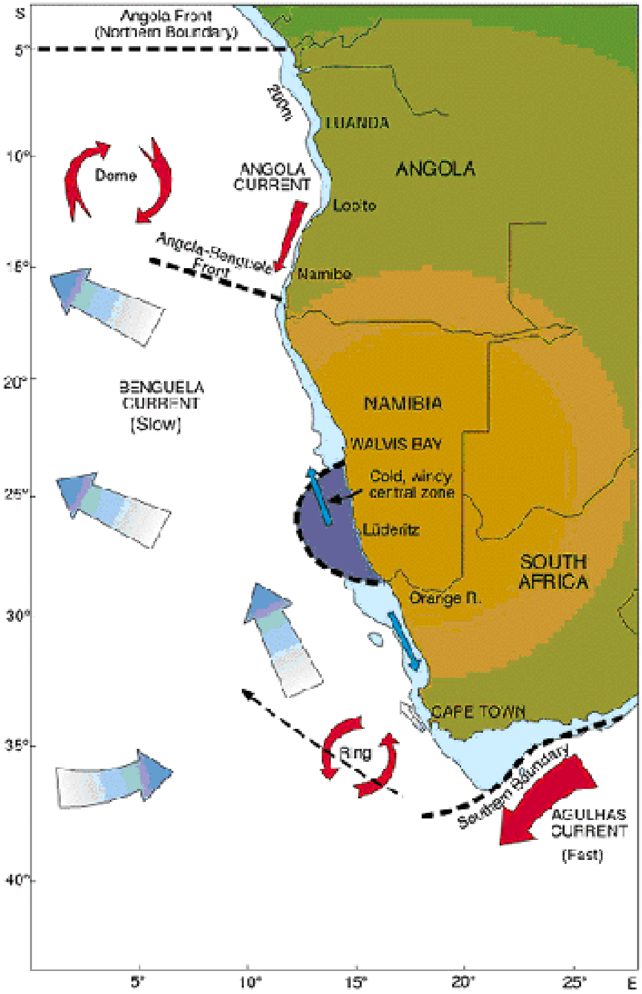

Figure 4: Main oceanographic features and surface currents of the Benguela Current Large Marine Ecosystem. (Source: BCLME programme website)

in the upper 50 m of the water column, but can be identified to at least 200 m. This zone is a permanent feature, migrating seasonally between 14°S and 17°S. The ABF is maintained through a combination of factors including coastal orientation, bathymetry, stratification, wind stress and the opposing flow directions of the Benguela and Angola Currents.

The distinctive bathymetry, hydrography, chemistry and trophodynamics combine to make the Benguela Current one of the most productive ocean areas in the world. This high productivity ensues from the continual fertilisation of surface waters by upwelled nutrient-rich deep water. In contrast to this high productivity, the BCLME carries relatively low biodiversity in all the major marine habitats, as result of the extremely variable nature of the marine environment at a range of temporal and spatial scales. Continuous change is a feature of the physical environment of the BCLME and its marine inhabitants are adapted to cope with this, resulting in generalists dominating over specialists (Maloney and Shannon, 2008; O'Toole, 2007). The biota varies spatially and temporally in assembly, structure and abundance in response to changes in the environment. Discrete biological environments of the BCLME tend to function in unison rather than in isolation.

Marine Mammals represented in Namibian waters include cetaceans and seals. Eight of the eleven species of baleen whales known globally have been seen in Namibian waters. In addition, twenty three species of dolphins and toothed whales have been recorded (NACOMA, 2013). Many cetacean species utilize the waters around southern African as feeding and breeding grounds or simply as part of their migration routes. Baleen whales that were targets of whaling operations in the past, but now find sanctuary in Namibian waters include Southern Right, Bryde's and Humpback whales. Walvis Bay was named by the Portuguese for its abundance of these huge cetaceans. Southern Right whales that were hunted from Walvis Bay and Swakopmund and were extinct in Namibian waters until the 1970s, are re-establishing recurrent birthing and nursing grounds, particularly in southern Namibia. The most common toothed whales in the BCLME include the Common, Dusky and Bottlenose Dolphins and the endemic Heavyside's Dolphin.

The Cape Fur Seal is a common resident of the BCLME, while the Subantarctic Fur Seal is a very rare vagrant in Namibian water and the Southern Elephant Seal a transient migrant. Seal populations vary in response to the abundance of pilchard. The quota for the annual cull, sanctioned by the Namibian government, is based on the status of fish stocks. A large non-breeding colony of Cape Fur Seals hauls out at Pelican Point.

2.3.1.1 Physio-Geo-Chemical Environment

Benguela Niño

The term Benguela Niño was coined by Shannon *et al.* (1986) to describe the almost decadal poleward intrusions of warm, saline tropical surface waters along the Angolan and Namibian coastlines and the associated unusually far southward displacement of the Angola- Benguela Front, moving southwards from 15°S to as far as 25°S. This wedge of warm, nutrient-poor, low-oxygen, salty Angola Current water extends some 150 km offshore and is up to 50 m deep. Concurrent heavy rains, changes SST, salinity and in fish abundance and location have been documented (Veitch *et al*., 2007).

Benguela Niños occur most often in late austral summer and early autumn and were recorded in 1934, 1963, 1984 and 1995. In situ measurements from Walvis Bay spanning 1958 to 2004 show that the frequency of unusually warm water appears to have increased since the early-1990s. Stander and De Decker (1969) observed a significant reduction in one species of zooplankton (*Paracalanus parvus*) during the 1963 warm event. The 1983/84 change from a declining trend to an increasing trend of total copepod abundance in the NBR corresponds to a Benguela Niño. The subsequent decline between 1993 and 1996 has been ascribed to the environmental changes brought on by the extensive hypoxic shelf waters that were present in 1993/94 and the Benguela Niño of 1995 (Veitch, 2007).

Low Oxygen Events

The Namibian continental margin has long been recognized as one of the world's most biologically productive oceanic regions, 30 to 65 times more productive per unit area than the global ocean average. However, massive productivity leads to immense quantities of dead and decomposing organic matter falling through the water column to the sediments below, initiating the development of oxygen-depleted water masses, hypoxic areas in deeper waters with limited oxygen exchange (called oxygen minimum zones) and anoxic sediment-water-interface conditions at the coastal shelf and upper coastal slope (Shannon, 1985). Oxygen-depleted water masses driven shoreward by upwelling in summer, cause mass mortalities of benthic populations (e.g. the well-documented crayfish "walk-outs").

An estimated 36% of phytoplankton and 5% of zooplankton fall to the seafloor annually. The sinking organic matter decomposes in the mid-water column, consuming dissolved oxygen, resulting in oxygen-depleted bottom waters. The combination of high oxygen demand, sluggish circulation and oxygen-poor source waters leads to the development of massive mid-water oxygen minimum zones. The zones are particularly prevalent in summer and autumn. The Benguela oxygen minimum zone starts at about - 200 m and is a few hundred meters thick. Bacteria that use sulphur rather than oxygen reside in the oxygen minimum zone.

Low oxygen water (LOW) variability in the NBR is entirely advection controlled and is strongly linked to the upwelling that peaks in June to August (Veitch, 2007). The periodicity of the wind regimes is an essential component of LOW, as it is the timing of wind-relaxation events that are instrumental in generating hypoxic conditions. The importance of wind variability is highlighted by the fact that a 20% decrease in the winds corresponds to an 80% decrease in productivity.

The LOW advected into the northern and central Benguela originates in the Angola Gyre area of the Southeast Atlantic where the processes of primary production, stratification and retention facilitate the maintenance of LOW in this area. The narrow Angolan shelf is conducive to the seasonal upwelling of water originating from the LOW reservoir and explains the correlation between seasonal oxygen and temperature measurements. As the Angola Current moves southward into the NBR it deepens to form the Benguela Poleward Undercurrent which extends to 27°S and forms the LOW boundary conditions for the northern and central Benguela systems.

A time series of temperature, salinity and oxygen off Walvis Bay shows that LOW variability on the central Benguela shelf does correlate with upwelling intensity or temperature. This is because it is subject to a number of processes and conditions that are not directly linked, such as intensity of and timing of low oxygen warm Angola Current water and the upwelling at both Cape Frio and Lüderitz.

Oxygen minimum zones are exacerbated by the southward intrusion of warm, oxygen-depleted Angola Current water into the NBR, off the self, at 200 – 300 m, most often during Benguela Niño events. The most recent event, in the summer of 1994/95, caused severe anoxic conditions on the shelf in near-bottom and bottom waters over an area stretching between 24°S and 21°S and mass mortality of benthos. While intrusions of Angola water and Benguela Niños are generally decadal events, there are also seasonal LOW intrusions that are less devastating (Veitch, 2007)

Harmful Algal Blooms (HABs)

Low oxygen events are often associated with diatom blooms or Harmful Algal Blooms (HABs / red tides). Although attributed to a number of marine planktonic algae, HABs are most often ascribed to the dinoflagellate species *Ceratium furca* and *Prorocentrum micans.* HABs usually occur in the summer-autumn, but have been documented in winter when warm *berg* winds blow for extended periods. These blooms are able to impact both commercial and recreational interests in the coastal region causing fish kills, contaminating seafood with toxins resulting in serious public health problems (www.nacoma.org.na)

Nearshore low oxygen events have catastrophic effects on the local marine community, as happened in 2008 when a *Ceratium furca* bloom resulted in the largest rock lobster walkout in Namibian recorded history. Mariculture in the Walvis Bay lagoon was badly affected that oyster farmers considered relocating to Lüderitz. Shallow subtidal species, trapped in the oxygen-depleted waters below the surf zone, also succumbed. The bloom was triggered by an unusually calm sea and windless period accompanied by high sea surface temperatures. The anoxic conditions were further exacerbated by concurrent hydrogen sulphide eruptions.

Hydrogen Sulphide Eruptions (H_2S)

Central Namibian waters are renowned for the large-scale, episodic sulphur and methane eruptions that can be traced by satellite photography (Fig. 5). In areas of low-oxygen bottom waters, aerobic decomposition of organic material within the sediments results in the generation of methane (CH_4), sulphur dioxide (SO_2) and hydrogen sulphide (H_2S) gasses that become trapped within the layers of organic-rich, anoxic mud. Over time, pressure exerted by the expansion of these gasses in the sediment, causes the gas to erupt into the water column. These eruption events accentuate the effect of oxygen minimum zones, by causing the upwelling of hypoxic and toxic waters. The sulphur forms visible slicks of discoloured waters on the surface. These events strip the surrounding water column of dissolved oxygen, resulting in mass mortality of the local marine community.

H_2S eruptions are a common phenomenon in Walvis Bay and Swakopmund, and have been recorded since 1901 (Waldron, 1901). Residents have become accustomed to H_2S periods characterised by a pungent odour, lime-green sea surface slicks and the formation of temporary mud islands, seen at low tide in the lagoon area. As these are natural, recurrent events, the local biota has adapted to the toxicity levels and the associated hypoxic water conditions. Some of the H_2S is actually consumed by autotrophic denitrifying bacteria in the intermediate water layers. A catch twenty-two situation arises, as a stronger and healthier upwelling ecosystem, with enhanced productivity, drives an increased *in situ* production of oxygen-depleted waters and therefore, an increased risk of H_2S eruptions (Veitch, 2007).

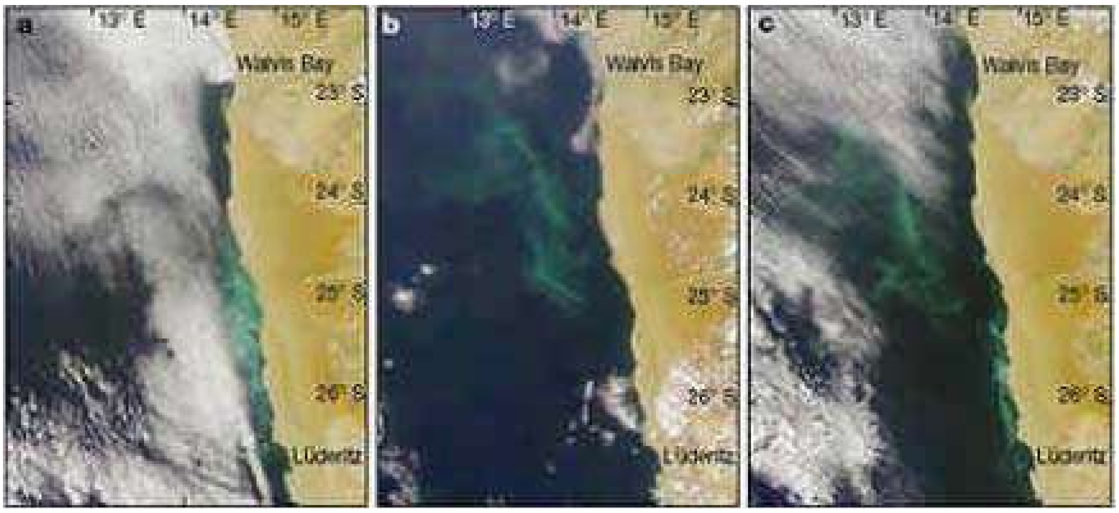

Figure 5: Satellite images showing natural H_2S eruptions (Source: Weeks *et al*, 2004).

2.3.2 The Greater Walvis Bay Area

The central Namibian coastline is influenced by major swells generated in the *Roaring Forties*. Wave shelter is extremely limited and found in isolated northward-facing J-bays, such as Lüderitz and Walvis Bay. Walvis Bay itself is defined as the deeper water enclosed between Pelican Point and Langstrand (CSIR, 1989). The eastern boundary of the bay is regarded as the main road between Swakopmund and Walvis Bay (north of the harbour) and the road running beside the lagoon (south of the harbour). The sandspit bar of Pelican Point peninsula separates the wave-dominated, open-ocean regime of the Benguela Current region (to the west) from the sheltered harbour waters to the east and northeast in Walvis Bay (CSIR, 2009).

The dominant south-westerly winds create a clockwise water flow in the bay, that travels southwards past the harbour. Bottom waters enter the bay area at Pelican Point and surface layers exit at the same point. Current velocities average 0.12 m/s, occasionally increasing to 0.25 m/s. Water circulation takes place mainly in the upper layer and depends on the direction of the wind. The current pattern is clockwise in the morning, towards the south, and reverses later towards the north. At Pelican Point the current is generally northward for the whole day (CSIR, 2009; Uushona and Makuti, 2008). Walvis Bay is flushed twice daily with nutrient-rich water from the open ocean (Namport, 2010).

Tides along the Namibia shelf are semi-diurnal with an average tidal range of between 0.5 and 1.3 m and up to 1.6 m range between mean spring lows and mean spring high tides. The mean spring tidal range for Walvis Bay is 1.42 m (0.27 m – 1.69 m), while the mean neap tide is 0.62 m (0.67 m – 1.29 m). Variations in the absolute water level as a result of strong winds and big waves can, however, occur adjacent to the shoreline, resulting in differences of up to 0.5 m from the tidal predictions. Tidal currents are small (0.1 m/s). (Namport, 2010; CSIR, 2009). Dolphins hunting fish are sometimes trapped in the lagoon when the tide ebbs.

The water depth in Walvis Bay ranges from -20 m chart datum (CD) at Pelican Point to approximately -2.5 m CD at the entrance to the lagoon. Although Pelican Point protects the mouth of the lagoon from the south-westerly swell, waves do occur in the shadow zone, but wave energy decreases progressively in magnitude southwards behind the sandspit. The refraction of waves around the point of the sandspit into Walvis Bay generates a southward longshore current. This transports sediment, including material derived from floods and introduced into the bay via the northern arm of the Kuiseb delta, contributing to the steady shallowing of the low energy environment within the shadow zone.

From the Pelican Point peninsula, the sea floor slopes steeply westward into the Atlantic Ocean. This wind-exposed sandspit is a source of sand for the beach north of Walvis Bay. The peninsula itself is fed by sand blown by the dominant south-easterly winds and brought by currents from Sandwich Harbour. It is estimated to be extending north-eastwards by 17 to 20 m per year (Namport, 2010; Uushona and Makuti, 2008). At the same time the mainland coast is growing southwards towards Pelican Point. Waves approaching the shoreline at an angle generate longshore surf-zone currents. These currents, dominated by wave-driven flows, generally transport unconsolidated sediments northward along the coast at a rate of approximately 800 000m^3/m/year (CSIR, 2009).

The movement of sediment within the central Namibian coastal region involves a dynamic interaction between land and marine components. The complex nature of the sedimentary environment within present-day Walvis Bay is a result of both fluvial and marine deposition over the past 6 000 years, as well as being impacted by the high productivity of the Benguela Current. Water transparency deteriorates from Pelican Point toward the bay, into the harbour and further into the lagoon. The Walvis Bay coastal waters appear are a major sink of organic material. The nutrient-rich, high productivity waters of the Benguela system extend into Walvis Bay lagoon and harbour, providing the basis for the associated organic mud deposits and subsequent H_2S eruptions. A thick, pungent, dark green diatomaceous ooze overlies fine to medium sand that has accumulated in sheltered parts of Walvis Bay at depths below -3 to -4 m. Integrated sedimentary components of silt, diatomaceous muds, aeolian and marine sand trap organic-rich material containing naturally high concentrations of heavy metals. The organic-rich sediments have a high oxygen demand and can become anoxic. Oxygen starvation, toxic red tides and H_2S eruptions occur most frequently during late summer or early autumn when light, predominantly onshore, winds prevail. Additionally, effluent and waste discharges from the fish processing industry require oxygen for neutralisation, which diminishes oxygen levels in the water. Anoxic and toxic conditions can build up in the sheltered waters of the bay, forcing mobile fauna to migrate out of the area and resulting (sometimes large-scale) sessile and benthic organism mortality. An especially large and long-lasting sulphur eruption severely affected aquaculture operations in Walvis Bay in 2008 (Namport, 2010; CSIR, 2009; Seely & Pallett, 2008; Uushona and Makuti, 2008; Heather-Clarke, 1996).

A variety of marine mammals has been recorded in Namibian waters, drawn by the abundance of plankton and fish. Eight of the eleven species of baleen whales known globally, and twenty-three species of dolphins and toothed whales have been recorded in Namibian waters. Baleen whales that were targets of whaling operations in the past, but now find sanctuary in Namibian waters include Southern Right, Bryde's and Humpback whales. Walvis Bay was named "*Ezorongondo*" (Bay with whales) by the indigenous Herero people and subsequently by Portuguese, Dutch and English whalers. Southern Right whales that were hunted from Walvis Bay and Swakopmund and were extinct in Namibian waters until the 1970s, are re-establishing recurrent birthing and nursing grounds, particularly in southern Namibia in protected areas near Lüderitz.

The most common toothed whales in the BCLME are the Atlantic Bottlenose, Common, Dusky, Risso's, Rough-toothed and Southern Right-whale Dolphins. The Heaviside's Dolphin is endemic to Namibian coastal waters. Walvis Bay is home to a small resident population (~77) of Bottlenose Dolphins and a larger (~505) population of Heaviside's Dolphins, that are often seen frolicking in nearshore waters and around pelican Point. There have been sporadic sightings of Killer Whales within the bay area over the past decade (NACOMA, 2017; Namibian Dolphin Project, 2017; Elwen and Leeney, 2010; O'Toole, 2009; Roux, J.P., 2008; Maloney and Shannon, 2008; Uushona and Makuti, 2008).

A non-breeding colony of Cape Fur Seals, numbering some 5 000 (but sometimes expanding to a significantly larger number) hauls out at Pelican Point (Fig. 6).

Figure 6: Cape Fur Seals at Pelican Point. (Source: Uushona and Makuti, 2008)

Recreational fishermen at Paaltjies and overland vehicles and visitors to Pelican Point can alarm the seals and birds. They also contribute to littering. Marine viewing cruises can disturb and harass dolphins. Besides litter from visitors, oil and debris from offshore vessels also pollute the point (NACOMA, 2013; O'Toole, 2009; Uushona and Makuti, 2008; Heather-Clarke, 1996).

2.3.3 Lagoon and Ramsar Site

The Walvis Bay lagoon is approximately 7 km long and up to 2.5 m deep on average, but significantly deeper at spring high tide. There is a maximum tidal range of 1.8 m. A straight line connecting the tip of Pelican Point and the southern boundary of the Walvis Bay harbour area at the Yacht Club has been arbitrarily designated as the north-eastern boundary of the lagoon and the extent of the Ramsar site. The lagoon is characterised by two main habitats: extensive shallow, sandy shores that are alternately covered and exposed by tidal action; and the deeper (up to 5 m) sub-tidal waters of the southern harbour area. The SSW-NNE orientation of the Walvis Bay lagoon closely parallels the dominant wind direction and it is likely that wind processes superimposed on tidal effects have played the dominant role in shaping the original development of the lagoon (Uushona and Makuti, 2008).

Nutrients are imported into the lagoon from the bay through tidal flux. The lagoon is, in general, well-oxygenated since a large portion of its volume is exchanged twice daily during each tidal cycle. Strong winds blowing across the surface facilitate oxygenation in the upper layers. The currents in the lagoon have inflow and outflow velocities of the order of 0.30 m/s at the mouth of the lagoon (Namport 2010; CSIR, 2009; Heather-Clarke, 1996).

Fine sediments and organic matter settle in the wave-sheltered lagoonal environment. These are exploited by a proliferation of invertebrate animals and small fish, which, in turn are a food source to the thousands of birds, larger fish and marine mammals. High primary productivity, warm temperatures and calm water inflow of seawater imports plankton, krill and young stages of fish and invertebrates. In the past, large numbers of coastal fish species were caught inside the lagoon. At present. fish species are limited to large schools of small mullet and springer, as well as skates and rays. Seals and dolphins frequently hunt in the lagoon and occasionally whales have entered, but they can be stranded by the outgoing tide (Namport 2010; CSIR, 2009; OLRAC, 2009; Uushona and Makuti, 2008; Heather-Clarke, 1996.

There is a relatively large degree of mixing of lagoon and bay water, however, due to its shallowness and dynamic nature, the water temperature and salinity within the lagoon vary across special and temporal scales. The limited flushing waters in the southern section result in extreme conditions. Surface heating and evaporation yield temperatures as high as 30°C and salinity values of 46 ppt in the southern-most tip of the lagoon. Bay water is found at the mouth, so salinity levels are much lower. There is a N-S temperature and salinity gradient across the length of the lagoon and a reverse vertical salinity and temperature gradient with water being hot and hypersaline at the surface and cooler and less saline near the bottom. The development of the salt works has profoundly changed the ecology of the lagoon area because of the extensive land reclamation. The access road is a physical barrier to the natural tidal dynamics, cutting off the southern edge of the lagoon and reducing tidal circulation and flushing in this part of the lagoon (Enviro Dynamics, 2012; Namport 2010; CSIR, 2009; OLRAC, 2009; Uushona and Makuti, 2008; Heather-Clarke, 1996).

Mariculture

The commercial farming of oysters is being undertaken in evaporation ponds in the Walvis Bay lagoon. Commercial aquaculture and mariculture ventures started in Namibia in the late 1990's.

Figure 7: Bottlenose dolphin swimming amongst an oyster farm's lines in Walvis Bay © R. Leeney, 2008. (Source: Namibian Dolphin Project, 2015)

Impacts from aquaculture and mariculture can include pollution and the introduction of alien species. These farms also close off spaces previously accessible to wild marine life, possibly impacting habitat and feeding and breeding patterns. They can lie in the direct path of migrating whales. A whale calf became entangled in the lines of an oyster farm in the bay area east of the Walvis Bay peninsula. Bottlenose Dolphins have also been seen swimming between the lines of oyster farms (Fig. 7) and there is a danger of injury or death resulting from entanglement (Namibian Dolphin Project, 2015).

2.3.4 Walvis Bay Harbour

Figure 8: The Port of Walvis Bay.
(From: Informante, 11 February 2016)

The bay is a safe haven for sea vessels because of its natural deepwater harbour, protected by the Pelican Point sandspit. The Yacht Club, port and container terminal are integrated into the town of Walvis Bay. The Walvis Bay harbour is located north and east of the outer lagoon zone. The port comprises a commercial harbour in the southern section, bounded on the west and north by the limits of Namport jurisdiction. It handles containerised and bulk cargo. The fishing harbour in the northern portion is bounded on the east by the shore and factories. This area supports some 15 processing factories and their vessels. In the north-eastern corner is an artificial guano platform for nesting birds. The port is controlled by the Namibia Ports Authority (Namport). Their role is to exercise general infrastructural and regulatory functions (dredging and customs), together with navigational and other commercial facilities. Namport is also responsible for the control of maritime pollution, oil spill containment within the harbour area, the upholding maritime safety and the supplying and/or co-ordinating search-and-rescue services in territorial waters (Namport, 2010; CSIR, 2009, Uushona and Makuti, 2008).

The harbour has a soft substrate measuring up to 15 m thick. The concentrations of metals in the sediment are generally of the same order of magnitude as the BCLME recommended guideline values. This compares favourably with sediment from other harbours around the world. Cadmium levels are elevated; its toxicity is inversely related to salinity, and in an anoxic environment like Walvis Bay, its potential impact is reduced (Namport, 2010; CSIR, 2009).

The tidal range within the harbour areas is as great as 2 m during spring tides. The harbour wall offers rare surfaces for the attachment of indigenous sessile marine animals. However, pollution from fish factory effluent within the harbour is thought to have reduced marine invertebrate biodiversity significantly. The water quality of the harbour changes seasonally as a result of organically polluted sea and freshwater discharges from the fish processing industry (Uushona and Makuti, 2008).

Commercial activities in the harbour occasionally cause minor oil spills and heavy metal pollution of the bay water. Moreover, some ships visiting the Namibian coastline tend to dump their bunker oil out to sea where it poses a threat to marine and bird life. Another source of maritime pollution is the waste and sewage that is dumped from ships anchoring in the harbour and bay area, although Namport does supply a waste collection service for all these ships and they are charged irrespective of whether or not they make use of this service. Unfortunately, substantial amounts of waste are still thrown overboard and washed up along the coastline. Anti-fouling paint and other toxic substances used during ship maintenance at the dry docks are another source of pollution. Such toxins are taken up by invertebrates and pose a threat to predators as bio-accumulation occurs (Uushona and Makuti, 2008, Heather-Clarke, 1996).

2.3.4.1 Dredging

In excess of 200 000 m3 of sediment is dredged from the entrance channel, turning circle and tanker basin by Namport annually. Namport subcontracts to Portnet (South African Ports Authority) to undertake major dredging operations every five to six years. Dredge material is dumped at one of three sites within the bay area, are presently being used.

2.3.4.2 Commercial Fisheries

Whilst individual fishing companies own their berthing facilities, the berths are maintained by Namport using their own internal standards. The fish processing plants in Walvis Bay harbour affect the water quality by both drawing (sometimes organically toxic) water from the bay and then discharging organically loaded effluent into it. Because the receiving waters of the bay area are frequently anoxic, the addition of high BOD waste can have cumulative effects. Fish factory effluent is compounding the already oxygen-stressed condition of the bay, particularly along its eastern shore (Namport, 2010).

2.4 SOCIO-ECONOMIC ENVIRONMENT

2.4.1 Walvis Bay Town

The economy of Walvis Bay is driven by the safe harbour port and associated industry, commercial fishing, tourism and local manufacturing. Other contributors to the economy are the salt works, tourism and mariculture industry. The unemployment rate is estimated at 36% (Enviro Dynamics, 2012; Namport, 2010).

2.4.4.1 The Harbour and Port

Walvis Bay harbour is the largest port in Namibia. It services vessels participating in marine exploration and fishing and serves as the country's main import/export facility. Exported goods are minerals such as uranium, copper, lead, feldspar, salt, beef and canned fish. Imports of general container cargo, motor vehicles and machinery, petroleum and bitumen also pass through the port facilities.

Walvis Bay Harbour is the only deep-water port in Namibia and is the main fishing harbour. The commercial fishing industry supports local worker and contributes significantly to the GDP of Namibia. Almost all processing industries and servicing facilities operate out of Walvis Bay. Fisheries working out of Walvis Bay target small pelagic species, such as pilchard, anchovy, and juvenile horse mackerel, inshore in the NBR. Bottom and mid-water trawlers work further offshore both north and south of Walvis Bay towards Lüderitz, targeting hake, monkfish and horse mackerel. Other commercial fish species include snoek, steenbras, kabeljou, and kingklip. Hangana Seafood are processors and exporters of fish and fish products. The commercial fishery accounts for a major part of Walvis Bay's economy (Nacoma, 2017).

Fishery has an impact on natural marine resources by removing a certain portion of the stock and the physical alteration of habitats. Accidental bycatch of marine mammals and sea birds is a concern.

2.4.4.2 Mariculture

Concessions for aquaculture in the form of oyster rafts have been granted within the broader Walvis Bay area, the lagoon area and the salt works area during the past decade. One oyster farm is located in the primary evaporation pond of the saltworks, while others are in the designated marine farm area in the lee of Pelican Point. Operational activities include diesel-powered pumping systems providing water for the evaporation ponds of the salt works, infrequent harvesting and inspection activities. While the flesh quality and growth rate of the oysters has been high (about 1/3 faster than elsewhere in the world), the risk of losses as a result of sulphur eruption is also high. Major losses were experienced in 2008.

While oyster production in Walvis Bay has been, on the whole, a financial success, possible extensions of this activity pose threats to marine mammals that utilise the bay area. Impacts from aquaculture and mariculture can include pollution and the introduction of alien species. A whale calf became entangled in the lines of an oyster farm in the bay area east of the Walvis Bay. A number of dolphins have been noted swimming amongst the oyster farms and with a potential increase in mariculture activities, the risk of entanglements grows (Namcoma, 2015; Namibian Dolphin Project, 2015; Namport, 2010).

2.4.4.3 Salt Recovery

The windy, arid coastal climate of Namibia is highly favourable for the cheap production of salt, through the evaporation of sea water in ponds that have been established around the Walvis Bay lagoon. The salt works have profoundly changed the functioning and ecology of the lagoon area, particularly in the southern end. Land reclamation and the construction of physical barriers to the tidal dynamics have resulted in decreased circulation and accompanied siltation and lowering of water clarity and quality with increased temperatures and salinity. Some of the natural wetland and lagoon area has been reclaimed for use as evaporation ponds. Access roads have been built which cut off tidal circulation to the southern extremity of the lagoon and also facilitate local and tourist routes through the wetlands to the fishing beach of Paaltjies and to Pelican Point on the sandspit peninsula.

2.4.4.4 Tourism

Pelican Point is a tourism key point because herds of seals and roosting shorebirds attract day visitors who drive there via the salt pans. There is a hotel at Pelican Point that is accessible by 4x4 vehicles.

Paaltjies beach on the sandspit is a popular local spot for shore anglers. Angling, from small craft or from the beach, is a major form of recreation throughout the coastal reaches of the Walvis Bay area.

