GOVERNMENT OF
WESTERN AUSTRALIA

Browse LNG Precinct

Browse Liquefied Natural Gas Precinct
Strategic Assessment Report

(Draft for Public Review)
December 2010

Appendix D-6

Infrastructure Assessment Study

Browse Liquefied Natural Gas Precinct

Prepared For Department of Planning

12 May 2010

Browse Liquefied Natural Gas Precinct

Infrastructure Assessment Study

Browse Liquefied Natural Gas Precinct

Infrastructure Assessment Study

Prepared for

Prepared For Department of Planning

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Executive Summary

Introduction

This report presents the findings of the infrastructure assessment required to support the proposed onshore Liquefied Natural Gas (LNG) processing precinct at James Price Point, north of Broome. It also considers the implications for infrastructure in Broome due to the precinct development, both directly (such as precinct workers and their families living in Broome) and indirectly (such as Browse Basin exploration works and employees).

The assessment reviewed the following infrastructure:

- Water
- Waste Water
- Solid Waste
- Power
- Telecommunications
- Gas
- Transport

Background

The Browse Basin is located off the north-west coast of Australia, more than 400 kilometres north of Broome and 250 kilometres from the mainland. The Basin contains proven gas reserves of 34.6 trillion cubic feet, 600 million barrels of condensate and 60 trillion cubic feet of probable gas reserves. These gas reserves will probably be extracted and processed by more than one company, and these companies will require an onshore liquefied gas processing complex. To reduce the impact (environmental, social, heritage) of these required facilities, the Northern Development Task (NDT) force was established in June 2007. The objective of the NDT was to undertake a site selection process to identify one multi-user liquefied gas processing complex on the north-western coast of Australia. After extensive review by the NDT, it was decided that James Price Point was the preferred location for this complex (referred here on as the Browse Liquefied Natural Gas (BLNG) Precinct (BLNG Precinct)). The BLNG Precinct will include facilities and infrastructure to process and export hydrocarbons including LNG.

Assumptions

As some of the key components have yet to be finalised, this assessment was based on the following:

- Workforce projections for the BLNG Precinct extracted from the Social Impact Assessment, September 2009, Precinct Workforce Projection.
- Population projections for Broome extracted from the November 2009, Kimberley LNG Social Impact Assessment, Sensitivity Analysis of Workforce Population Impacts Model.
- The BLNG Precinct will be located just south of James Price Point.
- The supply base required to service the operational aspects of the Browse Basin is excluded from this assessment.
- The offshore operations of any proponents who choose to use the BLNG Precinct are considered Category C activities (see **Scenarios**).
- There are two suitable potential locations for the workers accommodation (one within 5 kilometres and the other within 30 kilometres of the BLNG Precinct).

Scenarios

Each type of infrastructure was assessed for the following development scenarios, category activities and development phases:

- Scenario 1: the future base case with no BLNG Precinct
- Scenario 2: the future case with a low BLNG Precinct development (throughput of 15 million tonnes per annum)
- Scenario 3A: the future case with a medium BLNG Precinct development (throughput of 25 million tonnes per annum)
- Scenario 3B: the future case with a medium BLNG Precinct development (throughput of 35 million tonnes per annum)
- Scenario 4: the future case with a high BLNG Precinct development (throughput of 50 million tonnes per annum)
- Category A: activities directly related to the BLNG Precinct, such as movement of staff and services to and from the site, and infrastructure for the workers' accommodation and processing plant
- Category B: activities indirectly related to the BLNG Precinct but which will occur as a result of the BLNG Precinct, such as BLNG Precinct employees' families moving to Broome, or new businesses starting in Broome to support the BLNG Precinct
- Category C: activities related to and indirectly linked to the BLNG Precinct, but are proposed by separate entities, such as gas extraction or exploration in the Browse Basin
- Construction Phase
- Operation Phase

Assessment

As the BLNG Precinct is a greenfield site located on the south-western extremity of the Dampier Peninsula, approximately 50 kilometres north of Broome, no infrastructure currently services the site. Its distance from Broome will most likely result in the requirement for power, water and waste water treatment facilities on site. This will reduce the impact of Category A activities on Broome's infrastructure.

Category B and C activities will have an impact on Broome. Therefore an assessment of Broome's future infrastructure was undertaken.

Broome's identification as a development "hot spot" and the national importance of the BLNG Precinct has resulted in the production of a plethora of literature. A review of these reports highlighted conflicting information, especially with regard to projected population figures. To enable an assessment to be made of the infrastructure required for Broome and the BLNG Precinct, the population projections outlined in the following reports were adopted:

- Social Impact Assessment, Precinct Workforce Projection. September 2009
- DSD, Kimberley LNG Social Impact Assessment, Sensitivity Analysis of Workforce Population Impacts Model, November 2009
- DSD, Social Impact Assessment Workshop: Infrastructure, August 2009

The population figures used in this assessment are illustrated in **Figure E.1**. The upper set of projections has been used for each scenario, representing a "worst case" assessment. The source documents are included as **Appendices A**, **B** & **C**.

During the course of the Social Impact Assessment, the September / November population projections were revised and a December set of projections produced, as shown on **Figure E.2**. These December projections are lower than the September/November projections and form the basis of the Social Impact Assessment.

The infrastructure assessment has not be revised for the December projections as retaining the higher September / November projections provides a further factor of safety in assessing any potential infrastructure impacts due to the construction or operational phases of the BLNG Precinct.

Albeit using these figures has provided a highly unlikely scenario, this exercise has not flagged any additional areas of concern, other than those already identified as a result of natural growth of the base population in Broome.

Figure E.1 Projected Population for Broome for Each Scenario (November 2009 – Upper Set)

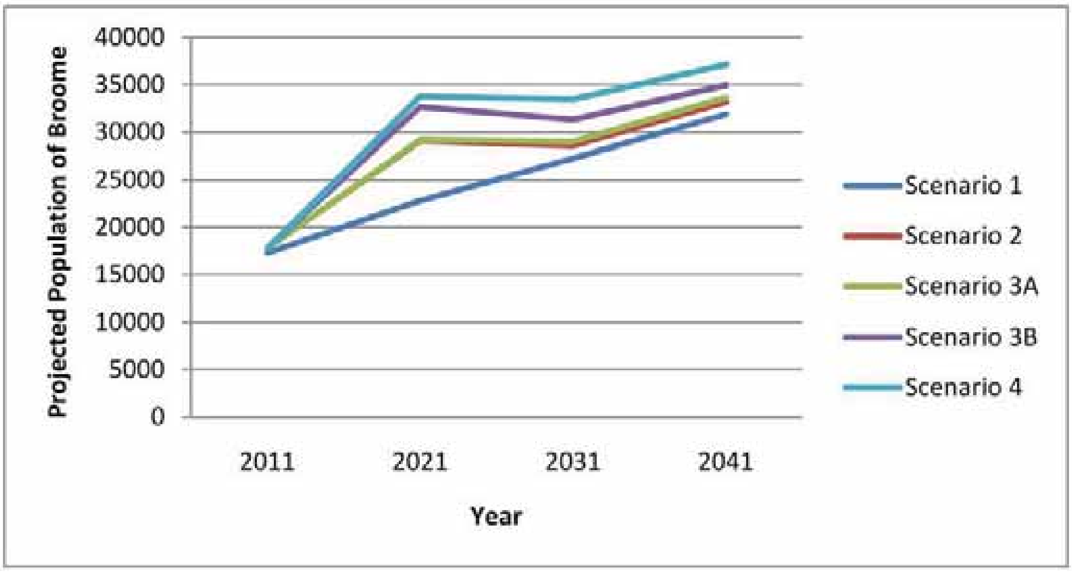
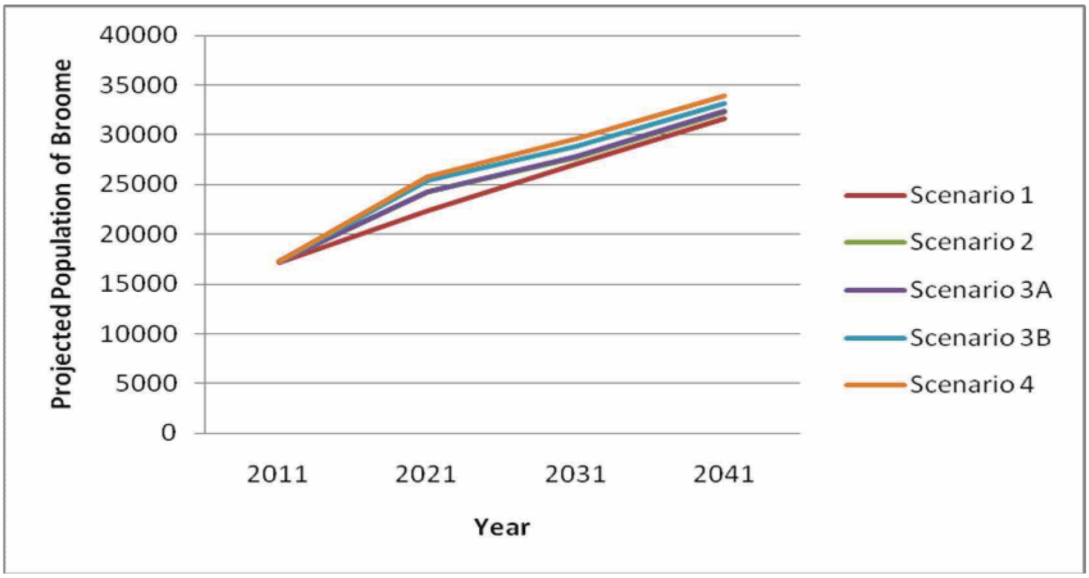


Figure E.2 Projected Population for Broome for Each Scenario (December 2009 – Upper Set)



Based on this information an assessment was undertaken on the impact of the BLNG Precinct on Broome infrastructure. The results of the assessment are as outlined in **Tables E.1**, **E.2** and **E.3**.

Table E.1 Infrastructure Requirements at the BLNG Precinct During Construction

Phase/Activity	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Water				
Workforce Accommodation Village	1,400 ML/yr	1,400 ML/yr	1,600 ML/yr	1,600 ML/yr
BLNG Precinct	2,800 ML/yr	2,200 ML/yr	2,300 ML/yr	2,900 ML/yr
Wastewater				
Workforce Accommodation Village	700 ML/yr	700 ML/yr	810 ML/yr	810 ML/yr
Desalination Plant	2,800 ML/yr	2,200 ML/yr	2,300 ML/yr	2,900 ML/yr
Solid Waste				
Workforce Accommodation Village	2,200 m^3/yr	2,200 m^3/yr	2,500 m^3/yr	2,500 m^3/yr
Toxic Waste Produced Over Construction Period	340 – 400 m^3	590 -700 m^3	830 – 1,000 m^3	1,170 – 1,400 m^3
Scrap / Recycle Metal Produced Over Construction Period	45 -100 m^3	80 - 175 m^3	115 - 250 m^3	160 - 350 m^3
Toxic Chemicals Produced Over Construction Period	15 -35 m^3	20 - 60 m^3	30 - 85 m^3	45 – 120 m^3
Power				
Workforce Accommodation Village	13,900 kW/h	13,900 kW/h	16,000 kW/h	16,000 kW/h
BLNG Precinct	2,000 kW/h	2,000 kW/h	4,000 kW/h	6,000 kW/h
Gas				
Total BLNG Precinct	None	None	None	None
Telecommunications				
Comments	Temporary installation of a microwave link, and mobile repeater			
Transport				
Workforce Accommodation Village	3 bus trips to and from Broome and 2 flights in and out of Broome a day	3 bus trips to and from Broome and 2 flights in and out of Broome a day	4 bus trips to and from Broome and 2 flights in and out of Broome a day	4 bus trips to and from Broome and 2 flights in and out of Broome a day
BLNG Precinct	Indicative peak daily traffic of approximately 430 vehicles			

Table E.2 Infrastructure Requirements at the BLNG Precinct During Operation

Phase/Activity	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Water				
Workforce Accommodation Village	120 ML/yr	130 ML/yr	230 ML/yr	270 ML/yr
BLNG Precinct (maximum demand using sea water)	8,000 ML/yr	14,000 ML/yr	19,000 ML/yr	27,000 ML/yr
Wastewater				
Workforce Accommodation Village	60 ML/yr	70 ML/yr	120 ML/yr	140 ML/yr
From BLNG Plant	9,000 ML/yr	15,000 ML/yr	20,000 ML/yr	30,000 ML/yr
Solid Waste				
Workforce Accommodation Village	180 m^3/yr	200 m^3/yr	350 m^3/yr	420 m^3/yr
General Waste Produced	5,300 – 10,700 m^3/yr	9,300 – 18,700 m^3/yr	13,300 – 26,700 m^3/yr	18,600 – 37,300 m^3/yr
General Recyclables Produced	500 – 1,000 m^3/yr	880 – 1,800 m^3/yr	1,300 – 2,500 m^3/yr	1,800 – 3,500 m^3/yr
Toxic Waste Produced	250 – 500 m^3/yr	430 – 880 m^3/yr	620 - 1,250 m^3/yr	860 – 1,750 m^3/yr
Mercury Produced	40 – 80 m^3/yr	70 – 140 m^3/yr	100 - 200 m^3/yr	140 – 280 m^3/yr
Chemical Drums Produced	20 – 40 m^3/yr	40 – 70 m^3/yr	50 - 100 m^3/yr	70 – 140 m^3/yr
Scrap / Recyclable Materials Produced	10 – 20 m^3/yr	15 – 40 m^3/yr	20 - 50 m^3/yr	30 – 70 m^3/yr
Highly Hazardous Materials Produced	1 – 4 m^3/yr	2 – 7 m^3/yr	3 - 10 m^3/yr	4 – 14 m^3/yr
Fluorescent Produced	Up to 4 m^3/yr	Up to 7 m^3/yr	Up to 10 m^3/yr	Up to 14 m^3/yr
Power				
BLNG Precinct Total	80,000 to 125,000 kW/h	160,000 to 200,000 kW/h	230,000 to 280,000 kW/h	320,000 to 400,000 kW/h
Gas				
BLNG Precinct Total	May use gas from processing plant to drive power plant			
Telecommunications				
Comments	Optical Fibre link will provide fixed line, internet and mobile services			
Transport				
Workforce Accommodation Village	3 bus trips to and from Broome and 1 flights in and out of Broome on one day a week	3 bus trips to and from Broome and 1 flights in and out of Broome on one day a week	5 bus trips to and from Broome and 1 flights in and out of Broome on one day a week	5 bus trips to and from Broome and 1 flights in and out of Broome on one day a week
BLNG Precinct	Indicative peak daily traffic of approximately 8,070 vehicles			

Table E.3 Impacts on Infrastructure in Broome

Phase/Activity	Scenario 1	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Water					
Total estimated water usage in Broome	8,600 ML/yr	8,960 ML/yr	9,080 ML/yr	9,440 ML/yr	10,020 ML/yr
Capacity of Infrastructure	10,600 ML/yr				
Comments	Within water supply capacity, will require 3 extra bores.	Within water supply capacity, will require no extra bores than required for Scenario 1 (3 bores).	Within water supply capacity, will require no extra bores than required for Scenario 1 (3 bores).	Within water supply capacity, will require a fourth bore.	Within water supply capacity, will require no extra bores than required for Scenario 3B (4 bores).
Waste Water					
Total estimated wastewater generated in Broome	4,300 ML/yr	4,480 ML/yr	4,540 ML/yr	4,720 ML/yr	5,010 ML/yr
Capacity of Infrastructure	5,110 ML/yr				
Comments	Within water treatment capacity	Within water treatment capacity	Within water treatment capacity	Within water treatment capacity	Within water treatment capacity
Solid Waste					
Waste Generated in Broome at Maximum Population Year	13,300 m^3/yr	13,800 m^3/yr	15,600 m^3/yr	14,800 m^3/yr	17,100 m^3/yr
Comments	A new landfill is required without the BLNG Precinct. This should be within the waste transport capacity for Scenarios 1, 2, 3A and 3B. Scenario 4 will need to be confirmed.				
Power					
Total estimated power usage in Broome	58,600 kW/h	60,000 kW/h	62,900 kW/h	59,600 kW/h	67,000 kW/h
Capacity of Infrastructure	46,300 kW/h				
Comments	A new power station will be required even without the BLNG Precinct				
Gas					
Total estimated gas usage in Broome	16.3 TJ/day	16.3 TJ/day	18.2 TJ/day	17.3 TJ/day	19.7 TJ/day
Capacity of Infrastructure	No current infrastructure. There is an opportunity to supply Broome Power Station and / or the township of Broome with gas from the BLNG Precinct.				
Telecommunication					
Comments	Increased telecommunications capacity in Broome will be required.				
Transport					
Comments	Planned transport improvements within Broome to accommodate the planned developments (including North Broome) will cater for the increased traffic movements required for the BLNG Precinct. The airport upgrades should be able to cater for the increased air traffic, and will not require relocation.				

Mitigation Management Plan

This section outlines the Mitigation Management Plan for each infrastructure type for each Scenario.

Water

The capacity of Broome's water supply is 10,600 megalitres per year, which is above the predicted requirement for Scenarios 1, 2, 3A and 3B. Thus, if these Scenarios are adopted, no upgrade to Broome's water supply is required. For Scenario 4, the estimated water requirement for two years (2036 and 2040) is greater than the supply's capacity. As this is a short term shortage alternative water supplies such as rain water harvesting and / or grey water could be investigated. These alternative sources would require new infrastructure such as covered rain water tanks and / or grey water pipe network. This infrastructure could be provided by the Shire of Broome, the Water Corporation, or by developers. Discussions will need to be held with the Shire of Broome and the Water Corporation to determine the viability of these alternatives.

Although the water supply has enough capacity, the bores collecting the water will require upgrading in each Scenario.

For Scenario 1, a new bore will need to be constructed and commissioned before each of the following years: 2029, 2035 and 2041.

For Scenario 2, two new bores will need to be constructed and commissioned before 2021, with a third before 2037.

For Scenario 3A, two new bores will need to be constructed and commissioned before 2021, with a third before 2033.

For Scenario 3B, two new bores will need to be constructed and commissioned before 2021, with a third before 2028 and a fourth before 2034.

For Scenario 4, three new bores will need to be constructed and commissioned before 2021, with and a fourth before 2028.

These upgrades will need to be discussed and agreed with the Water Corporation for inclusion in their works program.

The water supply for the BLNG Precinct will be sourced from either:

- Shallow aquifer abstraction of fresh water (for example Broome Sandstone)
- Desalination of deep aquifer (Wallal or Grant Aquifer)
- Desalination of sea water

The infrastructure required at the BLNG Precinct will include:

- Bores and associated infrastructure
- A desalination plant
- A pipe network to transport the water from the source to the desalination plant and then around the site

During the design of the BLNG Precinct opportunities to utilise grey water and / or harvest rain water should be investigated.

The Rights in Water Irrigation Act 1914 provides for regulation, management, use and protection of water resources and irrigation schemes. This includes the rights and licenses to take water; permit to obstruct or interfere with a watercourse or wetland including its bed or banks. Any such activities outlined in this section will need to adhere to this legislation.

Waste Water

The capacity of Broome's waste water treatment plant is 5,110 megalitres per year which is above the predicted requirement for Scenarios 1, 2, 3A and 3B. Thus, if these Scenarios are adopted no upgrade to Broome's waste water treatment plant is required. For Scenario 4, the estimated waste water generation for three years (2036, 2040 and 2032) is greater than the plant's capacity. As this is a short term over-demand, alternative waste water options could be investigated, such as grey water collection and reuse for industry. To enable this to happen,

infrastructure such as a grey water pipe network and / or changes to planning policy to encourage grey water recycling in new developments will be required. This will need to be discussed and agreed with the Shire of Broome and the Water Corporation.

At the BLNG Precinct, a waste water treatment facility will need to be constructed. The infrastructure required will include collection pipes, a treatment plant, testing facilities and an outlet pipe. The size and type of treatment facility will be determined during the design of the BLNG Precinct.

During the design of the BLNG Precinct, opportunities to utilise grey water should be reviewed.

Due to high seasonal rainfall, a drainage strategy for the BLNG Precinct will be required. This should outline how the surface runoff will be collected and stored, including any flood mitigation measures.

Solid Waste

Broome's solid waste facility has a remaining five year life span. Options for the location of a new landfill are currently being reviewed. The Shire of Broome will need to be consulted to ensure the new facility is designed to accommodate the predicted waste generated by the BLNG Precinct Category A, B and C Activities.

The capacity of the waste transport network should be able to cater for the predicted increase in waste generated for each scenario.

For the BLNG Precinct a solid waste management plan should be developed to outline:

- The type and amount of waste to be generated on site
- How each type of waste is to be handled, collected and stored
- Where each type of waste should be removed to and how and when

Power

A new power plant will be required in Broome in all the Scenarios. Discussions will need to be undertaken with Horizon Power to determine the size and timing of this station. The estimated power usage indicates that a new power station of the following size will be required for the following year for each Scenario:

- Scenario 1 an additional power station of at least 13,000 kW/h capacity is required by 2025
- Scenario 2 an additional power station of at least 14,000 kW/h capacity is required by 2021
- Scenario 3A an additional power station of at least 17,000 kW/h capacity is required by 2021
- Scenario 3B an additional power station of at least 14,000 kW/h capacity is required by 2020
- Scenario 4 an additional power station of at least 21,000 kW/h capacity is required by 2021

It may be possible to reduce the electricity demand through the use of renewable energy and / or gas. This will require additional infrastructure and planning policy change to encourage the use of cleaner energy. The Shire of Broome should be consulted to determine the viability of these alternative fuels.

At the BLNG Precinct power will be provided through power generating infrastructure using gas or steam driven turbines, with diesel back up generators. There are two options for this power supply, it can be either:

- Generated by individual power stations constructed and operated by each proponent with an agreement in place for the provision of power to the shared areas.
- Generated by a single power station constructed and operated by a third party.

The latter will require less area and management input.

Gas

There is an opportunity to supply Broome power station and / or township with gas from the BLNG Precinct. To enable this, a pipe network linking the BLNG Precinct with Broome's power station and / or the town of Broome will be required. The proposed service corridor connecting the BLNG Precinct includes provision for such a pipe (refer to **Service Corridor**). The Shire of Broome and Horizon Power will need to be consulted to determine the economic viability of this option.

The power station or stations on site will utilise gas from the processing plant to drive turbines. If the option of a single power plant operated by a third party is chosen, then the third party will be able to buy gas from any of the proponents.

Telecommunications

The telecommunications within Broome will need to be upgraded to cater for the predicted growth in each Scenario. The current infrastructure can be upgraded to accommodate a 20 percent population increase. This will be reached:

- In 2014 for Scenario 1
- In 2013 for Scenarios 2, 3A, 3B and 4

Discussions will need to be held with Telstra to agree the timeframe and extent of upgrades required.

Telstra will also need to be consulted regarding the timing and costs of connection of the optical fibre to, and installation mobile repeater at, the BLNG Precinct.

Transport

The remaining unsealed sections of Broome Cape Leveque Road will require upgrading prior to the commencement of the construction phase. Main Roads Western Australia (MRWA) will need to be consulted to agree a timeline.

The access road from Broome Cape Leveque Road to the site will be constructed as part of the pioneer works.

A traffic management plan will need to be prepared by the construction contractors to ensure that any high or wide loads requiring access to the BLNG Precinct from Broome Port or elsewhere can be accommodated.

As the design of the BLNG Precinct becomes more detailed, a full transport assessment will be required to identify any transport issues and suggest mitigation measures. This will require liaison with MRWA and the Shire of Broome.

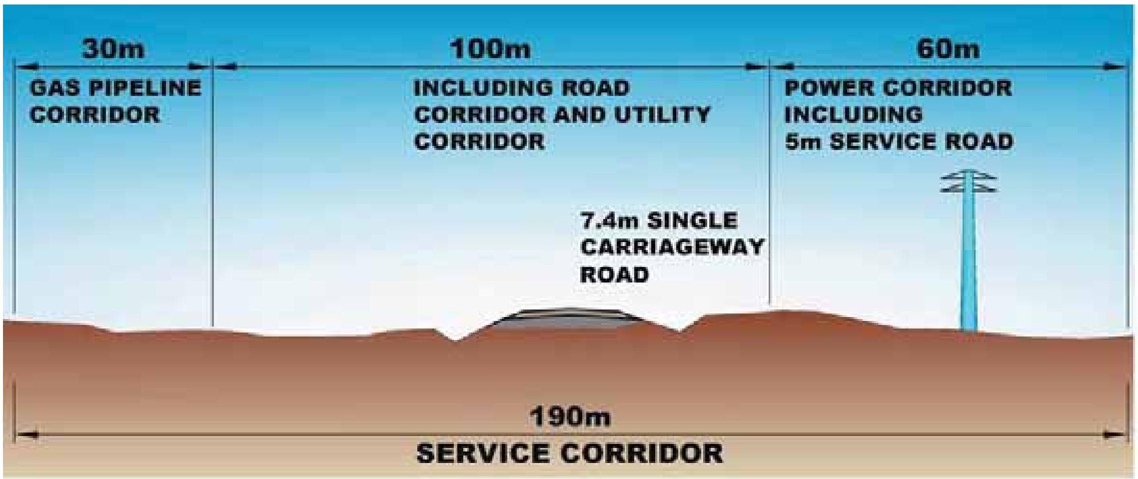
Service Corridor

The remote location of the BLNG Precinct will most likely necessitate the production and treatment of power, water and waste water at site. However, to cater for a potential connection to the infrastructure in Broome a service corridor will be included in the development plans. The exact location of this service corridor is yet to be determined. Its indicative width was calculated as approximately 190 metres. This includes:

- A road corridor (including utility corridor) of 100 metres
- A gas pipeline corridor of 30 metres
- Power corridor of 60 metres including a 5 metre access road

Figure E.3 provides an illustrative only diagram of the service corridor.

Figure E.3 Illustrative Only Diagram of the Service Corridor



Conclusion

The Shire of Broome has had a faster population growth rate than the State of Western Australia for a number of years. This growth has exhausted the existing infrastructure in Broome and encouraged the Shire and service providers to plan for future upgrades. These upgrades will take into account the potential for Broome to almost double in size from 17,100 people in 2011 to 31,400 in 2041 . This investment and forward planning will reduce the impact that the BLNG Precinct will have on the future infrastructure for all development phases and scenarios. For road, water and waste water these commissioned or planned improvements should provide a future capacity that can cater for the increased population.

Although the capacity of the water source is sufficient, additional bores will be required to collect it. Three new bores will be required for Scenario 1 (without the BLNG Precinct), Scenario 2 and Scenario 3A. The timing of these bores for each scenario is:

- Scenario 1 in 2029, 2035 and 2041
- Scenario 2 in 2021 and 2037
- Scenario 3A in 2021 and 2033

Scenarios 3B and 4 will require a fourth bore in 2034 and 2028 respectively.

The existing solid waste landfill is due for closure in five years without the addition of the BLNG Precinct. The four BLNG Precinct scenarios are likely to cause the landfill to close sooner than currently expected. As such, the BLNG Precinct proponent (DSD) will need to work with the Shire of Broome to ensure the new landfill is constructed to handle the additional waste produced by the BLNG Precinct within an appropriate timeframe.

The other solid waste disposal infrastructure in the region is either adequate or can be readily expanded (in consultation with the service providers) to meet the demands of the BLNG Precinct's solid waste needs.

The power supply planned infrastructure may not be able to cater for the future population Scenario 1 (no BLNG Precinct). A new power station may be required by 2025 for Scenario 1, 2021 for Scenarios 2, 3A and 4, and 2020 for Scenario 3B. However, this assessment was based on estimated current industrial and household usage. It should be reviewed once actual information is available.

The remote location of the BLNG Precinct will most likely necessitate the production and treatment of power, water and waste water on site. However, to cater for potential service connections to Broome, a service corridor of approximately 190 metres in width will be required. This corridor will include a single carriageway roadway reserve, utility corridor, gas pipeline corridor and a power corridor (including access road).

It should be noted that the infrastructure requirements in this report, and hence the above conclusions, are based upon the upper set of the November population projections for Broome. These projections have since been revised down (the December projections) meaning that the infrastructure requirements for water, waste water,

solid waste, power, gas, telecommunications and transport are likely to be less, and possibly significantly less, than identified in this report.

Further refinement of the requirements is therefore recommended as factors affecting the population projections, such as the assumed fly in fly out proportion, are firmed up during future stages of the BLNG Precinct design process.

1.0 Introduction

The Browse Basin is located off the north-west coast of Australia, more than 400 kilometres north of Broome and 250 kilometres from the mainland. The Basin contains proven gas reserves of 34.6 trillion cubic feet, 600 million barrels of condensate and 60 trillion cubic feet of probable gas reserves. These gas reserves will be extracted and processed by more than one company. Each of these companies will require an onshore liquefied gas processing complex. To reduce the impact (environmental, social, heritage) of these required facilities the Northern Development Task (NDT) force was established in June 2007. The objective of the NDT was to undertake a site selection process to identify one multi-user liquefied gas processing complex on the north-western coast of Australia.

The preferred site for this complex was selected by NDT through a five phase process:

- Phase 1: Suitable sites were identified using geographical information system (GIS) along the north-west coast of Australia. The suitable sites were then assessed to identify the technical viable options.
- Phase 2: The sites identified as technically viable in Phase 1 (43 sites) were assessed for regional environment, social and physiographical constraints.
- Phase 3: Multi-criteria analysis was used to evaluate social, environmental and economical risk factors. The NDT, the Department of Environment and Conservation (Western Australia) and the Department of Environment, Water, Heritage and the Arts (DEWHA) (Commonwealth) in consultation with the public developed the multi-criteria. The criteria included environmental, socio-economic, indigenous, community, fisheries, industry (technical) and tourism items. The outcome of this phase was a ranking of sites from least sensitive to most sensitive. This narrowed the potential sites down from 43 to 11.
- Phase 4: The remaining 11 sites were compared in terms of technical, environmental and cultural aspects, and were subject to extensive public and stakeholder consultation. The outcome of this phase was the identification of four preferred sites.
- Phase 5: More detailed environment and geotechnical assessments of each of the four remaining sites were completed, along with further consultation with industry and Traditional Owners. From this the most desirable site in terms of environment, technical and heritage was identified. That site was James Price Point situated some 50 kilometres north of Broome.

In December 2008, NDT was dissolved and the Department of State Development (DSD) took over the co-ordination role of the strategic assessment process. In September 2009, DSD appointed the AECOM-Strategen Consultancy team to prepare the Strategic Assessment for the Browse Basin Liquefied Natural Gas Precinct (BLNG Precinct) at James Price Point.

1.1 Purpose of this Report

The scope of works for the Strategic Assessment included the production of a Community Infrastructure and Services Capacity and a Transport Impact Assessment. The purpose of these two studies was to provide the environmental assessment team with information on the infrastructure requirements and impacts of the BLNG Precinct. The information required to complete these studies was to be sourced from the Infrastructure Assessment Study produced by the Department of Planning (DoP). The purpose of this study was to assess the impact of the BLNG Precinct on the following infrastructure:

- Water
- Waste (solid and water)
- Power
- Gas
- Telecommunications
- Transport (including road, public transport, port, airport, pedestrian and cycle)

The assessment was to include the following scenarios, activity categories and development phases as described in the publicly released scope of the Strategic Assessment for the BLNG Precinct:

- Scenario 1 (Base Case)
- Scenario 2 (Low Case)
- Scenario 3A (Medium Case A)
- Scenario 3B (Medium Case B)
- Scenario 4 (High Case)
- Category A (Direct Activities)
- Category B (Indirect Activities)
- Category C (Related Activities)
- Operation Phase
- Construction Phase

The Shire of Broome has had significant population growth in last few years due to the tourist and aquaculture and fisheries industries. With the increased appreciation of Broome's environment, the development of the Browse Basin and other resource extraction, these industries are predicted to develop further. This will result in a significant increase in population. To ensure this is accounted for in this infrastructure assessment, a base case scenario (Scenario 1) was developed. This scenario describes the future Broome without the BLNG Precinct.

The infrastructure sections of the Community Infrastructure and Services Capacity and the Transport Impact Assessment and the Infrastructure Assessment Study were combined into one study to be undertaken by AECOM. This report describes the outcome of this study.

1.2 Report Structure

This report is structured into 14 sections. These are:

1) **Introduction** outlines the background of the BLNG Precinct, purpose of the report and the report structure.
2) **Literature Review** lists the documents reviewed and information gathered.
3) **BLNG Precinct** describes the existing site and BLNG Precinct (including activity categories).
4) **Assessment Scenarios** outlines the development scenarios assessed.
5) **Water** outlines the existing water facilities, assesses the impacts of each scenario on the water infrastructure and suggests mitigation measures where required.
6) **Waste water** outlines the existing waste water facilities, assesses the impacts of each scenario on the waste water infrastructure and suggests mitigation measures where required.
7) **Solid Waste** outlines the existing solid waste facilities, assesses the impacts of each scenario on the solid waste infrastructure and suggests mitigation measures where required.
8) **Power** outlines the existing power facilities, assesses the impacts of each scenario on the power infrastructure and suggests mitigation measures where required.
9) **Telecommunications** outlines the existing telecommunications facilities, assesses the impacts of each scenario on the telecommunications infrastructure and suggests mitigation measures where required.
10) **Gas** outlines the existing gas facilities, assesses the impacts of each scenario on the gas infrastructure and suggests mitigation measures where required.
11) **Transport** outlines the existing transport facilities, assesses the impacts of each scenario on the transport infrastructure and suggests mitigation measures where required.
12) **Mitigation Management Plan** summarises the mitigation requirements and timeline.
13) **Service Corridor** describes the service corridor required to connect the BLNG Precinct to Broome.
14) **Summary and Conclusion** summarises the findings.

2.0 Literature Review

Broome's identification as a development "hot spot" and the national importance of the BLNG Precinct has resulted in the production of a plethora of literature. **Table 2.1** lists the literature that was reviewed as part of this study. An outline of the information gathered from this review is contained in **Appendix A** of this report.

Table 2.1 Literature Reviewed

Title	Author	Date
Kimberley LNG Social Impact Assessment Volume 1: Scope and Profile	Department of State Development	July 2009
Precinct Workforce Projection	Not Stated	September 2009
Strategic Infrastructure to Support the Browse Basin Oil and Gas Industry	Broome Port Authority	June 2009
Northern Development Taskforce: Final Site Evaluation Report	Dept of Industry and Resources	December 2008
Investigation into the capacity of the Port of Broome to support the Browse Basin development	Department of Planning and Infrastructure(URS)	July 2008
Roads 2025 Kimberley Region	Main Roads Western Australia	2007
Shire of Broome Draft Local Planning Strategy	Shire of Broome/DPI	April 2009
Relocation of Broome International Airport	Environmental Protection Authority	June 2001
Aeronautical study of Broome	Civil aviation safety authority	May 2009
Broome North West Water treatment Plant - Water Corporation and DEC application for waste water treatment plant	Department of Environment and Conservation	June 2009
Broome North Local development Plan	Shire of Broome	October 2009
Broome North District Development Plan	Shire of Broome	October 2009
Broome Regional Hot Spots Land Supply Update	Western Australian Planning Commission, Department of Planning and Infrastructure	November 2008
Kimberley LNG Precinct Social Impact Assessment update	Department of State Development	June 2009
Broome International Airport, Environment Report	Broome International Airport Group	June 2008
Airport Development Plan	Broome International Airport Group	November 2008
NDT final site evaluation report	Department of Industry and resources	December 2008
LNG Precinct fact sheets	Department of State Development	Not Stated
Town Planning Scheme 4	Shire of Broome	Not Stated
Kimberley LNG Precinct: review of potential sites	Environmental Protection Authority	December 2008
Map of site	Department of State Development	June 2009
Social Impact Assessment workshop: Infrastructure	Department of State Development	August 2009
Water Corporation community update	Water Corporation	January 2009
Broome Water Reserve: Water Source Protection Plan	Water and Rivers commission	2001
Email on Broome water capacity	Department of State Development	August 2009
Broome Port Growth 1889 -2009	Broome Port Authority	2009
Kimberley LNG social impact assessment, sensitivity analysis of	Department of State Development	November 2009

Title	Author	Date
workforce population impacts model		
Draft Kimberley LNG Precinct Consolidated Information Pack for Traditional Owners	Department of State Development	Not Stated
Draft Kimberley LNG Precinct – Scope of the Strategic Assessment	Department of State Development	Not Stated
BLNG Precinct, Draft Project Description including Emissions, Discharges and Wastes	Department of State Development	January 2010
Broome Power Station Environmental Assessment Report	Department of Environment and Conservation	June 2007

A literature review of these reports highlighted conflicting information, especially with regard to projected population figures. To enable an assessment of the infrastructure required for Broome and the BLNG Precinct, the projected populations for Broome and the BLNG Precinct outlined in the following reports were adopted:

- Precinct Workforce Projection, September 2009.
- DSD, Kimberley LNG Social Impact Assessment, Sensitivity Analysis of Workforce Population Impacts Model, November 2009.
- DSD, Social Impact Assessment workshop: Infrastructure, August 2009.

The population figures used in this assessment are illustrated in **Figures 2.1 and 2.2**. The upper set of projections has been used for each scenario, representing a "worst case" assessment. The source documents are included as **Appendices A**, **B** & **C**.

During the course of the Social Impact Assessment, the September / November population projections were revised and a December set of projections produced. These December projections are lower than the September / November projections, as shown on **Figures 2.3** and **2.4**.

The infrastructure assessment has not be revised for the December projections as retaining the higher September / November projections provides a further factor of safety in assessing any potential infrastructure impacts due to the construction or operational phases of the BLNG Precinct.

The infrastructure requirements in this report therefore represent the upper end of the potential range. This means that the requirements for water, waste water, solid waste, power, gas, telecommunications and transport are likely to be less, and possibly significantly less, than identified in this report.

Further refinement of the infrastructure requirements is therefore recommended as factors affecting the population projections, such as the assumed fly in / fly out proportion, are firmed up during future stages of the precinct planning and design process.

Figure 2.1 Projected Population for Broome for Each Scenario (November 2009 – Upper Set)

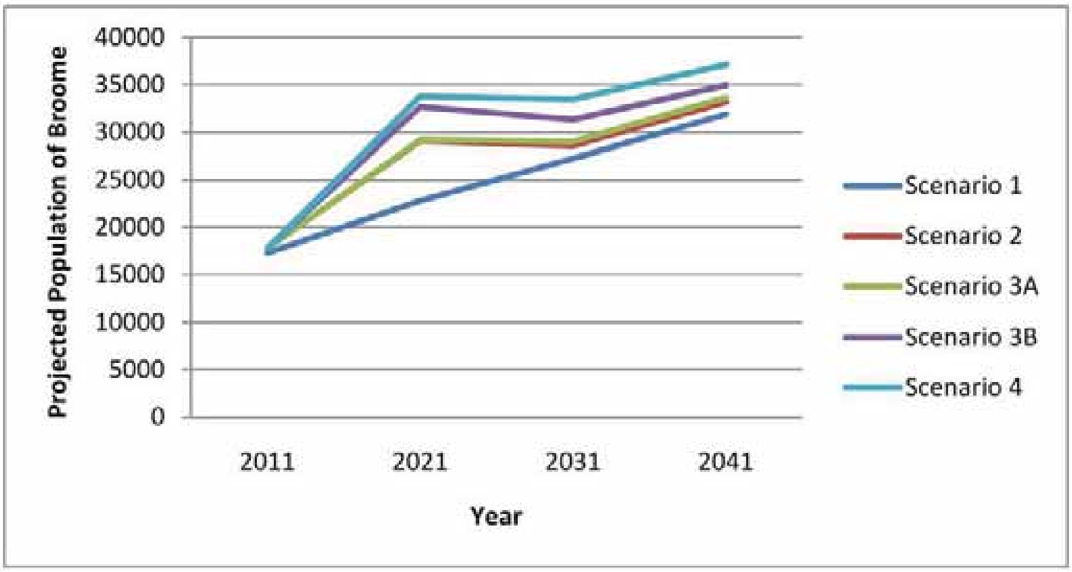


Figure 2.2 Projected Population for the BLNG Precinct for Each Scenario and Each Phase

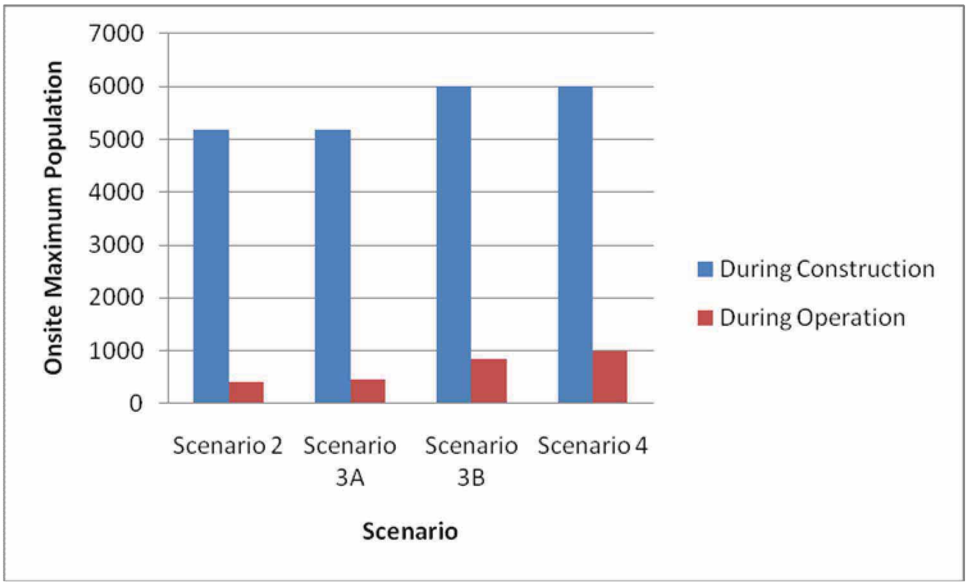


Figure 2.3 Projected Population for Broome for Each Scenario (December 2009 – Upper Set)

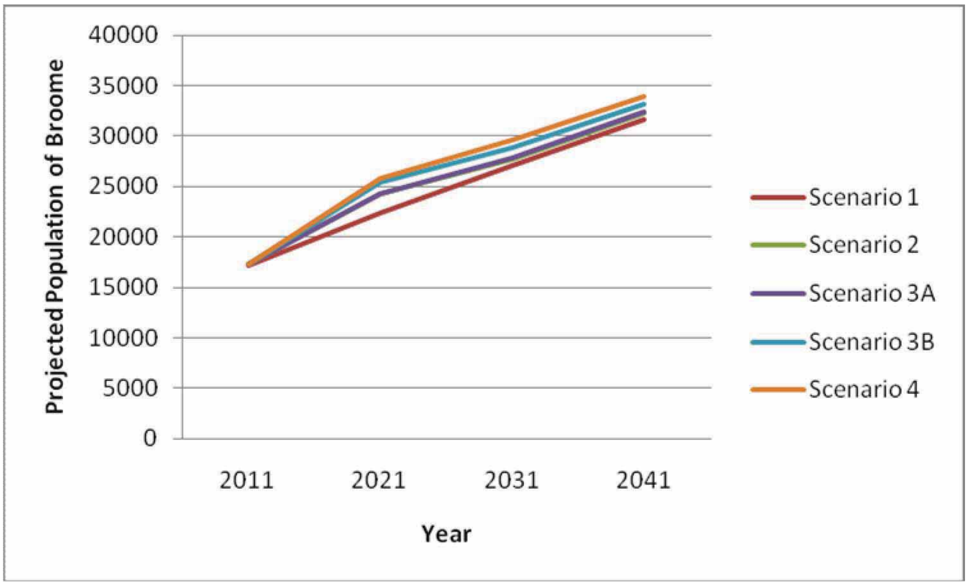
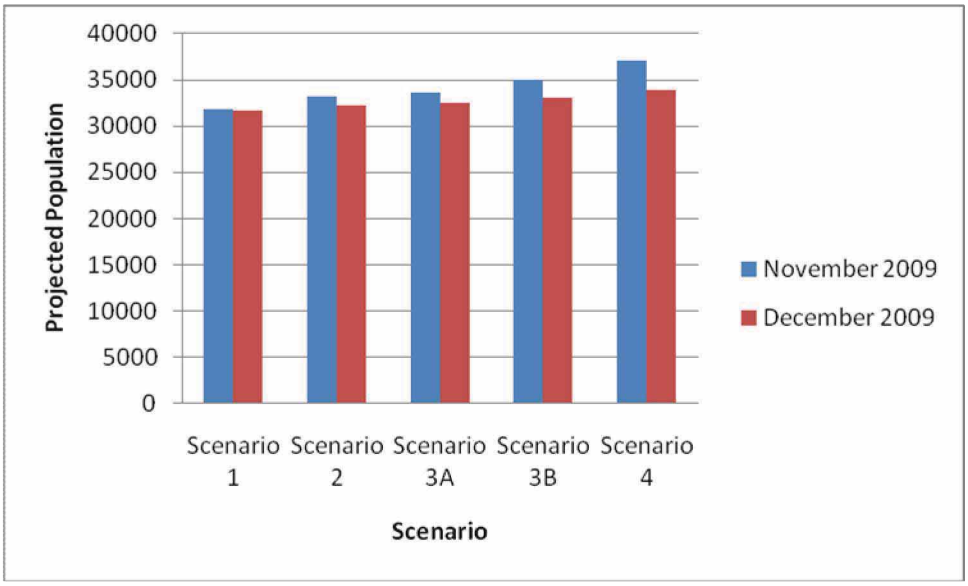


Figure 2.4 Comparison of the November 2009 and December 2009 Projected Population Figures for Broome in 2041

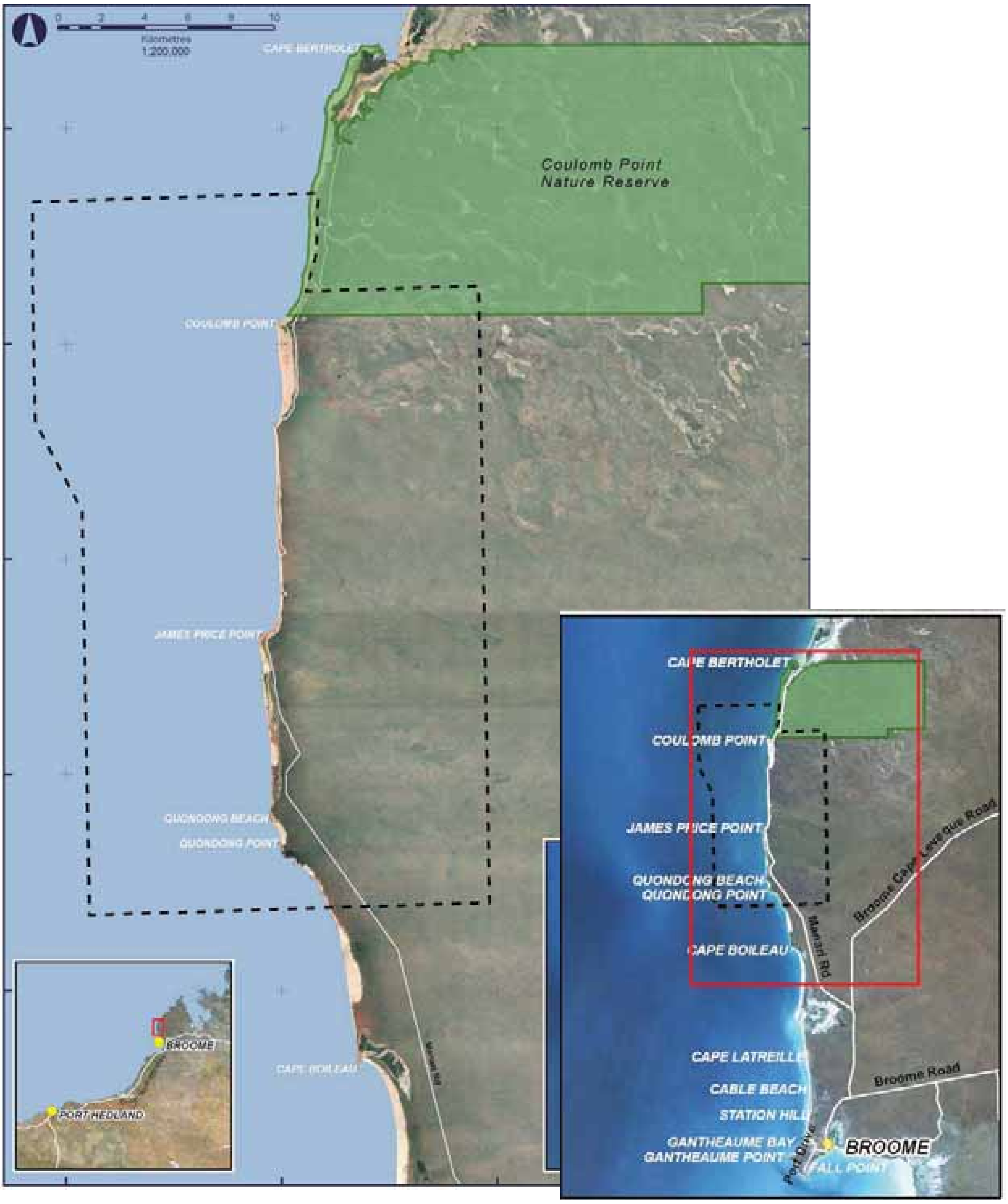


3.0 The BLNG Precinct

3.1 The BLNG Precinct Location

The BLNG Precinct is currently a greenfield site located on the south western extremity of the Dampier Peninsula in the Kimberley Region, approximately 50 kilometres north of Broome. The BLNG Precinct will cover an area between Coulomb Point and Quondong Beach, south of James Price Point. **Figure 3.1** illustrates its location.

Figure 3.1 Site Location



The BLNG Precinct will be located within the Shire of Broome. The Shire of Broome has experienced significantly higher population growth than that of the State of Western Australia for a number of years. This is attributed to a number of factors, including the rapid growth of the tourism industry and the growth of government services. Other industry sectors active in Broome include the retail, aquaculture, agriculture and resource support industries.

Development around the BLNG Precinct is currently sparse. There are several indigenous communities located between Broome and the BLNG Precinct, and a large number of communities to the north of the site in and around Beagle Bay. The closest is the Goolarabooloo Millibinyarri community located approximately 40 kilometres to the south near Cape LaTreille. The beaches along the south-west Dampier Peninsula are used regularly for camping and fishing by tourists and locals, and form part of the 70 kilometres long Lurujarri Heritage Dreaming Trail between Broome and Coulomb Point.

3.2 The BLNG Precinct Description

The BLNG Precinct will include the development of facilities and infrastructure to process and export hydrocarbons and liquefied natural gas (LNG). The exact scale and layout of the BLNG Precinct has not yet been defined, and the assessment scenarios discussed in **Section 4** are based on the best estimates of the annual LNG throughput and the typical infrastructure required to meet this capacity. The information provided in this section was sourced from the Draft Kimberley LNG Precinct, Scope of Strategic Assessment and DSD BLNG Precinct, Draft Project Description including Emissions, Discharges and Waste, January 2010. At this stage, the ultimate capacity of the BLNG Precinct is expected to be 50 million tonnes of LNG per annum, with a minimum of two independent processing plants and supporting infrastructure provided on the site (DSD Draft Kimberley LNG Precinct – Scope of the Strategic Assessment).

The infrastructure assessment included consideration of the activities during the construction and operational phases of the BLNG Precinct. An indication of the average timeframe for each phase is illustrated in **Table 3.1**.

Table 3.1 Indicative BLNG Precinct phases and timeline

Indicative Timeline	Project Phase	Activities
Years 1 - 5	Initial Construction	Site Preparation Provision of support infrastructure for the construction phase Construction of LNG facilities and operational support infrastructure
Years 5 - 15	Operations Phase 1	Operating at minimum capacity
Years 12 - 15	Construction of Expanded Facilities	Site Preparation Expansion of LNG facilities and operational support infrastructure
Years 16 - 29	Operations Phase 2	Operating at medium capacity
Years 26 - 29	Construction of Expanded Facilities	Site Preparation Expansion of LNG facilities and operational support infrastructure
Years 30 - 40	Operations Phase 3	Operating at ultimate capacity
Years 40 - 45	Plant Decommissioning	Operating at medium capacity

Source: DSD Draft Kimberley LNG Precinct, Scope of Strategic Assessment

3.2.1 Activities

The activities associated with the BLNG Precinct were separated into three categories for the assessment. These categories were:

- Category A: Direct Activities.
- Category B: Indirect Activities.
- Category C: Related Activities.

3.2.2 Direct Construction Activities (Category A)

The construction activities will include the initial site preparation, provision of pioneer services and access infrastructure required to support the main construction activity for the BLNG Precinct. This will include:

- The construction of access roads
- The construction of the jetty (Materials Offloading Facility (MOF)) to enable construction materials to reach the site
- The construction of power and water supplies
- The provision of accommodation and services for construction workers

Once the pioneer and supporting infrastructure is in place, construction will commence on the LNG pipelines, processing plants and operational support buildings for the BLNG Precinct. **Figure 3.2** provides a summary of the typical construction activities, that will take place at the site. **Figure 3.3** shows an illustration of an MOF.

Figure 3.2 Anticipated Construction Activities for the BLNG Precinct

Initial Construction Stage	
Site Preparation	
Marine	*Landside*
Dredging	Access road construction
Breakwater construction	Pioneer camp construction
	Site clearing and levelling
	Stormwater management
Construction Supporting Infrastructure	
Marine	*Landside*
Jetty construction	Construction camps
Pioneer Material Offloading Facility (MOF)	Power generation infrastructure
	Construction of fuel and chemical storage area
	Water supply infrastructure
	Waste water treatment plant installation
	Utility services installation
	Preparation of temporary lay down areas
	Construction of aggregate crushing and screening plant
Facilities and Operational Supporting Infrastructure	
Marine	*Landside*
Integrated Marine Facility construction, including a MOF and marine support facilities	LNG Plant construction
Pipeline installation	Pipeline installation
	Liquid effluent treatment and discharge systems
	Internal haul road construction
	Operational lay down areas
	Warehouse, administration, security, workshops, laboratory and training buildings
	Permanent worker accommodation buildings

Source: DSD Draft Kimberley LNG Precinct, Scope of Strategic Assessment

Figure 3.3 Example of a Pioneer Materials Offloading Facility (Woodside LNG plant at the Burrup Peninsula)

Source: AECOM

3.2.3 Direct Operational Activities (Category A)

The BLNG Precinct will involve the delivery of hydrocarbons from the offshore basin to the BLNG Precinct, where they will be treated, liquefied and stored before being exported by ship to national and international destinations. The export products will include market quality LNG, condensate (light oil) and potentially Liquid Petroleum Gas (LPG) (Propane and Butane) products. **Figure 3.4** shows an example of an LNG processing and export plant.

Figure 3.4 Example of the an LNG processing and export plant (Woodside LNG North West Shelf Venture, WA)

Source: AECOM

The integrated marine facility at the site will include:

- A MOF for operational activities
- Berths for export ships such as LNG carriers, condensate tankers and LPG carriers
- An all weather harbouring facility for support vessels, supply boats and tugs
- Marine support facilities for dredging, bunkering, refuelling and maintenance activities

The LNG processing, handling and storage facilities will include:

- Gas pre-treatment, conditioning and liquefaction processing trains
- Condensate and LPG processing facilities
- Storage (LNG, condensate and potentially LPG)
- Power generation and other utilities
- Flare and fuel system facilities
- Reservoir carbon dioxide removal facilities
- Liquid effluent storage and treatment systems
- Operations administration, maintenance and central control room
- LNG, LPG and condensate storage tanks

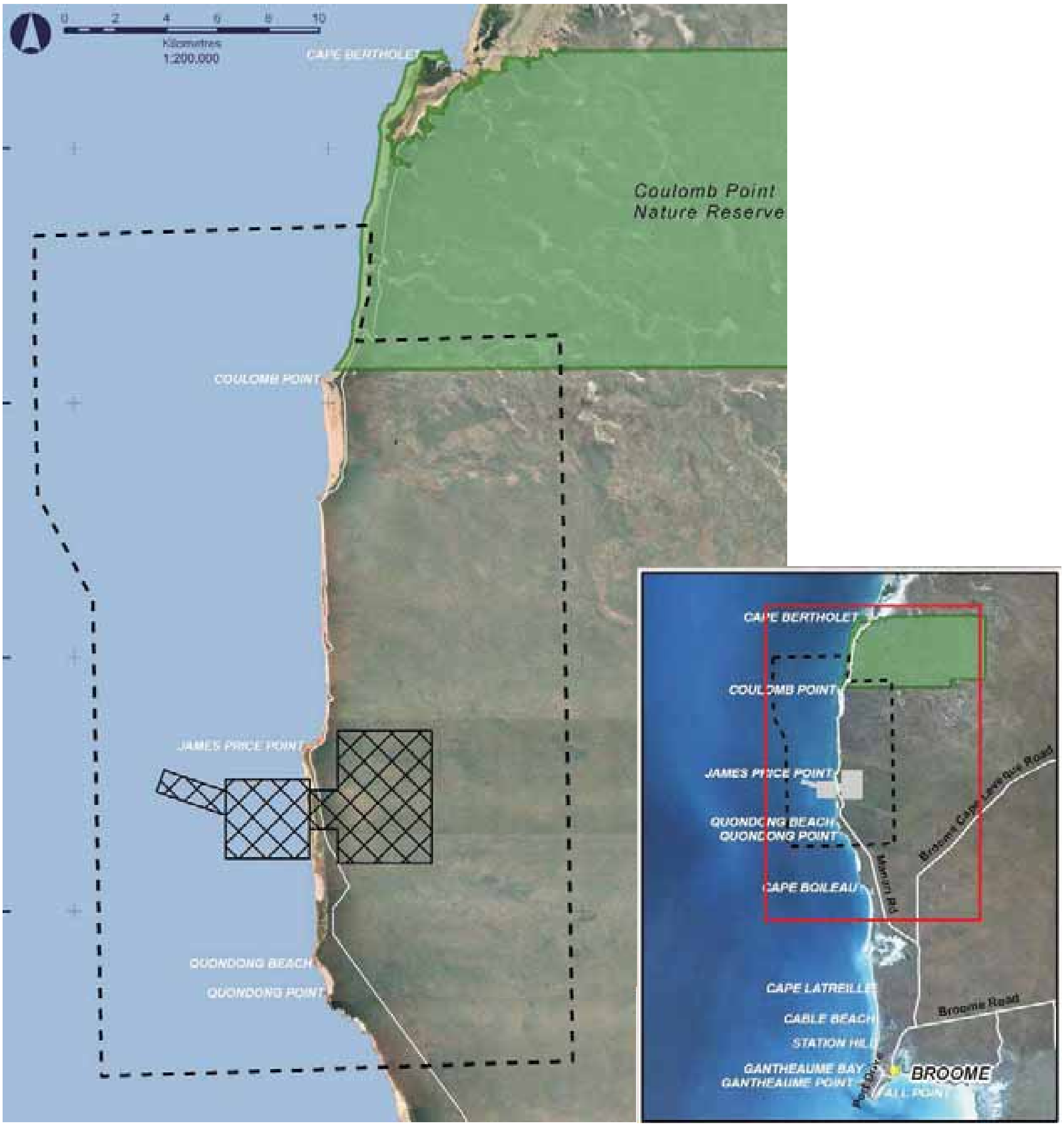
As well as the direct processing and export activities, there will also be ongoing administration and site maintenance activities will include dredging, equipment maintenance, stormwater management, waste management and fire management. Construction and operation staff will be required to live on site during their shifts, requiring additional resources to manage the accommodation facilities (including cooking and cleaning services), indoor and outdoor recreational facilities and maintenance of all the associated water, power, telecommunications and waste water services. Consumable supplies for onsite accommodation services will need to be delivered to the site by ship or road.

An indication of the potential footprint of the marine and landside operational infrastructure is illustrated in **Figure 3.5**. The actual facilities within the BLNG Precinct will depend on the design and operation methods used by the BLNG Precinct proponents.

The activities included in the assessment for Category A were:

- Power to operate the processing facilities, workers' accommodation and industrial precinct
- Water to operate the processing facilities
- Water required for the workers' accommodation and industrial precinct
- Telecommunications required for the processing facilities, workers' accommodation and industrial precinct
- Waste (solid and water) removal for the processing facilities, workers' accommodation and industrial precinct
- Transport required for the operation of the processing facilities, workers' accommodation and industrial precinct (including staff, service and logistic and construction vehicles)

Figure 3.5 Potential footprint of the marine and landside operational infrastructure (subject to change)



Source: Department of State Development

3.2.4 Indirect Activities (Category B)

The BLNG Precinct indirect activities were also considered as part of the infrastructure assessment. These indirect activities may affect the region outside the BLNG Precinct, particularly regional centres such as Broome, Derby, and local indigenous communities.

