Australian Pipeline Trust

ROMA – BRISBANE PIPELINE NETWORK

Optimised Replacement Cost Study

DOCUMENT NO: 167-R-01

Prepared by

Venton & Associates Pty. Ltd.
ABN: 86 081 612 053
PO Box 472
Bundanoon NSW 2578

TEL: *+61 2 4884 4470*

FAX: *+61 2 4884 4474*

January 4, 2006

REVIEW AND APPROVAL RECORD

REV	DATE	DESCRIPTION OF RELEASE	PREP'D	REV'D	APPRV'D
0	04/01/06	Issued	PBV		
C	16/12/05	Additional Comments Addressed, Reissued	PBV	SR	
B	8/12/05	Revised, Costs Finalised, Reissued	PBV	DB	
A	31/10/05	Draft – Internal & Client Review	PBV	SR	

Disclaimer

This report has been prepared on behalf of and for the exclusive use of Australian Pipeline Trust, and is subject to and issued in accordance with the agreement between Australian Pipeline Trust and Venton and Associates Pty Ltd. Venton and Associates Pty Ltd accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party.

TABLE OF CONTENTS

SECTION **PAGE**

ATTACHMENTS

1. EXECUTIVE SUMMARY

This report presents the findings of a study to develop and cost a pipeline system that will replace the existing Roma-Brisbane pipeline system with a new pipeline that is optimised to reflect the forecast service requirements the pipeline in the period 2005 to 2025.

The optimisation design study uses the same methodology that used for a pipeline project feasibility study. Engineering studies undertaken to develop technically feasible designs for the pipeline to satisfy forecast loads provide the basis for capital cost estimation. The optimised design selected was the technically feasible design that has the least cost over the life of the project having regard to future investment and consideration of operating costs. To provide transparency in the process, this report presents each of the designs and their costs.

The study has considered DN400 (16"), DN450 (18") and DN500 (20") pipelines between Wallumbilla and the Brisbane metropolitan area, and DN 400 and DN450 pipeline constructed through the Brisbane metropolitan area to Gibson Island.

Because the existing Brisbane metropolitan route is now highly urbanised, the study identified a new route from near Haigslea travelling south and east to a new city gate station located near the Swanbank Power Station Hub, and then following existing electricity transmission easements south and east of the current area of heavy residential development. This route is considered to be both constructible and capable of satisfying the pipeline developer's current obligations of the pipeline developer in relation to public safety. The congestion caused by urban development along the existing metropolitan route results in very high construction costs and the proximity to residences creates increased public safety concerns.

The optimised design proposed is a DN500 (20") pipeline between Wallumbilla and Swanbank with a maximum operating pressure of 12.5 MPa, and a DN400 (16") pipeline from Swanbank to Gibson Island, with a maximum operating pressure of 5.0 MPa. The DN450 (18") pipeline is considered a feasible design but requires a higher initial capital cost than DN500 (20") pipeline. The DN400 (16") pipeline is also considered feasible but the future capital required to satisfy future loads makes it a more expensive option over its life.

The forecast pipeline load will supply a significant proportion of the daily throughput to gas fired power stations which have an intermittent demand. Consequently the pipeline design is significantly influenced by producer requirements for the pipeline to receive gas at essentially constant rate, store it, and deliver it at a high rate when required by the power station.

The pipeline design optimisation was undertaken using an unsteady state computer model to allow the pipeline size to be optimised for the unsteady state loads. This approach results in a smaller pipeline diameter than would be determined using steady state methods. The pipeline capacity at each stage of its development is sufficient to deliver the maximum weekly demand in the period for a repeating period of at least 3 weeks. Design using the unsteady state simulation results in a smaller pipeline than could be used if the maximum daily loads were used to size the pipeline on a steady state basis.

The RBP is a relatively complex pipeline with six existing receipt points (and three planned) and eighteen delivery points, together with intermediate facilities required for it to function safely. Attachment 1 to this report presents a schematic of the pipeline. The total length of the proposed pipeline system including the Peat Lateral is 582 km. This compares with 560 km for the existing system.

The estimated capital cost of the Optimised Replacement Pipeline for the pipeline constructed along the proposed route through Metropolitan Brisbane is $456,145,000 in July-September quarter 2005 Australian dollars.

The estimated capital cost of the Optimised Replacement Pipeline for the pipeline constructed along the existing route through Metropolitan Brisbane is for the pipeline constructed along the proposed route through Metropolitan Brisbane, is $A521,720,000 in July-September quarter 2005 Australian dollars. Attachments 2 and 3 present these costs in detail.

Accordingly, the Optimised Replacement Cost of the Roma-Brisbane Pipeline is considered to be $456,145,000.

2. INTRODUCTION

This report presents an analysis of alternative designs for the Roma to Brisbane Pipeline (RBP) that are technically capable of satisfying the forecast pipeline service requirements between 2005 and 2025. Capital cost estimates for the designs constructed in 2005, and for development of the designs to provide additional capacity through to the end of the forecast period are presented.

The report was undertaken for Australian Pipeline Trust (APT) by Venton and Associates (Venton).

APT will use the designs and the estimates of capital costs in preparing a submission to the Australian Competition and Consumer Commission as part of the regulatory process for the RBP.

The conceptual pipeline designs were developed using unsteady state hydraulic modelling techniques to ensure than the minimum adequate pipeline configuration was identified. The conceptual designs are developed along the existing pipeline route from Wallumbilla to a point at Haigslea, west of Ipswich.

The extent of residential development along the existing pipeline route from Ipswich through to Gibson Island is considered to make it impractical and more expensive to redevelop a pipeline along this route. Consequently a new route has been selected that uses a combination of rural and industrial land, and existing electricity transmission easements through this area.

Capital cost estimates are developed for the design alternatives constructed along the proposed pipeline alignment, and also for the designs constructed along the slightly shorter, but highly urbanised existing route through Brisbane.

The capital cost estimates are considered to have an accuracy of ± 15%.

3. DESIGN BASIS

3.1 PIPELINE CONTEXT

The Roma to Brisbane Pipeline (RBP) was constructed in 1968 and commissioned in 1969.

At the time gas was sourced from a number of small gas fields north and south of Roma.

At the time of construction the pipeline route east of Toowoomba generally passed through rural land, and between Ipswich and Gibson Island. The pipeline route was generally well away from residential areas.

In recent years the energy demand in the Brisbane region has increased significantly with large loads supplied to BP's clean fuels refinery upgrade and associated cogeneration project gas fired power stations, as well as increased industrial, commercial and reticulation loads consistent with the growth of the South East Queensland region. This has resulted in the original pipeline being looped for all of its length from Wallumbilla to Ellengrove (east of Redbank), together with the installation of compression on the original pipeline and more recently, reallocation of the compression to satisfy the requirements of the looped pipeline.

APT has advised that this increased demand has been satisfied by new gas supplies from conventional gas fields in South West Queensland, and more recently, and in the foreseeable future, by new gas extracted from coal seam methane resources. Gas supply from PNG may be available in the future to further satisfy demand as the South West Queensland source declines. It is assumed that any gas from PNG enters the RBP at Wallumbilla.

Since the time of construction the supply and demand situation has changed significantly, and this change is expected to continue into the foreseeable future. These changes result in the optimised design for a new pipeline being significantly different from that which currently exists.

The purpose of this analysis is to identify a pipeline design which if constructed today would provide an *optimised* replacement for the existing asset, meeting expected current and future demand, satisfying existing constraints associated with the pipeline route, public safety and environmental requirements, and optimising the use of capital and the associated operating costs though the period for which the demand for gas transportation has been forecast.

3.2 GAS SUPPLY AND DEMAND

The pipeline design is *optimised* for forecast gas supply and demand through the period between 2005 and 2025. The forecast considers the actual demand growth in the period 2001-2005.

The supply and demand inputs to the study was provided by APT and are discussed in Section 4.

3.3 GAS QUALITY

The RBP accepts a broad gas specification.

The pipeline performance varies with the proportion of high and low specific energy gas delivered to it at any point in time.

This study has adopted gas compositions that are typical of the gases delivered for transportation over the past 12 months. **Table 3-1** illustrates gas compositions delivered to the pipeline inlet station at Wallumbilla. The CSM composition used in hydraulic calculations is also shown in the table

Table 3-1 Typical Gas Compositions in RBP

Component	Composition (mole %)				
	Run 1	**Run 2**	**Run 3**	**Run 4**	**CSM**
Methane	90.868	92.114	90.174	96.043	99.0
Ethane	5.067	5.133	4.966	0.432	-
Propane	0.706	0.500	1.100	0.082	-
n-Butane	0.098	0.006	0.222	0.015	-
i-Butane	0.157	0.007	0.138	0.009	-
n-Pentane	0.021	0.001	0.048	0.003	-
i-Pentane	0.048	0.002	0.050	0.003	-
$C6_+$	0.069	0.006	0.058	0.007	-
N_2	2.053	1.549	1.093	3.190	0.5
CO_2	0.915	0.682	2.151	0.213	0.5
Calculated Values					
SG	0.6107	0.5981	0.6239	0.5736	
HHV (MJ/scm)	38.9155	38.7129	39.1086	36.7056	37.4

Note: Table may not add due to rounding

The gas compositions in Runs 1, 2 and 3 are typical of gas derived from conventional natural gas sources. The composition in Run 4 is typical of gas derived from coal seam methane reserves.

The pipeline hydraulic design has assumed that gas entering the pipeline at Wallumbilla will have compositions similar to those in **Table 3-1**, and that all “new” gas required to satisfy increased load is high quality coal seam methane (CSM) with a typical higher heating value of 37.4 MJ/scm. (This typical CSM heating value is considered by APT as a reasonable composite from CSM sources).

Gas supplied from CSM includes Woodroyd/Peat and Scotia. This gas is assumed to have a composition similar to that nominated above for CSM.

3.4 SUPPLY AND DELIVERY POINTS

The study assumes that gas is delivered into the pipeline at existing receipt points at Wallumbilla, Peat and Scotia.

APT has advised that under current contracts it is required to accept future gas for transportation at existing receipt points or if agreed, at new receipt points downstream.

This study has assumed that all “new” gas will be received at the Wallumbilla pipeline inlet facility. Gas volumes delivered to existing receipt points at Peat and Scotia are assumed to continue to be delivered to those receipt points.

While the study notes that new receipt points may be constructed on the pipeline downstream of Wallumbilla, it is prudent to assume all "new" gas will be received at the Wallumbilla pipeline inlet because of contractual requirements to accept gas at that location.

The study assumes that gas is delivered to existing delivery points connected to the RBP.

Short lateral pipelines supply delivery points which are not located along the route proposed for the optimised pipeline. The lateral pipelines design and cost is included in the optimised design and optimised cost.

3.5 UNSTEADY STATE MODEL ASSUMPTIONS

The RBP supplies three load types:

1. Loads that are essentially constant. These include large industrial loads. These loads are essentially constant, with any significant variation being a result of scheduled maintenance or production activities.
2. Loads that are essentially constant for defined periods each day, and for each day in a week. The demands from gas turbine power stations represent loads of this type. When the equipment is operating, the turbines consume fuel at a constant rate for the duration of their operating cycle. When continued machine operation is no longer economic, the machine(s) are stopped and the demand reverts to zero.
3. Loads that vary throughout the day as a result of human need (cooking, some commercial and industrial loads) and seasonally (eg space heating).

The gas producers generally contract to supply a nominated daily gas quantity at a constant, daily average flow. For demands that have a known daily and weekly cycle (power stations), the gas producer may supply the weekly demand at a constant hourly flow, while the pipeline operator may provide a storage capability that may accept and store received gas when the power station is not operating, and then deliver the gas at a higher flow rate over a shorter duration when the plant is operating.

The pipeline expects to be required to transport increasing volumes of gas that will supply cyclic loads such as peak load power stations.

For pipelines with large, time varying loads, it is essential that the design optimisation is undertaken using an unsteady state hydraulic model[1] that is capable of analysing the effect of time varying supply and delivery flows and pressures.

Design on the basis of steady state, maximum demand flows will result in an unnecessarily conservative pipeline design (ie. sub-optimal, larger diameter than necessary, when analysed using an unsteady state model).

For this reason the *optimised* design of the RBP is determined using unsteady state modelling.

[1] Unsteady state modelling is an appropriate description of the methodology applied to gas pipelines. Unsteady state modelling uses a calculation method called *transient analysis*. Transients are usually a consequence of rapidly changing conditions that follow a single action in a pipeline generally operating under steady state conditions – for example pressure rise following rapid valve closure. Because a gas pipeline almost never operates in steady state, the appropriate term is *unsteady state*. Nevertheless the computer analysis method is the same, whether the analysis is for short duration transient effects, or long duration unsteady state flow effects.

The following assumptions and calculations have been applied to the demand side unsteady state modelling:

1. The pipeline design at any stage in its development must be capable of sustaining the maximum demand cycle, for more than one week. The method by which the design weekly demand profile in any year was determined using the following procedure.
    a. APT provided an annual load forecast for each delivery point from 2005 to 2025, and actual daily flows for the period 1 July 2004 to 30 June 2005.
    b. The actual weekly demand for the period 2004/2005 (starting Monday) was calculated.
    c. The demand in the maximum week and the average weekly demand were calculated, along with the ratio of maximum demand to average demand.
    d. Using the forecast annual demand (from a), the average weekly demand and the maximum/minimum week ratio (from c), calculate the maximum week for each week of the forecast period.
    e. Using the actual daily demand, calculate the distribution of the maximum demand week, by day.
2. Except for power stations, the daily demand in the maximum week is applied using the results of (d) and (e). The daily demand is applied as an average daily demand by day.
3. Power Station demand by day is modelled using the information provided by APT for intermediate, intermediate/base and base load station. The Power Station demand is applied as an hourly demand over each 168 hour week, depending on whether the power station is operating or not operating.

The following assumptions are applied to the supply side of the unsteady state modelling:

1. Each input is permitted to flow gas up to the forecast MDQ.
2. The intermediate and intermediate / base power station supply is assumed to be received at a constant flow rate over the week.
3. The weekly receipt from each supply is assumed to be equal to the maximum demand week. This is distributed by day on the basis that:
    a. Intermediate and intermediate-base power station demands are supplied at a constant average rate.
    b. The daily receipt (Monday through Sunday) is received in the same proportion as the weekly demand.
    c. A nominal receipt point is defined as a variable value to provide compressor fuel gas.

Each hydraulic modelling case is required to run for a minimum of three (3) consecutive weeks of this load to demonstrate that the solution provided by the model is stable. A *stable* model is one where the periodic supply and demands applied over the weekly cycle would, if applied for longer durations, be sustained with essentially no change in the line pack at the end of each period.

4. GAS SUPPLY AND DEMAND

4.1 General

APT provided a forecast of gas supply and demand by year for the 20 year period between 2005 and 2025. This is a reasonable period on which to base an investment decision on a new pipeline and is consistent with usual practice in pipeline development projects. Too short a period may result in an undersized pipeline, requiring additional investment to provide increased capacity early in the pipeline life, while too long a period may also result in a sub-optimal pipeline as a result of forecasting inaccuracy.

The forecast provided by APT includes actual supply and demand data for the years 2001 through to 2005, and forecasts of the supply and demand in subsequent years. The forecast is shown in **Figure 4-1**. The values shown for years 2001 to 2005 are actuals. [Confidential]

Figure 4-1 Forecast RBP Demand [Confidential]

The forecast demand shows: [confidential]

The forecast assumes that:

- No new alternative pipelines are developed to directly supply the Brisbane market.
- Any gas from proposed PNG pipe will flow through the RBP and replace gas from existing shippers.

4.2 Commercial, Industrial and Distribution Loads

Approximately 50% of the pipeline throughput east of Swanbank is delivered to major industrial gas users. These industrial plants operate under conditions that are essentially steady state. While the commercial, distribution and smaller industrial gas users exhibit relatively large daily and weekly load cycles, the high proportion of industrial demand dilutes the effect on pipeline performance from these higher load factor demands.

Modelling assumes that the characteristic load cycle for each day of the week from each delivery point taken from operating data in 2005 is typical of these types of load. Because this is the best available data, it is retained throughout the forecast period considered in this study.

Note: The analysis could have considered load variations on an hourly basis, but because relatively steady industrial loads are dominant at the eastern end of the pipeline, any improvement in the quality of the analysis that would result from hourly accurate modelling of the unsteady state flow, would be small.

4.3 Power Station Loads

Gas fired power stations currently represent significant demands on the pipeline.

Gas turbine driven power stations (with or without co-generation) are capable of efficiently satisfying short duration high demand electric loads. It is anticipated that in the future the pipeline will be required to supply a greater proportion of its throughput to gas fired power stations to meet increasing power demand.

Three types of power station are supplied. Peak Load, Intermediate Load and Intermediate/Base Load. **Figure 4-2**, **Figure 4-3**, and **Figure 4-4** shows the energy supply and demand characteristic of each power station, together with the typical gas supply contract for each power station type.

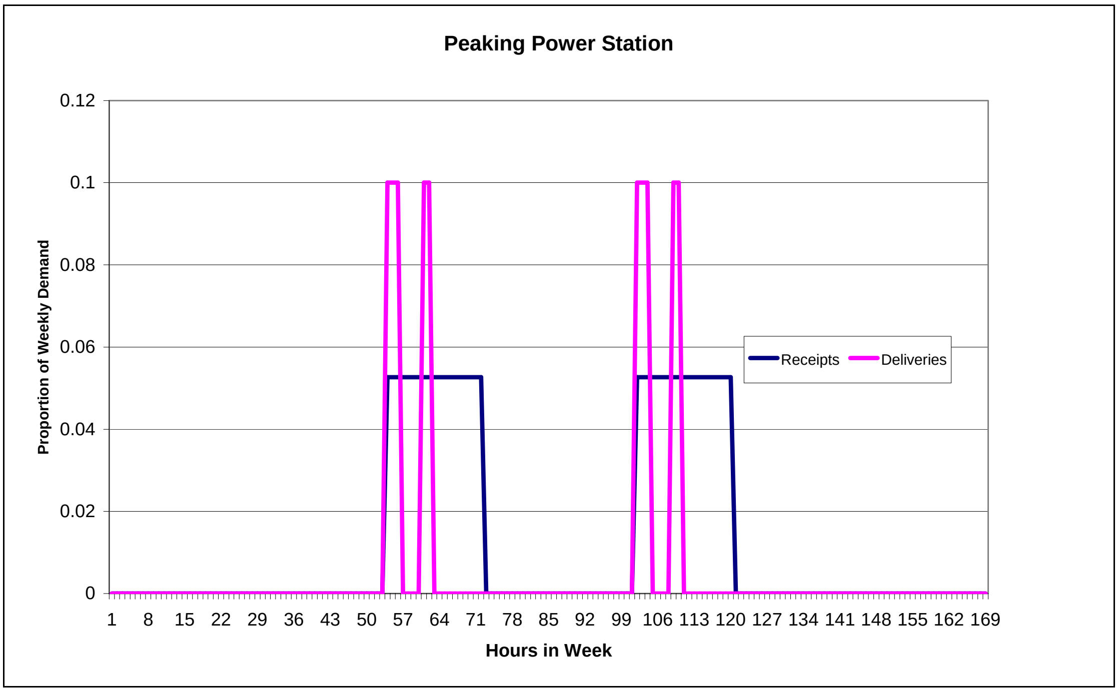

Figure 4-2 Gas Energy Flows - Peaking Power Station

To control the pipeline line pack, a peaking power station is required to replace its daily gas use at an average rate on the day that the gas is consumed. The daily demand is relatively small and can be delivered without significant impact on gas production.

