

## Section 5

### Alternatives



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## 5. Alternatives

### 5.1 Introduction

This section outlines the various project alternatives considered for the recovery, export and processing of gas and condensate from the Blacktip reservoirs. With the exception of the ‘no development’ option the alternative proposals allow the objectives of the project to be met. A combination of environmental, economic and technical selection criteria have been used to assist in the review and consideration of each option. Each option has been assessed in terms of its:

- advantages and disadvantages;
- positive and negative impacts;
- impacts on matters protected under Northern Territory and Commonwealth legislation.

The main alternatives assessed in regards to project feasibility are: whether or not to develop the Blacktip reservoir; how best to process the reservoir fluids; and where to site the various project components. Various alternatives have been considered with regards to the following project components:

- no development option;
- wellstream processing;
- location of production wells and wellhead platform;
- subsea export pipeline routes;
- pipeline shore crossing location;
- onshore export pipeline route;
- condensate treatment and export;
- location of onshore facilities.

As the project design develops over time, a number of project alternatives are eliminated on economic, technical, environmental or regulatory grounds. The positioning of the wellhead platform, the alignment of the subsea and onshore export pipeline routes and the location of the landfall and onshore facilities are all intrinsically linked to one another. Alternative options considered for any one of these components had to take into consideration their impacts on other project components.

### 5.2 No Development Option

The petroleum exploration and production industry is important to Australia’s overall economic welfare and provides a reliable and competitively priced source of energy, which directly meets 53 % of Australia’s primary needs. A strong and expanding industry will continue to offer a significant long term contribution towards the nation’s economic growth (APPEA 2002a). In the event that this project does not proceed there are likely to be negative implications for the Northern Territory and Australia.

On a regional scale, the Blacktip Project will have the following advantages:

- It will offer a significant long-term contribution towards the Northern Territory's economic and industrial growth, and capital investment (**Section 2**).
- It may act as a catalyst for other petroleum developments in the Joseph Bonaparte Gulf. If the Blacktip Project does not proceed, the Territory will fail to benefit from an estimated \$45 million worth of expenditure in addition to taxation benefits and financial benefits likely to be experienced at a national level (ACIL Tasman 2004).
- It may also provide an alternative gas supply to potential gas consumers in the Northern Territory.

Without development of alternative fuel sources, the Territory may experience increased dependence on less environmental-friendly fossil fuels such as oil and coal. The Territory and its residents may also fail to benefit from increased employment opportunities and growth in local businesses predicted to flow from the project.

The Blacktip Project is linked to two other major proposed projects, both of which will undergo separate environmental approval processes:

- Alcan Gove Expansion Project
- Trans Territory Pipeline Project (TTP)

Blacktip has been identified as the ideal source of gas for the Alcan Gove Refinery. Without gas from the Blacktip field the facility will be forced to continue to power its operation with fuel oil until an alternative gas source is found. Fuel oil has much greater potential to pollute the environment. The identification of another gas source suitable to Alcan's operation will be difficult as all approvals will need to be in place to meet with Alcan's intended project commissioning in late 2007. Without the Blacktip Project, Alcan's proposed gasification of the refinery will be delayed. Environmental benefits from the use of cleaner fuel will not be experienced until another gas source can be located and approved.

The TTP is proposed to transport gas across the Northern Territory from the Blacktip Project to Alcan's facility in Gove, and is dependant upon Alcan sourcing gas from Blacktip. Should the Blacktip Project not proceed the TTP will not proceed and vice versa.

In summary, development of the Blacktip reservoir is the preferred option, as opposed to the 'no development', for the following reasons:

- economic benefits for the Northern Territory and Australia;
- employment opportunities;
- encouragement of other petroleum production in the Joseph Bonaparte Gulf;
- provision of a gas supply to Alcan and other gas customers in the Northern Territory;
- environmental benefits of gas use by Alcan's alumina refinery;

- decreased dependence on oil and coal.

### 5.3 Wellstream Processing

Gas processing involves the removal of all reservoir liquids and heavy hydrocarbons from the well stream and subsequent compression of the dry gas for export.

A major design consideration was the technology available to undertake processing. Onshore gas processing has been undertaken successfully in various parts of the world, and silica gel technology is tried and tested. Offshore processing would use 'Twister' technology, a relatively new technology that presents significant risk because it has not been extensively tested in different environments.

Both onshore and offshore scenarios would include similar infrastructure such as a wellhead platform, an export pipeline and onshore facilities. The two processing options are illustrated in **Figure 5-1**.

