AGNES WATER – TOWN OF 1770 BENARABY - AGNES WATER PIPELINE COST REPORT

MIRIAM VALE SHIRE COUNCIL

DRAFT REPORT
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Version	**Date**	**Status**	**Author**		**Reviewer**	
			Name	**Initials**	**Name**	**Initials**
1 Rev A	26/05/2006	Draft	Gary Patterson	GP	Rolf Rees	RR
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3 Rev C	19/06/2006	Draft	Gary Patterson		Rolf Rees	

1.0 INTRODUCTION

The report investigates the estimated cost to design, construct and operate a water transfer pipeline to supply potable water from Benaraby to Agnes Water, a distance of approximately 105.8Km over a period of 80years.

The basis of the investigation was a desktop study of the proposed pipeline route using aerial photography and consultation with a Contractor who recently installed a telecom cable along the significant section of the proposed pipeline route.

The Scope of the report cover issues relating to:-

- Pipeline Alignment;
- Design Standards;
- Hydraulic Analysis;
- Expected Excavation Conditions;
- Environmental Issues;
- Water Quality Management;
- Cost Estimate; and
- Financial Analysis.

2.0 PIPELINE ALIGNMENT

The proposed pipeline alignment would be along the road reserves of Round Hill Road and Fingerboard Road from Agnes Water to Miram Vale. The section from Miriam Vale to Benaraby would follow the Bruce Highway. Refer to Figure 2.1 for proposed pipeline route.

Based on a review of the aerial photography there is a clear corridor within the road reserve for installation of the proposed pipeline however the location of other services, which may conflict with the proposed pipeline, was not determined.

3.0 DESIGN

The preferred pipe material is DICL. High Density Polyethylene may be considered as an acceptable alternative pipe material, however the issue of joints may be a constraint as a maximum of ten butt welds can be done per day. Handling long sections of pipe adjacent to a roadway may also be a limiting factor.

The design of the pipeline would be based on underground installation for the majority of the route. Minimum grades and cover requirements of 1:500 and 600-800mm respectively would be adhered to. For ND200/300 pipe a 600mm wide trench would be required.

Scour points would be included at significant low points and air valves at high points and on long sections of rising grades.

Swabbing points along the main would be considered a necessity in order to maintain the hydraulic efficiency of the pipeline. Usually swabbing points are located every 2,000m to minimise the amount of dirty water required to be handled at the discharge points. The proposed pipeline is located in a rural location where water from swabbing activities could be discharged onto adjacent land without significant adverse impact. It would therefore be considered acceptable to locate swabbing points every 25,000m for the proposed pipeline.

Section valves would be included every 5,000m.

Booster pump stations would be provided to maintain the required hydraulic grade. It has been assumed that the hydraulic gradient would be boosted at 120m head increments.

Where required to cross main roads or railway lines the pipeline would be designed to be installed by thrust boring techniques.

The proposed pipeline route crosses approximately 8 named small creeks ranging between 50m and 150m. There is one major river crossing of the Boyne River. The length of this crossing is approximately 350m. There are another 80 unnamed minor water courses which will be trenched across.

For the purpose of this report the 8 named small river/creek crossings have been assumed to be constructed by directional drilling techniques. The crossing of the Boyne River would be completed by attaching the pipeline to the side of the existing bridge.

There would be two rail crossings, one at Miriam Vale and the other just south of Iveragh. The pipeline would have to be installed across the rail lines by thrust boring.

4.0 DESIGN APPROVALS

Prior to finalisation of detailed design, plans of all road, rail and Ergon Energy easement crossings would have to be submitted to the relevant authority for their approval. Approval would have to be obtained from the following authorities during the detailed design:

- Main Roads – alignment approval;
- Queensland Rail – crossing of railway lines;
- Ergon Energy - Crossing Power Easement; and
- Hydraulics.