Imprudent discarding of plastic rubbish as well as fishing gear leads to ingestion and entanglement. Plastic waste blocks up the gut and the creature will slowly starve to death. Even if an animal doesn't drown as a result of entanglement in fishing gear, if not removed, ropes and line wrap ever-tighter, cutting off circulation. The lucky animals have scars where they escaped ropes and lines. In 2012 a Heaviside's Dolphin was photographed in Walvis Bay with a few metres of fishing line clearly embedded in her skin. Her dorsal fin had been cut almost halfway through by the fishing line (Namibian Dolphin Project, 2017).

Artisanal scale beach purse-seine fishing takes place from the beaches immediately north of Walvis Bay town. The catch, mainly mullet, is intended mainly for own consumption, but surplus may be sold. There is always a risk of mammals being caught in the nets.

Tourism (and eco-tourism) is the fastest-growing industry in Walvis Bay. The main limiting factor to tourism is infrastructure. As many as 26 tour boats (5 sailing catamarans and 21 catamaran ski boats, 6 to 9 m long) operate within the bay area, taking tourists to view seals, dolphins and whales, pelicans and the guano platform north of Walvis Bay. There are numerous small-boat enterprises that advertise scenic cruises to view Heaviside and

Bottlenose Dolphins directly north of Pelican Point on a daily basis. Although Walvis Bay is a commercial and fishing harbour, these tour boats represent the vast majority of boat traffic that interacts with dolphins in the bay. There is a “no swim with” policy in place, but Bottlenose and Heaviside’s Dolphins are actively pursued by tour boats to encourage bow or wake riding and maximise interaction with the vessel. All vessels operate under power when in the presence of dolphins and this puts them at risk of propeller strikes. A Heaviside’s Dolphin with injuries from a small motor was photographed in Walvis Bay on 12 February 2010. Given that tour boats interact with dolphins at Pelican Point on a daily basis and this is the only dolphin to be seen with propeller strikes suggests the risk of direct injury may be relatively low and that in general the animals are able to steer clear of danger (Namibia Dolphin Project, 2017).

Tour operators do, however, feed the mammals and birds to encourage them to approach the boats. Some have seals jump aboard their vessels (Fig. 9). All this interaction puts the mammals at risk of injury. Cetaceans are also susceptible to human diseases. Acclimatisation to humans will make some animals approach humans with less caution – and if something goes wrong, it will be the animal that pays. There are also incidents of rubbish blowing over-board, regardless of how carefully operators instruct tourists. Additionally, the feeding of seals by tour operators can potentially threaten the seabird population, as some lazy individuals will cease to forage out at sea, preferring easy meals within the bay. The practice of gathering food from tourists might reinforce the predatory behaviour of seals on seabirds in Walvis Bay (Namibia-1on1.com, 2017; Wild Africa Travel, 2017, Elwen *et al*., 2012).

Figure 9: Cape Fur Seal on a tour boat. (Source: Dune Safaris, 2017)

Sailing, wind-surfing and kite-boarding are popular activities on the lagoon. Wind conditions on the outer lagoon make this one of the world’s best locations for wind- and kite-surf speed sailing. Walvis Bay hosts world class wind-surfer and kite-surfers. Some of the world’s top speed-sailors have reached speeds approaching 50 knots in the unique conditions of the lagoon (Namibia-1on1.com, 2017; Wild Africa Travel, 2017).

The lagoon and surrounding area is also explored by kayak. Motorised craft were accorded limited access to the lagoon for fishing competitions. Owing to the difficulty in controlling motorised craft within the confines of the lagoon, a ban has been placed on all such craft within this zone.

The esplanade along the eastern shore of the lagoon affords visitors and locals the opportunity to view flamingos, pelicans, waders and other coastal birds from close range. It is a popular route for joggers and dog-walkers.

Despite the fact that Walvis Bay lagoon, the saltworks and the southern part of the bay west of the lagoon have been declared a protected Ramsar site (Wetland of International Importance), there is very little official regulation of visitors or activities. Whilst numerous notice boards inform the public of the sensitivity and importance of the area, it is by-and-large a self-regulatory system, with little obvious enforcement.

3. MARINE MAMMALS

3.1 OVERVIEW

The Benguela ecosystem is known for its diversity and abundance of marine birds and mammals that feed on the numerous fish resources. Marine mammals seen in Namibian waters include seals and cetaceans. Thirty-one species of whales and dolphins have been recorded off the Namibian coast. Of the 25 more frequently recorded species, only 5 are seen regularly in inshore of Walvis Bay. Some cetaceans are semi-permanent residents within Namibian waters, others come to breed and still others are long-distance travellers, entering and leaving the Benguela almost without pause, en route to preferred destinations. The most commonly seen mammals within the Walvis Bay area include Cape Fur Seals and Common Bottlenose, Dusky and Heaviside's Dolphins. The cold coastal waters supply food to migrating Humpback and Southern Right Whales. Killer Whales and Leatherback Turtles are infrequent visitors to the bay area. Risso's, Rough-toothed and Southern Right-whale Dolphins have been seen along the coast. The Heaviside's (or Benguela) Dolphin is the only odontocete endemic to the Benguela Current (Namibian Dolphin Project, 2017; NACOMA, 2017).

3.1.1. Cape Fur Seal

The Cape Fur Seal (*Arctocephalus pusillus pusillus*) is the predominant marine mammal in the Namibian portion of the BCLME, with as much as 60% of the global population resident in Namibia. It is misleadingly named, as *Fur seals* belong to the *Otariid* family together with sea lions. True seals (family *Phocidae*) do not have external ear flaps and are less mobile on land than sea lions. *Otariids* can rotate their back flippers to make it possible for them to walk and run on land. Their flippers are hairless and clawless enabling them to grip the surface of rocky terrains, where they rest and breed. Sea lions use their long, strong front flippers for power, steering with their back flippers. This gives them an advantage when escaping orcas and sharks, because if the predator bites their back flippers, they can still swim quickly to get away. A true seal would no longer have the power (back flippers) to keep it moving forward (Wild screen Arkive, 2017). Sea lions can't store as much oxygen in their lungs as seals can, so their dives are restricted to 450 m, but more commonly dive no deeper than 200 m (Enigma, 2012).

Figure 10: Injured Cape Fur Seal
(© Peter Scoones / naturepl.com)

The Cape Fur Seal is the only member of the order *Pinnipedia* which breeds on the Namibian coast, both on the mainland and on nearshore islands and reefs. The Cape Fur Seal population of South Africa and Namibia is regarded globally as being relatively large and stable. There are 23 breeding colonies of Cape Fur Seals along the west coast of southern African including Atlas Bay, Wolf Bay, Hollamsbird and Long Islands, near Lüderitz. At present, the largest breeding site in Namibia is the Cape Cross Seal Reserve, a 60 km^2 protected area within the Skeleton Coast National Park, some 130 km north of Swakopmund (Nacoma, 2015; Enigma, 2012; Kirkman et al., 2012).

Off Namibia, there has been a significant northwards shift in population distribution. New breeding colonies are thought to exist in northern Namibia and southern Angola. A significant number of Cape Fur Seals haul out at Cape Frio, on the Namibia-Angolan border, where a new breeding colony is possibly established. Seals on Pelican Point generally number around 5 000, but substantially greater numbers are seen at intervals. This mainland-based, non-breeding colony has grown rapidly in recent years. Before 1990, fewer than 10 pups were born annually at Pelican Point, but pup production increased to ~ 1 700 in 2006 and further to > 12 000 in December 2011 (last aerial census December 2011, MFMR unpubl. data) (Nacoma, 2017; Kirkman, 2012).

Figure 11: Cape Fur Seals mating. (Source: Wild screen Arkive, 2017)

The mating system in sea lions is polygynous. Bulls are not normally resident at the colonies out of breeding season. They generally arrive during late October and fight for territory, which they maintain for about six weeks, holding court over a harem of between 5 and 25 females. The older and more experienced the male: the better location he has and the more females he attracts. Females give birth to one pup during November / December.

Cape Fur Seals feed on at least 11 different species of fish. Their main prey in Namibian waters is juvenile Cape Hake, Horse Mackerel and Pelagic Goby as well as sardine, anchovy squid, lobsters and crabs. Cape Fur Seals generally forage in shallow shelf waters, but can range to distances of over 150 km from the coast. Bulls tend to range further out to sea than females. Individuals have been known to prey on seabirds in times of severe fish shortage. There has also been a substantial increase in predation by Cape Fur Seals on seabirds around southern African islands since the mid 1980s. The main predators of roosting and breeding seabirds are juvenile or adult male seals. Cape Fur Seals have been observed to predate upon African Penguins, Bank Cormorants, Cape Cormorants, Crowned Cormorants and even Cape Gannets. Due to the high predation rate and small population sizes of several of these bird species, particularly in southern Namibia, seal predation of seabirds can have negative impacts on the conservation status of these species. However, the bulk of the seal population in Namibia does not seem to be consuming large numbers of seabirds (Birdlife International, 2016; ICUN, 2016; NACOMA, 2015; Enigma, 2012; Currie et al., 2009; Maloney and Shannon. 2008; Kemper et al., 2007; Kirkman et al., 2007). Elwen et al, 2012 witnessed a Cape Fur Seal predating a Southern Giant Petrel near Pelican Point. The bird, which was attacked in the water from below, was injured and prevented from flying (and hence quick escape) by a rope or line entangled around its right wing. This may have been an opportunistic attack. There are no known breeding colonies of bird species typically preyed upon by Fur Seals on Pelican Point itself, but large numbers of Cape Cormorants from the man-made guano platform in the east of Walvis Bay regularly roost on the beaches around Pelican Point. They also form rafts at sea, potentially providing a nearby food source for seals. The feeding of seals by marine tour operators in Walvis Bay could also encourage some individual seals not to forage out at sea, but rather seek food in the vicinity of the tour boats. An increase in such feeding habits among the seal population could reinforce the predatory behaviour of seals on seabirds in Walvis Bay (Elwen et al., 2012).

3.1.1.1. General Threats to Cape Fur Seals

On land, Brown hyenas and jackals prey on young seals. At sea, seals fall prey to sharks and killer whales (orcas).

The Cape Fur Seal population showed a marked decrease as a result of uncontrolled harvesting from the early 1800s through the 1900s. Sealing was stopped in South Africa in 1990, but continues in Namibia as a population control measure. The Namibian seals are exploited mainly for their pelts (pups aged 7-10 months), blubber and male genitalia (Asian aphrodisiacs market). An annual cull is sanctioned by the Namibian government. There is a regulated quota, with numbers based on the status fish stocks. Seal populations vary in response to the abundance of pilchard (Enigma, 2012, NACOMA, 2013).

Commercial fishermen commonly view seals as a menace, but scientific studies have shown that competition between seals and hake fishing operations is small in the greater scheme of things. (Maloney and Shannon, 2008)

In recent years, rogue bull seals, unable to secure their own harem of females, have been responsible for killing unsustainable numbers of African Penguins, Bank Cormorants, Cape Gannets and Cape Cormorants all of which are endangered bird species. This led to control measures being implemented to deal with individual problem seals (Kemper et al., 2007; Kirkman et al., 2007; Maloney and Shannon, 2008; Currie et al., 2009).

The biggest threats to sustained seal populations are:

- a lack of prey as a result of environmental fluctuations (particularly changes in upwelling intensity) and overfishing, particularly in Namibia, where sardine and anchovy stocks have become inaccessible to breeding seals.
- incidental entanglement in fishing gear
- intentional attacks by fishermen who feel their catch is threatened
- human interference at breeding colonies
- poisoning from toxic algal blooms
- predation of pups by Brown Hyenas and Black-backed Jackals, accentuated by the increased access to remote and offshore areas (sediment redistribution and dumping)
- predation at sea by Great White sharks (*Carcharodon carcharias)*

3.1.2. Heaviside's Dolphin

The Heaviside's or the Benguela Dolphin (*Cephalorhynchus heavisidii*) is endemic to the BCLME and resident in nearshore waters. Heaviside's dolphin is a coastal delphinid with a limited inshore distribution off the west coast of southern Africa. It is one of the smallest dolphins, growing to about 1.8 m in length and weighing up to 75 kg. These dolphins are often mistaken for porpoises due to their small size and the bluntness of their heads.

Figure 12: Heaviside's Dolphin in Walvis Bay (Source: www.travelnewsnamibia.com)

Heaviside's Dolphins are endemic to the BCLME and thus only occur along a total of about 2 500 km of coastline. They are commonly seen between Cape Point (34°20'S) and northern Namibia (17°30'S) inshore of the 100 m isobaths, although the individuals have been noted as far out as the 200 m isobath. Their density is highest close to shore. In Namibia, they occur in abundance around Lüderitz and Walvis Bay where they are often seen close to shore in the mornings, where they can often be seen jumping or playing in the waves, although their presence inshore varies greatly with time of day and brightness of the moon. Heaviside's Dolphins exhibit strong onshore–offshore diurnal movements, generally being closest inshore between 6 am and noon and farthest offshore between 3 pm and 5 am. This pattern is assumed to be related to the movements of their principal prey, juvenile shallow-water hake (*Merluccius capensis*), which migrate into the upper water column at night. Heaviside's also feed on other small fish (usually juvenile hake) and cephalopods. They no doubt come inshore to rest and avoid predators (Elwen et al., 2006; 2009).

Heaviside's Dolphins live in social groups numbering anything between seven and a few hundred. Population size and status from the Namibian coast are unknown. A population of some 500 Heaviside's Dolphins resides within the Walvis Bay area, frequenting the waters north of Pelican Point. Heaviside's are lively animals and can often be seen riding the waves, jumping up to 2 m in the air and somersaulting to land with their flukes slapping the surface of the water. They move along the coast at high speeds, "porpoising" as they travel. They approach boats from a distance and are avid bow-riders. The Pelican Point group is a popular target with the local Walvis Bay eco-tourism industry and can be watched easily from tour vessels inshore as well as from the coast.

The species is categorised as *data deficient* by the *International Union for Conservation of Nature* (ICUN) but is considered vulnerable due to its limited distribution. It is listed by the Convention on the Conservation of Migratory Species of Wild Animals (CMS) as having an unfavourable conservation status or would benefit significantly from international co-operation organised by tailored agreements. Heaviside's Dolphins are covered by the Western African Aquatic Mammals Memorandum of Understanding.

3.1.2.1 General Threats to Heaviside's Dolphins

While Heaviside's Dolphins appear to face fewer threats than other members of its genus, several threats have been identified including:

- entanglement in a variety of inshore gear such as beach seines, purse seines, trawls, and gillnets
- commercial fishery by-catch and incidental mortality
- depletion of prey species in their restricted range
- targeting by illegal direct catch. Dolphin kills with hand-thrown harpoons and/or guns are suspected within the broader Benguela region, despite the full legal protection afforded to all marine mammals in Namibian waters
- interaction with tourists (propeller strikes, pollution, discarded fishing gear)

(Wikipedia, 2017; ICUN, 2015; NACOMA, 2015; Namibian Dolphin Project, 2014; Elwen and Leeney, 2010; Elwen et al., 2006; 2009).

3.1.3. Atlantic or Common Bottlenose Dolphin

Bottlenose dolphins are the most common and well-known species of dolphin. There are three distinct types of Bottlenose Dolphins: Common/Atlantic Bottlenose Dolphins (*Tursiops truncatus*), Indo-Pacific Bottlenose Dolphins (*Tursiops aduncus*) and Burrunan Bottlenose Dolphins (*Tursiops australis*). Bottlenose dolphins grow to between 2 and 4 m long and weigh 150 to 200 kg. Differences in size are related to geographical locations. Offshore ecotypes, adapted for cooler waters, tend to be larger than inshore ecotypes. The animals in Walvis Bay have a relatively large body size, growing to over 3.5 meters in length.

Bottlenose dolphins inhabit shallow areas of tropical and temperate oceans throughout the world. Namibian waters host two distinct forms of the Common Bottlenose dolphin (*Tursiops truncatus*). The larger form resides in waters less than 10 m deep in the extreme inshore region of northern Namibia, while a slightly smaller form appears throughout deeper (> 500 m) southern African offshore waters. There is a resident population between Walvis Bay and Cape Cross. This population is unique within the Benguela ecosystem. It is the only inshore population of Common Bottlenose Dolphins south of Angola and numbers less than 100 individuals.

Bottlenose Dolphins are feeding generalists, hunting a variety of fish, squid and shrimp. In Walvis Bay they are regularly observed feeding in association with Cape Fur Seals. When hunting they can reach speeds of over 30 kph. They surface two or three times a minute to breathe in a "porpoising" motion. Bottlenose Dolphins communicate through distinctive whistles and clicks.

Bottlenose Dolphins have a strong social structure with long-term, individual-based associations. Schools have been known to come to the aid of an injured dolphin and help it to the surface. Bottlenose Dolphins are generally known to have a calm and playful temperament, particularly around humans. When not travelling or hunting, they seem to enjoy surfing waves, jumping, slapping their tails and tail-walking. Bottlenose Dolphins have been observed to breach up to 5 m, landing with a splash on their back or side.

Figure 13: Bottlenose Dolphins playing in Walvis Bay (Source: Namibian Dolphin Project)

Because of their large geographical range and large distribution it is difficult to estimate population numbers and trends of Bottlenose Dolphins. The Red Data Book for southern African mammals lists the common species of Bottlenose Dolphin (*Tursiops truncates*) as *Data Deficient*. In Walvis Bay, their numbers are decreasing.

3.1.3.1. General Threats to Bottlenose Dolphins

Coastal populations of Common Bottlenose Dolphins are often resident and small in number, and those in Walvis Bay is no exception. The small population makes them susceptible to natural and man-made threats including interactions with fisheries, coastal degradation and harmful algal blooms. Their very coastal range (usually in waters < 30 m deep) means they come into contact with humans quite frequently. Changes in the behaviour and energy expenditure of Bottlenose Dolphins have been documented in association with tourist, research and recreational vessel proximity.

In 2009 a number of dolphins were stranded up the Walvis Bay lagoon. There seems to be some measure of avoidance behaviour by individuals since this stranding.

Other general threats include:

- predation by sharks and orcas
- by-catch of commercial fisheries
- entanglement in fishing gear and subsequent injury or drowning
- entanglement in mariculture lines and subsequent injury or drowning
- stranding in Walvis Bay lagoon

(Namibian Dolphin Project, 2017; Namibia Travel, 2017; Travel News Namibia, 2017; Heiler et al., 2016; ICUN, 2016, Wikipedia, 2015; Nacoma, 2015; Enigma, 2012; Bianchi et al., 1999)

3.1.4. Dusky Dolphin

Figure 14: Dusky Dolphin in Walvis Bay.
(Source: www.namibian.org/travel/)

The Dusky Dolphin (*Lagenorhynchus obscurus*) is the smallest of the world's 33 different species of dolphin, being less than 2 m in length and generally weighing less than 100kg. Dusky Dolphins are widely distributed along the coasts in temperate waters of the southern hemisphere. They are found off South America, New Zealand and the west coast of southern Africa. Like Heaviside's, Dusky Dolphins are distributed throughout and are resident year-round in the BCLME, but they tend to range more widely north-south and further offshore than do Heaviside's Dolphins. Their latitudinal range has been document from Danger Point, South Africa to southern Angola. This is the most abundant cetacean in Namibian waters, often seen in groups, varying in number from as little as 8 up to several hundred individuals. Dusky Dolphins are associated with the colder waters of the Benguela Current. Sightings are reported generally close to shore within the 50 m isobaths, although there have been reports of this species in water some 500 m deep. Dusky Dolphins are the least known of the coastal dolphins of southern Africa.

Dusky Dolphins take a wide variety of prey, including southern anchovy, sardines and mackerel near the surface in shallower waters, as well as mid-water and benthic prey, such as squid, hake and lantern-fish during nocturnal forages. While those in the Walvis Bay region show no predictable special variation with time of day, their numbers inshore are significantly lower when upwelling conditions exist offshore. Dusky Dolphins are able to dive for up to 90 seconds and can reach speeds of 37kph. Several groups of Dusky Dolphins will join together to form a large “hunting” pod. Males and females work together to corner shoals of fish. After feeding they have been seen playing, grooming and leaping together before breaking up into smaller groups again to return closer to the coast to rest.

They are a favourite target of dolphin cruises from Walvis Bay as they frequently bow-ride. Their spectacular aerial displays attract much attention. Dusky dolphins communicate through a series of whistles, but it is not known if they have any sonar abilities when communicating.

Assessment of the global population status is not possible with the current available estimates of abundance. Thus the Dusky Dolphin is classified as *data deficient* by the ICUN.

3.1.4.1. General Threats to Dusky Dolphins

Dusky Dolphins are susceptible to increasing levels of human activity. Direct catches and by-catches have been large and continuous in some regions. Dusky Dolphins are known to be taken directly in the multi-species small cetacean fisheries of Peru and Chile. In 1999 it was calculated that the fishing industry from just one port killed more than 700 Dusky Dolphins annually. Off New Zealand Dusky Dolphins are regularly entangled in gill nets. Incidental mortality at one fishing port was estimated to be 100 to 200 animals per year (Namibian Dolphin Project, 2017; Namibia Travel, 2017; Travel News Namibia, 2017; Wild Africa Travel, 2017; ICUN, 2015; NACOMA, 2015; Elwen et al., 2010; Elwen, 2009; Moloney, C and Shannon, L., 2008)

3.1.5. Risso’s Dolphin

Figure 15: Risso’s Dolphin. (Source:http://www.ocean-institute.org/visitor/risso_dolphin.html)

Risso's Dolphin (*Grampus griseus*) is the only species of dolphin in the genus *Grampus*. Risso's Dolphin has a relatively large anterior body and dorsal fin, while the posterior tapers to a relatively narrow tail. The bulbous head has a vertical crease in front. Juvenile Risso's Dolphins are slate-gray to black in colour. As they age, they lighten in colour and acquire white scars all over their body. These scars are assumed to be from the teeth of other Risso's Dolphins (called rake marks) and from the squid they prey upon, which have sharp hooks on their tentacles. Eventually, a Risso's Dolphin can be almost completely white. At full size these animals measure 3.6 to 4 m and weigh 300 to 400 kg. The oldest known Risso's Dolphin reached an age of 39.6 years. They communicate by a series of whistles and use sonar for echolocation.

Risso's Dolphins are found worldwide in temperate and tropical waters, usually in deep waters, but close to land. They occur in the tropical parts of the Indian, Pacific and Atlantic Oceans, as well as in the Persian Gulf and Mediterranean and Red Seas. Their preferred environment is just off the continental shelf on steep banks, with water depths varying from 400 to 1 000 m and water temperatures of between 15 and 20 °C (min 10 °C). This species is the 3rd most frequently encountered dolphin in the NBR, most often in deep waters of the Namibian coastline. They occur in small groups of around 10 individuals, and are found year-round near the shelf edge throughout the southeast Atlantic Ocean.

Risso's Dolphins travel in pods of 3 to 30 individuals, but these groups can reach 400 members. Smaller, stable subgroups exist within larger groups. They also travel with other cetaceans and are known to harass and surf the bow waves of Gray Whales. Risso's dolphins feed almost exclusively on neritic and oceanic squid, usually nocturnally.

Risso's Dolphin is categorised as *least concern* although they have an unfavourable conservation status or would benefit significantly from international co-operation organised by tailored agreements. They are covered by several international agreements and MoUs including the Western African Aquatic Mammals MoU).

3.1.5.1. General Threats to Risso's Dolphins

Predation does not appear significant in this species and mass strandings are infrequent.

(Namibia-1on1.com, 2017; Namibia Travel, 2017; Namibia Nature Foundation, 2015; ICUN, 2015).

3.1.6. Common Dolphin

The Common Dolphin is a member genus *Delphinus* within the dolphin family *Delphinidae.* Only in the mid-1990s were the different forms within *Delphinus* recognized as species: The Short-beaked Common Dolphin (*D. delphis*) and the Long-beaked Common Dolphin (*Delphinus capensis*). The Indo-Pacific Common Dolphin (*D. tropicalis*) is sometimes considered a separate species, but is more often considered a form of the Long-beaked Common Dolphin. The Long-beaked Common Dolphin is generally larger, with a longer beak and a longer rostrum, than the Short-beaked Common Dolphin.

The Long-beaked Common Dolphin has a dark grey back, a white underside and light grey, gold or mustard-coloured hourglass shapes on the sides. This species also has a rounded melon on tops of their heads used for echolocation. It has a long, thin rostrum with up to 60 small, sharp, interlocking teeth on each side of each jaw, more teeth than any other delphinid. Common Dolphins whistle to communicate with other members of its own species and use sonar for echolocation. This medium-sized dolphin is considerably smaller than the Common Bottlenose Dolphin, averaging around 2.5 m in length and weighing about 150 kg. Males are generally longer and heavier than females.

Despite its name, the Common Dolphin is less well known than the Bottlenose Dolphin, which is sometimes thought of as the "common" dolphin. This is due to its more restricted range and lower tolerance for human interaction. The Long-beaked Common Dolphin has a disjointed range in coastal areas in shallow, warmer temperature and tropical waters. The range includes parts of western and southern Africa, much of western South America, central California to central Mexico, coastal Peru, areas around Japan, Korea and Taiwan, and possibly near Oman. Vagrants have been recorded as far north as Vancouver Island. Common Dolphins avoid the cooler inshore waters of the BCLME region, but have been recorded as regular inhabitants of pelagic Namibian waters, within 50-100 nautical miles (90-185 km) of the coast. They can be found all year round off the coast of Namibia, but are more common in late summer.

The Long-beaked Common Dolphin *(Delphinus capensis)* is a popular attraction on a dolphin cruise around Walvis Bay and Swakopmund because it is very gregarious and highly vocal and can be seen in schools of hundreds. They seem to be compulsive bow-riders of sea-going vessels, regularly Individuals ride the bow-waves, breaching and performing aerial acrobatics. They communicate frequently using clicks, whistles, squeaks and creaks. Long-beaked Common Dolphins sometimes associate with other dolphin species, such as Pilot Whales and Bottlenose Dolphins, and have been seen bow-riding on baleen whales. They are also known to travel with Yellowfin Tuna.

Figure 16: Long-beaked Common Dolphins. (Source: Sea Search Africa, 2017)

Common Dolphins feed on small fish such as anchovies, sardines, mackerels, pilchards, mullet and squid and they can often be seen following fishing boats or herding prey together. Common Dolphins prey on locally abundant fish species and appears to be well adapted to cope with changes in prey species availability, without impacting on body condition. While feeding they can dive to depths of up to 250 m for as long as 8 minutes.

Since they gather in huge superpods and there is seldom enough food in one place to support all of them and smaller groups break away for a few hours to feed.

Unlike Bottlenose Dolphins, this extremely social species is nearly impossible to tame. If kept in captivity Long-beaked Common Dolphins are extremely stubborn, refuse to be trained and often die.

On the coast of California there are about 25 000 to 43 000 Long-beaked Common Dolphins and on the coast of South Africa there are between 15 000 and to 20 000. *Delphinus capensis* is covered by the Memorandum of Understanding Concerning the Conservation of the Manatee and Small Cetaceans of Western Africa and Micronesia and the Memorandum of Understanding for the Conservation of Cetaceans and Their Habitats in the Pacific Islands Region (Pacific Cetaceans MoU). It is listed by the IUCN as *data deficient*.

3.1.6.1. General Threats to Common Dolphins

Apart from captivity, threats to Long-beaked Common Dolphins include:

- Commercial Fisheries: 120 out of 930 dolphins observed off of Peru between 1985 and 2000 had numerous lacerations on their head, skin, appendages, and teeth. Most of these injuries were from fisheries-related connection.
- Direct targeting: in some regions, such as West Africa, East Asia and the east and west coasts of South America, undetermined numbers of long-beaked dolphins are being directly exploited, or taken as incidental bycatch in other fisheries. In Peru and West Africa in particular, there is increasing concern about the number of Long-beaked Common Dolphins being caught and used for human food and shark-bait
- Pollution: Many of this species have shown signs of organochlorine residue on their blubber.
- Restricted range and lack of quantifiable data

(Namibia Travel, 2017; Wikipedia, 2017; IUCN, 2016; Sea Search Africa, 2017; Ambrose et al., 2013; Wild screen Arkive, 2009).

3.1.7. Rough-toothed Dolphin

The Rough-toothed Dolphin *(Steno bredanensis)* is a primitive-looking dolphin named for the faint ridges on the crowns of the teeth of the upper and lower jaw. It is dark grey to purplish on the back, with yellowish-white or pink blotches and scars on the flanks that mostly come from cookie-cutter shark bites. The lips, snout and ventral surface of Rough-toothed Dolphins are white. It does not have a crease separating its beak from its melon, giving the head a conical shape. The relatively large eyes, narrow head and long, dark, powerful body give Rough-toothed Dolphins a somewhat reptilian appearance. This is a medium-sized dolphin species with males reaching 2.5 m and females 2.25m. On average Rough-toothed Dolphins weigh 145 kg. The Rough-toothed Dolphin is known to live for up to 36 years.

Although widespread, the Rough-toothed Dolphin is not frequently encountered, and thus few studies have been conducted on its ecology and biology. Rough-toothed Dolphins frequent deep, warm tropical waters. In Atlantic coastal areas it has been seen from Walvis Bay northwards to Möwe Bay on the Skeleton Coast. Schools of 50 to several hundred are common. They have been observed in the company of other species such as Pilot Whales, and offshore Bottlenose, Spotted and Spinner Dolphins. They are often associated with flotsam, but the reason is unknown.

Rough-toothed Dolphins are not extremely active animals and seldom bow-ride or perform aerial leaps. They are fast, powerful swimmers, but rather than "porpoising", they "skim" with their heads and chin above the surface of the ocean, facilitating species identification. They often swim in line, with several individuals shoulder-to-shoulder. They tend to travel in small groups of between 10-20 animals.

Figure 17: Rough-toothed Dolphins. (Source: Ocean Treasures, 2017)

Rough-toothed Dolphins feed on cephalopods, fish, and molluscs. The robust teeth indicate that some particularly large fish may be eaten. Algae have also been found in the stomachs of Rough-toothed Dolphins, although this may have been eaten accidentally. This species is known to dive up to 70 m to remain underwater for 15 minutes when hunting. There is evidence to suggest that this dolphin is actually capable of undertaking much deeper dives.

The global population of Rough-toothed Dolphins is estimated at 150 000. The IUCN Red List classifies this species as of *Least Concern.*

3.1.7.1. General Threats to Rough-toothed Dolphins

Threats to the Rough-toothed Dolphin include:

- small numbers of intentional takes (Japan, West Africa)
- accidental death resulting from bycatch
- entanglement in fishing gear (purse seine nets, gillnets, driftnets)
- possible ingestion of non-biodegradable rubbish (pollutants detected in the blubber).

(Marinebio.org, 2017; Namibia Travel, 2017; Wikipedia, 2017; whales.org, 2017; IUCN, 2016; Ocean Treasures, 2014; Wild screen Arkive, 2009).