The indirect activities included in the assessment were:

- Increased passenger throughput at Broome Airport due to fly in fly out BLNG Precinct construction and operation employees
- Increased tonnage throughput at Broome Port due to BLNG Precinct construction and operation activities
- Increased vehicle movement on roads in and around Broome due to BLNG Precinct construction and operation activities
- Increased population of Broome due to BLNG Precinct employees and families
- Construction of a service corridor connecting the BLNG Precinct to Broome

These indirect activities impact on the regional infrastructure including water, waste water, solid waste, power, gas, telecommunications and transport.

3.2.5 Related Activities (Category C)

Category C activities are described as related projects, which are indirectly linked to the BLNG Precinct but are proposed by entities separate to the precinct proponent (Department of State Development) and are thus outside of the scope of the BLNG Precinct Strategic Assessment. However, it is important to consider the potential impacts of these activities on the existing and proposed infrastructure. These activities include:

- Upstream developments (including gas extraction and transport) from the Browse Basin of proponents who elect to utilise the BLNG Precinct
- Upstream exploration and appraisal activities within the Browse Basin and the activities required to support such operations
- Upstream exploration and appraisal activities in the Canning Basin and other onshore hydrocarbon provinces within proximity to the BLNG Precinct location
- Other independent projects related to resource development as appropriate and that can be reasonably identified
- Any activities related to the workforce of the above projects

4.0 Assessment Scenarios

Four BLNG Precinct scenarios were developed to accommodate the various development options that may occur. These scenarios were all assessed as part of this study. The scenarios and their descriptions are provided in this section. The information regarding the descriptions was sourced from:

- Precinct Workforce Projection, September 2009
- DSD, Kimberley LNG Social Impact Assessment, Sensitivity Analysis of Workforce Population Impacts Model, November 2009
- DSD, BLNG Precinct, Draft Project Description including Emissions, Discharges and Waste, January 2010

The population data collected from the above reports is outlined in **Table 4.1**. The population projections for Broome are based on the upper set of figures in the November report (further information on these projections is provided in **Sections 2.0** and **Appendix C**).

4.1.1 Scenario Description

Scenario 1 was the base case for the assessment. For this scenario, it was assumed that the BLNG Precinct is not constructed. This scenario provides a future case where the Browse Basin is developed, but the BLNG Precinct is not constructed at James Price Point.

Scenario 2 (low case) assumed that the BLNG Precinct is constructed, however it only handles 15 million tonnes per annum and takes 15 years to reach this capacity.

Scenario 3A (Medium Case A) assumed that the BLNG Precinct is constructed to cater for 25 million tonnes per annum within 25 years.

Scenario 3B (Medium Case B) assumed that the BLNG Precinct is constructed to cater for 35 million tonnes per annum within 25 years.

Scenario 4 (High Case) is the optimum case of the BLNG Precinct with a capacity of 50 million tonnes per annum within 30 years.

Table 4.1 describes the key assumptions for the BLNG Precinct and Broome for each scenario.

Table 4.1 Scenario Key Assumptions

Item	Scenario 1 (Base Case) Description	Scenario 2 (Low Case) Description	Scenario 3A (Medium Case) Description	Scenario 3B (Medium Case B) Description	Scenario 4 (High Case) Description
BLNG Precinct Final Investment Decision	The BLNG Precinct does not go ahead	2012	2012	2012 for first proponent and 2016 for second proponent	2012 for first proponent, 2017 for second proponent and 2024 for third proponent
BLNG Precinct Capacity	None	15 million tonnes per annum	25 million tonnes per annum	35 million tonnes per annum	50 million tonnes per annum
BLNG Precinct Completion Date	Not Completed	2027	2037	2037	After 2040
Components on site	None	Various upstream facilities Interfiled pipeline Export pipeline Onshore infrastructure and utilities 3 LNG processing trains, with opportunity to add 1 or more processing trains	Various upstream facilities Interfiled pipeline Export pipeline Onshore infrastructure and utilities Initially 3 LNG processing trains, with an additional 4 trains added later	Various upstream facilities Interfiled pipeline Export pipeline Onshore infrastructure and utilities Initially 3 LNG processing trains, with an additional 4 trains added later A second proponent will then add 3 LNG processing trains	Various upstream facilities Interfiled pipeline Export pipeline Onshore infrastructure and utilities Initially 3 LNG processing trains, with an additional 4 trains added later A second proponent will then add 3 LNG processing trains 4 additional LNG processing trains are added
Number of Proponents	None	One	one	Two	Up to three
Material Sourcing	None	Downstream modules and upstream facilities fabricated in south east Asia			
Maintenance	Not Required	Turnaround maintenance scheduled every five years			
Construction Workforce	None	Maximum 5,185 in 2013	Maximum 5,185 in 2013	Maximum 6,000 in 2020	Maximum 6,000 in 2021
Construction Workforce Shifts	Not Required	Four weeks on and one week off			
Construction Workforce Living in Broome	None	15% of the maximum workforce live in Broome. This equates to 778 people.	15% of the maximum workforce live in Broome. This equates to 778 people.	20% of the maximum workforce live in Broome. This equates to 1,200 people.	20% of the maximum workforce live in Broome. This equates to 1,200 people.
Construction Workforce Living Elsewhere	None	At the maximum construction time in 2013, 4,407 construction workers will live elsewhere	At the maximum construction time in 2013, 4,407 construction workers will live elsewhere	At the maximum construction time in 2020, 4,800 construction workers will live elsewhere.	At the maximum construction time in 2021, 4,800 construction workers will live elsewhere.

Item	Scenario 1 (Base Case) Description	Scenario 2 (Low Case) Description	Scenario 3A (Medium Case) Description	Scenario 3B (Medium Case B) Description	Scenario 4 (High Case) Description
Operation Workforce	None	Maximum 417 from 2024 to 2041	Maximum 469 from 2033 to 2041	Maximum 835 from 2034 to 2041	Maximum 1,000 after 2041
Operation Workforce Shifts	Not Required	Two weeks on and two weeks off			
Operation Workforce Living in Broome	None	60% of the maximum operational workforce live in Broome. This equates to 250 people.	60% of the maximum operational workforce live in Broome. This equates to 282 people.	60% of the maximum operational workforce live in Broome. This equates to 501 people.	60% of the maximum operational workforce live in Broome. This equates to 600 people.
Operation Workforce Living Elsewhere	None	At the maximum operation time 2024-2041, 167 operation workers will live elsewhere.	At the maximum operation time 2033-2041, 187 operation workers will live elsewhere.	At the maximum operation time 2034-2041, 334 operation workers will live elsewhere.	At the maximum operation time after 2041, 400 operation workers will live elsewhere.
Broome Total Population Projection	Maximum year 2041 at 31,871 people. In 2030 26,811 people are predicted, in 2034 28,651 people are predicted, and in 2036 29,571 people are predicted.	In the maximum year of 2041, the population is predicted to be 33,180.	In the maximum year of 2034, the population is predicted to be 37,426. In the year 2041, it is predicted to be 33,650 people.	In the maximum year of 2030, the population is predicted to be 35,466. In the year 2041, it is predicted to be 34,959 people.	In the maximum year of 2036, the population is predicted to be 41,029. In the year 2041, it is predicted to be 37,131 people.
Additional Population in Broome due to the BLNG Project		1,309 people	For 2034 is 8,775 people and 2041 is 1,779 people	For 2030 is 8,655 people and 2041 is 3,088 people	For 2036 is 11,458 people and 2041 is 5,260 people

Source: Precinct Workforce Projection. September 2009, DSD. Kimberley LNG Social Impact Assessment, Sensitivity Analysis of Workforce Population Impacts Model. November 2009, DSD. BLNG Precinct Draft Project Description including Emissions, Discharges and Wastes. January 2010.

5.0 Water

This section describes the existing water infrastructure and the base case demand, and compares these against the water demand for the low, medium and high cases. The Rights in Water Irrigation Act 1914 provides for regulation, management, use and protection of water resources and irrigation schemes. This includes the rights and licenses to take water; permit to obstruct or interfere with a watercourse or wetland including its bed or banks. Any such activities outlined in this section will need to adhere to this legislation.

5.1 Existing

The existing water facilities servicing the BLNG Precinct are outlined in this section.

5.1.1 Potable Water

There is currently no water infrastructure servicing the BLNG Precinct. Water resources near the BLNG Precinct include both confined and unconfined aquifers of substantial extent. Other developments on the Dampier Peninsula, including the town of Broome, currently source their water from these aquifers.

Broome is entirely dependent on groundwater for its potable water supply. It's water supply is obtained from the unconfined Broome Sandstone aquifer north-east of the town (DSD July 2009). The aquifer provides high quality water, however is recharged directly from rain water, and thus is vulnerable to contamination (DSD July 2009).

There is 10,600 megalitres per year of sustainable capacity to draw on (DSD August 2009). The existing 14 bores produce 4,200 megalitres per year of water (Water and Rivers Commission 2001). The current town demand for water is 4,500 megalitres per year (DSD August 2009), thus the bore field has reached its production capacity (Water Corporation, January 2009). The pump station and supply mains have also reached their maximum capacity (Water Corporation, January 2009).

The Water Corporation has recently completed an upgrade of the bore field by drilling three new bores, which each produce 730 megalitres per year of water, plus a peaking bore, which will produce 730 megalitres per year when required (Water Corporation, January 2009).

5.1.2 Non Potable

The site is located adjacent to the Indian Ocean and experiences high seasonal rain fall. This provides an opportunity to utilise sea water and harvested rain water for construction and appropriate non-potable uses.

In Broome, a new waste water treatment plant now under construction on behalf of the Water Corporation is designed to recycle waste water for on-site usage (Water Corporation, January 2009).

5.2 Scenario 1 (Base Case)

The current water supply from the aquifer is estimated to be sufficient to supply Broome until the year 2050 (DSD August 2009). Based on the current water demand of 4,500 megalitres per year and the current population of 16,600 (WAPC / DPI November 2008), the estimated water consumption is about 0.27 megalitres per year per person.

The projected population in 2041 is 31,871 (DSD November 2009). The estimated future demand can be predicted at approximately 8,600 megalitres per year based on an average water usage of 0.27 megalitres per year per person. This is still within the available 10,600 megalitres per year of groundwater from the current aquifer.

The existing 14 bores produce 4,200 megalitres per year of water (Broome Water Reserve: Water Source Protection Plan, 2001), which is below the current water demand. The recently completed water infrastructure upgrades will increase the production level to approximately 7,120 megalitres per year. Further upgrades will be required to produce 8,600 megalitres per year in 2041.

5.3 Scenarios 2, 3A, 3B and 4 (Low, Medium and High Cases)

This section outlines the method used to calculate the predicted water demand for Scenarios 2, 3A, 3B and 4.

5.3.1 Construction – Category A – Workforce Accommodation

The construction workforce is anticipated to have an average water usage of 0.27 megalitres per year per person. This includes water for irrigation and other water activities such as swimming pools. The 0.27 megalitres per year per person water consumption rate is based on the current water usage in Broome and is likely to be conservative for a construction village situation.

5.3.2 Construction – Category A – BLNG Precinct

An estimate of water demand for the construction of the BLNG Precinct was determined based on a similar LNG facility (The Burrup) located in Withnell Bay near Dampier on the Burrup Peninsula. The Burrup facility produces 7.5 million tonnes per annum of LNG. **Table 5.1** outlines the construction water requirement for The Burrup and the equivalent calculated water requirements for the BLNG Precinct. These figures are just indicative and will require confirmation once construction methods are determined.

Table 5.1 Construction Water Requirements for The Burrup and BLNG Precinct

	Production	Approx Foot print Area (Ha) (based on ratio of scenario area)	Earth Works in m^3 (based on Burrup depth of construction)	Water required based on 700 l/m^3 of earthwork	Concrete in m^3 (based on a ratio of the gas production)	* Water required based on grade 32 and cement content of 335 kg/m^3 and a w/c of 0.53	Total Construction Water required with a contingency of 30% for other usage	Years of Construction (**)
Burrup LNG Gas Plant(*)	7.5 Mtpa	200	6.3 M	4,400 ML	132,000	24 ML	N/A	N/A
BLNG Precinct Scenario 2	15 Mtpa	600	19 M	13,300 ML	264,000	47 ML	17,000 ML	6
BLNG Precinct Scenario 3A	25 Mtpa	1,000	32 M	22,400 ML	440,000	78 ML	29,000 ML	13
BLNG Precinct Scenario 3B	35 Mtpa	1,400	44 M	30,800 ML	620,000	110 ML	40,000 ML	17.5
BLNG Precinct Scenario 4	50 Mtpa	2,000 (**)	63 M	44,000 ML	880,000	156 ML	57,000 ML	20

(*) Approximate from fact sheet "onshore facilities Burrup Gas Plant" and Technical Standard – SA Water Corporation, Supply and delivery of Grade 32, 40 or 50 Concrete.

(**) Sourced from DSD. BLNG Precinct, Draft Project Description including Emissions, Discharges and Waste. January 2010

It is possible to utilise salt water for some of the construction activities including earthworks and dust suppression. It is also possible to use salt water for fire fighting during construction. An investigation will need to be undertaken to determine the suitability and availability of untreated bore water for fire fighting and construction activities. The required potable water is likely to come from either fresh water shallow aquifer (for example Broome Sandstone), desalination of water from the Wallal or Grant aquifers or desalination of sea water. Desalination is done by reverse osmosis of sea water or brackish water (like that from the Wallal aquifer) through membranes to remove molecules larger than water including salt. The resulting freshwater can be used for drinking, construction and other operations.

The Wallal Aquifer is located approximately 200 metres below the ground and is slightly salty (around 2,500-3,500 parts per million salinity / salty water). The desalination of the water from this source will result in a higher efficiency and lower volume of residual brine mainly due to the low salt content compared to the sea water.

However, the amount of ground water extraction will need to be in accordance with ground water licences and subject to an environmental impact assessment.

During construction, it is possible that a temporary desalination plant for water supply will be required prior to completion of the permanent desalination plant. For the initial (pioneer) stage of the construction, it may be necessary to transport drinking water from Broome.

5.3.3 Operation – Category A – Workers Accommodation

The derived water requirement for the workers accommodation was again based on 0.27 megalitres per year per person. Depending on the location of the workers accommodation, the option of providing a desalination water treatment package for the initial stage could be considered. A single desalination plant could supply the workforce village and BLNG Precinct needs, with reserve storage capacity at each site.

5.3.4 Operation – Category A – BLNG Precinct

The water usage during operation will depend on the technology selected by the proponent and the water source. Indicative water demand estimates for each water source are outlined in **Table 5.2**.

Table 5.2 Indicative Operation Water Demand

Scenario	Water Demand if Water is Sourced from Fresh Water	Water Demand if Water is Sourced from Saline Aquifer	Water Demand if Water is Sourced from Sea Water
2	2,000 ML/yr	5,000 ML/yr	8,000 ML/yr
3A	4,000 ML/yr	8,000 ML/yr	14,000 ML/yr
3B	6,000 ML/yr	12,000 ML/yr	19,000 ML/yr
4	8,000 ML/yr	16,000 ML/yr	27,000 ML/yr

Source: DSD. BLNG Precinct, Draft Project Description including Emissions, Discharges and Waste. January 2010

BLNG Precinct freshwater is likely to come from either freshwater shallow aquifer, desalination of saline ground water from the Wallal or Grant aquifers or desalination of sea water.

The capacity of each water source to supply the operations water demand needs to be investigated. The amount of ground water used, would be in accordance with ground water licences and be subject to an environmental impact assessment.

The low salinity bore water could be used directly from the Wallal aquifer for non-potable demands during operation.

5.3.5 Construction and Operation – Categories B and C

The increased demand on Broome's water resources due to Category B and C activities was calculated based on the estimated average consumption of 0.27 megalitres per year per person. This figure was based on Broome's current water usage and thus includes households, civic and business water use. The population increases due to Category B and C activities used in the calculation were:

- 1,309 for Scenario 2
- 8,775 for Scenario 3A
- 8,655 for Scenario 3B
- 11,458 for Scenario 4

These figures were sourced from the DSD Kimberley LNG Social Impact Assessment, Sensitivity Analysis of Workforce Population Impacts Model November 2009 and are the maximum predicted population increase.

5.4 Assessment

The water requirements for each of the scenarios were calculated and compared against the base case requirements and the infrastructure capacities (where relevant). The calculated demand figures are illustrated in **Tables 5.3, 5.4** and **5.5**.

Table 5.3 Comparison of Construction Water Usage at Site

Phase/Activity	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Construction Category A Workforce Village	1,400 ML/yr	1,400 ML/yr	1,600 ML/yr	1,600 ML/yr
Indicative Yearly Water Usage Over the Construction Period	2,800 ML/yr	2,200 ML/yr	2,300 ML/yr	2,900 ML/yr

The size of the infrastructure required will depend on the water supply source.

Table 5.4 Comparison of Operation Water Usage at Site

Phase/Activity	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Operation Category A Workforce Village	120 ML/yr	130 ML/yr	230 ML/yr	270 ML/yr
Indicative Maximum Yearly Water Usage Over the Operation Period	8,000 ML/yr	14,000 ML/yr	19,000 ML/yr	27,000 ML/yr

The size of the infrastructure required and the amount of water required will depend on the water supply source (the figures in **Table 5.4** are based on the supply source being seawater which has the maximum water demand).

Table 5.5 Comparison of Water Usage in Broome

Phase/Activity	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Projected Scenario 1 Population	31,871			
Scenario 1 Water Usage	8,600 ML/yr			
Projected Population for 2041	33,180	33,650	34,959	37,131
TOTAL WATER USAGE	**8,960 ML/yr**	**9,080 ML/yr**	**9,440 ML/yr**	**10,020 ML/yr**
Capacity of Infrastructure	10,600 ML/yr			
Within Capacity	Yes	Yes	Yes	Yes
Percentage increase from Scenario 1	4%	6%	10%	17%

Table 5.5 illustrates that the water infrastructure in Broome is sufficient to cater for the predicted water demand in 2041. However, due to the predicted fluctuation in the construction workforce over the period from 2010 and 2041, the maximum predicted population is not in 2041 for all the scenarios. Scenarios 3A, 3B and 4 have the maximum populations in the years 2034, 2030 and 2036 respectively. In 2034, the projected population for Scenario 3A is 37,426, which equates to 10,110 megalitres per year of water usage. In 2030, the projected population for Scenario 3B is 35,466, which equates to 9,580 megalitres per year of water usage. In 2036, the projected population for Scenario 4 is 41,029, which equates to 11,080 megalitres per year of water usage. All of which are within the capacity of Broome's water supply, except for Scenario 4. Demand may exceed the capacity for two years (2036 and 2040) in Scenario 4.

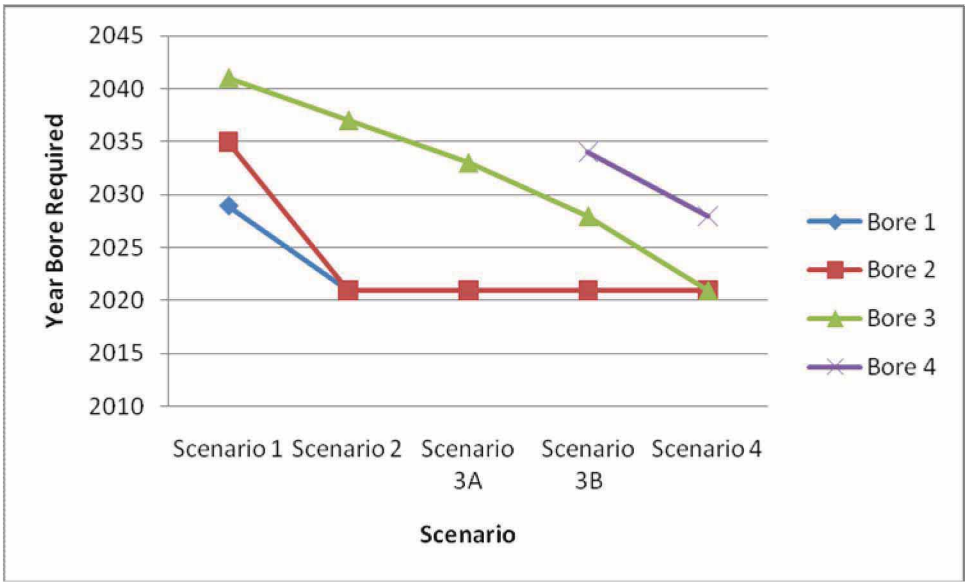
5.5 Mitigation Measures

As the water demand for Scenarios 2, 3A and 3B (Categories B and C) are within the capacity of Broome's water supply there is no requirement for mitigation measures. Scenario 4 will require alternative water supply for the years 2036 and 2040. This additional water supply could be collected from rain water harvesting or grey water recycling for use as non-potable water (such as for industry).

The Water Corporation has recently upgraded the bore infrastructure production to 7,120 megalitres per year by installing four additional bores, each producing 730 megalitres per year of water. However, for all Scenarios, new bores (with associated infrastructure such as storage tanks, pumping stations and pipelines) will be required to access this supply. Scenario 1 will require three new bores, one in each of the following years: 2029, 2035 and 2041. Scenario 2 will require no new additional bores compared to Scenario 1. However, it will require the construction of the bores to be brought forward to the years 2021 (for two bores) and 2037. Scenario 3A also does not require any new bores compared to Scenario 1. However, it also requires the construction of the bores to be brought forward to 2021 (two bores) and 2033. Scenario 3B requires an additional fourth bore to be constructed in 2034. It also requires the third bore to be constructed in 2028. Scenario 4 will also require a fourth bore, but this will be required in 2028. All of the other bores will be required in 2021 for Scenario 4.

Figure 5.1 outlines the tentative timing for the upgrade of Broome's water supply.

Figure 5.1 Predicted Timing of the Upgrade to Broome's Water Supply



6.0 Waste Water

This section describes the existing waste water infrastructure and the base case generation, and compares these against the waste water generation for the low, medium and high cases.

6.1 Existing

This section outlines the existing waste water treatment and collection facilities servicing the BLNG Precinct.

6.1.1 Surface Water

The site has a semi-arid, tropical climate with average temperatures of 28 to 35 degrees Celsius. Rainfall can range between 132 millimetres to 1,454 millimetres per annum with an average of 569 millimetres. Hot, wet, and humid conditions occur between December and March. The majority of rainfall occurs during this time and tropical cyclones may occur. A warm, dry season occurs from April to November.

The site currently has no infrastructure to cater for the seasonal heavy rainfall.

In Broome, the intensity and amount of rainfall has given rise to the requirement for significant drainage areas in the form of compensating basins, drains, drainage swales, and extensive natural open space to enable overland flow and infiltration into the ground water aquifer.

6.1.2 Sewerage

There are currently no sewerage treatment facilities servicing the site. The closest substantial facility is located in Broome.

The majority of the existing Broome town is provided with reticulated sewerage, which discharges via a combination of gravity and pressure sewers into the existing waste water treatment plant located south of Clementson Street between the town and the port.

The existing waste water treatment plant has a capacity of 1,280 megalitres per year (DSD July 2009), this has already been reached. A second waste water treatment plant is currently under construction by the Water Corporation north of Broome on Crab Creek Road. The new plant is planned to be operational by the end of 2009 or early 2010. The plant is designed to utilise recycled water on site (DSD July 2009).

6.1.3 Other Waste Water

No other waste water is currently generated at the site. In Broome 100 cubic metres of waste water per month are received from septic tanks (Water Corporation January 2009).

6.2 Scenario 1 (Base Case)

This section describes Scenario 1 (Base Case) condition.

6.2.1 Surface Water

All new subdivisions and developments in Broome are required to take into consideration the need for ‘best practices’ in relation to the design, implementation and management of drainage systems, including water harvesting and water sensitive techniques.

6.2.2 Sewerage

Broome's new waste water treatment plant has been designed for an additional capacity of 1,280 megalitres per year (DSD July 2009). Further waste water treatment upgrades are planned. It is estimated that these improvements will increase the waste water capacity to 5,110 megalitres per year by the year 2035 (DEC June 2009).

The projected population in 2041 is 31,871 (DSD November 2009). Based on the current waste water generation rate of 1,280 megalitres per year and population of 16,600 (WAPC / DPI November 2008), the estimated waste water volume is about 0.08 megalitres per person per year. However, this calculation of waste water generation per person is much less than the calculated water usage per person of 0.27 megalitres per year per person (based on current water demand of 4,500 megalitres per year and the current population of 16,600). The anticipated waste water volume is considered more realistically to be approximately 50 percent of the consumed water (0.135 megalitres per year). This identifies that the current waste water generation figures may be underestimate and underlines the urgent need for a waste water treatment plant upgrade to an additional 1,280 megalitres per year this will provide a total capacity of 2,560 megalitres per year, which is sufficient to cater for the current population of 16,600.

The predicted waste water volume generated in 2041 for the estimated population of 31,871 based on the above assumption is 4,300 megalitres per year. This is within the planned Broome waste water treatment plant capacity of 5,110 megalitres per year by 2035.

6.3 Scenarios 2, 3A, 3B and 4 (Low, Medium and High Cases)

This section outlines the calculated waste water generated by Scenarios 2, 3A, 3B and 4.

6.3.1 Construction – Category A – Workforce Accommodation

There are two major and a few minor creeks in the James Price Point area. To reduce the risk of flooding during the wet season a hydrology study should be completed. This will enable key facilities to be sited in areas outside of the 1 in 100 year flood plan. Where this is not possible, methods to mitigate against flooding will need to be implemented. Such measures could include a stormwater drainage system and flood barriers. There could also be the opportunity to harvest rain water for use on the site. Water collected and removed from site should be discharged via the existing runoff outlet and should be of the same quality as the existing run off water.

The workforce accommodation will require a sewer network for collection of waste water. This network will need to cater for 0.135 megalitres per person per year (50 percent of water consumption). The network will include a waste water treatment plant. This plant could be a package treatment plant with treated effluent reuse facility, installed in stages, or it could consist of onsite treatment ponds. The opportunity to produce recycled water should be investigated. However, this may not be viable given the level of treatment required.

6.3.2 Construction – Category A – BLNG Precinct

Brine is produced as a by-product of the proposed desalination process. The estimated brine volume is about 100 percent of the required water volume. It can be discharged into the sea at a rate and a location where there will be minimal impact on the marine environment. The other waste water source is from the construction camp population of 6,000 people. The estimated waste water volume is about 810 megalitres per year based on 0.135 megalitres per person per year of waste water discharge. The estimated volume will be treated on site to a standard acceptable to the Environmental Protection Authority (EPA) then discharged together with the desalination by-product into the sea.

6.3.3 Operation – Category A

The final location of the BLNG Precinct operating site needs to be investigated to minimise flood impact due to the high seasonal rainfall intensity. Onsite drainage systems will be designed to divert anticipated surface water into natural and existing water channels where possible, and will discharge to the sea following appropriate treatment. This discharge poses negligible environmental risk.

During operations, waste water management will be required to minimise the risk of environmental harm. Where possible re-use of waste water should be implemented.

The estimated waste water volume from the operating personnel is about 0.135 megalitres per person per year (50 percent of daily water usage).

It is difficult to quantify the waste water volume from the BLNG Precinct during operation because the water generating sources are dependent on process technology and are yet to be identified. However, Woodside, BLNG Precinct, Draft Emissions, Discharges and Wastes (Chapter 5), February 2010 has indicated the waste water produced during operation is between 9,000 and 30,000 megalitres per year. The waste water will include:

- Liquid effluent from processing
- Liquid from ancillary equipment
- Surface run off
- Brine from the desalination plant
- Sanitary waste water (both sewerage and grey water)

The other waste water source is from the LNG facility operating population of about 1,000 people. The estimated waste water volume is approximately 140 megalitres per year based on 0.135 megalitres per person per year of waste water discharge. The waste water will be treated on site to a standard that meets the EPA requirements before being discharged into the sea.

The BLNG Precinct will be designed and operated to ensure that spills and leaks are contained within a bunded area (see below) and that contaminated storm water is captured and treated to ensure that adverse impacts on the quality of the groundwater are minimised.

A bund is an embankment or wall of brick, stone, concrete or other impervious material, which may form part or all of the perimeter of a compound and provides a barrier to retain liquid.

The June 2007, EPA Guidelines for Bunding and Spill Management applies to facilities that use or store liquids above ground, and provides information on bunds or spill containment systems to minimise the risk of environmental harm from liquid spills and leaks.

Collected waste water may include sewage, grey water, and rainfall runoff from potentially contaminated and non-contaminated areas, machinery washdown water and brine from the desalination process. The waste water will be treated to a high standard. The treated waste water will be tested to ensure it meets Australian guidelines before it is discharged into the sea in a controlled manner and at an appropriate location. The exact discharge location will be subject to an environmental impact assessment via the strategic assessment process to minimise risk of environmental impact. However, it is anticipated that the outfall would be located two to three kilometres offshore. The outfall will be specifically designed to maximise mixing so that the water attains the same characteristics as the ocean water within tens of metres of where it is discharged.

The waste water treatment plant constructed to treat waste water produced on site during construction will be staged and upgraded to include the operation phase.

6.3.4 Construction and Operation – Categories B and C

The increased generation of waste water produced by Category B and C activities was calculated based on the estimated average generation of 0.135 megalitres per person per year. This figure is based on Broome's current waste water generation and thus includes households, civic and business waste water production.

Other waste water generated by Category B and C industries was not identified and assumed to be managed by industry to meet statutory requirements.

6.4 Assessment

The waste water generated for each of the scenarios was calculated and compared against the base case requirements and the infrastructure capacities (where relevant). The calculated generated volumes are illustrated in **Tables 6.1, 6.2 and 6.3**.

Table 6.1 Comparison of Construction Waste Water Generation at Site

Phase/Activity	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Construction Category A Workforce Village	700 ML/yr	700 ML/yr	810 ML/yr	810 ML/yr
From Desalination Plant	2,800 ML/yr	2,200 ML/yr	2,300 ML/yr	2,900 ML/yr

The size of the facility will depend on the treatment method used.

Table 6.2 Comparison of Operation Waste Water Generation at Site

Phase/Activity	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Operation Category A Workforce Village	60 ML/yr	70 ML/yr	120 ML/yr	140 ML/yr
From BLNG Plant	9,000 ML/yr	15,000 ML/yr	20,000 ML/yr	30,000 ML/yr

The size of the facility will depend on the treatment method used.

Table 6.3 Comparison of Waste Water Generation in Broome

Phase/Activity	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Scenario 1 Population	31,871			
Scenario 1 Waste Water Production	4,300 ML/yr			
Projected Population for 2041	33,180	33,650	34,959	37,131
TOTAL	**4,480 ML/yr**	**4,540 ML/yr**	**4,720 ML/yr**	**5,010 ML/yr**
Capacity of Infrastructure	5,110 ML/yr			
Within Capacity	Yes	Yes	Yes	Yes
Percentage increase from Scenario 1	4%	6%	10%	17%

Table 6.3 illustrates that the waste water infrastructure in Broome should be sufficient to cater for the predicted waste water production in 2041. However, due to the predicted fluctuation in the construction workforce over the period from 2010 and 2041, the maximum population does not occur in 2041 for all the scenarios. Scenarios 3A, 3B and 4 have the greatest population in the years 2034, 2030 and 2036 respectively. In 2034, the projected

population for Scenario 3A is 37,426, which equates to 5,050 megalitres per year of waste water. In 2030, the projected population for Scenario 3B is 35,466, which equates to 4,790 megalitres per year of waste water. In 2036, the projected population for Scenario 4 is 41,029, which equates to 5,540 megalitres per year of waste water. Scenarios 3A and 3B are within the capacity of Broome's waste water treatment plant. Scenario 4 has a maximum production above the treatment plant capacity. This is the case for the next two highest years (2040 and 2032). The fourth highest year is 2028 (37,180 population) which is within capacity of the treatment plant (5,020 megalitres per year).

6.5 Mitigation Measures

All of the Scenarios, except for three years (2036, 2040 and 2032) in Scenario 4, should generate waste water within the capacity of Broome's waste water treatment plant, and thus do not require mitigation. For Scenario 4, years 2036, 2040 and 2032 measures to reduce the volume of water requiring treatment could be utilised such as recycling grey water.

7.0 Solid Waste

This section describes the existing solid waste infrastructure and base case generation, and compares these against the solid waste generation for the low, medium and high cases. Information outlined in this section was sourced from the Social Impact Assessment Workshop August 2009 and conversations with the Shire of Broome and Kimberley Waste Services.

7.1 Existing

Currently the Shire of Broome operates one Class II Landfill for the region. It is located approximately seven kilometres north of Broome on a six metre wide sealed road from the Broome Highway. The landfill accepts:

- Clean fill
- Type 1 and 2 inert waste
- Putrescibles (domestic) waste
- Special waste types 1 (asbestos)
- Special waste type 2 (biomedical waste)

The Department of Environment and Conservation are in the process of amending the licence to also include Category 61 – Liquid waste.

The landfill is expected to remain open for approximately another five years at current filling rates. This equates to approximately 200,000 cubic metres of airspace remaining (based on 40,000 cubic metres of waste generated per year). The Shire has commenced the process of locating and planning for a new landfill to service the region after the existing landfill closes.

The Shire of Broome also offers waste and recyclable collection from domestic and commercial residences, provided by Kimberley Waste Services. Waste collection takes place weekly and uses a 19 cubic metre truck for collection. Kerbside recycling services include collection of the following material:

- Code 1 plastics
- Code 2 plastics
- Aluminium and steel cans
- Glass containers
- Old newspaper
- Old corrugated cardboard
- Liquid paperboard

Recycling services available at the landfill include:

- Scrap steel and car bodies
- Car batteries
- Gas bottles
- Electronic waste
- Waste oil
- Clean, empty chemical drums (the Drum Muster program)

These materials are transported away from the region for recycling on an as-needs basis.

Material collected for recycling from the kerbside is sorted in Broome by Kimberley Waste Services and processed for transportation to Perth. Currently, the Shire offers a fortnightly recycling service and the recycling sorting facility operates on a seven to eight day fortnight. Kimberley Waste Services have indicated that they have two to three extra days of capacity to process additional recyclable material (personal communication: Dave Shaw, Kimberley Waste Services, 9 December 2009).

Hazardous material and liquid waste are also processed by Kimberley Waste Services. These are transported to Port Hedland where there is a high temperature incinerator. Dangerous goods cannot be handled by Kimberley Waste Services.

In summary, the current landfill is not designed to service the existing community beyond another five years. However, there is spare capacity within the recycling and hazardous material services, which could be expanded on demand.

7.2 Scenario 1 (Base Case)

As outlined in **Section 7.1** the current landfill is not designed to service the existing community beyond another five years. To cater for the Scenario 1 predicted population growth to 31,871 by 2041 (DSD November 2009) the available landfill capacity will require upgrading.

7.3 Scenarios 2, 3A, 3B and 4 (low, medium and high cases)

To cater for the solid waste produced by the construction, operation and population growth predicted for each Scenario the available landfill capacity will require upgrading.

7.4 Assessment

This section outlines the assessment of Scenarios 2, 3A, 3B and 4.

7.4.1 Construction – Category A

During the construction period, the types of waste and maximum volumes outlined in **Table 7.1** are expected to be produced over a period of five years. The figures in **Table 7.1** are based on extrapolation of estimates provided in the DSD Social Impact Assessment Workshop, August 2009 for an initial three train process plant.

Table 7.1 Construction Solid Waste Volumes

Type of Waste	Scenario 2 Maximum Volume	Scenario 3A Maximum Volume	Scenario 3B Maximum Volume	Scenario 4 Maximum Volume
Toxic Waste	340 - 400 m^3	590 - 700 m^3	830 – 1,000 m^3	1,170 – 1,400 m^3
Scrap/Recyclable Metal	45 - 100 m^3	80 – 175 m^3	115 - 250 m^3	160 - 350 m^3
Toxic Chemicals in Drums	15 - 35 m^3	20 - 60 m^3	30 - 85 m^3	45 - 120 m^3

Source: DSD Social Impact Assessment Workshop August 2009

These amounts are considered relatively minor and there is existing capacity in Broome to transport this waste out of the region for further processing.

There would also be some general waste and recyclables generated by onsite offices and break / meal rooms. While no volume for this waste was estimated, it is expected to be minor in comparison to the waste produced by employees living on the site during the construction period, and could be absorbed by the existing and future infrastructure.

Table 7.2 lists the calculated annual waste production by the maximum number of people estimated to be directly employed by the project and living at the precinct during the peak construction period. It is anticipated that this will occur:

- 2 years after construction commences for Scenario 2 and 3A,
- 9 years after construction commences for Scenario 3B, and
- 10 years after construction commences for Scenario 4.

Table 7.2 Estimated Waste Production during construction period.

Item	Scenario 2 Maximum Volume	Scenario 3A Maximum Volume	Scenario 3B Maximum Volume	Scenario 4 Maximum Volume
Estimated maximum number of construction workers living in at the workforce accommodation	5,185	5,185	6,000	6,000
Kg waste produced per capita per annum*	541 kg	541 kg	541 kg	541 kg
Assumed Compacted Waste Density**	1.3 tonnes/m^3	1.3 tonnes/m^3	1.3 tonnes/m^3	1.3 tonnes/m^3
Calculated tonnes per annum	2,800	2,800	3,300	3,300
Calculated m^3	2,200	2,200	2,500	2,500

* Based on average regional waste production calculated from data provided in Zero Waste Plan Development Scheme 2006 – 2007 published by Zero Waste WA. Data derived from information provided by the Mid West Regional Council, Pilbara Regional Council and the Bunbury-Harvey Regional Council. This figure takes into account an average diversion rate of 10 percent to recycling.

** Taken from the Landfill Levy Regulations Policy 1998, Department of Conservation and Environment, West Australia. This figure is considered conservative.

This equates to the following additional truck trips (based on a 19 cubic metre collection truck) for each scenario:

- Scenarios 2 and 3A – approximately 116 additional truck trips to the landfill per year, or an additional two to three truck trips per week.
- Scenarios 3B and 4 - approximately 132 additional truck trips to the landfill per year, or an additional two to three truck trips per week.

These numbers of additional truck trips may require discussion with local collection contractors to ensure that capacity is available prior to the peak construction period. Alternative means of collection and transport may be necessary. Planning and design work for the upgrade and installation of access roads to the accommodation village will need to take into consideration the volume and route of these additional collection trucks.

For Scenarios 2, 3A, 3B and 4, the calculated volume of waste is equivalent to approximately 6 percent, 6 percent, 8 percent and 8 percent (respectively) of Broome's current annual waste disposal. However, as discussed in **Section 7.1** the existing landfill is scheduled to close in approximately five years, without the addition of this project. If Scenarios 2, 3A or 3B are adopted, an appropriate strategy to handle the increased waste generated prior to the opening of a new landfill will need to be negotiated with the Shire of Broome. The additional volume of waste is likely to bring forward the closure of the existing landfill. This will need to be accounted for in the planning and design of the new landfill and the proposed opening date (that is, it may be required earlier than five years). The planning and design of the new landfill should take into consideration the volume and type of waste to be produced by this project.

Based on a diversion rate of 10 percent, it is expected that there will be 60 kilograms of recyclable material generated *per capita* on an annual basis (derived from the same data as the *per capita* waste data shown above), resulting in an additional 311 tonnes of recyclables per year (for Scenarios 2 and 3A), 360 tonnes of recyclables per year (for Scenarios 3B and 4). Based on discussion with the current waste and recyclable collection contractors (personal communication, Dave Shaw, Kimberley Waste Services, 9 December 2009), there is currently two to three days capacity for collecting and sorting of recyclable material per fortnight. This should be adequate to handle the increased volume of recyclable material. However, further discussion with the recycling contractor should be held to ensure capacity is available prior to the peak construction period.

7.4.2 Operation – Category A

During the operation period, the types of waste and associated maximum volumes listed in **Table 7.3** are expected to be produced annually (based on the preliminary estimates provided in the DSD Social Impact Assessment Workshop, August 2009).

Table 7.3 Category A Waste Generation per annum for Each Scenario during Operation*

Item	Scenario 2 Maximum Volume	Scenario 3A Maximum Volume	Scenario 3B Maximum Volume	Scenario 4 Maximum Volume
General waste	5,300 – 10,700 m^3/yr	9,300 – 18,700 m^3/yr	13,300 – 26,700 m^3/yr	18,600 – 37,300 m^3/yr
General recyclables	500 – 1,000 m^3/yr	880 – 1,800 m^3/yr	1,300 – 2,500 m^3/yr	1,800 – 3,500 m^3/yr
Toxic waste	250 – 500 m^3/yr	430 – 880 m^3/yr	620 - 1,250 m^3/yr	860 – 1,750 m^3/yr
Mercury (filters) contaminated waste	40 – 80 m^3/yr	70 – 140 m^3/yr	100 - 200 m^3/yr	140 – 280 m^3/yr
Chemical drums	20 – 40 m^3/yr	40 – 70 m^3/yr	50 - 100 m^3/yr	70 – 140 m^3/yr
Scrap / recyclable materials	10 – 20 m^3/yr	15 – 40 m^3/yr	20 - 50 m^3/yr	30 – 70 m^3/yr
Highly hazardous material (i.e. radioactive waste)	1 – 4 m^3/yr	2 – 7 m^3/yr	3 - 10 m^3/yr	4 – 14 m^3/yr
Fluorescent tubes	Up to 4 m^3/yr	Up to 7 m^3/yr	Up to 10 m^3/yr	Up to 14 m^3/yr

*** Derived from the preliminary estimates provided in the Social Impact Assessment Workshop, August 2009 for the initial development of three processing trains. It was assumed that Scenario 2 included four processing trains, Scenario 3A included seven processing trains, Scenario 3B included 10 processing trains and Scenario 4 included 14 processing trains (DSD November 2009).**

It is not known if these represent compacted or uncompacted volumes. The general waste, recyclables and scrap/recyclable materials could all be handled by the existing waste infrastructure and collection contractors. The toxic waste, chemical drums and fluorescent tubes could be handled by the current collection contractors who would transport it out of the region for further processing and disposal. The volumes listed above are not expected to affect significantly the existing or future waste infrastructure.

The highly hazardous material and mercury contaminated waste is likely to require specific collection, treatment and disposal processes. There is currently only one Class 4 Landfill in Western Australia, located in Red Hill just outside of Perth.

Table 7.4 illustrates the calculated annual waste production by the maximum number of people estimated to be directly employed by the project and living at the precinct during the peak operational period. It is anticipated that this would occur the following years after construction commences:

- For Scenario 2 – 13
- For Scenario 3A – 22
- For Scenario 3B – 21
- For Scenario 4 – 30

Table 7.4: Estimated Waste Production during operational period of each Scenario.

Item	Scenario 2 Maximum Volume	Scenario 3A Maximum Volume	Scenario 3B Maximum Volume	Scenario 4 Maximum Volume
Estimated maximum number of Operation workers living in the workforce accommodation	417	469	835	1,000
Kg waste produced per capita per annum*	541 kg	541 kg	541 kg	541 kg
Assumed Compacted Waste Density**	1.3 tonnes/m^3	1.3 tonnes/m^3	1.3 tonnes/m^3	1.3 tonnes/m^3
Calculated tonnes	230	260	450	540
Calculated m^3	180	200	350	420

* Based on average regional waste production calculated from data provided in Zero Waste Plan Development Scheme 2006 – 2007 published by Zero Waste WA. Data used in calculations is derived from information provided by the Mid West Regional Council, Pilbara Regional Council and the Bunbury-Harvey Regional Council. This figure takes into account an average diversion rate of 10 percent to recycling.

** Taken from the Landfill Levy Regulations Policy 1998, Department of Conservation and Environment, West Australia. This figure is considered conservative.

This equates to the following additional truck trips to the landfill per year (based on a 19 cubic metre truck capacity):

- Scenario 2 – 10, or less than one truck trips per week
- Scenario 3A – 11, or less than one truck trips per week
- Scenario 3b – 19, or less than one truck trips per week
- Scenario 4 – 23, or less than one truck trips per week

It is not expected to result in a significant impact on the existing or future waste infrastructure.

Based on a diversion rate of 10 percent it is expected that there will be 60 kilogram of recyclable material generated per capita on an annual basis (derived from the same data as the per capita waste data shown above), resulting in an additional 25 tonnes of recyclables per year (for Scenario 2), an additional 28 tonnes of recyclables per year (for Scenario 3A), an additional 50 tonnes of recyclables per year (for Scenario 3B), and an additional 60 tonnes of recyclables per year (for Scenario 4).

7.4.3 Construction and Operation – Categories B and C

Table 7.5 outlines the calculated the annual waste produced by Categories B and C activities in Broome.

Table 7.5 Estimated Categories B and C Waste Production by new residents.

Item	Scenario 2 Maximum Volume	Scenario 3A Maximum Volume	Scenario 3B Maximum Volume	Scenario 4 Maximum Volume
Scenario 1 Population in the Scenario 2, 3A, 3B and 4 maximum year	31,871	28,651	26,811	29,571
Maximum population for Scenario 2, 3A, 3B and 4	33,180	37,426	35,466	41,029
Kg waste produced per capita per annum*	541 kg			
Assumed Compacted Waste Density**	1.3 tonnes/m^3			
Scenario 1 Calculated m^3	13,300	12,000	11,200	12,300
Scenario Calculated m^3	13,800	15,600	14,800	17,100
Difference m^3	500	3,600	3,600	4,800

* Based on average regional waste production calculated from data provided in Zero Waste Plan Development Scheme 2006 – 2007 published by Zero Waste WA. Data derived from information provided by the Mid West Regional Council, Pilbara Regional Council and the Bunbury-Harvey Regional Council. This figure takes into account an average diversion rate of 10percent to recycling.

** Taken from the Landfill Levy Regulations Policy 1998, Department of Conservation and Environment, West Australia. This figure is considered conservative.

This equates to the following additional truck trips to the landfill per year (based on a 19 cubic metre collection truck):

- For Scenario 2, approximately 27, or an additional one trip per week
- For Scenario 3A, approximately 190, or an additional three to four trips per week
- For Scenario 3B, approximately 190, or an additional three to four trips per week
- For Scenario 4, approximately 253, or an additional four to five trips per week

However, as waste is collected on a weekly basis this equates to approximately an additional two percent, nine percent, nine percent and twelve percent (for Scenarios 2, 3A, 3B and 4, respectively) for collection per week. There is existing capacity within the current collection arrangement to accommodate this additional waste for Scenarios 2, 3A and 3B. For Scenario 4 discussions will need to be held with the service providers to ensure adequate capacity is available.

Based on a diversion rate of 10 percent it is expected that 60 kilograms of recyclable material will be generated *per capita* on an annual basis (derived from the same data as the *per capita* waste data shown above), resulting in an additional 80 tonnes of recyclables per year (for Scenario 2), 530 tonnes of recyclables per year (for Scenario 3A), 520 tonnes of recyclables per year (for Scenario 3B), and 690 tonnes of recyclables per year (for Scenario 4).

7.5 Assessment

The existing solid waste disposal infrastructure (the Broome landfill) is currently scheduled to close in five years. Based on the assessment of the five scenarios, it is likely that, from a cumulative perspective, the five scenarios adopted would result in the landfill reaching capacity sooner than five years. However, it is expected that the new landfill proposed will have adequate capacity to handle all five scenarios.

The existing kerbside collection and sorting recycling facilities are likely to have capacity to either handle the additional material generated or be expanded (in consultation with the project) to meet the requirements of the additional population in the region for Scenarios 2, 3A and 3B. Scenario 4 will require liaison with the service provider.

The infrastructure for material that requires transportation out of the region for processing and disposal, such as hazardous material, could be expanded to meet the requirements of the five scenarios. However, some materials such as radioactive waste requires independent collection and disposal programs established by the BLNG Precinct, as there is currently no infrastructure in the region to handle these waste types.

7.6 Mitigation Measures

The operators of the BLNG Precinct should commence negotiation with the Shire of Broome to ensure that the planning and design of the new landfill incorporates the capacity to service the additional people in the region because of the BLNG Precinct. As the BLNG Precinct may result in the existing landfill reaching capacity sooner than currently expected, it is important to work with the Shire to facilitate the opening of a new facility ahead of the current schedule.

8.0 Power

This section describes the existing power infrastructure and the base case demand, and compares these against the power demand for the low, medium and high cases.

8.1 Existing

The BLNG Precinct has no access to electrical power. Horizon Power, the power utility responsible for the Kimberley Region, has not established transmission or distribution networks within the region, rather focusing on providing numerous small power plants to local indigenous communities and towns.

Broome, the closest available source of electrical power, is some 50 kilometres away from the BLNG Precinct, requiring a substantial investment to establish a transmission network connecting it to Broome's power station.

An investment of about $180 million in capital works and associated costs has been made recently (2006), with $400 million more expected in the next 20 years in the Kimberley region (DSD July 2009). The recently commissioned new power station replaced the existing diesel-fired power stations. These stations were up to 30 years old and in most cases did not meet noise admission standards (DSD July 2009). The new power station became operational at the beginning of 2008. It has the capacity to generate 33,400 kilowatts per hour of power, by using 17 x 1,850 kilowatt Caterpillar engine / generators (Department of Environment and Conservation (DEC) June 2007). As demand for power grows, the capacity will be increased to 46,300 kilowatts per hour by installing another 8 engine / generators. Liquefied natural gas produced by the Maitland LNG Facility, 20 kilometres south-west of Karratha, is trucked by road trains 850 kilometres to the Broome Fuel Storage Facility (DEC June 2007). It is then vaporised and odorised before being piped approximately 12.2 kilometres south-southwest to the power station. The high density polyethylene pipe is 315 millimetres in diameter and transports gas at a rate of up to 11.5 terajoules per day (DEC June 2007). **Figures 8.1** and **8.2** illustrate the location and layout of the Broome Power Station, respectively.

A few indigenous communities within the Kimberley Region are supplied by small power plants, generally 300 kilowatts per hour. The State Government Aboriginal Community Remote Area Power Supply program is responsible for supplying remote areas in the Kimberley region. This program provides incentives for use of renewable power sources in areas off the main power grid (DSD July 2009).

On the Dampier Peninsula, 50 kilowatt per hour diesel power stations were established at Ardyaloon, Beagle Bay and Lombadina / Djarindjin (DSD July 2009). These stations are modular and are capable of being expanded when required (DSD July 2009).

Along with Broome's new power station new power facilities are to be provided for in Derby, Halls Creek, Fitzroy Crossing and Camballin-Looma (DSD July 2009).

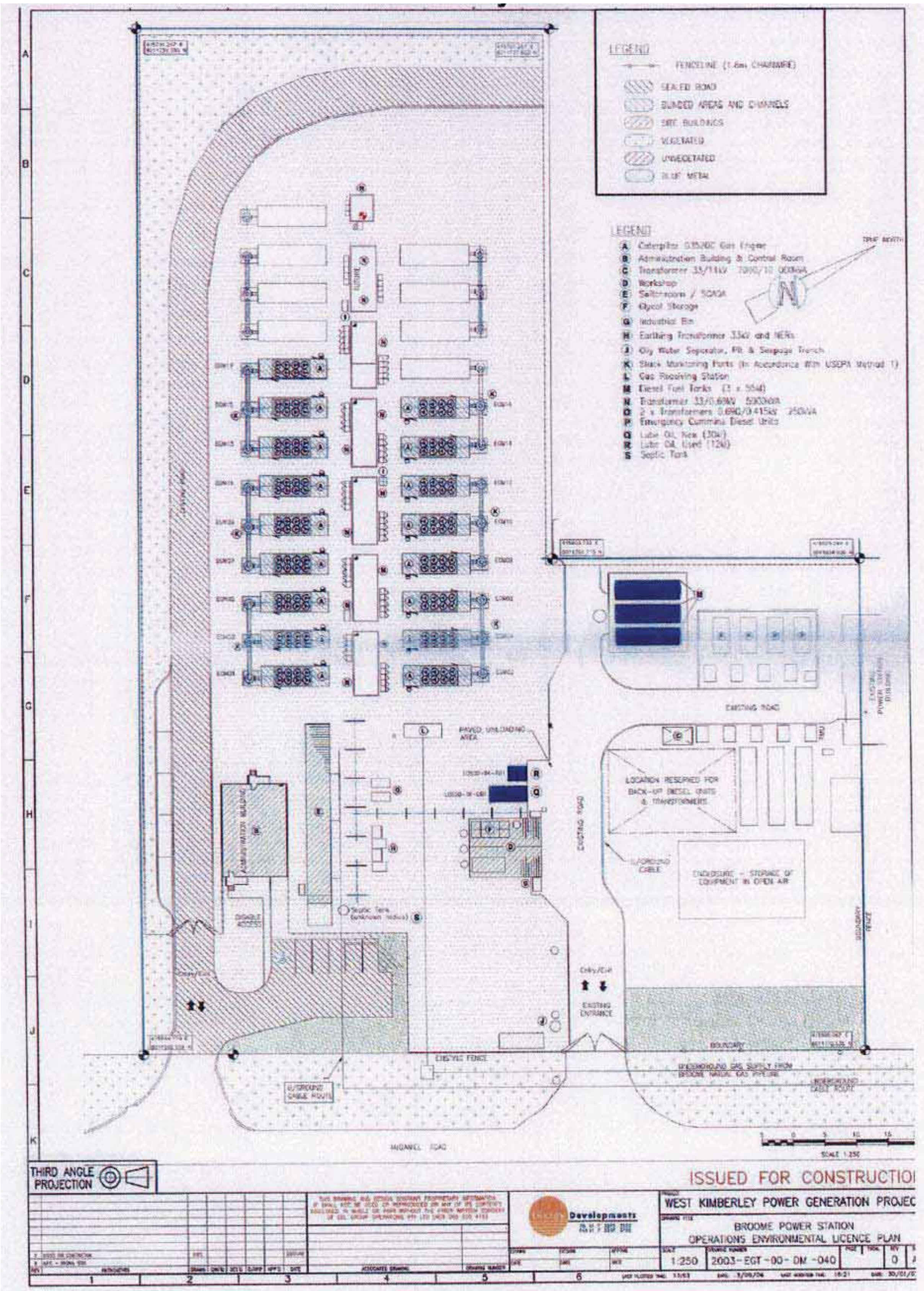
The power capacity constraints for developments north of the airport is being addressed with a proposed new substation (scheduled for completion in 2011 to 2012). Generation capacity upgrades are currently being negotiated to match expected load increases (DSD July 2009).

The Broome Land Development Programme has identified that Horizon Power is reviewing the power supply and current power station at McDaniel Road in Broome. An alternative site and / or power options are being considered. If necessary, a power station / distribution site could be accommodated in the future Water Bank Study area. The Water Bank Structure Plan provides for a 200 hectare site for infrastructure. This site is to contain future requirements for power, effluent ponds, waste disposal and a water reserve for ground water supply.

Figure 8.1 Broome Power Station Location

Source: DEC. Broome Power Station, Environmental Assessment Report, June 2007

Figure 8.2 Broome Power Station Layout



Source: DEC. Broome Power Station, Environmental Assessment Report, June 2007

8.2 Scenario 1 (Base Case)

The predicted population of Broome in 2041 is 31,871 (DSD November 2009). Assuming an average household size of 3.3 people (DSD November 2009), this equates to approximately 9,660 houses. The current average three phase demand per house is 2.3 kilowatts per hour per household based on industry estimates. This is expected to increase to 4.62 kilowatts per hour due to increase air-conditioning facilities in new housing. Therefore, the estimated residential power required is 33,400 kilowatts per hour (three phase).

The industry growth rate was assumed to be 1.5 percent per year, reflecting the predicted emphases on tourism growth rather than medium to heavy industry growth. The current assumed (Horizon Power is not willing to divulge this information) power supply usage in Broome is 29,000 kilowatts per hour. The estimated current residential usage based on a population of 16,600 (WAPC / DPI November 2008) is 11,600 kilowatts per hour three phase. Note this is a calculated estimate and not the actual current usage. This in turn equates to a current industry usage of approximately 17,400 kilowatts per hour. Thus, in 2041 the Scenario 1 estimated industry usage is approximately 25,200 kilowatts per hour of three phase electricity, equating to a total of 58,600 kilowatts per hour of power required.

8.3 Scenarios 2, 3A, 3B and 4 (low, medium and high cases)

The future power requirements for the BLNG Precinct will mainly depend upon decisions made by the Government and the BLNG Precinct foundation proponent. Power generation and distribution handled effectively will encourage growth within the BLNG Precinct.

8.3.1 Construction – Category A

The construction phase of the BLNG Precinct will require the use of diesel generators to provide electrical power for the construction camps, construction workshops, site offices and accommodation. Generally, the power requirement per person in a workforce accommodation is 2.67 kilowatts per hour, while power supply for site offices and construction workshops are approximately 2,000 kilowatts per hour per proponent.

To minimise costs and footprint, the diesel generators should be placed together near a common fuel supply tank. Each diesel generator is housed in a 40 foot container. For a 4,000 kilowatts per hour supply, two of these containers placed together near their fuel supply will cover an area of approximate 50 metres square.

8.3.2 Operation – Category A

During operation, power will be supplied to the BLNG Precinct via a steam or gas driven turbine power station. Diesel generators will provide emergency (“back up”) power.

For Scenario 2, the BLNG Precinct will contain only one LNG proponent producing approximately 15 million tonnes per annum of LNG. Its power requirement will be approximately 80 to125 megawatts per hour, including power supply for suitable accommodation, recreational facilities, medical and fire services, some small shops, a laundry and a petrol station. The LNG power plant size and buffer zone together with its black start diesel generator will cover an area of approximately 2,000 to 3,000 square metres.

For Scenario 3A, the BLNG Precinct will also contain only one LNG proponent, producing approximately 25 million tonnes per annum of LNG. Its power requirement will be approximately 160 to 200 megawatts per hour, including power supply for suitable accommodation, recreational facilities, medical and fire services, some small shops, a laundry and a petrol station. The LNG power plant size and buffer zone together with its black start diesel generator will cover an area of approximately 3,000 to 4,000 square metres.

For Scenario 3B, the BLNG Precinct will contain two LNG proponents producing approximately 35 million tonnes per annum of LNG. Its power requirement will be approximately 230 to 280 megawatts per hour, including power supply for suitable accommodation, recreational facilities, medical and fire services, some small shops, a laundry and a petrol station. The LNG power plant size and buffer zone together with its black start diesel generator would cover an area of approximately 4,000 to 5,000 square metres.

For Scenario 4, the BLNG Precinct will contain up to three LNG proponents producing approximately 50 million tonnes per annum of LNG. Its power requirement will be approximately 320 to 400 megawatts per hour, including power supply for suitable accommodation, recreational facilities, medical and fire services, some small shops, a laundry and a petrol station. The LNG power plant size and buffer zone together with its black start diesel generator would cover an area of approximately 6,000 to 8,000 square metres.

As mentioned in **Section 5** it is most likely that the BLNG Precinct water supply will require desalination. The electrical power required to operate a desalination plant depends upon the quantity of water needed by the BLNG Precinct, for this assessment it was assumed to be approximately 3 to 6 megawatts per hour.

The power distribution around the BLNG Precinct and to the workforce accommodation will be distributed by underground cables, to limit power interruptions during severe weather conditions (for example cyclones). The cables will be laid in the main service corridor or within the road easements where possible.

In Scenarios 3B and 4, there will be more than one proponent. Electrical power is critical for each proponent's production of LNG, and therefore a producer would ideally not want to be reliant on another LNG producer to supply its power requirements. Therefore, either a number of small separate power plants managed by each proponent are required, or one large one managed by a third party. A single larger power plant supplying power to the whole BLNG Precinct is preferable to numerous smaller individual power plants. Larger and more efficient plants have a smaller overall footprint than smaller power plants each with their own fuel storage and buffer zones. Numerous smaller plants operated by each proponent will also complicate the provision of power to the shared areas such as workers' accommodation, street lights and water and waste water facilities.

The third option is to transmit power from Broome via the service corridor. However, this may not be economical due to the distance from Broome (60 kilometres) and the resulting need to upgrade Broome's Power Station.

In summary, when establishing the power infrastructure at the BLNG Precinct, the following items will need to be addressed:

- Power plants are required to maintain a 20 percent spinning reserve, which increases the power requirement from the power plant.
- Power plants are composed of the plant, fuel storage area and a safety buffer zone. A single larger power plant will have a smaller total footprint than multiple smaller power plants.
- Service easements for power lines and cables in cities are normally within road reserves. Main Roads Western Australia (MRWA) normally makes allowance for services between the road edge and boundary of the road reserve. According to Australian Standards a 132 kilovolt power line between Broome and the BLNG Precinct will require an easement width of 15 metres.
- Responsibility for the generation, distribution and maintenance of electrical power to the LNG proponents, BLNG Precinct industrial users, accommodation, general services and other shared services within the BLNG Precinct will need to be assigned.
- Underground power supplies should be promoted where possible, due to the likelihood of severe weather conditions.

8.3.3 Construction and Operation – Categories B and C

The increased power demand produced by Category B and C activities was calculated based on an average household usage between 2.3 kilowatts per hour and 4.62 kilowatts per hour of three phase electricity (to account for new homes with air conditioning), 3.3 people per household (DSD November 2009) and the population figures outlined in **Table 4.2**. As discussed in **Section 8.2** the industrial growth was assumed to be 1.5 percent per year. The effect of gas and solar heating in household and industry consumption was not included in the power demand calculations.

