Pretty Pool Stage 3

Town Planning Scheme Amendment Report

Prepared by:

RPS AUSTRALIA EAST PTY LTD

38 Station Street, Subiaco WA 6008
PO Box 465 Subiaco WA 6904

T: +61 8 9211 1111
F: +61 8 9211 1122
E: planning@rpsgroup.com.au

Prepared for:

LANDCORP

Level 6 Wesfarmers House
40 the Esplanade Perth WA 6000

T: +61 8 9482 7499
F: +61 8 9481 0861
E: landcorp@landcorp.com.au
W: www.landcorp.com.au

Client Manager: Scott Vincent
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Approval for Issue

Name	Signature	Date
Scott Vincent		27.02.2014

Contents

Tables

Figures

Appendices

Summary

This report is prepared in support of a request to amend the Town of Port Hedland Town Planning Scheme No. 5 ('the Scheme') to facilitate the subdivision and development of approximately 3.41ha of land in the Pretty Pool area of Port Hedland, also known as Pretty Pool Stage 3.

Strategic planning at State and Local Government levels recognise the importance of providing additional residential land in Port Hedland that is attractive to new permanent residents and families, and helps achieve the precinct vision established by the Pilbara's Port City Growth Plan:

"The East End Urban Village is Port Hedland's primary residential area. The area, encompassing established Cook Point and Pretty Pool offers significant housing density and diversity together with sport and recreation opportunities, and school and community facilities. At its heart is a retail and mixed use village that offers a range of local convenience as well as dining and entertainment choices. Strong links to the coast and mangrove environs have been established which offer residents and visitors alike a closer connection with the landscape." (ToPH, 2012).

Acknowledging the Environmental Protection Authority's (EPA) concerns with previous rezoning and development proposals for the Pretty Pool Stage 3 area, LandCorp and RPS have undertaken comprehensive technical investigations and scenario modelling over the last two years to review the Stage 3 area and establish a set of planning and environmental controls to appropriately manage/mitigate potential impacts on the turtle nesting beach. This proposed scheme amendment represents the culmination of these investigation findings, and seeks to demonstrate that approximately 3.41ha is capable of supporting urban development in an appropriate and environmentally responsible manner.

This report, along with supporting environmental and engineering studies, demonstrates that:

- Rezoning and ultimate subdivision/development of the Stage 3 area is consistent with all relevant strategic and statutory planning frameworks, with many strategic plans identifying the site for future urban/residential development capacity subject to resolution of environmental constraints;
- A comprehensive suite of technical investigations and studies has been undertaken to appropriately define the proposed amendment area, having regard for critical environmental management issues including the protection of Flatback Turtle nesting beaches and consideration of coastal processes;
- The site is capable of being serviced to an urban standard, with an appropriate zoning allowing further detailed engineering investigations to progress through subsequent planning stages (e.g. development plan, subdivision etc); and
- Sufficient controls exist through the statutory planning frameworks, including the addition of new Scheme Text (Appendix 10) provisions, to appropriately control and manage future detailed planning stages to the satisfaction of state and local authorities.

Initiation of the amendment will enable formal assessment of potential environmental impacts by the EPA, and for the amendment to proceed to public advertising.

1.0 Introduction

1.1 Introduction

This report is prepared in support of a request to amend the Town of Port Hedland Town Planning Scheme No. 5 ('the Scheme') to facilitate the subdivision and development of Stage 3 of LandCorp's Pretty Pool project. This report seeks to demonstrate the appropriateness of applying an 'Urban Development' zoning and associated text provisions to approximately 3.41ha of land, and confirms that:

- Rezoning and ultimate subdivision/development of the Stage 3 area is consistent with all relevant strategic and statutory planning frameworks;
- Environmental impacts can be appropriately managed/mitigated, as demonstrated by a comprehensive suite of technical investigations and studies;
- The site is capable of being serviced to an urban standard; and
- Sufficient controls exist through the statutory planning frameworks to appropriately control and manage future detailed planning stages to the satisfaction of state and local authorities.

1.2 Background

In 2006 the Town of Port Hedland initiated Amendment No. 14 to its Town Planning Scheme No. 5 (TPS5) seeking to rezone approximately 36 hectares of land from 'Rural' to 'Urban Development' within the wider Pretty Pool development area. Following initiation by Council, the Environmental Protection Authority (EPA) advised that a formal level of environmental assessment would be set because the proposed development footprint for the 'Stage 3' area was viewed as an area of 'great concern' with respect to its close proximity to the turtle nesting beach (Pretty Pool Beach), and the impacts of light (both direct and light glow) on flatback turtles. Following removal of the Stage 3 area from the Amendment No.14 proposal, the EPA determined that "no formal assessment" was required for the remaining portion of the Pretty Pool development area, which proceeded to be rezoned and ultimately developed.

In May 2009 another Scheme Amendment (Amendment No.20) seeking rezoning of approximately 5.1ha of land for the Stage 3 area was initiated by the ToPH and referred to the EPA. The EPA subsequently determined that Scheme Amendment No.20 was unable to meet the EPA's objectives for flatback turtles, and that "the environmental issues pertaining to the Amendment cannot be resolved".

Acknowledging the EPA's previous concerns with the rezoning and development of the Stage 3 area, LandCorp and RPS have undertaken comprehensive technical investigations and scenario modelling over the last two years to review the Stage 3 area and establish a set of planning and environmental controls to appropriately manage/mitigate potential impacts on the turtle nesting beach. This proposed scheme amendment represents the culmination of these investigation findings, and seeks to demonstrate to the Town of Port Hedland, WA Planning Commission and the EPA that a reduced area (approximately 3.41ha) of the Pretty Pool Stage 3 site is capable of supporting urban development in an appropriate and environmentally responsible manner.

1.3 Amendment intent

The amendment proposes the application of the 'Urban Development' zone over approximately 3.41ha of land to the immediate north east of Counihan Crescent in the Pretty Pool area of Port Hedland. The proposed Scheme Amendment will ultimately enable the release of land for much needed urban development.

An Urban Development zoning, along with the land's existing status being within the existing Pretty Pool Development Plan Area, will ensure a coordinated approach to further planning of the site through preparation of a development plan for the area. This will ensure the orderly and proper planning of specific land use types, residential development densities, local movement networks and built form requirements. Other key issues such as stormwater management and utility servicing will also be coordinated through this process.

Importantly, this amendment also seeks to include additional provisions within Appendix 10 of the Scheme Text, similar to those already applied to the existing Urban Development zoned area of Pretty Pool. These conditions will guide and regulate further detailed planning and development of the land, particularly with regard to the management and protection of turtle habitat to the satisfaction of the Environmental Protection Authority.

1.4 Report scope and content

This report sets out the strategic planning context for the Pretty Pool Stage 3 area, and the suitability of this area to be included within the Urban Development zone having regard for critical environmental and servicing considerations. Key design considerations to be taken into account through subsequent planning processes are also explored in this report, for ultimate inclusion within Appendix 10 of the Scheme Text.

The report comprises the following sections:

- **Site location and context** – a description of the site in terms of its location, ownership and existing land uses.
- **Planning frameworks** – an analysis of key strategic and statutory planning frameworks applicable to the site, providing the context and imperative for future urban development in this location.
- **Environmental considerations** – a summary of key environmental considerations as addressed in detail through the accompanying Environmental Assessment Report (EAR);
- **Engineering considerations** – a summary of key earthworking, servicing and other infrastructure considerations as further addressed in the accompanying Engineering Assessment Report.
- **Proposed scheme amendment** – a description and justification for the proposed Scheme Amendment in terms of its proposed zoning and Scheme Text changes.
- **Conclusion.**

Upon initiation of an amendment by the Town of Port Hedland, formal amendment documents will be prepared for execution and referral to the Environmental Protection Authority for assessment.

2.0 Site location and context

2.1 Location

The Pretty Pool Stage 3 area is located to the north east of the existing developed Pretty Pool precinct, and represents the final remaining stage of the development without necessary zonings and statutory planning approvals in place for subdivision and development. It comprises an area of approximately 3.41ha and is situated to the immediate north east of Counihan Crescent, Panjya Parade and Dowding Way, approximately 200-250m from the coast.

Refer **Figure 1** for a diagram illustrating the site location and context, and **Figure 2** for a diagram illustrating the site in relation to the existing staged Pretty Pool development. An aerial site plan is provided at **Figure 3**.

2.2 Ownership

The proposed Stage 3 amendment area is wholly contained within Lot 5007 (Plan 57975), which has a lot area of approximately 6.48ha and is generally bound by Counihan Crescent/Panjya Parade to the west and Lot 5002 (originally intended to form an outer loop road) to the north, east and south.

The lot particulars and title details are summarised as follows:

Table 1 Land tenure and title details

Lot No.	Plan No.	Volume	Folio	Tenure	Owned	Principal Interest Holder	Size
5007	57975	LR3154	48	Crown Land – Leasehold	State of WA	WA Land Authority (trading as LandCorp)	6.48ha

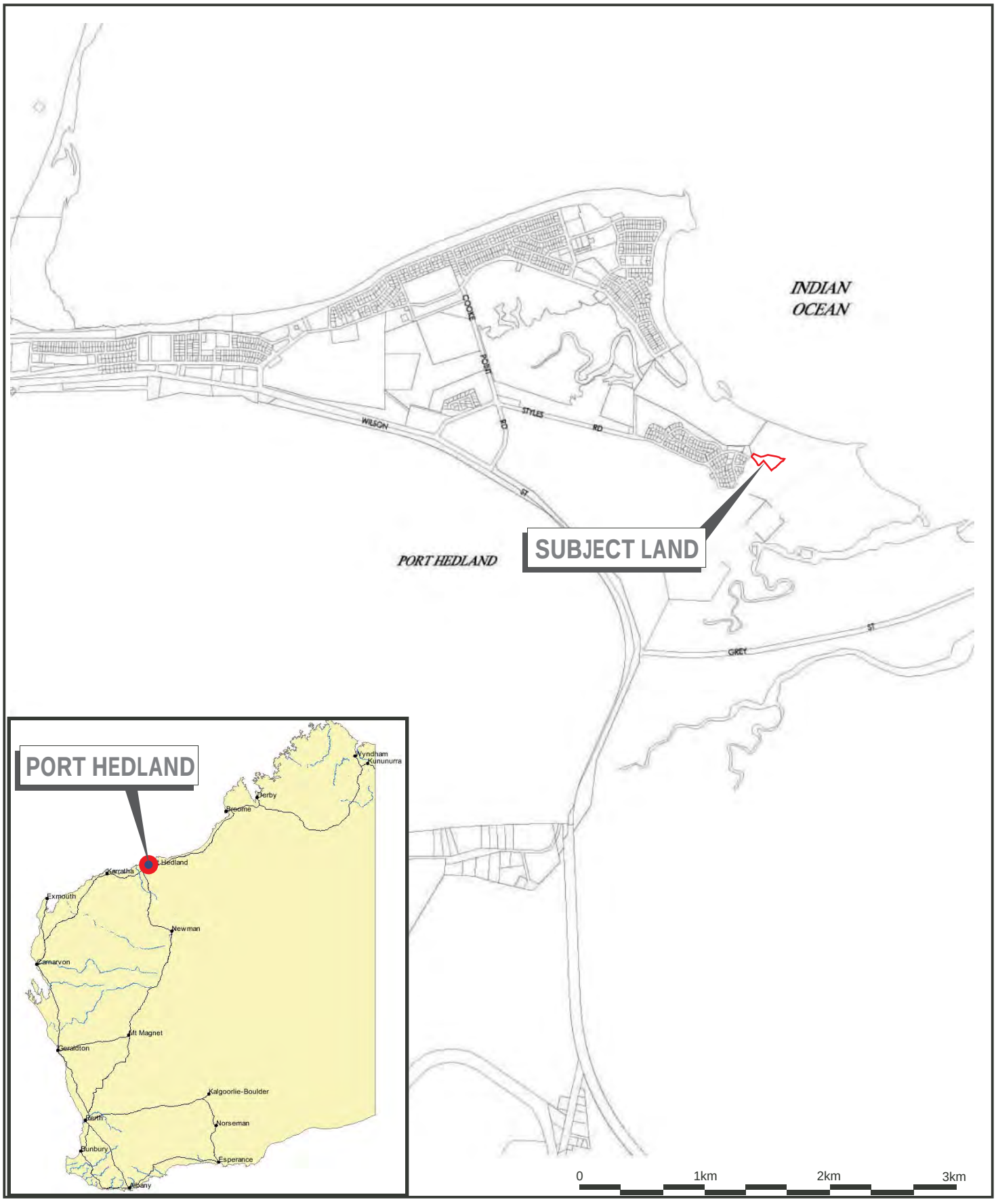
A copy of the Certificate of Title is provided at **Appendix 1**.

2.3 Existing and surrounding land uses

The land is currently vacant and not being used for any purpose. Surrounding land uses are described as follows:

- Land to the immediate south and west is developed for residential purposes, comprising LandCorp's existing Pretty Pool development. This area is characterised single residential dwellings on freehold lots of between 350m^2 and 800m^2. Three and four storey medium density mixed use development is also present along Dowding Way fronting Four Mile Creek.
- Vacant Crown land surround the remainder of the site, with Four Mile Creek further south east and the Indian Ocean further to the north.
- The Pretty Pool park and car park are located approximately 350m north west of the proposed amendment area.

As demonstrated above, the Pretty Pool locality is characterised by low and medium density residential development. It provides much needed quality residential accommodation in a high amenity location.



Subject Land

N

Source: DLI / Landgate

FIGURE 1
Site Location and Context

Pretty Pool Stage 3

Lot 5007 Counihan Crescent
Pretty Pool, Port Hedland

RPS

Pretty Pool Stage 3, Port Hedland

Figure 2 - Local Context

0 100 200 400

RPS Australia East Pty Ltd
ACN 140 292 762
ABN 44 140 292 762

PO Box 465 Subiaco WA 6904
38 Station Street
Subiaco WA 6008

T +61 8 9211 1111
F +61 8 9211 1122
W rpsgroup.com.au

Scale 1:4000@A3 | **Date** December 2013 | **Project No** 116386-5-002

Legend

Stage 3 Amendment Area

Pretty Pool Stage 3, Port Hedland

Figure 3 - Site Plan

0 50 100 200

RPS Australia East Pty Ltd
ACN 140 292 762
ABN 44 140 292 762

PO Box 465 Subiaco WA 6904
38 Station Street
Subiaco WA 6008

T +61 8 9211 1111
F +61 8 9211 1122
W rpsgroup.com.au

Scale 1:2000@A3 I **Date** November 2013 I **Project No** 116386-5-003

3.0 Planning frameworks

3.1.1 State Planning Strategy (1997)

The State Planning Strategy was published by the Western Australian Planning Commission (WAPC) in 1997, comprising a comprehensive list of strategies, actions, policies and plans to guide the planning and development of regional and metropolitan areas in Western Australia. It is the key strategic planning document coordinating the State Government's response to the major planning challenges and opportunities facing state and local authorities.

The State Planning Strategy sets the following five key principles intended to guide and coordinate action at all levels of government and across all agencies:

- The Environment - To protect and enhance the key natural and cultural assets of the State and deliver to all Western Australians a high quality of life which is based on sound environmentally sustainable principles.
- The Community - To respond to social changes and facilitate the creation of vibrant, accessible, safe and self-reliant communities.
- The Economy - To actively assist in the creation of regional wealth, support the development of new industries and encourage economic activity in accordance with sustainable development principles.
- Infrastructure - To facilitate strategic development by ensuring land use, transport and public utilities are mutually supportive.
- Regional Development - To assist the development of regional Western Australia by taking account of the region's special assets and accommodating the individual requirements of each region.

The State Planning Strategy identifies Port Hedland as a key population and economic growth area, and provides the following vision statement for the Pilbara Region:

In the next three decades, the Pilbara Region will be a world leading resource development area focusing on mineral extraction, petroleum exploration and production and the primary stages of downstream processing. The region's population will grow in the future, fuelled by specific resource development projects, the sustainable development of Karratha and Port Hedland and a more diverse economy. A growing tourism industry will have developed based on the region's unique natural environment.

This vision is to be achieved through implementation of strategies and actions such as:

- enable housing supply and service provision to respond quickly to resource development;
- provide for the centres within the region to expand and offer a wide range of services supporting the growing population;
- promote development opportunities and all aspects of economic activity, for example, tourism, small business and infrastructure provision;
- encourage alternatives to the fly in – fly out workers from projects; and
- provide coordination of Government agencies to minimise the obstructing / delaying of resource developments and associated infrastructure needs.

LandCorp's Pretty Pool project embraces this vision as it provide further housing supply and accommodate a rapidly growing population.

3.1.2 Draft State Planning Strategy (2012)

On 19 December 2012 the Minister for Planning launched a new draft State Planning Strategy for public consultation. Prepared by the Department of Planning, under the guidance of the Western Australian Planning Commission, this Strategy presents a vision for Western Australia to 2050 and beyond based on a framework of planning principles, strategic goals and State strategic directions.

The Strategy is the Government's proposed response to the opportunities and challenges Western Australia is likely to face in the future, and is structured around the five interrelated strategic goals:

- Global competitiveness will be enhanced through economic diversification;
- Economic expansion and inter-regional collaboration will build strong and resilient regions;
- Investment in infrastructure and social capital will build sustainable communities;
- Infrastructure planning and coordination will achieve efficiencies and promote economic growth; and
- Sustainable development and efficient use of resources will enhance environmental conservation.

Of particular relevance to the Pretty Pool project, the draft State Planning Strategy aspires to ensure suitable and affordable supply of land for the long-term needs of people, enterprise and industries across the state. It recognises the State's Pilbara Cities initiative, which will develop Port Hedland into a city where people choose to settle on a permanent basis, because it is a place to raise families with access to high standards of education, health and diverse employment and career opportunities. The Pretty Pool project seeks to provide quality accommodation in a high amenity setting, further contributing to the establishment of Port Hedland as a desirable place to raise families.

Upon final adoption the new Strategy will replace that which has been in place since 1997.

3.1.3 State Planning Policy No.2.6 – State Coastal Planning Policy

State Planning Policy 2.6 provides guidance for decision making within the coastal zone including establishment of foreshore reserves; managing development and land use change; and to protect, conserve and enhance coastal values. This policy recognises and responds to regional diversity in coastal types; ensures coastal hazard risk management and adaptation is appropriately planned for; and encourages innovative approaches to managing coastal hazard risk.

This policy applies to the coast throughout Western Australia, including:

- sandy shorelines, rocky shorelines, mixed sandy and rocky shorelines, coastal lowlands, and tidal reaches of inland waters;
- near shore marine waters, state waters;
- all islands within the state lying seawards of the mainland; and
- land use and development abutting the coast.

Given its location in proximity to the coast, proposals for the Pretty Pool Stage 3 area are required to demonstrate compliance with the policy provisions, including the establishment of coastal setbacks accounting for potential long term physical coastal processes (erosion, sea level change, storm events etc). These issues have been addressed as part of the rezoning proposal and are discussed further in Section 4.0 of this report.

3.1.4 Pilbara Planning and Infrastructure Framework

The Pilbara Planning and Infrastructure Framework provides a strategic direction for the future development of the Pilbara region spanning over the next 25 years. The document aims to address the scale and distribution of future population growth and housing development as well as identifying strategies for economic growth, environmental issues, transport infrastructure, water resources, tourism and the emerging impacts of climate change. It also sets out regional planning principles, goals, objectives and actions to achieve the above set outcomes that will guide the preparation of Local Planning Strategies and Local Planning Schemes.

The Framework reinforces Port Hedland's role as a Pilbara City to service the East Pilbara, given its pivotal location as one of the Pilbara's major ports and the increasing international demand for mineral resources. It acknowledges the Pilbara Cities vision of Port and South Hedland growing into a city of 50,000 people by 2035, and the need for residential densities to generally increase across the board to effectively quadruple the stock of dwelling units across Port and South Hedland.

The framework provides four (4) key objectives for planning and development in the Pilbara:

- Settlement: Develop the region's settlements to be sustainable and liveable communities.
- Housing: Provide choice, quantity, quality and affordability in housing provision.
- Fly-in fly-out: Provide for fly-in fly-out (fi-fo) workforces that do not adversely impact on the resident population.
- Urban Form: Create sustainable, well defined, cohesive settlements, with a strong sense of place and high quality urban design that is climate responsive.

Aligned with these objectives, the following actions are of particular relevance to the Pretty Pool project:

- Achieve an efficient supply of project-ready land, in a timely manner, to accommodate growth;
- Continue to undertake work that focuses on accelerating land releases for housing;
- Provide serviced residential land in identified growth areas to meet the needs of the labour market;
- Encourage higher density residential development in Port Hedland through the application of residential design codes;
- Identify ways that settlements can engender connectivity and create a sense of place;
- Develop a Pilbara vernacular design style that is sensitive to, and enhances the identity and character of settlements through the development and adoption of urban design guidelines;
- Provide for climate responsive urban form and buildings through the development and adoption of urban design guidelines; and
- Continue to implement water sensitive urban design policies and practices.

Importantly, the Pretty Pool Stage 3 area is identified for residential-medium density development in Map 5 of the framework document, being an extract of the Pilbara's Port City Growth Plan.

3.1.5 Port Hedland Regional Hotspots Land Supply Update

Prepared as part of the Urban Development Program, and encompassing the former Country Land Development Program (CLDP), the Regional HotSpots series reports on major regional centres across the State on an as required basis.

The Urban Development Program (UDP) coordinates and promotes the development of serviced land in a sustainable manner for the guidance of state infrastructure agencies, public utilities, local governments and the private sector. It tracks demand, land supply, development and infrastructure in Western Australia's major urban centres to deliver a more effective use of land, better staging of development and prioritisation of infrastructure investment to support urban growth.

The 2011 release for Port Hedland makes the following key statements and recommendations of relevance to the Pretty Pool project area:

- Port Hedland's greatest current challenges are developing land, housing and infrastructure to keep pace with rapid, and sometimes unpredictable, population and employment growth.
- The longer-term growth of Port Hedland will require a more diversified economy and a broader range of amenities, services and community facilities.
- There is a critical need for a more diverse range of housing in the region including more affordable accommodation for service workers (to support the retail, hospitality, tourism and general service sectors) and increased numbers of medium and higher density dwellings.
- The Pretty Pool Stage 3 area is nominated for residential land use, and identified as site PH08C (approximately 5ha) with capacity for some 130 dwellings in the medium term. It notes the development of this site as being on hold in light of the EPA's stance on previous Amendment No.20, and that monitoring of Flatback Turtles is continuing.

3.1.6 Pilbara's Port City Growth Plan

Pilbara's Port City Growth Plan (the 'Growth Plan') represents a significant step change in long term land use and infrastructure planning for Port Hedland as it continues its evolution into a city of 50,000 (consistent with the targets set by the Draft Pilbara Planning and Infrastructure Framework). The document provides a strategic blueprint for the sustained growth of Port Hedland, building on its relative competitive advantages and an enviable platform of strong and sustained projected economic growth into the future. As a key component of the State Government's Pilbara Cities initiative, the Growth Plan responds to the need to modernise and transform Port Hedland, improving the quality of life for existing residents and to attract and retain new residents.

The Eastern Gateway project area is located within Growth Plan Precinct 2 ('East End Urban Village'). The Growth Plan vision for precinct is as follows:

"The East End Urban Village is Port Hedland's primary residential area. The area, encompassing established Cook Point and Pretty Pool offers significant housing density and diversity together with sport and recreation opportunities, and school and community facilities. At its heart is a retail and mixed use village that offers a range of local convenience as well as dining and entertainment choices. Strong links to the coast and mangrove environs have been established which offer residents and visitors alike a closer connection with the landscape." (ToPH , 2012)

The Pilbara's Port City Growth Plan support the expansion of the existing Pretty Pool development into the Stage 3 area, identifying it as potentially suitable for "*Residential – Medium Density (R40-R60 Apartment, townhouse, villa residential*)". Key implementation indicators for the precinct of relevance to the Pretty Pool area include:

- Development subject to light spill compliance and related conditions for Flatback Turtle nesting sites;
- Coastal hazard management and adaptation planning for new development within areas identified as at risk of coastal erosion;
- Hazard risk management, assessment and adaptation planning for all new developments identified as at

risk of localised flooding and inundation;

- Precinct encapsulated in TPS5 as a 'Development Plan' area;
- Design Guidelines or Detailed Area Plans to address site architectural style, climate and built form recommendations.

3.2 Statutory planning context

3.2.1 Town of Port Hedland Town Planning Scheme No.5

The subject land is currently zoned 'Rural' and located within 'Development Plan Area Pretty Pool' pursuant to the Town of Port Hedland (ToPH) Town Planning Scheme No.5 (TPS5). The future urban development of the Stage 3 area is dependent upon a Scheme Amendment to rezone the subject site from 'Rural' to 'Urban Development', along with preparation/adoption of a 'Development Plan' to then guide subdivision and development. The current zoning and proposed amendment area for Pretty Pool Stage 3 is illustrated at **Figure 4**.

The precinct objectives for the Pretty Pool precinct, as outlined by Clause 5.3.3 of TPS5 are to:

(a) *reinforce the precinct as part of the entrance to Port Hedland;*

(b) *ensure that any further urban development within the precinct is compatible with its environmental values;*

(c) *give particular priority to the conservation and management of mangroves and tidal flats;*

(d) *ensure that the facilities and the active and passive recreation activities within the Pretty Pool reserve are consistent with its district function;*

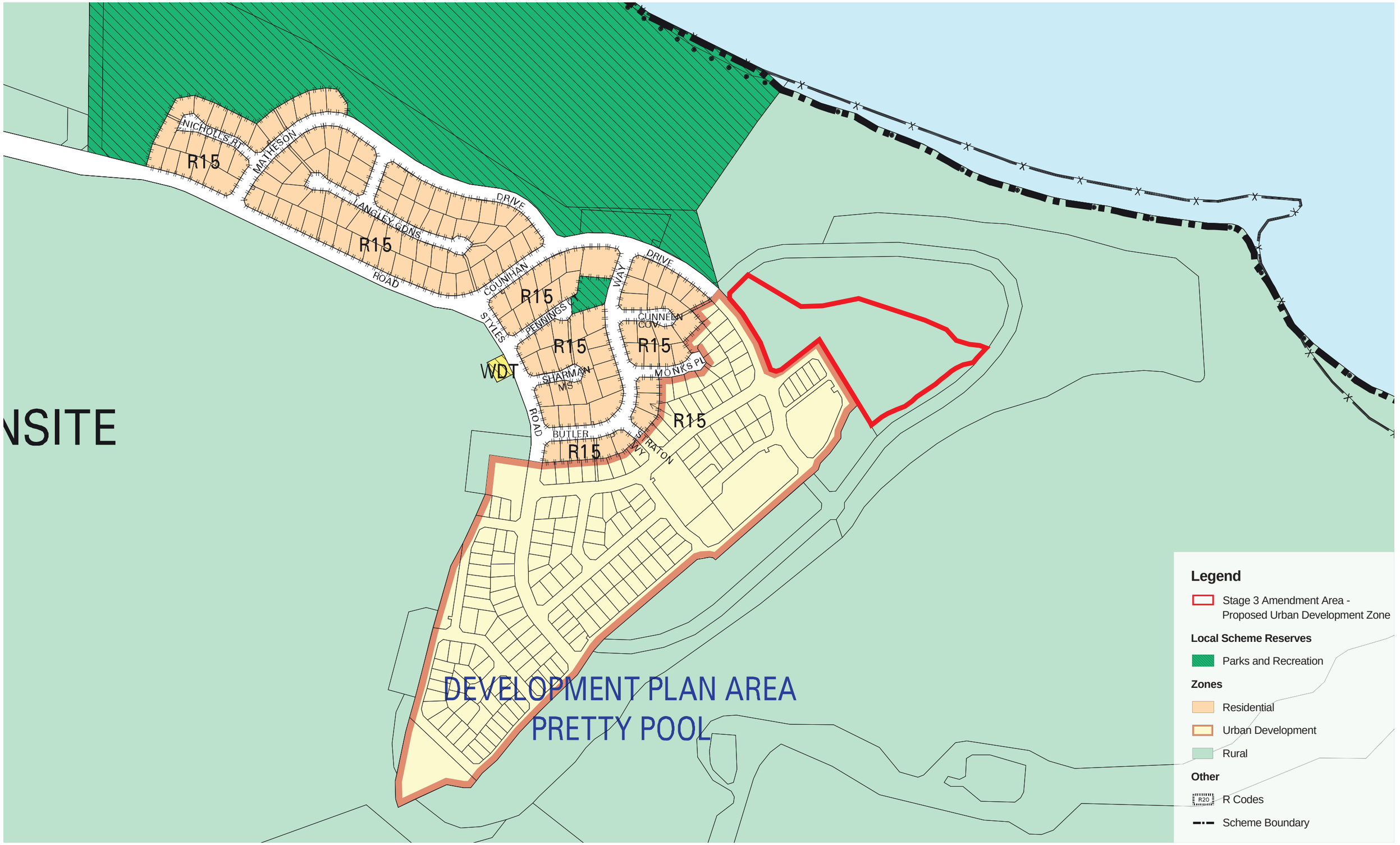
(e) *permit additional tourist facilities provided these do not detract from the district recreational function and the environmental values of the precinct; and*

(f) *ensure that development within the precinct is compatible with potential storm surge conditions within the precinct.*

The adjacent established area of Pretty Pool is already zoned 'Urban Development', and is subject to an approved Development Plan and Design Guidelines to guide and regulate land use and development. It is also identified within Appendix 10 of the scheme as being subject to a range of additional urban development zone requirements, covering issues such as:

- residential density;
- Design guidelines;
- Land use permissibility;
- Building height limits; and
- Management plans required to be prepared, adopted and implemented.

It is anticipated that similar urban development zone requirements/conditions will be required in association with the proposed Stage 3 amendment area, to provide the necessary statutory controls and parameters to inform further detailed site planning and ultimately, subdivision and development.



Pretty Pool Stage 3, Port Hedland

Figure 4 - Town of Port Hedland Town Planning Scheme No. 5 Zoning Plan

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RPS Australia East Pty Ltd
ACN 140 292 762
ABN 44 140 292 762

PO Box 465 Subiaco WA 6904
38 Station Street
Subiaco WA 6008

T +61 8 9211 1111
F +61 8 9211 1122
W rpsgroup.com.au

Scale 1:5000@A3 | **Date** December 2013 | **Project No** 116386-5-004

4.0 Environmental considerations

RPS has prepared an Environmental Assessment Report (EAR) in support of the proposed scheme amendment, with this report provided under separate cover. Importantly, the EAR considers and builds upon the findings of significant additional investigations carried out over the last 12 months, including:

- Preparation of an Environmental Scoping Document (ESD) and liaison with regulatory authorities in March 2013;
- Baseline Light Monitoring and Turtle Management Plan Audit Report (RPS, 2013);
- Local and regional Flatback Turtle review (RPS, 2013);
- Pretty Pool Coastal Assessment (MP Rogers, 2013);
- Pretty Pool Physical Coastal Processes Setback Assessment (MP Rogers, 2013);
- 3-D Line of Sight Modelling to validate TPS Amendment Area and inform built form heights (RPS, 2013).

A summary of the key environmental issues and management requirements is provided below.

4.1.1 Existing environment

The existing environmental characteristics of the proposed amendment area are summarised as follows:

- Pretty Pool Beach has a general northerly aspect and is approximately 1.1km long, with a 200m wide foredune. Behind this foredune is a relatively prominent, stable barrier dune (secondary dune) with crest elevations of between 13m and 16m AHD. The amendment area is located behind this dune ridge which runs in an east-west alignment to the north of the site.
- Groundwater is generally saline to brackish, and flows in a northerly direction, owing to the area's coastal proximity.
- Surface drainage generally runs in a south west direction toward Four Mile Creek, or northwards toward the ocean. Runoff is likely infiltrated into the coastal dunes or naturally discharges into Four Mile Creek, which is flushed twice a day through tidal movement.
- The amendment area is mapped as having 'moderate to low' Acid Sulfate Soils disturbance risk at less than 3m from the surface.
- The amendment area consists of sandy soils above underlying clays, with vegetation comprising low shrubland of *Acacia stellaticeps* over hummock grassland of *Triodia epactia* with open herbs of *Euphorbia tannensis* and *E. drummondii*. The vegetation found across the Stage 3 area is well represented in the Port Hedland area.
- Vegetation condition is considered as 'Good to Very Good', whilst a portion of the Stage 3 amendment area has been previously disturbed and is indirectly impacted by existing tracks to the beach.
- No Declared Rare or Priority Flora was observed within the Stage 3 Amendment Area.
- The Pretty Pool Beach foreshore area is a known nesting habitat (rookery) for Flatback turtles (*Natator depressus*), which are classified as "fauna that is rare or likely to become extinct" under the *Wildlife Conservation Act 1950*. The *Environmental Protection and Biodiversity Act 1999* classifies the Flatback Turtle as "Vulnerable". This status indicates the species is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium term future.
- No Aboriginal Heritage Sites are recorded for the Stage 3 amendment area.

