Oakajee Industrial Estate
Structure Plan

Integrated Transport Strategy

Prepared by: J de Villiers

Version No: 1.3
Version Date: 02 March 2012
Status: Final

LANDCORP

Government of Western Australia
Department of State Development

GHD

Contents

Table Index

Appendices

Executive Summary

A Structure Plan has been prepared for the Oakajee Industrial Estate (OIE) to guide its development.

The OIE is comprised of the following areas:

- Strategic Industry Area (SIA) 1,135ha
- General Industry Areas (GIAs) 196ha
- Coastal Area 1,002ha
- Buffer Area 4,072ha

Location and Topography

The OIE is located in the Shire of Chapman Valley, approximately 23 kilometres north of Geraldton. The SIA and GIAs lie on a gently undulating plateau set back 1 kilometre from the coastline. There is a general fall from the northern boundary of the SIA to the Buller River in the south, apart from a small area in the north that slopes towards the Oakajee River.

Geotechnical Considerations

The site includes the following soils types:

- Safety Bay Sand in the coastal dunes.
- Alluvium and Colluvium in the river beds.
- Superficial Sand over most of the industrial precincts. Most site works will be within this material.
- Tamala Limestone in the west, between the coastal dunes and the superficial sand.
- Chapman Group siltstones and sandstones at depths of 50 metres or more, rising to the east and showing occasional exposures in river beds.
- Granulite Bedrock underlying the Chapman Group and/or Tamala Limestone, with exposures in incised river beds and near the North West Coastal Highway (NWCH).

The SIA and GIAs are predominantly within the Superficial Sand layer on top of Tamala Limestone. This material provides a good subgrade standard for road construction and can generally be used as structural fill.

Trenching in the majority of the SIA and GIAs will be in deep sand with the exception being the ridges and western escarpment where it is expected that some limestone caprock will be encountered. This caprock is not considered to be problematic and should be removed easily by an excavator with a rock bucket.

With the exception of the area north of the Oakajee River, the buffer falls largely within the Chapman Group on top of Granulite Bedrock.

The siltstones and sandstones of the Chapman Group are not ideal for infiltration due to the low porosity of the material. The rocks, although hard, can easily be broken down by rockbreaking equipment.

No geotechnical issues have been identified which might constrain development of the site.

Integrated Transport Strategy

The Integrated Transport Strategy has considered the needs of the OIE, the Oakajee Port and the proposed Oakajee Port and Rail (OPR) project, as well as the wider regional context in terms of how these proposed developments will link to the surrounding transport network.

OPR has identified their required transport infrastructure for their project which includes a railway line and an access road to the port. Although the design of this infrastructure had not been finalised at the time of writing this report, it is assumed that the general layout and alignments will prevail.

The Integrated Transport Strategy considered a number of alternative road and rail options in developing the Structure Plan and a summary of the key findings are as follows:

Roads

- It is considered absolutely essential that the SIA and Port are provided with a minimum of two main access / egress points. These include a central access corridor and either a southern or northern access corridor.
- In terms of optimum integration and maximum functionality, the central access corridor is considered the most critical link for connectivity and linkage between the Port, the SIA, North West Coastal Highway (NWCH) and the Oakajee Narngulu Infrastructure Corridor (ONIC).
- The central access corridor will need to cater for heavy freight vehicles and will need to provide sufficient clearance (10m x 10m) for High Wide Loads when crossing the rail lines separating the Port and SIA. The preferred maximum grade on this road should be 3% and should not exceed 5%.
- A preferred location for the intersection between the central access corridor and the NWCH has been identified. This intersection will be at grade initially until an increase in traffic warrants a grade separated interchange. The central access road will be required when industry locates within the SIA.
- The mixing (conflict) of heavy freight vehicles and other traffic should be minimised to optimise safety, efficiency and reliability on the road network. The central access corridor as the primary freight route in combination with the southern access corridor as the primary route for light vehicles and commercial traffic could achieve this.
- Construction of the Geraldton Bypass and the consequent increase in heavy freight vehicles will most likely trigger the construction of the southern access corridor. This road could be extended to provide a southern access to the Port.
- The Geraldton Bypass will link the OIE and Narngulu Industrial Estate through the ONIC. This bypass road will be required to ensure that industries locating in the SIA have access to a land-backed Panamax berth at the Geraldton Port if a suitable berth is initially unavailable at Oakajee Port.
- It is possible that the Geraldton Bypass could initially consist of a link from the re-aligned NWCH to the existing Morrell Road which would require an upgrade to accommodate heavy freight vehicles. The long-term Geraldton Bypass would be within the ONIC.
- A grade separated interchange will be required for linking the re-aligned NWCH to the Geraldton Bypass.
- OPR have proposed to construct a northern access road to the Port. It is unlikely that this road will provide access to the SIA.
- In the initial stages of the development all intersections and crossings are likely to be at grade. As traffic volumes increase, critical intersections will be upgraded to grade separated interchanges.

Rail

- The SIA will require a multi-product railway line to service the needs of industry. This line is intended to run parallel to the iron ore lines and follow the perimeter of the SIA.
- The Oakajee Port will require a multi-product rail link to support the development of the berths on the future northern breakwater. It is important to make provision for a direct rail link between the SIA and the port and any future expansion to the north.
- The locations for a rail marshalling and maintenance / provisioning yards for multi user rail purposes for the estate and port require further consideration. Based on an initial high level review a preferred location for this yard is the OIE buffer to the east of the NWCH.
- When rail lines are introduced the main transport crossings will consist of a combination of level crossings and grade separation as required by the traffic volumes and safety and operational requirements. The intersections with main access and distributor roads will be grade separated.

Infrastructure Corridors

- Wherever feasible and practical the road, rail and services infrastructure will be co-located in shared infrastructure corridors.
- A service corridor will follow the Geraldton Bypass from the Wokathera Gap. This corridor will enter the SIA at the central access road.
- A service corridor, including provision for conveyors, is required between the SIA and the Port.
- Service corridors will be provided in SIA and GIAs either side of major roads.

1. Introduction

1.1 Background

Oakajee was selected by the Western Australian State Government in 1992 as a site for future processing industries and a deep water port. From 1997 to 2009, the State, through LandCorp, acquired and rezoned approximately 6,400ha of land for this purpose.

Existing and proposed iron ore mining projects in the Mid-West cannot develop to desired levels unless a rail link and deep water port are developed for the export of iron ore. The State Government acknowledged this need by appointing Oakajee Port and Rail (OPR) in March 2009 as the infrastructure provider for the project.

OPR are currently undertaking a Bankable Feasibility Study into construction of the port and rail and are forecast to start construction in 2012. The State has also initiated preparation of the Oakajee Port Master Plan (OPMP) to guide potential expansion of the port and related facilities into the future.

Construction of the port and rail and their future expansion will present a major opportunity for LandCorp and the Department of State Development (DSD) to develop the Oakajee Industrial Estate's Strategic Industry Area for heavy industry, the General Industry Areas for support industry and the Buffer Area for a range of compatible uses. The port and rail will make it possible to attract industry to the estate by providing a gateway to overseas markets and access to resources for value adding. This major investment in infrastructure will also bring water, power and possibly gas to the area, and these services can be upgraded and extended into the industrial estate when required.

Development of the port, rail and industrial estate cannot proceed until a Structure Plan for the area is completed in accordance with the Shire of Chapman Valley Town Planning Scheme No 1, Amendment 18. The Structure Plan will guide future development of the Strategic Industry Area, General Industry Areas and Buffer Area, and will ensure the industrial estate integrates, over the long-term, with the port and rail developments.

1.2 The Structure Plan

The Structure Plan for Oakajee Industrial Estate (OIE) considers, *inter alia*, each of the following elements:

- An integrated transport solution which incorporates an access corridor from OIE to the proposed Oakajee Port, trafficable by High Wide Load (HWL) vehicles , access to a multi-product rail line linking the SIA with the ONIC (and directly with the port if required) and a minimum of two access points to the North West Coastal Highway (NWCH).
- Provision of a suitable power supply.
- Provision of adequate potable water.
- Provision of feedwater for industries.
- Provision of natural gas.
- Provision of adequate infrastructure corridors (including conveyors and product pipelines) to service long-term requirements of the estate.

2. Site Description

2.1 Location

The OIE is located in the Shire of Chapman Valley approximately 23 kilometres north of Geraldton (see Figure 1). Its boundaries include Coronation Beach Road in the north, Buller River and White Peak Road in the south, the Port Reserve in the west, and the foothills of the Moresby Range in the east.

Access to the site is currently off the NWCH via several private tracks. There are no services in the vicinity of the site other than the Water Corporation's Northampton Branch Main, a 33kV aerial power line and Telstra's optic fibre cable.

Landholdings within the OIE comprise the following:

- Strategic Industry Area (SIA) 1,135ha
- General Industry Areas (GIAs) 196ha
- Coastal Area 1,002ha
- Buffer Area 4,072ha

The north-south axis of the SIA – the industrial core of the estate – is approximately 4.5km long and its east-west axis is approximately 2.5km at its widest point.

