Oakajee Industrial Estate Structure Plan

Engineering Services Report

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LANDCORP

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GHD

Contents

Appendices

Executive Summary

A Structure Plan has been prepared for Oakajee Industrial Estate (OIE) to guide its development. The estate comprises 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, 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, except for a small area in the north that slopes towards 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.

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.

Forecast Servicing Demands

Servicing demands, based on forecast industries expected to locate at Oakajee, were calculated to assist utility providers with their planning and consequently inform the Structure Plan. The forecast demands for services were developed using historic data from comparable industrial estates. The ultimate demands for servicing will be dependent on the timing and final makeup of industry at OIE.

Servicing

The following is a summary of the availability of services and the servicing strategy for OIE, as advised by the utility providers:

Power

The existing 33kV line to Northampton does not have sufficient capacity to provide power to Oakajee Port and Rail (OPR) and OIE. OPR's 30MVA requirement will most likely be met by the construction of a 17km long 132kV dual circuit line from the Chapman Substation or by establishment of an Independent Power Plant (IPP).

Initial demands within the OIE could be supplied by the 132kV line from the Chapman Substation, but ultimately the estate should be linked to the South West Interconnected System (SWIS) by a double circuit 330kV transmission line from Moonyoonooka Terminal Station, once the proposed 330kV transmission line from Eneabba to Moonyoonooka is in place. If an IPP is established within Oakajee it would initially be sized to meet OPR's needs but could ultimately expand to meet some of the demand from the OIE and future port expansion.

Sites have also been identified within the OIE buffer as potential locations for wind power and seawater pumped storage hydroelectricity.

Gas

There is an existing easement for a gas lateral from the Dampier to Bunbury Natural Gas Pipeline (DBNGP) located approximately 52km east of the OIE. Dampier Bunbury Pipeline Pty Ltd has undertaken preliminary investigations into the potential to provide gas for the proposed IPP and for future industry needs.

Potable water

While OPR is likely to source potable water from the existing Northampton Branch Main, this can provide only 20kL/day. The Water Corporation is therefore planning to supply the greater demands of the OIE by constructing a transfer main from the Brown Lane Tanks at White Peak to two 5ML on-ground tanks and a 25kL elevated tank at OIE. This will require the upgrade of existing infrastructure at Edward Road and the Brown Lane Tank before it can be implemented.

Feedwater

OPR will source its non-potable water requirements from a desalination plant. Options for feedwater for OIE industries include desalination of seawater, groundwater sourced from Alanooka (limited) or from Casuarinas (currently under investigation). There is potential for waste water from industries to be treated and recycled to achieve a better water balance and minimise discharge to waste, and for use of treated effluent from a waste water treatment plant proposed to locate in the OIE Buffer.

Waste Water

The Water Corporation is planning a waste water treatment plant (WWTP) in the OIE Buffer for treatment of domestic effluent from the northern precincts of Geraldton. This plant is likely to also accept sewage from industries within the GIAs, but larger industries in the SIA will have their own on-site package treatment plants.

Communications

There is an optic fibre cable running parallel and to the west of NWCH. Telstra will require a site for an exchange in the vicinity of the existing optic fibre cable and two sites for mobile phone towers. The location of these sites will need to be identified by Telstra.

Infrastructure Corridors and Service Sites

The Oakajee-Narngulu Infrastructure Corridor (ONIC) is a proposed link between the OIE and Narngulu to accommodate road, rail and a wide range of services required by the OIE.

Within the estate, the Structure Plan makes provision for infrastructure corridors and infrastructure sites for the OIE as follows:

- A central east-west corridor linking NWCH and the Port through the SIA via an underpass below the iron ore and multi-product railway lines.
- A north-south corridor linking the southern GIA to the SIA and the central east-west corridor.
- A southern east-west corridor providing a second access point on NWCH and linking the SIA to the southern port access road.
- Outer ring road and services including allowance for conveyors on the western boundary of the SIA.
- Sites for a gas pressure reduction station, power substations, water tanks, a telecommunications exchange, and mobile phone towers.

Aside from the above, OPR has its own proposed service corridors and associated facilities to meet its requirements.

Surface and Groundwater Management

Details of proposed groundwater and surface water management are contained in a separate District Water Management Strategy (DWMS) whose key elements include water supply options and site management and monitoring strategies to check and protect water quality and quantity.

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 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 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 High Wide Load (10m x 10m) access from OIE to the proposed Oakajee Port, access to a multi-product rail line linking the SIA with the ONIC and two access points to 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 to service long-term requirements of the estate.

2. Site Description

2.1 Location

The OIE is in the Shire of Chapman Valley approximately 23 kilometres north of Geraldton (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 North West Coastal Highway 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.