3.1.8. Killer Whale / Orca

Killer Whales (*Orcinus orca*) are classified as dolphins, making them the largest species of their kind. They grow up to almost 10 m and weigh as much as 9 000 kg. Females are slightly smaller than males. Killer Whales are easily recognised by their jet black bodies with white patches on their undersides and around the eyes. Their most distinctive feature is the large dorsal fins in the middle of their backs. Orcas live between 30 and 50 years in the wild, but their lifespan is much reduced in captivity. They are susceptible to diseases that can cause reproductive difficulties. They accumulate poisonous chemicals in their body tissue (e.g. PCBs), making them vulnerable to anthropogenic pollution.

The Killer Whales are seen in all oceans, from the polar regions to the tropics, as they tend to travel wherever they can find food. However, there appears to be a preference for higher latitudes and coastal areas over pelagic environments. Killer Whales are reported in southern African waters regardless of season or water depth. Visits to the coastal waters of Namibia by Killer Whales are sporadic. In Namibia, Killer Whales have been recorded on 16 occasions since 2003, usually in late summer and winter. Off Walvis Bay they are usually only seen between August and March, in groups ranging in size from 2 to 20 individuals, but the mostly with fewer than 7 animals.

Figure 18: Orca in Walvis Bay
(Source: Namibian Dolphin Project)

Orcas live in complex and cohesive family groups or pods. Their groups are intricately structured and can include up to 4 generations. Mothers calve once every five years usually to a single baby. Mortality is extremely high during the first seven months of life, when 37 - 50% of all calves die. To avoid inbreeding, males mate with females from other pods.

Killer Whale behaviour generally consists of foraging, travelling, resting and socializing. They engage in active and energetic surface behaviour such as breaching, spy-hopping, and tail-slapping. Orcas are notoriously fast swimmers. They are carnivorous hunters and different populations tend to specialize in prey species and use different techniques to catch. Those that feed on mammals may not even recognize fish as prey and vice versa. All pods use effective, cooperative hunting techniques, making use of numerous communications, no matter what the prey. *Resident* pods consume primarily fish and squid; *Transients* hunt small dolphins, seals and seabirds such as cormorants and penguins; while *Offshores* are thought to be responsible for attacks on Humpback and Fin Whales and for the beaching techniques used to grab seals onshore.

There is no current estimate of the number of Killer Whales in the African sub-region. Visits to a specific near-shore region in Walvis Bay seem to be sporadic and unpredictable both within and between years, but records indicate that they may stay in the region for a period of several days.

Due to their enormous range, numbers and density, distributional estimates are difficult to compare and validate. Global population estimates are uncertain, but recent consensus suggests an absolute minimum of 50 000 animals (IUCN, 2016). The IUCN currently assesses the Orca's conservation status as *data deficient* because of the likelihood that two or more killer whale types are separate species. The South African Red Data Book lists the Killer Whale *Orcinus orca* as *Data Deficient*.

3.1.8.1. General Threats to Killer Whales

Some local populations are considered threatened or endangered due to:

- prey depletion
- habitat loss
- anthropogenic pollution (e.g. PCBs)
- capture for marine mammal parks
- conflicts with fisheries.

(Namibian Dolphin Project, 2017; Namibia Travel, 2017; Travel News Namibia, 2017; ICUN, 2015; NACOMA, 2015; Wikipedia, 2015; Elwen and Leeney, 2011; Moloney and Shannon, 2008)

3.1.9. Humpback Whale

The Humpback Whale (*Megaptera novae-angliae*) is one of the larger rorqual species, ranging in length from 12 to 16 m and weighing approximately 36 000 kg, with females being on average slightly larger than males. At birth, calves measure 6 m and weigh approximately 1.8 tons. The Humpback Whale has a distinctive body shape, with unusually long pectoral fins and a knobbly head. Differences in tail fluke patterns are sufficient to identify individual Humpback Whales. The Humpback Whale is known for breaching and slapping the water with its tail and pectorals fins.

Humpback Whales have an incredibly wide distribution, inhabiting all major oceans from the Antarctic ice shelf in the Southern Ocean to 77° N in the Arctic Ocean. They are known for extreme migrations of up to 25 000 km annually, wintering in the tropics after travelling from feeding grounds in the polar regions.

The west coast of South Africa functions largely as a migration corridor, but also serves as a seasonal spring/summer feeding ground for a small number of Humpback Whales. Humpback Whales use migratory corridors along the Namibian coast, travelling from Antarctica to the southern end of Africa and then along the west coast of Southern Africa, through the inshore MPA of Namibia, to the equatorial East Atlantic Ocean offshore of Gabon. They are generally seen over the continental shelf between May and December, with numbers peaking in June/July during the northward migration and again in September, during the southward migration. Given that there are no recordings of Humpback Whales singing in Namibian waters, competitive groups are rarely sighted and very few calves have been observed, it is unlikely that this species breeds in the central Benguela Region. Despite the fact that they are one of the most well-studied whale species in the world, the population structure of Humpback Whales migrating past the west coast of Africa is poorly understood.

Figure 19: Humpback Whale breaching offshore of Walvis Bay. (Source: Mola-Mola Tours.com)

Some non-breeding juvenile Humpback Whales remain off the west coast throughout summer, possibly taking advantage of upwelling productivity to feed within the BCLME. There is evidence to suggest that these animals are, in fact, a sub-population that feeds in the upwelling system throughout the summer months, rather than returning to the Antarctic. Namibian observers have noted a prevalence of Killer Whale bite scars and fresh bites from Cookiecutter Sharks, suggesting that animals seen in Namibia in winter are on their northward migration and have intercepted the coast from farther offshore where Cookiecutter Sharks occur.

Humpback Whales are not exceedingly social animals and enjoy a loose-knit social structure. Typically, individuals live alone or in small, transient groups that come together in summer to forage and feed cooperatively, but disband thereafter. None-the-less, Humpback Whales appear to be a friendly species and are often seen interacting with other cetacean species such as Bottlenose Dolphins. Interaction between Humpback and Right Whales has been recorded in all oceans. Individual Humpback Whales are also known to appear in mixed groups with other species, such as the Blue, Fin, Minke, Gray and Sperm Whales.

Humpback Whales feed on krill, copepods and small shoaling fish. The Humpback is an energetic hunter and has the most diverse feeding repertoire of all baleen whales. Humpbacks hunt by direct attack or by stunning prey by hitting the water with pectoral fins or flukes, but the most inventive technique is known as *bubble net feeding*. Humpbacks feed primarily in summer. In winter they feed only rarely and opportunistically, generally living off fat reserves.

Humpback Whales were heavily exploited in the 19th and 20th centuries and the global population was severely depleted. Humpback Whales were hunted out of Walvis Bay in the early 20th century and Blue Whales were taken as by-catch. Uncontrolled whaling reduced the global Humpback Whale population by an estimated 90%, to 5 000 individuals. A moratorium, introduced in 1966, rescued this species from the brink of extinction, with its population recovering to 80 000 worldwide. Of those 18 000 to 20 000 are found in the North Pacific, 12 000 in the North Atlantic and over 50 000 in the Southern Hemisphere. There are no recent estimates of Humpback populations in the southeast Atlantic Ocean.
In August 2008, the International Union for the Conservation of Nature and Natural Resources (IUCN) changed Humpback Whale's status from *Vulnerable* to *Least Concern*. However, two sub-populations remain endangered. The Red Data Book for southern Africa lists the Humpback Whale as *Near-threatened.*

(National Geographic Society.com, 2017; Wikipedia, 2017; Nacoma, 2017; ICUN, 2015; Elwen at al., 2014; Namibian Dolphin Project, 2014; Enigma, 2012; Elwen and Leeney, 2011; Currie et al., 2009; Maloney and Shannon, 2008; Bianchi et al, 1999).

3.1.9.1. General Threats to Humpback Whales

The main threats to Humpback Whales (other than direct hunting) are:

- possible predation or injury by Orcas
- ship strikes and/or collisions
- entanglement in fishing gear
- entanglement in mariculture lines
- being taken as bycatch
- pollution of the ocean by non-biodegradable materials and accidental ingestion of foreign substances
- internal injuries resulting from noise pollution from marine vessel traffic, marine mining, survey and drilling operations and naval sonar and defence manoeuvres.

3.1.10. Southern Right Whale

The Southern Right Whale (*Eubalaena australis*) is one of three species classified as *Right* Whales belonging to the genus *Eubalaena*. One species is found in the northern Pacific Ocean, one in the North Atlantic and one in the southern hemisphere: *Eubalaena australis*. There are only minor differences in skull shape and size between the 3 species. Individual Southern Right Whales are easily distinguishable by the pattern of callosities on the head and upper jaw. Right Whales are so named because they were the *right* whales to hunt and all three species were decimated to the brink of extinction by early whalers.

Southern Right Whales have a circumpolar distribution between 20°S and 55°S. They migrate northwards in winter for breeding and can be seen along the coasts of Argentina, Australia, Brazil, Chile, Madagascar, Mozambique, Namibia, New Zealand, Peru, South Africa, Tristan de Cunha and Uruguay. Whaling records show that Southern Right Whales were found along the entire southern African coast prior to 1835. Whaling grounds stretched form Walvis Bay, Namibia to Maputo, Mozambique and southwards into the far South Atlantic and Southern Oceans. Whaling activities rendered the Namibian population of Southern Right Whales effectively extinct, before the species was granted protection in 1935. Between 1788 and 1803, more than 3 700 whales were killed out of Walvis Bay alone. The last recorded catch in the region was in 1913 in southern Angola.

Southern Right Whales were extinct in Namibian waters prior to 1971. Between 1971 and 1999 there were 36 incidental sightings of Southern Right Whales in Namibian waters over an area that ranged from 17°16'S to 28°03'S. All sightings were within 3 km of the shore. The coincidence of calves in incidental sightings seems to indicate the occurrence of a small breeding population off Namibia. Most of confirmed Southern Right Whale sightings are restricted to the south of Lüderitz, with only a few animals venturing further north to historical breeding (and hunting) grounds around Walvis Bay.

Figure 20: Adult female Southern Right Whale with her newborn calf in southern Namibia. © J-P. Roux

Southern Right Whales arrive in coastal waters off the southern African west coast in June, building up to a maximum number in September/October and departing again in December. The numbers in Namibia remain low. The population size and status from the Namibian coast are unknown, however, there appears to be an increasing trend from four animals the 1970s more than 150 animals in 80 sightings since 2000.

Global populations are recovering. In October 2008, National Geographic approximated that 10 000 Southern Right Whales are spread throughout the southern part of the Southern Hemisphere. Since whaling stopped, stocks are estimated to have grown by 7% a year. Despite these promising signs, the Southern Right Whale is categorised by the Convention on the Conservation of Migratory Species of Wild Animals (CMS) as being in danger of extinction throughout all, or a significant proportion, of its range.

3.1.10.1. General Threats to Southern Right Whales

The main threats to Southern Right Whales (other than direct hunting) are:

- ship strikes and/or collisions
- entanglement in fishing gear
- entanglement in mariculture lines
- pollution of the ocean by non-biodegradable materials and accidental ingestion of foreign substances

(Namibian Dolphin Project, 2017; Namibia Travel, 2017; Travel News Namibia, 2017; ICUN, 2015; NACOMA, 2015; Wikipedia, 2015; Elwen and Leeney, 2011; Moloney and Shannon, 2008)

3.1.11. Leatherback Turtles

Leatherback Turtles (*Dermochelys coriacea*), the largest living marine reptile, are occasionally sighted off central Namibia. This critically endangered species is known to frequent the cold southern ocean, but cross vast sections of ocean in search of food. Leatherbacks can dive to depths of over 100 m in search of prey, remaining submerged for as long as 35 minutes.

Figure 21: Leatherback Turtle in Walvis Bay area. (Source Namibian Dolphin Project, 2013)

Although they tend to avoid nearshore areas, normally inhabiting deeper waters and travelling the ocean currents in search of jellyfish (their prey of choice), Leatherback Turtles have been sighted by tourists on marine cruises in Walvis Bay and off Swakopmund between October and April. Opportunistic seasonal observations of Leatherback Turtles made during a cetacean research project in the vicinity of Walvis Bay recorded that Leatherback Turtles were only seen in the warmer periods of summer months (February–March) when the surface waters exceeded 15°C. The substantial increase in jelly fish within the BCLME has led to Namibia becoming recognised as a feeding area for Leatherback Turtles. Based on tag returns from animals found dead in Namibia, it has been established that these turtles are known to come from at least 3 breeding populations in the South-West Indian Ocean near Mozambique, Gabon and Brazil.

Leatherbacks are listed in the highest categories in terms of need for conservation in the Convention on International Trade in Endangered Species (CITES) and Convention on Migratory Species.

3.1.11.1. General Threats to Leatherback Turtles

Apart from predation the populations are Leatherback Turtles are threatened by:

- human consumption
- plastic pollution: Turtles mistake plastic waste for jellyfish and subsequently die of starvation as the plastic blocks their gut

As many as 700 sea turtles are caught by the Namibian pelagic longline fishery targeting tuna, swordfish and sharks each year. Catches are likely to be the highest in the northern Benguela, where sea turtle abundance and fishing (longline and artisanal) activity is the highest Additionally sea turtles are caught by artisanal fisheries for consumption in Angola. No mitigation measures are in place throughout the BCLME region.

(Namibian Dolphin Project, 2017; 2013; CITES, 2013; ICUN, 2015; Enigma, 2012; Elwen and Leeney, 2011).

4. POTENTIAL IMPACTS ON MARINE MAMMALS FROM HUMAN ACTIVITIES AND INTERACTION

The marine system is still suffering from the effects of whaling, sealing, the harvesting of guano and commercial fishing operations in the 19th and 20th centuries. It is being increasingly impacted by industrial and commercial activity as technology improves to make the marine environment more accessible. These activities have had serious negative impacts on many species, and while conservation efforts have resulted in some species regaining at least some of their original populations, many others have yet to recover to any significant degree.

The purpose of this section is to identify any possible risks and threats of the proposed Walvis Bay Waterfront Development to the identified marine populations. If any such risks exist, then, where possible, mitigation measures are suggested.

All marine mammals face threats in their natural environment, but many of these are a direct result of human activity. Deliberate targeting, research, exploration, mining, construction, military activities, invasion of territory, negligence and simple ignorance account for numerous injuries and fatalities, many of which can be avoided. The Sea Fisheries Act (29 of 1992) gives Namibia's marine mammals full protection within the 200 nautical mile Exclusive Economic Zone. None-the-less, these animals are strongly impacted by human activities both on- and off-shore. Many species are still vulnerable to human activities and accidental interaction.

4.1. MARINE TRAFFIC

The general increase in marine traffic and utilisation of marine resources results in more frequent accidental encounters between humans and marine animals. Most research has focused on mysticetes as these whales seem more vulnerable to collisions with ships, entanglement in fishing gear and noise pollution. Mammal-vessel collisions are dangerous to both parties. Ship-whale collisions in Tsushima Strait have resulted in injury to whales and passengers and damage to vessels.

Research into marine mammal-vessel collision indicates that the probability of collision depends on a number of factors including vessel type, speed, location, species, and behaviour (Todd eta al., 2015). Studies have shown that the risk of a collision resulting in severe or lethal injury increases when vessels exceed 10–14 knots, regardless of vessel type. Right Whales (*Eubalaena spp*.), Humpback Whales (*Megaptera novaeangliae*), and Fin Whales (*Balaenoptera physalus*) are considered some of the most prone to collisions. Calves and juveniles are struck more often than adults. An 18 m (60 ft) -long Fin Whale was found stuck on the bow of a container ship in New York harbour on Saturday, 12 April 2014, without the crew being aware of anything untoward. However, data on vessel collisions need to be assessed with caution, as most is obtained from historical or anecdotal records that are difficult to verify.

There appears to be a direct correlation between animal seasonality and behaviour with collision rates. Resting or feeding whales were deemed more at risk. Collision rates involving Fin Whales increased during months of intensive feeding, possibly due possibly to the fact that feeding animals are distracted and less aware of vessel movements (Todd et al, 2015).

The discovery of large hydrocarbon reserves off the Namibian coast has lead to an increase in deep-penetration seismic surveys for exploration purposes. While Cuvier's Beaked Whales tend to avoid ships naturally in the open ocean, the increased ship traffic in and out of Lüderitz and Walvis Bay harbours and the general noise in the environment can possibly have a negative effect on other whales and dolphins in the SBR. A species particularly at risk is the slow-moving Southern Right Whale, which makes use of numerous inshore bays for calving and nursing.

Figure 22: Southern Right Whales in Lüderitz Harbour entrance channel. © J-P. Roux 2008

These two Southern Right Whales were photographed swimming in the Lüderitz harbour channel. These slow moving creatures are increasingly at risk of ship strikes as they slowly return to their traditional grounds along the Namibian coast and their breeding habitat is encroached upon by harbour development and increased shipping (Roux, 2008).

Even small motorised tourist cruises pose a threat for mammal-vessel and mammal-human interaction. Porpoising Heaviside's, Bottlenose and Dusky Dolphins are activity pursued by tourist craft. Their energetic and social behaviour makes them a popular target. Movies such as *Flipper* have popularised the idea of human interaction with wild dolphins. Excitement and competition between tour operators can lead to irresponsible craft movement and increase the risk of accidental collision. Luckily, to date, only one case of propeller strike has been recorded in Walvis Bay (Elwen and Leeney, 2010).

Figure 23: Tourist boat pursuing dolphin in Walvis Bay. (Source: Mola-Mola Tours)

Longer dolphin dive times and shorter periods at the surface have been recorded when dolphin-watching boats were present (Marine Mammal Commission, 2007), suggesting that this human activity possibly leads to more energy expenditure on the part of the marine mammals. Changes in dolphin vocalization parameters have been recorded in the presence of tourist boats, most specifically if calves were present. Such changes could have a long-term impact if they reduce the communication range of whistles or increase energy expenditure (Heiler et al, 2016).

Dolphins and seals are sometimes considered to chase off or eat fish targeted by recreational fishermen. Uneducated and irresponsible fishermen sometimes deliberately try to drive away these animals by steering boats directly towards them.

4.2. POLLUTION

Chemical pollution in the world's oceans threatens marine species in general, but some more than others. Blubber samples show an accumulation of polychlorinated biphenyl (PCB) chemicals within the bodies of Blue Whales and Orcas. This is a quiet, less visible threat to population recovery.

Chemicals from ship maintenance end up in harbour waters. These can be toxic to local benthic fauna and fish populations. Anti-fouling paints, originating from the dry docks in the harbour, are among the most toxic anthropogenic compounds that are introduced into Walvis Bay. Together with the run-off from urban areas, such toxins can have severe impacts on the marine organisms as well as posing a health risk to recreational users of the bay water. Mammals feeding on contaminated prey are at risk of poisoning through bioaccumulation (CSIR, 2009; Uushona and Makuti, 2008; Heather-Clark, 1996).

Besides litter from visitors, oil and debris from offshore vessels collect near and pollute the waters around Pelican Point. Oil and petroleum products can have profound effects on marine and land organisms, including reproduction complications, inhibited growth, toxins in fish and shellfish and resultant bioaccumulation up the food chain. Widespread impacts include shifts in dominant species, changes in abundance and diversity and mortality.

Namport is responsible for the harbour/bay oil spill contingency plan and makes provision for oil to be cleaned from the harbour and direct surrounds at all times. However, in the event of a minor oil spill in south of the peninsula, the Namport Contingency Plan recommends that the oil be left to "natural cleaning" unless heavy deposits pollute the recreational facilities and threaten the ecology. This leaves a certain number of mammals and birds at risk of oil contamination (CSIR, 2009; Uushona and Makuti, 2008).

Eutrophication of harbour waters occurs as a result of the addition of high levels of inorganic nutrients, for example from sewage and fish factory effluent. This can lead to excessive algal growth and consequent increased consumption of dissolved oxygen, ultimately leading to anoxic conditions. Not only are algal blooms aesthetically displeasing, they also produce unpleasant odours, particularly when they accentuate H_2S eruptions. Such conditions have detrimental effects on both the fish and shellfish within Walvis Bay. Increasing organic loading of an area by additional sewage outflow or dumping of garbage can dramatically change the structure of the ecology within the bay area.

Plastic pollution and discarded or lost fishing gear are responsible for injury to, restriction of and possible loss of functionality and of appendages of seabirds and marine mammals. Many seals seen in harbours and fishing areas have straps or nooses cutting into their necks. If left unattended, the nooses get tighter and cut deeper into the flesh, causing nasty wounds that become infected and could lead to the death of the animal or become caught on underwater objects when the seal dives, resulting in drowning. These injuries are caused by the seals swimming into items such as fishing line, bait box bands, rope and raffia cord, that find their way into the water as a result of human negligence (Two Oceans Aquarium, 2016).

Figure 24: Cape Fur Seal entangled in a rope (Source: Bruce, 2015)

Figure 25: Seal entangled in fishing line and bait box bands (Source: Two Ocean Aquarium, 2017).

Discarded bait box bands and broken fishing line are a major source of strangulation in Cape Fur Seals (Bruce, 2015; South African SPCA Seal Unit, 2016). The hard plastic bands do not need to be cut to remove them from the box; they just slide off and end up in the water where seals swim into the loops. They become embedded around the neck, resulting in slow strangulation. A simple solution would be to cut plastic ties before discarding them, however, many fishermen are disinclined to do so or make an effort to recover bait box bands or other debris from the water. Few will take pity on an injured seal (Bruce, 2015).

Dolphins are also susceptible to entanglement in fishing line in the water. Several dolphins bearing entanglement scars have been recorded in Walvis Bay. Between 2011 and 2012 a Heaviside's Dolphin was recorded to have fishing line caught in her flesh and that had been dangling from her body for over a year after the first spotting (Namibian Dolphin Project, 2017).

Figure 26: Plastic waste (including balloons and string) recovered from a Green Turtle. (Source: Two Oceans Aquarium)

Drifting plastic bags are often ingested by mammals, turtles and birds that misidentify them as jellyfish. Ingested plastic causes bowel obstructions and the animal slowly starves to death. Plastic waste has caused fatalities in whales, birds, turtles and sharks (Two Oceans Aquarium, 2017).

4.3. COMPETITION WITH FISHERIES

Cape Fur Seals are known to regularly interact with the South African offshore demersal, inshore demersal and mid-water trawl fisheries in a number of ways that can be detrimental to either party (fishermen or seal):

- Seals are injured by the propeller
- Seals drown in the nets
- Live seals come aboard and may be severely injured or killed

- Seals take or damage netted fish (at an estimated 0.3% cost of the total fishery)
- Seals damage the nets
- Seals can damage some trawler propellers
- Seals caught onboard below decks can attack and injure fishermen

Seal mortality is mainly through drowning in trawl nets, with between 2 500 and 3 600 deaths recorded annually in South African waters during the 90's. Brightly coloured strips of plastic and canvas are sometimes used to deter the seals, but these have not been very effective. Instead they pose a pollution threat to other sea creatures when they break off in the open waters (Wickens and Sims, 1994).

As many as 570 seals are deliberately killed annually, but this most likely takes place only when they are caught in the nets, are brought onboard and they enter the area below deck, where they are difficult to remove and pose a safety threat to the crew (Wickens and Sims, 1994). The New Zealand trawl fishery uses choker poles, deck and fire hoses and nets to attempt to remove seals from onboard vessels. There are no published data for Namibian trawl statistics with reference to seal injury, mortality or damages and cost to the fishing industry.

In general, the relationship between fishermen and seals is not an amicable one. Local artisanal fishermen describe the seals actions as *theft* from men trying to make a living. Seals are known to simply take snoek off the line. Some fishermen get so angry they shoot the seals, despite seals being protected by South African and Namibian law. In the first half of 2015, 7 seals with bullet holes washed up on the Cape beaches (Bruce, 2015).

4.4. MARICULTURE

Commercial aquaculture and mariculture ventures started in Namibia in the late 1990's. A serious potential impact of mariculture in Walvis Bay lagoon is competition for space. There is a competition in the bay area between the commercial and fishing harbours, marine tourism, recreational users and nature conservation.

Figure 27: Bottlenose Dolphin swimming between the lines of an oyster farm in Walvis Bay © R. Leeney, 2008.

Space required for the rafts will also conflict with the birds and marine mammals that use the bay area as a habitat and feeding grounds. These farms close off spaces previously accessible to wild marine life, possibly impacting feeding and breeding patterns. In Vancouver a dead Humpback Whale was found entangled in empty aquaculture lines on 20 November 2016. That was the second time within 2 months that a whale had been trapped at the same site (Vancouver Sun, 2016). A whale calf became entangled in the lines of one of the oyster farms east of the Walvis Bay peninsula. Dolphins have been reported swimming amongst the lines of oyster farms in Walvis Bay lagoon.

Mussels and oysters are filter feeders that will extract food particles from the water that are required by the other organisms living in the surrounding water. This impact is mitigated to a certain extent by the extremely nutrient-rich water and high productivity rates within the Benguela system and consequently, the bay waters. Introduction of alien species for mariculture is of concern as alien species may be invasive, thus threatening indigenous species and change the composition of the Walvis Bay communities.

Mariculture farms can impact marine populations through pollution from equipment and diesel engines used for pumping.

4.5. LIGHT AIRCRAFFT NOISE

Low-flying aircraft taking scenic tours over the bay and lagoon to Sandwich Harbour can cause startle response and panic if they approach too close to seal colonies and roosting or nesting birds. They can disrupt feeding birds and mammals at sea. At present this does not appear to be a major problem in the Walvis Bay area due to the infrequent nature of these flights.

4.6. MARINE NOISE

(Miller et al., 2011; Finneran and Schlundt, 2010; SOCAL-10; Thomsen et al., 2009; Finneran et al., 2005a; b; Kastelein et al., 2002; Thompson, 2000; Richardson et al., 1995)

The marine environment is filled with noise, but increasingly so through anthropogenic activities. Natural physical phenomena that contribute to underwater ambient noise include wind, waves, swell patterns, bubbles, currents, turbulence, earthquakes, volcanic eruptions, precipitation, lightening strikes and ice (Figure 28). In the absence of anthropogenic and biological sound, ambient noise is wind dependent over an extremely broad frequency band from below 1 Hz to at least 100 kHz. Spilling and plunging breakers can increase noise levels by more than 20 dB (10 Hz to 10 kHz band). Precipitation can raise ambient noise levels by up to 35 dB across a broad band of frequencies (100 Hz to more than 20 kHz). The dominant source of ambient noise in tropical and sub-tropical waters are snapping shrimp, which can increase ambient noise levels by 20 dB in the mid-frequency band (Convention on Biodiversity, 2012).

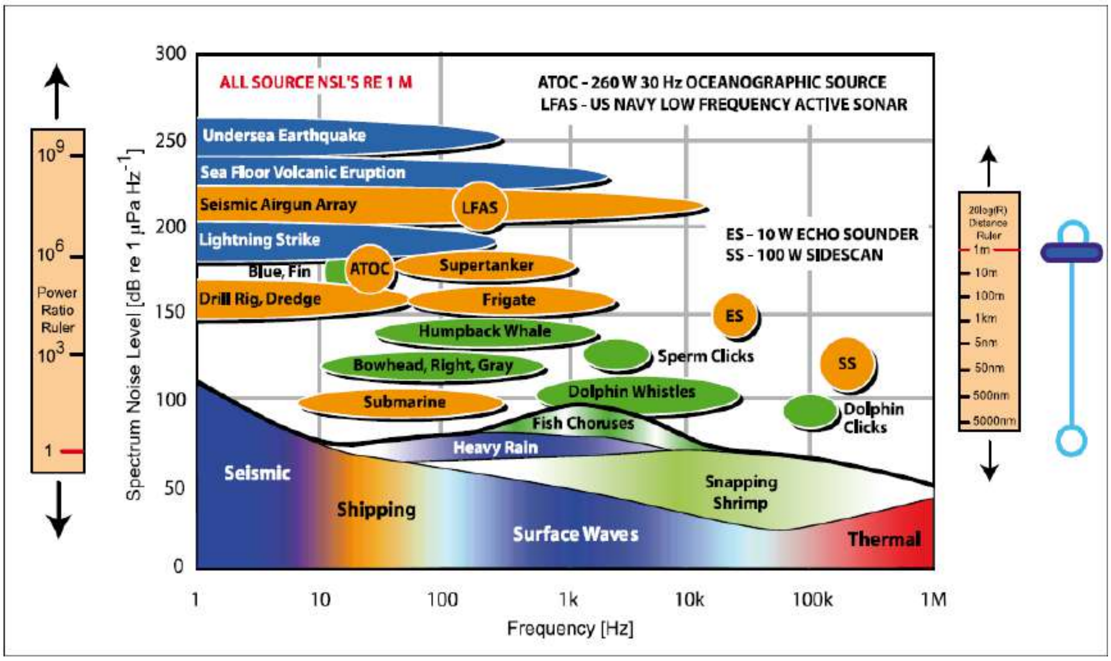

Figure 28: Range of noises in the marine environment showing natural, biological and anthropogenic. (From ESF, 2008)

It is generally considered that intense anthropogenic noise has adverse effects on marine organisms and mammals. While there have been a few cases of strandings of Beaked Whales and Giant Squids coinciding with academic seismic surveys and Humpback Whale mortality has been linked to naval exercises; there is no conclusive evidence of a link between construction noise and marine mammal mortality. As a result of public outcry over the assumed detrimental side-effects and sometimes lethal consequences of man-made activities on some marine mammals, governments (in particular the USA, UK, Australia and Sweden) have commissioned major research projects to identify culprits and differentiate between anecdotal and scientific evidence (NOAA, 2015; AFTT, 2012; Convention on Biodiversity, 2012; OSPAR, 2009; ESF, 2008; Marine Mammal Commission, 2007; NRC, 2005; 2003; DEFRA, 2004; 2003).

The amount of acoustic energy that an animal experiences as a result of an underwater energy source discharge is expressed as the sound exposure level (SEL), which is a measure of the acoustic intensity. This takes into account the overall acoustic energy impinging on a receiver per unit area within 1 second (dB re 1 μPa^2-s.). This measurement allows sounds of differing durations to be characterized in terms of energy (Woodside, 2008). Sound pressure levels (SPL) in water are measured in decibels (dB) relative to a reference pressure of 1 micropascal (1 µPa). The reference distance is 1 m. Thus, the commonly used pressure reference level for underwater acoustics is 1 µPa at 1 m or 1 µPa@1m. The reference level used for air (which matches human hearing sensitivity levels) is 20 µPa@1m.

A variety of marine life has developed special mechanisms both for emitting and detecting underwater sound. In marine mammals (cetaceans and pinnipeds), sound is used for communication, orientation, predator avoidance and foraging. Sounds range from the 10 Hz low-frequency calls of Blue Whales to the ultrasonic clicks of more than 200 kHz in certain offshore dolphins and Harbour Porpoises. Communicative signals tend to be longer in duration, but at lower source levels. Table 1 shows that the hearing of marine mammals spans as wide a range of frequencies as the emitted sounds do (<1 kHz - 180 kHz).