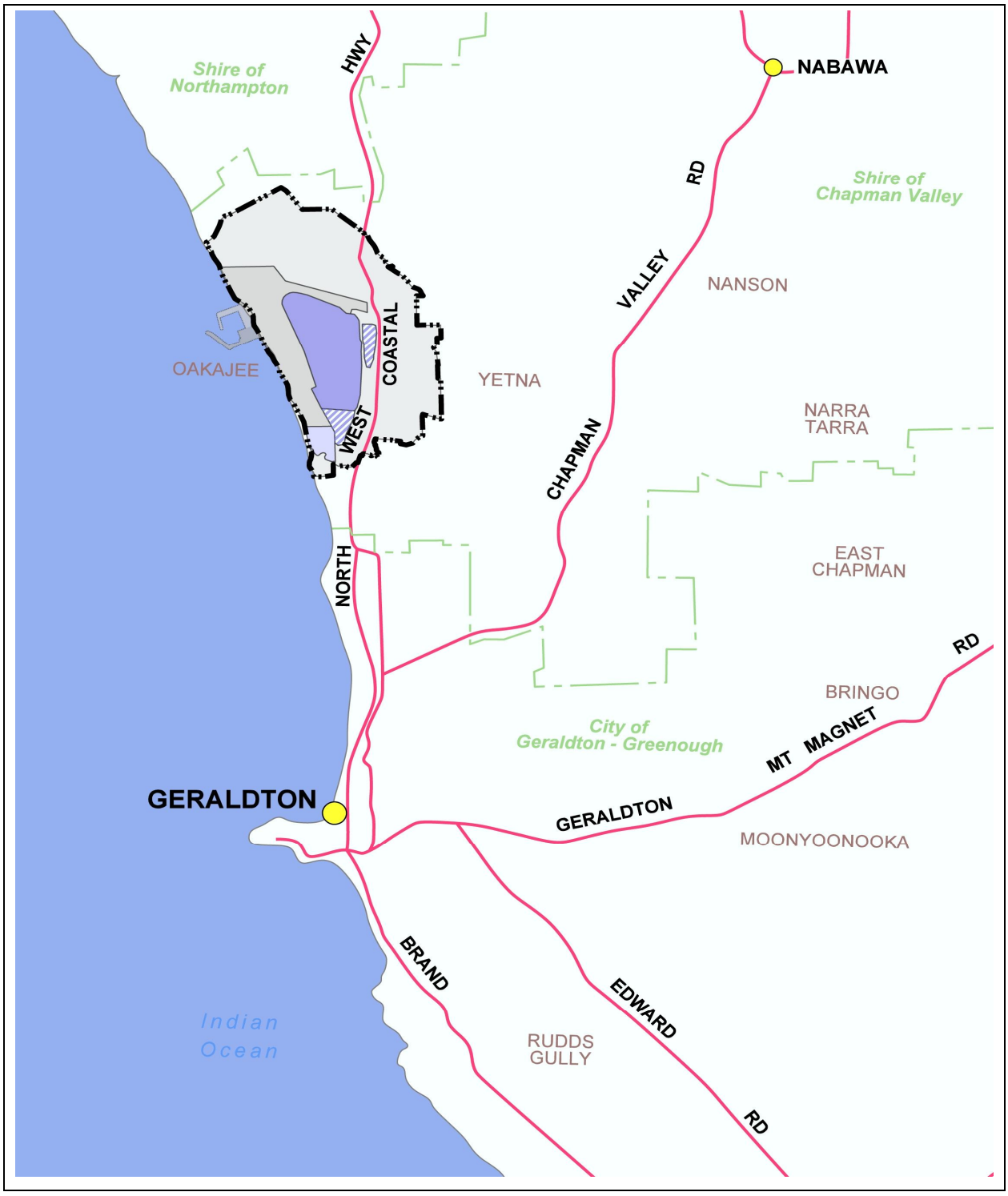


Figure 1 Oakajee Industrial Estate (OIE) Location Plan

2.2 Topography and Landform

The SIA lies largely on a plateau about 1km back from the coastline, undulating gently between RL70m AHD and RL95m AHD. There is a general fall from the northern boundary of the SIA towards the Buller River, apart from a limited area in the north that slopes towards the Oakajee River.

The Coastal Area is largely dunal, with the sand dunes supporting remnant vegetation but including two large, exposed sand sheets. The dunes rise to a height of about 30m. A well vegetated escarpment with numerous limestone outcrops separates the lower coastal area and the higher plateau.

East of the SIA, the NWCH runs parallel to a tributary of the Buller River. The land drops beyond the eastern boundary of the SIA to the NWCH and this river tributary beyond it.

With the exception of pockets of remnant scrub in the north-west and south-west, the SIA has been cleared and is used for cropping and grazing.

2.3 Geotechnical Considerations

A desk top review of previous geotechnical studies and available geological mapping forms the basis of the following geotechnical assessment of the site. These studies include a report on a geotechnical site investigation by GHD in 1994 and a hydrogeological investigation undertaken by Rockwater in 1996.

The purpose of the desktop review was to determine the nature of the soil and underlying geology, and whether either might constrain development of the SIA and the GIAs.

2.3.1 Safety Bay Sand

The coastal dunes comprise Safety Bay Sand on and below the coastal escarpment. It is a highly fragile material if exposed and should therefore be disturbed as little as possible unless its stability is protected and undeveloped areas are promptly revegetated. The sands are generally loose and, whilst difficult to compact, could be used for bulk filling.

When contained, the soil will have good engineering properties, but trenches or exposed faces will be unstable.

This soil type does not occur within the SIA or the GIAs.

2.3.2 Alluvium and Colluvium

These materials occur in and adjoining the river beds and their tributaries and are not widespread. Generally stable, they would be suitable for fill. Their properties are, however, variable, and some blending would be required to obtain consistency. Removal of this material would, however, cause considerable environmental damage, as areas of floodplain and neighbouring steep terrain would be stripped to obtain useful quantities.

2.3.3 Superficial Sand

This sand covers most of the SIA and the GIAs and is up to 25 metres deep in places, although the average depth is less than 10 metres. The majority of site works will be within this material.

It is considered to be residual from erosion and dissolution of Tamala Limestone and has been mobilised and redeposited by wind. It contains some lime and in places has nodules or sheets of re-cemented sand.

In 1992 a backhoe investigation by GHD encountered refusal on cemented material (caprock) within some areas of the Superficial Sand from near surface to 4m depth. This caprock is not expected to be consistent in plan or depth and should be readily broken by large earthmoving equipment.

Excavations will be moderately stable in both natural and re-compacted material, although more sandy exposures will require stabilisation. The material should provide reasonable fill if any cemented sections are broken down to less than 300mm size. The resulting fill will be stable with limited settlement, provided it is compacted correctly. It should also provide good subgrade material for road construction.

There may be areas with more consistent limestone and/or cementing, and this will have similar potential uses to Tamala Limestone (see 2.3.4 below).

2.3.4 Tamala Limestone

This is a stable landform unit found in the west of the SIA. It comprises moderately cemented to well cemented rock with some re-cemented capping. Massive and consistently cemented limestone was encountered in only one or two boreholes, and it is concluded that the occurrence is random and may even represent buried pinnacles or re-cemented material.

When broken, this material will form a rubbly mixture of quartz and lime sand together with pieces of harder limestone which, when graded suitably, will be a potential source of sub-base for roads and can serve as a general wearing surface to prepared ground, strong enough to resist construction traffic and wind/rain erosion.

In most situations the material will be readily excavated by heavy earthmoving equipment, as there are sufficient weaker layers and variable cementing to allow fracture. It will be stable in shallow excavations up to 1 metre in depth.

A deeper unit of the Tamala Limestone is more sandy, with patches of lime cementation. This unit lies beneath the limestone and is only near the surface in southern portions of the site. It is likely to have better properties than Superficial Sand but will not be as consistently good as limestone in the upper unit.

There is a remote chance of cavities or vugs in the limestone of sufficient size to influence the design of foundations. Movement of heavy equipment should collapse weaker voids, but a small risk remains and excavations should be inspected by experienced professionals for a better appreciation of any potential risk.

2.3.5 Chapman Group

The siltstones and sandstones of this group are at depths of 50 metres or more, rising to the east where they are about 10 metres below the surface. There are occasional exposures in the incised river beds and near NWCH. Generally they will not be encountered in site works, but if they are they will provide stable excavations.

The rocks of the Chapman Group are impervious but are not particularly strong and can usually be broken by heavy equipment, forming a rubbly mixture which is not superior to Tamala Limestone for use as fill.

2.3.6 Granulite Bedrock

This underlies the Chapman Group and/or Tamala Limestone in most places, with exposures in incised river beds and near NWCH. It is exposed below Tamala Limestone on the western escarpment near the centre of the site, and there is also a rare surface exposure through sand south of the site near Buller River.

The material is not likely to be exposed in site works, except perhaps in railway cuttings. Apart from weathering of its upper layers, it consists of hard and durable rock difficult to excavate but providing steep and stable faces.

The nature of this rock was not investigated in detail, but examination of exposures indicates it should provide stable rock or crushed gravel fill, but it may not be suitable as concrete aggregate.

2.3.7 Summary of Geotechnical Implications

The SIA and GIAs are located largely on Superficial Sand over Tamala Limestone. This material offers good subgrade standard for road construction.

Trenching in the majority of the SIA and the GIAs will be in deep sand, except on ridges and the western escarpment where limestone caprock may be encountered. This caprock is not

considered problematic and should lend itself to extraction by an excavator with a rock bucket. No blasting is envisaged.

With the exception of land north of Oakajee River, the Buffer Area predominantly falls within the Chapman Group overlying Granulite Bedrock. This is of generally low porosity and its rocks, although hard, should be readily broken by rock breaking equipment.

Based on the desktop geotechnical assessment, there are no known geotechnical issues that should constrain development of the SIA or the GIAs.

3. Transport Principles

3.1 Introduction

The Integrated Transport Strategy considers the OIE, the Port and the OPR development and incorporates the following:

- Identification of key strategic infrastructure corridors (including road, rail and services).
- Proposed road access for SIA and GIAs.
- Proposed route for a multi-product railway line to service the SIA.
- Integration of the OIE and Oakajee Port.
- Proposed location of conveyors and product pipelines.
- Provision for linking the SIA to the ONIC.

The Integrated Transport Strategy is based on extensive work undertaken by LandCorp (Draft Structure Plan), the Geraldton Port Authority (Draft Port Master Plan) and OPR.

3.2 Key Principles

The following key principles have been identified for the Integrated Transport Strategy for the Port and OIE:

- A simple layout providing a well defined network and clear hierarchy of roads and rail.
- Flexible and robust infrastructure corridors with sufficient provision of space to accommodate all services, utilities and transport requirements.
- Strong links between the Port and the SIA and GIAs – particularly with regard to road, conveyor and High Wide Load (10m x 10m) access.
- A minimum of two main access points to the SIA should be established as an absolute minimum.
- Industry within the SIA will require access to a multi-product rail line.
- Strong links between the OIE and the ONIC will be promoted to support and develop good connection to the wider region, the hinterland and Narngulu Industrial Estate and Geraldton Port.
- In all cases, the design and construction of road access to the site shall be to Austroads and Main Roads WA (MRWA) standards and the Local Authority requirements where applicable, and all rail design and shall be to the specification and requirements of the Public Transport Authority (PTA).

The following sections of the report describe the integrated road and rail systems in more detail.

4. Integrated Road Transport Strategy

4.1 Existing Road Infrastructure

4.1.1 North West Coastal Highway

NWCH forms part of the strategic coastal link between Perth and the major regional population and employment centres of Geraldton, Carnarvon, Karratha, Northampton and Port Hedland.

This highway is a major freight route as well as the principal access route to coastal tourist destinations north of Geraldton. Currently, heavy vehicles up to 53.5 metres long are not permitted on the section of the highway south of Carnarvon.

4.1.2 Coronation Beach Road

Coronation Beach Road forms the northern boundary of the Oakajee buffer. This road predominantly provides access for recreation purposes to Coronation Beach and is not considered desirable as an access road to the Port or SIA.

4.1.3 Other roads

Other minor roads that are located within the Buffer Area are Olsen Road, Wells Road and White Peak Road.

4.2 Future Road Development Requirements

4.2.1 North West Coastal Highway

Growth in industrial development in the Pilbara is putting increasing pressure on the extension of the heavy vehicle network, including the NWCH and the stretch of road from south of Geraldton to just north of Northampton.

Currently, work is being undertaken by MRWA on options for the north-south Geraldton bypass route.