#### 5.3.1 Offshore Processing

The offshore processing scenario would involve gas processing on the wellhead platform, whereby the reservoir fluids would be separated into hydrocarbon gas and a mixed condensate/water stream. The dry gas product would be exported to shore via the export pipeline to onshore compression facilities.

The offshore processing option considered making use of 'Twister' Supersonic Separator technology, a new gas conditioning technology developed by 'Twister', a Shell affiliated company, that separates and condenses hydrocarbons at high velocity. The device does not have any rotating parts and operates without chemicals, making it suitable for unmanned operation. Gas field tests have been undertaken to test the use of 'Twister' technology in tropical areas and the first commercially operated 'Twister' system began operation in December 2003 on a wellhead platform offshore Sarawak, East Malaysia.

With offshore processing and separation a number of options arise. The condensate could be reinjected into the reservoirs by use of high-pressure pumps, while the PW could be discharged directly from the wellhead platform to sea after treatment in line with current industry practice. Alternatively, both condensate and PW could be reinjected into the reservoir, or the condensate could be transported via pipeline to export facilities.

Onshore facilities for the offshore processing scenario would still require a 64 ha footprint which would include an inlet pig-receiver, a compression station and utility systems including flare, instruments, drains and a construction camp.

#### 5.3.2 Onshore Processing

Onshore processing is the preferred option as is detailed in **Section 4**. In this case no processing will be undertaken offshore, and the wellhead platform will be remotely operated and unmanned

with minimal facilities. Facilities will be installed on the wellhead platform for pigging operations, and remote control of well flow and pressure will take place. Safety, control and communications equipment will be installed. Access to the wellhead platform for maintenance will be by helicopter or marine vessel.

The gas, associated condensate and PW will flow directly via a multi-phase export pipeline to an onshore gas plant. The gas will then be treated on site to remove the condensate and water. The excess condensate will be stored on site and the PW will be treated onshore prior to disposal via a pipeline to sea.

Onshore facilities will include the following:

- slug catcher;
- water and hydrocarbon dew-pointing;
- gas compression;
- utility systems including power generation, firewater, instrument air, liquid and gaseous fuel systems, condensate export facilities, gas metering.

The footprint for the onshore processing facilities will be 64 ha.