The hearing systems of animals are not equally sensitive to all frequencies (Table 1). The hearing threshold is the average sound pressure level (SPL) that is just audible to a subject under quiet conditions. For example, the Harbour Porpoise's hearing threshold at 500 Hz is about 90 dB re 1 µPa, while its hearing threshold at 50 kHz is in the order of 35 dB re 1 µPa. This would mean that a sound with an SPL of 100 dB re 1 µPa and a frequency of 500 Hz would be barely audible to the porpoise, however, the same SPL at a frequency of 50 kHz would be perceived as relatively loud.

Table 1: Vocalisation and functional hearing frequency ranges for marine mammals (from AFTT, 2012; OSPAR, 2009, Thompson, 2000)

MAMMALS	VOLALISATION RANGE	HEARING RANGE	VOLALISATION SOURCE LEVEL
Low-frequency Cetaceans: Humpback, Southern Right Whales	10 Hz – 20 kHz	7 Hz – 22 kHz	150 - 192 dB re 1 µPa @ 1 m
Mid-frequency Cetaceans: Killer Whales, Bottlenose, Dusky, Long-beaked Common, Risso's, Rough-toothed Dolphins	100 Hz – >100 kHz	150 Hz – 160 kHz	137 - 236 dB re 1 µPa @ 1 m
High-frequency Cetaceans: Harbour Porpoise, Koiga species	100 Hz – 200 kHz	100 Hz – 200 kHz	120 - 205 dB re 1 µPa @ 1 m
Northern Fur Seals And California Sea Lions	125 Hz – 40 kHz	200 Hz – 50 kHz	95 - 160 dB re 1 µPa @ 1 m
Phocid Seals	100 Hz – 120 kHz	75 Hz – 75 kHz	103 - 180 dB re 1 µPa @ 1 m

Species also differ markedly in their audiograms with respect to the frequency range they can hear, and with respect to their absolute sensitivity. Figure 29 shows audiograms for common dolphin species (from Thomsen et al., 2009).

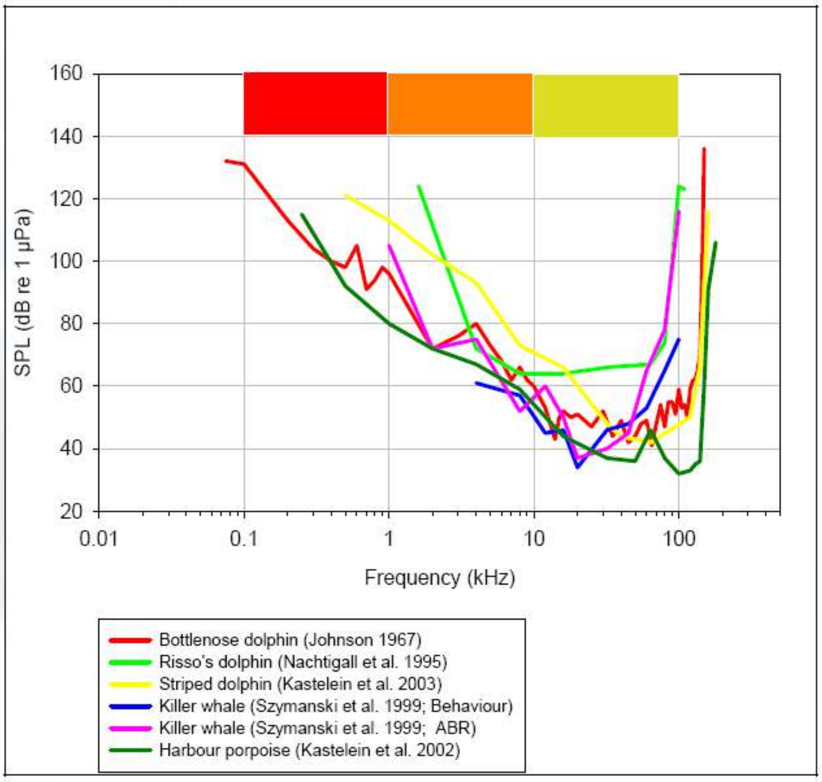

Figure 29: Representative audiograms of some common odontocetes. ABR = auditory brainstem response.

The colours at the top represent the bandwidth and relative energy content of dredging noise:
red = high
orange = low
gold = very low.

(After Thomsen at al., 2009).

The response of and/or injury to a marine mammal to an anthropogenic sound will depend on numerous factors including the frequency, duration, temporal pattern and amplitude of the sound (peak-peak), the distance from the sound source and whether it is perceived as approaching or moving away (SOCAL-10). In a report to the US Congress in 2007 the Marine Mammal Commission identified the various scales of damage that can be affected on marine fauna. A simplistic analysis, as provided by the Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Commission) is shown in Table 2.

In extreme cases and at very high received SPLs close to the source, very intense sounds can result in internal injuries and might also lead to the death of the receiver. For example, underwater explosions used during construction or from the detonation of marine ammunition dumps can cause not only hearing damage and injury, but death from the sound shock waves. The only known case where acute exposure to non-explosive sound has led to lethal effects involves atypical mass strandings of beaked whales during navy sonar exercises (AFTT, 2012).

Table 2: Damage affected on marine fauna by anthropogenic sounds. (Source: OSPAR 2009).

IMPACT	TYPE OF EFFECT
Physiological Non-Auditory Auditory - Sound Induced Hearing Loss (SIHL)	- Damage to body tissue: *e.g.* massive internal haemorrhages with secondary lesions, ossicular fractures or dysiocation, leakage of cerebro-spinal fluid into the middle ear, rupture of lung tissue. - Induction of gas embolism (Gas Embolic Syndrome, Decompression Sickness/DCS, 'the bends', Caisson syndrome) - Induction of fat embolism - Gross damage to the auditory system – *e.g.* resulting in: rupture of the oval or round window or rupture of the eardrum - Vestibular trauma – *e.g.* resulting in: vertigo, dysfunction of co-ordination, and equilibrium - Permanent hearing threshold shift (PTS) – *e.g.*, a permanent elevation of the level at which a sound can be detected - Temporary hearing threshold shift (TTS) – *e.g.*, a temporary elevation of the level at which a sound can be detected
Perceptual	- Masking of communication with con-specifics - Masking of other biologically important sounds
Behavioural	- Stranding and beaching - Interruption of normal behaviour such as feeding, breeding, and nursing - Behaviour modified (less effective/efficient) - Adaptive shifting of vocalisation intensity and/or frequency - Displacement from area (short or long term)

Masking is the term used to describe a temporary reduction in ability to detect biologically relevant sounds as a result of a loud noise or strong SPL. The *zone of masking* is defined by the range at which sound levels from the noise source are received above hearing threshold levels. It starts when the received sound level of the masking sound (e.g. a nearby ship engine) equals the ambient noise (e.g. wave or wind) in the frequency of the signal. Masking can shorten the range over which sounds can be detected and across which conspecifics are able to communicate (e.g. mother and calf). In some species (e.g. Killer Whales) communication networks span several thousand kilometres. Masking by continuous noise can considerably reduce the functionality of these distances. However, most mammals communicate across a range of frequencies, so it is highly unlikely that the full range of frequencies used by one species will be completely masked for any significant time period.

Threshold shifts refer to an animal's ability to hear at a particular frequency and occurs at two levels of severity: Temporary threshold shift (TTS) represent changes in the ability of an animal to hear a particular frequency with a for a period of hours to days; permanent threshold shift (PTS) represents a permanent loss of hearing within a particular frequency range. Both TTS and PTS are triggered by the level and duration of the received signal. TTS have been induced in captive dolphin species at received levels higher than 190 dB. Finneran and Schlundt (2010) found that non-impulsive sounds with frequencies above 10 kHz are more hazardous than those at lower frequencies for Bottlenose Dolphins. Although no PTS have been recorded in cetaceans, it is argued that severe damage can occur in high-frequency cetaceans swimming within 265 m of the most powerful active acoustic sources such as hull-mounted sonar (AFTT, 2012). Tables 3 and 4 summarise the threshold levels for TTS and PTS in marine mammals that function in different frequency ranges.

Table 3: Acoustic criteria and thresholds for predicting physiological effects on marine mammals (from AFTT, 2012)

Group	Species	Physiological	
		Onset TTS	Onset PTS
Low-Frequency Cetaceans	All mysticetes	178 dB re 1μPa^2-s (low-freq weighting)	198 dB re 1μPa^2-s (low-freq weighting)
Mid-Frequency Cetaceans	Dolphins, beaked whales, and medium and large toothed whales	178 dB re 1μPa^2-s (mid-freq weighting)	198 dB re 1μPa^2-s (mid-freq weighting)
High-Frequency Cetaceans	Harbor porpoise and *Kogia* spp.	152 dB re 1μPa^2-s (high-freq weighting)	172 dB re 1μPa^2-s (high-freq weighting)
Phocid Seals (In-Water)	Harbor, bearded, hooded common, spotted, ringed, harp, ribbon, & gray seals	183 dB re 1μPa^2-s (phocid weighting)	197 dB re 1μPa^2-s (phocid weighting)
Manatees	West Indian manatee		

In only 2 out of 11 studies of impulsive sounds did measurable TTS occur (NOAA, 2015). This may indicate that marine mammals are more tolerant of human activity than previously supposed (Table 5).

Behavioural disturbances are reflected by noticeable changes in activity and demeanour in direct response to a sound source. These effects are difficult to measure and quantify as they depend on a wide variety of factors, for example the characteristics of the signal, the composition of the group (sex, calves present), the behavioural and motivational state (hunting, resting, socialising) prior to the sound disturbance and the individual perceiving the sound (age, sex , social status). Thus, the extent of behavioural disturbance for any given signal can vary both within a population as well as within the same individual.

Kastelein et al. (2013) monitored the response of a captive porpoise in a quiet pool to playback pile-driving sounds. The respiration rate of the porpoise appeared to increase at a threshold SEL of 127 dB re 1 µPa2·s. When exposed to SELs of 145 dB re 1 µPa2·s, the animal tried to avoid the sound by regularly jumping out of the water, whereas it never jumped during the baseline periods. Table 4 summarises the threshold source levels for the onset of behavioural response in marine mammals.

Table 4: Behavioural Response sound source thresholds in marine mammals (after AFTT, 2012)

MAMMALS	BEHAVIOURAL RESPONSE
Low-frequency Cetaceans: Humpback, Southern Right Whales	<= 160 dB re 1 µPa
Mid-frequency Cetaceans: Killer Whales, Bottlenose, Dusky, Long-beaked Common, Risso's, Rough-toothed Dolphins	167 - >170 dB re 1 µPa
High-frequency Cetaceans: Harbour Porpoise, Koiga species	90 - 140 dB re 1 µPa
California Sea Lions	165-170 dB re 1 µPa
Phocid Seals	<= 190 dB re 1 µPa

Table 5: Summary of TTS studies on marine mammals using impulsive sounds (from NOAA, 2015)

Source	Species (n)	Measured TTS Frequencies ‡	Peak Pressure	Pulse Duration	Ratio* (Pa/s)	Reference
Explosion simulator (500 kg charge)	Beluga (1); Bottlenose dolphin (2)	1.2, 1.8, and 2.4 kHz	69183 Pa (216.8 dB)	0.0095 s	7,282,421	Finneran et al. 2000
Water gun (80 in3)	Beluga (1)	**0.4**, 4, and **30** kHz	158489 Pa (224 dB)	0.0063 s	**25,156,984**	Finneran et al. 2002
Water gun (80 in3)	Bottlenose dolphin (1)	0.4, 4, and 30 kHz	218776 Pa (226.8 dB)	0.01 s	21,877,600	Finneran et al. 2002
Arc-gap transducer	California sea lion (2)	1 and 10 kHz	13963 Pa (202.9 dB)	0.0142	983,310	Finneran et al. 2003
Airgun (20 in3)	Harbor porpoise	**4**, 32, and 100 kHz	5623 Pa (195 dB)	0.05 s+	**112,460**	Lucke et al. 2009
Impact pile driver (4.2 m pile at 800 m)	Harbor porpoise	0.5, 1, 2, 4, 8, 16, 32, 63, and 125 kHz	1000 Pa (180 dB)	0.124 s	1452	Kastelein et al. 2015a
Airgun (40-150 in3)	Bottlenose dolphin (3)	0.25, 0.5, 1, 2, 4, 8, 16, 32, 40, 45, 50, and 64 kHz	31622 Pa (210 dB)	0.3 s	105,407	Finneran et al. 2015

‡ Frequencies in **bold** indicate those where measurable **TTS occurred**.
* Ratios in bold text indicate exposure scenarios where measurable TTS occurred.
\+ Lucke et al. 2009 did not provide the exact pulse duration in their experiment and only indicated it was less than 0.05 s. NOAA conservatively chose to use 0.05 s for calculating the ratio (i.e., the use of a shorter duration would only result in a higher ratio).

4.6.1. Impact of Noise on Cape Fur Seals

As there are no data available for the hearing sensitivity of Cape Fur Seals, research relating to other seal species has been investigated. Most research has been undertaken in the Northern Hemisphere, predominantly on phocid species (true seals). Captive phocid seals demonstrate a larger range in hearing and vocalisation frequency compared to otariids (sea lions and fur seals), especially within the higher frequency bands (Brough et al, 2014; Kastelein et al. 2009). Seals and sea lions produce sounds both in air and water that range in frequency from approximately 200 Hz to 40 kHz. It is believed that these sounds are only for social communication (SOCAL-10). The high-frequency limit for California Sea Lions is traditionally considered to be 40 kHz and 80 kHz for Harbour Seals. However, one recent study notes a second detection limit for both species at 180 kHz (two full octaves above the traditional California sea lion high-frequency hearing limit of 36 - 40 kHz). The audiograms for both species showed two distinct slopes relating to frequency-dependant hearing sensitivity (Cunningham and Reichmuth, 2016). A male Wedell Seal exhibits a very high amplitude source level trill of is 193 dB re 1 _Pa recorded at a distance of 1 m from the vocalizing seal. These data possibly indicate extremes of pinnipedia functional ranges.

Evidence suggests that some pinnipeds (seals, sea lions and walruses) can detect underwater sound at frequencies well above the traditional high-frequency hearing limits for their species. Pinniped audiograms are characterized by a rapid decrease in sensitivity with increasing frequency. Steller (Northern) Sea Lions (*Eumetopias jubata*) and California Sea Lions (*Zalophus californianus*) exhibit general avoidance behaviour at exposure levels above 170 dB re 1 µPa (Bain & Williams 2006), while Phocid seals (true seals) showed avoidance reactions at or below 190 dB re 1 µPa (SOCAL-10).

While TTS have been reported in Harbour Seals exposed to continuous industrial noise (sand blasting), there is no documented evidence of marine noise inducing PTS (NOAA, 2015; OSPAR, 2009).

Although otariids have less sensitive hearing thresholds than phocid seals, all seals generally move away from any source of discomfort, thus it is expected that Cape Fur Seals will show similar avoidance behaviour and be beyond the range at which physiological damage can occur. Otariids are known to become habituated to underwater sound, but whether they are capable of voluntarily masking noise as an internal defence is unknown (NRC, 2005; 2003; Edren et al., 2004; Richardson et al., 1995). The presence of Cape Fur Seals near operational mining and survey vessels, returning to construction sites and becoming habituated to "seal bombs" suggests that they are fairly tolerant of loud noise pulses. After an initial startle reaction, it has been noted that individuals quickly reverted back to normal behaviour.

4.6.2. Impact of Noise on Cetaceans

Increased levels of anthropogenic noise can cause cetaceans to avoid areas they would normally inhabit, sometimes permanently. It provokes changes in diving and foraging behaviour, leading to greater energy expenditure and potential loss of feeding opportunities. Anthropogenic noise has the ability to limit communication and the detection of biologically important sound sources. It can cause temporary and permanent deafness and, in some cases, lead to fatalities (Sonic Sea, 2017).

Figure 28 shows that there is a distinct difference in the hearing range of mysticetes (baleen whales) and odontocetes (toothed whales and dolphins): the low-frequency mysticete frequency range is centred below 1 Hz, while the odontocetes operate at higher-frequency ranges between 10 and 100 kHz. Most mysticetes produce low-frequency sounds usually below 10 kHz with the notable exception of Humpback Whales, where some calls exceed 10 kHz. The dolphins and Killer Whales found in the Walvis Bay area are mid-frequency cetaceans with hearing between 150 Hz - 160 kHz (Thomsen et al., 2009). It is possible that some odontocetes are able to detect low-frequency sounds using mechanisms other than conventional hearing, such as perceiving changes in particle velocity or identifying a combination of pressure and velocity in the near-field. At sea observations suggest that Bottlenose Dolphins, Common Dolphins and Harbour Porpoises exhibit behavioural responses to low-frequency pulses of seismic surveys, however most studies agree that the range of best hearing is well above 10 kHz with sensitivity below 1 kHz being relatively poor.

Odontocetes produce a variety of sounds for communication and echolocation, including narrowband, frequency-modulated continuous tonal sounds or "*whistles*" that range from 500 Hz to 80 kHz, and broadband sonar clicks between 250 Hz and 220 kHz including burst pulse sounds. Source levels of most mid-frequency odontocetes range between 137 and 236 dB re 1 µPa @ 1 m, while mysticete cetacean vocalisations range from 140 to 190 dB re 1 µPa (OSPAR, 2009, Marine Mammal Commission, 2008).

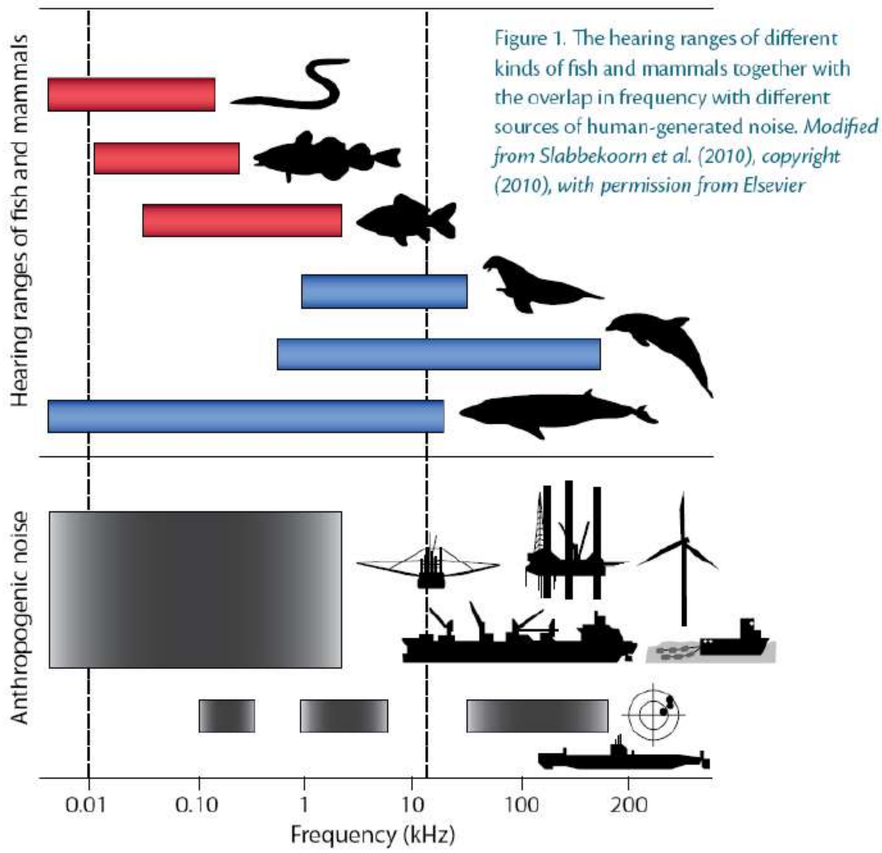

Figure 30: The hearing ranges of marine animals relative to anthropogenic noise. (From Boyd et al., 2011)

Apart from mortal injuries inflicted by naval sonar, there is little evidence of other sources of anthropogenic underwater noise causing direct physical damage to marine mammals. There are a few poorly documented cases of injury (organ damage and rupture of gas-filled cavities such as lungs, sinuses and ears) and deaths of marine mammals being caused by the use of high explosives. The death of two Humpback Whales was attributed to acoustic trauma and severe injury to the temporal bones following a 5000 kg explosion. There is no documented case of injury caused by pile driving for marine mammals at sea, although experimental studies of animals in captivity using simulated source levels indicate the noises are strong enough to cause noise induced hearing loss or TTS in some species of high-frequency hearing-sensitive mammals. These mammals were also exposed at much closer distances to the sound source than would be expected in the wild (Convention on Biodiversity, 2012).

TTS have been induced in captive dolphin species at received levels higher than 190 dB. Finneran and Schlundt (2010) found that non-impulsive sounds with frequencies above 10 kHz are more hazardous to Bottlenose Dolphins than those at lower frequencies.

The Royal Netherlands Navy identified threat of TTS based on species-specific hearing sensitivity for maximum exposure levels of 15 to 20 dB for the following ranges in received sound levels (ESF, 2008):

- Baleen whales and some dolphins 160-185 dB
- Sperm and killer Whales 140-160 dB
- Porpoise 135-155 dB

As with hearing loss, auditory masking can limit the distance over which a marine mammal can communicate, detect biologically relevant sounds, and, in the case of odontocetes, echolocate. Humpback whales were observed to increase the length of their “songs” in the presence of low-frequency sonar (AFTT, 2012), indicating there may be some compensatory response to the increased noise level. Whether this is an attempt to transcend the noise or is a competitive or social response is uncertain. It has been found that dolphins can “turn down” the sensitivity of their hearing to avoid damage that could result from loud sounds (Nachtigall and Supin 2013). During these periods of reduced sensitivity they are less likely to detect the vocalisations of conspecifics.

A review of studies conducted since 1995 indicated that most low-frequency cetaceans (mysticetes) avoided sound sources at levels of less than or equal to 160 dB re 1 µPa (SOCAL-10). Subtle behavioural responses (changes in depth and time of dives) have been noted at levels of above 120 dB (Marine Mammal Commission, 2007). Mid-frequency cetaceans (including Killer Whales and Bottlenose Dolphins) showed no clear avoidance patterns, reinforcing the idea that odontocetes are less inclined to avoidance behaviour, or less impacted by impulsive sounds. Studies on captive animals indicated SEL in excess of 170 dB re 1 µPa before the expression of discomfort reactions, such as erratic swimming and attacking the test apparatus. High-frequency cetaceans (observed from studies of Harbour Porpoises) exhibited changes in respiration and avoidance behaviour at levels between 90 and 140 dB re 1 µPa (SOCAL -10).

While the prey of resident odontocetes (Dolphins and Killer Whales) may be temporarily displaced through stress and avoidance of the construction noise, this would be of limited duration in time and space. Odontocetes have a varied diet and a temporary special shift of one species should not cause any feeding stress.

4.6.3. Impact of Noise on Turtles

The effect of noise impacts on turtles is poorly studied in comparison to studies on cetaceans, but those that have been conducted suggest that there are unlikely to be any physical effects or shifts in hearing threshold, if the turtle is not within the immediate vicinity of the sound source. Basking turtles may not move away sufficiently quickly from a sound source and if it is initiated at full power within close range (<15 m), pathological injury can be expected. Bartoli *et al*. (1999) concluded that the hearing sensitivity range for sea turtles is between 250 and 700 Hz.

Research indicates that masking is unlikely to be a significant impact. This mainly because it has been shown that magnetic signals are turtles' main navigational tools rather than sound signals (Lohmann et al., 2001). Trials conducted on caged Loggerhead and Green Turtles (McCauley et al., 2000) revealed behavioural changes at levels in excess of 175 dB re 1 µPa @ 1m. Several experimental results indicate that behavioral responses (rising to the surface, altered swimming patterns) occur at about 2 km from the seismic source at sound exposure levels of 166 dB re 1 µPa @ 1m. The turtles exhibited avoidance behavior (i.e. moving away and not returning to the depths at which they usually rest) at 1 km from the source and sound exposure levels of 175 dB re 1 µPa @ 1m (McCauley et al., 2000; Lendhart, 1994).

5. POTENTIAL THREATS TO MARINE MAMMALS SPECIFICALLY RELATED TO ACTIVITIES ASSOCIATED WITH THIS DEVELOPMENT PROJECT

Any construction of harbour and quay facilities will impact on the natural environment. Hydrological changes are brought about by the construction of quay sides and breakwaters and the implementation of dredging programs and dumping of dredged material. Runoff from quays and walkways can change the water quality and composition. Increased organic loading can result from additional sewage outflow or dumping of garbage. Explosive devices and pile driving can cause physical trauma, hearing loss and behavioural change in marine fauna. Dredging to deepen approach channels and basins can result in habitat destruction and displacement, loss of benthic communities and subsequent forced behavioural changes in higher-order fauna. Marine mammals are particularly sensitive to marine contaminants and at risk of any marine pollution resulting from the development activities. Increased tourism and numbers of recreational vessels can lead to masking of biologically important sounds. Imprudent disposal of waste products and rubbish can lead to entanglement, injury and death in mammals and turtles. There is an increased risk of vessel-animal and human-animal interactions and these pose a risk to both the animals and to humans.

This section looks at potential threats associated with the proposed Walvis Bay Waterfront Development, as they are likely to impact marine mammals. The marine mammals that could possibly be impacted by the development include migrating baleen whales (mysticete cetaceans) such as Humpback and Southern Right Whales, mid-frequency odontecete cetaceans such as Dusky, Common and Bottlenose Dolphins and Orcas and the only resident pinnipeds, Cape Fur Seals.

There is little information relating to the frequency ranges of Heaviside's Dolphins. There are no published audiograms for Cape Fur Seals, so data relating similar type species (e.g. Stellar and New Zealand Fur Seals or Sea Lions) are used. Some mention is also given to sea turtles as Leatherback Turtles are occasionally seen in the NBR.

The level of that impact can be reduced through the implementation of mitigation measures. The extent of mitigation required for a particular project, or a component of the project, depends on the significance level of the perceived impact. Mitigation is not necessary when there is sufficient evidence to show that the animals are not affected by a particular aspect of development. Mmitigation measures that have been applied to harbour and marine construction elsewhere are proposed. The levels of the potential impacts to marine mammals with regard to different aspects of the development are then assessed, based on mitigation being applied.

5.1. CONSTRUCTION PHASE

5.1.1. Construction Noise

Marine construction involves a number of noise-generating processes including pile driving, dredging, dumping of stone, fill and dredge spoil and the use of explosives, if blasting of rock is required.

Stone dumping for breakwaters and harbour walls can generate a substantial amount of underwater noise; however, there are no reports on sound levels emitted by this procedure. Noise pollution could be increased by the physical dumping of large loads of fill into the marine environment. The noise is likely to originate from cavitations as the fill enters the water. The sound levels and frequency spectrum of the dumping of fill are unknown, however for large loads, the levels may be significant and across a broad frequency band. Increased ambient noise can affect marine mammals in a number of ways, so it is important to take into account any addition to ambient noise from dumping of fill.

There are numerous sources of anthropogenic-generated sound in the world's oceans today. Table 6 shows the general acoustic properties of a selection of anthropogenic sources of noise in the marine environment (OSPAR Commission, 2009).

Source levels of most mysticete cetacean sounds range from 137 to 190 dB re 1 µPa and those of most mid-frequency odonticete cetacean (like those found in the Walvis Bay region) vocalisations range from 150 - 236 dB re 1 µPa @ 1 m. Source levels for California Sea Lions and Northern/Stellar Fur Seals are in the order of 95 - 160 dB re 1 µPa @ 1 m.

The vocalisation frequency range of these mammals is 10 Hz – 20 kHz, 100 Hz – >100 kHz and 125 Hz – 34 kHz, respectively. The hearing range is 7 Hz – 22 kHz, 150 Hz – 160 kHz and 200 Hz – 50 kHz respectively (Bailey et al, 2010; AFTT, 2012; Marine Mammal Commission, 2008).

It has been noted that sensitivity to sound of seals and sea lions decreases rapidly with increasing frequency (Cunningham and Reichmuth, 2016). Bartol et al., (1999) concluded that the hearing sensitivity range for sea turtles is between 250 and 700 Hz.

Table 6: Overview of the acoustic properties of anthropogenic sounds (Source: OSPAR, 2009).

SOUND	SOURCE LEVEL (dB re 1µPa-m)	Bandwidth (Hz)	MAJOR AMPLITUDE (Hz)	DURATION (ms)	DIRECTIONALIT
OFFSHORE CONSTRUCTION					
TNT (1-100 lbs)	272 – 287 Peak	2 – 1000	6 – 21	~1 – 10	Omnidirectional
Pile driving (1 = 120lbs)	228 Peak 243 – 257 PtoP	20 - >20 000	100 - 500	50	Omnidirectional
OFFSHORE INDUSTRIAL ACTIVITIES					
Dredging	168 - 186 rms	30 - > 20 000	100 – 500	Continuous	Omnidirectional
Drilling	145 – 190 rms	10 – 10 000	< 100	Continuous	Omnidirectional
Wind Turbine	142 rms	16 - 20 000	30 – 200	Continuous	Omnidirectional
SHIPPING					
Small boats and ships	160 – 180 rms	20 - >10 00	> 1000	Continuous	Omnidirectional
Large Vessels	180 – 190 rms	6 - > 30 000	> 200	Continuous	Omnidirectional
SONAR					
Military Sonar Low frequency	215 Peak	100 – 500	-	600 – 1000	Horizontally Focussed
Military Sonar Mid- frequency	223 – 235 Peak	2800 – 8200	3,500	500 – 2000	Horizontally Focussed
Echo-sounders	235 Peak	Variable	1 500 – 36 000	5 – 10	Vertically Focussed
SEISMIC SURVEYS					
3-DAirgun Array	260 -262 P to P	10 – 100 000	10 - 120	30 – 60	Vertically Focussed
OTHER ACTIVITES					
Acoustic Determent or Harassment Devices	132 – 200 Peak	5000 – 30 000	5000 – 30 000	Variable 15 – 500	Omnidirectional
Tidal and Wave Energy Devices	165 – 175 Rms	10 - 50 000	-	Continuous	Omnidirectional

5.1.1.1. Blasting / Explosions

Underwater explosions are one of the strongest point sources of anthropogenic sound in the marine environment and the sound effects can travel tremendous distances. Explosions are used in construction to deepen areas where bedrock lies close to the seafloor surface and occasionally in the removal of unwanted subsea structures. The transmission of sound and energy from submarine explosions is complex and phased: an initial shock pulse with a high pressures and fast rise time (microseconds) is followed by a succession of oscillating bubble pulses. The pressure decreases with each subsequent bubble; the second bubble has a peak pressure of only 1/5th of the first bubble. As distance from the source increases, the pressure signatures are affected by refraction and multipath propagation, especially the high-frequency sound components (NOAA 2015).