5.0 HYDRAULICS

The design horizon for the pipeline is until 2086. The design population and water demand projection used in the analysis are sourced from the Agnes Water/Town of 1770 Water Supply Desalination Report. The required flow will increase from 59ML/y in 2007 to 1802ML/y in 2086. Based on the projected flow rates a single ND200 would suffice until 2055 when augmentation with another ND200 pipeline would be required. Alternatively a single ND300 would accommodate the range of flows over the 80year period.

The 2007 required supply rate is 59Ml/year increasing to and ultimate supply rate of 1802Ml/year in 2081. Figure 5.1 shows the water transfer growth for the 80 year supply horizon.

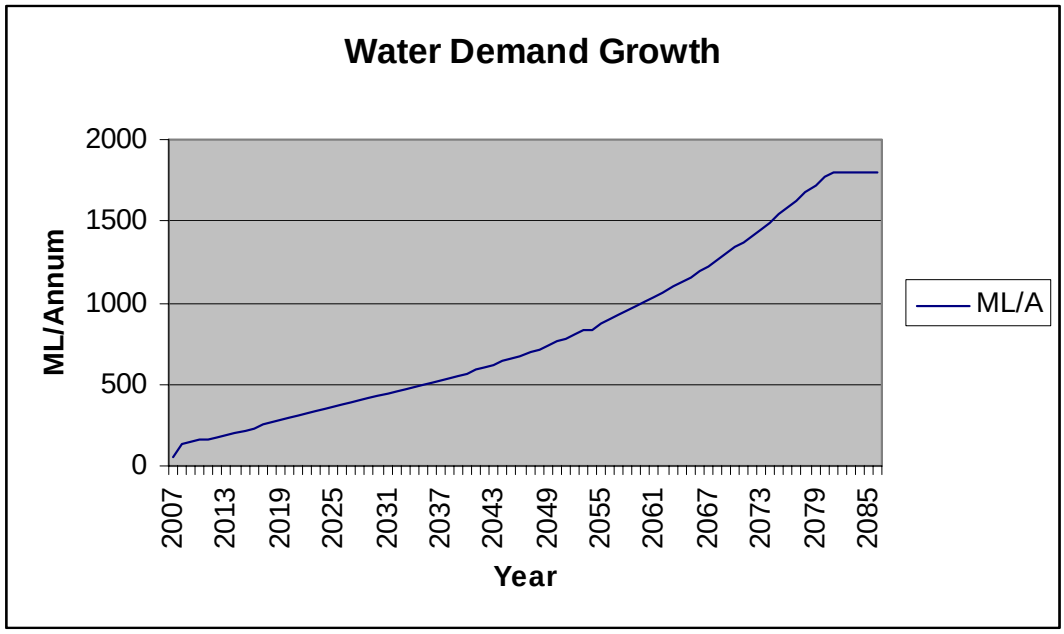


Figure 5.1

Based on the projected water transfer requirement the hydraulic retention in the pipeline is shown in Figure 5.2 below.