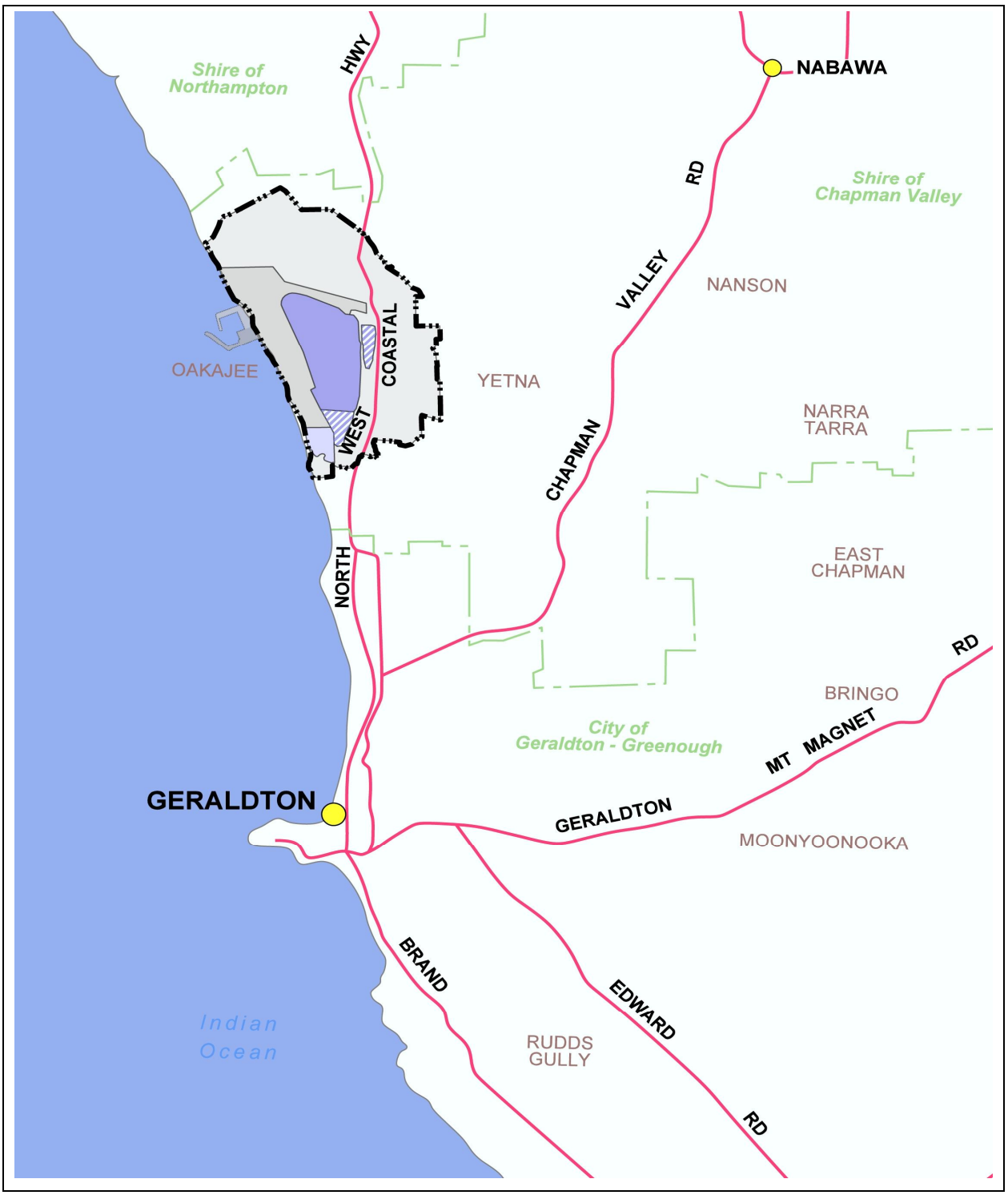

Figure 1 - Oakajee Industrial Estate (OIE) Location Plan

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, 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. Forecast Servicing Demands

Forecast servicing demands were calculated to assist utility providers with strategic planning and, in turn, to inform the Structure Plan. The forecasts were developed using historic data on industries most likely to locate at the OIE.

3.1 Qualifications

The following qualifications are relevant to the forecast servicing demands:

- The forecasts assume an indicative mix of industries selected using the findings of a market analysis by ACIL Tasman and an Industrial Ecology Strategy which is an addendum to the Structure Plan.
- Forecast utility demands for the industries in question have been derived from the use of data from existing industrial estates.
- Estimates do not allow for increasing efficiencies through developments in technology.
- Forecast demands do not include the requirements of Oakajee Port and Rail.

3.2 Timing and assumptions

Forecasts for timing of industries entering the OIE are based on historical data for similar industrial estates, leading to the assumptions outlined below.

3.2.1 Strategic Industry Area

- The first heavy industry will establish in 2015.
- One heavy industry will establish in the SIA every 2.5 years thereafter (average estimate based on historical development in Kwinana Industrial Area and Gladstone Industrial Area).
- An ultimate total of 16 heavy industries have been identified as potentially locating in the SIA. These industries are:
  - Magnetite iron ore pelletising plant
  - Direct Reduced Iron / alternative smelting iron plant
  - Integrated steel making plant
  - Large nickel processing plant
  - 2 medium size non-ferrous processing plants
  - Water factory (not included in forecast water and power demands)
  - Energy factory - steam, electricity, heat, chill (not included in forecast power and gas demands)
  - Large manufacturing plant
  - 3 medium size manufacturing plants
  - Large processing plant
  - 2 Organic processing plants

  - Heavy construction company
- The above assumptions imply that heavy industries will establish in the SIA over a period of about 40 years.
- Utility demands have been averaged over the 16 industries listed above.
- The sequence of industries establishing in OIE is not known, but a ferrous processing industry likely to be the first to establish.

3.2.2 General Industry Areas

- The first general industry will establish in 2015.
- Development thereafter of 2.5 ha per annum per GIA.
- Estimated Net Developable Area (NDA):
  - General Industrial Area 1 = 64 ha (80% of total area)
  - General Industrial Area 2 = 93 ha (80% of total area)

3.2.3 Coastal Area

- First industry will establish in 2015.
- Development thereafter of 5 ha per annum.
- Estimated NDA of 200 ha (20% of total area).

3.2.4 Buffer Area

- First industry establishes in 2015.
- Development thereafter of 40 ha per annum.
- Estimated NDA of 1,358 ha.