Source levels vary depending on the type and amounts of explosive and the water depth in which the explosion occurs. Source levels can range between 272 and 287 dB re 1 µPa zero to peak at 1 m distance (1 - 100 lb TNT). The peak energy duration is generally extremely short (< 1 - 10 ms). Underwater explosions transmit at low frequencies (2Hz - 1 kHz) with the main energy between 6 and 21 Hz. (Richardson et al. 1995; NRC 2003; OSPAR, 2009).

There are some poorly documented cases of injury and death of marine mammals thought to have been caused by explosions (Richardson et al., 1995). Ketten et al., (1993) report injuries to the ears of two Humpback Whales found stranded after underwater explosions. The use of underwater explosives in structure removals can injure and even kill sea turtles.

There are limited TTS studies for marine mammals exposed to impulsive sounds and out of 11 studies only 2 induced measurable TTS (Finneran et al., 2002; Lucke et al., 2009). Neither was related to construction and both affected mammals species are not found in Walvis Bay (Harbour Porpoise and Beluga Whale). The studies involving Bottlenose Dolphins exposed to an explosion simulator equal to a 500 kg charge showed no TTS for sound exposure levels (SELs) up to 216 dB re 1 µPa peak to peak (Finneran et al., 2000). Table 5 presents these data (from NOAA, 2015). It is also important to note that TTS studies on captive marine mammals are undertaken with the animals extremely close to the source (i.e. much closer than animals are expected to be to the source in real-world conditions) and one of the species where TTS onset occurred is the Harbour Porpoise (a high frequency cetacean), which is known to have a lower TTS onset acoustic threshold level (both impulsive and non-impulsive sources) compared to most other cetaceans measured, such as the mid-frequency dolphins and Killer Whales occurring in Walvis Bay (NOAA, 2015).

There is very little published data on the behavioural reaction of marine mammals to explosions caused by offshore construction or demolition operations. Humpback Whales in the North Atlantic showed no clear short-term behavioural responses or changes in foraging patterns when exposed to explosions associated with marine construction ~~operations~~ in Newfoundland (AFTT, 2012). No immediate behavioural disturbances were noted in Humpback Whales exposed to SPL of 140 - 153 dB re 1 µPa rms at 1.8 km from blasting during the development of an offshore oil platform. However, a higher than usual number of entanglements of these whales in nets was recorded in the area at the time. Although no control data were provided, nor cause-effect relationships established, these entanglements may have resulted from the progressive effects of exposure to damaging sound levels (Todd et al., 1996).

Madsen and Møhl (2000) found no auditory response in five Sperm Whales exposed to the sounds of distant detonators at received SPLs of 180 dB re 1 µPa rms. Additionally, behavioural response at the surface was absent in one individual. This is possibly because the detonator noise resembled Sperm Whale clicks and might have therefore been perceived as signals from conspecifics. Killer Whales have very similar audiograms to Sperm Whales and can thus be expected to be similarly unaffected.

Behavioural responses were noted in trained dolphins when they were exposed to sound pulses replicating explosions of 5 kg TNT at 9.3 km and 5 kg TNT at 1.5 km, with corresponding sound flux densities of 153 and 169 dB re 1 µPa2s, respectively (Todd et al., 1996). Captive Bottlenose Dolphins sometimes vocalized after an exposure to impulsive sound from a seismic watergun (Finneran et al., 2002a).

Seal “bombs” are used to prevent seals feeding around fishing operations and damaging catches. Reports indicate that they initially cause startle and flight responses in some pinnipeds, but the seals become habituated after repeated exposure. “Bombs” have also been used to scare dolphins away from fishing operations with no apparent physical trauma (Richardson et al., 1995).

Trials using impulsive sounds were conducted on caged Loggerhead and Green Turtles (McCauley et al., 2000). Behavioural changes were noted at levels in excess of 175 dB re 1 µPa @ 1m. Several experimental results indicate that behavioral responses (rising to the surface, altered swimming patterns) occur at about 2 km from the seismic source at sound exposure levels of 166 dB re 1 µPa @ 1m. The turtles exhibited avoidance behavior (i.e. moving away and not returning to the depths at which they usually rest) at 1 km from the source and sound exposure levels of 175 dB re 1 µPa @ 1m (McCauley et al., 2000; Lendhart, 1994).

Mitigation

Survey and/or geotechnical investigations will be necessary to determine the depth of bedrock and any need for blasting in the development area.

To date, much of the effort made to mitigate ocean noise has focused on proximity, i.e. trying to spot marine mammals within a few hundred meters of a powerful explosive source and pausing operations until there is no longer any perceived risk of direct injury. Trained marine mammal observers will be required to ensure no mammals are present within the bay or lagoon during blasting. Depending on the size of the blast, exclusion distances of between 2 and 5 km should be considered.

It will be preferable to undertake any blasting outside of known Humpback migration seasons (June, July, September).

Lessening of impacts is also possible through the use of acoustic harassment devices. These have been used effectively against Ringed Seals and Harbour Porpoises. Avoidance zones using pingers have been reported at distances of 200 to 500 m (OSPAR, 2009). It might be necessary to deploy several pingers at different distances from the construction site to keep mammals outside of potential TSS zones.

Assessment with Mitigation

Humpback Whales are the most sensitive to blasting noise and will be highly impacted if in close range. However, as they are only transient migrants, the impact level of blasting on these whales is considered to be of very low significance, particularly if timing of the blasting can be scheduled not to coincide with peak migration periods.

Cape Fur Seals appear to have a high tolerance for underwater sounds. Blasting is unlikely to significantly impact their behaviour of impair their hearing at distances greater than 700 m.

Dolphins and Killer Whales are more sensitive and need to be further removed from the sound source to avoid suffering TTS.

Research indicates that masking in turtles is unlikely to be significant. This is mainly because it has been shown that magnetic signals are turtles' main navigational tools rather than sound signals (Lohmann et al., 2001).

Blasting can be of moderate to high significance depending on the amount of explosives used and the extent of the mammal exclusion zone. The level can be lowered by decreasing the explosive charge and increasing the exclusion area.

5.1.1.2. Pile driving

Pile-driving is undertaken in harbour construction, oil and gas platform installations and in the construction of offshore wind farms. Source levels vary depending on the diameter of the pile and the method of pile driving: impact or vibro-piling. Impact pile drivers have much lower peak pressures and far longer rise times than explosives.

The frequency spectrum for pile driving ranges from less than 20 Hz to more than 20 kHz with most energy around 100 - 200 Hz. Although Humpback Whales can produce sounds up to 8.2 kHz, the dominant frequency band for this species is between 25 Hz and 4 kHz (Table 4; Richardson et al., 1995). Consequently, it would be expected that pile driving noise would significantly mask Humpback Whale vocalisations. However, as Humpback Whales are transient migrants through the NBR, and don't come into the Bay itself, it is expected that any pile driving operations will have minimal impact on this species. Seasonality of operations with respect to migration patterns of Humpback Whales (numbers peak June/July and September) could be considered by the developers.

Mid-frequency dolphins (Bottlenose, Dusky, Common) and Killer Whales have less sensitive hearing below 1 kHz. Thus, increased ambient noise in the low-frequency spectra may not interfere significantly with their sonar. In contrast, Fur Seals produce sounds as low as 100 Hz and so their detection of biologically important sounds may be impacted by increased low spectrum noise.

Madsen et al. (2006) used information about pile driving noise characteristics (sound levels, duration, frequency spectrum and propagation likelihoods) and the acoustic characteristics of four cetacean species to assess the degree of potential masking attributable to pile driving noise. The four species were chosen because they represent a range of functional frequencies:

- Harbour Porpoise – high-frequency cetacean
- Bottlenose Dolphin – mid-frequency cetacean
- North Atlantic Right Whale – low-frequency cetacean
- Harbour Seal – phocid (true seal) higher frequency and hearing sensitivity than otariids (Fur Seals and Sea Lions)

The authors report that significant masking problems were unlikely for all four species assessed, possibly because of the short duration and low duty cycle of pile driving sounds. They determined that pile driving would not significantly interfere with the detection of biologically important sounds in any of the test species.

A protected population of Bottlenose Dolphins (*Tursiops truncatus*) in the Moray Firth Special Area of Conservation (NE Scotland) was monitored during pile driving for the erection of wind turbines in deep water (> 40 m) some 25 km away from Moray Firth. The maximum broadband peak to peak sound level was 205 dB re 1 µPa. Noise was measured at specified distances of 100 m up to 80 km away where it was no longer distinguishable above background noise. It was concluded that for Bottlenose Dolphins, auditory injury through exposure to non-repeated stimuli (224 dB re 1 µPa), PTS and TTS would have occurred only within 5-10 and 10-20 m, respectively, of the pile-driving process, and masking was unlikely beyond 100 m (Bailey et al., 2010).

Although absorption reduced the sound level beyond 10 km from the source, the authors argue that the Bottlenose Dolphins could have experienced behavioural disturbance from the pile driving sounds as far as 50 km away, at a received level of 140 dB re 1 µPa (source 226 dB re 1 µPa), despite their apparently low auditory sensitivity to low-frequency sound.

This deduction contrasted with Southall et al. (2007) who indicated that there was no clear relationship between received noise levels and behavioural response for mid-frequency hearing cetaceans exposed to multiple pulses. They suggested that other factors played a role, such as the duration of the noise and behaviour of the animals at the time of exposure.

Brandt et al. (2011) found a clear relationship between decreasing Harbour Porpoise (*Phocoena phocoena*) acoustic activity and the onset of pile driving for the construction of a wind farm in the North Sea. Acoustic activity can be directly related to mammal abundance in a specific area. It was found that impulsive sounds with peak levels of 235 dB re 1 µPa at 1 m caused the porpoises to move away from the sound source. The effect was concurrent with the onset of pile driving. The duration of this effect decreased with distance from the piling location. At the furthest monitoring station, 21 km away, acoustic activity increased. This suggests that the porpoises moved away from piling action, temporarily increasing the relative abundance of populations at more distant locations. At the acoustic monitoring location closest to the pile driving, porpoise acoustic activity remained lower than baseline levels for 24 to 78 hrs after cessation of pile driving. The median time between pile driving events was 16 hrs, during which time there was no recovery of porpoise activity within 4.8 km from the piling site.

Similarly, earlier records of acoustic activity of Harbour Porpoises during the construction of the offshore wind farms at similar locations in the North Sea (Horns Reef) and Danish Baltic Sea (Nysted) indicated a marked decrease shortly after each ramming event. However, all acoustic activity reverted to baseline conditions within 3 to 4 hours, a much shorter time than in the second phase of construction. The decrease in vocal activity was also recorded at monitoring stations between 11 and 15 km from the construction site, suggesting that the porpoises left the area during ramming periods. Densities of porpoises in the entire Reef area were significantly lower during ramming periods than during baseline observation. Additionally, porpoises exhibited significant behavioural changes from non-directional movement (presumably associated with feeding) to directional movement on days with pile driving operations. All behaviour returned to baseline levels within 4 hours of cessation of ramming, suggesting no long-term effects (Tougaard et al,. 2005; 2003a; b).

Although it has been suggested that pile driving will mask vocalisations in Bottlenose Dolphins (David, 2006) as well as echolocation in Hector's Dolphins (Brough et al., 2014), there is currently no empirical information on the extent to which pile driving may mask biologically significant sounds for these marine mammals. Behavioural changes in high-frequency dolphins (such as Hector's Dolphins) are expected to occur within a 20 km radius from the pile driving site (Brough et al., 2014).

During pile driving procedures for a pier in Hong Kong, the dolphins remained in the vicinity of piling process before and during the operation, but were found to be lower in abundance afterwards. However, the dolphins did exhibit higher travelling speeds during active pile driving periods (Würsig et al. 2000).

Three different received pressure phases are identified for radiated underwater noise generated by pile-driving (Fig. 31) with reference to time duration (Dahl et al., 2015). Behavioural response may be related not only to the sensitivity level of a particular mammal, but also to the "phase" in which the sounds is experienced.

Brough et al. (2014) suggest that pile driving noise can cause physical injury to New Zealand Fur Seals (*Arctocephalus forsteri*) that swim within 700 m of construction opeations. In contrast, Bailey et al. (2010) found that PTS would have occurred in pinnipeds swimming within 20 m of non-repeated stimuli at 212 dB re 1 µPa when considering the peak source levels of the piling action. TTS would have occurred at 40 m. The authors determined that no form of injury or hearing impairment would have been likely beyond a distance of 100 m, based on a SEL of 166dB re1 µPa2-S.

Edren et al. (2004) showed that during the construction and piling stage of building the Nysted offshore wind farm (Danish Baltic Sea) there was a 20 - 60% reduction in the number of Harbour Seals (*Phoca vitulina*) hauling out at sandbanks 4 – 10 km away from the piling operations. It is likely these seals moved to an adjacent area where the noise from pile driving was less intense. The avoidance behaviour was very short-term as seal haul-out returned to base level numbers accompanied by normal behaviour on days when no ramming was undertaken.

In contrast, pile driving had no noticeable effect on Ringed Seals (*Phoca hispida*) off Alaska at received sound pressure levels of 150 dB re 1µPa rms. This was thought to be as a result of this population's habituation to industrial noise in the study area (Blackwell et al., 2004).

Pile driving for wind farm construction is generally louder than for port development and differences between coastal/open ocean and harbour environments may mean received sound pressure levels are different at similar distances from the activity.

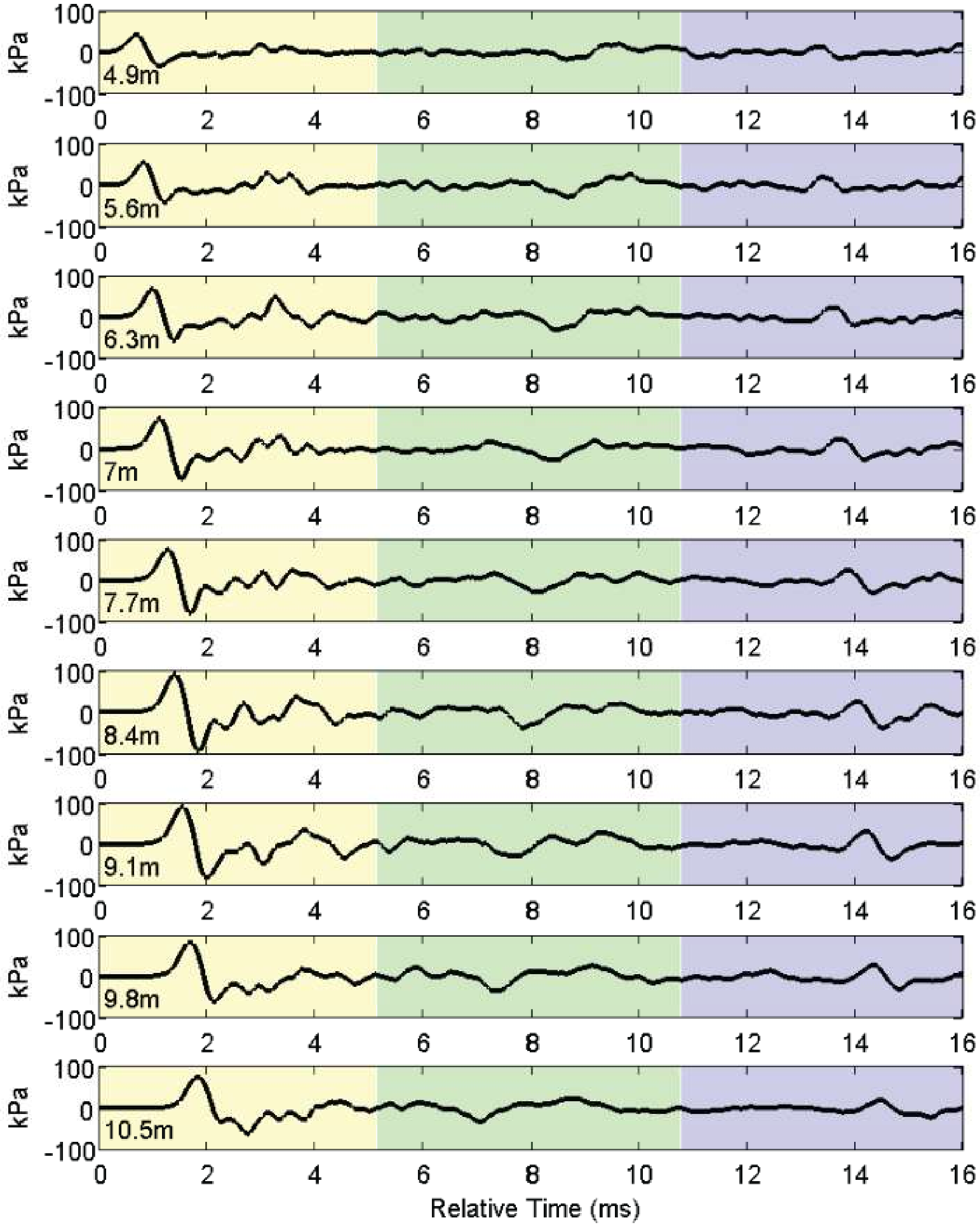

Figure 31: Sound pressure-time series for the radiated underwater noise measured at a 12 m range from a pile undergoing impact driving. Three phases are identified by the different shadings. Hydrophone measurement depth is given at the beginning of each time series. (From Dahl et al., 2015)

Mitigation

There are various approaches within legislation being used in Europe with respect to pile driving in marine construction and its impact on marine mammals. The United Kingdom requires marine mammal observers to visually, and sometimes acoustically, monitor an exclusion zone around the pile driving to ensure the absence of marine mammals. In The Netherlands, no piling may occur during the seasons with the highest abundance of sensitive species. An obligation is also placed on the developer to deter animals from the vicinity through the use of acoustic deterrent devices or by implementing "soft start" procedures (i.e. the pile driving at a lower hammer energy for a specified time period at the start of the piling process). If the level of sound being produced is known and that level is no more than 5 dB above the level where no known effects have been recorded, then there is no need to have 10 to 15 dB attenuation of the source sound signal (Dahl et al., 2015). The German government issued a *Concept for the Protection of Harbour Porpoises from Sound Exposures during the Construction of Offshore Wind Farms in the German North Sea* (BMU, 2014) which states that it is plausible to assume that avoidance and flight behaviour are likely to occur at exposure to a received SELs of 140 dB re 1 $\mu Pa^2 \cdot s$. The German authorities regard a temporary hearing loss or threshold shift (TTS) as an injury and defined noise-induced injury prevention thresholds, declaring that SELs may not exceed 160 dB re 1 $\mu Pa^2 \cdot s$ and a peak-to-peak and SPL may not exceed 190 dB re 1 μPa at a distance of 750 m from the piling activity. The authorities assume (based on research by Lucke et al., 2009) that complying with these criteria will reduce the avoidance distance to 8 km (Todd et al., 2015).

There are several technical options available to mitigate the impacts of pile driving at the source:

- extending the duration of the drive during piling will decrease SL by 10-15 dB at frequencies > 2 kHz);
- enclosing the ramming pile with acoustically-isolated material can decrease SL by 5 – 25 dB;
- installing an air-bubble curtain around the pile reduces the radiated sound levels of piling in shallow waters up to 20 dB, particularly at 400–6400 Hz.

(Brough et al., 2014; OSPAR, 2009; Würsig *et al* .2000)

These methods have both benefits and costs. Ramping-up may cause confusion for mammals trying to pinpoint the sound source. Extending the duration of the strike reduces the source energy level, but the longer noise duration may mask communication signals to a greater extent than shorter noise pulses. This method is also limited technically, since shorter pulses are more effective in driving the pile into the bottom than longer ones. Mantling has shown promising results in relatively short piles. Pile driving using a vibratory hammer is not as loud as impact pile driving. Hydraulic pile driving may provide an alternative method for the installation of foundations. This method results in noise emissions at low levels close to marine background noise level (< 100 dB re 1μPa). Air bubble curtains are expensive, but very effective in relatively shallow water. "Soft-starts" have shown success in alerting mammals and enabling them to swim away before sound levels became harmful (Todd et al., 2015; Brough et al., 2014; Bailey et al., 2010; OSPAR, 2009; Marine Mammal Commission, 2008; Würsig et al*.,* 2000).

As there is some conflicting data and research results and some animals seem to become habituated more easily than others, a precautionary approach is advised. Precautionary mitigation measures should include:

- not carrying out pile driving in confined areas in close proximity to feeding or breeding populations.
- avoiding intense construction activity during known migration periods (June-July and September) and peak breeding seasons should be considered (Autumn and Spring).
- delaying the start of or stopping piling operations if turtles or marine mammals are detected (visually or acoustically) close to the source may also be effective in mitigating TTS or PTS (Todd et al., 2015; OSPAR, 2009).
- the use of MMOs can ensure that there were no marine mammals a specified safe distance (500 m for Cape Fur Seals and 2 km for dolphins).
- minimising multiple activities that generate compound underwater noises where practical
- avoiding pile driving that impacts hard substrates where possible.

It is important to calculate the likely extent of the mammal exclusion zone, in order to minimise the animals' exposure to harmful sound. This would require monitoring of pile driving sound and sound propagation modelling within Walvis Bay, as well as collecting information about the received pressure levels required to induce TTS in specific species, such as Heaviside's Dolphins. As this information is not currently available, a recommended precautionary approach would be to use the ranges given above (as identified by Madsen et al., 2006). Experienced and independent marine mammal observers are the only effective way of searching for and identifying marine mammals in the area before, during and after pile driving.

Underwater noise from pile driving ~~activities~~ should be monitored to verify that it does not exceed 30 kPa at a distance of 1 m to 2 m from the pilings. If it does, measures should be taken to reduce either the intensity of the sound or the way the sound is propagated. These measures can be chosen based on practicality and effectiveness (e.g. installing silt or bubble curtains, vibratory/hydraulic vs impact piling).

No mitigation measures other than "soft starts" are deemed necessary with respect to the presence of turtles, as scientific evidence suggests that turtles will move away from the noise source.

Assessment

As Humpback Whales are transient migrants through the NBR, and don't come into the Bay itself, it is expected that any pile driving operations will have little impact on this species.

Seasonality of operations with respect to migration patterns of Humpback Whales could be considered by the developers. Peak numbers have been recorded in the Benguela Region in June, July and September. The potential impact of pile driving operations inside the bay on Humpback populations is considered low.

'Soft-start' procedures and acoustic harassment devices have been proven to be effective in scaring the animals away from the source at close ranges (OSPAR, 2009). Using a precautionary exclusion zone of up to 2 km for dolphins will assure limited impact, particularly if attention is paid to breeding and nursing seasons. The impact of pile driving with respect to masking and hearing impairment in mid-high frequency cetaceans is considered to be of low significance in the long term. The impact on behavioural changes, avoidance of the construction area and/or relocation following prey species can be significant to population densities in the short-term, but is considered of moderate to low significance in the long term.

Habituation to deterrents is possible, particularly in Cape Fur Seals. None-the-less, the potential for injury or masking in seals is considered to be low as they are such mobile animals. Additionally, their continued presence around marine survey, mining and fishing vessels, in spite of operations and the use of deterrents, shows a strong resilience to noise impacts. The temporary displacement of preferred prey species may be of concern, but seals are known to adjust to available food sources. Thus based on available information, pile driving activity will not significantly impact Cape Fur Seals.

Although Leatherback Turtles are frequenting the BCLME waters more in recent years, they are still only occasional visitors and sightings are rare. Impacts are considered to be of very low probability. None-the-less, should a turtle be in close range, the potential impact is considered to be of high intensity in the short-term. The long-term impact of impulsive noise on turtle migration and feeding is considered to be of low significance, since turtles make use of magnetic cues rather than acoustics for navigation (Lohmann *et al.*, 2001).

5.1.1.3. Dredging

Available data indicate that dredging is not as noisy as sonar, seismic surveys or pile driving, but it is louder than most shipping (Fig. 32). Dredging to maintain shipping lanes emits continuous broadband sound, mostly in the lower frequencies with bandwidths between 20 Hz and 1 kHz (Richardson et al., 1995). These sounds primarily fall within the lower frequency ranges of baleen whales. Most toothed whales are less sensitive to such low-frequency sounds (Robinson et al., 2011). Defra (2003) measured sound spectrum levels emitted by an aggregate dredger at different distances and found most energy to be below 500 Hz. Robinson et al. (2011) found that trailing suction hopper dredgers emit sound levels at frequencies below 500 Hz that are generally in line with those expected for a cargo ship travelling at a modest speed. It was also found that dredger sounds with source levels at frequencies above 1 kHz attenuate rapidly with distance.

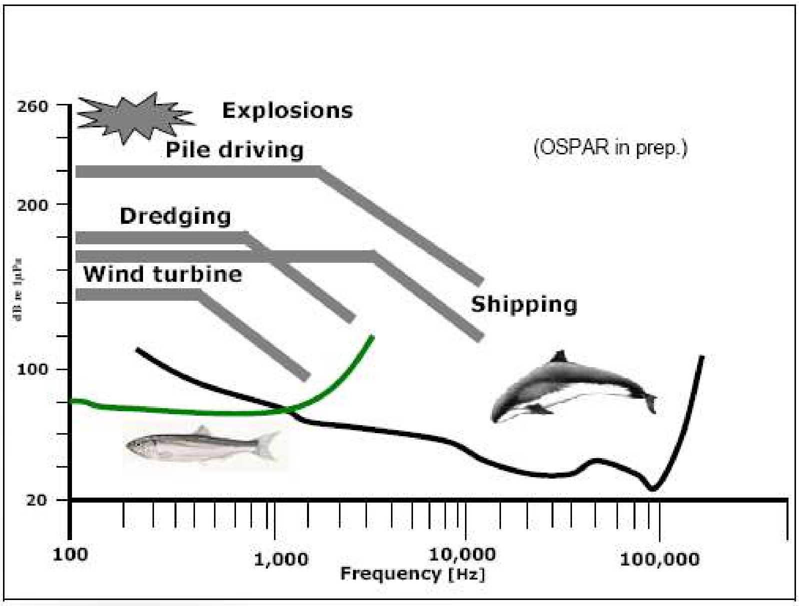

Figure 32: Overview of construction noise sources (SPL and frequencies) with reference to the hearing sensitivity of herring and Harbour Porpoise (from OSPAR, 2009)

Dredging is at the lower end of the scale with regards to emitted sound pressure levels (Fig. 32). Source levels range from 160 to 180 dB re 1 µPa at 1 m to 133 dB re 1 µPa at 0.19 km and 140 dB re 1 µPa at 0.2 km from the dredgers. SPLs and operational frequencies vary depending upon the type of dredger, as indicated in Table 7.

Table 7: Frequencies and Sound Pressure Levels of dredgers (after Todd et al., 2015; Robinson et al., 2011; 1995; Defra, 2003)

DREDGER TYPE	SOURCE SOUND PRESSURE LEVEL	OPERATIONAL FREQUENCY
Cutter Suction Dredger (CSD)	149.3 dB re 1 µPa rms at 89 m	< 500 Hz
Trailing Suction Hopper Dredger (TSHD)	max SPL 189.9 dB re 1 µPa at 1 m	< 500 Hz
Bucket Dredger	163 dB re 1 µPa at 1 m	20 Hz – 100 Hz
Backhoe Dredger	179 dB re 1 µPa at 1 metre	3 Hz – 20 Hz

Behavioural responses of baleen whales vary according to the type of construction activity and dredge method. Off Anchorage, Alaska, Bowhead Whales (*Balaena mysticetus*) showed no apparent response to a suction dredge. However, elsewhere, individuals avoided dredges when exposed to 122 - 131 dB re 1 µPa or 20-30 dB above ambient noise (Richardson et al., 1990). Gray Whales (*Eschrichtius robustus*) avoided a particular breeding lagoon in Mexico after an increase in industrial activities, including shipping and dredging (Bryant et al., 1984).

However, it is not clear whether the avoidance was due to dredging noise or the increased number of ships.

In the Port of Anchorage, Beluga Whales (*Delphinapterus leucas*) were often sighted in proximity to operating dredgers. They could have habituated over time to the general increase in industrial activity.

In contrast, the numbers of Bottlenose Dolphins (*Tursiops truncatus*) in foraging areas in Aberdeen Harbour declined as dredging intensity increased (Todd et al., 2015). The dolphins had previously been exposed to high volumes of shipping, so it was deduced that the avoidance behaviour was directly related to the dredging activities.

Most of the studies undertaken on pinnipeds suggest that the impact of dredging sounds is limited. Observations of dredging operations in Geraldton, Western Australia between 2002 and 2003 concluded that New Zealand Fur Seals (*Arctocephalus forsteri*) and Australian Sea Lions (*Neophoca cinerea*) showed no disturbance reactions, despite the relative closeness of the dredging to popular haul-outs (EPA, 2007). Similarly, Hawaiian Monk Seals (*Monachus schauinslandi*) showed no adverse reactions to bucket dredgers around Tern Island (Todd et al., 2015).

In fact, it has been noted that in some cases pinnipeds and dolphins are actually attracted to areas of active dredging (Anderwald et al., 2013 cited by Todd et al., 2015), possibly because of increased prey numbers as a result of seabed disturbance. Larger than usual numbers of Bottlenose Dolphins were reported around Doonanierin Point, Ireland, during construction involving dredging. While this increase in numbers cannot be conclusively linked to increased prey abundance as a result of seabed disturbance, it was considered a possibility (Anderwald et al., 2013). It was also suspected that Grey Seals (*Halichoerus grypus*) were taking advantage of increased food supply close to operating dredgers (Todd et al., 2015).

Changes in topography could also benefit marine mammals. Allen et al. (2001) found that Bottlenose Dolphins in Anclote Key, Clearwater, Florida, favoured previously dredged channels, over other habitats. They argued that the dolphins used the structural features to aid in prey detection and capture.

Inevitably, dredging results in suspended sediment in the water column. Impacts of increased suspended sediment concentrations are highly species-specific and vary with sediment characteristics. Dredging plumes can release contaminants into the water column that can then become available to marine organisms, and potentially accumulate up the food chain. However, remobilization and bioavailability of contaminants is complex, being site-specific and affected by a multitude of factors (Todd et al., 2015).

Natural events, such as storms, increase turbidity and marine organisms have evolved varying levels of tolerance and survival mechanisms. Cetaceans often create their own sediment plumes through feeding (e.g. Grey Whales) indicating that individual species must have some level of tolerance. However, dredging-related increases in turbidity may exceed natural levels, or vary in terms of timing, which can put strain on some organisms (Todd et al., 2015). Heaviside's, Dusky and Common Bottlenose Dolphins are highly mobile and would readily avoid turbid water. They also have the ability to use sonar, so that they do not have to rely solely on vision.