In addition, there is general agreement for the need to progress with an alignment definition study for the north-south road through Geraldton to support future development of the Greater Geraldton Region and Geraldton City. MRWA is carrying out further planning work for the southern section of the north-south route.

There is also a requirement for a freight network review to be undertaken, to consider the management of heavy vehicles through Geraldton, including a critical review of the ONIC and potential Geraldton Bypass. The planning of the ONIC is currently underway and the indicative alignment is shown on the Main Roads Strategic Transport Network Plan shown in Figure 2

The North West Coastal Highway is classified as a State Road and is a Primary Distributor. The road is currently a single carriageway and has a posted speed of 110 km/h.

Existing NWCH traffic volumes in the vicinity of the Oakajee development are shown in the table below.

Table 1 NW Coastal Highway Existing Traffic Volumes

Location	Year	Vpd	HGV %	Class 10-12 (Long Vehicles and Road Trains)
NW Coastal Highway (south of Coronation Beach Road)	2009	2700	14%	5.6%
NW Coastal Highway (south of Cooper Road)	2008	2720	15.3%	4.9%
NW Coastal Highway (south of Chapman Valley Road)	2008	12,800	7.7%	1.6%

Source: Main Roads WA.

Road network improvements identified in the Roads 2025 - Road Development Strategy (MRWA and WALGA) indicate the development needs for NWCH as follows:

Function of North West Coastal Highway

- Link to the north-west of the state that caters for the tourism, fishing, agricultural, mining and oil and gas industries. It is a strategic tourist, freight and inter-town route. Regional Functional Road Hierarchy class is Primary Distributor.
- North West Coastal Highway is a Restricted Access Vehicle (RAV) Network 8 road. This allows a maximum vehicle length of 36.5 m, however there is a major exception to this for the operation of livestock, hay and straw cartage. These products may be transported on North West Coastal Highway, south to Ogilvie, at a length up to 53.5 m.
- With the proposed development on the North-West Shelf with further expansion of the Woodside facility and the Gorgon Project coupled with increased activity in the iron-ore sector, this road will be inadequate to safely and efficiently handle the additional transport task.
- The Oakajee industrial development will attract much higher numbers of large Restricted Access Vehicle (RAV) combinations which in turn will add to the already high numbers using this road. This will reduce the efficiency of this road and increase the accident rate.
- Major bridge works have seen the replacement of the single lane structures at Carnarvon (Gascoyne Region) and Nanutarra (Pilbara Region) with full width, high capacity structures. This gives the whole route greater load capacity than previously existed. There are still further bridges that require capacity upgrades such as Bridge #0804 over the Wooramel River.

The Roads 2025 Road Development Strategy

This strategy identifies the requirement for the following:

- Increase the passing opportunities on the NWCH to minimise delays for other traffic caused by vehicles with low acceleration. This will assist in the management of the level of driver frustration and delays.
- Extend the dual carriageway north from Geraldton-Mt Magnet Road.
- Ensure a suitable access road to the proposed Oakajee (port and) industrial development to avoid stacking of vehicles on or near North West Coastal Highway.
- Provide a heavy vehicle detour around Northampton to ensure social benefits for the community.
- Undertake geometric improvements between Geraldton and Binnu to more safely cater for the tourist/heavy vehicle mix.

It is noted that NW Coastal Highway is not a triple road train route between Geraldton and Carnarvon.

Figure 2 provides a plan of the strategic transport network for the greater Geraldton area, including Oakajee.

Figure 2 Strategic Transport Network Plan – Greater Geraldton Area

4.2.2 Geraldton Bypass

As part of the ONIC, MRWA proposes to construct the Geraldton Bypass to pass through the Wokathera Gap from the east, heading towards the SIA to tie into the current existing NWCH.

The first proponent to locate at the SIA that requires access to a land-backed Panamax berth will most likely trigger the construction of the Geraldton Bypass as far back as Morrell Road and the upgrading of Morrell Road. This will allow freight to be trucked to the existing Geraldton Port until a suitable berth is available at Oakajee.

Development to the north in the Pilbara could result in significant increases in heavy vehicle movements to the north. This could also be a trigger for the construction of the bypass as these vehicles are unable to use the existing NWCH.

4.2.3 Re-alignment and Classification of the NWCH

Besides the proposed Geraldton Bypass, MRWA is also planning to upgrade the section of NWCH to accommodate a future dual lane highway.

The NWCH south of the tie-in to the proposed Geraldton Bypass will be downgraded and re-aligned to follow the old Geraldton to Northampton rail corridor (south of the Buller River) when the bypass is constructed. This will require a new grade separate interchange where the section of re-aligned NWCH ties into the Geraldton Bypass.

There are some further re-alignments proposed by OPR to the NWCH north of the SIA.

4.3 Oakajee Port and Rail (OPR) Proposed Road Infrastructure

OPR is intending to construct a road off NWCH for access to a temporary workers camp and for access to their proposed rail infrastructure. The location for the intersection on NWCH has been identified.

OPR is also planning to construct a northern port access road and quarry haul road with access on NWCH north of the Oakajee River.

In order to accommodate the OPR proposed rail line into the port, OPR are also proposing to re-align a portion of the NWCH to provide a grade separated interchange over the new rail line and this re-aligned section of the NWCH will be extended further north to just beyond the OPR proposed northern access route to the port to provide for this new intersection.

4.4 Oakajee Industrial Estate Traffic Study

As part of the development of the integrated transport strategy for the Structure Plan, GHD carried out a high level traffic study for the OIE.

Based on this traffic study and the predicted traffic generation forecasts for the OIE it is evident that the primary link between the SIA and the Port will be the central access corridor which will carry the bulk of the heavy freight traffic between these two strategic developments.

The traffic study also demonstrates the requirement for a strong link and connection between the OIE and Geraldton (and the ONIC) to the south, motivating the need for a southern access road.

The traffic study also identifies a movement to the north of the OIE along the NWCH. This traffic could either share the central access corridor or access the NWCH by means of a northern access road.

This study supported the general road network layout outlined in the draft OPMP which identified the requirement for a main central access road and a north and south access road to service both the OIE and the Port.

4.4.1 Forecast Traffic Generation

In order to establish the likely traffic generation from the OIE at full capacity, trip rates based on industry guidelines (RTA Guide to Traffic Generating Developments) were considered together with trip rates used by MRWA for the Kwinana Industrial Area.

The potential industries that will locate at the OIE are based on a Market Analysis undertaken by ACIL Tasman and an Industrial Ecology Strategy which is an addendum to the Draft Structure Plan.

The RTA rates would appear to be high in view of the likely land use and site coverage, and following consideration and discussion with MRWA these rates were discounted.

Instead, the MRWA indicated trip rate for the Kwinana Industrial Area of 4.7 trips per employee (which is much lower than the RTA rates) was selected for use in the OIE traffic study.

Applying the rate of 4.7 trips per employee results in 24,440 trips per day for the OIE (5,200 employees x 4.7 trips).

This was considered a fairly conservative estimate for an industrial development of this nature and based on review and GHD's experience of similar developments, it was determined that a total traffic volume of **20,000vpd** would be used in the traffic study assessment.

4.4.2 Traffic Volume Distribution

Traffic generated by the industrial estate at full development has been estimated at 20,000 vehicles per day, distributed as shown below:

Table 2 Traffic Distribution for the Proposed OIE Development

Destination	Distribution	Vpd	Vph
Internal	10%	2,000	400
Northern Destinations	10%	2,000	400
Southern Destinations, Geraldton via NWCH	40%	8,000	1,600
Southern Destinations, Narngulu via Bypass	15%	3,000	600
Eastern Destinations via Bypass	5%	1,000	200
Oakajee Port	20%	4,000	800
Total		**20,000**	**4,000**

Vpd = vehicles per day, Vph = vehicles per hour (based on peak hour flow in both directions) = assumed 20% of vpd for this report

Existing traffic on North West Coastal Highway is approximately 2700vpd.

Assuming this value doubles to 5500, and an additional 2700vpd is introduced by the Geraldton bypass, total volumes circulating in the vicinity of the estate at the time of full development will be as shown in Figure 3.

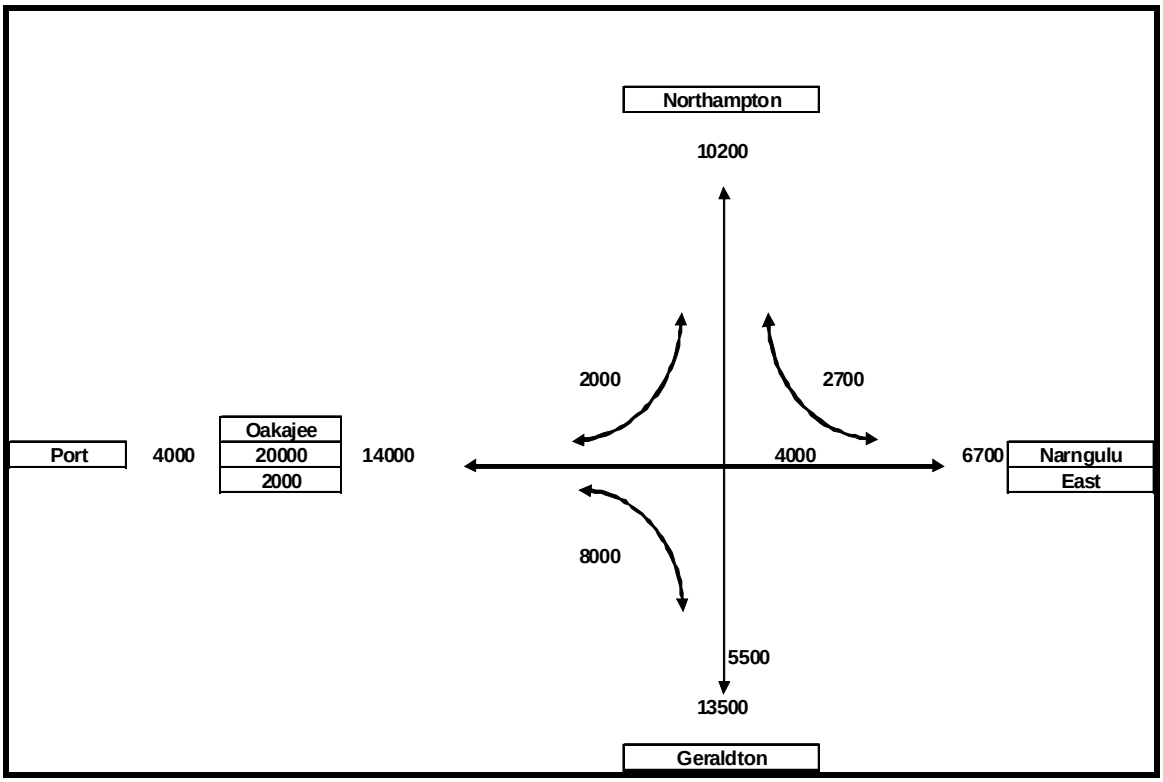


Figure 3 - Anticipated Traffic Volumes

4.4.3 Traffic Generation from Surrounding Area

The following reports were reviewed as part of the traffic study carried out for the OIE in order to determine traffic generation from the surrounding area:

- DPI - Transport impact on the road network abutting the Glenfield structure plan (technical working report)

  This report is an internal working document and considers the traffic generation from the Glenfield Structure Plan area. The report identifies the construction of Oakajee Port (due completion 2013) will also be a major employer for the region. Therefore, after Oakajee Port and industrial estate are completed, there will be an increase in traffic generated to the north of the Glenfield Structure Plan area.