8.4 Assessment

Table 8.1 illustrates the estimated power required for construction of the BLNG Precinct.

Table 8.1 Power Required at BLNG Precinct During Construction

Phase/Activity	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Construction Category A Workforce Village	13,900 kW/h	13,900 kW/h	16,000 kW/h	16,000 kW/h
BLNG Precinct	2,000 kW/h	2,000 kW/h	4,000 kW/h	6,000 kW/h

Table 8.2 illustrates the estimated power required for operation of the BLNG Precinct.

Table 8.2 Power Required at BLNG Precinct During Operation

Phase/Activity	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Total BLNG Precinct	80,000 to 125,000 kW/h	160,000 to 200,000 kW/h	230,000 to 280,000 kW/h	320,000 to 400,000 kW/h

Table 8.3 illustrates the predicted future power demand (three phase) in Broome for each Scenario (values indicated are peak power demand).

Table 8.3 Estimated Power Demand (Three Phase) in Broome for Each Scenario.

Item	Base Case	Scenario 1	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Maximum Predicted Population in Broome	16,600 (Current population)	31,871 in 2041	33,180 in 2041	37,426 in 2034	35,466 in 2030	41,029 in 2036
Number of Households	5,030	9,660	10,060	11,340	10,750	12,440
Usage per Household	2.3 kW/h	Mixture 2.3 kW/h and 4.62 kW/h				
Residential Power required	11,600 kW/h	33,400 kW/h	34,800 kW/h	39,200 kW/h	37,200 kW/h	43,100 kW/h
Industry and Other	17,400 kW/h	25,200 kW/h	25,200 kW/h	23,700 kW/h	22,400 kW/h	23,900 kW/h
Power Required	29,000 kW/h	58,600 kW/h	60,000 kW/h	62,900 kW/h	59,600 kW/h	67,000 kW/h
Power Capacity	33,000 kW/h	46,300 kW/h				
Within Capacity	Yes	No	No	No	No	No

This assessment illustrates that Broome power station does not appear to have the capacity to cater for future growth even without the BLNG Precinct. However, as no information on current power consumption was available from the Horizon Power, the figures in **Table 8.3** were derived on best estimates using industry knowledge. Thus, the capacity of the power station will need to be assessed again once information is available.

8.5 Mitigation Measures

The method of power generation at the BLNG Precinct will need to be discussed and agreed with the proponents early in the design process. A single power plant is recommended to reduce total area requirements, costs, environmental impact, excess infrastructure and complicated management of the power supply to the common areas. This power plant should be operated and maintained by a third party.

The assessment highlighted that Broome will require a new power station to cater for the projected 2041 population even without the BLNG Precinct. This power station could be in the form of a new station or as an expansion to the existing one. There is also the opportunity to reduce power requirements through the use of gas or renewable energy.

9.0 Gas

This section describes the existing gas facilities and future requirements.

9.1 Existing

There is no reticulated gas currently supplying Broome or the BLNG Precinct. Bottled gas is available.

9.2 Scenario 1 (Base Case)

In Scenario 1, at the BLNG Precinct, there will be no production of gas and thus no requirement for gas pipelines.

In Broome, the gas demand will increase steadily as tourism in and around Broome increases. This is assumed to be in the form of bottled not piped gas.

9.3 Scenarios 2, 3A, 3B and 4 (low, medium and high Cases)

This section outlines the gas requirements for Scenarios 2, 3A, 3B and 4.

9.3.1 Construction – Category A

No Gas services will be provided during construction. The BLNG Precinct's construction period will have little effect on Broome's bottled gas industry, unless certain construction processes have a high bottled gas requirement.

9.3.2 Operation – Category A

Gas pipelines supplying gas to the power plant from the LNG proponent will be within a dedicated easement of 30 metres, whilst allowing a further 15 metres on either side for excavation purposes. Gas pipelines supplying the BLNG Precinct facilities will be either within the service corridor or within the road reserve.

Providing gas to the workforce accommodation will reduce the power demand required by the BLNG Precinct, but this will be insignificant compared to the power required by the LNG processing.

A gas pipeline supplying gas to Broome from the BLNG Precinct could be provided within a dedicated easement of 30 metres within the service corridor. Gas could be supplied to the Broome power station and, depending upon the Shire of Broome, also to every house and business.

9.3.3 Construction and Operation – Categories B & C

The operation of the BLNG Precinct and possible creation of a gas pipeline between the BLNG Precinct and Broome may provide an opportunity to supply gas to Broome, which may have an impact on Broome's economy. It may provide the opportunity for The Shire's residents and businesses to have access to cheap and clean energy. This may attract industries to the area, which in turn, may stimulate economic growth and increase job opportunities for residents.

The possible predicted gas usage in Broome was derived from estimated gas consumption for a household in Perth (provided by Alinta). This figure is between 3,000 and 7,000 units per year, with a unit representing 3.6 megajoules of gas. The maximum figure was used to calculate a daily consumption of 69 megajoules of power. Broome is unlikely to use as much gas as Perth, due to higher average temperatures.

9.4 Assessment

Table 9.1 illustrates the predicted possible future gas demand in Broome for each scenario. Values indicated are peak gas demand.

Table 9.1: Estimated Possible Gas Demand in Broome for Each Scenario.

Item	Base Case	Scenario 1	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Maximum Predicted Population in Broome	16,600 (Current population)	31,871 in 2041	33,180 in 2041	37,426 in 2034	35,466 in 2030	41,029 in 2036
Number of Households	6,640	9,660	10,060	11,340	10,750	12,440
Usage per Household	69 MJ/day					
Residential Gas required	Nil	Nil	0.694 TJ/day	0.782 TJ/day	0.742 TJ/day	0.858 TJ/day
Industry and Other	Nil	Nil	1.2 TJ/day	1.2 TJ/day	1.2 TJ/day	1.2 TJ/day
Power Station Requirement	7 TJ/day	16.3 TJ/day	16.3 TJ/day	18.2 TJ/day	17.3 TJ/day	19.7 TJ/day
Pipe Capacity Required	7 TJ/day	16.3 TJ/day	18.2 TJ/day	20.2 TJ/day	19.2 TJ/day	21.8 TJ/day

The estimated possible gas usage outlined in **Table 9.1** will reduce the estimated power usage outlined in **Table 8.3**. Thus, providing the opportunity to decrease the demand on Broome's power station. The estimated power demand for housing could decrease by 25 percent and for industry 20 percent, though these amounts have not been deducted from the total power demand outlined in **Table 8.3**.

Currently, gas is trucked 850 kilometres to Broome's fuel storage facility by road trains from the Maitland LNG facility, 20 kilometres south-west of Karratha. Presently, a 315 millimetre diameter pipe transports gas at a rate of up to 11.5 terajoules per day from the storage facility to the power station.

A gas pipeline between Broome and the BLNG Precinct, which is large enough to supply the power station and Broome would be beneficial to the township of Broome, as it would reduce vehicle movements and pollution and provide a cheaper and cleaner energy source.

The Government of Western Australia is presently investigating options to extend the Dampier – Bunbury Pipeline to Albany, which will increase the demand for gas from Dampier. A suitable sized gas pipeline from the BLNG Precinct to the Pilbara could firstly remove the Pilbara's gas consumption from Dampier and secondly be able to supply gas directly to Dampier using the Pilbara Gas Pipeline (a gas pipeline between the Kimberley and the Pilbara).

ARC Energy has submitted an application for a licence to install a gas pipeline between the Pilbara and the Kimberley Region. This pipeline will be approximately 650 kilometres long and require at least five pump stations. The Pilbara Gas Pipeline presently transports approximately 188 terajoules of gas per day through a 418 millimetre diameter pipe from Dampier to the Pilbara. A pipeline approximately 660 millimetres in diameter will therefore be adequate to support the gas demands of the Pilbara region and its future expansion, as well as providing a sufficient gas supply to Dampier.

Note, the amount of gas that could be used by Industry has been estimated at 1.2 terajoule per day, this equates to approximately 5 megawatts of power.

10.0 Telecommunications

This section describes the existing telecommunication facilities and future requirements.

10.1 Existing

Telecommunications within the Kimberley region includes television, telephone, radio and internet.

Broome residents have access to various television and radio stations such as ABC, SBS, WIN, GWN, GTC 35, ABC Regional Radio, ABC Radio National, WAFM and North West Radio (DSD July 2009). Some of the remote communities have access to community radio stations such as Goolarri radio and Imparja (DSD July 2009). Many of the indigenous communities within the Kimberley have access to television and radio stations through the Broadcasting for Remote Aboriginal Communities Scheme (BRACS), introduced in 1987 (DSD July 2009).

People in the Kimberly have access to broadband through the Higher Bandwidth Incentive Scheme, which reduces the cost of broadband in rural areas. A growing number of communities also have access to Integrated Services Digital Network (ISDN), which enables local call access to the Internet (DSD July 2009).

A digital mobile phone service is accessible in Broome and at some mining sites.

Public phone services are primarily provided by Telstra within the Kimberly. There are currently 230 Telstra pay phones within the region (DSD July 2009). In Broome itself there are 18 public payphones in street locations and 17 at private sites (DSD July 2009). Telstra are planning to decommission some of these public phones due to low usage. It may also decommission 15 public phones in remote communities that appear abandoned (DSD July 2009).

Telecommunications, as is the case with electrical power, are not directly accessible to the site without establishing some sort of infrastructure.

Telstra, presently the only telecommunications provider within the Kimberley Region for fixed line communications, mainly focuses its efforts on established towns and very little effort is directed to rural areas.

Telstra has drafted a report, detailing the telecommunications infrastructure, capabilities and future plans around the Broome area. This report also covers telecommunications for the BLNG Precinct and the off shore telecommunications for the Browse Basin. The confidentiality of Telstra's report precludes any direct reference to it in this report.

Telstra's existing infrastructure within Broome caters for fixed line, internet (ADSL, ADSL 2 & ADSL +2) and mobile presently has sufficient capacity to allow for a 20 percent natural growth in population and light industry. Thereafter Telstra will need to expand the existing exchange building by increasing the building's size (Telstra indicates that there is sufficient land available to do so) (personal communication with Telstra January 2010). Fixed line is easily available within Broome, but rather sketchy moving out from Broome. The internet capacity / speed is comparable to that of Perth or Sydney, and depends on what each individual client is willing to pay for a given level of service. High Speed internet is limited to approximately four to five kilometres from any exchange and deteriorates further away. The mobile coverage extends to a distance of approximately 40 kilometre radius from Broome depending upon land topography (personal communication with Telstra January 2010).

Telstra presently has a six pair optical fibre installed between Broome and Cape Leveque, catering to the needs of the local communities for social development and economic growth (personal communication with Telstra January 2010).

Broome will not receive any benefit from the National Broadband Network initiative. Only the connection between Perth and Geraldton will be funded by the Government.

10.2 Scenario 1 (Base Case)

In Scenario 1, Telstra will be required to invest in additional infrastructure to meet the demand on the telecommunications due to the natural population and light industry growth, being well above 20 percent.

10.3 Scenarios 2, 3A, 3B and 4 (Low, Medium and High Cases)

This section outlines the telecommunications requirements for Scenarios 2, 3A, 3B and 4.

10.3.1 Operation and Construction – Category A

Fixed link telecommunications during construction could be limited to the construction site offices, workshops and camps. The temporary installation of a microwave link could fulfil this need until a permanent optical fibre cable is later installed. Optical fibre cables are not suited to construction sites.

Mobile phone communication could be maintained between construction personnel, construction site offices and workshops by means of a mobile repeater established on site and connected to the fixed link communications network.

During operation, the BLNG Precinct's future telecommunication needs will be met with the installation of a suitably sized optical fibre link to Broome, to meet all of the data and voice requirements for the LNG producers as well as the onsite services and accommodation.

Telstra has considered the option of establishing a major communications centre / exchange at James Price Point which would cater for the BLNG Precinct and provide sub-sea optical fibre connections to the Browse Basin. This communications centre would initially have a 10 gigabyte capacity with a high capacity feed back to Broome in the form of a 60 or 120 pair optical fibre. This centre would provide fixed line, internet and mobile services comparable to national standards.

10.3.2 Operation and Construction – Categories B and C

All BLNG Precinct scenarios will require upgraded and / or expanded communication infrastructure as Broome will experience growth rate greater than 20 percent.

10.4 Assessment

Optical fibre is the preferred choice for voice and data links to be installed between Broome and the BLNG Precinct as well as around the BLNG Precinct (including the workforce accommodation). Besides fixed line communications, BLNG Precinct staff may require the use of mobile phones, thereby requiring a mobile operator to install necessary repeaters / exchange.

Telstra indicated that it plans to create either a major communications centre, or a smaller repeater / Next G base at James Price Point, and connect this to Broome using a 60 or 120 pair optical fibre cable. The telecommunication will have suitable capacity to handle the whole BLNG Precinct, land lines, mobile and high speed internet.

Two repeaters / base stations will be required along the route between Broome and the BLNG Precinct to ensure proper mobile coverage. The bases could cost anywhere between $600,000.00 and $1.2 million depending upon site requirements, power supply and environmental / land rights. Each base is expected to be between 50 square metres and 75 square metres and consume approximately 4 to 5 kilowatts of electrical power.

In Broome itself a base case population increase of approximately 90 percent will require Telstra to upgrade its existing exchange building and connection infrastructure. This will be required by:

- 2014 for Scenario 1
- 2013 for Scenarios 2, 3A, 3B and 4

11.0 Transport

This section describes the existing and future transport infrastructure servicing the BLNG Precinct and Broome. It also outlines the future demands on this infrastructure.

11.1 Existing Services

The existing transport infrastructure is outlined in this section.

11.1.1 Regional Road Network

The existing regional road network connecting the BLNG Precinct to the region, in particular Broome is illustrated in **Figure 11.2** and described in **Table 11.1**and includes:

- Broome Road (Savannah Way)
- Great Northern Highway
- Broome Beagle Bay Road
- Manari Road
- Broome Cape Leveque Road

Broome Road (Savannah Way)

Broome Road is the main north route out of Broome. It connects Broome's local road network to the regional road network (including the Great Northern Highway and Broome Beagle Bay Road). It is a sealed two lane bi-directional single carriageway stretching from Broome to the Great Northern Highway.

Great Northern Highway

The Great Northern Highway is the primary road through the Kimberley Region, connecting Kununurra, Broome and Port Hedland. It is a sealed two lane bi-directional single carriageway.

The Great Northern Highway is important to the region as it provides for freight transport by land from Perth and Port Hedland. It also provides connectivity for tourism, which is an important contributor to the economy of the Kimberley Region.

The Great Northern Highway connects to Broome Road approximately 34 kilometres east of Broome on the Broome to Derby Road. Broome Road (Savannah Way) connects Broome to Derby and further on to the rest of the Kimberley Region.

Broome Beagle Bay Road

Broome Beagle Bay Road connects Broome Road (at approximately 10 kilometres north-east of Broome) to Broome Cape Leveque Road, Manari Road and the Dampier Peninsula. The Broome Beagle Bay Road is a two lane bi-directional single carriageway.

Broome Cape Leveque Road

The Broome Cape Leveque Road is the only road connecting Broome and the Great Northern Highway to the north of the Dampier Peninsula. The Broome Cape Leveque Road is approximately 196 kilometers in length and ranges in MRWA standards from a Type 4 (sealed) to a Type 1 (unformed). The Road starts 10 kilometres from Broome on the Broome Highway and finishes at the Cape Leveque and One Arm Point road junction. Access roads to Beagle Bay, Lombadina / Djarindin and One Arm Point are sealed and are 7 metres in width.

The road is an important access route for a number of indigenous communities, and is also a popular tourist route to attractions in Beagle Bay and Cape Leveque. The Broome Cape Leveque Road comes under the control of the Shire of Broome who is responsible for carrying out improvement and maintenance works. The Broome Cape

Leveque Road is currently being upgraded to a sealed surface in sections. Federal, State and Local Governments have all contributed to the funding for this upgrade. The first 13.5 kilometres from Broome Road are sealed, as is the northern section between the Beagle Bay turnoff and Cape Leveque / One Arm Point junction. The middle section, which is parallel to the site, reduces to a narrow, sandy four wheel drive (4WD) track.

Some of the unsealed sections of the road are depressed below the natural surface and have been reduced in width making it necessary for vehicles to negotiate steep banks in order to pass one another (refer to **Figure 11.1**). Other sections are badly corrugated and have numerous sand holes making it a hazard for drivers.

The road is trafficable during the dry season but is subject to many complaints by road users claiming the road is the cause of vehicle accidents, excessive travel times and damage to vehicles. These problems are only compounded during the wet season when the road is often closed for long periods.

Figure 11.1 Unsealed Sections of Broome Cape Leveque Road

Source: Main Roads Western Australia

Manari Road

Manari Road is an unsealed track providing access to a number of camping and fishing spots along the south-western Dampier Peninsula coastline. This section of coast offers free camping and is popular amongst locals and tourists, with some of the more well known locations include Willie Creek, Barred Creek and Quondong Beach. Manari Road is maintained as a gravel road up to James Price Point, and then continues as a narrow, rough 4WD track to the Point Coulomb Nature Reserve. There are a number of smaller 4WD tracks extending from Manari Road, which provide access onto the beach.

Figure 11.2 Regional Road Network around the BLNG Project

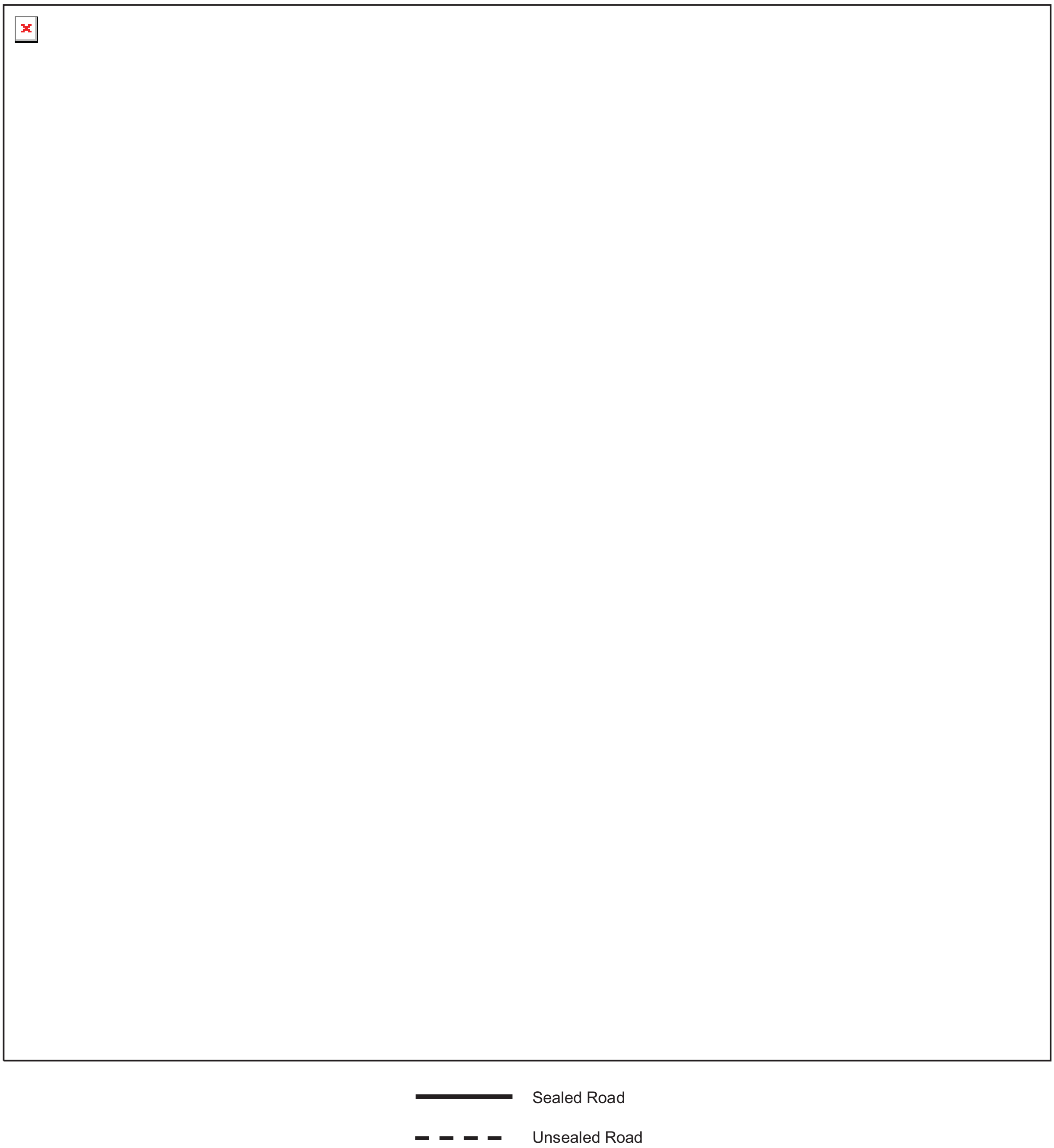


Table 11.1 Existing Road Characteristics of Important Regional Road Links

Road Name	From / To (by section)	Length (Approximate Kms)	Sealed/unsealed	Road Type	Function	Condition
Great Northern Highway	Port Hedland to Broome Rd	612	Sealed	1 Lane per Direction, unsurfaced shoulders	Regional Freight / Tourism Route	Good
Broome Road	Broome to Broome Cape Leveque Road	9.8	Sealed	1 Lane per Direction, unsurfaced shoulders	Regional Freight / Tourism Route	Good
Broome Road	Broome Cape Leveque Road to Great Northern Highway	24.3	Sealed	1 Lane per Direction, unsurfaced shoulders	Regional Freight / Tourism Route	Good
Broome Road	Great Northern Highway to Derby	187	Sealed	1 Lane per Direction, unsurfaced shoulders	Regional Freight / Tourism Route	Good
Broome Cape Leveque Road	Broome Road to South of Manari Road	12.6	Sealed	1 Lane per Direction, unsurfaced shoulders (6 metre-wide nominal width, MRWA Type4 Road)	Regional Freight / Tourism Route	Fair
Broome Cape Leveque Road	South of Manari Road to Manari Road	0.9	Sealed	1 Lane per Direction, unsurfaced shoulders (8 metre-wide nominal width, MRWA Type4 Road)	Regional Freight / Tourism Route	Good, recently constructed
Broome Cape Leveque Road	Manari Road to South of Beagle Bay Turnoff	89.1	Unsealed	Width varies, unformed and formed sections (MRWA Type 1&2)	Regional Freight / Tourism Route	Fair to poor, dependant on seasonal flooding and maintenance program
Broome Cape Leveque Road	Beagle Bay Turnoff to Cape Leveque / One Arm Point junctions	93.2	Sealed	1 Lane per Direction, unsurfaced shoulders (7 metre-wide nominal width, MRWA Type4 Road)	Regional Freight / Tourism Route	Good, recently constructed
Manari Road	Broome Cape Leveque Road to James Price Point	35.2	Unsealed	Approx. 6 metre-wide gravel road	Tourism Route	Fair to poor, dependant on seasonal flooding and maintenance

Road Name	From / To (by section)	Length (Approximate Kms)	Sealed/unsealed	Road Type	Function	Condition
						program
Manari Road	James Price Point to Point Coulomb Nature Reserve	16.2	Unsealed	Dirt track (4WD)	Tourism Route	Poor, dependant on seasonal flooding and maintenance programme

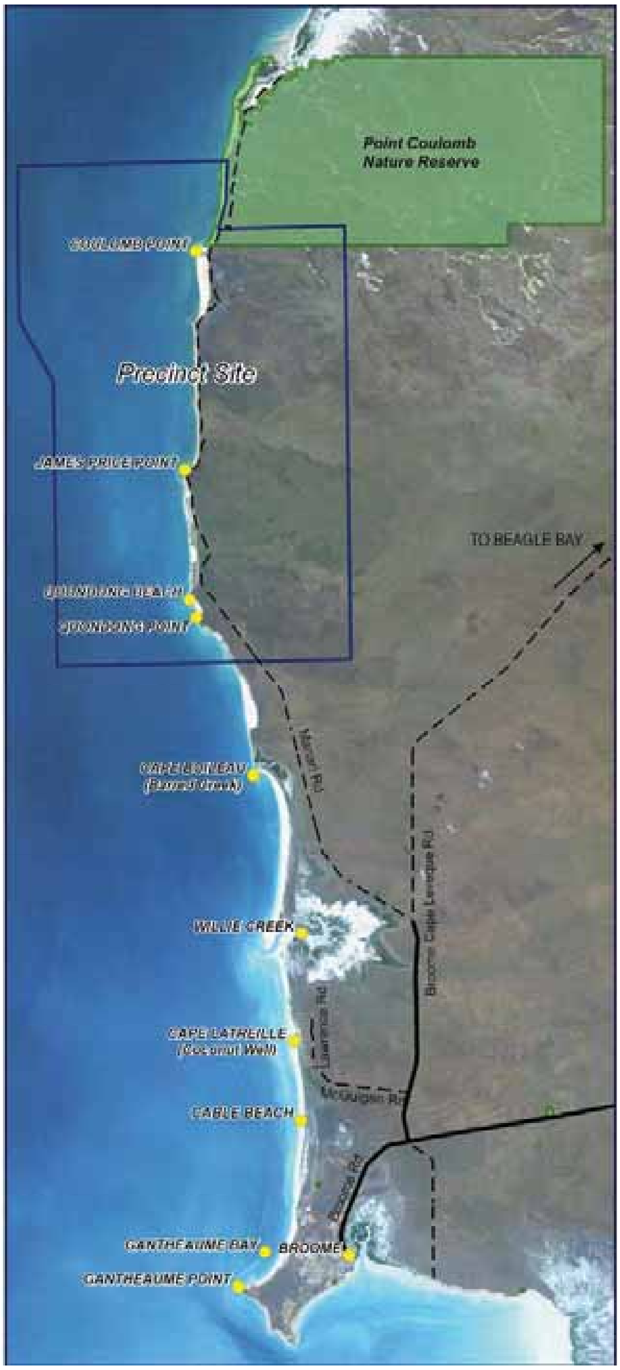
11.1.2 Site Access

The existing roads near the BLNG Precinct are illustrated in **Figure 11.3**. The existing direct access to the BLNG Precinct is via Manari Road, which commences approximately 13.5 kilometres north of Broome Road from the junction with Broome Cape Leveque Road. However, it is intended that a more direct route will be provided to the BLNG Precinct further north along the Broome Cape Leveque Road. The corridor for which is road will be located is illustrated in **Figure 11.4**.

Access to the BLNG Precinct from Broome Port will be via Port Drive, Gubinge Road, Broome Road and Broome Cape Leveque Road.

From Broome Airport, the BLNG Precinct will be accessed either via Coghlan Street and Frederick Street on to Broome Road, or via Napier Terrace directly on to Broome Road.

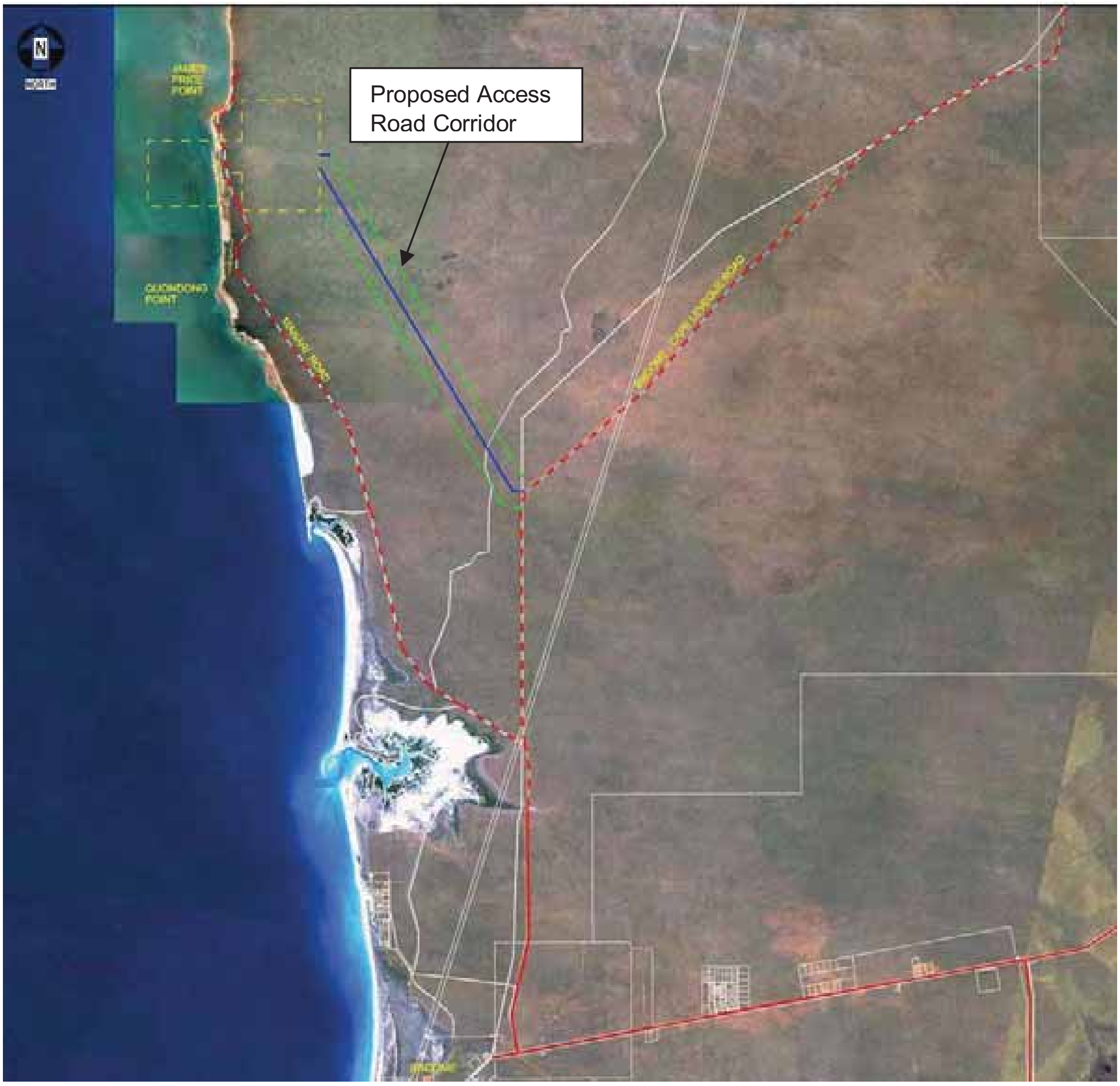
Figure 11.3 Existing roads close to the BLNG Project



Sealed Road

Unsealed Road

Figure 11.4 Site Access Road Location



Source: DSD, Browse LNG Precinct, Master Plan Report, January 2010 (Figure 26)

11.1.3 Broome Township – Local Road Network

Table 11.2 outlines the characteristics of the important existing local road network in the town of Broome.

Table 11.2 Existing Road Characteristics of Important Local (Shire of Broome) Road Links

Road Name	From / To (by section)	Length (Approximate Kms)	Sealed / Unsealed	Road Type	Function	Condition
Port Drive	Port Terminal to Gubinge Road	3.5	Sealed	1 Lane per Direction, unsurfaced shoulders	Regional connector, freight route with industrial / commercial and residential usage on certain road links	Good
Gubinge Road	Port Drive to Broome Road	7.5	Sealed	1 Lane per Direction, concrete pathway on selected links	Regional connector, freight route with public transport, commercial and residential usage on certain road links	Good
Coghlan Street	Airport Terminal-Macpherson Street to Frederick Street	4.7	Sealed	6 metre-wide two way with concrete pathway	Residential light vehicle traffic, airport light industrial and tourist bus	Good
Frederick Street	Coghlan Street to Broome Road	0.5	Sealed	2 Lanes per Direction	Collector Road - Residential light vehicle traffic, airport light industrial and tourist bus	Good
Macpherson Street -Napier Terrace-Baggot Street-Coghlan	Airport Terminal to Broome Road	0.8	Sealed	6 metre-wide two way with concrete pathway	Residential light vehicle traffic, airport light industrial and tourist bus	Good
Broome Road	Frederick Street to Gubinge Road	3	Sealed	1 Lane per Direction, unsurfaced shoulders	Regional connector road	Good
Broome North Development	Magabala Road to Gubinge Road	-	Unsealed	Dirt track	To be developed	Poor
Broome North Development	Broome North Development to Sanctuary Road	-	Unsealed	Not constructed. Sanctuary road is 6 metre-wide, two way with concrete pathway	To be developed as part of the Broom North Development. Residential light vehicle traffic uses Sanctuary Road	NA Good
Public transport Route Network	-	-	Sealed		Existing public transport routes, overlapping with freight route on Gubinge road	Generally Good

11.1.4 Existing Traffic

Actual traffic count figures (taken in April 2006) are contained in the Traffic Study for Broome International Airport, Roebuck Estate and Surrounding Areas report prepared by Uloth and Associates. The report also contains predicted traffic models for the Broome area for the years 2011 and 2031. The 2011 figures are based on the Broome 2011 Base Traffic Model, which models traffic through Broome on the future road network. For all scenarios construction works are predicted to begin around 2011, thus the predicted 2011 traffic flow has been used in the assessment.

Broome Cape Leveque Road connects Broome to locations including Beagle Bay, Cape Leveque, One Arm Point and the BLNG Precinct. Traffic counts undertaken in July 2006 show a peak daily volume of 338 vehicles along Broome Cape Leveque Road between McGuigan Road and Manari Road. Broome Cape Leveque Road has a theoretical peak hour traffic capacity of approximately 3,600 vehicles (Guide to Traffic Engineering Practice Roadway Capacity AustRoads); therefore, the existing daily traffic is less than 1% of the theoretical peak hour capacity of the road.

Frederick Street (east of Coghlan Street) is one of the possible routes connecting the site to Broome Airport. It is classified as a two lane undivided road. It is expanded to four lanes on limited sections. It also has a peak hour theoretical capacity of 3,600 vehicles (including both directions).

11.1.5 Public Transport

No public transport currently services the proposed BLNG Precinct. There is a local bus service in Broome, providing two services per hour during the peak dry season and one service per hour during the offpeak wet season. The services travel through the centre of Broome, connecting the northern Cable Beach area to the airport, town centre and southern Town Beach.

The Australian Bureau of Statistics census data from 2006 for the suburbs of Broome, Cable Beach and Dugan shows that just 46 people take the bus to work each day, compared to 2,627 people who drive to work each day. This data illustrates the current low utilisation of public transport in Broome.

Greyhound Australia provides regular coach services along the Great Northern Highway and Broome Road, with five services a week between Broome and Perth, and a daily service between Broome, Derby and Darwin.

11.1.6 Port

There are currently no port facilities at James Price Point. The closest port facility is in Broome. Broome Port is ideally located to service the Browse Basin Oil and Gas industry. In 2006, the wharf was upgraded to cater for survey vessels, drill rigs and supply vessels servicing the industry. These upgrades included lengthening of the outer berth face, and strengthening and installation of fuel and water delivery points. There is currently berth capacity for five drill rigs and 15 supply boats at 60 percent utilisation, with scope for expansion when and if demand requires this.

Access between Broome Port and the BLNG Precinct will be via Port Drive, Binge Road, Broome Road and Broome Cape Leveque Road, as described in **Section 11.1.2**. The section of Binge Road between Gantheaume Point Road and Port Drive was constructed recently to enable freight to bypass Broome town centre.

11.1.7 Airport

There are currently no airport facilities at James Price Point. The closest airport facility is in the centre of Broome, accessed via Broome Road and the route mentioned in **Section 11.1.2**.

Broome International Airport (BIA) is situated within the Broome town site and is now privately owned. In 2007 / 2008, the airport catered for 406,000 passengers and in 2008 / 2009 this increased to 406,000 on scheduled regular passenger transport (RPT) and charter flights (BIA submission to DSD provided in email dated 13 October 2009). The charter flights predominantly service the oil and gas and mining industries. In excess of 130 scheduled services arrive and depart each week.

Typically, over 60 percent of passengers are associated with tourism, with the remainder being local business and residents. Passenger numbers are expected to increase to almost 818,000 by 2025 (BIA Group 2008), the

majority of which are likely to be related to tourism. In terms of air movements, industry experience suggests that total flight numbers may not increase in line with passenger numbers, instead larger aircraft will be deployed.

Previous studies have found that air congestion is a growing problem at Broome Airport and in the surrounding airspace, particularly during the dry season with peak tourism demand. Consequently, the Civil Aviation Authority has directed Air Services Australia to construct and operate a new control tower by 2010. This new facility is expected to adequately handle future anticipated growth in air movements.

The current runway has significant capacity (DSD August 2009).

A major heliport servicing the oil and gas industry was completed in April 2009. A range of helicopter types regularly use these facilities. Operations by heavy helicopters are increasing as Broome becomes the base for exploration and production well drilling in the Browse Basin.

An alternative airport site has been identified 13 kilometres north-east of the Broome township if and when the current airport becomes capacity constrained, or other environmental factors (such as noise and amenity) impinge on the airport operations. The BIA masterplan (developed in June 2008) indicated that the airport would remain in its current location until at least 2025.

The existing airport currently generates an estimated 3,400 vehicle trips per day during the dry season (peak tourism) (BIA Group November 2008). The majority of vehicles (over 2,900) access the airport via MacPherson Street and on to Coghlan Street on the southern side of the airport. Traffic modelling undertaken for the airport clearly show that the overall road network for Broome can accommodate the long term future traffic flows (BIA Group June2008).

11.1.8 Cyclists and Pedestrians

The urban setting of Broome provides concrete pathways on most of the critical collector roads and public transport links.

There are no formal walking and cycling routes to the BLNG Precinct. The coastal area adjacent to the site is used for recreational activities, including beach walking by people camping or fishing in the area.

The Broome town centre has a network of footpaths through the residential area. There are intermittent paths along the busier, higher speed roads, which are likely to be used as shared walking and cycling paths. The majority of Broome’s lower speed local roads provide a pleasant cycling environment.

There are three self-guided walks along the coastal reserve between Cable Beach and Gantheaume Point that are promoted to tourists and locals for recreational use.

11.2 Scenario 1 (Base Case)

The Scenario 1 (Base Case) transport infrastructure is outlined in this section. The existing and proposed transport routes are illustrated in **Figures 11.5** and **11.6**.

11.2.1 Road

Table 11.2 illustrates that road conditions in Broome are generally good. Heavy vehicles travelling north of Broome are catered for on the strategic freight route from the port via Port Drive and Gubinge Road to Broome Road. The recent construction of the Gubinge Road link between Port Drive and Gantheaume Point Road was pivotal in separating heavy vehicles from residential, tourism and public transport within the town of Broome. This separation contributes to the safety of local residents and tourists. However, conflict points from central Broome across Cubinge Road to Cable Beach, as well as the further development of Broome North, need to be carefully planned with safety and accessibility objectives in mind.

To connect Broome to areas such as James Price Point, Beagle Bay and Cape Leveque, the Shire of Broome and MRWA maintain important regional connector road links. This includes Manari Road (for tourist destinations) and Broome Cape Leveque Road (to ensure accessibility to local and indigenous communities further north of Broome).

In Scenario 1, Broome is predicted to expand from its current population of 16,600 to 31,871 in 2041. To cater for this population, new developments, such as Broome North, are being planned. The planning approval for these development should include transport infrastructure upgrades designed to cater for this substantial increase in residents.

11.2.2 Public Transport

As the population of Broome increases over time, it is anticipated that public transport will play an increasing role in providing accessible and affordable transport options for residents. With this in mind, the Broome North District Development Plan anticipates that the Broome North Development would generate as many as 1,500 public transport passenger trips per day when buses are provided to the area. Buses will be provided to the area as the development grows and sufficient demand is reached.

The Broome North District Development Plan predicts that two bus routes will eventually service the residential site. One bus route will connect Broome North to the Broome Town Centre via Gubinge Road and Broome Road, while the second bus route will link Broome North to Cable Beach via Sanctuary Road.

The Broome North Local Development Plan states that new bus stops are proposed along the neighbourhood connectors within the Broome North Development and will ensure that all dwellings are within 400 metres of the bus routes in this area. Both of the proposed routes will also ensure direct service to the proposed primary school.

Public transport services for the greater Broome township area should be upgraded to meet growing demand from the planned development in Broome. The public transport options detailed in the Broome North Local Development Plan should be integrated with the Shire of Broome’s future public transport plans.

As noted in **Section 11.1.5** current public transport usage is low. While the increasing local population and provision of the two bus routes through Broome North is likely to increase public transport utilisation, other measures to increase the attractiveness of public transport for residents should also be considered. These could include:

- Provision of more direct routes to the town centre during peak hours
- Extended peak hour service frequencies
- Reduced number of car parking bays available in the town centre
- Annual travel pass loan schemes

By providing accessible public transport options to residents, as well as visitors, public transport in Broome could become a viable and attractive option for the multitude of new families anticipated to reside in Broome.

11.2.3 Port

With no onshore construction at the BLNG Precinct, it is unlikely that Scenario 1 will have a material impact on the vessel numbers or types above those engaged in exploration and supply for the offshore infrastructure. There may be marginal increases in fuel and supply trucks servicing the port associated with the increase in oil and gas industry vessels, however this increase is likely to be negligible in terms of the overall traffic demand in Broome.

11.2.4 Airport

According to the Airport Development Plan, BIA will experience a slight percentage growth in passenger numbers (primarily charter flights) through increases in fly in / fly out personnel crewing the offshore platforms. The current airport should readily handle these increases, particularly when taken in the context of the overall growth in tourism and flights undertaken by local residents and businesses.

The growth in passenger numbers for crewing the offshore platforms will also lead to an increase in helicopter movements between the airport and offshore.

The Airport Development Plan (BIA Group November 2008) acknowledges the future need to provide air transport services to the Browse Basin oil and gas production facilities, should Broome be used as their aviation hub. The

airport can accommodate aircraft up to Boeing 737 in size. The report indicated that the projected growth on both aircraft and passenger movements can be accommodated by the existing airport for the foreseeable future.

By 2025, the airport is forecast to receive 818,000 passengers, which the current airport (including the runway) and its planned upgrades should be able to cater for (BIA Group 2008).

11.2.5 Pedestrians and Cyclists

The upgrade of Gubinge Road has incorporated, in some sections, safe pedestrian crossings at intersections and pathways. However, the connectivity of these pathways to the broader network, and their level of connectivity needs to be addressed.

Figure 11.5 Existing and Proposed Regional Transport Routes

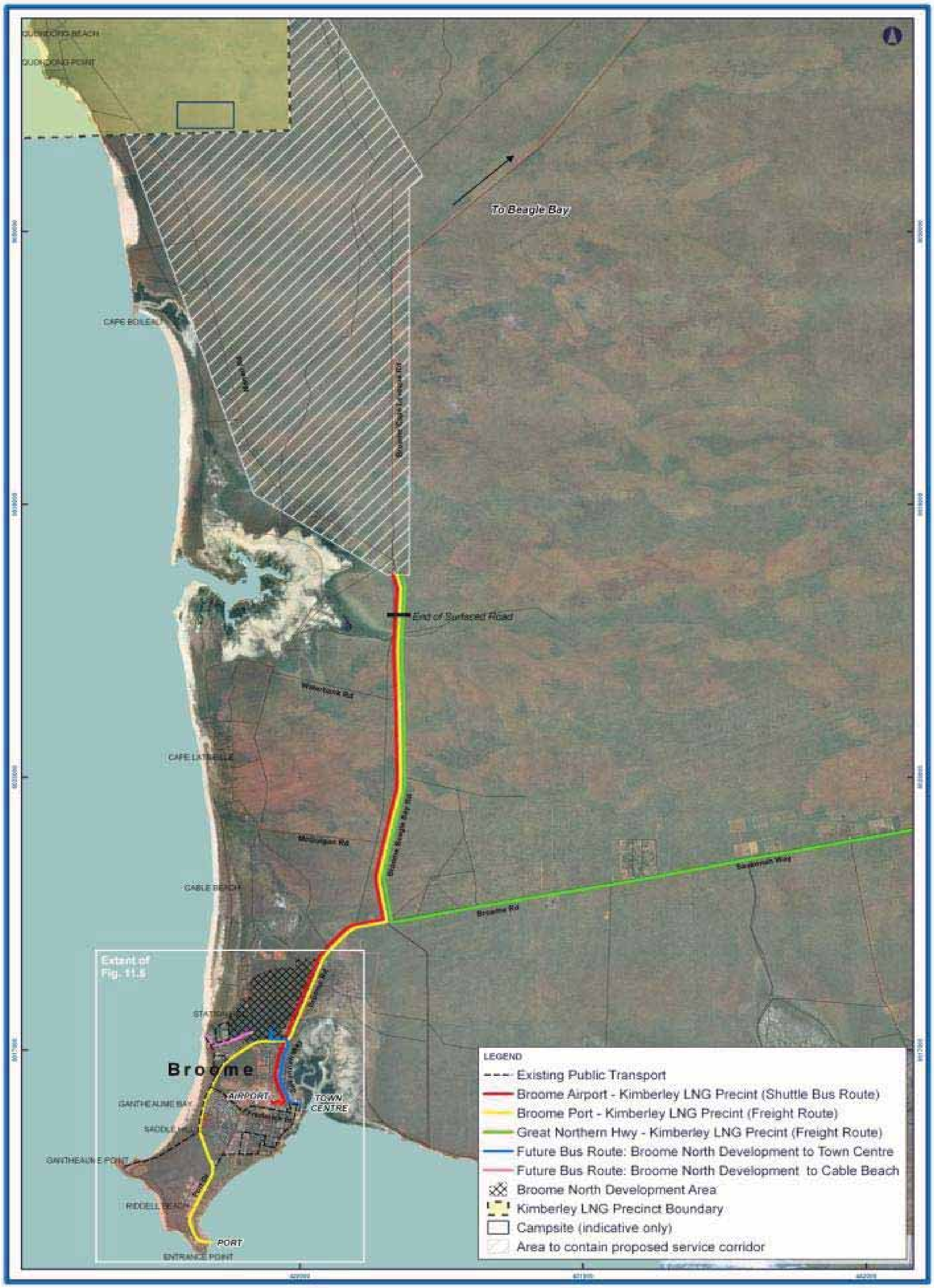


Figure 11.6 Existing and Proposed Broome Township Transport Routes

11.3 Scenarios 2, 3A, 3B and 4 (Low, Medium and High Cases)

Scenarios 2, 3A, 3B and 4 transport infrastructure are outlined in this section.

11.3.1 Road

Traffic generated by the BLNG Precinct will come from four sources:

- Staff travel
- Vehicles servicing workers' accommodation
- Vehicles servicing the LNG processing facilities and supporting infrastructure
- Vehicles servicing the light industrial area (including staff)

The number of vehicles movements generated by the site will differ depending on the phase (construction or operation)

The number of vehicles on the site will also be impacted by the amount of freight arriving by road. This will be influenced by the ability and cost of transporting material and equipment by sea, construction and operation techniques used, and the ability to reuse material recovered on site (for example using dredging spoil for onshore earthworks).

Construction

At the peak construction phase, 6,000 employees will be travelling to and from the site. The employees will be based at the workers accommodation within the BLNG Precinct during their shifts. The shift patterns are yet to be determined, however for this assessment they were assumed to be four week on and one week off (DSD January 2010). Assuming shift changes will occur daily (that is staff arrive and depart from the BLNG Precinct daily); on any one day, 172 people arrive and leave the BLNG Precinct. This equates to four round bus trips per day (assuming 50 seater buses) to and from Broome Airport. This is less than one percent of the theoretical road capacity, thus the impact should be minimal.

The workers accommodation will require servicing during the construction period. This is assumed to be four round trips per day.

Freight travelling between Broome Port and the BLNG Precinct will utilise Gubinge Road, Broome Road and Broome Cape Leveque Road. As outlined in **Section 11.1.4** the predicted traffic volumes indicate that the future traffic volumes on this route (without the BLNG Precinct) should be well below its theoretical capacity. The calculated traffic generated by the site is outlined in **Table 11.3**. This figure is indicative and will depend on the construction techniques used. At the peak construction time this figure will be to approximately 430 trips per day, this equates to less than two percent of the theoretical daily capacity of the route. Thus, this is considered to be of minimal impact.

Operation

At the peak operation phase, 1,000 employees will be travelling to and from the site. The employees will be based at the workers' accommodation within the BLNG Precinct during their shifts. The shift patterns are yet to be determined, however for this assessment they were assumed to be two week on and two week off (DSD January 2010). Assuming shift changes occur weekly (that is staff arrive and depart from the BLNG Precinct weekly); on one day on any week 250 people arrive and leave the BLNG Precinct. This equates to five round bus trips per day (assuming 50 seater buses) to and from Broome Airport. This is less than one percent of the theoretical road capacity, thus the impact should be minimal.

The workers accommodation will require servicing during the operation period. This is assumed to be at the most four round trips per day.

Table 11.4 outlines the calculated freight movements servicing the LNG processing plant and supporting facilities during operation. At the peak operation time, this figure equates to approximately 8,070 trips per day, which is less than one percent of the theoretical daily capacity of the route. Thus, is considered a minimal impact that his figure is only indicative and will depend on the operation of the BLNG Precinct.

The light industrial area located within the BLNG Precinct will service the LNG processing plant during operations. It will be a 200 hectare (DSD January 2010) site containing a number of service providers, which may include scaffolding yards, crane and equipment hire, warehouses, welding yards, fabrication yards, sand blasting and transport companies (DSD January 2010). From the RTA Guide to Traffic Generating Development October 2002, four vehicle trips will be made per 100 square metres of gross floor area. Assuming 40 percent of the site area is single storey building (gross floor area), 50 percent of product arrives by sea and 75 percent of the trips generated by the site are within the BLNG Precinct, this equates to 8,000 vehicles per day on the route to Broome. This is approximately 25 percent of the theoretical capacity, and thus will have an impact. However, this impact will be reduced due to the low traffic volume predicted on the route in the future.

Table 11.3 Predicted Land Based Traffic Demand based on Key Construction Activities for the BLNG Project

Construction Activities		
Activity	**Estimated Maximum No. of Trips per day to BLNG Precinct**	**Comments**
Site preparation		
Road construction	20	Assumed construction vehicles per day, one way single trip
Pioneer camp/facilities	15	Assumed construction vehicles per day, one way single trip
Site clearing and levelling	10	Assumed construction vehicles per day, one way single trip
Storm water management	0	Onsite treatment
Source of fill – aggregate, road base, etc.	130	Multi trips, based on 6 trucks hauling material from an external quarry to the precinct via the access road. Include provision of commercial supplies. Note – No other bulk earthworks to be transported via access road, pending on outcome of earthworks strategy
Onshore Construction		
Transport of materials – terrestrial	15	Assumed construction vehicles per day, one way single trip. Include construction of haul road on site from MOF to plant, storage tanks, etc that might be transported by road
Transport of materials – marine port facilities (including modules)	15	Interim until marine facility has been constructed, Assumed construction vehicles per day, one way single trip
Foundations construction	12	Assumed construction vehicles per day, one way single trip
Tank construction	12	Assumed construction vehicles per day, one way single trip
Plant construction (LNG and other)	60	Assumed construction vehicles per day, one way single trip. Include construction of LIA facilities, laydown areas, crushing and screening, concrete batch plant, construction camp, etc.
Near shore construction		
Marine Offloading Facility	20	Assumed construction vehicles per day, one way single trip
Dredging	0	Assume via MOF
Export jetty	0	Assume via MOF

Construction Activities		
Activity	**Estimated Maximum No. of Trips per day to BLNG Precinct**	**Comments**
Breakwater	0	Assume via MOF
Integrated marine facility	0	Assume via MOF
Pipelines (product, MEG, CO2, etc.)		
Installation of pipelines in state waters (3nm)	0	Via MOF
Shore crossings	0	Via MOF
Installation of pipelines onshore	0	From MOF and on site activity
Supporting Infrastructure		
Construction camp	15	Assumed 15 construction vehicles, one direction, per day
Workers movements	8	Shuttle bus trips to and from plant, based on 4 buses serving 2 flights on one day
Camp servicing and logistics	8	
Lay down area	8	
Crushing and screening	10	
Fuel and chemical storage	20	
Water supply	10	Construction of boreholes, and initial water carted in from Broome for pioneering camp
Waste water treatment	15	
Additional Trips		
Refrigerated food and dry goods	5	
Transport of Fuel	2	
Transport of Waste	12	Including construction and camp waste
Total Estimated Peak Daily Traffic to Precinct		422

Table 11.4 Predicted Land Based Traffic Demand based on Key Operational Activities for the BLNG Project

Operational Activities		
Activity	**Estimated Maximum No. of Trips per day to BLNG Precinct**	**Comments**
Site		
Site Maintenance	5	On-site maintenance, occasional external trips allowed for contractors
Storm water management	2	On-site maintenance, occasional external trips allowed for contractors
Fire management	2	On-site maintenance, occasional external trips allowed for contractors
Processing		
Gas processing	2	Occasional external trips allowed for contractors
Product storage	5	Occasional external trips allowed for contractors
Dredging		
Maintenance dredging	2	Occasional external trips allowed for contractors
Vessel operation		
Shipping movements	0	Marine side transport
Support vessels	0	Marine side transport
Vessel maintenance, servicing, Refuelling	2	
Support Infrastructure		
Waste management	18	Including processing and camp
Operations camp	10	Shuttle bus trips one day per week of shift workers from Airport and workers residing in Broome
Camp Servicing and Logistics	8	
Fuel and chemical storage	2	
Water supply	0	Onsite
Waste Water Treatment	0	Onsite
Additional		
Refrigerated food and dry goods/materials	10	Include goods and materials to light industrial area, admin buildings and accommodation villages in the Precinct
Transport of Fuel	2	

Operational Activities		
Activity	**Estimated Maximum No. of Trips per day to BLNG Precinct**	**Comments**
Light Industrial Area	8,000	Indicative number
Total Estimated Peak Daily Traffic on Precinct Access Road	8,070	

New Road

A new service corridor will be provided from the corner where Cape Leveque Road alters direction from north to north-east, heading north-west to the BLNG Precinct (refer to **Figure 11.4**). The service corridor will include two, 3.7 metre sealed traffic lanes on a single carriageway with two 2.5 metre sealed shoulders.

Road Upgrades

Table 11.3 illustrates that the estimated traffic volume during construction should have a minimal impact on the road network. However, the type of vehicles and the significant number of road freight movements that will be generated by the BLNG Precinct in its ultimate scenario will have an impact on the road pavement and the class of road. Given the traffic volume predictions on Broome Cape Leveque Road could increase somewhat, the major concern is the need to ensure that heavy vehicles (up to triple road trains) and high and wide load vehicles will be able to access the BLNG Precinct via Broome Cape Leveque Road. This will result in the need to ensure the upgrade of intersections to the appropriate MRWA geometric and pavement design standards.

Table 11.4 illustrated that during operation significantly more traffic will be generated due to the Light Industrial Area. The predicted 8,070 vehicles per day is two percent of the theoretical capacity of the road network.

As described in **Section 11.1.1** the road network connecting the BLNG Precinct to Broome includes Broome Road, Broome Cape Leveque Road and a new access road from Cape Leveque Road. The access road link from Broome Cape Leveque Road will be constructed as a sealed road according to MRWA Design Standards, with one lane in each direction. Due to very low existing traffic volumes there should be sufficient capacity on Broome Cape Leveque Road to cater for traffic generated by the BLNG Precinct in its ultimate stage.

Category B and C Activities

Category B and C activities will also have an impact on Broome. In Scenario 4, the population of Broome is expected to increase due to the Category B and C activities by 11,458 people in 2036 (the maximum population year), equating to approximately 3,480 dwellings (DSD November 2009). As the number of new dwellings anticipated in Broome because of the BLNG Project is within the number of new dwellings planned for Broome, the transport infrastructure in Broome should be sufficient to cater for this increase. However, depending on the rate at which employees settle in Broome, the staging of the future road network upgrades may have to be adjusted to suit increasing demand.

11.3.2 Public Transport

As the number of new dwellings as a result of the Category B and C activities is within the planned new development in Broome (including Broome North Development), and public transport upgrades are to be undertaken within Broome to cater for this proposed development, no additional public transport is required.

11.3.3 Port

During construction of the LNG Precinct, Broome port may experience a significant increase in bulk, break-bulk and equipment through put across the wharf, however it is anticipated that as soon as the BLNG Precinct MOF is completed (in the early stages of the construction phase), most of this traffic will be transferred to it. Broome port

has adequate capacity to handle the increased support requirements for the Browse Basin and the BLNG Precinct construction.

Depending on the construction phasing, there will be an increase in road haulage from the port, primarily during the road construction works, due to the import of bitumen and other materials. Other items that will be transported to the site will include cranes, other heavy equipment and construction camp materials such as 'dongas'. This increase in port throughput should not have an appreciable impact on total traffic volumes in and around Broome.

11.3.4 Airport

As described in **Section 11.1.7**, in excess of 130 scheduled services arrived and departed each week during 2008. It is assumed the BLNG Precinct will add approximately 28 flights per week (assuming 100 seater planes and in and out movements) during the peak construction period. This was derived from 172 people leaving and arriving each day and 10 percent living in Broome (DSD November 2009). During normal operation this will be reduced to two flights per week (in and out movements), based on 60 percent of staff living in Broome (DSD November 2009).

Two flights per week is approximately 2 percent of the current scheduled services. This increase is not considered significant, especially when compared to the proposed future upgrades to the airport to enable the airport to cater for 818,000 passengers per year by 2025 (BIB submission to DSD emailed 13 October 2009). The increase in flights in the peak construction phase is 21 percent of the existing services, although the percentage is high, it is for a short period and thus considered manageable.

The BLNG Precinct does not require the relocation of the airport.

11.3.5 Cyclists and Pedestrians

The upgrade of Gubinge Road has incorporated some safe pedestrian crossings at intersections and pathways. However, the connectivity of these pathways to the broader network, and their connectivity needs to be assessed.

11.4 Assessment

The assessment of the five scenarios reached the following conclusions:

- In general, the regional and local road networks should support Category A, B and C activities. However, upgrades to the geometric design of some intersections and pavement of some sections of road will need to be undertaken to cater for the freight routes.
- The new road link along Gubinge Road provides a "bypass" freight route avoiding the town centre, however it still creates severance between the existing north-western and planned northern suburbs of Broome, and the town centre and Cable Beach.
- The peak traffic demand during certain periods of construction and operation should not significantly affect flow within the region or Broome. However, traffic management measure will need to be introduced to deal with periodic traffic peaks that may occur (such as high or wide loads).
- The transport facility upgrades proposed in Broome as part of the planned development (such as Broome North) will decrease the impact of BLNG Precinct's Categories B and C activities on Broome.
- The construction of the MOF at the BLNG Precinct will reduce the road based freight movements significantly. The decision between importing freight via marine transport or road transport will influence the impact of the BLNG Precinct on the surrounding road network. Regardless, the Broome Cape Leveque Road will require upgrading to cater for heavy vehicles including pavement and road amenities such as signs and barriers (if applicable) to allow for high and wide loads. The vertical and horizontal clearway is 10 metres in width, however, passing facilities will have to be provided to ensure that other traffic can pass the high and wide loads safely.
- The Broome Port, including planned upgrades and expansion, should adequately handle the increase in vessel traffic because of the BLNG Precinct construction activities. The resulting increase in road haulage

movements should have minor impact on total road traffic volumes. The operation phase of the BLNG Precinct should also have minor impact on both vessel and road traffic volumes associated with the Port.

- At the peak of construction of the BLNG Precinct total passenger numbers and air flight movements should be adequately handled by the planned upgraded airport facility.

11.5 Mitigating Measures

From a strategic perspective, the following measures could be introduced to mitigate the impact of the BLNG Precinct on the Kimberley Region, and in particular Broome:

- A Full Transport Assessment should be prepared once the BLNG Precinct design is more advanced. This will confirm traffic generation numbers and impact.
- Although the Gubinge Road link from Broome Road to Port Road has been upgraded and is used as the primary route from the Port, it would be beneficial to undertake a freight study to assess the detail impact of the BLNG Precinct on routes from the Broome port and the Great Northern Highway to the site. Although this traffic assessment indicates that in Scenario 4 (High Case) the maximum number of vehicles expected is minimal from a road capacity perspective, the impact on the pavement design and life cycle may be significant.
- Once the preferred alignment from the surfaced section of Broome Cape Leveque Road going north-west to the BLNG Precinct has been identified within the proposed corridor, the road link needs to be designed to MRWA Design Standards. All intersections forming part of the freight road network need to be assessed from a geometric perspective based on the design vehicle (assuming triple road train and occasional high and wide load movement). The Broome Cape Leveque Road section that is not surfaced, as well as the road link to the BLNG Precinct needs to be defined. The Shire of Broome and MRWA will need to be consulted regarding funding and alignment.
- The construction contractor will need to prepare a traffic management plan to accommodate high and wide loads.