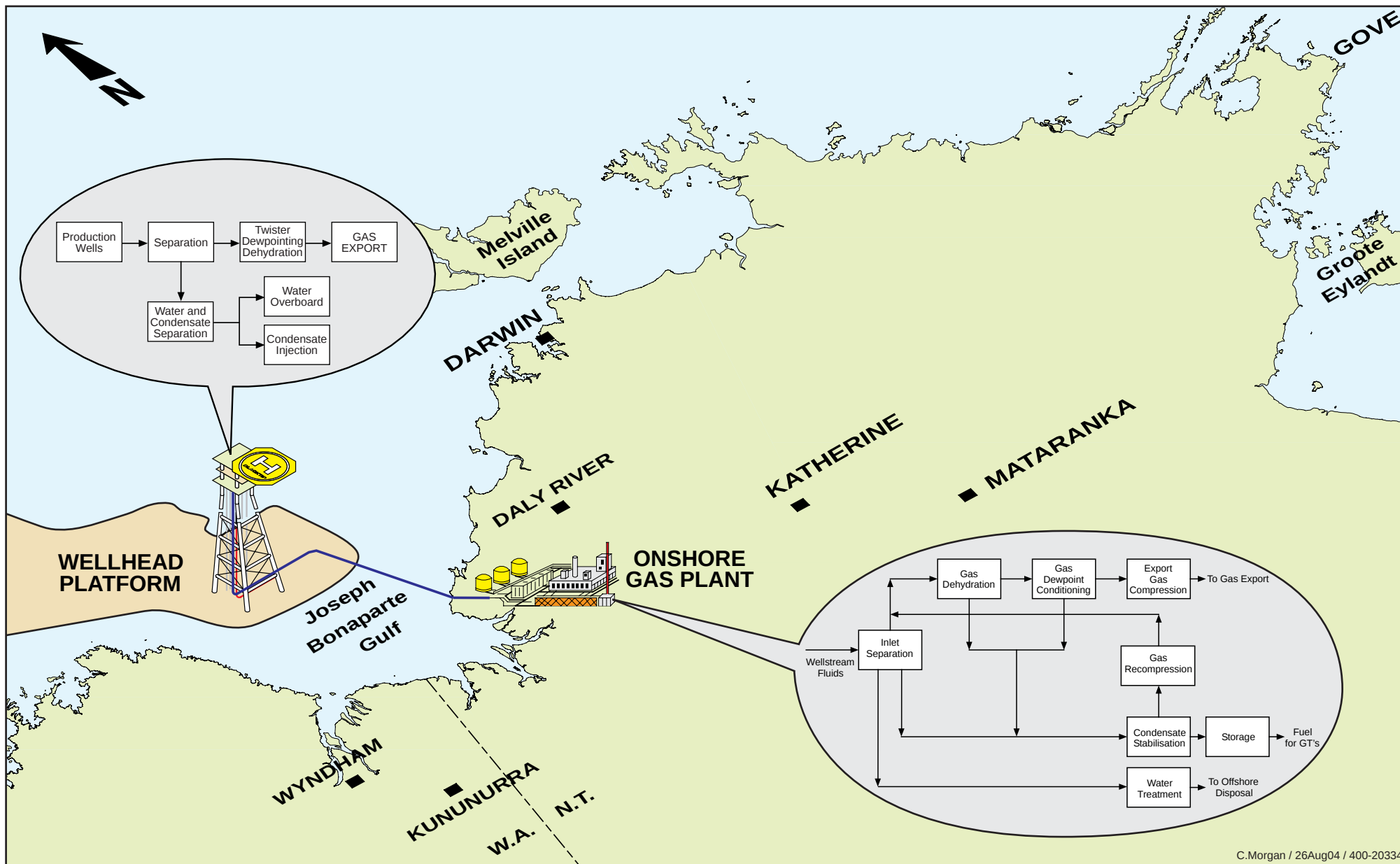
### **5.3.3 Alternative Power Sources**

Renewable energy technologies were considered during the design of the plant and wellhead platform. Of these technologies, solar power was considered the most feasible. However, due to the size of the solar array required, the use of solar power was not considered practical or affordable. Power supply for the wellhead platform needs to be as simple and reliable as possible due to the remoteness of the project location. The preferred option is therefore to power the wellhead platform by using two small gas-driven Closed Circuit Vapour Turbines (CCVT). Fuel gas will be derived from the wellstream.

### **5.3.4 Summary**

Both the onshore and offshore processing options were carried forward and assessed by the proponent during the initial design stages. Onshore processing was deemed to be the most viable, both economically and technically, and offered similar environmental safeguards and is therefore the preferred option.

Offshore gas processing and the drying technology proposed is relatively unknown and presents a degree of risk, leading to a preference for the onshore option. Offshore 'Twister' technology would require either condensate re-injection or condensate processing and loading at the platform. Condensate re-injection represents a waste of resources and was not considered an acceptable outcome. However, to provide condensate processing and loading facilities at the platform for relatively small quantities of condensate would be expensive.



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## ONSHORE AND OFFSHORE PROCESSING OPTIONS

Figure 5.1

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In both cases, an onshore footprint of 64 ha is required, and given that there is no significant environmental benefit in moving processing offshore, the better-known technology used in onshore processing makes onshore processing the preferred option.

#### **5.4 Location of Production Wells and Wellhead Platform**

The locations of offshore wells and well platform were selected based on data obtained during exploratory drilling and on detailed design processes. The location and extent of the gas field largely determines the locations of the offshore production wells and wellhead platform. Consequently, only relatively minor changes in the positioning of these facilities can be considered.

The approach of the offshore export pipeline to shore is another determining factor, and was taken into consideration in view of the location of the wellhead platform. With confirmation of the preferred pipeline route, the wellhead platform was located further west than initially expected in order to maintain a relatively direct pipeline approach.

Initial investigation of the seabed around the Blacktip reservoir revealed that it was featureless and devoid of any environmental sensitivities; therefore, there were no major issues with the preferred location of the wellhead platform. No alternative locations were examined from an environmental perspective, as the seabed is fairly uniform within the vicinity of the reservoirs.

#### **5.5 Subsea Export Pipeline Routes**

During the initial stages of the route selection process for the export pipeline, the shortest straight-line path between the wellhead platform and landfall provided a preliminary route. As the site selection process progressed, desktop geological reviews revealed the presence of historical river channels and irregular bathymetry along sections of the route. These features are not conducive to pipe laying and alternative routes would subsequently avoid the unfavourable seabed conditions. This alternative route to the north skirts around a large depression before veering south to the same landfall site.