- Geraldton North South Highway (MRWA April 2009)

  This report prepared by GHD for MRWA considered the broad traffic generation from the area around the proposed Geraldton North South Road and indicates in excess of 9,000vpd could be attracted to Oakajee.

4.4.4 Access onto North West Coastal Highway

Peak Hour

Table 2 above (traffic distribution for the OIE) indicates that in the order of **2,200vph** are likely to access onto NWCH in the evening peak hour of which 600vph could head north and east via NWCH and 1600vph could head south via NWCH .

A further 600vph (southern destinations – Narngulu) are forecast to use the Geraldton Bypass.

Assuming a minimum of two access points for the SIA onto the NWCH and that 30% of the forecasted traffic uses the central access corridor and 70% uses the southern access corridor would result in approximately 840vph on the central access road and 1960vph on the southern access road.

Daily Traffic

The traffic figures indicate that in the order of **14,000vpd** are likely to access onto NWCH of which 2,000vpd could head north and east via NWCH and 8,000vpd could head south via NWCH.

A further 4,000vpd are forecast to use the Geraldton Bypass.

Assuming two access points onto NWCH and 30% use the central access and 70% the southern access would result in approximately 4,200vpd on the central access road and 9,800vpd on the southern access road.

Based on surveys for the Wedgefield Estate the proportion of Long Vehicles and Roads Trains is approximately 6% applying this to Oakajee would result in 1,200vpd (class 10-12).

Table 2 above indicates that connections onto NWCH may ultimately require a dual carriageway configuration depending on the actual split of traffic.

The NWCH should also be constructed as a dual carriageway adjacent to and south of the site to accommodate forecast traffic volumes of 10,700vpd (8000vpd + 2700vpd existing).

4.5 Port Generated Traffic

To gauge the possible traffic generated by the proposed Oakajee Port requires an understanding of likely Port use and, in the absence of this detailed information, a Trade Forecast was used to determine port generated traffic and is summarised in the table below.

Table 3 Oakajee Port Projected Traffic Volumes (based on Trade Forecast)

Location	Year	Total Vpd	HGV %	Class 10-12 (Long Vehicles and Road Trains)
NW Coastal Highway and OIE – Port	2014	1,900	15%	7.5%
NW Coastal Highway and OIE – Port	2020	3,700	15%	5.0%
NW Coastal Highway and OIE – Port	2040	4900	15%	3.0%

These projected port traffic volumes of 4900 vpd (based on trade forecast and the draft OPMP) compare quite well with the traffic volumes predicted by the traffic studies of 4000 vpd undertaken for the OIE Structural Plan.

4.6 Road Transport Opportunities and Constraints

The following opportunities and constraints have been identified in regard to the transport requirements identified for the OIE:

- The only viable access to the OIE is via the NWCH.
- The horizontal and vertical geometry of the NWCH only provides limited opportunities to access the Port and the SIA, particularly where the entry intersections are to be designed to standards that comply with MRWA and AustRoads - "Guide to Traffic Engineering Practice, Part 5 - Intersections at Grade". For a major intersection with a design speed of 120kph, an entering sight distance of 500 metres is required.

- A study of the contour and level information confirms that there are generally only two or three suitable major access intersection locations for Oakajee, one at the northern end of the site, one approximately central to the site and the other at the southern end of the site, where access that satisfies the design criteria can be accommodated.
- The proposed southern access entry to the SIA is 2.5km north of the Buller River bridge crossing and the proposed central access entry is approximately 1500m south of the proposed iron ore rail lines. The general location of these access entry points have been agreed in principle with MRWA and are subject to further design and final approval by the relevant authorities. The details of these proposed access corridors are provided on the Draft Structure Plan layout for the OIE.
- The preferred heavy freight vehicle access road into the Port and SIA is the main central access corridor entry. This entry is approximately 5.5km south of Coronation Beach Road. The horizontal and vertical alignment of the NWCH at this location affords adequate entering sight distance to accommodate an intersection at grade. This entry road would be constructed when industry locates within the SIA.
- When traffic volumes justify it, heavy freight traffic coming from the Geraldton Bypass could use the central access corridor while passenger and light vehicles coming from Geraldton could use the southern access. A northern access to Oakajee Port will provide further flexibility and accommodate future expansion of the port to the north as well as potentially relieving the volume of heavy traffic to the Port on the central access corridor.
- As further development occurs, the proposed internal roads within the Oakajee Port and OIE will experience significant traffic volumes and are expected to have a high percentage of truck movements. To accommodate heavily laden truck movements, the vertical grade of the roads should have a maximum grade of 4% - 5% and ideally a preferred maximum grade of 3% or less where practical and feasible given the difficult site terrain.
- The proposed intersections on the internal road network serving the SIA and GIAs will be controlled by give-way and / or traffic signals initially followed by grade separation for critical intersections when justified by traffic volume. It is recommended that roundabouts are not used for intersection management or as traffic control measures for the OIE unless warranted
- If required, all road / rail intersections would ultimately be grade separated but may be provided with controlled level crossings in the short term. This will be dictated by the volume of traffic and the operational, safety and traffic management requirements for the OIE as industries establish on the site
- The location of the rail lines creates a barrier to the direct link between the SIA and the Port, particularly in regard to the primary central access corridor and therefore this access road will require a bridge solution (underpass or overpass) which will need to be sized to accommodate HWL's.
- Uncertainty over the timing of the proposed Geraldton Bypass and the associated ONIC development has a number of implications for the proposed transport infrastructure for the OIE and this will need on-going consultation with all the key stakeholders
- Limited available design information for the proposed Geraldton Bypass and re-alignments of the NWCH will require further investigation and on-going development of the transport corridors identified in the Draft Structure Plan, subject to final agreement and approval of the relevant authorities.
- The existing NWCH needs to be maintained as a High Wide Load route until such time as the future Geraldton Bypass is constructed – the timing of the development of the bypass

and all other proposed re-alignments to the NWCH will have to be carefully managed as part of the delivery of the OIE and Port.

- No traffic information for the Geraldton Bypass and difficulty in predicting traffic volumes from the Port and OIE has meant that the traffic study carried out for the OIE should be reviewed as more information and data becomes available and the findings and recommendations adjusted accordingly.
- The use of trade forecasts (which are bound to change) to determine the main drivers and needs for key infrastructure and the associated scale of the required infrastructure as identified in the Draft OPMP and adopted for the Draft OIE Structure Plan needs to be regularly reviewed and the proposed infrastructure requirements adjusted accordingly if required.

4.7 Oakajee Industrial Estate Road Transport Corridors

4.7.1 Overview

A safe and efficient road network will be required to service the OIE and Oakajee port, as well as general north-south traffic on the NWCH. The mixing (conflict) of heavy freight vehicles and other traffic should be minimised, wherever practical and feasible to optimise safety, efficiency and reliability on the road network.

It is anticipated that a number of key issues relating to the proposed OIE road network include the following:

- The heaviest traffic demand will likely be between the SIA and Geraldton via the NWCH and will predominantly consist of commuter traffic and service vehicles.
- The majority of heavy multi-unit vehicles (RAVs) will use the Geraldton Bypass for access to the Port, SIA, GIAs and northern destinations.
- Heavy vehicles would require uninterrupted flows, especially on the climb to the Wokathera Gap.
- High wide loads need to be accommodated on the network, including to and from the Port and SIA.
- The provision of uninterrupted flows using grade separations may result in interchange options which are out of scale for the relatively low overall traffic volumes.

Strategically the draft OPMP identifies three main access corridors for the Oakajee Port and the OIE – namely a southern access corridor (providing access to the OIE and Port), a central access corridor (providing the main heavy traffic access to the OIE and Port) and a northern access corridor providing for future direct access to the port.

4.7.2 High Wide Loads

For the purpose of this report and the OIE integrated transport requirements it is assumed that High Wide Loads (based on provision of 10m x 10m clearances minimum) would use the following links:

- Oakajee Port ←→ SIA
- Geraldton Bypass → NWCH northbound
- NWCH north → Geraldton bypass southbound
- Geraldton Bypass → SIA westbound
- SIA → Geraldton Bypass eastbound
- NWCH north → SIA

- SIA → NWCH northbound

High Wide Loads to and from the port may be accommodated via a number of route options:

1. From NWCH (south) via the southern access corridor to the Port, which will be constrained by the height of the shiploader conveyors between the estate, the stockpiles and the port.
2. Via a direct link into the industrial estate, passing under the OPR railway near the north-west corner of the estate, which will be constrained by the size of the underpass structure.
3. Via the northern port access road proposed by OPR, which could provide unrestricted HWL access to the port. This road would not provide direct access to the SIA.

4.7.3 Grade separations and the Geraldton Bypass

In order to maintain uninterrupted traffic flows on the NWCH and the future Geraldton Bypass, as well as providing good road access to the Oakajee Port and OIE, a number of options for the road interchanges have been considered.

The key operating parameters of the interchanges are:

- The movement with the heaviest demand (primarily light and commercial vehicles) will be between Geraldton and the OIE via NWCH.
- The northbound and southbound movements on NWCH and Geraldton bypass should be uninterrupted.
- Loaded heavy vehicles should have an uninterrupted path up to the Wokathera Gap.
- High Wide Loads (10m x 10m) should be accommodated.
- Staged development, with initial at-grade intersections, should be feasible.

It is noted that traffic volumes are insufficient to warrant grade separations under normal MRWA guidelines. However the relatively steep grades and high proportion of heavy vehicles likely to use some of the links may require grade separation.

On this basis, the road and rail systems should be designed to allow ultimate grade separation, although at-grade intersections and level crossings may suffice until traffic volumes warrant grade separated intersections.

Grade separation requirements between road and rail infrastructure will also need careful consideration and further study and design development is required to ensure good integration, co-ordination and management of these critical interfaces.

4.8 Oakajee Narngulu Infrastructure Corridor

The ONIC is a proposed rail, road, services and utilities corridor that will link the OIE to Narngulu. The corridor will split at Wokathera Gap, with rail heading north and the Geraldton Bypass and services heading east through the Buffer Area to the central access corridor into the SIA.