Pinnipeds are not known to produce sonar for prey detection purposes, so increased turbidity could potentially affect their ability to hunt. However, three apparently blind (identified by opaque and white corneas) Harbour Seals (*Phoca vitulina*) on Gertrude Island, Puget Sound, Washington appeared healthy, suggesting that their ability to forage was unaffected by blindness (Dehnhardt et al., 2001 in Todd et al., 2015). McConnell et al. (1999) tracked foraging areas and trip durations of Grey Seals in the North Sea. The one blind seal that was included in the study showed no significant difference in foraging behaviour. These results indicate that vision is not essential to pinnipeds' survival or ability to forage and hence the level of turbidity is inconsequential as it is likely that pinnipeds use other senses instead of, or in conjunction with, vision.

Turbidity has the potential to impact fish feeding ability, predominantly for piscivorous fish that feed on larger prey that is detected visually over longer distances. Planktivorous fish that detect prey visually over short distances are less affected. Dolphins and seals often enter the lagoon to hunt small schools of fish. Mullet are known to frequent the Walvis Bay lagoon, but may temporarily avoid it during dredging operations. However, mullet are bottom feeders and used to murky, poorly oxygenated conditions, thus the populations are unlikely to be adversely affected by increased turbidity. Additional food sources for dolphins and seals will also be available outside of the lagoon.

A positive aspect of dredging is the release of nutrients into the water column, which can increase productivity, with resultant up-chain benefits due to an increased food supply (Bailey et al., 2010).

Remobilization of contaminants through dredging and dumping can increase uptake by marine organisms, which will disseminate through the foodweb to marine mammals (Marine Mammal Commission, 2008). Linking remobilization of contaminants from dredging to negative biological effects in marine mammals is challenging: Types and levels of toxins in the blubber need to be known before an activity begins and then compared during and after dredging in order to provide conclusive links.

Mitigation

As a continuous source of noise and disturbance, which might last for extended time periods during construction, dredging could be considered to have some impact that will require mitigation, especially in areas of high ecological sensitivity.

Minimum impact is expected from dredging noise on the marine mammals in Walvis Bay, as they are not deemed to be sensitive to such low frequencies. Mitigation of dredging noise is not a necessity.

Mitigation measures to limit the impacts of sediment resuspension by dredging include:

- testing the level of contaminants in the sediment to be dredged to determine the likely concentration that marine mammals (and other marine life) will be exposed to during dredging and dumping of dredge spoil
- Locating dredge spoil dump sites so they have the least possible impact on marine mammals and their prey. If possible, spoil sites used for the maintenance of the Walvis Bay Harbour and approach channel should be used to avoid degradation of new areas
- minimizing the impact and reducing cumulative effects (vessel traffic, noise and sediment plumes) by not scheduling maintenance dredging of the harbour to coincide with construction dredging
- keeping the dumping site away from any known feeding or nursery grounds
- using clean uncontaminated fill where fill is required.

(Todd et al., 2015; Brough et al, 2014; OSPAR, 2009)

Assessment

The overlap of dredging noises with the hearing sensitivity of marine mammals suggests that all marine mammals are likely to be affected to some degree by noise from dredging but that impacts might be more consequential in baleen whales which communicate at very low frequencies (Tervo et al., 2012; Au et al., 2000). Humpback Whales are transient migrant through the Walvis Bay area, and their migration patterns are unlikely to be affected by dredging noise. At present no baleen whales are known to enter Walvis Bay directly or use inshore areas for breeding, so the effect of dredging on baleen whales is regarded as null.

Consensus across numerous studies state that the range of best hearing in toothed whales is shifted to frequencies well above 10 kHz with sensitivity below 1 kHz being relatively poor (Todd et al., 2015) and dredging noise ranges between 0.03 and 0.5 kHz. There are few studies which can conclusively attribute effects on marine mammals entirely to dredging activities in isolation from other sources of potential impact. As the dolphins in Walvis Bay vocalise and hear in the mid-frequency ranges, the effects of dredging noise on the dolphin populations, and any visiting Orcas, is considered negligible.

The impacts from dredging noise, with respect to physiological sensitivity, are potentially greater for seals and fish than for cetaceans, as the overlap between the dredging frequency spectrum and the bandwidth of hearing is larger in seals and fish than for cetaceans (Thomsen et al., 2009). Most research into noise effects on seals has been undertaken on phocids such as Harbour and Grey Seals, which have relatively good hearing at frequencies below 1 kHz. Otariids, such as Fur Seals, have a slightly broader hearing frequency range than phocids, but they tend to vocalise at lower frequencies. However, studies have revealed that otariids are relatively insensitive to marine noise, or become quickly habituated to new sounds. Although investigations indicate that the impact of dredging sounds is limited, caution has been voiced that some degree of masking may occur which could impact on reproduction success if dredging ~~activities~~ were to occur in breeding areas. There are no Cape Fur Seal breeding colonies near the proposed development site, so the impact of dredging noise on Cape Fur Seals is considered insignificant.

In terms of direct effects on marine mammals, collisions are possible, but improbable, given that operating dredgers are either stationary or moving at slow speeds and the marine mammals in the bay are highly mobile and have been exposed to small tour boats as well as larger sea-going vessels.

The effects of turbidity are often localized with minimal direct impact on marine mammals, particularly highly mobile ones such as those that occur within the Bay area. Walvis Bay itself is not an important fishing ground. Limited artisanal beach seine netting for mullet takes place along the shore north of the port and some sport angling in the lagoon. Increased turbidity is unlikely to have a substantial direct impact on the marine mammals that inhabit the bay because they do not rely solely on vision to hunt or forage and hence the level of turbidity is inconsequential (Todd et al., 2015).

Even if some prey species avoid the lagoon during dredging, the varied diet of cetaceans and seals means that significant impacts from turbidity-induced prey reduction are improbable. The dolphin species within Walvis Bay are highly mobile and are able to re-locate to more favourable areas for the duration of any period when dredge plumes are present. This may impact the local population densities somewhat in the short term, but is likely to be of low significance in the long term.

Dredging could even have positive impacts, such as temporarily increasing prey availability. On the other hand, entrainment in nursery or spawning grounds of prey could cause reductions in prey abundance. Still, marine mammals can likely compensate for small-scale changes in prey abundance by switching prey species, moving to alternative foraging grounds or increasing time spent foraging (Todd et al., 2015; Bailey et al., 2010).

Migrating baleen whales (Humpback) do not enter the bay itself. They only feed opportunistically when food sources, such as shoals of sardine, are readily available within their routes, so their feeding patterns are unlikely to be affected by dredging process.

The level of the impact of remobilising contaminants within dredged material will be determined by the distance of the dump site from known breeding and feeding grounds and haul-out sites. If the sediments contain a high degree of toxins that can become bioavailable, the impact of dredging and dredge spoil dumping can be very high in the long term. However, a properly designed and managed dredging programme can have a low impact on the mammal population. There are no reports of significant long-term impact related to the regular maintenance dredging in Walvis Bay Harbour. It is assumed that the ecosystem would have adapted to this type of short-term disturbance to some degree.

The mammals in Walvis Bay are not likely to be significantly impacted by the dredging noise, and if appropriate management procedures are implemented, the effects are most likely to be masking and short-term behavioural alterations. There may be changes to prey availability during dredging periods. Impacts would be similar to those encountered during regular maintenance dredging of Walvis Bay Harbour and the entrance channel, and these have not caused long-term detrimental effects to the ecosystem of the area.

Positive impacts of dredging disturbance have been reported from a number of sources (Todd et al., 2015 cited Claveleau and Desprez, 2009; Newell et al., 2004; van Dalfsen and Essink, 2001; Poiner and Kennedy, 1984; Jones and Candy, 1981). The release of organic nutrients from suspended sediments has reportedly enhanced diversity and abundance of benthic fauna near dredged channels. An increase in species abundance augments food availability at different trophic levels.

5.1.2. Pollution and Water Contamination

General construction activities have the potential to increase contaminants due to inadequate disposal of construction materials, rubbish generation and the risk of accidents. During construction, oil, chemicals and flotsam may enter the water of the bay. These will have the same impact on the environment as oil and chemical spills and litter from ships coming into port.

Additionally, construction activity may increase runoff of terrestrial pollutants from general construction activities. Stormwater runoff, particularly during the construction phase of the development may cause water pollution and reduce water clarity if adequate stormwater treatment systems are not established.

Coastal development can result in localised increases in marine pollution. Contaminants can be introduced from the dumping of fill from dredging or from land reclamation. Depending on its origin, fill may include a range of contaminants that are harmful to marine life, and marine mammals are especially susceptible to the effects of pollutants due to their high trophic level (Brough et al., 2014). The inshore distribution and movement of the resident dolphin species is a factor of concern. Pollution can impact the health of individual marine mammals and have longer-lasting, population-level impacts such as reproductive complications, strandings and other mortality events. Therefore, any increased risk of marine pollution from the development should be given due consideration.

Marine mammals are susceptible to bioaccumulation because they feed at high trophic levels and have a large proportion of lipid-rich blubber which readily accumulates toxins. High contaminant levels have been linked to depressed immune systems, endocrine disruption, reproductive complications and developmental defects (Todd et al., 2015; Brough et al., 2014; Bailey et al., 2010, Marine Mammal Commission, 2008). However, marine mammals accumulate high levels of contaminants, irrespective of whether they are exposed to construction and dredging activity, as they are highly mobile creatures and come into contact with contaminants throughout their entire range.

Mitigation

The construction of quays, jetties, walkways and business and residential buildings next to large bodies of water can pose significant threats of pollution. A properly designed construction environmental management plan to ensure that stormwater and contaminant treatment is upheld to a standard of modern "best practise" will mitigate most negative effects from chemical and material pollution, thus reducing the likelihood of marine mammals being exposed to toxins. Mitigation measures include:

- introducing appropriate systems to eliminate or minimise contamination of runoff and storm water
- introducing and enforcing no dumping policies for construction material and rubbish
- placing shade netting fences around active construction sites to minimise dust blow-off into the bay and mitigate impacts
- analysing any sediments used for fill before deposition, thus reducing the likelihood of marine mammals being exposed to toxins
- adhering to local and international policies that reduce the risk of an oil/fuel/chemical spill
- having appropriate systems in place to deal with such an event

(Todd et al., 2015; Brough et al., 2014)

Assessment

If construction activities introduce large quantities of foreign chemicals into the water of the bay and lagoon, there could be a highly significantly long-term impact. Short term impacts of high intensity and significance can result from oils spills from construction vessels and machinery, but can be lessened by quick response and following preset clean-up procedures. Appropriate design and management can reduce the risks of intense impacts (both long- and short-term) to moderate levels of significance.

5.1.3. Increased Marine Traffic

There is likely to be a substantial increase in marine vessel traffic to and from the development site during the construction phase of this project. As there is already a large range of vessel types and sizes making use of the Port of Walvis Bay, mammals in the bay area are likely to be used to the engine noise. Larger vessels enter the harbour under pilotage, following a designated route and at reduced speed.

There will likely be more vessels entering the lagoon area (dredge and construction) during the construction phase of this project than at any time previously. This will create more disturbance within a confined space. Given that active dredgers are stationary (or travel at very slow speed), collision risk is perhaps greatest when dredgers are in transit, but in areas already characterized by heavy shipping traffic, the addition of dredging vessels is unlikely to increase the collision risk substantially.

A study of Bottlenose Dolphins in Walvis Bay revealed an upward shift of up to 1.99 kHz in several whistle frequency parameters when dolphins were in the presence of one or more tour boats and the research vessel (Heiler et al., 2016). A similar, although less pronounced difference was observed in response to engine noise generated by the research vessel when idling, suggesting that noise alone plays an important role in driving this shift in whistle frequency. The greatest difference in whistle parameters was detected between resting and behavioural states that are associated with higher degrees of emotional arousal. Additionally, the presence of calves affected the variation observed (Heiler et al., 2016). The authors did not comment on the significance of the vocal change. It is likely that construction, transport and dredge vessels will illicit similar responses.

Mitigation

During construction there is expected to be a significant increase in the amount of traffic around the construction area. This will have significant impact on all wildlife life for the duration of the construction.

There are no effective mitigation measures to reduce ship-generated noise other than reducing vessel speed.

Collision risk is perhaps greatest when dredgers are in transit, mostly at times when animals may be distracted (e.g. while foraging) or in areas where calves are abundant. The probability of impacts and intensity levels can be mitigated in the following ways:

- all project vessels should follow predetermined shipping lanes and navigation routes
- all project vessels should maintain a constant course and constant speed where practical
- crews of vessels involved in construction activities should remain vigilant for marine mammals in the area
- under no circumstances, other than an emergency, will vessels purposely approach within 100 m of any marine mammal
- if marine mammals approach within 100 m, vessel speed should be reduced and, if possible, cautiously manoeuvre away from the animal
- vessel speed may be resumed once a mammal has moved at least 100 m from the vessel

(Todd et al., 2015; Brough et al., 2014; Bailey et al., 2010).

Assessment

The expected increase in vessel numbers during construction will have significant impact on all wildlife life for the duration of the construction. Marine mammals are likely to become habituated to the increase in marine traffic and the associated noise levels in the long term. Cape Fur Seals will possibly habituate faster than the cetaceans in the bay. Initially and in the short term, a high level of disruption to cetaceans and seals is probable, but the significance and level of intensity will moderate with time as the mammals become habituated.

There is always a risk of collision, but in areas already characterized by heavy shipping traffic, the addition of dredging vessels is unlikely to increase the collision risk substantially.

The impact of changed noise levels due to increased vessels traffic on cetaceans and seals is low and is unlikely to be lowered significantly by any on-board measures, other than running at reduced speed when approaching Walvis Bay.

5.2. OPERATIONAL PHASE

5.2.1. Dredging Pollution, Sediment Plumes and Sedimentation

The noise impacts of maintenance dredging will be similar to those described for the construction phase, but presumably less intense and of shorter time duration. They will also be similar to the maintenance dredging for Walvis Bay Harbour and approach channel. The potentially positive effect of nutrient enrichment into the water column is likely to be short-lived during these periods. The potential effect of release of toxins and accumulation by mammals is difficult to predict without baseline studies.

In general, regularly disturbed habitats characterized by fine sands and fast-growing opportunistic species are affected less and recover more quickly than stable habitats monopolized by coarse gravels and slow-growing sessile fauna and flora.

The dumping of dredge spoil will cause noise and turbidity disturbance that will be of short duration, but on a regularly recurring basis. The location of the disposal site must be carefully considered so as not to impact habitat that is important for marine mammals and other taxa. The level of the impact will be determined by the distance of the dump site from known feeding grounds and haul-outs. If it is possible to utilise the same dump site as that already used by harbour maintenance dredging, this will limit the damage from this procedure.

The most obvious long-term effect of the construction of additional quays and walkways is the effect on the water circulation in the bay and upon tidal flow in and out of the lagoon. Assuming that structures will reduce wave action, wave-driven longshore sediment transport could also consequently be dramatically reduced. The channel, basin and quays could trap finer sediments generally carried by the clockwise circulation to the mouth of the lagoon. On the plus side, less sediment transported to the lagoon mouth can be seen as beneficial to an area under pressure from siltation and competition for space and natural resources as a result of increased mariculture.

Mitigation

Adverse impacts from periodic dredging can be limited by implementing mitigation measures, such as the use of environmental windows. Cognisance should be taken of breeding seasons for all the marine mammals that are found in and around Walvis Bay.

To minimize impact and reduce cumulative effects (vessel traffic, noise and sediment plumes), maintenance dredging of the harbour should not coincide with construction dredging.

Assessment

Dredging is undertaken to maintain the Walvis Bay Harbour and approach channel. So mammals will previously have been exposed to the noise and turbidity levels. There are no reports of significant long-term impact related to this activity. Similarly, maintenance dredging of the new development should have very low impact levels.

As the Walvis Bay area experiences heavy shipping traffic and periodic dredging for the harbour, addition of dredging vessels for the new development is unlikely to increase the risk of mammal-vessel collisions. Even so, marine mammals will tolerate disturbance, and remain near active dredgers, in a prime foraging location, if rewards are high. In these cases the short-term risk of collision and injury to distracted animals is high. If dredging is well managed and dredgers avoid critical times when animals may be distracted or areas where calves are abundant, and if the skipper and crew remain vigilant, the risk of collision between marine mammals and active dredgers is minimal given their slow operational speeds.

The possible, though unlikely, effects of masking, avoidance and short-term changes to prey availability are of limited significance in the long term, as periodic dredging to maintain entrance channels and basin depth can be scheduled across non-biologically critical periods.

5.2.2. Increased Marine Traffic

The Port of Walvis Bay is Namibia's largest harbour and already accommodates a range of vessels, both within the harbour and moored offshore. Large sea-going vessels entering and exiting the Port of Walvis Bay do so under pilotage and follow the designated channel at low speed. Consequently cetaceans become habituated to this pattern and will likely avoid ships.

Smaller craft do not need to use the dredged approach channel and behave more randomly. They are thus more likely to have encounters with marine mammals. An increase in the number of small craft making use of the new basins can consequently raise the risk of mammal strikes. Dolphins are usually easily able to avoid vessels and generally can co-exist comfortably with both ships and smaller craft. Nevertheless careless and reckless handling of high-speed craft in the presence of dolphins could result in injury through propeller-strikes.

Wounds of dolphins and whales are known to heal rapidly and thoroughly in both natural and controlled situations, though scarring may be forever. Even severe wounds exposing muscle have been reported to heal within 5 to 8 months. A Heaviside's Dolphin with propeller cuts (Fig. 33) was photographed in Walvis Bay in February 2010 and the healing process monitored and documented (Elwen and Leeney, 2011). As this is the only such injury

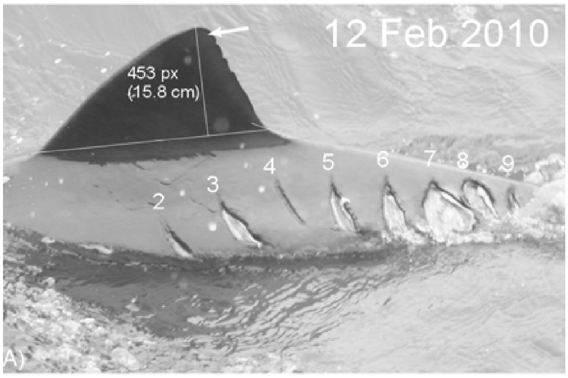

Figure 33: Propeller strike wounds on a dolphin in Walvis Bay. (Source: Elwen and Leeney, 2010)

of which they are aware, the authors feel that, despite daily visits to the resident dolphin population, small craft tourism is, at present, not major cause of distress to the marine mammals in Walvis Bay.

5.2.2.1. Marine Tourism Cruises

Nacoma argues that the pressure on seals, dolphins and the recovering whale populations is increasing with the growing number of tour operators. They feel that it is necessary to be very careful and vigilant, in particular as the Southern Right Whales are slowly recovering from extinction in the Namibian waters. A new waterfront development could add to the number of tour operators and the daily amount of people interacting with marine mammals. Even if they abide by the “Code of Conduct” drawn up by CETN, MFMR and MTAN by remaining outside of the *critical distance* zone, motorboats bringing visitors close to the dolphins, seals and birds on a daily basis present an almost permanent disturbance factor.

Although there is a “no swim with” policy for the Walvis Bay marine cruises, people want to get as close as possible to these generally friendly and tolerant animals. Cetaceans in captivity are known to be susceptible to human diseases. There is little data relating to the illness in wild dolphins from repeated exposure to humans.

Figure 34: Tourist boats closing in on a Heaviside’s Dolphin in Walvis Bay. © S. Elwen 2008

The presence of calves in a group has been noted to affect the vocalisations of the dolphins (Heiler et al., 2016), suggesting that dolphins become more stressed by human presence at such times. Cognisance should be taken of behavioural patterns and rules applied to the tourist cruises accordingly.

Cape Fur Seals are known to predate birds (African Penguins, Bank Cormorants, Cape Cormorants, Crowned Cormorants and even Cape Gannets) on the southern Namibian islands, particularly in times of limited fish abundance (Kemper et al., 2007). A Fur Seal was recorded predating a Southern Giant Petrel off Pelican Point (Elwen et al., 2012). The authors felt that marine tour operators feeding seals in Walvis Bay could reinforce the predatory behaviour of seals on seabirds.

Mitigation

Marine mammals become habituated to vessel movement, especially where there are pre-defined routes into harbours and ports. None-the-less, an increase in tourism and more small craft anchorage facilities, as a result of the development, will provide the potential for an increase in the number of marine tour operators. Collisions and injury from propeller strikes are possible. This, along with the increased noise and disturbance, could have a significant negative impact on the resident mammal populations. A number of measures can be introduced to diminish the potential impact:

- speed limits must be set, adhered to and enforced
- the number of marine tour operators should be limited and controlled
- crews should remain vigilant at all times
- the number boats on site at Pelican Point at one time should be restricted
- marine vessels approaching groups with calves should be stringently regulated
- feeding of wild animals (particularly Cape Fur Seals) should be reduced or stopped
- dispersal of rubbish into the ocean should be rigorously controlled.

Promoting knowledge and understanding is generally the best way to convey any message. This can be achieved by introducing obligatory educational programmes for recreational boat users to increase awareness of marine mammal and vessel related issues. Such programmes could be incorporated into the new marina development.

Although the overall impact of the increased ship traffic on marine mammals, particularly within Walvis Bay, is deemed to be low, all skippers should be mindful of the potential for ship strikes, especially outside of the harbour area where migrating whales may be encountered. This will become especially significant as Southern Right Whales move further up the Namibian coast. Should Southern Right Whales begin frequenting the Walvis Bay area again, policies should be developed to reduce ship strike risk by limiting large vessel speeds and compelling the use of marine mammal observers.

Assessment

If established guidelines for speed, routes and approaching marine mammals are adhered to, then the impact of increased marine traffic can be kept moderate and be of low significance. Despite a daily exposure to tour boats in this area, specialists suggests the risk of direct injury through collision may be relatively low (Elwen and Leeney, 2011). However, impact levels will increase proportionally with increased tourist pressure and commercial competition.

While the impact level of marine eco-tourism at the moment is low, it could become moderately to highly significant with increased pressure, particularly at biologically critical times. Besides, the reality is that regulations will not be followed by all people at all times, resulting in an increased impact level, which will vary according to and be dependent on increased numbers of users of the bay and lagoon waters.

5.2.3. Increase in Visitors to Pelican Point

Overland visitors to Pelican Point disturb and alarm seals and birds and could contribute to accidental injury and trampling of young seals, fledglings and eggs. Although all pedestrian and vehicular traffic must keep a minimum of 50 m away from resting seals and roosting birds, these regulations are not necessarily enforced due to a lack of permanent authoritative presence. Non-motorized vessels such as kayaks and canoes also frequent the shores of Pelican Point, but possibly pose less of a perceived threat.

Over-fishing, due to the increased number of fisherman, is an impact of recreational fishing and it may result in pronounced changes in the fish community structure of the bay. This may lead to competition over food supply and change the structure of other ecological levels in the bay. Apart from over-fishing, over-collection of bait species due to increased number of fisherman is a possibility. Over-collection of bait species may also result in a change in the community structure of benthic and sessile organisms. The Sea Fisheries Act (Act No. 29 of 1992) is an attempt to manage the impacts of recreational fishing through regulating the amount of different species of fish that may be caught daily or transported per vehicle, as well as the quantity and type of species of bait organisms that may be harvested from the sea. However, numbers of Sea Fisheries Inspectors patrolling the coast to enforce these regulations are limited. As tourism increases in the area, further exploitation can be expected that may have an up-chain effect on the top level predatory species in the Walvis Bay area.

On the positive side a new breakwater will provide new niches for small fish, fish spawning, bait and other fauna and flora. This will benefit the ecosystem once construction is complete.

Mitigation

The increase in numbers of recreational users of the lagoon and visitors to Pelican Point will have similar effects to increased marine tour operators. Similar mitigation measures can be applied:

- numbers should be limited and controlled – this applies to fishermen as well as tourists.
- dispersal of rubbish and discarded fishing gear should be rigorously controlled and penalties imposed (e.g. fines or banning from the area).
- approach distances to mammals on land and in the water must be applied.
- observers can be appointed to limit human-mammal interaction and have the authority to intervene in legitimate infringement cases.

- regulations regarding type and amount of fish and bait removal must be enforced (These regulations may have to be revised dependent on the number of fishermen present in a specific area).

Assessment

The impact and level of significance is totally dependent on the number of recreational users and tourist visitors and the enforcement of regulations. No enforcement or control of numbers will have a significantly high, long-term effect on the natural integrity of Pelican Point and the sandspit. However, as long as the interactions and activities are controlled the impact should be fairly low.

5.2.4. Marine Pollution and Litter

With increased marine traffic comes the increased risk of accidental oil and chemical spills into the water. Development may lead to water impurity if adequate stormwater treatment systems are not established. Solid surfaces (walkways, jetties) near and around residences and businesses will facilitate the addition of pollutants into the lagoon waters due to suspension in rainwater run-off and cleaning water that is washed into the waterways. Toxins may also accumulate in the bottom sediments and may be re-suspended into the water column by storms and maintenance dredging, and subsequently be taken up by marine mammals.

Pollutants bioaccumulate in food chains and marine mammals, being high up, are particularly at risk from contaminants (Brough et al., 2014). Oil, petroleum, pesticides and cleaning chemicals can by acutely toxic and/or cause sub-lethal and chronic effects. However, any impending cumulative effects are only possible to calculate with known baseline levels of toxins in the marine mammals that already inhabit the Walvis Bay area. Dolphins and seals have some of the highest concentrations of organochlorides for any marine animal owing to their fairly regular contact with humans, the close proximity of their habitat, their large coastal distribution and high trophic level.

Figure 35: Cape Fur Seal pup caught in netting.
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Apart from detracting from an area's natural beauty, litter has a serious negative effect on the marine environment. Wind-blown plastic and discarded fishing gear pose a serious threat to seabirds and marine animals, such as seals and turtles. Fishing lines, rope, plastic bait box bands, netted carrier bags (e.g. for oranges) and such cause entanglement of seals and seabirds, leading to severe injuries and often death.

Turtles often mistake plastic for food. Items such as plastic bags and rubber balloons cause bowl blockage, resulting in starvation and a slow, painful death.

Mitigation

Measures to reduce the likelihood of marine mammals being exposed to toxins include:

- introducing appropriate systems to eliminate or minimise contamination of runoff and stormwater
- introducing and enforcing no dumping policies for rubbish
- introducing and enforcing policies for type and disposal of chemical cleaning agents (domestic and commercial)
- more stringent control measures need to be implemented on fishing beaches and within the harbour
- enforcement and issuing of penalties for littering

Assessment

The impact of toxin accumulation in dolphins as a result of increased exposure to chemical waste is considered high in the long term.

The impact on seal and turtle injury and mortality due to entanglement or garbage consumption is considered to be highly significant, both in the short- and long-term.

All the above mitigation and assessed impacts and levels of significance as a result of increased tourism and people-presence will only be effective if there is regular and visible enforcement of regulations.

5.2.5. Increase in Activities On and Around the Lagoon

The Walvis Bay Lagoon is explored by boat and kayak. Wind surfing and kite-boarding are popular on the leeward side of Pelican Point. The shoreline is popular for walking with locals and tourists alike. There is a potential for increased activity in the lagoon area on a daily basis as a result of the development attracting more visitors as well as local residents, particularly when the accommodation phases are complete. With increased numbers of people comes associated increased disturbance of all nature wildlife in the immediate area, as well as a higher likelihood of human-animal interaction.

Cape Fur Seals are known to become habituated to human presence, particularly if they associate the presence of humans with an easy and readily available food supply. As with all encounters with wild animals, there is potential for injury – both to the animal and to humans. Uneducated visitors and curious children who approach wild animals pose a particular risk (to themselves and the animals). Cape Fur Seals regularly rest on jetties in harbours and waterfront developments (e.g. Kalk Bay; V & A Waterfront, Cape Town). Sudden disturbance of a resting seal can cause aggressive startle reactions with severe consequences.

Figure 36: Cape Fur Seals on Kalk Bay Harbour wall (from Bruce, 2015)

The feeding of seals by the public, as well as workers in local business and restaurants (e.g. throwing food and garbage into the water), will only encourage predatory and scavenging behaviour and enhance the risk of animal-human conflicts, potentially encouraging aggression from the seals. This practice also puts the seal at risk of injury and mutilation through entanglement and ailment resulting from ingestion of non-biodegradable and toxic substances. An apparently easy source of food will encourage more seals to frequent the lagoon area and this, in turn, will lead to more human-seal interaction, both in the water and out of it.

Figure 37: Cape Fur Seals on jetty in Kalk Bay Harbour (from Bruce, 2015)

Mitigation

The increase in numbers of recreational users of the lagoon will have similar effects to the increased numbers of visitors to Pelican Point. Similar mitigation measures can be applied, such as controlling approach distances to mammals and enforcing littering regulations.

The greater increase in people presence will be along the edges of the lagoon and on newly constructed quays, jetties and walkways. Fixed measures can be incorporated into the construction and design to hinder seals from getting onto these structures (safety rails), but still supplying them with possible resting facilities (tyres and beams fixed at levels below the walkways).

People need to be educated with respect to approaching and feeding marine mammals, especially Cape Fur Seals. Seals become habituated to human presence, but can be aggressive. The fact that they will come out of the water represents a greater threat. These are strong animals and encounters will more often than not favour the seals.

The direct impact of human presence could be mitigated through:

- strict control and enforcement of rubbish disposal
- limiting human-mammal interaction through controlling accessibility
- employment of observers to limit access and prevent feeding and harassment of animals
- providing educators and educational material and/or facilities

Assessment

The impact of increased users of the lagoon waters is very low, but the impact of increased numbers of users of the terrestrial environment can be very high if mitigation measures are not applied and enforced.

The impact of human-seal interaction and potential injury is considered high in the short term and moderate in the medium- to long-term, if education measures and monitors are introduced.

Tourism can have substantial positive impacts for Walvis Bay in that it generates employment and foreign exchange. The tourist interest in the birdlife of the Walvis Bay lagoon generates a few million Namibian dollars per annum. This gives the lagoon and wetlands area an explicit monetary value. A well managed waterfront can be economically beneficial and if there is a strong environmental component to the managed, the long-term negative impacts will be low.

6. CONCLUSION

Human activities in the marine environment cause disturbance to a lesser or greater degree. The purpose of this report is to identify and assess the potential impacts of the proposed Walvis Bay Waterfront Development on marine mammals within the Walvis Bay area. As no scientific research relating to the impact of noise from construction activities on marine mammals has been undertaken specifically within Namibian waters, the assessments of potential impacts are based on international, peer-reviewed studies.

Any construction of harbour and quay facilities will impact on the natural environment from the construction phase (blasting, piling, dredging) through to the final use (pollution, more marine traffic, higher risk of human-animal interactions). Firstly, the impacts of noise trauma, vessel collisions, water pollution and turbidity, prey displacement, and disturbances (inducing behaviour responses) that may be caused by the construction have been considered. Thereafter, the impacts of increased tourism and human activity that will result from the completed waterfront development were discussed.