4.1.2 Environmental assessment and confirmation of amendment area

As noted above, Pretty Pool Beach is a known nesting location for Flatback Turtles. This is the most significant environmental issue of note for the proposed Stage 3 amendment area, and was the critical factor in preventing the area's rezoning under previous Scheme Amendments No.14 and 20. Accordingly, LandCorp has adopted a phased environmental assessment approach to inform this scheme amendment request. This approach is described in full within the EAR report, and summarised as follows:

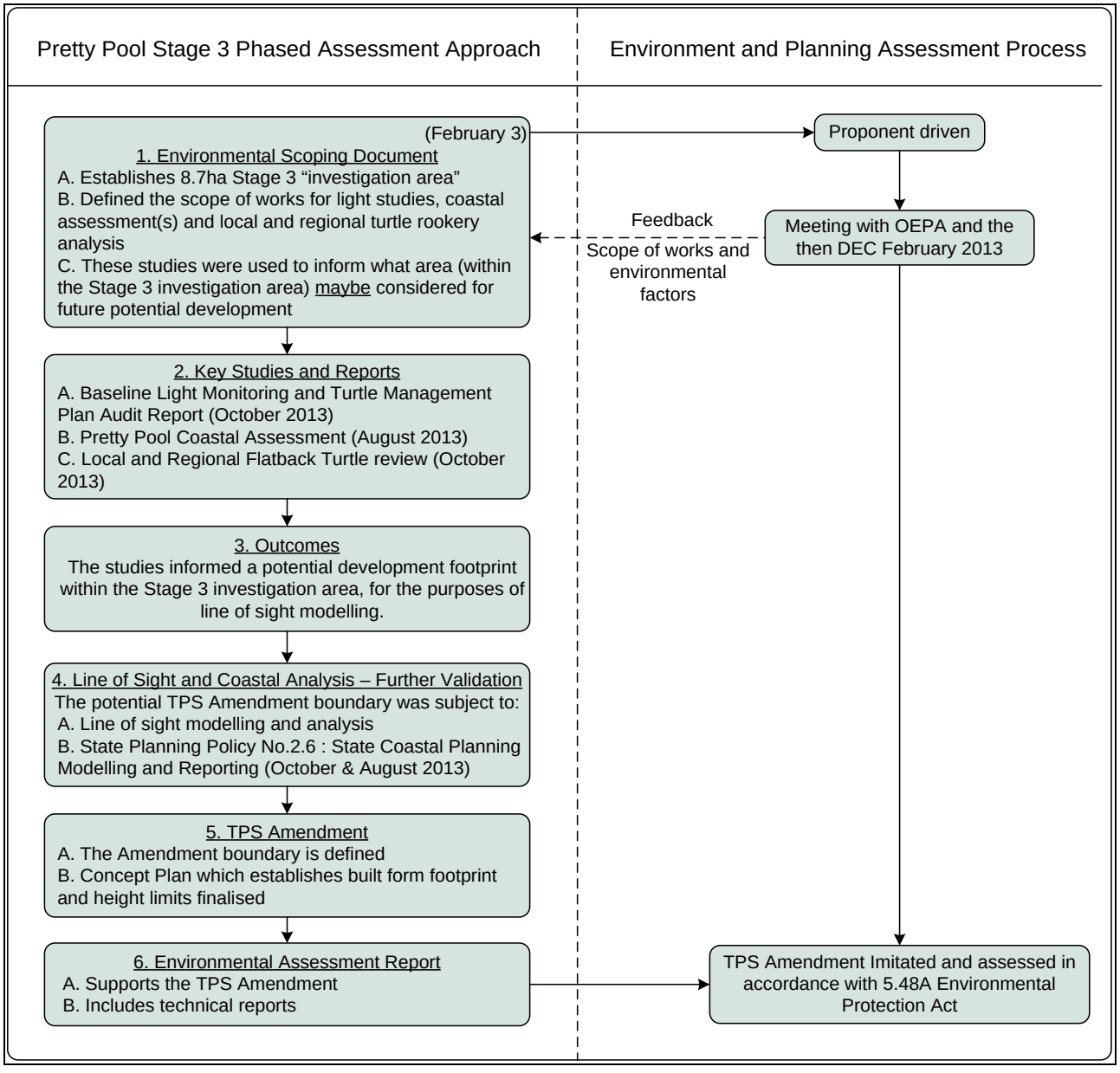

Figure 5 Pretty Pool Stage 3 Phased Assessment Approach

4.1.2.2 Environmental scoping and liaison with environmental agencies

The Pretty Pool Stage 3 Environmental Scoping Document (ESD) was finalised in March 2012. The ESD defined an 8.7 ha area for investigation, generally aligning with the area comprising Lots 5007 and 5002 Counihan Crescent. The purpose of the ESD was to present a scope of works to define an area potentially capable of supporting urban development within the 8.7 ha investigation area. The scope of works to define this area focused on:

- understanding the local and regional context of the Pretty Pool turtle nesting beach (rookery)
- background and line of sight light impact studies on the Pretty Pool turtle nesting beach
- coastal vulnerability / engineering studies

LandCorp met with the Office of the Environmental Protection Authority (OEPA) in February 2013 to further discuss the proposed development of the Stage 3. The key outcome of the meeting was the OEPA advised the EPA's 2009 determination and advice in regards to the potential impacts to the Pretty Pool Beach turtle rookery remained valid. A key concern expressed was the ability to successfully implement the turtle sensitive lighting guidelines throughout the Pretty Pool development over a long term timeframe.

A meeting was held with the (then) Department of Conservation in March 2013, post review of the ESD to determine the acceptability of the coastal vulnerability, light impact and turtle survey methodology proposed to support an environmental impact assessment of any proposed development area within the Stage 3 investigation area by the EPA.

The DEC provided feedback regarding the key potential environmental issues for development within the Stage 3 investigation area, specifically in relation to the Pretty Pool Beach Flatback Turtle rookery. The DEC confirmed the key environmental factors identified in the ESD, however request further focus on the following:

- coastal stability;
- impacts from lighting;
- impacts from human disturbance;
- predation of turtle nests; and
- effectiveness of management actions.

These matters were subsequently incorporated into, and addressed by, the detailed investigations undertaken by LandCorp and its consultants.

4.1.2.3 Baseline light monitoring and turtle management plan audit

This report specifically addresses the Pretty Pool turtle and light studies and management plan audit as outlined in the ESD and responds to the key environmental issues identified by the DEC. The key components of this study include:

- Review of the coastal environment of Pretty Pool Beach.
- A baseline lighting analysis for Pretty Pool Beach.
- An audit of the Pretty Pool development Turtle Management Plan.

The baseline light study concluded that no light sources in the existing Pretty Pool development directly or indirectly influence the beach night light environment, largely due to the presence of the secondary (barrier dune) shading the beach area. Rather, the existing night light environment of Pretty Pool Beach is influenced by light emissions produced in the Cooke Point area (street lights, Caravan Park etc). These Cooke Point sources emit large amounts of shortwave light and are likely to be more attractive to flatback turtle hatchlings than the skyglow produced by port facilities under new moon conditions.

The management plan audit found that the majority of management actions and performance requirements were assessed as being Compliant or Partially compliant, with some actions recommended for continuation to comply with the intent of the specific management plan objectives.

4.1.2.4 Pretty Pool Beach and dune stability assessment

Coastal engineers, MP Rogers and Associates were commissioned to undertake a coastal assessment of the area, specifically assessing the likely movement and stability of the shoreline and dune system over a 100 year planning period. This assessment investigated:

- Potential erosion of the shoreline due to the ongoing action of the coastal processes.
- Potential recession of the shoreline due to sea level rise.
- Potential effect of storm erosion on the shoreline.
- Potential change in form of the coastline.
- Potential for impact on sight lines and light spill from development to turtle nesting sites.

The coastal assessment produced the following results:

- Location/elevation of nesting sites over a 100 year planning period.
- Location of the secondary (barrier dune) over a 100 year planning horizon, with the landward area behind this modelled line unlikely to be affected by coastal processes over a 100 year period.
- Elevations of the secondary barrier dune crest, ranging between 10m and 16m AHD.

These results ultimately formed key inputs and considerations for the 3-D light modelling and line of sight analysis.

4.1.2.5 SPP2.6 coastal processes assessment

In addition to MP Rogers and Associates' investigations of Pretty Pool Beach and secondary (barrier) dune stability, it was identified that a full coastal processes assessment in accordance with State Coastal Planning Policy No.2.6 (SPP2.6) was required to confirm an appropriate amendment footprint/area and its location outside of the coastal processes risk area.

The assessment identified the following physical processes setbacks as being applicable to the Pretty Pool Stage 3 area:

- Indian Ocean frontage – 165m.
- Four Mile Creek Mouth – 318m; and
- Four Mile Creek – 60m.

These coastal processes setbacks are further described in **Table 2** below, and illustrated in **Figure 6**.

Table 2 Total recommended physical processes setback

Area/Interface	Acute Storm Erosion Allowance (S1)	Chronic Shoreline Recession Allowance (S2)	Sea Level Rise Coastal Recession Allowance (S3)	Allowance for Uncertainty	Total Recommended Physical Processes Setback
Indian Ocean	33m	22m	90m	20m	**165m**
Four Mile Creek Mouth	33m	175m	90m	20m	**318m**
Four Mile Creek	8m	5m	27m	20m	**60m**

Source: Pretty Pool Physical Coastal Processes Setback Assessment (MP Rogers, 2013)

4.1.2.6 3-D light modelling and line of sight analysis

Having regard for the studies and investigations carried out, along with the existing topography of the area (the existing barrier dune and its rear face in particular), an investigation footprint was established for further detailed 3-D light modelling and review. The footprint area is shown in green on the figure below, along with the various factors influencing its extent.

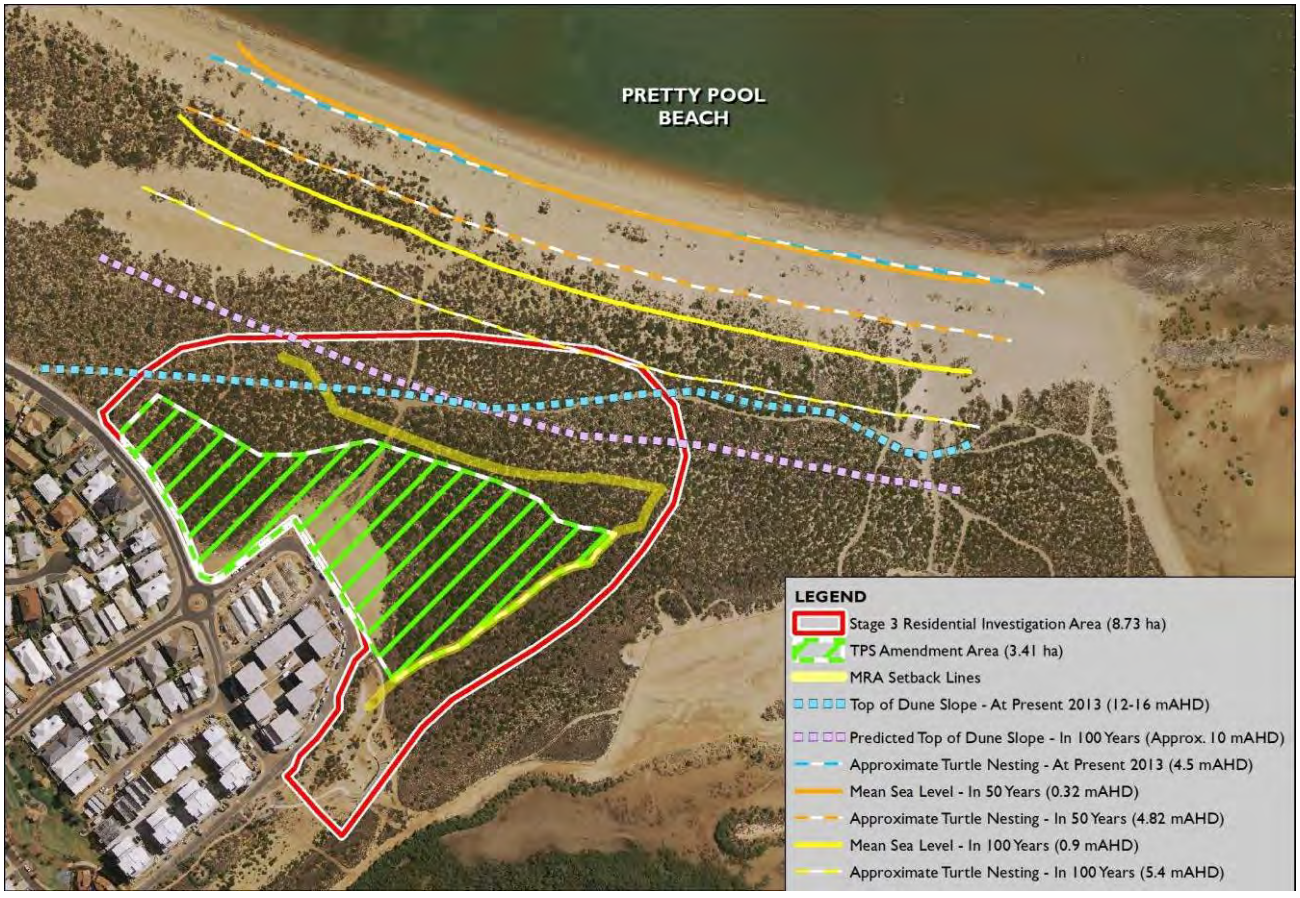

Figure 6 Pretty Pool Stage 3 Amendment Area and Key Influencing Factors

The established footprint area was interrogated through 3-D "line of sight" analysis, with a view to confirming appropriate built form height limits within the ultimate amendment area. This analysis included:

- Development of a 3-D terrain model for the investigation area based on the current coastal topography.
- Development of additional 3-D terrain models for 50 year and 100 year planning periods, accounting for modelled coastal process and potential dune movement.
- Preliminary cross-section analysis to provide an indication of development heights to be modelled further.
- Full modelling of built form within each of the present day, 50 year and 100 year terrain models, demonstrating the height(s) at which buildings (and therefore potential direct light) within the proposed amendment area will be visible to nesting adult and emergent hatchling Flatback Turtles over the full 100 year planning period.

The line of sight 3-D modelling established a series of building height limits within the 3.41 ha Amendment area, expressed in AHD. **Figures 7 to 9** below illustrate the modelling undertaken for the site and the ultimate development height limits established for the site.

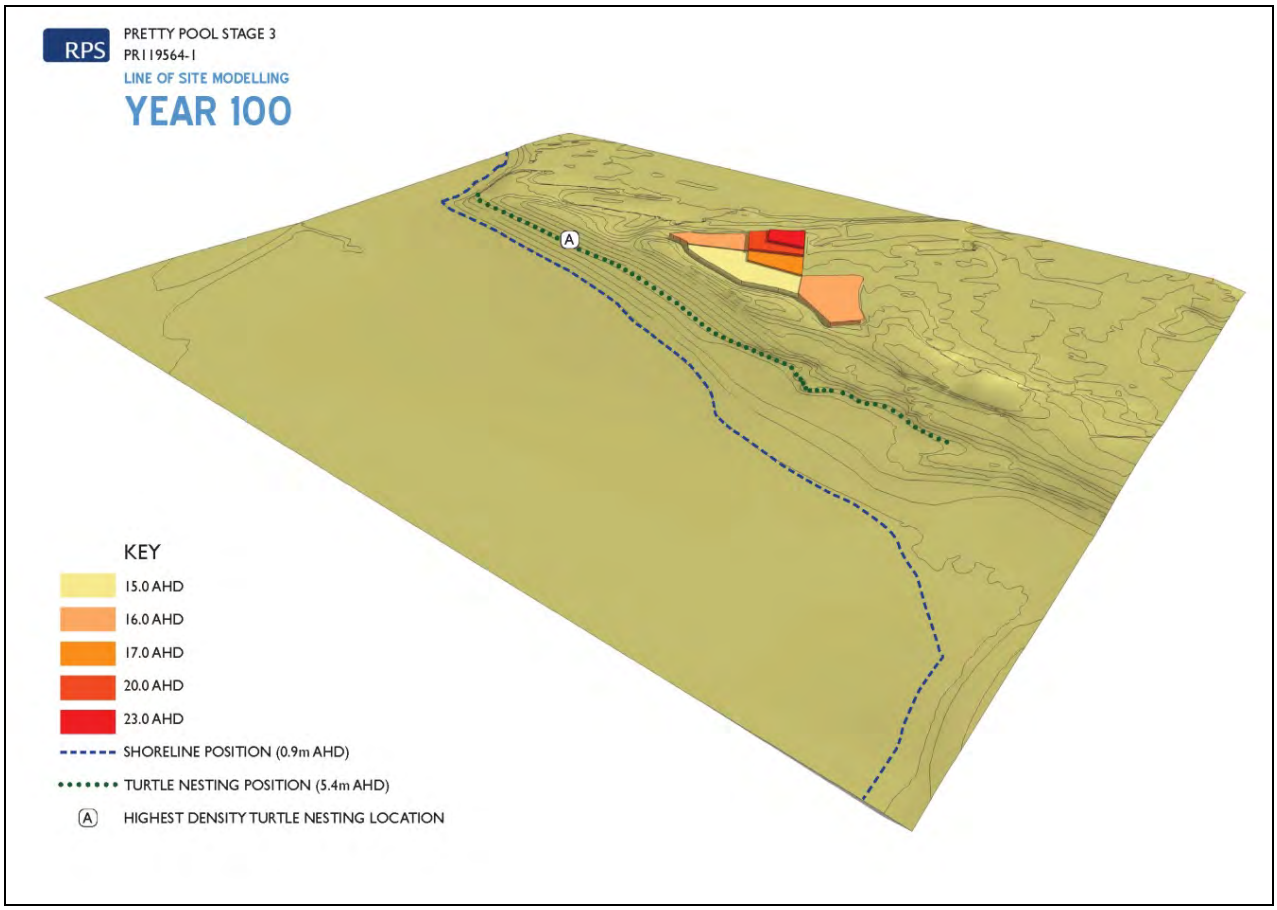

Figure 7 Line of Sight Model – Year 100

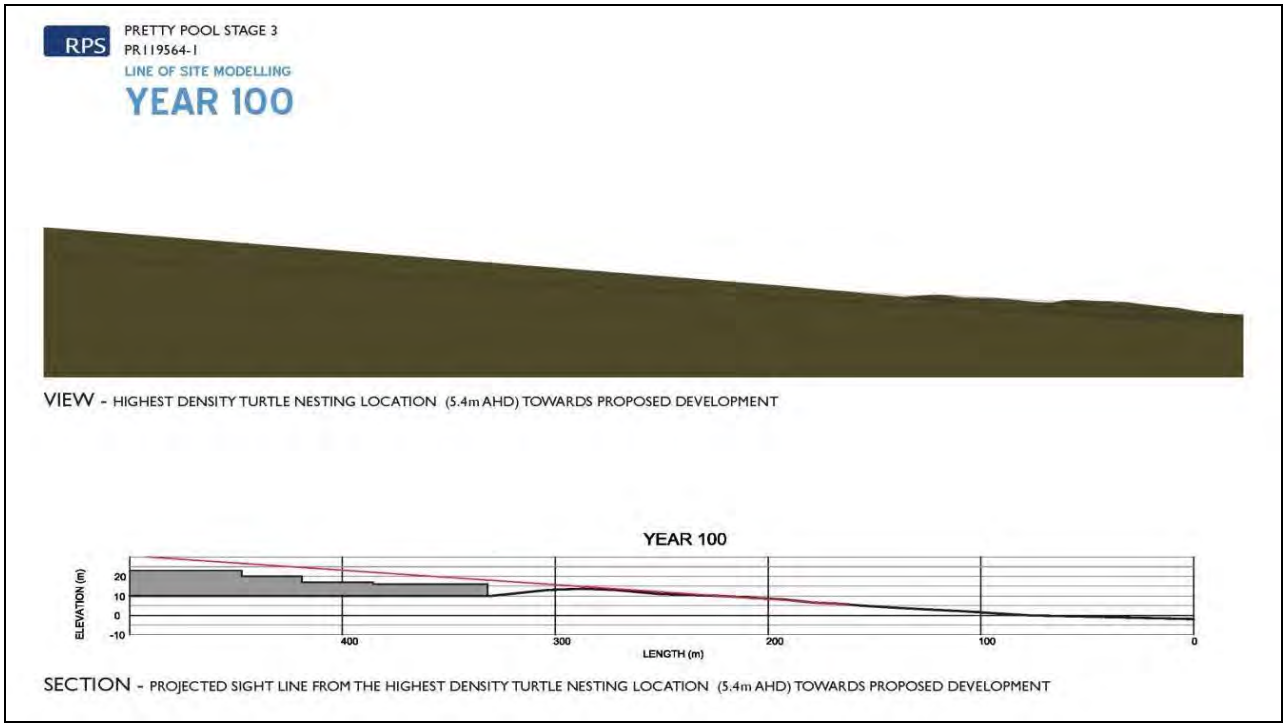

Figure 8 Line of Sight Model Results – Year 100

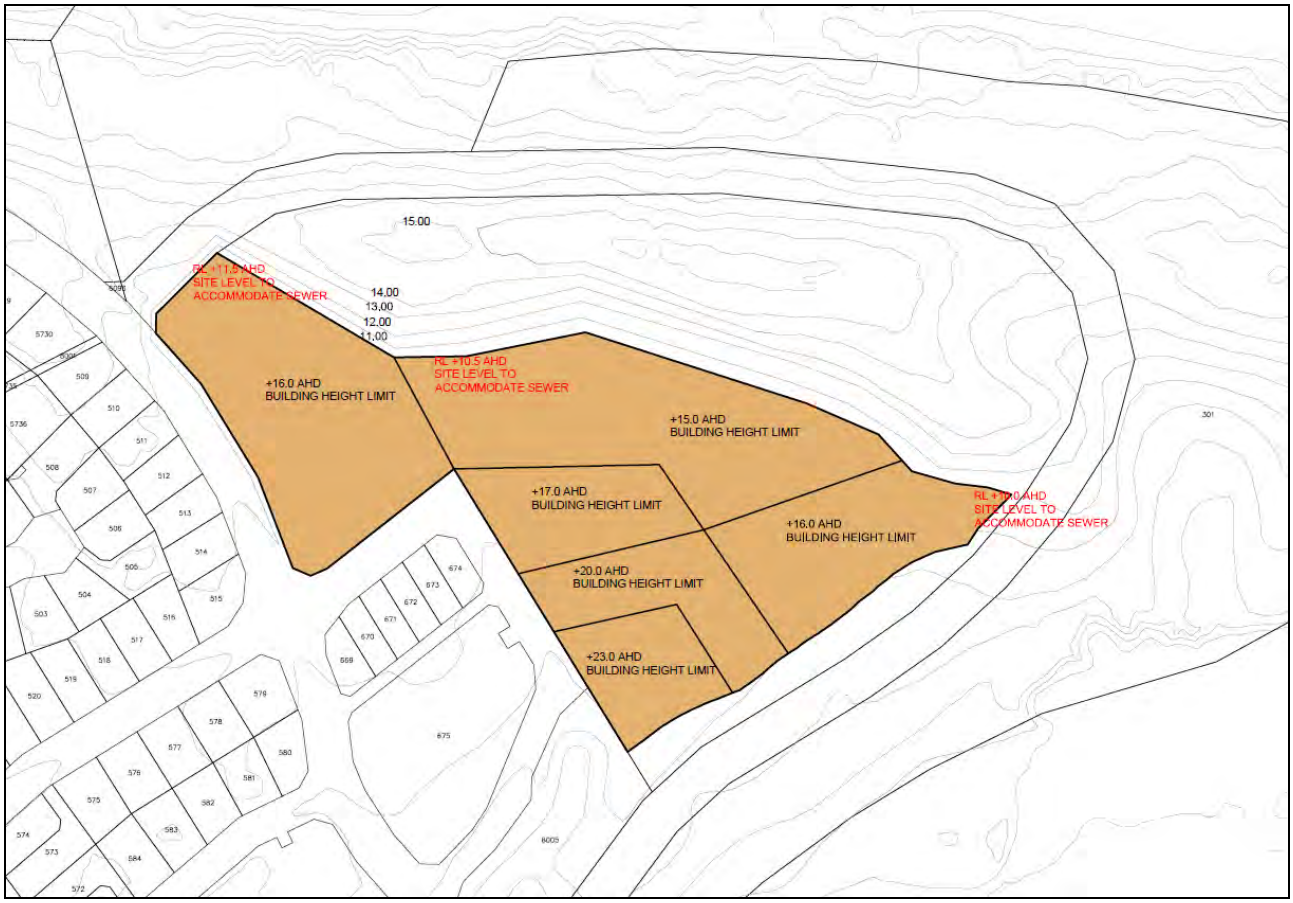

Figure 9 Modelled Building Height Limits – Pretty Pool Stage 3

As illustrated above, the establishment of building height limits of between from 15 m AHD and 23 m AHD across the site will ensure no direct light spill onto the Flatback Turtle nesting beach over the full 100 year planning period. In applying any such limits to built form, it is anticipated that the limit would apply to the top of the external wall, which will allow for further contingency given windows are typically set lower than this level and potentially obscured by eaves etc.

Assuming an average finished site level of approximately 10.5m AHD, and an average height of 3m per floor/storey, the height limits established could potentially accommodate development of between 1 and 4 storeys, with low-rise development around the western/northern perimeter and mid-rise development in the southernmost portion of the site adjacent to the existing multi-unit development sites. Subject to successful rezoning of the site, further detailed planning through preparation of a Development Plan will allow these built form height limits to be refined and applied to a more considered urban development form/layout.

Full details of the line of sight modelling and all other environmental and coastal reporting is provided in the EAR presented under separate cover.

4.1.3 Management strategies required

Effective management of potential environmental impacts is critical to the success of the Pretty Pool Development. The 2006 subdivision approval granted for previous stages 1, 2 and 4 required the preparation and implementation of the following key management plans:

- Turtle Management Plan (TMP);
- Mangrove Management Plan (MMP);
- Foreshore Management Plan (FMP);
- Shorebird Management Plan (SMP); and
- Mosquito and Midge Management Plan (MMMP).

These management plans were finalised to the satisfaction of the Town of Port Hedland and were required by the (then) Department of Environment and Conservation. The management plans were implemented from 2009 to 2012, with the MMP and SMP requiring annual monitoring and reporting throughout the subdivision implementation phase. The monitoring results indicate that the implementation measures for Pretty Pool stages 1,2 and 4 have been successful in mitigating potential impacts to environmental factors, specifically in regards to flatback turtles and mangroves.

For Stage 3 of the Pretty Pool Development, the EAR recommends the following environmental management strategies be prepared and implemented as part of any future planning/development of the site:

- **Turtle management plan** – to detail the turtle monitoring program established in collaboration with Care for Hedland for the Pretty Pool nesting population, with an annual auditing/compliance report submitted to the Office of the EPA.
- **Foreshore management plan** – to include details on rehabilitation requirements/measures, weed control methodology, public access controls/restrictions and community education initiatives. Annual auditing/compliance reporting will be submitted to the Office of the EPA.
- **Mosquito management plan** – to include consideration of mosquito and/or midge nuisance and management/mitigation techniques to be used.
- **Local Water Management Strategy and Urban Water Management Plan** – outlining the proposed drainage management arrangements during normal rainfall events and intense cyclone events, in line with contemporary urban water management principles.

The inclusion of new Scheme Text provisions at Appendix 10 of Town Planning Scheme No.5 will provide the necessary statutory mechanism requiring these management plans to be prepared and implemented, thereby ensuring the responsible management of on and off-site environmental factors.

Importantly, it is recommended that the preparation and implementation of proposed management plans (specifically the turtle management plan, foreshore management plan and mosquito management plan) be to the satisfaction of both the Town of Port Hedland and Office of the EPA. This dual signoff mechanism will ensure that the authorities responsible for local planning, management and implementation (i.e. the Town of Port Hedland) as well as environmental protection and monitoring (Office of the EPA) are satisfied with the management arrangements.

5.0 Engineering considerations

JDSi Consulting Engineers have prepared an Engineering Assessment Report for the proposed amendment area, considering earthworks and geotechnical issues and servicing requirements. This report confirms that the land is capable of being suitably engineered/services to accommodate urban development.

A Traffic Assessment Report has also been prepared by Riley Consulting, considering potential traffic issues associated with the Stage 3 amendment area. This analysis has concluded that Stage 3 will have no detrimental impact on the road network.

A copy of the engineering and traffic reports are provided at **Appendix 2** and **Appendix 3** respectively, with key findings and recommendations summarised below.

5.1.1 Earthworks

Consideration of earthworks requirements to support future urban development has had regard for four (4) key factors:

- **Stormwater inundation** – review of the Port Hedland Coastal Vulnerability Study (Cardno, 2011) indicates that over a 100 year planning period, the design total still water for a 500 year ARI event is expected to be at RL 7.8m. This figure incorporates a vertical sea level rise factor of 0.9m and excludes any freeboard requirements.
- **Light spill** – Considering the light spill management requirements and anticipated building height limits, development levels at around RL 10.5m would be sufficient to support low to medium rise development across the site. Levels in excess of RL 10.5m may not be able to support development in certain locations.
- **Gravity sewer –** It is anticipated that the minimum level at the furthest point of the catchment required to service the development by gravity sewer is RL 10.5m.
- **Surrounding levels** – The existing level along the adjacent developed area ranges from RL 9m to 10.8m. The proposed lot levels along this interface will need to match that of existing development.

In light of these factors, it is anticipated that the optimal development level is between RL 9m and 10.5m.

5.1.2 Wastewater

Following preliminary advice from the Water Corporation, it is anticipated that the proposed development will be serviced by extension of the existing 150mm main in Dowding Way. It is intended to service the area by gravity sewer, however, should this not be achievable (due to development height considerations and corresponding development level requirements) the following options are also available:

- Alternative option 1 – construct a pump station and discharge into a Water Corporation approved connection point (subject to further discussion with the Water Corporation).
- Alternative option 2 – re-lay a portion of steep sewer to minimum grade, subject to cost feasibility and further discussion with Water Corporation.

5.1.3 Water Supply

Following preliminary advice from the Water Corporation, it is anticipated that the development will be serviced by extension of existing mains (200mm main in Panjya Parade and a 150mm main in Dowding Way).

5.1.4 Power Supply

There is currently a high voltage cable running along Dowding Way adjacent to the proposed amendment area. The HV feeder that supplies this area is the Mckay 22kV feeder which emanates from the Anderson Substation.

The available capacity to supply additional development is likely to be limited. Information provided by Horizon Power does not clarify if headworks are required in light of such capacity limitations, however it appears that a connection to the HV working end is all that is required.

5.1.5 Telecommunications

NBN Communications will not comment on whether the development is in their fibre footprint until an application is made for reticulation. However, information obtained from the NBN roll out map indicates that there is no NBN network currently available in the area and that the construction of fibre cable will commence by 2016.

Telstra services exist in the area, with the existing network located along Panjya Parade and Dowding Way adjacent to the proposed amendment area. If NBN do not support the development it is expected that Telstra will supply communications to the development.

5.1.6 Roads

Notwithstanding the fact that Stage 3 requires further detailed planning prior to ultimate subdivision and development, the Traffic Assessment Report has assumed that the area could accommodate up to 70 new dwellings, resulting in approximately 630 vehicle trips per day (at 9 trips per dwelling). Analysis of these movements and their potential impacts on the local and regional road network has concluded that:

- The development will have no significant traffic impact to the regional road network (Wilson Road).
- An impact to Cooke Point Drive and Styles Road will occur, as the forecast increases are greater than 5% of the current daily traffic flow. However, the impacts are not severe and neither road will operate in a manner contrary to current expectations. Good Levels of Service are maintained to the external road network.
- Analysis of externally affected intersections indicates that the development of Stage 3 will have minimal impact to current intersection operation. All intersections are forecast to operate with good Levels of Service.
- Internally to Pretty Pool, the development of Stage 3 will not result in any street operating in a manner contrary to its classification under the Liveable Neighbourhoods hierarchy.
- It is concluded that the development of Stage 3 will have no detrimental traffic impact.

In addition to the traffic report findings, it is also noted that detailed design and placement of street lights will need to respond to building height limitations for the area to avoid potential light spill onto the turtle nesting beach. The use of low or high pressure sodium vapour lamps will also be mandated to further reduce potential turtle exposure to shortwave light, with detailed design/siting considerations to be addressed through the preparation of a Development Plan for the site.

5.1.7 Drainage

Stormwater drainage will need to be designed and constructed to a similar standard as that of the existing Pretty Pool development. Based on preliminary discussion, the Town of Port Hedland will require:

- For street drainage, minimum retention volume equivalent to 1 in 5 ARI events for 10 minute duration.

- A Stormwater Management Plan to be prepared by a qualified hydrologist and approved by both the Town of Port Hedland and Department of Water.

The Port Hedland Coastal Vulnerability Study (Cardno, 2011) indicates that, over a 100 year planning horizon (2110 Climate scenario), the total still water level for 500 years ARI is expected to be at RL 7.8m. This figure incorporates an estimated sea level rise of 0.9m.It is expected that the minimum pad level required to avoid stormwater inundation is at a minimum RL 7.8m excluding any freeboard requirements.

It is anticipated that the stormwater will be conveyed by kerb gutter to kerb opening and discharged into surrounding bushland and beaches for minor event (10 years ARI). For major event (100 years ARI and above), stormwater inundation is expected in roads for a period of time with property remains above the 500 years ARI event. Such detailed stormwater management arrangements are to be addressed through preparation of a Development Plan and Local Water Management Strategy/Urban Water Management Plan for the site.

6.0 Proposed Scheme Amendment

6.1 Proposal summary

It is proposed to rezone the subject land from 'Rural' to 'Urban Development' and amend the Appendix 10 schedule of the Scheme Text to provide the necessary statutory planning basis to support further detailed planning of the site and ultimately, its subdivision and development for residential purposes.

Following gazettal of the Scheme Amendment, the following additional planning tasks will be required to facilitate subdivision and development of the Pretty Pool Stage 3 area:

- Preparation and adoption of a Development Plan to further guide subdivision and development, in accordance with Scheme requirements (both general Development Plan requirements and Appendix 10 conditions), WAPC guidelines and the urban design principles of Liveable Neighbourhoods.
- Subdivision application(s); and
- Preparation and adoption of Design Guidelines and/or Detailed Area Plan(s) to further guide / control detailed development of land and implement management strategies/actions as required (e.g. built form and lighting controls to avoid light spill onto turtle nesting habitat).

While further detailed planning and consideration of densities, design features and local management issues will be facilitated through the preparation of a Development Plan for the site, it is anticipated that residential densities will be consistent with existing adjacent development whilst seeking to maximise density opportunities in appropriate locations (e.g. higher building height limits and close to other multiple dwelling sites). In this regard, it is anticipated that the site could potentially accommodate in the order of 50 to 80 dwelling units, arranged in a single residential and/or multiple dwelling configuration.

6.2 Zone Amendments

The amendment area is currently zoned Rural and is yet to undergo detailed planning and infrastructure provision. The land's transfer from the Rural zone to the Urban Development zone will enable further detailed planning to progress and ultimately facilitate residential development.

It is proposed to transfer approximately 3.41ha of land within Lot 5007 Counihan Crescent (as illustrated in **Figure 4** of this report) from the Rural zone to the Urban Development zone,.