The ONIC, which is broken down into a number of segments, includes provision for an easement for underground services, including telecoms, low voltage power, up to three slurry pipelines, water supply and high pressure gas. It also allows for a rail reserve of 60m – 80m and a road reserve of 70m – 90m. These road and rail reserves, when combined with the proposed services easement, result in an overall corridor width up to 230m where it passes through the Wokathera Gap. A 60m rail corridor has been allowed for railway lines heading north from the Wokathera Gap and the Geraldton Bypass and services heading east through the Buffer Area will be accommodated in a 170m wide corridor, comprising 90m for services and 80m for the road reserve.

Figure 4 shows the indicative proposed route for the ONIC.

Figure 4 Indicative route of the proposed Oakajee–Narngulu Infrastructure Corridor

The proposed corridor will facilitate the provision of the following infrastructure to service OIE and Oakajee Port:

- a dual gauge rail line from Narngulu to the port and industrial area for general freight and other possible mine sites to the south and east of Geraldton,
- a standard gauge heavy rail for the haulage of iron ore and mineral sands from the north east of Geraldton (Jack Hills, Weld Range and beyond),
- a controlled access, regional dual carriageway road which will act as a bypass for Geraldton for freight and regional traffic to the port and industrial estate and points further north,
- underground services and utilities including water, gas and telecoms,
- underground pipelines for the transport of iron ore slurry,

The railway component of the corridor will have a direct link to the existing southern WestNet rail network which connects to the Narngulu industrial area and Geraldton port.

The northern portion of the corridor passes through the Wokathera Gap in the Moresby Range where it splits into two corridors just west of the Gap. One corridor will accommodate the regional road and services, and the other will accommodate the multi use dual gauge rail lines.

The OPR heavy duty standard gauge rail line will also pass through the Wokathera Gap parallel to the alignment of the ONIC before proceeding north and linking into the port on the western boundary of the SIA.

4.9 Strategic Road Access Options to the Port and the OIE

Based on the topography and location of the Port, and the forecast freight throughput volumes and associated traffic, there are three main options for major, external road access to the OIE and the port, namely a northern, central and southern access road.

Considering the freight forecasts, the Draft OPMP recommends a direct freight link between the SIA and the Port for heavy haulage vehicles, including High Wide Loads which is vital to the successful operation and development of the estate and its interaction with the Port.

MRWA, LandCorp and GPA, have also stated their preference for provision of more than one access road and a separation of light traffic from heavy haulage vehicles.

The current ‘State’s Port Requirements, Design Criteria and Performance Specification’ identifies the following road infrastructure requirements as part of the ultimate port and rail development:

- ‘Northern, Central and Sothern Services Corridors linking the Port to the NWCH and the ONIC are to accommodate all of those public utilities (for example roadway, standard and narrow gauge railways, water, electricity, gas and telecommunications) that may be required for ultimate development of the Port and OIE, as documented in the OPMP and the OIESP’
- ‘The Central Port Access Road shall be a four-lane divided road located within the Central Services Corridor passing from the Port Services Corridor through the Strategic Industry Zone of the OIE to NWCH….. It also serves as a direct Port / OIE connecting road.’

Based on the critical importance of the link between the SIA and the port, a number of options for the location of adequate and suitable road access have been investigated to provide sufficient capacity, maximum integration, flexibility and robust provision for future requirements (both projected and unforseen).

4.9.1 Main Oakajee Industrial Estate Access Corridors

Considering that by 2040 the main road link between the SIA and the port is predicted to carry approximately 450 heavy vehicles per day at very low speeds to accommodate the steep grades (3 - 4% is considered the best achievable grade given the existing topography and terrain), it would be important from a safety and operating point of view to provide separate access to the port for commuters (light) and service (heavy) vehicles.

Effectively the most direct route between the port, the SIA and the NWCH is the central route and for the purposes of the Draft Structure Plan and the Draft OPMP this has been designated as the main heavy traffic and main haulage strategic corridor for the SIA.

In order to provide the most flexible and robust transport system for the Port and the OIE, it is acknowledged that a number of further access / egress transport and infrastructure corridors would be preferable and advisable.

Accordingly two further corridors for the Port / OIE access roads have been considered, as follows:

- A southern access road between the NWCH, SIA and southern GIA providing access to the industrial areas and the Port. The Draft OPMP envisages that this road could become the permanent access road to the port in the medium term. It is likely that this road will be required when the Geraldton Bypass is constructed which would result in an increase in heavy vehicles using the NWCH and encouraging the development of the southern access road to separate heavy and light traffic as much as possible.
- The Draft OPMP identified a requirement for a northern access road to the port in the longer term to provide direct access to the port and support anticipated expansion of the port and industry to the north. The northern port access road would not provide direct benefit or access to OIE, but would facilitate traffic requiring direct access to the port without having to enter or traverse the estate. This access would also support and alleviate pressure on the central and southern access roads as industries establish and activity at the port and the estate increases.

It should be noted that the original OPR proposals for the Oakajee port development identified the southern access road as the main, direct link to the port from the NWCH.

However the current OPR proposal has been amended and is now favouring a northern access road as the preferred direct link between the NWCH and the port.

4.9.2 Central Access Corridor Alternatives

It should be noted that while this infrastructure corridor has been designated as the primary heavy haulage route for both the Port and the SIA, it is possible to use this as a shared route to accommodate both heavy and light traffic until an increase in heavy vehicles using this access road warrants either a separate access road (the southern access) and / or other forms of traffic separation including a potential separate lane for light vehicles.

This is not considered ideal and another access from the south is considered essential in the medium term or when the bypass is constructed.

A number of options for the location and routing of the central access corridor were considered as part of the development of the Draft OPMP and Draft Structure Plan. The details of the optioneering study carried out for the central access corridor are fully addressed in the draft OPMP and a further, separate study on the proposed OPR rail bridge structure for the central access corridor.

4.9.3 Proposed OPR Bridge Structure between the OIE and Port

The critical significance of the central port access road is fully recognised and acknowledged in the Draft OPMP and the Draft OIE Structure Plan.

It is also recognised that an important element of the required works to facilitate the central link and connectivity between the Port, the OIE and the NWCH is the provision of a suitable bridge structure (either an overpass or underpass) to allow passage of the required central access corridor over / under the alignment of the OPR heavy rail line which effectively separates the port and estate.

The details and requirements for this proposed bridge are currently the focus of a separate study and the ultimate requirements will need to be reviewed and incorporated in the final Structure Plan for the OIE.

4.9.4 Proposed Typical Access Corridor Cross Section

The final configuration of the cross sections to be applied to the main distributors (arterials) and connectors and other minor roads serving the OIE will be subject to further development.

The proposed typical cross section detail is as follows:

Road Reserve	45m width (minimum) with provision for a 50m total reserve recommended
	An additional 10m is proposed each side of the road reserve in which no permanent structures are to be constructed (to allow for module movement and a landscaped / screening zone)
	A 20m-50m trunk services corridor is proposed each side of the road reserve in which future product pipelines etc can be located
Lanes	2 No. x 3.5m (sealed) per carriageway
Shoulders	2.0m (1.0m sealed, 1m gravel) outer shoulder, 1.5m (1.0m sealed, 0.5m gravel) inner shoulder
	Outer sealed shoulder + lane should be a minimum of 4.5m to allow for pre-assembled modular (PAM) movements
Drainage	Table drains and bio-retention swales (where appropriate) with appropriate sediment control measures
Verge width (for reticulated services)	~9.0m (6.0m excluding swales)
Paths	3.0m shared / dual use path and 1.5m footpath
Clearance envelope	70m (includes 10m either side of the 50m road reserve width)
Batter Slopes	Cut - 1:2 (1:1 max)
	Fill - 1:3 (1:2 max) – 1:2 where barriers are installed
Batter Clearance	3m to 5m (Dependant on site constraints)
Barriers	1.5m from edge line or as required by regulatory authority

A typical infrastructure corridor incorporating road access is shown at Appendix A.

4.9.5 Southern Access Corridor

There are a number of advantages and disadvantages associated with providing a southern access corridor to the OIE and Port, including the following:

Advantages

- Commuters and service vehicles will be separated from the heavy freight route when the Geraldton Bypass is operational. Development in OIE is likely to trigger the construction of the Geraldton Bypass to Morrell Road as a first stage, which would require an upgrade of Morrell Road, to provide initial access to land-backed berths at the existing Geraldton Port until available at Oakajee.
- This access road can be constructed without compromising expansion of the SIA and GIA southwards and minimises interaction and conflict with the OPR heavy rail and the proposed primary central access corridor to the port and the estate.
- Commuters will be able to access the port without travelling past major construction sites when new proponents establish at the industrial estate
- The southern access road to the port can be combined with a southern access to the OIE to provide commuters from Geraldton safe access without having to travel extra distance along the NWCH or the primary central access freight route

Disadvantages and Constraints

- The current intersection on NWCH is not ideal and further discussion with MRWA is required to develop a temporary solution until the Geraldton Bypass is constructed. This is not a major constraint and will require some further design of the southern access road to accommodate the preferred location. It will be possible to incorporate this requirement into the OIE layout in the longer term.
- The final sizing, details and location of stockpiles along the coastline has not been finalised and this will be an important consideration in determining the final route for this important access corridor.
- There are environmental considerations that will need to be taken into account.

4.9.6 Southern Access Alternatives

A number of options for the southern infrastructure corridor were considered and these are fully discussed in the Draft OPMP.

4.9.7 Northern Access Corridor

Although not considered absolutely essential in terms of general access to the port until the northern breakwater and related infrastructure are developed, and not critical to the OIE, the Draft OPMP recommends a third access point / infrastructure corridor for the port from the north.

OPR are proposing to construct a northern access road to the port as part of their Stage 1 works. This road will most likely be adopted as the northern access road for the port in the future. It should be noted however, that this road is likely to be under utilised when the central access road and associated bridge solution (underpass or overpass) are constructed and until such time as freight throughput for the port requires a separate northern access road.

Advantages

- Facilitates future expansion of the Port to the north to cater for both heavy freight in / out of the port and light traffic.

Disadvantages and Constraints

- Longer travel for commuters to the port, particularly for the main traffic movement which will be from / to the south between the port / estate and Geraldton.
- Unlike the central and southern access roads, this road does not provide direct access to the OIE.
- Light vehicles and commercial traffic wanting to access the port will have to travel further along the NWCH (a very busy heavy haulage freight route).

4.9.8 Northern Access Alternatives

A number of options for the northern infrastructure corridor were considered as part of the draft OPMP and are fully discussed in that document.

5. Integrated Rail Transport Strategy

5.1 Existing Rail Network

There is no existing rail infrastructure in the immediate vicinity of the proposed Port and OIE.

5.2 Oakajee Port and Rail Proposed Rail Infrastructure

OPR proposes to construct a standard gauge railway line from the mines in the interior to a car dumper located on the western boundary of the SIA.

As part of their operations, OPR have proposed rail maintenance facilities on the northern boundary of the SIA.