Because the cyclic demand of the Intermediate and the Intermediate/Base power stations is much greater, and because they normally operate on a standardised weekly cycle, each of these power stations is required to supply its weekly gas consumption at a constant average rate.

Figure 4-2, **Figure 4-3**, and **Figure 4-4** illustrate the supply profile together with the demand profile.

The pipeline is required to absorb the difference between the 7 day steady state gas supply and the gas consumed each operating day (5 or 6 days of each 7 day week), as line pack. The line pack is required to supplement the daily gas input by each power station shipper, to satisfy the daily demand.

This characteristic (a requirement for storage capacity) is critical in the hydraulic design of the pipeline.

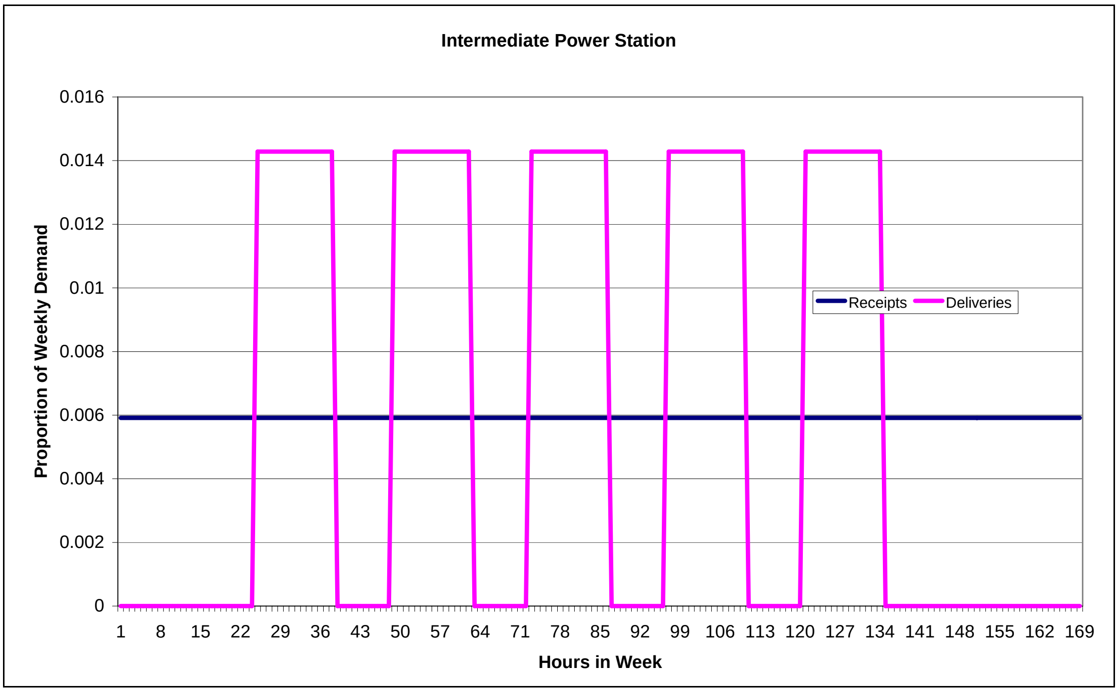

Figure 4-3 Energy Flows - Intermediate Power Station

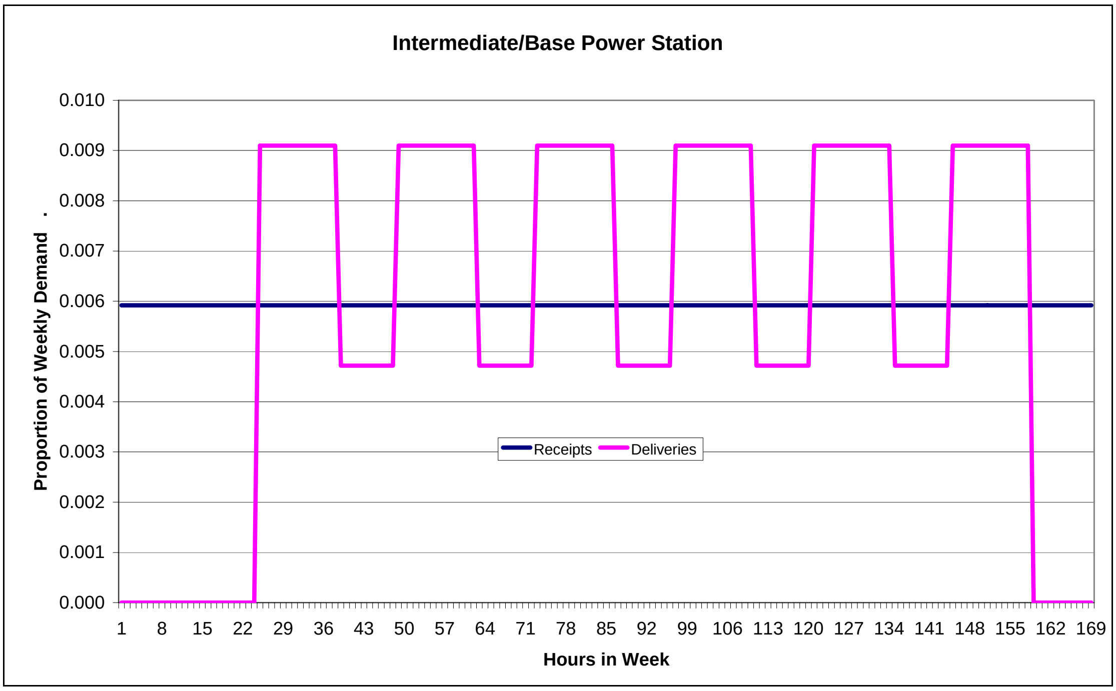

Figure 4-4 Energy Flows - Intermediate / Base Power Station

Figure 4-5 illustrates how these demands combine to deliver the forecast maximum pipeline demand in 2005 and 2017. This illustration reinforces the comments made above in relation to the impact of the short duration loads on the pipeline hydraulic performance.

(Note-Simulation time 504 represents the commencement of the maximum week cycle commencing 08:00 on Monday).

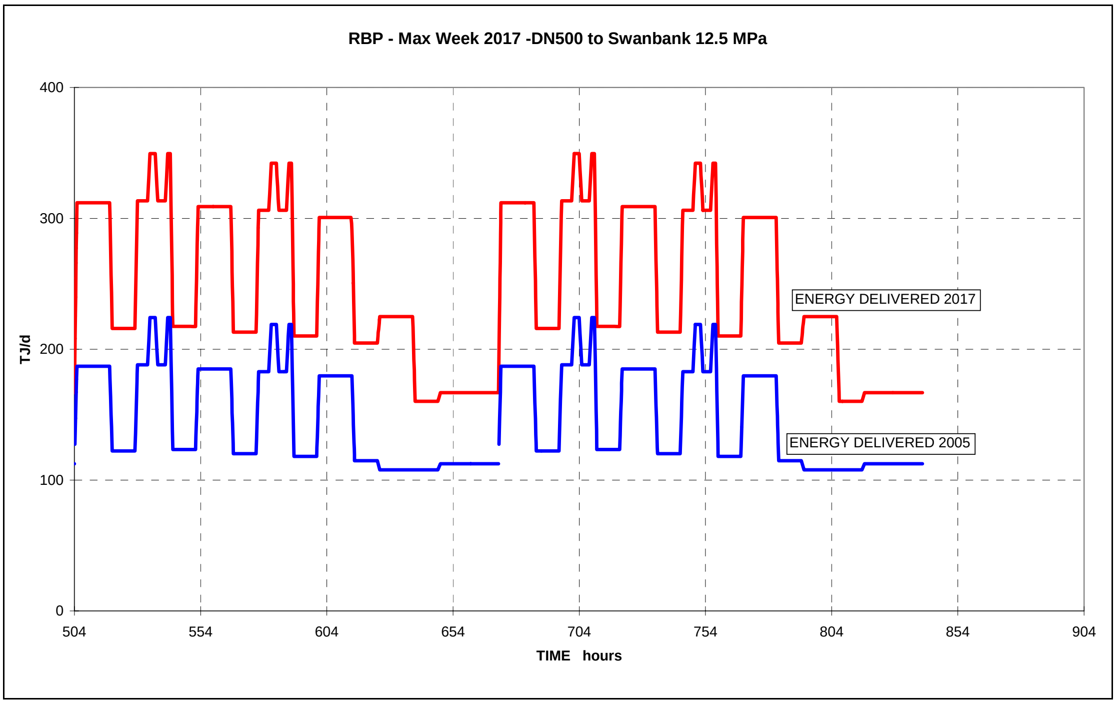

Figure 4-5 Maximum Demand Forecast – 2005 and 2017

4.4 LOCATION OF NEW POWER STATIONS

This study is based on an assumption provided by APT that new gas fired power stations will be constructed in the vicinity of Swanbank.

4.5 GAS SUPPLY

Gas comprises supplies from the mix of existing gas sources, while new gas is largely sourced from coal seam methane resources. Gas supply from PNG may be available in the future to meet demand as the South West Queensland source declines. It is assumed that any gas from PNG enters the RBP at Wallumbilla.

5. PIPELINE ROUTE

5.1 GENERAL

The RBP is the only transportation pipeline supplying gaseous energy to Brisbane. **Figure 5-1** shows an overview of the pipeline route, together with the route of gathering and lateral pipelines, the Moonie Oil Pipeline, and the proposed route of a number of future pipelines.

The pipeline routes shown in **Figure 5-1** represent data available for public download from the Natural Resources and Environment (NRE) (Qld) web site. The status of each pipeline can be determined from associated properties, when viewed on a geographic information system (GIS) computer program. For constructed pipelines for which an as-built survey was provided to the NRE the data has a high level of accuracy, and indeed, the original RBP and the parallel looped pipeline are visible on the data when viewed at an appropriate scale.

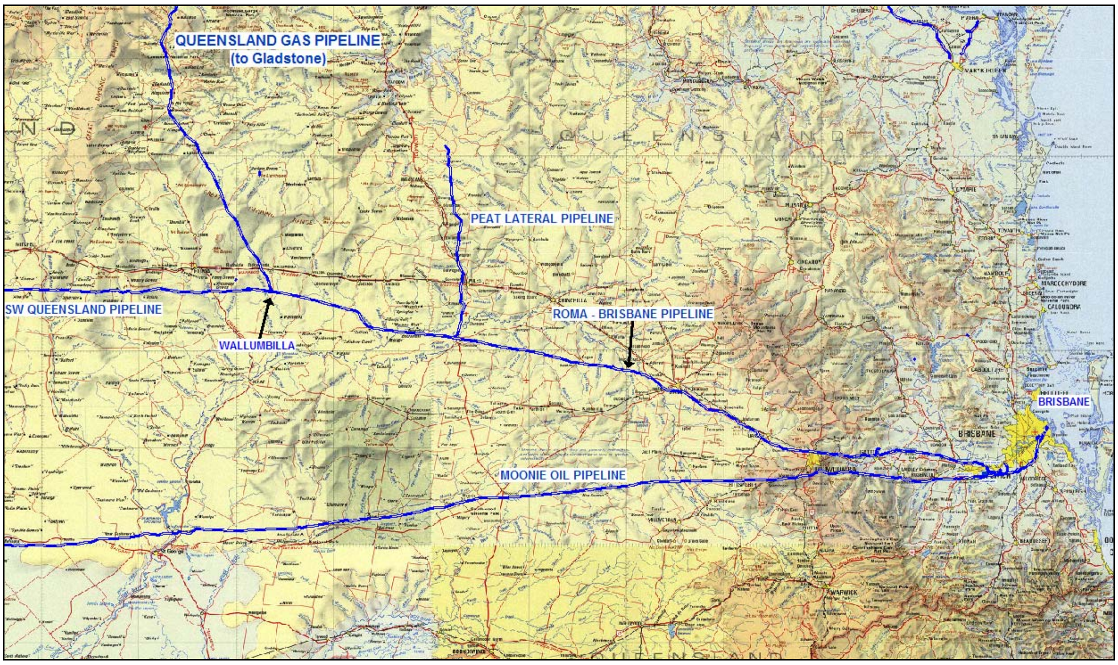

Figure 5-1 Pipeline Route Overview

There is an extensive system of gathering pipelines connected to the RBP at its receipt station at Wallumbilla. Also connected at this point are the South West Queensland gas pipeline, delivering gas from Ballera, in far south west Queensland and the Queensland Gas Pipeline which commences at Wallumbilla, and delivers gas to Gladstone and Rockhampton.

Figure 5-1 shows that Brisbane occupies a section of coastal plain surrounded by the Great Dividing Range to the west, the D'Aguilar Range to the north, and the McPherson Range to the south. The existing route generally follows the least difficult topography to access the Brisbane market.

In the past there have been a number of studies to assess whether there is an alternative route to the Brisbane market from the Surat Basis gas resources. In 1996/7 PGT Australia, the then owner of the Queensland Gas Pipeline undertook an extensive investigation of an alternative pipeline route, considering one that would service a potential power station north of Dalby, and a possible one in the Petrie area. This route passed north of the Somerset Dam and the D'Aguilar range, entering the Brisbane area from the north, and potentially crossing the Brisbane River to access markets to the south. **Figure 5-2** illustrates the topography of the area traversed by the existing pipelines, and shows the significant deviation required if the pipeline was to be routed north of the D'Aguilar Range.

Figure 5-2 Pipeline Route Topography

This general route was considered as a possible route for an optimised pipeline constructed in 2005, but it was discarded because:

1. The length of the route to Gibson Island is greater than the existing route;
2. Most markets exist along the corridor formed by the existing pipeline, there appears to be no justification for the alternative; and
3. There is extensive residential development along possible pipeline corridors entering from the north;

The RBP runs slightly south of east from Wallumbilla to Kogan and Dalby, then generally follows the highway from Dalby past Oakey to the north side of Toowoomba. It then crosses down the Great Dividing Range, passing north of Gatton, and Ipswich, where it joins the Moonie Oil Pipeline easement which with the exception of a few short areas, it shares to its termination at Gibson Island.

Construction of a new pipeline along the whole of the existing route is considered in the capital cost estimate. However given the known constraints that exist along the route of the existing route between the Redbank area and Tingalpa, the existing route is not considered to be a viable route for a new pipeline. (When the existing pipeline was constructed the land through this area was essentially used for rural purposes. Since the 1980's there has been extensive residential and industrial development along the whole of the route including significant encroachment over the pipeline easement such that in some places, the existing pipeline cannot be maintained without major disturbance to residences).

In the period since its construction there has been a great deal of development along the route to the east of Toowoomba, and in particular, the route from approximately Haigslea to Tingalpa is no longer considered optimal because of the cost associated with constructing along the highly developed corridor, and the associated public safety issues associated with the high population densities along the route.

An alternative route is proposed as an optimal route for this study. Between the Redbank area and Tingalpa it is based on a route selected in about 2002 as part of a study associated with an analysis of alternatives that would improve the safety and supply security of the pipeline. Between Haigslea and Redbank the route was selected from topographic mapping, aerial photography and from a physical inspection of the area.

This development makes it appropriate to consider the route in three sections.

Because the alternative route in some locations does not coincide with the existing customer metering stations, the optimal pipeline route includes routes for short pipelines between the new pipeline and the existing customer metering stations, in order for the forecast demands at those sites to be met.

5.2 WALLUMBILLA TO HAIGSLEA

The RBP route between Wallumbilla and Haigslea (just west of Ipswich) has not been exposed to significant development since the pipeline was originally constructed, although the area through the Lockyer Valley and east to Marburg/Haigslea has developed from broad rural land usage to smaller landholdings, bordering on semi rural use (allotment size less than 5 Ha).

Notwithstanding this, there does not appear to be any constraint that would, require the new pipeline to be constructed along an alignment that except for short distances, differs from the existing alignment.

5.3 HAIGSLEA TO SWANBANK

The RBP was constructed along a route that runs to the north of Ipswich, crossing the main western highway and railway just to the west of Redbank. **Figure 5-3** and **Figure 5-4** shows the existing pipeline route, including the lateral pipeline to Swanbank, and the existing route of the Moonie oil pipeline. At the eastern end of the illustration the RBP route splits to accommodate the original pipeline and the recently constructed loop pipeline.