6.3 Scheme Text Amendments

It is proposed to amend the Scheme Text by the inclusion of a new entry in *Appendix 10 – Urban Development Zone Additional Requirements*. Such additional controls and conditions are necessary to establish clear terms and environmental parameters for the preparation of a development plan for the area (either a new plan or amended/expanded version of the currently adopted Pretty Pool Development Plan). This will provide a sufficient statutory head of power for the Town of Port Hedland and State Government agencies to require these issues to be addressed and maintain the environmental integrity of the area.

The proposed new 'Urban Development Zone Additional Requirements' are set out in **Table 3** below. These respond to the range of environmental management issues identified/recommended in the EAR whilst maintaining a high degree of consistency with the provisions already in place for the existing Pretty Pool development (covered under a separate entry for 'Pretty Pool 1').

Table 3 Proposed Urban Development Zone Additional Requirements

No.	Description of Land	Conditions
Pretty Pool 3	Lot 5007 Counihan Crescent.	i. Subdivision and development of the land shall be in accordance with the requirements of Development Plan(s) approved by the Town of Port Hedland and adopted by the Western Australian Planning Commission. ii. The permissibility of uses for the land use categories shown in the Development Plan shall accord with the appropriate zoning in the zoning table, with the exception of 'single house' which will require planning approval, with development to be in accordance with the Detailed Area Plan / Design Guidelines adopted by Council. iii. The Development Plan is to set clear 'Building Height Limitation Areas' across the site, and provide detailed guidance with regard to the location, placement and design of street lights based on detailed consideration and assessment of potential light spill impacts on turtle nesting areas over a 100 year planning period. iv. Prior to ground disturbing activities, a Turtle Management Plan shall be prepared and approved to the specification and satisfaction of the Town of Port Hedland and the Department of Parks and Wildlife, consistent with the Environmental Assessment Guidelines No.5: *Environmental Assessment Guideline for Protecting Marine Turtles from Light Impacts* three-staged approach. The Turtle Management Plan shall incorporate: a. A description of the turtle species, turtle nesting locations, and key environmental factors relating to marine turtle nesting habitat requirements; b. A prediction of impacts on marine turtles from the development, including lighting and human disturbance of nesting females and hatchlings; c. Design guidelines for reducing light emissions; d. Protection of turtle populations and habitat areas through measures to restrict disturbance and access, including fox control; e. Details of a community education and awareness program to be established; f. Details of the turtle monitoring and reporting program for the Pretty Pool nesting population to be established in collaboration with the Care for Hedland Environmental Association; g. Annual compliance auditing and reporting arrangements for the Turtle Management Plan. h. Identification of Turtle Management Plan implementation, monitoring and management responsibilities, including contingency measures to be implemented in the event that monitoring indicates that turtle management is unsatisfactory; i. Strategies to collaborate with relevant stakeholders in relation to turtles in the region; and j. Any other matters deemed relevant by the Town of Port Hedland and/or Department of Parks and Wildlife. v. The Turtle Management Plan is to be implemented in conjunction with the Development Plan prepared for Lot 5007. Certificates of Title will not be issued until such time as the Turtle Management Plan has been prepared and adopted by the Town of Port Hedland and the Department of Parks and Wildlife. vi. Within three months of every 12 month anniversary of the Turtle Management Plan being adopted, the subdivider/developer must publish a report on their website addressing compliance with the Turtle Management Plan requirements. Documentary evidence providing proof of the date of publication and non-compliance with any of the management plan requirements must be provided to the Office of the Environmental Protection Authority at the same time as the compliance report is published. The management plan must be published on the website for the full duration of the adopted monitoring period. vii. The following additional Management Plans shall be prepared, adopted and implemented to the satisfaction of the Town of Port Hedland and on advice from the relevant State Government agencies: a. Foreshore Management Plan; b. Mosquito and Midge Management Plan;

		c. Urban Water Management Plan; and d. Construction Management Plan. viii. Council shall adopt a Detailed Area Plan and/or Design Guidelines for the entire area to address detailed development matters including: a. Design interface between new and existing development; b. Building heights; c. Climate sensitive design; d. Colours and materials; e. Lighting restrictions and standards; f. Landscaping and fencing; g. Access. The Detailed Area Plan and/or Design Guidelines shall be prepared in accordance with the requirements of the Town. All development shall comply with the Detailed Area Plan / Design Guidelines adopted by the Town of Port Hedland.

7.0 Conclusion

Strategic planning at State and Local Government levels recognise the importance of providing additional residential land in Port Hedland that is attractive to new permanent residents and families and helps achieve the precinct vision established by the Pilbara's Port City Growth Plan:

"The East End Urban Village is Port Hedland's primary residential area. The area, encompassing established Cook Point and Pretty Pool offers significant housing density and diversity together with sport and recreation opportunities, and school and community facilities. At its heart is a retail and mixed use village that offers a range of local convenience as well as dining and entertainment choices. Strong links to the coast and mangrove environs have been established which offer residents and visitors alike a closer connection with the landscape." (ToPH, 2012).

This report is prepared in support of proposals to amend the Town of Port Hedland Town Planning Scheme No. 5 ('the Scheme') to facilitate the subdivision and development of Stage 3 of LandCorp's Pretty Pool project. The application of an 'Urban Development' zoning to approximately 3.41ha of land in the Stage 3 area is considered appropriate for the following reasons:

- Rezoning and ultimate subdivision/development of the Stage 3 area is consistent with all relevant strategic and statutory planning frameworks, with many strategic plans identifying the site for future urban/residential development capacity subject to resolution of environmental constraints;
- A comprehensive suite of technical investigations and studies has been undertaken to appropriately define the proposed amendment area, having regard for critical environmental management issues including the protection of Flatback Turtle nesting beaches and consideration of coastal processes;
- The site is capable of being serviced to an urban standard, with an appropriate zoning allowing further detailed engineering investigations to progress through subsequent planning stages (e.g. development plan, subdivision etc); and
- Sufficient controls exist through the statutory planning frameworks, including the addition of new Scheme Text (Appendix 10) provisions, to appropriately control and manage future detailed planning stages to the satisfaction of state and local authorities.

The amendment will allow orderly and proper planning processes to progress, enabling the ultimate subdivision and development of the proposed area.

Initiation of the amendment will enable formal assessment of the environmental impacts by the EPA and for the amendment to proceed to public advertising.

Appendix 1

Certificate of Title

REGISTER NUMBER	
5007/DP57975	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

WESTERN AUSTRALIA

VOLUME **LR3154** FOLIO **48**

RECORD OF CERTIFICATE OF CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 5007 ON DEPOSITED PLAN 57975

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: LEASEHOLD

PRIMARY INTEREST HOLDER: WESTERN AUSTRALIAN LAND AUTHORITY OF LEVEL 3, 40 THE ESPLANADE, PERTH.

(LC J948171) REGISTERED 11 OCTOBER 2006

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. J948171 LEASE. SUBJECT TO THE TERMS AND CONDITIONS AS SET OUT IN THE LEASE. REGISTERED 11.10.2006.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF CROWN LAND TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP57975.
PREVIOUS TITLE:	LR3147-716.
PROPERTY STREET ADDRESS:	LOT 5007 COUNIHAN CR, PORT HEDLAND.
LOCAL GOVERNMENT AREA:	TOWN OF PORT HEDLAND.
RESPONSIBLE AGENCY:	DEPARTMENT OF LANDS (SLSD).

NOTE 1: K608840 CORRESPONDENCE FILE 50969-2004-02RO.

Appendix 2

Engineering Assessment Report

PRETTY POOL STAGE 3,
PORT HEDLAND
ENGINEERING ASSESSMENT REPORT

LandCorp

December 2013 – Revision 0

Project Numbers: JDS13675

JDSi Consulting Engineers
Level 1, 59 Parry St
Perth WA 6000

Telephone (08) 9227 0595
Fax (08) 9227 8617

TABLE OF CONTENTS

DOCUMENT REVIEW				
Revision	**Date Issued**	**Written By**	**Reviewed By**	**Approved By**
Rev A	13/09/2013	J. Tayati	G. Coffey	J. Gray
Rev B	9/10/2013	J. Tayati	G. Coffey	J. Gray
Rev C	14/10/2013	J. Tayati	G. Coffey	J. Gray
Rev 0	19/12/2013	J. Tayati	G. Coffey	J. Gray

1.0 Introduction

JDSi Consulting Engineers (JDSi) was commissioned by LandCorp to undertake an Engineering Services Assessment at the Pretty Pool Stage 3 Residential Development Site. The site is located 3.3 km east of Port Hedland Town Center and to the north east of existing development. The site is currently zoned as “Rural” as indicated in “Town of Port Hedland Planning Scheme no. 5 with a proposal in place for amendment of this land use into “Urban Development”.

1.1 Key Objectives

This report has been prepared by JDSi to provide LandCorp with information concerning risks, development constraints and servicing strategy. JDSi understands that development footprint has not been finalized and may change as a result of ongoing due diligence of the site, as such, it is our intent to adopt a “global” perspective independent of the final footprint of the development.

Key objectives of this report are to;

- Identify existing infrastructure assets
- Assess the viability of the development site from servicing point of view.
- Identify current development constraints
- Identify potential problems and risks associated with the development
- Provide advice on the current and future planning

This engineering service report is based on a desktop study which covers the engineering infrastructure requirements to service the proposed development. The study incorporates engineering review of earthworks requirements, stormwater drainage, roadworks and utility services including sewer, water, power and telecommunication.

2.0 Earthworks and Geological Characteristics

SKM carried out geotechnical investigation and prepared a report for LandCorp in 2008. The report covered area previously planned for multiple stages of Pretty Pool development including Stage 3 which is now the subject of this study.

Extracts below are sections of the geotechnical report which are relevant to stage 3 development;

2.1 Surface Conditions

"The surface condition across the study site is covered by sand and low lying shrubs and grass. Approximately 80% of the site is covered with sand and in good condition. There are no surface signs of soft spots on any area of the site or adjacent areas to site at the time of investigation." (SKM, 2008)

Aerial photographic study indicates that stage 3 area remains unchanged since the geotechnical investigation was carried out and fits with the description provided in SKM's geotechnical report.

2.2 Site Geology

"Geological information was obtained from the Geological Survey of Western Australia (GSWA) Port Hedland Bedout Island Region 1:250,000 Geology Series Maps: Sheet SF50-4 and part if sheet SE50-16, second edition 1981. The surface geology of the site is indicated as Bossut Formation (Qpb) and is described as sandy calcarenite, oolite and calcilulite, which includes Holocene beach ridges.

Geological information was also obtained from Port Hedland 1:50,000 Urban Geology (GSWA) Sheet 2657 III (First edition 1983). From this urban Geology Series, the surface geology is indicated as Younger beach and dune shelly sand, and mobile sand. In the area closer to the Pretty Pool Creek, South of the study site, the surface geology is indicated as Mud and silt, and mangroves flats (tidal)." (SKM, 2008)

2.3 Subsurface Condition

"Results of CPT and tests pits are found to be generally consistent with the published geological information of the site." (SKM, 2008)

The subsurface profile deduced from relevant CPT and test pits results to stage 3 site area is summarized below;

Unit	Description	Depth
Topsoil (Sand)	Brown, dark brown, red brown, fine to medium grained loose and dry.	Thickness between 100mm and 300mm
Sand	Medium dense to dense	Depths vary from 2.6m to 7.7 m below existing ground level.
Clay	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.	Depths range from 6.0m to 8m below existing ground level.

2.4 Groundwater

"No groundwater was encountered in any of test pits and in CPT holes. In CPT, groundwater was measured from the remaining holes after probing only if the holes are remained open.

It should be noted that the groundwater level across the site is likely to exhibit some degree of variation on a seasonal basis. There is potential for development of perched groundwater tables following periods of rainfall. Depending on the time of construction, groundwater may affect the construction activities and, therefore, need to be taken into account in the costing and scheduling" (SKM, 2008).

2.5 Site Classification

"Using a classification system from AS2870, Section 2 Site Classification, Table 2.1 General Definitions of Site Classes, and the preliminary site classification for the site (in its present condition) is ***Class A*** *based on the sandy subsoil".* (SKM, 2008)

It important to note that, although majority of stage 3 site is likely to be in sand condition with clay layer at depth between 6m to 8m, shallow clay layer was encountered to the south of the site toward the Four Mile Creek, in this case, a classification of Class S may be more appropriate.

2.6 Earthworks Pad Levels

Earthworks operation will be required to grade the existing ground surface in preparation for the development. Based on available information, design pad levels are likely to be constrained by 4 factors.

1. Design pad levels will need to take into consideration a possibility of stormwater inundation following periods of rainfall. Cardno (2011) study indicates that, over a 100 year planning period (2110 climate scenario), the design total still water for 500 years ARI storm event is expected to be at RL 7.8m. The figure incorporates a sea level rise of 0.9m and excludes any freeboard requirements. As state Coastal Planning Policy 2.6 indicates a requirement to allow for the 500 years ARI event with no specification for freeboard, a minimum pad level should be set at RL 7.8m.

2. Second consideration is given to maximum allowable pad level to prevent light spill beyond existing sand dune. Studies by RPS (2013) and MRA (2013a) indicate that flatback turtle hatchings are affected by artificial bright light. The two studies conclude that presently the amount of light spill is shaded by sand dunes separating existing development and shoreward flatback turtle nesting areas. However, with anticipated sea level rise and changes due to coastal morphological process, existing sand dune is likely to reduce in height from the range of RL 13 to 16m to a range of RL 10m to 16m by 2110. It is important to note that the impact of this reduced dune height on the amount of light spill is not clear at this stage. A line of sight modeling study is currently being carried out. This study will influence the maximum allowable development lot levels. Our preliminary advice would be to set a maximum lot levels at RL 10.5m as it is known that the development at this level does not affect the current Pretty Pool Beach night light environment.

3. Third consideration is given to minimum level required to service the development with gravity sewer. Based on existing Water Corporation asset information, invert level of existing sewer at the boundary of the development site is at RL 7.7m. It is anticipated that the minimum level at the furthest point of the catchment required to service the development by gravity sewer is at RL 10.5m. (Refer to Section 3.0 for further discussion)

4. Fourth consideration is given to surrounding existing levels. The proposed development site is bounded by sand dunes to the northern and eastern boundaries, sand beach to the south and existing development to the south west. Existing level along the adjacent existing development ranges from RL 9m to 10.8m. The proposed lot levels long this boundary will need to match that of the existing development.

In light of the above information, JDSi anticipates that the optimal range of pad levels is between RL 9m and 10.5m and should be adopted for this site. These levels are based on our interpretation of the above constraints and are subject to confirmation by relevant consultants.

3.0 Wastewater

The Water Corporation owns and maintains all sewerage reticulation systems in this area. Any sewer connection point provided to the development site will need to be designed and constructed in accordance with Water Corporation requirements.

Dial Before You Dig search and Water Corporation online database indicate that there is an existing 150mm sewer reticulation mains currently running along Dowding Way. This sewer along with other reticulation network in the vicinity is currently discharging into existing “Style Road” pump station.

Preliminary advice from Water Corporation suggests that the proposed development can be serviced by existing mains.

In light of the above information, JDSi anticipates that the proposed development will be serviced by extension of the existing 150mm main in Dowding Way. However, it is important to note that due to level constraint imposed by light spill prevention requirement, servicing the development by gravity sewer may be difficult.

Should the site not be able to be serviced by gravity sewer, we foresee two possible options to enable sewer service to the development.

- First option would be to construct a pump station and discharge into existing Water Corporation approved connection point. This option is subjected to further discussion with Water Corporation.

- Second option would be to re-lay a portion of steep sewer to minimum grade in order to overcome level constraint. Based on our preliminary calculation, segments of the existing sewer from access chamber no. AC0563 to AC0567 along Dowding Way can be reconstructed to achieve new invert level at the boundary of RL 7.2m. In our view, this option may not be feasible due to associated cost but should be kept in mind as possible solution. This option is subjected to further discussion with Water Corporation and its approval.

From planning point of view, Pretty Pool catchment will ultimately be redirected to future pump station (“Port Hedland Pump Station D–121”) as part of Water Corporation planning. This will not affect immediate development.

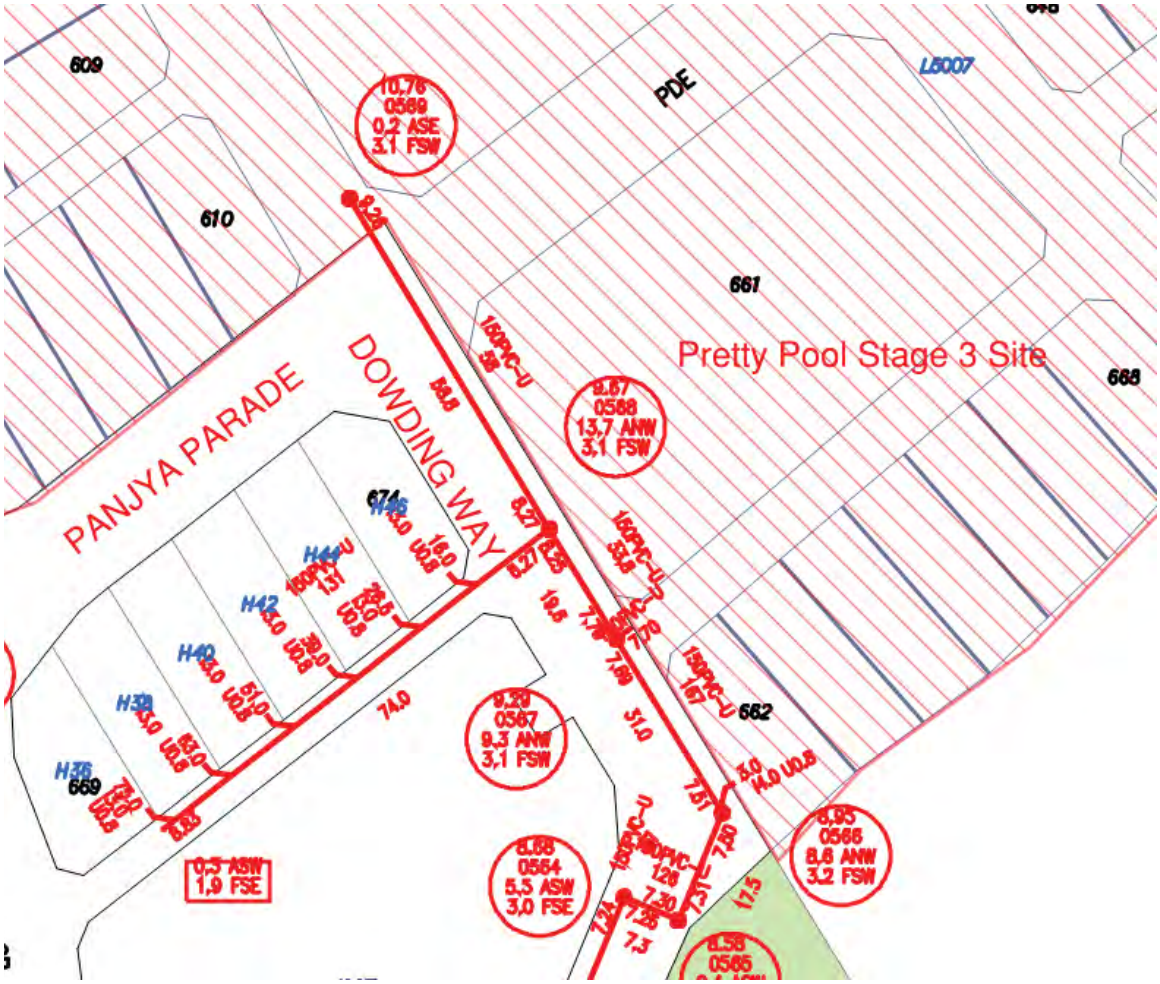

Figure 1 Extract from DBYD showing Water Corporation wastewater asset

4.0 Water Supply

Water reticulation assets in Port Hedland are owned and maintained by Water Corporation. Any extension and/or connection into these existing assets must be designed, approved and constructed to Water Corporation Standards.

Dial Before You Dig search and Water Corporation online database indicate that there are two existing reticulation mains in the vicinity. There is a 200mm dia PVC running along Panjya Parade and is currently terminated at the boundary of the proposed Pretty Pool Stage 3 site. Another water mains is a 150mm PVC running along Dowding Way. This service has a road crossing south east of Dowding Way / Jarpull Lane intersection and is terminated at the boundary of the proposed site. (Refer Figure 2.0 below)

Preliminary advice from Water Corporation suggests that the proposed development can be serviced from these existing mains.

In light of the above information, JDSi anticipates that the development will be serviced by extension of existing mains.

Figure 2 Extract from DBYD showing Water Corporation water reticulation asset

5.0 Power Supply

Horizon power is the service provider within the Port Hedland region and all power infrastructures will need to be to their standards and requirement.

Currently there is high voltage cable in the vicinity of proposed development along Dowding Way (refer to figures 3 & 4 below which are excerpts of Horizon Power DIP – EPS0041). The HV feeder that supplies this area is the Mckay 22kV feeder which emanates from the Anderson Substation.

There has been significant development in this area and as such we believe the available capacity to supply additional development is likely to be limited. Unfortunately the DIP doesn't clarify if headworks are required due to the capacity limitations mentioned above. However it does appear all Horizon Power require is the connection to the HV working end.

The Design Information Package (DIP) has been provided and states connection to the existing high voltage feeder cable to supply the future subdivision. Please find excerpt of the DIP below. Please note we understand that the DIP is only valid for 3 months from date of issue hence late January 2014.

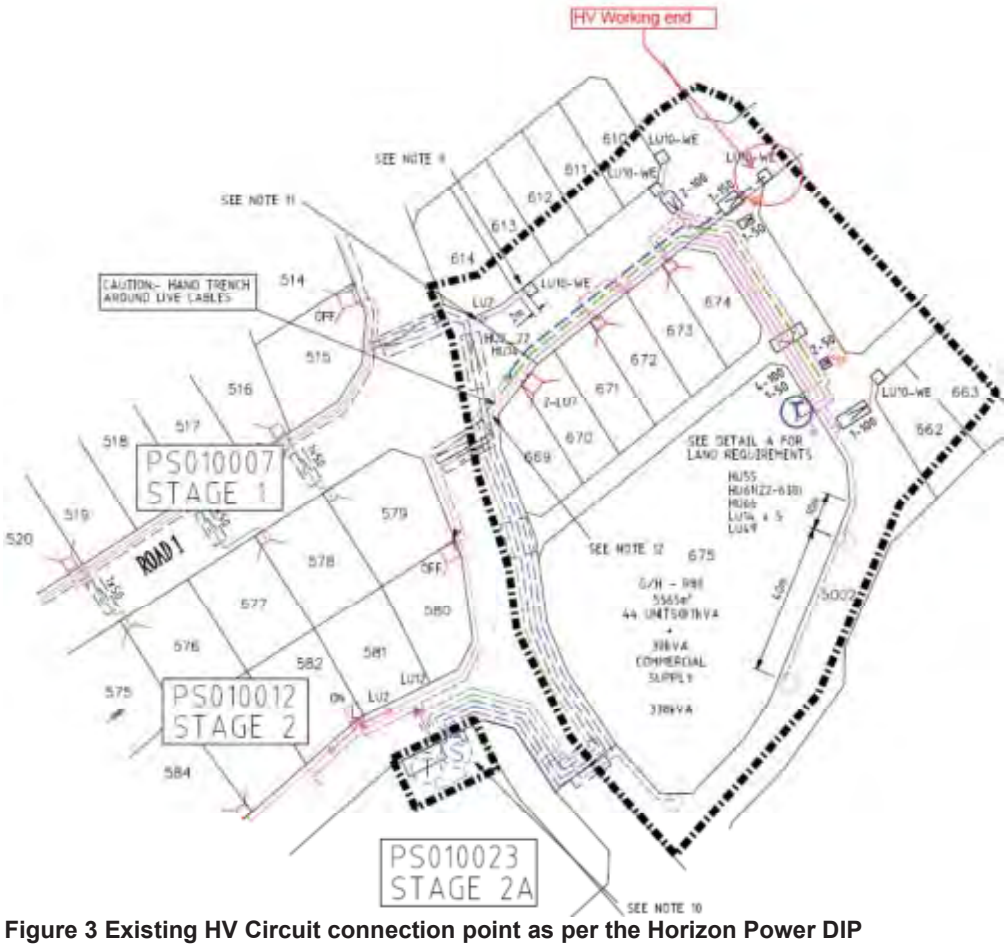

Figure 3 Existing HV Circuit connection point as per the Horizon Power DIP

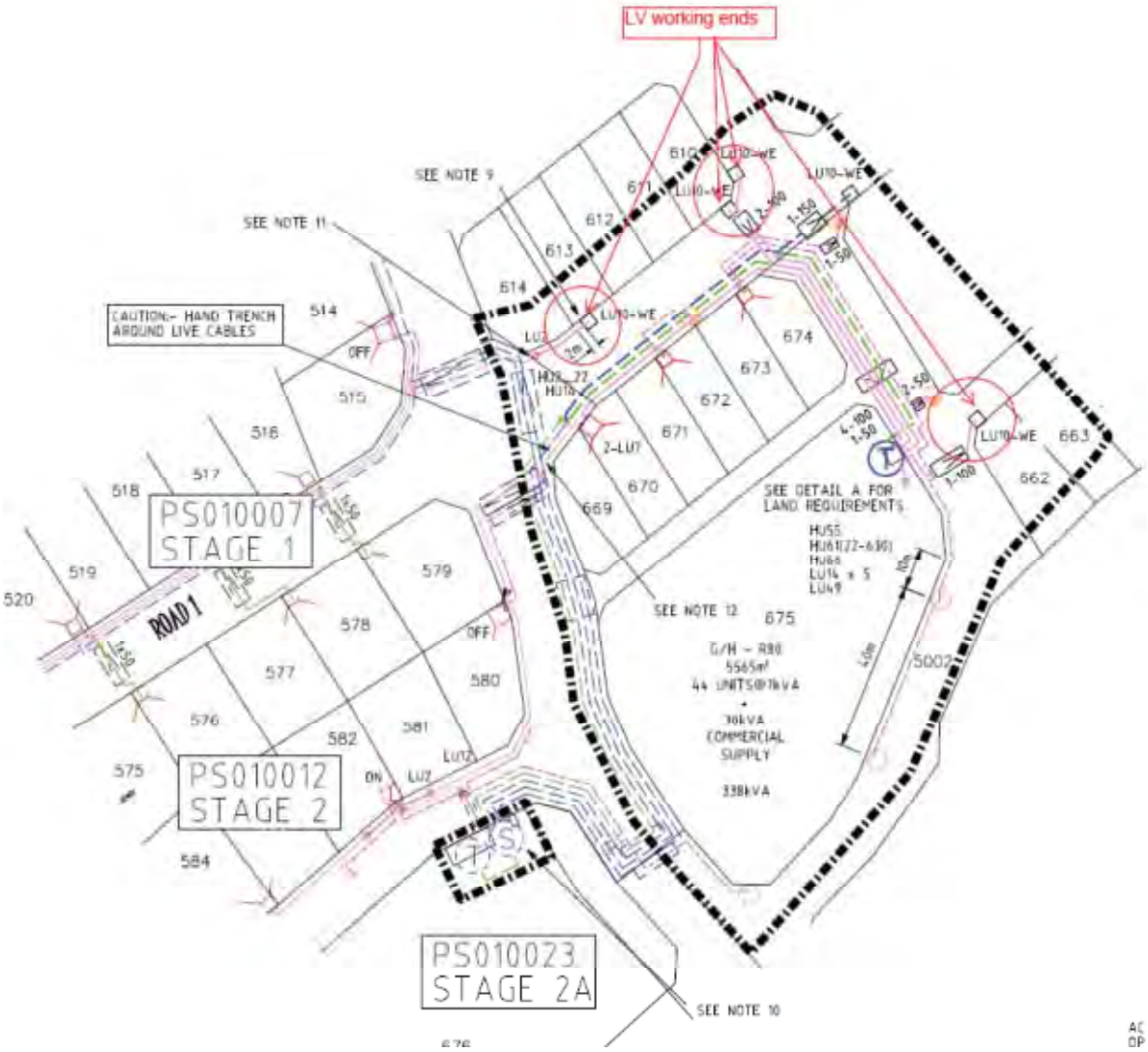

Figure 4 Existing LV Circuit along near the proposed development site

6.0 Gas Supply

There is no gas infrastructure currently available within the vicinity.

7.0 Telecommunications

As a result of the Australian Government's decision to roll out a National Broadband Network (NBN) the ownership issues of delivering the wholesale fibre to the home system have been transferred to the Government with a number of retail service providers likely to offer services over the network.

NBN Communications has advised they will not comment on whether the development is in their fibre footprint until an application is made for reticulation. However, information obtained from the NBN roll out map indicates that there is no NBN network currently available in the area and that the construction of fibre cable will commence by 2016.

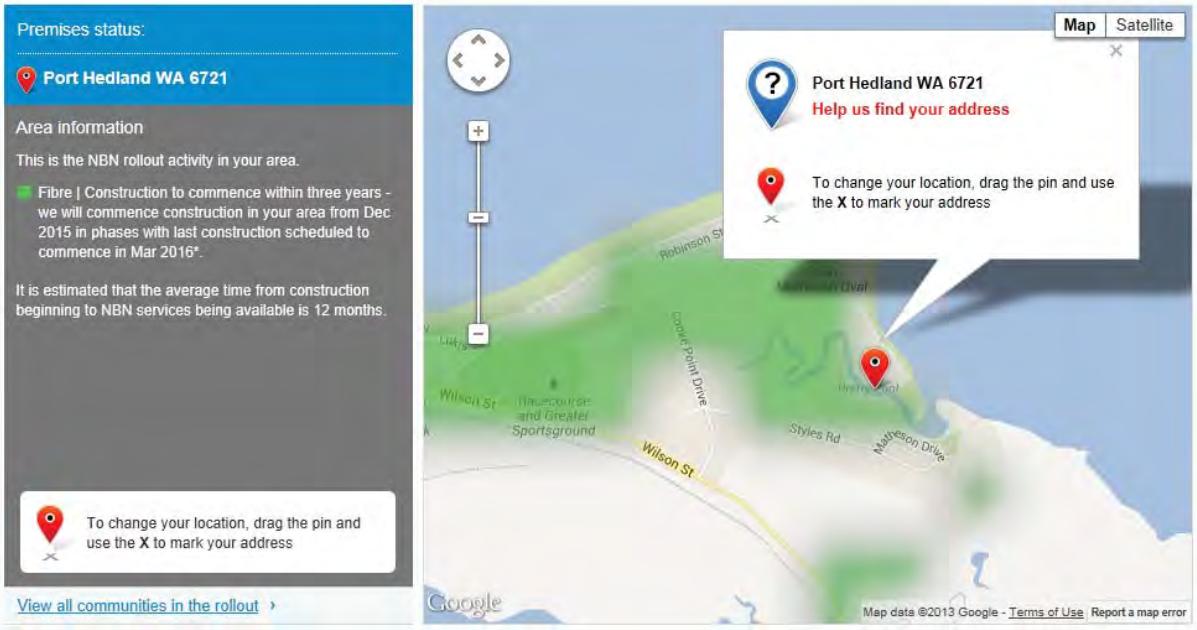

Figure 5 NBN rollout map, www.nbnco.com.au

Dial Before You Dig search indicates that Telstra services exist in the area. Existing network is located to the south west of the proposed development site along Panjya Parade and Dowding Way and thus if NBN will not support the development it is expected that Telstra will supply communications to the development.

General communication services for the development will consists of the installation of standard pit and pipe network in accordance will NBN Co guidelines and standards. The current design practice for road reserves, pavement and verge provisions will make adequate allowance for services including broadband in accordance with the agreed Utilities Service Providers handbook. There will be some local land requirements for equipment sites, similar to current provisions which will be accommodated at detailed subdivision stage.

Developers will be required to cover the costs of trenching and ducting for the infrastructure, however, NBN Co will cover the other costs of installing fibre infrastructure, including backhaul.

Post construction and due to the possible NBN Co delays in rollout programming, negotiation with Telstra may be required for an interim mobile service, and access to the internet will only be available through wireless broadband services.

All communication assets within the development will remain in the ownership of the developer (until rollout and takeover of assets by NBN Co) and easement where required will need to be granted in favor of the service provider.

8.0 Roads

Road infrastructure is owned and maintained by Town of Port Hedland. Any new road infrastructure will need to be designed, approved and constructed to the Town of Port Hedland requirements.

Based on preliminary discussion with the council, the followings will be required;

- A traffic impact assessment outlining the impact of the development on current traffic capacity. The report should also identify any road upgrade as necessary.
- Any road upgrade identified in the traffic impact assessment report shall be carried out as part of subdivision works.
- New roads to be constructed to Main Roads Standard.
- Footpath to be provided on at least one side of new roads.
- New roads to be well lit with sufficient street lighting.

Geotechnical investigation was carried out and indicates that natural subgrade in sand condition has design CBR of 12%. However, recommendation will be provided at time of detailed design.

In light of the above information, JDSi anticipates that new roads will be sealed and kerbed. Intersection treatment and beautification will be achieved by the use of brick paving units to match existing development. Foot path will be required on one side of the roads.

It is important to note that, due to potential light spill, preference should be given to the use of low or high pressure sodium vapour lamps in street lighting to reduce exposure of shortwave light to flatback turtle hatchlings (RPS, 2013).

9.0 Drainage

Town of Port Hedland owns and maintains stormwater drainage assets in Pretty Pool area. Any new stormwater drainage infrastructure asset will need to be designed, approved and constructed to Town of Port Hedland requirements.

It is anticipated that the stormwater drainage will need to be designed and constructed to a similar standard to that of the existing development to the south west of the proposed Pretty Pool Stage 3 site.

Based on aerial photographic study, it appears that drainage infrastructure in this area comprised of kerbed road gutter and kerb openings for runoff disposal to surrounding beaches and bushland. Stone pitching are provided at these outlets to prevent soil erosion.

Based on preliminary discussion, the council will require;

- For street drainage, minimum retention volume equivalent to 1 in 5 ARI events for 10 min duration.
- For lot area, a Stormwater Management Plan will need to be prepared by qualified hydrologist and approved by both Town of Port Hedland and Department of Water. The requirement of onsite retention outlined in the report will need to be adhered to.