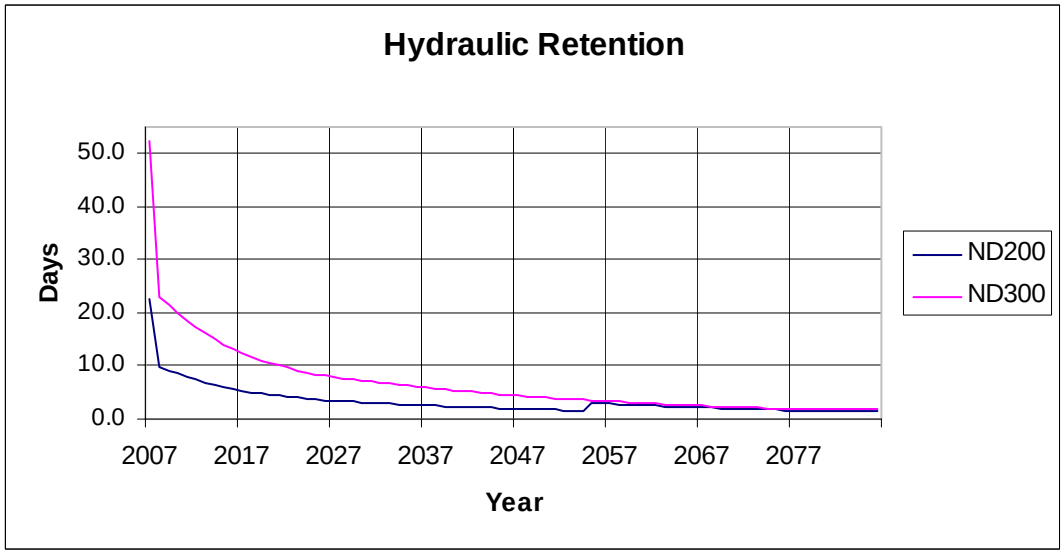


Figure 5.2

For both pipe sizes the hydraulic retention is excessive, being in excess of 3 days until 2031 and 2061 for the ND200 and ND300 respectively.

The hydraulic analysis of the pipeline determined that the system losses for a ND200 pipe augmented in 2055 were significantly higher than those of a single ND300 pipe.

The outcome of the analysis is shown in Table 5.1 below:

Table 5.1 – Hydraulic Analysis

Nominal Diameter	Material	Internal Diameter (m)	Pipeline Velocity (m/s) 2007-2026	Peak Flow Rate (m^3/s) 2007-2026	Average Head Loss (m) 2007-2026
200	DICL	0.2094	0.1 - 1.37	0.003 - 0.1	8 - 1200
300	DICL	0.319	0.04 – 1.29		1 - 570

A number of booster pump stations would be required to maintain the hydraulic gradient along the pipeline. Using a boost head of 120m per pump station, the required number of booster pump stations for the two pipeline options are shown in Table 5.2 below.

Table 5.2 – Booster Pump Stations

Pump Station Number	Year Required ND200	Year Required ND300
1	2007	2007
2	2018	2051
3	2026	2064
4	2033	2072
5	2039	2077
6	2043	-
7	2047	-
8	2050	-
9	2052	-
10	2081	-

Due to the significantly lower system requirements for a ND300 pipe, a comparison with a ND200 pipe augmented in the year 2055, based on construction, pumping and operating and maintenance costs, was prepared.

The results of this analysis are presented in Section 9.

6.0 EXCAVATION CONDITIONS

No geotechnical information was available along the proposed pipeline route at the time of writing this report. It is anticipated that the ground conditions will vary significantly along the route.

Based on discussions with the Contractor responsible for the installation of a telecommunications cable along the majority of the proposed pipeline route there are sections along the route where very hard rock occurs.

A 4km section between Benaraby/ Bororen and another section of similar length between Miriam Vale and Agnes Water were identified having very hard rock where excavation progress would be slow. For removal of hard rock a 40T excavator with rock breaker was used as the basis for the estimate. It was assumed that blasting would not be permitted.

7.0 ENVIRONMENTAL

A water transfer pipeline is required to transfer water from Benarby to Agnes Water. The pipeline route will be contained within the following road reserves:

- Bruce Highway from Benarby to Miriam Vale;
- Baffle Creek Road and Fingerboard Road between Miriam Vale and Mount Tom; and
- Round Hill Road from Mount Tom to Agnes Water.

A preliminary desktop analysis of the environmental impacts of the pipeline route was undertaken to determine environmental approvals that may be required for installation of the pipeline along the proposed route. It is to be noted that even if development of the pipeline is exempt from approval under the Integrated Planning Act 1997 an approval is still required pursuant to other State's environmental legislation. The analysis identified the following permits and reporting requirements.

- The Environment Protection and Biodiversity Conservation Act 1999 requires that any proposal likely to have a significant impact on a matter of national environmental significance requires referral to the Commonwealth Department of Environment and Heritage. A search of the pipeline route using the EPBC Protected Matters search tool was undertaken. The results indicate that listed threatened species occur in the locality of the pipeline route. Construction of the pipeline is unlikely to have a significant impact, as defined within the EPBC Act's Administrative Guidelines on Significance, upon any threatened species and in this respect would not:
- lead to a long-term decrease in the size of a population; or
- reduce the area of occupancy of the species, or fragment an existing population into two or more populations; or
- adversely affect habitat critical to the survival of a species; or
- disrupt the breeding cycle of a population; or
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; or
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat; or
- interfere with the recovery of the species.

