GOVERNMENT OF WESTERN AUSTRALIA

PILBARA REGION WATER RESOURCES REVIEW AND DEVELOPMENT PLAN 1996

APPENDICES VOLUME II OF II

WATER RESOURCE ALLOCATION AND PLANNING SERIES

WATER & RIVERS COMMISSION REPORT WRAP 4 1996

WATER AND RIVERS COMMISSION

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PILBARA REGION
WATER RESOURCES REVIEW AND DEVELOPMENT PLAN
1996
APPENDICES
VOLUME II OF II

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&
Jade Coleman

Water and Rivers Commission
Policy and Planning

WATER AND RIVERS COMMISSION
WATER RESOURCE ALLOCATION & PLANNING SERIES
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APPENDICES

Appendix 1: Rainfall Information

FIGURE A1.1: HISTOGRAM FOR KARRATHA

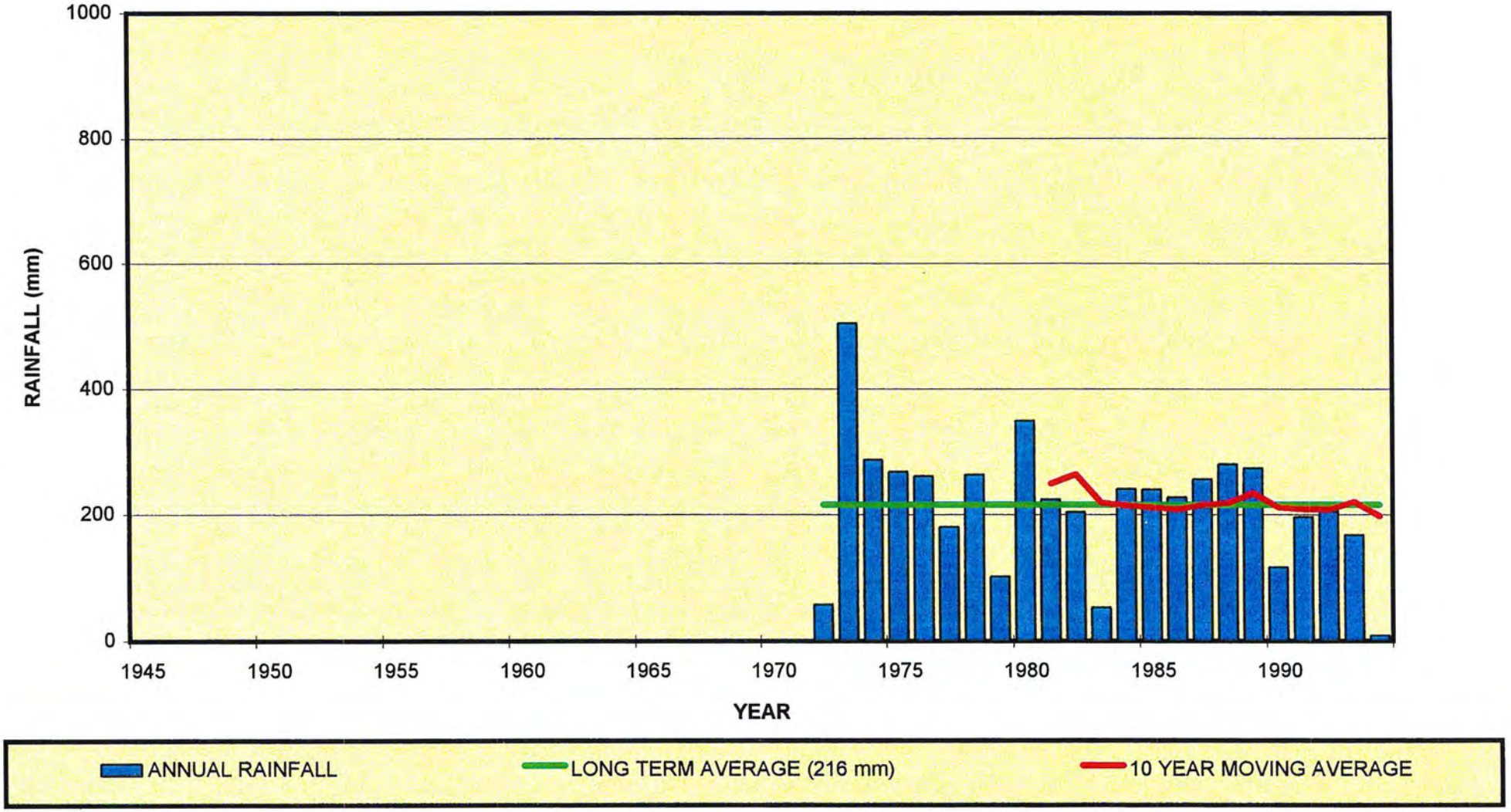


FIGURE A1.2: HISTOGRAM FOR ONSLOW

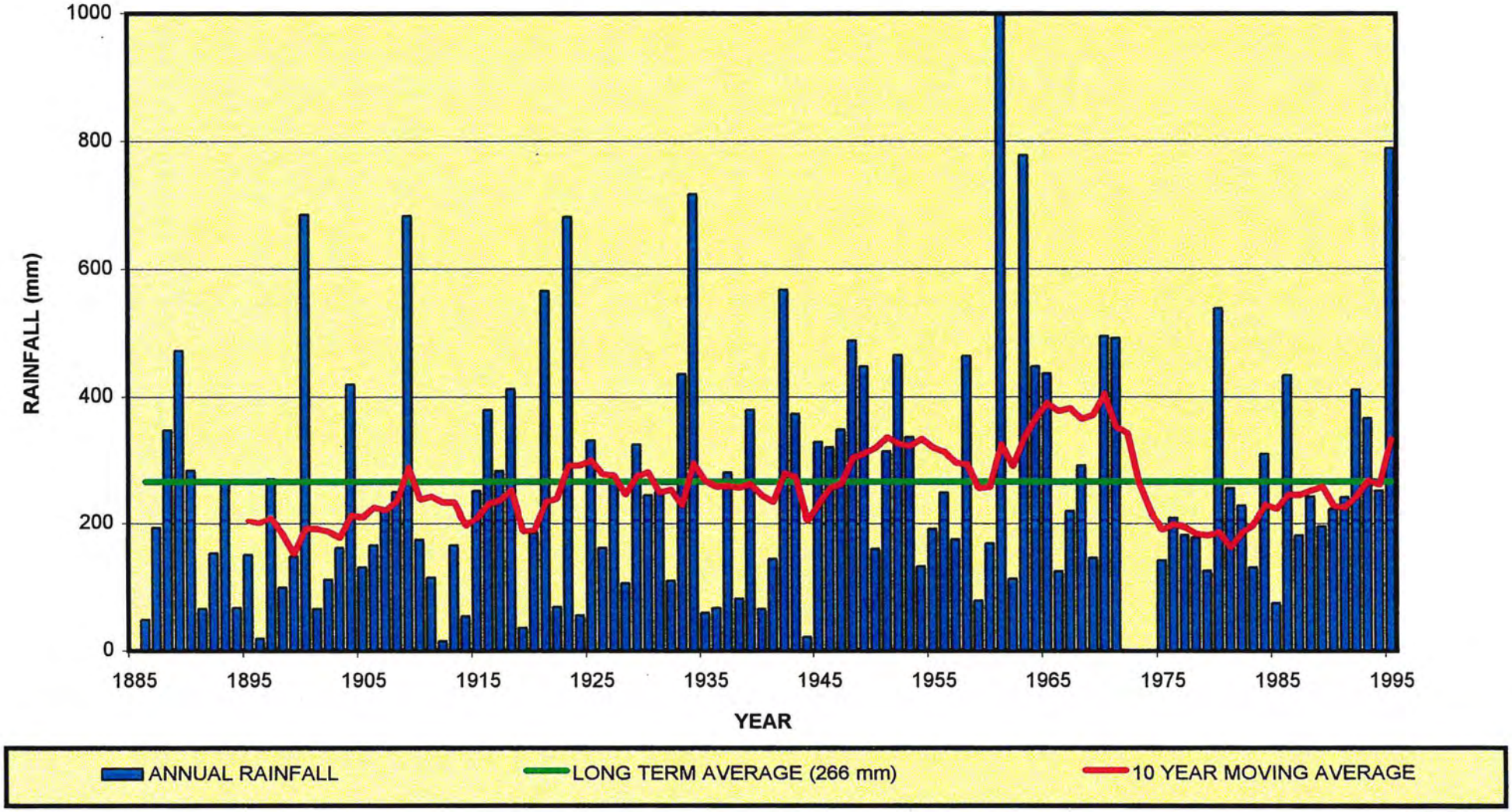


FIGURE A1.3: HISTOGRAM FOR TOM PRICE

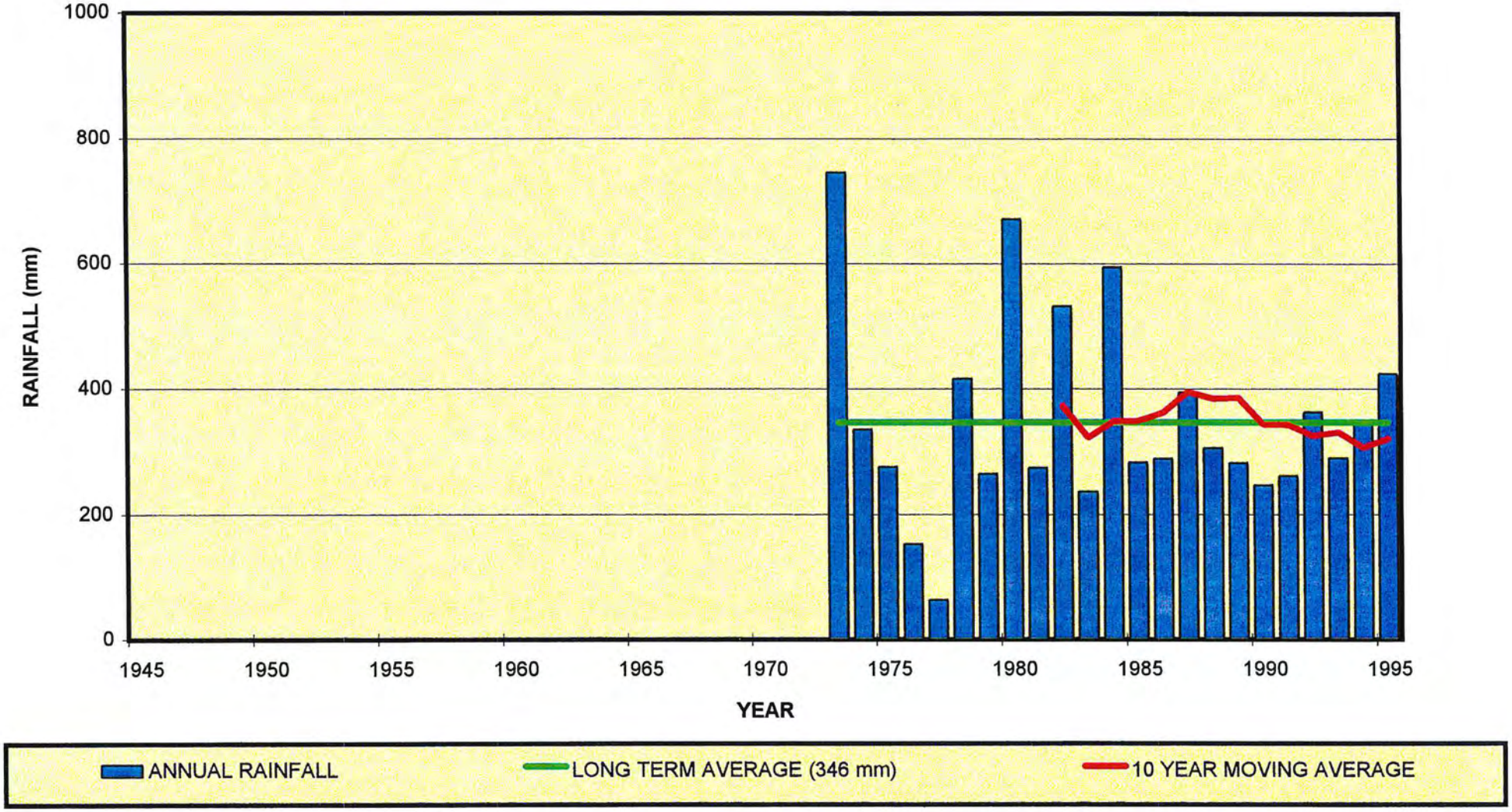


FIGURE A1.4: HISTOGRAM FOR PARABURDOO

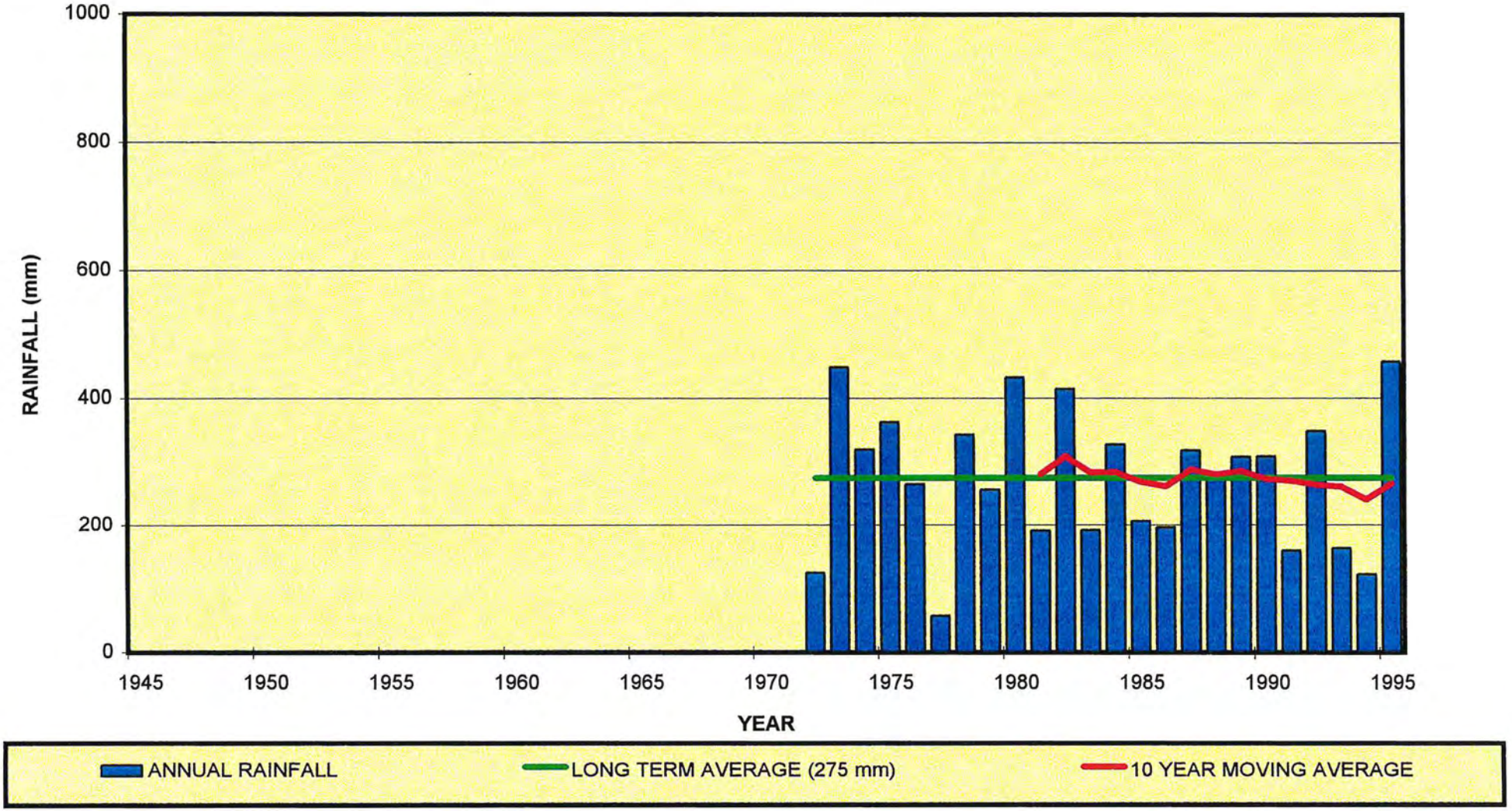


FIGURE A1.5: HISTOGRAM FOR PANNAWONICA

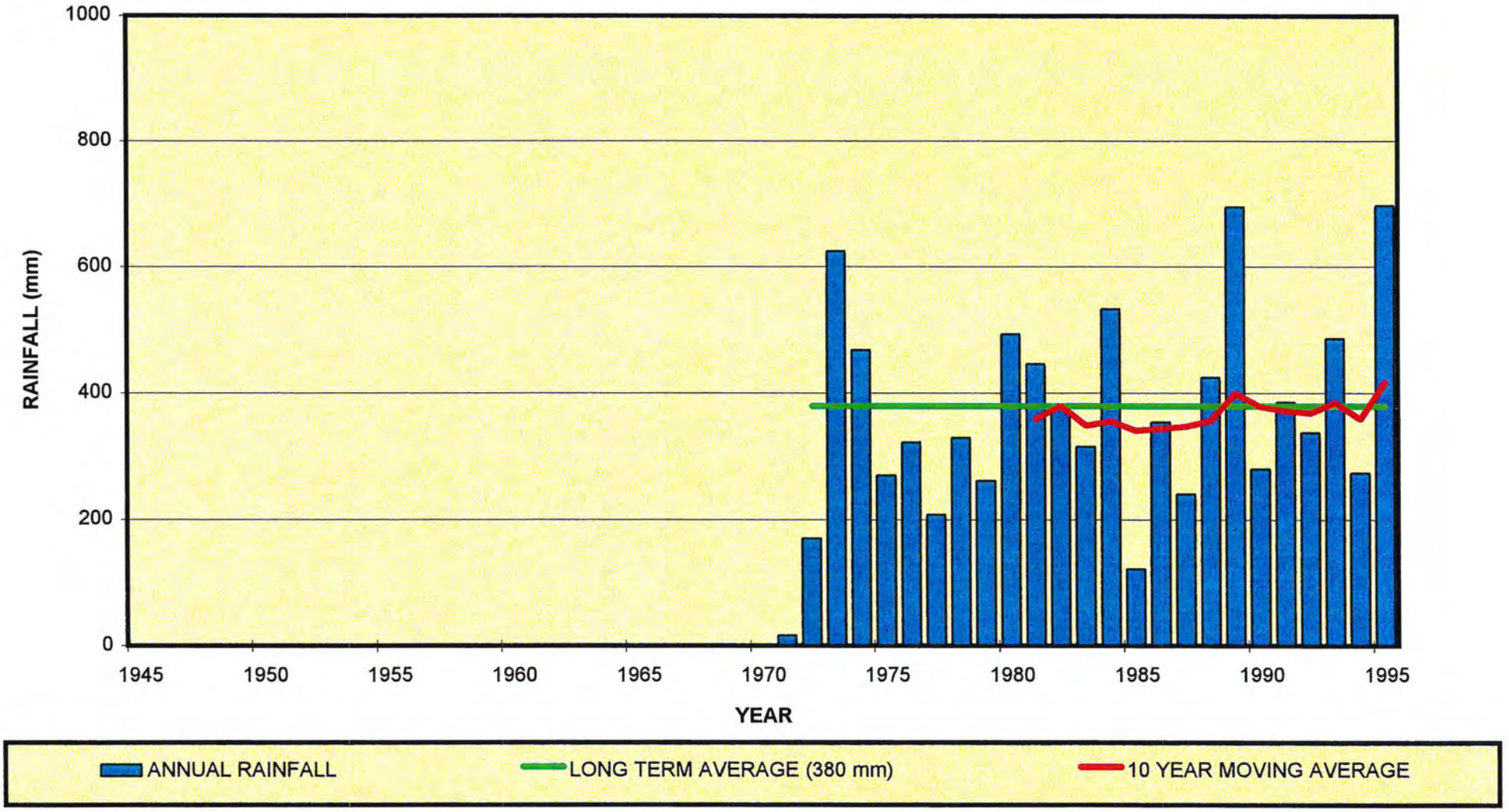


FIGURE A1. 6: HISTOGRAM FOR PORT HEDLAND

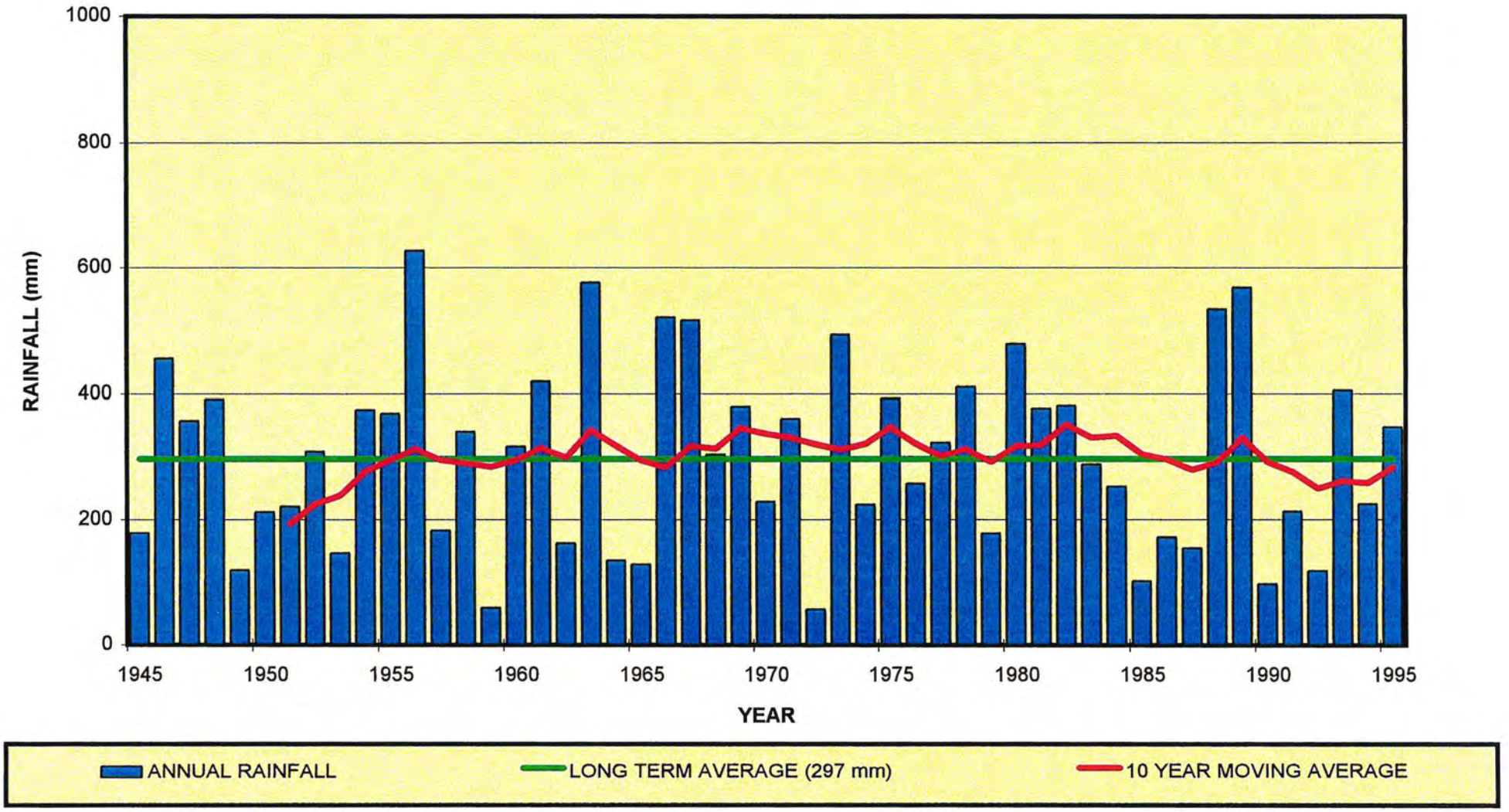


FIGURE A1.7: HISTOGRAM FOR MARBLE BAR

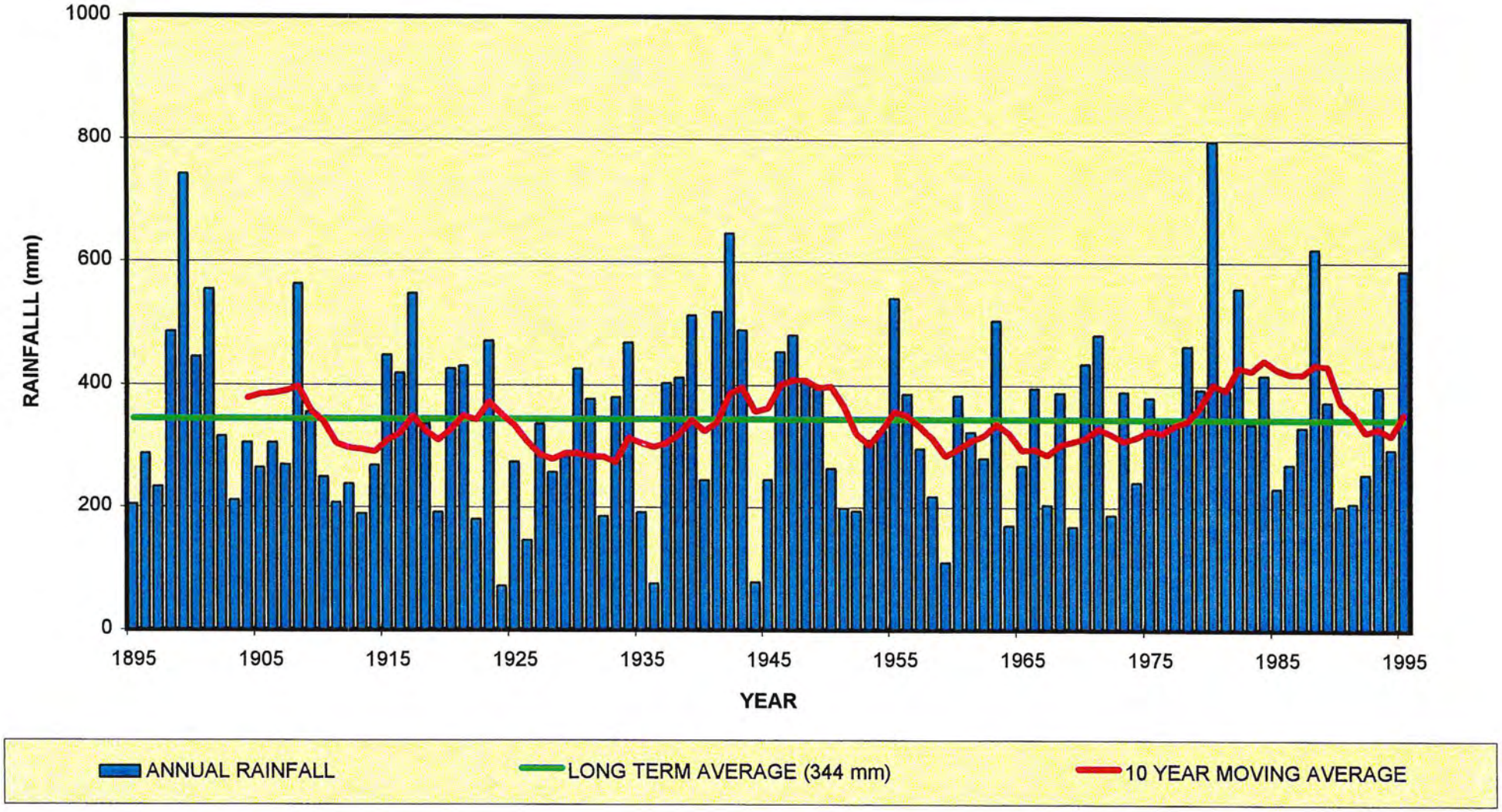