Cardno carried out a Coastal Vulnerability Study on behalf of LandCorp in 2011. The study indicates that, over a 100 year planning horizon (2110 Climate scenario), the total still water level for 500 years ARI is expected to be at RL 7.8m. This figure incorporates an estimated sea level rise of 0.9m.It is expected that the minimum pad level required to avoid stormwater inundation is at a minimum RL 7.8m excluding any freeboard requirements.

In light of the above findings, JDSi anticipates that the stormwater will be conveyed by kerb gutter to kerb opening and discharged into surrounding bushland and beaches for minor event (10 years ARI). For major event (100 years ARI and above), stormwater inundation is expected in roads for a period of time with property remains above the 500 years ARI event.

10.0 Development Constraints

JDSi has reviewed available information and identifies the followings as possible development constraints

1. It is known that the development site is located in close proximity to flatback turtle nesting area. A study carried out by RPS (2013) indicates that turtle hatchlings tend to attract and are disoriented by artificial light source. As a result, there is a requirement for turtle management plan and a measure to prevent light spill from the development. The study indicates that the Pretty Pool Beach night light is not impacted by existing artificial light sources within the Pretty Pool Development due to presence of the secondary sand dune in the coastal zone of Pretty Pool Beach. The study provides key Management Recommendations to manage existing impacts to the flatback turtles from sources of artificial light.

   In addition to the above assessment, a study carried out by MP Roger Associated (MRA, 2013a) shows that over 100 years planning horizon, the barrier sand dune height is expected to reduce due to coastal geomorphological process and predicted sea level rise.

   The two studies presented above do not address the impact of reduced dune height on amount of light spill that could potentially happen over the 100 year planning period. It is, therefore, recommended that a further study be carried out to assess the impact of reduced barrier dune height on potential future light spill.

   Notwithstanding the above, it is arguable that the maximum pad level could be set at RL 10.5m to match existing development because it is known that development at this level does not impact the Pretty Pool beach night light environment. A detail line of sight modeling is currently being carried out. The result of the study will be used to verify the above assumption.

2. MRA (2013b) carried out “Physical Coastal Processes Setback Assessment” on behalf of LandCorp. In the study, three factors were included in modeling possible final location of shoreline at the end of 100 years planning period. These factors are

   - Effect of severe storm erosion
   - Long term shoreline movement
   - Effect of sea water level rise

   The study recommends that the development should be constrained by the proposed setback as indicated in Figure 6 below.

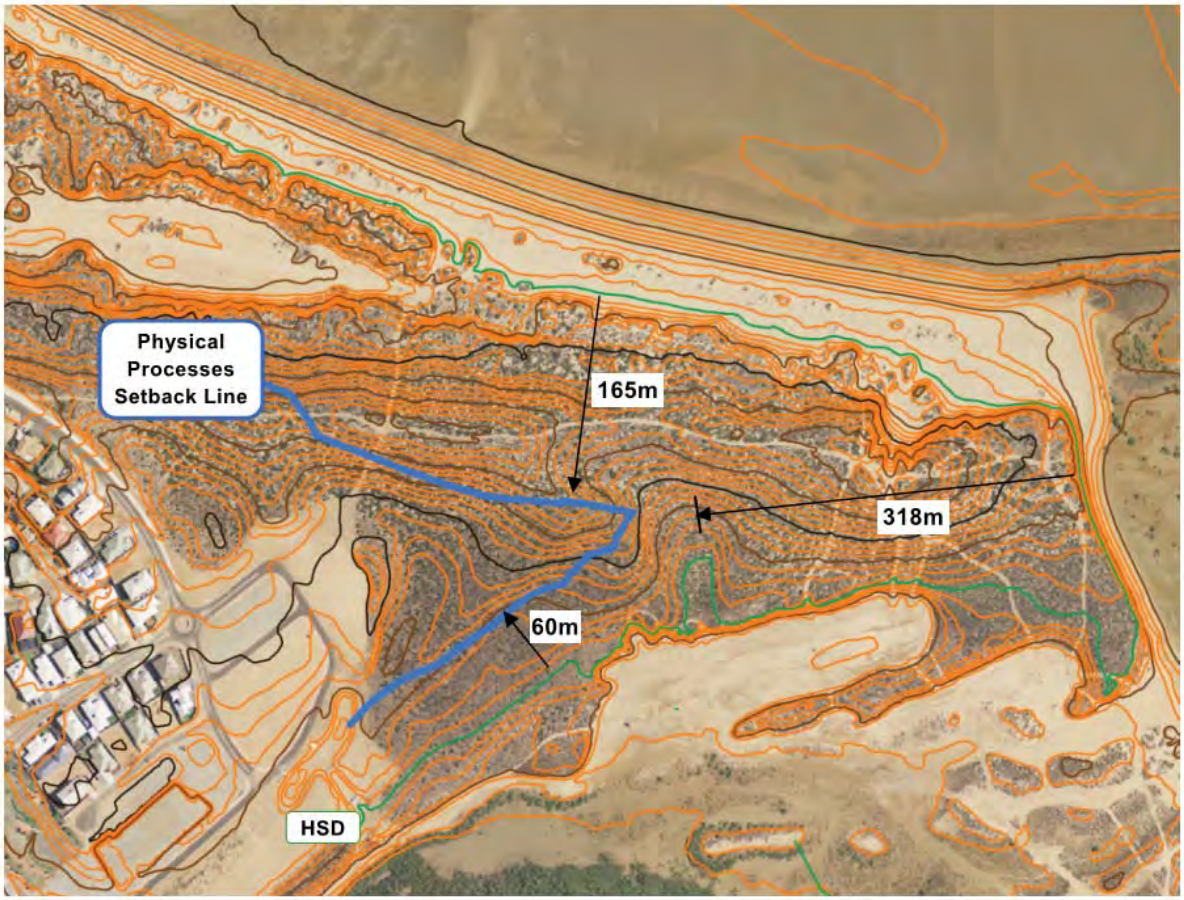

Figure 6 Total Recommended Physical Processes Setback (MRA,2013b)

3. As discussed in section 3, servicing the development by gravity sewer may be difficult due to level constraints imposed by both existing connection invert level and maximum pad level allowable to minimize risk of light spill. Two options discussed in section 3 suggests

    - The sewer re-lay may not be feasible due to high cost associated with the reconstruction of sewer but should be kept in mind as a possible solution. This is subjected to Water Corporation Approval.
    - A pump station may be required in order to service the lot. This is subjected to Water Corporation Approval.

    It is recommended that this issue be revisited once draft layout of the development is completed for detailed assessment.

11.0 Disclaimer

JDSi have undertaken this assessment based on limited information and subsequently assumptions have been made which, if incorrect, have the potential to change costs. Major cost implications exist through factors which cannot be assured at this time including upgrading and provision of utility services, WAPC conditions of development, Local Authority Scheme Requirements, ground conditions, timing of adjacent developments, etc.

While JDSi has taken all care in the preparation of the likely development requirements and has noted key assumptions, JDSi accepts no responsibility for the accuracy of this report and provides it only as an indicative summary of engineering requirements.

If any further information is required or should you wish to clarify any issue, please contact our office.

References

Cardno 2011, *Port Hedland Coastal Vulnerability Study Report*, Cardno, Perth

M P Rogers & Associates Pty Ltd 2013a, *Pretty Pool Coastal Assessment*, M P Rogers & Associates, Perth

M P Rogers & Associates Pty Ltd 2013b, *Pretty Pool Physical Coastal Processes Setback Assessment*, M P Rogers & Associates, Perth

RPS 2013, *Draft Baseline Light Monitoring and Turtle Management Plan Audit Report*, RPS, Perth

Sinclair Knight Merz Pty Ltd 2008, *Pretty Pool Stages 3 & 4 Geotechnical Investigation and Assessment Report*, Sinclair Knight Merz Pty Ltd, Perth

APPENDIX 1 Geotechnical Report

SKM Geotechnical investigation and assessment report 2008

Pretty Pool Stages 3 & 4
Port Hedland

GEOTECHNICAL INVESTIGATION AND ASSESSMENT REPORT

- Revision 1
- 18 June 2008

Pretty Pool Stages 3 & 4
Port Hedland

GEOTECHNICAL INVESTIGATION AND ASSESSMENT REPORT

- Revision 1
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Sinclair Knight Merz
ABN 37 001 024 095
7th Floor, Durack Centre
263 Adelaide Terrace
PO Box H615
Perth WA 6001 Australia
Tel: +61 8 9268 4400
Fax: +61 8 9268 4488
Web: www.skmconsulting.com

Contents

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0	8 May 2008	P Hutchinson	P Hutchinson	9 May 2008	Issued to Client
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1. Introduction

1.1 General

Sinclair Knight Merz (SKM) was commissioned by Land Corp to undertake a geotechnical investigation for the residential development of Pretty Pool stages 3 & 4, Pretty Pool, located approximately 4 km east of Port Hedland along the coast. The investigation area generally lies from north-east to south-west, bounded by a residential area to the north-west, and vacant land to the north, east, and south. The site location plan is shown in Figure 1.

This report details the field work carried out, describes the results of the in situ and laboratory tests undertaken as part of the geotechnical investigation and provides recommendations for foundation assessment. The inferred subsurface profile provides the basis for recommendations relating to the site classification, foundation design parameters and site preparation procedures.

It is recommended that an experienced Geotechnical Engineer review plans and specifications which affect or are affected by geotechnical issues to provide an effective interpretation of the geotechnical assessment contained in this report.

1.2 Limitations

SKM derived the data in this report from data provided by Land Corp (the Client) and through field investigations conducted and coordinated by SKM. The passage of time, manifestation of latent conditions or impacts of future events may require further exploration at the site and subsequent data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, SKM has relied upon and presumed accurate certain information (or absence thereof) provided by the Client. Except as otherwise stated in the report, SKM has not attempted to verify the accuracy or completeness of any such information.

No warranty or guarantee, whether expressed or implied, is made with respect to the data reported or to the findings, observations and conclusions expressed in this report. Further, such data, findings, observations and conclusions are based solely upon information, drawings supplied by the Client, and information available in the public domain in existence at the time of the investigation.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between SKM and the Client. SKM accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party. This report should be read in conjunction with the geotechnical limitations presented in Appendix A

2. Scope of Work

The scope of work carried out as follows:

- Desktop study of published geological and geotechnical information related with the proposed site;
- Conduct Electric Friction Cone Penetrometer Testing (CPT) at five (5) locations to a depth up to 10 m;
- Excavate seven (7) test pits across the site to a target depth of 2.5 m;
- Conduct seven (7) handheld Dynamic Cone Penetrometer (DCP) located adjacent to the test pits location;
- Prepare engineering test pits logs in accordance with SKM's standard field descriptions and Australian Standard AS1726, Geotechnical Site Investigation;
- Undertake limited laboratory testing in a NATA accredited laboratory to characterise the material properties for engineering purposes. Collection of bulk samples from test pits for laboratory testing, which would include Particle Size Distribution (PSD), Atterberg Limit (AL), Shrink-Swell Index, Modified Compaction and California Bearing Ratio (CBR) tests;
- Preparing a geotechnical report summarising the findings in the field investigation and laboratory testing. This report will also provide recommendations regarding site classification, recommended foundation design parameters and will address other geotechnical issues that are identified to have potential impact on the development.

3. Site Conditions

3.1 Surface Conditions

The surface condition across the study site is covered by sand and low lying shrubs and grass. Approximately 80 % of the site is covered with sand and in good condition. There are no surface signs of soft spots on any areas of the site or adjacent areas to site at the time of investigation. Access to the site for the CPT rig and backhoe was available from Styles Rd and Counihan Crescent. Some of the vacant lots are covered with plants and mangrove.

3.2 Site Geology

Geological information was obtained from the Geological Survey of Western Australia (GSWA) Port Hedland-Bedout Island Region 1:250,000 Geology Series Maps: Sheet SF50-4 and part of Sheet SE50-16, second edition 1981. The surface geology of the site is indicated as Bossut Formation (Qpb) and is described as sandy calcarenite, oolite and calcilutite, which includes Holocene beach ridges.

Geological information was also obtained from Port Hedland 1:50,000 Urban Geology (GSWA Sheet 2657 III (first edition 1983). From this Urban Geology series, the surface geology is indicated as Younger beach and dune shelly sand, and mobile sand. In the area closer to the Pretty Pool Creek, south of the study site, the surface geology is indicated as Mud and silt, and mangroves flats (tidal).

4. Fieldwork

Fieldwork for the investigation was undertaken on 17 March 2008 and 18 March 2008, under full time supervision of a SKM geotechnical engineer. This included the following tasks:

- Site walkover to inspect surface conditions;
- Supervision of CPT probing;
- Supervision of test pits excavation and recording soil stratigraphy and preparation of engineering logs of test pits
- Conduct handheld Dynamic Cone Penetrometer; and
- Collection of disturbed bulk soil samples for laboratory testing.

The work above was performed in general accordance with Australian Standard AS1726 guidelines for geotechnical site investigation.

4.1 Electric Friction Cone Penetrometer Testing

CPT testing uses a standard electric friction cone, consisting of a 60 degree cone with 10 cm^2 base area and a 150 cm^2 friction sleeve with a filter of pore pressure measurement located behind the cone. The standard rate of penetration is 20 mm/s.

CPT probes were carried out at 5 locations (CPT-01, CPT-02, CPT-03, CPT-05 and CPT-06) across the site. CPT-01, CPT-02, CPT-3 and CPT-05 were distributed across the Pretty Pool Stage 3 and CPT-06 is located in Pretty Pool Stage 4. The CPT refusal depths were encountered from nominally 3.5 m to 10 m below the existing ground surface which is anticipated as underlying limestone. Additional CPT were done within a distance of 1 m from CPT locations where shallow refusals were encountered and those are designated as CPT-2A, CPT-3A, and CPT-5A. All CPT were performed by Probedrill Pty Ltd with a 7 tonne truck rig and locations are shown in Figure 2. The locations and refusal depths of CPT are presented in Table 1. CPT profiles are presented in Appendix B.

SKM

Table 1 Summary of CPTU Test Locations and Depths

CPT	Easting[1] (m)	Northing[1] (m)	Refusal Depth (m)	Locality
CPT-01	671949	7752346	9.5	Stage 3
CPT-02A	672011	7752474	10	Stage 3
CPT-03A	671980	7752542	9	Stage 3
CPT-05A	671877	7752280	4.5	Stage 3
CPT-06	671346	7751880	5.5	Stage 4

[1] Co-ordinates are measured by hand held GPS and in GDA94

4.2 Test Pits

A total of 7 test pits were excavated by Pilbara Plant Hire Pty Ltd using a 20 ton backhoe, equipped with a 500 mm wide bucket. The test pits TP-01 and TP-02 were located at Pretty Pool Stage 3 and the depth was extended to between 2.0 m to 2.2 m, whereas TP-06 to TP-10 were excavated at Pretty Pool Stage 4. In TP-09 and TP-10, the shallow refusal was encountered due to underlying limestone. Disturbed samples of representative soil types were taken for laboratory examination and testing. After the excavation and logging, each test pit was backfilled and tamped with the machine bucket as part of reinstatement of the test pit location.

The locations of the test pits are presented in Figure 2. Locations and depths of maximum excavation for all test pits are presented in Table 2. Test pit logs are presented in Appendix C.

Table 2 Summary of Test Pit Locations and Termination Depths

Test Pit	Easting[1] (m)	Northing[1] (m)	Termination or Refusal Depth (m)	Locality
TP-01	671900	7752497	2.0	Stage 3
TP-02	671824	7752583	2.2	Stage 3
TP-06	671485	7752212	2.5	Stage 4
TP-07	671491	7752075	2.5	Stage 4
TP-08	671525	7752083	2.5	Stage 4
TP-09	671427	7751948	1.0	Stage 4
TP-10	671504	7751934	1.0	Stage 4

[1] Co-ordinates are measured by hand held GPS and in GDA94

5. Laboratory Testing

Disturbed bulk soil samples were collected from the test pits and were sent to Western Geotechnics Groups Pty Ltd in Welshpool, WA, for testing in their NATA accredited laboratory in accordance with the relevant Australian Standards. The schedule of laboratory testing undertaken for this project comprised the following:

- Three (3) Particle Size Distribution (PSD) (AS 1289.3.6.1)
- One (1) Modified Compaction (AS 1289.5.2.1)
- One (1) California Bearing Ratio (AS 1289.6.1.1)

The test results are presented inTable 3 and the laboratory test certificates are presented in Appendix D.

- **Table 3 Summary of Geotechnical Laboratory Test Results**

Test Pit	Depth	Particle Size Distribution					Modified Compaction and CBR
		>2.36 mm	2.36 ~0.075mm	<0.075 mm	Max Dry Density	OMC[1]	CBR[2]
	(m)	%	%	%	(t/m^3)	%	%
TP-01	1.2 -1.5	1	97	2			
TP-02	1.2 -1.5	9	87	4	1.78	10.5	17
TP-07	1.0-1.2	1	97	2			

[1]. OMC –Optimum Moisture Content
[2]. CBR is done on sample with 95% MDD from modified compaction, 4 day soaked under 4.5kg surcharge, CBR at 5.0 mm penetration

5.1 Particle Size Distribution (PSD)

The PSD tests were carried out from the selected soil samples collected from test pits to determine the distribution of particle sizes. The result from the PSD sieve analysis shows all the soil collected from the test pits (TP-01, TP-02 and TP-07) consists mainly of poorly graded, medium to coarse grained sand with little amount of gravel and fines (clay and silt). The fine content (particles less that 0.075 mm) ranges from 2 % to 4%. The PSD curves for all tests are presented in Figure 3 and Appendix D.

5.2 Modified Compaction and California Bearing Ratio (CBR)

Results of the maximum dry density and the optimum moisture content are 1.78 t/m^3 and 10.5 % for TP-02. CBR value is 17% at 5.0 mm penetration.

6. Geotechnical Assessment

It is understood that the proposed development includes a group of residential buildings, car park and associated roads. This section presents a brief description of the geotechnical assessment based on geotechnical field observation and tests.

6.1 Subsurface Profile

The subsurface profile encountered in the CPTs and test pits is found to be generally consistent with the published geological information of the site. The subsurface profile for the site (within the Pretty Pool Stage 3 and 4) may be summarised as follows:

- **Unit 1: TOPSOIL (SAND)**: brown, dark brown, red brown, fine to medium grained, loose, and dry. This unit of material was encountered at the ground surface at all test pit locations and has a thickness between 100 mm and 300 mm.

- **Unit 2: SAND**: This unit was encountered in all CPT. The consistency ranges from medium dense to dense and depths vary from 2.6 m to 7.7 m below existing ground level.

- **Unit 3: CLAY (CL):** This unit was encountered in CPT (CPT-01, CPT-2A, CPT-3A) at depth between 6.0 m and 8.0 m below existing ground level.

- **Unit 4**: **Sandy SILT (ML) / Clayey SILT (ML) / Silty CLAY (CL)**: This unit was encountered in CPT-06 at depth from 2.7 m to 5.4 m, which is the refusal depth due to inclination of the cone rods.

- **Unit 5**: **LIMESTONE (cemented calcareous sand):** Pale brown to pale red brown, medium to coarse grained, moderately weakly cemented**.** This unit was only encountered in two of the test pits (TP-09 and TP-10) at approximately 0.5 depths below existing ground surface.

6.2 Groundwater

No groundwater was encountered in any of test pits and in CPT holes. In CPT, groundwater was measured from the remaining holes after probing only if the holes are remained open.

It should be noted that the groundwater level across the site is likely to exhibit some degree of variation on a seasonal basis. There is potential for development of perched groundwater tables following periods of rainfall. Depending on the time of construction, groundwater may effect the construction activities and, therefore, need to be taken into account in the costing and scheduling.

6.3 Site Classification

In order to meet the requirements of AS 2870 – 1996 Residential slabs and footings – Construction, this site (each residential lots within a sub-division) should be classified by the contractor. This report is aimed at obtaining a generalized sub-surface profile for the site and presents a preliminary site classification based on the limited number of test locations investigated, provided the recommended site preparation is adhered to.

Ground movement as a result of moisture change in the soil can be estimated based on the guidelines presented in AS2870 – 1996. Using a classification system from AS2870, Section 2 Site Classification, Table 2.1 General Definitions of Site Classes, and the preliminary site classification for the site (in its present condition) is **Class A** based on the sandy subsoil with the exception of the CPT-06 (7470 m^2 R40 Lot shown on Figure 2) location, which may be classified as **Class S** due to the present of shallow clay layer at depth of 2.7 m below existing ground level. This Class S site could be upgraded to Class A by placing of 3.0 m of sand fill materials, which should contain not more than 3 % passing a 0.075 mm sieve.

The site classification must be verified and certified by the contractor during earthworks. Should ground conditions other than those encountered in this assessment be encountered, it shall be brought to the immediate attention of an experienced geotechnical engineer for verification.

6.4 Earthworks and Site Preparation

It is recommended that the existing topsoil be stripped from the footprint of the proposed structures to the depth of at least 0.3 m below the existing ground surface and the exposed natural surface proof rolled with a vibrating roller. The compaction should be checked using Perth Sand Penetrometer (PSP) tests with blow count not less than 8 per 300 mm penetration to 0.9 m depth. Any soft or weak spots identified during the proof rolling must be locally over-excavated and the resultant excavation backfilled with granular, non-reactive fill in 300 mm loose lift and compacted to the required level.

We understand that no basement is required. Assuming that footing depths up to 1 m is required, footing excavation can be achieved using standard excavator. If hard limestone materials are encountered, rock breaker may be required.

Any temporary excavation with depth not more than 2.0 m can be battered at 1V:2H or shallower, while excavation with depth greater than 2.0 m shall be battered at 1V:2.5H. The temporary excavation can be back filled with the excavated material, exclusive of the topsoil and material containing organic content, in loose lifts of 300 mm thickness and compact to achieve not less than 95 % of Modified Compaction (AS 1289 5.2.1) or 8 blow count per 300 mm penetration using PSP. The backfill material needs to be conditioned to within 3.0 % of the Optimum Moisture Content as determined by AS 1289.5.2.1 before the compaction.

Earthworks in general should be carried out in accordance with AS3798-1996 and supervised by an experienced geotechnical engineer.

6.5 Pavements

Following stripping of topsoil, it would be expected that pavement subgrades would generally consist of Sand. Soaked CBR test on Sand shows that CBR values for this material is 17 % for 5.0 mm penetration. It is recommended that design CBR of 12 % be adopted for the design of pavements on the site. The recommended CBR value assumes:

- Any topsoil and root-affected soil is initially stripped. Stripping to depths between 0.2 m and 0.3 m can be anticipated. The underlying subgrade should be conditioned to within ±3 % of the optimum moisture content and compacted to achieve a dry density ratio of at least 95 % based on Standard Compaction (AS1289 5.1.1). Any soft, wet, weak or organic materials encountered during rolling should be removed and replaced with engineered fill. Field testing is undertaken on subgrade and pavement materials during construction to ensure compliance with the above recommendations.
- A 250 mm thick layer of well-graded crushed rock or similar material is recommended for use as basecoarse; and
- The pavement construction commences soon after subgrade preparation to prevent softening of the subgrade due to ponding of water or that such softened material is removed and replaced with suitable material.

6.6 Foundation Assessment

Following the recommended site preparation procedures, it is expected that the structure footings will be founded on the existing SAND (SP) material across the majority of the site except near (CPT-06, see below), which is in an existing medium dense condition. Shallow footings such as pad or strip footings, are believed to be suitable for supporting the residential buildings. An allowable bearing pressure of 150 to 200 kPa is recommended for strip footings with width, up to 2.5 m and pad footings, with widths up to 3.0 m when a minimum 500 mm depth of embedment is adopted. The settlement of footings under such a pressure is assessed to be unlikely to exceed 20 mm.

However, as the clay layer encountered at shallow depth of 2.7 m below existing ground level in CPT-06 (Stage 4), the long term consolidation settlement should be taken into account under the net foundation pressure at this depth. The estimated consolidation settlement may be between 25mm to 50 mm for 100 kPa pressure for the 7470 m^2 R40 Lot.

However, this settlement prediction adopts a soil profile based on data obtained from CPT and test pits. Should soil conditions other than those assumed in design be encountered on site during construction, an experienced geotechnical engineer should be consulted.

It needs to be noted that the depth of the footing base should be counted from the ground surface in the immediate vicinity of the footing and this could be different from the ground surface outside the excavation zone.

6.7 Geotechnical Design Parameter for Retaining wall

Table 5 presents the recommended soil material parameters if the adoption of a retaining system is considered necessary.

Table 5 Retaining Wall Design Parameters

Material	ϕ' (°)	γ (kN/m^3)	C (kPa)	K_a	K_0	K_p
Sand and compacted sand fill	33	20	0	0.30	0.46	3.4
Where	ϕ' is the effective friction angle; C is the cohesion; γ is the total unit weight above the groundwater table; K_a is the Coefficient of Active Earth Pressure; K_o is the recommended Coefficient of Earth Pressure for retaining wall design; K_p is the Coefficient of Passive Earth Pressure.					

7. Conclusions and recommendations

The following conclusions can be drawn from this geotechnical investigation:

- On the results of the field investigation and laboratory tests undertaken as part of the geotechnical investigations, the subsurface profile of the site is mainly consists of medium dense sand to dense sand encountered in CPT and test pits to the depth of 0.7 to 7.7 m below the ground level which underlain by clayey soils. The top layer of clay was encountered in CPT at depth ranging from 2.7 m to 8.0 m below existing ground surface. The shallow limestone surface was encountered in TP 09 and TP 10 at Pretty Pool Stage 4 at 0.4 m depth below existing ground level.
- The subsurface profile encountered in the CPTs and Test Pits is found to be consistent with the published geological information of the site except in the developed area where sand fill was encountered.
- Using a classification system from AS2870, the majority of the site at its present condition can be classified as "Class A" provided the site preparation is adhered to, except for the 7470 m^2 R40 Lot where CPT-06 demonstrated "Class S" due to shallow clay surface.
- From the geotechnical point of view, the proposed site is suitable to be developed for the proposed structures.
- The design CBR of 12% be adopted for the design of pavement on the site provided the recommended site preparation procedure is adhered to.

These assessments are based on limited information from the preliminary geotechnical investigations designed to obtain a general idea of subsurface condition and identify potential geotechnical issues. The following are highly recommended if the proposed building is to be constructed:

- The site earthworks be witnessed by an experienced engineer to confirm the site classification.

An experienced geotechnical engineer review plans and specifications which are influenced by geotechnical issues to provide an effective interpretation of the geotechnical parameters presented in this report.

8. References

AS1289 Methods of testing soils for engineering purposes, Standards Australia, Sydney, Australia.

AS1726-1993 Geotechnical site investigations, Standards Australia, Sydney, Australia.

AS2870-1996 Residential slabs and footings – Construction, Standards Australia, Sydney, Australia.

AS3798-2007 Guidelines on earthworks for commercial and residential developments, Standards Australia, Sydney, Australia.

Bowles, J. E. (1996). "Foundation Analysis and Design – 5th Edition".

Simons, N.E., and Menzies, B.K (1997). " A short course in Foundation Engineering".

Figures

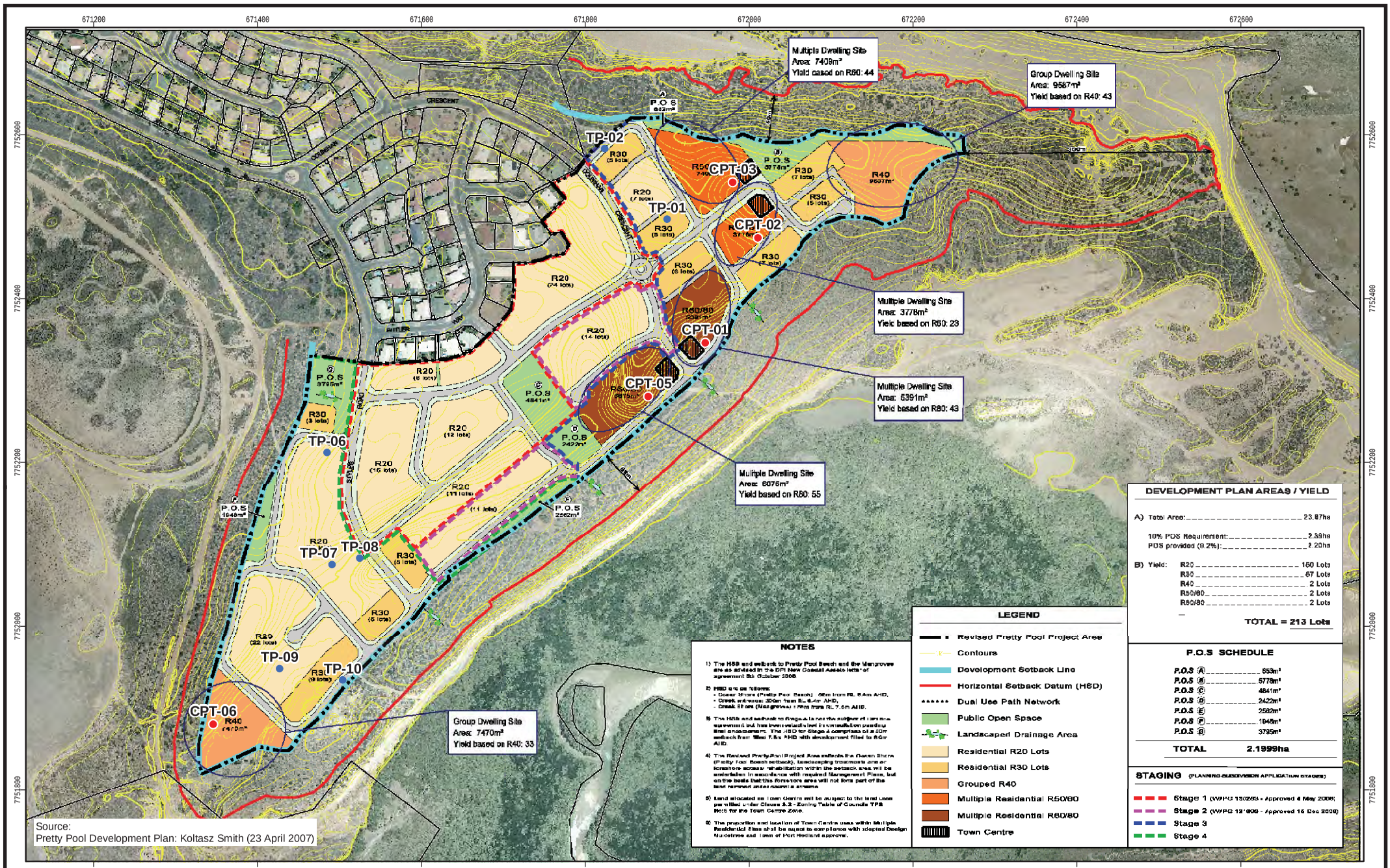
SKM
Sinclair Knight Merz
263 Adelaide Tce
Perth WA 6000
Tel: +61 8 9268 4500
Fax: +61 8 9268 9625

LANDCORP

FIGURE 1: SITE LOCATION
PRETTY POOL, PORT HEDLAND

Rev No. B
Project: WV03574
Drawn: 14/04/08

I:\WVES\Projects\WV03574\Technical\Spatial\ArcMap\Pretty_Pool_development_plan_revB.mxd



NOTES

1) The HSB and setback to Pretty Pool Beach and the Mangroves are as advised in the DPI New Coastal Assets letter of agreement 8th October 2008.

2) HSB are as follows:
- Ocean Shore (Pretty Pool Beach) - 6m from RL 6.4m AHD,
- Creek entrance: 30m from RL 6.4m AHD,
- Creek Shore (Mangroves) - 15m from RL 7.5m AHD.

3) The HSB and setback to Stage 4 is not the subject of this subdivision and has been retained in its current form pending final assessment. The HSB for Stage 4 comprises of a 20m setback from RL 7.5m AHD with development filled to 6.0m AHD.

4) The Revised Pretty Pool Project Area reflects the Ocean Shore (Pretty Pool Beach setback), landscaping treatments and/or foreshore access/ rehabilitation within the setback area to be undertaken in accordance with required Management Plans, but on the basis that the Foreshore area will not form part of the land assessed under council's scheme.

5) Land allocated as Town Centre will be subject to the land uses permitted under Clause 3.2 - Zoning Table of Councils TPS No.5 for the Town Centre Zone.

6) The proportion and location of Town Centre uses within Multiple Residential Sites shall be subject to compliance with adopted Design Guidelines and Town of Port Hedland approval.