4. Power

4.1 Existing Services

The closest substation to OIE is the Chapman Substation, which is supplied from Geraldton Substation. These two are linked to the Rangeway Substation. Supply to Geraldton Substation is limited and will not cope with demand beyond 2014.

The existing 33kV line which passes through the OIE en route to Northampton only has capacity for an additional 5MVA, although planned reinforcements will see this increase to 10MVA. This supply cannot meet the power demand for both the Port and OIE.

4.2 Forecast Demands

Forecast power demands for the OIE from initial to ultimate development are summarised in Table 1 below. The forecasts do not include demands of the water and energy factories.

OIE precincts	Indicative forecasted electricity use (MW)									
	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
Strategic Industrial Area	17	50	83	116	150	183	216	250	266	266
General Industrial Area 1	1	6	12	18	25	31	32	32	32	32
General Industrial Area 2	2	9	18	27	36	45	54	63	67	67
Coastal Zone	1	7	15	22	29	37	44	52	59	59
Buffer Zone	0	2	4	7	9	11	13	15	15	15
Total Oakajee Industrial Estate	**22**	**75**	**133**	**191**	**249**	**307**	**360**	**411**	**439**	**439**

Table 1 – Forecast Power Demand

Although the initial demand for power at OIE is relatively small, subsequent development in the SIA will result in large block loads, and ultimately the OIE will require almost 450MW. Western Power is unable to meet this requirement from existing infrastructure, and development at OIE will most likely trigger Stage 2 of the Mid-West Energy Project if alternative power supplies are not developed at OIE. This is discussed further at 4.4 below.

4.3 Oakajee Port and Rail's Requirements

The existing 33kV line to Northampton cannot meet OPR's requirements for 30 MVA (24 MW). This demand might be met by a 17km double circuit 132kV line from Chapman Substation to a 60MVA Zone Substation at Oakajee, with the substation located in the buffer between the iron ore railway line and the eastern GIA. This line might eventually provide up to 144 MVA (115 MW).

An alternative option OPR is investigating is power supply by an Independent Power Plant (IPP) developed within the SIA using gas from a lateral off the Dampier-Bunbury Pipeline (DBP).

4.4 The Mid-West Energy Project

Western Power's Mid-West Energy Project aims to provide capacity to meet increasing demand within the region while at the same time facilitating connection of power generators to its network. The project is in two stages, as discussed below.

Figure 2 - Mid-West Energy Project

4.4.1 Stage 1

Stage 1 is required urgently to boost supply to mines south-east of Geraldton and to provide transmission lines to wind turbines on the coast south of Geraldton. It comprises 200km of new double circuit 330kV line from Neerabup to Eneabba plus a new 330/132kV Terminal Substation at Three Springs. Target completion date is March 2013, and Western Power is currently going through a consultation process to secure necessary approvals by early 2011.

4.4.2 Stage 2

Stage 2 comprises 160km of double circuit 330kV line from Eneabba to Moonyoonooka Terminal Station to boost supply to the Geraldton region. Western Power will undertake a detailed planning assessment during 2011 to determine the best method of delivery and timing for this development.

Western Power currently predicts natural load growth in Geraldton can be met by existing transmission lines until 2015/2016, with minor works to address voltage constraints. This date, and thus the timing of Stage 2, may be brought forward should a major block load requirement emerge at the OIE in the meantime. The timing of Stage 2 could also be influenced by the power supply option selected by OPR.

4.5 Power Supply for Oakajee Industrial Estate

A 132kV transmission line from Chapman Substation to a Zone Substation (60MVA) located at Oakajee could supply the demand from OPR and initial loads for the industrial estate. Based on a capacity of 144 MVA in the 132kV line (approximately 115MW) and OPR's requirement for 30MVA (approximately 24MW), this supply should be sufficient to 2020 when considering the projected demand for power in Table 1 above. To supply power beyond this date, Western Power will need to consider the feasibility of a second 132kV line from Chapman Substation or the ultimate 330kV power line from Moonyoonooka.

The Zone Substation discussed above will not have capacity to supply customers with large block loads of 60MW or more within OIE. These industries will be supplied off at least one 132kV transmission line located within the infrastructure corridors in the SIA and the individual proponents requiring the large loads will need to make allowance for a Zone Substation (120m x 100m) within their boundaries.

Ultimately the OIE should be linked to the South-West Interconnected System (SWIS) by construction of a double circuit 330kV line from Moonyoonooka Terminal Station to a Terminal Substation at Oakajee. The transmission line will occupy a 100m to 110m wide corridor and will require sufficient land at the OIE for a Terminal substation (330m x 330m) and an adjacent Zone Substation (120m x 100m). These facilities can be located in the Buffer Area.

Aerial reticulation through the estate for high voltage lines (66kV or higher) will utilise infrastructure corridors parallel to road reserves. Power cables of 22kV or less will be placed underground within road reserves, in easements reserved for power as per the Utility Providers Code of Practice.

Should OPR choose an IPP as its supply option, the power station would initially be sized to meet its requirements and could potentially be expanded to provide power to the OIE and the grid though 132kV transmission lines.

4.6 Renewable Energy

The Structure Plan makes allowance for sites for wind turbines and a pumped seawater storage hydroelectric scheme in the northern Buffer Area. These renewable energy opportunities are discussed in more detail in the Sustainability Report which is an addendum to the Structure Plan. Their implementation will require connection to a 132kV transmission line so that power can be supplied to the grid and allow the draw of off-peak power for pumping seawater into the hydroelectric storage reservoir at times when insufficient power is generated, for this purpose, by the wind turbines.