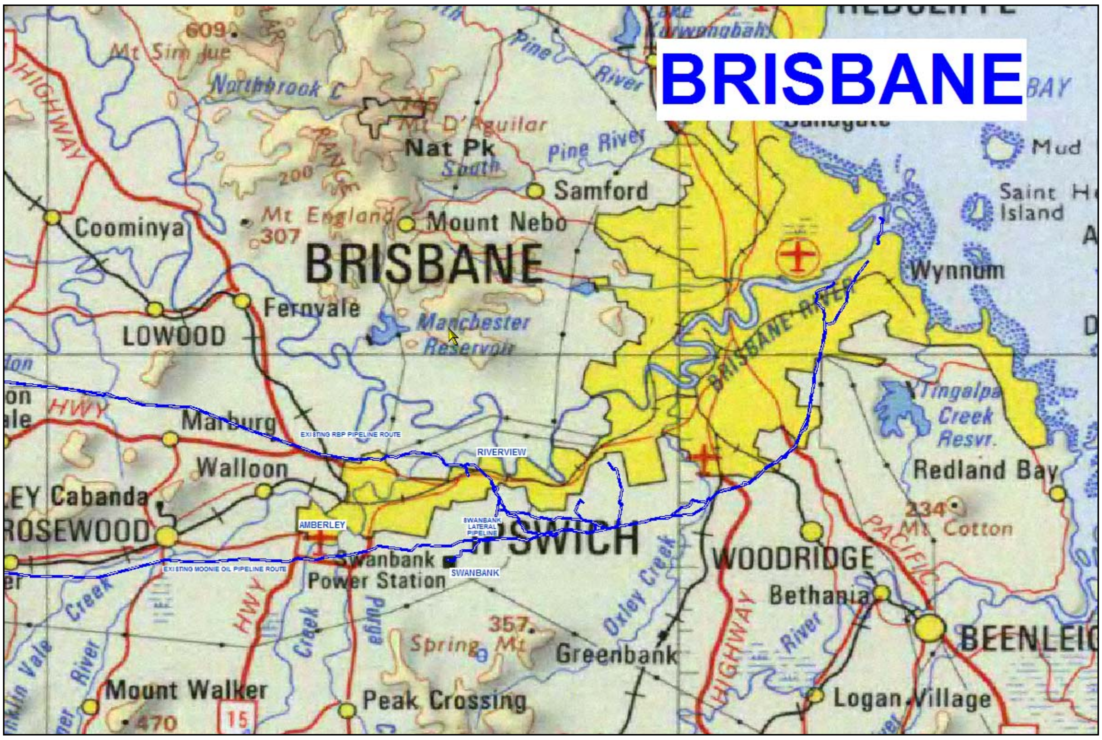

Figure 5-3 Pipeline Route - Haigslea to Swanbank Area

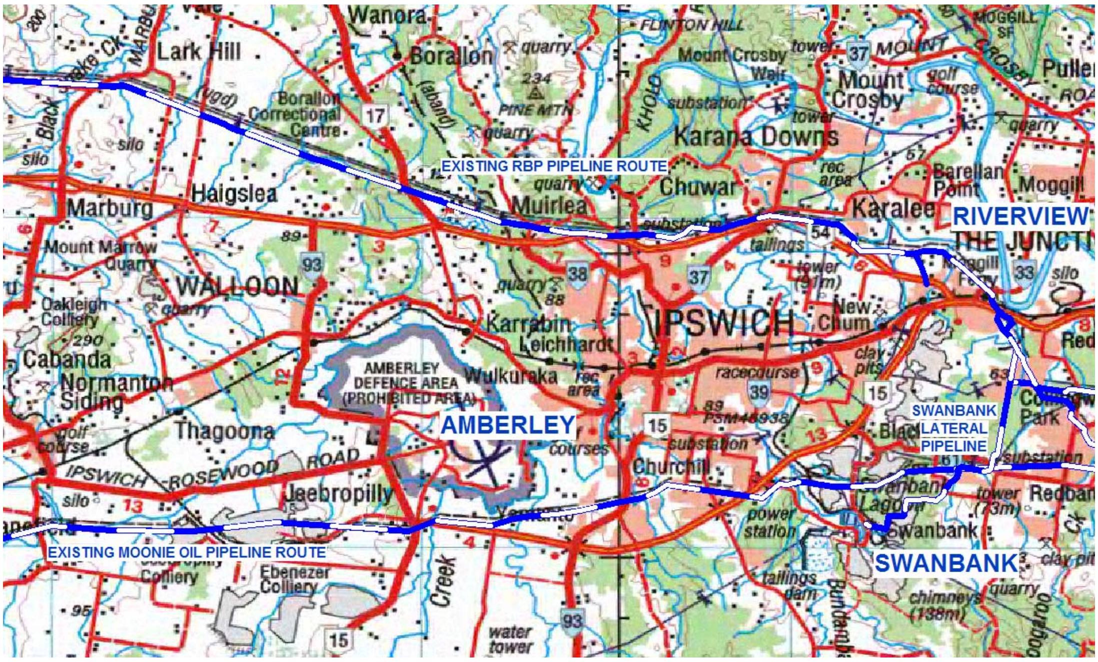

Figure 5-4 Pipeline Route - Haigslea to Swanbank Area (Detailed Map)

Since the RBP's original construction three significant changes have occurred in this area:

1. The land use between Haigslea has changed from broad rural, to semi rural and residential. In the vicinity of Riverview the land use is industrial. Residential development is expected to grow along the corridor formed by the highway between

Ipswich and Toowoomba, and along the Brisbane Valley Highway towards the Wivenhoe Dam.

2. Changes in electric power use have required construction of gas fired turbine peak load power stations. One of these is constructed at Swanbank, adjacent to the existing Swanbank coal fired base load power station, making use of the existing electric power transmission network that transports power from this site to South East Queensland. In designing the pipeline APT has advised that it is assumed that growth in the power generation load will be in this location.
3. The Queensland Government has published a regional development plan that identifies the region along the Brisbane – Ipswich corridor and west along the corridor for development to occupy future population growth in the South East Queensland region.

Furthermore the area around Amberley has been identified as a location for development of an aerospace industry.

For these reasons this study considers that the existing RBP pipeline route is inappropriate for a new pipeline.

A new pipeline constructed along the existing route will:

- Introduce increased public safety issues by construction of a high pressure pipeline through existing and future residential areas.
- Not provide for an existing and expected future significant gas loads in the Swanbank area.

It will also limit a potential opportunity to deliver gas to the Amberley region.

This study proposes that the replacement pipeline be constructed along a route that deviates south from the existing route in the vicinity of Haigslea, passing to the west of the Amberley Air force base (but east of existing coal mines), and then running in undeveloped land on the south side of the existing Ipswich bypass highway running between Ipswich and Warwick. The pipeline will join or parallel the existing Moonie oil pipeline easement, and continue to a city gate station located a short distance from the existing gas fired power station.

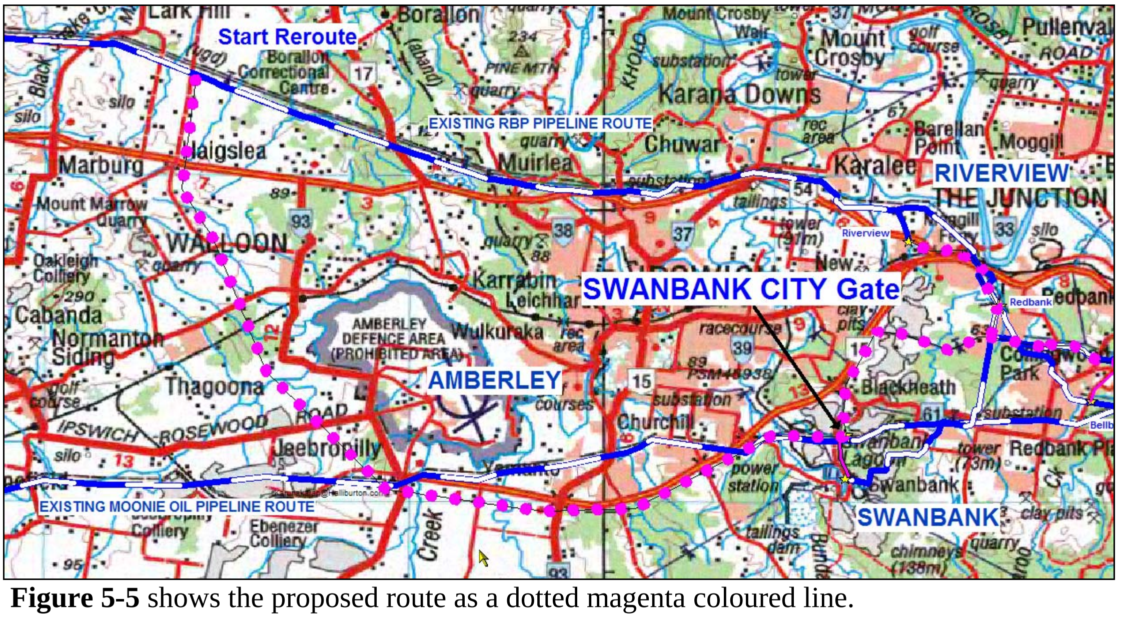

Figure 5-5 shows the proposed route as a dotted magenta coloured line.

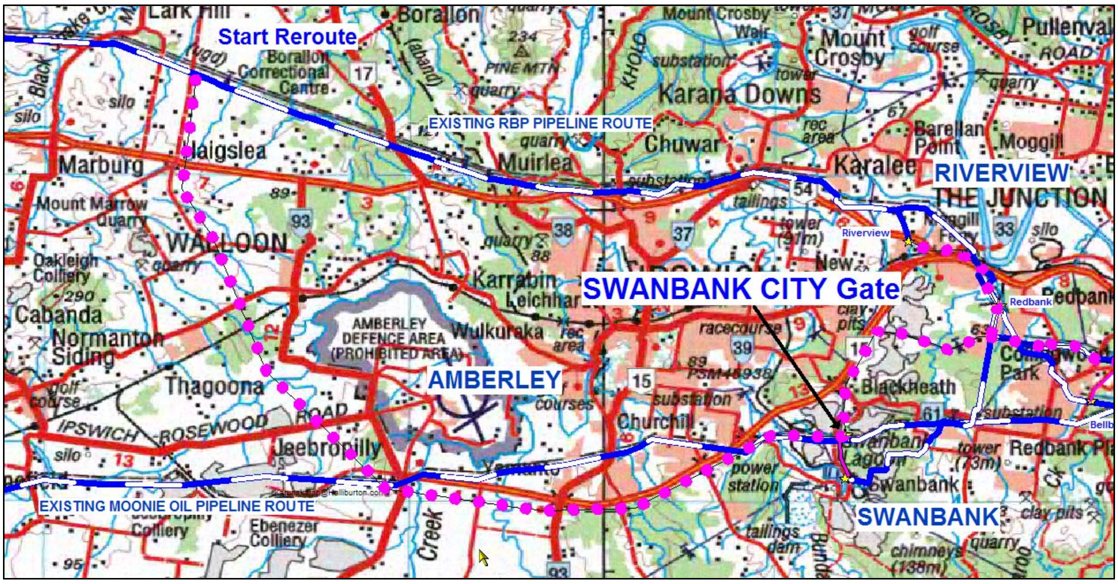

Figure 5-5 Proposed Pipeline Route - Haigslea to Swanbank

The benefits of this route include:

- The land is relatively undeveloped.
- The land to the west of both Swanbank and Amberley is industrial land used for coal extraction.
- The City Gate station proposed at Swanbank is located in an industrial area associated with the Swanbank power station. The land in this area is protected against significant development by the presence of the mine and power stations.
- The route will adjoin the existing oil pipeline easement, accepting a level or protection against development conferred by that existing easement.

This route is 14 km longer than the existing route, but it does offer construction cost advantages associated with construction of the new pipeline in a location that is generally unencumbered.

5.4 SWANBANK TO GIBSON ISLAND

The original pipeline route passed through Redbank, and joined the existing Moonie Oil Pipeline route. The gas pipeline was constructed in an easement generally on the south and east side of the oil pipeline easement (although there are multiple locations where because the oil pipeline was constructed first and used the most constructible part of the easement, it was necessary for the gas pipeline to cross to the other side of the easement, and in some locations to use a dedicated easement).

At the time of construction, most of the route between the original city gate station south of Goodna and the Gibson Island delivery point was used for rural purposes including some horticultural use and a few large allotment rural residential areas.

Since that time there has been rapid residential growth over the whole of this portion of the route, to the extent that roads have been constructed along the pipelines, and in a number of locations the pipelines pass through residential allotments.

Figure 5-6 provides an overview of the land through this region.

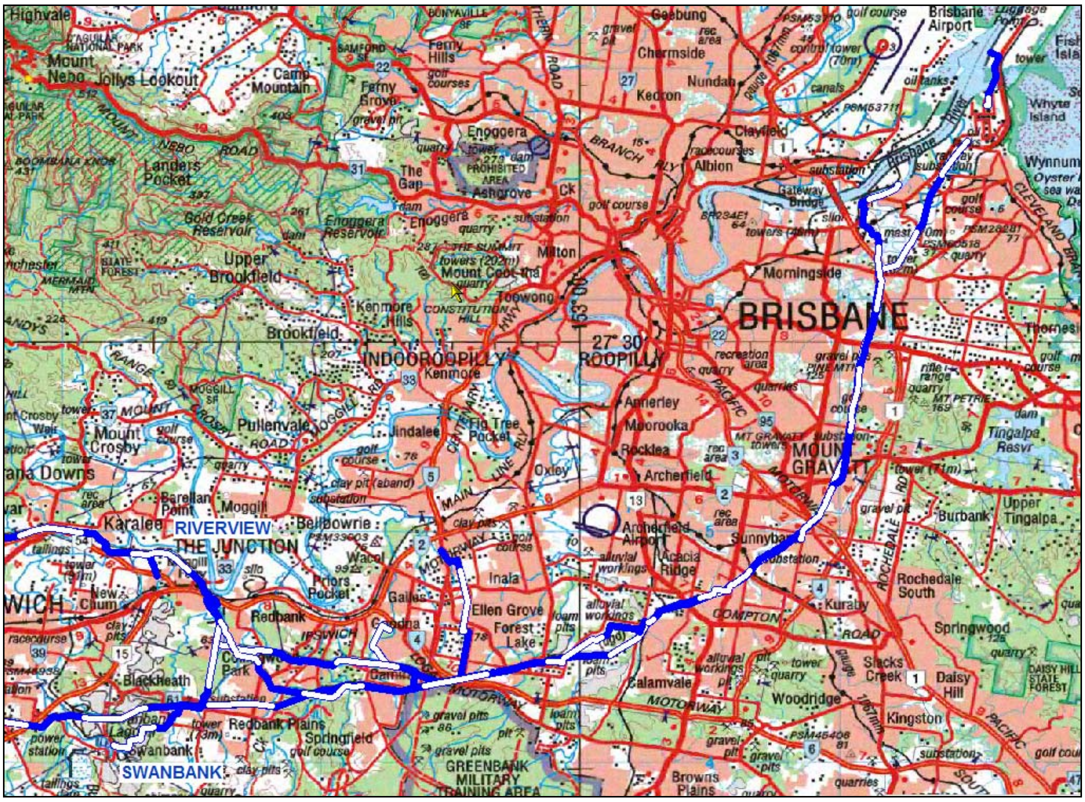

Figure 5-6 Existing Pipeline Route - Swanbank to Gibson Island

It is most unlikely that a new pipeline could be constructed along the existing route except at great cost, because of existing constraints of residential, road, sensitive development and general congestion that exists in the area.

If a new pipeline was to be constructed along the existing route to take advantage of such easements as exist, there is expected to be a very significant cost associated with gaining approvals, access and compensation, which, together with a substantial increase in the cost of construction through the congested area will make this alternative unattractive.

There is an existing corridor between the Swanbank Power station and the Brisbane River that generally follows the Logan Motorway east to the Gateway Motorway, running north and west of the Gateway Motorway. This study considers that this corridor would provide an acceptable route for construction of a new pipeline.

Other power transmission corridors exist along parts of the route, but the selected route represents the most direct and constructible of the alternatives.

Figure 5-7 shows the proposed route along this power line easement (a magenta coloured dotted line).

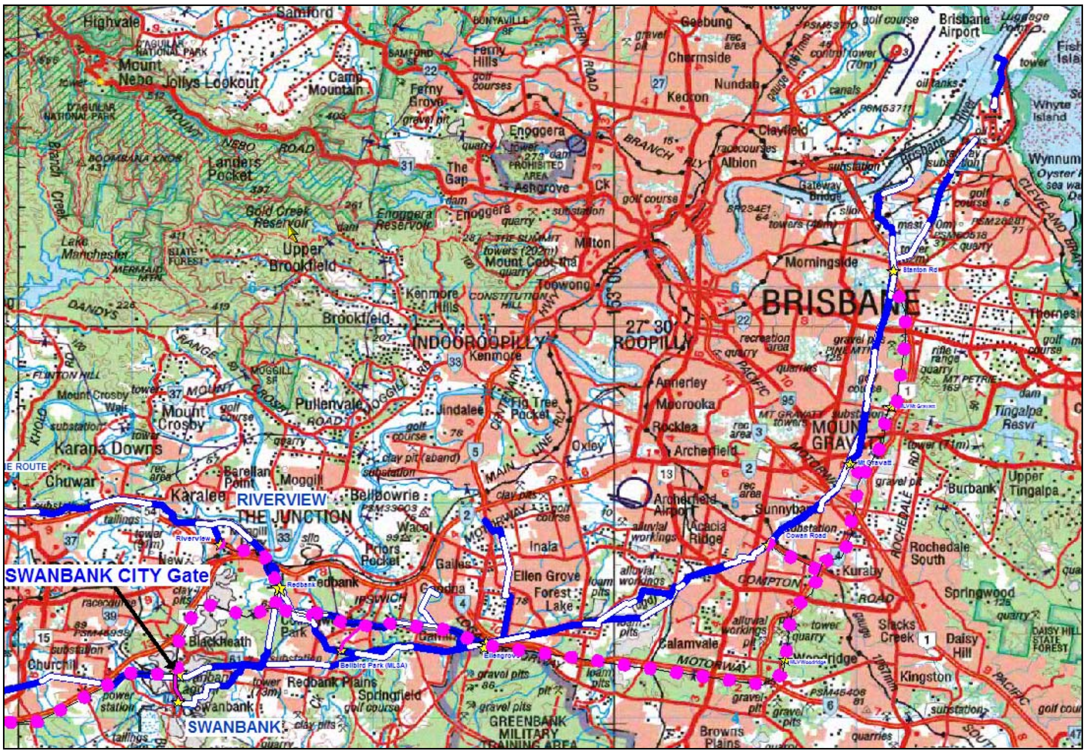

Figure 5-7 Proposed Pipeline Route - Swanbank to Gibson Island

The benefits of this route are:

- Compared with the existing route it is reasonably constructible
- The route is relatively remote from residential developments (and hence increases public safety)
- The land is currently burdened by a power transmission easement that prevents residential construction along it and is expected to reduce the difficult and cost of acquiring an additional easement over part of it for the pipeline

The disadvantages of this route include:

- Its increased length
- It is constructed parallel to high voltage power lines, introducing a requirement for additional equipment to protect personnel from voltages induced on the metallic pipeline by load and fault currents
- It requires construction of short lateral pipelines to delivery points at:
  - Redbank and Riverview
  - Runcorn
  - Mt Gravatt

This study has developed costs to construct the pipeline along both the existing route and the proposed route so that the relative costs along the two routes can be compared.

The proposed route is considered to reasonably reflect the route which would be selected if a pipeline owner was required to construct a new pipeline to service loads at the existing delivery points along the existing pipeline.

For the new pipeline constructed along the proposed route, this study has made provision for the development of lateral pipeline where necessary to deliver gas to existing loads. If this was not done, the capital cost of the optimised pipeline would be incomplete.

The routes of new lateral pipelines required to deliver gas to delivery points at Riverview, Redbank, Runcorn and Mt Gravatt are assumed to follow an existing route in the case of the Riverview/Redbank delivery points, and along roads and through public areas in the case of the Runcorn and Mt Gravatt lateral pipelines.

The route of the existing lateral pipeline from Scotia and Woodroyd/Peat gas fields is considered optimal, and no change to this route is proposed.

6. PIPELINE DESIGN

6.1 GENERAL

The optimisation design study has been undertaken using the methodology usually adopted for a pipeline project feasibility study. This involved engineering studies to develop technically feasible designs for the pipeline followed by capital cost estimation. The optimised design selected was the technically feasible design that can be constructed at the least cost.

Attachment 1 presents a schematic of the pipeline system.

The pipeline designs proposed in this study comply with the requirements of AS 2885, the Australian Standard for design, construction and operation of Oil and Gas Pipelines.

A revision of the design Standard, AS 2885.1 is to published in the near future, after a development period of 5 years required to consider significant changes to design and public safety provisions of the Standard.

The pipeline designs presented in this standard comply with the intent of the public comment draft of AS 2885.1 (published in December 2004), particularly in relation to the public safety requirements proposed to be implemented where the pipeline is constructed in areas where the land use is generally residential.