5.3 Strategic Rail Transport Requirements

5.3.1 Iron Ore Rail lines (heavy rail)

According to the ACIL Tasman Market Analysis, the rail requirements for minerals (iron ore) to the Oakajee Port can be summarised as follows:

- 2014: approximately 41mtpa of iron ore will be exported through the port – the single, standard gauge heavy rail line provided by OPR should be sufficient to cater for this throughput.
- 2020 – 2040: approximately 75mtpa of iron ore will be exported through the port – the single, standard gauge heavy rail line provided by OPR should be sufficient to cater for this throughput.
- In the event that iron ore that is currently been shipped through Geraldton is diverted to Oakajee in the future then it is anticipated that the heavy rail infrastructure proposed by OPR within the port should be adequate to cater for this – depending on the timing and assuming these volumes are in the region of 5–10mtpa.
- Beyond 2040 and up to 2100: the projections indicate that a second line could be required for heavy rail transport of iron ore.
- The Draft OPMP recommends that a further rail access infrastructure corridor for the port is provided to the north of the OPR line to facilitate and accommodate future port activities and expansion to the north by 2040. This could be a multi-product rail. This multi-product line could also service the expansion of other industries to the north.
- Should throughput volumes exceed 80mtpa at any stage, and when the development progresses to the 105mtpa iron ore export volumes anticipated for the port, a second heavy duty track for iron ore will be required.
- In the event that more than one proponent is located at the port, and provided the OPR heavy duty rail is available for open, common use, the track infrastructure proposed is sufficient to cater for up to 80mtpa, however, a further track will be required when this volume of material is exceeded
- In the event of more than one mineral ore export proponent being located at the Port, the track infrastructure will need to be expanded and increased to allow for further car dumpers, rolling stock and rail yards for the marshalling, maintenance, servicing and operations of the rail infrastructure for the port.

5.3.2 Multi-Product Rail

Based on the ACIL Tasman trade forecasts the volumes of non-mineral materials that will need to be transported directly to the Port do not warrant a separate, dedicated rail service and can be transported to the Port by road.

However, based on the potential proponents identified in the ACIL Tasman trade forecast there is a significant volume of material that will be required and / or generated by industry within the SIA and this will require transport of goods by rail.

The transport requirement for multi products including non-minerals and manufactured goods (bulk and break-bulk) from the SIA to the Port can be catered for by a combination of rail, road and conveyor.

This can be summarised as follows:

- With the initial development within SIA, bulk goods and break-bulk goods will need to be transported between the Port and the SIA – the 4 lane dual carriageway, central access distributor road link and underpass proposed between the Port and the SIA should be sufficient to cater for this throughput.
- Further development within the SIA will require transport of bulk goods and break-bulk goods between the Port and the SIA – the 4 lane dual carriageway, central access distributor road link and underpass proposed between the Port and the SIA, supplemented by a multi-user conveyor system between the SIA and the Port should be sufficient to cater for this additional throughput.
- Ultimately, development of the OIE will require transport of goods into and from SIA via a multi-product rail system along with associated infrastructure provided to cater for this throughput. The draft OPMP and draft OIE Structure Plan has identified a southern multi product rail link for this purpose.
- The development of the northern breakwater and berths of the Port will place greater pressure on the requirement for rail and road infrastructure and it is considered critical that provision for both road and rail to the Port from the north be provided.
- Provision for a future direct rail between the SIA and the port, particularly in the longer term and as the port and industry expand northwards is recommended and should be catered for. The draft OPMP and draft OIE Structure Plan has identified a northern multi product rail link for this purpose.

5.3.3 Multi Product Rail Options

Strategic corridor options for both a southern and northern multi product rail have been considered as part of the draft OPMP study to address the anticipated requirements for multi-product rail lines. These options are fully discussed in the draft OPMP and are shown on the Draft OIE Structure Plan.

6. Technical Basis of Design Parameters

The following sections outline the design parameters used for the development of the integrated transport infrastructure identified in the draft OIE Structure Plan.

6.1 Oakajee Narngulu Infrastructure Corridor

Table 4 summarises the main design parameters identified for use in developing the transport infrastructure for the ONIC.

Table 4 Oakajee to Narngulu Corridor – Design Criteria

Design Element	Typical Cross Section	Typical Grades
Roads	2 x 7.0m carriageways, 12.0m median, 2 x 3.0m shoulders	3.0% maximum
Rail	Heavy rail (iron ore) – single track, standard gauge (see OPR details)	Ruling grade – mines to port 1:300 Ruling grade – port to mines (empty) 1:100
	Multi-product rail (standard gauge) rail (other materials)	Ruling grade – 1:100, both directions
Services	90 m through the Buffer (excludes O/H power transmission) – telecoms / LV, slurry pipelines, services, 30m high pressure gas	

6.2 Oakajee Port and Rail Infrastructure Corridor/s

Table 5 summarises the main design parameters identified for use in developing the proposed transport infrastructure for OPR.

Table 5 OPR Corridor – Design Criteria

Design Element	Typical Cross Section	Typical Grades	Typical Radii
Roads	Various	Various	Various
Rail	Heavy rail (iron ore) – single track, standard gauge	Ruling grade – mines to port 1:275 Ruling grade – port to mines (empty) 1:66	Horizontal – 1000m minimum (2000m min preferred) 600m – 800m in yards and loops
Services	Various		

6.3 Proposed Oakajee Industrial Estate Infrastructure Corridor Design Parameters

In order to develop the strategic corridors for the Port and OIE, the following design parameters as set out in Table 6 have been selected to ensure a relatively harmonised approach to road and rail design parameters and to ensure future compliance and minimum differentiation between the various sections of the overall regional network, on the basis of the design parameters identified for the OPR and ONIC infrastructure.

Table 6 Oakajee Port Masterplan Corridor/s – Design Criteria

Design Element	Typical Cross Section	Typical Grades	Typical Radii
Roads	Single carriageway, 2 lanes – minimum 25.0m reserve, 2 x 3.5m lanes, 2 x 2.5m shoulders (sealed), 2 x 6.5m verges	6.0% maximum, 3.0% max preferred	Horizontal – 80kph design speed, 3% super, 520m radius (for 100kph – 980m min)
	Dual carriageway, minimum 45.0m reserve, 2 x 7.0m carriageways (4 lanes divided), 6.0m median, 2 x 3.0m shoulders (sealed), 2 x 7.0m verges	3.0% maximum	
Rail	Typical minimum 36.0m reserve – 4 tracks, 6.0m centres (x 4) , 2 x 9.0m cess and maintenance track		80kph design speed
	Heavy rail (iron ore) – single track, standard gauge	Ruling grade – mines to port 1:300 Ruling grade – port to mines (empty) 1:100	
	Standard gauge rail (multi-product rail)	Ruling grade – minimum 1:100, both directions	Horizontal – 1000m minimum (2000m min preferred) 500m – 800m in yards and loops
Services	Varies 20.0m – 60.0m		
Conveyors	Varies 10.0m – 30.0m		

6.4 Typical Infrastructure capacities

The following has been used to determine a road hierarchy for the OIE.

Roads

- >300 vpd requires a 2 lane carriageway
- 3,000 – 10,000 vpd requires a 4 lane, divided carriageway
- >10,000 vpd requires a separate access corridor

Traffic Volumes based on trade throughput

- A typical B-Triple vehicle (class 10 – 12) can transport up to 100 tonnes
- A typical B-Triple vehicle is equivalent to 5 passenger car units
- HGV's make up 15% of traffic
- Port / OIE traffic will operate 300 days of the year

6.5 Road Hierarchy

The general road classification used in this study is generally based on the MRWA road hierarchy system, as set out in Table 7.

MRWA directly manages approximately 17,000 kilometres of State Roads outside the Perth Metropolitan area. These are typically 'highways' and 'main roads', collectively known as State Roads. All have a similar role, to provide efficient mobility of people and goods. They carry relatively high traffic volumes of fast moving traffic to meet the primary road transport

needs of the State. Main Roads also manages regulatory signs and traffic signals on all public roads in regional areas.

The Regional Road Hierarchy (RRH) consists of four types of roads:

- Primary Distributor;
- Regional Distributor;
- Local Distributor/Industrial; and
- Local Access Road.

Criteria that define the four road types are shown in Table 7.

It should be noted that the classification “Primary Distributor” is reserved for State Roads only.

Table 7 Regional Road Hierarchy – Road Types and Criteria

CRITERIA	PRIMARY DISTRIBUTOR	REGIONAL DISTRIBUTOR	LOCAL DISTRIBUTOR/ INDUSTRIAL ROAD	ACCESS ROAD
* AA Essential Criteria	Must be a State Road – Responsibility of Main Roads	Must be an agreed Roads 2025 "Local Govt Significant Road"	Must function as a Distributor Road	Main function is access – usually services less than 10 properties/km.
1 **Predominant Activity	Major networks linking significant towns and destinations e.g. highways.	Local Government roads linking significant destinations and designed for efficient movement of people and goods	Local government roads carrying trucks, machinery, tourists and sometimes have slower moving traffic.	Roads other than Primary and Rural Distributor roads which form part of local distribution network to individual properties
2 Degree of Connectivity	High. Connects to other Primary and to Rural Distributors.	High. Connects to Primary and to other Rural Distributors.	Medium. Connects to other Rural Distributors and to Rural Access Roads.	Generally connects to Rural Distributors and properties.
3 Intersections	Controlled with appropriate measures e.g. high speed traffic management measures, signing and	Controlled with measures such as signing and line marking of intersection.	Controlled with measures such as signing.	Self controlling with minor measures.
4 ***Indicativ	Greater than 200 vehicles per day.	Greater than 100 vehicles per day.	Up to 100 vehicles per day.	Up to 75 vehicles per day.
5 Frontage Access Allowed	Preferably none but limited access exists to service individual properties, paddocks and service stations.	Prefer not to have property access and limited commercial. Generally via lesser roads.	Property and commercial access due to its historic status. Prefer to limit whenever possible.	Yes. Majority of property access. Should be from these roads.
6 Pedestrians Allowed	Should be controlled to encourage crossing at safe locations and have signs to warn drivers.	Measures for control and safety such as careful siting of school bus stops and rest areas.	Yes	Yes
7 Recommended Operating Speed	Generally 110km/h – an open road	Generally up to 110 km/h	Generally less than 90-km/h due to road geometry/road condition	Safe operating speed may be limited due to road geometry, surface or condition.
8 Buses Allowed	Yes	Yes	Yes	If required e.g. school buses.
9 On Road Parking	No – emergency parking on shoulders – encourage parking in off road rest areas.	No – emergency parking on shoulders – encourage parking in off road rest areas where possible.	No – emergency parking on shoulders – encourage parking in off road rest areas where possible.	Yes. Where sufficient width and sight distance to allow safe passing.
10 Signs & Linemarking	Centrelines, speed signs, guide and service signs to highway standard.	Centrelines, speed signs and guide signs.	Speed and guide signs.	Guide signs.
11 % Heavy Vehicle	Major through route with greater than 10%	Greater than 10%	Road is capable of seasonal truck and machinery traffic, or in the case of Industrial Roads, trucks servicing industry	Only to service individual properties but capable of seasonal truck and machinery use.
12 Roadside Amenity	Parking Bays/Rest Areas. Desired at 40km spacing.	Parking Bays/Rest Areas. Desired at 60km spacing.	Parking Bays/Rest Areas. Desired at 80km spacing.	No bays provided.
13 Responsibility	Main Roads Western Australia	Local government	Local government	Local government

Notes for Regional Road Hierarchy (RRH):

(*) Ideally, when considering road networks, every road would meet all the criteria of one Regional Road Hierarchy type, but many roads meet some of the criteria appropriate to several different hierarchy types and are designated by determining the majority of criteria that apply. All must meet 'AA' Essential Criteria.