12.0 Mitigation Management Plan

This section outlines the Mitigation Management Plan for each infrastructure type for each Scenario.

12.1 Water

The capacity of Broome's water supply is 10,600 megalitres per year, which is more than the predicted requirement for Scenarios 1, 2, 3A and 3B. Thus, if these Scenarios are adopted, no upgrade to Broome's water supply is required. For Scenario 4, the estimated water requirement for two years (2036 and 2040) is greater than the supply's capacity. As this is a short term shortage alternative water supplies such as rain water harvesting and / or grey water could be investigated. These alternative sources would require new infrastructure such as covered rain water tanks and / or grey water pipe network. This infrastructure could be provided by the Shire of Broome, the Water Corporation, or by developers. Discussions will need to be held with the Shire of Broome and the Water Corporation to determine the viability of these alternatives.

Although there is adequate water in the aquifer, additional bores headworks, and water supply network upgrades will be required.

For Scenario 1, a new bore will need to be constructed and commissioned before each of the following years: 2029, 2035 and 2041.

For Scenario 2, two new bores will need to be constructed and commissioned before 2021, with a third before 2037.

For Scenario 3A, two new bores will need to be constructed and commissioned before 2021, with a third before 2033.

For Scenario 3B, two new bores will need to be constructed and commissioned before 2021, with a third before 2028 and a fourth before 2034.

For Scenario 4, three new bores will need to be constructed and commissioned before 2021, with and a fourth before 2028.

These upgrades will need to be discussed and agreed with the Water Corporation for inclusion in their works program.

The water supply for the BLNG Precinct will be sourced from either the Wallal Aquifer or sea water. Both of these water supplies have a salt content, and thus will require desalination prior to use. The infrastructure required to be built at the BLNG Precinct will include:

- Bores and associated infrastructure.
- A desalination plant.
- A pipe network to transport the water from the source to the desalination plant and then around the site.

During the design of the BLNG Precinct, opportunities to utilise grey water or harvest rain water should be investigated.

The Rights in Water Irrigation Act 1914 provides for regulation, management, use and protection of water resources and irrigation schemes. This includes the rights and licenses to take water; permit to obstruct or interfere with a watercourse or wetland including its bed or banks. Any such activities outlined in this section will need to adhere to this legislation.

12.2 Waste Water

The capacity of Broome's waste water treatment plant is 5,110 megalitres per year, which is above the predicted requirement for Scenarios 1, 2, 3A and 3B. Thus, if these Scenarios are adopted, no upgrade to Broome's waste water treatment plant is required. For Scenario 4, the estimated waste water generation for three years (2036, 2040 and 2032) is greater than the plant's capacity. As this is a short term over demand, alternative waste water options could be investigated. Such as grey water collection and reuse for industry. To enable this to happen

infrastructure such as a grey water pipe network and / or changes to planning policy to encourage grey water recycling in new developments will be required. This will need to be discussed and agreed with the Shire of Broome and the Water Corporation.

At the BLNG Precinct, a waste water treatment facility will need to be constructed. The infrastructure required will include collection pipes, a treatment plant, testing facilities and an outlet pipe. The size and type of treatment facility will be determined through the design of the BLNG Precinct.

During the design of the BLNG Precinct, opportunities to utilise grey water should be reviewed.

Due to high seasonal rainfall, a drainage strategy for the BLNG Precinct will be required. This should outline how the surface runoff will be collected and stored, including any flood mitigation measures.

12.3 Solid Waste

Broome's solid waste facility has a remaining five year life span. Options for the location of a new landfill are currently being reviewed. The Shire of Broome will need to be consulted to ensure the new facility is designed to accommodate the predicted waste generated by the BLNG Precinct Category A, B and C Activities.

The capacity of the waste transport network should be able to cater for the predicted increase in waste generated by Scenarios 2, 3A and 3B. Scenario 4 will require discussions with the service provider.

For the BLNG Precinct a Solid Waste Management Plan should be developed to outline:

- The type and amount of waste to be generated on site
- How each type of waste is to be handled, collected and stored
- Where each type of waste should be removed to and how and when

12.4 Power

A new power plant will be required in Broome in all the Scenarios. Discussions will need to be undertaken with Horizon Power to determine the size and timing of this station. The estimated power usage indicates that a new power station of the following size will be required for the following year for each scenario:

- Scenario 1 an additional power station of at least 13,000 kW/h capacity is required by 2025
- Scenario 2 an additional power station of at least 14,000 kW/h capacity is required by 2021
- Scenario 3A an additional power station of at least 17,000 kW/h capacity is required by 2021
- Scenario 3B an additional power station of at least 14,000 kW/h capacity is required by 2020
- Scenario 4 an additional power station of at least 21,000 kW/h capacity is required by 2021

There is also the possibility of reducing the power demand through the use of renewable energy and / or gas. This will require additional infrastructure and planning policy change to encourage the use of cleaner energy. The Shire of Broome should be consulted to determine the viability of these alternative fuels.

At the BLNG Precinct power will be provided through power generating infrastructure using gas or steam driven turbines, with diesel back up generators. There are two options for this power supply, it can be either:

- Generated by individual power stations constructed and operated by each proponent with an agreement in place for the provision of power to the shared areas
- Generated by a single power station constructed and operated by a third party

The latter will require less area and management input.

12.5 Gas

There is an opportunity to supply Broome Power Station and / or township with gas from the BLNG Precinct. To enable this, a pipe network linking the BLNG Precinct with Broome's Power Station and / or the town of Broome will be required. The proposed service corridor connecting the BLNG Precinct includes provision for such a pipe

(refer to **Section 13**). The Shire of Broome and Horizon Power will need to be consulted to determine the economic viability of this option.

The power station or stations on site will utilise gas from the processing plant to drive turbines. If the option of a single power plant operated by a third party is chosen then, the third party will be able to buy gas from any of the proponents.

12.6 Telecommunications

The telecommunications within Broome will need to be upgraded to cater of the predicted growth in each scenario. The current infrastructure can be upgraded to accommodate a 20 percent population increase. This will be reached in:

- In 2014 for Scenario 1
- In 2013 for Scenarios 2, 3A, 3B and 4

Discussions will need to be held with Telstra to agree the timeframe and amount of upgrades required.

Telstra will also need to be consulted regarding the timing and costs of the connection of the optical fibre to, and installation mobile repeater at, the BLNG Precinct with regard to.

12.7 Transport

The remaining unsealed sections of Broome Cape Leveque Road will require upgrading prior to the commencement of the construction phase. MRWA will need to be consulted to agree a timeline.

The access road from Broome Cape Leveque Road to the site will be constructed as part of the pioneer works.

A traffic management plan will need to be prepared by the construction contractors to ensure that any high or wide loads requiring access to the BLNG Precinct from Broome Port or elsewhere can be accommodated.

As the design of the BLNG Precinct becomes more detailed, a full transport assessment will be prepared to identify any transport issues and suggest mitigation measures, this will require liaison with MRWA and the Shire of Broome.

13.0 Services Corridor

The remote location of the BLNG Precinct will most likely result in the provision of stand alone water, power and waste water systems on site. To cater for the possibility of linking these services to the Broome network, provide road access, telecommunications and gas connections, a service corridor will be required. The service corridor will include:

- A road corridor including utilities (such as telecommunications, water and waste water)
- A gas pipeline corridor
- A power corridor including a service road

As the BLNG Precinct design is still in its early stages the exact width of the service corridor cannot be determined at this time. Instead, an indicative width has been determined. This width is considered conservative and is to provide an envelope sufficient for development. The indicative width of the service corridor has been determined to adhere to the following regulation requirements:

- AS 2885.1:2007 – Pipelines. Gas and Liquid Petroleum (Design & Construction)
- AS/NZS 3000:2007 – Wiring Rules
- AS/NZS 3500 – Water Services
- AS 5601 – Gas Services
- ENA C (b) 1 – 2007 Guidelines for Design and Maintenance of Overhead Distribution and Transmission Lines
- Land Use Guideline (Dampier to Bunbury Natural Gas Pipeline Corridor)
- Austroads, Rural Road Design, A Guide to the Geometric Design of Rural Roads
- MRWA, Utility Providers Code of Practice for Western Australia

13.1 Road Corridor

The road corridor will include the following:

- Road carriageway
- Shoulder
- Verge
- Drainage
- Embankments / elevated structures
- Utility Corridor

The road carriageway shall be designed to MRWA standards and will be a MRWA Type 4 (sealed) two lane, bi-directional, single carriageway. The indicative lane width is 3.7 metres with a 2.5 metre wide sealed shoulder. To ensure that the road will be operational all year round the road corridor is extended to 44 metres on each side to cater for elevated structures, substantial drainage facilities and / or embankments. This equates to a total road corridor width of 100 metres.

13.2 Utility Corridor

The utility corridor will include:

- Telecommunications
- Gas
- Water
- Waste Water

It will be provided as part of the 100 metre road corridor.

13.2.1 Telecommunications

The telecommunication facilities included in this service corridor are optical fibre and telecommunication cables.

The telecommunications optical fibre between Broome and BLNG Precinct will be installed at a depth of 1.2 metres within a 4 metre corridor. Sufficient space must be allowed for the optical fibre joints and the repeater and / or base stations (50 - 75 square metres).

In a road reserve, telecommunication cables are nominally buried at least 450 millimetres below ground level and are placed either 4.1 metres from the road carriageway, within a 0.8 metre corridor (general services) or 1.4 metres from the road carriageway, within a 1.2 metre corridor (main conduit services).

A four metre corridor will be sufficient for the installation of an optical fibre cable, at a depth of 1.2 metres, and associated optical fibre joints. To extend the telecommunication coverage between Broome and the BLNG Precinct, two repeaters / base stations will be required along the route. Suitable portions of land within the corridor will need to be available.

13.2.2 Water

The exact size of the water corridor will depend on the size of the pipe required. An indicative corridor of 3 metres has been assumed for this assessment. The pipeline will be located a minimum of 0.75 metres below ground.

13.2.3 Waste Water

The exact size of the waste water corridor will depend on the size of the pipe required. An indicative corridor of 3 metres has been assumed for this assessment. The pipeline will be located a minimum of 0.9 metres below ground.

13.3 Gas Pipeline Corridor

The gas infrastructure included in this service corridor is high and low pressure gas lines.

In a road reserve, gas pipelines (low pressure) are buried at least 0.75 metres below ground level and are placed approximately 3.45 metres from the road carriageway, within a 0.5 metre corridor.

In general high pressure gas pipelines are buried at depths ranging from 0.75 metres in pastoral areas to over 2 metres in built up areas. However, it may be more economical to install the pipeline above ground.

A 30 metre corridor is required for a high pressure gas pipeline, generally the full width of the corridor is utilised during construction. Once in operation certain above ground and underground activities / services may be allowed to infringe on the corridor if a written request is submitted to the pipeline operator / authority.

Above Ground Services

All activities, including digging, drilling, trenching, drainage, land levelling, land contouring, use of vibrating machinery and transportation of heavy loads inside or across the gas corridor are generally discouraged and will require prior approval from pipeline operator / authority.

Services like antennae, poles and towers are also generally discouraged, particularly adjacent to surface pipelines. Other activities and structures, which would be severely discouraged, are:

- Airstrips
- Use and storage of explosives, flammables, corrosives
- Blasting
- Construction of storm water basins, artificial lakes, swimming pools
- Garbage, sandfill, refuse disposal
- Erection of street signs, neon signs, billboards, and permanent storage

Buildings and/or structures of any nature are not to be permitted under any circumstance.

Underground Services

Consent may be given for underground services within the gas corridor, if:

- A recommended 0.6 metre vertical clearance above or below any gas pipeline is maintained for the full width of corridor, with a minimum of 0.3 metre allowable on request
- Special protection such as concrete casing, steel casing or concrete culvert and lid are provided as determined by pipeline operator/authority
- Other Services are only allowed to cross the gas pipeline at right angles to the pipeline
- Special studies and mitigation measures are implemented for services running parallel to gas pipeline

The total width of the gas pipeline corridor is 30 metres.

13.4 Power Corridor

The power supply requirements and selected network layout will determine the final power corridor width. Given that the distance between Broome and the BLNG Precinct is approximately 50 kilometres, a high voltage transmission network (132 kilovolts) will be required. Three factors, namely cost, environmental impact and reliability will determine whether an overhead power line or underground cable network is established.

Overhead lines are approximately 50 percent cheaper, however, have a far greater visual impact on the environment and are less reliable than underground cables, being exposed to the cyclonic weather conditions. A 132 kilovolts overhead power line will require a corridor width of approximately 15 metres, where as an underground cable most probably requires five metres.

Generally it is accepted that the power utility concerned will be contacted before any activity, i.e. building, construction, digging or work is carried out near its transmission lines and cables.

In addition to the transmission power line connection between the BLNG Precinct and Broome, a second power line will be required to supply streetlights, Telstra's repeater / Next G base stations, and various communities along the route.

13.4.1 High Voltage Power

Overhead power lines require a vertical clearance of 6.5 metres each side. Underground power cables are required to be installed under gas and water mains at crossings where possible, the power cables require protection by means of duct or concrete slabs when the minimum clearance of 0.15 metres cannot be maintained.

In a road reserve, high voltage cables are buried at least 0.75 metres below ground level and are generally placed within the first 0.5 metres from the property line or the last 0.5 metres of the five metre reserve from the road carriageway. The high voltage overhead lines are generally placed approximately 2.3 metres from the road carriageway, within a 0.6 metre corridor for each cable.

13.4.2 Low Voltage Power

Low voltage electrical cables will require the separation distances outlined in **Table 13.1** for the underground services.

Table 13.1 Minimum Separation of Underground Services (low voltage)

Type of Service	Minimum separation to low voltage electrical service (mm)	Minimum separation to low voltage electrical earthing electrode (mm)
Water Service – Pipe internal diameter < $65mm^2$	100	500
Water Service – Pipe internal diameter > $65mm^2$	300	500
Sanitary Drainage	100	500
Stormwater Drainage	100	600
Gas	100	500
Telecommunications	100	100

In a road reserve, low voltage cables are buried at least 0.75 metres below ground level and are generally placed within the first 0.5 metres from the property line or the last 0.5 metres of the five metre reserve from the road carriageway.

The low voltage overhead lines, like high voltage overhead lines, are generally placed approximately 2.3 metres from the road carriageway, within a 0.6 metre corridor for each cable.

13.4.3 Power Corridor Width

The indicative power corridor width has been calculated based on:

- Two over head power lines (to ensure a constant service)
- One underground cable
- Room to provide supporting infrastructure
- A five metre access road

The power corridor width has been rounded up to 60 metres.

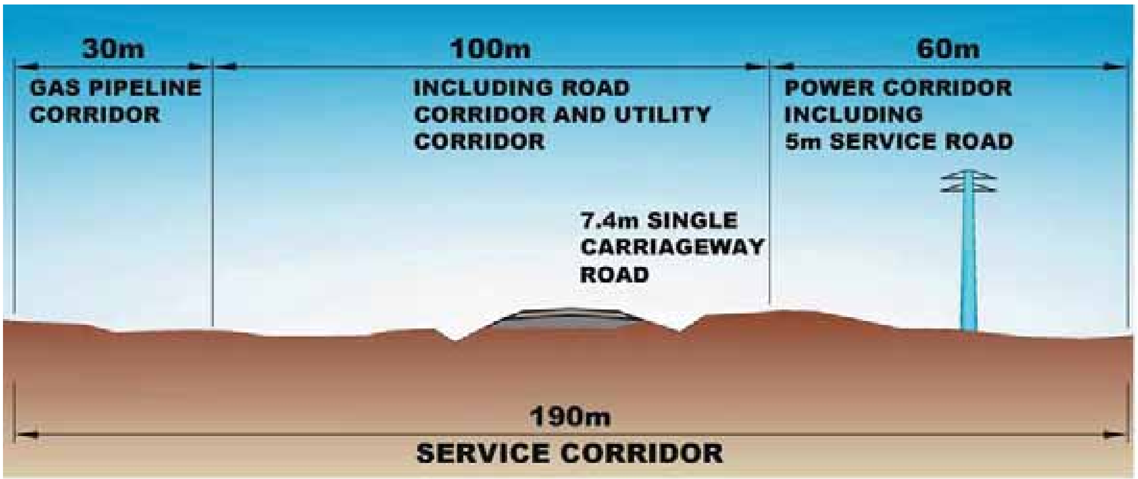
13.5 Service Corridor Width

The total width of the service corridor has been determined as 190 metres. This includes:

- A single road carriageway of 12.4 metres in width (including lanes and shoulders)
- Drainage, embankment and batter area of 44 metres each side of the road carriageway
- Utility corridor of 50 metres wide including the 30 metre gas pipeline reserve and five metre access road
- Power corridor of 60 metres wide including five metre access road

Figure 13.1 provides an illustrative only diagram of the service corridor.

Figure 13.1 Illustrative Only Diagram of the Service Corridor



The exact location of the service corridor is yet to be determined. However, however it is envisaged that it will follow the Broome Cape Leveque Road where possible and will avoid any environmental or heritage sensitive areas. Currently the allocated road reserve area does not match the actual road alignment and thus the road reserve may require relocation.

14.0 Summary and Conclusion

The proposed BLNG Precinct is located approximately 60 kilometres north of the township of Broome. The proposed location is a greenfield site with very little development within its vicinity and no infrastructure currently servicing it.

The following infrastructure was assessed in this study:

- Water
- Waste Water
- Solid Waste
- Power
- Telecommunications
- Gas
- Transport

Each type of infrastructure was assessed for the following development scenarios, category activities and development phases:

- Scenario 1: the future base case with no BLNG Precinct
- Scenario 2: the future case with a low BLNG Precinct development (throughput of 15 million tonnes per annum)
- Scenario 3A: the future case with a medium BLNG Precinct development (throughput of 25 million tonnes per annum)
- Scenario 3B: the future case with a medium BLNG Precinct development (throughput of 35 million tonnes per annum)
- Scenario 4: the future case with a high BLNG Precinct development (throughput of 50 million tonnes per annum)
- Category A Activity: direct activities
- Category B Activity: indirect activities
- Category C Activity: related activities
- Construction Phase
- Operation Phase

The Shire of Broome has witnessed a faster population growth rate than the State of Western Australia for a number of years. This growth has exhausted the existing infrastructure in Broome and encouraged the Shire and service providers to plan for future upgrades. These upgrades will take into account the potential for Broome to double in size. This investment and forward planning has reduced the impact that the BLNG Precinct will have on the future infrastructure for all development phases and scenarios.

These commissioned or planned improvements for road, water and waste water should provide a future capacity to cater for the increased population.

Although the capacity of the water source is sufficient, additional bores will be required to collect this water. Three new bores will be required for Scenario 1 (without the BLNG Precinct), Scenario 2 and Scenario 3A. The timing of these bores for each Scenario is:

- Scenario 1 in 2029, 2035 and 2041.
- Scenario 2 in 2021 and 2037.
- Scenario 3A in 2021 and 2033.

Scenarios 3B and 4 will require a fourth bore in 2034 and 2028 respectively.

The existing landfill is due for closure in five years without the influence of the BLNG Precinct. The five scenarios are likely to cause the landfill to close sooner than currently expected. As such, the BLNG Precinct proponent (DSD) will need to work with the Shire of Broome to ensure the new landfill is constructed to handle the additional waste produced by the BLNG Precinct and within an appropriate timeframe.

The other solid waste infrastructure in the region is either adequate or can be readily expanded (in consultation with the service providers) to meet the demands of the BLNG Precinct's solid waste needs.

In terms of power, the assessment highlighted that the planned infrastructure may not be able to cater for the future population without the BLNG Precinct (Scenario 1). Thus, requiring a new power station by 2025 for Scenario 1, 2021 for Scenarios 2, 3A and 4, and 2020 for Scenario 3B. However, this assessment was based on estimated current industrial and household usage and thus will need to be reviewed once actual information is available.

The BLNG Precinct provides the opportunity to supply Broome Power Station and / or the township of Broome with a cheaper and cleaner energy.

Telstra is currently considering the construction of a communication centre / exchange at James Price Point, which would provide the BLNG Precinct fixed lines, internet and mobile needs. The telecommunication infrastructure in Broome will require upgrading including a new exchange building and associated infrastructure.

The Broome port, including planned upgrades and expansion, will adequately handle an increase in vessel traffic because of the BLNG Precinct construction activities. The resulting increase in road haulage movements will have minor impact on total road traffic volumes. The operations phase of the Precinct will again have minor impact on both vessel and road traffic associated with the port.

At the peak of construction of the BLNG Precinct, total passenger numbers and air flight movements will be adequately handled by the existing airport facility. There is no requirement to relocate the airport.

The predicted vehicle movements during the peak time (operation phase) should have minimal impact on the surrounding road network. However, a traffic management plan will need to be prepared by the construction contractors to determine high and wide load routes.

A summary of the infrastructure assessment is contained in **Tables 14.1**, **14.2** and **14.3**.

Table 14.1 Infrastructure Requirements at the BLNG Precinct During Construction

Phase/Activity	Scenario 2	Scenario 3	Scenario 3B	Scenario 4
Water				
Workforce Accommodation Village	1,400 ML/yr	1,400 ML/yr	1,600 ML/yr	1,600 ML/yr
BLNG Precinct	2,800 ML/yr	2,200 ML/yr	2,300 ML/yr	2,900 ML/yr
Wastewater				
Workforce Accommodation Village	700 ML/yr	700 ML/yr	810 ML/yr	810 ML/yr
Desalination Plant	2,800 ML/yr	2,200 ML/yr	2,300 ML/yr	2,900 ML/yr
Solid Waste				
Workforce Accommodation Village	2,200 m^3/yr	2,200 m^3/yr	2,500 m^3/yr	2,500 m^3/yr
Toxic Waste Produced Over Construction Period	340 – 400 m^3	590 -700 m^3	830 – 1,000 m^3	1,170 – 1,400 m^3
Scrap / Recycle Metal Produced Over Construction Period	45 -100 m^3	80 - 175 m^3	115 - 250 m^3	160 - 350 m^3
Toxic Chemicals Produced Over Construction Period	15 -35 m^3	20 - 60 m^3	30 - 85 m^3	45 – 120 m^3
Power				
Workforce Accommodation Village	13,900 kW/h	13,900 kW/h	16,000 kW/h	16,000 kW/h
BLNG Precinct	2,000 kW/h	2,000 kW/h	4,000 kW/h	6,000 kW/h
Gas				
Total BLNG Precinct	None	None	None	None
Telecommunications				
Comments	Temporary installation of a microwave link, and mobile repeater			
Transport				
Workforce Accommodation Village	3 bus trips to and from Broome and 2 flights in and out of Broome a day	3 bus trips to and from Broome and 2 flights in and out of Broome a day	4 bus trips to and from Broome and 2 flights in and out of Broome a day	4 bus trips to and from Broome and 2 flights in and out of Broome a day
BLNG Precinct	Indicative peak daily traffic of approximately 430 vehicles			

Table 14.2 Infrastructure Requirements at the BLNG Precinct During Operation

Phase/Activity	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Water				
Workforce Accommodation Village	120 ML/yr	130 ML/yr	230 ML/yr	270 ML/yr
BLNG Precinct (maximum demand assuming seawater)	8,000 ML/yr	14,000 ML/yr	19,000 ML/yr	27,000 ML/yr
Wastewater				
Workforce Accommodation Village	60 ML/yr	70 ML/yr	120 ML/yr	140 ML/yr
From BLNG Plant	9,000 ML/yr	15,000 ML/yr	20,000 ML/yr	30,000 ML/yr
Solid Waste				
Workforce Accommodation Village	180 m^3/yr	200 m^3/yr	350 m^3/yr	420 m^3/yr
General Waste Produced	5,300 – 10,700 m^3/yr	9,300 – 18,700 m^3/yr	13,300 – 26,700 m^3/yr	18,600 – 37,300 m^3/yr
General Recyclables Produced	500 – 1,000 m^3/yr	880 – 1,800 m^3/yr	1,300 – 2,500 m^3/yr	1,800 – 3,500 m^3/yr
Toxic Waste Produced	250 – 500 m^3/yr	430 – 880 m^3/yr	620 - 1,250 m^3/yr	860 – 1,750 m^3/yr
Mercury Produced	40 – 80 m^3/yr	70 – 140 m^3/yr	100 - 200 m^3/yr	140 – 280 m^3/yr
Chemical Drums Produced	20 – 40 m^3/yr	40 – 70 m^3/yr	50 - 100 m^3/yr	70 – 140 m^3/yr
Scrap / Recyclable Materials Produced	10 – 20 m^3/yr	15 – 40 m^3/yr	20 - 50 m^3/yr	30 – 70 m^3/yr
Highly Hazardous Materials Produced	1 – 4 m^3/yr	2 – 7 m^3/yr	3 - 10 m^3/yr	4 – 14 m^3/yr
Fluorescent Produced	Up to 4 m^3/yr	Up to 7 m^3/yr	Up to 10 m^3/yr	Up to 14 m^3/yr
Power				
BLNG Precinct Total	80,000 to 125,000 kW/h	160,000 to 200,000 kW/h	230,000 to 280,000 kW/h	320,000 to 400,000 kW/h
Gas				
BLNG Precinct Total	May use gas from processing plant to drive power plant			
Telecommunications				
Comments	Optical Fibre link will provide fixed line, internet and mobile services			
Transport				
Workforce Accommodation Village	3 bus trips to and from Broome and 1 flights in and out of Broome on one day a week	3 bus trips to and from Broome and 1 flights in and out of Broome on one day a week	5 bus trips to and from Broome and 1 flights in and out of Broome on one day a week	5 bus trips to and from Broome and 1 flights in and out of Broome on one day a week
BLNG Precinct	Indicative peak daily traffic of approximately 8,070 vehicles			

Table 14.3 Impacts on Infrastructure in Broome

Phase/Activity	Scenario 1	Scenario 2	Scenario 3A	Scenario 3B	Scenario 4
Water					
Total estimated water usage in Broome	8,600 ML/yr	8,960 ML/yr	9,080 ML/yr	9,440 ML/yr	10,020 ML/yr
Capacity of Infrastructure	10,600 ML/yr				
Comments	Within water supply capacity, will require 3 extra bores.	Within water supply capacity, will require no extra bores than required for Scenario 1 (3 bores).	Within water supply capacity, will require no extra bores than required for Scenario 1 (3 bores).	Within water supply capacity, will require a fourth bore.	Within water supply capacity, will require no extra bores than required for Scenario 3B (4 bores).
Waste Water					
Total estimated wastewater generated in Broome	4,300 ML/yr	4,480 ML/yr	4,540 ML/yr	4,720 ML/yr	5,010 ML/yr
Capacity of Infrastructure	5,110 ML/yr				
Comments	Within water treatment capacity	Within water treatment capacity	Within water treatment capacity	Within water treatment capacity	Within water treatment capacity
Solid Waste					
Waste Generated in Broome at Maximum Population Year	13,300 m^3/yr	13,800 m^3/yr	15,600 m^3/yr	14,800 m^3/yr	17,100 m^3/yr
Comments	A new landfill is required without the BLNG Precinct. This should be within the waste transport capacity for Scenarios 1, 2, 3A and 3B. Scenario 4 will need to be confirmed.				
Power					
Total estimated power usage in Broome	58,600 kW/h	60,000 kW/h	62,900 kW/h	59,600 kW/h	67,000 kW/h
Capacity of Infrastructure	46,300 kW/h				
Comments	A new power station will be required even without the BLNG Precinct				
Gas					
Total estimated gas usage in Broome	16.3 TJ/day	16.3 TJ/day	18.2 TJ/day	17.3 TJ/day	19.7 TJ/day
Capacity of Infrastructure	No current infrastructure. There is an opportunity to supply Broome Power Station and / or the township of Broome with gas from the BLNG Precinct.				
Telecommunication					
Comments	Increased telecommunications capacity in Broome will be required.				
Transport					
Comments	Planned transport improvements within Broome to accommodate the planned developments (including North Broome) will cater for the increased traffic movements required for the BLNG Precinct. The airport upgrades should be able to cater for the increased air traffic, and will not require relocation.				

The remote location of the BLNG Precinct will most likely necessitate the production and treatment of power, water and waste water on site. However, to cater for potential service connections to Broome, a service corridor of approximately 190 metres in width will be required. This corridor will include a single carriageway roadway reserve, utility corridor, gas pipeline corridor and a power corridor (including access road).

It should be noted that the infrastructure requirements in this report, and hence the above conclusions, are based upon the upper set of the November population projections for Broome. These projections have since been revised down (the December projections) meaning that the infrastructure requirements for water, waste water, solid waste, power, gas, telecommunications and transport are likely to be less, and possibly significantly less, than identified in this report.

Further refinement of the requirements is therefore recommended as factors affecting the population projections, such as the assumed fly in fly out proportion, are firmed up during future stages of the BLNG Precinct design process.

Appendix A

Literature Review

Appendix A Literature Review

Table A.1 Summary of Literature Review

Topic	Document Title and Date	Population Projection	Estimated Annual Demand	Existing infrastructure	Plant Maintenance Upgrade	Additional info
Water Supply						
	Airport Development Plan Nov 2008	18000 by 2011 23,800 by 2021				
Potable Water	Regional Hotspots-Broome Nov 2008	21,900 in 2018 and 2800 in 2028				
	Social Impact Assessment Workshop Infrastructure Aug 2009		4.5 Gigalitre /day	10.6 Gigalitre /day to draw on.	3 New bores have been drilled. Expansion predominantly in the North of Town.	Water is available in the P1 Aquifer to supply Broome to 2050.
	Social Impact Assessment - Broome July 2009	Without the LNG development, the population in Broome is projected to increase from 15386 in 2008 to 22100 in 2021 to 26800 in 2031.				
	Shire of Broome Town Planning Scheme 4 - Date?					The ground water supply reserve is the only water supply for the town

Topic	Document Title and Date	Population Projection	Estimated Annual Demand	Existing infrastructure	Plant Maintenance Upgrade	Additional info
	Shire of Broome Town Planning Scheme 4 - Date?					An annual growth rate of approximately 4% is estimated for the town and projected populations of 26,414 (town site) to 34,986 (Shire) in the year 2021.
	EPA Section 16 - Advice Kimberley LNG Precinct: review of potential sites for a proposed multiuser LNG processing precinct in the Kimberley region - Dec 2008	3000-4000 employees required to construct the precinct and facilities, over a 3-4 year period. A permanent workforce of between 400-600 people would be required for on-going operations plus additional employees in service industries				Visitation estimated to double in the next decade
	Social Impact Assessment - Broome July 2009			Broome's water supply is obtained from bores screened in the unconfined Broome Sandstone aquifer north east of the town.	Water Corporation has recently upgraded the bore field for augmentation of water supply until 2017 - 2020.	

Topic	Document Title and Date	Population Projection	Estimated Annual Demand	Existing infrastructure	Plant Maintenance Upgrade	Additional info
	Community Update - Jan 2009			Drinking water is sourced from a bore field 10 Km north of the town. The bore field has reached its production capacity. The Pump stations and pipelines have reached their maximum capacity.	Broome bore field expansion is underway. 3 bores and a peaking bore, each of 2000 KL/day have been drilled. Works are underway to upgrade supply mains and increase storage via new tanks around Broome.	
	Broome Water Reserve - Water Source protection Plan - 2001			Broome is supplied with ground water from a bore field located 12 KM to its north east. Existing 14 production bores producing 4200000 kL/annum.		
						Expansion of rural living and agricultural uses is limited unless groundwater quantity and quality guaranteed or reticulated water provided.
Waste Water						

Topic	Document Title and Date	Population Projection	Estimated Annual Demand	Existing infrastructure	Plant Maintenance Upgrade	Additional info
Sewerage	Social Impact Assessment - Broome July 2009		3.5 ML per day. Reached its max capacity.	One Wastewater Treatment Plant at Clementson Street , another planned by WC 13 KM from Broome near Broome / Derby Road	The second Waste Water Treatment Plant is under construction by WC, North of Broome on Crab Creek road. Planned to be operational by 2010 with staged upgrades until 2050.	2020 - 3.5 ML/day, 2030-2035-3.5ML/day, 2050- +3.5ML/day
	Works Approval March 2009		3.5ML/day		Proposed additional Waste Water Treatment Plant	Works approval for stage 1 is valid from 19 June 2009 - 18 June 2012. Two more stages are planned in the next 35 years.
	Regional Hotspots-Broome Nov 2008				Proposed WWTP10 KM North East of Broome.	
	Community Update - January 2009				The second Waste Water Treatment Plant is under construction by WC, North of Broome on Crab Creek road. Planned to be operational by 2009 and utilising recycled water on site.	

Topic	Document Title and Date	Population Projection	Estimated Annual Demand	Existing infrastructure	Plant Maintenance Upgrade	Additional info
On Site Waste water			100 cubic meter per month from septic tanks			
Solid Waste						
Domestic	Social Impact Assessment - Broome July 2009			The Shire of Broome manages a waste management facility, located 9km from the town of Broome on the Broome Highway. Through contracted service providers, the Shire provides weekly household refuse collection services and provides a comprehensive recycling service.		
	SOCIAL IMPACT ASSESSMENT Workshop Infrastructure Aug 2009		Estimate of 10-20% increase to existing waste	Limited lifespan	New waste management site and potential future locations are being identified	
Power						
	Regional Hotspots- Broome Nov 2008				Proposed new Power Station North of the Airport - scheduled completion 2011 - 2012	

Topic	Document Title and Date	Population Projection	Estimated Annual Demand	Existing infrastructure	Plant Maintenance Upgrade	Additional info
	SOCIAL IMPACT ASSESSMENT Workshop Infrastructure Aug 2009					Electricity capacity needs to be increased due to proposed plans for commercial and residential development in Broome North. Surveying for a new sub-station is being undertaken.
	Social Impact Assessment - Broome July 2009			Horizon Power provides electricity in Broome. 180 Million $ was spent on Capital Works in 2006. Expected to invest 400 Million $ in the next 20 years.	The 76 MW new Broome Power Station was commissioned in 2008. The power stations, to be built, owned and operated by Australian company Energy Developments Limited, are aimed at improving the quality and reliability of power supplies in Broome, Derby, Halls Creek, Fitzroy Crossing and Camballin-Looma and improving the amenity of these five towns (Horizon Power	On the Dampier Peninsula Horizon, power recently established 50kW diesel power stations at Ardyaloon, Beagle Bay and Lombadina/Djarindjin (DPI 2008).

Topic	Document Title and Date	Population Projection	Estimated Annual Demand	Existing infrastructure	Plant Maintenance Upgrade	Additional info
					2006).	
	Shire of Broome Town Planning Scheme			The Broome Land Development Programme identifies that Western Power is reviewing the power supply and current power station in McDaniel Road situated in the townsite. An alternative site and/or power options is being considered. An alternative power station/distribution site, if necessary, can be accommodated in the future industrial area/infrastructure/airport relocation site		
Telecommunication						

Topic	Document Title and Date	Population Projection	Estimated Annual Demand	Existing infrastructure	Plant Maintenance Upgrade	Additional info
	Social Impact Assessment - July 2009			The urban centres have access to various television and radio stations, ABC and SBS national television, WIN and GWN commercial television, ABC Regional Radio, ABC Radio National, commercial WAFM and North West Radio. In addition, GTV 35, a community TV station, is in operation in Broome (DLGRD & KDC 2006).Major towns and several mining operations have access to digital mobile phone services		
Gas						
	Social Impact Assessment - Broome July 2009			No piped Gas lines in Broome .Available bottled gas.		
	SIA workshop: Infrastructure Aug 2009					The infrastructure services corridor may be 200m wide and allow the future possibility of a gas pipeline (but gas will not necessarily be transported this way)

Topic	Document Title and Date	Population Projection	Estimated Annual Demand	Existing infrastructure	Plant Maintenance Upgrade	Additional info
Other						
Access Corridor	SIA Workshop Infrastructure - 6 Aug-2009					200 m wide corridor for road, providing space for a gas pipeline.
Population	Social Impact Assessment - Broome July 2009	No LNG:2018-20,000 ,2028 - 25000,2030- 26,700				
	Shire of Broome Town Planning Scheme Date?	26414 -2021 for the town site and 34,986 for the shire - year 2021				
Fire Fighting	Social Impact Assessment - Broome July 2009			FESA has office in Broome. The Broome Bushfire Brigade has two water tankers. Broome volunteers get approximately 500 calls a year for a variety of emergency incidents.		
Airport	SIA Workshop Infrastructure - 6 Aug-2009		2009 - 9% increase in passengers	2008 - catered for 400,000 passengers, which was a 7% increase on the previous year.	Master plan for the Broome airport until 2025	The Airport Master Plan can be updated to take into account expansion planning for James Price Point precinct needs. The precinct will not have its own airstrip and will use the Broome Airport for precinct and offshore requirements

Topic	Document Title and Date	Population Projection	Estimated Annual Demand	Existing infrastructure	Plant Maintenance Upgrade	Additional info
Roads	SIA Workshop Infrastructure - 6 Aug-2009	Access road will eventually be sealed, with an all weather highway configuration/standards				
Port						
	Broome Port - 1889-2009			Fuel and water delivery points have been added all round the wharf perimeter. The length of the existing wharf is 331 m and the load limit is 100 Tonnes.		Broome town and industries presently act as a support centre for the Browse Basin inclusive of all the support facilities required for oil and gas.
	Social Impact Assessment - Broome July 2009			Approximately 50 hectares of port land, including present leases, are presently dedicated towards port operations and another 46 hectares of industrial land is potentially available outside but adjacent to the port boundaries.	The Broome Port Authority has undertaken preliminary studies to construct a second heavy lift wharf to allow for port expansion and the servicing of Browse Basin production operations.	

Appendix B

September 2009. Precinct Workforce Projection

TABLE OF CONTENTS

1. INTRODUCTION

An LNG precinct is planned to be development near James Price Point in the Kimberley, 60km north of Broome. The LNG precinct will comprise LNG processing facilities for a capacity up to 50mtpa including supporting utilities and supporting infrastructure. Gas for the LNG precinct will be sourced from the Browse basin and surrounding fields.

The workforce to manage and construct the onshore LNG facilities, the offshore facilities, subsea drill centres / tie-backs and pipelines will be largely fly-in / fly-out through Broome. Long-term operational personnel may be a combination of fly-in / fly-out and Broome residential.

This document summarises the workforce forecasted under various development scenarios for the LNG precinct. The cases analysed include:

Case 1 – No development of Precinct
Case 2 – 15Mtpa LNG Precinct within 15 years
Case 3A – 25Mtpa LNG Precinct within 25 years
Case 3B – 35Mtpa LNG Precinct within 25 years
Case 4 – 50Mtpa LNG Precinct within 30 years

The analysis has been focused on defining the Australian based management, engineering and fabrication / construction workforce. No detailed modelling of the manufacturing or offshore fabrication workforce is included in this report.

2. WORKFORCE FORECAST ASSUMTPIONS

The following development scenarios have been considered and the workforce forecasts analysed.

Case 1 – No development of Precinct
Case 2 – 15Mtpa LNG Precinct within 15 years
Case 3A – 25Mtpa LNG Precinct within 25 years
Case 3B – 35Mtpa LNG Precinct within 25 years
Case 4 – 50Mtpa LNG Precinct within 30 years

Due to the uncertainty around the technical solutions, phasing and contracting approaches, a range reflecting the potential workforce impacts has also been assessed. No differentiation between Perth based management and site based construction management has been made during the actual construction phase. However, pre-FID management and engineering personnel are assumed to be Perth based for all related Australian based workforce.

For each for the cases analysed the various assumptions have been made. The assumptions made are summarised in the following sections.

2.1.1 Case 1 – No development of Precinct

The key assumptions attributable to Case 1 are:

- Final Investment Decision (FID) date isn't defined;
- Initial development assumes development of Browse Basin fields with an offshore export pipeline back to Karratha;

- The basis for the workforce loading is premised on the development of the Browse Basin fields and tied back to the Karratha. The scope comprises the following:
  - Various upstream facilities;
  - Interfield pipelines;
  - Offshore export pipeline to Karratha (assumed all export pipeline workforce are routed via Broome);
  - Construction of supply base in Broome;
- Workforce in Karratha to support the following is not included:
  - Onshore infrastructure and utilities to receive gas;
  - Any debottlenecking on existing facilities; and
  - No additional LNG Processing trains are allowed.
- Upstream facilities and gravity based structures are fabricated in SE Asia; and
- Additional campaigns and ongoing drilling & completions will continue subject to flow-rates and backfill requirements.

2.1.2 Case 2 - 15Mtpa LNG Precinct within 15 years

The key assumptions attributable to Case 2 are:

- FID for the initial development is 2012;
- The basis for the workforce loading is premised on the Precinct LNG Development in the Kimberley by Foundation Proponent comprising the following:
  - Various upstream facilities;
  - Interfield pipeline
  - Export pipeline
  - Onshore infrastructure and utilities; and
  - Three LNG Processing trains (nominal 11 MTPA total capacity)
- Additional campaigns and ongoing drilling & completions will continue out to circa 2030.
- Adoption of a downstream modular execution strategy with modules fabricated in SE Asia;
- Upstream facilities are fabricated in SE Asia;
- A fourth LNG processing train is ready for start-up circa 2022;
- Gas for the 4th LNG train is sourced from a field in the Browse basin and is developed via a subsea tieback to the existing offshore facilities (ie no additional offshore facilities are required); and
- Turnaround maintenance is scheduled every 5 years with any overlapping conflicts managed out.

2.1.3 Case 3A - 25Mtpa LNG Precinct within 25 years

The key assumptions attributable to Case 3A are:

- FID for the initial development is 2012;
- The basis for the workforce loading is premised on the Precinct LNG Development in the Kimberley by foundation proponent comprising the following:
  - Various upstream facilities;
  - Interfield pipeline
  - Export pipeline
  - Onshore infrastructure and utilities; and
  - Three LNG Processing trains (nominal 11 MTPA total capacity)
- Additional campaigns and ongoing drilling & completions will continue out to circa 2030.
- Downstream modular execution strategy with modules fabricated in SE Asia;
- Upstream facilities are fabricated in SE Asia;

- Four additional LNG processing trains are built in sequence with the separation optimised to avoid workforce conflicts;
- Additional subsea tiebacks and upstream facilities are fabricated in SE Asia and installed offshore;
    - Gas for the 4th LNG train is sourced from a field in the Browse basin and is developed via a subsea tieback to the existing offshore facilities (ie no additional offshore facilities are required);
    - Gas for the 5th and 6th LNG Trains is sourced from a range of fields in the Browse basin that require additional deepwater or shallow water facilities to access the reservoir. Workforce to support the installation of these facilities is included;
    - Interfield and export pipelines to tieback the facilities to either the shelf based platform or directly to the onshore facility would be required. Workforce for the installation of these pipelines is included;
- Additional development drilling programs (excluding any appraisal drilling) to source the additional gas reserves is required and the workforce has been included;
- Turnaround maintenance is scheduled every 5 years with any overlapping conflicts managed out.

2.1.4 Case 3B – 35Mtpa LNG Precinct within 25 years

In addition to the assumptions for Case 3A, the following key assumptions are also attributable to Case 3B:

- It is assumed that a second proponent will develop an additional ~10mtpa LNG capacity facility within the precinct through the development of three LNG Trains;
- FID for the 1st of the three trains would be during 2022 with start-up achieved circa 4 years later;
- Infrastructure, utilities, expanded marine facilities and additional LNG and condensate storage would be required to support the 3 train development. This work is assumed to be undertaken in parallel with the 1st train;
- The 1st LNG train will be followed by a second and third LNG train developed by the second proponent;
- The additional LNG trains will be separated by 6-12 months depending on the
- Additional construction accommodation is required to support the development of LNG trains in parallel by both proponents;
- Additional accommodation for operational personnel is provided;
- Major offshore facilities are required comprising typically a deepwater floating facility and additional shelf based facilities. These are fabricated and installed based on a schedule to support the commencement of LNG processing from each additional LNG Train;
- Additional export pipeline from the offshore processing facility to the onshore LNG facilities;
- An ongoing drilling campaign to support a 3 train development continues for 5 years.

2.1.5 Case 4 – 50Mtpa LNG Precinct within 30 years

In addition to the assumptions for Case 3B, the following key assumptions are also attributable to Case 4:

- Four additional LNG processing trains are built by the second proponent in sequence with the separation between LNG trains optimised to avoid workforce conflicts;
- Additional subsea tiebacks and upstream facilities are fabricated in SE Asia and installed offshore;

  - Gas for the 4th LNG train is sourced from a field in the Browse basin and is developed via a subsea tieback to the existing offshore facilities (ie no additional offshore facilities are required);
  - Gas for the 5th and 6th LNG Trains is sourced from a range of fields in the Browse basin that require additional deepwater or shallow water facilities to access the reservoir. Workforce to support the installation of these facilities is included;
  - Interfield and export pipelines to tieback the facilities to either the shelf based platform or directly to the onshore facility would be required. Workforce for the installation of these pipelines is included;
- Additional development drilling programs (excluding any appraisal drilling) to source the additional gas reserves is required and the workforce has been included;

2.1.6 General Assumptions

The following assumptions apply to all cases:

- Workforce for the installation and construction of modular Greenfield LNG Trains is in a range from 2500 to 6000 direct and indirect personnel. The wide range accounts for variations in the success of the construction program and the potential for program acceleration;
- Expansion of LNG facilities requires a combination of Greenfield and Brownfield work. The workforce requirements for expansion trains are therefore higher than the workforce requirements for Greenfield LNG Trains;
- No allowance has been made for the workforce constraints of multiple trains being constructed by 2 different proponents.
- Operational workforce for a typical LNG train is assumed to be between 50 – 80 personnel.
- Operational workforce for typical upstream facility plus marine support is assumed to be between 20 – 50 personnel, dependent on the manning philosophy and the size and functionality of the facility. For the purpose of this analysis deepwater facilities are assumed to be unmanned and shallow water facilities are manned.
- Major turnaround maintenance is scheduled for each major facility every 5 years. Workforce for turnarounds varies between 500 – 1000 personnel dependent on the size of the facility and the planning for the shutdown.
- Ongoing drilling programs assume an ongoing workforce of 100 – 150 personnel which covers drill rig personnel and support boat personnel.
- A general assumption is made with regard to the accuracy of the figures proposed. The range applied is -10% + 30%. This range is allocated to account for changes in contracting strategy, success in execution and variations in construction productivity.

2.2 WORKFORCE HISTOGRAMS

Various workforce histograms are included in the Appendix B – Australian Workforce Histograms (Cases 1 – 5). The histograms in Appendix B are a reflection of the figures contained in Appendix A – Australian Workforce Forecasts (Cases 1 – 5). These figures are a representation of the Australian based workforce.

3. APPENDIX A – AUSTRALIAN WORKFORCE FORECASTS (CASES 1 – 5)

Year	Case 1 - No Development for 20 years											
	Construction					Operational						
	Supply Base	Offshore	**Total**	Range Above	Range Below	Supply Base	Offshore	**Total**	Range Above	Range Below	Combined Range	Combined Range
1 (FID)	84	84	168	218	151			0	0	0	218	151
2	100	186	286	371	257			0	0	0	371	257
3	120	249	369	480	332			0	0	0	480	332
4	120	299	419	545	377			0	0	0	545	377
5	20	771	791	1,028	712			0	0	0	1,028	712
6	20	1558	1578	2,051	1,420			0	0	0	2,051	1,420
7	20	569	589	766	530			0	0	0	766	530
8	0	215	215	280	194	20	65	85	111	77	390	270
9	0	120	120	156	108	20	65	85	111	77	267	185
10	0	120	120	156	108	20	65	85	111	77	267	185
11	0	150	150	195	135	20	65	85	111	77	306	212
12	0	120	120	156	108	20	65	85	111	77	267	185
13	0	170	170	221	153	20	65	85	111	77	332	230
14	0	120	120	156	108	20	65	85	111	77	267	185
15	0	876	876	1,139	788	20	65	85	111	77	1,249	865
16	0	339	339	441	305	20	65	85	111	77	551	382
17	0	120	120	156	108	20	65	85	111	77	267	185
18	0	80	80	104	72	20	65	85	111	77	215	149
19	0	0	0	0	0	20	65	85	111	77	111	77
20	0	0	0	0	0	20	65	85	111	77	111	77
21	0	0	0	0	0	20	65	85	111	77	111	77
22	0	0	0	0	0	20	65	85	111	77	111	77
23	0	50	50	65	45	20	65	85	111	77	176	122
24	0	0	0	0	0	20	65	85	111	77	111	77
25	0	0	0	0	0	20	65	85	111	77	111	77
26	0	0	0	0	0	20	65	85	111	77	111	77
27	0	0	0	0	0	20	65	85	111	77	111	77
28	0	0	0	0	0	20	65	85	111	77	111	77
29	0	0	0	0	0	20	65	85	111	77	111	77
30	0	0	0	0	0	20	65	85	111	77	111	77
31	0	0	0	0	0	20	65	85	111	77	111	77

	Case 2 - Low Case - up to 15 mtpa over 15yrs															
	Construction Workforce							Operational Workforce								
	Trains 1-3	Offshore	Trains 4	Offshore	**Total**	Range Above	Range Below	Trains 1-3	Offshore	Trains 4	Offshore	**Total**	Range Above	Range Below	Combined Range	Combined Range
2010	326	238	0	0	564	734	508					0	0	0	734	508
2011	707	274	0	0	981	1,275	882					0	0	0	1,275	882
2012	2,053	528	0	0	2,581	3,355	2,323					0	0	0	3,355	2,323
2013	2,532	1,457	0	0	3,989	5,185	3,590					0	0	0	5,185	3,590
2014	1,025	867	0	0	1,892	2,459	1,702					0	0	0	2,459	1,702
2015	306	421	0	0	726	944	654	281				281	365	253	1,309	907
2016	74	169	0	0	243	316	219	281				281	365	253	681	472
2017	0	120	18	70	208	271	187	281				281	365	253	636	440
2018	0	60	3	46	109	142	98	281				281	365	253	507	351
2019	10	377	496	40	923	1,200	830	281				281	365	253	1,565	1,083
2020	85	1,290	1,839	220	3,434	4,465	3,091	281				281	365	253	4,830	3,344
2021	293	1,407	265	80	2,045	2,659	1,841	281				281	365	253	3,024	2,094
2022	94	399	0	0	492	640	443	281				281	365	253	1,005	696
2023	10	160	0	0	170	221	153	281		20		301	391	271	612	424
2024	5	1,094	0	0	1,099	1,429	989	281		40		321	417	289	1,846	1,278
2025	5	508	0	0	513	667	462	281		40		321	417	289	1,084	751
2026	205	392	75	50	722	939	650	281		40		321	417	289	1,356	939
2027	54	1,034	0	0	1,088	1,414	979	281		40		321	417	289	1,832	1,268
2028	0	0	0	0	0	0	0	281		40		321	417	289	417	289
2029	0	90	0	0	90	117	81	281		40		321	417	289	534	370
2030	0	0	0	0	0	0	0	281		40		321	417	289	417	289
2031	200	50	75	50	375	488	338	281		40		321	417	289	905	626
2032	0	0	0	0	0	0	0	281		40		321	417	289	417	289
2033	0	0	0	0	0	0	0	281		40		321	417	289	417	289
2034	0	0	0	0	0	0	0	281		40		321	417	289	417	289
2035	0	0	0	0	0	0	0	281		40		321	417	289	417	289
2036	200	50	75	50	375	488	338	281		40		321	417	289	905	626
2037	0	0	0	0	0	0	0	281		40		321	417	289	417	289
2038	0	0	0	0	0	0	0	281		40		321	417	289	417	289
2039	0	0	0	0	0	0	0	281		40		321	417	289	417	289
2040	0	0	0	0	0	0	0	281		40		321	417	289	417	289

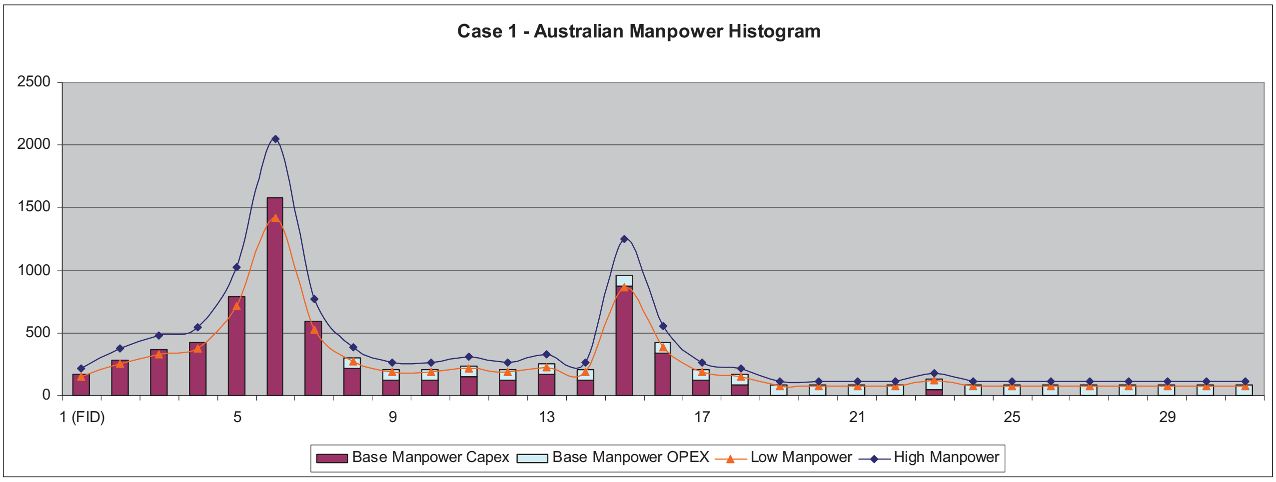
	Case 3A - Medium Case - 25 mtpa over 25yrs																			
	Construction Workforce									Operational Workforce										
	Trains 1-3	Offshore	Trains 4	Offshore	Trains 5-6-7	Offshore	**Total**	Range Above	Range Below	Trains 1-3	Offshore	Trains 4	Offshore	Trains 5-6-7	Offshore	**Total**	Range Above	Range Below	Combined Range	Combined Range
2010	326	238	0	0	0	0	564	734	508							0	0	0	734	508
2011	707	274	0	0	0	0	981	1,275	882							0	0	0	1,275	882
2012	2,053	528	0	0	0	0	2,581	3,355	2,323							0	0	0	3,355	2,323
2013	2,532	1,457	0	0	0	0	3,989	5,185	3,590							0	0	0	5,185	3,590
2014	1,025	867	0	0	0	0	1,892	2,459	1,702							0	0	0	2,459	1,702
2015	306	421	0	0	0	0	726	944	654	281						281	365	253	1,309	907
2016	74	169	0	0	0	0	243	316	219	281						281	365	253	681	472
2017	0	120	18	70	0	0	208	271	187	281						281	365	253	636	440
2018	0	60	3	46	0	0	109	142	98	281						281	365	253	507	351
2019	10	377	496	40	18	70	1,011	1,314	910	281						281	365	253	1,679	1,163
2020	85	1,290	1,839	220	3	46	3,483	4,528	3,135	281						281	365	253	4,894	3,388
2021	293	1,407	265	80	362	49	2,456	3,193	2,210	281		20				301	391	271	3,584	2,481
2022	94	399	0	0	1,857	238	2,586	3,362	2,328	281		20				301	391	271	3,753	2,599
2023	10	160	0	0	335	83	588	764	529	281		20				301	391	271	1,155	800
2024	5	1,094	0	0	33	73	1,205	1,566	1,084	281		20		20		321	417	289	1,983	1,373
2025	5	508	0	0	9	124	647	841	582	281		20		20		321	417	289	1,258	871
2026	205	392	75	50	406	125	1,253	1,629	1,128	281		20		20		321	417	289	2,047	1,417
2027	54	1,034	0	0	2,035	230	3,353	4,359	3,018	281		20		20		321	417	289	4,776	3,306
2028	0	0	0	0	437	130	567	737	511	281		20		40		341	443	307	1,181	817
2029	0	90	0	0	0	0	90	117	81	281		20		40		341	443	307	560	388
2030	0	0	0	0	80	80	160	208	144	281		20		40		341	443	307	652	451
2031	200	50	75	50	16	16	407	529	366	281		20		40		341	443	307	973	673
2032	0	0	0	0	764	148	912	1,186	821	281		20		40		341	443	307	1,629	1,128
2033	0	0	0	0	2,969	724	3,693	4,801	3,324	281		20		40		341	443	307	5,244	3,630
2034	0	0	0	0	428	98	526	684	473	281		20		60		361	469	325	1,153	798
2035	0	0	0	0	0	0	0	0	0	281		20		60		361	469	325	469	325
2036	200	50	75	50	0	0	375	488	338	281		20		60		361	469	325	957	662
2037	0	0	0	0	0	0	0	0	0	281		20		60		361	469	325	469	325
2038	0	0	0	0	150	100	250	325	225	281		20		60		361	469	325	794	550
2039	0	0	0	0	0	0	0	0	0	281		20		60		361	469	325	469	325
2040	0	0	0	0	75	50	125	163	113	281		20		60		361	469	325	632	437

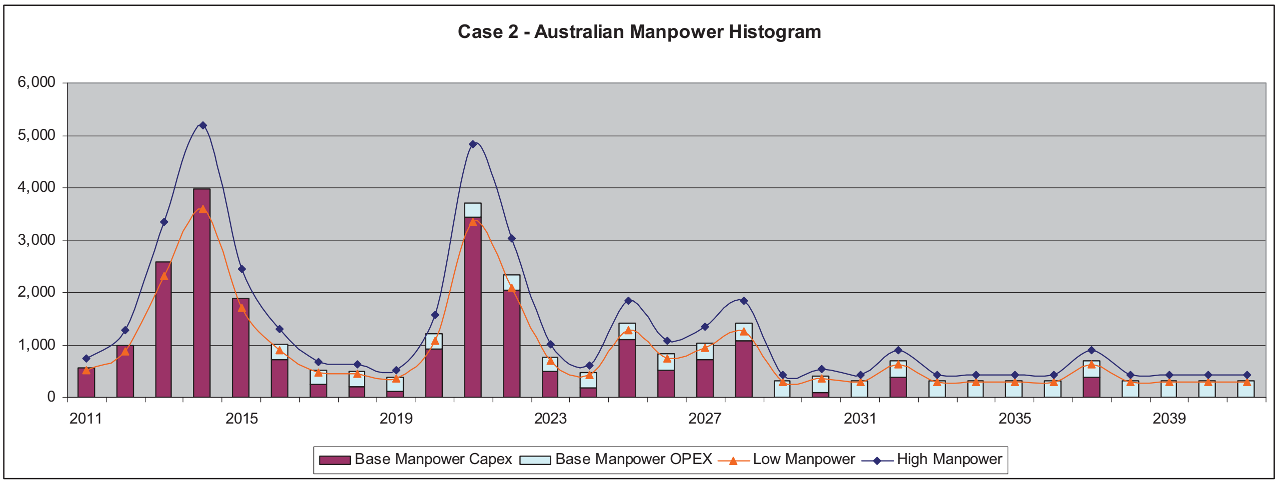
	Case 3B - Medium Case - 35 mtpa over 25yrs																						
	Construction Workforce											Operational Workforce											
	Trains 1-3	Offshore	Trains 4	Offshore	Trains 5-6-7	Offshore	Trains 8-9-10	Offshore	**Total**	Range Above	Range Below	Trains 1-3	Offshore	Trains 4	Offshore	Trains 5-6-7	Offshore	Trains 8-9-10	Offshore	**Total**	Range Above	Range Below	Combined Range	Combined Range
2010	326	238	0	0	0	0	0		564	734	508									0	0	0	734	508
2011	707	274	0	0	0	0			981	1,275	882									0	0	0	1,275	882
2012	2,053	528	0	0	0	0			2,581	3,355	2,323									0	0	0	3,355	2,323
2013	2,532	1,457	0	0	0	0			3,989	5,185	3,590									0	0	0	5,185	3,590
2014	1,025	867	0	0	0	0			1,892	2,459	1,702									0	0	0	2,459	1,702
2015	306	421	0	0	0	0	15	377	1,118	1,454	1,007	281								281	365	253	1,819	1,259
2016	74	169	0	0	0	0	75	451	769	1,000	692	281								281	365	253	1,365	945
2017	0	120	18	70	0	0	126	647	980	1,274	882	281								281	365	253	1,640	1,135
2018	0	60	3	46	0	0	1037	846	1,992	2,589	1,792	281								281	365	253	2,954	2,045
2019	10	377	496	40	18	70	2542	860	4,413	5,737	3,972	281								281	365	253	6,102	4,225
2020	85	1,290	1,839	220	3	46	870	323	4,677	6,080	4,209	281						281		562	731	506	6,810	4,715
2021	293	1,407	265	80	362	49			2,456	3,193	2,210	281		20				281		582	757	524	3,949	2,734
2022	94	399	0	0	1857	238			2,586	3,362	2,328	281		20				281		582	757	524	4,119	2,851
2023	10	160	0	0	368	155			693	901	624	281		20				281		582	757	524	1,658	1,148
2024	5	1,094	0	0	9	124			1,233	1,603	1,109	281		20		20		281		602	783	542	2,385	1,651
2025	5	508	0	0	406	125			1,044	1,358	940	281		20		20		281		602	783	542	2,140	1,482
2026	205	392	75	50	2115	310			3,147	4,091	2,832	281		20		20		281		602	783	542	4,874	3,374
2027	54	1,034	0	0	378	96			1,562	2,031	1,406	281		20		20		281		602	783	542	2,814	1,948
2028	0	0	0	0	764	148			912	1,186	821	281		20		40		281		622	809	560	1,994	1,381
2029	0	90	0	0	2837	636			3,563	4,632	3,207	281		20		40		281		622	809	560	5,440	3,766
2030	0	0	0	0	435	103			538	700	485	281		20		40		281		622	809	560	1,509	1,044
2031	200	50	75	50	0	0	406		781	1,016	703	281		20		40		281		622	809	560	1,824	1,263
2032	0	0	0	0	0	0	1906		1,906	2,478	1,716	281		20		40		281		622	809	560	3,287	2,275
2033	0	0	0	0	0	0	1726		1,726	2,244	1,553	281		20		40		281		622	809	560	3,052	2,113
2034	0	0	0	0	0	0	226		226	294	203	281		20		60		281		642	835	578	1,128	781
2035	0	0	0	0	0	0			0	0	0	281		20		60		281		642	835	578	835	578
2036	200	50	75	50	0	0			375	488	338	281		20		60		281		642	835	578	1,322	915
2037	0	0	0	0	0	0			0	0	0	281		20		60		281		642	835	578	835	578
2038	0	0	0	0	0	0			0	0	0	281		20		60		281		642	835	578	835	578
2039	0	0	0	0	0	0			0	0	0	281		20		60		281		642	835	578	835	578
2040	0	0	0	0	0	0			0	0	0	281		20		60		281		642	835	578	835	578