Marine mammals use sound to hunt, communicate and protect themselves and are thus susceptible to noise disruption in their natural habitats. Marine mammals vocalise and hear over a range of frequencies and sound pressure levels and consequently are not impacted equally by different anthropogenic sound producing activities. Similarly, marine construction procedures produce different sound energy levels at varying frequencies.

Physical injuries can be expected at very close ranges and high sound intensities, but are improbable in most species present in Walvis Bay, as free-swimming animals will initiate avoidance behaviour well before they are within ranges at which physical effects are felt. Noise levels and construction disturbance (e.g. turbidity and entrainment by dredging) may distress or displace some fish species that are generally food sources for the mammals in Walvis Bay. Dolphins and seals can compensate for small-scale changes in prey abundance by switching prey species, moving to alternative foraging grounds or increasing time spent hunting.

Noise emissions associated with the construction operations of this project (blasting, pile driving, dredging) are in the lower frequency ranges with energy or source sound pressure levels generally below 1 kHz. The construction will, thus, have more impact on low frequency mysticetes (5 Hz – 25 kHz vocalisation and hearing range) than on the mid-frequency odontocetes (100 Hz – 220 kHz) more commonly found in the bay. Fur Seals have lower hearing sensitivity as well as lower function ranges (125 Hz– 50 kHz) than the phocids (true seals) which have been used for most auditory research studies.

Blasting

Underwater explosions are one of the strongest point sources of anthropogenic sound in the marine environment. Source levels for blasts from 1 - 100 lbs TNT range between 272 and 287 dB re 1 µPa zero to peak at 1 m (OSPAR, 2009). However, the peak energy duration is extremely short (< 1 - 10 ms). Also, underwater explosions transmit at low frequencies (2Hz - 1 kHz), below the functional range of most mammals.

At close range, the energy generated by explosions can kill turtles and cause fatal trauma to Humpback Whales by destroying auditory canals (Ketten et al., 1993). Killer Whales are unlikely to be affected by isolated blasting noise at greater than 2 km (Madsen and Møhl, 2000). Studies involving Bottlenose Dolphins exposed to noise simulating a 500 kg explosion showed no TTS for sound exposure levels below 216 dB re 1 µPa (Finneran et al., 2000). Some short-term behavioural changes can be expected for dolphins between 5 and 10 km away. Cape Fur Seals appear to have a high tolerance for underwater sounds and have shown habituation to seal “bombs” and seismic equipment. Blasting is unlikely to significantly impact their behaviour or impair their hearing at distances greater than 700 m from the sound source. Turtles exhibited avoidance behavior at 1 km from the source at SELs of 175 dB re 1 µPa @ 1m (McCauley et al., 2000).

Blasting can be of moderate to high significance depending on the amount of explosives used and the proximity to marine mammals. The most realistic mitigation is exclusion distance. Marine mammal observers should ensure that no mammals or turtles are present within the bay or lagoon during blasting at exclusion distances of between 1 and 5 km (700 m for Cape Fur Seals, 1 km for turtles and 2 km minimum for dolphins). Mammals most affected by explosive noise are baleen whales, so it would be preferable to preclude blasting operations during known Humpback Whale migration seasons (June, July, and September).

Pile driving

There is no documented case of injury to cetaceans in the wild as a direct result of pile driving. Source levels for the various types of piling range from 243 to 257 dB re 1 µPa@ 1m, in a frequency bandwidth of 20 Hz to 20 kHz (Dahl et al., 2015). Research indicates that for Bottlenose Dolphins PTS and TTS will only occur within 5 – 10 m and 10 - 20 m, respectively, of the pile-driving activity. Masking for mid-frequency cetaceans and seals is unlikely beyond 100 m (Bailey et al., 2010, Ma Madsen et al., 2006).

Behavioural responses (including avoidance) in dolphins, porpoises and seals have been inferred for distances ranging from 4 to 20 km from the construction site, lasting for a time period of between 4 and 72 hours after cessation of piling (Brandt et al., 2011; Bailey et al., 2010; Edren et al., 2004; Tougaard et l., 2003). The intensity and extent of behavioural response may be related, not only to the sensitivity level of a particular mammal, but also to the "phase" in which the sounds is experienced, the duration of the noise and conduct of the animals at the time of exposure (Dahl et al., 2015; Southall et al., 2007).

Based on available information, pile driving operations are unlikely to have long-term significant impacts on Cape Fur Seals, dolphins or Killer Whales, particularly if the suggested mitigation measures are applied. These include:

- Minimising multiple activities that generate compound underwater noises where possible
- Instigating ramping-up or "soft-starts" procedures
- Avoiding pile driving into hard substrates where feasible
- Using methods with lower level noise emissions, e.g. Vibratory hammer or Hydraulic piling
- Extending the duration of the piling strike to reduce the source energy level, where practical
- Mantling or using air bubble curtains

The highest potential impact from piling will be on Humpback Whales and the lowest on Cape Fur Seals. A precautionary approach would be to of preclude pile driving near feeding or breeding populations and limit high intensity activity during migration periods. Applying visual monitoring and exclusion zones (500 m for Cape Fur Seals, 1 km for dolphins) will reduce the potential impact levels with respect to masking and hearing impairment to low significance. The impact of behavioural changes (avoidance of the construction area and/or relocation to find preferred prey species) can be significant to population densities in the short-term, but is considered of moderate to low significance in the long term.

Dredging

Compared to other activities that generate underwater sound, dredging is within the lower range of emitted sound pressure levels. However, the overlap in the dredging noise frequency spectrum and the hearing bandwidths of marine mammals indicates that the impact of dredging noise is potentially greater for mysticetes and seals than for mid-frequency cetaceans, such as are found in Walvis Bay. Source levels range from 149 to 180 dB re 1 µPa @ 1 m depending on the dredger type, across a frequency band of 20 Hz - 1 kHz (Todd et al., 2015; Robinson et al, 2011; 1995; Defra, 2003).

There are hardly any studies where any negative impacts on marine mammals can be attributed wholly to dredging activities in isolation from anything else. In general, evidence suggests that if management procedures are implemented, effects will probably be partial masking of low-frequency communications of baleen whales and seals, short-term behavioural reactions in all species, and changes in prey availability. Observations of Bottlenose Dolphins around dredging areas show contradictory behavioural responses: In Scotland, Bottlenose dolphins avoided locations where dredgers were working, but off Ireland, they were apparently attracted to areas of active dredging (Todd et al, 2015). Some short-lived hearing loss is possible if mammals stay near the dredger for extended periods of time (Todd et al. 2015; Thomsen et al., 2002), but indications are that if seabed disturbance temporarily increases food supply, both seals and dolphins will approach operating dredgers. Observation from a number of construction sites indicate that, on the whole, marine mammals are not overly bothered by dredging activities (Todd et al., 2015; Thomsen et al., 2009). No disturbance reactions were observed in New Zealand Fur Seals, Australian Sea Lions or Hawaiian Monk Seals, despite the proximity of dredgers to haul-out sites (Todd et al., 2015; EPA, 2007).

Minimum impact is expected from dredging noise on the marine mammals in Walvis Bay, as they are not deemed to be sensitive to such low frequencies. Mitigation of dredging noise is not a necessity. The Walvis Bay environment is already exposed to dredging activity for harbour maintenance and, thus far, no long-term negative impacts have been reported. Cumulative impacts of dredging (vessel traffic, noise and sediment plumes) can be lessened by not letting maintenance dredging of the Walvis Bay harbour coincide with construction dredging. Degradation of new areas can be circumvented by using the existing harbour dump site for construction dredge spoil.

Entrainment could cause reductions in prey abundance, but dolphins and seals have a varied diet. They are highly mobile and will be able to compensate for small-scale changes in prey abundance by switching prey species or seeking alternative foraging grounds. Migrating Humpback Whales (Humpback) feed opportunistically when food sources are readily available within their routes, so their feeding patterns are unlikely to be affected by dredging.

Dredging could even have positive impacts: Bottlenose Dolphins are known to preferentially use dredged channels when hunting (Allen et al., 2001). The release of organic nutrients from suspended sediments has reportedly enhanced diversity and abundance of benthic fauna near dredged channels with concomitant supplementary food availability at upper trophic levels.

Dredging can cause a temporary, but significant increase in turbidity levels. Heaviside's, Dusky and Bottlenose Dolphins are highly mobile and would readily avoid turbid water. They also have the ability to use sonar, so that they do not have to rely solely on vision. Sight is not essential to pinnipeds' survival or ability to forage and hence the level of turbidity is inconsequential (Dehnhardt et al., 2001; McConnell et al., 1999). Turbidity has the potential to impact fish abundance and distribution within the lagoon. However, aadditional food sources for dolphins and seals will be available in the rest of the bay.

The effects of turbidity are often localized with minimal direct impact on marine mammals, particularly highly mobile ones that can relocate to more favourable feeding areas for the periods when dredge plumes are present. This may impact the local population densities somewhat in the short term, but is likely to be of low significance in the long term.

Increased Marine Traffic

There will be an increase in marine traffic both during the construction phase and afterwards owing to the new basins within the waterfront development. Collisions between dredgers and mammals are possible, but improbable, given that operating dredgers are either stationary or moving at slow speeds. Risks of collision are greatest when dredgers are in transit, but Walvis Bay is already characterized by heavy shipping traffic, so the addition of dredging vessels is unlikely to increase the collision risk substantially. The marine mammals in the bay are highly mobile and have been exposed to small tour boats as well as larger sea-going vessels making use of Walvis Bay harbour facilities. Precautionary measures that can be applied include setting predetermined shipping lanes and maintaining a constant course and speed where practical. There is a necessity for visual attentiveness to the presence of marine mammals and evasion distances of 100 m should be enforced where practical. Cape Fur Seals are known to approach active survey, mining and fishing vessels, so there is a strong probability that they will approach construction vessels. Despite their apparent lack of concern, caution must still be exercised by the skippers.

The large increase in the number of vessels in the lagoon and travelling between the construction site and the harbour will have significant impact on all wildlife for the duration of the construction. Changes in the whistle frequency parameters of Bottlenose Dolphins in the presence of tour boats have been recorded in Walvis Bay. Similar reactions can be expected owing to the increased presence of construction vessels. There are no effective mitigation measures to reduce ship-generated noise other than reducing vessel speed. Initially, and in the short term, a high level of disruption to cetaceans and seals is probable, but the significance and level of intensity will moderate with time as the mammals become habituated. Cape Fur Seals will probably habituate faster than the cetaceans in the bay.

Despite concerns voiced by Nacoma, there is no scientific proof that the current amount of marine boat tourism is a threat to the populations of dolphins presently in Walvis Bay. There will certainly be an increase in small motorised craft on completion of the new waterfront. Increased noise and vessel traffic outside of the bay may impact on any Southern Right Whales that may venture further north than their current distribution. The risk to these whales is equally high from harbour activity.

Dolphins are usually easily able to avoid vessels and can generally co-exist comfortably with both ships and smaller craft. To date there has only been 1 recorded incident of a dolphin being injured by a propeller. However, with greater numbers of small, high-speed craft comes a higher potential for collisions and injury to marine mammals. The increased noise and physical disturbance could have a significant negative impact on the resident mammal populations. If guidelines for speed, routes and approaching marine mammals are established and enforced, then the impact of increased marine traffic can be moderated.

Pollution

Being at the high end of the food chain, marine mammals are very susceptible to pollution, particularly through bioaccumulation. There is a substantially higher risk of contaminants entering the water during marine construction than at present. An increase in marine pollution can be brought about by inadequate disposal of construction materials, rubbish generation, oil and chemical spills and general flotsam accumulation. The impact on the environment will be equal to any oil and chemical spills and litter from ships coming into port and appropriate clean-up procedures must be established and implemented.

Storm-water runoff, particularly during the construction phase of the development, may cause water pollution and reduce water clarity if adequate storm-water treatment systems are not established. Addionally, windblown material can accumulate in and around the construction area. A well thought-out and executed construction environmental management plan will mitigate most negative effects from chemical and material pollution. The plan should be cognisant of runoff containing pollutants, storm water and contaminant treatment, construction dust accumulation in the bay, containment of construction material and the dumping of rubbish.

If construction activities introduce large quantities of foreign chemicals into the water of the bay and lagoon, there could be highly significantly long-term impact. Short term impacts of high intensity and significance can result from oils spills from construction vessels and machinery, but these can be lessened by quick response and following preset clean-up procedures. Water pollution can be mitigated by proper implementation of a good management plan.

Dredge plumes can release contaminants into the water column that can potentially accumulate through the food web. Coastal cetaceans are prone to elevated levels of toxins owing to their habitat range and regular interaction with humans and anthropogenic waste and the propensity for chemical accumulation by the lipid-rich blubber. Connecting the release of contaminants from dredge plumes to potentially negative effects in marine mammals requires baseline information regarding current blubber toxicity levels in a statistically valid number of specimens. If significantly large proportions of bioavailable toxic compounds are remobilised, then the impact of dredging and dredge spoil dumping can be very high in the long term. However, a properly designed and managed dredging programme can have a low impact on the health of the mammal population. As yet, there have been no documented negative, long-term impacts linked to the regular maintenance dredging of the Walvis Bay harbour. It is assumed that the ecosystem would have adapted to this type of short-term disturbance and will be able to tolerate similar levels of turbidity and compound suspension from the proposed development.

Harbour and residential developments may lead to water impurity through the addition of pollutants (cleaning chemicals, rubbish, effluent) into the waters of the lagoon and bay. Pesticides and cleaning chemicals can be acutely toxic and have chronic lasting effects. Although dolphins and seals generally have high concentrations of organochlorides, additional absorption of noxious substances can have severe, long-term, population-level consequences. The development plan should devise and encompass appropriate systems to eliminate or minimise contamination of runoff and storm water. The impact of toxin accumulation in dolphins as a result of increased exposure to chemical waste is considered high in the long term. Therefore, policies for waste disposal must be established and enforced.

Non-biodegradable litter and discarded fishing gear pose a serious threat to seabirds and marine animals, such as seals and turtles. Stringent controls and penalties for littering need to be imposed. The impact on seal and turtle injury and mortality due to entanglement or garbage consumption is considered to be highly significant, both in the short- and long-term.

Human Interactions

Seals swim in and around harbours. They become habituated to humans, scavenge rubbish and scraps and see humans as food providers (Bruce, 2015). Humans become accustomed to their presence and forget they are wild animals. An overall increase in tourism at the new Walvis Bay Waterfront may facilitate such negative trends. The impact of human-seal interaction and the potential for injury is considered high in the short-term and moderate in the medium- to long-term, if education measures and monitors are introduced.

Predation of seabirds by seals may be stimulated by the practice of feeding seals from tour boats. It is suggested that this practise be stopped, as it encourages seals not to hunt, but rather to approach humans for food. This can lead to aggressive behaviour if the desired outcome is not forthcoming.

Frequent contact between humans and dolphins, achieved through the regular tourist cruises, can have unknown long-term negative impacts on dolphin health (to population level) owing to the nearness of the interactions. Captive dolphins are susceptible to human illnesses and the dolphin populations in the bay may be similarly exposed through daily contact. Stress and discomfort will make them vulnerable to infection.

Recreational fishing is undertaken at a number of locations around the lagoon and bay. An increase in tourism can result in exploitation of the natural resources. Over-fishing may lead to competition over food supply among the top level predatory species. On the plus side, a new breakwater will provide new niches for small fish, fish spawning, bait and other fauna and flora. This will benefit the ecosystem once construction is complete. The impact of recreational users of the lagoon and coastal environment can be very high if mitigation measures and regulatory controls are not applied and enforced.

Concluding Statements /Assertion

Precautionary regulation is leading to considerable burdens being placed upon future development in some areas. Development that will secure employment and increase domestic income must be considered beneficial to Namibia. All development, industry and activities have some impact on the natural environment. If the impacts are inconsequential or can be mitigated to an acceptable level, then progress should continue.

The impacts and level of significance associated with the proposed Walvis Bay Waterfront Development have been presented. There will be considerable disruption during the construction phase, but the overall, long-term impacts on the marine mammals in the Walvis Bay area will probably be low, if mitigation measures are applied. Certain potential impacts need to be assessed prior to construction, for example the chemical properties and characteristic of the sediments to be dredged.

The level of impact of the completed development is dependent upon what control measures are instigated to combat pollution. High levels of chemical pollution and non-biodegradable waste can potentially cause irreparable harm.

The safeguarding and preservation of the natural status quo depends on controlling the number of recreational users and tourist visitors to the lagoon and bay areas and relies upon the enforcement of regulations. Lack of enforcement or failing to impose penalties can have a significantly high, long-term effect on the natural integrity of the entire bay area. However, if activities and actions are controlled and human-animal interactions limited, the impacts can be moderated.

Tourism can have substantial positive impacts for Walvis Bay in that it generates employment and foreign exchange. A conscientiously constructed and well managed waterfront can be economically beneficial and if there is a strong environmental component to the management, the long-term negative impacts will be low.

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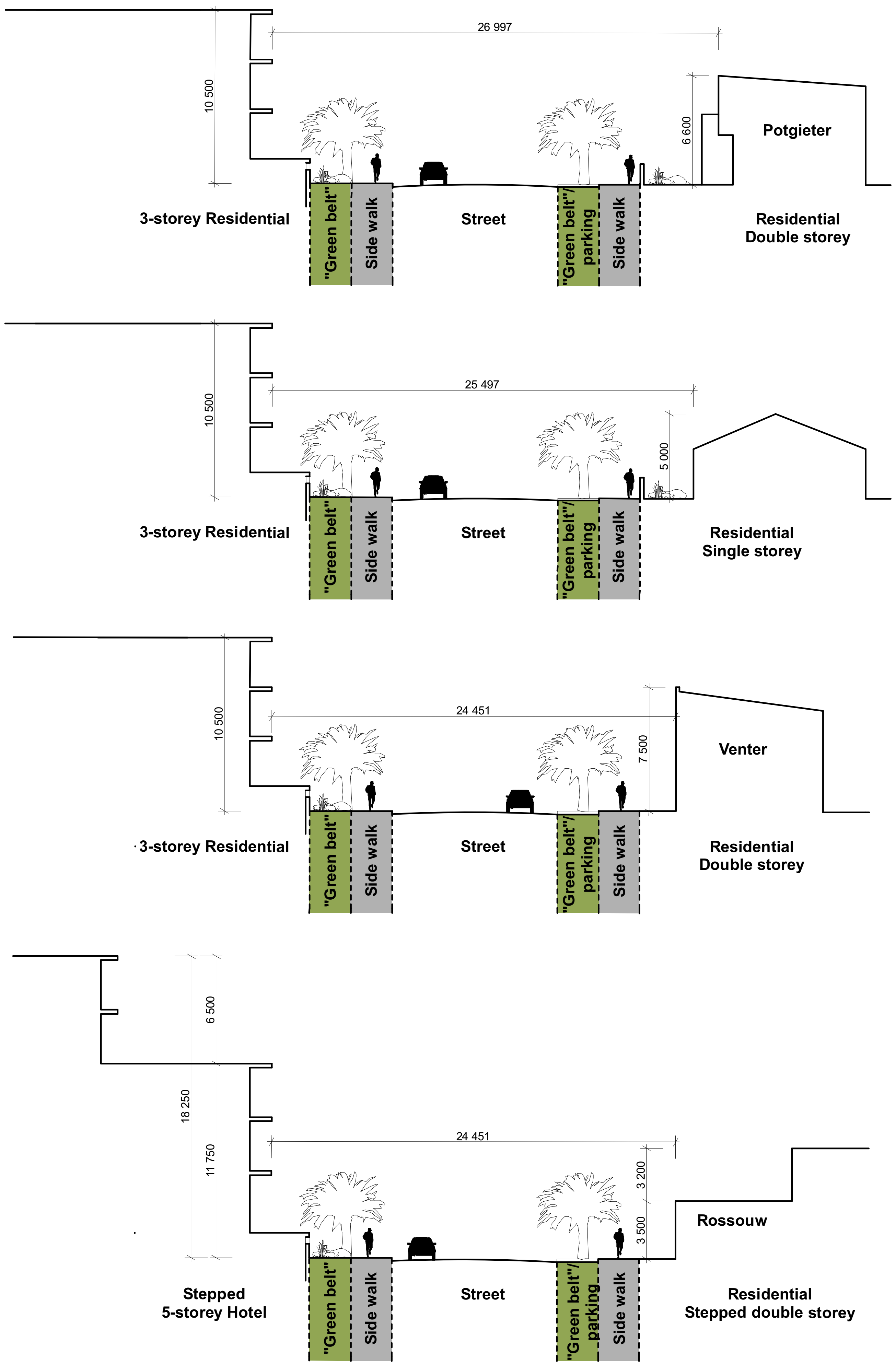
HEIGHT STUDY

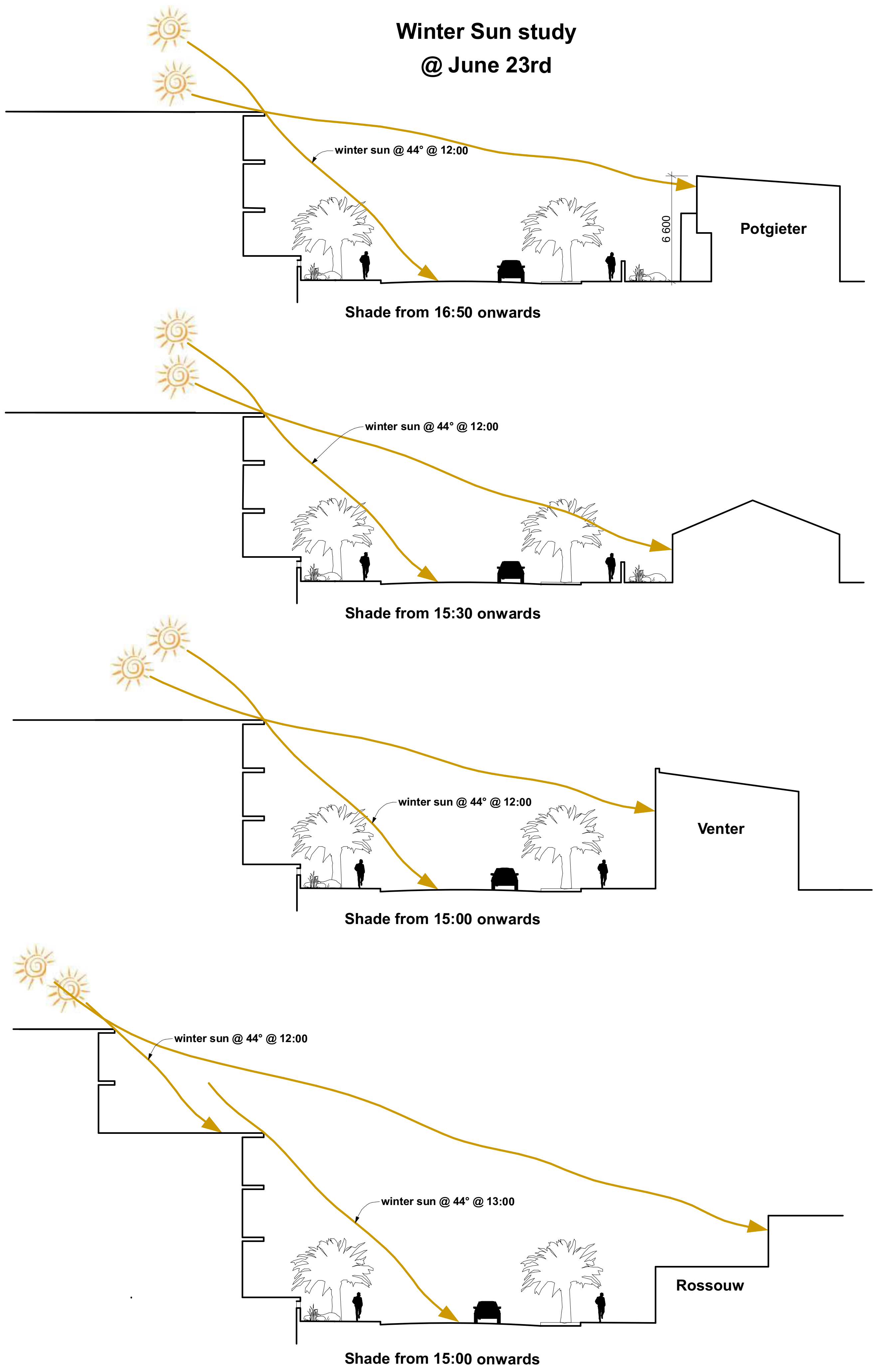
Sections not to scale

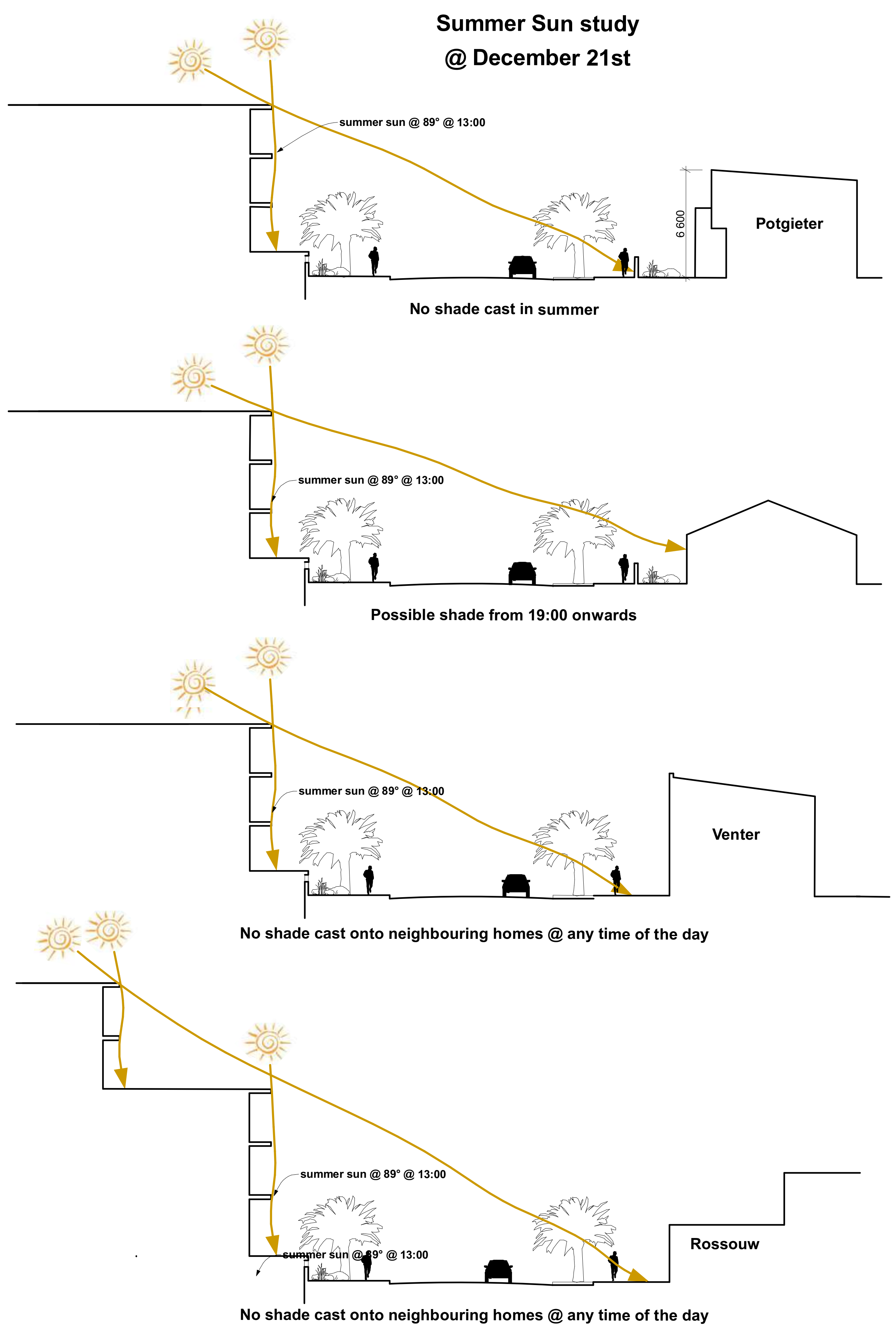


Examples of other Multi-storey Residential buildings in the vacinity

SUN STUDY

Reference: Info retrieved from [www.Suncalc.org]





Method Statement for relocation of the sewer gravity main through the proposed Walvis Bay Waterfront Development

1. INTRODUCTION

The purpose of this method statement is to provide insight into the construction of the proposed relocation of the gravity sewer through the Walvis Bay Waterfront Development. This method statement will be supplemented and further developed through the Preliminary and Detailed Engineering Design Phase.

2. EXISTING AND FUTURE SEWER RETICULATION

2.1 Existing reticulation through the development

There are three existing sewer gravity mains running through the proposed development site. These sewers will have to be relayed. The existing sewermains convey sewage from the Protea Hotel in Pelican Bay, and the Yacht Club. The existing sewer mains on property 4941 are indicated on "Drawing 2" attached in Annexure A.

The 2 sewer mains from the Yacht Club and Protea Hotel respectively (110 mm diameter mains) connects in the middle of the proposed development site, from which it becomes a 200 mm diameter gravity main flowing towards KR Thomas Street (previously First Street West), from which it flows into the existing reticulation network in an easterly direction.

2.2 Planned upgrades

The intention is to construct a new sewerage pumpstation on site. This pumpstation will then collect sewerage from the proposed development and pump (via a new rising main) along Esplanade Street and Union Street towards the existing pumpstation as indicated in the marked up image below. The pumpstation will pump from a height of around 2 m to approximately 7 m (pumpheight around 5 m). The average annual daily dry weather flow is expected to be approximately 220 kl/day (based on the assumption that sewage will be approximately 80% of the water demand). Based on a peak factor of 2.5, and allowing for an additional 20% for potential stormwater infiltration and other unknowns, the peak flow will be approximately 8 l/s.

The existing sewage from the Protea Hotel and the Yacht club will be diverted through new gravity mains, first south along The Esplanade Street and then west (just north of the planned new Marina), crossing via the planned pedestrian bridge (or underneath the planned channel should the invert levels not make it possible to gravitate if fixed under the bridge) towards the new proposed pumpstation (situated close to the corner of KR Thomas Street and The Esplanade Street). The new pumpstation will be designed to also include for the sewage from these diverted mains to be pumped. The exact flow and pump details will be confirmed and calculated during the detailed design phase.

The drawing below indicates the proposed rising main route. The pipeline will be laid within the existing road reserve and then within the existing golf course as indicated. The final position will depend on the detailed design requirements and the discussion with the relevant owners and local authority. The yellow marked in the drawing below indicates the proposed development, from where the sewage will be pumped, towards the red arrow (the position of the connection and discharge into the existing reticulation system).

The local authority has confirmed verbally that the existing system has sufficient capacity from this point to deal with the additional flow as a result of the proposed development.