FIGURE A1.8: HISTOGRAM FOR NULLAGINE

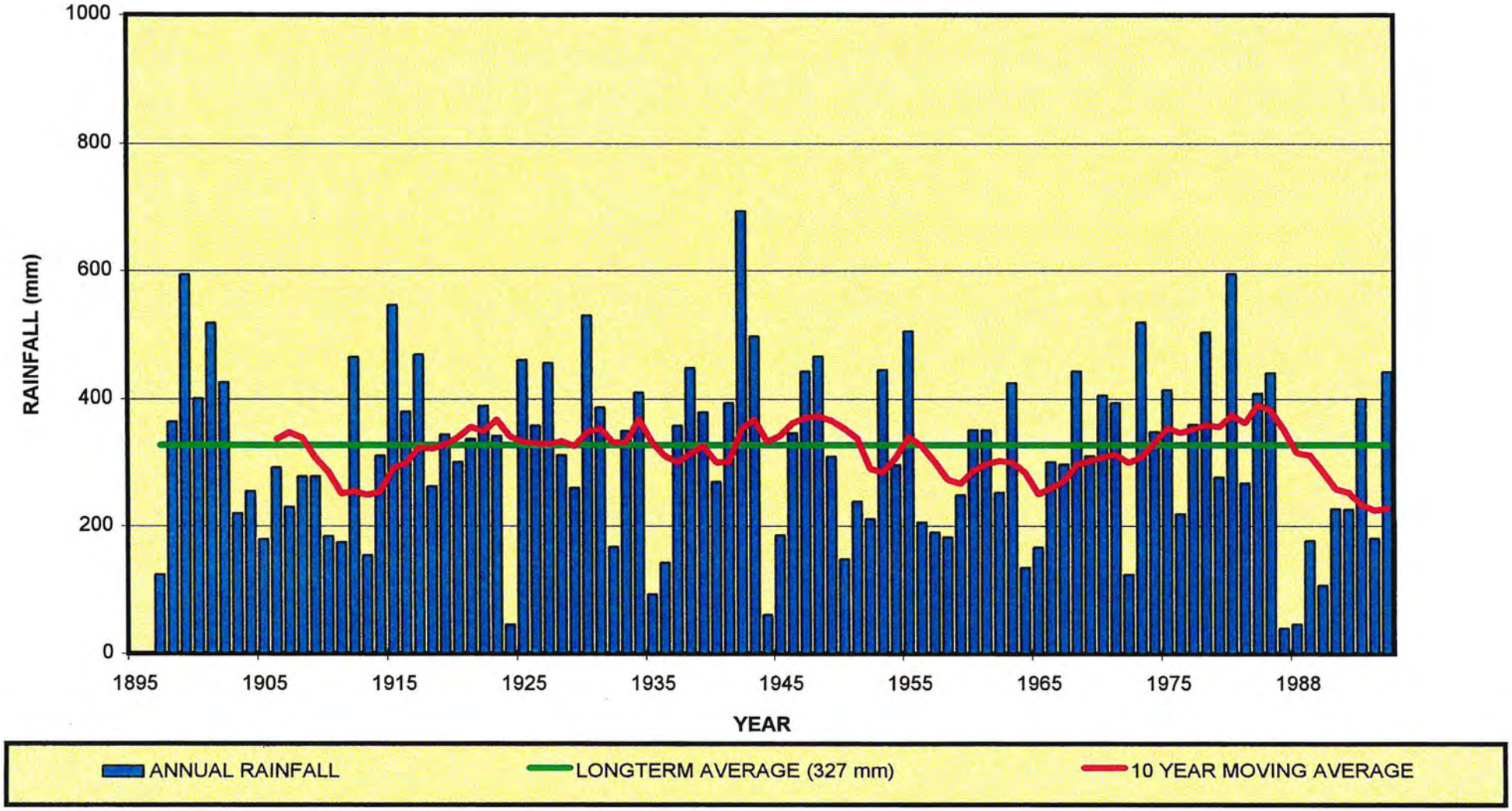


FIGURE A1.9: HISTOGRAM FOR WITTENOOM

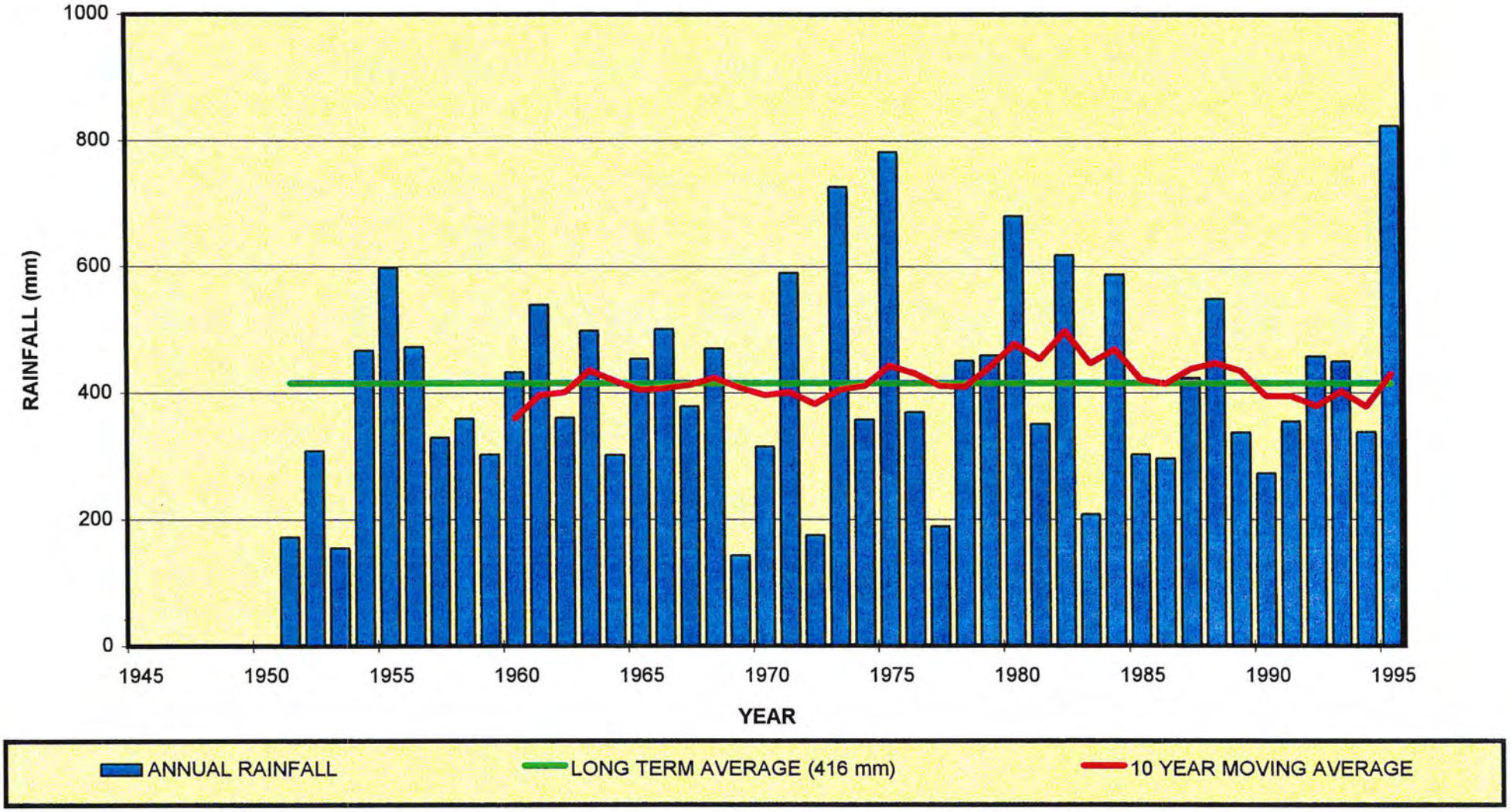


FIGURE A1.10: HISTOGRAM FOR NEWMAN

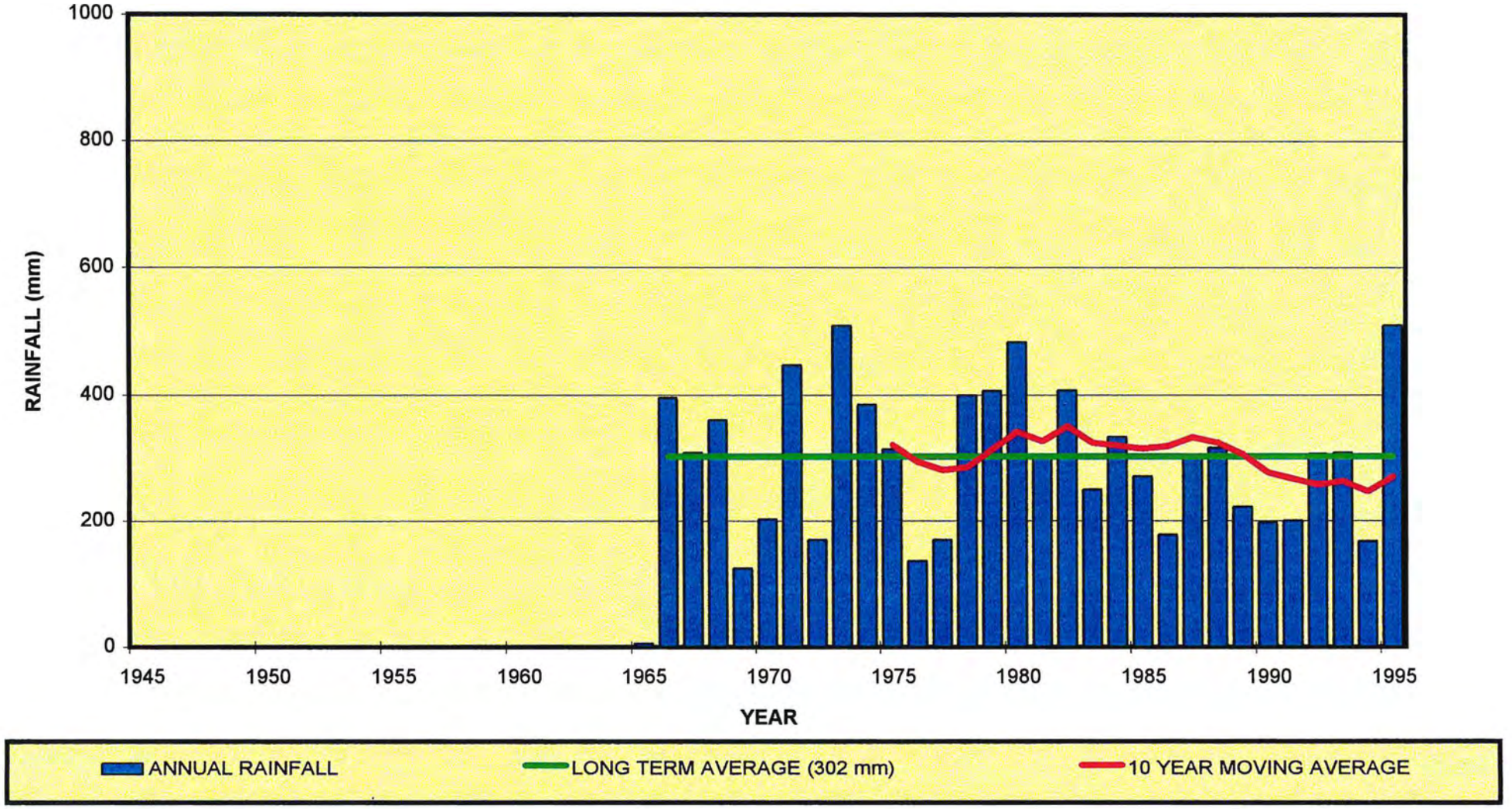
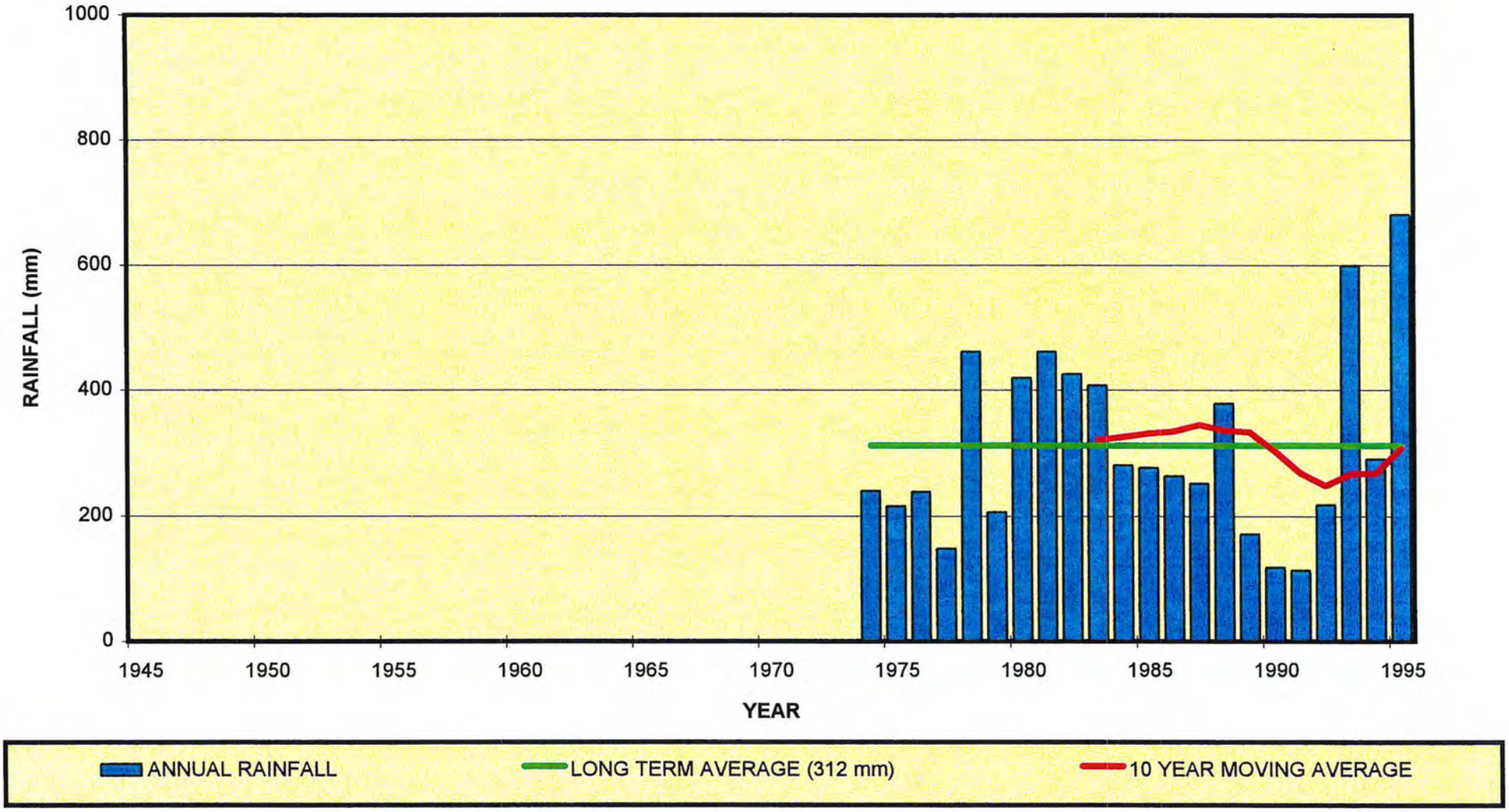


FIGURE A1.11: HISTOGRAM FOR TELFER



Appendix 2: Physiography and Geology

Figure A2. 1: Physiographic Subdivisions of the Pilbara Region (modified after Beard, 1975)

Figure A2. 2: Major Geological Subdivisions of the Pilbara Region

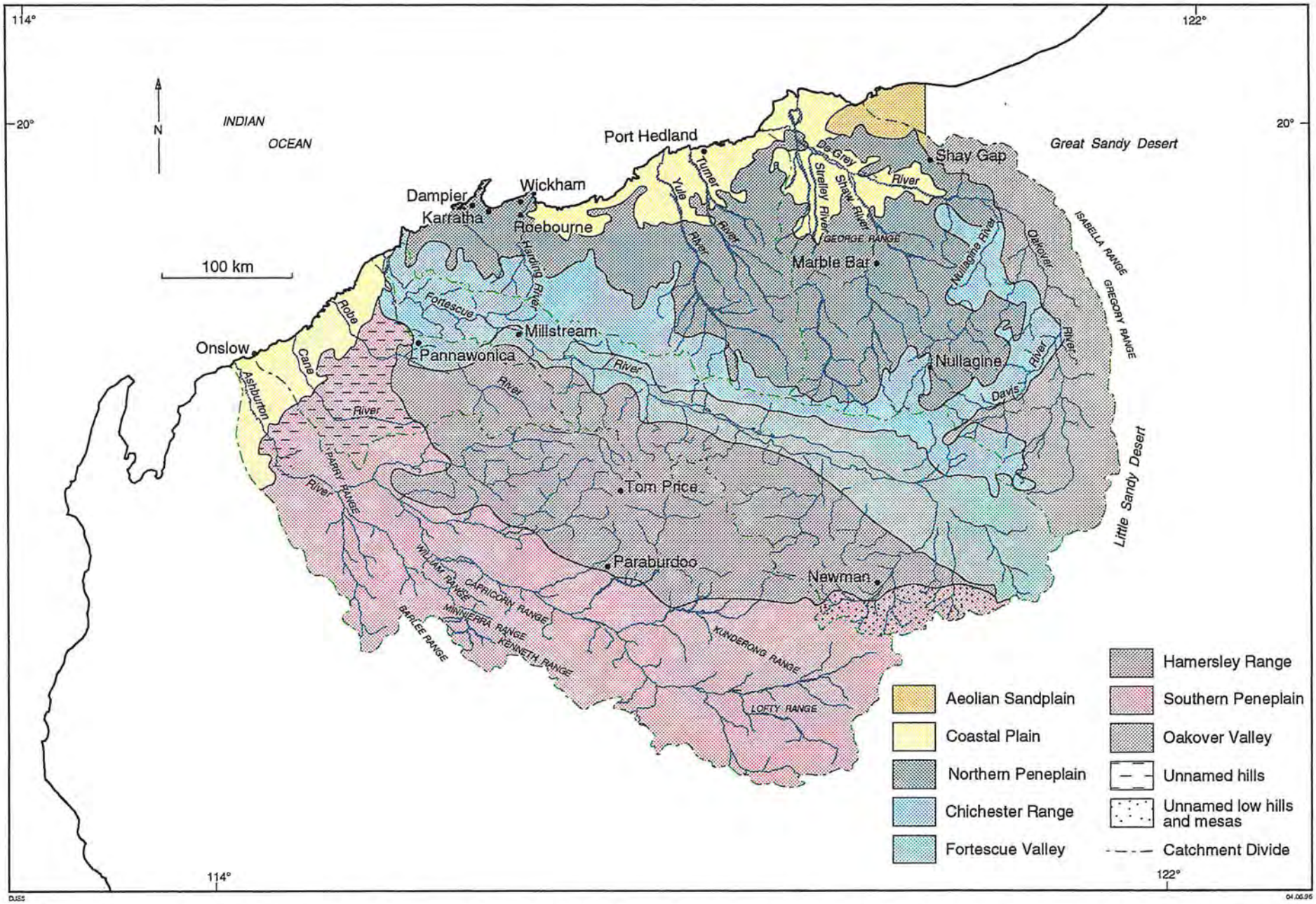


Figure A2.1:(source: Skidmore,1996) Physiographic Subdivisions at the Pilbara Region (modified after Beard, 1975).

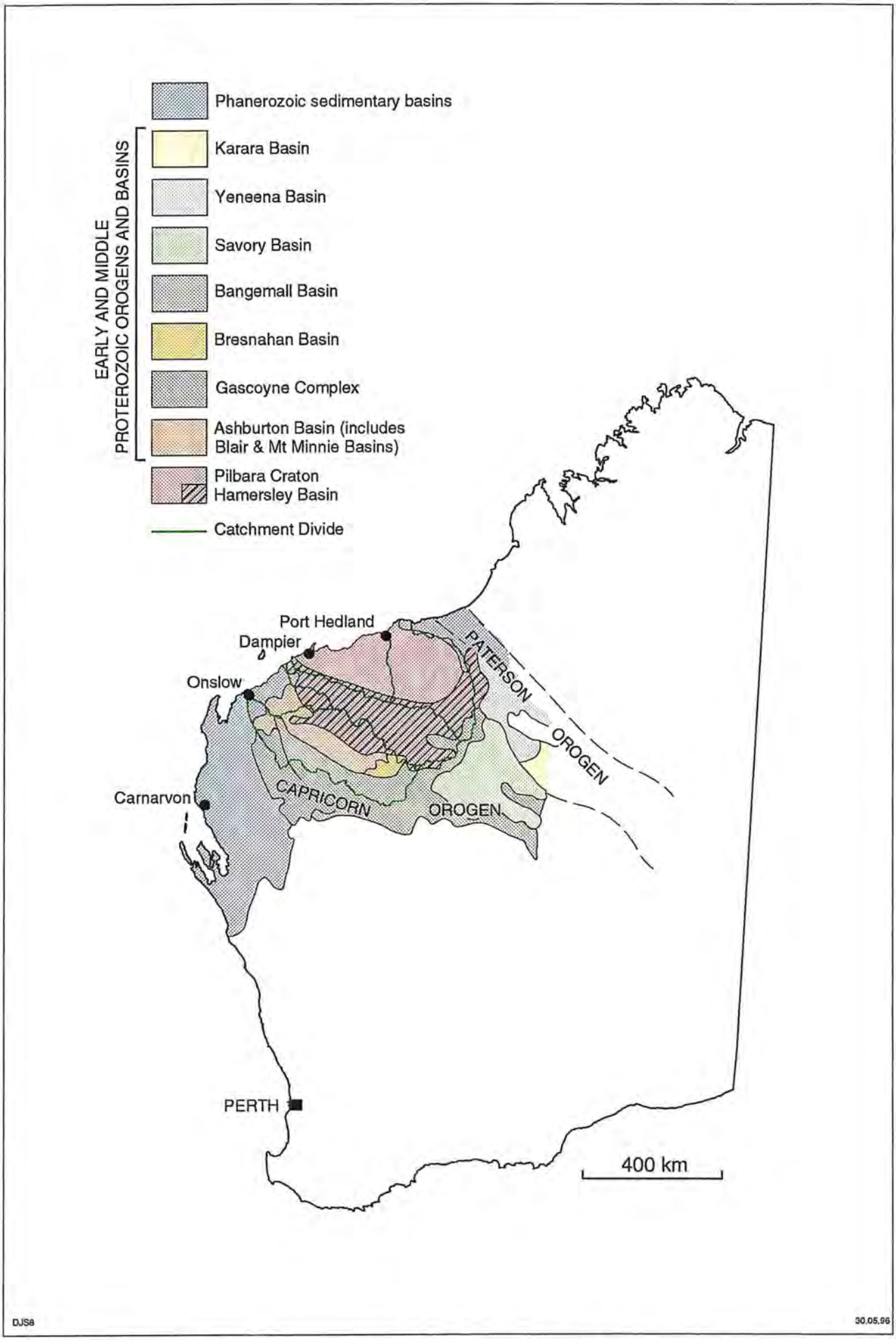


Figure A2.2:(source: Skidmore,1996)
Major geological subdivisions of the Pilbara Region

Appendix 3: Surface Water Resources

Surface Water Source: Ashburton River

River Basin: Ashburton **AWRC Basin No: 706**

Location: DS340 (Capricorn Range)
7 423 200 m N, 478 600 m E

Catchment Details:

Area:	41400 km^2
Average rainfall:	375 mm/annum
Pan evaporation:	3400 - 3700 mm/annum
Alienated:	50%
Cleared:	No significant clearing.
Land use:	50% vacant Crown land and Reserves, 50% sheep and cattle grazing on pastoral leases.