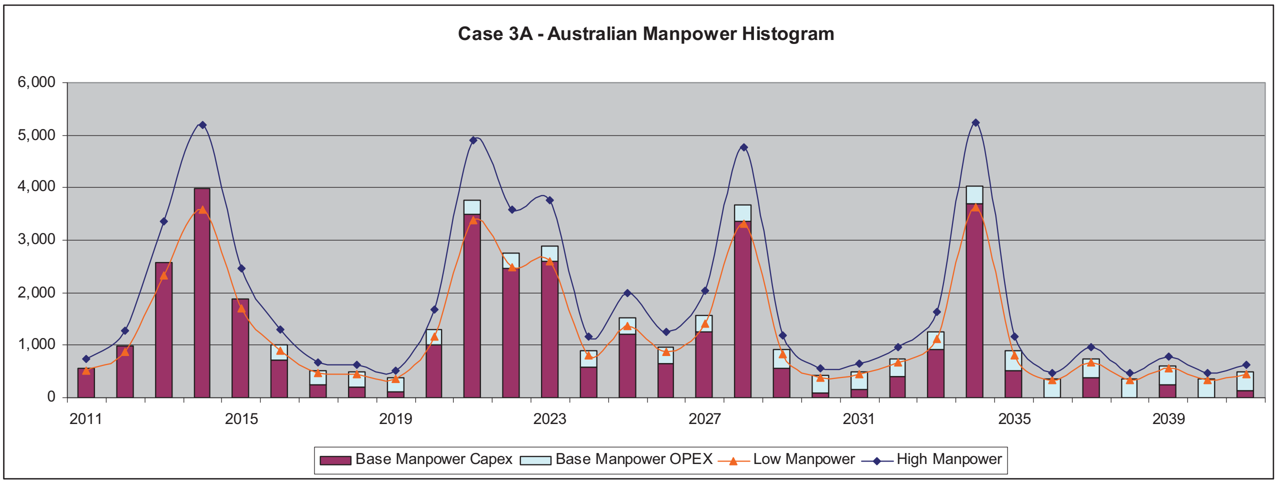
Precinct Workforce Projection – September 2009

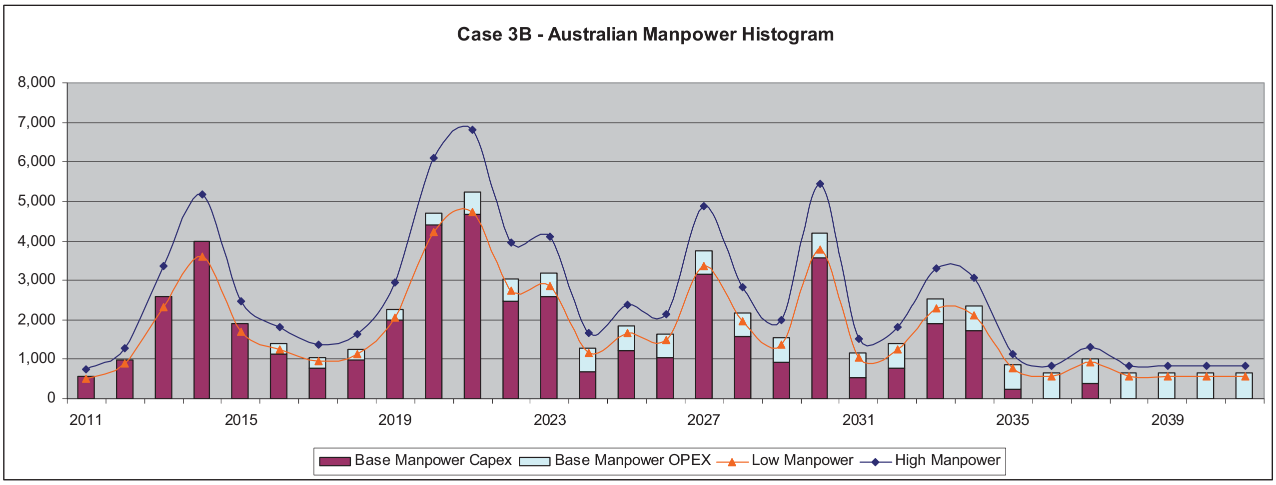
	Case 4 - High Case - 50 mtpa over 30 yrs																											
	Construction Workforce													Operational Workforce														
	Trains 1-3	Offshore	Trains 4	Offshore	Trains 5-6-7	Offshore	Trains 8-9-10	Offshore	11-12-13-14	Offshore	**Total**	Range Above	Range Below	Trains 1-3	Offshore	Trains 4	Offshore	Trains 5-6-7	Offshore	Trains 8-9-10	Offshore	11-12-13-14	Offshore	**Total**	Range Above	Range Below	Combined Range	Combined Range
2010	326	238	0	0							564	734	508											0	0	0	734	508
2011	707	274	0	0							981	1,275	882											0	0	0	1,275	882
2012	2,053	528	0	0							2,581	3,355	2,323											0	0	0	3,355	2,323
2013	2,532	1,457	0	0							3,989	5,185	3,590											0	0	0	5,185	3,590
2014	1,025	867	0	0							1,892	2,459	1,702											0	0	0	2,459	1,702
2015	306	421	0	0							726	944	654	281										281	365	253	1,309	907
2016	74	169	0	0							243	316	219	281										281	365	253	681	472
2017	0	120	18	70			15	377			600	780	540	281										281	365	253	1,146	793
2018	0	60	3	46			75	451			635	826	572	281										281	365	253	1,191	825
2019	10	377	496	40	18	70	126	647			1,783	2,318	1,605	281										281	365	253	2,683	1,858
2020	85	1,290	1,839	220	3	46	1,037	846			5,366	6,976	4,829	281						281				562	731	506	7,706	5,335
2021	293	1,407	265	80	362	49	2,542	860			5,858	7,615	5,272	281		20				281				582	757	524	8,372	5,796
2022	94	399	0	0	1,857	238	1,323	323			4,232	5,501	3,809	281		20				281				582	757	524	6,258	4,332
2023	10	160	0	0	368	155	2,650	25			3,368	4,378	3,031	281		20				281				582	757	524	5,135	3,555
2024	5	1,094	0	0	9	124	1,210	23	80	80	2,625	3,413	2,363	281		20		20		281				602	783	542	4,196	2,905
2025	5	508	0	0	406	125	0	0	16	16	1,076	1,399	969	281		20		20		281				602	783	542	2,182	1,511
2026	205	392	75	50	2,115	310	0	0	764	148	4,059	5,277	3,653	281		20		20		281				602	783	542	6,060	4,195
2027	54	1,034	0	0	378	96	150	100	2,834	639	5,285	6,871	4,757	281		20		20		281				602	783	542	7,653	5,299
2028	0	0	0	0	839	198	0	0	514	184	1,736	2,256	1,562	281		20		40		281				622	809	560	3,065	2,122
2029	0	90	0	0	2,819	624	0	0	16	16	3,565	4,635	3,209	281		20		40		281		20		642	835	578	5,469	3,786
2030	0	0	0	0	428	98	150	100	773	14	1,563	2,032	1,407	281		20		40		281		20		642	835	578	2,866	1,984
2031	200	50	75	50	0	0	0	0	2,851	657	3,883	5,048	3,495	281		20		40		281		20		642	835	578	5,882	4,072
2032	0	0	0	0	75	50	150	100	443	181	999	1,298	899	281		20		40		281		40		662	861	596	2,159	1,495
2033	0	0	0	0	75	50	0	0	155	105	386	502	347	281		20		40		281		40		662	861	596	1,362	943
2034	0	0	0	0	0	0	0	0	764	148	912	1,186	821	281		20		60		281		40		682	887	614	2,072	1,435
2035	0	0	0	0	150	100	150	100	2,892	698	4,090	5,318	3,681	281		20		60		281		40		682	887	614	6,204	4,295
2036	200	50	75	50	0	0	0	0	464	134	973	1,265	876	281		20		60		281		60		702	913	632	2,178	1,508
2037	0	0	0	0	75	50	150	100	172	122	669	869	602	281		20		60		281		60		702	913	632	1,782	1,234
2038	0	0	0	0	75	50	0	0	576	263	964	1,253	867	281		20		60		281		60		702	913	632	2,165	1,499
2039	0	0	0	0	0	0	0	0	1,576	686	2,262	2,940	2,036	281		20		60		281		60		702	913	632	3,853	2,667
2040	0	0	0	0	150	100	150	100	251	117	868	1,128	781	281		20		60		281		80		722	939	650	2,066	1,431

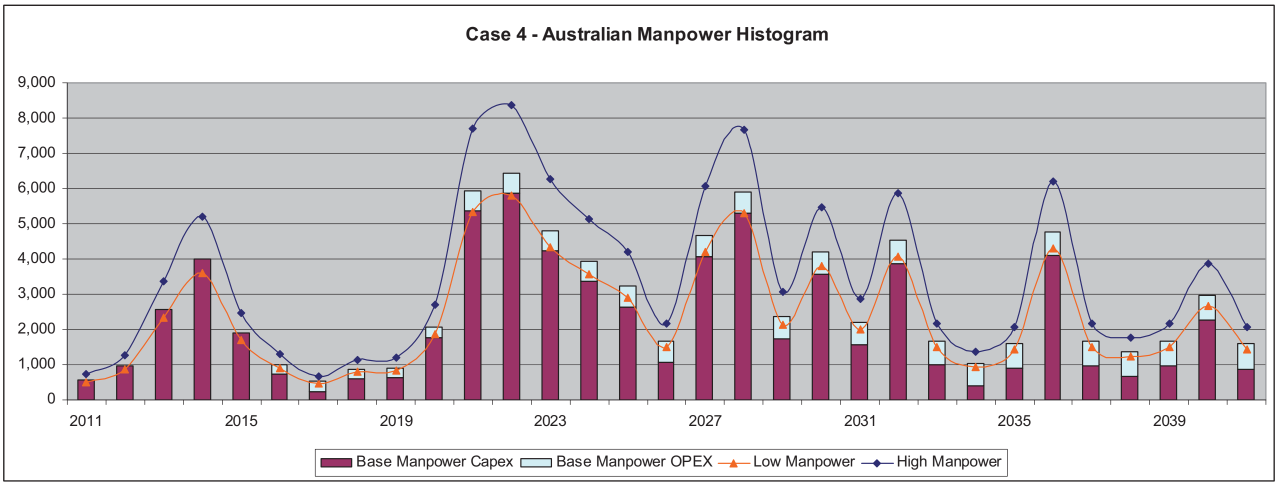
4. APPENDIX B – AUSTRALIAN WORKFORCE HISTOGRAM (CASES 1 - 5)








Case 3B - Australian Manpower Histogram
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2011
2015
2019
2023
2027
2031
2035
2039
Base Manpower Capex
Base Manpower OPEX
Low Manpower
High Manpower


Case 4 - Australian Manpower Histogram
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2011
2015
2019
2023
2027
2031
2035
2039
Base Manpower Capex
Base Manpower OPEX
Low Manpower
High Manpower

Appendix C

November 2009. Kimberley LNG Social Impact Assessment, Sensitivity Analysis of Workforce Population Impacts Model

KIMBERLY LNG SOCIAL IMPACT ASSESSMENT: SENSITIVITY ANALYSIS OF WORKFORCE POPULATION IMPACTS MODEL

November 2009

Report Prepared for:
Department of State Development
1 Adelaide Terrace
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1 INTRODUCTION

The following report is based on a workforce population model developed for the Kimberly Browse LNG project[1]. Given an anticipated construction and operational workforce for five development scenarios and by defining specific input parameters, the model estimated the likely population impacts on the town of Broome.

In order to determine how "sensitive" the model was to changes in the values of the input parameters a partial sensitivity analysis was performed. Parameter sensitivity is usually performed as a series of tests in which the different parameter values are input to see how a change in the parameter causes a change in the outcome of the model. In the current analysis, a partial sensitivity analysis has been undertaken using (i) the optimum input parameters, (ii) input parameters decreased by ten percent and (iii) input parameters increased by ten percent.

By showing how the model responds to changes in the parameter values, sensitivity analysis was used to indicate (i) how robust the model was to changes in these values and (ii) identify confidence intervals for the estimation of population impacts on Broome.

2 OBJECTIVES

The partial sensitivity analysis that was undertaken had three core objectives which were:

1) To determine how robust to changes in the values of input parameters;
2) To identify 10% upper and lower confidence intervals for population impacts on Broome; and
3) To provide a documented illustration of the model inputs and outputs.

[1] *Fenton, D. M. (2009). Kimberley Browse LNG project: Population and workforce model (Version 5). Department of State Development, Western Australia*

3 MODEL CONSTRUCTION AND ANALYSIS

Figure 1 provides a description of the population and workforce model. As shown in Figure 1 the model is based on five 30 year development scenarios. For each of the scenarios the estimated construction and operational workforce for each year has been defined. With the exception of the start date, the five development scenarios and the estimated and construction workforce are fixed input parameters and cannot be varied in the model.

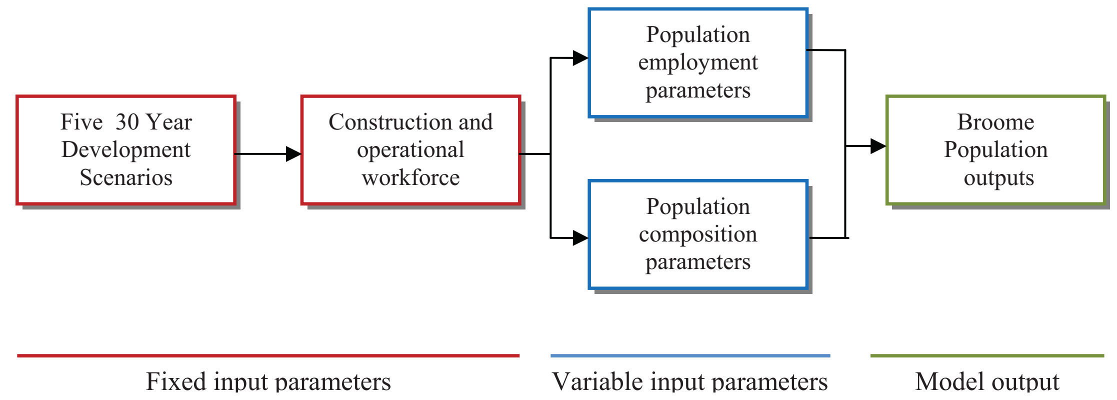


Figure 1. Population and workforce model

Variable input parameters are also shown in Figure 1 as including (i) population employment parameters and (ii) population composition parameters.

The population employment parameters include a range of parameters which focus on indirect and direct employment; the percent of employees likely to be resident in Broome; number of employees per dwelling; and the family size of employees resident in Broome. As these are variable input parameters, the model can be run using different values for these parameters.

Population composition parameters are also able to be defined within the model and different values used when the model is run. Population composition parameters include the age profiles of the construction and operation workforce families resident in Broome; the average annual salary of employees; population service ratios for education, health and community services; and average household energy consumption and waste production. As these are variable input parameters, the model can be run using different values for these parameters.

Given the fixed input parameters and specific values entered for each of the variable input parameters, the model produces specific population outputs for the town of Broome. The different model outputs for the town of Broome are described in this report and include estimates of direct and indirect employees resident in Broome; the number of dwellings required; resident family size; population projections; age profile composition of resident employee families; estimates of household expenditure; and indicative social infrastructure service requirements.

3.1 Thirty Year Development Scenarios

A description of the five development scenarios, which is drawn from the Woodside report included[2]:

1. **Scenario 1: No development of Precinct**
   - Initial development assumes development of Browse Basin fields with an offshore export pipeline back to Karratha;
   - The basis for the workforce loading is premised on the development of the Browse Basin fields and tied back to the Karratha. The scope comprises the following:
     - Various upstream facilities;
     - Interfield pipelines;
     - Offshore export pipeline to Karratha (assumed all export pipeline workforce are routed via Broome);
     - Construction of supply base in Broome;
   - Workforce in Karratha to support the following is not included:
     - Onshore infrastructure and utilities to receive gas;
     - Any debottlenecking on existing facilities; and
     - No additional LNG Processing trains are allowed.
   - Upstream facilities and gravity based structures are fabricated in SE Asia; and
   - Additional campaigns and ongoing drilling & completions will continue subject to flow-rates and backfill requirements.

2. **Scenario 2: 15Mtpa LNG Precinct within 15 years**
   - The basis for the workforce loading is premised on the Precinct LNG Development in the Kimberley by Foundation Proponent comprising the following:
     - Various upstream facilities;
     - Interfield pipeline
     - Export pipeline
     - Onshore infrastructure and utilities; and
     - Three LNG Processing trains (nominal 11 MTPA total capacity)
   - Additional campaigns and ongoing drilling & completions will continue out to circa 2030.
   - Adoption of a downstream modular execution strategy with modules fabricated in SE Asia;
   - Upstream facilities are fabricated in SE Asia;
   - A fourth LNG processing train is ready for start-up circa 2022;
   - Gas for the 4th LNG train is sourced from a field in the Browse basin and is developed via a subsea tieback to the existing offshore facilities (ie no additional offshore facilities are required); and
   - Turnaround maintenance is scheduled every 5 years with any overlapping conflicts managed out.

[2] *Although the model allows different initial development dates to be set, for the purpose of this report 2011 has bee assumed. The Woodside report also describes a series of assumptions associated with the scenarios and the development of workforce data.*

3. **Scenario 3A: 25Mtpa LNG Precinct within 25 years**
    - The basis for the workforce loading is premised on the Precinct LNG Development in the Kimberley by foundation proponent comprising the following:
        - Various upstream facilities;
        - Interfield pipeline
        - Export pipeline
        - Onshore infrastructure and utilities; and
        - Three LNG Processing trains (nominal 11 MTPA total capacity)
    - Additional campaigns and ongoing drilling & completions will continue out to circa 2030.
    - Downstream modular execution strategy with modules fabricated in SE Asia;
    - Upstream facilities are fabricated in SE Asia;
    - Four additional LNG processing trains are built in sequence with the separation optimised to avoid workforce conflicts;
    - Additional subsea tiebacks and upstream facilities are fabricated in SE Asia and installed offshore;
        - Gas for the 4th LNG train is sourced from a field in the Browse basin and is developed via a subsea tieback to the existing offshore facilities (ie no additional offshore facilities are required);
        - Gas for the 5th and 6th LNG Trains is sourced from a range of fields in the Browse basin that require additional deepwater or shallow water facilities to access the reservoir. Workforce to support the installation of these facilities is included;
        - Interfield and export pipelines to tieback the facilities to either the shelf based platform or directly to the onshore facility would be required. Workforce for the installation of these pipelines is included;
    - Additional development drilling programs (excluding any appraisal drilling) to source the additional gas reserves is required and the workforce has been included;
    - Turnaround maintenance is scheduled every 5 years with any overlapping conflicts managed out.

4. **Scenario 3B: 35Mtpa LNG Precinct within 25 years**
    In addition to the assumptions for Scenario 3A, the following key assumptions are also attributable to Scenario 3B:

    - It is assumed that a second proponent will develop an additional ~10mtpa LNG capacity facility within the precinct through the development of three LNG Trains;
    - FID for the 1st of the three trains would be during 2022 with start-up achieved circa 4 years later;
    - Infrastructure, utilities, expanded marine facilities and additional LNG and condensate storage would be required to support the 3 train development. This work is assumed to be undertaken in parallel with the 1st train;
    - The 1st LNG train will be followed by a second and third LNG train developed by the second proponent;
    - The additional LNG trains will be separated by 6-12 months depending on the
    - Additional construction accommodation is required to support the development of LNG trains in parallel by both proponents;
    - Additional accommodation for operational personnel is provided;

- Major offshore facilities are required comprising typically a deepwater floating facility and additional shelf based facilities. These are fabricated and installed based on a schedule to support the commencement of LNG processing from each additional LNG Train;
- Additional export pipeline from the offshore processing facility to the onshore LNG facilities;
- An ongoing drilling campaign to support a 3 train development continues for 5 years.

5. **Scenario 4 – 50Mtpa LNG Precinct within 30 years**
   In addition to the assumptions for Scenario 3B, the following key assumptions are also attributable to Scenario 4:

- Four additional LNG processing trains are built by the second proponent in sequence with the separation between LNG trains optimised to avoid workforce conflicts;
- Additional subsea tiebacks and upstream facilities are fabricated in SE Asia and installed offshore;
  - Gas for the 4th LNG train is sourced from a field in the Browse basin and is developed via a subsea tieback to the existing offshore facilities (ie no additional offshore facilities are required);
  - Gas for the 5th and 6th LNG Trains is sourced from a range of fields in the Browse basin that require additional deepwater or shallow water facilities to access the reservoir. Workforce to support the installation of these facilities is included;
  - Interfield and export pipelines to tieback the facilities to either the shelf based platform or directly to the onshore facility would be required. Workforce for the installation of these pipelines is included;
- Additional development drilling programs (excluding any appraisal drilling) to source the additional gas reserves is required and the workforce has been included;

3.2 Construction and Operational Workforce

The model was developed using estimates provided by Woodside[3] of the construction and operational workforce required for five LNG development scenarios across a thirty year period. The workforce estimates include a 'best estimate' and a lower estimate (-10%) and an upper estimate (+30%). The upper and lower estimates need to be recognised in any interpretation of the model outputs and have currently not been included in estimating outputs from the model.

3.3 Population Employment Parameters

The values for the population employment parameters shown in Tables 1 and 2 have been used in the current sensitivity analysis. The model has been run using the lower, middle and upper estimates. The middle values for each of the population parameters were the 'best estimates' and agreed upon through consultation between staff of the Department of State Development and Woodside. On the basis of the 'best estimate' values approximately 10% lower and 10% higher were also defined.

Table 1. Percentage of the workforce resident in Broome (all scenarios)

	Lower			Middle			Upper		
Workforce	2011-20	2021-30	2031-41	2011-20	2021-30	2031-41	2011-20	2021-30	2031-41
Construction	0	0	5	5	10	15	15	20	25
Operational	0	40	40	10	50	50	20	60	60

Source: EBC (2009)

[3] *Woodside (September, 2009). Precinct workforce projections. Report prepared for the Department of State Development, Western Australia*

Table 2. Workforce characteristics (Broome resident population)

	Lower	Middle	Upper
Percentage of direct employees who are existing employees			
Construction	0	10	20
Operational	0	5	15
Indirect employment multiplier			
Construction	1.50	2.50	3.50
Operational	1.50	2.50	3.50
Percent of indirect employees who are existing residents			
Construction	5	15	25
Operational	10	20	30
Percent new residents seeking opportunistic employment			
Construction	0	10	20
Operational	0	10	20
Number of employees per dwelling			
Indirect	1.0	1.50	2.00
Construction (direct)	1.0	1.50	2.00
Operational (direct)	1.0	1.50	2.00
Family size of resident employees (inc. employee)			
General population	2.50	2.90	3.30
Construction	1.00	1.20	1.40
Operational	2.50	2.90	3.30

Note: These values were applied across all scenarios. EBC (2009)

3.4 Population Composition Parameters

Tables 3 and 4 show the population composition parameters used in the model. While these are variable parameters, with the values able to be changed when the model is run, in the case of the sensitivity analysis the values have been fixed as shown in Tables 3 and 4. The population service ratios used in Table 4 should only be used as indicative as planning for infrastructure provision is dependent upon a wide range of factors in addition to population size.

Table 3. Workforce composition (Broome resident population)

Characteristic	Value
Age profile of employee family households	
Construction workforce *(percent)*	
0-4 Pre-school	2.0
5-12 Primary school	8.0
13-17 High school	5.0
18-24 Youth	5.0
25-44 Providers	50.0
45-54 Middle age	15.0
55-64 Pre-retirement	15.0
65+ Retirement	0.0
Operational workforce *(percent)*	
0-4 Pre-school	8.6
5-12 Primary school	13.0
13-17 High school	6.1
18-24 Youth	9.8
25-44 Providers	35.7
45-54 Middle age	14.4
55-64 Pre-retirement	7.9
65+ Retirement	4.6
Average annual salary of employees resident in Broome	
Construction workforce ($)	$200,000
Operational workforce ($)	$131,800
Average annual household expenditure per employee in Broome	
Construction workforce ($)	$108,782
Operational workforce ($)	$96,959

Source: EBC (2009)

Table 4. Population service ratios for Broome

Service	Number of Services	Population Size
Education		
Preschools (1st preschool)	1	30 (four year olds)
Preschools (subsequent preschools)	1	120 (four year olds)
Primary schools (population service ratio)	1	10,000
High schools (population service ratio)	1	20,000
Health		
Medical doctors	1	1,012
Dentists	1	22,000
Hospital beds (number of beds)	4.8	1,000
Local community health centre	1	3,000
Neighbourhood community health centre	1	10,000
District community health centre	1	30,000
Nursing home (number of beds)	40	1,000
Ambulance officers	0.41	1,000
Disabled respite centre	1	50,000
Aged respite centre	1	50,000
Community Services		
Public library - central facilities	1	10,000
Public library - additional branch facilities	1	75,000
Museums	1	75,000
Youth centre	1	30,000
Community hall	1	10,000
Senior citizens centre	1	25,000
Fire station	1	50,000
Police (Sworn police officers)	2.45	1,000
Household energy and waste		
Waste per household		906 kilograms per year
Electricity consumption per household		11,648 KWh per year
Water use per household		549 kilolitres per year
Waste water per connection		262 kilolitres per year

Note: *The population service ratios are only intended to be indicative. Planning for service provision is dependent upon a wide range of factors in addition to population size.*

Source: *EBC (2009)*

4 INTERPRETATION OF MODEL OUTPUTS

The model has been run separately using the lower, middle and upper values of the population employment parameters shown in Section 3.3.

For each model output, a table is provided showing for each scenario the lower, middle, and upper estimates across a 30 year period. In addition graphs are shown illustrating for each scenario the lower, middle and lower estimates across the same 30 year period.

For each output an additional graph has been shown which is referred to as the 'aggregate across scenarios'. This graph shows (i) the lower estimate for scenario 1; (ii) the upper estimate for scenario 4; and (iii) a middle estimate based on the average of the lower and upper estimates. As such this graph gives estimates for population output parameters when the development scenarios are unknown.

In the case of the model outputs related to social infrastructure provision the use of the lower, middle and upper estimates based on plus and minus 10% did not yield any significant changes to social infrastructure requirements. As such the Tables and graphs in Sections 19 to 22 use lower, middle and upper values based on the 'aggregate across scenarios' as described previously.

5 NEW DIRECT EMPLOYEES RESIDENT IN BROOME

This table includes the number of direct employees involved in construction and operation who would become residents of Broome.

Table 5: New direct employees resident in Broome: Combined construction and operational workforces

Year	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	0	8	20	0	25	68	0	25	68	0	25	68	0	25	68
2012	0	13	34	0	44	118	0	44	118	0	44	118	0	44	118
2013	0	17	44	0	116	310	0	116	310	0	116	310	0	116	310
2014	0	19	50	0	179	479	0	179	479	0	179	479	0	179	479
2015	0	36	95	0	85	227	0	85	227	0	85	227	0	85	227
2016	0	71	189	0	59	135	0	59	135	0	77	182	0	59	135
2017	0	27	71	0	38	77	0	38	77	0	61	140	0	38	77
2018	0	18	40	0	36	73	0	36	73	0	71	165	0	54	120
2019	0	13	29	0	32	61	0	32	61	0	116	287	0	55	124
2020	0	13	29	0	110	195	0	72	169	0	225	577	0	107	262
2021	34	54	67	112	443	693	112	447	701	225	688	1,035	225	750	1,145
2022	34	51	63	112	318	471	120	364	546	233	497	690	233	804	1,234
2023	34	56	71	112	178	222	120	376	567	233	509	711	233	657	974
2024	34	51	63	120	158	181	120	196	248	233	339	408	233	580	836
2025	34	119	184	128	251	340	128	261	356	241	397	504	241	522	727
2026	34	71	98	128	199	246	128	211	267	241	380	474	241	383	479
2027	34	51	63	128	217	279	128	265	364	241	569	811	241	651	956
2028	34	48	56	128	250	338	128	454	700	241	427	557	241	762	1,153
2029	34	40	43	128	152	164	136	213	265	249	378	463	249	452	595
2030	34	40	43	133	165	182	136	170	188	249	616	887	257	626	898
2031	34	40	43	128	152	164	144	184	206	276	368	425	335	516	640
2032	34	40	43	147	203	239	157	217	255	288	401	473	451	829	1,104
2033	37	47	53	128	152	164	182	285	356	344	553	698	315	449	537
2034	34	40	43	128	152	164	321	661	912	335	528	662	284	367	415
2035	34	40	43	128	152	164	171	242	289	268	335	373	318	447	530
2036	34	40	43	128	152	164	144	171	184	257	305	327	477	876	1,166
2037	34	40	43	147	203	239	163	222	259	276	356	402	329	465	553
2038	34	40	43	128	152	164	144	171	184	257	305	327	314	424	492
2039	34	40	43	128	152	164	157	205	234	257	305	327	329	464	551
2040	34	40	43	128	152	164	144	171	184	257	305	327	394	639	810
2041	34	40	43	128	152	164	151	188	209	257	305	327	332	460	542

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009)*

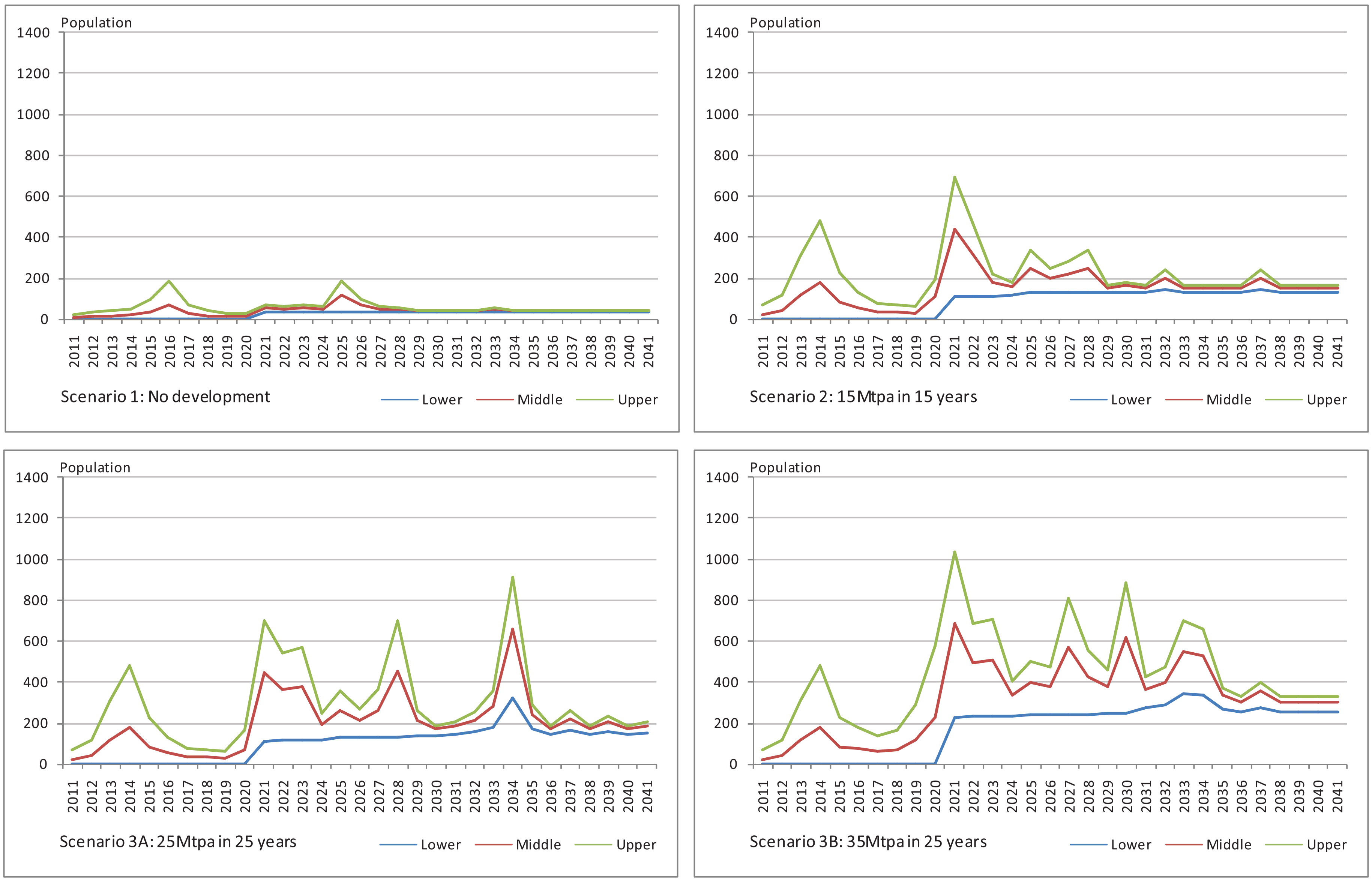
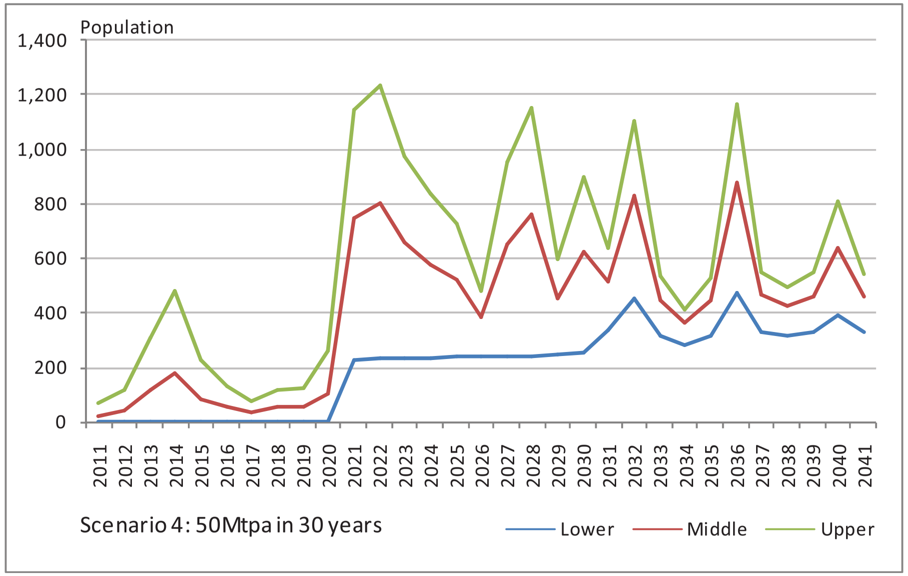


Figure 2. New direct employees resident in Broome: Combined construction and operational workforces



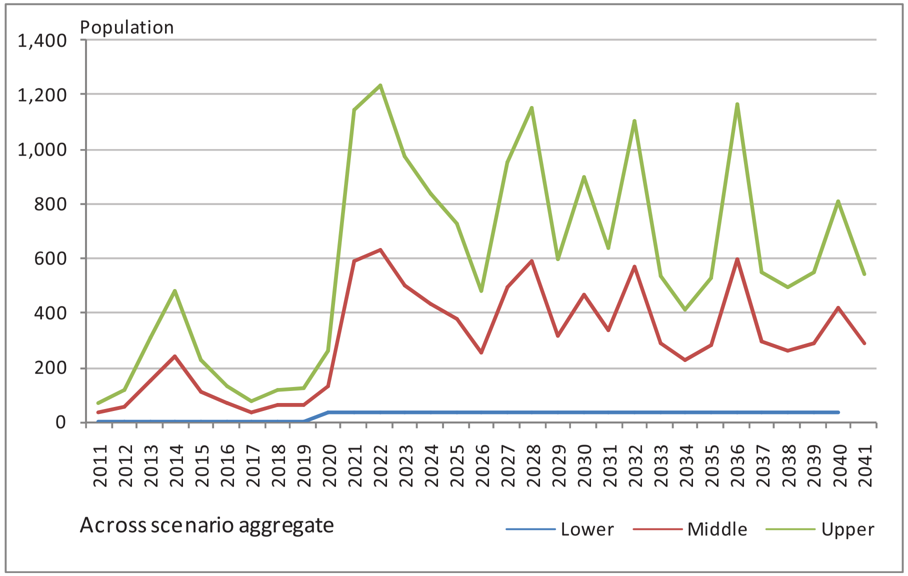


Figure 2 (cont). New direct employees resident in Broome: Combined construction and operational workforces

6 NEW DIRECT AND INDIRECT EMPLOYEES RESIDENT IN BROOME

This table includes the number of direct and indirect employees involved in construction and operation who would become residents of Broome.

Table 6: New direct and indirect employees resident in Broome: Combined construction and operational workforces

Year	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	0	19	72	0	64	243	0	64	243	0	64	243	0	64	243
2012	0	32	123	0	112	423	0	112	423	0	112	423	0	112	423
2013	0	42	159	0	294	1,113	0	294	1,113	0	294	1,113	0	294	1,113
2014	0	48	181	0	454	1,720	0	454	1,720	0	454	1,720	0	454	1,720
2015	0	90	341	0	215	816	0	215	816	0	215	816	0	215	816
2016	0	179	681	0	146	471	0	146	471	0	190	640	0	146	471
2017	0	67	254	0	91	262	0	91	262	0	151	489	0	91	262
2018	0	44	140	0	87	247	0	87	247	0	175	580	0	132	416
2019	0	33	99	0	76	204	0	76	204	0	290	1,016	0	136	431
2020	0	33	99	0	210	592	0	178	593	0	565	2,060	0	266	926
2021	49	130	229	163	1,097	2,447	163	1,109	2,475	326	1,696	3,633	326	1,853	4,030
2022	49	123	212	163	781	1,648	175	897	1,918	338	1,213	2,390	338	1,987	4,346
2023	49	134	241	163	428	755	175	927	1,993	338	1,243	2,465	338	1,617	3,411
2024	49	123	212	175	377	603	175	472	844	338	812	1,376	338	1,421	2,914
2025	49	295	647	186	611	1,171	186	635	1,232	349	958	1,720	349	1,275	2,521
2026	49	173	338	186	478	834	186	508	911	349	915	1,612	349	922	1,630
2027	49	123	212	186	525	954	186	646	1,260	349	1,393	2,821	349	1,601	3,345
2028	49	114	189	186	609	1,165	186	1,124	2,467	349	1,033	1,910	349	1,880	4,050
2029	49	96	143	186	361	539	198	513	899	361	907	1,569	361	1,095	2,043
2030	49	96	143	191	386	595	198	404	625	361	1,510	3,094	372	1,533	3,128
2031	49	96	143	186	361	539	210	438	688	400	883	1,432	488	1,256	2,202
2032	49	96	143	214	489	809	228	523	866	418	966	1,606	659	2,047	3,869
2033	53	113	179	186	361	539	265	695	1,228	501	1,350	2,415	458	1,086	1,830
2034	49	96	143	186	361	539	470	1,644	3,227	488	1,289	2,285	412	876	1,390
2035	49	96	143	186	361	539	248	586	984	389	799	1,241	463	1,078	1,801
2036	49	96	143	186	361	539	209	406	606	372	722	1,079	697	2,163	4,086
2037	49	96	143	214	489	809	237	534	876	400	850	1,348	479	1,122	1,879
2038	49	96	143	186	361	539	209	406	606	372	722	1,079	456	1,018	1,660
2039	49	96	143	186	361	539	228	491	786	372	722	1,079	478	1,119	1,872
2040	49	96	143	186	361	539	209	406	606	372	722	1,079	574	1,562	2,805
2041	49	96	143	186	361	539	219	449	696	372	722	1,079	483	1,108	1,837

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

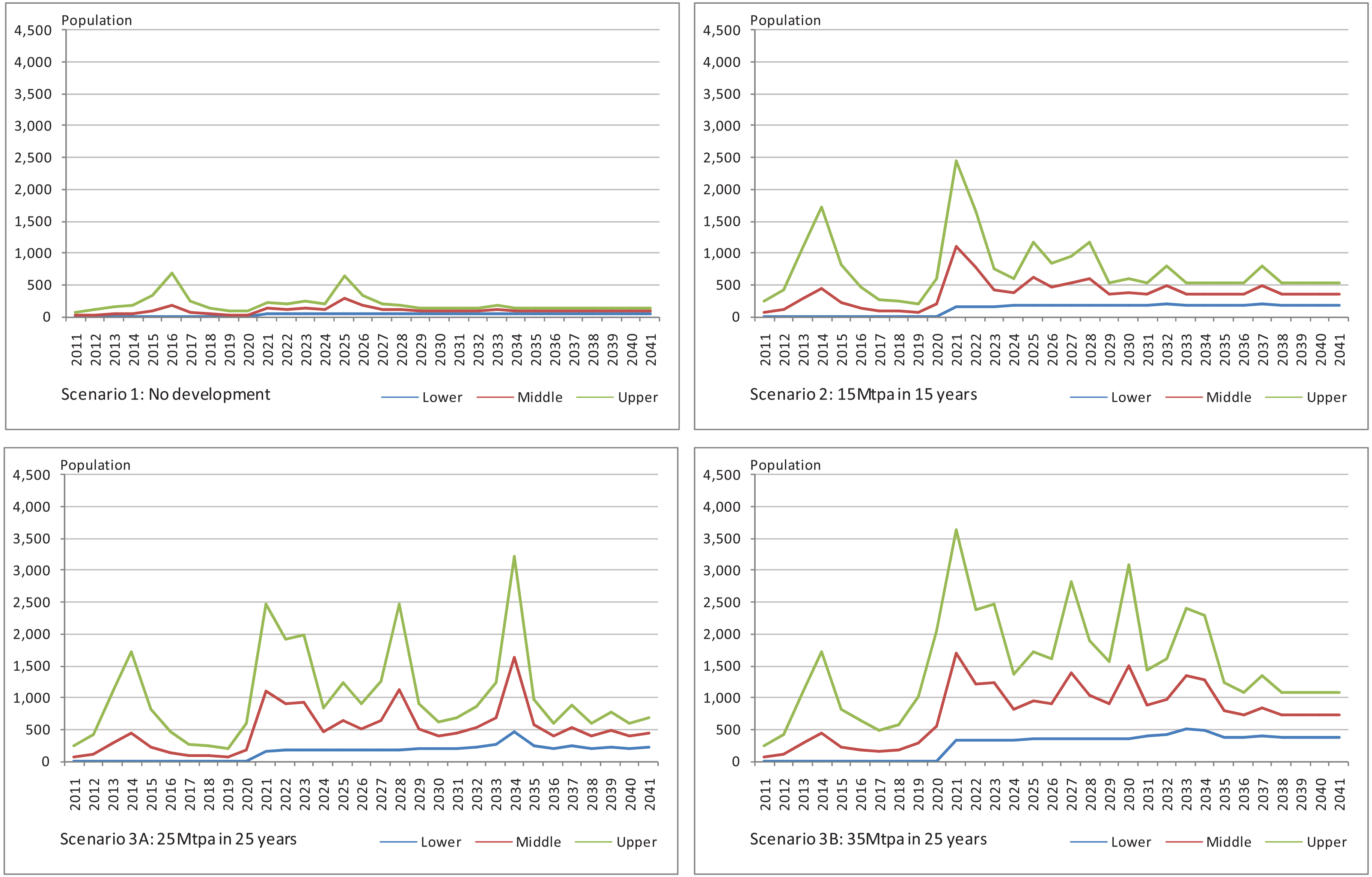
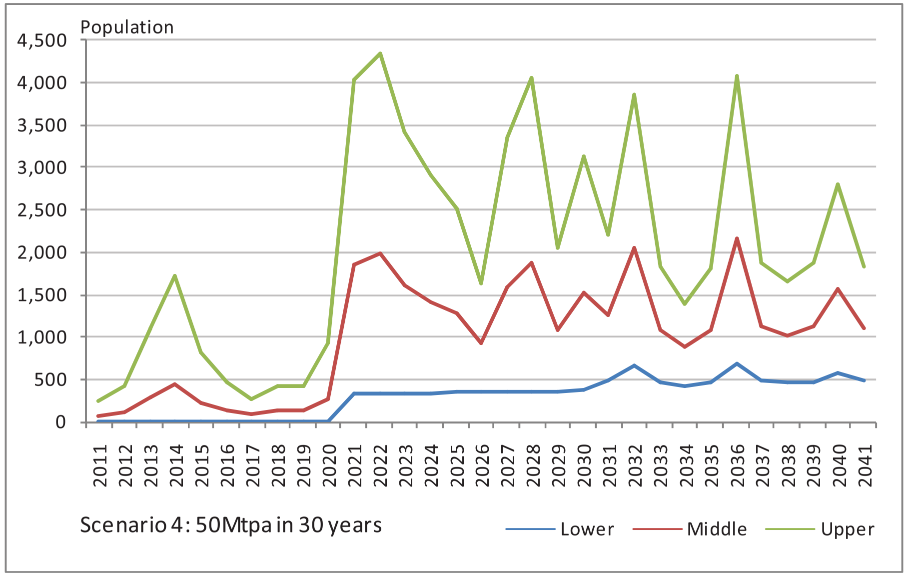


Figure 3. New direct and indirect employees resident in Broome: Combined construction and operational workforces



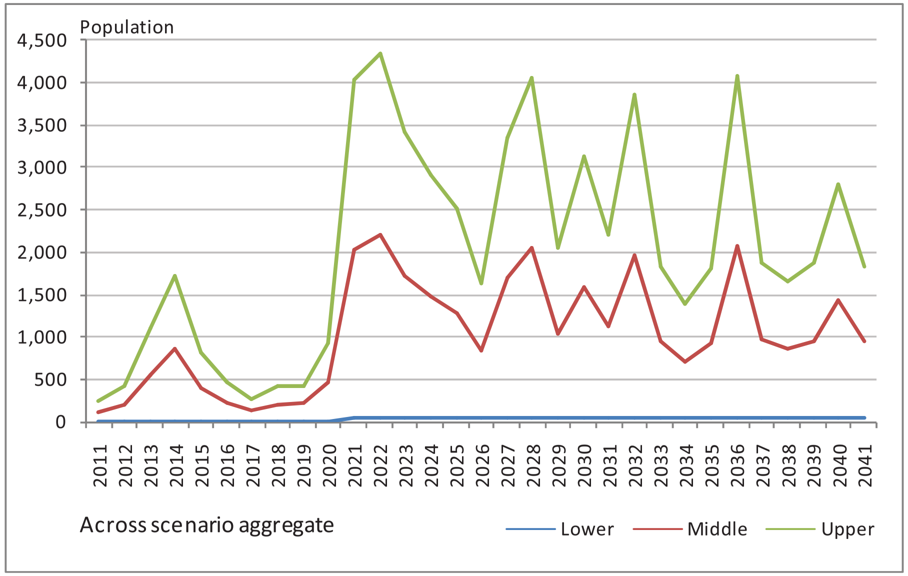


Figure 3 (cont). New direct and indirect employees resident in Broome: Combined construction and operational workforces

7 NUMBER OF DWELLINGS FOR NEW EMPLOYEES IN BROOME

This table identifies the number of residential dwellings required in Broome for direct and indirect construction and operational workforces.

Table 7: Number of new residential dwellings required in Broome: Combined direct and indirect construction and operational workforces

Year	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	0	13	36	0	43	122	0	43	122	0	43	122	0	43	122
2012	0	22	62	0	74	211	0	74	211	0	74	211	0	74	211
2013	0	28	80	0	196	556	0	196	556	0	196	556	0	196	556
2014	0	32	90	0	302	860	0	302	860	0	302	860	0	302	860
2015	0	60	171	0	143	408	0	143	408	0	143	408	0	143	408
2016	0	120	340	0	97	235	0	97	235	0	127	320	0	97	235
2017	0	45	127	0	61	131	0	61	131	0	100	245	0	61	131
2018	0	29	70	0	58	124	0	58	124	0	116	290	0	88	208
2019	0	22	50	0	50	102	0	50	102	0	193	508	0	90	216
2020	0	22	50	0	140	296	0	119	297	0	377	1,030	0	177	463
2021	49	87	115	163	732	1,223	163	739	1,237	326	1,131	1,817	326	1,235	2,015
2022	49	82	106	163	521	824	175	598	959	338	809	1,195	338	1,325	2,173
2023	49	90	120	163	285	377	175	618	996	338	829	1,232	338	1,078	1,706
2024	49	82	106	175	252	302	175	315	422	338	542	688	338	947	1,457
2025	49	197	323	186	407	586	186	423	616	349	638	860	349	850	1,260
2026	49	115	169	186	319	417	186	339	456	349	610	806	349	615	815
2027	49	82	106	186	350	477	186	431	630	349	929	1,411	349	1,067	1,673
2028	49	76	94	186	406	582	186	749	1,234	349	688	955	349	1,253	2,025
2029	49	64	71	186	241	270	198	342	450	361	605	785	361	730	1,021
2030	49	64	71	191	257	297	198	269	312	361	1,007	1,547	372	1,022	1,564
2031	49	64	71	186	241	270	210	292	344	400	589	716	488	837	1,101
2032	49	64	71	214	326	404	228	348	433	418	644	803	659	1,365	1,935
2033	53	75	89	186	241	270	265	463	614	501	900	1,207	458	724	915
2034	49	64	71	186	241	270	470	1,096	1,614	488	859	1,143	412	584	695
2035	49	64	71	186	241	270	248	390	492	389	533	620	463	719	901
2036	49	64	71	186	241	270	209	271	303	372	482	539	697	1,442	2,043
2037	49	64	71	214	326	404	237	356	438	400	567	674	479	748	940
2038	49	64	71	186	241	270	209	271	303	372	482	539	456	679	830
2039	49	64	71	186	241	270	228	328	393	372	482	539	478	746	936
2040	49	64	71	186	241	270	209	271	303	372	482	539	574	1,041	1,403
2041	49	64	71	186	241	270	219	299	348	372	482	539	483	739	918

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

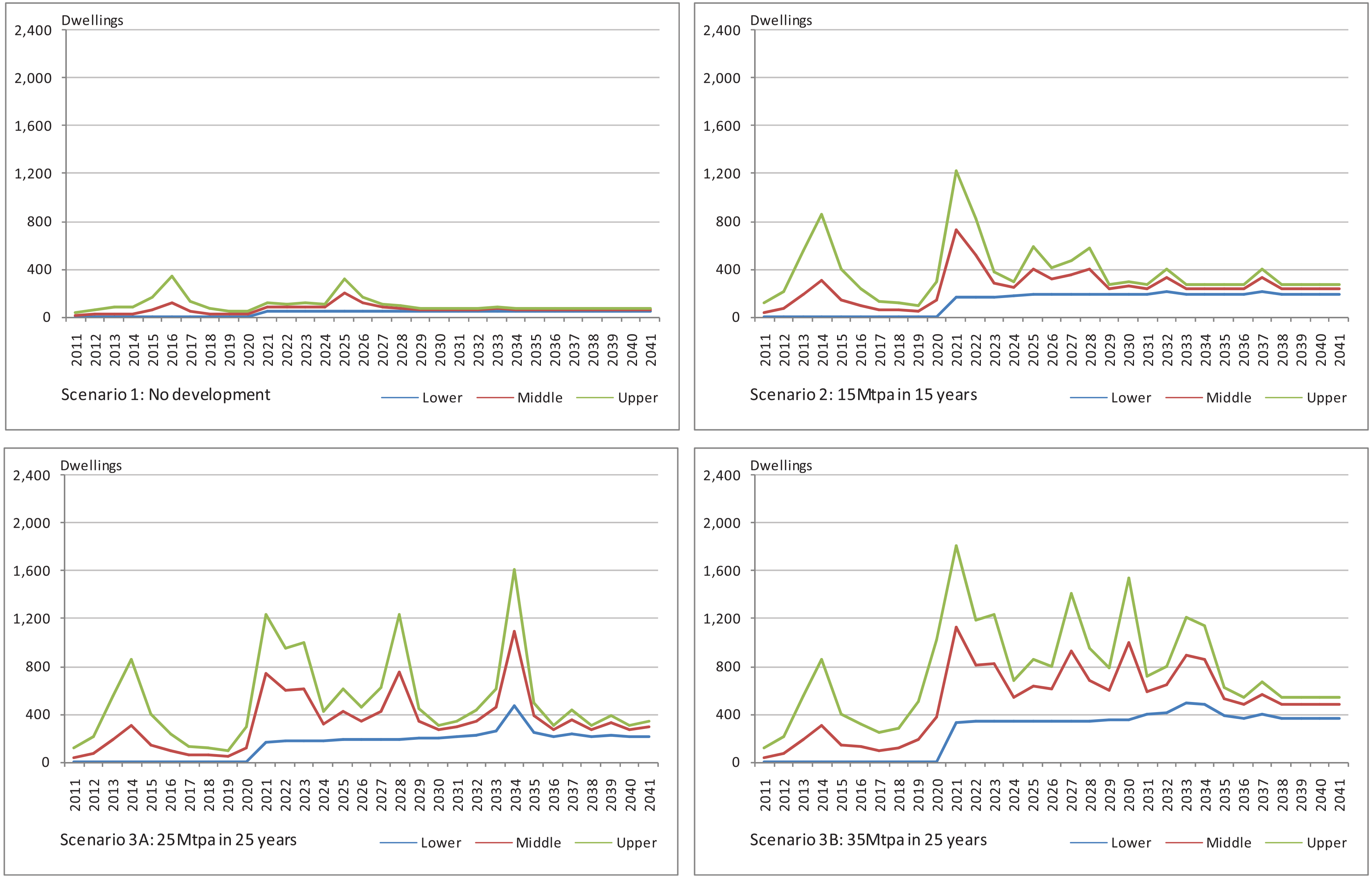


Figure 4. Number of new residential dwellings required in Broome: Combined direct and indirect construction and operational workforces

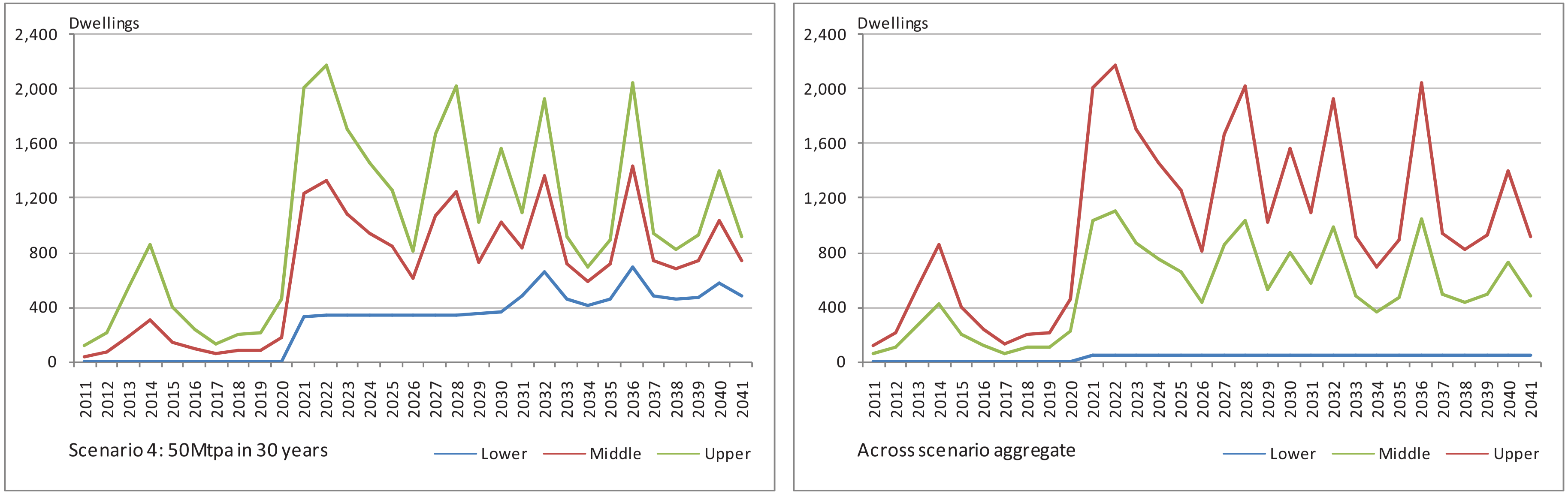


Figure 4 (cont). Number of new residential dwellings required in Broome: Combined direct and indirect construction and operational workforces

8 FAMILY SIZE AMONGST NEW EMPLOYEES IN BROOME

This table identifies the total population based on family size in Broome for direct and indirect construction and operational workforces.