5. Gas

5.1 Existing Services

There are no gas mains located in the vicinity of the site. An easement for a lateral off the Dampier-Bunbury Natural Gas Pipeline to the OIE (52km to the west) has been secured.

5.2 Forecast Demands

Forecast gas demands for the OIE from initial to ultimate development are summarised in Table 2 below. The forecasts do not include demands of a possible gas-fired IPP or of the water and energy factories.

OIE precincts	Indicative forecasted gas use (TJ/a)									
	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
Strategic Industrial Area	9,414	28,243	47,072	65,901	84,729	103,558	122,387	141,216	150,630	150,630
General Industrial Area 1	6	32	63	95	126	158	162	162	162	162
General Industrial Area 2	24	122	245	367	490	612	735	857	908	908
Coastal Zone	15	73	146	219	292	364	437	510	583	584
Buffer Zone	59	295	589	884	1,179	1,473	1,768	2,000	2,000	2,000
Total Oakajee Industrial Estate	**9,519**	**28,765**	**48,115**	**67,465**	**86,816**	**106,166**	**125,489**	**144,745**	**154,283**	**154,284**

Table 2 – Forecast Gas Demand

Initial demands are small, but long-term demand forecasts are substantial and a decision will have to be made by any supplier as to whether a staged approach for supply pipelines is the best approach.

5.3 Oakajee Port and Rail's Requirements

OPR is currently investigating the option of a gas-fired IPP at Oakajee. If this is selected as its preferred option, the IPP will be supplied via a lateral from the Dampier to Bunbury Natural Gas Pipeline.

5.4 Gas Supply for the Oakajee Industrial Estate

5.4.1 Gas Lateral

Dampier Bunbury Pipeline Pty Ltd (DBP) has investigated the potential to construct a lateral to the OIE from the Dampier to Bunbury Natural Gas Pipeline. Such a lateral could be developed to provide gas for the IPP and for future industry needs, although its capacity is unknown at this stage.

The lateral will require a pressure reduction station to reduce operating pressure before reticulating gas through the SIA. Based on information from DBP, it is anticipated the pressure reduction station (Gate Station) will require an area of approximately 100m x 100m. It will also

require a buffer that complies with Planning Bulletin 87 – High Pressure Pipelines in the Perth Metropolitan Region. This buffer will need to be a 200m wide around the site.

5.4.2 Gas Distribution

Class 150 and lesser gas pipelines will be located in road reserves on the standard alignment allocated for gas in the Utility Providers Code of Practice. These pipes have an operating pressure up to 2.1MPa.

Larger pipelines with higher operating pressure, such as Class 600, will be located in dedicated easements at least 15m wide within infrastructure corridors and will have to be removed at least 90m from buildings.

Commercial customers within the SIA will require 6-8 inch Class 150 gas mains, while large industrial plants such as smelters will likely require 10 to 12 inch diameter pipes, possibly of a higher class.

The industries in the two GIA's will be smaller and less reliant on gas, unless it is required for hot-water systems and/or for kitchens. Historically, natural gas has not been piped to general industrial areas and industries within these use bottled gas, such as LPG, or electricity for their requirements. Natural gas is normally not suitable for fabrication industries and alternative gas supplies are stored in tanks on individual sites.

6. Potable Water

6.1 Existing Services

The only Water Corporation infrastructure in the vicinity of the site is the DN375 Northampton Transfer Main. This main has limited capacity and indications are that, without upgrade, it would provide the estate with a maximum of only 20kL/day.

The closest developed potable water resource is the borefield at Allanooka approximately 40km south-east of Geraldton. The Water Corporation's Draft Groundwater Management Plan for Allanooka indicates a potential sustainable yield of 28.8GL/year from the resource, of which 12GL is currently allocated for public water supply. The Corporation has applied for this allocation to be increased to 14GL and has plans to expand the borefield within 5 years to supply up to 18GL per year.

6.2 Forecast Demands

Forecast potable water demands for the OIE from initial to ultimate development are summarised in Table 3 below. The forecasts do not include demands of the water factory.

OIE precincts	Indicative forecasted domestic use of potable water (ML/a)									
	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
Strategic Industrial Area	4	13	21	30	38	46	55	63	68	68
General Industrial Area 1	1	2	5	7	9	12	12	12	12	12
General Industrial Area 2	0	2	4	6	8	10	11	13	14	14
Coastal Zone	0	2	3	5	6	8	9	11	13	13
Buffer Zone	0	0	1	1	1	1	2	2	2	2
Total Oakajee Industrial Estate	**5**	**19**	**33**	**48**	**62**	**77**	**89**	**101**	**108**	**108**

Table 3 – Forecast Water Demand

The forecast long-term total of 108ML/a is low compared with the 4.6ML/day ADPW (Average Day Peak Week) estimated in the Geraldton Regional Water Supply Scheme Review (GRWSS) of 2007 for the OIE. Based on the above forecast demands, the Water Corporation will be undertaking further modelling and will update their Capital Investment Programme within the GRWSS to reflect timing of infrastructure implementation to respond to the forecast development at OIE.

The dates in the current CIP in the 2007 GRWSS review will not meet the forecast demands indicated in the above table.

6.3 Oakajee Port and Rail's Requirements

OPR will likely source potable water from the Northampton Branch Main. This will be stored in a transfer tank which will feed header tanks for the rail yard and port landside areas, as well as separate fire water storage tanks.

6.4 Potable Water Supply for the Oakajee Industrial Estate

Potable water for OIE could potentially be supplied via the following alternatives:

- Scheme water from Water Corporation infrastructure, supplied from storage tanks.
- Desalination plant operated by private enterprise using SWRO technology and a sea water supply.