(**) Criterion 1- Predominant Activity

"Significant destinations" as defined by Roads 2025 criteria includes State or regional tourist destinations, communities of greater than 500 population and remote communities with greater than 250 population or remote communities of greater than 50 population with limited road access.

(***) Criterion 4 – Indicative Traffic Volume

As these criteria are for State wide use, the Traffic Volume Figures are intended to reflect volumes in the majority of Regions. However, some Regions will have roads that don't reach the indicative volume, while others will have volumes far in excess of those indicated.

7. Summary of Transport Options

Table 8 summarises the transport corridors considered (note – the table is not meant to compare the access corridors, all of which are considered necessary for ultimate development of the Port and OIE, but summarises the key strengths and weaknesses of each):

Table 8 Summary of Transport Options

Item	Advantages	Disadvantages and Constraints
Southern Access Road	◗ Separation of light commuter vehicles from Geraldton and the heavy vehicles on the Bypass ◗ Separation of commuters from construction of the industrial estate ◗ Provides direct commuter access to the port and OIE ◗ Provides effective and efficient link for the main traffic movement (south) identified between the Port / OIE and Geraldton ◗ Provides for possible future connection to the ONIC ◗ Provides an additional escape exit for emergency events	◗ Environmental considerations ◗ Requires further consideration in terms of ultimate location of stockpiles ◗ Future grade separation / rail-road and road-road interfaces need to be developed
Northern Port Access Road	◗ Shorter route from NWCH to Port from the north (compared to southern access road) ◗ Future heavy haulage route for Port expansion. ◗ Provides a viable alternative, and a more balanced road access network, in combination with the central and southern access ◗ Provides greater linkage and connectivity for the overall transport network for the area	◗ Clash of heavy and light traffic on NWCH. ◗ Longer travel for commuters from the south ◗ Future grade separation / rail-road and road-road interfaces need to be developed and agreed ◗ Critical Intersection / Interchange details to be developed ◗ As this road is likely to be constructed first as part of OPR's project, it will become under utilised when the central access road is constructed to service industry until Port development to the north requires a separate access road for freight

Item	Advantages	Disadvantages and Constraints
Central Access Road	◗ Main access for heavy traffic and HWL's ◗ Most direct link between Port, SIA and NWCH ◗ Provides good linkage and integration between Port and industrial areas.	◗ Requires bridge (underpass or overpass) across OPR rail ◗ Gradients between the Port and the SIA are not ideal for HWL traffic ◗ Future grade separation / rail-road and road-road interfaces need to be developed and agreed ◗ Critical Intersection / Interchange details to be developed
Multi-Product Rail (southern rail link)	◗ Provides for future rail service to the SIA	◗ Geometry / gradients are not ideal for optimum rail operations ◗ Requires further, careful consideration of interfaces (grade separation) between road and rail infrastructure ◗ Co-location of infrastructure within ONIC / OPR corridors needs to be confirmed and agreed
Northern Rail access to the port	◗ Provides for future rail to the port from the north and potential direct rail link between SIA and port	◗ Geometry / gradients are not ideal for optimum rail operations ◗ Requires further, careful consideration of interfaces (grade separation) between road and rail infrastructure ◗ Co-location of infrastructure within ONIC / OPR corridors needs to be confirmed and agreed
OPR's heavy rail	◗ Provides for the transport of mineral exports through the Port (iron ore)	

8. Summary of the Proposed Transport Strategy

8.1 Roads

The proposed road access strategy is shown in Figure 01 at Appendix B and can be summarised as follows:

Southern Access Road to the Port and OIE

This road is the preferred access road to GIAs, SIA and the Port for commuters and light traffic from the south as it will provide a separation of commuter traffic from heavy freight traffic using the Geraldton Bypass and entering eastern and northern GIAs and SIA at the central access road.

This road will ultimately be connected at grade to the realigned NWCH north of White Peak Road once the Geraldton Bypass and associated intersection with the NWCH is constructed.

A temporary at grade intersection on the NWCH will be provided until the NWCH is realigned.

Central Access Road to the Port and OIE

The central access road will be required to provide access to the first industrial proponents in the SIA.

It is proposed that the intersection on the NWCH will initially be at grade with suitable arrangements for left and right turn movements into the eastern GIAs. Due to the current vertical alignment of the existing NWCH, the preferred location identified for this intersection / interchange is considered to be suitable for this arrangement.

The at-grade intersection will be replaced with a grade separated interchange when development at the OIE and an increase in heavy traffic requires the construction of the Geraldton Bypass.

The central access road will provide the critical link between the Port, SIA and NWCH. To achieve this, an underpass suitable for HWL traffic under the iron ore and multi product railway lines dividing the Port and the SIA is required.

The road between the port and the SIA will be carrying heavy traffic and grades should be kept to a maximum preferred gradient of 3 %, and should not exceed an absolute maximum of 5%. It is also intended that the road will have sufficient width for two lanes for heavy vehicles at very slow speeds and a separate lane for commuter traffic.

Northern Access Road to the Port

The Geraldton Port Authority's Draft OPMP identifies the requirement for a northern access road to the Port when development of the northern breakwater and berths justifies the need for a separate access road for freight entering and leaving the Port.

This road will not have any direct advantage for the SIA or GIAs apart from providing a route to the Port without any height restrictions.

It is anticipated that the proposed OPR northern access road will be able to be adapted to meet these requirements.

If OPR construct a northern access road to the port, it is envisaged that this will become a secondary road when the central access road is constructed as the majority of the traffic, coming from the south and east will use the shorter route to the Port.

Geraldton Bypass / NWCH Interchange

Development in the SIA will most likely trigger the construction of the Geraldton Bypass. In the interim, it is likely that the bypass will be constructed from Oakajee as far as Morrell Road with associated upgrading of Morrell Road for heavy vehicles.

The interchange with NWCH will be grade separated to allow priority for freight travelling along the bypass.

North West Coastal Highway

MRWA are planning to realign NWCH in the vicinity of the Buller River. They are also planning a re-alignment further north and will be setting a 100m road reserve for a future duplication.

Once the Geraldton Bypass and NWCH interchange is constructed, NWCH north of the interchange will be considered as a controlled access road and primary freight route. The section of NWCH between the bypass interchange and Geraldton will be downgraded and will most likely carry commuter traffic and recreational vehicles.

Ultimately, road intersections on NWCH in the vicinity of the OIE will need to be grade separated and road over rail crossings will need to be provided.

The Draft OIE Structure Plan outlines the details of the integrated road transport networks proposed for the ultimate development of the Port and OIE.

8.2 Rail

The proposed road access strategy is shown in Figure 02 at Appendix C and can be summarised as follows:

Multi-product Railway Line

Considering that the OPR line will be for bulk export of iron ore only, there is a need for dual and / or standard gauge railway lines to the SIA to provide rail access to industrial proponents.

It is proposed that the multi-product railway lines will initially follow the OPR alignment from Wokathera Gap to the SIA and will ultimately return along the perimeter of the SIA. This will provide sufficient flexibility for industrial proponents that need access to a railway line.

The alignment of the railway lines and associated infrastructure including yards and marshalling, provisioning and materials handling facilities will need to be considered in more detail once the OPR proposals and design details are finalised. There are currently two alternative alignments west of the NWCH for this railway line:

- Co-location of the iron ore lines with the multi-product lines located south of the iron ore lines. This alignment would only require one bridge on the NWCH.
- The multi-product lines located further south than the iron ore lines requiring a second bridge on the NWCH.

All major road and rail intersections will need to be grade separated.

The multi-product railway lines will follow the Oakajee-Narngulu Infrastructure Corridor.

Port Rail Access

The Draft OPMP concluded that there was no need for a direct rail link between SIA and Oakajee Port in the short to medium term, however, advice from the PTA is that this option be kept available and provision made for a future direct link if required

A standard gauge railway line to the port from the north was identified for when the port activities expand to the north and there is a requirement to rail freight into and out of Oakajee Port. If a requirement for a rail link between SIA and the port arises in the future, a connection between the multi-product line to SIA and the northern rail line to the port will need to be made at a suitable location.

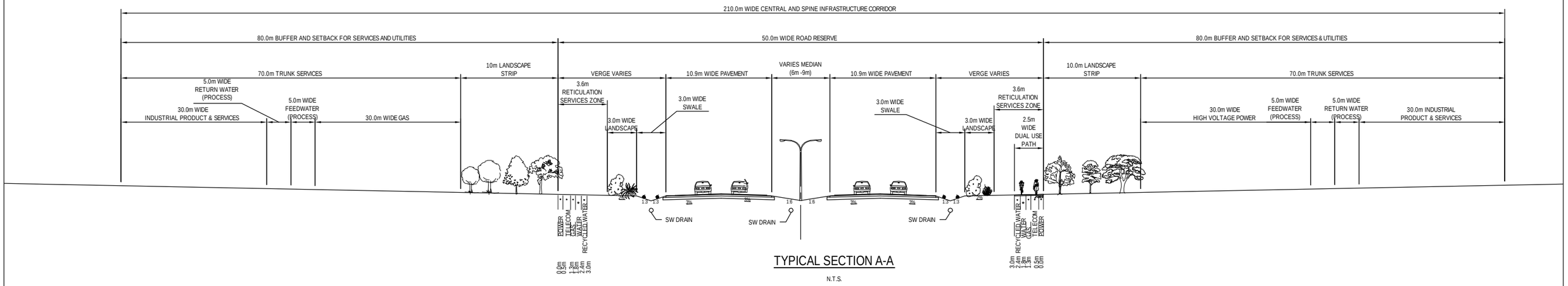
The OIE Structure Plan outlines the details of the integrated rail transport network proposed for the ultimate development of the Oakajee port and Industrial Estate.

8.3 Combined Road and Rail Transport Network

The OIE Structure Plan shows the overall, combined proposed transport network layout for the OIE which integrates the proposed road and rail access corridors both internally (within the estate) and externally with the proposed Port, the existing and proposed external road network and the proposed OPR and ONIC corridors.