LEGEND

- Revised Pretty Pool Project Area
- Contours
- Development Setback Line
- Horizontal Setback Datum (HSD)
- Dual Use Path Network
- Public Open Space
- Landscaped Drainage Area
- Residential R20 Lots
- Residential R30 Lots
- Grouped R40
- Multiple Residential R50/80
- Multiple Residential R60/80
- Town Centre

DEVELOPMENT PLAN AREAS / YIELD

A) Total Area: 23.87ha

10% POS Requirement: 2.39ha
POS provided (9.2%): 2.20ha

B) Yield:

R20	160 Lots
R30	67 Lots
R40	2 Lots
R50/60	2 Lots
R80/80	2 Lots
TOTAL =	213 Lots

P.O.S SCHEDULE

P.O.S (A)	653m²
P.O.S (B)	5778m²
P.O.S (C)	4841m²
P.O.S (D)	2422m²
P.O.S (E)	2562m²
P.O.S (F)	1646m²
P.O.S (G)	3795m²
TOTAL	2.1999ha

STAGING (PLANNING-SUBDIVISION APPLICATION STAGES)

- Stage 1 (WAPC 130265 - Approved 4 May 2009)
- Stage 2 (WAPC 131908 - Approved 16 Dec 2009)
- Stage 3
- Stage 4

SKM
Sinclair Knight Merz
263 Adelaide Tce
Perth WA 6000
Tel: +61 8 9268 4500
Fax: +61 8 9268 9625

LANDCORP

Legend

- CPT
- Test pits (TP)

FIGURE 2: INVESTIGATION LOCATIONS PRETTY POOL, PORT HEDLAND

N
W E
S

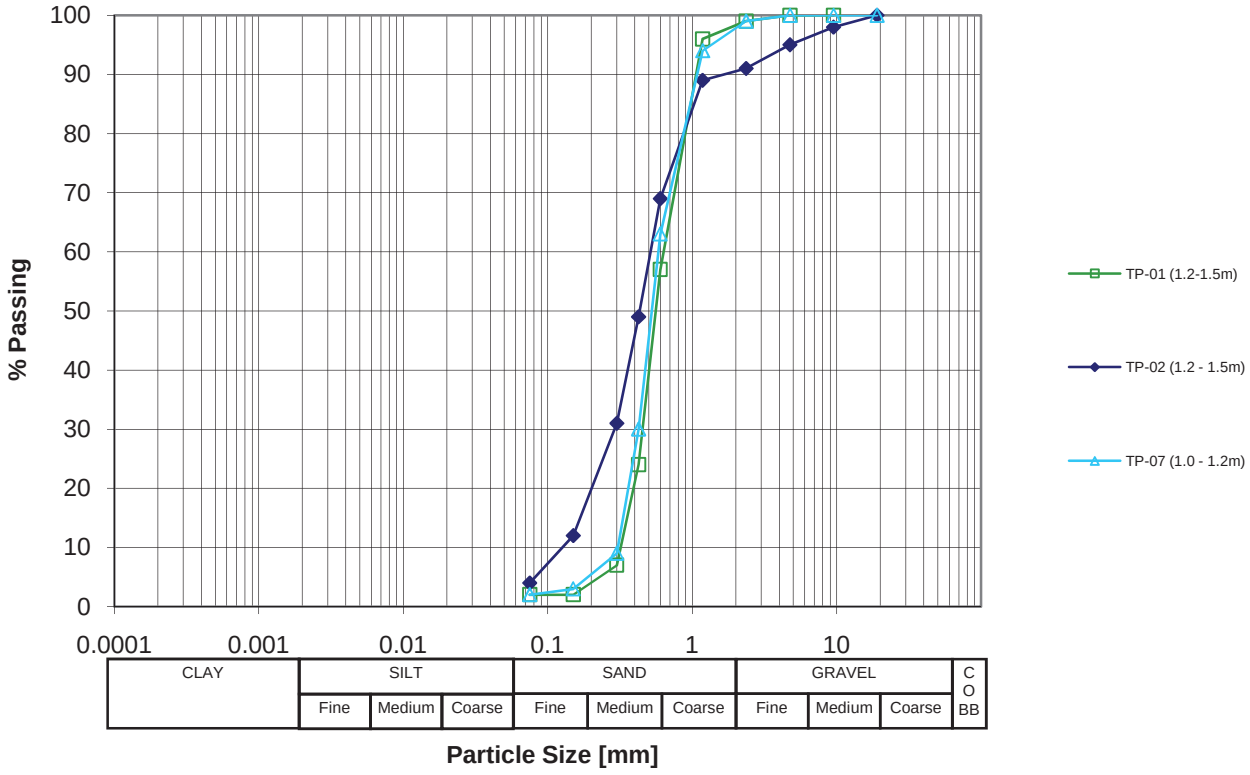
0 100 200
metres

Datum: GDA94
Map Grid: MGA94 Zone 50

Rev No. C
Project: WV03574
Drawn: 05/05/08

I:\WVES\Projects\WV03574\Technical\Spatial\ArcMap\Pretty_Pool_development_plan_revC.mxd

Particle Size Distribution Test Results



Test results according to AS1289 3.6.1

SKM

WV03574

FIGURE 3
PROJECT: PRETTY POOL STAGE 3 AND 4
TITLE: PARTICLE SIZE DISTRIBUTION CURVES
CLIENT: LANDCORP

Appendix A Limitations

SKM

Important Information About Your Sinclair Knight Merz Report

These guidelines have been compiled to assist you in understanding and interpreting this geotechnical report, AND THEREFORE MUST BE READ IN CONJUNCTION WITH YOUR SINCLAIR KNIGHT MERZ REPORT. Research shows that a majority of project delays, cost over-runs, claims and disputes result from inadequate understanding of the sub-surface conditions or their misinterpretation or inappropriate interpretation or usage of these investigations.

This Geotechnical Report is Project Specific

This geo-technical report was prepared to address geo-technical issues relating to the specific site based on SKM's understanding of the scope of works. The findings presented in this report should not be applied to another site or another development within the same site without consulting SKM.

The report reflects SKM's understanding or the project criteria and any changes to the project scope must be communicated to SKM immediately.

Sub-surface Conditions Can Change

The findings of this geo-technical report reflect the condition of the sub-surface at the time of the investigation. If this report is being referenced after some period of time has elapsed since it was drafted, then it is recommended that SKM be consulted regarding the possible effects of time and the current validity of this report, as we cannot accept any responsibility for any matter encountered as a result of changed circumstances or due to the passage of time.

Interpretation of Geo-technical Data

The site assessment presented in this report is a reflection of the data gathered from discrete sampling in select borehole locations. This data has been reviewed by SKM's Engineers and Geologists to understand and model the sub-surface profile based on their understanding, so as to form an opinion. It is possible that actual site conditions could vary from the borehole locations and from the opinion expressed by SKM, as it is impossible for any professional, regardless of experience, to be 100% accurate in unveiling what is in fact hidden by earth, rock and time. It is recommended that the services of SKM be retained throughout the construction or the remaining phase of the project so as to attempt to address any unexpected ground conditions.

The Findings of This Report Are Preliminary In Nature

The report was prepared based on ground conditions encountered at the borehole locations and on the assumption that the borehole locations are representative of the site conditions. This important assumption cannot be substantiated until site work commences. It is important that SKM are retained to review the site conditions during the site works phase to confirm assumptions made during the preparation of this report.

Until actual site conditions are satisfactorily established, the findings of this report must be treated as an estimate and possibly subject to change.

Interpretation of This Report by Others

The contents of this report are specific for this project and should not be applied to other projects or used by parties other than those for whom this report is intended. We recommend that SKM be retained for discussions and consultations when other parties are using this report. We also recommend that SKM review foundation drawings and other relevant documents to assess the impact of this report on those documents.

Using Information Presented in This Report

This report is a whole document which must not be copied in parts, have parts removed or quoted in isolation, logs re-drawn or otherwise altered under any circumstances without the written consent of SKM.

Environmental and Geo-Environmental Issues

This report does not address environmental or geo-environmental issues including the presence of any contaminants or hazardous materials at the site unless SKM was specifically and expressly retained to do so. To perform an environmental assessment of the site, specialist equipment and skills are required. If there are concerns regarding potential contamination of the site or there is inadequate information about the site history, it is advisable to contact SKM for further information.

Additional Information

As part of the engineering team, SKM is aware of various site issues and constraints, all of which may not be reflected in this report. As the project progresses, SKM could be in a position to offer specialist advice or guidance that would be beneficial to the overall project and provide some cost savings. It is, therefore important to keep SKM informed as the project develops in order that the knowledge and experience acquired in the production of this report can be applied to develop alternative approaches to problems which could have a beneficial effect on cost and time.

References:

1) Guidelines for the Provision of Geo-technical Information in Construction Contracts, published by Institute of Engineers Australia, 1987

2) ASFE Publication, 1993

Appendix B CPT Profile

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: LandCorp

PROJECT: Pretty Pool

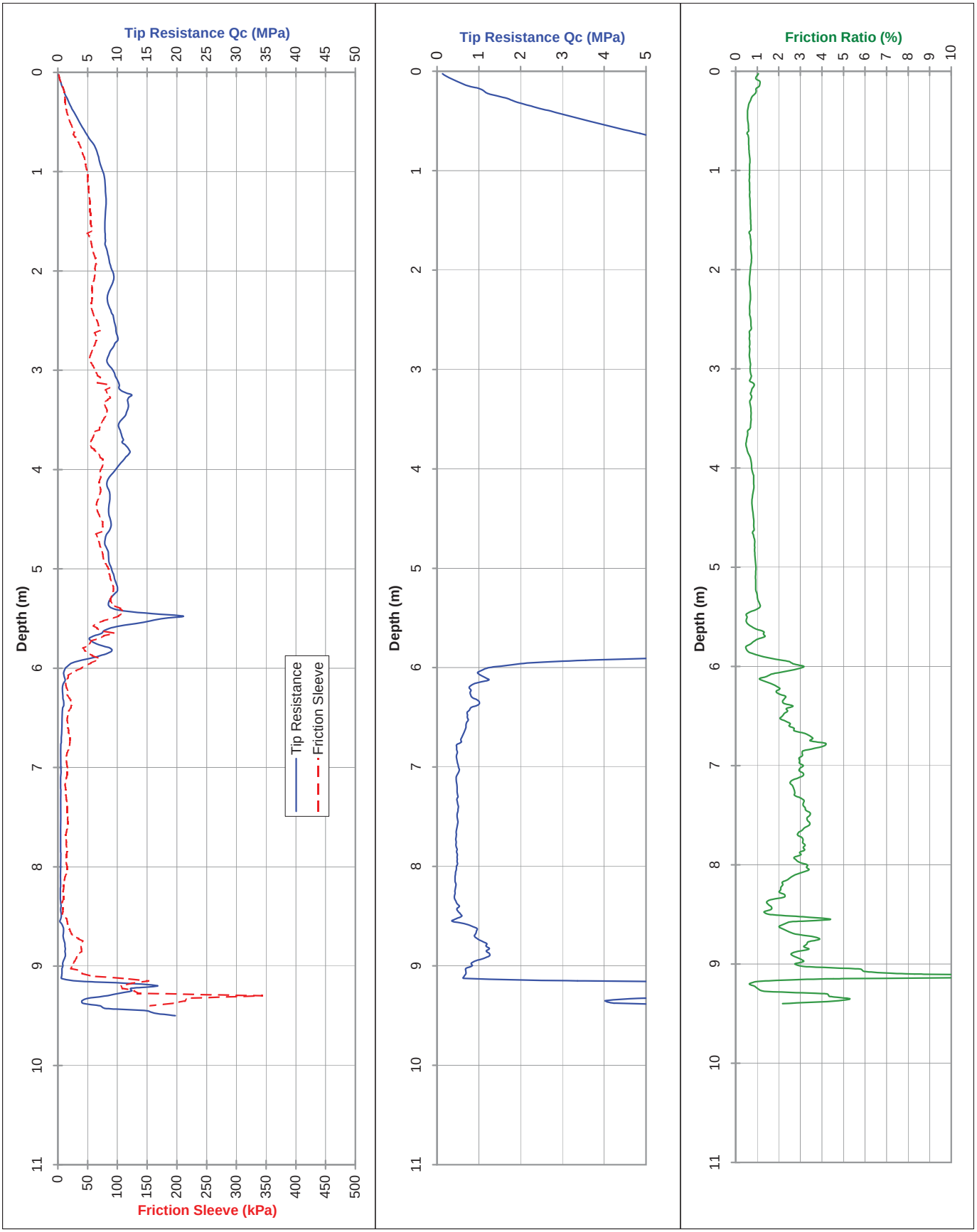
LOCATION: Port Hedland

Date: 18/3/08

Probe No.: CPT 1

Job Number: WV03574

Co-ordinates:



PROBEDRILL PTY LTD
GEOTECHNICAL SURVEY
Ph: 9314 6611 Fax: 9314 6699

Water (m): -

Refusal: Inclination

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: SK7028T.txt

Dummy probe to (m):

Cone I.D. : EC23GM

7 tonne track mounted CPT rig.

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: LandCorp

PROJECT: Pretty Pool

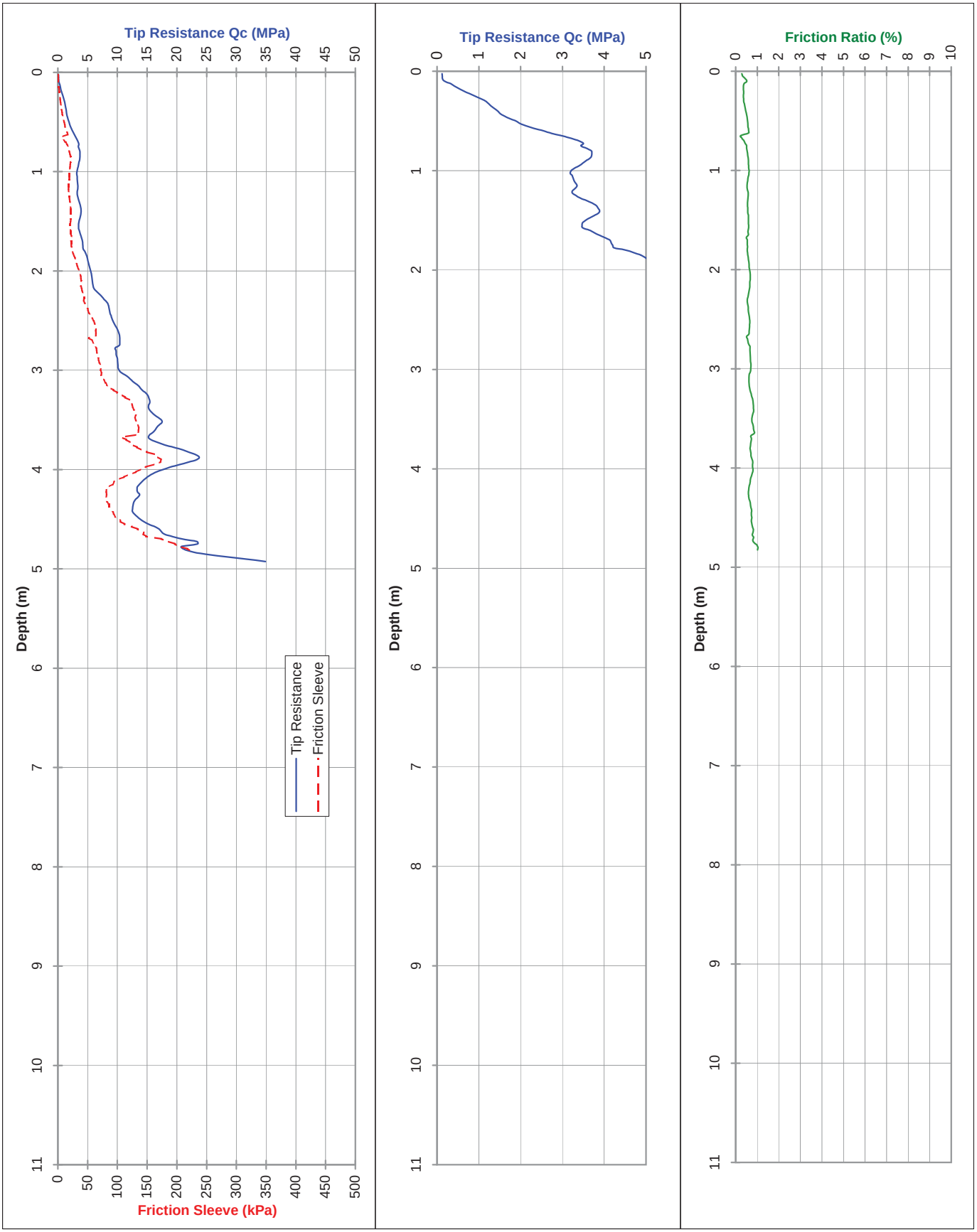
LOCATION: Port Hedland

Date: 18/3/08

Probe No.: CPT 2

Job Number: WV03574

Co-ordinates:



PROBEDRILL PTY LTD
GEOTECHNICAL SURVEY
Ph: 9314 6611 Fax: 9314 6699

Water (m): -

Refusal: 35MPa

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: SK7029T.txt

Dummy probe to (m):

Cone I.D. : EC23GM

7 tonne track mounted CPT rig.

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: LandCorp

PROJECT: Pretty Pool

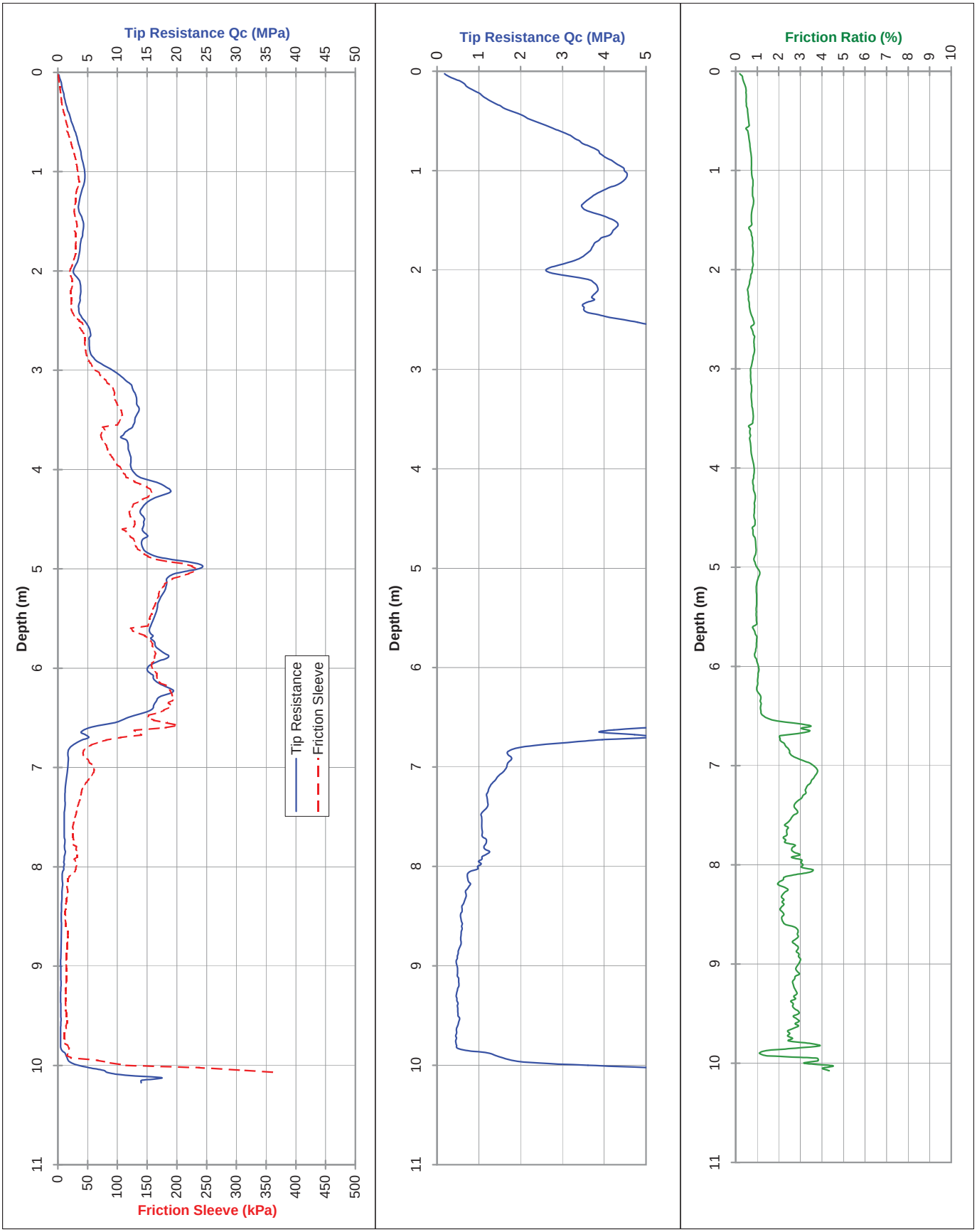
LOCATION: Port Hedland

Date: 18/3/08

Probe No.: CPT 2A

Job Number: WV03574

Co-ordinates:



PROBEDRILL PTY LTD
GEOTECHNICAL SURVEY
Ph: 9314 6611 Fax: 9314 6699

Water (m): Dry to 4.0

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: SK7030T.txt

Dummy probe to (m):

Cone I.D. : EC23GM

7 tonne track mounted CPT rig.

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: LandCorp

PROJECT: Pretty Pool

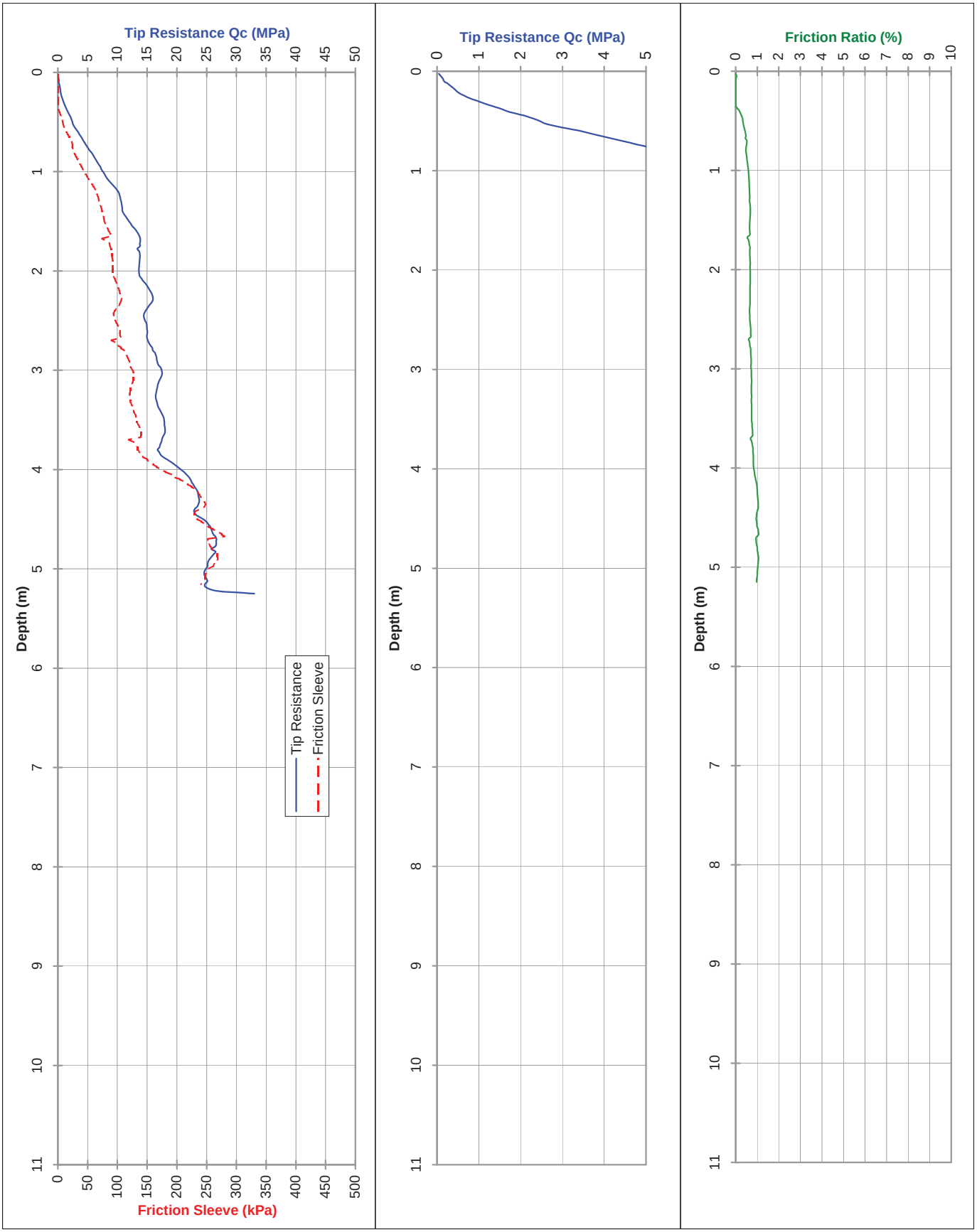
LOCATION: Port Hedland

Date: 18/3/08

Probe No.: CPT 3

Job Number: WV03574

Co-ordinates:



PROBEDRILL PTY LTD
GEOTECHNICAL SURVEY
Ph: 9314 6611 Fax: 9314 6699

Water (m): -

Refusal: 33MPa

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: SK7031T.txt

Dummy probe to (m):

Cone I.D. : EC23GM

7 tonne track mounted CPT rig.

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: LandCorp

PROJECT: Pretty Pool

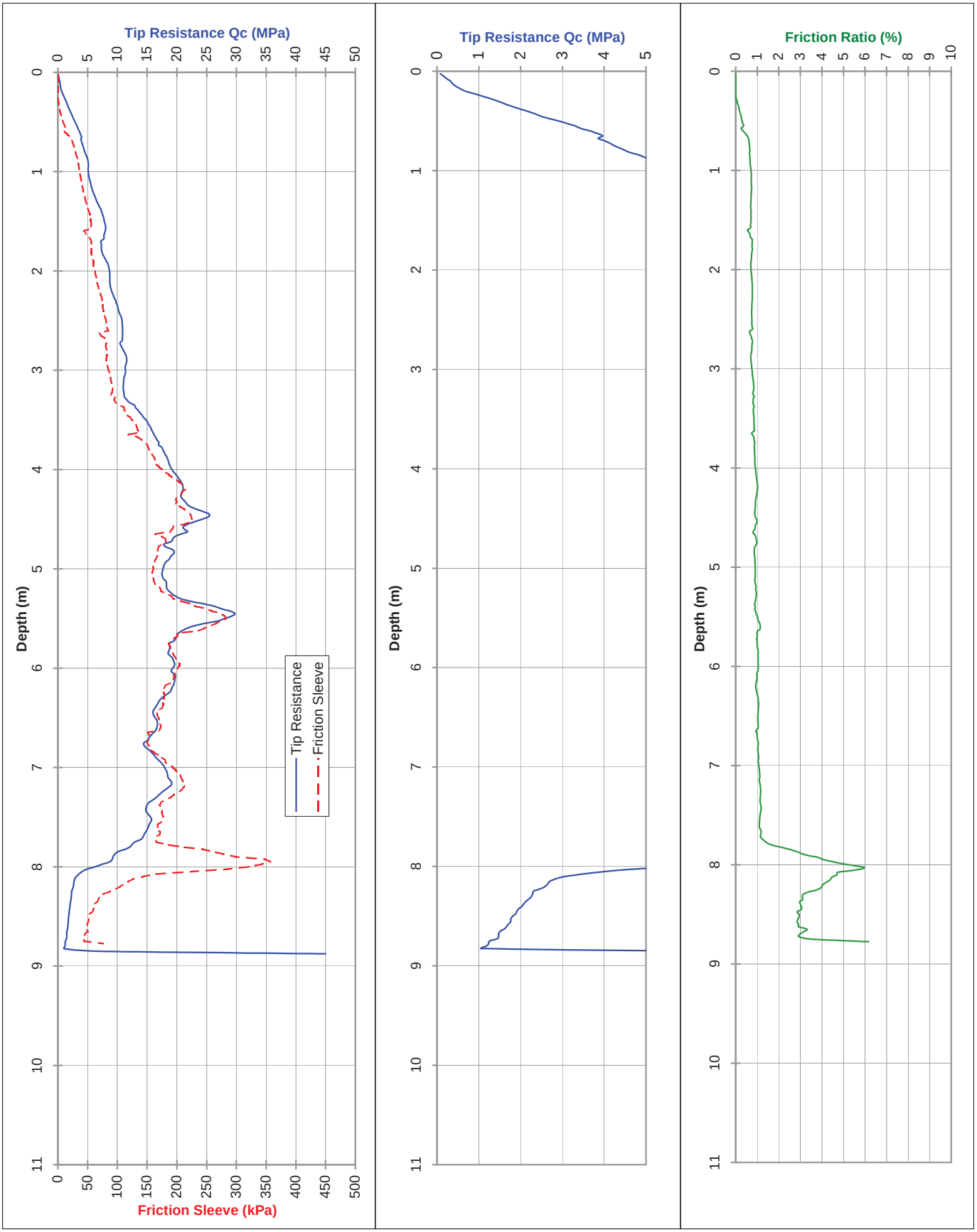
LOCATION: Port Hedland

Date: 18/3/08

Probe No.: CPT 3A

Job Number: WV03574

Co-ordinates:



PROBEDRILL PTY LTD
GEOTECHNICAL SURVEY
Ph: 9314 6611 Fax: 9314 6699

Water (m): Dry to 8.8

Refusal: 45MPa

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: SK7032T.txt

Dummy probe to (m):

Cone I.D. : EC23GM

7 tonne track mounted CPT rig.

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: LandCorp

PROJECT: Pretty Pool

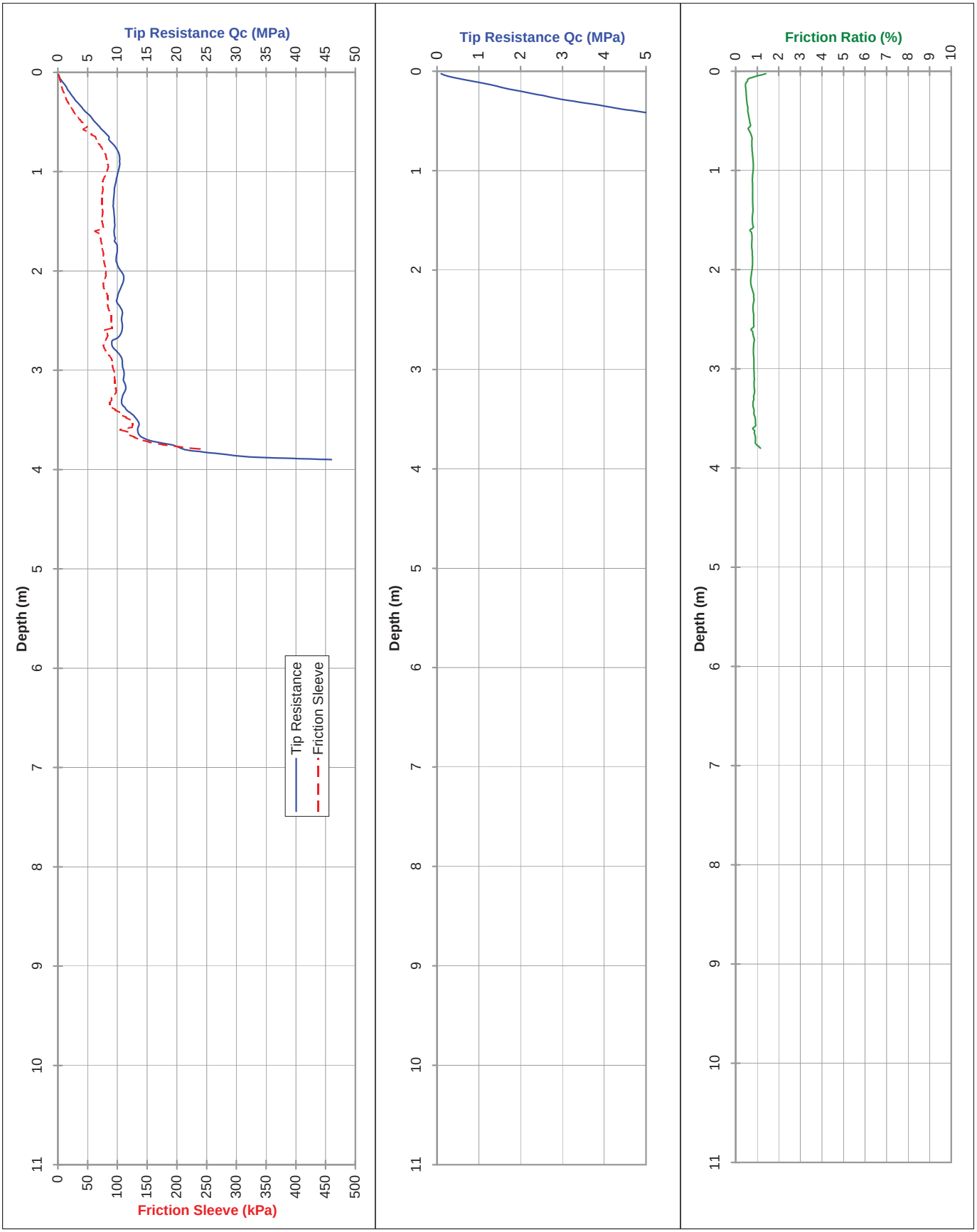
LOCATION: Port Hedland

Date: 18/3/08

Probe No.: CPT 5

Job Number: WV03574

Co-ordinates:



PROBEDRILL PTY LTD
GEOTECHNICAL SURVEY
Ph: 9314 6611 Fax: 9314 6699

Water (m): -

Refusal: 46MPa

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: SK7036T.txt

Dummy probe to (m):

Cone I.D. : EC23GM

7 tonne track mounted CPT rig.