The discussion which follows assumes the first of these options is adopted.

The Water Corporation review of the Geraldton Regional Water Supply Scheme (GRWSS) makes provision to service Oakajee with potable water. The Water Corporation planning indicates the following infrastructure will be required at Oakajee in the long term:

- Two on-ground tanks (Oak 1 and Oak 2).
- One 25kL elevated tank (Oak 3).
- 200/300 P12 transfer main to Oakajee tanks.
- Associated pump stations.

This system requires the Brown Lane Tanks to be operational and the review has identified approximately $3M of urgent work that needs to be carried out at the Brown Land Tank site (White Peak). The Water Corporation's Capital Investment Program (CIP) originally indicated an anticipated 2010 implementation date, however, this date will be revised after further review of the GRWSS. It should be noted that "implementation dates" in the CIP are normally considered to be the commissioning date of the required infrastructure.

The Water Corporation has also identified approximately $20M of infrastructure required to boost the supply to north Geraldton to permit the supply to Oakajee via Brown Lane Tank. This infrastructure involves construction of pump stations and new mains from Edward Road. The CIP has identified an implementation date of 2012, which is subject to review.

The three tanks, Oak 1, 2 and 3, will be located in the Buffer Area north-east of the SIA, at an elevation of approximately RL105m - 110m AHD. They will require an area approximately 100m by 180m – sufficient to accommodate the tanks, a booster pump station and an overflow detention basin.

Trigger for development of Oak 1, the first on-ground tank, will be commencement of industrial development at OIE, and the implementation date indicated in the CIP is 2017. Its inlet main will need to be DN300 PVC and this can connect initially to the Northampton Transfer Main. As mentioned at 6.1, this main can, however, provide only 20kL/day without upgrade, so Oak 1 will ultimately be supplied from a dedicated DN300 PVC transfer main from Brown Lane Tank.

The second on-ground tank (Oak 2) will be required to meet growing demand and emergency storage requirements, with the trigger for its installation being demand for potable water at OIE increasing above 2.3 ML/ADPW. Implementation date indicated in the CIP is 2017.

The eastern GIA is located an elevation of approximately RL95m – 105mAHD and is therefore too high to be serviced by the proposed on-ground tanks. To overcome this constraint, the Water Corporation plans to install a 25kL elevated tank (Oak 3) to service the eastern GIA, the

tank's size having been determined to meet the 1 hour peak-instantaneous demand of the eastern GIA's share of the OIE's 4.6ML/d allowance.

This elevated storage will likely have a top water level of about RL 120mAHD. It will require a transfer pump station with duty of 6L/s at 15m head to lift water from one of the on-ground tanks. Implementation date for Oak 3 in the CIP is 2019.

An alternative to the high level tank would be a booster pump station.

Development of support industry in the eastern GIA that proceeds ahead of the elevated tank implementation will need a temporary boosted supply from the on-ground tanks.

7. Feedwater

7.1 Existing Services

There is no known surface or groundwater supply within the OIE suitable to meet predicted needs of industries for high and low quality feedwater. Indicative demands for high and low quality feedwater are outlined below.

7.2 Forecast Demands

Forecast feedwater demands for the OIE from initial to ultimate development are summarised in Tables 4 and 5 below.

OIE precincts	Indicative forecasted high quality industry feedwater use (ML/a)									
	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
Strategic Industrial Area	798	2,395	3,992	5,589	7,186	8,783	10,380	11,977	12,775	12,775
General Industrial Area 1	1	3	6	9	12	16	16	16	16	16
General Industrial Area 2	6	28	56	84	113	141	169	197	209	209
Coastal Zone	5	26	53	79	105	132	158	184	211	211
Buffer Zone	0	0	0	0	0	0	0	0	0	0
Total Oakajee Industrial Estate	**810**	**2,453**	**4,107**	**5,762**	**7,416**	**9,071**	**10,723**	**12,374**	**13,210**	**13,211**

Table 4 – Forecast High Quality Feedwater

OIE precincts	Indicative forecasted low quality industry feedwater use (ML/a)									
	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
Strategic Industrial Area	1,427	4,280	7,133	9,986	12,839	15,692	18,545	21,398	22,825	22,825
General Industrial Area 1	1	7	15	22	29	37	38	38	38	38
General Industrial Area 2	6	29	58	87	116	145	174	203	215	215
Coastal Zone	11	53	107	160	214	267	321	374	428	429
Buffer Zone	30	149	298	447	596	745	893	1,011	1,011	1,011
Total Oakajee Industrial Estate	**1,474**	**4,518**	**7,610**	**10,702**	**13,794**	**16,886**	**19,971**	**23,024**	**24,516**	**24,517**

Table 5 – Forecast Low Quality Feedwater

High quality feedwater is intended for boiler feedwater / steam production and for high quality process water, and is expected to meet a standard of 100 to 200 mg/L TDS. Low quality feedwater is intended for cooling water, process water, dust suppression, wash water, slurry water and irrigation, and is expected to meet a standard of 800 to 1,000 mg/L TDS

7.3 Oakajee Port and Rail's Requirements

OPR's non-potable water requirements are predominantly for dust suppression on iron ore stockpiles and also to service construction requirements and will be supplied by a desalination plant. The proposed plant would be sized to produce 10ML/d, which includes allowance for a

20% contingency. The desalination plant may be privately operated which would allow for the possibility of its future expansion to supply potable and/or feedwater to the OIE.