Mean Annual Flow (GL/year):	320
Estimated Divertible Yield (GL/year):	37

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Turbidity high in high flow events.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

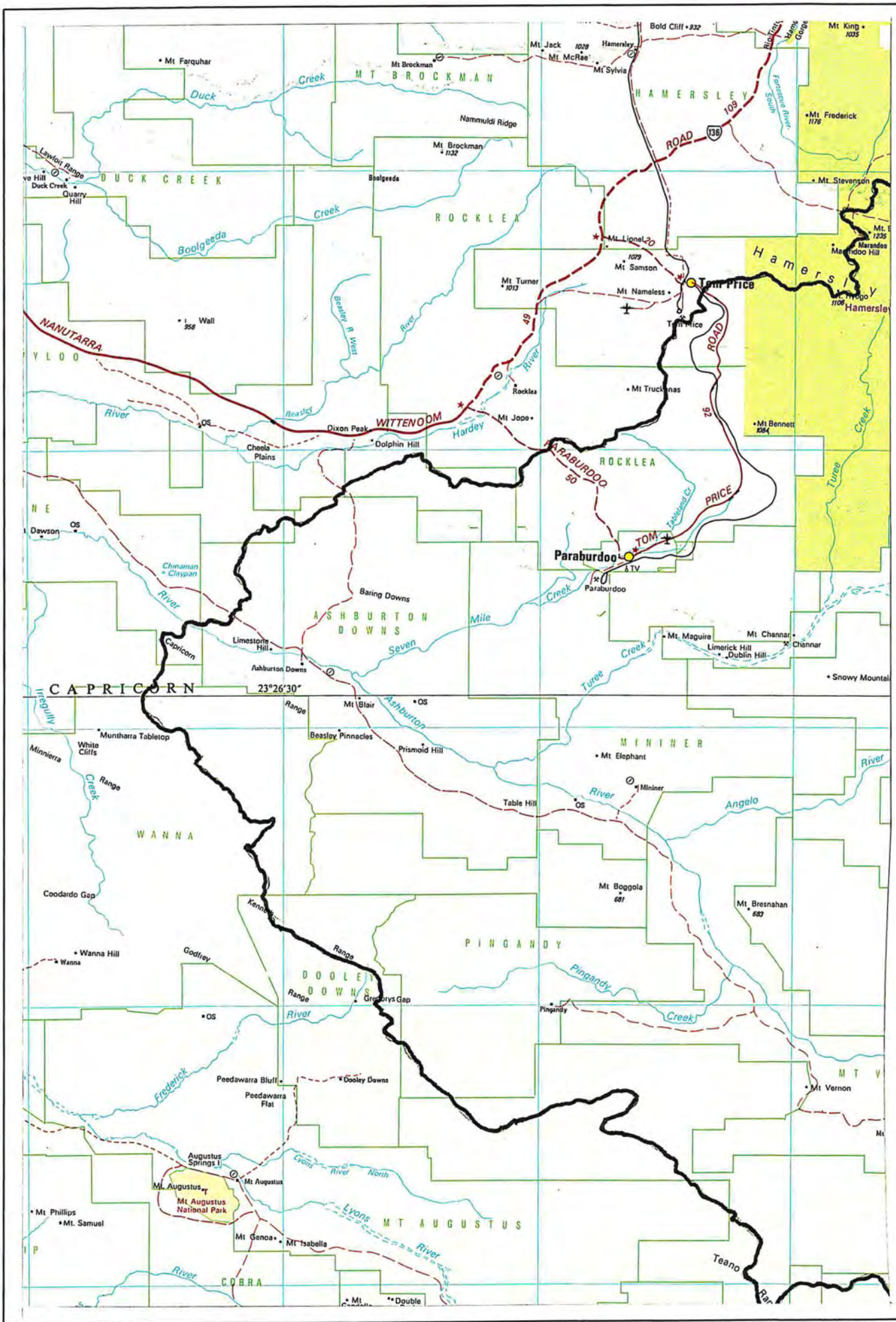
Possible future uses:

Possible water supply for West Pilbara development. The potential yield is based on a single reservoir. Additional yield may be available if this site is used conjunctively with a groundwater source.

Factors (environmental, social and economic) which may affect future development:

Comments:

The reliability of estimated divertible flow is fair. Treatment for turbidity may be required.



Ashburton River

Surface Water Source: Robe River

River Basin: Onslow Coast **AWRC Basin No: 707**

Location: DS124
7 594 500 m N, 456 000 m E

Catchment Details:

Area:	3000 km^2
Average rainfall:	330 mm/annum
Pan evaporation:	3400 mm/annum
Alienated:	40%
Cleared:	No significant clearing, but some overgrazing along river frontage.
Land use:	60% vacant Crown land in ranges, 40% sheep and cattle on pastoral leases, some open cut ore mining.

Mean Annual Flow (GL/year): 27
Estimated Divertible Yield (GL/year): 4

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Turbidity high in high flow events.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

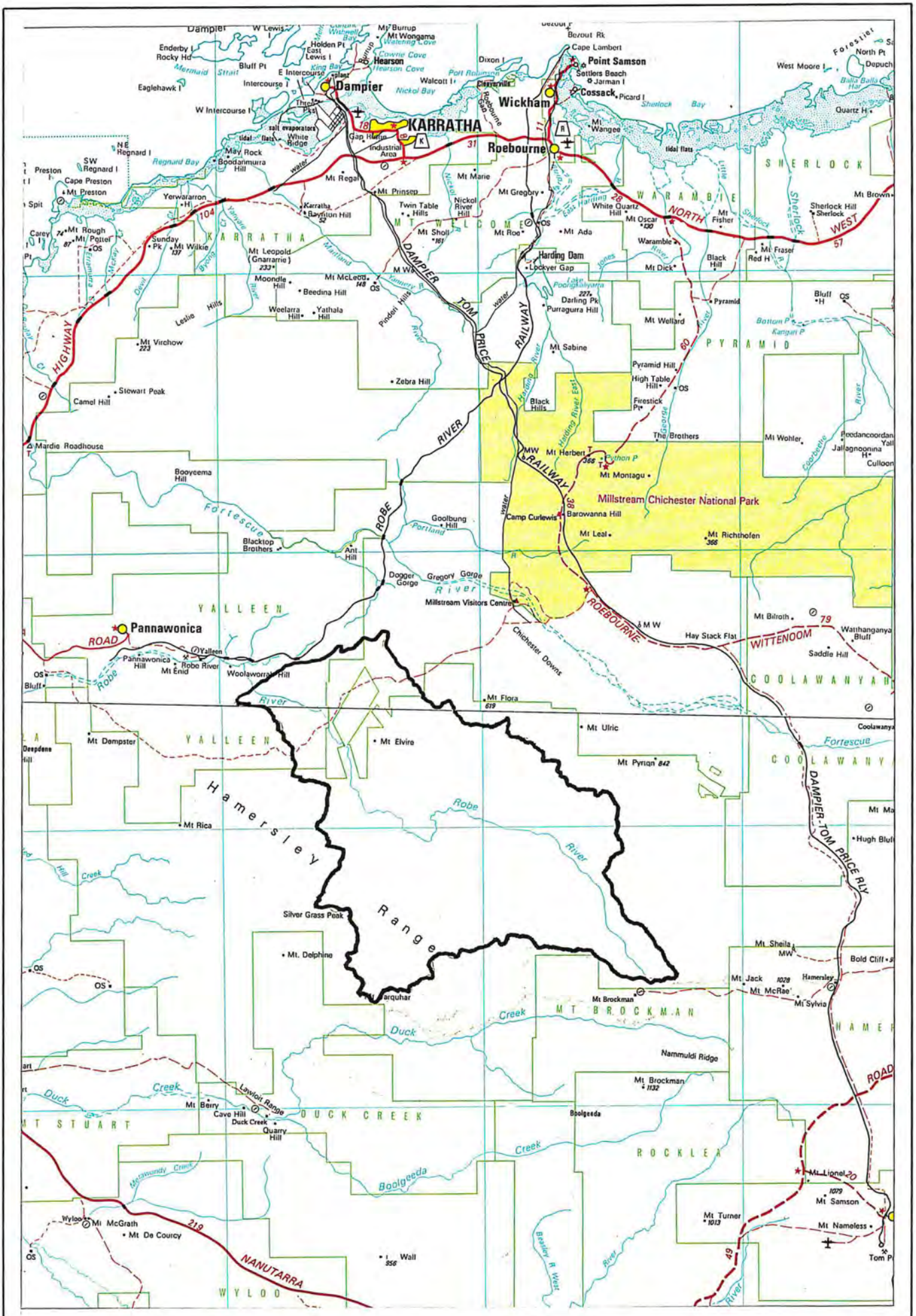
Possible future uses:

Possible water supply for West Pilbara development.

Factors (environmental, social and economic) which may affect future development:

1. Aboriginals in the past have indicated they would not object to a dam being constructed.
2. Loss of extensive area of River Gum forest and woodland associated shrublands of the valley floor. Similar areas upstream and downstream of the reservoir would remain.
3. Loss of temporary pools in the reservoir area and reduction in flooding causing further reduction of temporary aquatic habitats downstream of the dam. However, these habitats, being temporary, do not have the biological value of pools on the Harding, Sherlock or Fortescue Rivers.

Comments:
The reliability of data for estimated divertible flows is poor. Treatment for turbidity may be required.


Dampier
Karratha
Wickham
Roebourne
Point Samson
Cossack
Pannawonica
Yalleen
Robe River
Fortescue River
Hamersley Range
Silver Grass Peak
Mt. Delphine
Mt Elvire
Mt Flora
Mt Ulric
Mt Pyrton
Mt Rica
Mt Dempster
Mt Brockman
Mt Farquhar
Duck Creek
Boolgeeda Creek
Millstream Chichester National Park
Millstream Visitors Centre
Dogger Gorge
Gregory Gorge
Ant Hill
Goolbung Hill
Blacktop Brothers
Woolaworra Hill
Pannawonica Hill
Mt Enid
Mardie Roadhouse
Booyeema Hill
Camel Hill
Stewart Peak
Mt Virchow
Zebra Hill
Harding Dam
Camp Curlewis
Barowanna Hill
Mt Leal
Mt Richthofen
Mt Herbert
Mt Montagu
Hay Stack Flat
Mt Bilroth
Chichester Downs
Nammuldi Ridge
Mt Sheila
Mt Jack
Mt McRae
Mt Sylvia
Mt Lionel
Mt Samson
Mt Turner
Mt Nameless
Tom Price
Lawloit Range
Mt Berry
Cave Hill
Duck Creek
Quarry Hill
Mt McGrath
Mt De Courcy
Wylloo
Wall
DAMPIER TOM PRICE RAILWAY
ROBE RIVER RAILWAY
ROEBOURNE - WITTENOOM ROAD
NORTH WEST HIGHWAY
NANUTARRA ROAD
YALLEEN
MT BROCKMAN
DUCK CREEK
MT STUART
ROCKLEA
WYLOO
COOLAWANYAH
PYRAMID
MT WELCOME
KARRATHA
SHERLOCK
WARAMBIE

Robe River

Surface Water Source:	Robe River

River Basin: Onslow Coast **AWRC Basin No: 707**

Location: DS154
7 577 000 m N, 474 300 m E

Catchment Details:

Area:	1970 km^2
Average rainfall:	330 mm/annum
Pan evaporation:	3400 mm/annum
Alienated:	60%
Cleared:	No significant clearing, but some overgrazing along river frontage.
Land use:	40% vacant Crown land in ranges, 60% sheep and cattle on pastoral leases.

Mean Annual Flow (GL/year): 18
Estimated Divertible Yield (GL/year): 9

Water Quality:

Salinity:
Other significant parameters:

Existing Developments:

WC:
Other:
Current uses:

Possible future uses:

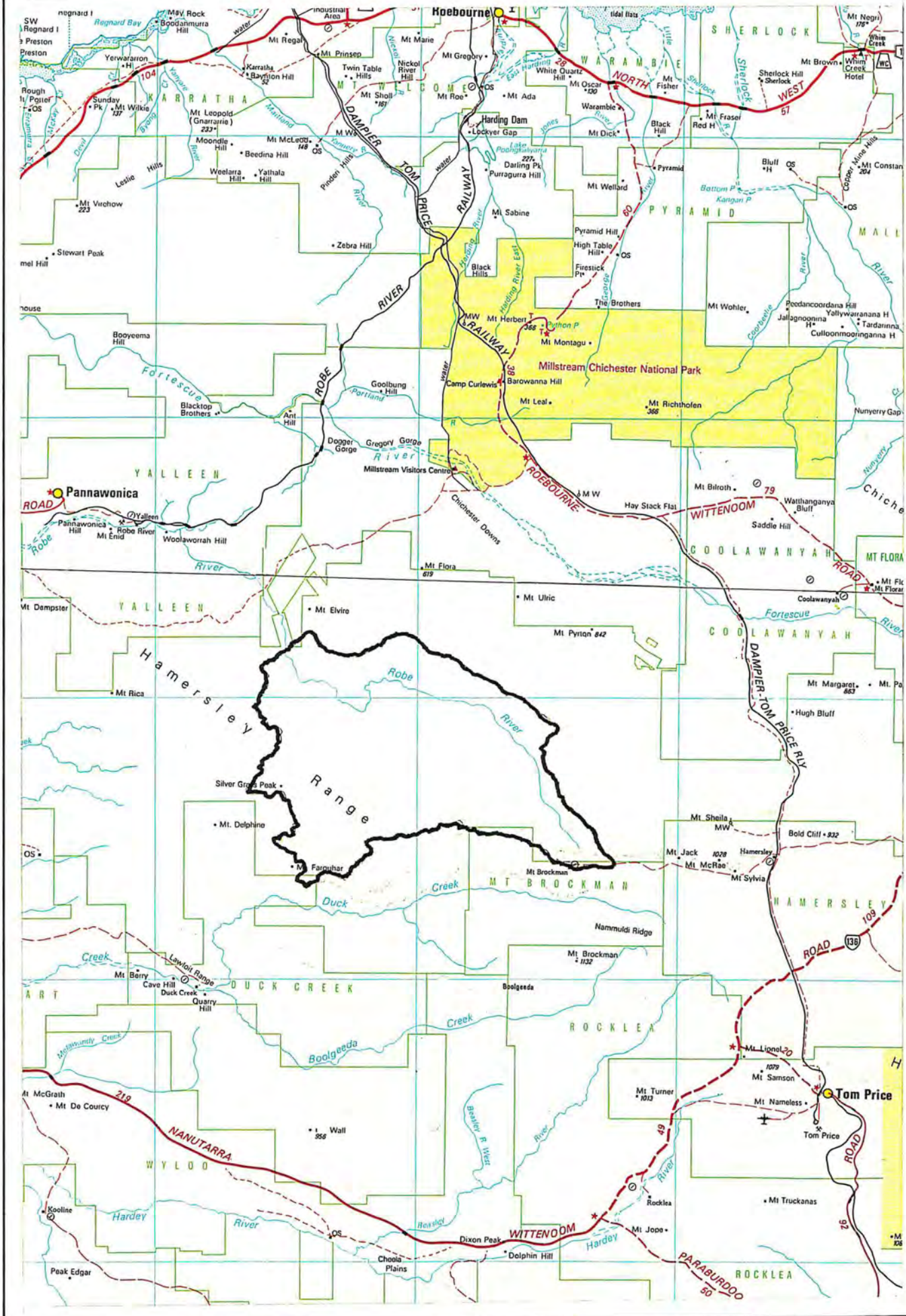
Possible water supply for West Pilbara development.

Factors (environmental, social and economic) which may affect future development:

The Robe River Catchment is the subject of extensive mining claims and these have a profound impact on the development of water resources.

Comments:

The reliability of data for the mean annual flow and estimated divertible flow is poor.


Roebourne
Pannawonica
Millstream Chichester National Park
Hamersley Range
Robe River
Fortescue River
Hardey River
Duck Creek
Boolgeeda Creek
Mt Brockman
Mt Bruce
Mt Meharry
Mt Tom Price
Tom Price
Wittenoom
Dampier-Tom Price Rly
Nanutarra
Parabardoo
Yalleen
Karratha
Mt Welcome
Warambie
Sherlock
Pyramid
Rocklea
Hamersley
Coolawanyah
Mt Flora
Mt Stuart
Mt Whaleback
Mt Newman
Newman
Jigalong
Wittenoom
Tom Price
Paraburdoo
Rocklea
Millstream Chichester National Park
Robe River

Robe River

Surface Water Source: Kumina Creek

River Basin: Onslow Coast **AWRC Basin No: 707**

Location: DS20
7 588 200 m N, 482 300 m E

Catchment Details:

Area:	506 km^2
Average rainfall:	330 mm/annum
Pan evaporation:	3400 mm/annum
Alienated:	60%
Cleared:	No significant clearing, but some overgrazing along river frontage.
Land use:	40% vacant Crown land in ranges, 60% sheep and cattle on pastoral leases.

Mean Annual Flow (GL/year): 2.5
Estimated Divertible Yield (GL/year): 0

Water Quality:

Salinity:
Other significant parameters:

Existing Developments:

WC:
Other:
Current uses:

Possible future uses:

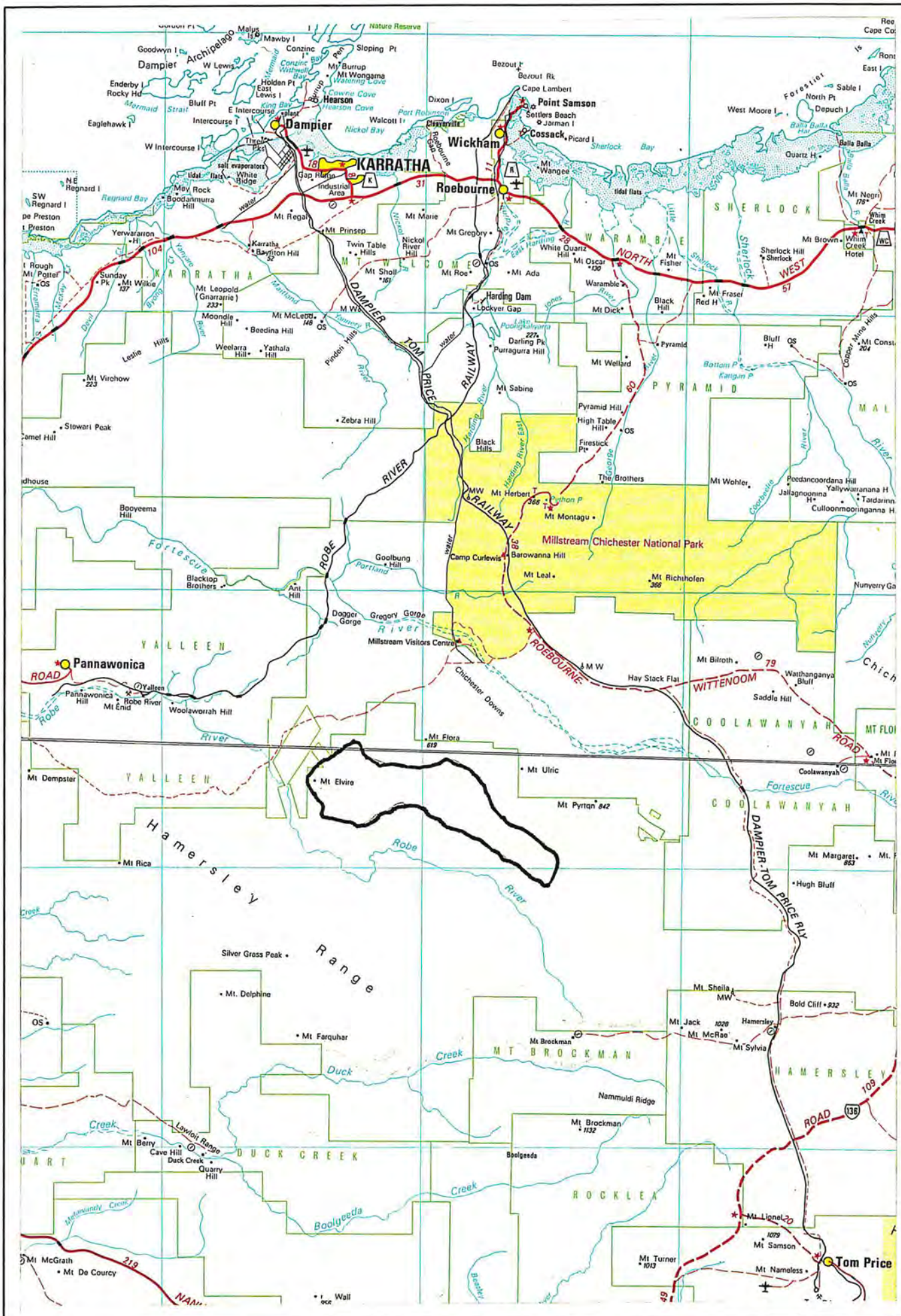
Possible water supply for West Pilbara development.

Factors (environmental, social and economic) which may affect future development:

The base of the Hamersley Ranges, between Kumina Creek and Robe River, is the subject of a State Agreement mining tenement associated with the Robe River Mining operation.

Comments:

The reliability of data for estimated divertible flows is poor.



Kumina Creek

Surface Water Source:	Cane River

River Basin: Onslow Coast **AWRC Basin No: 707**

Location: DS74
7 559 000 m N, 358 000 m E

Catchment Details:

Area:	2290 km^2
Average rainfall:	330 mm/annum
Pan evaporation:	3400 mm/annum
Alienated:	
Cleared:	
Land use:	

Mean Annual Flow (GL/year):	62
Estimated Divertible Yield (GL/year):	6

Water Quality:

Salinity:	150 mg/L TSS.
Other significant parameters:	Turbidity high in high flow events.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

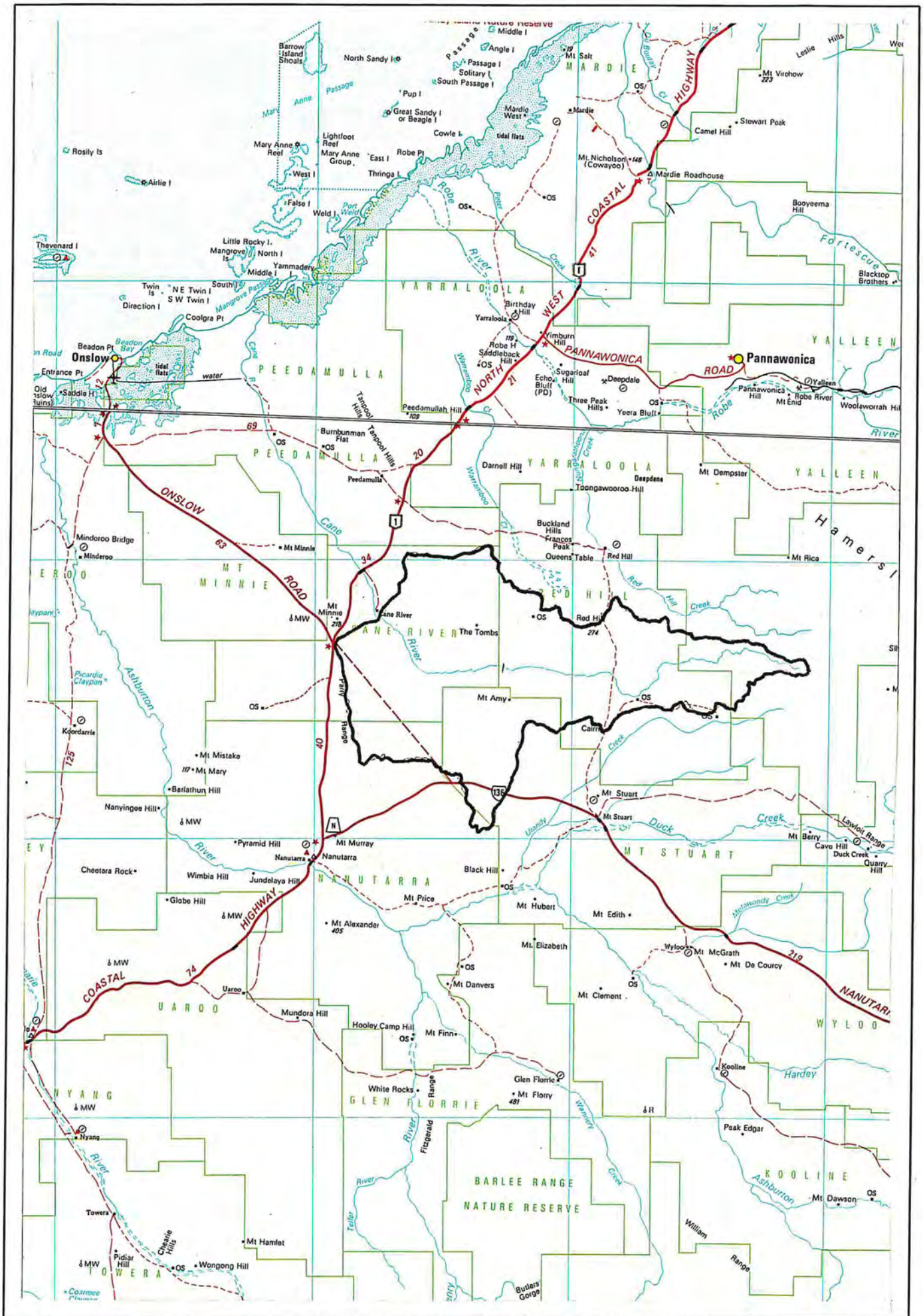
Possible future uses:

Conjunctive use by artificial recharge with a groundwater resource may be a possibility, but no firm options have been identified, even though the coastal areas have been indicated as being prospective for groundwater developments.