3. DRAWINGS

Drawings relating to the proposed site and relocation of the sewer has been included in Annexure A. These include the following:

a) Marked-up "Drawing 2" indicating the existing infrastructure (water, sewer and irrigation network within the development area).
b) Drawing A105 – indicating the Site plan and detailed Phase 1 development area.
c) Drawing A103 – layout indicating the proposed Marina and Canal with pedestrian crossing (Phase 1)
d) Drawing A114 – Isometric View of the design development (Phase 1)

4. CONSTRUCTION METHODOLOGY

4.1 Role-players

During the general construction phase the following role-players will be involved (in addition to the Environmental Agent and Health and Safety Agent).

Surveyor
At start-up of the construction phase the surveyor needs to peg out the construction route. Existing benchmarks will be used where applicable. In addition, all existing manhole invert levels and services will be confirmed. The levels will be confirmed with the design engineer to ensure that all gravity mains and connections are still correct and can drain.

Contractor
After the surveyor is finished pegging out the site, the Contractor will clear and grub the route before excavation starts. Excavation will commence thereafter but will necessitate the allocation of stockpile areas where the excavation material can be placed. Excavated material should as far as possible be used for backfilling. Where it is unsuitable, the material should be spoiled off site. Where there is a shortfall of material, material may be imported as required. Bedding material should match that as specified in SABS 1200 LB.

Engineer
The Engineer shall inspect all construction work as detailed in the Contractor's programme and as stated in the Bill of Quantities of the Contract Document.

Structural Engineer

The Structural Engineer will design and detail all concrete and reinforcing steel required for the pumpstation structure (where applicable) based on the loads imposed on it. The inputs required include the geotechnical conditions, dead loads and live loads on the structure. The Structural Engineer will be responsible to ensure that all required structural checks are done in accordance with hold points as agreed beforehand with the Contractor.

Local Authority

The Local Authority will be invited to the start-up meeting and will be involved from the beginning to ensure that they are satisfied with the works in accordance with the local authorities' expectations and standards.

4.2 Construction Sequencing for Sewer mains

The following items shall be addressed during construction, ideally during the summer months, and will follow in sequence of each other:

a) Set-out planned works (pipelines and pumpstations)

b) Clear and grub site

c) Excavate and place services located in road reserve

d) Backfill above services

e) Place, shape and compact remaining layerworks to required densities

f) Ensure area where pipes will be located is dry at all times. Dewatering may be required

g) Where concrete encasement is required, cast 30 MPa/19mm concrete in dry conditions. Contractor to compact adequately to prevent voids from forming

h) Once the sewer main has been constructed, overpumping of the existing sewerage from the manhole upstream to the manhole downstream to where the connection to the existing sewer network will be done, will occur. The new sewer main will be connected into the existing network (either at a new manhole or at an existing manhole). The existing main downstream of this connection will be plugged.

i) Once the existing sewer network through the development is blocked off, the existing sewer mains will be removed.

j) The new pumpstation needs to be operational prior to the blocking off the existing sewers through the development. Only once the pumpstation has been tested and is in a condition to be taken over by the local authority, can the existing sewer mains be blocked off.

k) The new sewer main will cross over the new planned canal leading into the marina (refer to the attached drawings indicating the Marina). Depending on the levels of the canal and new pumpstation (can only be confirmed during the detailed design stage), can it be confirmed whether the pipeline will cross over the pedestrian bridge, or underneath the canal.

l) Refer to items below for methodologies on “Clearing and Grubbing”, “Stripping, Stockpiling and Re-instatement of Topsoil”, “Backfill”, “Gabions”, “Re-instatement”, Safety and Health Requirements.

4.3 Clearing and Grubbing

a) Unless otherwise specified, the area designed for clearing and grubbing shall be cleared of all trees, stumps, bushes, roots, rubbish, debris and other objectionable matters.

b) Before removal of any trees or shrubs written consent needs be obtained from Resident Engineer prior of the plant removal. The Engineer’s approval of any removal of trees and undergrowth will be obtained before commencement of work. No indigenous riparian vegetation, including dead trees, will be removed from any area located outside the approved work area.

c) For the full width to be cleared, all objectionable materials and any other obstructions shall be grubbed from areas to be excavated, to the satisfaction of the Engineer.

d) Any rubble, litter or other foreign material found within the demarcated work area will also be removed from site and taken to an approved spoil site.

4.4 Stripping, Stockpile and Reinstatement of Topsoil

a) Activities will start-up stream and proceed in the downstream direction.
b) Prior to the commencement of any works, topsoil will be removed from the area of work.
c) The topsoil will be removed to a depth of at least 150 mm and investigated if any unsuitable materials exist. The unsuitable materials, if any, shall be removed to the depth required by the Engineer's Representative and replaced by approved suitable material. All excavated material will be stock piled as per Specification and as per stock pile management procedure, all bulk stock pile areas will be pre-approved by the Engineer.
d) It will then be stockpiled at the designated stockpile areas for later use in the rehabilitation/reinstatement process. This stockpile area to be some 30 m away from the areas mentioned previously.
e) All topsoil will be stockpiled in such a way that it does not exceed 2 metres in height.
f) If the stockpile starts to erode significantly or cause excessive dust, water will be used for dust control.

4.5 Backfilling

a) Where possible the original material that was excavated will be used to backfill. This is to preserve and restore the construction areas back to its original state.
b) Imported material of similar soil type may have to be used, (the source and type of material will however be pre-approved by the Engineer & Environmental Control Officer (if applicable)).
c) With both methods of backfilling, the soil must be compacted. This compaction will be done by means of a wacker and/or pedestrian roller to the required compaction specified.
d) Care will be taken not to over compact soils and ensure embankment profiles are retained/reinstated.

4.6 Gabions

Should gabions be required, the approved area will be cleared, grubbed and reduced to level as required. Gabion mattresses and baskets shall be packed where applicable and its position and sizing will be determined during the detailed design stage of the project. The gabion rock to be used will be pre-approved by the Engineer.

4.7 Reinstatement

a) The contractor will ensure that upon reinstatement, stormwater flow is no way restricted or hindered. Any outstanding shaping of disturbed area will be undertaken to ensure embankment profiles are reinstated.
b) The remaining topsoil and any indigenous foliage will be redistributed along the affected area, and the area reinstated as much as possible to the original condition or pre-construction condition.
c) Alien vegetation (if applicable) will be removed and taken offsite to a registered waste facility.
d) The area will then be inspected by the site Environmental Control Officer and Engineer to assess whether any further action or active rehabilitation is required.

4.8 Safety Requirements

a) The working area should be barricaded and warning signs to be placed to prevent public from entering the work area.
b) Work area to be kept as dry as possible.
c) Employees to wear proper steel-toe water boots and rain suite when working in the muddy area.
d) Training by means of Toolbox Talks on the works should be held prior to activity commences.

4.9 Environmental Requirements

a) Drip trays will be provided for any parked or standing plant and machinery.
b) In the event of an oil spill or other related emergency a full 200l capacity spill kit will be on site and in close proximity of the works. Trained persons will be on hand to apply and to utilize the spill kit.
c) All other environmental requirement as per the Environmental Management Plan will be adhered to.

4.10 Site Demarcation & No-Go Areas

a) 1m high aero-mesh with wooden poles with 2 wire strands will be erected and maintained both sides of the construction areas within the road reserve and golf course, in order to minimise impacts on the system due to construction activity.
b) Proper sign boards with the wording "NO-GO AREA" will be attached to the constructed aero mesh to prevent people from entering the restricted area.
c) Any servicing required and refuelling of plant will be done outside of the no-go area, on an open space area located on the proposed development site.
d) The exact demarcation will be confirmed with the contractor during the tender phase.

5. MECHANICAL EQUIPMENT

For the objectives of the Contractor to adequately complete all construction work, they would likely require the following mechanical equipment (which can only be confirmed once the contractor has tendered and been appointed to construct the works):

a) Grader
b) Digger loader
c) TLB
d) Smooth drum roller
e) Watercart
f) Wacker
g) Concrete mixer
h) $6m^3$ up to $10m^3$ tippers – At the Contractor's discretion
i) Pipe testing equipment as per SABS 1200
j) Laboratory for concrete test results
k) Vibrating poker

6. QUALITY MANAGEMENT

The Engineer must obtain all test results and as-built records from the Contractor in accordance with standards and local authority requirements/quality control specifications.

The design will be done in accordance with the "RED BOOK" and relevant SANS standards. Where applicable, the local authorities' standards will apply.

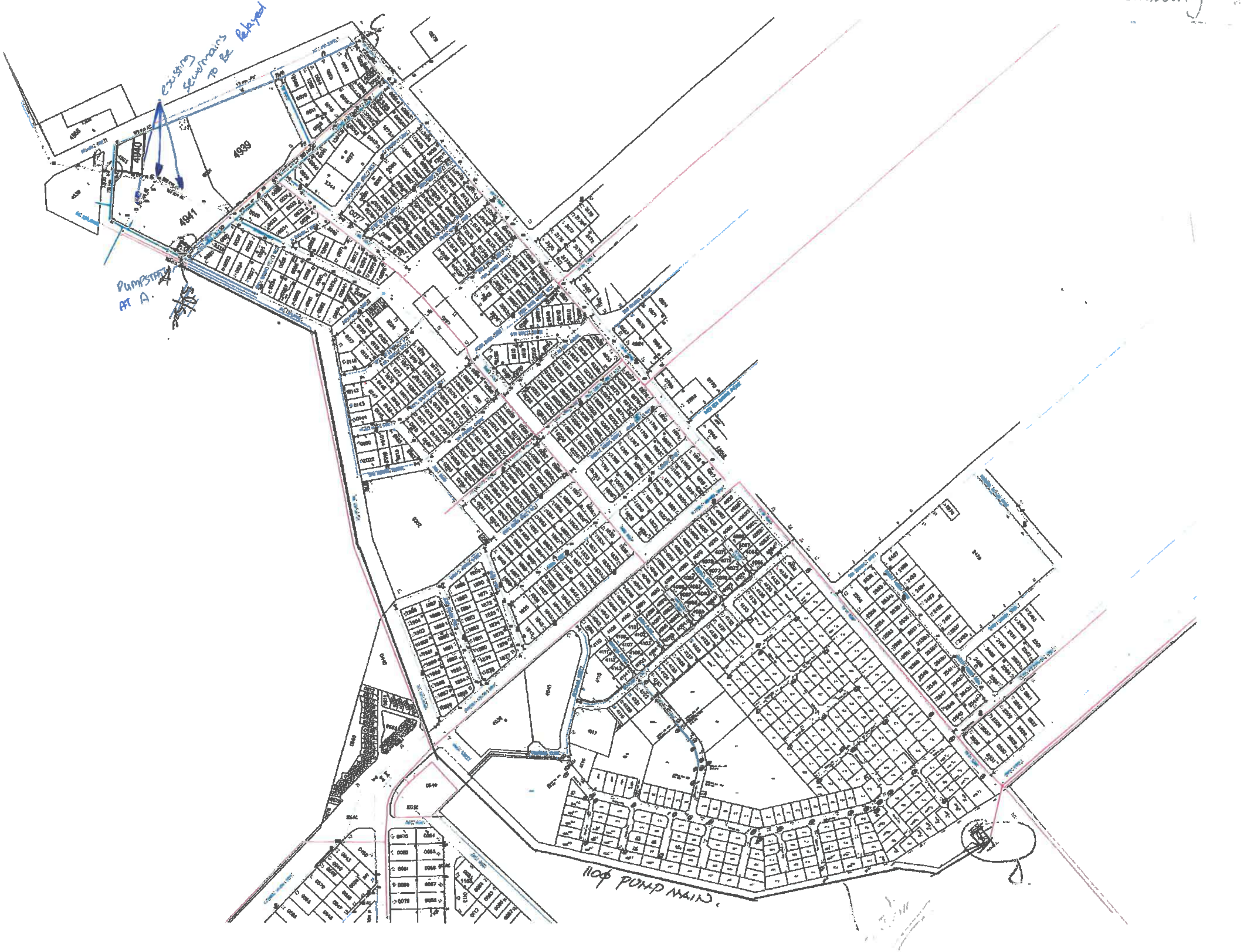
Daniel Smit

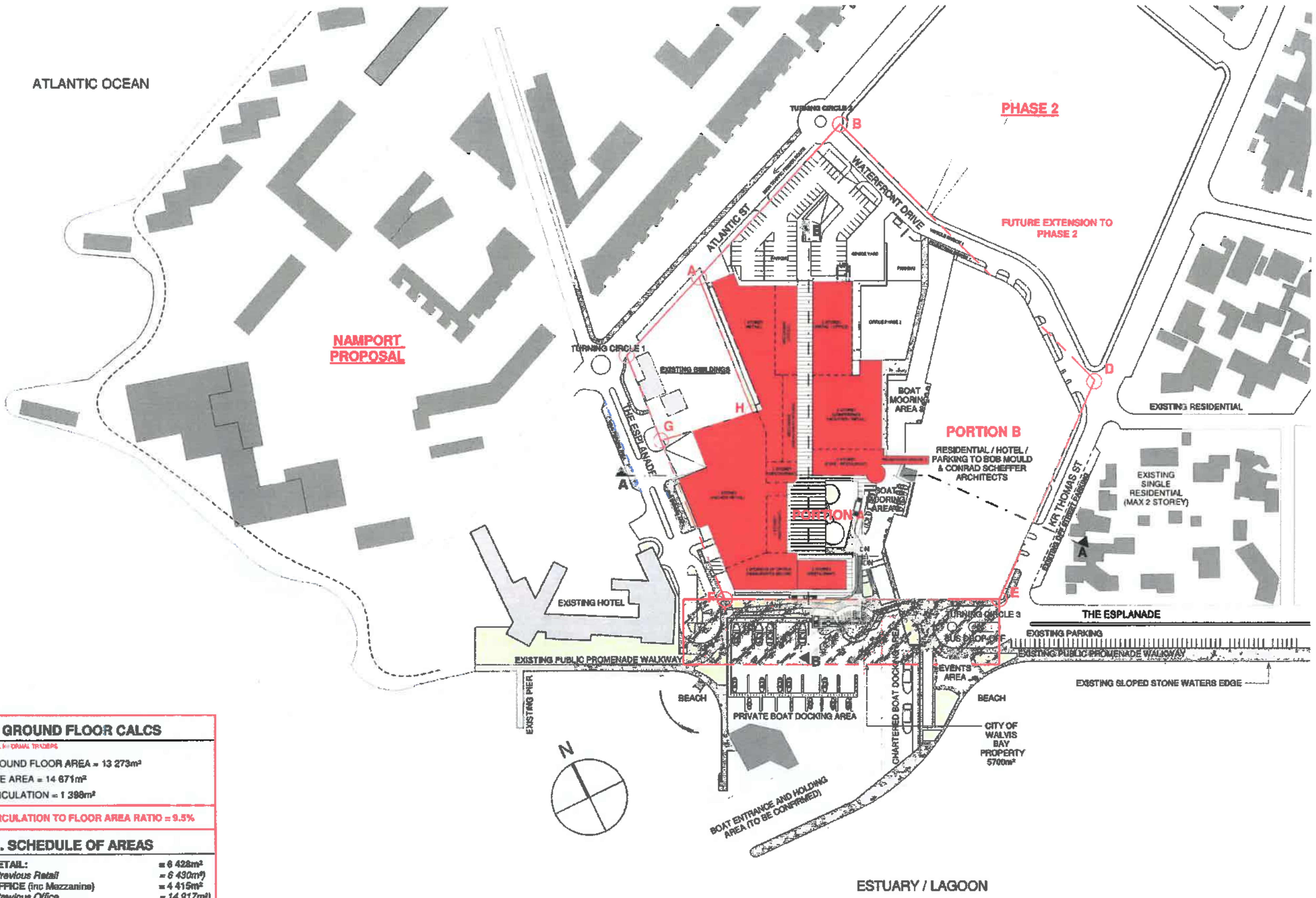
on behalf of

BIGEN AFRICA SERVICES (PTY) LTD

ANNEXURE A: DRAWINGS

Drawing 2


existing sewermains to be relayed
4939
4940
4941
PUMPSTATION AT A.
110φ PUMP MAIN.



A. GROUND FLOOR CALCS

EXCL. INFORMAL TRADERS

GROUND FLOOR AREA = 13 273m²

SITE AREA = 14 671m²

CIRCULATION = 1 398m²

CIRCULATION TO FLOOR AREA RATIO = 9.5%

B. SCHEDULE OF AREAS

RETAIL:	= 6 428m²
(Previous Retail	*= 6 430m²)*
OFFICE (inc Mezzanine)	= 4 415m²
(Previous Office	*= 14 917m²)*
Note: This excludes the future phased office block on the Northern area of the site	
RESTAURANTS	= 2 139m²
MULTI - USE EXHIBITION SPACE	= 1 797m²
BREAK AWAY ROOMS	= 266m²
CIRCULATION AREA	= 2 468m²
ABLUTIONS	= 1 543m²
PUBLIC SQUARE TOTAL	= 2 406m²
(Covered)	= 596m²
(Open Air)	= 1 810m²
BASEMENT AREA	= 14 240m²
TOTAL AREA	= 21 198m²

WALVIS BAY WATERFRONT

NO	DATE	DESCRIPTION OF REVISION

GENERAL NOTES

CLIENT

AFRIKUUMBA

PROJECT

Walvis Bay - Waterfront Urban Development

DRAWING

Design Development

Site Plan - PHASE 1

SIGNATURE

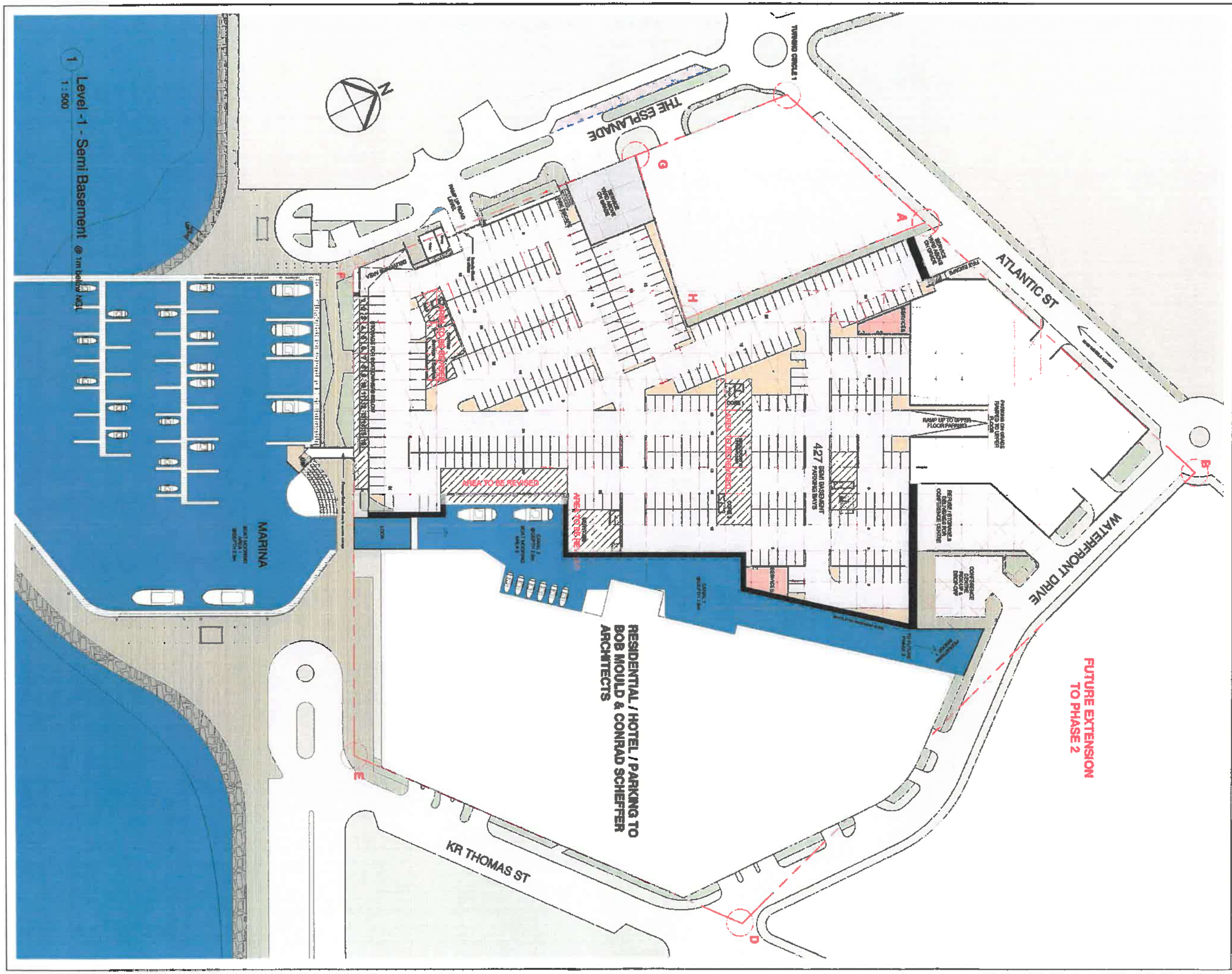
CLIENT | ARCHITECT

ARC CAPE TOWN

Bob Mould Scheffer architects

DVDM PROPERTIES (PTY) LTD

SCALE	1 : 1000
DRAWN	Author
CHECKED	Checker
DATE	31/03/2017
PROJECT NO.	2016_118
DRAWING NO.	A105
REVISION NO.	
SHEET	A1



WALVIS BAY WATERFRONT

NO	DATE	DESCRIPTION OF REVISION

GENERAL NOTES

CLIENT: AFRIKUUMBA

PROJECT: Walvis Bay - Waterfront Urban Development

DRAWING: Design Development

SEMI - BASEMENT PHASE 1

SIGNATURE

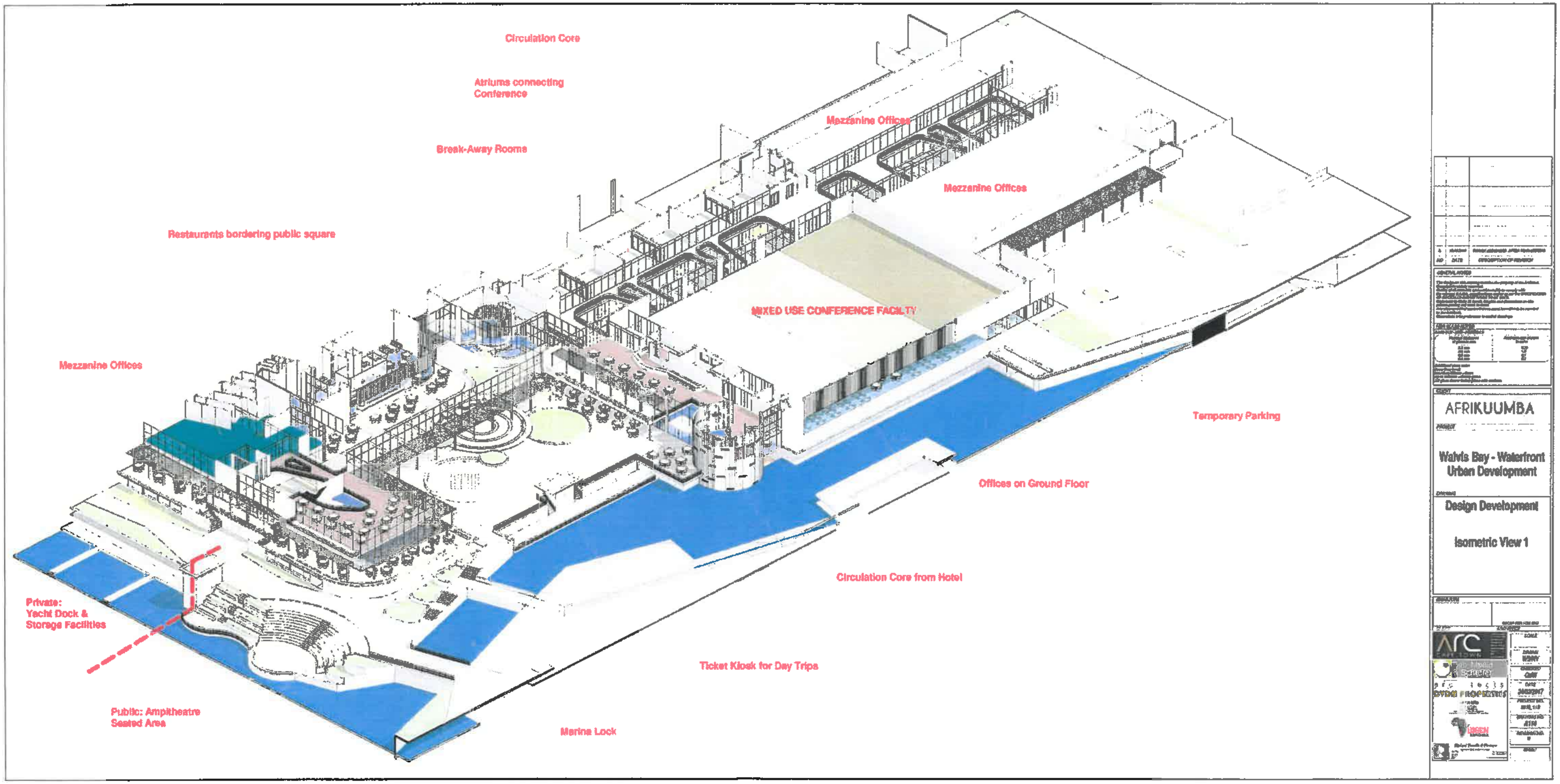
CLIENT / ARCHITECT

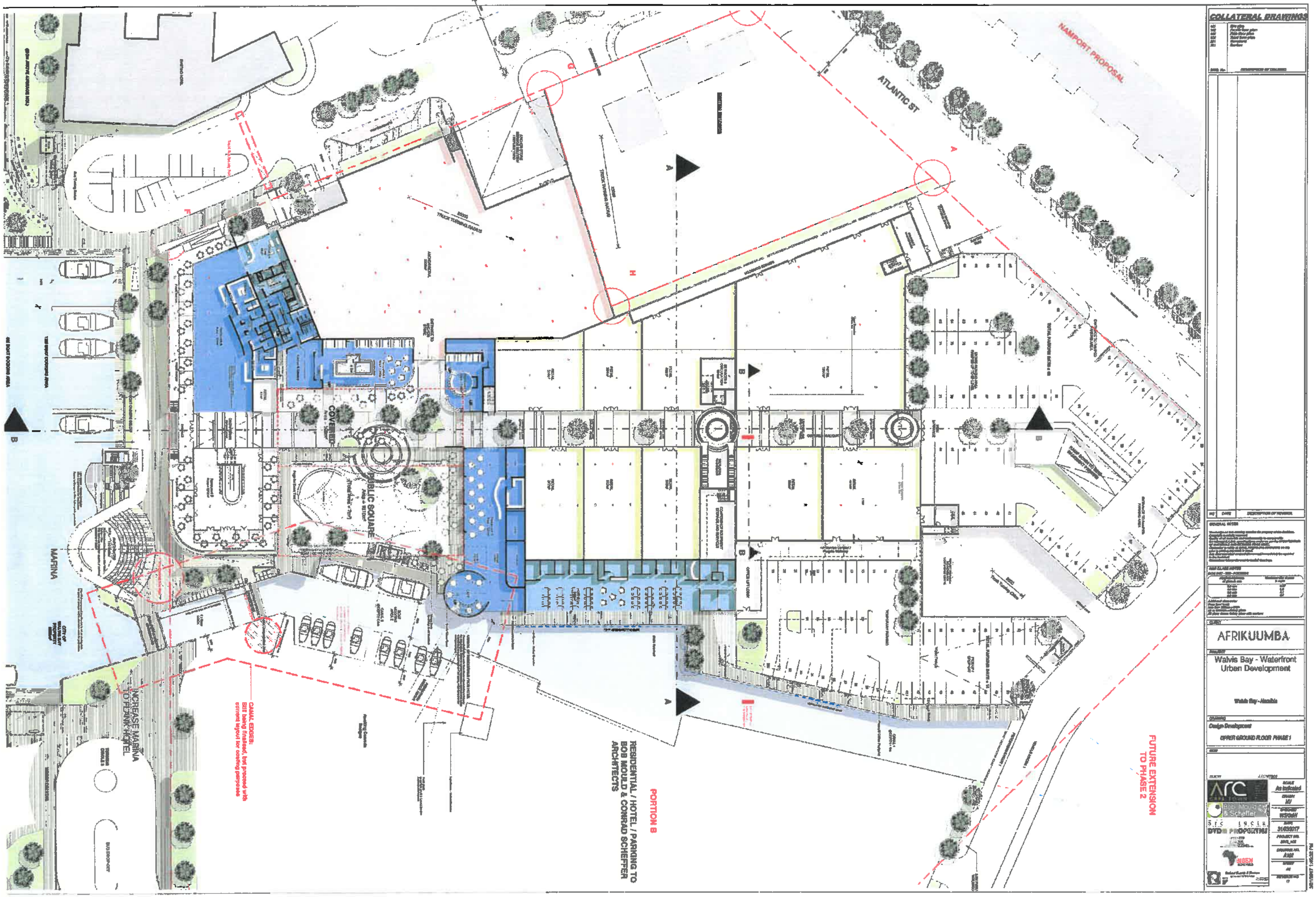
ARC CAPE TOWN

Bob Mould & Scheffer architects

OVDM PROPERTIES

SCALE	1 : 500
DRAWN	lw
CHECKED	lw
DATE	02/11/2016
PROJECT NO.	2016_158
DRAWING NO.	A103
REVISION NO.	17
SHEET	A1


Circulation Core
Atriums connecting Conference
Break-Away Rooms
Mezzanine Offices
Mezzanine Offices
Restaurants bordering public square
MIXED USE CONFERENCE FACILITY
Mezzanine Offices
Temporary Parking
Offices on Ground Floor
Circulation Core from Hotel
Private: Yacht Dock & Storage Facilities
Ticket Kiosk for Day Trips
Public: Ampitheatre Seated Area
Marina Lock
AFRIKUUMBA
Walvis Bay - Waterfront Urban Development
Design Development
Isometric View 1


COLLATERAL DRAWINGS
NAMPORT PROPOSAL
ATLANTIC ST
PUBLIC SQUARE
COVERED
MARINA
INCREASE MARINA
TO FLAMINGO HOTEL
CANAL EDGES:
Still being finalised, but proceed with
current layout for costing purposes
PORTION B
RESIDENTIAL / HOTEL / PARKING TO
BOB MOULD & CONRAD SCHEFFER
ARCHITECTS
FUTURE EXTENSION
TO PHASE 2
AFRIKUUMBA
Walvis Bay - Waterfront
Urban Development
Design Development
UPPER GROUND FLOOR PHASE 1
As indicated