Geotechnical and other on site investigations later confirmed that the initial shorter route would not cause any construction problems. In addition, the longer route to the north presented no advantages over the original shorter route and would be more expensive to construct due to the extra length of pipe required (**Figure 5-2**). The initial shorter route was therefore carried forward.

#### **5.6 Pipeline Shore Crossing Location**

The selection of an appropriate landfall site for the export pipeline had the most influence in dictating the location of the other project components. Landfall site selection depended on the suitability of the receiving environment to pipeline installation, and needed to provide adequate shoreline stability, limited rock and a reasonable degree of sheltering from waves and currents. Several other factors, including sediment type, seabed gradient and land gradient also influenced the suitability of particular sites.

Locations for a shore crossing are limited, as the Joseph Bonaparte Gulf coast is characterised by numerous estuaries, inlets, mangroves and swamp areas. Initial potential sites were identified from hydrographic charts, aerial photography and mapping, and included Cape Dommert, Shakespeare Hill, Gordon Spring, Cape Dombey, Wadeye and Dundee Beach (**Figure 5-3**). During the preliminary design phase, the options were further investigated and two potential locations for the pipeline landfall were identified based on overall geography and pipeline route selection. One site was located at Cape Dombey and the other on a beach near the Aboriginal community of Wadeye.

On closer investigation the Cape Dombey site was identified to be rocky and generally unsuitable for pipeline installation. Cape Dombey would result in longer offshore and onshore pipeline routes and had numerous offshore reefs to avoid. Cape Dombey is also more remote than Wadeye in terms of onshore access.

The Wadeye site offers the most flexibility in the event that minor deviations to the offshore components are made. Wadeye offers a better alignment with the TTP, and a shorter offshore route with no offshore reefs.

In summary, the beach location near Wadeye was identified to be the preferred landfall location. This site was selected on the basis that it offers a relatively short distance to deep water, a suitable beach and a suitable site for construction activities. The preferred site and initial options are shown in **Figure 5-3**.

## 5.7 Onshore Export Pipeline Route

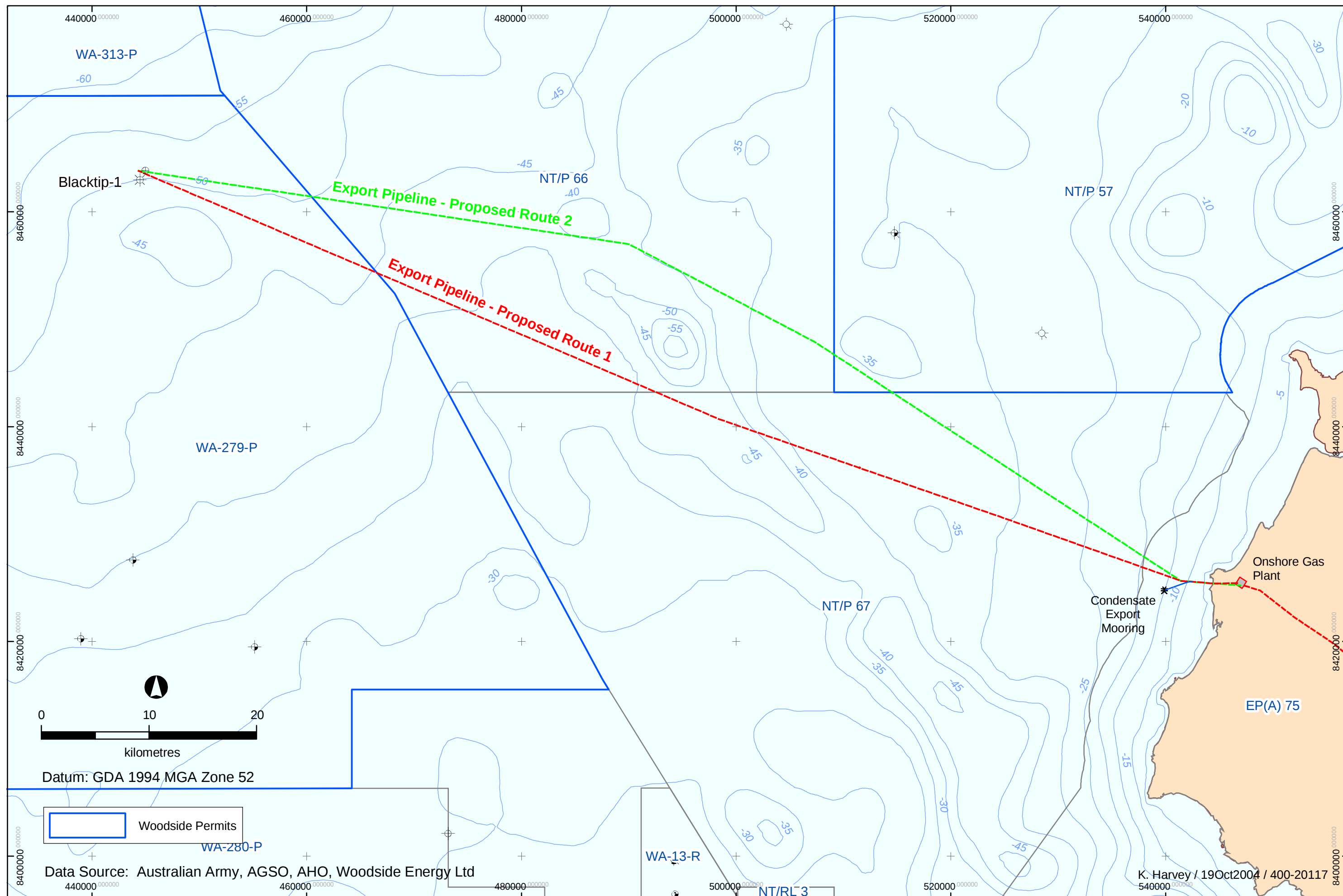
The route for the onshore section of the export pipeline was dictated by the preferred locations of the pipeline landfall and the onshore gas plant. The original onshore section of the pipeline route was chosen based on the most direct approach from the landfall site to the proposed gas plant site.