Factors (environmental, social and economic) which may affect future development:

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is fair. Treatment for turbidity may be required. Surface source will need to be developed taking into account the impact on the groundwater source.


Onslow
Pannawonica
ONSLOW ROAD
NORTH WEST COASTAL HIGHWAY
PANNAWONICA ROAD
COASTAL HIGHWAY
NANUTARRA HIGHWAY
Cane River
Mt Minnie
Mt Stuart
Mt Nanutarra
Glen Florrie
Barlee Range Nature Reserve
Peedamulla
Yarraloola
Yalleen
Mardie
Mt Salt
Mardie Roadhouse
Mt Nicholson (Cowayoo)
Mt Virchow
Camel Hill
Stewart Peak
Booyeema Hill
Fortescue
Blacktop Brothers
Birthday Hill
Yimburn Hill
Saddleback Hill
Sugarloaf Hill
Deepdale
Three Peak Hills
Yeera Bluff
Pannawonica Hill
Yalleen
Robe River
Mt Enid
Woolaworrah Hill
Peedamullah Hill
Tenpool Hills
Burnbunman Flat
Darnell Hill
Toongawooroo Hill
Mt Dempster
Deepdene
Buckland Hills
Frances Peak
Queens Table
Red Hill
Mt Rica
Hamersley
Minderoo Bridge
Minderoo
Mt Minnie
The Tombs
Red Hill Creek
Mt Amy
Cairra
Koordarrie
Mt Mistake
Mt Mary
Barlathun Hill
Nanyingee Hill
Picardie Claypan
Ashburton
Pyramid Hill
Nanutarra
Cheetara Rock
Wimbia Hill
Jundelaya Hill
Globe Hill
Mt Price
Black Hill
Mt Hubert
Mt Edith
Mt Alexander
Mt Elizabeth
Mt Danvers
Mt Clement
Mt McGrath
Mt De Courcy
Wyloo
Mt Stuart
Duck Creek
Mt Berry
Cave Hill
Quarry Hill
Layloll Range
Uaroo
Mundora Hill
Hooley Camp Hill
Mt Finn
White Rocks
Glen Florrie
Mt Florry
Kooline
Hardey
Peak Edgar
Mt Dawson
Nyang
Towera
Mt Hamlet
Pidiar Hill
Wongong Hill
Chirrie Hills
Coomee
Fitzgerald River
Barlee Range
William Range
Butlers Gorge
Thevenard I
Rosily Is
Airlie I
Barrow Island Shoals
North Sandy I
Middle I
Angle I
Passage I
Solitary I
South Passage I
Pup I
Great Sandy I or Beagle I
Lightfoot Reef
Mary Anne Reef
Mary Anne Group
Robe Pt
Thringa I
Cowle I
Weld I
False I
Port Weld
Little Rocky I
Mangrove Is
North I
Middle I
Yammaderry
South I
Twin Is
NE Twin I
SW Twin I
Direction I
Coolgra Pt
Beadon Pt
Beadon Bay
Entrance Pt
tidal flats
water
Saddle H
Old Onslow (ruins)
Mangrove Passage
Cane River
Warramboo Creek
Tenpool Hills
Peedamulla
Burnbunman Flat
Minderoo
Mt Minnie
Cane River
The Tombs
Red Hill
Mt Amy
Cairra
Mt Stuart
Duck Creek
Mt Berry
Cave Hill
Layloll Range
Quarry Hill
Mt Hubert
Mt Edith
Mt Elizabeth
Mt Danvers
Mt Clement
Mt McGrath
Mt De Courcy
Wyloo
Mundora Hill
Hooley Camp Hill
Mt Finn
White Rocks
Glen Florrie
Mt Florry
Kooline
Hardey
Peak Edgar
Mt Dawson
Nyang
Towera
Mt Hamlet
Pidiar Hill
Wongong Hill
Chirrie Hills
Fitzgerald River
Barlee Range Nature Reserve
William Range
Butlers Gorge
Ashburton
Duck Creek
Quarry Hill
Layloll Range
Cave Hill
Mt Berry
Mt Stuart
Mt Dawson
Mt Hamlet
Mt Finn
Mt Florry
Mt Alexander
Mt Price
Mt Hubert
Mt Edith
Mt Elizabeth
Mt Danvers
Mt Clement
Mt McGrath
Mt De Courcy
Wyloo
Kooline
Peak Edgar
Hardey
Ashburton
Fitzgerald River
Barlee Range
William Range
Butlers Gorge
Nanutarra
Glen Florrie
Mt Stuart
Mt Minnie
Peedamulla
Yarraloola
Yalleen
Mardie
Uaroo
Towera
Nyang
Onslow
Pannawonica
Cane River

Cane River

Surface Water Source: Cane River

River Basin: Onslow Coast **AWRC Basin No: 707**

Location: DS114
7 546 000 m N, 389 000 m E

Catchment Details:

Area:	817 km^2
Average rainfall:	330 mm/annum
Pan evaporation:	3400 mm/annum
Alienated:	
Cleared:	
Land use:	

Mean Annual Flow (GL/year):	18
Estimated Divertible Yield (GL/year):	3

Water Quality:

Salinity:	150 mg/L TSS.
Other significant parameters:	Turbidity high in high flow events.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

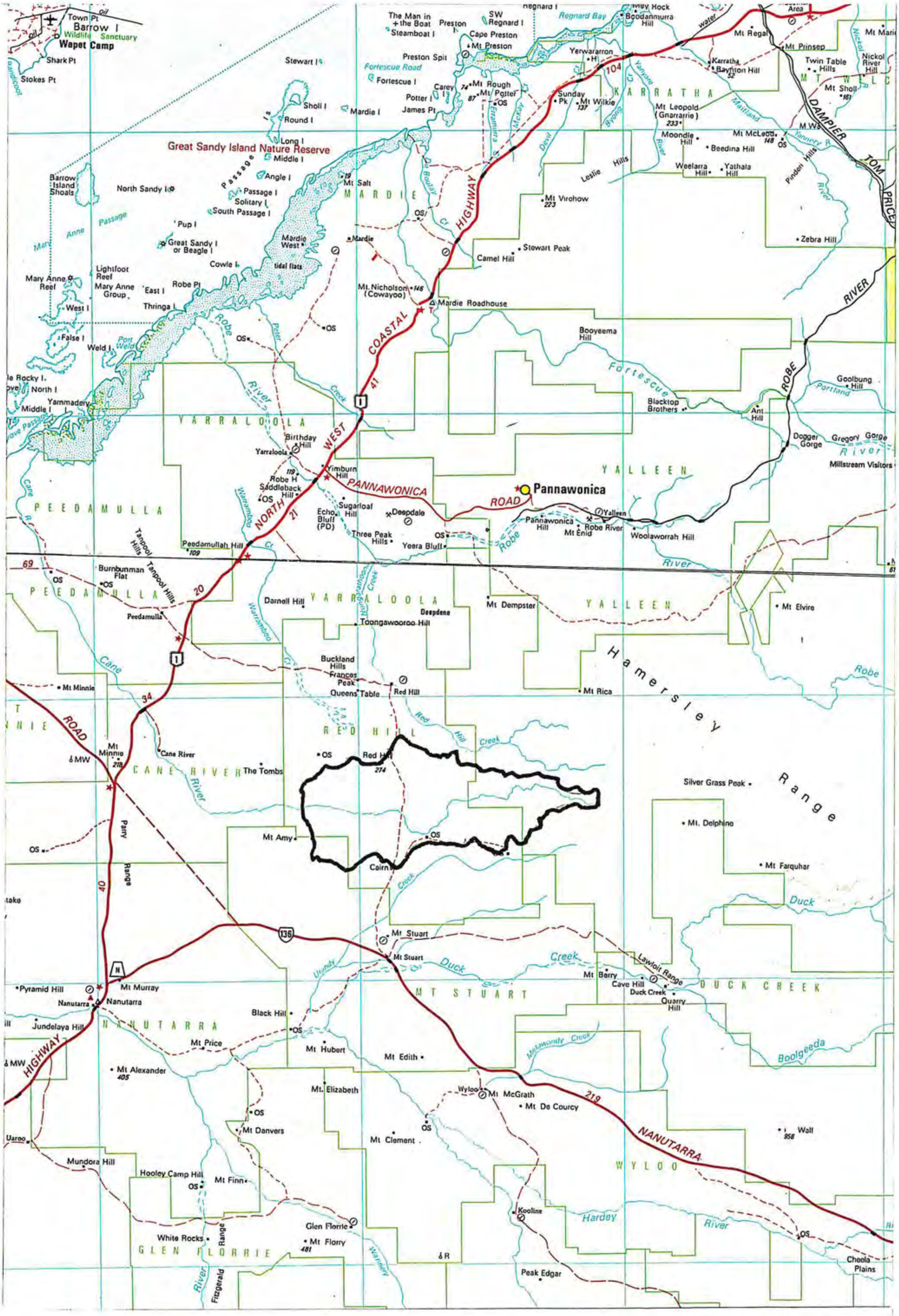
Possible future uses:

Conjunctive use by artificial recharge with a groundwater resource may be a possibility, but no firm options have been identified, even though the coastal areas have been indicated as being prospective for groundwater developments.

Factors (environmental, social and economic) which may affect future development:

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is fair. Treatment for turbidity may be required. Surface source will need to be developed taking into account the impact on the groundwater source.



Barrow I
Wapet Camp
Great Sandy Island Nature Reserve
Mardie Roadhouse
NORTH WEST COASTAL HIGHWAY
PANNAWONICA ROAD
Pannawonica
K A R R A T H A
Y A R R A L O O L A
P E E D A M U L L A
Y A L L E E N
Hamersley Range
R E D H I L L
C A N E R I V E R
Red Hill
Mt Amy
Cairn
The Tombs
Mt Minnie
Cane River
Mt Stuart
M T S T U A R T
D U C K C R E E K
Mt Murray
Nanutarra
N A N U T A R R A
NANUTARRA
W Y L O O
G L E N F L O R R I E
Mt Alexander
Mt Edith
Mt McGrath
Peak Edgar
Fortescue
Robe River
Duck Creek
Hardey River
Paraburdoo

Cane River

Surface Water Source:	Fortescue River

River Basin: Fortescue **AWRC Basin No: 708**

Location: Opthalmia Dam

Catchment Details:

Area:	4200 km^2
Average rainfall:	300 mm/annum
Pan evaporation:	3600 mm/annum
Alienated:	50%
Cleared:	No significant clearing, some overgrazing along river frontages.
Land use:	About 50% vacant Crown Land, 50% cattle and sheep grazing on pastoral leases, some open cut ore mining.

Mean Annual Flow (GL/year):	31
Estimated Divertible Yield (GL/year):	10

Water Quality:

Salinity:
Other significant parameters:

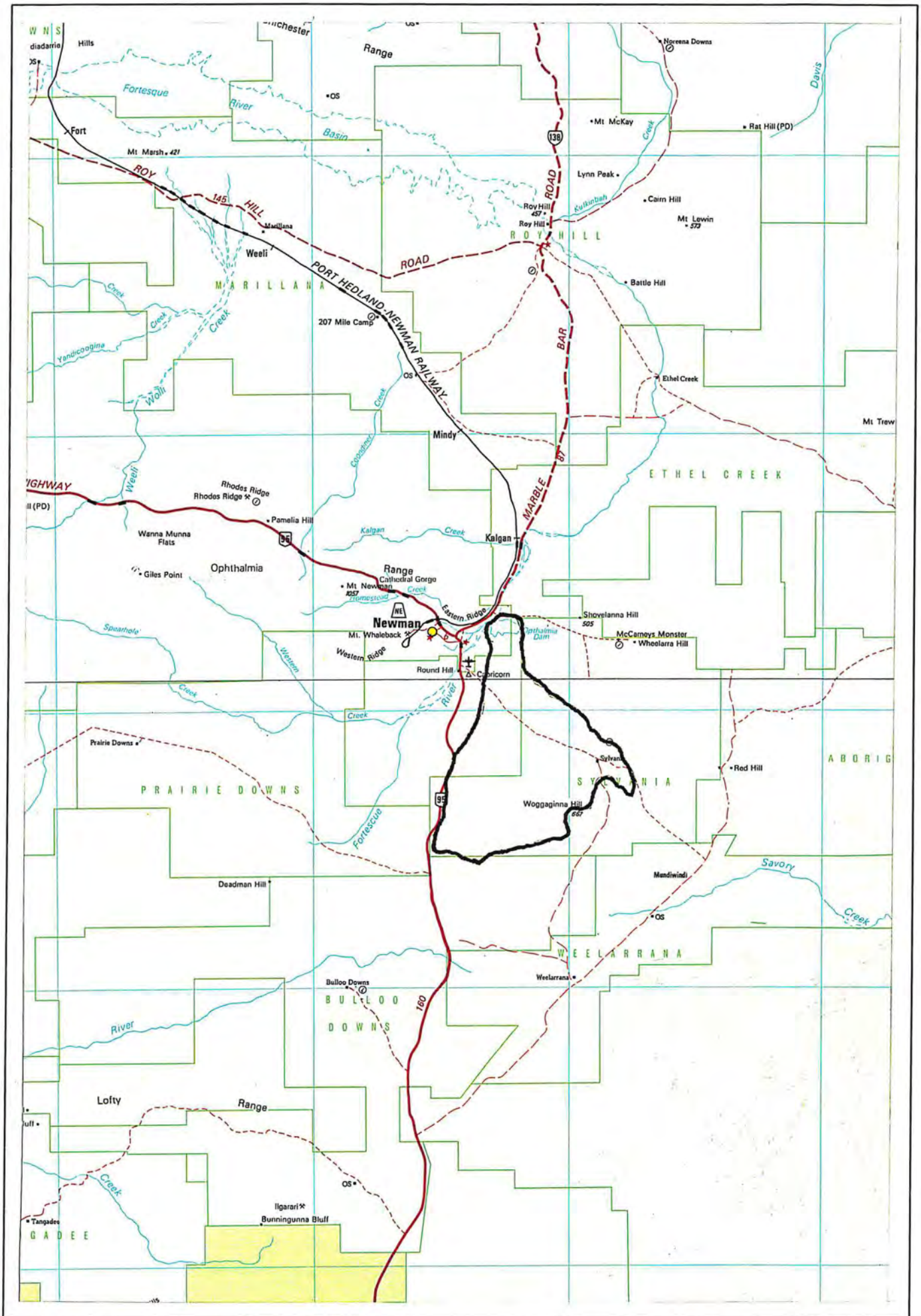
Existing Developments:

WC:
Other:
Current uses: aquifer recharge.

Possible future uses:

Factors (environmental, social and economic) which may affect future development:

Comments:



Fortescue River

Surface Water Source: Fortescue River

River Basin: Fortescue **AWRC Basin No: 708**

Location: DS48 (Bullinnarwa)
7 635 200 m N, 414 500 m E

Catchment Details:

Area:	18 500 km^2 (for 1 in 100 year flood the area is 50 200 km^2)
Average rainfall:	250 - 350 mm/annum
Pan evaporation:	3400 - 3800 mm/annum
Alienated:	60%
Cleared:	No significant clearing, but some overgrazing of river frontages.
Land use:	40% vacant Crown land and Reserves, 60% cattle and sheep on pastoral leases.

Mean Annual Flow (GL/year):	200
Estimated Divertible Yield (GL/year):	54

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Turbidity high in high flow events.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

Possible future uses:

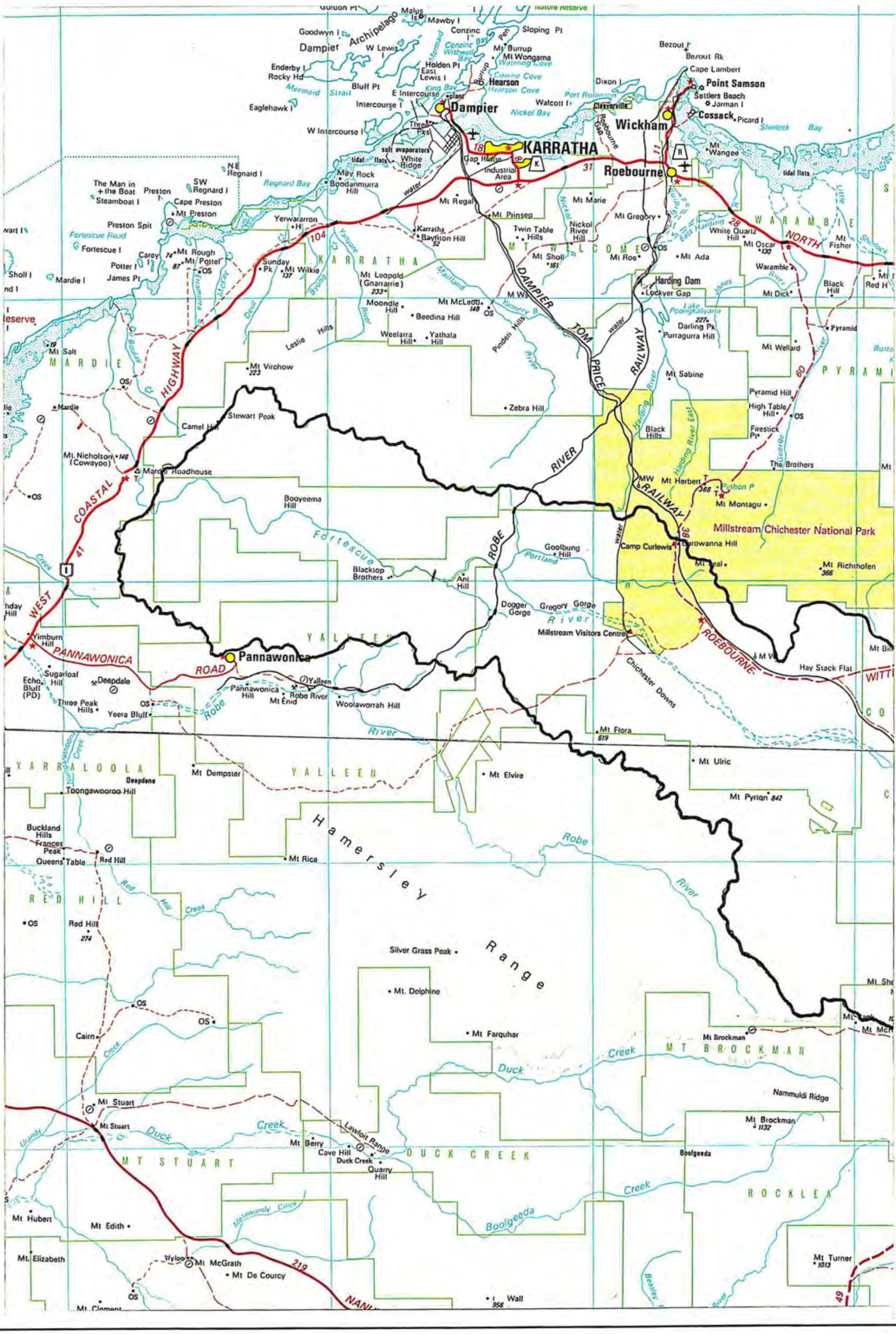
Possible water supply for West Pilbara development.

Factors (environmental, social and economic) which may affect future development:

1. Possible Aboriginal sites.
2. Construction of a dam at Bullinnarwa would have an impact on the environment.

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is good. Treatment for turbidity may be required. A dam on the Fortescue River, at Bullinnarwa, could be used in isolation, without groundwater augmentation.



Fortescue River

Surface Water Source:	Fortescue River

River Basin: Fortescue **AWRC Basin No: 708**

Location: DS123 (Booyeemala)
7 622 400 m N, 471 000 m E

Catchment Details:

Area:	16 200 km^2
Average rainfall:	250 - 350 mm/annum
Pan evaporation:	3400 - 3800 mm/annum
Alienated:	60%
Cleared:	No significant clearing, but some overgrazing of river frontages.
Land use:	40% vacant Crown land and Reserves, 60% cattle and sheep on pastoral leases.

Mean Annual Flow (GL/year): 147
Estimated Divertible Yield (GL/year): 42

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Turbidity high in high flow events.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

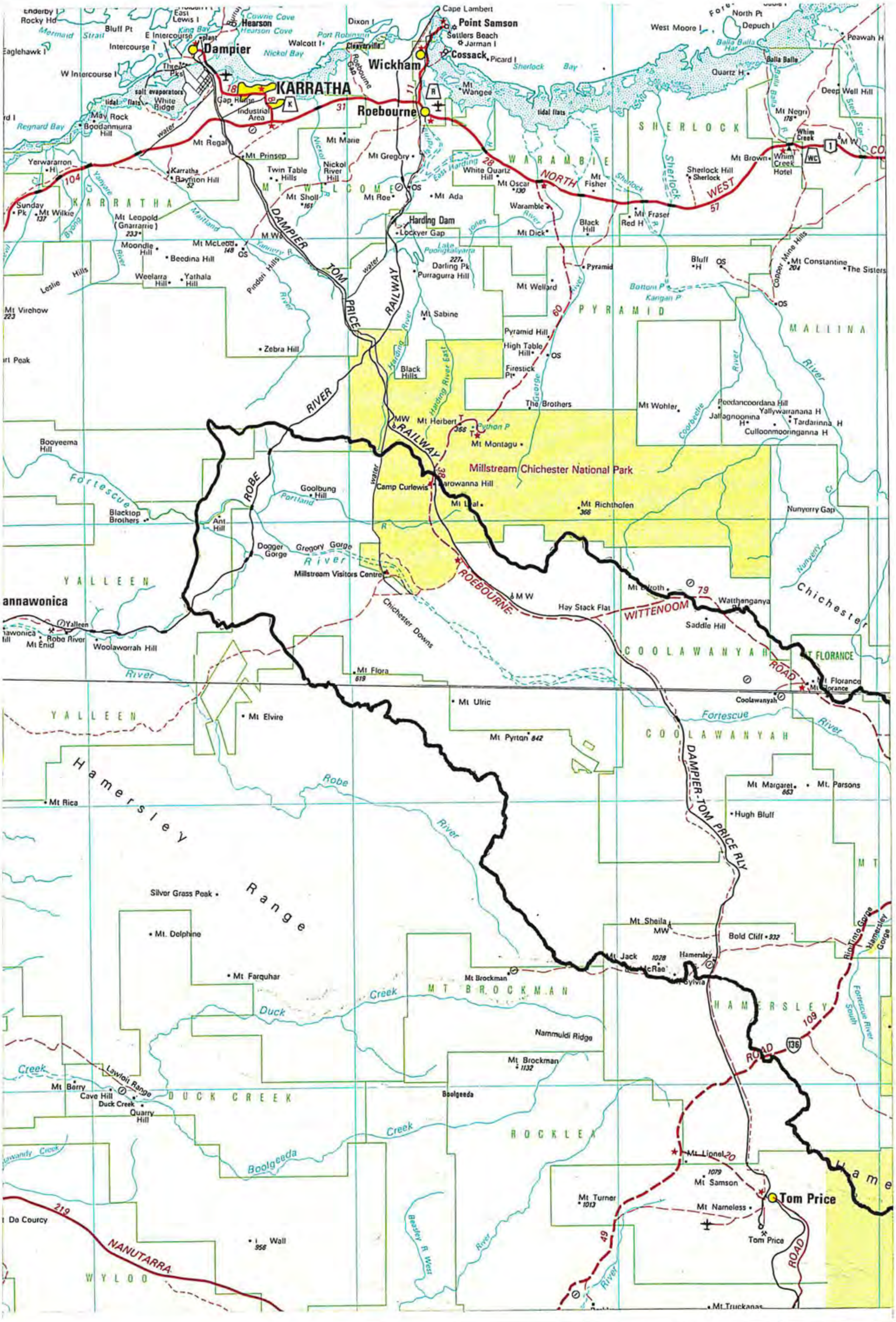
Possible future uses:

Possible water supply for West Pilbara development.

Factors (environmental, social and economic) which may affect future development:

1. The biological impact (the loss of riverine vegetation and permanent pool ecosystems) would be small in relation to those of most other reservoirs.
2. There would be an adverse impact on aquatic ecosystems located downstream of the dam. However, the severity of this impact could be reduced, if necessary, by controlled release of water from the reservoir.
3. Loss of numerous Aboriginal engravings and development within the area of the "ancestral route" which is an important feature of the mythology of traditional Aborigines. However, the reservoir would not affect any known sacred sites.
4. The reservoir would constitute a new tourist attraction and potential recreational resource.

Comments:
The reliability of estimated divertible flow is good. Treatment for turbidity may be required. A dam at Booyeemala could be used as an independent water supply.



Fortescue River

Surface Water Source: Yule River

River Basin: Port Hedland Coast **AWRC Basin No: 709**

Location: DS95 (Kangan Pool)
7 664 000 m N, 651 000 m E

Catchment Details:

Area:	7830 km^2
Average rainfall:	300 mm/annum
Pan evaporation:	3500 - 3700 mm/annum
Alienated:	70%
Cleared:	No significant clearing, but some overgrazing of native vegetation along river frontages.
Land use:	30% vacant Crown land and Reserves, 70% cattle and sheep on pastoral leases.