Table 8: Total population based on family size in Broome: Combined direct and indirect construction and operational workforces

Year	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	0	42	200	0	143	674	0	143	674	0	143	674	0	143	674
2012	0	72	341	0	248	1,172	0	248	1,172	0	248	1,172	0	248	1,172
2013	0	94	442	0	654	3,084	0	654	3,084	0	654	3,084	0	654	3,084
2014	0	106	501	0	1,011	4,767	0	1,011	4,767	0	1,011	4,767	0	1,011	4,767
2015	0	200	945	0	479	2,261	0	479	2,261	0	479	2,261	0	479	2,261
2016	0	400	1,886	0	367	1,387	0	367	1,387	0	467	1,856	0	367	1,387
2017	0	149	704	0	245	810	0	245	810	0	378	1,439	0	245	810
2018	0	110	414	0	236	768	0	236	768	0	432	1,691	0	335	1,237
2019	0	86	300	0	211	650	0	211	650	0	688	2,899	0	344	1,279
2020	0	86	300	0	467	1,674	0	439	1,727	0	1,301	5,793	0	635	2,650
2021	123	353	710	407	2,657	7,030	407	2,682	7,109	815	4,203	10,568	815	4,553	11,666
2022	123	338	662	407	1,953	4,817	436	2,227	5,582	844	3,143	7,140	844	4,867	12,561
2023	123	363	742	407	1,166	2,342	436	2,293	5,790	844	3,209	7,348	844	4,043	9,970
2024	123	338	662	436	1,068	1,940	436	1,280	2,605	844	2,250	4,332	844	3,605	8,593
2025	123	721	1,867	465	1,604	3,531	465	1,658	3,699	873	2,589	5,302	873	3,294	7,521
2026	123	449	1,011	465	1,307	2,597	465	1,375	2,810	873	2,493	5,001	873	2,510	5,053
2027	123	338	662	465	1,413	2,930	465	1,682	3,777	873	3,559	8,353	873	4,021	9,806
2028	123	318	599	465	1,599	3,513	465	2,746	7,122	873	2,756	5,827	873	4,642	11,760
2029	123	277	471	465	1,047	1,780	494	1,400	2,794	902	2,491	4,902	902	2,909	6,214
2030	123	277	471	470	1,098	1,928	494	1,158	2,034	902	3,835	9,126	931	3,901	9,240
2031	123	277	471	465	1,047	1,780	512	1,234	2,210	961	2,439	4,521	1,102	3,283	6,672
2032	123	277	471	506	1,332	2,527	539	1,422	2,702	987	2,623	5,004	1,356	5,046	11,293
2033	129	315	571	465	1,047	1,780	594	1,806	3,707	1,110	3,478	7,245	1,069	2,919	5,659
2034	123	277	471	465	1,047	1,780	898	3,920	9,246	1,091	3,341	6,886	1,002	2,453	4,439
2035	123	277	471	465	1,047	1,780	581	1,578	3,049	956	2,266	4,009	1,089	2,918	5,598
2036	123	277	471	465	1,047	1,780	523	1,178	2,001	931	2,095	3,559	1,436	5,334	11,929
2037	123	277	471	506	1,332	2,527	564	1,463	2,748	972	2,380	4,306	1,124	3,030	5,831
2038	123	277	471	465	1,047	1,780	523	1,178	2,001	931	2,095	3,559	1,091	2,799	5,224
2039	123	277	471	465	1,047	1,780	551	1,368	2,499	931	2,095	3,559	1,123	3,023	5,812
2040	123	277	471	465	1,047	1,780	523	1,178	2,001	931	2,095	3,559	1,265	4,009	8,397
2041	123	277	471	465	1,047	1,780	537	1,273	2,250	931	2,095	3,559	1,142	3,015	5,731

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

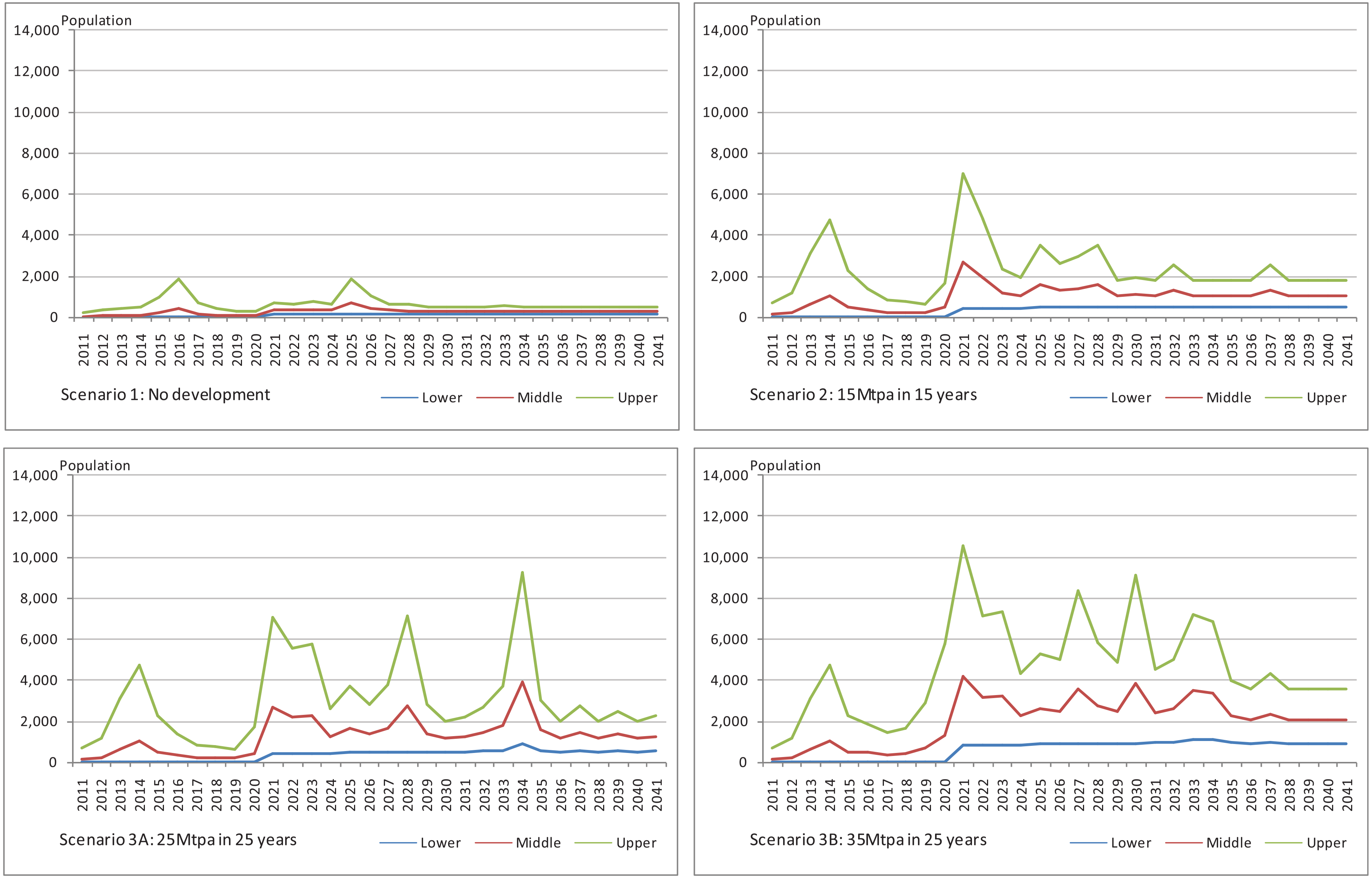
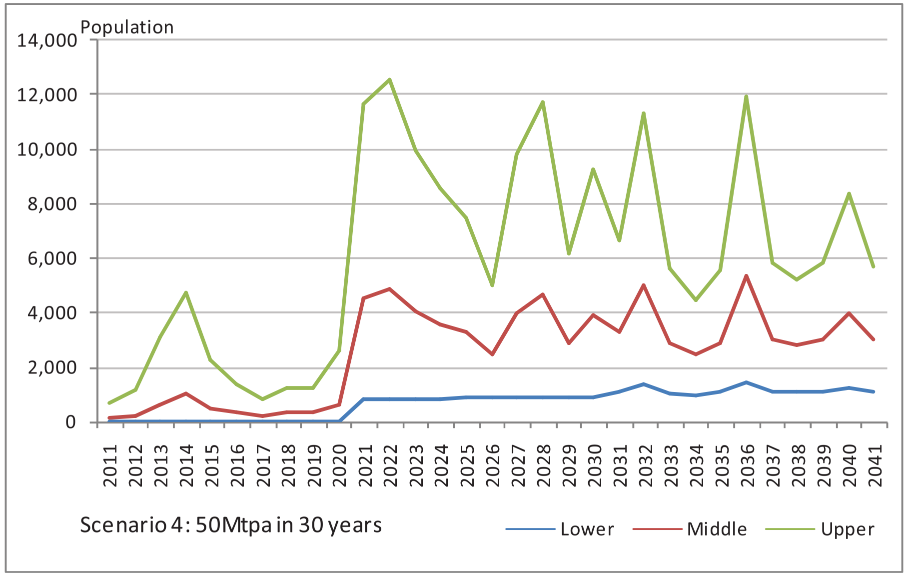


Figure 5. Total population based on family size in Broome: Combined direct and indirect construction and operational workforces



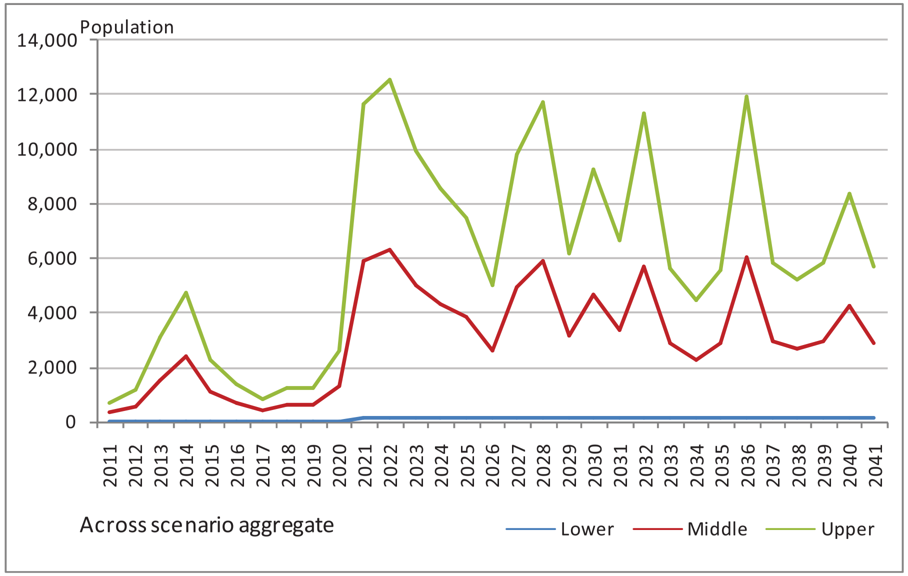


Figure 5 (cont). Total population based on family size in Broome: Combined direct and indirect construction and operational workforces

9 TOTAL POPULATION PROJECTIONS FOR BROOME

This table identifies the total population of Broome using the base population and population increase from direct and indirect employees and their families.

Table 9: Total population change: Base population with direct and indirect construction and operational workforce families

Year	Base	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Population	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	17,100	17,100	17,142	17,300	17,100	17,243	17,774	17,100	17,243	17,774	17,100	17,243	17,774	17,100	17,243	17,774
2012	17,600	17,600	17,672	17,941	17,600	17,848	18,772	17,600	17,848	18,772	17,600	17,848	18,772	17,600	17,848	18,772
2013	18,100	18,100	18,194	18,542	18,100	18,754	21,184	18,100	18,754	21,184	18,100	18,754	21,184	18,100	18,754	21,184
2014	18,600	18,600	18,706	19,101	18,600	19,611	23,367	18,600	19,611	23,367	18,600	19,611	23,367	18,600	19,611	23,367
2015	19,100	19,100	19,300	20,045	19,100	19,579	21,361	19,100	19,579	21,361	19,100	19,579	21,361	19,100	19,579	21,361
2016	19,600	19,600	20,000	21,486	19,600	19,967	20,987	19,600	19,967	20,987	19,600	20,067	21,456	19,600	19,967	20,987
2017	20,100	20,100	20,249	20,804	20,100	20,345	20,910	20,100	20,345	20,910	20,100	20,478	21,539	20,100	20,345	20,910
2018	20,600	20,600	20,710	21,014	20,600	20,836	21,368	20,600	20,836	21,368	20,600	21,032	22,291	20,600	20,935	21,837
2019	21,100	21,100	21,186	21,400	21,100	21,311	21,750	21,100	21,311	21,750	21,100	21,788	23,999	21,100	21,444	22,379
2020	21,600	21,600	21,686	21,900	21,600	22,067	23,274	21,600	22,039	23,327	21,600	22,901	27,393	21,600	22,235	24,250
2021	22,100	22,223	22,453	22,810	22,507	24,757	29,130	22,507	24,782	29,209	22,915	26,303	32,668	22,915	26,653	33,766
2022	22,580	22,703	22,918	23,242	22,987	24,533	27,397	23,016	24,807	28,162	23,424	25,723	29,720	23,424	27,447	35,141
2023	23,060	23,183	23,423	23,802	23,467	24,226	25,402	23,496	25,353	28,850	23,904	26,269	30,408	23,904	27,103	33,030
2024	23,540	23,663	23,878	24,202	23,976	24,608	25,480	23,976	24,820	26,145	24,384	25,790	27,872	24,384	27,145	32,133
2025	24,020	24,143	24,741	25,887	24,485	25,624	27,551	24,485	25,678	27,719	24,893	26,609	29,322	24,893	27,314	31,541
2026	24,500	24,623	24,949	25,511	24,965	25,807	27,097	24,965	25,875	27,310	25,373	26,993	29,501	25,373	27,010	29,553
2027	24,960	25,083	25,298	25,622	25,425	26,373	27,890	25,425	26,642	28,737	25,833	28,519	33,313	25,833	28,981	34,766
2028	25,420	25,543	25,738	26,019	25,885	27,019	28,933	25,885	28,166	32,542	26,293	28,176	31,247	26,293	30,062	37,180
2029	25,880	26,003	26,157	26,351	26,345	26,927	27,660	26,374	27,280	28,674	26,782	28,371	30,782	26,782	28,789	32,094
2030	26,340	26,463	26,617	26,811	26,810	27,438	28,268	26,834	27,498	28,374	27,242	30,175	35,466	27,271	30,241	35,580
2031	26,800	26,923	27,077	27,271	27,265	27,847	28,580	27,312	28,034	29,010	27,761	29,239	31,321	27,902	30,083	33,472
2032	27,260	27,383	27,537	27,731	27,766	28,592	29,787	27,799	28,682	29,962	28,247	29,883	32,264	28,616	32,306	38,553
2033	27,720	27,849	28,035	28,291	28,185	28,767	29,500	28,314	29,526	31,427	28,830	31,198	34,965	28,789	30,639	33,379
2034	28,180	28,303	28,457	28,651	28,645	29,227	29,960	29,078	32,100	37,426	29,271	31,521	35,066	29,182	30,633	32,619
2035	28,640	28,763	28,917	29,111	29,105	29,687	30,420	29,221	30,218	31,689	29,596	30,906	32,649	29,729	31,558	34,238
2036	29,100	29,223	29,377	29,571	29,565	30,147	30,880	29,623	30,278	31,101	30,031	31,195	32,659	30,536	34,434	41,029
2037	29,560	29,683	29,837	30,031	30,066	30,892	32,087	30,124	31,023	32,308	30,532	31,940	33,866	30,684	32,590	35,391
2038	30,020	30,143	30,297	30,491	30,485	31,067	31,800	30,543	31,198	32,021	30,951	32,115	33,579	31,111	32,819	35,244
2039	30,480	30,603	30,757	30,951	30,945	31,527	32,260	31,031	31,848	32,979	31,411	32,575	34,039	31,603	33,503	36,292
2040	30,940	31,063	31,217	31,411	31,405	31,987	32,720	31,463	32,118	32,941	31,871	33,035	34,499	32,205	34,949	39,337
2041	31,400	31,523	31,677	31,871	31,865	32,447	33,180	31,937	32,673	33,650	32,331	33,495	34,959	32,542	34,415	37,131

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

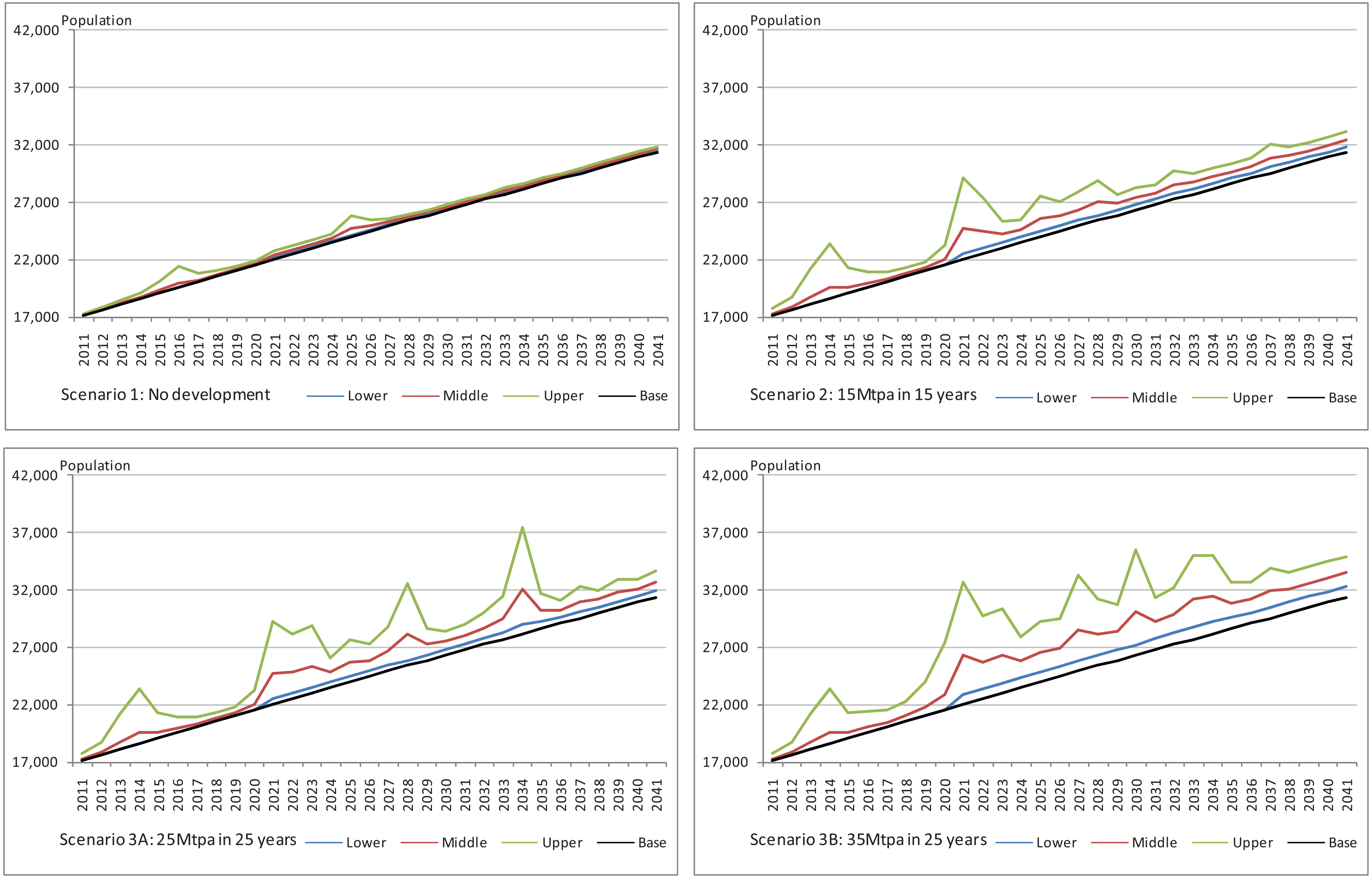
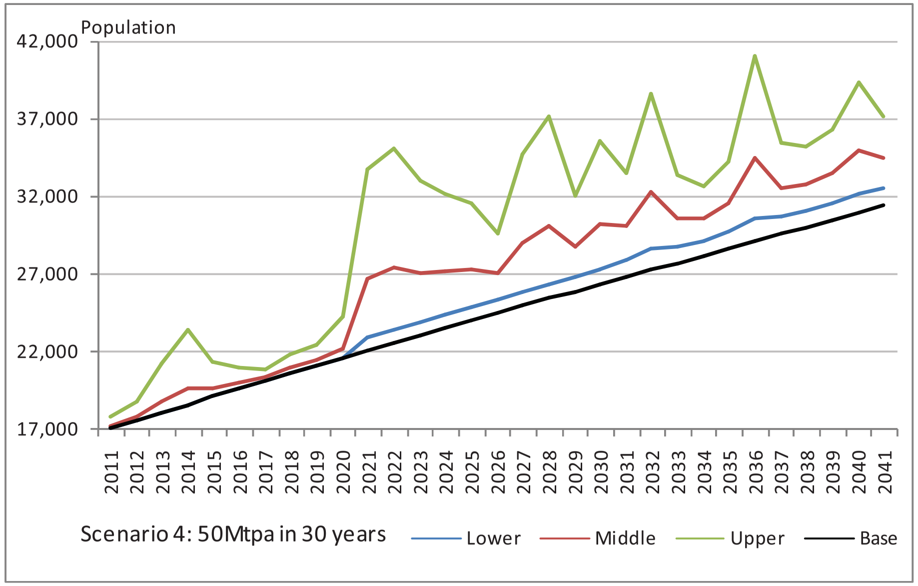


Figure 6. Total population change: Base population with direct and indirect construction and operational workforce families



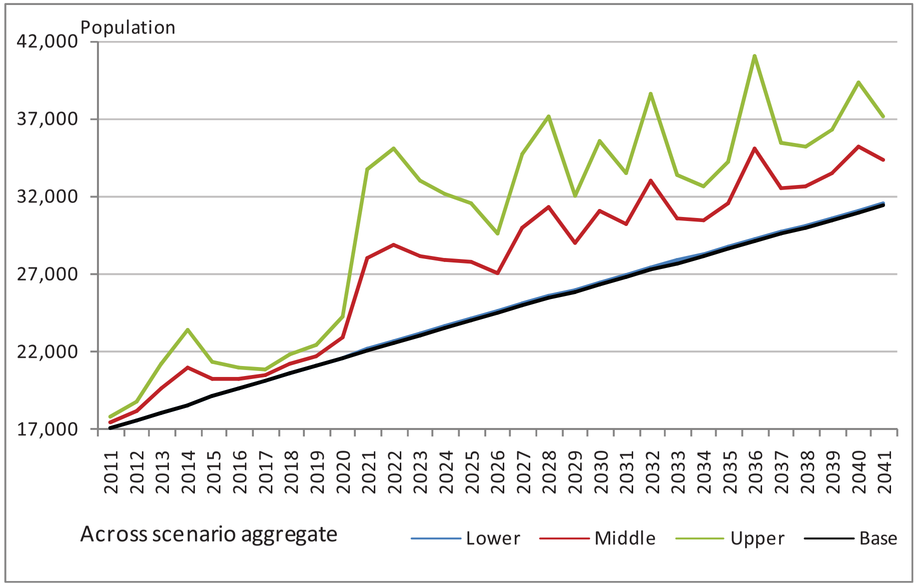


Figure 6 (cont). Total population change: Base population with direct and indirect construction and operational workforce families

10 AGE PROFILE (0-4 YEARS OF AGE)

This table identifies the 0-4 year age population of Broome using the base population and population increase from direct and indirect employees and their families.

Table 10: Population Age 0 – 4 years: Base population and direct and indirect construction and operational workforce families

Year	Base	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Population	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	1,471	1,471	1,474	1,486	1,471	1,481	1,522	1,471	1,481	1,522	1,471	1,481	1,522	1,471	1,481	1,522
2012	1,514	1,514	1,519	1,540	1,514	1,531	1,604	1,514	1,531	1,604	1,514	1,531	1,604	1,514	1,531	1,604
2013	1,557	1,557	1,563	1,590	1,557	1,604	1,793	1,557	1,604	1,793	1,557	1,604	1,793	1,557	1,604	1,793
2014	1,600	1,600	1,607	1,638	1,600	1,672	1,965	1,600	1,672	1,965	1,600	1,672	1,965	1,600	1,672	1,965
2015	1,643	1,643	1,657	1,715	1,643	1,677	1,816	1,643	1,677	1,816	1,643	1,677	1,816	1,643	1,677	1,816
2016	1,686	1,686	1,714	1,830	1,686	1,715	1,797	1,686	1,715	1,797	1,686	1,722	1,833	1,686	1,715	1,797
2017	1,729	1,729	1,739	1,783	1,729	1,749	1,796	1,729	1,749	1,796	1,729	1,758	1,844	1,729	1,749	1,796
2018	1,772	1,772	1,780	1,805	1,772	1,791	1,835	1,772	1,791	1,835	1,772	1,805	1,906	1,772	1,798	1,871
2019	1,815	1,815	1,822	1,839	1,815	1,832	1,869	1,815	1,832	1,869	1,815	1,867	2,042	1,815	1,842	1,918
2020	1,858	1,858	1,865	1,882	1,858	1,891	1,988	1,858	1,892	1,995	1,858	1,954	2,307	1,858	1,906	2,066
2021	1,901	1,911	1,930	1,959	1,936	2,105	2,454	1,936	2,106	2,460	1,971	2,229	2,740	1,971	2,254	2,825
2022	1,942	1,952	1,970	1,997	1,977	2,095	2,326	1,979	2,116	2,386	2,014	2,195	2,520	2,014	2,319	2,936
2023	1,983	1,994	2,013	2,044	2,018	2,080	2,177	2,021	2,162	2,443	2,056	2,241	2,577	2,056	2,301	2,778
2024	2,024	2,035	2,053	2,080	2,062	2,115	2,189	2,062	2,130	2,240	2,097	2,213	2,387	2,097	2,311	2,714
2025	2,066	2,076	2,122	2,213	2,106	2,196	2,353	2,106	2,200	2,366	2,141	2,280	2,503	2,141	2,330	2,674
2026	2,107	2,118	2,143	2,189	2,147	2,216	2,323	2,147	2,221	2,339	2,182	2,314	2,522	2,182	2,315	2,526
2027	2,147	2,157	2,175	2,202	2,187	2,263	2,388	2,187	2,282	2,453	2,222	2,430	2,818	2,222	2,463	2,930
2028	2,186	2,197	2,213	2,236	2,226	2,316	2,472	2,226	2,398	2,749	2,261	2,412	2,664	2,261	2,548	3,119
2029	2,226	2,236	2,250	2,266	2,266	2,316	2,379	2,268	2,342	2,458	2,303	2,433	2,634	2,303	2,463	2,734
2030	2,265	2,276	2,289	2,306	2,305	2,359	2,429	2,308	2,364	2,439	2,343	2,570	2,997	2,345	2,575	3,007
2031	2,305	2,315	2,329	2,345	2,345	2,395	2,458	2,348	2,409	2,492	2,386	2,509	2,684	2,394	2,570	2,850
2032	2,344	2,355	2,368	2,385	2,387	2,455	2,555	2,389	2,462	2,569	2,427	2,562	2,760	2,448	2,737	3,244
2033	2,384	2,395	2,411	2,432	2,424	2,474	2,537	2,432	2,529	2,686	2,473	2,663	2,972	2,473	2,624	2,852
2034	2,423	2,434	2,447	2,464	2,464	2,514	2,577	2,489	2,721	3,150	2,512	2,692	2,984	2,508	2,630	2,798
2035	2,463	2,474	2,487	2,504	2,503	2,553	2,616	2,511	2,593	2,716	2,544	2,656	2,804	2,554	2,704	2,928
2036	2,503	2,513	2,526	2,543	2,543	2,593	2,656	2,548	2,604	2,675	2,583	2,683	2,809	2,613	2,918	3,453
2037	2,542	2,553	2,566	2,583	2,584	2,653	2,753	2,589	2,664	2,772	2,625	2,743	2,906	2,636	2,792	3,026
2038	2,582	2,592	2,606	2,622	2,622	2,672	2,735	2,627	2,683	2,754	2,662	2,762	2,888	2,673	2,815	3,019
2039	2,621	2,632	2,645	2,662	2,661	2,711	2,774	2,668	2,736	2,832	2,701	2,801	2,927	2,715	2,871	3,103
2040	2,661	2,671	2,685	2,701	2,701	2,751	2,814	2,706	2,762	2,833	2,741	2,841	2,967	2,762	2,981	3,341
2041	2,700	2,711	2,724	2,741	2,740	2,790	2,853	2,746	2,809	2,892	2,780	2,881	3,006	2,796	2,950	3,177

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

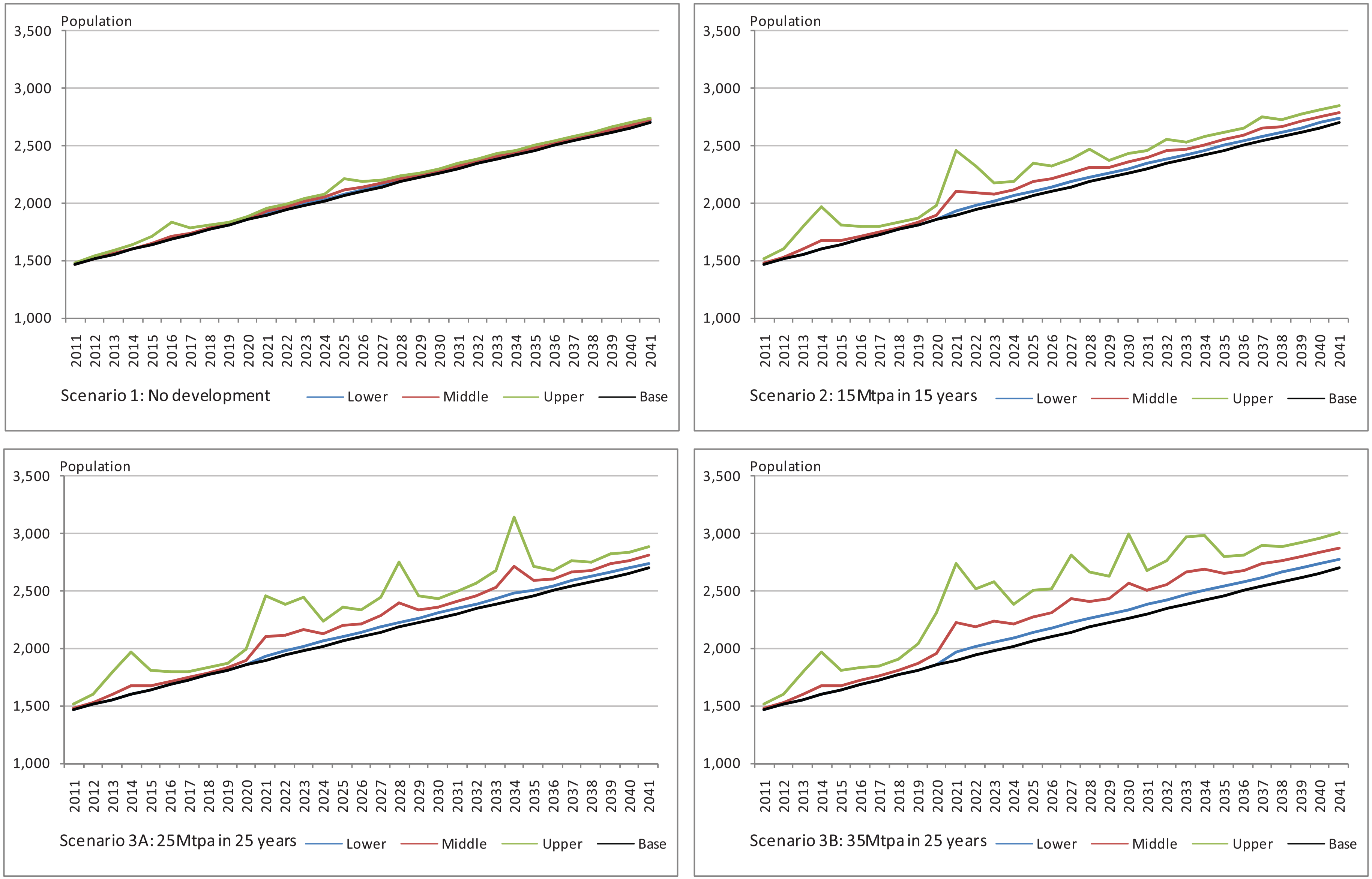
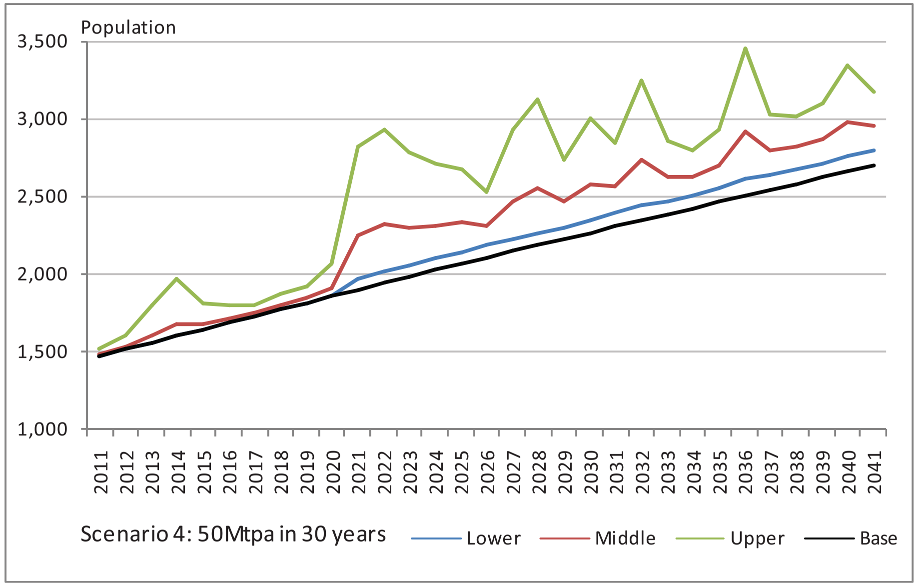


Figure 7. Population Age 0 – 4 years: Base population and direct and indirect construction and operational workforce families



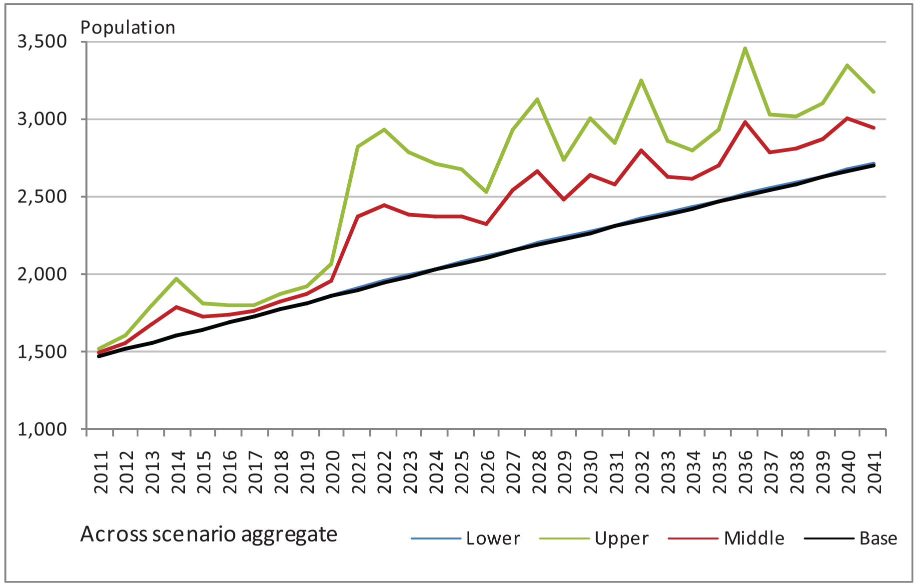


Figure 7 (cont). Population Age 0 – 4 years: Base population and direct and indirect construction and operational workforce families

11 AGE PROFILE (5-12 YEARS OF AGE)

This table identifies the 5-12 year age population of Broome using the base population and population increase from direct and indirect employees and their families.

Table 11: Population Age 5 - 12 years: Base population and direct and indirect construction and operational workforce families

Year	Base	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Population	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	1,471	1,471	1,474	1,486	1,471	1,481	1,522	1,471	1,481	1,522	1,471	1,481	1,522	1,471	1,481	1,522
2012	1,514	1,514	1,519	1,540	1,514	1,531	1,604	1,514	1,531	1,604	1,514	1,531	1,604	1,514	1,531	1,604
2013	1,557	1,557	1,563	1,590	1,557	1,604	1,793	1,557	1,604	1,793	1,557	1,604	1,793	1,557	1,604	1,793
2014	1,600	1,600	1,607	1,638	1,600	1,672	1,965	1,600	1,672	1,965	1,600	1,672	1,965	1,600	1,672	1,965
2015	1,643	1,643	1,657	1,715	1,643	1,677	1,816	1,643	1,677	1,816	1,643	1,677	1,816	1,643	1,677	1,816
2016	1,686	1,686	1,714	1,830	1,686	1,715	1,797	1,686	1,715	1,797	1,686	1,722	1,833	1,686	1,715	1,797
2017	1,729	1,729	1,739	1,783	1,729	1,749	1,796	1,729	1,749	1,796	1,729	1,758	1,844	1,729	1,749	1,796
2018	1,772	1,772	1,780	1,805	1,772	1,791	1,835	1,772	1,791	1,835	1,772	1,805	1,906	1,772	1,798	1,871
2019	1,815	1,815	1,822	1,839	1,815	1,832	1,869	1,815	1,832	1,869	1,815	1,867	2,042	1,815	1,842	1,918
2020	1,858	1,858	1,865	1,882	1,858	1,891	1,988	1,858	1,892	1,995	1,858	1,954	2,307	1,858	1,906	2,066
2021	1,901	1,911	1,930	1,959	1,936	2,105	2,454	1,936	2,106	2,460	1,971	2,229	2,740	1,971	2,254	2,825
2022	1,942	1,952	1,970	1,997	1,977	2,095	2,326	1,979	2,116	2,386	2,014	2,195	2,520	2,014	2,319	2,936
2023	1,983	1,994	2,013	2,044	2,018	2,080	2,177	2,021	2,162	2,443	2,056	2,241	2,577	2,056	2,301	2,778
2024	2,024	2,035	2,053	2,080	2,062	2,115	2,189	2,062	2,130	2,240	2,097	2,213	2,387	2,097	2,311	2,714
2025	2,066	2,076	2,122	2,213	2,106	2,196	2,353	2,106	2,200	2,366	2,141	2,280	2,503	2,141	2,330	2,674
2026	2,107	2,118	2,143	2,189	2,147	2,216	2,323	2,147	2,221	2,339	2,182	2,314	2,522	2,182	2,315	2,526
2027	2,147	2,157	2,175	2,202	2,187	2,263	2,388	2,187	2,282	2,453	2,222	2,430	2,818	2,222	2,463	2,930
2028	2,186	2,197	2,213	2,236	2,226	2,316	2,472	2,226	2,398	2,749	2,261	2,412	2,664	2,261	2,548	3,119
2029	2,226	2,236	2,250	2,266	2,266	2,316	2,379	2,268	2,342	2,458	2,303	2,433	2,634	2,303	2,463	2,734
2030	2,265	2,276	2,289	2,306	2,305	2,359	2,429	2,308	2,364	2,439	2,343	2,570	2,997	2,345	2,575	3,007
2031	2,305	2,315	2,329	2,345	2,345	2,395	2,458	2,348	2,409	2,492	2,386	2,509	2,684	2,394	2,570	2,850
2032	2,344	2,355	2,368	2,385	2,387	2,455	2,555	2,389	2,462	2,569	2,427	2,562	2,760	2,448	2,737	3,244
2033	2,384	2,395	2,411	2,432	2,424	2,474	2,537	2,432	2,529	2,686	2,473	2,663	2,972	2,473	2,624	2,852
2034	2,423	2,434	2,447	2,464	2,464	2,514	2,577	2,489	2,721	3,150	2,512	2,692	2,984	2,508	2,630	2,798
2035	2,463	2,474	2,487	2,504	2,503	2,553	2,616	2,511	2,593	2,716	2,544	2,656	2,804	2,554	2,704	2,928
2036	2,503	2,513	2,526	2,543	2,543	2,593	2,656	2,548	2,604	2,675	2,583	2,683	2,809	2,613	2,918	3,453
2037	2,542	2,553	2,566	2,583	2,584	2,653	2,753	2,589	2,664	2,772	2,625	2,743	2,906	2,636	2,792	3,026
2038	2,582	2,592	2,606	2,622	2,622	2,672	2,735	2,627	2,683	2,754	2,662	2,762	2,888	2,673	2,815	3,019
2039	2,621	2,632	2,645	2,662	2,661	2,711	2,774	2,668	2,736	2,832	2,701	2,801	2,927	2,715	2,871	3,103
2040	2,661	2,671	2,685	2,701	2,701	2,751	2,814	2,706	2,762	2,833	2,741	2,841	2,967	2,762	2,981	3,341
2041	2,700	2,711	2,724	2,741	2,740	2,790	2,853	2,746	2,809	2,892	2,780	2,881	3,006	2,796	2,950	3,177

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

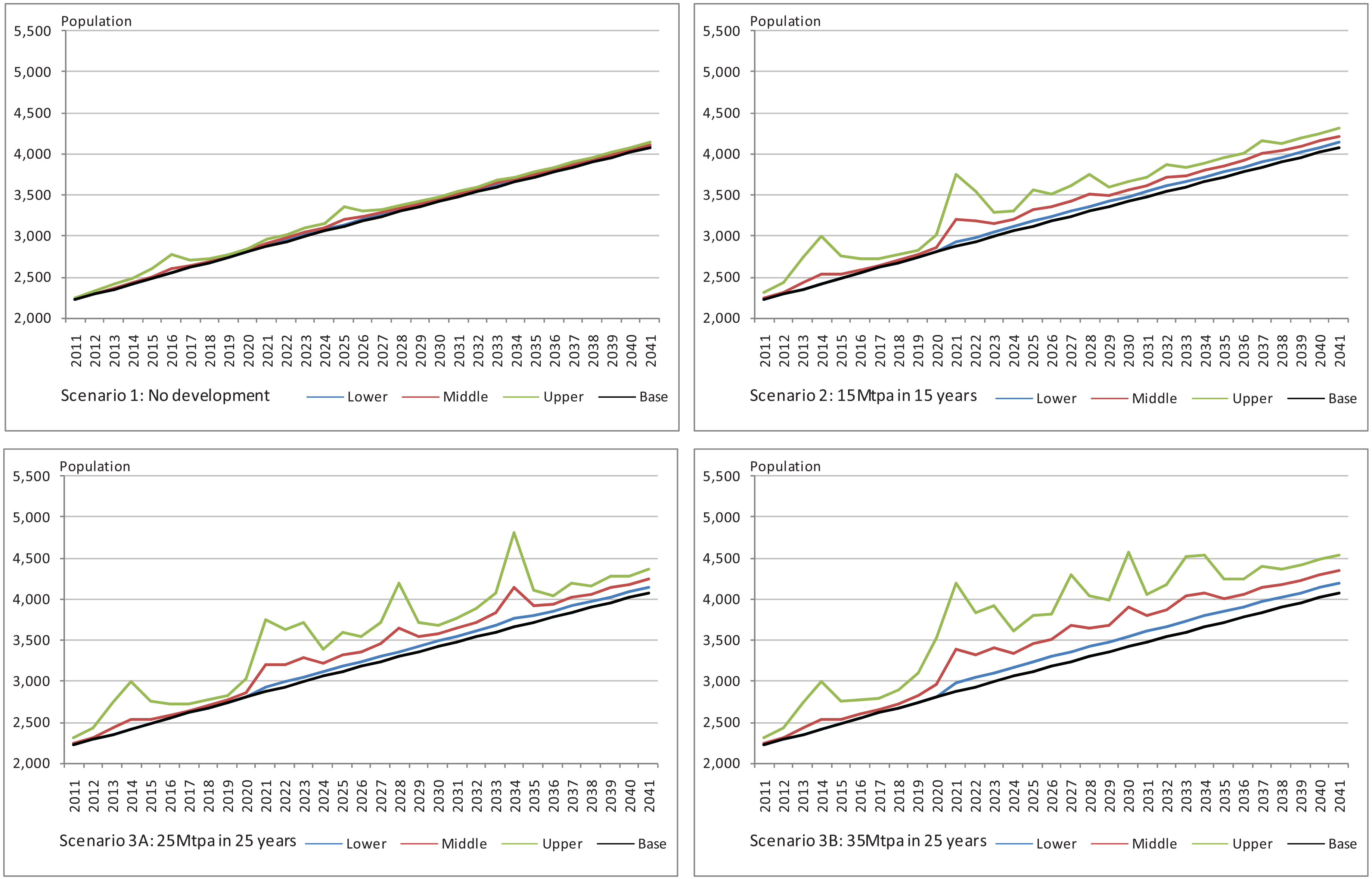
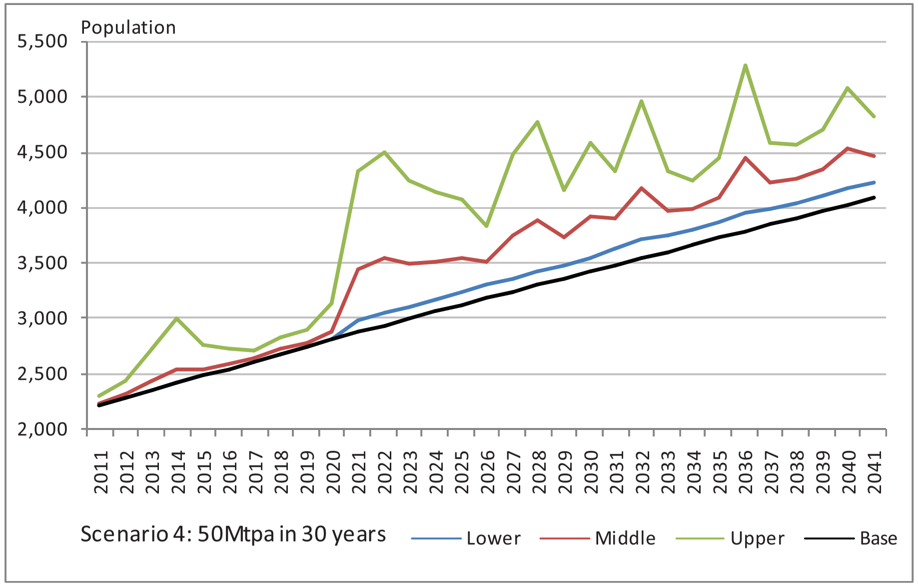


Figure 8. Population Age 5 - 12 years: Base population and direct and indirect construction and operational workforce families



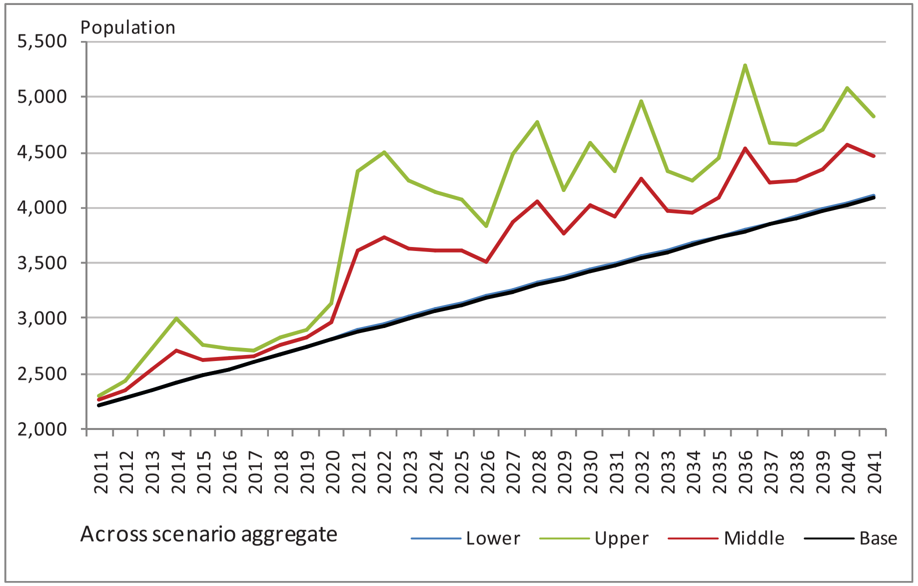


Figure 8 (cont). Population Age 5 - 12 years: Base population and direct and indirect construction and operational workforce families

12 AGE PROFILE (13-17 YEARS OF AGE)

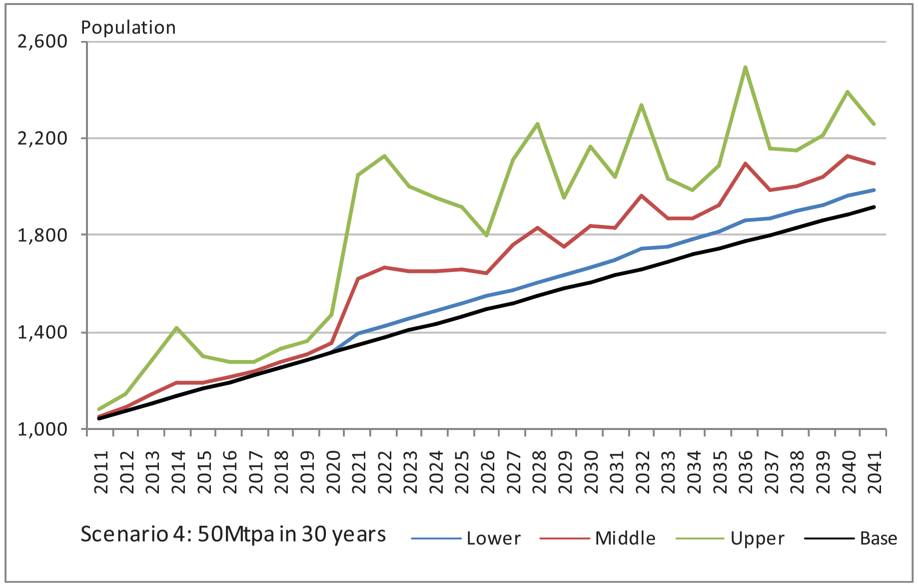
This table identifies the 13-17 year age population of Broome using the base population and population increase from direct and indirect employees and their families.

Table 12: Population Age 13-17 years: Base population and direct and indirect construction and operational workforce families

Year	Base	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Population	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	1,043	1,043	1,046	1,055	1,043	1,051	1,083	1,043	1,051	1,083	1,043	1,051	1,083	1,043	1,051	1,083
2012	1,074	1,074	1,078	1,094	1,074	1,088	1,143	1,074	1,088	1,143	1,074	1,088	1,143	1,074	1,088	1,143
2013	1,104	1,104	1,110	1,130	1,104	1,142	1,287	1,104	1,142	1,287	1,104	1,142	1,287	1,104	1,142	1,287
2014	1,135	1,135	1,141	1,164	1,135	1,194	1,418	1,135	1,194	1,418	1,135	1,194	1,418	1,135	1,194	1,418
2015	1,165	1,165	1,177	1,221	1,165	1,193	1,299	1,165	1,193	1,299	1,165	1,193	1,299	1,165	1,193	1,299
2016	1,196	1,196	1,219	1,308	1,196	1,218	1,279	1,196	1,218	1,279	1,196	1,223	1,307	1,196	1,218	1,279
2017	1,226	1,226	1,235	1,268	1,226	1,241	1,275	1,226	1,241	1,275	1,226	1,249	1,312	1,226	1,241	1,275
2018	1,257	1,257	1,263	1,281	1,257	1,271	1,303	1,257	1,271	1,303	1,257	1,282	1,358	1,257	1,277	1,331
2019	1,287	1,287	1,292	1,305	1,287	1,300	1,327	1,287	1,300	1,327	1,287	1,328	1,460	1,287	1,308	1,364
2020	1,318	1,318	1,323	1,336	1,318	1,345	1,417	1,318	1,344	1,421	1,318	1,394	1,663	1,318	1,355	1,476
2021	1,348	1,356	1,369	1,391	1,373	1,506	1,768	1,373	1,508	1,773	1,398	1,599	1,981	1,398	1,619	2,047
2022	1,377	1,385	1,398	1,417	1,402	1,494	1,666	1,404	1,510	1,712	1,429	1,566	1,807	1,429	1,667	2,129
2023	1,407	1,414	1,429	1,452	1,432	1,477	1,548	1,433	1,543	1,753	1,458	1,599	1,849	1,458	1,648	2,004
2024	1,436	1,443	1,456	1,476	1,463	1,501	1,554	1,463	1,513	1,593	1,487	1,572	1,698	1,487	1,652	1,952
2025	1,465	1,473	1,508	1,577	1,494	1,562	1,678	1,494	1,565	1,688	1,518	1,622	1,786	1,518	1,663	1,918
2026	1,495	1,502	1,521	1,555	1,523	1,574	1,652	1,523	1,578	1,664	1,548	1,645	1,797	1,548	1,646	1,800
2027	1,523	1,530	1,543	1,563	1,551	1,608	1,700	1,551	1,624	1,750	1,576	1,736	2,024	1,576	1,763	2,111
2028	1,551	1,558	1,570	1,587	1,579	1,647	1,762	1,579	1,714	1,977	1,604	1,717	1,902	1,604	1,828	2,255
2029	1,579	1,586	1,596	1,607	1,607	1,643	1,687	1,609	1,663	1,748	1,634	1,730	1,875	1,634	1,754	1,953
2030	1,607	1,614	1,624	1,635	1,635	1,674	1,724	1,637	1,677	1,731	1,662	1,836	2,155	1,664	1,840	2,162
2031	1,635	1,642	1,652	1,664	1,663	1,699	1,743	1,666	1,710	1,769	1,693	1,783	1,909	1,701	1,832	2,037
2032	1,663	1,670	1,680	1,692	1,694	1,743	1,816	1,696	1,749	1,826	1,723	1,821	1,966	1,743	1,964	2,340
2033	1,691	1,699	1,710	1,726	1,719	1,755	1,799	1,727	1,799	1,914	1,758	1,900	2,127	1,756	1,867	2,033
2034	1,719	1,726	1,736	1,748	1,747	1,783	1,828	1,772	1,951	2,272	1,785	1,920	2,134	1,780	1,868	1,989
2035	1,747	1,755	1,764	1,776	1,775	1,811	1,856	1,782	1,842	1,931	1,805	1,885	1,991	1,813	1,923	2,086
2036	1,775	1,783	1,792	1,804	1,803	1,839	1,884	1,807	1,847	1,897	1,832	1,903	1,992	1,860	2,093	2,490
2037	1,803	1,811	1,820	1,832	1,834	1,884	1,956	1,837	1,892	1,970	1,862	1,948	2,065	1,871	1,986	2,156
2038	1,831	1,839	1,848	1,860	1,860	1,895	1,940	1,863	1,903	1,953	1,888	1,959	2,048	1,897	2,001	2,148
2039	1,859	1,867	1,876	1,888	1,888	1,923	1,968	1,893	1,942	2,011	1,916	1,987	2,076	1,927	2,042	2,211
2040	1,887	1,895	1,904	1,916	1,916	1,951	1,996	1,919	1,959	2,009	1,944	2,015	2,104	1,963	2,128	2,393
2041	1,915	1,923	1,932	1,944	1,944	1,979	2,024	1,948	1,993	2,052	1,972	2,043	2,133	1,985	2,098	2,262

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

Figure 9. Population Age 13-17 years: Base population and direct and indirect construction and operational workforce families



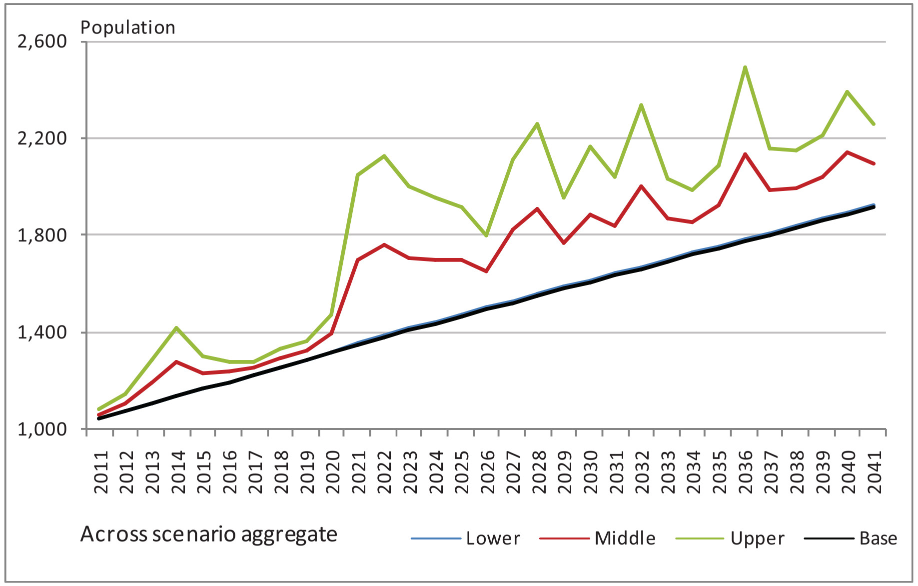


Figure 9 (cont). Population Age 13-17 years: Base population and direct and indirect construction and operational workforce families

13 AGE PROFILE (18-24 YEARS OF AGE)

This table identifies the 18-24 year age population of Broome using the base population and population increase from direct and indirect employees and their families.