7.4 Feedwater Alternatives for the Oakajee Industrial Estate

7.4.1 Groundwater Sources

The Department of Water is currently concluding an investigation of the Casuarina area which is immediately north of the Allanooka Borefields. Initial indications were that there will not be sufficient yield from this area to meet the OIE's needs, but recent testing has yielded more positive results.

The other potential source of groundwater – at least for initial feedwater demands – is the Allanooka borefield 40km south-east of Geraldton. There is a potential sustainable yield of 28.8GL/year from this borefield of which 18GL will likely be allocated for potable water. Water from this source would be pumped approximately 80km to Oakajee via a large diameter pipeline. From Narngulu north, this pipeline would follow the ONIC service corridor, entering the estate at the intersection of the central access road and NWCH.

The groundwater will likely require a storage tank on site and may need to be treated prior to supply to industry, or it could be supplied raw, in which event individual industries would have to undertake their own treatment to render the water suitable for their particular operations.

7.4.2 Desalination

Industry feedwater could also be supplied from a desalination plant. This could be in the form of a central Sea Water Reverse Osmosis (SWRO) plant to supply all OIE needs or reticulation of seawater through the estate to users who would then develop their own SWRO plants to bring the water to a standard suitable to their individual needs. Both options would require a large ocean intake and a brine ocean outfall.

7.4.3 Recycling

It is anticipated initial demands for feedwater will be met from the sources discussed above. In the longer term, as industries establish, industrial waste water could be harvested, treated and recycled to achieve a water balance and limit discharge to waste. This possibility is covered in more detail in the Sustainability Report.

There is also the possibility, mentioned at 8.4 below, of sewage effluent processed by a Waste Water Treatment Plant proposed to be located within the Buffer Area being treated to a level so it could be used as lower quality feedwater by industry.

8. Waste Water Disposal

8.1 Existing Services

The nearest sewers are in the residential precinct of Drummond Cove south of the OIE. These gravitate to pump stations which transfer effluent to the Water Corporation's Geraldton North Wastewater Treatment Plant (WWTP) at Glenfield. They are well removed from the OIE and do not, in any event, have capacity to accept domestic effluent from the OIE.

8.2 Forecast Demands

Forecast sewage generation at OIE, based on a unit rate of 70kL per person per day, is summarised in Table 6 below.

OIE precincts	Indicative forecasted domestic sewage (ML/a)									
	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
Strategic Industrial Area	4.81	14.44	24.07	33.70	43.33	52.96	62.59	72.22	77.03	77.03
General Industrial Area 1	0.82	4.08	8.16	12.25	16.33	20.41	20.95	20.95	20.95	20.95
General Industrial Area 2	0.70	3.52	7.03	10.55	14.07	17.58	21.10	24.62	26.06	26.06
Coastal Zone	0.37	1.83	3.66	5.50	7.33	9.16	10.99	12.83	14.66	14.69
Buffer Zone	0.07	0.36	0.72	1.07	1.43	1.79	2.15	2.43	2.43	2.43
Total Oakajee Industrial Estate	**6.77**	**24.23**	**43.65**	**63.07**	**82.48**	**101.90**	**117.78**	**133.04**	**141.13**	**141.16**

Table 6 – Forecast Waste Water Disposal

8.3 Oakajee Port and Rail's Waste Water Management

OPR proposes to use Biomax waste water treatment systems at its rail and port areas.

8.4 Waste Water Management for the Oakajee Industrial Estate

The Water Corporation is planning to construct a WWTP at OIE to service the northern precincts of Geraldton. It is not, however, planning to accept industrial effluent from Oakajee, and will only accommodate sewage from offices and toilet blocks within the site.

The WWTP will probably use lower technology treatment incorporating evaporation ponds. This will require a 1km wide buffer around the WWTP site. The Water Corporation is investigating means of disposing the treated domestic effluent by infiltration or spraying the effluent on woodlots. There will, however, be opportunities for the Water Corporation to treat effluent further to permit its use by industry within OIE as low quality feedwater.

The preferred location of the WWTP indicated in the Structure Plan complies with the Water Corporation's requirements for road access and avoidance of at-grade rail crossings. It also allows sufficient separation from residential precincts to the south.

It is anticipated that individual industries in the SIA will provide on-site package treatment plants to treat their own industrial effluent. This could then be recycled or pumped to a central water treatment facility for recycling through the estate.

Domestic effluent from each industry will be treated by Aerated Treatment Units (ATUs) or disposed in septic tanks attached to leach drains until such time as the WWTP is operational and provides reticulated sewer to the estate. Even with such reticulated sewerage, it is likely that industries within the SIA will rely on their own ATU's for domestic effluent, whereas industries on the smaller lots of the two GIA's will more likely be connected to sewers feeding to the WWTP.

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9. Infrastructure Corridors and Service Sites

9.1 Oakajee Narngulu Infrastructure Corridor (ONIC)

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.

High voltage power transmission lines are not included in the proposed corridor.

9.2 Oakajee Port and Rail's Infrastructure and Service Corridors

OPR has proposed a number of service corridors and associated facilities in its concept plans. The most relevant of these proposed corridors to the Structure Plan is the 150m wide common use infrastructure corridor located west of the rail lines, between the rail and the port.

9.3 Oakajee Industrial Estate Infrastructure Corridors and Service Sites

The indicative widths for infrastructure corridors have been set to ensure future proofing to allow the OIE to reach capacity without being compromised by inadequate services easements.