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: LandCorp

PROJECT: Pretty Pool

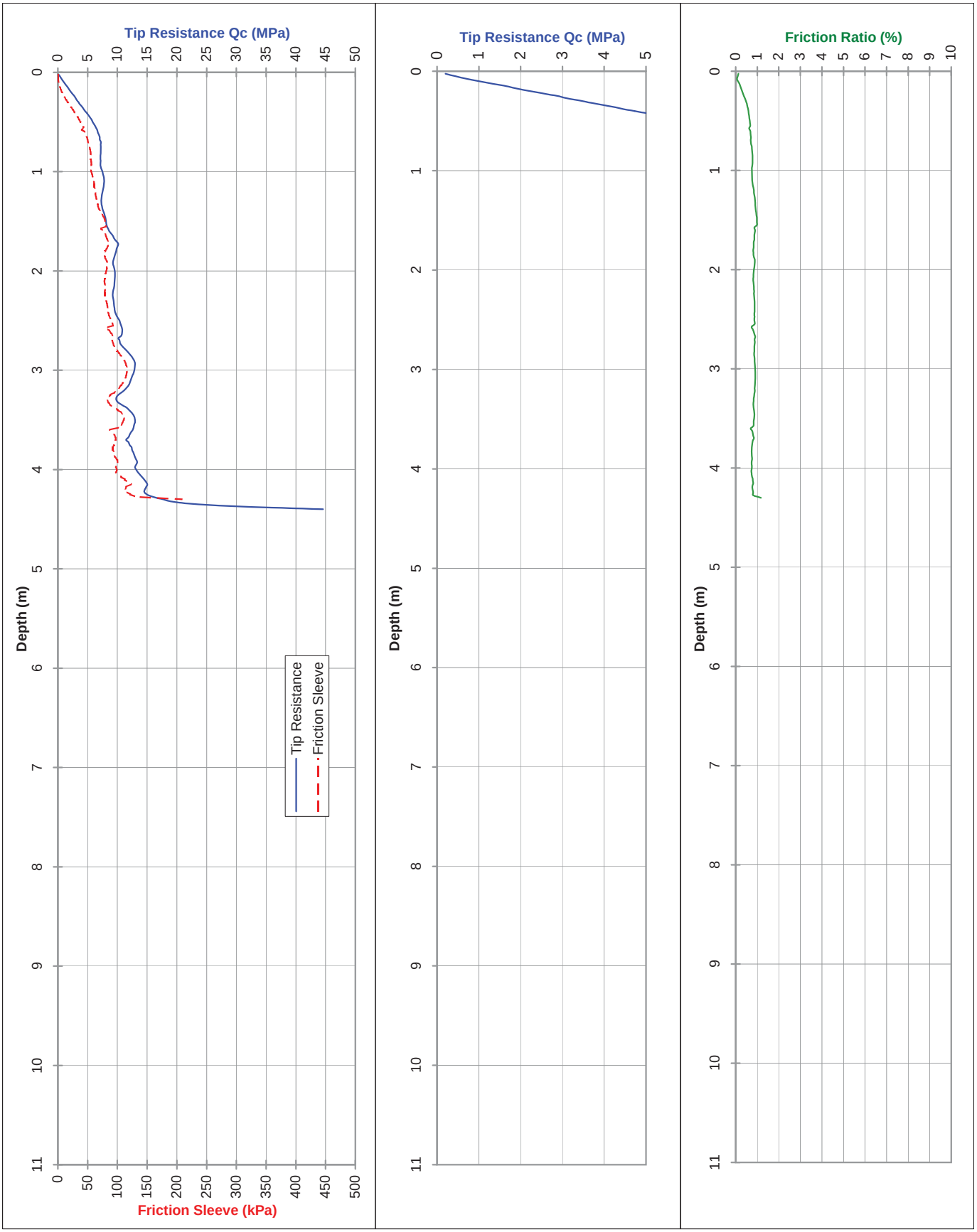
LOCATION: Port Hedland

Date: 18/3/08

Probe No.: CPT 5A

Job Number: WV03574

Co-ordinates:



PROBEDRILL PTY LTD
GEOTECHNICAL SURVEY
Ph: 9314 6611 Fax: 9314 6699

Water (m): -

Refusal: 46MPa

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: SK7037T.txt

Dummy probe to (m):

Cone I.D. : EC23GM

7 tonne track mounted CPT rig.

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: LandCorp

PROJECT: Pretty Pool

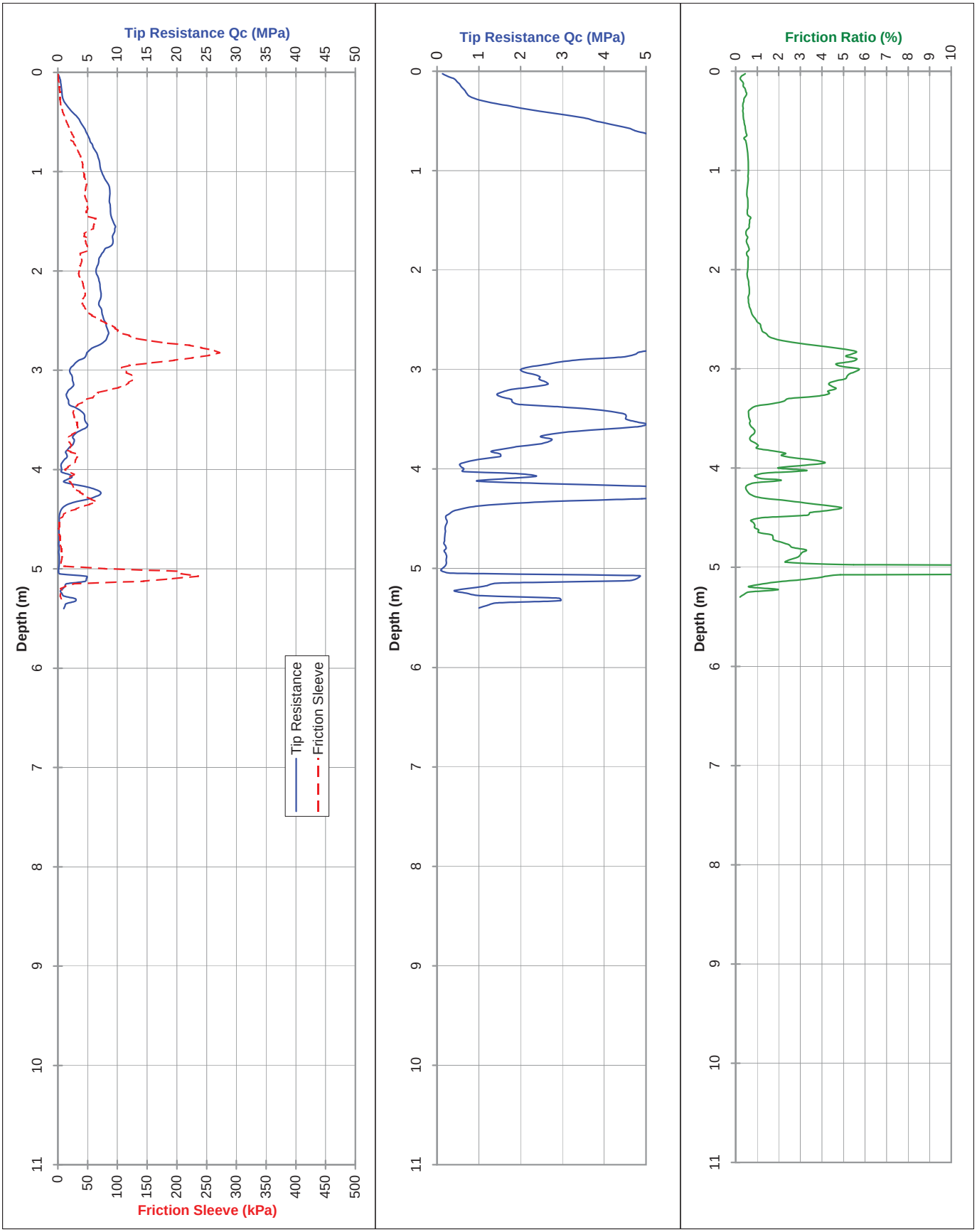
LOCATION: Port Hedland

Date: 18/3/08

Probe No.: CPT 6

Job Number: WV03574

Co-ordinates:



PROBEDRILL PTY LTD
GEOTECHNICAL SURVEY
Ph: 9314 6611 Fax: 9314 6699

Water (m): -

Refusal: Inclination

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: SK7038T.txt

Dummy probe to (m):

Cone I.D. : EC23GM

7 tonne track mounted CPT rig.

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: LandCorp

PROJECT: Pretty Pool

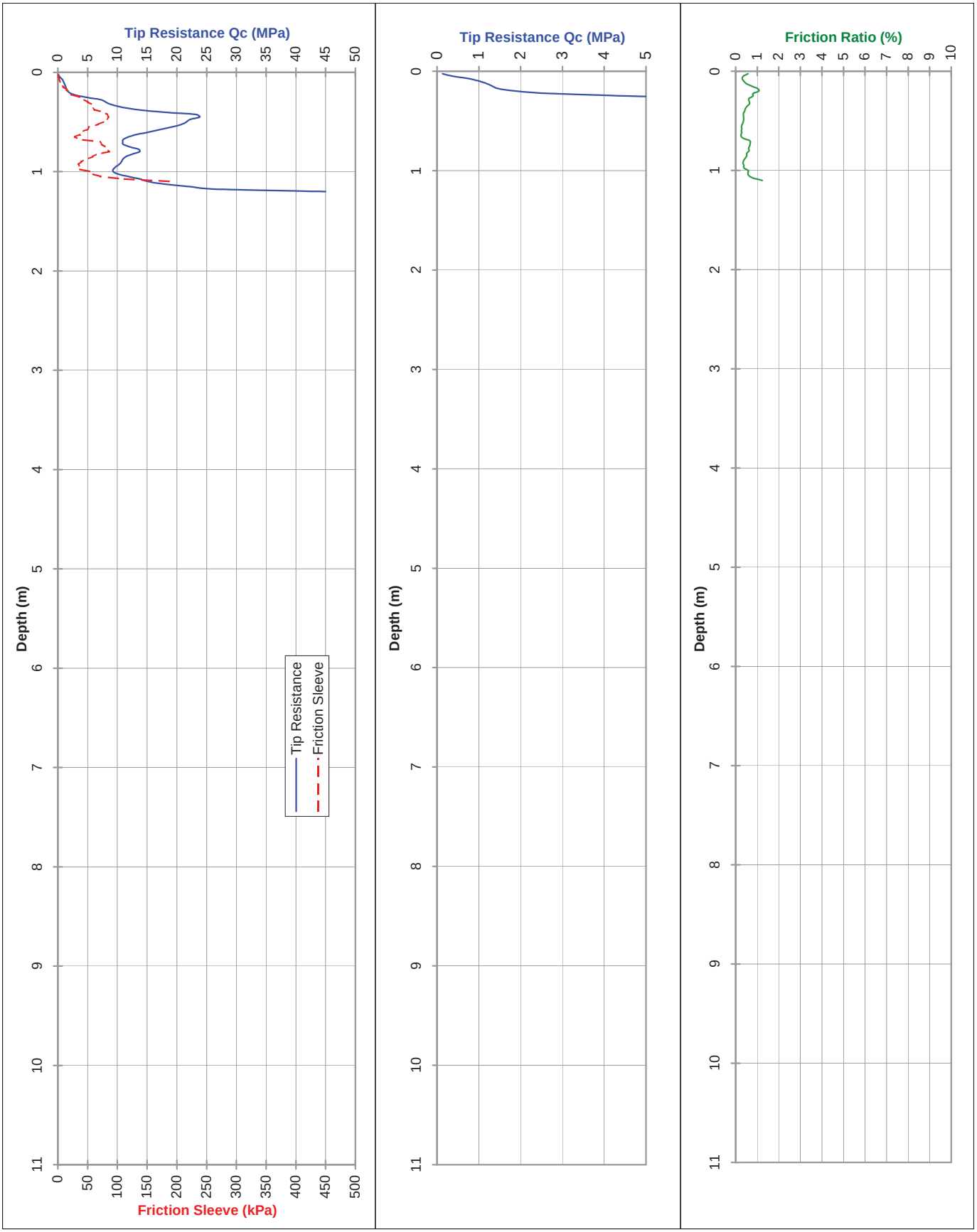
LOCATION: Port Hedland

Date: 18/3/08

Probe No.: CPT 6A

Job Number: WV03574

Co-ordinates:



PROBEDRILL PTY LTD
GEOTECHNICAL SURVEY
Ph: 9314 6611 Fax: 9314 6699

Water (m): -

Refusal: 45MPa

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: SK7039T.txt

Dummy probe to (m):

Cone I.D. : EC23GM

7 tonne track mounted CPT rig.

Appendix C Test Pit Logs

SOIL AND ROCK DESCRIPTION
ABBREVIATIONS

COLOUR

BROWN (br)

GREY – BROWN (gy/br)

GREY (gy)

PURPLE (pr)

BLUE – GREY (bl/gy)

BLUE (bl)

OLIVE (ol)

BLUE – GREEN (bl/gr)

GREEN (gr)

YELLOW (yl)

YELLOW – BROWN (yl/br)

ORANGE (or)

RED (rd)

RED – BROWN (rd/br)

MODIFIERS
Light - (lt)
Dark - (dk)
Mottled – (mtld)
And – (&)
Yellow- brown = yl/br
Grey and brown = gy & br

Soil and rock descriptions on the logs are generally in accordance with the recommendations of AS1726. The order in which descriptions are provided on the logs is as follows:

SOIL:
SOIL TYPE (Unified Classification), colour, structure, particle characteristics, geological origin, other minor components. The consistency/density and moisture condition are listed as abbreviations in seperate columns.

ROCK:
ROCK TYPE (Degree of Weathering), colour, grain size, texture and fabric, structure, bedding dip and geological formation. A histogram of rock mass defect spacing and minor defect descriptions are listed under separate columns. Major defects are individually identified in the description column and shown on the graphic log as a single dashed lines for defects 10 to 100mm thick and as a seam between 2 dashed lines if > 100mm thick. The material in the seam is fully described.

Field tests are used to assess soil consistency, rock strength and grain size. Unless specifically stated otherwise, these assessments have been transferred directly to the record sheets and not modified. Descriptive terms used on the record sheets are explained on the following pages. Colour should be determined in the "moist" condition using the basic terms provided on the adjacent chart and black (bk) & white (wh). Abbreviations should be used for describing seams.

Other abbreviations used for field tests, consistency, density, strength, moisture condition and contaminant ranking are summarised at the base of the log sheets.

STRUCTURE

The structure of soil (or rock) is usually applicable to cohesive soils or rock. Typical terms used are; ***intact*** (no joints), ***fissured*** (closed joints), ***voided*** (confined to open joints), ***slickensided*** (sheared), ***interbedded*** (laminated) and ***cemented***.

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

Extremely weathered material	Structure and fabric of parent rock visible
Residual soil	Structure and fabric of parent rock not visible

TRANSPORTED SOILS

Aeolian soil	Deposited by wind.
Alluvial soil	Deposited by streams and rivers.
Colluvial soil	Desposited on slopes (transported downslope)
Lacustrine soil	Deposited by lakes.
Marine soil	Deposited in ocean, bays, beaches and estuaries.

FILL MATERIALS

Soil Fill	Describe soil type, UCS symbol and add 'FILL'.
Rock Fill	Rock type, degree of weathering, and word 'FILL'.
Domestic Fill	Percent soil or rock, whether pretrucible or not.
Industrial Fill	Percent soil, whether contaminated, particle size & type of waste product, ie – brick, concrete, metal

MOISTURE CONDITION

Term	Symbol	Description		
		Cohesive Soils	Granular Soils	Rock
Dry	**D**	Cohesive; hard and friable or powdery, dry of Plastic Limit (PL)	Cohesion-less and free running	Dry on broken faces
Moist	**M**	Soil feels cool, darkened in colour, can be moulded, near PL	Soil feels cool, darkened in colour, tends to cohere	Rock is darkened, moisture on broken faces
Wet	**W**	Soil feels cool, dark, usually weakened, free water, >> PL	Soil feels cool, darkened in colour, tends to cohere	NA

SOIL AND ROCK DESCRIPTION
SOIL CLASSIFICATION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60mm and basing fractions on estimated mass)				GROUP SYMBOLS	SYMBOL	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS
COARSE GRAINED SOILS – More than 50% of material less than 63 mm is larger than 0.075 mm	GRAVELS – More than 50% of coarse fraction is larger than 2.36mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	GW		Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name, symbol, indicate approximate % of sand and gravel, max. size, angularity, surface condition, and strength of coarse grains: colour, amount plasticity of fine component. For undisturbed soils add information on moisture content, degree of compactness, stratification, cementation, odour. Give local and other pertinent descriptive information. Example: SILTY SAND (SM), fine to coarse, light grey, about 20% strong angular gravel particles – 10mm max. size, rounded and sub-angular sand, about 12% non-plastic fines, moist, dense alluvial sand.
			Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	GP		Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels	
		GRAVELS WITH FINES (Appreciable amount of fines)	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	GM		Silty gravels, gravel-sand-silt mixtures	
			'Dirty' materials with excess of plastic fines, medium to high dry strength	GC		Clayey gravels, gravel-sand-clay mixtures	
	SANDS – More than 50% of coarse fraction is smaller than 2.36mm	CLEAN SANDS (little or no fines)	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	SW		Well graded sands, gravelly sands, little or no fines	
			Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	SP		Poorly graded sands and gravelly sands; little or no fines, uniform sands	
		SANDS WITH FINES (Appreciable amount of fines)	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	SM		Silty sands, sand-silt mixtures	
			'Dirty' materials with excess of plastic fines, medium to high dry strength	SC		Clayey sands, sand-clay mixtures	
FINE GRAINED SOILS – More than 50% of material less than 63 mm is smaller than 0.075 mm	IDENTIFICATION PROCEEDURES ON FRACTIONS < 0.2 mm						
	SILTS AND CLAYS – Liquid limit less than 50	DRY STRENGTH	DILATANCY	TOUGHNESS			
		None to low	Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with low plasticity. Silts of low to medium Liquid Limit.	Give typical name, symbol, indicate degree and character of plasticity, colour, amount and size of coarse grains. For undisturbed soils add information on moisture content, consistency, structure, stratification, odour. Give local or geologic name and other pertinent descriptive information. Example: clayey SILT (ML), slightly plastic, brown, small percentage of sand, firm, dry, numerous vertical root holes.
		Medium to high	None to very slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.	
		Low to medium	Slow	Low	OL	Organic silts and organic silt-clays of low to medium plasticity	
	SILTS AND CLAYS – Liquid limit greater than 50	Low to medium	Slow to none	Low to medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, silts of high Liquid Limit	
		High to very high	None	High	CH	Inorganic clays of high plasticity	
		Medium to high	None to very slow	Low to medium	OH	Organic clays of high plasticity	
HIGHLY ORGANIC SOILS		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			Pt	Peat and other highly organic soils	

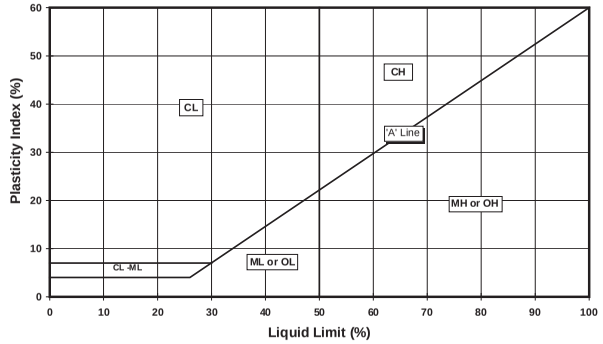
LABORATORY CLASSIFICATION CRITERIA

Use grain size curve in identifying the fractions as given under field identification

Determine percentages of gravel and sand from grain size curve
Depending on percentage smaller than 0.06mm size coarse grained soils are classified as follows:

Less than 5%	GW, GP, SW, SP	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} x D_{60}}$ Between 1 & 3
		Not meeting all gradation requirements for GW.
More than 12 %	GM, GC, SM, SC	Atterberg limits below 'A' line or I_p less than 4 — Above 'A' line with PI between 4 and 7 are borderline cases requiring use of dual symbols.
		Atterberg limits above 'A' line with I_p greater than 7.
5% to 12%	Borderline cases requiring use of dual symbols	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} x D_{60}}$ Between 1 & 3
		Not meeting all gradation requirements for SW
		Atterberg limits below 'A' line or I_p less than 4 — Above 'A' line with PI between 4 and 7 are borderline cases requiring use of dual symbols.
		Atterberg limits above 'A' line with I_p greater than 7.

Plasticity Chart (for laboratory classification of fine grained soils)



Boundary classifications – Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well graded gravel-sand mixture with clay binder.

SHEET 2
SOIL & ROCK DESCRIPTION
SOIL CLASSIFICATION

SKM

SOIL AND ROCK DESCRIPTION
SOIL DESCRIPTION

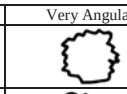
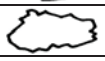
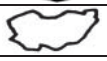
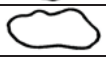
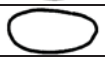
SOIL TYPE

Classification of soils for engineering purposes is based on the *Unified Classification System* which uses 75 microns as the division of fine grained and coarse grained soils.

The soil type is based on the particle size less than 63 mm diameter and the plasticity of the material passing the 425 μm sieve. If more than 50% of the material passes the 75 μm sieve it is a fine grained soil (CLAY or SILT). The predominant particle size is noted as the primary soil type and this may be modified by the coarse grained portion if it is greater than 30% of the total dry mass, ie SANDY CLAY. If there is less than 30% coarse grained material but more than 12% of the secondary particle size then the modifier is fine grained, ie SILTY CLAY. In the case of where there are less than 50% fines but more than 12% fines then the predominant coarse grained fraction (sand or gravel) is modified by the predominant fine grained soil type, ie SILTY GRAVEL. ***Do not use*** multiple soil type descriptions such as SILTY CLAYEY GRAVEL, make a decision on the predominant minor constituents or its engineering characteristics, ie. plastic then it is a clay. Where mixtures of soil occur, the secondary components should be described as per a primary material.

GRAIN SIZE

Soil Type (Abbrev.)	CLAY (CL) < 2 μm	SILT (SI) 2 – 75 μm	SAND (SA)			GRAVEL (GR)			COBBLES (CO) 63-200 mm
			Fine (f) 0.075-0.2 mm	Medium (m) 0.2-0.6 mm	Coarse (c) 0.6-2.36 mm	Fine (f) 2.36-6 mm	Medium (m) 6-20 mm	Coarse (c) 20-63 mm	
Shape & Texture	Shiny	Dull	very angular / angular / subangular / subrounded / rounded / well rounded (low/high sphericity)						
Field Guide	Not visible under 10x	Visible under 10x	Visible by eye	Visible at < 1 m	Visible at < 3 m	Visible at < 5 m	Road gravel	Rail ballast	Beaching

	Very Angular	Angular	Subangular	Subrounded	Rounded	Well Rounded
High Sphericity						
Low Sphericity						

DENSITY (non-cohesive soils) based on range of SPT blowcounts for fine to medium sands

Term	Very Loose	Loose	Medium Dense	Dense	Very Dense	Compact
Symbol	VL	L	MD	D	VD	CO
SPT (N) Blowcount	0 - 4	4 - 10	10 - 30	30 - 50	50 - 100	> 50/150 mm
Density Index (%)	< 15	15 - 35	35 - 65	65 - 85	85 - 95	> 95
Field Guide	Ravels	Shovels easily	Shovelling very difficult	Pick required	Pick difficult	Cannot be picked

CONSISTENCY (cohesive soils) based on undrained strength (S_u) (estimated in field from pocket penetrometer or shear vane)

Term	Very Soft	Soft	Firm	Stiff	Very Stiff	Hard
Symbol	VS	S	F	St	VSt	H
Undrained Shear Strength (kPa)	< 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
SPT (N) Blowcount	0 - 2	2 - 4	4 - 8	8 - 15	15 - 30	> 30
Field Guide	Exudes between the fingers when squeezed	Can be moulded by light finger pressure	Can be moulded by strong finger pressure	Cannot be moulded by fingers. Can be indented by thumb nail	Can be indented by thumb nail	Can be indented with difficulty with thumb nail

MINOR COMPONENTS

Term	Trace of	With some
% Minor Component	Coarse grained soils: < 5% Fine grained soils: <12%	Coarse grained soils: 5 – 12% Fine grained soils: 12 – 30%
Field Guide	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary components	Presence easily detectable by feel or eye, soil properties little different to general properties of primary component

ORGANICS

Organic matter (non-waste fill) should be described as fibrous peat, charcoal, wood fragments, roots (>2mm diam.) or root fibres (<2mm diam.)

TEST PIT No. TP-01

Sheet 1 of 1

Project: Pretty Pool Stages 4	Client: Landcorp	Operator: Pilbara P.Hire	Northings: 7752497.0mN
Location: Port Hedland	Date: 17/3/08 - 17/3/08	Excavator: CAT 307C	Eastings: 671900.0mE Logged: CS
Job No: WV03574	Pit Width: 1x2 m	Surface Conditions:	RL: Checked: KO

LABORATORY DATA						FIELD DATA				SOIL DESCRIPTION		SOIL CONDITION		COMMENTS
dry density (t/m³)	moisture content (%)	liquid limit (%)	plasticity index (%)	percent fines (%)	[illegible]	DCP blows/100mm	[illegible]	sample type	field tests ground water depth (m)	graphic log	soil type, unified classification, colour, structure, particle characteristics, minor components	consistency/density	moisture condition	excavation method, water and additional observations
				2		0 0 1 1 2 2 2 2 3 3 3 3 3 3 4 4 4 4 5 5			0.5 1.0 1.5 2.0 2.5 3.0		**Top Soil (SAND)** reddish brown, fine to medium grained, some roots **SAND(SP)** reddish brown/brown, fine to coarse grained, trace roots **SAND(SP)** brown, fine to coarse grained, trace gravels and roots Test pit terminated at 2.0 m (Soil Collapsing)	L L L	D D D	

LABORATORY DATA

UQN Unconfined Comp. (Natural)
UQC Unconfined Comp. (Compacted)
TQN Uncons. Undrained Triax. (Natural)
TQC Uncons. Undrained Triax. (Compacted)
TRX Consolidated Undrained Triaxial with pwp measurement
PSA Particle Size Analysis
CS 1D oedometer Test
LPM Laboratory Permeability

FIELD DATA ABBREVIATIONS

Suv = Uncorrected vane shear (kPa)
Sup = Pocket penetrometer (kPa)
Sur = Remoulded vane shear (kPa)

GROUNDWATER SYMBOLS

= Water level (static)
= Water level (during excavation)
= Outflow / Inflow

FIELD DATA SYMBOLS

× = Shear vane test
⊥ = Pocket Penetrometer test
○ = Environmental Sample
■ = Undisturbed Tube Sample
● = Disturbed Sample
▮ = Bulk Sample

DENSITY (N-value)

VL	(very loose)	0 - 4
L	(loose)	4 - 10
MD	(medium dense)	10 - 30
D	(dense)	30 - 50
VD	(very dense)	50 - 100
CO	(compact)	>50/150mm

MOISTURE CONDITION
D = Dry M = Moist W = Wet

CONSISTENCY (Su)

VS	(very soft)	< 12 kPa
S	(soft)	12 - 25
F	(firm)	25 - 50
St	(stiff)	50 - 100
VSt	(very stiff)	100 - 200
H	(hard)	> 200 kPa

TEST PIT No. TP-02

Sheet 1 of 1

Project: Pretty Pool Stages 4	Client: Landcorp	Operator: Pilbara P.Hire	Northings: 7752583.0mN	
Location: Port Hedland	Date: 17/3/08 - 17/3/08	Excavator: CAT 307C	Eastings: 671824.0mE	Logged: CS
Job No: WV03574	Pit Width: 1x2 m	Surface Conditions:	RL:	Checked: KO

LABORATORY DATA						FIELD DATA					SOIL DESCRIPTION	SOIL CONDITION		COMMENTS
dry density (t/m³)	moisture content (%)	liquid limit (%)	plasticity index (%)	percent fines (%)	Emerson classification	DCP blows/100mm	field & other tests	sample type	field tests	ground water depth (m)	graphic log	soil type, unified classification, colour, structure, particle characteristics, minor components	consistency	moisture condition	excavation method, water and additional observations
						0						**Top Soil (SAND)** reddish brown, fine to medium grained, some roots	L	D	
						0						**SAND(SP)** reddish brown/brown, fine to coarse grained, trace gravel and roots	L	D	
						1									
						1									
						2									
						3				0.5					
						4						**SAND(SP)** reddish brown, fine to coarse grained, trace gravels	L	D	
						5									
						6									
						6				1.0					
						4									
						4									
1.78	10.5			4		4	CBR = 17%								
						4									
						4				1.5					
						5						**SAND(SP)** reddish brown, fine to coarse grained	MD	M	
						5									
						4									
						4									
						6				2.0					
												Test Pit terminated at 2.2 m.			
										2.5					
										3.0					

LABORATORY DATA

UQN	Unconfined Comp. (Natural)
UQC	Unconfined Comp. (Compacted)
TQN	Uncons. Undrained Triax. (Natural)
TQC	Uncons. Undrained Triax. (Compacted)
TRX	Consolidated Undrained Triaxial with pwp measurement
PSA	Particle Size Analysis
CS	1D oedometer Test
LPM	Laboratory Permeability

FIELD DATA ABBREVIATIONS

Suv	= Uncorrected vane shear (kPa)
Sup	= Pocket penetrometer (kPa)
Sur	= Remoulded vane shear (kPa)

GROUNDWATER SYMBOLS

= Water level (static)
= Water level (during excavation)
= Outflow / Inflow

FIELD DATA SYMBOLS

= Shear vane test
= Pocket Penetrometer test
= Environmental Sample
= Undisturbed Tube Sample
= Disturbed Sample
= Bulk Sample

DENSITY (N-value)

VL	(very loose)	0 - 4
L	(loose)	4 - 10
MD	(medium dense)	10 - 30
D	(dense)	30 - 50
VD	(very dense)	50 - 100
CO	(compact)	>50/150mm

MOISTURE CONDITION
D = Dry M = Moist W = Wet

CONSISTENCY (Su)

VS	(very soft)	< 12 kPa
S	(soft)	12 - 25
F	(firm)	25 - 50
St	(stiff)	50 - 100
VSt	(very stiff)	100 - 200
H	(hard)	> 200 kPa

TEST PIT No. TP-06

Sheet 1 of 1

Project: Pretty Pool Stages 4
Location: Port Hedland
Job No: WV03574

Client: Landcorp
Date: 17/3/08 - 17/3/08
Pit Width: 1x2 m

Operator: Pilbara P.Hire
Excavator: CAT 307C
Surface Conditions:

Northings: 7752212.0mN
Eastings: 671485.0mE
RL:

Logged: CS
Checked: KO

LABORATORY DATA						FIELD DATA				SOIL DESCRIPTION		SOIL CONDITION		COMMENTS
dry density (t/m³)	moisture content (%)	liquid limit (%)	plasticity index (%)	percent fines (%)	Emerson classification	DCP blows/100mm	field & other tests	sample type	groundwater depth (m)	graphic log	soil type, unified classification, colour, structure, particle characteristics, minor components	consistency / density	moisture condition	excavation method, water and additional observations
						1 4 7 7 9 10 10 9 9 8					**Top Soil (SAND)** reddish brown, fine to medium grained	L	D	
									0.5		**SAND(SP)** brown/reddish brown, fine to medium grained	L	D	
									1.0		**SAND(SP)** reddish brown, fine to coarse grained	MD	M	
									1.5		**SAND(SP)** brown/reddish brown, fine to coarse grained	MD	M	
									2.0					
									2.5		Test pit terminated at 2.5m			
									3.0					

LABORATORY DATA

UQN	Unconfined Comp. (Natural)
UQC	Unconfined Comp. (Compacted)
TQN	Uncons. Undrained Triax. (Natural)
TQC	Uncons. Undrained Triax. (Compacted)
TRX	Consolidated Undrained Triaxial with pwp measurement
PSA	Particle Size Analysis
CS	1D oedometer Test
LPM	Laboratory Permeability

FIELD DATA ABBREVIATIONS

Suv	= Uncorrected vane shear (kPa)
Sup	= Pocket penetrometer (kPa)
Sur	= Remoulded vane shear (kPa)

GROUNDWATER SYMBOLS

= Water level (static)
= Water level (during excavation)
= Outflow / Inflow

FIELD DATA SYMBOLS

= Shear vane test
= Pocket Penetrometer test
= Environmental Sample
= Undisturbed Tube Sample
= Disturbed Sample
= Bulk Sample

DENSITY (N-value)

VL	(very loose)	0 - 4
L	(loose)	4 - 10
MD	(medium dense)	10 - 30
D	(dense)	30 - 50
VD	(very dense)	50 - 100
CO	(compact)	>50/150mm

MOISTURE CONDITION
D = Dry M = Moist W = Wet

CONSISTENCY (Su)

VS	(very soft)	< 12 kPa
S	(soft)	12 - 25
F	(firm)	25 - 50
St	(stiff)	50 - 100
VSt	(very stiff)	100 - 200
H	(hard)	> 200 kPa

TEST PIT No. TP-07

Sheet 1 of 1

Project: Pretty Pool Stages 4	Client: Landcorp	Operator: Pilbara P.Hire	Northings: 7752075.0mN		
Location: Port Hedland	Date: 17/3/08 - 17/3/08	Excavator: CAT 307C	Eastings: 671491.0mE	Logged: CS	
Job No: WV03574	Pit Width: 1x2 m	Surface Conditions:	RL:	Checked: KO	

LABORATORY DATA						FIELD DATA					SOIL DESCRIPTION	SOIL CONDITION		COMMENTS
dry density (t/m³)	moisture content (%)	liquid limit (%)	~~plasticity index~~	percent fines (%)	Emerson classification	DCP blows/100mm	field & other tests	sample type	field tests ground water	depth (m)	graphic log	soil type, unified classification, colour, structure, particle characteristics, minor components	~~consistency~~ density	moisture condition	excavation method, water and additional observations
						0 1 5 8 10 14 16 23 26				0.5 1.0 1.5 2.0 2.5 3.0		**Top Soil (SAND)** brown, fine to medium grained	L	D	
												SAND(SP) brown/reddish brown, fine to medium grained	L	D	
				2								**SAND(SP)** reddish brown, fine to coarse grained	MD	M	
												SAND(SP) dark reddish brown, fine to coarse grained	MD	W	
												Test pit terminated at 2.5m			

LABORATORY DATA

UQN	Unconfined Comp. (Natural)
UQC	Unconfined Comp. (Compacted)
TQN	Uncons. Undrained Triax. (Natural)
TQC	Uncons. Undrained Triax. (Compacted)
TRX	Consolidated Undrained Triaxial with pwp measurement
PSA	Particle Size Analysis
CS	1D oedometer Test
LPM	Laboratory Permeability

FIELD DATA ABBREVIATIONS

Suv	= Uncorrected vane shear (kPa)
Sup	= Pocket penetrometer (kPa)
Sur	= Remoulded vane shear (kPa)

GROUNDWATER SYMBOLS

= Water level (static)
= Water level (during excavation)
= Outflow / Inflow

FIELD DATA SYMBOLS

= Shear vane test
= Pocket Penetrometer test
= Environmental Sample
= Undisturbed Tube Sample
= Disturbed Sample
= Bulk Sample

DENSITY (N-value)

VL	(very loose)	0 - 4
L	(loose)	4 - 10
MD	(medium dense)	10 - 30
D	(dense)	30 - 50
VD	(very dense)	50 - 100
CO	(compact)	>50/150mm

MOISTURE CONDITION
D = Dry M = Moist W = Wet

CONSISTENCY (Su)

VS	(very soft)	< 12 kPa
S	(soft)	12 - 25
F	(firm)	25 - 50
St	(stiff)	50 - 100
VSt	(very stiff)	100 - 200
H	(hard)	> 200 kPa

TEST PIT No. TP-08

Sheet 1 of 1

Project: Pretty Pool Stages 4
Location: Port Hedland
Job No: WV03574

Client: Landcorp
Date: 17/3/08 - 17/3/08
Pit Width: 1x2 m

Operator: Pilbara P.Hire
Excavator: CAT 307C
Surface Conditions:

Northings: 7752083.0mN
Eastings: 671525.0mE
RL:

Logged: CS
Checked: KO

LABORATORY DATA						FIELD DATA					SOIL DESCRIPTION	SOIL CONDITION		COMMENTS
dry density (t/m³)	moisture content (%)	liquid limit (%)	plasticity index (%)	percent fines (%)	Emerson classification	DCP blows/100mm	field & other tests	sample type	field tests ground water depth (m)	graphic log	soil type, unified classification, colour, structure, particle characteristics, minor components	consistency (excavation) / density (backfill)	moisture condition	excavation method, water and additional observations
						9 24 9 8 17 23 29					**Top Soil (SAND)** red, fine to medium grained	L	D	
											SAND(SP) reddish brown, fine to medium grained	L	D	
											SAND(SP) brown, fine to medium grained	L	D	
									0.5		**SAND(SP)** brown/reddish brown, fine to medium grained	L	D	
									1.0		**SAND(SP)** brown/dark brown, fine to medium grained	MD	M	
									1.5		**SAND(SP)** brown, fine to medium grained	MD	M	
									2.0		**SAND(SP)** dark brown, fine to medium grained	MD	M	
									2.5		Test pit terminated at 2.4m			
									3.0					

LABORATORY DATA

- UQN Unconfined Comp. (Natural)
- UQC Unconfined Comp. (Compacted)
- TQN Uncons. Undrained Triax. (Natural)
- TQC Uncons. Undrained Triax. (Compacted)
- TRX Consolidated Undrained Triaxial with pwp measurement
- PSA Particle Size Analysis
- CS 1D oedometer Test
- LPM Laboratory Permeability

FIELD DATA ABBREVIATIONS

- Suv = Uncorrected vane shear (kPa)
- Sup = Pocket penetrometer (kPa)
- Sur = Remoulded vane shear (kPa)

GROUNDWATER SYMBOLS

- = Water level (static)
- = Water level (during excavation)
- = Outflow / Inflow

FIELD DATA SYMBOLS

- × = Shear vane test
- ⊥ = Pocket Penetrometer test
- ○ = Environmental Sample
- ■ = Undisturbed Tube Sample
- ● = Disturbed Sample
- ▮ = Bulk Sample

DENSITY (N-value)

VL	(very loose)	0 - 4
L	(loose)	4 - 10
MD	(medium dense)	10 - 30
D	(dense)	30 - 50
VD	(very dense)	50 - 100
CO	(compact)	>50/150mm

MOISTURE CONDITION
D = Dry M = Moist W = Wet

CONSISTENCY (Su)

VS	(very soft)	< 12 kPa
S	(soft)	12 - 25
F	(firm)	25 - 50
St	(stiff)	50 - 100
VSt	(very stiff)	100 - 200
H	(hard)	> 200 kPa

TEST PIT No. TP-09

Sheet 1 of 1

Project: Pretty Pool Stages 4	Client: Landcorp	Operator: Pilbara P.Hire	Northings: 7751948.0mN	
Location: Port Hedland	Date: 17/3/08 - 17/3/08	Excavator: CAT 307C	Eastings: 671427.0mE	Logged: CS
Job No: WV03574	Pit Width: 1x2 m	Surface Conditions:	RL:	Checked: KO

LABORATORY DATA						FIELD DATA					SOIL DESCRIPTION		SOIL CONDITION		COMMENTS
dry density (t/m³)	moisture content (%)	liquid limit (%)	plasticity index (%)	percent fines (%)	Emerson classification	DCP blows/100mm	field & other tests	sample type	field tests ground water	graphic log	soil type, unified classification, colour, structure, particle characteristics, minor components		consistency / density	moisture condition	excavation method, water and additional observations
						2 4 30					**Top Soil (SAND)** dark brown, fine to medium grained		L	D	
											SAND(SP) brown, fine to medium grained, trace silt		L	D	
											LIMESTONE light brown to light reddish brown, medium to coarse grianed, moderately cemented, with shell fragments		H	D	
											Refusal at 1.0 m and terminated.				