Table 13: Population Age 18-24 years: Base population and direct and indirect construction and operational workforce families

Year	Base	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Population	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	1,676	1,676	1,680	1,694	1,676	1,688	1,737	1,676	1,688	1,737	1,676	1,688	1,737	1,676	1,688	1,737
2012	1,725	1,725	1,731	1,756	1,725	1,747	1,832	1,725	1,747	1,832	1,725	1,747	1,832	1,725	1,747	1,832
2013	1,774	1,774	1,782	1,814	1,774	1,831	2,055	1,774	1,831	2,055	1,774	1,831	2,055	1,774	1,831	2,055
2014	1,823	1,823	1,832	1,868	1,823	1,912	2,258	1,823	1,912	2,258	1,823	1,912	2,258	1,823	1,912	2,258
2015	1,872	1,872	1,889	1,958	1,872	1,914	2,078	1,872	1,914	2,078	1,872	1,914	2,078	1,872	1,914	2,078
2016	1,921	1,921	1,956	2,093	1,921	1,955	2,051	1,921	1,955	2,051	1,921	1,964	2,094	1,921	1,955	2,051
2017	1,970	1,970	1,983	2,034	1,970	1,993	2,047	1,970	1,993	2,047	1,970	2,005	2,105	1,970	1,993	2,047
2018	2,019	2,019	2,029	2,058	2,019	2,041	2,092	2,019	2,041	2,092	2,019	2,059	2,177	2,019	2,050	2,135
2019	2,068	2,068	2,076	2,096	2,068	2,088	2,131	2,068	2,088	2,131	2,068	2,130	2,336	2,068	2,100	2,188
2020	2,117	2,117	2,125	2,145	2,117	2,158	2,271	2,117	2,157	2,278	2,117	2,233	2,649	2,117	2,174	2,362
2021	2,166	2,178	2,200	2,234	2,206	2,408	2,818	2,206	2,411	2,825	2,246	2,553	3,151	2,246	2,584	3,251
2022	2,213	2,225	2,245	2,276	2,253	2,394	2,663	2,256	2,418	2,734	2,296	2,508	2,886	2,296	2,659	3,381
2023	2,260	2,272	2,295	2,331	2,300	2,372	2,484	2,303	2,471	2,799	2,343	2,561	2,952	2,343	2,634	3,191
2024	2,307	2,319	2,339	2,371	2,350	2,411	2,495	2,350	2,429	2,556	2,390	2,524	2,724	2,390	2,643	3,113
2025	2,354	2,366	2,420	2,528	2,400	2,505	2,688	2,400	2,510	2,704	2,440	2,601	2,860	2,440	2,663	3,063
2026	2,401	2,413	2,443	2,496	2,447	2,526	2,650	2,447	2,532	2,669	2,487	2,640	2,880	2,487	2,641	2,885
2027	2,446	2,458	2,479	2,510	2,492	2,581	2,725	2,492	2,604	2,803	2,532	2,779	3,231	2,532	2,819	3,363
2028	2,491	2,503	2,522	2,549	2,537	2,642	2,824	2,537	2,743	3,153	2,577	2,753	3,045	2,577	2,919	3,587
2029	2,536	2,548	2,563	2,582	2,582	2,639	2,711	2,585	2,670	2,804	2,625	2,776	3,007	2,625	2,812	3,127
2030	2,581	2,593	2,608	2,628	2,627	2,688	2,769	2,630	2,694	2,780	2,670	2,939	3,437	2,673	2,945	3,449
2031	2,626	2,638	2,654	2,673	2,672	2,729	2,801	2,676	2,746	2,841	2,719	2,861	3,062	2,731	2,936	3,259
2032	2,671	2,684	2,699	2,718	2,720	2,799	2,914	2,723	2,808	2,931	2,766	2,922	3,151	2,795	3,136	3,726
2033	2,717	2,729	2,747	2,772	2,762	2,819	2,891	2,773	2,886	3,068	2,821	3,043	3,401	2,819	2,995	3,258
2034	2,762	2,774	2,789	2,808	2,807	2,864	2,936	2,841	3,117	3,618	2,864	3,076	3,413	2,859	2,999	3,191
2035	2,807	2,819	2,834	2,853	2,852	2,909	2,981	2,862	2,957	3,098	2,900	3,027	3,197	2,911	3,086	3,343
2036	2,852	2,864	2,879	2,898	2,897	2,954	3,026	2,903	2,967	3,048	2,943	3,057	3,201	2,983	3,343	3,966
2037	2,897	2,909	2,924	2,943	2,946	3,025	3,139	2,951	3,037	3,161	2,991	3,127	3,314	3,005	3,186	3,455
2038	2,942	2,954	2,969	2,988	2,988	3,045	3,116	2,993	3,057	3,138	3,033	3,147	3,291	3,047	3,211	3,445
2039	2,987	2,999	3,014	3,033	3,033	3,090	3,161	3,040	3,119	3,229	3,078	3,192	3,336	3,095	3,276	3,544
2040	3,032	3,044	3,059	3,078	3,078	3,135	3,207	3,083	3,148	3,228	3,123	3,237	3,381	3,151	3,407	3,825
2041	3,077	3,089	3,104	3,123	3,123	3,180	3,252	3,130	3,201	3,296	3,168	3,282	3,426	3,187	3,366	3,627

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

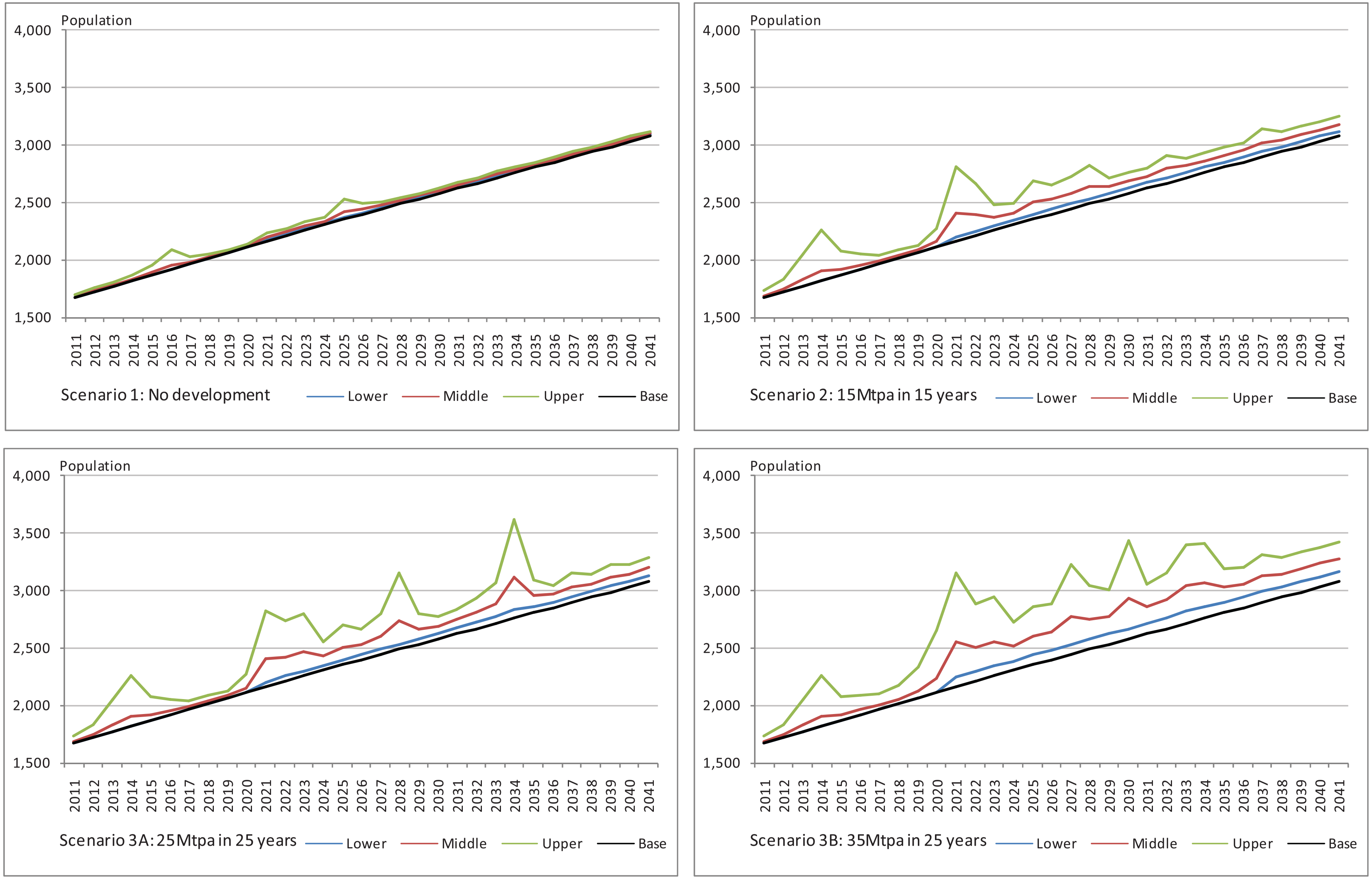
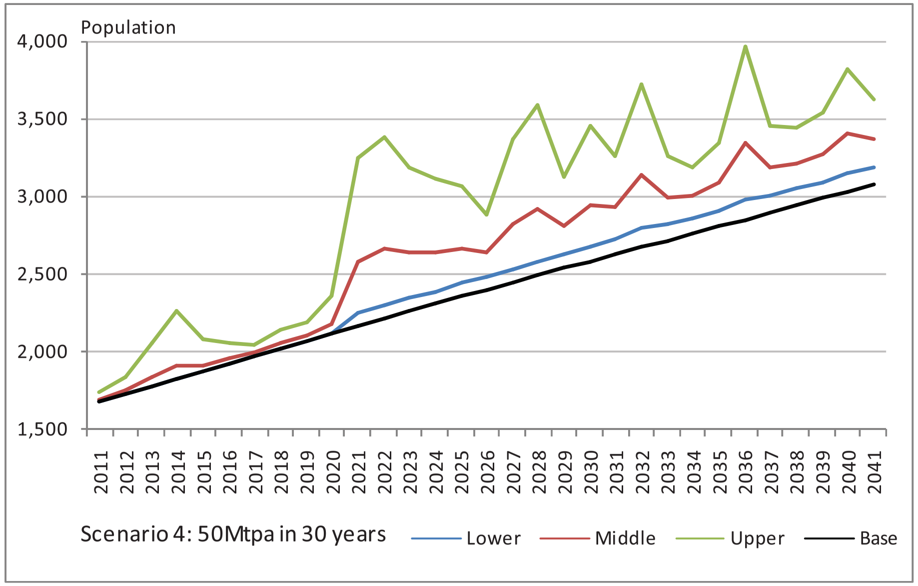


Figure 10. Population Age 18-24 years: Base population and direct and indirect construction and operational workforce families



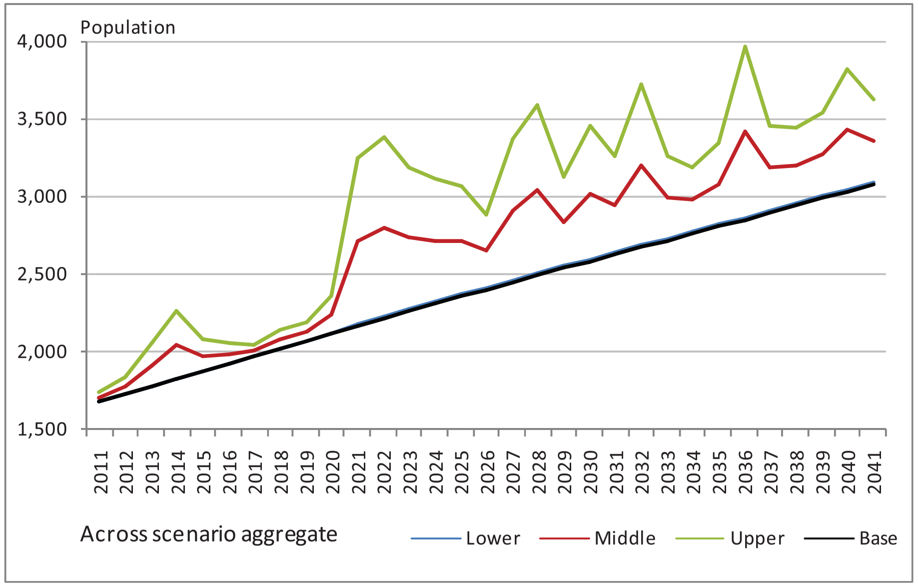


Figure 10 (cont). Population Age 18-24 years: Base population and direct and indirect construction and operational workforce families

14 AGE PROFILE (25-44 YEARS OF AGE)

This table identifies the 25-44 year age population of Broome using the base population and population increase from direct and indirect employees and their families.

Table 14: Population Age 25-44 years: Base population and direct and indirect construction and operational workforce families

Year	Base	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Population	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	6,105	6,105	6,121	6,180	6,105	6,160	6,359	6,105	6,160	6,359	6,105	6,160	6,359	6,105	6,160	6,359
2012	6,283	6,283	6,311	6,412	6,283	6,379	6,725	6,283	6,379	6,725	6,283	6,379	6,725	6,283	6,379	6,725
2013	6,462	6,462	6,498	6,628	6,462	6,715	7,625	6,462	6,715	7,625	6,462	6,715	7,625	6,462	6,715	7,625
2014	6,640	6,640	6,681	6,829	6,640	7,032	8,438	6,640	7,032	8,438	6,640	7,032	8,438	6,640	7,032	8,438
2015	6,819	6,819	6,896	7,175	6,819	7,004	7,671	6,819	7,004	7,671	6,819	7,004	7,671	6,819	7,004	7,671
2016	6,997	6,997	7,152	7,708	6,997	7,134	7,510	6,997	7,134	7,510	6,997	7,172	7,687	6,997	7,134	7,510
2017	7,176	7,176	7,234	7,441	7,176	7,265	7,471	7,176	7,265	7,471	7,176	7,317	7,708	7,176	7,265	7,471
2018	7,354	7,354	7,395	7,507	7,354	7,440	7,633	7,354	7,440	7,633	7,354	7,516	7,981	7,354	7,479	7,810
2019	7,533	7,533	7,564	7,643	7,533	7,609	7,767	7,533	7,609	7,767	7,533	7,794	8,616	7,533	7,661	8,004
2020	7,711	7,711	7,743	7,821	7,711	7,892	8,338	7,711	7,876	8,352	7,711	8,210	9,885	7,711	7,952	8,700
2021	7,890	7,934	8,018	8,148	8,035	8,891	10,510	8,035	8,901	10,539	8,181	9,463	11,812	8,181	9,598	12,226
2022	8,061	8,105	8,184	8,301	8,207	8,790	9,846	8,217	8,894	10,133	8,362	9,221	10,689	8,362	9,889	12,733
2023	8,232	8,276	8,365	8,503	8,378	8,656	9,084	8,388	9,091	10,382	8,534	9,418	10,938	8,534	9,741	11,927
2024	8,404	8,448	8,526	8,644	8,560	8,788	9,102	8,560	8,870	9,353	8,705	9,218	9,972	8,705	9,743	11,580
2025	8,575	8,619	8,846	9,270	8,741	9,165	9,871	8,741	9,186	9,934	8,887	9,518	10,507	8,887	9,792	11,344
2026	8,747	8,791	8,912	9,118	8,913	9,221	9,690	8,913	9,247	9,770	9,058	9,653	10,565	9,058	9,659	10,585
2027	8,911	8,955	9,033	9,151	9,077	9,426	9,980	9,077	9,531	10,299	9,222	10,230	11,993	9,222	10,409	12,541
2028	9,075	9,119	9,190	9,291	9,241	9,662	10,364	9,241	10,107	11,725	9,387	10,083	11,205	9,387	10,814	13,442
2029	9,239	9,283	9,338	9,407	9,405	9,613	9,874	9,416	9,748	10,255	9,561	10,143	11,018	9,561	10,304	11,513
2030	9,403	9,447	9,502	9,572	9,572	9,797	10,095	9,580	9,818	10,132	9,725	10,827	12,775	9,736	10,851	12,816
2031	9,568	9,612	9,667	9,736	9,734	9,941	10,203	9,752	10,012	10,363	9,914	10,451	11,203	9,972	10,776	12,012
2032	9,732	9,776	9,831	9,900	9,915	10,216	10,649	9,927	10,249	10,713	10,090	10,686	11,550	10,244	11,623	13,919
2033	9,896	9,942	10,010	10,102	10,062	10,270	10,531	10,115	10,562	11,256	10,306	11,182	12,559	10,285	10,961	11,956
2034	10,060	10,104	10,159	10,228	10,226	10,434	10,696	10,407	11,545	13,509	10,462	11,293	12,588	10,421	10,945	11,660
2035	10,224	10,268	10,323	10,393	10,391	10,598	10,860	10,436	10,800	11,334	10,567	11,039	11,665	10,620	11,287	12,259
2036	10,389	10,433	10,488	10,557	10,555	10,763	11,024	10,576	10,809	11,103	10,721	11,136	11,659	10,931	12,388	14,811
2037	10,553	10,597	10,652	10,721	10,736	11,037	11,470	10,757	11,084	11,549	10,903	11,411	12,105	10,961	11,657	12,673
2038	10,717	10,761	10,816	10,885	10,883	11,091	11,352	10,904	11,138	11,432	11,049	11,465	11,988	11,111	11,732	12,609
2039	10,881	10,925	10,980	11,050	11,048	11,255	11,517	11,080	11,375	11,784	11,214	11,629	12,152	11,289	11,983	12,995
2040	11,046	11,090	11,145	11,214	11,212	11,419	11,681	11,232	11,466	11,760	11,378	11,793	12,316	11,513	12,529	14,134
2041	11,210	11,254	11,309	11,378	11,376	11,584	11,845	11,402	11,667	12,018	11,542	11,958	12,480	11,624	12,306	13,290

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

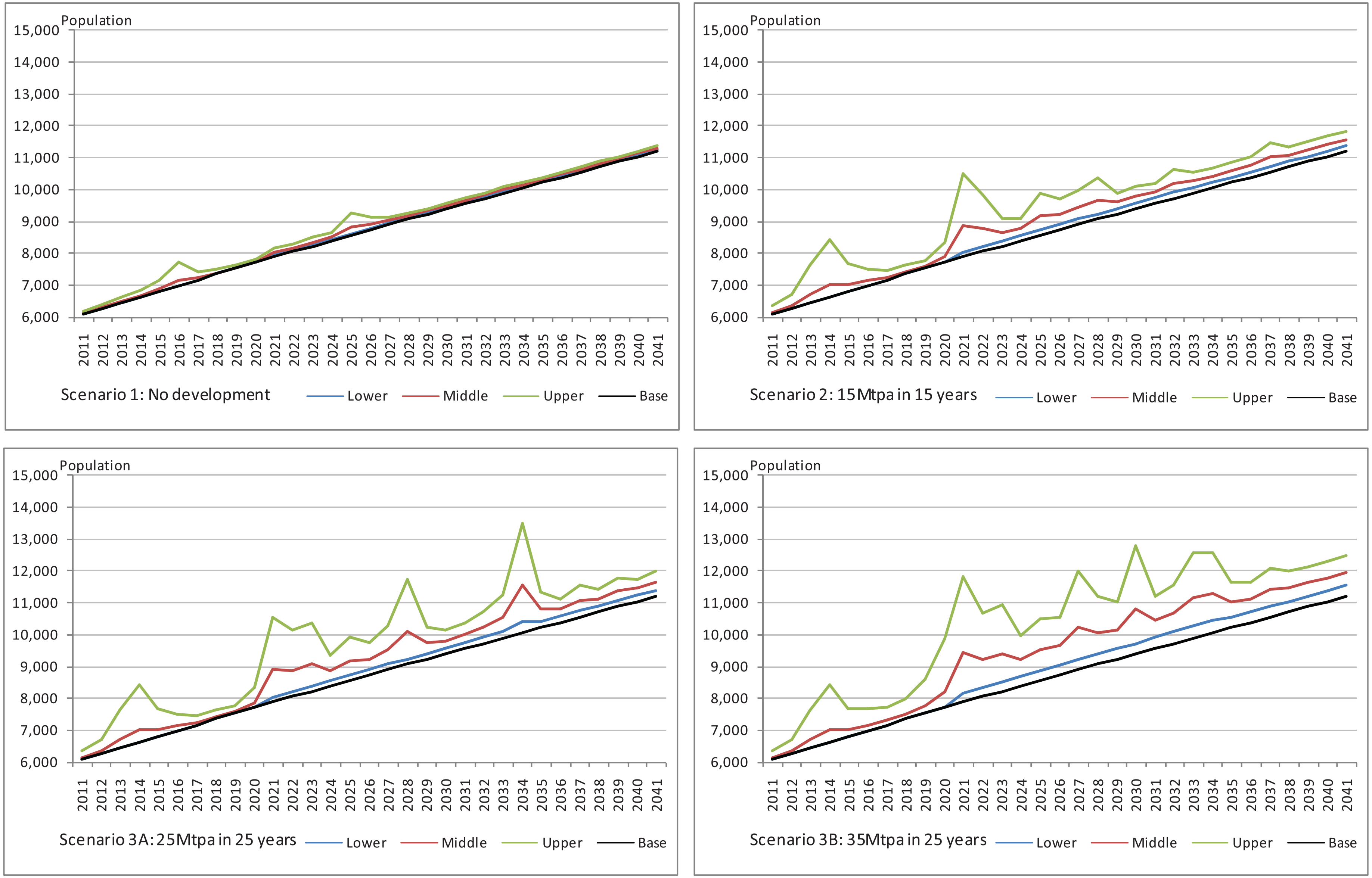
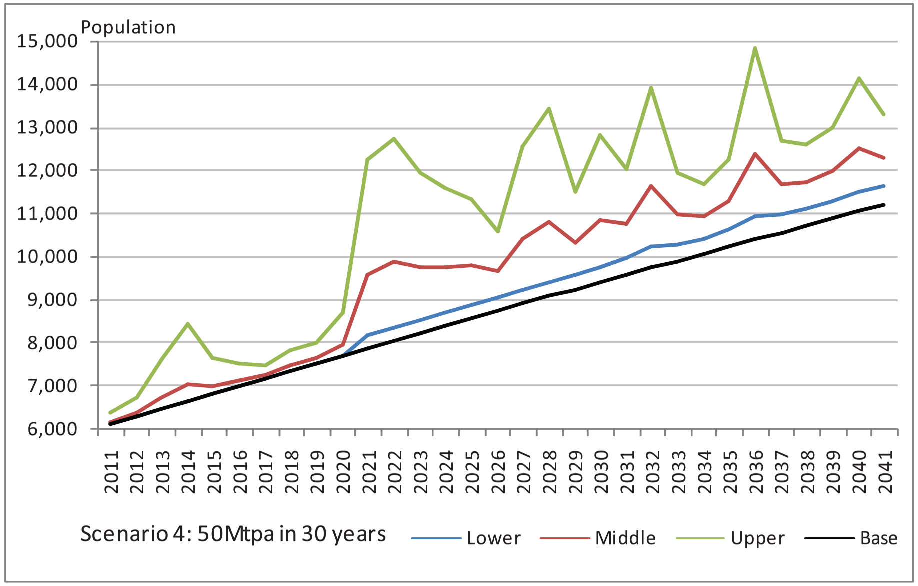


Figure 11. Population Age 25-44 years: Base population and direct and indirect construction and operational workforce families



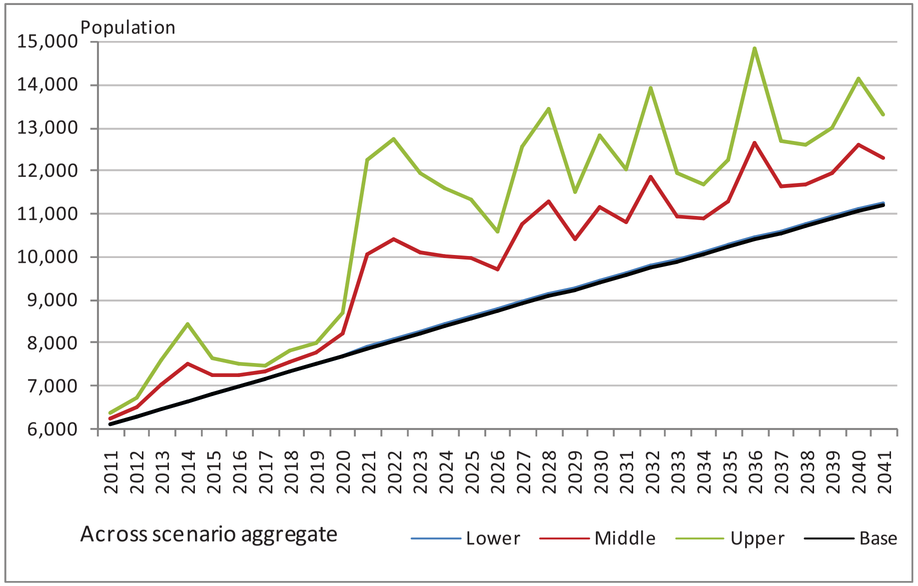


Figure 11 (cont). Population Age 25-44 years: Base population and direct and indirect construction and operational workforce families

15 AGE PROFILE (45-54 YEARS OF AGE)

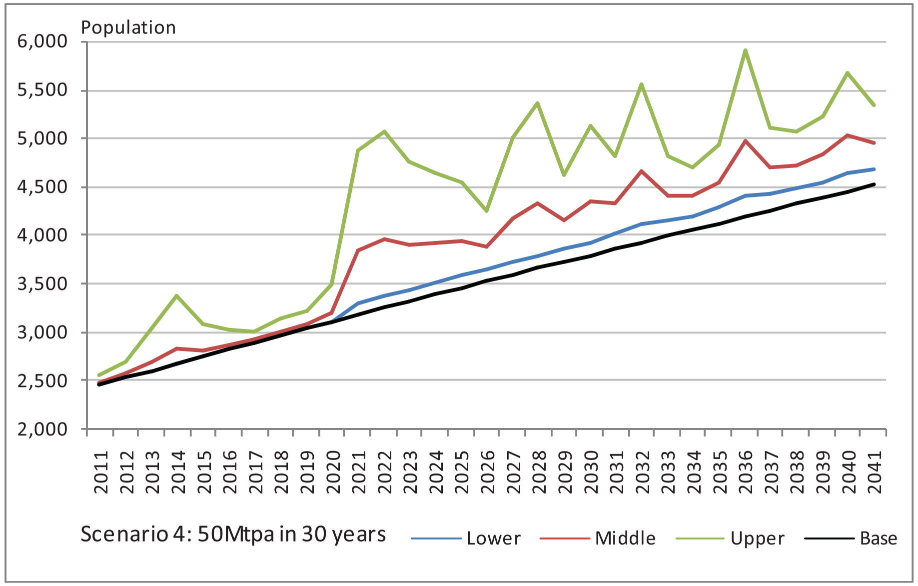
This table identifies the 45-54 year age population of Broome using the base population and population increase from direct and indirect employees and their families.

Table 15: Population Age 45-54 years: Base population and direct and indirect construction and operational workforce families

Year	Base	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Population	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	2,462	2,462	2,469	2,491	2,462	2,483	2,560	2,462	2,483	2,560	2,462	2,483	2,560	2,462	2,483	2,560
2012	2,534	2,534	2,545	2,584	2,534	2,570	2,704	2,534	2,570	2,704	2,534	2,570	2,704	2,534	2,570	2,704
2013	2,606	2,606	2,620	2,670	2,606	2,701	3,053	2,606	2,701	3,053	2,606	2,701	3,053	2,606	2,701	3,053
2014	2,678	2,678	2,694	2,751	2,678	2,825	3,369	2,678	2,825	3,369	2,678	2,825	3,369	2,678	2,825	3,369
2015	2,750	2,750	2,780	2,887	2,750	2,820	3,078	2,750	2,820	3,078	2,750	2,820	3,078	2,750	2,820	3,078
2016	2,822	2,822	2,880	3,096	2,822	2,876	3,023	2,822	2,876	3,023	2,822	2,890	3,091	2,822	2,876	3,023
2017	2,894	2,894	2,916	2,996	2,894	2,930	3,011	2,894	2,930	3,011	2,894	2,949	3,102	2,894	2,930	3,011
2018	2,966	2,966	2,982	3,026	2,966	3,000	3,077	2,966	3,000	3,077	2,966	3,029	3,211	2,966	3,015	3,145
2019	3,038	3,038	3,051	3,082	3,038	3,069	3,132	3,038	3,069	3,132	3,038	3,138	3,458	3,038	3,088	3,223
2020	3,110	3,110	3,123	3,154	3,110	3,178	3,353	3,110	3,174	3,360	3,110	3,299	3,949	3,110	3,202	3,494
2021	3,182	3,200	3,233	3,285	3,241	3,567	4,199	3,241	3,571	4,211	3,300	3,791	4,710	3,300	3,841	4,870
2022	3,252	3,269	3,300	3,347	3,310	3,534	3,948	3,314	3,574	4,059	3,373	3,706	4,283	3,373	3,956	5,068
2023	3,321	3,338	3,373	3,428	3,379	3,489	3,659	3,383	3,652	4,158	3,442	3,784	4,382	3,442	3,906	4,762
2024	3,390	3,408	3,439	3,485	3,453	3,544	3,669	3,453	3,574	3,766	3,511	3,714	4,014	3,511	3,911	4,632
2025	3,459	3,477	3,563	3,729	3,526	3,691	3,969	3,526	3,698	3,993	3,585	3,832	4,224	3,585	3,935	4,545
2026	3,528	3,546	3,593	3,674	3,595	3,717	3,903	3,595	3,726	3,934	3,654	3,888	4,250	3,654	3,890	4,257
2027	3,594	3,612	3,643	3,690	3,661	3,798	4,017	3,661	3,837	4,140	3,720	4,109	4,801	3,720	4,176	5,012
2028	3,660	3,678	3,706	3,747	3,728	3,891	4,168	3,728	4,058	4,691	3,786	4,058	4,502	3,786	4,332	5,361
2029	3,727	3,744	3,767	3,795	3,794	3,878	3,983	3,798	3,929	4,130	3,857	4,086	4,434	3,857	4,147	4,624
2030	3,793	3,811	3,833	3,861	3,861	3,951	4,071	3,864	3,960	4,086	3,923	4,347	5,112	3,927	4,357	5,128
2031	3,859	3,877	3,899	3,927	3,926	4,010	4,115	3,933	4,037	4,178	3,998	4,211	4,511	4,018	4,333	4,823
2032	3,925	3,943	3,965	3,993	3,998	4,118	4,290	4,003	4,131	4,315	4,068	4,304	4,647	4,122	4,656	5,558
2033	3,992	4,010	4,037	4,074	4,059	4,142	4,248	4,078	4,253	4,527	4,152	4,494	5,038	4,146	4,413	4,808
2034	4,058	4,076	4,098	4,126	4,125	4,209	4,314	4,188	4,626	5,396	4,215	4,541	5,052	4,202	4,412	4,698
2035	4,124	4,142	4,164	4,192	4,191	4,275	4,380	4,208	4,352	4,564	4,262	4,451	4,702	4,281	4,545	4,932
2036	4,190	4,208	4,230	4,258	4,257	4,341	4,447	4,266	4,360	4,479	4,324	4,492	4,703	4,398	4,963	5,915
2037	4,257	4,274	4,297	4,324	4,330	4,449	4,621	4,338	4,468	4,653	4,397	4,600	4,877	4,419	4,694	5,098
2038	4,323	4,341	4,363	4,391	4,390	4,474	4,579	4,398	4,492	4,611	4,457	4,624	4,835	4,480	4,727	5,076
2039	4,389	4,407	4,429	4,457	4,456	4,540	4,645	4,469	4,586	4,749	4,523	4,691	4,902	4,551	4,825	5,228
2040	4,455	4,473	4,495	4,523	4,522	4,606	4,712	4,531	4,625	4,744	4,589	4,757	4,968	4,638	5,035	5,668
2041	4,522	4,539	4,562	4,589	4,589	4,672	4,778	4,599	4,705	4,846	4,656	4,823	5,034	4,686	4,957	5,348

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

Figure 12. Population Age 45-54 years: Base population and direct and indirect construction and operational workforce families



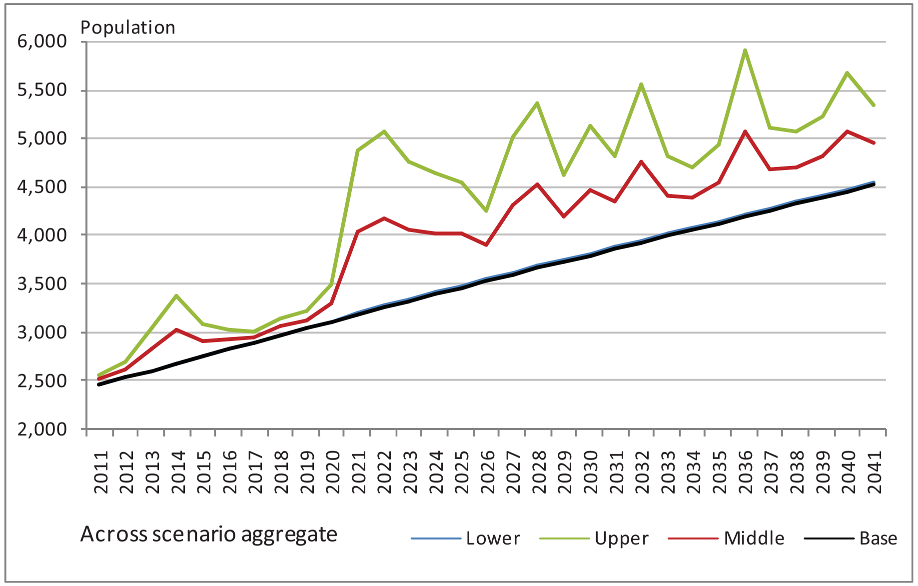


Figure 12 (cont). Population Age 45-54 years: Base population and direct and indirect construction and operational workforce families

16 AGE PROFILE (55-64 YEARS OF AGE)

This table identifies the 55-64 year age population of Broome using the base population and population increase from direct and indirect employees and their families.

Table 16: Population Age 55-64 years: Base population and direct and indirect construction and operational workforce families

Year	Base	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Population	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	1,351	1,351	1,355	1,369	1,351	1,364	1,411	1,351	1,364	1,411	1,351	1,364	1,411	1,351	1,364	1,411
2012	1,390	1,390	1,397	1,421	1,390	1,414	1,495	1,390	1,414	1,495	1,390	1,414	1,495	1,390	1,414	1,495
2013	1,430	1,430	1,439	1,469	1,430	1,491	1,704	1,430	1,491	1,704	1,430	1,491	1,704	1,430	1,491	1,704
2014	1,469	1,469	1,479	1,514	1,469	1,565	1,894	1,469	1,565	1,894	1,469	1,565	1,894	1,469	1,565	1,894
2015	1,509	1,509	1,528	1,593	1,509	1,554	1,710	1,509	1,554	1,710	1,509	1,554	1,710	1,509	1,554	1,710
2016	1,548	1,548	1,586	1,716	1,548	1,580	1,667	1,548	1,580	1,667	1,548	1,590	1,708	1,548	1,580	1,667
2017	1,588	1,588	1,602	1,651	1,588	1,608	1,655	1,588	1,608	1,655	1,588	1,621	1,711	1,588	1,608	1,655
2018	1,627	1,627	1,637	1,663	1,627	1,647	1,691	1,627	1,647	1,691	1,627	1,665	1,773	1,627	1,656	1,732
2019	1,667	1,667	1,674	1,692	1,667	1,684	1,720	1,667	1,684	1,720	1,667	1,729	1,920	1,667	1,697	1,775
2020	1,706	1,706	1,714	1,732	1,706	1,750	1,853	1,706	1,745	1,855	1,706	1,826	2,217	1,706	1,763	1,937
2021	1,746	1,756	1,775	1,804	1,778	1,982	2,356	1,778	1,984	2,363	1,810	2,114	2,655	1,810	2,147	2,753
2022	1,784	1,794	1,811	1,838	1,816	1,954	2,197	1,818	1,979	2,264	1,850	2,051	2,387	1,850	2,213	2,869
2023	1,822	1,831	1,852	1,883	1,854	1,918	2,015	1,856	2,023	2,320	1,888	2,095	2,443	1,888	2,174	2,677
2024	1,860	1,869	1,887	1,914	1,894	1,945	2,016	1,894	1,965	2,075	1,926	2,043	2,213	1,926	2,170	2,592
2025	1,898	1,907	1,961	2,059	1,934	2,033	2,194	1,934	2,038	2,209	1,967	2,112	2,336	1,967	2,178	2,534
2026	1,936	1,945	1,974	2,021	1,972	2,043	2,149	1,972	2,049	2,168	2,004	2,140	2,347	2,004	2,142	2,352
2027	1,972	1,982	1,999	2,026	2,009	2,089	2,215	2,009	2,114	2,290	2,041	2,277	2,682	2,041	2,321	2,811
2028	2,008	2,018	2,034	2,057	2,045	2,143	2,303	2,045	2,251	2,624	2,077	2,238	2,493	2,077	2,415	3,021
2029	2,045	2,054	2,066	2,082	2,081	2,127	2,185	2,084	2,159	2,274	2,116	2,248	2,446	2,116	2,288	2,563
2030	2,081	2,091	2,103	2,118	2,118	2,169	2,235	2,120	2,173	2,243	2,152	2,411	2,858	2,154	2,416	2,868
2031	2,117	2,127	2,139	2,154	2,154	2,200	2,258	2,158	2,217	2,295	2,195	2,316	2,485	2,210	2,394	2,675
2032	2,154	2,163	2,175	2,191	2,195	2,263	2,361	2,198	2,271	2,375	2,234	2,370	2,564	2,274	2,597	3,123
2033	2,190	2,200	2,215	2,236	2,227	2,273	2,330	2,240	2,343	2,501	2,284	2,487	2,800	2,278	2,432	2,657
2034	2,226	2,236	2,248	2,263	2,263	2,309	2,367	2,310	2,578	3,030	2,319	2,510	2,805	2,307	2,424	2,585
2035	2,263	2,272	2,284	2,300	2,299	2,345	2,403	2,310	2,393	2,514	2,339	2,444	2,584	2,352	2,504	2,723
2036	2,299	2,309	2,321	2,336	2,336	2,382	2,439	2,340	2,392	2,457	2,372	2,464	2,580	2,427	2,767	3,323
2037	2,335	2,345	2,357	2,372	2,377	2,445	2,542	2,381	2,455	2,560	2,413	2,528	2,683	2,428	2,586	2,815
2038	2,372	2,381	2,393	2,409	2,408	2,454	2,512	2,413	2,465	2,530	2,445	2,537	2,653	2,460	2,600	2,798
2039	2,408	2,418	2,430	2,445	2,445	2,491	2,549	2,452	2,519	2,610	2,481	2,573	2,689	2,500	2,658	2,886
2040	2,444	2,454	2,466	2,481	2,481	2,527	2,585	2,486	2,537	2,602	2,518	2,610	2,725	2,552	2,787	3,153
2041	2,481	2,490	2,503	2,518	2,517	2,563	2,621	2,523	2,583	2,661	2,554	2,646	2,762	2,574	2,729	2,951

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

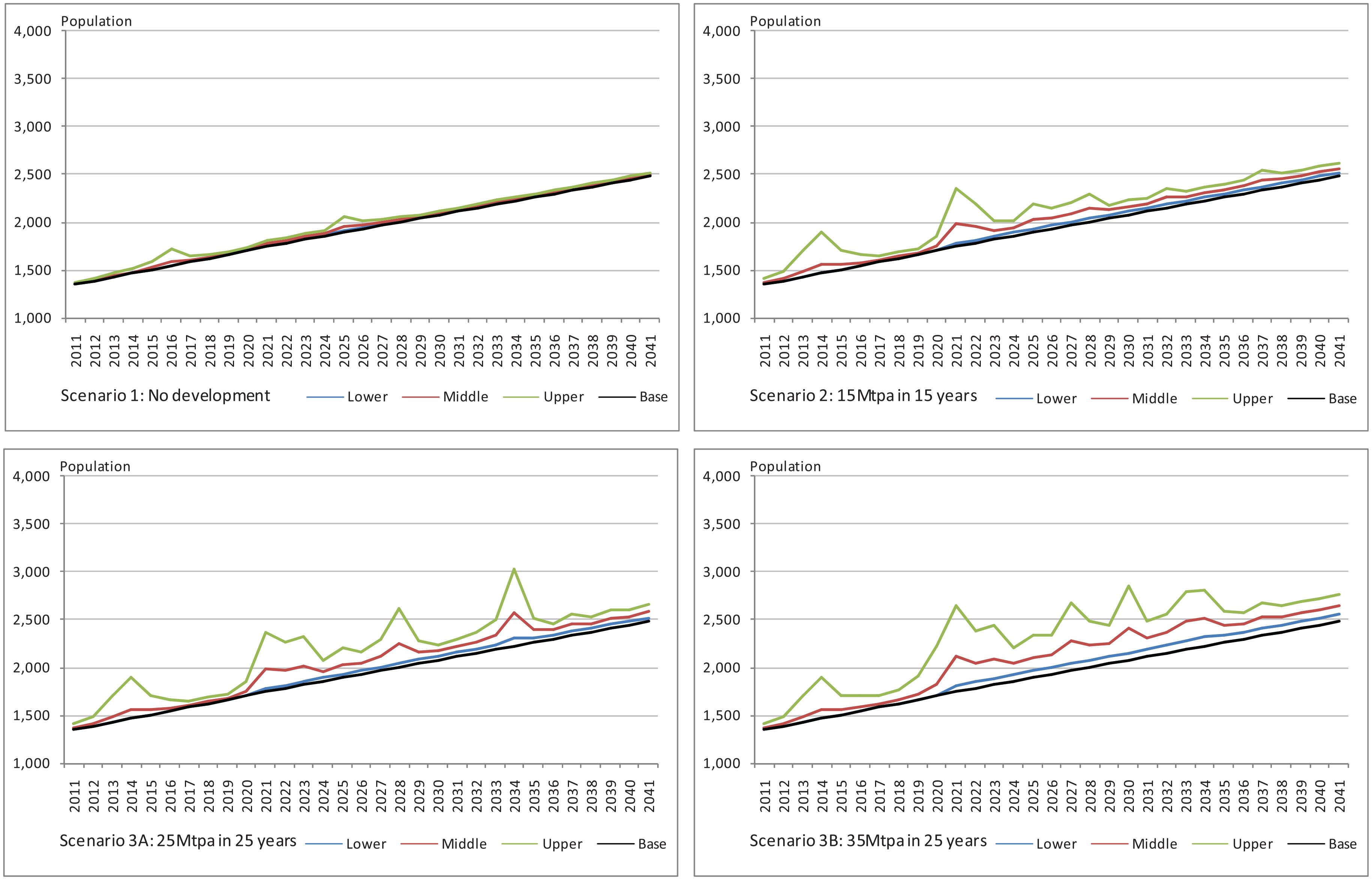
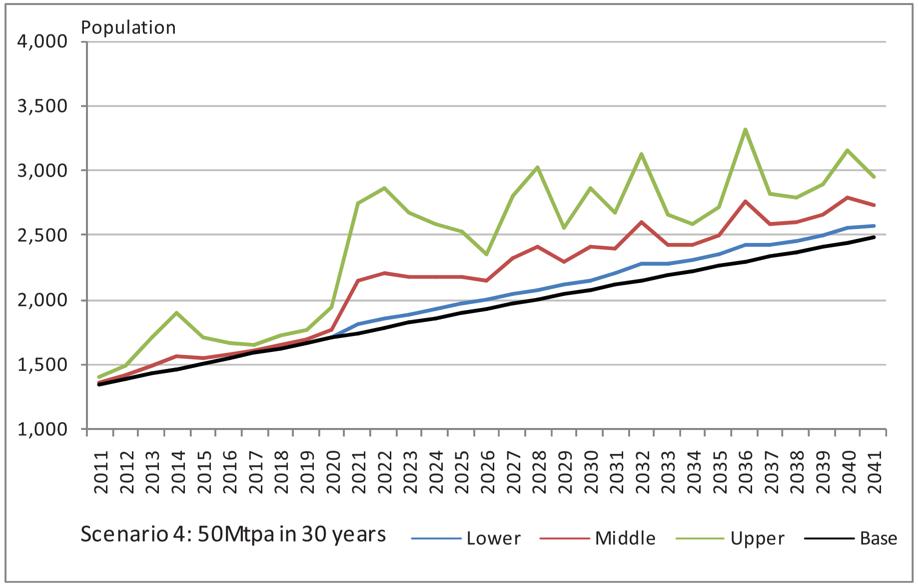


Figure 13. Population Age 55-64 years: Base population and direct and indirect construction and operational workforce families



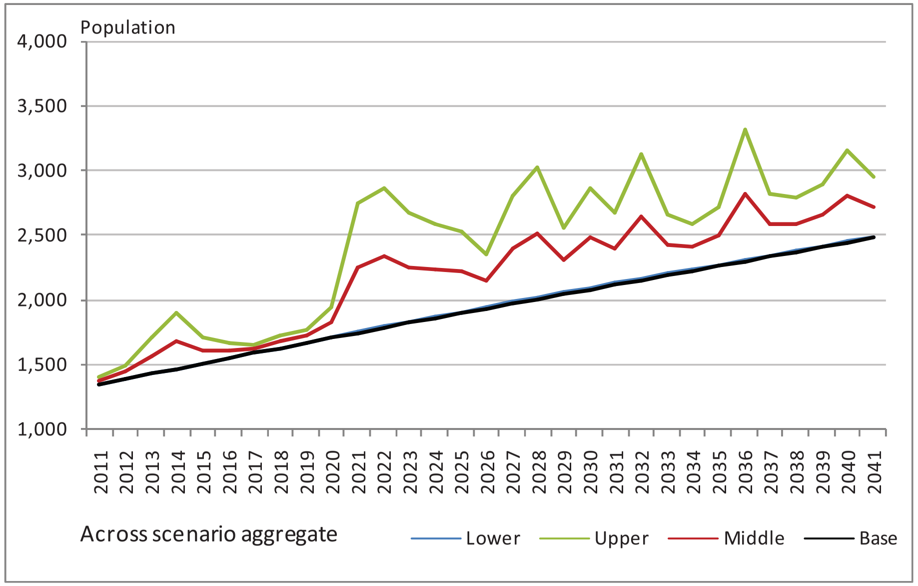


Figure 13 (cont). Population Age 55-64 years: Base population and direct and indirect construction and operational workforce families

17 AGE PROFILE (65+ YEARS OF AGE)

This table identifies the 65 plus age population of Broome using the base population and population increase from direct and indirect employees and their families.

Table 17: Population Age 65+ years: Base population and direct and indirect construction and operational workforce families

Year	Base	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Population	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	787	787	788	795	787	792	813	787	792	813	787	792	813	787	792	813
2012	810	810	812	823	810	819	856	810	819	856	810	819	856	810	819	856
2013	833	833	836	850	833	856	955	833	856	955	833	856	955	833	856	955
2014	856	856	859	875	856	892	1,044	856	892	1,044	856	892	1,044	856	892	1,044
2015	879	879	886	916	879	896	968	879	896	968	879	896	968	879	896	968
2016	902	902	916	976	902	917	960	902	917	960	902	920	978	902	917	960
2017	925	925	930	952	925	935	960	925	935	960	925	940	985	925	935	960
2018	948	948	952	965	948	958	981	948	958	981	948	965	1,018	948	962	1,000
2019	971	971	974	983	971	980	1,000	971	980	1,000	971	997	1,089	971	985	1,025
2020	994	994	997	1,006	994	1,010	1,061	994	1,011	1,065	994	1,043	1,226	994	1,018	1,102
2021	1,017	1,022	1,032	1,048	1,035	1,122	1,305	1,035	1,123	1,308	1,054	1,187	1,455	1,054	1,199	1,498
2022	1,039	1,044	1,054	1,068	1,057	1,118	1,239	1,059	1,129	1,270	1,077	1,171	1,342	1,077	1,233	1,556
2023	1,061	1,066	1,077	1,093	1,080	1,112	1,163	1,081	1,153	1,300	1,100	1,196	1,372	1,100	1,226	1,476
2024	1,083	1,089	1,098	1,112	1,103	1,131	1,170	1,103	1,139	1,197	1,122	1,183	1,275	1,122	1,232	1,443
2025	1,105	1,111	1,134	1,182	1,126	1,173	1,256	1,126	1,175	1,263	1,145	1,218	1,336	1,145	1,243	1,424
2026	1,127	1,133	1,146	1,170	1,148	1,185	1,241	1,148	1,187	1,250	1,167	1,236	1,346	1,167	1,237	1,348
2027	1,148	1,154	1,163	1,177	1,170	1,210	1,276	1,170	1,219	1,309	1,188	1,296	1,500	1,188	1,313	1,557
2028	1,169	1,175	1,184	1,196	1,191	1,237	1,320	1,191	1,279	1,462	1,209	1,288	1,421	1,209	1,357	1,656
2029	1,190	1,196	1,203	1,212	1,212	1,239	1,272	1,213	1,252	1,313	1,232	1,301	1,407	1,232	1,316	1,458
2030	1,212	1,217	1,224	1,233	1,233	1,261	1,299	1,234	1,264	1,304	1,253	1,370	1,595	1,254	1,373	1,600
2031	1,233	1,238	1,246	1,254	1,254	1,281	1,315	1,256	1,288	1,332	1,276	1,341	1,434	1,280	1,372	1,520
2032	1,254	1,260	1,267	1,276	1,276	1,312	1,365	1,278	1,316	1,373	1,298	1,369	1,474	1,307	1,457	1,723
2033	1,275	1,281	1,289	1,301	1,297	1,323	1,357	1,300	1,351	1,434	1,322	1,421	1,584	1,322	1,402	1,523
2034	1,296	1,302	1,309	1,318	1,318	1,344	1,378	1,329	1,449	1,674	1,342	1,437	1,591	1,341	1,406	1,495
2035	1,317	1,323	1,330	1,339	1,339	1,366	1,399	1,343	1,386	1,451	1,361	1,420	1,499	1,365	1,445	1,563
2036	1,339	1,344	1,351	1,360	1,360	1,387	1,420	1,363	1,393	1,431	1,381	1,435	1,502	1,395	1,553	1,835
2037	1,360	1,365	1,373	1,381	1,382	1,418	1,471	1,385	1,424	1,481	1,404	1,466	1,553	1,409	1,492	1,615
2038	1,381	1,387	1,394	1,403	1,402	1,429	1,463	1,405	1,435	1,473	1,424	1,477	1,545	1,430	1,505	1,613
2039	1,402	1,408	1,415	1,424	1,423	1,450	1,484	1,427	1,463	1,514	1,445	1,498	1,566	1,452	1,534	1,657
2040	1,423	1,429	1,436	1,445	1,445	1,471	1,505	1,447	1,477	1,515	1,466	1,520	1,587	1,476	1,591	1,780
2041	1,444	1,450	1,457	1,466	1,466	1,493	1,526	1,469	1,502	1,546	1,487	1,541	1,608	1,495	1,577	1,697

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

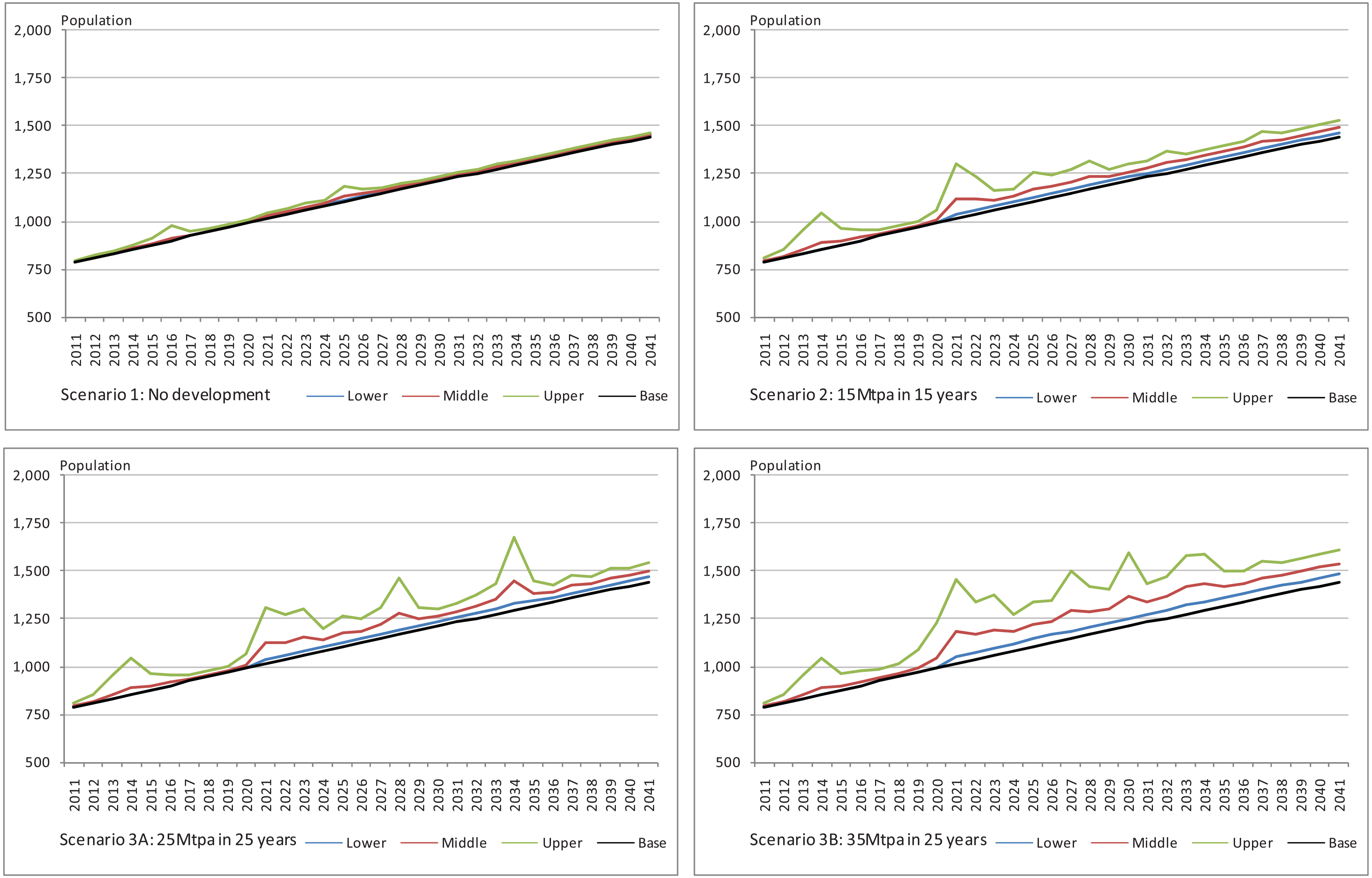
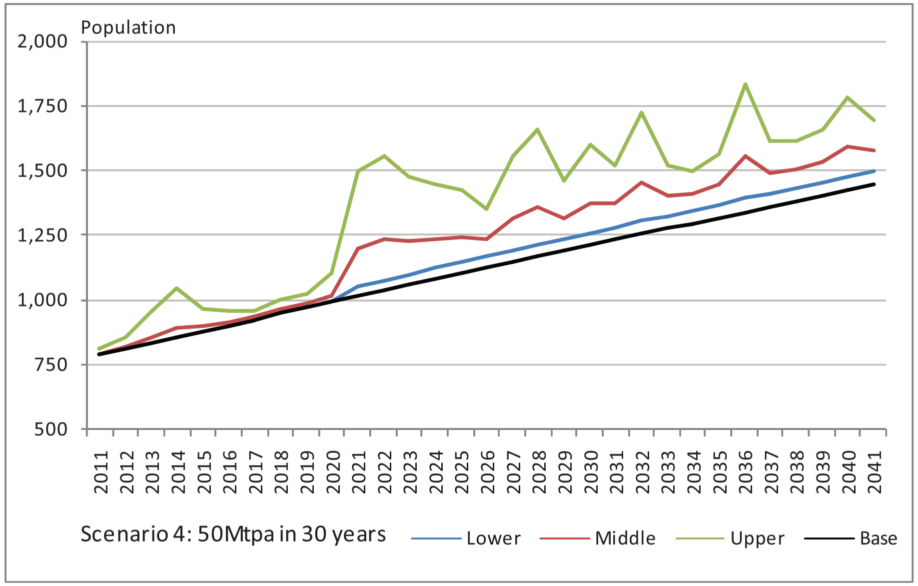


Figure 14. Population Age 65+ years: Base population and direct and indirect construction and operational workforce families



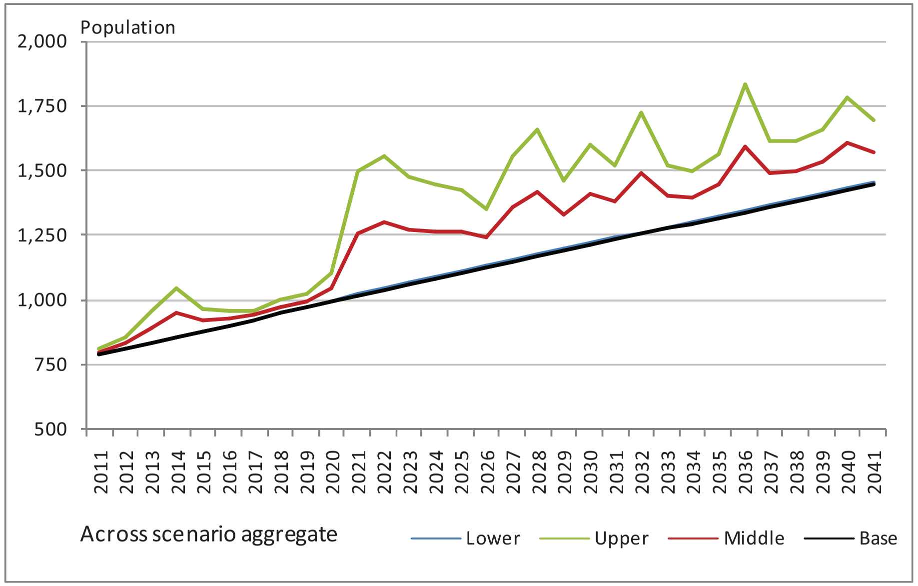


Figure 14 (cont). Population Age 65+ years: Base population and direct and indirect construction and operational workforce families

18 HOUSEHOLD EXPENDITURE

This table identifies the annual household expenditure in Broome of the base population and the base population with the direct and indirect construction and operational workforce.

Table 18: Annual household expenditure in Broome: Base population and direct and indirect construction and operational workforces (millions dollars)

Year	Base	Scenario 1			Scenario 2			Scenario 3A			Scenario 3B			Scenario 4		
	Population	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	237.3	237.3	238.2	239.6	237.3	240.3	245.1	237.3	240.3	245.1	237.3	240.3	245.1	237.3	240.3	245.1
2012	244.2	244.2	245.7	248.2	244.2	249.5	257.8	244.2	249.5	257.8	244.2	249.5	257.8	244.2	249.5	257.8
2013	251.1	251.1	253.1	256.3	251.1	265.1	286.9	251.1	265.1	286.9	251.1	265.1	286.9	251.1	265.1	286.9
2014	258.1	258.1	260.3	263.9	258.1	279.7	313.4	258.1	279.7	313.4	258.1	279.7	313.4	258.1	279.7	313.4
2015	265.0	265.0	269.3	276.0	265.0	275.3	291.3	265.0	275.3	291.3	265.0	275.3	291.3	265.0	275.3	291.3
2016	271.9	271.9	280.5	293.8	271.9	278.8	286.9	271.9	278.8	286.9	271.9	280.9	292.4	271.9	278.8	286.9
2017	278.9	278.9	282.1	287.1	278.9	283.1	287.2	278.9	283.1	287.2	278.9	285.9	294.5	278.9	283.1	287.2
2018	285.8	285.8	287.8	290.3	285.8	289.8	293.6	285.8	289.8	293.6	285.8	294.0	304.3	285.8	291.9	299.0
2019	292.7	292.7	294.3	295.9	292.7	296.2	299.2	292.7	296.2	299.2	292.7	306.4	325.3	292.7	299.1	306.5
2020	299.7	299.7	301.2	302.8	299.7	310.6	319.4	299.7	308.0	318.6	299.7	326.5	365.8	299.7	312.2	329.3
2021	306.6	310.6	312.6	313.8	319.9	358.3	384.9	319.9	358.8	385.8	333.2	386.2	422.6	333.2	393.7	435.4
2022	313.3	317.3	318.9	320.0	326.6	349.9	365.9	327.5	355.4	374.5	340.8	369.7	389.2	340.8	406.7	452.2
2023	319.9	324.0	326.1	327.5	333.2	339.7	343.8	334.2	363.4	383.6	347.5	377.8	398.3	347.5	395.7	428.7
2024	326.6	330.6	332.3	333.3	340.8	343.9	345.5	340.8	348.4	353.2	354.1	363.9	369.9	354.1	393.0	419.4
2025	333.3	337.3	347.1	353.9	348.4	361.6	370.4	348.4	362.8	372.4	361.7	377.5	387.6	361.7	392.6	413.4
2026	339.9	343.9	348.0	350.6	355.1	361.9	366.2	355.1	363.4	368.7	368.4	382.1	390.8	368.4	382.4	391.4
2027	346.3	350.3	352.0	353.0	361.5	370.6	376.5	361.5	376.3	386.3	374.8	411.3	436.1	374.8	421.2	453.0
2028	352.7	356.7	357.9	358.6	367.9	380.9	389.6	367.9	405.5	431.6	381.2	400.5	413.1	381.2	440.9	482.0
2029	359.1	363.1	363.4	363.5	374.2	375.5	375.9	375.2	382.7	387.4	388.5	400.8	408.5	388.5	409.7	423.8
2030	365.4	369.5	369.8	369.9	381.1	383.1	384.1	381.6	383.9	385.0	394.9	436.0	464.0	395.8	437.0	465.1
2031	371.8	375.9	376.2	376.3	387.0	388.3	388.6	389.0	391.9	393.4	404.8	412.4	416.9	412.4	430.1	441.6
2032	378.2	382.2	382.6	382.7	395.9	400.8	403.7	397.0	402.3	405.5	412.8	422.8	428.9	434.1	474.3	501.7
2033	384.6	388.9	389.8	390.2	399.8	401.0	401.4	406.7	416.9	423.6	426.5	447.5	461.3	422.5	434.7	442.4
2034	391.0	395.0	395.3	395.4	406.2	407.4	407.8	431.3	468.6	494.3	431.7	450.9	463.5	424.8	431.1	434.6
2035	397.4	401.4	401.7	401.8	412.5	413.8	414.2	417.9	424.4	428.4	429.2	433.9	436.2	435.6	447.1	454.2
2036	403.7	407.8	408.1	408.2	418.9	420.2	420.6	420.8	422.2	422.6	434.1	436.6	437.4	462.8	505.3	534.1
2037	410.1	414.1	414.5	414.6	427.8	432.7	435.6	429.7	434.7	437.7	442.9	449.1	452.4	449.7	461.9	469.4
2038	416.5	420.5	420.9	421.0	431.7	432.9	433.3	433.6	435.0	435.4	446.9	449.4	450.1	454.1	463.3	468.7
2039	422.9	426.9	427.2	427.3	438.1	439.3	439.7	441.6	445.4	447.6	453.2	455.7	456.5	462.4	474.5	481.9
2040	429.3	433.3	433.6	433.7	444.5	445.7	446.1	446.3	447.7	448.2	459.6	462.1	462.9	477.3	502.0	518.4
2041	435.7	439.7	440.0	440.1	450.8	452.1	452.5	453.5	456.2	457.5	466.0	468.5	469.3	475.5	486.7	493.5

Note: *Section 4.2 provides a description of the values used in the lower, middle and upper estimates for each of the scenarios.*
Source: *EBC (2009).*

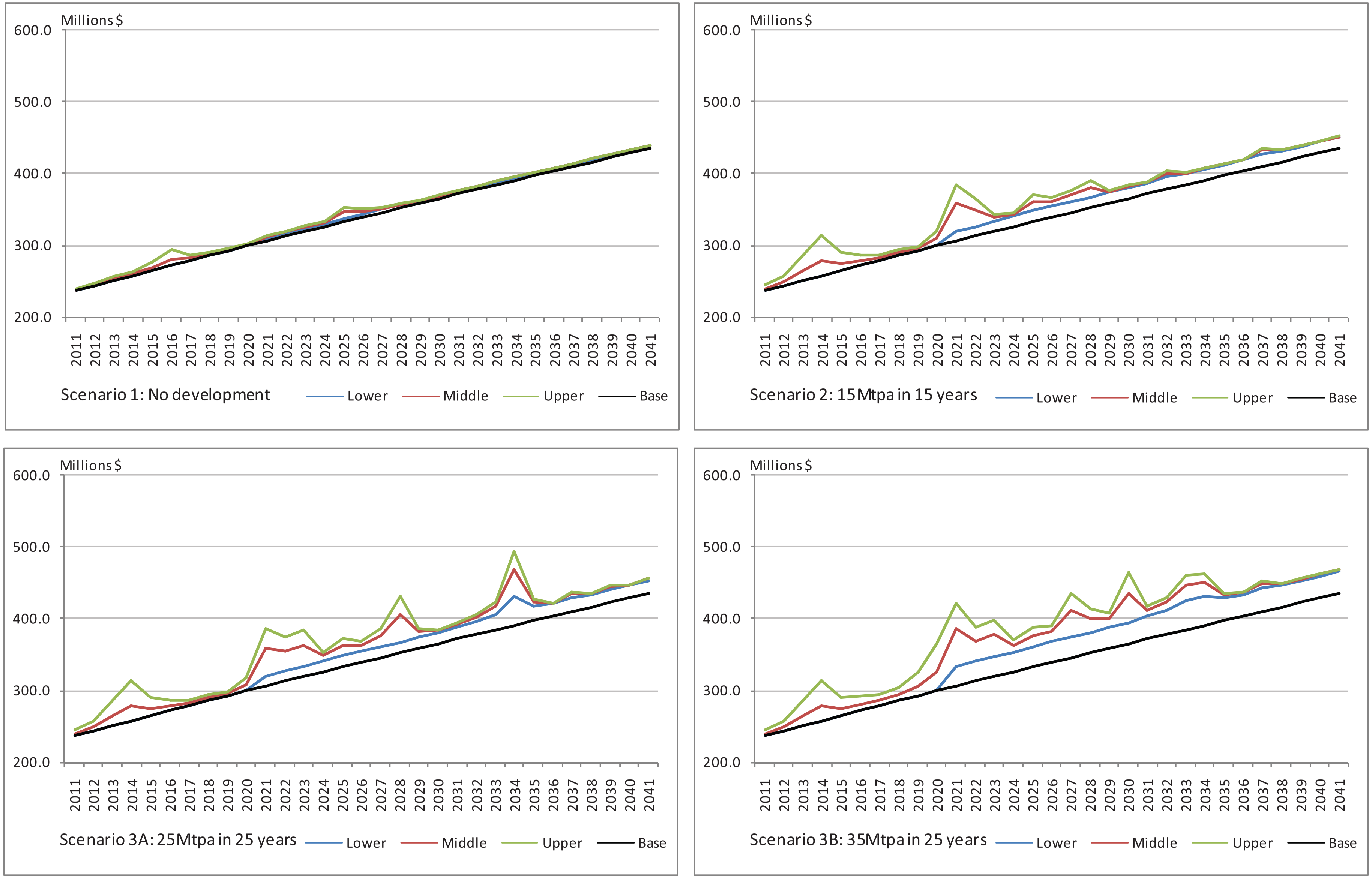


Figure 15. Annual household expenditure in Broome: Base population and direct and indirect construction and operational workforces (millions dollars)

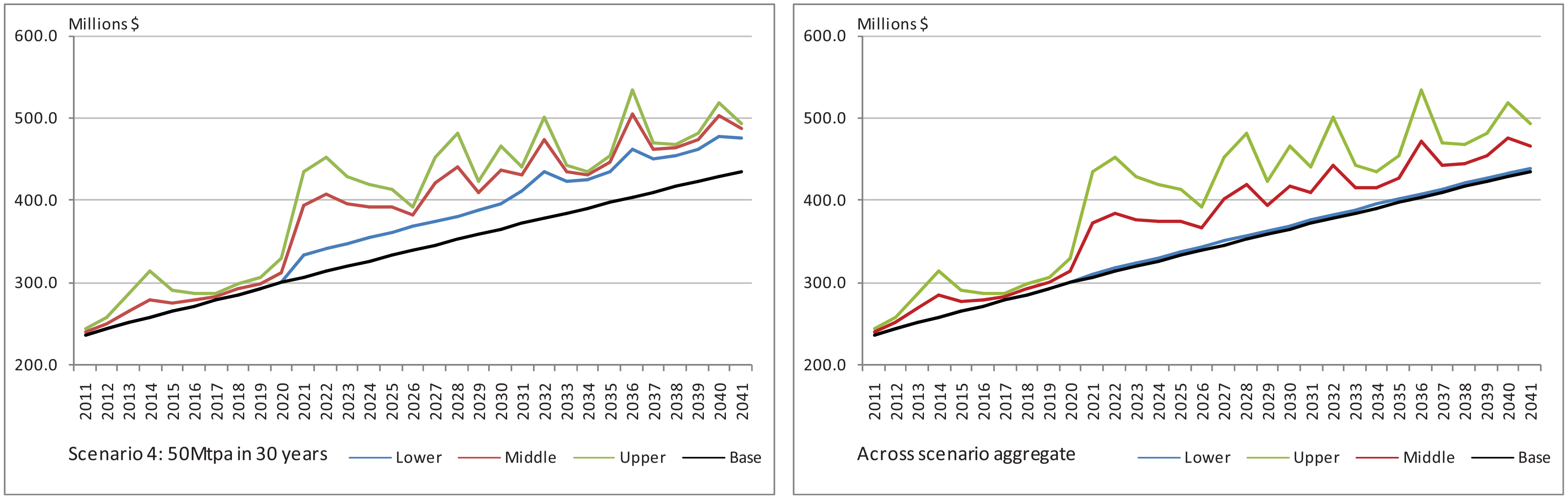


Figure 15 (cont). Annual household expenditure in Broome: Base population and direct and indirect construction and operational workforces (millions dollars)

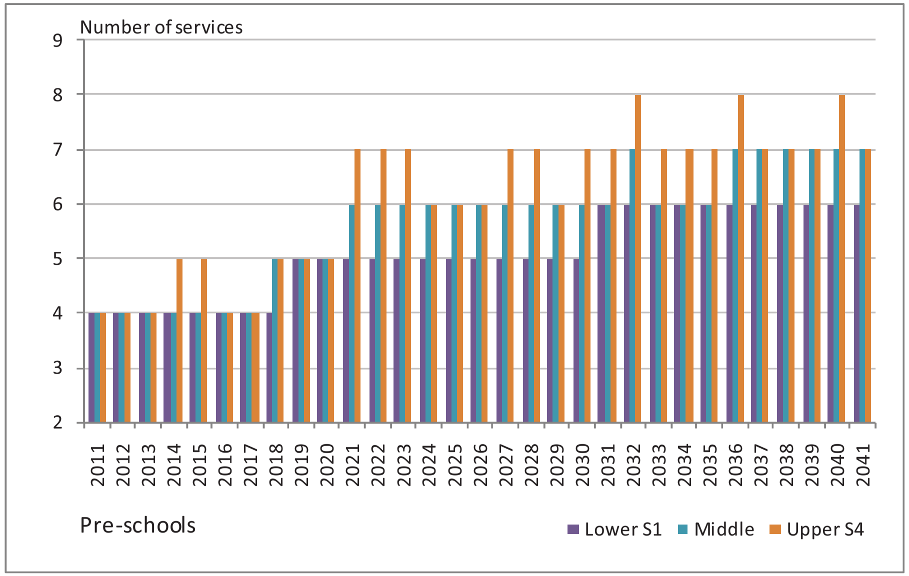
19 SERVICE RATIOS: EDUCATION

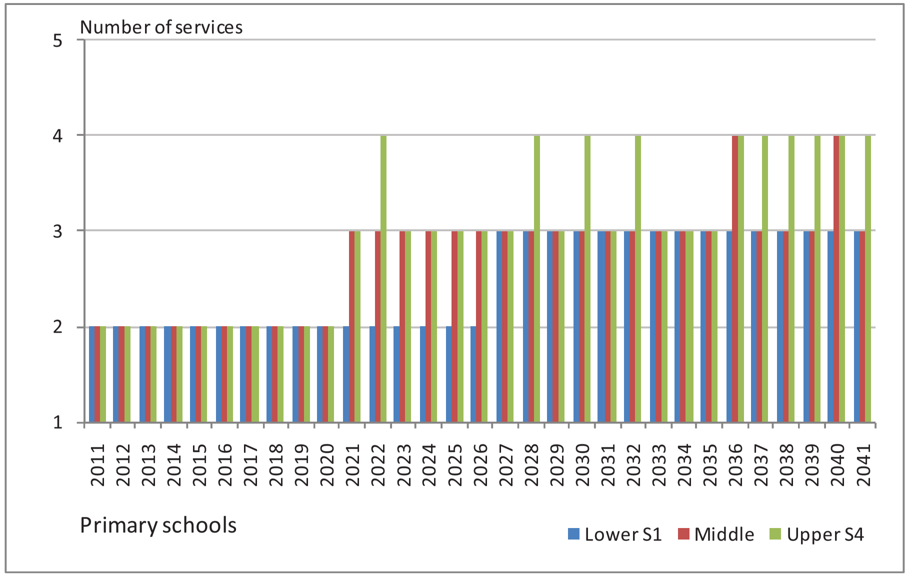
Using only population services ratios, this table identifies the number of education services required for the direct and indirect workforces in Broome. The table is indicative only as many other factors other than population size will also determine social infrastructure provision.