This is due to the facts that:

- none of the threatened species identified have important populations within the pipeline route; and
- the pipeline will be constructed entirely within an established road reserve.

Notwithstanding the above, it would be necessary to carry out a detailed flora and fauna survey of the site to confirm whether or not any threatened species occur along the pipeline route and to derive appropriate management strategies for any identified species. If any threatened species are identified it would also be prudent to:

- implement a weed management plan to ensure no species that are harmful to threatened species become established; and
- refer the proposal to the Commonwealth for a confirmation that the proposal is not a "controlled action" requiring assessment and approval under the provisions of the EPBC Act.

The Vegetation Management Act 1999 provides for management of remnant vegetation throughout Queensland. Given that the pipeline route traverses mapped remnant vegetation, an Integrated Development Assessment System (IDAS) development approval to remove the remnant vegetation is required. The application for the IDAS development approval (application) will be assessed by the Department of Natural Resources and Mines (DNRM). The application will need to be accompanied by a Property Vegetation Management.

- Plan (PVMP). The PVMP is to address the DNRM Vegetation Management Code for Ongoing Clearing Purposes (Coastal Wide Bay Region).
- Analysis of 1:25,000 topographic maps identified 89 watercourse crossings on the pipeline route. Pursuant to Part 8 of the Water Act 2000, a Riverine Protection Permit is required for each watercourse crossing to install the pipeline if:
  - removal of native vegetation is required; or
  - excavation within the watercourse is required.
- Pursuant to the Fisheries Act 1994, any requirement to raise a waterway barrier for a period of more than 28 days for installation of the pipeline within any of the 53 identified watercourses will require an IDAS development approval for raising waterway barrier works. Pursuant to Schedule 8 Table 4 of the Integrated Planning Act 1997 raising of waterway barriers across any freshwater watercourse for less than 28 days is self assessable.
- Where construction works for installation of the pipeline will require excavation of more than 100m3 of material from land below 5m AHD construction will need to comply with the requirements of the State Planning Policy 2/02: Planning and Managing Development Involving Acid Sulfate Soils.
- A cultural heritage review will need to be undertaken to identify any areas of potential cultural heritage significance. The Aboriginal Cultural Heritage Act 2003 states that all activities are subject to a duty of care to protect aboriginal cultural heritage values. To comply with the duty of care, an assessment will need to be undertaken to confirm the status of the land and any potential impacts on cultural heritage. Appropriate management actions will need to be defined to manage any potential impacts identified. As the pipeline route is in a road reserve, it is considered likely that the construction works would be classified as causing No Additional Surface Disturbance, as defined by the duty of care, and would therefore be compliant with the duty of care. This should be confirmed by a site survey.
- A search of the Contaminated Lands Register and Environmental Management Register is required to determine whether any contaminated lands are located along the pipeline route. If contaminated land is identified, management actions will need to be defined to appropriately manage any risks associated with the works.

- In order to comply with the provisions of the Environment Protection Act 1994, an Environment Management Plan is required to be followed during construction of the pipeline. The EMP will need to have regard to the provisions of the Environmental Protection (Air) Policy 1997, Environmental Protection (Noise) Policy 1997, Environmental Protection (Water) Policy 1997 and Environmental Protection (Waste Management) Policy 2000. The EMP should address the following elements.
  - Community Awareness.
  - Air Quality Management.
  - Noise and Vibration Management.
  - Erosion and Sedimentation Control.
  - Acid Sulphate Soils Management.
  - Water Quality Management.
  - Waste Management.
  - Flora and Fauna Management.
  - Weed Management.

8.0 WATER QUALITY MANAGEMENT

The hydraulic retention time will be excessive for both pipelines ranging between twenty three and one and a half days for the ND200 and fifty two and two days for the ND300 over the 80 year analysis period.