In response to minor deviations to the subsea pipeline route and hence relocation of the gas plant further inland, the length of the onshore pipeline increased to approximately 2.5 km. However, this represents the most direct route from the landfall to the onshore gas plant (**Section 5.8**). Given that the distance is only 2.5 km in length, there is limited scope for examining alternative route options.

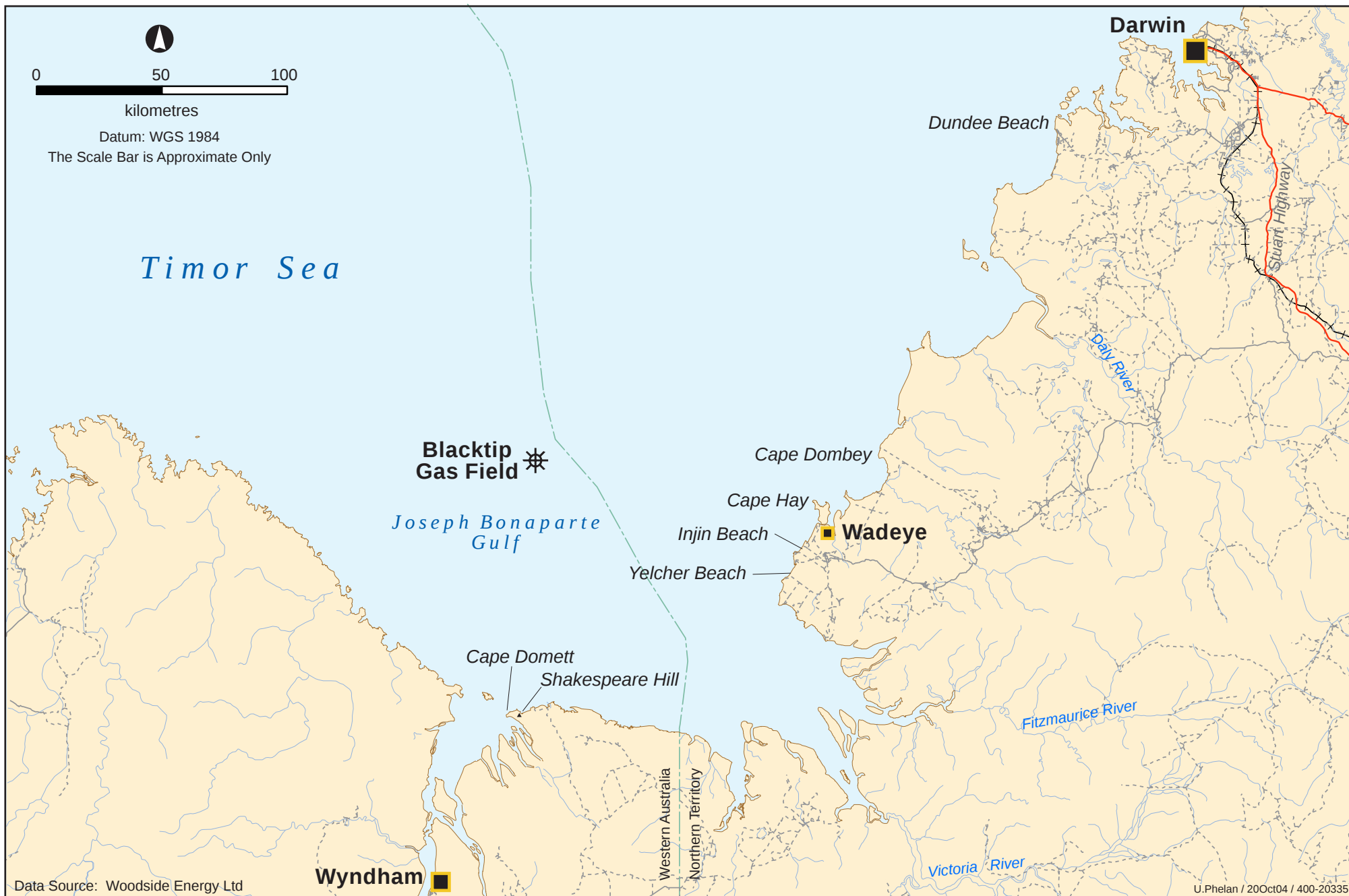
## 5.8 Location of Onshore Gas Plant

The onshore gas plant location was selected to optimise the site suitability for plant construction, whilst also fulfilling the processing functions of the plant such as gas compression. During preliminary site investigations, the general location of the onshore facilities was identified to be any area adjacent to the onshore pipeline alignment, above the 10 m contour line to avoid inundation of water and waterlogging during the wet season.

Based on this broad criterion a site for the onshore facilities was originally selected approximately 800 m directly inland from the pipeline landfall.



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## EXPORT PIPELINE LANDFALL ALTERNATIVES

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An alternative site, further inland, was developed in response to changes to the offshore components. A 64 ha area of land is required for the onshore facilities, and a number of parameters were assessed to locate the most appropriate site. Environmental and social parameters evaluated included geology, topography, archaeological and ethnographic sites, security and site access. The preferred site was chosen to take advantage of the natural contours and to avoid intersecting any natural drains or low points.

Flora and fauna surveys of the preferred gas plant site indicated there were no rare or endangered species at the selected location. Heritage surveys and consultation with the traditional Aboriginal owners revealed that there were no sacred sites. The alternative and preferred locations are illustrated on **Figure 5-4**. Several minor alterations have been made to the preferred gas plant location but because these were minor relocations and were concerned with construction aspects (rather than environmental) they have not been assessed further here.