Mean Annual Flow (GL/year):	184
Estimated Divertible Yield (GL/year):	8.0

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Turbidity high in high flow events.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

Possible future uses:

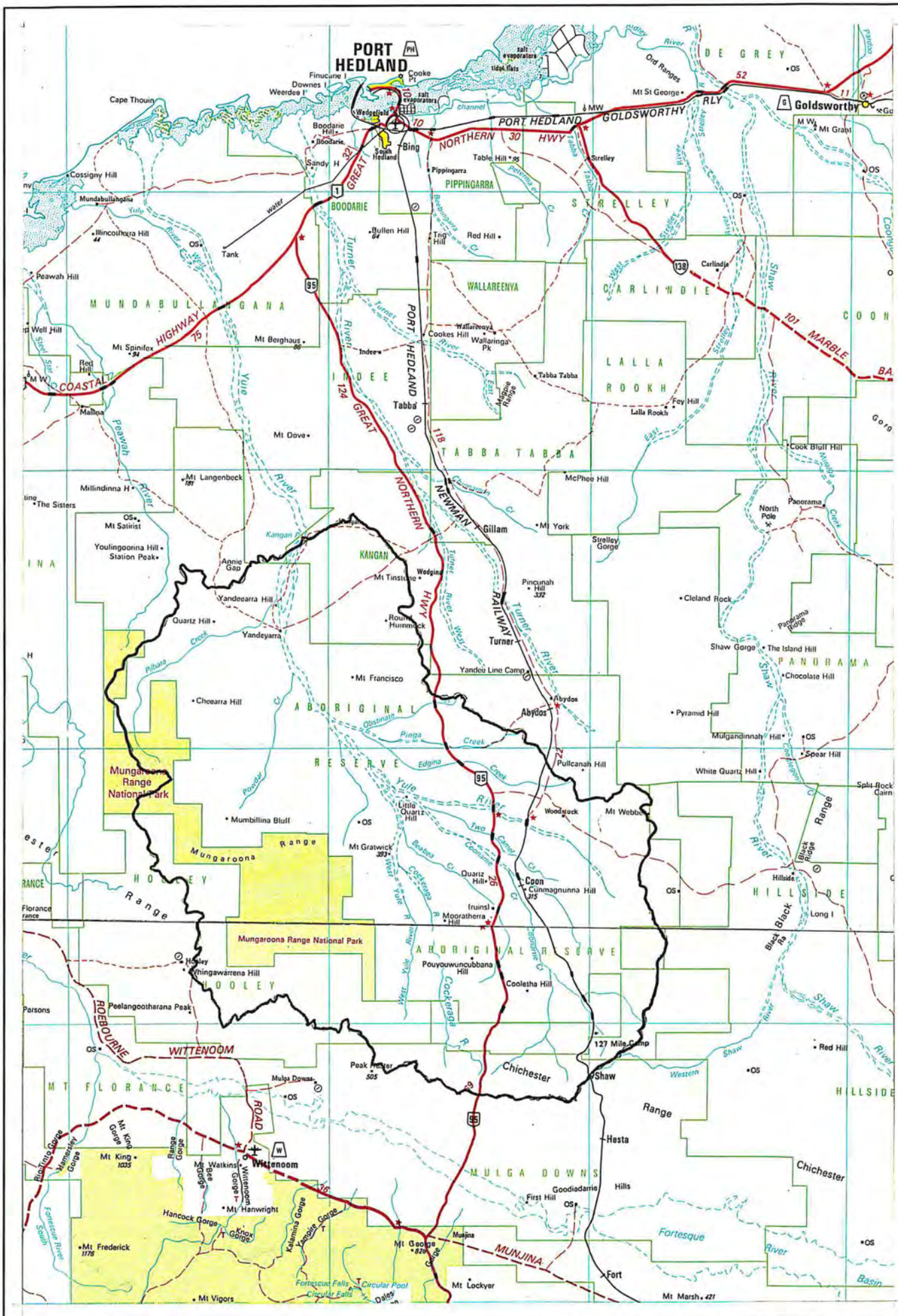
1. The main value of the storage will be its ability to recharge the major groundwater aquifer downstream of the site.
2. Water could be pumped on for the recharge of the Turner River aquifers.

Factors (environmental, social and economic) which may affect future development:

1. The permanent pool at the site has always been a haven for bird and animal life and the pool itself is usually well stocked with fish.
2. A major alluvial gold mining operation has been operating in the area.
3. The catchment for the storage lies in the immediate locality of the Yandearra Aboriginal Community who have a strong interest in the area.

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is fair. Treatment for turbidity may be required. Additional divertible yield may be possible if this source is developed conjunctively with groundwater.


PORT HEDLAND
Cooke Pt
Finucane I
Downes I
Weerdee I
Cape Thouin
salt evaporators
tidal flats
channel
Wedgefield
South Hedland
Bing
Boodarie Hill
Boodarie
Sandy H
Cossigny Hill
Mundabullangana
Illincolhara Hill
Peawah Hill
Well Hill
Red Hill
Mt Spinifex
Malboa
Mt Berghaus
Mt Dove
Millindinna H
The Sisters
Mt Satirist
Mt Langenbeck
Youlingoorina Hill
Station Peak
Annie Gap
Yandeearra Hill
Quartz Hill
Yandeyarra
Cheearra Hill
Mumbillina Bluff
Mungaroona Range National Park
Mungaroona Range
Peelangootharana Peak
Whingawarrena Hill
Hooley
Parsons
Florance
Mt King
Mt Watkins
Wittenoom
Mt Hanwright
Mt Frederick
Mt Vigors
Hancock Gorge
Knox Gorge
Kalamina Gorge
Knox Gorge
Mt George
Mt Lockyer
Fortescue Falls
Circular Pool
Circular Falls
Daley
Mulga Downs
Peak Prester
Table Hill
Pippingarra
Bullen Hill
Red Hill
Tank
Tog Hill
Cookes Hill
Wallareenya
Wallaringa Pk
Indee
Tabba
Tabba Tabba
Maddie Range
Lalla Rookh
Fey Hill
Carlindie
Strelley
Mt Grant
Mt St George
Goldsworthy
Ord Ranges
Ridley River
Table Top
Cook Bluff Hill
McPhee Hill
Panorama
North Pole
Strelley Gorge
Mt York
Gillam
Newman
Kangan
Mt Tinstone
Wodgina
Pinnunah Hill
Cleland Rock
Round Hummock
Turner
Yandeo Line Camp
Abydos
Shaw Gorge
The Island Hill
Chocolate Hill
Pyramid Hill
Mulgandinnah Hill
Spear Hill
White Quartz Hill
Pullcanah Hill
Split Rock Cairn
Woodstock
Mt Webber
Mt Gratwick
Quartz Hill
Coon
Cunmagnunna Hill
Hillside
Long I
Mooratherra Hill
Pouyouwuncubbana Hill
Cooletha Hill
127 Mile Camp
Chichester
Shaw
Hesta
Goodiadarrie Hills
First Hill
Fort
Mt Marsh
Red Hill
Roebourne
Wittenoom
Mulga Downs
Mulgina
Munjina
Aboriginal Reserve
Panorama
Hillside
Mt Florance
Range
Yule River
Fortescue River
Shaw River
Turner River
Strelley River
Coongan River
Great Northern Highway
Port Hedland Goldsworthy Rly
Marble Bar Road
Coastal Highway
Great Northern Hwy
Newman Railway
Wittenoom Road
Roebourne Wittenoom Road
Munjina Roy Hill Road
Port Hedland Tabba Tabba Road
Great Northern Hwy
Goldsworthy Rly
Marble Bar Road
Coastal Highway
Great Northern Hwy
Newman Railway
Wittenoom Road
Roebourne Wittenoom Road
Munjina Roy Hill Road
Port Hedland Tabba Tabba Road

Yule River

Surface Water Source: Sherlock River

River Basin: Port Hedland Coast **AWRC Basin No: 709**

Location: DS48 (Kangan Pool)
7 667 000 m N, 565 500 m E

Catchment Details:

Area:	4140 km^2
Average rainfall:	300 mm/annum
Pan evaporation:	3500 - 3600 mm/annum
Alienated:	
Cleared:	
Land use:	

Mean Annual Flow (GL/year):	172
Estimated Divertible Yield (GL/year):	8.3

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Highly variable, improves dramatically at high flows.

Existing Developments:

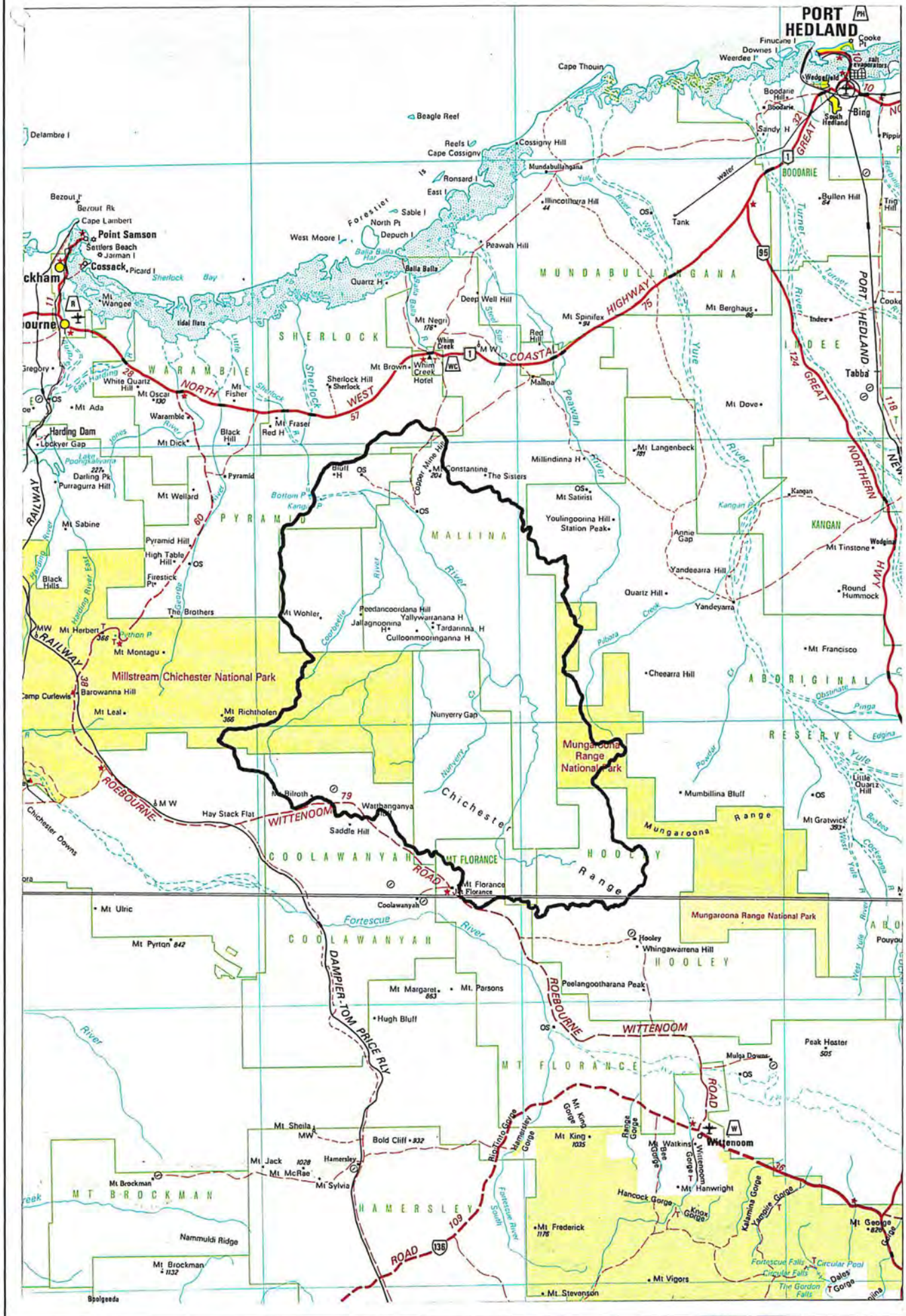
WC:	None.
Other:	None.
Current uses:	None.

Possible future uses:
This site, in conjunction with the Nunyerry storage, is very promising as a conjunctive use option for supply to the West Pilbara independently of the Harding/Millstream system.

Factors (environmental, social and economic) which may affect future development:

1. Loss of extensive areas of River Gum forests and woodlands adjacent to the Sherlock River and its tributaries. However, this vegetation is well represented outside the reservoir limits.
2. Loss of temporary pools, one of which is an important habitat for water birds. The permanent pools would not be inundated.
3. There is a relatively high risk of eutrophic conditions developing in the Sherlock Reservoir.
4. The area of inundation would be 102 km^2 at FSL. During periods when the water level is low large areas of the reservoir bed will be exposed.
5. The reservoir will provide an unsuitable habitat for many of the existing aquatic species.
6. Inundation of several Aboriginal habitation sites and at least one ceremonial site.
7. Loss of approximately 9% of the grazing land of Pyramid Station.

Comments:
The reliability of data on the mean annual flow and estimated divertible flow is fair. Treatment for turbidity may be required. Additional divertible flow of approximately 20 GL available if used in conjunction with another source. A dam on the Sherlock River at Kangan Pool could not be used as an independent source.



Sherlock River

Surface Water Source: Nunyerry Creek

River Basin: Port Hedland Coast **AWRC Basin No: 709**

Location: DS9
7 624 500 m N, 595 000 m E

Catchment Details:

Area:	300 km^2
Average rainfall:	300 mm/annum
Pan evaporation:	3500 - 3600 mm/annum
Alienated:	
Cleared:	
Land use:	

Mean Annual Flow (GL/year):	10
Estimated Divertible Yield (GL/year):	5

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Highly variable, improves dramatically at high flows.

Existing Developments:

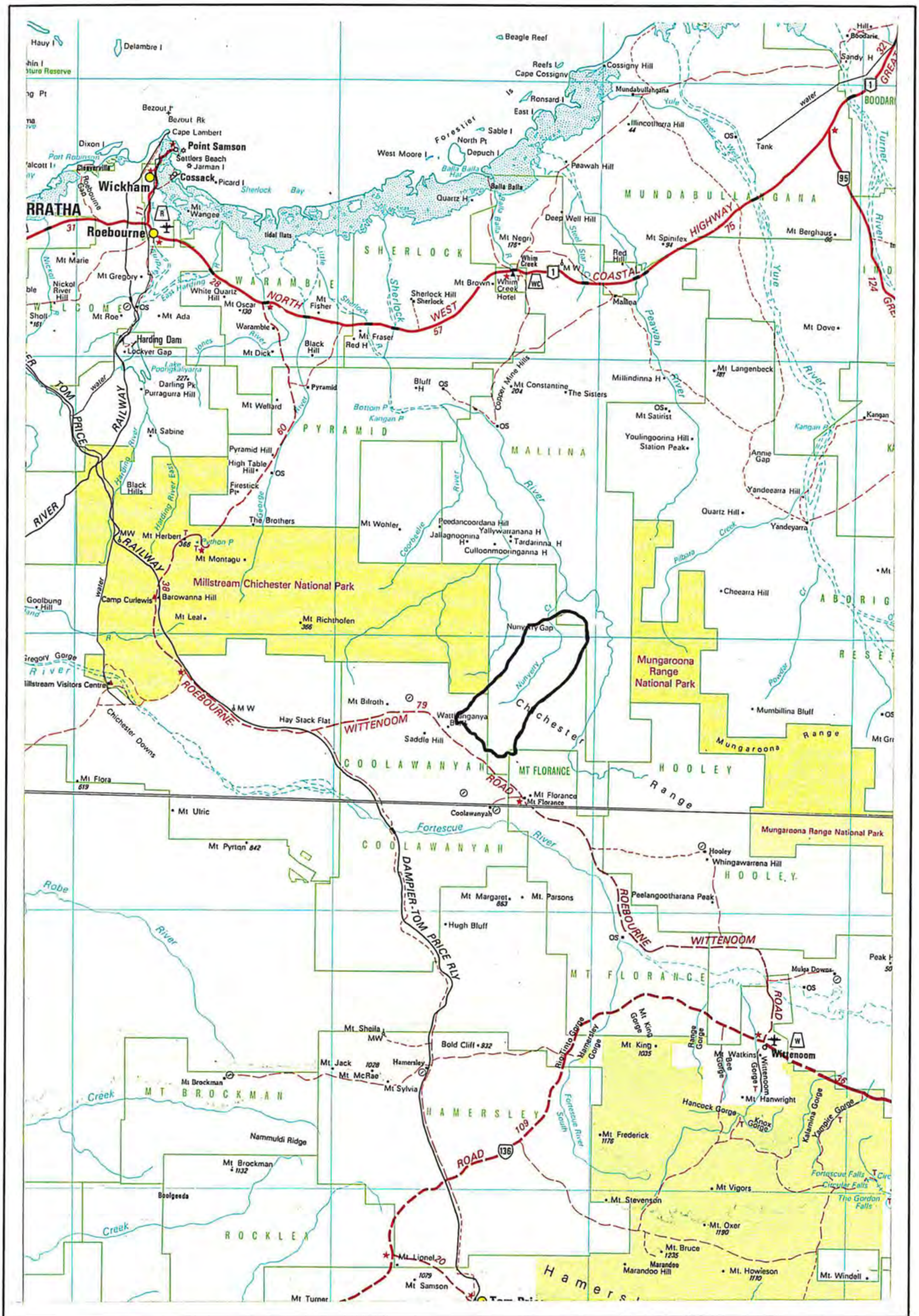
WC:	None.
Other:	None.
Current uses:	None.

Possible future uses:
This site, in conjunction with the Sherlock storage, is very promising as a conjunctive use option for supply to the West Pilbara independently of the Harding/Millstream system.

Factors (environmental, social and economic) which may affect future development:

1. Loss of vegetation including riverine River Gum woodlands and shrublands. Larger areas of the vegetation types would remain upstream and downstream of the reservoir and along other creeks in the region.
2. Loss of temporary pools and one permanent pool. However, such habitats are widespread in the region. There would also be some threat to the more biologically valuable pool at Ellawarrina Spring if the reservoir was to lead to tourist usage of that area.
3. Development of the reservoir would have beneficial impacts both as a tourist and recreational site and as a new aquatic habitat. In this latter respect, its stability compared to other reservoirs under consideration would make it more biologically valuable, especially for migratory birds.

Comments:
The reliability of data on the mean annual flow and estimated divertible flow is fair. Treatment for turbidity may be required. The estimated divertible yield can be increased by 17 GL if used in conjunction with Sherlock River - Kangan Pool and another source.



Nunyerri Creek

Surface Water Source:	Munni Munni Creek

River Basin: Port Hedland Coast **AWRC Basin No: 709**

Location: DS15
7 664 400 m N, 483 500 m E

Catchment Details:

Area: 574 km^2 (assumes the Maitland River is also dammed where the catchment boundary for Munni Munni Creek is close to Maitland River).
Average rainfall: 300 mm/annum
Pan evaporation: 3500 - 3600 mm/annum
Alienated:
Cleared:
Land use:

Mean Annual Flow (GL/year): 20
Estimated Divertible Yield (GL/year): 1.5

Water Quality:

Salinity:
Other significant parameters:

Existing Developments:

WC:
Other:
Current uses:

Possible future uses:

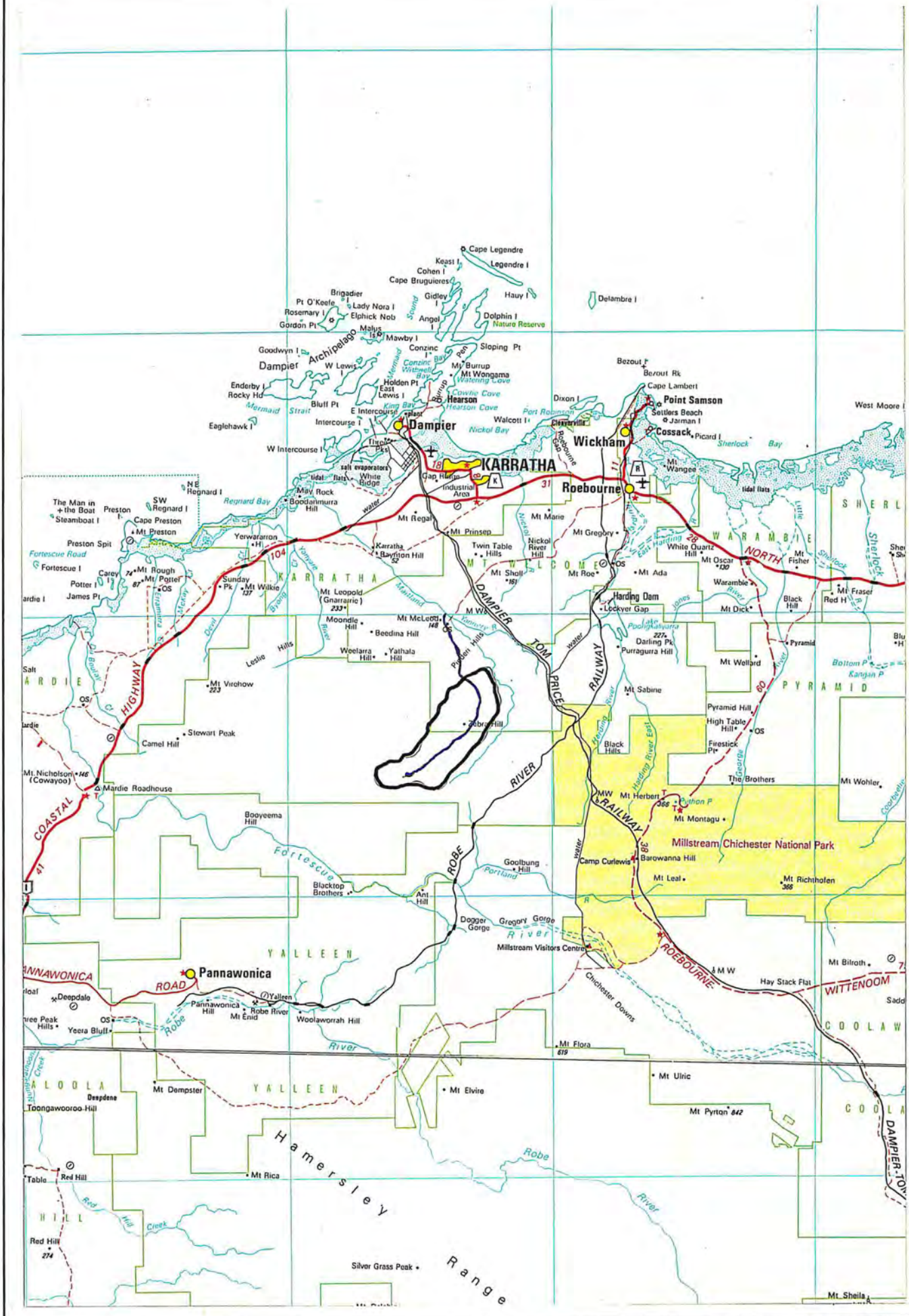
Possible water supply for West Pilbara development.

Factors (environmental, social and economic) which may affect future development:

1. Possible Aboriginal sites in the area.
2. The construction of a dam on Munni Munni Creek and the low barrage structure across the Maitland River would have an environmental impact in the area.
3. The area has a large number of well developed petroglyphs.

Comments:

The reliability of data for mean annual flow and estimated divertible flow is poor. A water supply on Munni Munni Creek could not be used as an independent source because yield from the catchment is not reliable on an annual basis.



Munni Munni Creek

Surface Water Source: Harding River

River Basin: Port Hedland Coast **AWRC Basin No: 709**

Location: Harding Dam

Catchment Details:

Area:	1020 km^2
Average rainfall:	330 mm/annum
Pan evaporation:	3400 mm/annum
Alienated:	50%
Cleared:	No significant clearing, but considerable over grazing on valley plains.
Land use:	About 50% in National Park, remainder sheep and cattle grazing on pastoral leases.