These provisions include:

1. The pipeline constructed in residential and high rise location classes will not rupture when exposed to an identified threat.
2. In the event of the pipeline being penetrated, the maximum energy release rate will not exceed 10 GJ/s in a residential area, or 1 GJ/s in a location where the predominant development is high rise.
3. The other major change proposed in the standard is that it is expected to permit pipelines to be designed for operation at increased stress levels (allowing the wall thickness required to contain internal pressure to be reduced).

   The pipelines designed for this optimised design do not take advantage of this proposed change because it is not currently approved (and there is still some chance that it may not be approved), and because the new pipeline is required to accommodate large and relatively frequent stress cycles. The combination of a large stress range applied to the pipeline at frequent intervals, reduces the time to failure by fatigue.

The no rupture and energy release requirements of the draft Standard mean that it is unlikely that the existing RBP metropolitan pipeline could be constructed in 2005 along the existing pipeline route.

Fatigue failure risk is most easily managed by designing the pipeline for operation at modest stress levels, and this study considers that a pressure design thickness based on the current (1997) revision of AS 2885.1 will conservatively provide resistance to fatigue failure for the design life of the pipeline.

6.2 PIPELINE DESIGN – RURAL AND SEMI-RURAL AREAS

In semi rural areas the following principles apply to the pipeline design:

1. The steel grade used in the pipeline is API 5L Grade X70. A thickness saving provided by the use of higher strength steel (API 5L Grade X80) will reduce the steel cost a little. However the competing requirements for pipe thickness including fatigue design, penetration resistance, and fracture control are expected to introduce additional requirements that will not enable the full benefit of the higher strength to be realised.

   API 5L Grade X70 steel has been used in each large gas transmission pipeline constructed in Australia over the last 10 years. A number of these pipeline projects have undertaken studies to assess the benefit of the higher grade steels, and none have been able to demonstrate a material benefit provided. In part, this is understood to be a result of the increased proportion of high cost alloying elements required for the higher grade steel.

2. Where increased wall thickness pipe is required at locations where it is necessary to accommodate increased loads, or to provide increased protection against external interference, or for other purposes. This study has assumed that a thickness based on a stress level at maximum allowable operating pressure equal to 60% of the specified minimum yield stress of the pipe, is sufficient.

   Recently constructed Australian pipelines have determined that a thickness based on this stress level is appropriate.

3. Pipes are supplied in 18 metre (nominal) lengths and are welded by high productivity manual metal arc welding. Each welded joint is inspected by X radiography.

4. The pipe is coated with a factory applied coating system, consisting of a fusion bonded epoxy layer, a co-polymer adhesive and a protective layer of high density polyethylene. The typical layer thicknesses are 250 microns, 150 microns and 1000 microns respectively.

5. Pipeline joints are prepared by sand blasting and are coated using a proprietary liquid polymer, or a shrink sleeve coating system comprising a liquid epoxy and a heat shrink sleeve.

6. Pipelines are designed with the minimum depths of cover nominated in **Table 6-1**.

Table 6-1 Design Depth of Cover

Location	Minimum Depth of Cover (mm)
Rural and semi rural locations where the land use is pastoral or grazing, and in any case where the maximum depth of soil disturbance is 300 mm.	750
All locations where land is cropped	1200
Road Crossings	1200
Rail Crossings	2000
Stream Crossings	1200
River Crossings	1500

Table 6-1 Design Depth of Cover	
Pipeline installed parallel to road and rail, and within the road or rail reserve	1200
Semi-Rural areas	900

7. Each pipeline is divided into sections to allow its integrity to be inspected using in-line inspection tools. Each section is equipped with permanently installed scraper launchers and receivers.
8. Each pipeline is equipped with isolation and vent valves at locations determined in accordance with the requirements of AS 2885.1, and as determined by the operating and maintenance requirements of the pipeline. Each isolation valve is designed for remote operation.
9. Roads which have a bitumen surface are constructed by underboring to maintain traffic flow, and to avoid damage to the pavement.
10. Rivers and stream crossings are constructed by conventional open cut methods when this is practical. At large crossings and at environmentally sensitive locations the crossings will be made using directional drilling technology.

6.3 MAXIMUM ALLOWABLE OPERATING PRESSURE IN RURAL AND SEMI RURAL AREAS

The pipeline length from Wallumbilla to Swanbank is approximately 397 km. The original pipeline has a MAOP of 7.1 MPa. The looped pipeline has a MAOP of 9.6, but currently operates at 8.0 MPa.

Recently constructed transmission pipelines have a MAOP of up to 15.3 MPa.

The pipeline design pressures are typically based on the nominal operating pressure of standard piping flanges. Class 600 flanges have a maximum working pressure of 10.2 MPa, while Class 900 flanges have a maximum working pressure of 15.3 MPa.

Until recently the pressure limit for these flanges was limited by the maximum working temperature; however the design Standard (AS 2885.1) now permits these flanges to be used at their rated pressure for temperatures not exceeding 120°C, significantly higher than the normal pipeline working temperature limit

The factors to consider in establishing the pipeline MAOP include:

1. The capital and operating cost of compression required to raise the gas pressure from the receipt pressure to the pipeline operating pressure (Currently all connected receipt points are designed for the MAOP of the existing pipelines, and will require compression to inject gas into an optimised pipeline operating at a higher MAOP).
2. Transmission pipelines operate efficiently when the ratio between maximum and minimum pipeline pressure is 1.4 to 1.5. This is because the friction loss increases in proportion to the square of the flowing velocity. When the pipeline delivers gas at low pressure, the length of pipeline that operates at a pressure less than about 60% of its inlet pressure becomes increasingly less efficient (that is, the friction loss increases rapidly with reducing pressure).

   This effect is more severe with 15.3 MPa pipelines intended to deliver to a receipt point at say, 5.0 MPa than with 10.2 MPa pipelines intended to deliver to a receipt point at the same pressure.

3. For pipelines that are required to store gas for later delivery, significantly more gas can be stored in a pipeline at 15.3 MPa than can be stored in a similarly dimensioned pipeline at 10.2 MPa.

   However this effect may be negated with a hydraulic design for a higher pressure pipeline that operates at a higher pressure, but with a smaller diameter than a pipeline designed for a lower pressure.

   This means that the storage capacity of a higher pressure pipeline is not necessarily greater than the capacity of a lower one of larger diameter.

   Table 6-2 illustrates this with two designs considered as potentially satisfying the "optimised" design for the RBP.

Table 6-2 Maximum Line pack for 396 km Pipeline at 20°C

	DN 500 – 12.5 MPa	DN 450 - 15.3 MPa
Pipeline Volume (m^3)	74,066	59,340
Line pack at MAOP (sm^3)	11,630,000	11,370,000

   The two designs are essentially the same when assessed on the basis of line pack. The line pack available in a DN 400, Class 900 pipeline is approximately 9 million standard cubic metres.

4. The cost of connections for future gas supplies is higher if the pipeline MAOP is 15.3 MPa because the connection will be required to design the pipeline and associated compression equipment for the next highest pressure Class (Class 1500). This increases the cost of materials and equipment.

   Provided the receiving pipeline pressure is sufficiently low to allow the pipelines supplying the gas to be designed for within the Class 900 limit, the cost of these gas supply facilities will be lower, potentially delivering an optimised overall gas delivery system.

6.4 PIPELINE DESIGN IN RESIDENTIAL AREAS

The existing pipeline is designed in accordance with the practice of terminating the transmission pipeline at a city gate station located near the city limits.

The transmission pipeline pressure is reduced at the city gate station for two reasons:

1. The reduced operating pressure is selected so that pressure regulation at delivery points along the high pressure main can be undertaken without a requirement for heating the gas prior to pressure regulation. (The gas temperature falls by about 5°C for each 1,000 kPa of pressure reduction – where the temperature drop is sufficient to exceed process or contract limits it is necessary to install a fired heater to maintain the temperature of the pressure regulated gas).
2. Reduced operating pressures in residential areas contribute to increased levels of public safety.

The metropolitan section of the existing pipeline is designed as a Class 300 pipeline, with a maximum operating pressure of 5.0 MPa (ANSI Class 300), but it is understood to be currently operated at a maximum pressure of 4.6 MPa.

The high pressure mains installed in the Sydney metropolitan area operate at 3.5 MPa, while those installed in Melbourne operate at 2.8 MPa. Part of the reason for the lower pressures in Sydney and Melbourne is that the minimum winter temperature is lower in Melbourne than Sydney, and part of the reason is that the pressures satisfy the pipeline designers perception of a design for public safety.

There are recent examples of pipelines installed close to populated areas without any pressure reduction. The SEA Gas pipeline is one of these. The design was based on the process requirement to deliver specific load profiles, and on the pipeline route, which was selected to avoid areas planned for development for high population densities. This pipeline incorporates an effective “city gate station” at the location where it delivers gas to the metropolitan high pressure main system in Adelaide.

The new revision of AS 2885.1 will incorporate two provisions that will govern public safety of pipelines in residential areas. These are the “no rupture” provision and the provision that the energy release rate from any loss of containment must not exceed 10 GJ/s in residential areas, or 1 GJ/s in high rise areas.

The “no rupture” provision is satisfied by either:

- Designing the pipeline to operate at a stress level not exceeding 30% of the specified minimum yield strength of the pipe steel or;
- Designing the pipe thickness so that the critical through wall defect size is 150% of the maximum defect size that can be made by the identified external interference (or other) threat.

The energy release rate provision is satisfied by either:

- Reducing the operating pressure or;
- Increasing the pipeline thickness and grade to a value where it can be assured that the maximum size of a hole will satisfy the energy release rate or;
- A combination of each.

Designs with an operating pressure of 3.5 MPa and 5.0 MPa were considered for the optimised replacement pipeline. **Table 6-3** shows that the energy release rate from holes in the pipe reduces with the pipeline maximum operating pressure. The table suggests that pipelines operating at either 5.0 MPa or 3.5 MPa would comply with the intent of the proposed revision of AS 2885.1.

Table 6-3 Energy Release Rates (GJ/s) for Holes at Different MAOP's

Effective Hole Size (mm)	5.0 MPa	3.5 MPa
80	2.4	1.6
100	3.7	2.5
150	7.9	5.4

The proximity of the existing pipeline to residential development (the existing route) is such that the energy release rate proposed in the Draft Standard (10 GJ/s) is unlikely to reduce the risk to a tolerable level in many areas, and risk assessment would most likely require the design to be further enhanced to lower the maximum energy release rate, compared with a pipeline constructed along the proposed route.

Table 6-4 shows the delivery temperature for the two supply pressures at gas supply temperatures typical of Brisbane area winter soil temperatures, for a number of pressures that are typical of reticulation systems.

Table 6-4 Temperature of Gas Downstream of Pressure Regulator

Outlet Pressure (MPa)	Outlet Temperature (°C)	
	Inlet Pressure = 5.0 MPa at 20°C	Inlet Pressure = 3.5 MPa at 20°C
1.0	-0.4	7.5
1.5	2.4	10.1
2.0	5.1	12.7
3.0	10.4	17.6
Outlet Pressure (MPa)	**Outlet Temperature (°C)**	
	Inlet Pressure = 5.0 MPa at 17°C	**Inlet Pressure = 3.5 MPa at 17°C**
1.0	-9.9	4.2
1.5	-1.1	6.9
2.0	1.7	9.5
3.0	7.1	14.6

A pipeline system that operates at 3.5 MPa offers a clear advantage over one that operates at 5.0 MPa on the basis of lowest temperature delivered downstream of the pressure regulator. The minimum temperature is important when there are components in the gas that will condense at low temperatures.

Because it offers a combination of increased safety and greater flexibility for gas distribution customers, the optimised pipeline should be based on the metropolitan pipeline designed for a maximum allowable operating pressure of 3.5 MPa. However the technical reasons are not compelling and given that the existing pipeline has operated safely in the environment it is difficult to justify an increased pipeline cost for a lower operating pressure design.

Hydraulic calculations were undertaken for metropolitan pipelines operating at both 5.0 MPa and 3.5 MPa and costs developed for both designs to enable a cost comparison of the alternative operating pressures.

7. PIPELINE HYDRAULIC DESIGN

7.1 GENERAL

The pipeline hydraulic design was undertaken using the unsteady state modelling software "FlowTran". This product is used by most Australian transmission pipelines and has a documented history as an effective and reliable model of gas pipeline systems operating under unsteady state conditions.

The model pipeline represents the existing pipeline with connected supplies and demands. The pipeline follows the existing route, and centreline dimensions to the proposed deviation at Haigslea. The pipeline dimensions from here to the Gibson Island terminal represent the proposed route for the new pipeline discussed in Section 5. **Figure 7-1** presents a graphical representation of the pipeline hydraulic model.

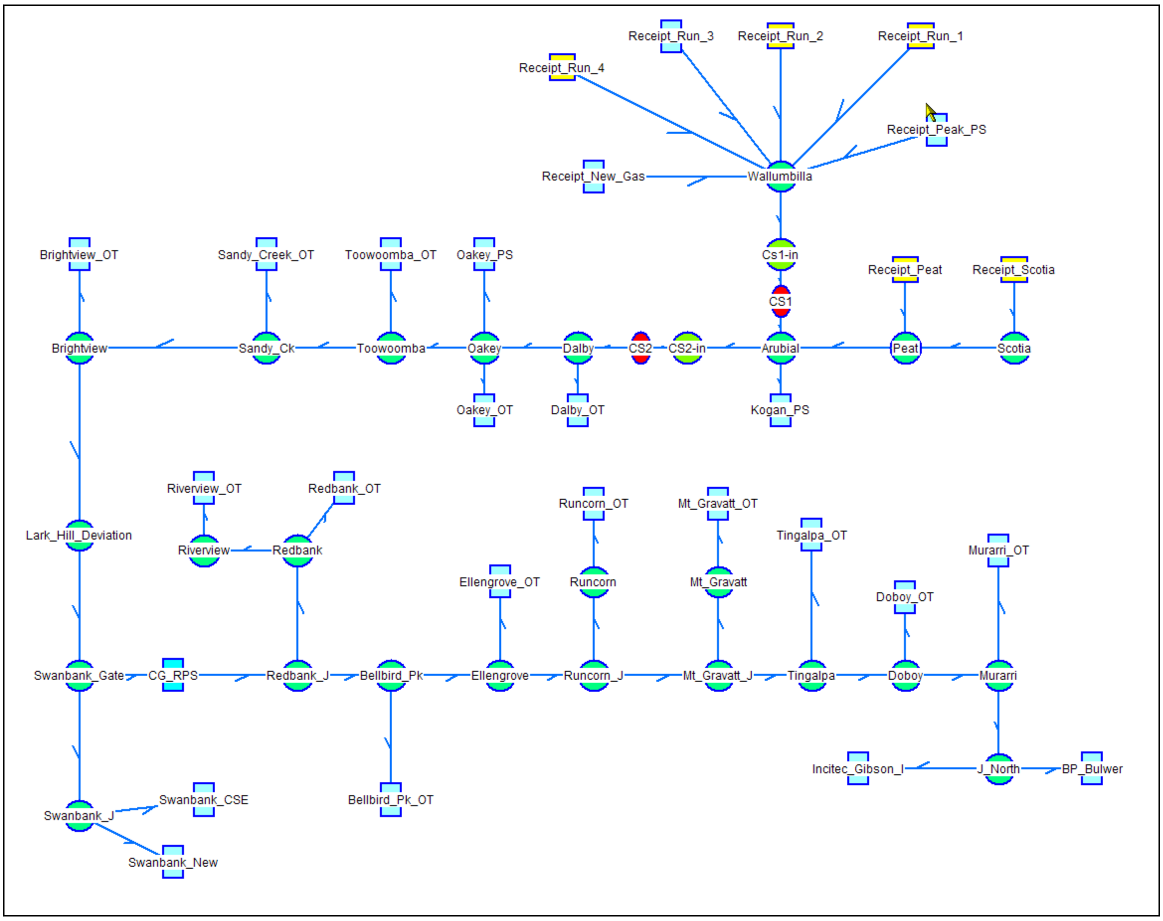

Figure 7-1 Pipeline Hydraulic Model Overview

Symbols used in the model are:

- Yellow squares = Constant pressure or constant flow nodes
- Blue rectangles = Flow regulator, either supply or delivery
- Red circles = Compressor stations
- Green circles = Junctions connecting pipes

- Blue lines = Pipeline

7.2 MODELLING CONDITIONS

[confidential]

These three changes in load represent reasonable points in time for changes in investment to the pipeline to provide for increased pipeline capacity.

Thus at:

2005 The pipeline is installed with equipment to support the load forecast in 2008.

2008 Investment is made to provide the pipeline with the capacity it requires to deliver the load forecast for 2011.

2011 Investment is made to provide the pipeline with the capacity it requires to deliver the load forecast for 2017.

Three pipeline diameters with different operating pressures and compressor configurations are considered for the rural pipeline, and two diameters with different operating pressures are considered for the metropolitan pipeline. The development required for each of these designs at the required development stages is determined by hydraulic modelling.

7.3 LIMITING PIPELINE CONDITIONS

The limiting conditions established for the unsteady state model during any simulation are:

1. The pressure at the Swanbank Power station must not fall below 4.5 MPa (based on current obligations).
2. The pressure at the Gibson Island delivery point must not fall below the 1.5 MPa (based on current contractual obligations)
3. The maximum pressure is not permitted to exceed the selected maximum allowable operating pressure of the pipeline.
4. The gas is received into the pipeline each day in the amount in which it is delivered, except for peak load power stations, which are required to deliver their weekly demand at a constant hourly rate equal to the weekly demand divided by 168 (hours).
5. The pipeline storage capacity must be sufficient to allow it to store gas received during periods of low load and deliver the gas at periods of high load on a weekly cycle. The pipeline model simulation is run for a period of 3 or 5 weeks to show that the operating load cycle can repeat essentially for ever. This is assessed by inspection of the line pack over the last two weekly cycles.
6. There is a special supply profile for the existing Oakey power station.
7. Each gas fired power station is assumed to operate each day in accordance with a nominated cycle. Operating cycle were nominated by APT for power stations with the following load classifications:
    - Peak;

- Intermediate, and;
- Intermediate/base load

These load profiles are understood to be based on current and forecast operation for gas fired power stations in the region.

Because a significant proportion of the forecast load will supply gas fired peak, intermediate or intermediate/base load power stations that operate for a portion of the day, the pipeline design is governed by a requirement to store gas during periods when the power stations are not operating. This requirement has greater impact on the physical dimensions of the pipeline than the size required to actually transport the average daily throughput.

To ensure that the commercial obligations in relation to gas supply are satisfied, the pipeline model controls both the gas receipt and the gas delivery. Because a proportion of the gas entering the pipeline is consumed as fuel, and the fuel varies with the compressor duty, some professional experience based judgement is exercised to identify the conditions that satisfy the repeating conditions rather than undertaking exhaustive iterative calculations to reach an exactly balanced solution.

Except in cases where the pipeline clearly has inadequate capacity, the pipeline pressure profile typically shows that the pressure between Wallumbilla and the intermediate compressor station (when required) is lower than MAOP. This shows that the intermediate compressor station is required to operate at maximum power levels to transfer the gas received into the pipeline the downstream section to provide line pack to satisfy the cyclic demand.