At the time of writing this report no data was available on the actual water quality parameters. Notwithstanding this, the Gladstone water is from surface water source and therefore the likelihood of having stability issues (Langelier Stability Index – LSI & Calcium Carbonate Precipitation Index - CCPI) is high. With such a long retention time and having a cement lined pipe it is anticipated that the corrosion of the pipeline will be an issue. The addition of lime/soda ash dosing at the start of the pipeline would be considered appropriate. A dose rate of 30mg/L of lime has been used assumed for the purposed of this report. It is anticipated that a lime silo and clarifier would be constructed at the water supply point. This aspect would be addressed in detail during the detailed design of the pipeline.

With the excessive hydraulic retention times that will be experienced in the pipeline, re-chlorination of the water would be required. Two chlorination stations were allowed for on the ND300 pipeline option and a single station for the ND200 Option. A dosing rate of 2mg/l of gaseous chlorine was used to ensure the required disinfection levels in the water.

The long retention time will result in depletion of the oxygen levels in the water leading to problem with taste. Aeration of the water at the discharge into the storage reservoir would be advisable.

9.0 COST ESTIMATE

9.1 Detailed Design

The following components will comprise the detailed design for the pipeline:

- Engineering – Process, Civil , Mechanical and Electrical;
- Design Approvals;
- Survey and Service Locations; and
- Geotechnical Investigation.

An allowance of 3% of the capital cost was included to cover the cost of the detailed design.

- ND200 $1,057,461.51
- ND300 $1,325,910.07

9.2 Construction Supervision

An allowance of 2.5% of the capital cost was included to cover the cost of construction supervision.

- ND200 $881,217.92
- ND300 $1,104,925.05

9.3 Construction Estimate

9.3.1 Pipeline

The construction of the trenched sections of the pipeline was based on hourly rates for personnel and equipment and materials costs. Table 9.1 shows the basis of the cost estimate for the construction of the trenched sections of the pipelines.

Table 9.1 – Construction Rates

Ground Conditions	Estimated Progress m/d	Supply and Installation Cost $/m		Percentage of Pipeline Route
		ND200	ND300	
Soft	150	$127.00	$188.00	60
Intermediate	90	$157.00	$203.00	32.5
Hard	8	$1036.00	$1098.00	7.5

An additional allowance was included extra over the base trenching rate for pipeline fittings, river/creek crossings and railway crossings. Table 9.2 sets out the basis of these additional costs.

Table 9.2 – Extra Over Pipeline Construction Costs

Cost	Cost Basis	Extra Over Cost $	
		ND200	ND225
Fittings	2%	$556,008.45	$700,996.77
River Crossings	550m	$412,500.00	$440,000
Rail Crossings	100m	$75,000.00	$80,000

9.3.2 Booster Pump Stations

The proposed booster pump station cost estimate was based Table 9.3 indicates when these stations will be required on booster pumps installed in a concrete block work building with a standby generator.

Based on a twenty five year design life for the mechanical and electrical equipment the replacement of the mechanical and electrical equipment at the pump stations is required periodically. Table 9.3 - ND200 and Table 9.4 - ND300 indicate the required provision and replacement of the pump station for the respective pipelines.

Table 9.3 – ND 200 Booster Pump Station Replacements

Year No.	Pumps Station Required	Mechanical and Electrical Replacement– Year Required
1	2007	2032, 2057, 2081
2	2018	2043, 2068
3	2026	2051, 2076
4	2033	2058, 2083
5	2039	2064
6	2043	2068
7	2047	2072
8	2050	2075
9	2052	2077
10	2081	-

Table 9.4 – ND 300 Booster Pump Station Replacements

Year No.	Pumps Station Required	Mechanical and Electrical Replacement– Year Required
1	2007	2032, 2057, 2081
2	2051	2076
3	2064	-
4	2072	-
5	2077	-

9.3.3 Construction Cost Details

The estimated initial project construction costs for the ND200 pipeline are set out in Table 9.5. The estimate excludes amounts for future pump stations and pipeline augmentations.