Mean Annual Flow (GL/year):	38
Estimated Divertible Yield (GL/year):	15

Water Quality:

Salinity:
Other significant parameters:

Existing Developments:

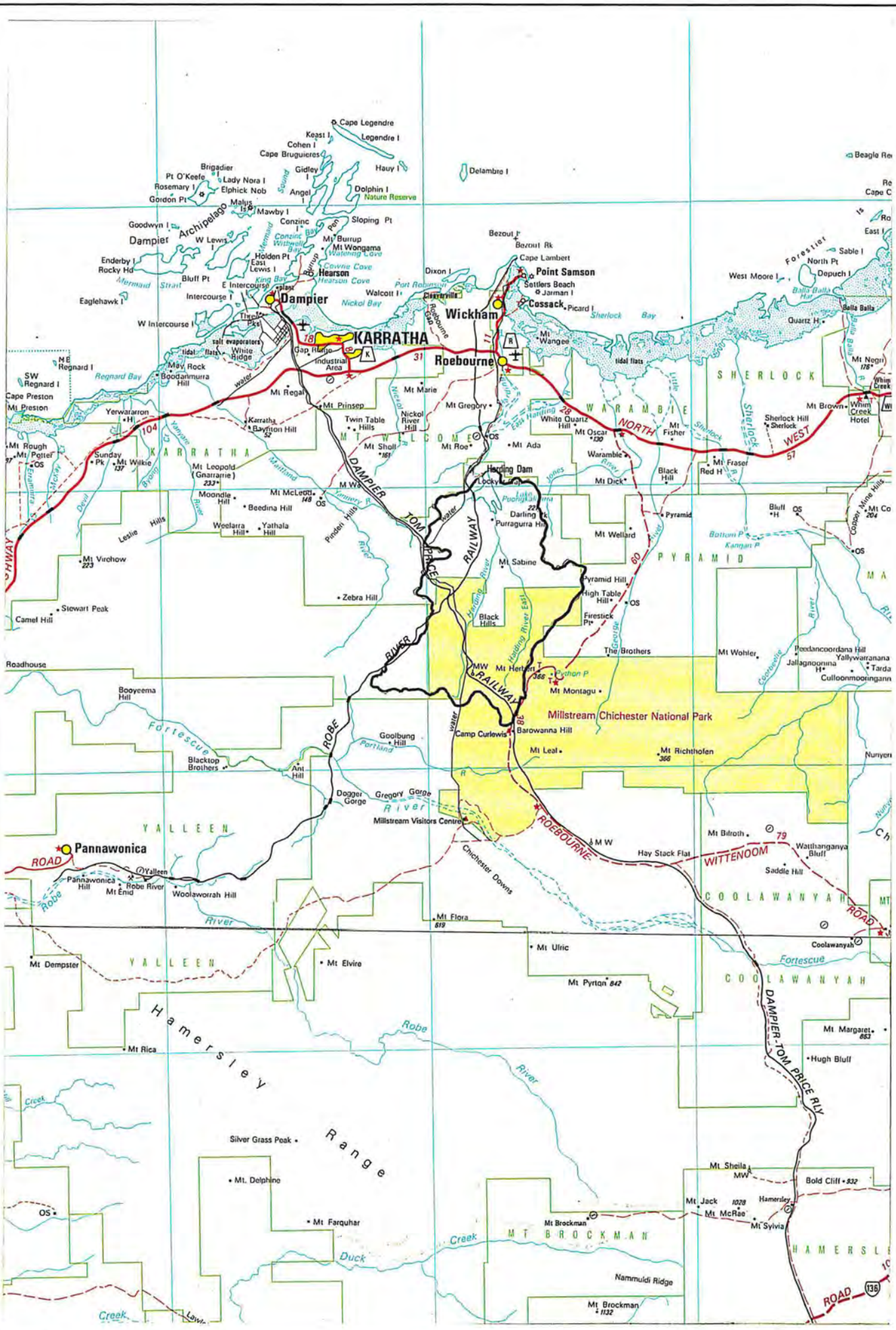
WC:
Other:
Current uses: West Pilbara Water Supply Scheme.

Possible future uses:

Factors (environmental, social and economic) which may affect future development:

Comments:

The reliability of data for mean annual flow and estimated divertible flow is good.



Harding River

Surface Water Source:	Shaw River

River Basin: DeGrey **AWRC Basin No: 710**

Location: DS88 (North Pole)
7 665 600 m N, 740 500 m E

Catchment Details:

Area:	6500 km^2
Average rainfall:	250 - 350 mm/annum
Pan evaporation:	3600 mm/annum
Alienated:	65%
Cleared:	No significant clearing, but some overgrazing along valley plains.
Land use:	35% vacant Crown land and Reserves, 65% cattle and sheep on pastoral leases.

Mean Annual Flow (GL/year):	180
Estimated Divertible Yield (GL/year):	80

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Highly variable, improves at high flows.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

Possible future uses:

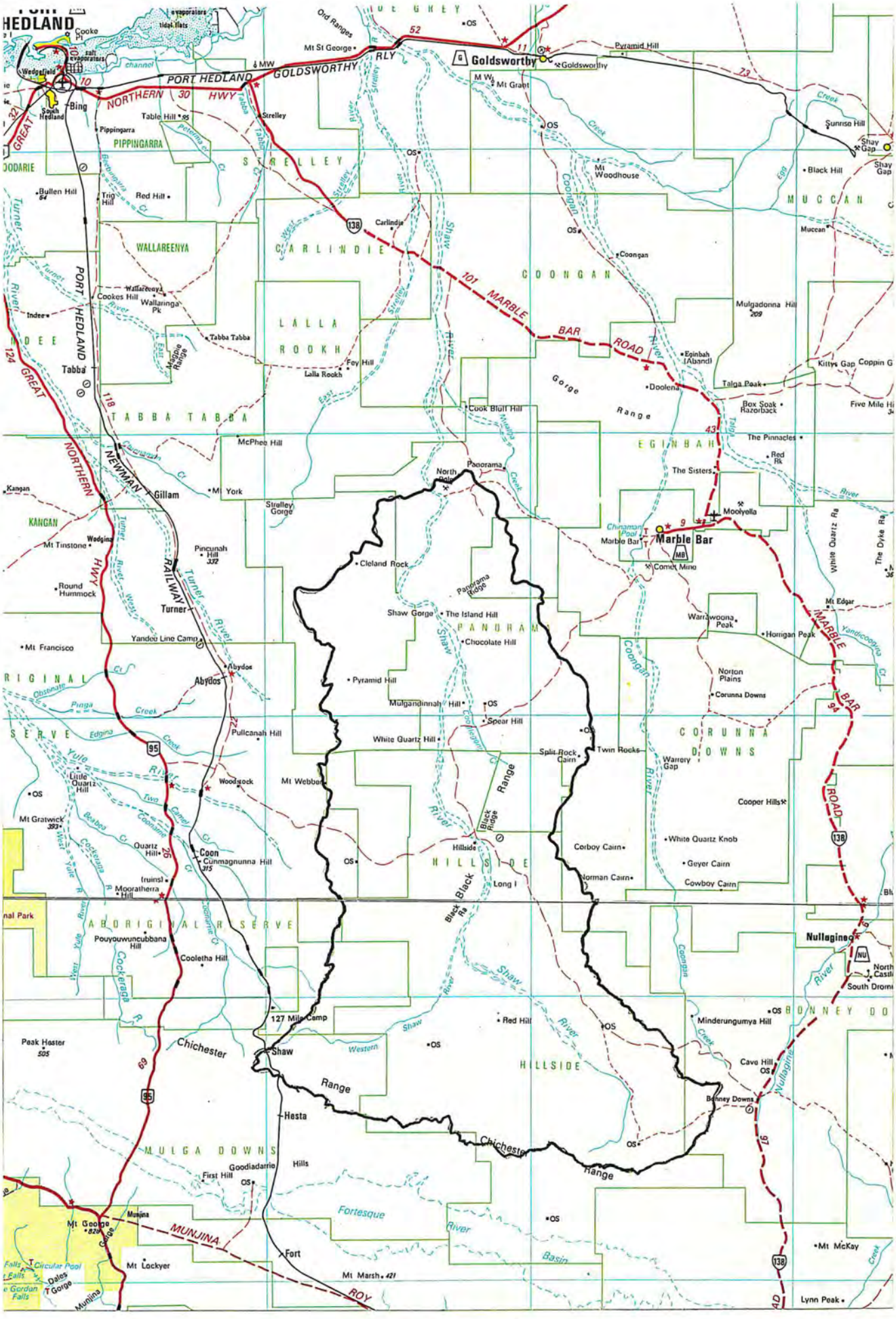
The North Pole dam must be one of the best potential sources of water in the Pilbara and must be considered as a prime source of water for developments in Port Hedland.

Factors (environmental, social and economic) which may affect future development:

Current mining claims overly the North Pole dam site.

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is fair. Treatment for turbidity may be required.


Shaw River
Goldsworthy
Marble Bar
Nullagine
Port Hedland
Newman
Abydos
Coongan
Shaw
Chichester
Hesta
Mt George
Mt Lockyer
Mt Marsh
Mt Webber
Mt Woodhouse
Mt Edgar
Mt McKay
Mt Francisco
Mt Tinstone
Mt Gratwick
Mt Grant
Mt St George
Pyramid Hill
Sunrise Hill
Black Hill
Mulgadonna Hill
Talga Peak
Kitty's Gap
Five Mile Hill
Box Soak Razorback
The Pinnacles
The Sisters
Red Rk
Panorama
North Gate
Cleland Rock
Shaw Gorge
The Island Hill
Chocolate Hill
Panorama Ridge
Pyramid Hill
Mulgandinnah Hill
Spear Hill
White Quartz Hill
Split Rock Cairn
Twin Rocks
Warrery Gap
Norton Plains
Corunna Downs
Cooper Hills
White Quartz Knob
Geyer Cairn
Corboy Cairn
Norman Cairn
Cowboy Cairn
Long I
Hillside
Black Range
Black Ridge
Range
Cave Hill
Minderungumya Hill
Red Hill
Bonney Downs
Lynn Peak
Warrawoona Peak
Horrigan Peak
Comet Mine
Moolyella
Egina
Mulga Downs
Hills
Basin
Fortesque River
Shaw River
Coongan River
Yule River
Turner River
Strelley River
Tabba Tabba
Lalla Rookh
Foy Hill
Carlindie
Coongan
Muccan
Strelley
Pippingarra
Wallareenya
Kangan
Indee
Abydos
Aboriginal Reserve
Nullagine
Marble Bar
Great Northern Highway
Port Hedland
Goldsworthy
Marble Bar Road
Munjina
Roy
Circular Pool
Dales Gorge
Gordon Falls
Cooke Pt
Wedgefield
South Hedland
Bing
Table Hill
Strelley
Bullen Hill
Trig Hill
Red Hill
Carlindie
Wallareenya
Cookes Hill
Wallaringa Pk
Indee
Tabba Tabba
Foy Hill
Lalla Rookh
Cook Bluff Hill
McPhee Hill
Gillam
Mt York
Strelley Gorge
Kangan
Wedgina
Mt Tinstone
Round Hummock
Pincunah Hill
Turner
Yandeo Line Camp
Abydos
Pullcanah Hill
Woodstock
Mt Webber
Little Quartz Hill
Quartz Hill
Coon
Cunmagnunna Hill
Mooratherra Hill
Pouyouwuncubbana Hill
Cooletha Hill
127 Mile Camp
Peak Hester
Goodiadarrie Hills
First Hill
Munjina
Dales Gorge
Circular Pool
Gordon Falls
Fort
Mt Lockyer
Mt George
Mt Marsh
Lynn Peak
Mt McKay
Minderungumya Hill
Cave Hill
Bonney Downs
Nullagine
Marble Bar
Comet Mine
Moolyella
Egina
Doolena
Egina Abandl
Coongan
Muccan
Carlindie
Strelley
Pippingarra
Wallareenya
Kangan
Indee
Abydos
Aboriginal Reserve
Mulga Downs
Hills
Basin
Fortesque River
Shaw River
Coongan River
Yule River
Turner River
Strelley River
Tabba Tabba
Lalla Rookh
Foy Hill
Carlindie
Coongan
Muccan
Strelley
Pippingarra
Wallareenya
Kangan
Indee
Abydos
Aboriginal Reserve
Nullagine
Marble Bar
Great Northern Highway
Port Hedland
Goldsworthy
Marble Bar Road
Munjina
Roy

Shaw River

Surface Water Source:	Coongan River

River Basin: DeGrey **AWRC Basin No: 710**

Location: DS54 (Doolena Gap)
7 683 200 m N, 789 800 m E

Catchment Details:

Area:	4310 km^2
Average rainfall:	300 mm/annum
Pan evaporation:	3600 mm/annum
Alienated:	60%
Cleared:	No significant clearing, but some overgrazing along valley plains.
Land use:	Part vacant Crown land and Reserves, mostly cattle and sheep on pastoral leases (60%).

Mean Annual Flow (GL/year):	130
Estimated Divertible Yield (GL/year):	15

Water Quality:

Salinity:
Other significant parameters:

Existing Developments:

WC:
Other:
Current uses:

Possible future uses:

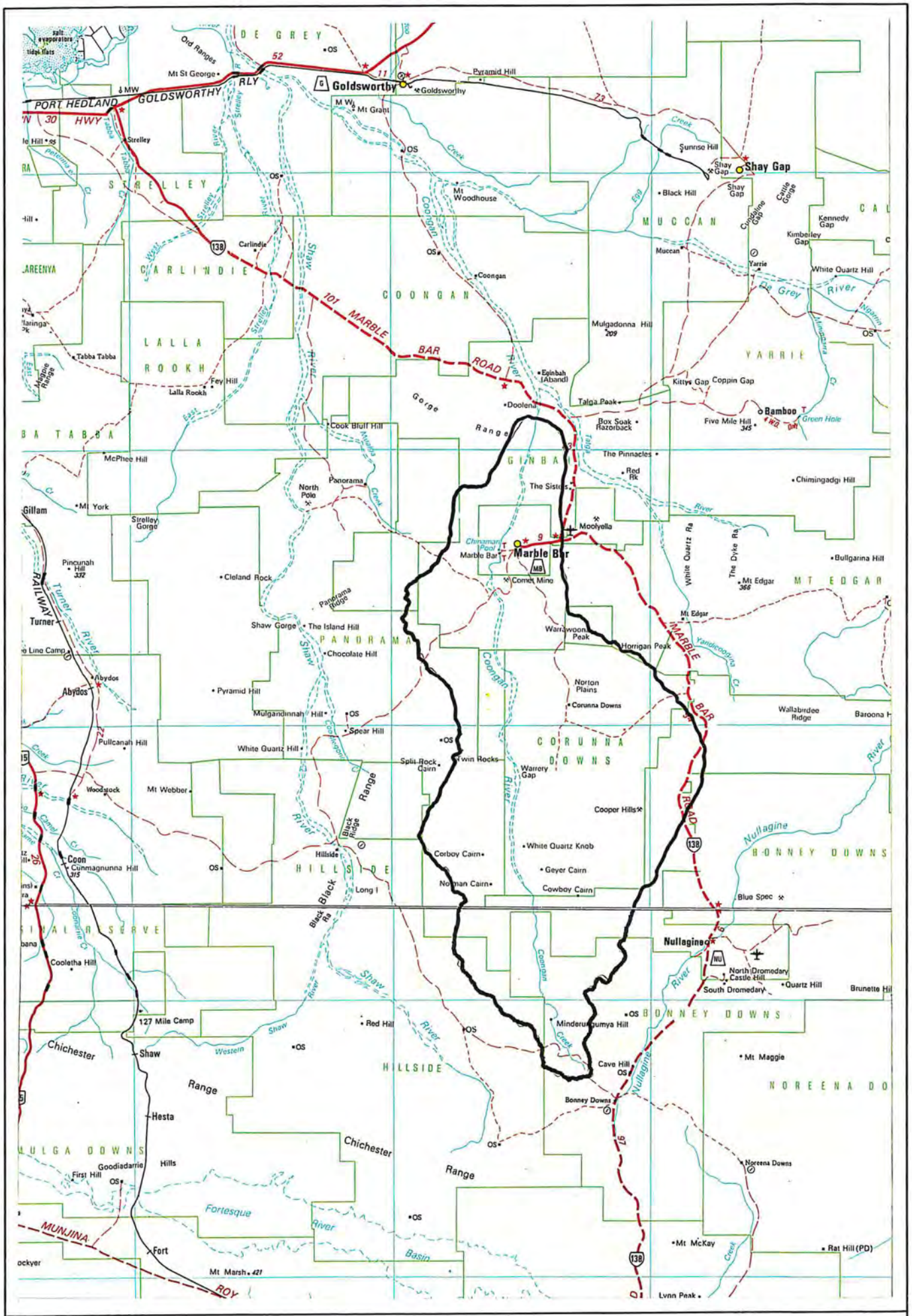
Possible water supply for the Port Hedland Scheme.

Factors (environmental, social and economic) which may affect future development:

1. The abandoned Talga Talga mining centre lies close to the dam site and there was a small lead mine to the west.
2. Sills of ultra basic rock of a type favourable for nickel deposits are known in the area.
3. The granting of mining tenements over some of these areas where they encroach on possible dam and reservoir sites has been a cause of concern in the past.

Comments:

The reliability of data for the mean annual flow and estimated divertible flow is poor.


Goldsworthy
Shay Gap
Marble Bar
Nullagine
Bamboo
Coongan River
Mt Woodhouse
Mt Grant
Mt St George
Pyramid Hill
Sunrise Hill
Black Hill
Mucca
Yarrie
Kittys Gap
Coppin Gap
Talga Peak
Five Mile Hill
Mulgadonna Hill
Eginbah (Abandl)
Doolena
Box Soak
Razorback
The Pinnacles
Red Rk
Chimingadgi Hill
The Sisters
Moolyella
Comet Mine
Bullgarina Hill
Mt Edgar
Warrawoon Peak
Horrigan Peak
Norton Plains
Corunna Downs
Wallabirdee Ridge
Baroona
Warrery Gap
Coopor Hills
White Quartz Knob
Geyer Cairn
Cowboy Cairn
Corboy Cairn
Norman Cairn
Blue Spec
Minderumunya Hill
Cave Hill
Bonney Downs
Noreena Downs
Mt Maggie
Mt McKay
Rat Hill (PD)
Lynn Peak
Quartz Hill
Brunette Hill
North Dromedary
South Dromedary
Castle Hill
Red Hill
Hillside
Split Rock Cairn
Twin Rocks
White Quartz Hill
Mt Webber
Woodstock
Pullcanah Hill
Abydos
Pyramid Hill
Mulgandinnah Hill
Spear Hill
Chocolate Hill
Shaw Gorge
The Island Hill
Panorama
North Pole
Cleland Rock
Pincunah Hill
Gillam
Mt York
McPhee Hill
Cook Bluff Hill
Fey Hill
Lalla Rookh
Tabba Tabba
Carlindie
Strelley
Goldsworthy
Port Hedland
Ord Ranges
Salt evaporators
tidal flats
Cooletha Hill
127 Mile Camp
Chichester
Shaw
Hesta
Goodiadarrie Hills
First Hill
Fortesque River
Munjina-Roy
Mt Marsh
Fort
Coon
Cunmagnunna Hill
Long I
Hillside
Black Ra
Black Ridge
Coongan Range
Chichester Range
Shaw River
Turner River
Strelley River
Yandeyarra Cr
Nullagine River
Nullagine Creek
Marble Bar Road
Great Northern Highway
Railway
Gorge Range
Cattle Gorge
Kimberley Gap
Kennedy Gap
Cinglalong Gap
White Quartz Hill
Five Mile Hill
Green Hole
Bamboo
Yarrie
Mucca
Mt Edgar
Mt Maggie
Noreena Downs
Bonney Downs
Hillside
Corunna Downs
Panorama
Yarrie
Mulga Downs
Nullagine
Strelley
Carlindie
Coongan
Lalla Rookh
Tabba Tabba
Yarrie
Mt Edgar
Bonney Downs
Noreena Downs
Hillside
Mulga Downs
Sinclair Serve
De Grey
Shay Gap
Goldsworthy
Marble Bar
Nullagine
Bamboo
Coongan River

Surface Water Source: Coongan River

River Basin: DeGrey **AWRC Basin No: 710**

Location: DS85 (Marble Bar)
7 653 400 m N, 781 500 m E

Catchment Details:

Area:	3800 km^2
Average rainfall:	250 - 350 mm/annum
Pan evaporation:	3700 mm/annum
Alienated:	60%
Cleared:	No significant clearing, but some overgrazing along valley plains.
Land use:	Part vacant Crown land and Reserves, mostly cattle and sheep on pastoral leases (60%).

Mean Annual Flow (GL/year):	110
Estimated Divertible Yield (GL/year):	26

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Highly variable, improves at high flows.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

Possible future uses:

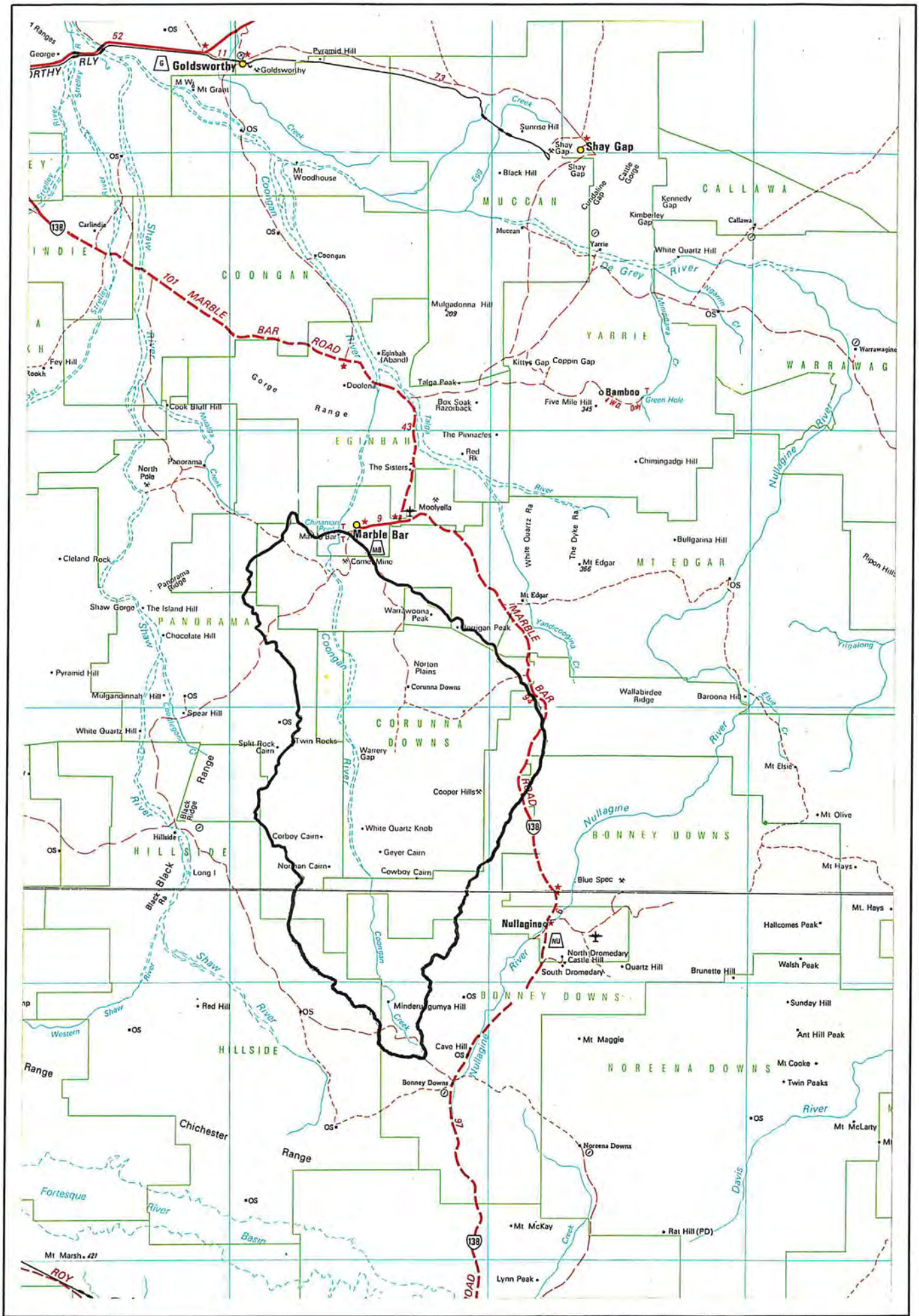
Possible water supply for the Port Hedland Scheme.

Factors (environmental, social and economic) which may affect future development:

1. A dam at Marble Bar would have some impact on mining in the area.
2. The jaspillite at the Marble Bar site is an important tourist attraction as well as being of scientific interest.

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is poor. Treatment for turbidity may be required.



Coongan River

Surface Water Source:	DeGrey River

River Basin: DeGrey **AWRC Basin No: 710**

Location: DS158 (Yarrie Station)
7 709 000 m N, 214 000 m E

Catchment Details:

Area:	32 000 km^2
Average rainfall:	300 mm/annum
Pan evaporation:	3600 mm/annum
Alienated:	
Cleared:	
Land use:	

Mean Annual Flow (GL/year):	600
Estimated Divertible Yield (GL/year):	120 - 200

Water Quality:

Salinity:
Other significant parameters:

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

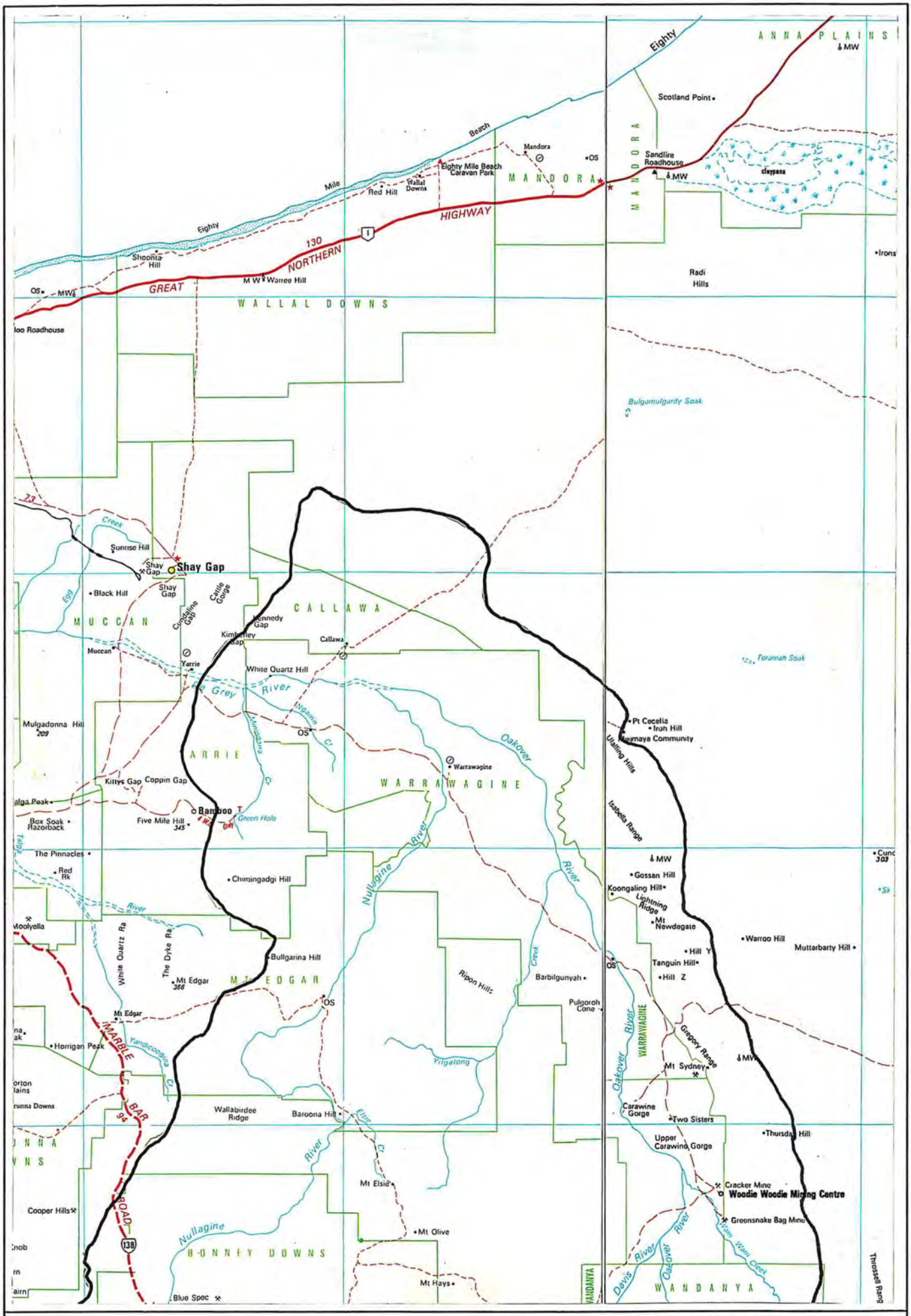
Possible future uses:

Possible water supply for the Port Hedland Scheme.