7.4 MODEL DEVELOPMENT

The pipeline model was developed to satisfy the largest load in the forecast period [confidential]. The model was then run for the loads forecast in 2011, 2008 and 2005 to establish the pipeline configuration required for the load at that time.

The pipeline model considers a single diameter pipeline whose capacity is expanded ahead of the forecast load growth by the installation or expansion of compression.

Looping was considered as a method of expanding capacity, but an assessment indicated that the load growth characteristic favoured capacity expansion by compression, rather than by a reduction in pipeline friction loss (ie, looping). [Confidential] Looping with large diameter pipe does increase the effective pipeline volume which in turn provides capacity to increase the pipeline line pack, and consequently to satisfy increased cyclic demand from gas fired power stations. However to be effective, a large volume increase (ie, a long length of looped pipeline) is required, together with increased compression.

Where the demand can be satisfied by increased compression, it is the most cost effective approach because of the high cost associated with constructing a parallel pipeline.

7.5 DN 400 PIPELINE – WALLUMBILLA TO SWANBANK

Hydraulic modelling first considered the ability of a DN 400, ANSI Class 900 (15.3 MPa) pipeline to support the forecast [Confidential] load.

Modelling showed that the volume of a DN 400 pipeline is insufficient to absorb the line pack required to sustain the forecast power station intermittent loads.

The performance of this pipeline is illustrated in **Figure 7-2** and **Figure 7-3**.

Figure 7-2 shows that at the commencement of the load week (08:00, Monday), the pipeline is essentially fully packed, with a small pressure gradient required to transport the base loads.

Figure 7-3 shows that by Wednesday, the pipeline is not able to deliver from line pack and essentially steady state inputs, the flow required by power station loads at Swanbank (approx 725 hours through the simulation).

The only way that this pipeline could satisfy the load is to substantially expand its storage capacity by looping (**Figure 7-2** shows that additional compression cannot provide any significant increase in line pack).

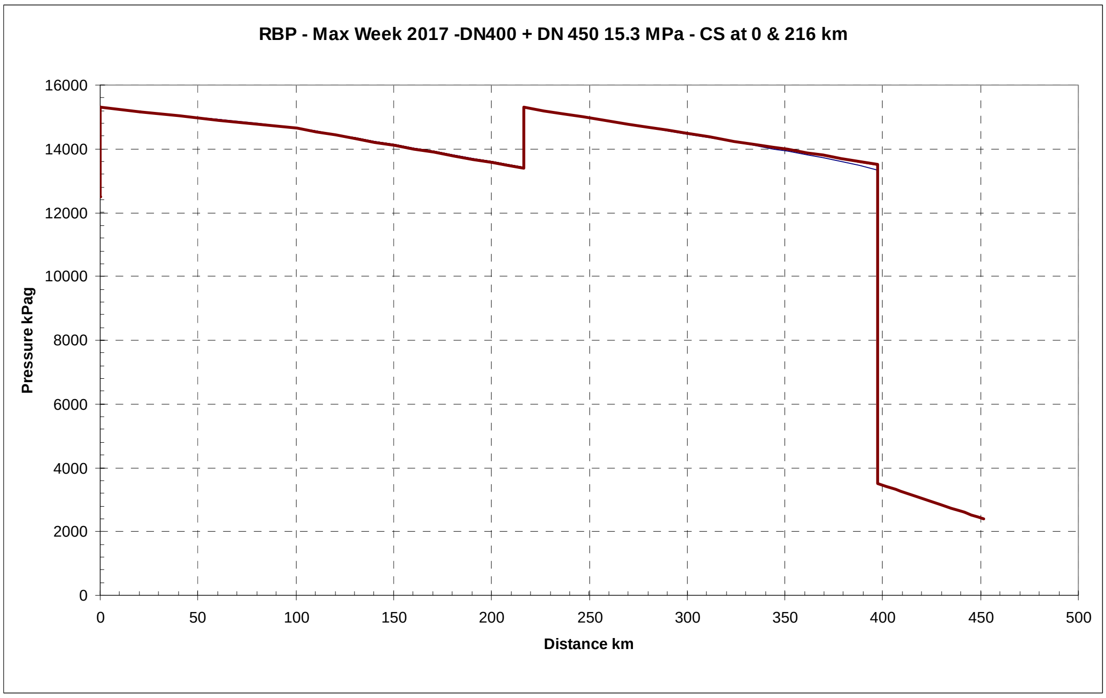

Figure 7-2 Pressure Profile of Packed DN 400, 15.3 MPa Pipeline (08:00 Monday)

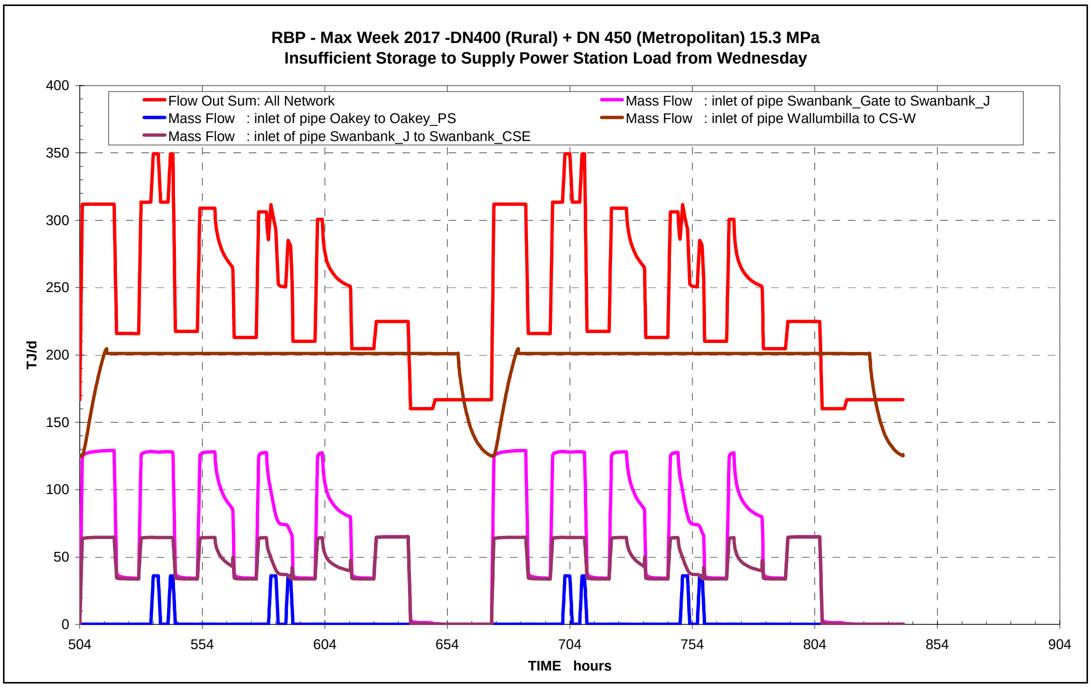

Figure 7-3 Flow Profile from DN 400 Pipeline – Delivery Shortfall from Wednesdays

The hydraulic model was run for the maximum [confidential] load to assess whether there was a possibility that the DN 400 pipeline could reasonably be used, with future capital injections between the initial installation (either 2005 or 2001).

This showed that the DN 400 pipeline could be used, but it would require either:

- An initial and a single intermediate compressor station with a compressor power of 9 MW or;
- An initial and two intermediate compressor stations each with a compressor power of 5 MW.

Given that substantial pipeline looping would be required to provide the storage volume to achieve the 2017 load, and given that the compression required to deliver the 2011 (and 2008) loads is excessive, the DN 400 pipeline option was abandoned.

7.6 DN 500 – 12.5 MPa Pipeline Design – Wallumbilla to Swanbank

A DN 500 pipeline between Wallumbilla and Swanbank, designed for a maximum allowable operating pressure of 12.5 MPa, and equipped with a single, mid line booster compressor station will satisfy the forecast pipeline maximum week supply and demand forecast[confidential].

The pipeline parameters are shown in **Table 7-1**.

Table 7-2 presents the basic facilities required for the pipeline.

Where practicable, facilities are co-located with identified gas delivery points.

Facilities are installed on an as-required basis, consistent with the requirements of AS 2885, and the land use categories along the pipeline, with consideration of the potential for development along the pipeline route during the life of the pipeline.

The pipeline design complies with the basic design parameters outlined in Section 6.2.

The pipeline has a single mid line scraper receiver-launcher facility.

The mid line booster compressor is located at this facility.

Provision is made for installation of a future compressor to increase capacity if required at kP 100.

Table 7-1 Pipeline Parameters - DN 500 Pipeline

Wallumbilla to Swanbank City Gate

Parameter	Value
MAOP	12.5 MPa
Diameter	508 mm
Grade	API Grade X70
Wall thickness (Standard)	9.2 mm
Wall thickness (Heavy)	11.0 mm
Overall Length	396.9 km
Length of Standard Pipe	361.4 km
Length of Heavy Pipe	35.5 km
Steel	45,700 tonnes
Pipeline Coating	Tri-laminate 250 / 125 / 1000 micron
Pipe Coating (Bores & HDD’s)	Tri-laminate 250 / 125 / 3000 micron

Table 7-2 Pipeline Facilities – Wallumbilla to Swanbank City Gate

Site Name	Location (kP)	Separation (km)
Wallumbilla Scraper Launcher	kP 0	-
MLV 1 (Arubial)	kP 100	100
Dalby Scraper Receiver-Launcher	kP 216	216 (scraper), 116 (MLV)
MLV 2 (Oakey)	kP 269.2	53
MLV 3 (Sandy Creek)	kP 323.6	54
MLV 4 (Lark Hill)	kP 369.1	46
Swanbank Gate Scraper Receiver	kP 396.6	181 (scraper), 28 (MLV)

This pipeline configuration, with a compressor station at Dalby will deliver the maximum weekly demand on a repeating cycle. **Figure 7-4** illustrates the pressure profile in the pipeline under this load scenario for each day of a 7 day cycle. The figure also shows the pipeline pressure profile at 21:00 hours on Friday. This is a limiting condition, where the delivery pressure at Swanbank power station has fallen practically to the minimum contract pressure of 4,500 kPa.

The model represented in **Figure 7-4** operates the booster compressor at maximum discharge pressure continuously, transferring gas from the pipeline upstream of the Dalby Compressor for storage in the pipeline on the load side of the compressor.

The model represented in **Figure 7-5** shows the performance of the same pipeline with the compressor located at Arubial (kP 100). At this location, the compressor power demand is a little lower than that for the Dalby location.

This shows that either compressor location will satisfy the forecast load. In the absence of any other criteria, a location at about kP 150 (in the vicinity of Wambo) represents the optimal location, providing a good balance between operating flexibility and fuel demand.

The Dalby location was selected as the intermediate compressor station location for this study because it does permit a future capacity increase by the addition of a second mid line compressor station, should that be required.

For the purpose of this study, the location of the compressor station does not impact on the capital cost estimate.

In each case, flow into the pipeline is controlled so that the gas receipt during the maximum week is the same (less compressor fuel) as the gas delivered.

The illustration shows that the line pack in the pipeline is less than the maximum that could be stored in the pipeline (the section upstream of the compressor does not reach its maximum pressure during the operating cycle). This is because the gas is required on the delivery side of the compressor. Inspecting the slope of the graphs, it is apparent that a higher pressure (15.3 MPa) pipeline with a single compressor station at the pipeline inlet may also provide an acceptable hydraulic solution.

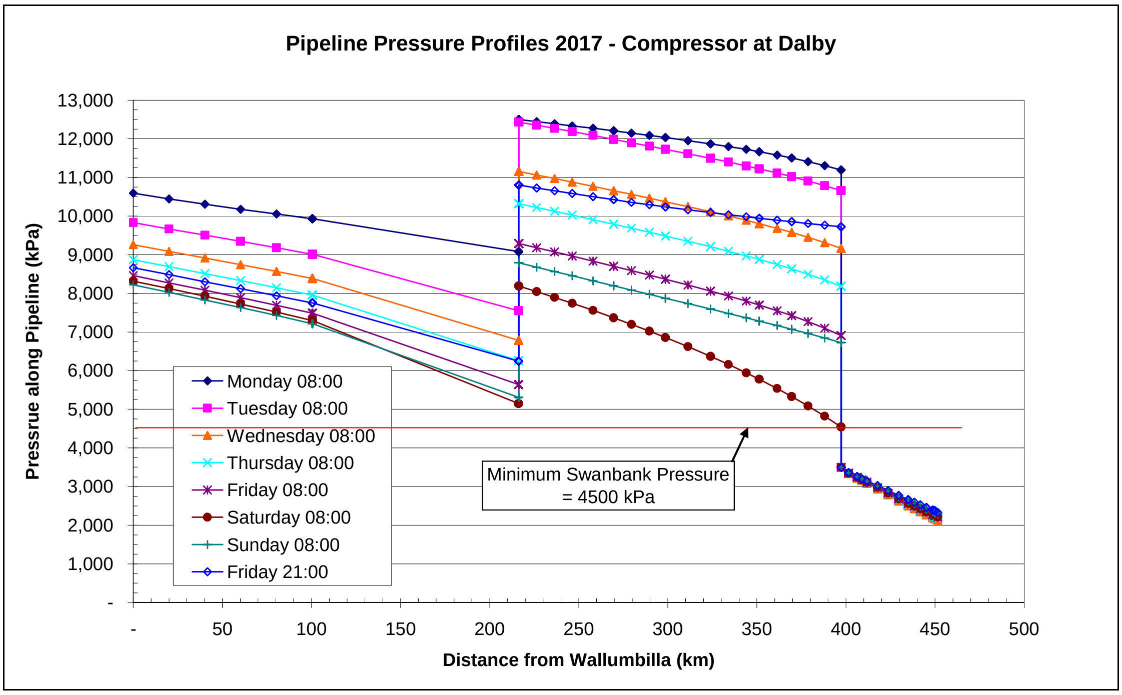

Figure 7-4 Daily Pipeline Pressure Profile - DN 500 Pipeline – Dalby Compressor

The fact that the pipeline does not fully pack the pipeline section between Wallumbilla and the compressor station at the end of the weekend period shows that the design has a little spare capacity (it is unlikely that the forecast load on which the pipeline design is optimised and the maximum capacity of the optimised design will coincide exactly, because the pipelines are built from a standardised sequence of diameters).

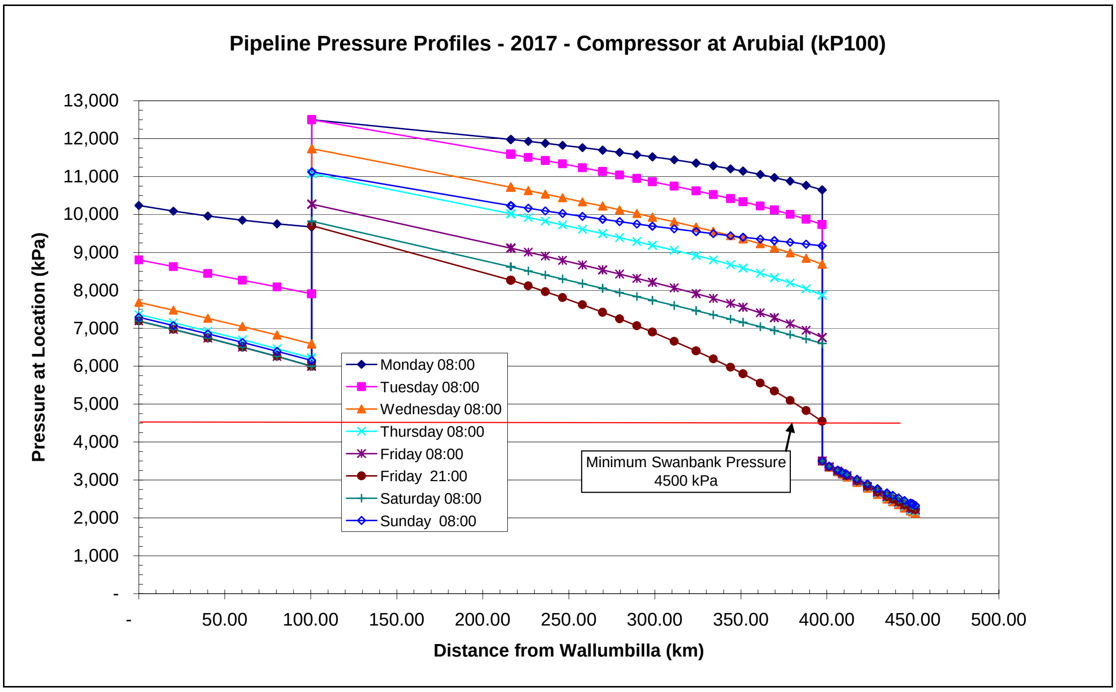

Figure 7-5 Daily Pipeline Pressure Profile - DN 500 Pipeline – Arubial Compressor

Compression requirements for the pipeline by forecast year are shown in **Table 7-3**.

Table 7-3 DN 500 Pipeline - Compressor Power by Year

Year	Compressor Power (MW)	
	Wallumbilla	Intermediate
2005	-	2.5
2008	4	3.5
2011	4	5
2017	5	5

The DN 500 pipeline operated at 12.5 MPa will not deliver the forecast 2017 load with a single compressor at Wallumbilla. While a single Wallumbilla compressor station is capable of packing the pipeline to practically its maximum line pack by 08:00 on Mondays, the pressure at Swanbank falls during the weekly operating cycle to the minimum pressure during Thursday and Friday. Consequently supply to the power stations must be curtailed.

To resolve this, a mid-line compressor must be used to transfer line pack from the Wallumbilla end of the pipeline to the Swanbank end.

If the DN 500 pipeline was pressure rated to 15.3 MPa operating pressure, then the 2017 delivery obligations could be satisfied with a single compressor station.

While this is a comfortable design, it does not represent an optimised design because of the increased steel (9,500 tonnes) required to accommodate the higher pressure. The additional steel will raise the initial capital cost by around $13M.

7.7 DN 450 – 15.3 MPa Pipeline Design – Wallumbilla to Swanbank

To satisfy the gas transport and storage requirements in 2017, the DN 450 pipeline must be designed with a maximum allowable operating pressure of 15.3 MPa.

The pipeline parameters are shown in **Table 7-4**.

Table 7-4 Pipeline Parameters - DN 450 Pipeline

Parameter	Value
MAOP	15.3 MPa
Diameter	457 mm
Grade	API Grade X70
Wall thickness (Standard)	10.1 mm
Wall thickness (Heavy)	12.1 mm
Overall Length	396.9 km
Length of Standard Pipe	361.4 km
Length of Heavy Pipe	35.5 km
Steel	44,950 tonne
Pipeline Coating	Tri-laminate 250 / 125 / 1000 micron
Pipe Coating (Bores & HDD's)	Tri-laminate 250 / 125 / 3000 micron

Figure 7-6 and **Figure 7-7** present pressure profiles of the DN 450 pipeline operated with an initial and a booster compressor, with the booster compressor located at either kP 100 or kP 216.