0.5
1.0
1.5
2.0
2.5
3.0

LABORATORY DATA

UQN	Unconfined Comp. (Natural)
UQC	Unconfined Comp. (Compacted)
TQN	Uncons. Undrained Triax. (Natural)
TQC	Uncons. Undrained Triax. (Compacted)
TRX	Consolidated Undrained Triaxial with pwp measurement
PSA	Particle Size Analysis
CS	1D oedometer Test
LPM	Laboratory Permeability

FIELD DATA ABBREVIATIONS

Suv	= Uncorrected vane shear (kPa)
Sup	= Pocket penetrometer (kPa)
Sur	= Remoulded vane shear (kPa)

GROUNDWATER SYMBOLS

= Water level (static)
= Water level (during excavation)
= Outflow / Inflow

FIELD DATA SYMBOLS

= Shear vane test
= Pocket Penetrometer test
= Environmental Sample
= Undisturbed Tube Sample
= Disturbed Sample
= Bulk Sample

DENSITY (N-value)

VL	(very loose)	0 - 4
L	(loose)	4 - 10
MD	(medium dense)	10 - 30
D	(dense)	30 - 50
VD	(very dense)	50 - 100
CO	(compact)	>50/150mm

MOISTURE CONDITION
D = Dry M = Moist W = Wet

CONSISTENCY (Su)

VS	(very soft)	< 12 kPa
S	(soft)	12 - 25
F	(firm)	25 - 50
St	(stiff)	50 - 100
VSt	(very stiff)	100 - 200
H	(hard)	> 200 kPa

TEST PIT No. TP-10

Sheet 1 of 1

Project: Pretty Pool Stages 4	Client: Landcorp	Operator: Pilbara P.Hire	Northings: 7751934.0mN	
Location: Port Hedland	Date: 17/3/08 - 17/3/08	Excavator: CAT 307C	Eastings: 671504.0mE	Logged: CS
Job No: WV03574	Pit Width: 1x2 m	Surface Conditions:	RL:	Checked: KO

LABORATORY DATA						FIELD DATA					SOIL DESCRIPTION	SOIL CONDITION		COMMENTS
dry density (t/m³)	moisture content (%)	liquid limit (%)	plasticity index (%)	percent fines (%)	Emerson classification	DCP blows/100mm	field & other tests	sample type	field tests ground water	graphic log	soil type, unified classification, colour, structure, particle characteristics, minor components	consistency density	moisture condition	excavation method, water and additional observations
						2 6 23					**Top Soil (SAND)** dark brown, fine to medium grained	L	D	
											SAND(SP) brown, fine to medium grained, trace silt	L	D	
											LIMESTONE light brown to light reddish brown, medium to coarse grianed, moderately cemented, with shell fragments	H	D	
											Refusal at 1.2 m and terminated.			

0.5
1.0
1.5
2.0
2.5
3.0

LABORATORY DATA

UQN	Unconfined Comp. (Natural)
UQC	Unconfined Comp. (Compacted)
TQN	Uncons. Undrained Triax. (Natural)
TQC	Uncons. Undrained Triax. (Compacted)
TRX	Consolidated Undrained Triaxial with pwp measurement
PSA	Particle Size Analysis
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FIELD DATA ABBREVIATIONS

Suv = Uncorrected vane shear (kPa)
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GROUNDWATER SYMBOLS

= Water level (static)
= Water level (during excavation)
= Outflow / Inflow

FIELD DATA SYMBOLS

= Shear vane test
= Pocket Penetrometer test
= Environmental Sample
= Undisturbed Tube Sample
= Disturbed Sample
= Bulk Sample

DENSITY (N-value)

VL	(very loose)	0 - 4
L	(loose)	4 - 10
MD	(medium dense)	10 - 30
D	(dense)	30 - 50
VD	(very dense)	50 - 100
CO	(compact)	>50/150mm

MOISTURE CONDITION
D = Dry M = Moist W = Wet

CONSISTENCY (Su)

VS	(very soft)	< 12 kPa
S	(soft)	12 - 25
F	(firm)	25 - 50
St	(stiff)	50 - 100
VSt	(very stiff)	100 - 200
H	(hard)	> 200 kPa

SKM 001 TEST PIT PRETTY POOL STAGES 3&4.GPJ SKM_TESTPIT2.GDT 07/05/08

Appendix D Laboratory Test Results

Western Geotechnics Group
PO Box 219 Bentley WA 6982
36 Railway Parade
Welshpool WA 6106

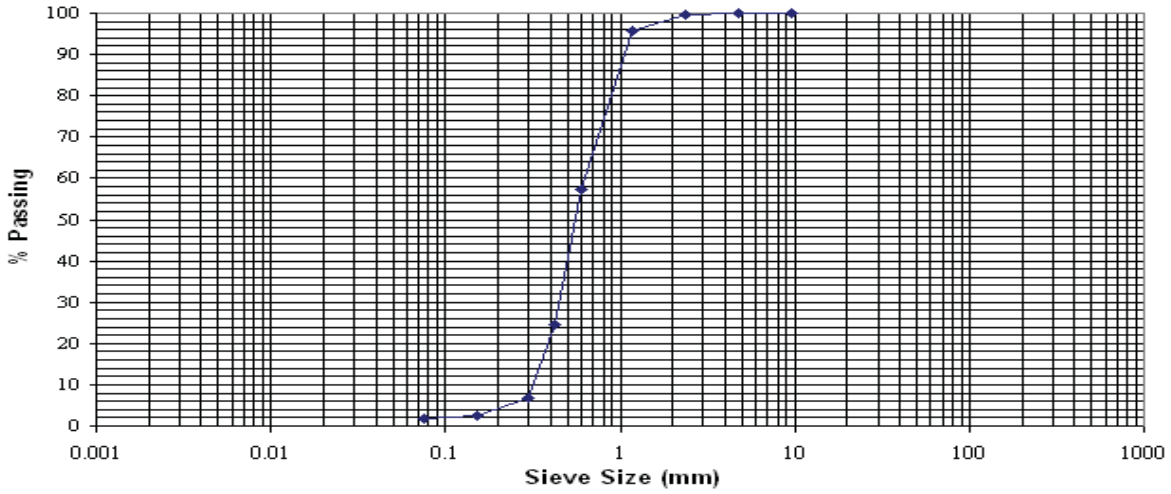
TEST CERTIFICATE

perth@westerngeo.com.au
ABN: 91105324436
ph: 1300 781 744
fx: (08) 9458 3700

Client:	Sinclair Knight Merz	Client Job No:	WV03574
Project:	Pretty Pool Stages 3&4	Order No:	
Location:		Tested Date:	17/04/2008
Sample No:	08-WG-4221	WG Job Number:	08-01-741
Sample ID:	TP-01 1.2 - 1.5	Lab:	Welshpool

PARTICLE SIZE DISTRIBUTION

AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
		2.36	99
		1.18	96
		0.600	57
		0.425	24
		0.300	7
9.5	100	0.150	2
4.75	100	0.075	2

Note: Sample supplied by client.

Approved Signatory: (Mark .Matthews) Date: 30/04/2008

Western Geotechnics Group
PO Box 219 Bentley WA 6982
36 Railway Parade
Welshpool WA 6106

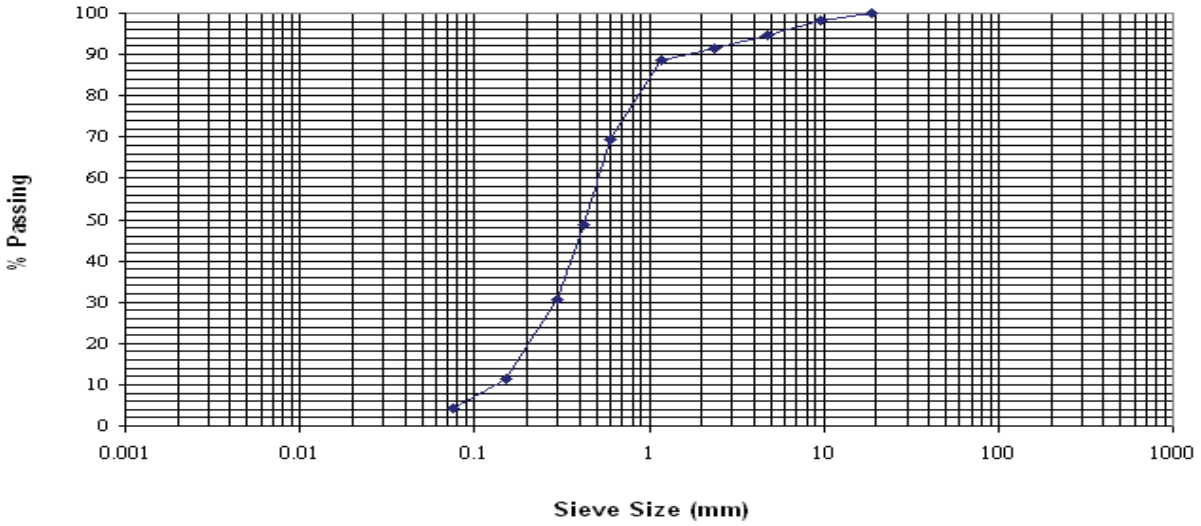
TEST CERTIFICATE

perth@westerngeo.com.au
ABN: 91105324436
ph: 1300 781 744
fx: (08) 9458 3700

Client:	Sinclair Knight Merz	Client Job No:	WV03574
Project:	Pretty Pool Stages 3&4	Order No:	
Location:		Tested Date:	12/04/2008
Sample No:	08-WG-4222	WG Job Number:	08-01-741
Sample ID:	TP-02 1.2 - 1.5	Lab:	Welshpool

PARTICLE SIZE DISTRIBUTION

AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
		2.36	91
		1.18	89
		0.600	69
		0.425	49
19.0	100	0.300	31
9.5	98	0.150	12
4.75	95	0.075	4

Note: Sample supplied by client.

This Certificate replaces the previously issued Certificate No.: 08-WG-4222-S301

Approved Signatory: (Mark .Matthews) Date: 8/05/2008

Western Geotechnics Group
PO Box 219 Bentley WA 6982
36 Railway Parade
Welshpool WA 6106

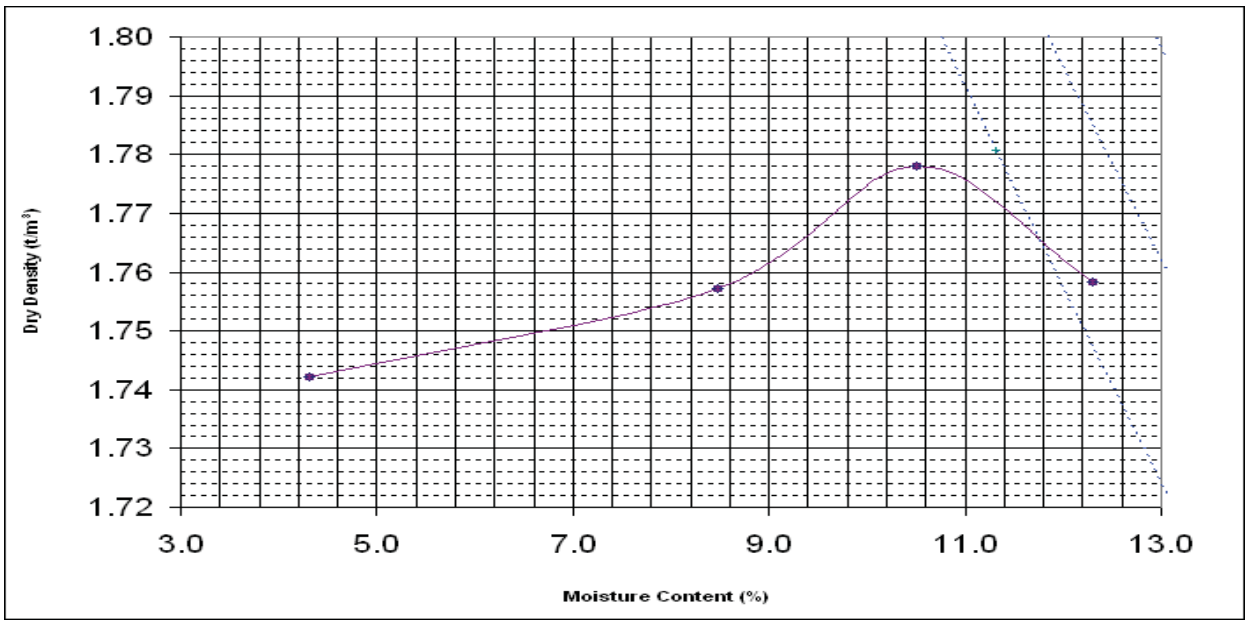
TEST CERTIFICATE

perth@westerngeo.com.au
ABN: 91105324436
ph: 1300 781 744
fx: (08) 9458 3700

Client:	Sinclair Knight Merz	Client Job No:	WV03574
Project:	Pretty Pool Stages 3&4	Order No:	
Location:		Tested Date:	14/04/2008
Sample No:	08-WG-4222	WG Job Number:	08-01-741
Sample ID:	TP-02 1.2 - 1.5	Lab:	Welshpool

DRY DENSITY/MOISTURE CONTENT RELATIONSHIP OF A SOIL

AS 1289.5.2.1 (Modified Compactive Effort)



Modified Effort

Maximum Dry Density (t/m3)	**1.78**
Optimum Moisture Content (%)	**10.5**
% Retained 19.0mm	**0**
% Retained 37.5mm	**0**
Air Voids Curves:	Voids %: 0 - 2 - 4 - 6 - 8 at SPD: 2.48

Note: Sample supplied by client.

This Certificate replaces the previously issued Certificate No.: 08-WG-4222-S402

Approved Signatory: (Mark .Matthews) Date: 8/05/2008

Western Geotechnics Group
PO Box 219 Bentley WA 6982
36 Railway Parade
Welshpool WA 6106

TEST CERTIFICATE

perth@westerngeo.com.au
ABN: 91105324436
ph: 1300 781 744
fx: (08) 9458 3700

Client:	Sinclair Knight Merz	Client Job No:	WV03574
Project:	Pretty Pool Stages 3&4	Order No:	
Location:		Tested Date:	17/04/2008
Sample No:	08-WG-4222	WG Job Number:	08-01-741
Sample ID:	TP-02 1.2 - 1.5	Lab:	Welshpool

METHOD FOR DETERMINATION OF CALIFORNIA BEARING RATIO

AS1289.6.1.1 (Soaked)

	SOAKED MODIFIED
COMPACTIVE EFFORT USED:	
Rammer Mass (kg):	4.9
Drop Height (mm):	450
No. of Layers	5
No. Blows/Layer	9
MOISTURE CONTENTS:	
At Compaction:	10.2 % - 97 % OMC
After Soaking:	17 % - 162 % OMC
AFTER PENETRATION	
Top 30mm:	19.2
Remaining Depth (mm):	16.9
DRY DENSITY	
At Compaction:	1.69 t/m³ - 95 %MDD
After Soaking:	1.69 t/m³ - 95 %MDD
SOAKING DETAILS	
Swell (%) - Soaking Period	-0 % - 4 Days
Surcharge (kg):	4.5
MAXIMUM DRY DENSITY	
	1.78 t/m³ @ OMC:10.5%
	Acc. To: AS1289.5.2.1 Referenced from: 08-WG-4222
CALIFORNIA BEARING RATIO:	**17 % At 5.0mm Penetration**
% Retained 19.0mm:	0 (Not Replaced)

Note: Sample supplied by client.

This Certificate replaces the previously issued Certificate No.: 08-WG-4222-S500

Approved Signatory: (Mark .Matthews) Date: 8/05/2008

Western Geotechnics Group
PO Box 219 Bentley WA 6982
36 Railway Parade
Welshpool WA 6106

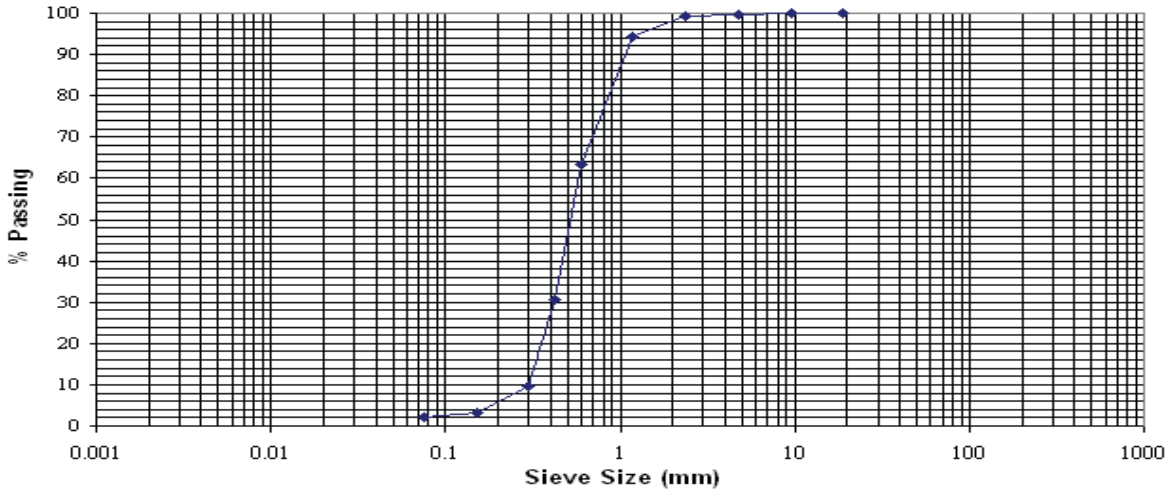
TEST CERTIFICATE

perth@westerngeo.com.au
ABN: 91105324436
ph: 1300 781 744
fx: (08) 9458 3700

Client:	Sinclair Knight Merz	Client Job No:	WV03574
Project:	Pretty Pool Stages 3&4	Order No:	
Location:		Tested Date:	17/04/2008
Sample No:	08-WG-4224	WG Job Number:	08-01-741
Sample ID:	TP-07 1 - 1.2	Lab:	Welshpool

PARTICLE SIZE DISTRIBUTION

AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
		2.36	99
		1.18	94
		0.600	63
		0.425	30
19.0	100	0.300	9
9.5	100	0.150	3
4.75	100	0.075	2

Note: Sample supplied by client.

Approved Signatory: (Mark .Matthews) Date: 30/04/2008

APPENDIX 2 Water Corporation Advice

Water Corporation Planning Advice

Jim Tayati

From: Jason Gray
Sent: Monday, 16 September 2013 10:25 AM
To: Jim Tayati
Subject: FW: Pretty Pool Stage 3 Development - Landcorp
Attachments: 201308261525.pdf

Jason Gray
DIRECTOR

M: 0430 195 988
P: 08 9227 0595
F: 08 9227 8617

Level 1
59 Parry Street
Perth WA 6000

PO Box 8523
Perth BC WA 6849

JDSi CONSULTING ENGINEERS

www.jdsi.com.au

From: Mark Busher [mailto:Mark.Busher@watercorporation.com.au]
Sent: Monday, 26 August 2013 4:36 PM
To: Jason Gray
Subject: RE: Pretty Pool Stage 3 Development - Landcorp

Jason,

Water and wastewater extensions from adjacent existing mains can supply this proposal.
Wastewater planning attached.

Regards,

Mark Busher
Team Leader
Development Services
Planning and Capability
Water Corporation
T: (08) 9420 2076

From: Jason Gray [mailto:jason@jdsi.com.au]
Sent: Tuesday, 20 August 2013 10:42 AM
To: Land Planning; Mark Busher
Cc: Glenn Coffey
Subject: Pretty Pool Stage 3 Development - Landcorp

Hi Mark

Our client "Landcorp" are investigating the potential expansion of their Pretty Pool Development. Although this development is part of the existing Pretty Pool estate I am not sure if this area was included in the Water Corporations catchment planning for the previous Pretty Pool stages. If Landcorps business case is accepted by their

board it is programmed that that construction will start on these lots in mid-2014 with titles being available mid-2015.

I have attached a plan showing the proposed development area and yields.

Are you able to advise on the following:

- Does the Water Corporation currently have the capacity to serve the site for both water and sewer .
- What network reinforcements and upgrades are required to be able to serve the development area.
- Planned Water Corporation assets upgrades or installations that will affect the servicing of the development area.
- Timing on the planned Water Corporation assets.

Regards

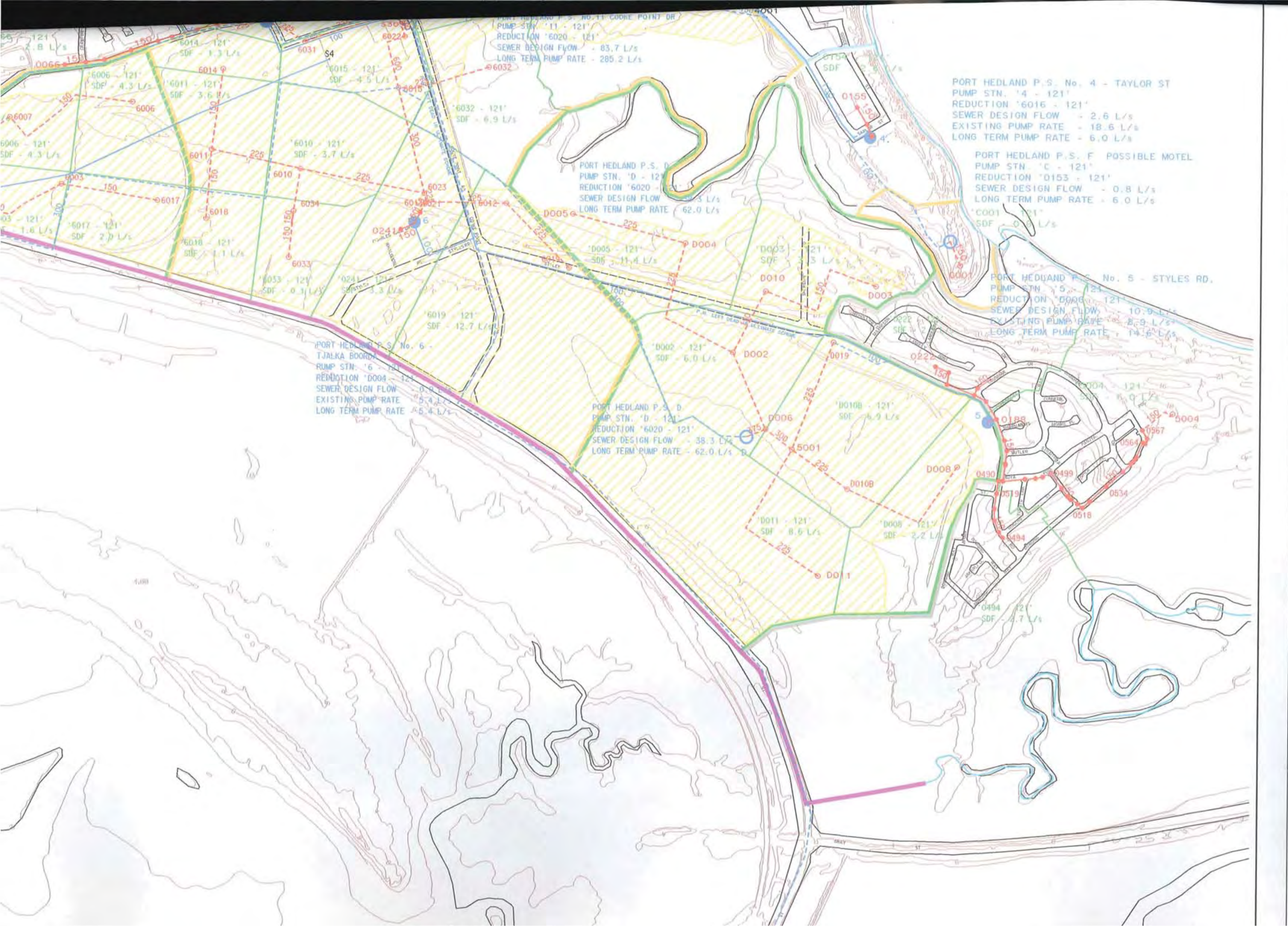
Jason Gray
DIRECTOR

M: 0430 195 988
P: 08 9227 0595
F: 08 9227 8617

Level 1
59 Parry Street
Perth WA 6000

PO Box 8523
Perth BC WA 6849

www.jdsi.com.au


PORT HEDLAND P.S. No. 4 - TAYLOR ST
PUMP STN. '4 - 121'
REDUCTION '6016 - 121'
SEWER DESIGN FLOW - 2.6 L/s
EXISTING PUMP RATE - 18.6 L/s
LONG TERM PUMP RATE - 6.0 L/s
PORT HEDLAND P.S. F POSSIBLE MOTEL
PUMP STN. 'C - 121'
REDUCTION '0153 - 121'
SEWER DESIGN FLOW - 0.8 L/s
LONG TERM PUMP RATE - 6.0 L/s
PORT HEDLAND P.S. No. 5 - STYLES RD.
PUMP STN. '5 - 121'
REDUCTION 'D006 - 121'
SEWER DESIGN FLOW - 10.9 L/s
EXISTING PUMP RATE - 8.9 L/s
LONG TERM PUMP RATE - 14.6 L/s
PUMP STN. '11 - 121'
REDUCTION '6020 - 121'
SEWER DESIGN FLOW - 83.7 L/s
LONG TERM PUMP RATE - 285.2 L/s
PORT HEDLAND P.S. D
PUMP STN. 'D - 121'
REDUCTION '6020 - 121'
SEWER DESIGN FLOW - 38.3 L/s
LONG TERM PUMP RATE - 62.0 L/s
PORT HEDLAND P.S. No. 6 -
TJALKA BOORDA
PUMP STN. '6 - 121'
REDUCTION 'D004 - 121'
SEWER DESIGN FLOW - 0.9 L/s
EXISTING PUMP RATE - 5.4 L/s
LONG TERM PUMP RATE - 5.4 L/s
'D005 - 121'
SDF - 11.4 L/s
'D002 - 121'
SDF - 6.0 L/s
'D010B - 121'
SDF - 6.9 L/s
'D011 - 121'
SDF - 8.6 L/s
'D008 - 121'
SDF - 2.2 L/s
'6019 - 121'
SDF - 12.7 L/s
'6032 - 121'
SDF - 6.9 L/s
'6010 - 121'
SDF - 3.7 L/s
'6014 - 121'
SDF - 1.3 L/s
'6011 - 121'
SDF - 3.6 L/s
'6015 - 121'
SDF - 4.5 L/s
'6006 - 121'
SDF - 4.3 L/s
'6017 - 121'
SDF - 2.0 L/s
'6018 - 121'
SDF - 1.1 L/s
'0494 - 121'
SDF - 3.7 L/s
'D004 - 121'
SDF - 6.0 L/s

APPENDIX 3 Horizon Power DIP

Horizon Power Design Information Package

EPS0041
Pretty Pool Stage 3

REQUIREMENTS AND DESIGN INFORMATION - OPTION B ONLY

Distribution Voltages

Horizon Power's nominal distribution voltage within its Port Hedland Town site network is 22 kV for the High Voltage system and 415/240V for the Low Voltage system.

Existing Network System Upgrade

Dependant on final designs submitted it might be necessary for headwork's to be undertaken to enable connection of this scheme to the existing system. A final analysis of this possibility will be done when your design is submitted for costing and conformance. Any costings involved in these head works will be advised at that time.

Note All cables listed below are termite proof as per Horizon Power specifications.

High Voltage Feeder Cables
- EE2169 400mm 3 x1C alum XLPE 22 kV

High Voltage Transformer Cables
- EE2558 35mm 3x1C alum XLPE 22 kV

Low Voltage
- EC1104 25mm 3 Core stranded copper XLPE
- EC1337 240mm 3 Core solid alum XLPE

Street Lighting
- EE2559 16mm 1 Core stranded copper XLPE

Transformers
- Transformers are to be kept to a maximum size of 630kVA

A.D.M.D Residential Subdivisions Only

- A value of 10kVA is to be used for single phase diversified residential loads (Type A) in LV Design for calculation of volt drop in the proposed LV network.
- For group housing lots contained in the subdivision, each proposed residence on that lot should have the above A.D.M.D value applied as a multiple to give a value at the connection point.