A number of infrastructure corridors (see layout at Appendix A) and service sites have been identified to service the industrial estate as follows:

- The primary central east-west distributor road through the SIA which includes easements for utility providers within the road reserve, 10m landscape easements on either side and 70m easements for trunk services on either side, providing a 210m wide infrastructure corridor linking the estate to the port and NWCH. This typical infrastructure corridor is shown at Appendix B.
- The main north-south distributor road within the SIA which includes easements for utility providers within the road reserve, 10m landscape easements on either side and 70m easements for trunk services on either side, providing a 210m wide infrastructure corridor.
- A bridge solution (underpass or overpass) to cross the railway lines to provide High Wide Load (10m x 10m) access between Oakajee Port and the SIA via the central east-west corridor.

- The southern east-west link which includes a distributor road, utility services within the road reserve, a multi-user railway line and services easements on either side, providing a 180m – 200m infrastructure corridor linking the estate, the port and the future ONIC;
- The outer estate ring road will include services for the utility providers within the road reserve and will also allow for a multi user rail corridor, a conveyor corridor (along the western boundary only) and 20m – 40m wide services easements on either side, - providing an outer infrastructure corridor on the boundary of the SIA ranging from 120m - 200m in width.
- A site for a gas pressure reduction station to step down the operating pressure of the lateral main off the Dampier to Bunbury pipeline.
- A Terminal Substation and adjacent Zone Substations for power transmission lines.
- A site for Water Corporation infrastructure including two ground tanks, an elevated tank and a booster pump station.
- A site for Telstra to house an exchange, to be located in the vicinity of the optic fibre cable.
- Two mobile phone tower sites whose locations will be negotiated with Telstra or other carrier(s).

10. Surface Water and Groundwater Management

GHD has prepared a District Water Management Strategy (DWMS) for the OIE. District water management is a component of integrated water cycle management that recognises 'water supply, stormwater and sewage services are interrelated components of catchment systems (DoW 2004). The DWMS focuses on the SIA and the two GIAs. Its key aspects are summarised below

The OIE development is considered a district scale scheme under State Government Planning, hence the requirement for a DWMS which will inform LandCorp and the Shire of Chapman Valley of implications of the estate's development for water management, so responsibilities can be fulfilled under Section 6 of State Planning Policy 2.9 Water Resources (WAPC 2006).

Relevant planning documents that relate to the development include Shire of Chapman Valley Town Planning Policies, Amendment No 1 to its Town Planning Scheme No. 1, the Town Planning & Development Act (1928), the Shire's Local Rural Strategy, and the Subdivision and Planning Development Guidelines (2009).

The site is slightly undulating, with 3 north-south ridges running through it, and is currently used for farming and grazing.

Twenty one bores were installed by Rockwater in 1996 and water levels in these ranged from 6 – 65 mBGL. Groundwater quality was generally brackish and elevated levels of nitrate and arsenic were encountered in some bores. The source of these analytes is likely to be farming activities.

Up to 37 GL/yr is forecast as the total feedwater demand for OIE when fully developed. To ensure reliable and water efficient supply to the development, alternative water sources were considered as follows:.

- Groundwater from Casuarina, Tumblagooda, Allanooka and local artesian aquifers;
- Desalination (reverse osmosis);
- Recycled industrial wastewater from a proposed Water Recycling Factory;
- Recycled treated organic wastewater from the proposed Waste Water Treatment Plant.

Surface and groundwater management strategies are recommended to ensure best management of water within the development and protection of downstream ecological communities. Water management (quality and quantity) will be the responsibility of each proponent for areas located within lot boundaries, whilst LandCorp will be responsible for water management in public areas (notably road drainage).

Specific surface water management strategies are summarised below:

<u>1 yr ARI</u>

- To retain and treat the 1-year ARI event, rooves will be connected to soak wells and, where they are adopted, to rainwater tanks.
- Clean runoff from hardstand areas will be contained and infiltrated within each lot boundary.
- Contaminated runoff will be contained within each lot and treated prior to discharge.

- Road runoff will be infiltrated as close to source as practicable using water sensitive urban design (WSUD) measures, including roadside swales / table drains.

10 yr ARI

- Road runoff will be infiltrated as close to source as practicable using water sensitive urban design (WSUD) measures, including roadside swales / table drains / bio-retention structures.
- Bio-retention structures within individual lots will treat and infiltrate stormwater runoff.