The pipeline configuration is similar in all respects to that of the DN 500 pipeline, except in its diameter and operating pressure.

Table 7-5 shows the compressor power required through the forecast period for this study.

Table 7-5 DN 450 Pipeline - Compressor Power by Year

Year	Compressor Power (MW)	
	Wallumbilla	Intermediate
2005	1.5	4.5
2008	3.5	5
2011	5	5
2017	5	5

To achieve sustained maximum week demand, the booster compressor is required for the DN 450 pipeline from 2005.

The power nominated at the intermediate compressor station represents the power absorbed by the model compressor, limited to 5 MW. In 2005 a smaller unit could be used, and operated under power limited mode, rather than operating over a wide power band permitted by a larger unit.

For the purpose of this study, refinement of the compressor unit does not materially affect the capital cost estimate.

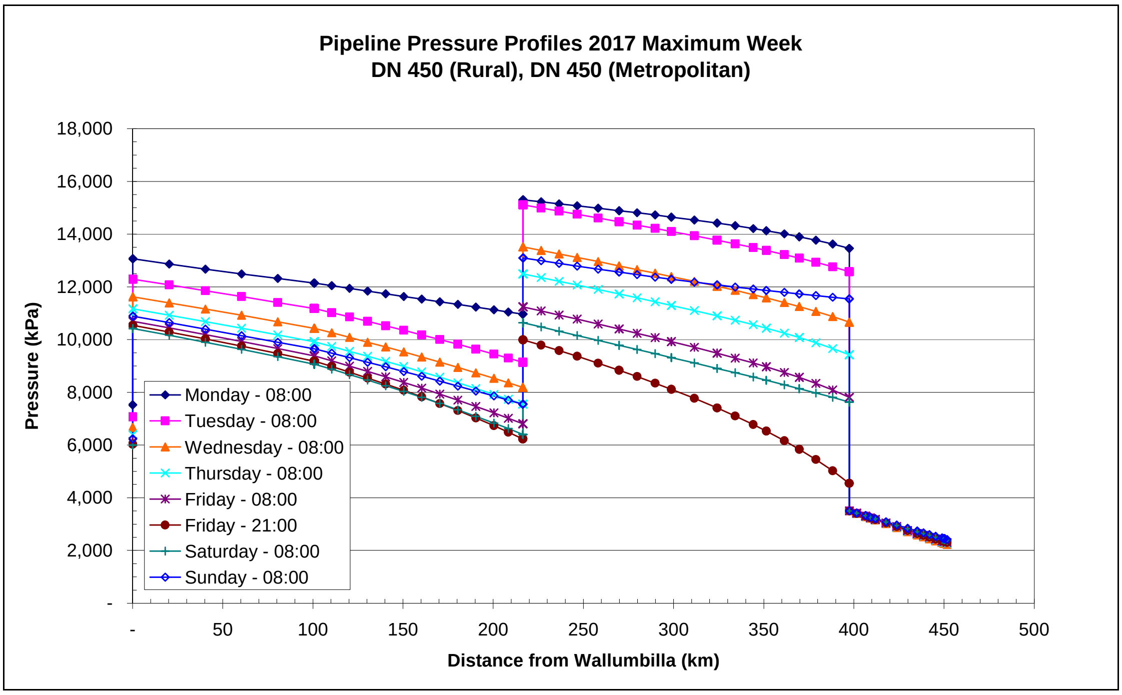

Figure 7-6 Pressure Profiles - 2017 Maximum Week - DN 450 Pipeline (Wallumbilla to Swanbank)

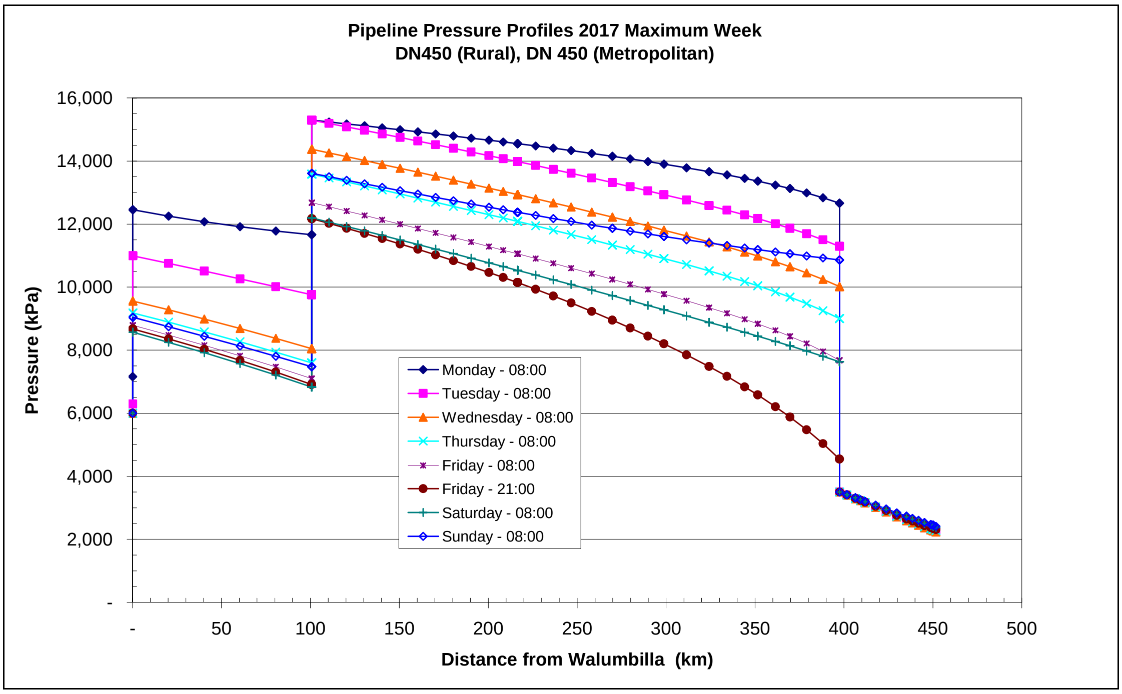

Figure 7-7 Pressure Profiles - 2017 Maximum Week - DN 450 Pipeline (Wallumbilla to Swanbank) – Alternative Compressor Location

7.8 SCOTIA AND WOODROYD (PEAT) PIPELINE

The existing pipeline receives gas at Arubial (kP 100) from coal seam methane gas resources at Woodroyd and Scotia, 111 and 120 km north of the Arubial site at kP 100.

The existing pipeline is DN 250, with a maximum allowable operating pressure of 10.2 MPa.

This design is retained for the replacement pipeline except that the MAOP is increased from 10.2 MPa to 15.3 MPa for the pipeline supplying the DN 500, 12.5 MPa pipeline.

For the pipeline supplying the DN 450, 15.3 MPa pipeline the MAOP of the lateral pipeline is 18 MPa. This pressure increase provides the pipeline with the capacity to deliver into the pipeline at its maximum operating pressure.

The design pressure of the lateral pipeline feeding into a DN 450 pipeline might be unnecessarily conservative, given that the maximum pressure at the connection point based on hydraulic analysis is approximately 12.5 MPa (**Figure 7-6**) (because the pipeline pressure is drawn down by the intermediate compressor station.

For the purpose of this study, the design has assumed that normal operation will not require the higher pressure until some future time when future demands may require the pressure at the connection point to be raised to MAOP.

Consequently, for the DN 450 pipeline option only the additional pipe material is provided to allow future upgrade to the higher operating pressure. If this is required, additional cost will be incurred to upgrade compressors and station piping at that time.

7.9 PIPELINE DESIGN - SWANBANK TO GIBSON ISLAND

The metropolitan section of the pipeline has an additional constraint which is evident from the existing pipeline – future modification to expand the pipeline capacity will be very costly, because of land use change through the life of the pipeline. Consequently it is essential that the metropolitan pipeline is designed with the capacity required to deliver the maximum forecast load in its forecast design life. Capacity expansion by looping is unlikely to be capable of justification on the basis of incremental growth.

Hydraulic designs were developed for two pipeline diameters, DN 500, operating at 3.5 MPa, and DN 450, operating at 5.0 MPa.

The physical configuration of each pipeline is similar – the only change is the maximum operating pressure for each design. The operating pressure / wall thickness selection is predominantly based on public safety issues discussed in Section 6.4.

Table 7-6 presents the parameters of the two pipeline designs considered.

Table 7-6 Pipeline Parameters - Metropolitan Pipeline		
Parameter	**Value**	
MAOP	3.5 MPa	5.0 MPa
Diameter	457 mm	406
Grade	API Grade X56	API Grade X56
Wall thickness (Standard)	10.0 mm	10.0 mm
Wall thickness (Heavy)	-	-
Excavator Size to Puncture (tiger teeth)	25-40 tonne	25-40 tonne
Approximate Hole Size	90-140 mm	90-140 mm
Hoop Stress (% SMYS) at MAOP	21%	26%
Overall Length	57 km	57 km
Length of Standard Pipe	57 km	57 km
Length of Heavy Pipe	- km	- km
Pipeline Coating	Tri-laminate 250 / 125 / 1000 micron	
Pipe Coating (Bores & HDD's)	Tri-laminate 250 / 125 / 3000 micron	

Because of the proximity of the pipeline to residential and industrial areas throughout most if its length each pipeline is conservatively designed. Each pipeline will not fail by rupture should it be punctured because the hoop stress at MAOP is less than 30% of the specified yield strength (SMYS) of the pipe.

Each pipeline has a high level of resistance to puncture. The energy release rate from either pipeline under an extreme, but credible puncture scenario will not exceed the 10 GJ/s limit proposed to be introduced in the forthcoming revision of AS 2885.

Because the new pipeline will be constructed along a new alignment for most of its length, the pipeline is not located adjacent to existing delivery points at Riverview, Redbank, Runcorn, and Mt Gravatt. A lateral pipeline is also required from the Swanbank City Gate Station to the Swanbank Power Station. **Table 7-8** presents the parameters for each of these pipelines.

Each lateral pipeline is designed to be inspected using in-line inspection tools, but permanent scraper launcher and receiver equipment is not installed because the equipment is used infrequently, and the cost of permanent installation is not justified. One pair of scraper launcher and receivers for the pipelines is provided in the allowance for operating spares.

A DN 350 pipeline operating at 5.0 MPa was considered for the Metropolitan pipeline. Modelling showed that it was not capable of sustaining the minimum end of pipeline pressure.

Both the DN 450 and the DN 400 pipelines satisfy the hydraulic design requirement to deliver gas at a pressure not less than 1,500 kPa at the Gibson Island plant. **Figure 7-8** and **Figure 7-9** illustrate the pressure profile in each pipeline for the design week in 2017, and show that each pipeline will exceed the minimum delivery pressure.

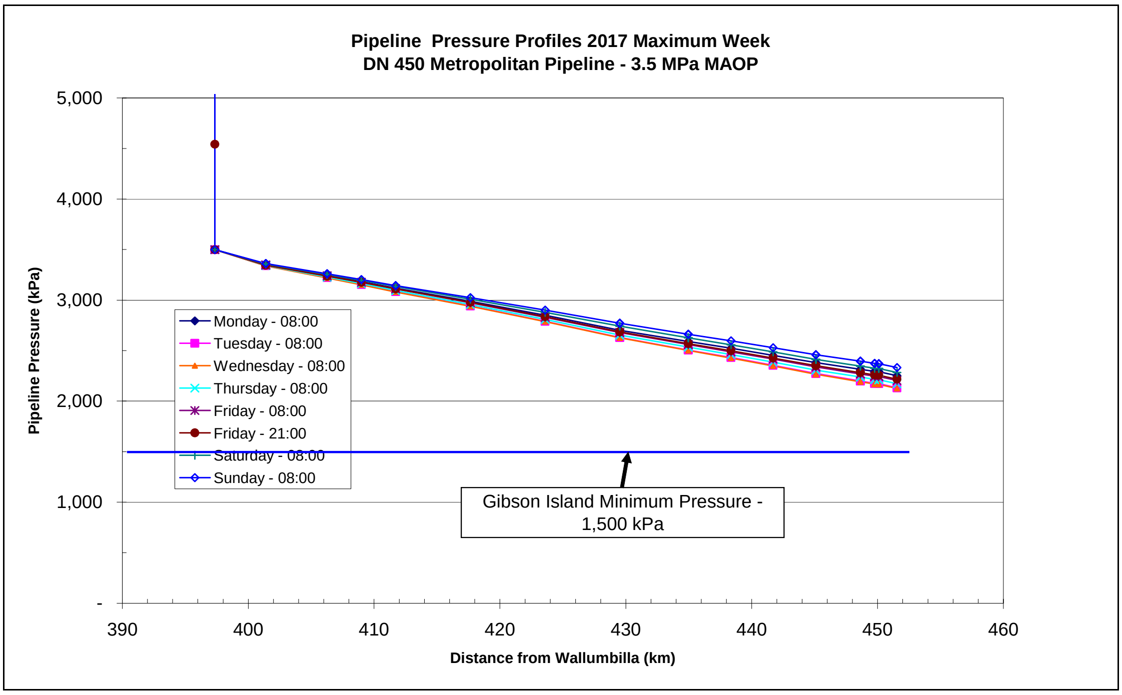

Figure 7-8 Daily Pipeline Pressure Profile - DN 450 Metropolitan Pipeline

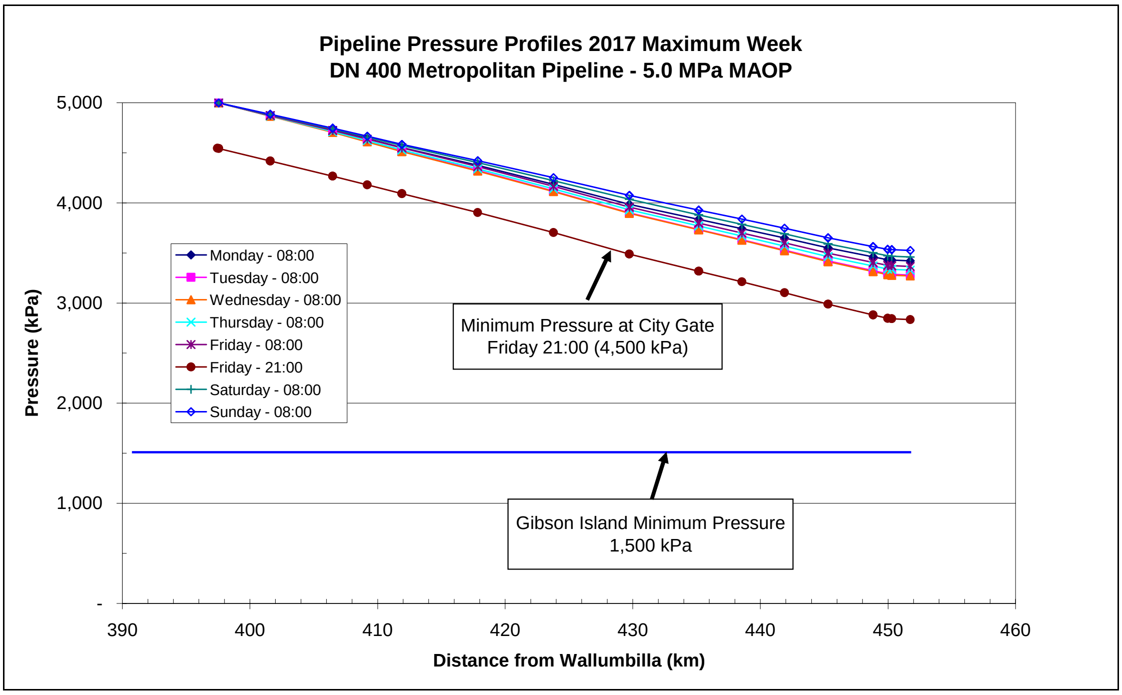

Figure 7-9 Daily Pipeline Pressure Profile - DN 400 Metropolitan Pipeline

The DN 400 pipeline has more capacity than the DN 450 pipeline, by virtue of its higher design pressure.

Three remotely actuated valves are installed along the metropolitan pipeline, with a nominal separation of 15 km between isolation points, in accordance with the requirements of AS 2885. Pipeline inlet and terminal isolation valves provide inlet and outlet isolation.

There are ten (10) sites along the existing pipeline to which gas is delivered in the metropolitan area. The new pipeline must supply each of the existing facilities. Where the new pipeline can be routed close to an existing facility, the new pipeline offtake will be located adjacent to the existing offtake facility. At other locations, a short pipeline installed between the pipeline and the existing facility will be constructed.

Table 7-7 shows the location and type of each facility installed on, or connected to the metropolitan pipeline.

Table 7-7 Pipeline Facilities - Metropolitan Pipeline

Site Name	Location (kP)	Distance between Sites (km)
Swanbank Scraper Launcher	kP 396.9	-
Redbank Lateral Offtake	kP 406	
MLV–B1 (Ellengrove) & Offtake	kP 411.2	14.3
MLV-B2 (Woodridge)	kP 424.5	13.3
Runcorn Sales Stn. Offtake		
MLV-B3 (Mt Gravatt)	kP 437.6	13.1
Mt Gravatt Sales Stn. Offtake	kP 437.6	
Tingalpa Sales Stn Offtake	kP 448.1	
Doboy Sales Stn. Offtake	kP 451.7	
Murrarrie-Bulwer Sales Stn. Offtake	kP 452	
Gibson Island Scraper Receiver & Delivery Stn.	kP 453.5	56.6 (scraper), 15.9 (MLV)
Redbank Sales Stn. Offtake	kP 1.0	Stations on DN 150 Lateral pipeline, 5 km long
Riverview Sales Stn Offtake	kP 5.0	
Runcorn Sales Stn Offtake	kP 2.6	Station on DN 200 Lateral
Mt Gravatt Sales Stn. Offtake	kP 1.0	Station on DN 200 Lateral

Table 7-8 Pipeline Parameters – Metropolitan Lateral Pipelines

Parameter	**Value**			
MAOP	12.5 MPa	As Metropolitan Pipeline		
	Swanbank	Redbank	Runcorn	Mt Gravatt
Diameter	DN 300	DN 150	DN 200	DN 100
Grade	X 70	X 42	X 42	X 42
Wall thickness (Standard)	8.4 mm	6.4 mm	6.4 mm	6.0 mm
Wall thickness (Heavy)	-	-	-	-
Excavator Size to Puncture (tiger teeth)	>25 t	>10 t	>10 t	>10 t
Approximate Hole Size	80-120	60-90	60-90	60-90
Hoop Stress (% SMYS) at MAOP	50	23	30	16
Overall Length	1.5 km	5.0 km	2.6 km	1.0 km
Length of Standard Pipe	1.5 km	5.0 km	2.6 km	1.0 km
Length of Heavy Pipe	-	-	1	-
Pipeline Coating	Tri-laminate 250 / 125 / 1000 micron			
Pipe Coating (Bores & HDD's)	Tri-laminate 250 / 125 / 3000 micron			

8. PIPELINE STATIONS

8.1 GENERAL

A number of stations are constructed to supply gas to the pipeline, to transfer gas through the pipeline and to deliver gas to users at nominated points along the pipeline.