Factors (environmental, social and economic) which may affect future development:

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is poor. Treatment for turbidity may be required.



De Grey River

Surface Water Source:	Oakover River

River Basin: DeGrey **AWRC Basin No: 710**

Location: DS102
7 619 500 m N, 299 000 m E

Catchment Details:

Area:	15 430 km^2
Average rainfall:	250 mm/annum
Pan evaporation:	3800 mm/annum
Alienated:	
Cleared:	
Land use:	

Mean Annual Flow (GL/year):	260
Estimated Divertible Yield (GL/year):	20 - 50

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Turbidity high in high flow events.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

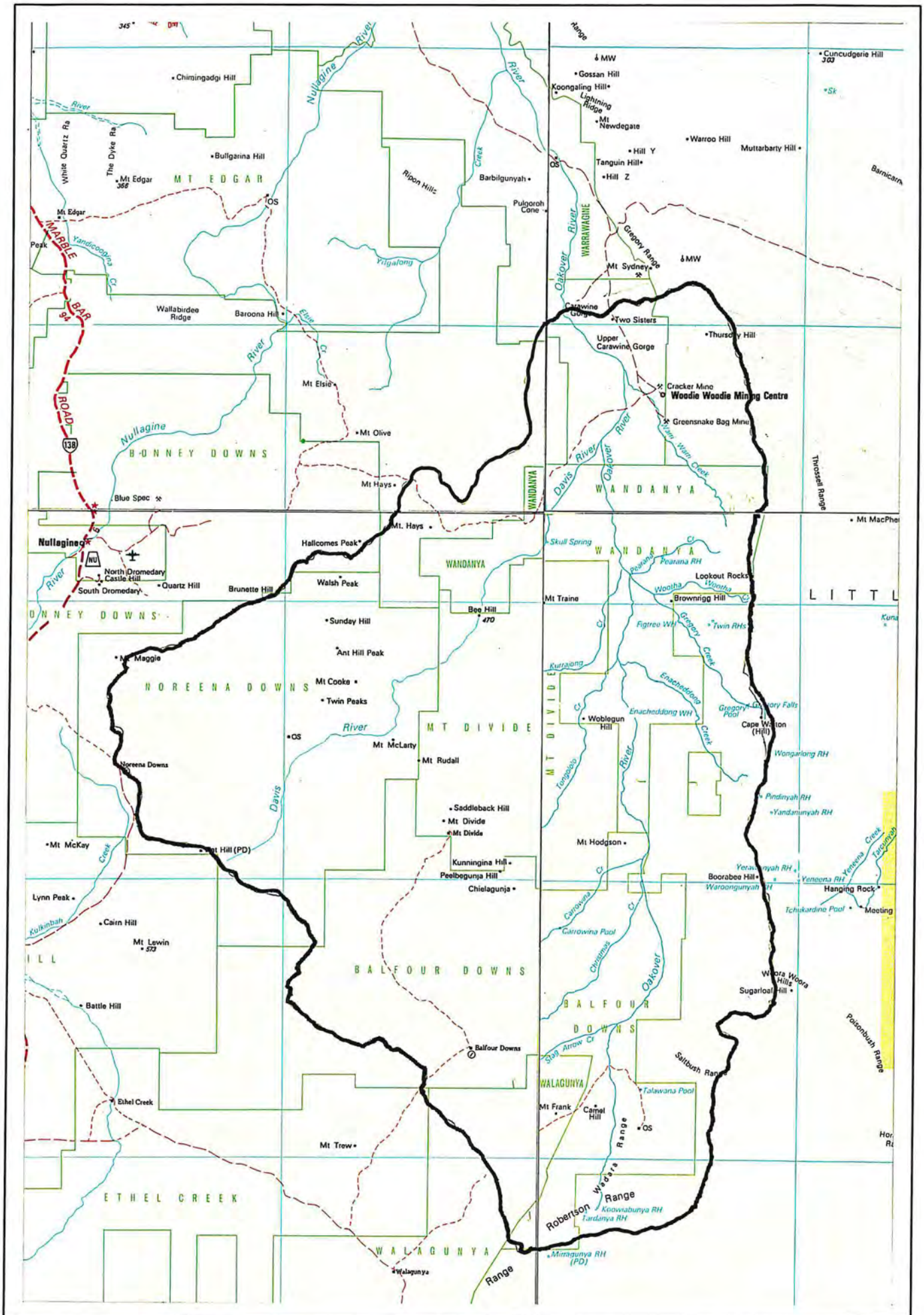
Possible future uses:

Possible water supply for the Port Hedland Scheme.

Factors (environmental, social and economic) which may affect future development:

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is poor. Treatment for turbidity may be required.



Oakover River

Surface Water Source:	Oakover River

River Basin: DeGrey **AWRC Basin No: 710**

Location: DS145
7 586 300 m N, 305 300 m E

Catchment Details:

Area:	9280 km^2
Average rainfall:	250 mm/annum
Pan evaporation:	3800 mm/annum
Alienated:	
Cleared:	
Land use:	

Mean Annual Flow (GL/year):	120
Estimated Divertible Yield (GL/year):	5 - 25

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Turbidity high in high flow events.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

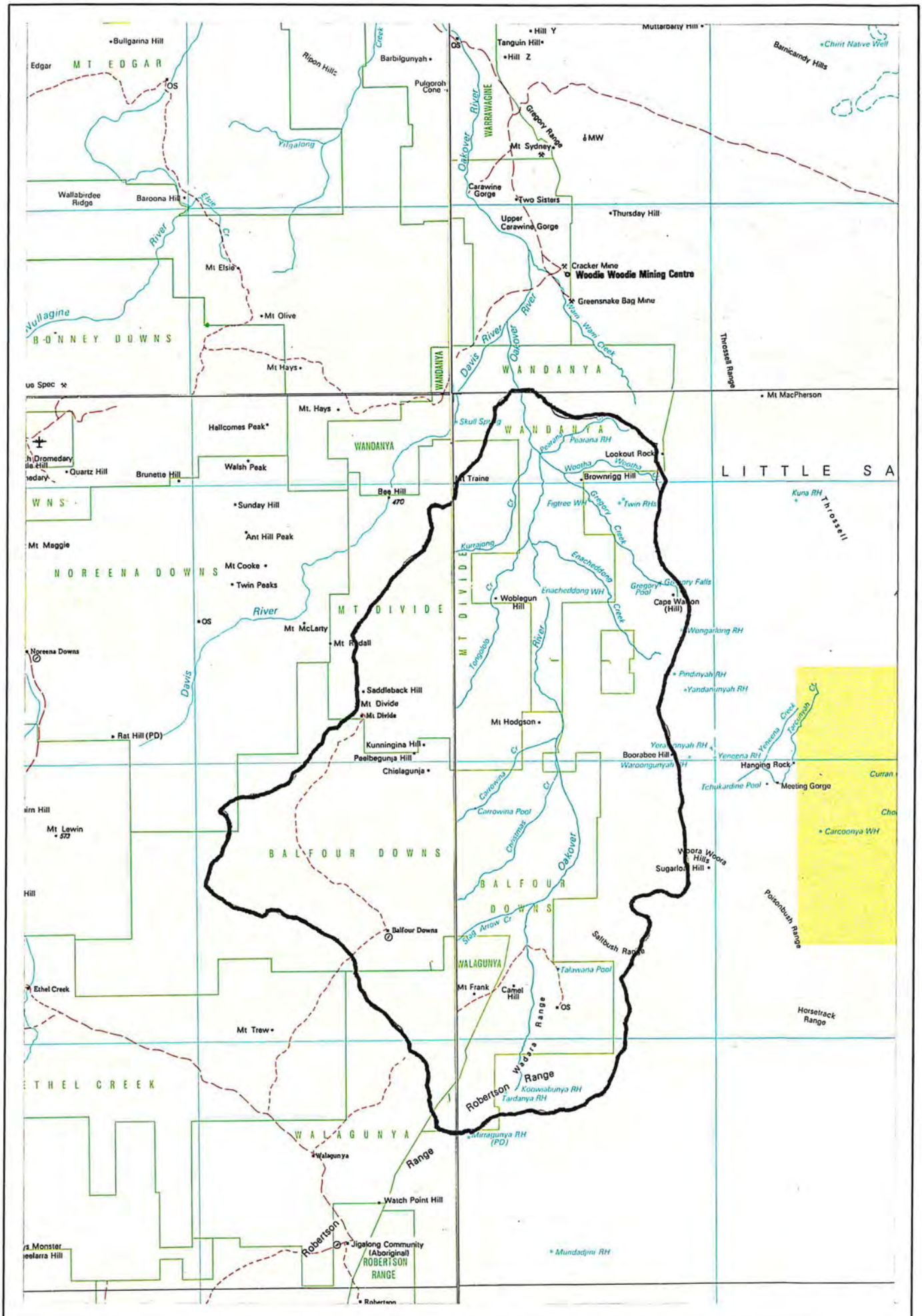
Possible future uses:

Possible water supply for the Port Hedland Scheme.

Factors (environmental, social and economic) which may affect future development:

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is poor. Treatment for turbidity may be required.



Oakover River

Surface Water Source: Nullagine River

River Basin: DeGrey **AWRC Basin No: 710**

Location: DS40
7 678 200 m N, 256 100 m E

Catchment Details:

Area:	6425 km^2
Average rainfall:	250 - 300 mm/annum
Pan evaporation:	3600 - 3800 mm/annum
Alienated:	
Cleared:	
Land use:	

Mean Annual Flow (GL/year):	125
Estimated Divertible Yield (GL/year):	0 - 20

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Highly variable, improves at high flows.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

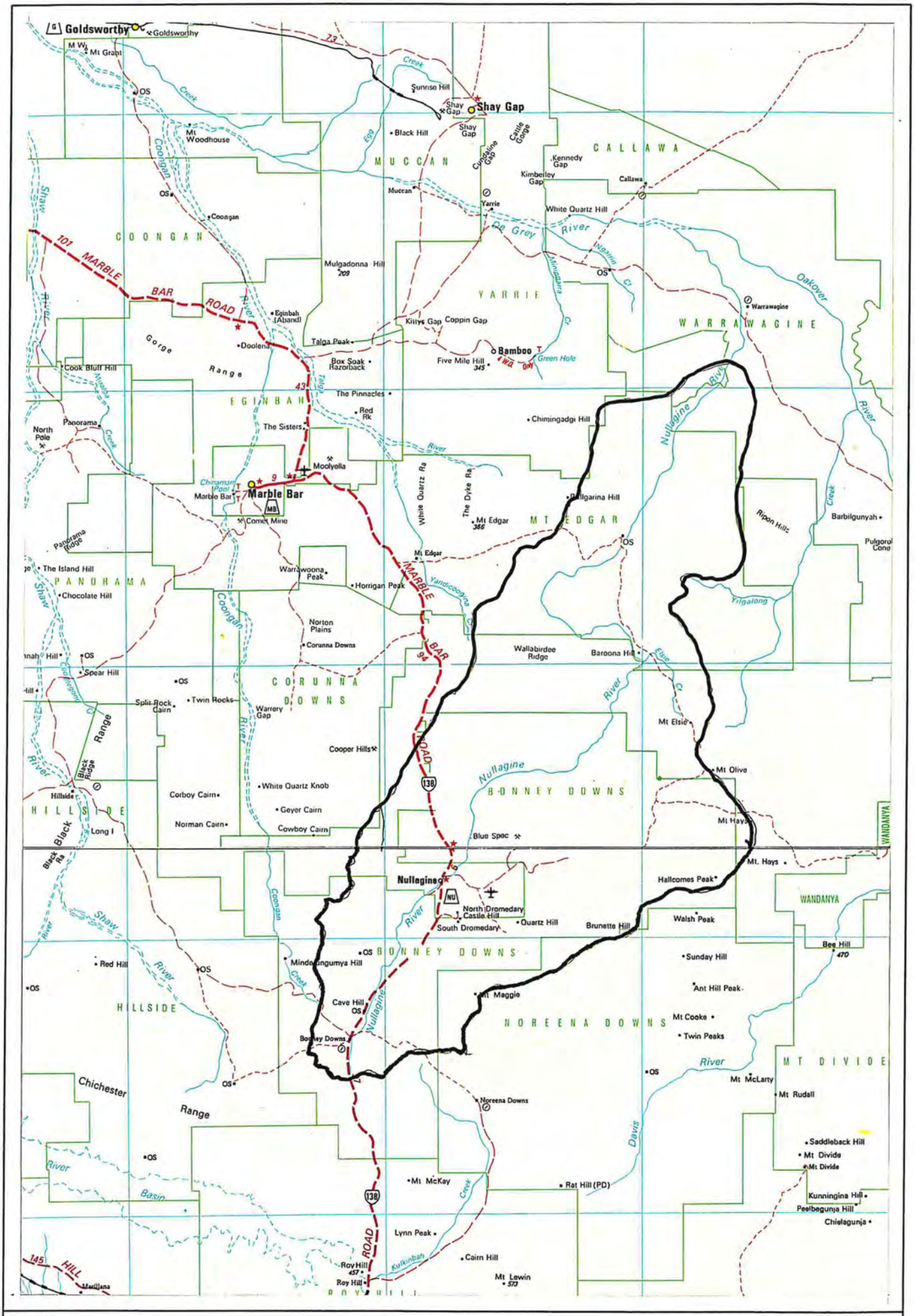
Possible future uses:

Possible water supply for the Port Hedland Scheme.

Factors (environmental, social and economic) which may affect future development:

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is poor. Treatment for turbidity may be required.



Nullagine River

Surface Water Source: Nullagine River

River Basin: DeGrey **AWRC Basin No: 710**

Location: DS56
7 666 000 m N, 246 000 m E

Catchment Details:

Area:	5895 km^2
Average rainfall:	250 - 300 mm/annum
Pan evaporation:	3600 - 3800 mm/annum
Alienated:	
Cleared:	
Land use:	

Mean Annual Flow (GL/year):	115
Estimated Divertible Yield (GL/year):	25 - 40

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Highly variable, improves at high flows.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

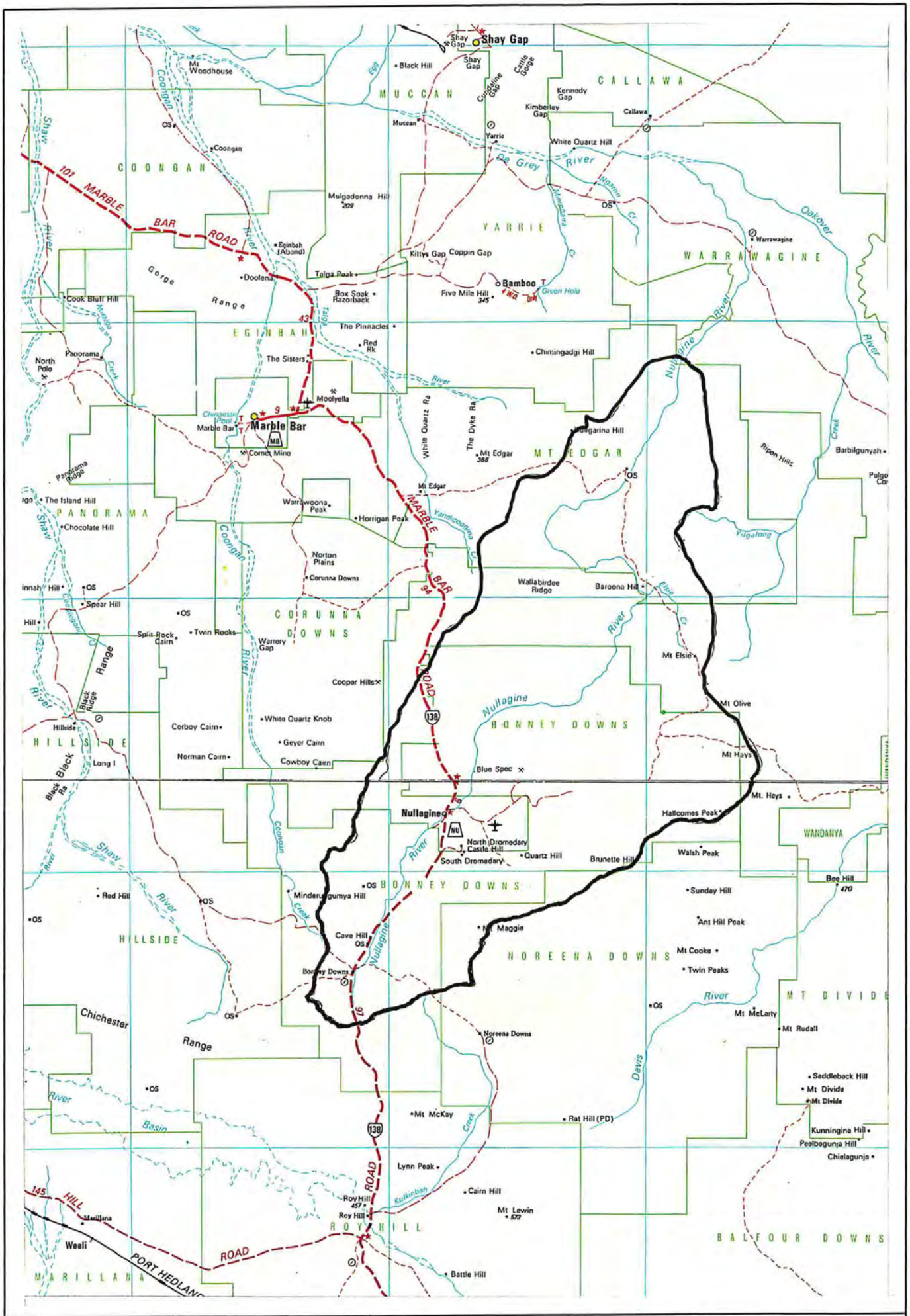
Possible future uses:

Possible water supply for the Port Hedland Scheme.

Factors (environmental, social and economic) which may affect future development:

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is poor. Treatment for turbidity may be required.



Nullagine River

Surface Water Source: Nullagine River

River Basin: DeGrey **AWRC Basin No: 710**

Location: DS108
7 625 900 m N, 228 900 m E

Catchment Details:

Area:	4525 km^2
Average rainfall:	250 - 300 mm/annum
Pan evaporation:	3600 - 3800 mm/annum
Alienated:	
Cleared:	
Land use:	

Mean Annual Flow (GL/year):	90
Estimated Divertible Yield (GL/year):	20 - 35

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Highly variable, improves at high flows.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

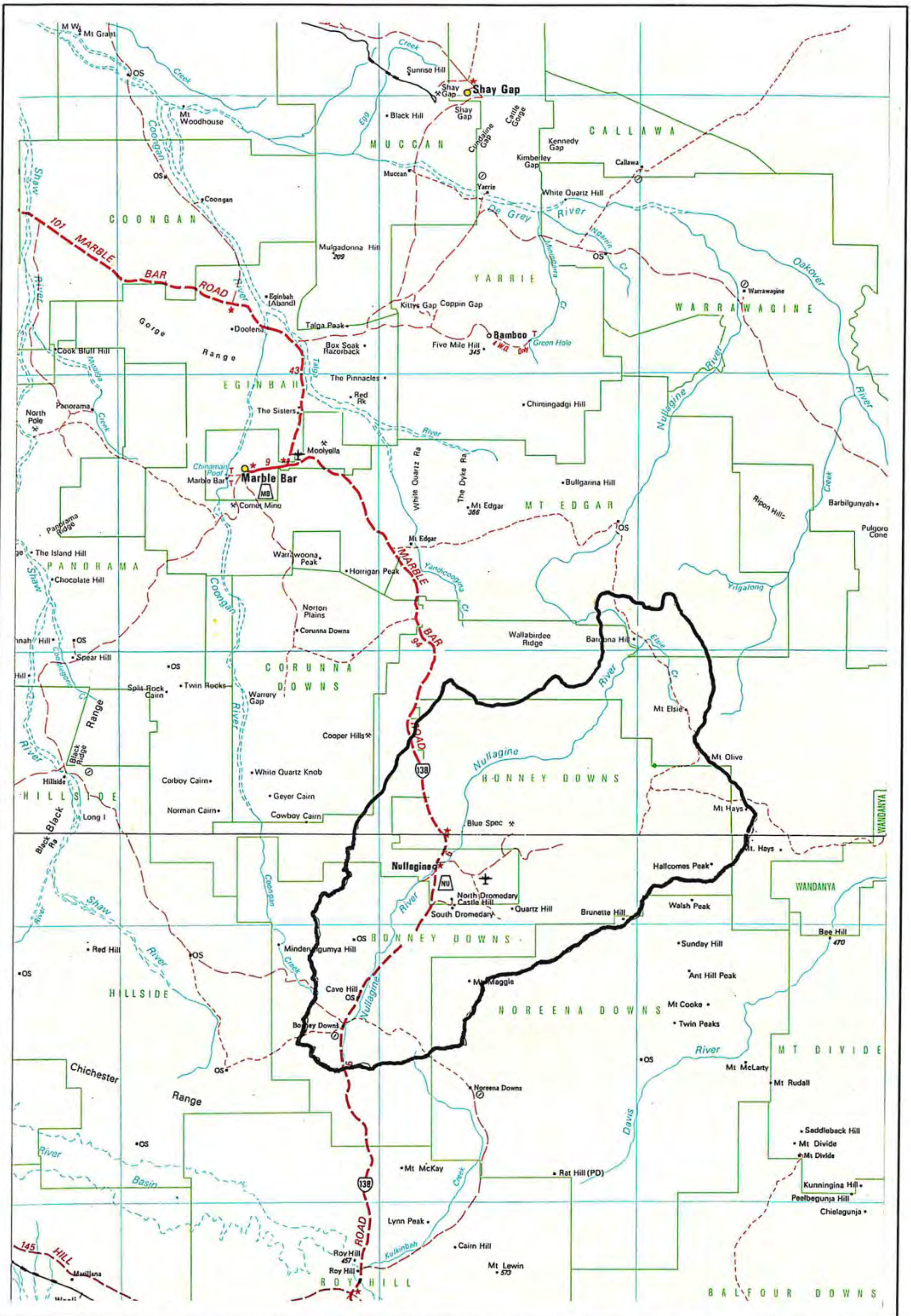
Possible future uses:

Factors (environmental, social and economic) which may affect future development:

Possible water supply for the Port Hedland Scheme.

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is poor. Treatment for turbidity may be required.



Nullagine River

Surface Water Source: Nullagine River

River Basin: DeGrey **AWRC Basin No: 710**

Location: DS142
7 617 500 m N, 238 000 m E

Catchment Details:

Area:	4150 km^2
Average rainfall:	250 - 300 mm/annum
Pan evaporation:	3600 - 3800 mm/annum
Alienated:	
Cleared:	
Land use:	

Mean Annual Flow (GL/year):	80
Estimated Divertible Yield (GL/year):	15 - 30

Water Quality:

Salinity:	Fresh.
Other significant parameters:	Highly variable, improves at high flows.

Existing Developments:

WC:	None.
Other:	None.
Current uses:	None.