Table 9.5 – ND200 Construction Cost Estimate

	Unit Pipe Cost	Supply & Installation Cost $/m	Percentage on Project	Length- m		Cost
200 Dia Pipe	$58.00			105800		
Good Ground		$126.76	60.00%	63480		$11,728,564.80
Intermediate Ground		$156.87	32.50%	34385		$7,388,190.33
Rock		$1,036.35	7.50%	7935		$8,683,667.25
Pipeline Fittings			2.00%			$556,008.45
River Crosings - Directional Drilling		$750.00		550		$412,500.00
Rail Crossings		$750.00		100		$75,000.00
Chlorination Facility						$30,000.00
Lime and Carbon Dioxide Dosing Facility						$500,000.00
					Sub Total	**$29,373,930.83**
				Contingency	20%	**$5,874,786.17**
				Capital Cost		**$35,248,717.00**
Pump Stations						
No Pump Stations	1	$480,000.00				$480,000.00
				Contingency	20%	**$96,000.00**
				Capital Cost		**$576,000.00**
				Total Estimated Construction Cost		**$35,248,717.00**

The estimated project construction costs for the ND300 pipeline are set out in Table 9.5. The estimate excludes amounts for future pump stations

Table 9.5 – ND300 Construction Cost Estimate

	Unit Pipe Cost	Supply & Installation Cost $/m	Percentage on Project	Length- m		Cost
300 Dia Pipe	$109.00			105800		
Good Ground		$142.36	60.00%	63480		$16,375,300.80
Intermediate Ground		$159.27	32.50%	34385		$9,410,028.33
Rock		$1,051.95	7.50%	7935		$9,264,509.25
Pipeline Fittings			2.00%			$700,996.77
River Crosings - Driectionl Drilling		$800.00		550		$440,000.00
Rail Crossings		$800.00		100		$80,000.00
Chlorination Facility						$60,000.00
Lime and Carbon Dioxide Dosing Facility						$500,000.00
					Sub Total	**$36,830,835.15**
				Contingency	20%	**$7,366,167.03**
				Capital Cost		**$44,197,002.18**
Pump Stations						
No Pump Stations	1	$480,000.00				$480,000.00
				Contingency	20%	**$96,000.00**
				Capital Cost		**$576,000.00**
					Total Project Cost	**$44,773,002.18**

9.4 Operating and Maintenance

The following assumptions were made in determining the operation and maintenance cost:

- Chemical consumption has been determined on a pro rata basis with annual water production;
- Chlorine dosed at 2mg/l at a cost of $1,920/tonne;

- Lime dosed at 30mg/l at a cost of $250/tonne;
- Power consumption has been determined on a pro rata basis with annual water production;
- Power costs have been assessed at 8.5 cents per kWhr; and
- The cost of water at $1.00/kL purchased from Gladstone Area Water Board has been used.

9.5 Financial Analysis

The most cost effective pipe size for the proposed pipeline was determined using a Net Present Value (NPV) Analysis comparing the ND200 and ND300 pipelines. The NPV included the capital cost, operating, maintenance and replacement costs and water purchase cost.

The parameters used in the financial analysis are shown in Table 9.7 below.