This section discusses the receipt and delivery facilities.

8.2 WALLUMBILLA RECEIPT STATION

The Wallumbilla Station receives gas from each production source, meters the gas and compresses to pipeline pressure.

The existing Wallumbilla facility has four (4) gas receipt systems.

This study assumes that these facilities are retained for the new pipeline. It is assumed that the equipment and associated piping, control equipment and instrumentation are sufficient to accommodate the increased flows from the respective gas sources, with minor upgrading to supply the "new" pipeline.

The existing supplies, after metering, are co-mingled and delivered to the pipeline inlet compressor (new).

APT expects that there will be "new" gas supplies to deliver part of the load growth anticipated through the term of this optimised design. Three "new' supplies are currently expected to be connected via new receipt stations in 2006 and 2007, and others may follow. These supplies are derived from developing coal seam methane gas resources.

These new receipt points may be constructed on the pipeline downstream of Wallumbilla. However in designing the pipeline it is prudent to assume all "new" gas will be received at the Wallumbilla pipeline inlet as contracts generally allow shippers to provide gas at multiple receipt points.

This study assumes that "new" gas will be supplied under contract at a pressure sufficient to be delivered into the pipeline at maximum pipeline pressure. It also assumes that the supply contract will include plant and control equipment compatible with the RBP systems that will meter and control the flow of gas into the pipeline.

Beyond minor upgrading no significant change is anticipated to the existing Wallumbilla facilities to supply the new pipeline.

8.3 SCOTIA AND WOODROYD RECEIPT STATIONS

Scotia and Woodroyd are two locations on the pipeline known as the Peat Lateral that receive gas extracted from coal seam methane gas resources. At each location gas is conditioned, cleaned, metered and delivered via flow control valves to the pipeline inlet by the gas producer.

Each pipeline receipt station consists of an actuated pipeline isolation valve that connects the gas production facility to the pipeline.

Each site also includes communications equipment for site monitoring and control, and to receive gas flow data provided by the gas supplier for management of the RBP.

The Scotia station also incorporates an end of line cathodic protection unit.

Because the optimised pipeline requires the lateral pipeline to be operated at a higher pressure, additional compression will be required at both the Woodroyd/Peat and the Scotia stations. Allowance for this (compressor power to raise the pressure from 10.2 MPa to the required delivery pressure) is included in the capital cost estimates using a unit cost per kW of compression.

At 2017, the incremental compression power to raise the pressure of the produced gas from 10.2 MPa (the current value) to 15.3 MPa (the maximum value) is:

- For Woodroyd – Peat production = 320 kW
- For Scotia = 500 kW

A capital cost allowance is applied to the inlet facility at each location. More detailed study may show that it is more appropriate to make one installation at Woodroyd-Peat, compressing gas from both production locations in one installation.

8.4 DELIVERY STATIONS

Delivery stations connected to the pipeline, their ownership and operatorship are shown in **Table 8-1**.

The APT owned stations are each on the transmission (high pressure) pipeline. The Dalby site and each of the metropolitan sites are owned by others. For these sites, APT will provide only the connecting pipeline and an actuated isolation valve.

Table 8-1 Pipeline Delivery Stations

Location (kP)	Station Name	Nominal Capacity (TJ/d)	Ownership
100	Arubial	15	APT owned and operated
216	Dalby	2	APT = Actuated Station Isolation Valve Other equipment on the site owned and operated by customer
269	Oakey	2	APT owned and operated
	Oakey Power Station	10	APT = Actuated Station Isolation Valve Other equipment on the site owned and operated by customer
298	Toowoomba	6	APT owned and operated
323	Sandy Creek	2	APT owned and operated
351	Brightview	2	APT owned and operated
397	Swanbank City Gate	160	APT owned and operated
	Swanbank CSE	70	APT = Actuated Station Isolation Valve Other equipment on the site owned and operated by customer
	Swanbank Future Power Station	70	APT = Actuated Station Isolation Valve Other equipment on the site owned and operated by customer
	Riverview	3	APT = Actuated Station Isolation Valve & scraper receiver

Table 8-1 Pipeline Delivery Stations			
Location (kP)	**Station Name**	**Nominal Capacity (TJ/d)**	**Ownership**
			Other equipment on the site owned and operated by customer
	Redbank	5	APT owned and operated
411	Ellengrove	10	APT = Actuated Station Isolation Valve Other equipment on the site owned and operated by customer
429	Runcorn	20	APT = Actuated Station Isolation Valve Other equipment on the site owned and operated by customer
435	Mt Gravatt	5	APT = Actuated Station Isolation Valve Other equipment on the site owned and operated by customer
447	Tingalpa	15	APT = Actuated Station Isolation Valve Other equipment on the site owned and operated by customer
448	Doboy	3	APT = Actuated Station Isolation Valve Other equipment on the site owned and operated by customer
449	Murarrie	40	APT = Actuated Station Isolation Valve Other equipment on the site owned and operated by customer
449	Bulwer Island	35	APT = Actuated Station Isolation Valve Other equipment on the site customer
451	Gibson Island	50	APT = Actuated Station Isolation Valve and scraper receiver, Other equipment on the site owned by customer and operated by APT

Except for the Arubial delivery site, the design configuration of each of the APT owned (high pressure) delivery sites is similar. These incorporate:

- An actuated station inlet isolation valve.
- Inlet gas filtration (typically with a duty and standby filter).
- Inlet gas heating (typically with a gas fired duty and a standby natural draft water bath gas heater). Except at Swanbank, a single heater vessel is used, with redundancy being provided by the installation of two fire tubes, burner assemblies and burner control units. Swanbank incorporates separate 100% capacity heaters.
- Custody transfer gas metering. Smaller sites (up to about 20 TJ/d) will use dual coriolis meters, installed on a skid and configured for series (duty/check) or parallel (both duty, or one removed for maintenance). Larger sites will use dual ultrasonic meters that are similarly configured.

- Pressure regulation. Smaller sites will use two pressure regulation runs. The duty run will be configured with two control valves (active and monitor) and a high pressure shut down valve. Larger sites will use two runs each configured with an active and monitor regulating valve, and a high pressure shut down valve).
- Noise control sufficient to satisfy environmental compliance requirements. This will include a combination of site and equipment selection, equipment treatment and where necessary acoustic enclosures.
- A control system, including flow computation, site monitoring and control and communications with the pipeline control system.
- Security fencing, access road, and improvements for visual amenity.

Because the Arubial site is only required to limit the maximum pressure of gas entering the main pipeline, it does not include:

- Gas filtration
- Gas heating
- Gas metering
- Flow control

The City Gate station at Swanbank will be equipped with a duty and standby gas chromatograph which will provide gas composition and specific energy data for use in custody transfer metering at each delivery point.

The forecast demand east of the Swanbank City Gate Station will increase throughout the project. The station piping and layout is designed for the maximum demand through the forecast period. However, equipment is installed incrementally to provide the capacity required in each period of the forecast.

The nominal maximum capacity of the city gate station through the forecast period is shown in **Table 8-2**.

Table 8-2 Swanbank City Gate Station - Nominal Installed Capacity

Forecast Demand Year	Nominal Maximum Throughput Required (TJ/d)	Nominal Installed Maximum Capacity (TJ/d)
2005	115	145[1]
2008	[Confidential]	[Confidential]
2011	[Confidential]	[Confidential]
2017	[Confidential]	[Confidential]

Note 1: This represents the nominal maximum flow through the City Gate station in each year. It is anticipated that the initial design will incorporate the capacity required in 2017 (pipe and equipment sizes), because the expected demand growth through the period to 2025 is only modest.

Gas supplied to the Swanbank power stations does not pass through the City Gate station. This is delivered to the Power Station gas receiving facilities at the pipeline pressure upstream of the City Gate station. The customer owned gas receiving facility will incorporate filtration, heating and pressure reduction equipment, installed at customer cost.

The delivery point at Arubial is a new facility that will be constructed in 2006 to supply gas to the new pipeline being constructed by others for the planned Braemar Power Station. This study assumes that because the delivery point will operate under flow control at the receipt points, minimal equipment is provided at the site, except for pressure limiting equipment.

9. COMPRESSOR STATIONS

9.1 GENERAL

The RBP requires inlet compression to raise the receipt gas pressure to that required for transport in the new pipeline, and as the load increases, mid-line booster compression.

The demand profile requires compression to transfer line pack from near the inlet of the pipeline to the pipe near the delivery points. This duty is more demanding, rather than compression simply to transfer gas along a long distance pipeline (for example, the Dampier to Bunbury pipeline).

9.2 PIPELINE INLET COMPRESSOR STATION

Existing supplies to the RBP are delivered at a nominal pressure of 7.1 MPa (original pipeline) or 8.0 MPa (loop pipeline). Some of the contracts have the ability for the pipeline owner to request that the supply pressure be increased to as high as 9.6 MPa.

This study provides a compressor facility capable of raising the pressure of all gas received from existing supplies from 7.0 MPa to the pipeline operating pressure of 12.5 MPa and 15.3 MPa in the case of .the DN 450, 15.3 MPa pipeline.

The compressor power required by year is presented in **Table 9-1**.

Table 9-1 Compressor Power – Wallumbilla Inlet Station

Year	Nominal Throughput (TJ/d)	Nominal Compression Power (MW)	
		DN 500	DN 450
2005	114	-	1.5
2008	[Confidential]	4.0	3.5
2011	[Confidential]	4.0	5.0
2017	[Confidential]	5.0	5.0

The compressor installation will consist of:

- Two compressor units, each with a nominal power of 3.0 MW (duty and standby)
- Fuel gas skid
- Two gas coolers (air cooled type)
- Control equipment
- Gas engine driven backup power supply for compressor auxiliaries and coolers
- Instrument air supply, including supply for dry gas seals.

Each compressor will be installed on the existing site in a dedicated enclosure that provides environmental protection and noise insulation.

Inlet air filtration, exhaust silencing, lubrication and associated equipment auxiliary to the gas turbine compressor set are supplied with the compressor package.

9.3 BOOSTER COMPRESSOR STATION

Booster compression is required from 2008 for the DN 500 pipeline and from 2005 for the DN 450 pipeline.

The study considered three locations:

- kP 100 (approx), immediately upstream of the receipt point at Arubial (Peat and Scotia gas supplies)
- kP 150 (approx)
- kP 216 (approx), located in the vicinity of Dalby

The optimal separation between compressor stations varies with pipeline diameter, pipeline operating pressure, and the operating objectives of the pipeline.

Examples of "optimised" compressor station locations for recent gas pipelines include:

- Eastern Gas Pipeline – Pipeline length 800 km, DN 450, Class 900 – Provision for 3 mid-line compressor stations with a nominal separation of 145 km, selected for maximum future capacity
- SEA Gas pipeline – Pipeline length 690 km, DN 450, Class 900 – Provision for 3 mid line compressor stations with separation between 140 and 200 km, selected for capacity and peak load supply

For the 2017 load profile, booster compressor location at either kP 150 or kP 216 will satisfy the requirements of either a DN 500 (12.5 MPa) or a DN 450 (15.3 MPa) pipeline.

A location at kP 100 is not effective for the DN 450 (15.3 MPa) pipeline.

A location in the vicinity of kP 150 is probably optimal for the DN 500 pipeline for the loads projected for this study but does limit expansion options, should they be required, compared with the Dalby location.

This study selected the Dalby (kP 216) location on the basis that it will provide more rapid response to demand changes than a location further upstream while providing an opportunity for future expansion with the installation of a compressor station in the vicinity of Arubial (kp 100).

For the purpose of this study, the location does not impact on the capital cost, although it does impact on the cost of fuel consumed.

Table 9-2 Compressor Power – Booster Compressor Station

Year	Nominal Throughput (TJ/d)	Nominal Compression Power (MW)	
		DN 500	DN 450
2005	152	2.5	4.5
2008	[Confidential]	3.5	5.0
2011	[Confidential]	5	5.0
2017	[Confidential]	5	5.0

The booster compressor station is configured similarly to a standard pipeline booster compressor station.

The compressor station consists of:

1. Inlet and outlet actuated isolation valves, and compressor station bypass valve.
2. Inlet gas filtration with provision for entrained liquid separation.
3. Two (2) gas turbine driven centrifugal compressor sets, delivered as a package complete with inlet air filtration, exhaust silencing, lubrication system and unit control system.
4. A fuel gas conditioning skid, with active and standby regulating runs.
5. Control equipment.
6. Gas engine driven backup power supply for compressor auxiliaries and coolers.
7. Instrument air supply, including supply for dry gas seals.
8. A services building containing a control room (for unit and facility control), a parts store and maintenance room, basic lunch and ablutions equipment for use by personnel who are periodically on site for equipment maintenance.
9. An oil storage store.
10. Water and waste water treatment.
11. Vents for station piping and pressure relief.

Power supply for the compressor station is normally taken from the existing mains power in the area. The backup generator is designed for automatic start in the event of power failure, while the station control system is designed to manage the transition from mains power to back-up power.

The compressor station power varies throughout the operating cycle. The station is power limited during parts of each weekly operating cycle when it draws down the upstream pipeline section and packs gas into the downstream pipeline. During the time the station is power limited, gas accumulates in the pipeline upstream of the compressor station, raising the pressure.

The compressor station is located on a fenced site nominally 250 metres square. The site is selected above the 1:100 level of recorded floods and graded and / or raised above the natural grade to prevent inundation during local rainfall events.

10. COMMUNICATION AND CONTROL SYSTEMS

10.1 GENERAL

The pipeline system is designed for remote, unattended operation. This requires a reliable communications system installed to enable the central control system to communicate with each remote facility that requires control, or provides data to the control system.

The central control system provides the equipment to provide information to the pipeline operator, to acquire data for the business operation of the pipeline, and to store the data for future analysis.

Equipment that represents current proven technology is installed to provide the required functionality.

10.2 COMMUNICATIONS

This optimised replacement pipeline has provided equipment to join a communications system at each site on the RBP that is required to be monitored or controlled. This communications system includes digital satellite communications equipment at each remote site. This equipment will communicate via satellite to satellite earth stations, and then via high capacity terrestrial communications links to the control room.

The capital cost of this equipment is based on the cost of a standardised site installation developed by the project. The sites for which digital satellite communication is provided are nominated in **Table 10-1**. A number of sites in the Metropolitan area will require communication at the pipeline offtake valve, and at the meter station site. For these locations the study assumes that a fibre optic cable will be installed between the pipeline equipment and the remote site to save the capital and operating cost of an additional satellite link. (At some locations where high capacity land lines exist, it may be more economic to provide leased land lines in lieu of a satellite system - however the detailed study needed to analyse the most cost effective solution is beyond the scope of this study).

At locations where measurements are made by others (third party owned meter stations), the optimised design assumes that a data link is provided between that site and the APT owned communications equipment.

Table 10-1 Site Communication

kP	Name
0	Wallumbilla
100 (119)	Arubial
216	Dalby
269.3	Oakey
298.2	Toowoomba
323.6	Sandy Creek
350.9	Brightview
369.1	Lark Hill
396.9	Swanbank

Table 10-1 Site Communication	
kP	**Name**
	Swanbank CSE
406	Redbank
5	Riverview
441.2	Ellengrove
424.5	Woodridge
	Runcorn
	Mt Gravatt
437.6	Mt Gravatt Offtake
448.1	Tingalpa
451.7	Doboy
	Murarrie
452	Bulwer Island
453.5	Gibson Island
0	Redbank Lateral
1	Redbank
5	Riverview
0	Scotia
9	Woodroyd
120	Arubial (provided on main pipeline)

The design assumes that an optic fibre cable is installed with the pipeline to provide a communication link between Swanbank CSE, Runcorn and Mt Gravatt sites and the closest satellite site on the main pipeline.

This study makes no special provision for voice communication required between the control room and field staff. It assumes that remote communication will be provided by mobile telephony, supported as required by satellite mobile telephones. Some operating organisations prefer to provide an additional two way radio system for voice communications, but for the purpose of this study it is assumed that the mobile/satellite telephony is adequate, and the equipment is included in the project's operating cost.

10.3 CONTROL

The replacement pipeline will be equipped with a modern supervisory control and data acquisition (SCADA) system installed in a pipeline operations building in Brisbane.

Part of the building will be set aside for pipeline operations. This area will include a control room, an emergency response room, an office for the pipeline operations manager, a shared office for pipeline operators, and a computer room.

The control room equipment will include:

- Operator and engineering work stations
- Engineering work station
- Printers
- Online pipeline simulation model
- Gas management systems (nomination management, line pack management, billing etc)
- History data storage
- Equipment installed at a separate location that will mirror the duty control system and allow normal pipeline operation to be maintained should a disaster (eg, a fire) because the main control room to become inoperable.

11. BUILDINGS

11.1 GENERAL

The project includes the cost to construct or purchase a building that will house the pipeline management and operations.

The building will be an office – warehouse structure that will provide both office and control room space and space for field operations staff located in the Brisbane area.

The building will be equipped with security systems, fire protection equipment and power supply appropriate to its use for control of a major gas transportation pipeline.

The building is assumed to be located in the Mt Gravatt area. From here there is good highway access to each of the metropolitan pipeline sites, and to the city for business purposes.

12. CAPITAL COST ESTIMATE

12.1 General

A detailed capital cost estimate (Case 1) was developed for the pipeline considered on the above analysis to be the *optimised* design (DN 500, Wallumbilla to Swanbank, DN 450, Swanbank to Gibson Island), constructed along the existing pipeline route between Wallumbilla and Haigslea, and along a new route between Haigslea via Swanbank to Gibson Island.

A second detailed estimate (Case 5) was developed for the same pipeline design constructed along the whole of the existing route, and specifically along the existing route from Haigslea through Brisbane to Gibson Island. This estimate permits assessment of the cost effectiveness of the new route proposed for the optimised design. This clearly shows that construction using the new route would be less expensive than construction using the existing route.

To allow assessment of the alternative designs (Case 3 and 4) the capital cost along the new pipeline route was adjusted to take account of the change in material and construction cost associated with the alternative design.

This work shows that the DN 500 pipeline between Wallumbilla and Swanbank, and the DN 400 pipeline between Swanbank and Gibson Island represents the lowest initial capital cost, and this is considered to represent the optimised design. This design requires the installation of additional compressors later in the design period. However the capital expenditure associated with the future installation is not considered sufficient to change the conclusion that this design is optimal.

12.2 Estimated Capital Cost

The estimated cost of the pipeline alternatives considered in this Study is presented in **Table 12-1** (new Metropolitan Route) and **Table 12-2** (existing Metropolitan Route).