Appendix A

Typical Infrastructure Corridor



TYPICAL SECTION A-A

N.T.S.

NOTE:

TYPICAL INFRASTRUCTURE CORRIDORS ARE INDICATIVE AND BASED ON ULTIMATE DEVELOPMENT OF THE OIE. FINAL DEVELOPMENT OF THE PROPOSED INFRASTRUCTURE WILL BE STAGED AS REQUIRED TO MEET DEMAND AS INDUSTRIES LOCATE & EXPAND AT THE OIE

0 2 4 6 8 10m

SCALE 1:200 AT ORIGINAL SIZE

SKETCH

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
C	ISSUED FOR COMMENT		YV			20.01.11
B	ISSUED FOR COMMENT		YV			14.12.10
A	ISSUED FOR COMMENT		SL			24.11.10

GHD CLIENTS | PEOPLE | PERFORMANCE

GHD House, 239 Adelaide Tce Perth WA 6004
PO Box Y3106 Perth WA 6832 Australia
T 61 8 6222 8222 **F** 61 8 6222 8555
E permail@ghd.com.au **W** www.ghd.com

Drawn		Designer	
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

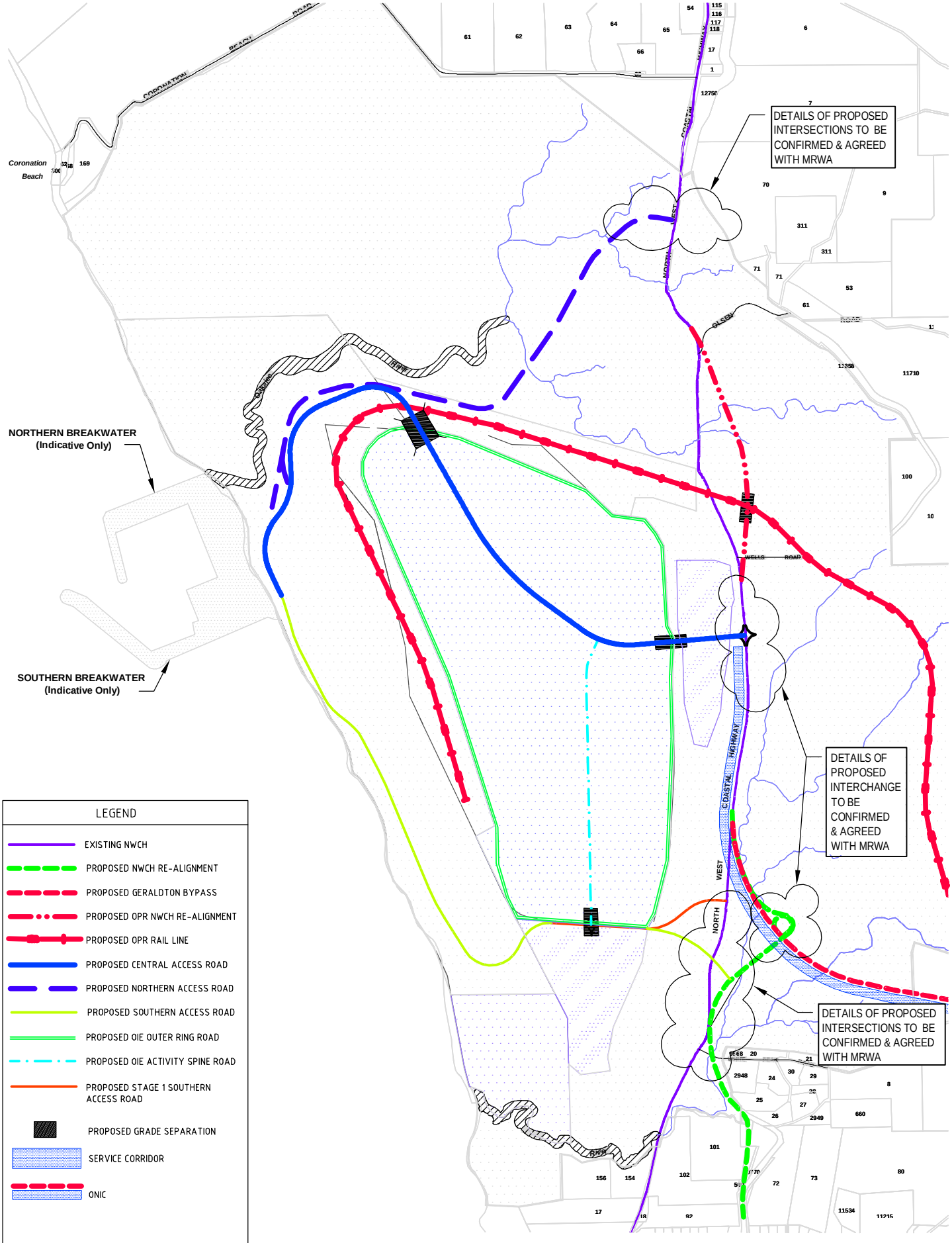
Client **LANDCORP**
Project **OIE STRUCTURE PLAN**
Title **TYPICAL INFRASTRUCTURE CORRIDOR**

Original Size **A1** **Drawing No: 61-24611-SK107** **Rev: C**

Plot Date: 20 January 2011 - 11:50 AM Plotted by: Yvonne Vermaak/Perth\GHD/AU Cad File No: G:\61\24611\CADD\Road Cross Sections\61-24611-SK107.dwg

Appendix B

Transport Network – Road Corridors



LANDCORP
OAKAJEE INDUSTRIAL ESTATE
STRUCTURE PLAN
TRANSPORT NETWORK
ROAD CORRIDORS

Job Number 61-24611
Revision D
Date 02.12

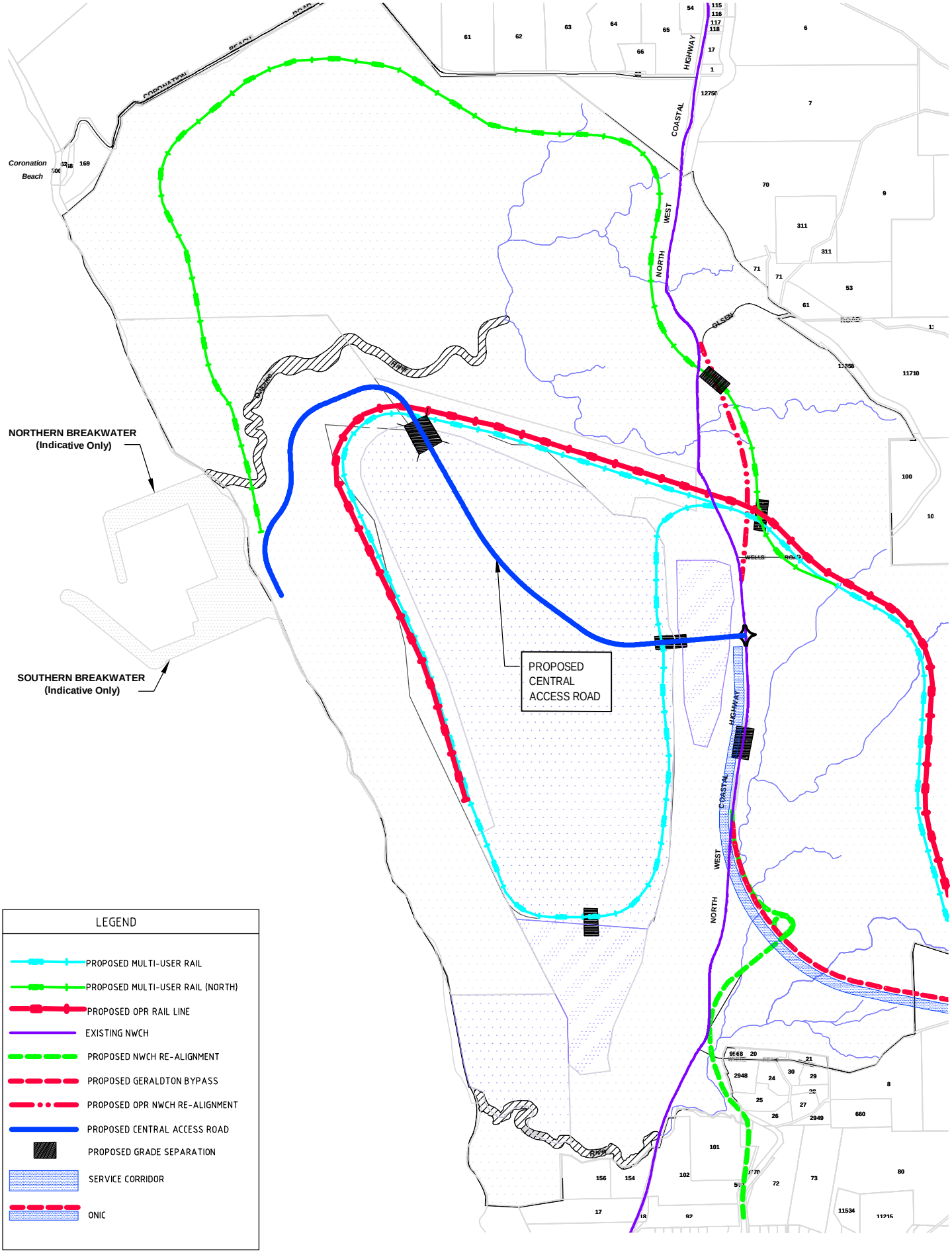
Figure 01

GHD House, 239 Adelaide Tce Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com

Plot Date: 6 March 2012 - 1:25 PM Plotted by: Elizabeth Scicluna/Perth/GHD/AU Cad File No: G:\61\24611\CADD\FIGURES\61-24611-01-RD.dwg

Appendix C

Transport Network – Rail Corridors



LANDCORP
OAKAJEE INDUSTRIAL ESTATE
STRUCTURE PLAN
TRANSPORT NETWORK
RAIL CORRIDORS

Job Number	61-24611
Revision	D
Date	02.12

Figure 02

GHD House, 239 Adelaide Tce Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com

Plot Date: 6 March 2012 - 1:29 PM Plotted by: Elizabeth Scicluna/Perth/GHD/AU Cad File No: G:\61\24611\CADD\FIGURES\61-24611-02-RD.dwg

GHD

GHD House, 239 Adelaide Tce. Perth, WA 6004
P.O. Box 3106, Perth WA 6832
T: 61 8 6222 8222 F: 61 8 6222 8555 E: permail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	J Grierson	J de Villiers	*JDV*	J Grierson	*JSG*	22/11/2010
1.1	J de Villiers	J Grierson	*JDV*	J Grierson	*JSG*	24/01/2011
1.2	J de Villiers	J Grierson	*JDV*	J Grierson	*JSG*	24/03/11
1.3	J de Villiers	J Grierson	*JDV*	J Grierson	*JSG*	02/03/12