## **5.9 Condensate Treatment & Export**

Various environmental and technical factors were considered when investigating options to manage the condensate produced from the Blacktip Project. Existing facilities at Wadeye were explored, as well as options for creating new purpose-built facilities. The volumes of condensate are estimated to be too large for disposal by burning as fuel, and are too small for export via pipeline. Trucking was considered but this would have required a significant number of road upgrades.

The capacity of the existing boat ramp in Sandfly Creek, near Wadeye, was evaluated as an option for condensate export (Woodside 2003e). Access to the ramp was found to be restricted in terms of the width, length and draft of vessels able to use the facility, as well as the creek's tidal range (the ramp and creek are completely dry at low tide). The facility was found to have a very limited condensate export capacity, as the largest vessel able to access the ramp, having approximately 363,000 litres liquid capacity, can only carry approximately 3.5 days production. The limited capacity and design of the ramp result in this option being unfeasible.

The preferred option for technical and environmental reasons is to export condensate via an export facility that has the capacity to store a marketable volume of condensate, whilst ensuring adequate size of the ships required to move that volume. A conventional jetty with loading arms is not considered viable due to the frequency of cyclones. Various offshore mooring options were evaluated, including single buoy moorings, conventional buoy moorings, spread moorings and catenary anchor leg moorings.

The mooring options were assessed in terms of design considerations such as wind, waves, water depth, currents, vessel size, operation, maintenance and cost constraints. This option was also most suited to the environmental constraints, as well as being practical and economic.

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