Table 19: Service ratios: Educational services

Year	Pre-schools			Primary schools			High schools		
	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	4	4	4	2	2	2	1	1	1
2012	4	4	4	2	2	2	1	1	1
2013	4	4	4	2	2	2	1	1	1
2014	4	4	5	2	2	2	1	1	1
2015	4	4	5	2	2	2	1	1	1
2016	4	4	4	2	2	2	1	1	1
2017	4	4	4	2	2	2	1	1	1
2018	4	5	5	2	2	2	1	1	1
2019	5	5	5	2	2	2	1	1	1
2020	5	5	5	2	2	2	1	1	1
2021	5	6	7	2	3	3	1	1	2
2022	5	6	7	2	3	4	1	1	2
2023	5	6	7	2	3	3	1	1	2
2024	5	6	6	2	3	3	1	1	2
2025	5	6	6	2	3	3	1	1	2
2026	5	6	6	2	3	3	1	1	1
2027	5	6	7	3	3	3	1	1	2
2028	5	6	7	3	3	4	1	2	2
2029	5	6	6	3	3	3	1	1	2
2030	5	6	7	3	3	4	1	2	2
2031	6	6	7	3	3	3	1	2	2
2032	6	7	8	3	3	4	1	2	2
2033	6	6	7	3	3	3	1	2	2
2034	6	6	7	3	3	3	1	2	2
2035	6	6	7	3	3	3	1	2	2
2036	6	7	8	3	4	4	1	2	2
2037	6	7	7	3	3	4	1	2	2
2038	6	7	7	3	3	4	2	2	2
2039	6	7	7	3	3	4	2	2	2
2040	6	7	8	3	4	4	2	2	2
2041	6	7	7	3	3	4	2	2	2

Note: *The sensitivity analysis for service ratios is based on the values across all five scenarios. The lower estimate is based on the lower estimate for scenario 1 and an upper estimate is based on the upper estimate for scenario 4. The middle estimate is the value equidistant from the lower and upper estimates Surce:EBC (2009).*





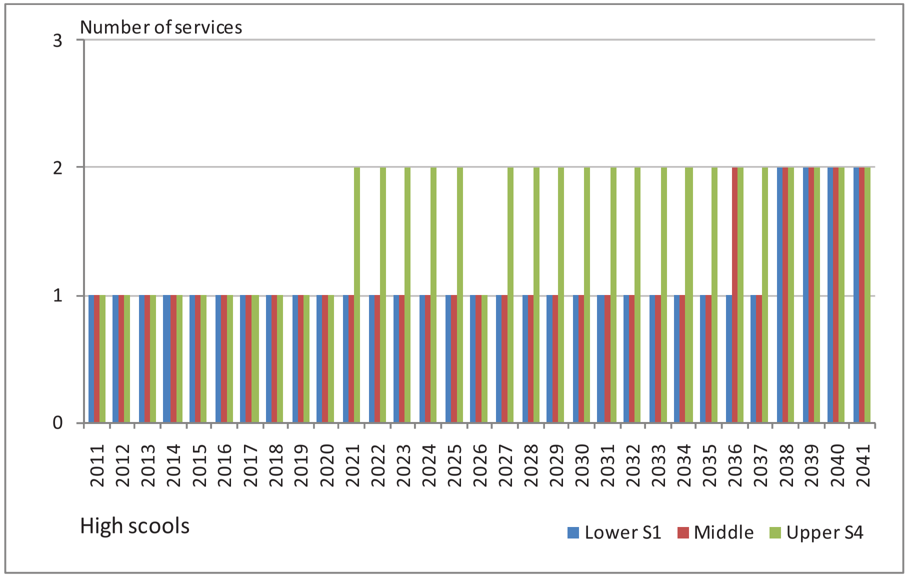


Figure 16. Service ratios and the provision of educational services

20 SERVICE RATIOS: HEALTH SERVICES

Using only population services ratios, this table identifies the number of health services required for the direct and indirect workforces in Broome. The table is indicative only as many other factors other than population size will also determine social infrastructure provision.

Table 20: Service ratios: Health services

Year	Medical doctors			Dentists			Hospital beds			Local community health centres			Neighbourhood health centres		
	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	17	17	18	1	1	1	82	84	85	6	6	6	2	2	2
2012	17	18	19	1	1	1	84	87	90	6	6	6	2	2	2
2013	18	19	21	1	1	1	87	94	102	6	7	7	2	2	2
2014	18	21	23	1	1	1	89	101	112	6	7	8	2	2	2
2015	19	20	21	1	1	1	92	97	103	6	7	7	2	2	2
2016	19	20	21	1	1	1	94	97	101	7	7	7	2	2	2
2017	20	20	21	1	1	1	96	98	100	7	7	7	2	2	2
2018	20	21	22	1	1	1	99	102	105	7	7	7	2	2	2
2019	21	21	22	1	1	1	101	104	107	7	7	7	2	2	2
2020	21	23	24	1	1	1	104	110	116	7	8	8	2	2	2
2021	22	28	33	1	1	2	107	134	162	7	9	11	2	3	3
2022	22	29	35	1	1	2	109	139	169	8	10	12	2	3	4
2023	23	28	33	1	1	2	111	135	159	8	9	11	2	3	3
2024	23	28	32	1	1	1	114	134	154	8	9	11	2	3	3
2025	24	28	31	1	1	1	116	134	151	8	9	11	2	3	3
2026	24	27	29	1	1	1	118	130	142	8	9	10	2	3	3
2027	25	30	34	1	1	2	120	144	167	8	10	12	3	3	3
2028	25	31	37	1	1	2	123	151	178	9	10	12	3	3	4
2029	26	29	32	1	1	1	125	139	154	9	10	11	3	3	3
2030	26	31	35	1	1	2	127	149	171	9	10	12	3	3	4
2031	27	30	33	1	1	2	129	145	161	9	10	11	3	3	3
2032	27	33	38	1	1	2	131	158	185	9	11	13	3	3	4
2033	28	30	33	1	1	2	134	147	160	9	10	11	3	3	3
2034	28	30	32	1	1	1	136	146	157	9	10	11	3	3	3
2035	28	31	34	1	1	2	138	151	164	10	11	11	3	3	3
2036	29	35	41	1	2	2	140	169	197	10	12	14	3	4	4
2037	29	32	35	1	1	2	142	156	170	10	11	12	3	3	4
2038	30	32	35	1	1	2	145	157	169	10	11	12	3	3	4
2039	30	33	36	1	2	2	147	161	174	10	11	12	3	3	4
2040	31	35	39	1	2	2	149	169	189	10	12	13	3	4	4
2041	31	34	37	1	2	2	151	165	178	11	11	12	3	3	4

Note: *The sensitivity analysis for service ratios is based on the values across all five scenarios. The lower estimate is based on the lower estimate for scenario 1 and an upper estimate is based on the upper estimate for scenario 4. The middle estimate is the value equidistant from the lower and upper estimates. Source: EBC (2009).*

Table 20 (continued) Service ratios: Health services

Year	District community health centres			Nursing home (Number of beds)			Ambulance officers			Disabled respite centres			Aged respite centres		
	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	1	1	1	31	32	33	7	7	7	0	0	0	0	0	0
2012	1	1	1	32	33	34	7	7	8	0	0	0	0	0	0
2013	1	1	1	33	36	38	7	8	9	0	0	0	0	0	0
2014	1	1	1	34	38	42	8	9	10	0	0	0	0	0	0
2015	1	1	1	35	37	39	8	8	9	0	0	0	0	0	0
2016	1	1	1	36	37	38	8	8	9	0	0	0	0	0	0
2017	1	1	1	37	38	38	8	8	9	0	0	0	0	0	0
2018	1	1	1	38	39	40	8	9	9	0	0	0	0	0	0
2019	1	1	1	39	40	41	9	9	9	0	0	0	0	0	0
2020	1	1	1	40	42	44	9	9	10	0	0	0	0	0	0
2021	1	1	1	41	50	60	9	11	14	0	1	1	0	1	1
2022	1	1	1	42	52	62	9	12	14	0	1	1	0	1	1
2023	1	1	1	43	51	59	10	12	14	0	1	1	0	1	1
2024	1	1	1	44	51	58	10	11	13	0	1	1	0	1	1
2025	1	1	1	44	51	57	10	11	13	0	1	1	0	1	1
2026	1	1	1	45	50	54	10	11	12	0	1	1	0	1	1
2027	1	1	1	46	54	62	10	12	14	1	1	1	1	1	1
2028	1	1	1	47	57	66	10	13	15	1	1	1	1	1	1
2029	1	1	1	48	53	58	11	12	13	1	1	1	1	1	1
2030	1	1	1	49	56	64	11	13	15	1	1	1	1	1	1
2031	1	1	1	50	55	61	11	12	14	1	1	1	1	1	1
2032	1	1	1	50	60	69	11	14	16	1	1	1	1	1	1
2033	1	1	1	51	56	61	11	13	14	1	1	1	1	1	1
2034	1	1	1	52	56	60	12	12	13	1	1	1	1	1	1
2035	1	1	1	53	58	63	12	13	14	1	1	1	1	1	1
2036	1	1	1	54	64	73	12	14	17	1	1	1	1	1	1
2037	1	1	1	55	60	65	12	13	15	1	1	1	1	1	1
2038	1	1	1	55	60	65	12	13	14	1	1	1	1	1	1
2039	1	1	1	56	61	66	13	14	15	1	1	1	1	1	1
2040	1	1	1	57	64	71	13	14	16	1	1	1	1	1	1
2041	1	1	1	58	63	68	13	14	15	1	1	1	1	1	1

Note: *The sensitivity analysis for service ratios is based on the values across all five scenarios. The lower estimate is based on the lower estimate for scenario 1 and an upper estimate is based on the upper estimate for scenario 4. The middle estimate is the value equidistant from the lower and upper estimates*

Source: *EBC (2009).*

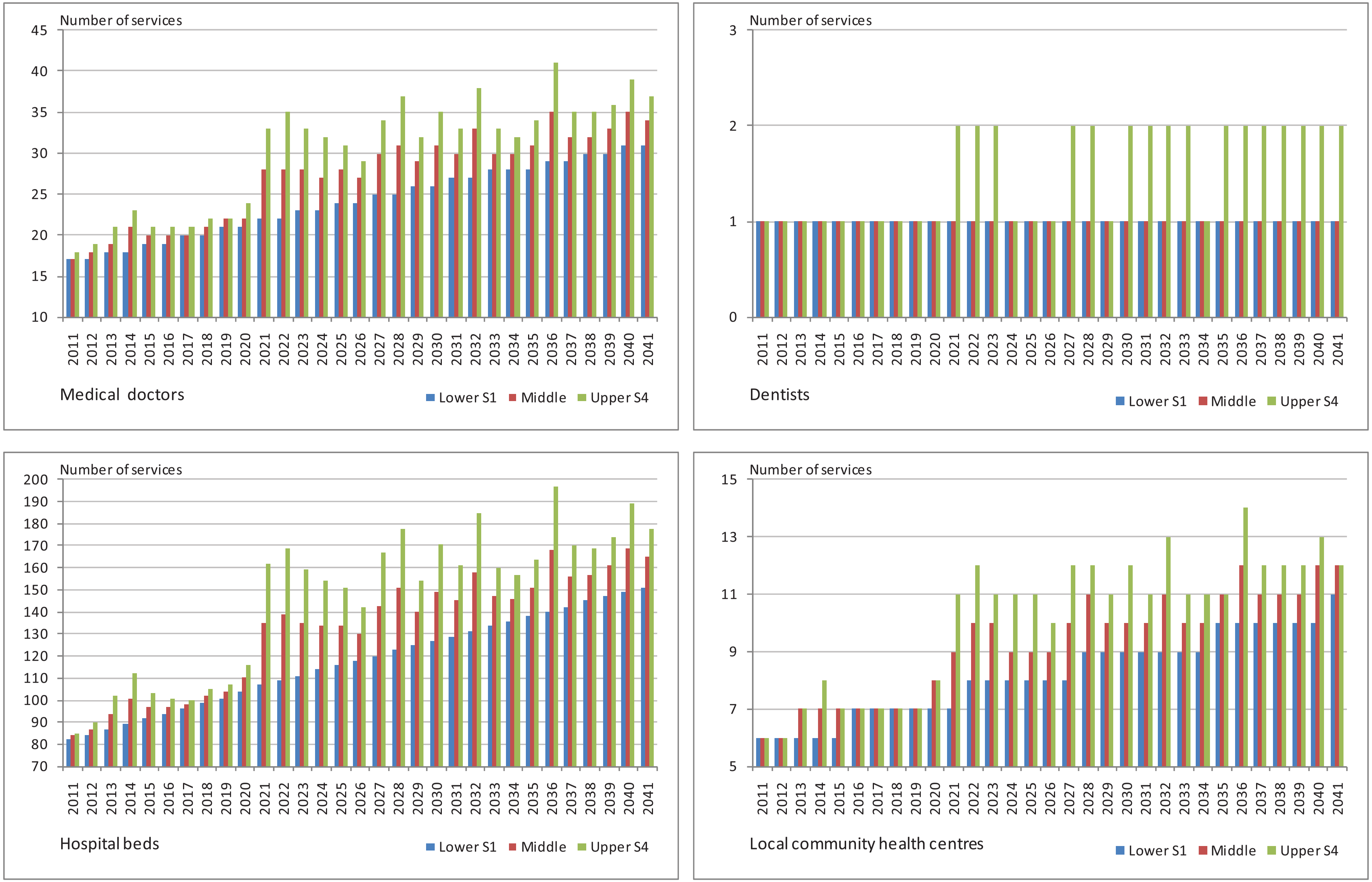


Figure 17. Service ratios and the provision of health services

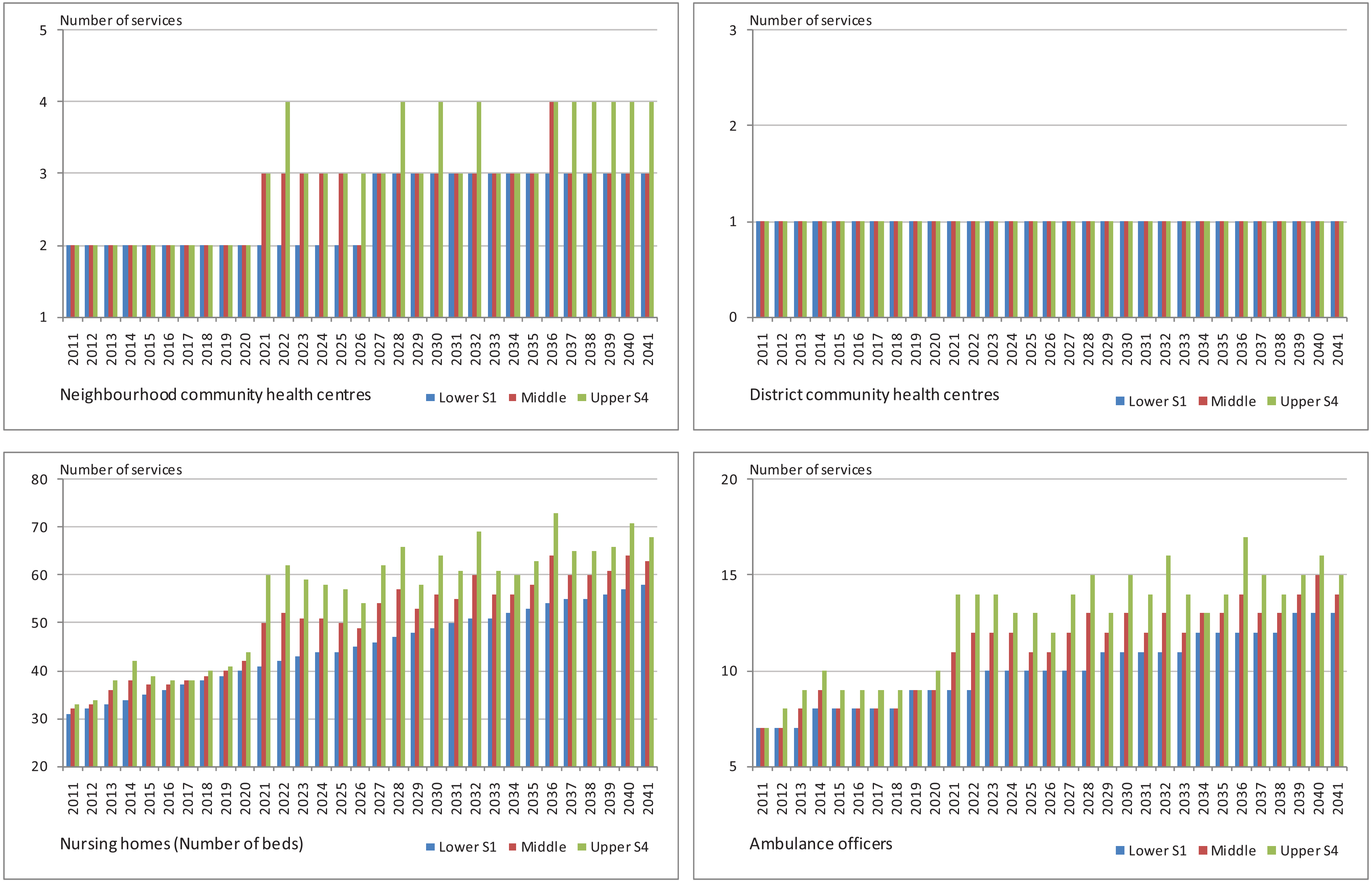
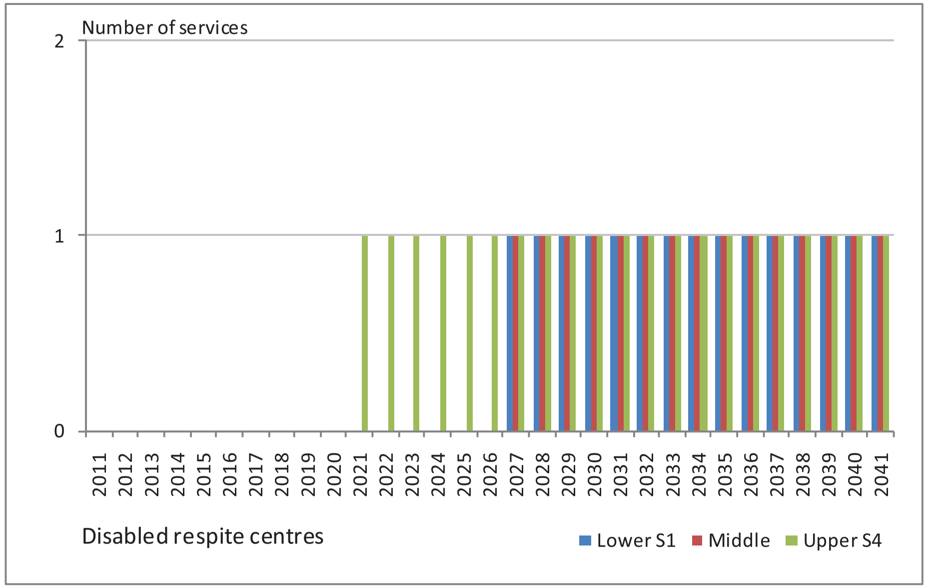


Figure 17 (cont). Service ratios and the provision of health services



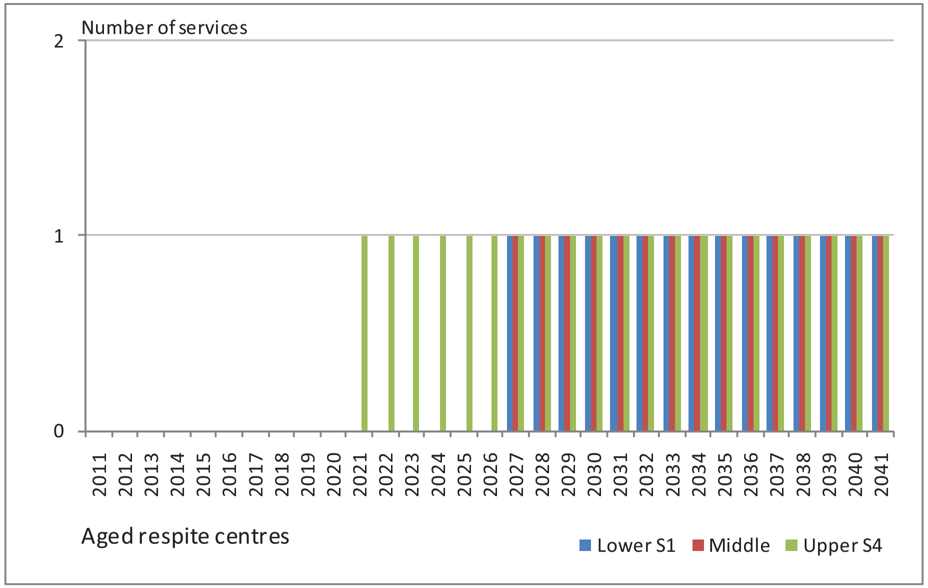


Figure 17 (cont). Service ratios and the provision of health services

21 SERVICE RATIOS: COMMUNITY SERVICES

Using only population services ratios, this table identifies the number of community services required for the direct and indirect workforces in Broome. The table is indicative only as many other factors other than population size will also determine social infrastructure provision.

Table 21. Service ratios: Community services

Year	Public libraries			Museums			Youth centres			Community halls			Senior Citizens centres		
	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	1	1	1	0	0	0	1	1	1	2	2	2	1	1	1
2012	1	1	1	0	0	0	1	1	1	2	2	2	1	1	1
2013	1	1	1	0	0	0	1	1	1	2	2	2	1	1	1
2014	1	1	1	0	0	0	1	1	1	2	2	2	1	1	1
2015	1	1	1	0	0	0	1	1	1	2	2	2	1	1	1
2016	1	1	1	0	0	0	1	1	1	2	2	2	1	1	1
2017	1	1	1	0	0	0	1	1	1	2	2	2	1	1	1
2018	1	1	1	0	0	0	1	1	1	2	2	2	1	1	1
2019	1	1	1	0	0	0	1	1	1	2	2	2	1	1	1
2020	1	1	1	0	0	0	1	1	1	2	2	2	1	1	1
2021	1	1	1	0	0	0	1	1	1	2	3	3	1	1	1
2022	1	1	1	0	0	0	1	1	1	2	3	4	1	1	1
2023	1	1	1	0	0	0	1	1	1	2	3	3	1	1	1
2024	1	1	1	0	0	0	1	1	1	2	3	3	1	1	1
2025	1	1	1	0	0	0	1	1	1	2	3	3	1	1	1
2026	1	1	1	0	0	0	1	1	1	2	3	3	1	1	1
2027	1	1	1	0	0	0	1	1	1	3	3	3	1	1	1
2028	1	1	1	0	0	0	1	1	1	3	3	4	1	1	1
2029	1	1	1	0	0	0	1	1	1	3	3	3	1	1	1
2030	1	1	1	0	0	0	1	1	1	3	3	4	1	1	1
2031	1	1	1	0	0	0	1	1	1	3	3	3	1	1	1
2032	1	1	1	0	0	1	1	1	1	3	3	4	1	1	2
2033	1	1	1	0	0	0	1	1	1	3	3	3	1	1	1
2034	1	1	1	0	0	0	1	1	1	3	3	3	1	1	1
2035	1	1	1	0	0	0	1	1	1	3	3	3	1	1	1
2036	1	1	1	0	0	1	1	1	1	3	4	4	1	1	2
2037	1	1	1	0	0	0	1	1	1	3	3	4	1	1	1
2038	1	1	1	0	0	0	1	1	1	3	3	4	1	1	1
2039	1	1	1	0	0	0	1	1	1	3	3	4	1	1	1
2040	1	1	1	0	0	1	1	1	1	3	4	4	1	1	2
2041	1	1	1	0	0	0	1	1	1	3	3	4	1	1	1

Note: The sensitivity analysis for service ratios is based on the values across all five scenarios. The lower estimate is based on the lower estimate for scenario 1 and an upper estimate is based on the upper estimate for scenario 4. The middle estimate is the value equidistant from the lower and upper estimates Source: EBC (2009).

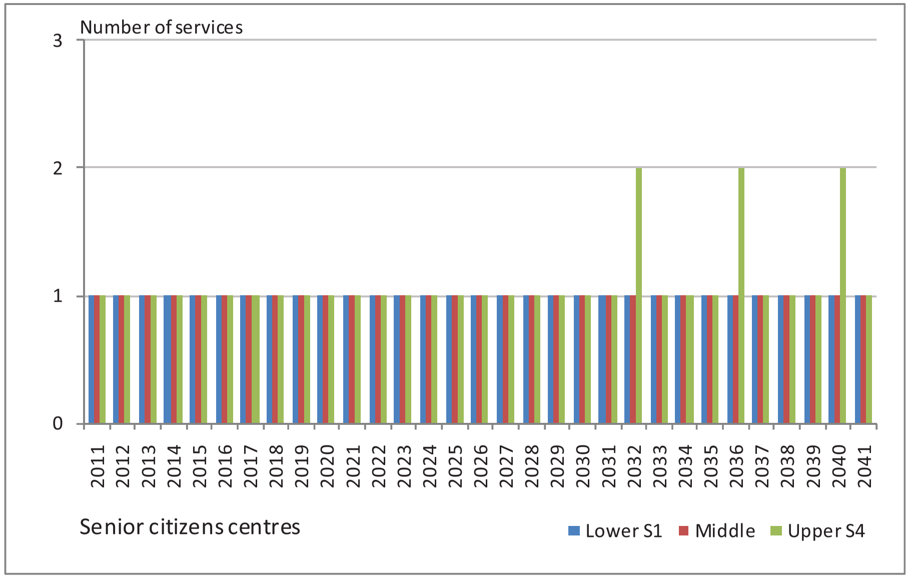
Table 21 (Continued). Service ratios: Community services

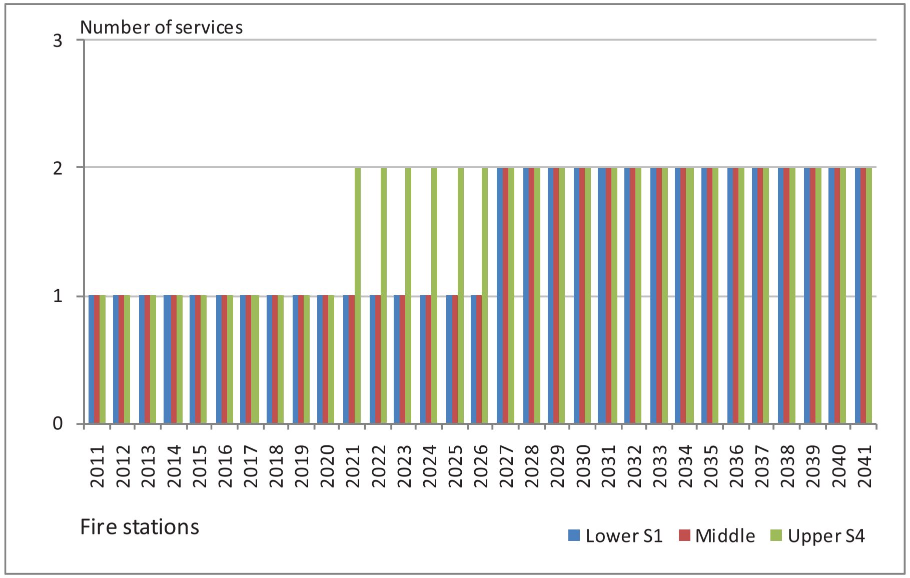
Year	Fire stations			Sworn police officers		
	Lower	Middle	Upper	Lower	Middle	Upper
2011	1	1	1	42	43	44
2012	1	1	1	43	45	46
2013	1	1	1	44	48	52
2014	1	1	1	46	51	57
2015	1	1	1	47	50	52
2016	1	1	1	48	50	51
2017	1	1	1	49	50	51
2018	1	1	1	50	52	54
2019	1	1	1	52	53	55
2020	1	1	1	53	56	59
2021	1	2	2	54	69	83
2022	1	2	2	56	71	86
2023	1	2	2	57	69	81
2024	1	2	2	58	68	79
2025	1	2	2	59	68	77
2026	1	2	2	60	66	72
2027	2	2	2	61	73	85
2028	2	2	2	63	77	91
2029	2	2	2	64	71	79
2030	2	2	2	65	76	87
2031	2	2	2	66	74	82
2032	2	2	2	67	81	94
2033	2	2	2	68	75	82
2034	2	2	2	69	75	80
2035	2	2	2	70	77	84
2036	2	2	2	72	86	101
2037	2	2	2	73	80	87
2038	2	2	2	74	80	86
2039	2	2	2	75	82	89
2040	2	2	2	76	86	96
2041	2	2	2	77	84	91

Note: *The sensitivity analysis for service ratios is based on the values across all five scenarios. The lower estimate is based on the lower estimate for scenario 1 and an upper estimate is based on the upper estimate for scenario 4. The middle estimate is the value equidistant from the lower and upper estimates*

Source: *EBC (2009).*

Figure 18. Service ratios and the provision of community services





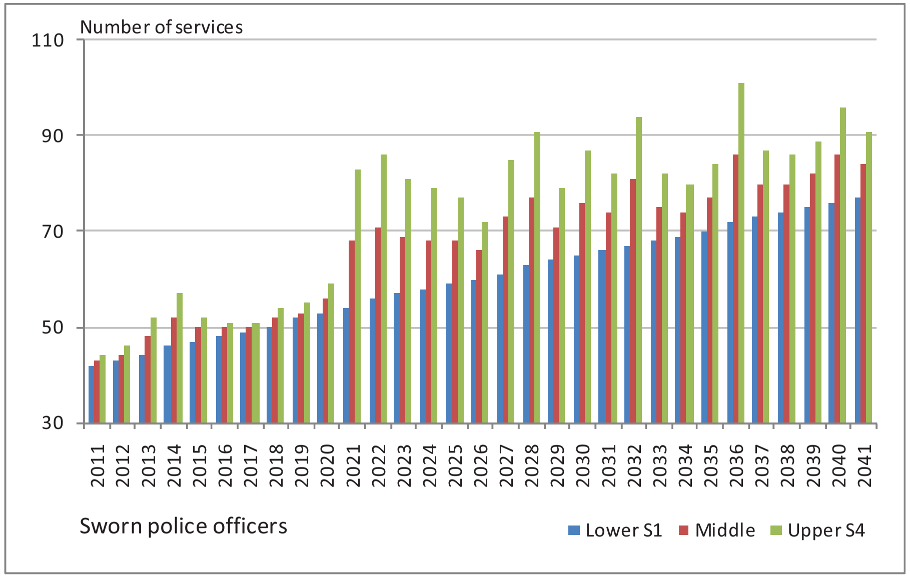


Figure 18 (cont). Service ratios and the provision of community services

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22 SERVICE RATIOS: HOUSEHOLD ENERGY AND WASTE

This table identifies the estimated household waste and energy consumption for direct and indirect employee households in Broome.

Table 22. Service ratios: Household energy and waste

	Waste (Tonnes)			Electricity use (Megawatts)			Water use (Megalitres)			Waste water (Megalitres)		
Year	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
2011	4,548	4,603	4,658	58,479	59,188	59,897	2.76	2.79	2.82	1.32	1.33	1.35
2012	4,681	4,776	4,872	60,189	61,421	62,652	2.84	2.89	2.95	1.35	1.38	1.41
2013	4,814	5,066	5,318	61,899	65,140	68,381	2.92	3.07	3.22	1.39	1.47	1.54
2014	4,947	5,336	5,726	63,609	68,618	73,627	3.00	3.23	3.47	1.43	1.54	1.66
2015	5,080	5,264	5,449	65,319	67,695	70,070	3.08	3.19	3.30	1.47	1.52	1.58
2016	5,212	5,319	5,426	67,029	68,399	69,770	3.16	3.22	3.29	1.51	1.54	1.57
2017	5,345	5,405	5,464	68,739	69,502	70,266	3.24	3.28	3.31	1.55	1.56	1.58
2018	5,478	5,573	5,667	70,449	71,661	72,873	3.32	3.38	3.43	1.58	1.60	1.62
2019	5,611	5,709	5,807	72,159	73,415	74,671	3.40	3.46	3.52	1.62	1.64	1.65
2020	5,744	5,954	6,164	73,869	76,566	79,264	3.48	3.61	3.74	1.66	1.70	1.74
2021	5,922	6,812	7,702	76,153	87,600	99,047	3.59	4.13	4.67	1.71	1.87	2.02
2022	6,050	7,012	7,973	77,795	90,163	102,532	3.67	4.25	4.83	1.75	1.85	1.95
2023	6,177	6,927	7,677	79,436	89,082	98,728	3.74	4.20	4.65	1.79	1.83	1.87
2024	6,305	6,943	7,580	81,078	89,277	97,476	3.82	4.21	4.59	1.82	1.86	1.89
2025	6,433	6,981	7,530	82,719	89,773	96,827	3.90	4.23	4.56	1.86	1.93	2.00
2026	6,560	6,907	7,254	84,361	88,821	93,281	3.98	4.19	4.40	1.90	1.95	1.99
2027	6,683	7,418	8,153	85,934	95,388	104,843	4.05	4.50	4.94	1.93	1.99	2.05
2028	6,805	7,700	8,595	87,507	99,015	110,522	4.12	4.67	5.21	1.97	2.04	2.11
2029	6,927	7,368	7,808	89,080	94,742	100,404	4.20	4.47	4.73	2.00	2.03	2.06
2030	7,050	7,736	8,422	90,653	99,476	108,299	4.27	4.69	5.10	2.04	2.07	2.10
2031	7,172	7,648	8,125	92,226	98,351	104,476	4.35	4.64	4.92	2.07	2.10	2.13
2032	7,294	8,148	9,002	93,799	104,780	115,760	4.42	4.94	5.46	2.11	2.16	2.20
2033	7,420	7,810	8,201	95,416	100,436	105,456	4.50	4.73	4.97	2.15	2.17	2.20
2034	7,539	7,831	8,124	96,946	100,705	104,464	4.57	4.75	4.92	2.18	2.21	2.24
2035	7,661	8,047	8,432	98,519	103,477	108,435	4.64	4.88	5.11	2.22	2.24	2.27
2036	7,784	8,686	9,589	100,092	111,702	123,313	4.72	5.26	5.81	2.25	2.28	2.31
2037	7,906	8,309	8,712	101,665	106,850	112,034	4.79	5.04	5.28	2.29	2.33	2.38
2038	8,028	8,382	8,735	103,238	107,785	112,332	4.87	5.08	5.29	2.32	2.35	2.38
2039	8,151	8,552	8,954	104,811	109,976	115,140	4.94	5.18	5.43	2.36	2.39	2.42
2040	8,273	8,886	9,499	106,384	114,266	122,147	5.01	5.39	5.76	2.39	2.42	2.45
2041	8,395	8,789	9,182	107,958	113,018	118,079	5.09	5.33	5.57	2.43	2.46	2.49

Note: *The sensitivity analysis for service ratios is based on the values across all five scenarios. The lower estimate is based on the lower estimate for scenario 1 and an upper estimate is based on the upper estimate for scenario 4. The middle estimate is the value equidistant from the lower and upper estimates Source: EBC (2009).*

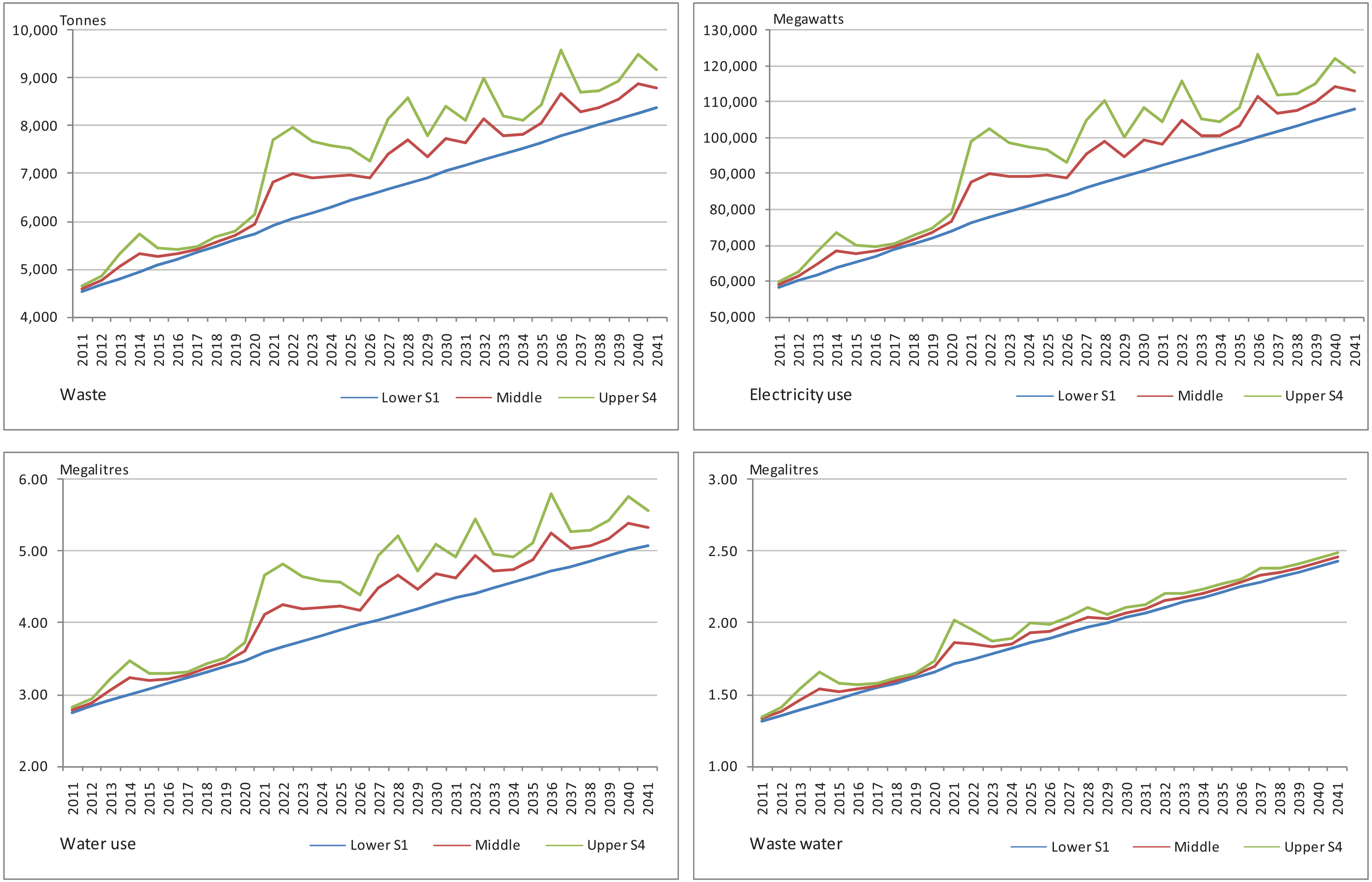

Figure 19. Household energy and waste

Appendix D

August 2009. Social Impact Assessment Workshop: Infrastructure

Kimberley LNG Project

Social Impact Assessment Workshop: INFRASTRUCTURE

WORKSHOP NOTES

Date: Thursday 6 August 2009
Time: 8:45am – 3:00pm
Venue: Department of State Development - Broome Office
Woody's Arcade, Dampier Terrace

Facilitator: Duncan Ord, Executive Director, Kimberley LNG Project, DSD

Registration/Tea&Coffee	**0845-0915**
Welcome: Duncan Ord	**0915-0930**
Presentations	**0930-1045**

- KLNG Project Summary — Gary Simmons
- Woodside – Proponent Perspective — Alec Cumming
- KLNG Social Impact Assessment — Andrea Jardine-Orr

Morning Tea	**1045-1100**
DISCUSSION	**1100-1500**

Introduction

- The impact assessment process was explained and participants received photocopies of excerpts from the *Kimberley LNG Precinct – Scope of the Strategic Assessment* relating to infrastructure.

- Discussion included explanation of impact assessment as an iterative process, sources of impact, environmental factors and risk rating.

- It was emphasised that this Workshop aimed to identify and fill-in gaps relating to infrastructure issues.

- The Department of Planning is conducting an infrastructure audit and assessment.

- The Workshop discussed the following infrastructure issues:

  1) Airport
  2) Roads
  3) Waste Management
  4) Ports
  5) Water
  6) Electricity
  7) Telecommunications

1) AIRPORT

Broome International Airport Issues

- Last year, Broome airport catered for 400,000 passengers, which was a 7% increase on the previous year. This year there has been a 9% increase in passengers. These increases can be attributed to both tourism and the oil and gas industry.
- The Broome Airport is experiencing tourism growth but it also needs a mix with corporate travel to support it.
- Qantas has three services per day and Virgin has two services per day.
- There is the possibility of Broome Airport servicing flights from Singapore in the future. One view was that this would require support from corporate travellers in addition to tourists.
- A heliport with two hangars services the oil and gas industry.
- The Broome Airport is sensitive to community concerns and there is a noise management plan and an active group with Broome Shire and community representation.
- Surveys conducted about the Broome Airport suggest that people like its current location.
- The current runway has significant capacity and there is capacity for a code three runway.
- The Workshop discussed the capacity of Broome Airport to cope with a potential increase in demand for parking. There were divergent views. Unlike Karratha, workers are more likely to be bussed to the LNG precinct, therefore reducing the potential number of vehicles.
- There is a Master Plan for the Broome Airport until 2025 including upgrading of the terminal, taxiways, noise management plan and parking.
- The Airport Master Plan is being considered by the Broome Shire over the next three months.
- The Airport Master Plan can be updated to take into account expansion planning for James Price Point precinct needs.
- The new Broome Airport site is 13 kilometres from the Broome town. Moving of the Broome Airport would be undertaken in stages.
- The new airport will require a review of past environmental approvals.
- Some stakeholders suggested that a lead time of 4-5 years would be required for the relocation of Airport.
- Aircraft fuel is transported from the storage at the Port to Broome Airport via Gubinge Road.

Helicopter Flight Paths

- Helicopter traffic is a new component to serve offshore platforms and is likely to increase significantly.
- Helicopter flight paths out of Broome include a training circuit in the south, around the port. Flight training is the biggest concern with residents due to need for circling.
- The Airport has worked with the Department of Environment and Conservation on helicopter paths to avoid nesting birds.
- Helicopter companies are professional and have expressed a desire to work with the community to minimise impacts.

Lombadina/Djarindjin Airstrip

- There is an emergency airstrip at Lombadina/Djarindjin.
- This airstrip has a sealed runway and lights. Strategically, it enables de-manning and refuelling of aircraft.
- Djarindjin currently has three fuel tanks.
- Inpex has emergency fuel supplies at the Djarindjin airstrip and there is a possibility that other companies could enter into a sharing agreement for emergency supplies.
- An operator for the Djarindjin Airstrip was appointed at the end of last year on behalf of the Djarindjin Aboriginal Corporation.

General LNG Precinct Issues and Discussion

- The precinct will not have its own airstrip and will use the Broome Airport for precinct and offshore requirements (e.g. Fly-in/Fly-Out workers).
- The Broome community is fairly tolerant regarding noise issues from the Airport but if noise increases they may be less tolerant.
- This is likely to be more of an issue during construction rather than production at the precinct.
- The Workshop discussed whether the workers would be separated from other passengers at the Airport. Timing and scheduling of flights will be important to manage this issue. In addition, the workers' Code of Conduct could be used to prevent disruptive alcohol consumption.
- There is a possibility that there may be fly-in/fly-out workers coming through Singapore, but there are likely to be more workers from other Australian states. E.g. Pluto sourced 10% of its workforce from Queensland and up to 10% from New South Wales.
- A related issue is what other gas projects would be underway at the same time as the precinct as they would increase competition for workers.

2) ROADS

General

- The Department of Planning's Infrastructure Assessment includes roads. Preliminary maps have been formed and these will be further developed. The broader task is to look at impacts beyond the precinct.
- The Workshop discussed the concept of an infrastructure service corridor in the Dampier Peninsula, linking the LNG precinct with Broome. This corridor will include road linkages.
- Initially, it is envisaged that Cape Leveque Road will be linked with the precinct. The conversation with Main Roads and the Shire has just been initiated and the concept will be developed further.
- The infrastructure services corridor may be 200m wide and allow the future possibility of a gas pipeline (but gas will not necessarily be transported this way).
- Envisaged that the access road will eventually be sealed, with an all weather highway configuration/standards.

- A freight demand and road needs assessment will be conducted to look at current and expected precinct impacts.

Indigenous Issues

- Main Roads is working with the Shire of Broome, it will need to upgrade the existing seal and intersections.
- Main Roads has completed some initial testing of the existing Broome – Cape Leveque Road and would be interested in completing a ground search for gravel sources and quality but needs approval from Aboriginal stakeholders.
- The LNG project is in negotiations with KLC and Native Title claimants and there is a one-off chance to resolve Native Title and land use agreements. This could include the potential to build a gas pipeline in the future. Hence, the idea of an infrastructure corridor to allow for all things potential.
- Mapping of potential infrastructure would be useful to provide to indigenous groups soon so that they can provide input.
- The precinct access road needs clearance from traditional land owners.

Traffic and Road Standard issues

- The main traffic requirements relating to the LNG precinct would be buses to and from the airport.
- The Workshop discussed the standard of road required and it was agreed that highway standard is assumed.
- It is likely that infrastructure for the construction camp will be transported to the precinct by road.
- If the breakwater structures come by road it will be a major impact.
- The meeting agreed that the access road to the precinct is on the critical path for the project. The Main Roads regional office will require funding for a gravel search and alignment definition study.

Road Access Issues

- Improved roads in the Dampier Peninsula can improve the ability for indigenous communities to provide workers for the precinct.
- The Sport and Recreation Workshop raised the possibility that improved roads could provide recreational road users with access to sensitive areas, which would need to be managed.
- An ongoing issue in the Kimberley has been that tourists are using roads to access sensitive areas. This issue is now coming to a head.
- The Workshop agreed that it is important to try to limit road usage that is not precinct related.
- Heritage approvals have not yet been obtained for these roads.

Timelines for Heritage Process, Engineering and Building of Roads

- Heritage listing timeline is unclear. Some departmental advice suggests the time needed to obtain heritage approval would mean that building could start in mid-2011 and finish by the end of 2012.
- This timeline would impact on Woodside's potential construction phase and other options such as using existing roads and sealing parts of the road would need to be considered.
- A sealed road is required for the transport of supplies.

Actions

- Discussion between the State and Woodside regarding the timing of road upgrades is required.
- Department of State Development will consult with Main Roads regarding timeframes for the upgrading of roads. Deadlines may need to be brought forward, including potentially speeding up the sealing of Cape Leveque Road.

3) WASTE MANAGEMENT

- The existing waste management facility has a limited lifespan and the number of years that the site can continue to operate adequately is being determined.
- The existing facility is on reserve land at the end of Buckleys Road and it has been extinguished of native title.
- There are risk management issues related to gas storage right next to the waste management site.
- The waste management site needs to be large enough for the growing town of Broome, as well as offshore and onshore developments.
- How to combine operations for the most efficient program possible.

New Waste Management Site

- Very beginnings of negotiation for a new waste management site and potential future locations are being identified.
- If the future site is inside the Rubibi area, it will have to be negotiated separately.

Preliminary Waste Estimates for Onshore facility during construction

The following are very preliminary waste estimates for the onshore facility for the <u>initial 3 train development, over 5 years</u>:

- Largest proportion of waste would be Class 2 landfill (Broome currently has Class 2 landfill): 15,000-20,000m^3. A lot of this would come from the workers' accommodation camp.
- Toxic waste: 250-300m^3
- Scrap/recyclable metal: 35-75m^3
- Toxic chemicals in drums: 10-25m^3

Preliminary Waste Estimates for Operations

The following are very preliminary estimates for operations and are <u>annual figures:</u>

- Class 2 landfill: 4000-8000m^3
- General recyclables: 375-750m^3
- Toxic Waste: 185-375m^3
- Mercury (filters) contaminated waste: 30-60m^3 (To be sent to Switzerland for treatment)
- Chemical drums 15-30m^3
- Scrap/recyclable material: 7-15m^3
- Class 4 landfill: 1-3m^3 (highly hazardous, e.g. Radioactive)
- Fluorescent tubes: up to 3m^3

- These waste estimates represent a 10-20% increase to Broome's existing waste. There is the technical capacity to deal with waste in Broome.
- The preliminary estimates relate only to the direct impact from Woodside and not potential waste from indirect sources.
- Waste from the offshore rigs will be managed by Woodside.

Waste Water

- Produce water will be treated on site, probably using an evaporation pond (at the precinct).
- Potential concentrated brine from reverse osmosis will be piped offshore and dispersed.
- There is a desalination plant on each platform.

Dampier Peninsula Land Use Plan

- The Dampier Peninsula Land Use Plan (Department of Planning) will link with the Shire of Broome's Local Planning Strategy. A comprehensive study will be required to identify a site for a Class 2 landfill.
- There are a number of ad-hoc waste sites in operation in the Dampier Peninsula – would need to organise and coordinate this in the future.
- Department of Planning has spoken to communities - outstations not against bringing waste to a central facility.

Conclusion

- Waste management is getting close to being a critical path issue.

4) PORTS

Port at the Precinct

- Department of Transport – Marine Safety needs to be involved in port site layout plan.
- From a marine safety perspective, the port at the precinct could have a port authority governing structure. This structure should not detract from industry's management of the precinct.
- During construction phase:
    - expect vessels with large modules from Australia or rest of the world: ~1/day;
    - additional traffic, particularly from offshore activity: might have more than 40 vessels in the field on any one day; and
    - support for drilling operation, supply of drill rigs: initial phase of development won't need a massive increase in drilling – 6-10 wells over 2 year period.
- During operations:
    - expect the number of LNG tankers to the port to be a little less than 1 tanker/day for the first 15mtpa (~300 LNG tankers/year);
    - LNG tankers need tugs to bring them in and safety berths.
- Management of marine facilities has not yet been decided.
- LPG tankers: up to 20/year

- Condensate tankers: up to 20/year
- By far, most vessels would be LNG vessels and less than 1 tanker/day.
- Integrated Marine Facility – some of the supply activities integrated with processing of LNG but not for other platforms or proponents.
- Workshop discussed the possibility of the support base being based at the precinct. Stakeholder views on the location of a support base were diverse.
- The precinct is primarily for LNG processing.
- Quarantine facilities will be included in the precinct.
- Breakwater structure approx 400 m long, large amount of rock or concrete, potentially road transport, a range of options considered.

Broome Port

- The existing exploration supply base in Broome is supporting rig tenders and could comfortably support 4-5 rigs for exploration in the long term.
- Broome Port Authority has jurisdiction from Wyllie Creek to Station Hill.
- Oil and gas industry is very important for Broome Port. It accounts for 59% of the Port's revenue, compared to pearling, which accounts for 2%.
- Lead time of 2-3 years is required for port expansion.
- New jetty in the vicinity of $160-200 million, no environmental approval yet.
- Potential for port to be an Infrastructure Australia project.
- Land availability issues are being addressed with Yawuru.

Other Issues

- The supply base is a running issue and a Worley Parsons report has been completed, on behalf of the Government.
- Woodside is likely to need a 400m breakwater and is looking at alternatives including concrete case-ons, traditional rock or not using a breakwater.

Conclusion

- Many infrastructure issues, including ports, are close to being critical task issues.

5) WATER

Precinct and Offshore Water Requirements

- Options for water supply to the precinct include using a surface aquifer or desalination of ocean water.
- During the pioneering phase, may use potable water initially for the precinct while other options are developed.
- Drilling requirements are not big – closed systems are used and there is a one-off supply of drill water. Industry proponent would not need to use Broome water supply (except in very initial stages).

Accommodation Requirements

- Water required for workers' accommodation will depend on timing.
- Accommodation will require facilities to make potable water and in the short-term will need to use water from the surface aquifer (Broome supply).
- The pioneering stage is complicated at any greenfields site.

- A water plan is required for early works.

Broome Water Requirements

- There is water in the P1 aquifer to supply Broome to 2050.
- There are 10.6 gigalitres/year of sustainable capacity to draw on. At the moment, 4.5 gigalitres/year are used by the town.
- Three new bores have just been drilled. Expansion would predominantly be to the north.
- Previous discussions with the Department of Water suggest that the capacity of the aquifer may have been over-estimated in the past. → confirmed by Kimberley expert.

Actions

- Need for follow up with Department of Water and the Water Corporation regarding possible over-estimation of Broome's water supply capacity.

6) ELECTRICITY

Precinct Requirements

- The precinct will be able to generate power internally and be self-sustaining in terms of power needed for the plant during operations.
- Offshore operations will also be self-sustaining.
- Workers' accommodation (during construction) can be powered by diesel generators.
- Power arrangements for workers' accommodation during operations have not yet been decided.
- The precinct itself is likely to have limited impact on the Broome power supply.
- These power requirements do not include requirements of third party contractors. They would need power supply from Broome.

Broome Expansion

- Infrastructure in Broome will grow.
- There are proposed plans for commercial and residential development in Broome North. Therefore need to increase electricity capacity.
- Surveying for a new sub-station in Broome North is being undertaken to provide capacity for Broome North and Cable Beach.
- An expansion plan will be discussed at the Broome Planning meeting later in August 2009.
- The new sub-station will allow for more capacity in the area around Broome Road. Not certain whether there is capacity for the Water Corporation borefield, or if this will be required.

7) TELECOMMUNICATIONS

Precinct Issues

- Telecommunications for the precinct will be largely self-sufficient.
- There will be no mobile phones on the precinct site itself. During construction, mobile phone coverage would be required, areas vary.
- Providing communication for accommodation areas will need to be planned.

- Fibre optic link may be required during operation, satellite is not suitable.

Broome Issues

- With adequate planning time, telecommunications can be adequately provided for any expansions to the town of Broome.
- ADSL is limited by the length of copper cable.
- Currently assessing possibilities at Broome North.

OTHER DISCUSSION

- There will be upcoming DSD-organised workshops on Housing and Land, Health and Heritage issues.