Table 12-1 Estimated Capital Cost - New Metropolitan Pipeline Route

Case	Pipeline Diameter Combinations		Estimated Capital Cost ($M)
	Pipeline Diameter Wallumbilla Swanbank	Pipeline Diameter Swanbank to Gibson Island	2005 Construction
1	DN 500 – 12.5 MPa	DN 450 - 3.5 MPa	465,613,000
2	**DN 500 – 12.5 MPa**	**DN 400 – 5.0 MPa**	**456,145,000**
3	DN 450 – 15.3 MPa	DN 450 – 5.0 MPa	483,618,000
4	DN 450 – 15.3 MPa	DN 400 – 5.0 MPa	495,396,000

Table 12-2 Estimated Capital Cost – Existing Metropolitan Pipeline Route			
Case	Pipeline Diameter Combinations		Estimated Capital Cost ($M)
	Pipeline Diameter Wallumbilla Swanbank	Pipeline Diameter Swanbank to Gibson Island	2005 Construction
1	DN 500 – 12.5 MPa	DN 450 - 3.5 MPa	527,447,000
2	DN 500 – 12.5 MPa	DN 400 – 5.0 MPa	521,720,000
3	DN 450 – 15.3 MPa	DN 450 – 5.0 MPa	545,580,000
4	DN 450 – 15.3 MPa	DN 400 – 5.0 MPa	539,852,000

The estimate details are presented in Attachment 2 (New Pipeline Route) and Attachment 3 (Existing Pipeline Route).

12.3 CAPITAL COST AREA BREAKDOWN

The capital cost of the optimised design, (Case 2) (new route) and for Case 2 along the existing route broken into major cost areas is presented in **Table 12-3**

Table 12-3 Capital Cost Breakdown by Cost Area (Case 2 Only)		
Cost Item	Estimated Capital Cost ($M'000s)	
	New Pipeline Route	Existing Pipeline Route
Pipeline	368,202	431,871
Compressor Stations	53,980	54,468
Receipt & Delivery Stations	13,729	13,853
Land	13,341	14,571
Buildings	2,090	2,110
Communications	4,803	4,847
Other Plant & Equipment	-	-
Total	456,145	521,720

The cost breakdown was developed from inspection of he detailed estimate. Indirect costs are spread against each cost area in proportion to the direct cost for that area.

12.4 ESTIMATED FUTURE COST

The optimised pipeline requires construction of a compressor station at Wallumbilla in 2008 to accommodate increased pipeline flows through to the end of the project life. The estimated cost of this installation is $38.2 million.

The power required at each compressor station is sufficient to satisfy the demand over the life of the pipeline. Initially, the compressors are operated at modest power and intermittently. As the pipeline load increases, the absorbed power and the duration of the operation at full load will increase.

It may be possible to install a single compressor unit at the Wallumbilla compressor station in 2008 and to delay the installation of a standby unit needed to assure continuous operation at maximum throughput. This would result in a higher initial cost, but a slightly lower cost over the life of the assed. A detailed risk-reliability study is required to fully analyse whether an apparent saving can be justified given the variable load profile.

The booster compressor station is required to operate continuously from the date of commissioning. Consequently, a standby unit is required in the initial installation and there is no possible saving from delaying the installation of standby compressor unit.

12.5 BASIS OF ESTIMATE

These estimates were compiled by a senior pipeline and civil engineering estimator experienced in major resource and infrastructure projects in Australia.

The capital cost estimates are largely centred on a database of strongly supported cost information for oil and gas pipelines gathered over many years of pipeline engineering throughout Australia. The construction portion of the estimate takes advantage of experience gained by the estimator through 2005 in developing construction cost estimates for major pipelines planned to be constructed in Queensland and Papua New Guinea as part of the PNG Gas Project.

The estimates incorporate allowance for the features that currently exist along the pipelines, and features advised by APT.

Costs are based on the nominal quantities identified on the detailed worksheets, and in particular, on the actual lengths of the existing pipeline routes.

All costs are third quarter 2005 dollars.

Costs are GST exclusive.

Contingency factors are applied to the estimated capital costs as provision for omissions. The contingency reflects that the preliminary nature of the station and pipeline design as well as uncertainties and unknowns presently prevailing in relation to the route, particularly ground conditions.

12.6 ASSUMPTIONS

A number of assumptions were made in developing the estimate. The extent to which the first two assumptions influence the overall cost of constructing the pipelines through undisturbed country is unknown but is not expected to affect the cost significantly. The assumptions are:

- All felled trees and vegetation are stockpiled and respread on the right of way, or burned after completion. No allowance is made for chipping and/or mulching of felled trees.
- The estimate assumes that mobilisation costs are spread over more than one construction spread. Accordingly, mobilisation and demobilisation costs are spread across each of the pipeline projects.
- Currency conversion: 1 AUD = 0.75 USD.

- There is no provision for cost escalation during the period required to design and construct the pipeline.
- Owner's costs are assumed to be 2% of the capital cost of the project.
- The quantity and cost of the gas required to fill the pipeline to the minimum level required to sustain the maximum demand in 2005 (the minimum calculated line pack during a weekly operating scenario). This quantity (227 TJ) includes a small allowance for gas consumed during pipeline commissioning. The gas is assumed to cost $3.00/GJ.

12.7 ENGINEERING AND PROJECT MANAGEMENT

Various pipeline project execution strategies have been used in Australia over recent years including:

1. Engineering, Procurement and Construction Management (EPCM)
2. Design and Construct
3. Owner, Designer and Construction Contractor Alliance
4. Engineering, Lands and Project Management

The traditional project execution strategy was EPCM. With this approach, the pipeline owner engages an organisation to provide a service to engineer the pipeline, undertake land acquisition and management, purchase major materials, manage construction, provide quality inspection services and commission and test the pipeline. This approach is expected to result in a higher cost than other alternatives, and for this reason was not adopted.

The Design and Construct and the Alliance approaches are favoured for some projects on the basis of risk management. The Design and Construct approach is thought to assign all of the project delivery risk onto the selected contractor, and as such is a method favoured by lenders, while the Alliance approach is favoured by some project developers on the basis that an integrated alliance provides benefits through resolution of issues in a manner that best benefits the project. However each of these methods rely on arrangements negotiated specifically for each project and as such are not appropriate to use as the basis of an estimate.

As a result, this estimate is based on the fourth approach identified above, and assumes that the construction contractors would have ISO 9000 quality certification, and that their quality systems can be used to manage construction quality. The use of this system can eliminate the need for detailed construction quality inspection, providing a significant cost saving as against EPCM by the elimination of field personnel.

The owner will undertake engineering, land acquisition and management, major procurement and procurement inspection and expediting, project and contract management and construction auditing services. This activity may be undertaken through a team engaged by the owner, or through selected service providers working through a project management team on behalf of the owner. Construction quality is to be provided by the construction contractor, while the commissioning activities are undertaken under the owner's direction by a small organisation comprising the engineer, the operator and the construction contractor.

The cost for the Owner engaged services is applied at a percentage of the total cost based on experience. Land management cost is included separately.The cost for Contractor provided quality management and rectification is included in the construction cost.

12.8 Estimate Exclusions

The estimate makes no allowance for:

- Escalation of costs during the construction period
- Decommissioning costs
- Import duties (generally a small amount for pipeline projects
- Capitalised spares (It is usual practice to include an initial stock of spare parts including emergency repair equipment, pipeline, control system and instrumentation hardware and long lead compressor equipment items as part of the capital cost of the project. However this estimate has treated these as consumable items, whose cost is brought into the operating and maintenance budget. Spare line pipe is included in the overall pipe purchase).

12.9 Estimate Accuracy

For this estimate, Estimate Accuracy is:

The estimate reliability or confidence, specifically relating to quantities, reliability of budget quotations, reliability of construction labour costs, construction productivity and similar items.

The accuracy, of the cost estimate presented is considered to be ± 15%. It is as likely that the cost would be at the upper bound (being $524,570,000) as it is that the cost would be at the lower bound (being $387,725,000).

This level of confidence is developed through the combination of a number of parts of the estimate comprising costs which have various levels of confidence. To achieve this level of confidence, allowances have to be applied to significant cost items to make provision for omissions.

12.10 Contingency – Omissions Allowance

For this estimate, Contingency is:

An allowance that provides for unknowns. When applied to the base estimate, the allowance is sufficient to achieve the stated estimate accuracy.

The unknowns include:

- the quality of the project definition;
- the correctness of all base data;
- the extent of the site information;
- the suitability of the pipeline route and;
- the appropriateness of the chosen construction methods

Factors significant to the construction cost estimate of this pipeline include:

- Ground conditions. Ground conditions have a very significant effect on trenching, padding and backfill costs. The estimate is based on an assessment of the extent of soil and rock areas along both routes made from inspection of the metropolitan pipeline routes, and from broad familiarity with the balance of the route. The actual rock trench quantity may differ from this assessment. A substantial difference will impact on the construction portion of the estimate.

- The impact of urban development the Brisbane area on the construction cost estimate. Costs through suburban areas are very much controlled by construction constraints, traffic implications, the extent of road restoration and the degree of underground services.

  Avoiding and relocating buried services is a major cost item and the determination of such costs is a major exercise, and a significant allowance is made for this item in the estimate prepared for the pipeline constructed along the existing route. While the *new* metropolitan pipeline route avoids most residential development the accuracy of the estimated construction cost between Swanbank and Gibson Island is expected to be approximately ± 20%, lower than the overall accuracy of the estimate.

  Construction along the existing route is much more heavily impacted by urban development than construction along the new route, and consequently the impact on the accuracy of the construction cost proportion of the existing route considered to be approximately ± 30%.

  These items contribute to the overall estimate accuracy,

- Line pipe cost. The line pipe cost used in developing this estimate is based on current budget quotations for the pipe required to construct the pipeline.

It is expected that the amounts in the contingency cost category will be spent. The amount is allocated against a contingency item because at the level of detail at which the estimate was undertaken, it is known that there are a multiple of real cost items that are not included in the major component costs. If each of these were known (which can only occur through undertaking a considerably greater design and development exercise) then the amounts in each of the cost categories would be increased to incorporate the missing or inadequately estimated items.

Because the estimate is a relatively high level one, the industry accepted practice is to include these known but not identified items as a contingency item (it could also be referred to as an allowance for omissions).

The estimate does not make any allowance for over-run risk.

12.11 PROJECT APPROVALS / LAND ACQUISITION COSTS

12.11.1 General

The cost for easement acquisition was estimated by a pipeline approvals and lands specialist. This specialist has previously undertaken lands work on the RBP and is familiar with the existing easement and associated pipeline approval and land acquisition costs in Queensland.

This project will be developed generally along the current route to the area west of Haigslea which has in the past been acquired for pipeline use. The route from Haigslea, through Swanbank to Tingalpa is located in land not subject to previous assessment.

Despite this, it should not be assumed that where the existing corridor is re-used, it (the existing route) is approved for use for construction and operation of a new natural gas pipeline. Areas associated with the development of the optimised pipeline will require cultural heritage, environmental assessment and regulatory agency approved management plans to the same extent as would be required if the pipeline was new.

Allowance is therefore made for a level of assessment and consultation suitable for preparation of an Environmental Impact Statement, and the development of all management plans and environmental licensing over the whole of the existing pipeline route and over the deviation proposed for the new pipeline from Haigslea, through Swanbank to Tingalpa.

The estimate includes a reasonable allowance for studies to satisfy cultural heritage, environmental, public safety, engineering design, noise and other statutory and regulatory requirements in relation to construction and operation of a pipeline through the new route. The affected length is approximately 75 kilometres (between Haigslea and Tingalpa).

Between Wallumbilla and Haigslea, the pipeline will be constructed over a variety of land tenures, and it is assumed that easements can be negotiated over the same route. It is assumed that associated environmental and cultural constraints can be resolved, and where necessary, compensation paid.

Between Haigslea and the Swanbank area, the pipeline will be constructed over privately held land. Landowners are required to be compensated for the easement. It is considered that the easement compensation costs will be significant, and due to the varied land uses and proximity to the growth areas of Brisbane, it is more likely that compensation settlements will often exceed 'rule of thumb' diminution rates than are often applied to rural properties.

Between Swanbank and Tingalpa, the pipeline will be constructed along existing electricity easement. Compensation will apply to both the land owner, and some compensation may apply to the owner of the electricity easement. Despite these areas of land being currently affected by the electricity easement which restricts use of the land within the easement, it cannot be presumed that this will significantly reduce the easement compensation costs. The Wardens Court decision in regard to the proposed Gatton to Gympie pipeline concluded that it is not acceptable for a new easement party to rely on the existence of a previous easement in determining compensation.

12.11.2 Environmental Assessment Requirements

The study assumes that due to the Project size and its relative proximity to a range of landscapes and land users, the Project will be required to undertake an Environmental Impact Statement (EIS).

It is assumed that the Project will not be a 'controlled action' pursuant to the Commonwealth Environmental Protection and Biodiversity Conservation Act.

It is assumed that there are no 'fatal flaws' associated with the Project, and that approval can be obtained on reasonable conditions. Accordingly no unusual amounts have been included in addressing major or unusual regulatory requirements.

12.11.3 Easement Acquisition Cost

The project will be required to acquire easements over the whole of the pipeline route. It is assumed that even in areas where the pipeline is proposed to be laid in existing corridors – pipeline or powerlines, there will be substantial negotiation required, and usual transaction costs.

It is assumed that compulsory acquisition of land interests by the State will be a last resort, and only contemplated when all avenues of negotiation and mediation have been exhausted.

12.11.4 Native Title

The land through which the pipeline passes is subject to Native Title claimants. In acquiring an easement for the pipeline it will be necessary to resolve Native Title claims with claimants.

The cost estimate assumes that there are 5 Registered Native Title claims over the Project area, and that the Project will need to negotiate in some way with each group in regard to some land tenure which may be subject to Native Title.

Compensation is assumed to be paid to each Native Title Claim group, if not purely for Native Title impacts, in some other way to achieve a 'Consent Agreement' to the Project.

It is expected that the Proponent will be required to negotiate and develop a Cultural Heritage Management Plan (CHMP) through agreements with Aboriginal people, and to have these Plans 'Approved' pursuant to the Aboriginal Cultural Heritage Act (ACHA).

It is assumed that cultural heritage surveys will need to be undertaken in development and assessment of route, and that in accordance with common practice, Aboriginal Monitors will be employed during construction. It is expected this will apply to areas adjacent to original pipeline.

12.12 LINEPIPE COSTS

Line pipe costs make up a significant proportion of the estimate.

In developing this cost estimate budget cost quotations for the line pipe were obtained from Australian and overseas pipe suppliers. Budget cost quotations were also obtained for the pipe coating from the two Australian pipe coating applicators. The range of costs offered are summarised in **Table 12-4**.

Table 12-4 Range of Pipe Material Cost based on Budget Quotations Received

Pipe Diameter, Thickness and Grade	Pipe Cost (USD/t)	3 Layer Coating Cost ($A/m)
DN 500 x 9.2 mm - X70	1,260 to 1,448	23.9 - 27.0
DN 500 x 11 mm – X70	1,234 to 1,440	26.3 – 29.6
DN 450 x 10 mm – X56	1,378	22.3 – 25.3

Table 12-4 Range of Pipe Material Cost based on Budget Quotations Received

Pipe Diameter, Thickness and Grade	Pipe Cost (USD/t)	3 Layer Coating Cost ($A/m)
DN 300 x 8.4 mm – X70	1,492	16 - 17.3
DN 250 x 6.0 mm – X70	1,548	13.1 – 14.8
DN 250 x 7.2 mm – X70	1,529	14.6 – 14.9
DN 200 x 6.4 mm – X42	1,450	11.7 – 14.1
DN 150 x 6.4 mm – X42	1,461	9.3 – 12.8
DN 100 x 6.0 mm – X42	1,492 to 1,530	7.2 – 11.6

12.13 PROJECT SCHEDULE

A conceptual schedule for the project in presented in Attachment 4 to this report.

Four key items drive a pipeline project schedule:

1. The time required for project approvals

   Project approval includes the activities to:

   - Select and acquire the pipeline easement
   - Acquire native title over the affected lands
   - Undertake statutory environmental studies
   - Negotiate commitments, leading to approval and grant of licence.

   The duration of the approvals phase for similar pipeline projects is 12-24 months.

   This study assumes that project approval will be granted in a relatively short period.

   Furthermore, it is assumed that the existing pipeline route and the proposed route through the metropolitan area represent “corridors” that have no significant land access, native title, cultural heritage or environmental issues that would result in unusual delays to the approval process.

2. The time for delivery of long lead items

   Pipeline materials are “long lead time”. Typically line pipe delivery can commence 12 weeks after order placement, valves and major components have deliveries of 20-46 weeks. These periods are highly dependent on the status of order books of the major suppliers.

3. The time for construction and commissioning

   The pipeline construction estimate is based on a duration of approximately 6 months, and the estimate is resourced to achieve this. The schedule is based on separate construction contracts being allocated to “mainline” construction through rural areas, (where high daily production rates can be achieved), and to metropolitan construction (where the increased congestion substantially reduces the daily construction rate). Furthermore the estimate assumes construction during the low rainfall period of the year.

The preferred route through the metropolitan area is relatively unencumbered because it follows existing power transmission easements. Along this easement the construction rate is expected to be in the order of 500-1000 metres per day.

The schedule includes a separate line for construction of the pipeline along the existing route through Brisbane. This route is highly congested, and construction rates between 60 and 250 metres per day are expected. If the pipeline was constructed along the existing route the project duration is expected to be increased by 4-5 months.

It should be noted that because pipeline construction costs are duration driven, an increase in the construction time will increase the cost of the construction activity.

4. Project Closeout

This period is required to finalise:

- Easement acquisition, compensation and approval
- Project construction closeout
- As-built documentation
- Transfer project from the development team to the operations team.

The owners cost continues during this period.

12.14 OWNERS FUNDING DURING CONSTRUCTION

Owners funding cost during construction is applied using a simple approach based on quarterly drawdown of amounts equal to the payment obligations in the quarter.

The cost of funding is 10.6% pa. on the drawdown through to the end of the construction, in accordance with the schedule. This rate was supplied by APT.

The expenditure through each quarter is allocated on an assessment of the commitments made during the period.

12.15 ESTIMATE QUALITY

The capital cost estimates present a considered estimate of the current cost to develop the Roma to Brisbane Pipeline Project. The pipeline design represents one that will satisfy the requirements for a pipeline, that will provide a service to receive gas at essentially constant rate (to satisfy the technical requirements of the gas producers) and will deliver the gas at times and rates required by gas consumers both now and in the future, and in particular, intermittent load power stations.

It is recognised that the cost of the pipelines presented in this study may be perceived as being higher than may be expected by a casual observer. This is a result of significant cost increases in all sectors of the pipeline industry over the past 2 years. Major changes include:

- Material cost (steel, and components manufactured from steel)
- Construction fuel
- Construction labour (both the direct labour cost, plus a margin that reflects the current availability of experienced pipeline construction labour

- Engineering resources
- Land acquisition and approvals cost.
- General compliance related costs (including technical compliance, records keeping and documentation and other approvals related costs).

There is no evidence that the underlying costs will reduce in the foreseeable future, unless there is a worldwide economic slowdown.

Attachment 1

Pipeline Schematic

Attachment 2

Estimate Detail
Pipeline Constructed along New Metropolitan Route

Attachment 3

Estimate Detail
Pipeline Constructed along Existing Metropolitan Route

Attachment 4

Project Schedule