Table 9.7 – Financial Analysis Parameters

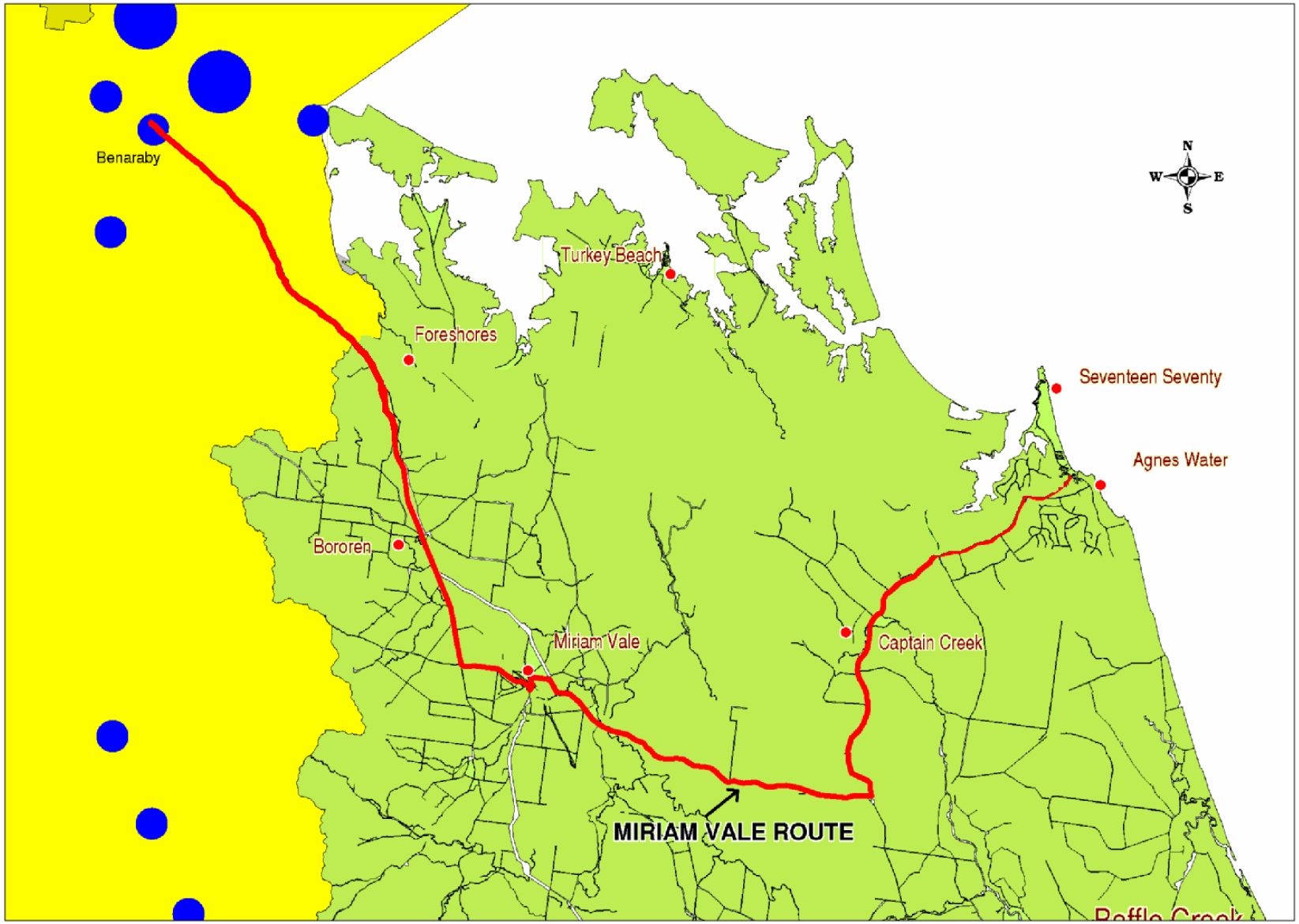
Parameter	Value
Cost of Water	$1.00/kL
Cost of Power	$0.85kWh
Annual Water Requirement (2007 – 2086)	59ML – 1802ML
Maintenance Cost - Pipelines	0.6% of Capital Cost
Maintenance Cost – Pump Stations	5% of Capital Cost
Replacement Period - Pipelines	80 Years
Replacement Period – Pump Stations	25 Years

The results of the NPV analysis of the project are set out below in Table 9.8.

Table 9.8 – NPV

Discount Rate	ND200	ND300
3%	$73,658,266.41	$72,882,065.01
5%	$52,659,352.80	$59,432,072.74
7%	$43,395,536.60	$53,286,555.24

FIGURES


Benaraby
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Foreshores
Seventeen Seventy
Agnes Water
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