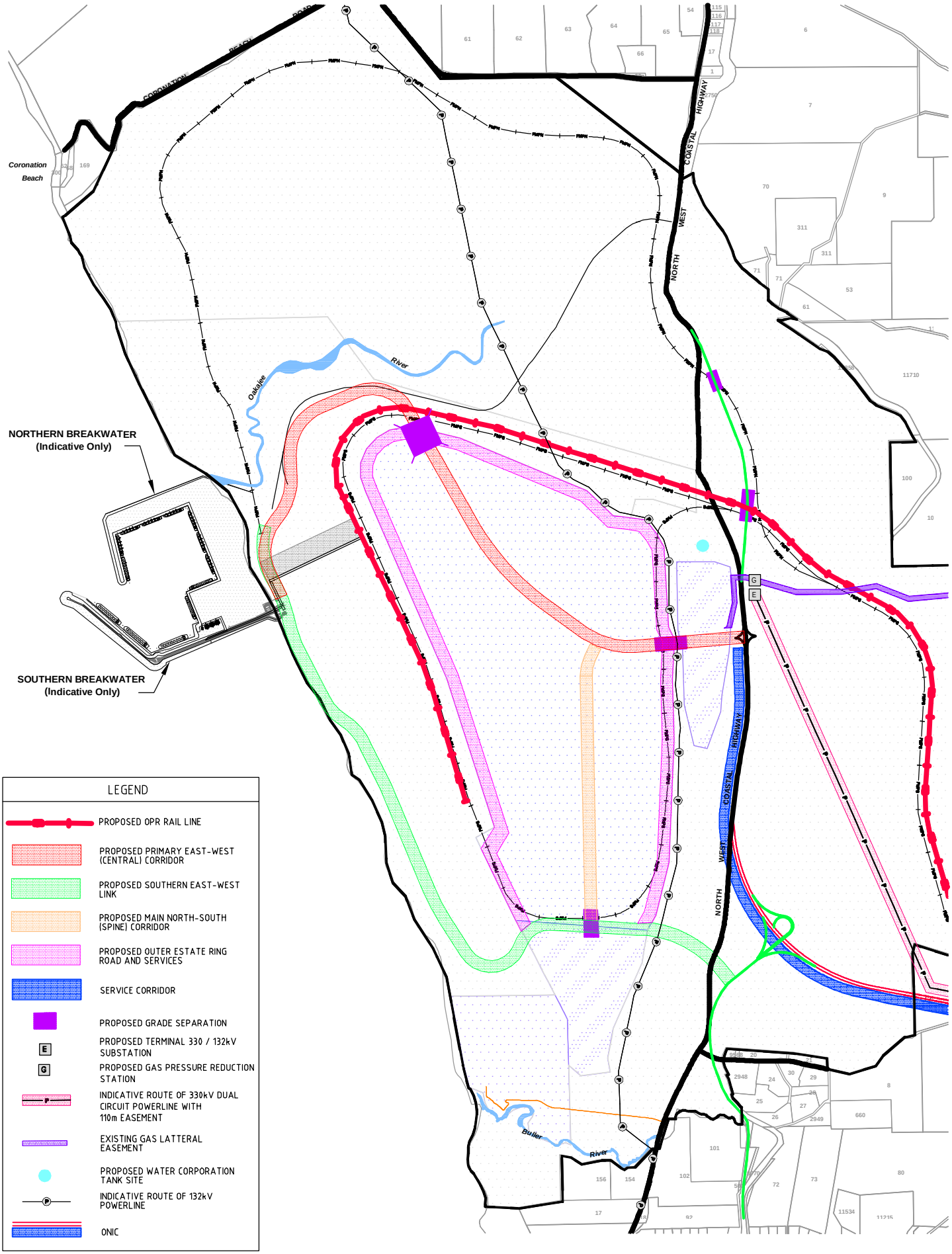
100 yr ARI

- Provision via overland flow paths will enable discharge of stormwater from each lot such that it will not exceed 100-year ARI pre-development peak flows.

To ensure protection of groundwater and its ecological value, groundwater monitoring is recommended throughout the various stages of development and during the subsequent operational phase to check against contamination. This will be the responsibility of proponents.

Appendix A

Layout of Infrastructure Corridors



LEGEND

- PROPOSED OPR RAIL LINE
- PROPOSED PRIMARY EAST-WEST (CENTRAL) CORRIDOR
- PROPOSED SOUTHERN EAST-WEST LINK
- PROPOSED MAIN NORTH-SOUTH (SPINE) CORRIDOR
- PROPOSED OUTER ESTATE RING ROAD AND SERVICES
- SERVICE CORRIDOR
- PROPOSED GRADE SEPARATION
- E — PROPOSED TERMINAL 330 / 132kV SUBSTATION
- G — PROPOSED GAS PRESSURE REDUCTION STATION
- INDICATIVE ROUTE OF 330kV DUAL CIRCUIT POWERLINE WITH 110m EASEMENT
- EXISTING GAS LATTERAL EASEMENT
- PROPOSED WATER CORPORATION TANK SITE
- INDICATIVE ROUTE OF 132kV POWERLINE
- ONIC

LANDCORP
OAKAJEE INDUSTRIAL ESTATE
STRUCTURE PLAN
INFRASTRUCTURE CORRIDORS

Job Number 61-24611
Revision D
Date 02.12

Figure 05

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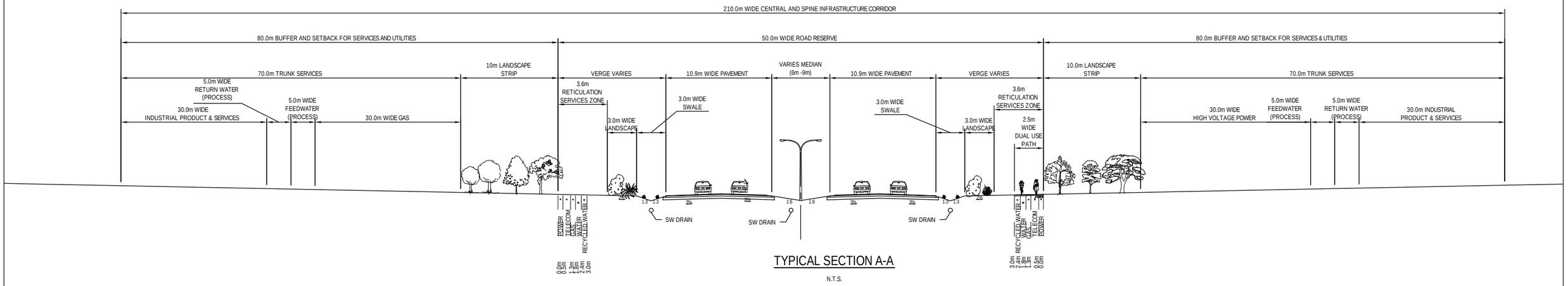
Plot Date: 6 March 2012 - 1:00 PM Plotted by: Elizabeth Scicluna/Perth/GHD/AU Cad File No: G:\61\24611\CADD\FIGURES\61-24611-05-RD.dwg

Appendix B

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

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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

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