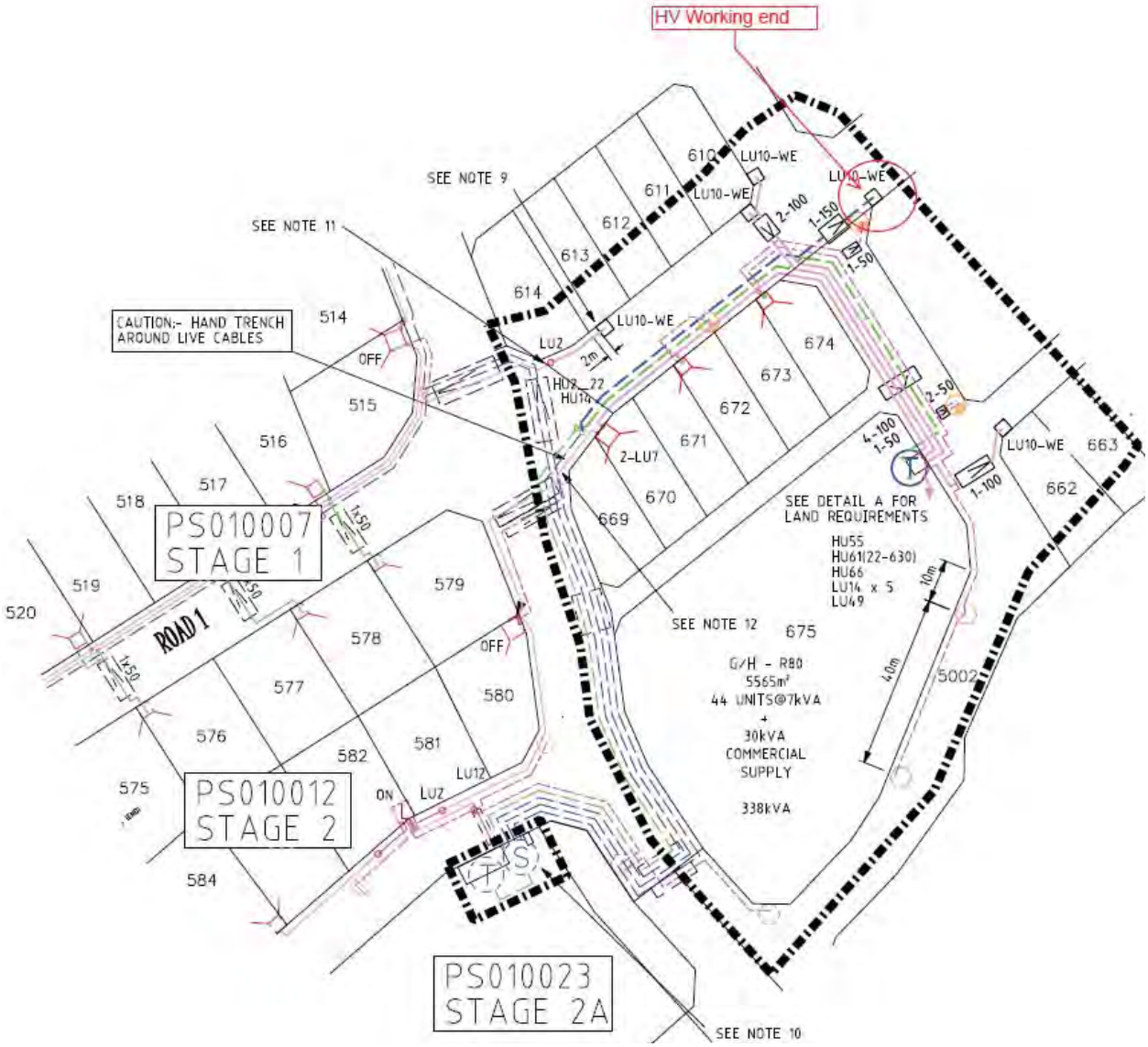
Example:
Number of proposed residence on the lot x the above kVA = Total required kVA at the connection point for that lot.

A.D.M.D Commercial/Industrial Subdivisions Only

- A value of 200 kVA per hectare is to be used for three phase diversified commercial loads (Type C) in LV Design for calculation of volt drop in the proposed LV network, unless otherwise advised.

High Voltage Connection Points

Any HV circuits installed will need to be designed for future developments, and to make allowances for the installation of HV underground switching stations (RMU's) to supply individual proposed and possible future transformer requirements and HV network extensions.

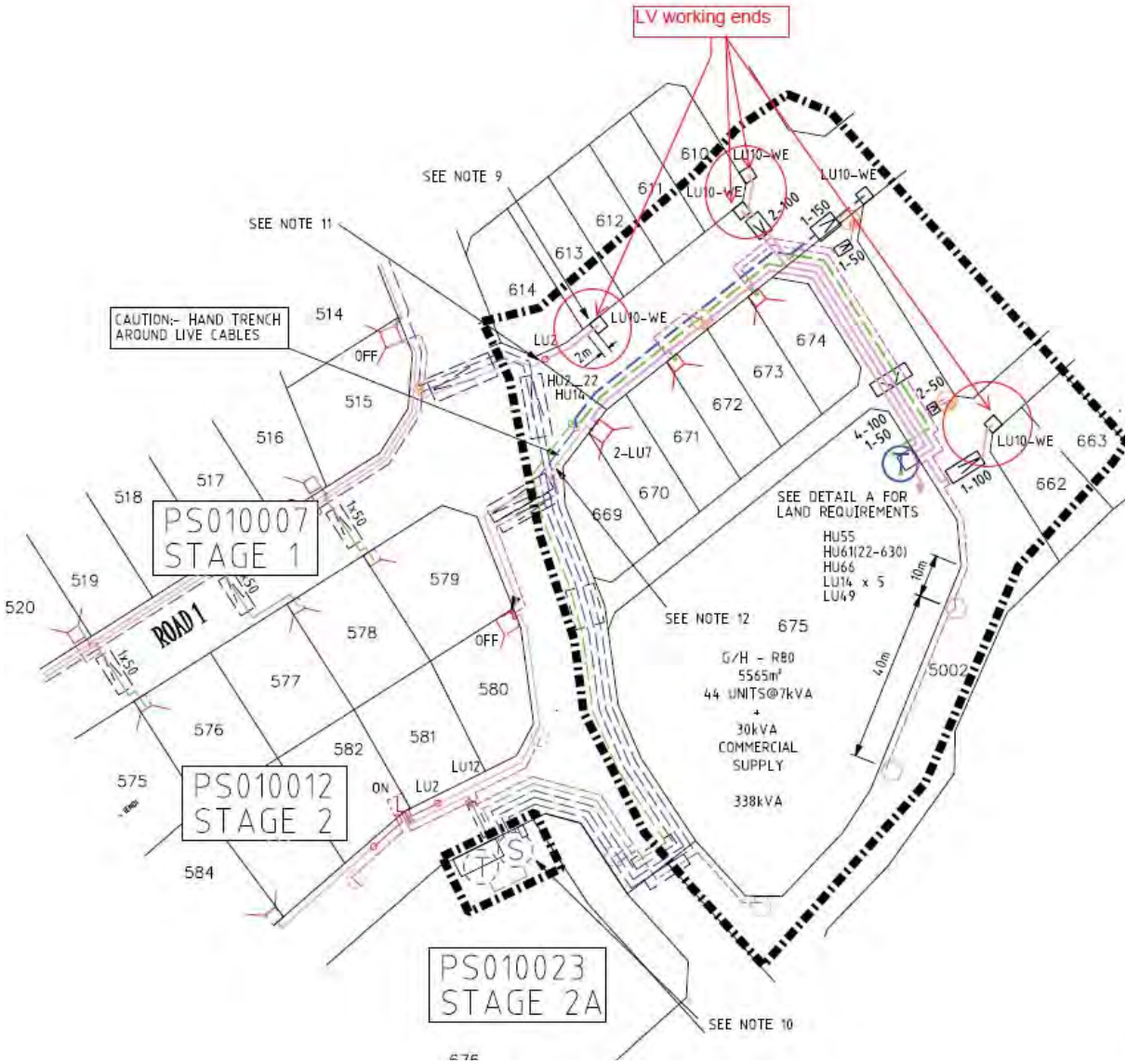


1.

Figure 1

Low Voltage Connection Points

Any LV cables that are to terminate permanently, with no future extension to the network from that point (e.g. cul-de-sacs), are to be terminated in a universal pillar and not in an in ground termination. Working ends still apply where the network will or can be extended.

1. 

Street Light Connection Points

- **Horizon Power Requirements**

All street lighting is to be dusk to dawn and installed as per the requirements contained in Horizon Power's Underground Distribution Schemes Manual located on Horizon Power's website.

- **Local Government Authority Requirements**

All street lighting to be installed is to meet Local Government Authority requirements.

Appendix 3

Traffic Assessment Report

LANDCORP

STAGE 3 PRETTY POOL
PORT HEDLAND

TRAFFIC ASSESSMENT

December 2013

Riley Consulting

PO Box Z5578

Perth WA 6831

0413 607 779 Mobile

Issued on	09 December 2013	Amendments
Version	1	
Reference	762	

CONTENTS

1.0 EXECUTIVE SUMMARY

Riley Consulting has been commissioned by Landcorp to consider the traffic issues associated with the Stage 3 development of the Pretty Pool subdivision, Port Hedland. The analysis undertaken in this report indicates the following:

- The development of Stage 3, Pretty Pool, can be expected to generate an additional 630 vehicle movements per day to the local road network.

- Assessment of the forecast traffic increases shows that the development will have no significant traffic impact to the regional road network (Wilson Road).

- The assessment indicates that an impact to Cooke Point Drive and Styles Road will occur, as the forecast increases are greater than 5% of the current daily traffic flow. However, the impacts are not severe and neither road will operate in a manner contrary to current expectations. Good Levels of Service are maintained to the external road network.

- Analysis of externally affected intersections indicates that the development of Stage 3 will have minimal impact to current intersection operation. All intersections are forecast to operate with good Levels of Service.

- Internally to Pretty Pool, the development of Stage 3 will not result in any street operating in a manner contrary to its classification under the *Liveable Neighbourhoods* hierarchy.

- It is concluded that the development of Stage 3 will have no detrimental traffic impact.

2.0 THE SITE AND SURROUNDING ROAD NETWORK

The site is located in the suburb of Pretty Pool, which lies to the east of Port Hedland town. The site has already been part developed and this report considers the final developable area (Stage 3) of the subdivision. The location of the site is shown in Figure 1.

Figure 1 Site Location

Roads of significance to the development site are considered below.

Counihan Crescent

Counihan Crescent is a local street and would be classified as a higher order access street in the planning for Pretty Pool. It is constructed with a standard 7.2 metre wide pavement and is provided with a footpath to its northern side. Based on the current level of development, Counihan Crescent would be expected to pass about 720 vehicles per day (vpd).

Styles Road

Styles Road provides the only connecting road to Pretty Pool. It is constructed with a standard 7.2 metre pavement and would be classified as a neighbourhood connector. No traffic flow data is available, but as a non-through road and the level of development accessed, it would be expected to pass about 2,810vpd.

Cooke Point Drive

Cooke Point Drive provides a main connection to Wilson Street and will be the primary access point for the Pretty Pool locality. It is constructed with a standard 7.2 metre pavement and would be classified as a lower order arterial street.

Traffic data sourced from Main Roads Western Australia (MRWA) indicates a flow of 4,662vpd to the north of Wilson Street (May 2013).

Wilson Street

Wilson Street is the main access road into the town of Port Hedland. It is constructed with a single carriageway of 7.2 metres in the vicinity of Cooke Point Drive. The intersection at Cooke Point Drive is provided with full standard turning pockets. Current traffic data sourced from MRWA indicates 11,825vpd using Wilson Street to the west of Cooke Point Drive.

Figure 2 shows an aerial image of the existing development at Pretty Pool. Appendix A shows the staging plan for the development of Pretty Pool.

Figure 2 Aerial Image of Pretty Pool

3.0 TRAFFIC GENERATION AND DISTRIBUTION

Stage 3 of the development of Pretty Pool is expected to provide an additional 52 lots that may be able to provide for up to 70 new dwellings if grouped dwelling site are developed to maximum density.

Traffic data is available on the MRWA website for the existing residential development around Robinson Street. The data shows 619vpd on Robinson Street to the east of Thompson Street. Based on the catchment of Robinson Street, it is estimated that the current trip generation rate is slightly over 8 trips per dwelling per day. For the purpose of the road network assessment for Pretty Pool stage 3, a trip rate of 9 trips per dwelling used.

Based on the potential for 70 new dwellings in Stage 3, the site can be expected to generate (70 x 9) 630 trips per day.

Stage 3 may generate up to 630 movements per day.

Distribution

Traffic generated at Pretty Pool will be required to leave the locality to access local facilities. Therefore all traffic will access Styles Road to Point Cooke Drive. At Point Cooke Drive 80% can be expected to access Wilson Road with about 55% of traffic leaving town to access external destinations. Figure 3 indicates the anticipated traffic movements.

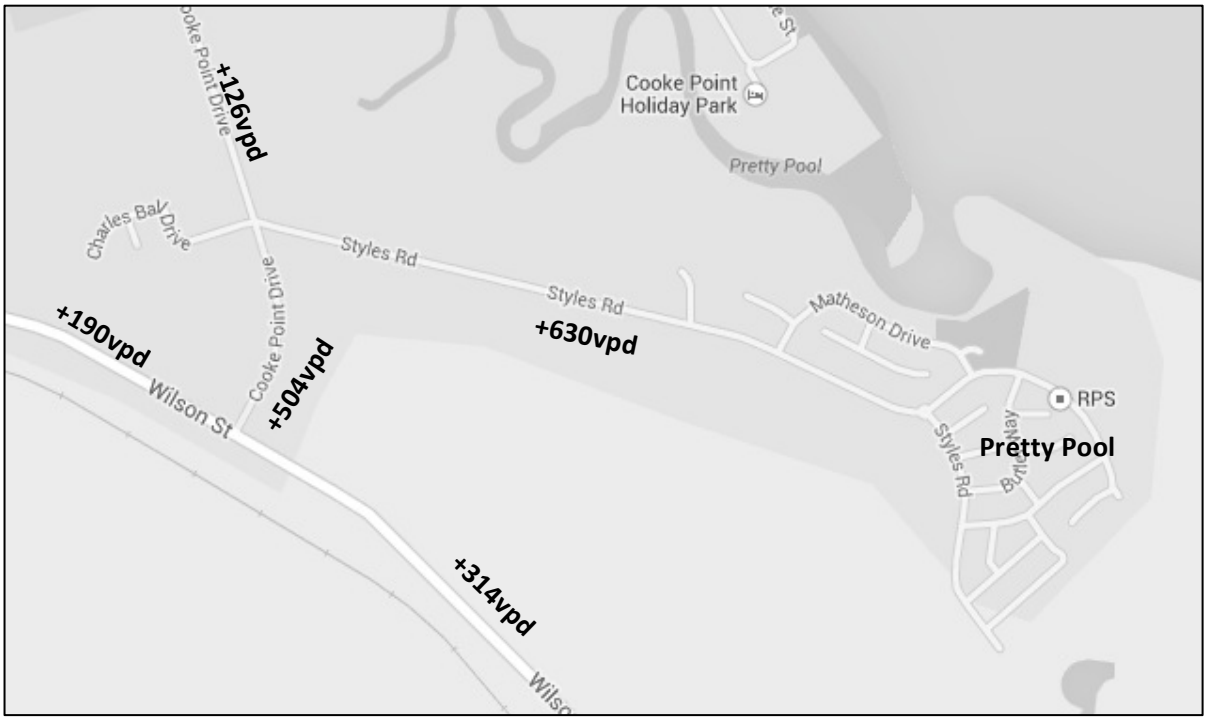


Figure 3 Forecast Increase to Daily Traffic Movements

4.0 TRAFFIC IMPACT

Figure 3 indicates the anticipated traffic increases to the local road network, based on 9 trips per dwelling per day. Table 1 considers the anticipated traffic generation of the site in comparison to the current daily traffic volumes.

Table 1 Increases to Local Road Network

Road	Daily Flow	Development	% Change
Counihan Crescent	720	+630	+90%
Styles Road	2,810	+630	+22%
Point Cooke Drive north	3,555*	+126	+3.5%
Point Cooke Drive south	4,662	+504	+11%
Wilson Street east	11,825	+190	+2%
Wilson Street west	14,600**	+314	+2%

*Data from May 2009 ** derived volume

Table 1 indicates the expected traffic increases to the surrounding road network. In traffic engineering terms it is recognised that daily traffic flows can vary by +/-5% and when a development increases the daily flow within this range it is considered to have no significant impact.

It can be seen from Table 1 that the proposed development of Stage 3 Pretty Pool can be expected to have no traffic impact to Wilson Street.

Stage 3 of Pretty Pool will not impact Wilson Street

The local road network is shown to experience increases of greater than 5% and consideration of road capacity and function is required.

Counihan Crescent

Counihan Crescent would be classified as a local access street and providing connectivity to other streets, would be a higher order access street under the *Liveable Neighbourhoods* road hierarchy classification. Current traffic flows are in the order of 720vpd and the development of Stage 3 can be expected to increase the forecast by about 630vpd. The

resulting traffic demand of 1,350vpd falls within the acceptable traffic levels for an access street and Stage 3 of Pretty Pool can be expected to retain the expected residential amenity of Counihan Crescent.

Stage 3 will not affect the classification of Counihan Crescent.

Styles Road

Styles Road would be classified as a neighbourhood connector under the *Liveable Neighbourhoods* road hierarchy classifications. A daily volume of up to 7,000vpd is appropriate for neighbourhood connectors. It is noted however, that existing residential dwellings have direct lot access and therefore, a maximum volume of 5,000vpd is the maximum desirable flow under *Liveable Neighbourhoods* (as higher volumes may warrant controls to frontage access).

The current traffic demands on Styles Road within Pretty Pool are in the order of 2,043vpd to the north of the Counihan Crescent intersection. East of Sheridan Road, the daily volume increases to about 2,810vpd. The development of Stage 3 is expected to result in an increased demand of 630vpd. The resulting future demand will therefore be 3,440vpd at the busiest section of Styles Road. The forecast demand is well within the 5,000vpd set out by Liveable Neighbourhoods.

Stage 3 will not affect the operation of Styles Road.

Point Cooke Drive

Point Cooke Drive would be considered as an arterial street and a daily volume of about 15,000vpd would be acceptable for this street. However, as a single carriageway road a daily flow of up to 9,000vpd would be considered desirable to maintain good Levels of Service. Functionality of Cooke Point Drive would be affected once traffic reached about 13,000vpd[1].

The highest volume of traffic on Point Cooke Drive is to the north of Wilson Street and MRWA data shows 4,662vpd (May 2013). Stage 3 of Pretty Pool is expected to increase this traffic flow by about 504vpd, increasing the demand to 5,155vpd. The forecast demand is well within the appropriate levels of the road classification.

[1] The upper volume of Level of Service D.

As a single carriageway road, the forecast demand can be expected to lower the Level of Service (LoS) from its present LoS B (volume up to 4,800vpd) to LoS C (volumes up to 7,900vpd). The forecast Levels of Service are considered good.

Stage 3 will not have a detrimental impact to Point Cooke Drive.

Intersection Operation

The development of Stage 3 Pretty Pool is not expected to impact the operation of internal intersections, as the increase in traffic flow is a maximum of 630vpd. However, the peak hour increases to Point Cooke Drive are considered to ensure the intersections continue to operate in a safe an appropriate manner. Analysis using Sidra has been undertaken to assess the expected operation of the affected intersections with the full development of Stage 3.

Table 2 shows the summary analysis of the Styles Road / Point Cook Drive intersection for the AM and PM peaks respectively. The Sidra summary is attached as Appendix C.

Table 2 Styles Road / Point Cooke Drive

Approach	Saturation	Delay	Level of Service
AM Peak Hour			
Point Cooke Drive south	0.97	3s	A
Styles Road	0.212	10s	A
Point Cooke Drive north	0.132	3s	A
PM Peak Hour			
Point Cooke Drive south	0.26	5s	A
Styles Road	0.20	14s	B
Point Cooke Drive north	0.093	3s	A

It can be seen from the Sidra analysis of the intersection that good Levels of Service can be expected. No upgrading of the existing intersection would be warranted from the development of Stage 3, Pretty Pool.

Table 3 shows the summary analysis of the Point Cook Drive / Wilson Street intersection for the AM and PM peaks respectively. The Sidra summary is attached as Appendix D.

Table 4 Point Cooke Drive / Wilson Street

Approach	Saturation	Delay	Level of Service
AM Peak Hour			
Wilson Street east	0.134	3s	A
Point Cooke Drive	0.599	21s	B
Wilson Street west	0.389	1s	A
PM Peak Hour			
Wilson Street east	0.389	5s	A
Point Cooke Drive	0.168	16s	B
Wilson Street west	0.135	3s	A

Table 3 shows that good Levels of Service can be expected. At the intersection of Point Cooke Drive / Wilson Street no upgrading of the existing intersection would be warranted from the development of Stage 3, Pretty Pool.

No external intersections will require upgrading as a result of the Stage 3 Pretty Pool development.

5.0 ACCESS

Access for Stage 3 of the Pretty Pool development will be to existing constructed roads within the development area. Figure 4 shows the expected access locations.

Figure 4 **Local Access** (site plan indicative)

Access A

Access A will provide access for a cul-de-sac of about 9 lots. Traffic demands from this access will be very low. A simple tee layout is sufficient. No turning lanes would be required. Visibility to current standards can be achieved.

Access B

Access B will be provided as a continuation of the existing east-west road named Panjya Parade. The existing 90^0 bend to Dowding Way will be replaced by a tee intersection layout, with Dowding Road yielding to Panjya Parade. Visibility to current standards can be achieved. Forecast traffic demands are low and priority control will operate with excellent Levels of Service.

Access C

Access C will connect to Dowding Way at its southern end and will remove the current 90^0 bend to the road (as Access B). The north-south section of Dowding Way would be required to yield to the east-west road connection.

6.0 INTERNAL ROADS

Roads internal to Stage 3 are forecast to carry less than 500vpd and a reduced road reservation and pavement would be suitable. *Liveable Neighbourhoods* identifies a minimum road reservation width of 14.2 metres. A road pavement of 5.5m to 6m for streets carrying less than 1,000vpd is acceptable. However, the road reservations and pavements will need to accord to current policies of the Town of Port Hedland.

All internals roads to Stage 3 will be Access Streets.

Roads Adjacent to Open Space

Where the road reservation abuts POS, bushland, golf courses etc., there is limited need to provide a verge. The verge may be reduced where parking and/or services are not required and should be considered at the time of subdivision. A minimum verge of 0.75 metres is advised by current road planning standards to accommodate street furniture. Footpaths do not need to be adjacent to the road where POS is provided, but must be provided in a safe and appropriate manner. Figure 5 shows an example of a reduced road reservation adjacent to open space.

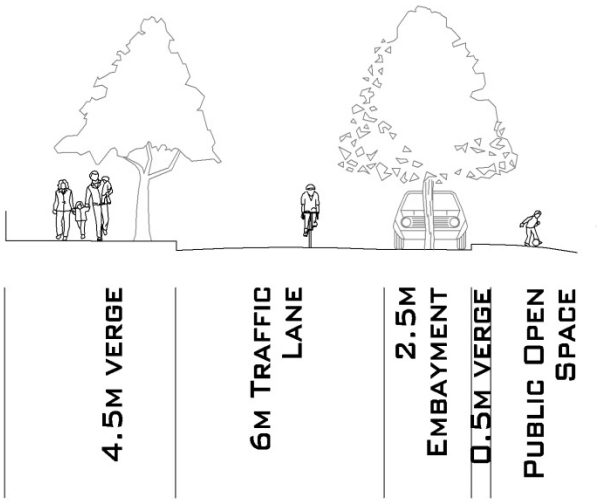


Figure 5 Road Reservation Adjacent to POS

Four-way Intersections

Within the Stage 3 plan area, daily traffic volumes are shown to be low and the use of four-way intersections is appropriate. Only 1 four-way intersection is indicated and will be formed on Dowding Way by two laneways. This is an acceptable layout.

Corner Treatments

To reduce the opportunity for speeding it is recommended that corner radii advised by *Liveable Neighbourhoods* be used within the subdivision. The recommended radii are:

- 6.0 metres - access street / access street intersections
- 9.0 metres - access street / neighbourhood connector

Where larger vehicles are expected, such as buses accessing a school, larger radii may be required and should be considered at subdivision stage.

All streets are of relatively short lengths and high traffic speeds would not be expected. Further, the narrower carriageway widths proposed in low traffic residential streets will assist in reducing the attraction for speeding making a safer environment for local children.

No specific traffic management features are considered to be required within Stage 3.

7.0 PEDESTRIANS, CYCLISTS AND PUBLIC TRANSPORT

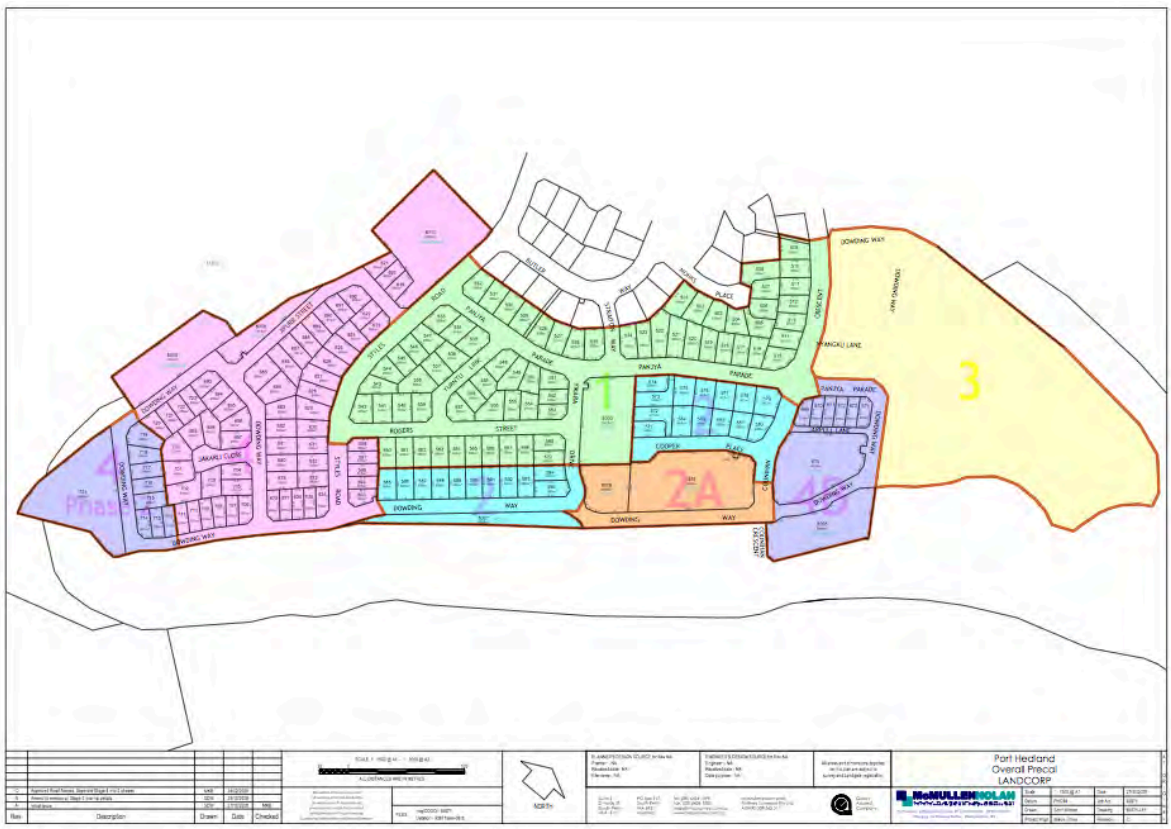
The site is located within an existing residential area, but is isolated from existing commercial and entertainment facilities. As a new development, Pretty Pool is provided with footpaths to local streets. Stage 3 would be required to provide the same level of footpaths.

The footpath provided to Counihan Crescent is expected to be available for use by cyclists, but local traffic flows are low and cycling on street would not be considered as unsafe.

There is no public transport service available and the level of development is unlikely to sustain a bus service.

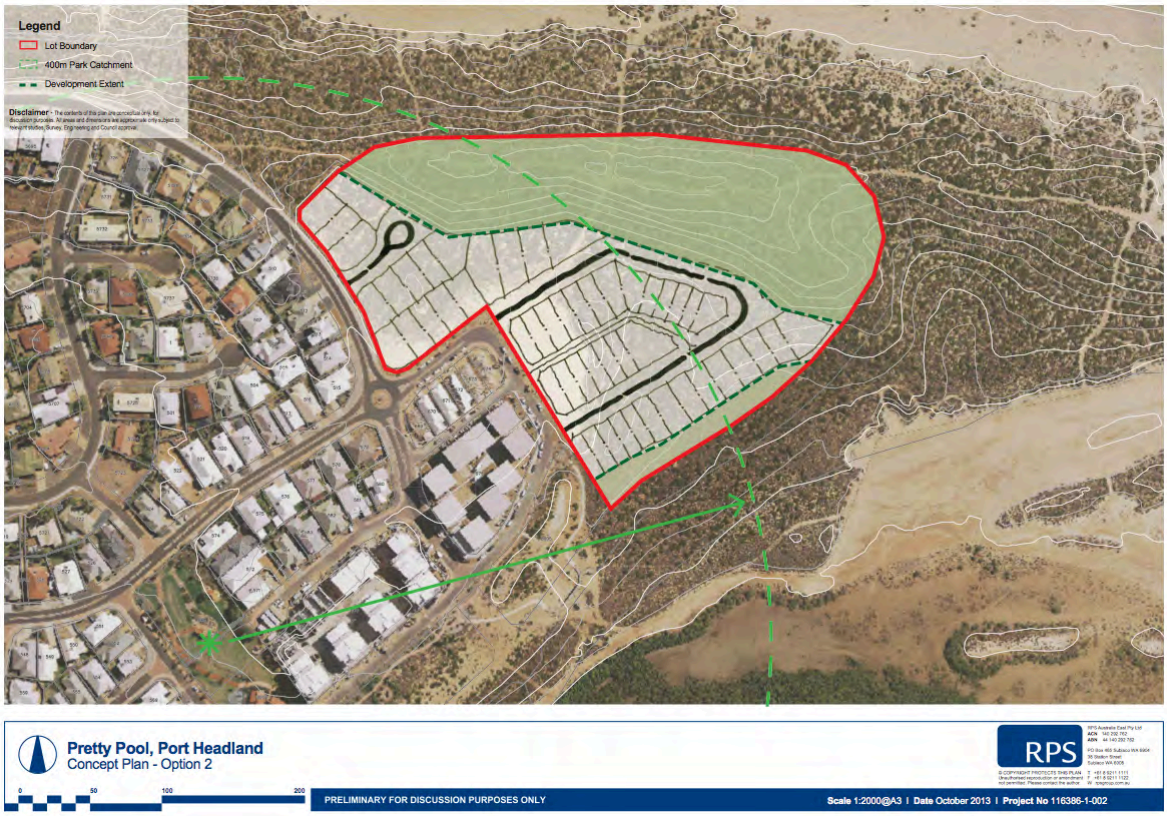
APPENDIX A

Staging Plan



APPENDIX B

Development Concept Plan



APPENDIX C

Sidra Analysis for Styles Road / Point Cooke Drive

Styles Road / Point Cooke Road
Stage 3 Pretty Pool
AM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Point Cooke Road south											
2	T	128	0.0	0.097	1.1	LOS A	0.8	5.3	0.38	0.00	52.7
3	R	35	0.0	0.097	9.4	LOS A	0.8	5.3	0.38	0.86	48.8
Approach		163	0.0	0.097	2.9	LOS A	0.8	5.3	0.38	0.18	51.8
East: Styles Road											
4	L	202	0.0	0.212	9.5	LOS A	1.1	7.5	0.36	0.68	47.4
6	R	51	0.0	0.101	13.0	LOS A	0.5	3.4	0.52	0.80	44.1
Approach		253	0.0	0.212	10.2	LOS A	1.1	7.5	0.39	0.71	46.7
North: Point Cooke Road north											
7	L	77	0.0	0.132	8.2	LOS A	0.0	0.0	0.00	0.91	49.0
8	T	177	0.0	0.132	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		254	0.0	0.132	2.5	LOS A	0.0	0.0	0.00	0.27	56.2
All Vehicles		669	0.0	0.212	5.5	NA	1.1	7.5	0.24	0.41	51.2

Styles Road / Point Cooke Road
Stage 3 Pretty Pool
PM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Point Cooke Road south											
2	T	177	0.0	0.258	1.0	LOS A	1.9	13.4	0.36	0.00	52.5
3	R	202	0.0	0.258	9.3	LOS A	1.9	13.4	0.36	0.76	48.2
Approach		379	0.0	0.258	5.4	LOS A	1.9	13.4	0.36	0.40	50.1
East: Styles Road											
4	L	35	0.0	0.034	8.9	LOS A	0.2	1.1	0.26	0.63	47.8
6	R	77	0.0	0.203	16.4	LOS B	1.0	6.7	0.63	0.89	41.3
Approach		112	0.0	0.203	14.0	LOS B	1.0	6.7	0.52	0.81	43.1
North: Point Cooke Road north											
7	L	51	0.0	0.093	8.2	LOS A	0.0	0.0	0.00	0.92	49.0
8	T	128	0.0	0.093	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		179	0.0	0.093	2.3	LOS A	0.0	0.0	0.00	0.26	56.4
All Vehicles		669	0.0	0.258	6.0	NA	1.9	13.4	0.29	0.43	50.2

APPENDIX D

Sidra Analysis for Point Cooke Drive / Wilson Street

Point Cooke Road / Wilson Street
AM Peak with Stage 3
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wilson Street east											
5	T	261	0.0	0.134	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R	49	0.0	0.092	13.9	LOS A	0.4	2.9	0.65	0.89	43.4
Approach		311	0.0	0.134	2.2	LOS A	0.4	2.9	0.10	0.14	56.6
North: Cooke Point Road											
7	L	265	0.0	0.599	20.3	LOS B	4.2	29.7	0.81	1.11	38.5
9	R	114	0.0	0.441	22.7	LOS B	1.8	12.9	0.82	1.01	36.8
Approach		379	0.0	0.599	21.0	LOS B	4.2	29.7	0.81	1.08	38.0
West: Wilson Street west											
10	L	114	0.0	0.061	8.2	LOS A	0.0	0.0	0.00	0.67	49.0
11	T	759	0.0	0.389	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		873	0.0	0.389	1.1	LOS A	0.0	0.0	0.00	0.09	58.3
All Vehicles		1562	0.0	0.599	6.1	NA	4.2	29.7	0.22	0.34	51.3

Point Cooke Road / Wilson Street
PM Peak with Stage 3
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wilson Street east											
5	T	758	0.0	0.389	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R	265	0.0	0.268	10.3	LOS A	1.5	10.5	0.49	0.75	46.7
Approach		1023	0.0	0.389	2.7	LOS A	1.5	10.5	0.13	0.19	55.9
North: Cooke Point Road											
7	L	49	0.0	0.058	9.9	LOS A	0.3	1.8	0.39	0.68	47.2
9	R	32	0.0	0.168	24.3	LOS B	0.6	3.9	0.82	0.95	35.9
Approach		81	0.0	0.168	15.5	LOS B	0.6	3.9	0.56	0.79	42.0
West: Wilson Street west											
10	L	114	0.0	0.061	8.2	LOS A	0.0	0.0	0.00	0.67	49.0
11	T	263	0.0	0.135	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		377	0.0	0.135	2.5	LOS A	0.0	0.0	0.00	0.20	56.2
All Vehicles		1481	0.0	0.389	3.3	NA	1.5	10.5	0.12	0.23	55.0