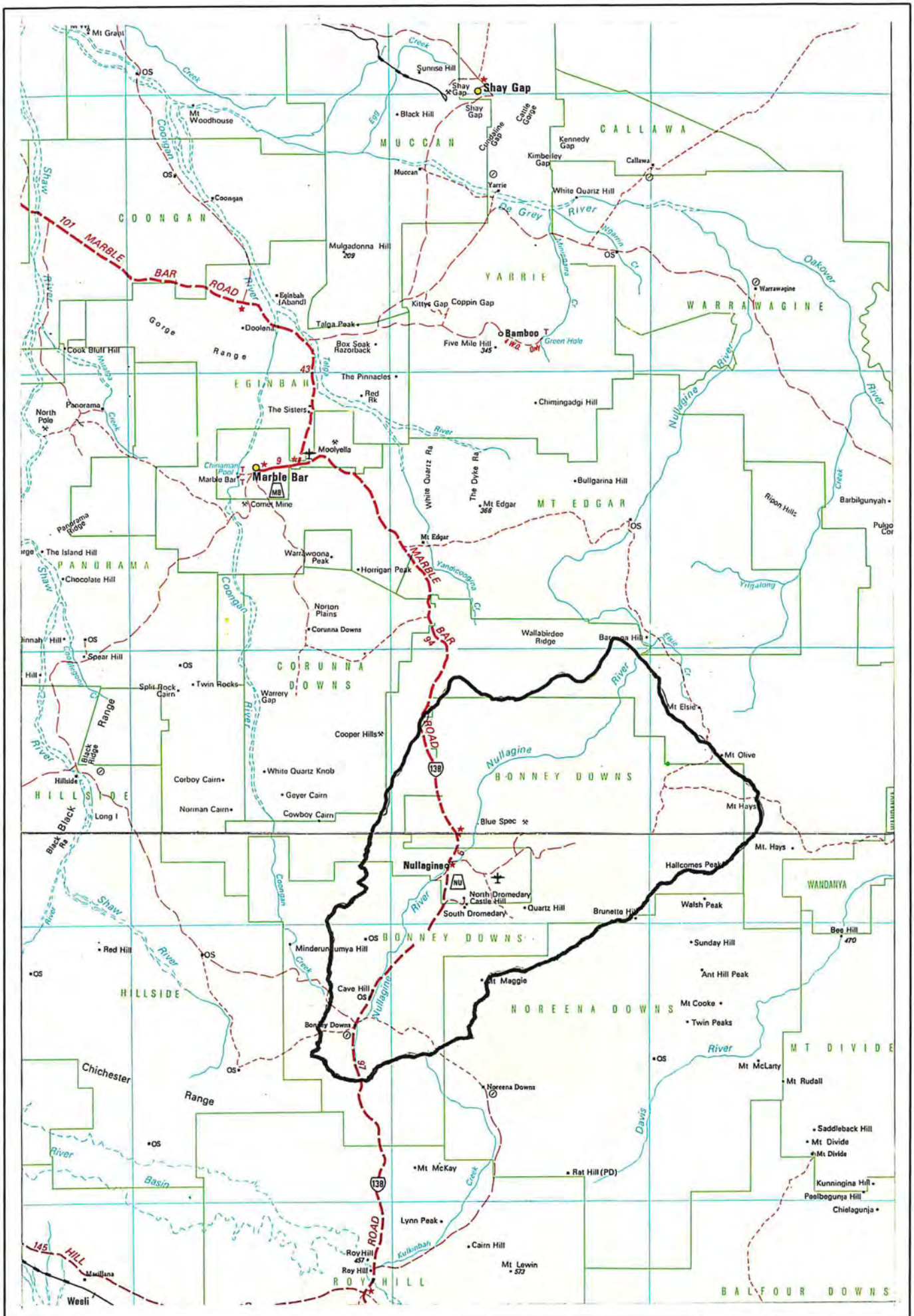
Possible future uses:

Possible water supply for the Port Hedland Scheme.

Factors (environmental, social and economic) which may affect future development:

Comments:

The reliability of data on the mean annual flow and estimated divertible flow is poor. Treatment for turbidity may be required.



Nullagine River

Appendix 4: Groundwater Resources

Groundwater Source:	Robe River

River Basin: Onslow Coast **AWRC Basin No: 707**

Location: **Lower Robe aquifer** - near the mouth of the Robe River

Aquifer Details:

Extent:	
Rock unit:	alluvium
Estimated Recharge:	
Estimated Yield:	10 GL/year
No of production wells:	6

Water Quality:

Salinity:	Fresh - salinity ranges between 400 - 800 mg/L.
Other significant parameters:	Highly variable, improves at high flows.

Possible future uses:

Possible water supply for West Pilbara development. The groundwater source could be used as part of a conjunctive use scheme.

Factors (environmental, social and economic) which may affect future development:

1. Environmental and social impacts are minimal if water is drawn sustainably.
2. No known Aboriginal sites in the vicinity of the proposed wellfield.

Investigations / Comments:

Groundwater Source: Kumina Creek

River Basin: Onslow Coast **AWRC Basin No: 707**

Location: **Kumina Creek aquifer**

Aquifer Details:

Extent:
Rock unit:
Estimated Recharge:
Estimated Yield: 1 GL/year
No of production wells: 13 (3 of which would be on standby)

Water Quality:

Salinity: Fresh.
Other significant parameters:

Possible future uses:

Possible water supply for West Pilbara development. The groundwater source could be used as part of a conjunctive use scheme.

Factors (environmental, social and economic) which may affect future development:

Located within mining leases. Low direct impact on the environment and on Aboriginal sacred sites.

Investigations / Comments:

For this quantity of water it is proposed that an engineering and economic assessment is not warranted.

Groundwater Source:	Fortescue River

River Basin: Fortescue River **AWRC Basin No: 708**

Location: **Lower Fortescue (Balmoral) aquifer**

Aquifer Details:

Extent:	200 km^2
Rock unit:	alluvial gravel
Estimated Recharge:	11 GL/year
Estimated Yield:	16 GL/year
No of production wells:	10
Wells Yield:	up to 800 kL/d

Water Quality:

Salinity:	Fresh - salinity range between 400 - 800 mg/L.
Other significant parameters:	

Possible future uses:

Possible water supply for West Pilbara development. The groundwater source could be used as part of a conjunctive use scheme.

Factors (environmental, social and economic) which may affect future development:

1. There are no known Aboriginal sites in the vicinity of the proposed wellfield.
2. It is probable that populations and foliage of species such as the Ghost Gum, Water Wood and perhaps the Snakewood Mulga, would be thinned by a drop in the watertable by 2 m.
3. Even without causing significant changes in vegetation, development of the borefield could affect the population of the Flock Pigeon, a species which does not readily adapt to human activity.
4. Potential for severe adverse impacts on the aquatic ecosystem of the Lower Fortescue borefield.

Investigations / Comments:

This data was obtained from exploratory drilling and test pumping of the alluvium carried out between 1983 and 1985. Development of a dam at Bullinnarwa, and to a lesser extent, Booyeemala, would have a significant impact on the recharge of the aquifer. It is possible the yield could drop by 50%. This requires further investigation.

Groundwater Source: Fortescue River

River Basin: Fortescue River **AWRC Basin No: 708**

Location: **Upper Fortescue aquifer**

Aquifer Details:

Extent:
Rock unit: Alluvial fans
Estimated Recharge:
Estimated Yield: 0 GL/year
No of production wells:

Water Quality:

Salinity: Fresh.
Other significant parameters:

Possible future uses:

Possible water supply for West Pilbara development. The groundwater source could be used as part of a conjunctive use scheme.

Factors (environmental, social and economic) which may affect future development:

1. Low direct impact on the environment and on Aboriginal sacred sites.
2. The only vegetation likely to be directly influenced by a lowered watertable would be the open woodland of River Gums on the shingle beds of the main tributary creeks.
3. The proposed wellfield is located within the same catchment area as Millstream. Hence abstracting water from the upper Fortescue aquifer could reduce the throughflow of water which ultimately naturally drains into the Millstream system.

Investigations / Comments:

From hydrogeological and environmental information, it would appear that the proposed Upper Fortescue wellfield is located within the same catchment area as Millstream. Abstracting water from the Upper Fortescue aquifer could reduce the throughflow of water which ultimately naturally drains into the Millstream system.

Groundwater Source: Maitland River

River Basin: Port Hedland Coast **AWRC Basin No: 709**

Location: **Maitland River Aquifer** - near Karratha Station

Aquifer Details:

Extent:	
Rock unit:	alluvium
Estimated Recharge:	
Estimated Yield:	3 - 5 GL/year
No of production wells:	6 (depending on investigative drilling)

Water Quality:

Salinity:
Other significant parameters:

Possible future uses:

Possible water supply for West Pilbara development. The groundwater source could be used as part of a conjunctive use scheme.

Factors (environmental, social and economic) which may affect future development:

1. Proposed investigation area is located within an Aboriginal Native Title Claim.
2. Close to some significant permanent pools used for tourism and recreation.

Investigations / Comments:

Investigative drilling is proposed to be undertaken in the near future by the Water Corporation. If a subsequent hydrogeological report indicates that there is sufficient water available, the Water Corporation will seek EPA approval for a borefield on the Maitland River.

Groundwater Source: West Canning Basin

River Basin: Sandy Desert **AWRC Basin No: 025**

Location: **West of Shay Gap**

Aquifer Details:

Extent:	
Rock unit:	sedimentary basin
Estimated Recharge:	
Estimated Yield:	15 - 50 GL/year
No of production wells:	

Water Quality:

Salinity:	Fresh.
Other significant parameters:	

Possible future uses:

Possible water supply for West Pilbara development. The groundwater source could be used as part of a conjunctive use scheme.

Factors (environmental, social and economic) which may affect future development:

Investigations / Comments:

Table A4. 1: Summary of the Groundwater Resources of the Ashburton River Basin - Upland Area

Aquifer - Geological Unit	Sheet Name	Total Area ($m^2 \times 10^6$)	Area x 20% ($m^2 \times 10^6$)	Groundwater Storage: Saturated Thickness (m)	Specific Yield	Storage ($m^3 \times 10^6$)	Recharge: Rainfall (mm/a)	% Rainfall	(m^3/year x 10^4)	(m^3/day/km^3)	Salinity	Bore Yields (m^3/day) [A]	Potential for Supply
Valley Fill -	Wyloo	190	-	30	0.1	570	Recharge by discharge of drainages into aquifer				Fresh - Marginal	250 - 1000	Station
	Mt. Bruce	650	-	30	0.1	1950	along valley margins.					(3270)	Town
Alluvium and colluvium as well as Robe	Turee Creek	290	-	30	0.1	870	Equivalent to 90000 m^3/year/km or						Horticultural
Pisolite and calcrete that occurs in thick	Newman	404	-	30	0.1	1212	69 x 10^6 m^3/year over 770 km of valley length.						
valley fill sequences.	Total	1534				4602			69				
Calcrete -	Wyloo	80	-	15	0.15	180	250	2	0.4	14	Fresh - Brackish	< 500	Station
	Edmund	430	-	15	0.15	968	250	2	2	14	Some Saline		
Undifferentiated deposits of calcrete.	Turee Creek	530	-	15	0.15	1193	250	2	3	14			
	Mt. Eggerton	270	-	15	0.15	608	250	2	1	14			
	Newman	215	-	15	0.15	484	250	2	1	14			
	Collier	960	-	15	0.15	2160	250	2	5	14			
	Total	2485				5591			12				
Pisolite -	Wyloo	1	0.2	34	0.1	1	325	3	0.002	5	Fresh - Marginal	< 500 - > 5000	Station
	Mt. Bruce	181	36	34	0.1	123	325	3	0.4	5			
Robe Pisolite	Turee Creek	5	1	34	0.1	3	325	3	0.01	5			
	Newman	6	1	34	0.1	4	325	3	0.01	5			
	Total	193				131			0.4				
Morrissey Metamorphic -	Yanrey	1720	344	20	0.01	69	300	1	1	2	Marginal -Saline	< 100	Station
	Winning Pool	100	20	20	0.01	4	300	1	0.1	2		(540)	
Variety of metamorphic rocks -	Wyloo	1343	269	20	0.01	54	300	1	1	2			
gneiss, schist, amphibolite, migmatite	Edmund	447	89	20	0.01	18	300	1	0.3	2			
skarn, marble and quartzite developed around Proterozoic granites.	Total	3610				144			2				
Brockman -	Wyloo	985	197	20	0.02	79	325	1	1	2	Fresh - Marginal	< 100	Station
	Mt. Bruce	894	179	20	0.02	72	325	1	1	2		(2248)	
Brockman Iron Formation	Turee Creek	560	112	20	0.02	45	325	1	0.4	2			
	Roy Hill	40	8	20	0.02	3	325	1	0.03	2			
	Newman	397	79	20	0.02	32	325	1	0.3	2			
	Total	2876				230			2				

Aquifer - Geological Unit	Sheet Name	Total Area ($m^2 \times 10^6$)	Area x 20% ($m^2 \times 10^6$)	Groundwater Storage: Saturated Thickness (m)	Groundwater Storage: Specific Yield	Groundwater Storage: Storage ($m^3 \times 10^6$)	Recharge: Rainfall (mm/a)	Recharge: % Rainfall	Recharge: (m^3/year x 10^6)	Recharge: (m^3/day/km^2)	Salinity	Bore Yields (m^3/day) *	Potential for Supply
Dolomite-	Wyloo	296	59	25	0.1	148	350	2	0.4	4	Fresh - Brackish	50 - 2000	Station
	Mt. Bruce	506	101	25	0.1	253	350	2	1	4			Town
	Turee Creek	230	46	25	0.1	115	350	2	0.3	4			Horticultural
Wittenoom Dolomite	Roy Hill	9	2	25	0.1	5	350	2	0.01	4			
	Newman	305	61	25	0.1	153	350	2	0.4	4			
	Total	**1346**				**673**			**2**				
Marra Mamba -	Wyloo	285	57	25	0.05	71	350	2	0.4	4	Mostly marginal	< 500	Station
	Mt. Bruce	878	176	25	0.05	220	350	2	1	4	with some	(1702)	
Marra Mamba Iron Formation	Turee Creek	100	20	25	0.05	25	350	2	0.1	4	brackish.		
	Roy Hill	8	2	25	0.05	2	350	2	0.01	4			
	Newman	223	45	25	0.05	56	350	2	0.3	4			
	Total	**1494**				**374**			**2**				
Hardy -	Wyloo	63	13	30	0.02	8	300	2	0.1	3	Fresh - marginal,	< 200 - 1000	Station
	Mt. Bruce	824	165	30	0.02	99	300	2	1	3	some brackish.	(1900)	Town
Hardy Sandstone	Turee Creek	396	79	30	0.02	48	300	2	0.5	3			Horticultural
	Total	**1283**				**154**			**2**				
Mafic Volcanic Rocks-	Wyloo	1253	251	10	0.05	125	325	3.0	2	5	Fresh - marginal,	100 - 1000	Station
	Mount Bruce	3483	697	10	0.05	348	325	3.0	7	5	some brackish.	(4087)	Town
Bunjinah, Pyradie, Boongal and Bellary	Turee Creek	1317	263	10	0.05	132	325	3.0	3	5			Horticultural
Formations as well as the Mount Roe and	Newman	92	18	10	0.05	9	325	3.0	0.2	5			
Cheela Springs Basalt, and Mount Jope Volcanics.	**Total**	**6145**				**615**			**12**				

Aquifer - Geological Unit	Sheet Name	Total Area ($m^2 \times 10^6$)	Area x 20% ($m^2 \times 10^6$)	Groundwater Storage: Saturated Thickness (m)	Groundwater Storage: Specific Yield	Groundwater Storage: Storage ($m^3 \times 10^6$)	Recharge: Rainfall (mm/a)	Recharge: % Rainfall	Recharge: (m^3/year x 10^6)	Recharge: (m^3/day/km^2)	Salinity	Bore Yields (m^3/day) *	Potential for Supply
Undifferentiated Proterozoic Rocks-	Yanrey	312	62	20	0.02	25	250	1	0.2	1	Fresh -Saline	300 - 500	Station
	Wyloo	7236	1447	20	0.02	579	250	1	4	1		(1658)	
Undifferentiated rocks of the Hamersley,	Edmund	10610	2122	20	0.02	849	250	1	5	1			
Ashburton, Blair, Mount Minnie, Bresnahan	Mount Bruce	2505	501	20	0.02	200	250	1	1	1			
and Bangemall Basins.	Turee Creek	13900	2780	20	0.02	1112	250	1	7	1			
	Mt Eggerton	5523	1105	20	0.02	442	250	1	3	1			
	Roy Hill	15	3	20	0.02	1	250	1	0.01	1			
	Newman	6749	1350	20	0.02	540	250	1	3	1			
	Collier	8436	1687	20	0.02	675	250	1	4	1			
	Total	**55286**				**4423**			**28**				
Felsic Volcanics	Wyloo	360	72	30	0.05	108	350	2.0	0.5	4	Probably Fresh -	< 500	- Station
	Mt Bruce	283	57	30	0.05	85	350	2.0	0.4	4	Marginal.		
Woongarra Volcanics	Turee Creek	353	71	30	0.05	106	350	2.0	0.5	4	May be some		
	Newman	41	8	30	0.05	12	350	2.0	0.1	4	Brackish.		
	Total	**1037**				**311**			**1.5**				
Granitic Rocks -	Yanrey	950	190	38	0.05	361	275	2.0	1	3	Fresh - Saline	<500	Station
	Winning Pool	110	22	38	0.05	42	275	2.0	0.1	3	Mostly Marginal -	(1632)	
Various rocks of Capricorn Orogen	Wyloo	1000	200	38	0.05	380	275	2.0	1	3	Brackish.		
and Pilbara Craton granitoid complex	Edmund	244	49	38	0.05	93	275	2.0	0.3	3			
inliers.	Newman	136	27	38	0.05	52	275	2.0	0.1	3			
	Total	**2440**				**927**			**3**				
Greenstone Rocks -	Newman	15	3	30	0.04	4	225	2	0.01	2	Fresh - Brackish	50 - 500	Station
	Wyloo	24	5	30	0.04	6	300	2	0.03	3			
Various rocks of Pilbara Craton													
granite-greenstone inliers.	**Total**	**39**				**9**			**0.04**				
CATCHMENT TOTAL		**79768**				**18184**			**135**				

* Known maximum yield in brackets.

Table A4. 2: Summary of the Groundwater Resources of the Onslow Coast River Basin - Upland Area

Aquifer - Geological Unit	Sheet Name		Groundwater Storage: Total Area ($m^3 \times 10^6$)	Area x 20% ($m^3 \times 10^6$)	Saturated Thickness (m)	Specific Yield	Storage ($m^3 \times 10^6$)	Recharge: Rainfall (mm/a)	% Rainfall	Volume (m^3/year 10^4)	Volume (m^3/day km^2)	Salinity	Bore Yields (m^3/day) [A]	Potential for Supply
Pisolite -	Yarraloola		253	-	10	0.1	253	300	3	2	25	Marginal	< 500 - > 5000 (1343)	Station Town Horticultural
Robe Pisolite Poondano Formation		Total	253				253			2				
Yarraloola -	Yarraloola		919	-	25	0.1	2298	300	1.0	3	8	Mostly saline but is fresh to brackish close to the rivers.	1000 (309)	Station
	Wyloo		28	-	25	0.1	70	300	1.0	0.1	8			
Yarraloola Conglomerate Nanutarra Formation	Yanrey		17	-	25	0.1	43	300	1.0	0.1	8			
		Total	964				2410			3				
Morissey Metamorphic -	Wyloo		20	4	20	0.01	1	300	1	0.01	2	Mostly saline with some fresh to brackish water close to the water courses.	<100 - 500 (540)	Station
	Yanrey		53	11	20	0.01	2	300	1	0.03	2			
Variety of metamorphic rocks - gneiss, schist, amphibolite, migmatite skarn, marble and quartzite developed around Proterozoic granites.		Total	73	15			3			0.04				
Brockman -	Yarraloola		1267	253	20	0.05	253	325	2	2	4	Probably fresh to marginal.	< 100 - 500	Station
	Wyloo		1172	234	20	0.05	234	325	2	2	4			
Brockman Iron Formation	Mt Bruce		577	115	20	0.05	115	325	2	1	4			
	Pyramid		804	161	20	0.05	161	325	2	1	4			
		Total	3820	764			764			5				
Dolomite -	Yarraloola		435	87	25	0.1	218	300	2.5	0.7	4	Fresh to marginal. Rare brackish to saline.	< 50 - 2000	Station Town Horticultural
Wittenoom Dolomite		Total	435	87			218			0.7				
Marra Mamba -	Yarraloola		482	96	25	0.05	121	300	1	0.3	2	Mostly fresh to marginal.	< 500	Station
Marra Mamba Iron Formation		Total	482	96			121			0.3				

Aquifer - Geological Unit	Sheet Name		Groundwater Storage: Total Area ($m^3 \times 10^6$)	Area x 20% ($m^2 \times 10^6$)	Saturated Thickness (m)	Specific Yield	Storage ($m^3 \times 10^6$)	Recharge: Rainfall (mm/a)	% Rainfall	Volume (m^3/year 10^6)	Volume (m^3/day km^2)	Salinity	Bore Yields (m^3/day) *	Potential for Supply
Mafic Volcanic Rocks -	Yarraloola		530	106	10	0.05	53	300	4.5	1.4	7	Fresh to marginal	200-500	Station
	Wyloo		76	15	10	0.05	8	300	4.5	0.21	7		(500)	Town
Maddina Volcanics														Horticultural
Cheela Springs Basalt		Total	606	121			61			2				
Undifferentiated Proterozoic Rocks -	Yarraloola		3227	645	20	0.02	258	325	2	4	4	Mostly brackish to	< 150	Station
	Wyloo		2567	513	20	0.02	205	325	2	3	4	saline. Some fresh to	(966)	
Undifferentiated rocks from the Hamersley,	Mt Bruce		118	24	20	0.02	9	325	2	0.2	4	marginal supplies		
Ashburton, Mount Minnie and Bangemall	Pyramid		44	9	20	0.02	4	325	2	0.1	4	close to the drainage		
Basins.												lines.		
		Total	5956	1191			476			8				
Felsic Volcanic Rocks -	Yarraloola		184	37	30	0.05	55	325	2.0	0.2	4	Probably fresh to	< 500	Station
	Wyloo		106	21	30	0.05	32	325	2.0	0.1	4	marginal.		
Woongarra Volcanics	Mt Bruce		63	13	30	0.05	19	325	2.0	0.1	4			
	Pyramid		96	19	30	0.05	29	325	2.0	0.1	4			
		Total	449	90			135			0.6				
Granitic Rocks -	Yarraloola		5	1	38	0.05	2	300	2.0	0.01	3	Variable fresh to	< 50 - 2000	Station
	Yarrey		50	10	38	0.05	19	300	2.0	0.1	3	saline but mostly		
Variety of rocks from Pilbara Craton	Wyloo		94	19	38	0.05	36	300	2.0	0.1	3	brackish to saline.		
and Gascoyne Complex granitoid complexes.														
		Total	149	30			57			0.2				
CATCHMENT TOTAL				2394			4496			21				

* Known maximum yield in brackets.

Table A4. 3: Summary of the Groundwater Resources of the Onslow Coastal Plain

Aquifer - Subcatchment / Geological Unit	Sheet Name	Salinity (mg/L)	Groundwater Storage: Area ($m^2 \times 10^6$)	Saturated Thickness (m)	Specific Yield	Storage ($m^3 \times 10^6$)	Recharge/Safe Yield: River Length (km)	Volume (m^3/year/km)	Total (m^3/year $\times 10^6$)	Bore Yields (m^3/day) *	Potential for Supply
Alluvial -	Yarraloola	< 500	92	12	0.15	166	27	590000	16	1000	Station
		500 - 1000	98	13	0.15	191				(1702)	Town
Fortescue River/		1000-1500	41	10	0.05	21					Horticultural
		1500-3000	53	5	0.05	13					
Alluvium		>3000	177	14	0.05	124					
Colluvium											
Eluvium	**Total**		**461**			**514**			**16**		
Alluvial -	Yarraloola	<500	48	6	0.05	14	100	49000	5	100	Station
		500-1000	152	6	0.05	46					
Peter Creek/		1000-1500	470	6	0.05	141					
		1500-3000	722	6	0.05	217					
Alluvium		>3000	1147	6	0.05	344					
Colluvium											
Eluvium	**Total**		**2539**			**762**			**5**		
Alluvial -	Yarraloola	< 500	48	14	0.15	101	25	490000	12	1400	Station
		500 - 1000	84	11	0.15	139	10	294000	3	(1640)	Town
Robe River/		1000-1500	100	9	0.05	45					Horticultural
		1500-3000	104	12	0.05	62					
Alluvium		>3000	158	12	0.05	95					
Colluvium											
Eluvium	**Total**		**494**			**442**			**15**		
Alluvial -	Yarraloola & Onslow	<500	20	5	0.05	5	20	49000	1	< 50	Station
		500-1000	11	5	0.05	3					
Warramboo Creek/		1000-1500	30	5	0.05	8					
		1500-3000	154	5	0.05	39					
Alluvium		>3000	546	5	0.05	137					
Colluvium											
Eluvium	**Total**		**761**			**190**			**1**		

Aquifer - Subcatchment / Geological Unit	Sheet Name		Salinity (mg/L)	Groundwater Storage: Area ($m^3 \times 10^6$)	Saturated Thickness (m)	Specific Yield	Storage ($m^3 \times 10^6$)	Recharge/Safe Yield: River Length (km)	Volume (m^3/year/km)	Total (m^3/year x 10^6)	Bore Yields (m^3/day) *	Potential for Supply
Alluvial -	Yarraloola		<500	85	10	0.05	43	40	100000	4	< 50	Station
	Onslow		500-1000	130	10	0.05	65					Town (a)
Cane River/	Yanrey		1000-1500	338	10	0.05	169					Horticultural (a)
	Wyloo		1500-3000	470	8	0.05	188					
Alluvium			>3000	775	6	0.05	233					
Colluvium												
Eluvium		Total		1798			697			4		
Alluvial -	Onslow		<500	38	12	0.15	68	31	490000	15	500	Station
	Yanrey		500-1000	113	12	0.15	203				(131)	Town
Ashburton River/			1000-1500	228	8	0.05	91					Horticultural
			1500-3000	428	8	0.05	171					
Alluvium			>3000	1720	6	0.05	516					
Colluvium												
Eluvium		Total		2527			1050			15		
Trealla -	Yarraloola		Fresh to saline	3743	15	0.002	112	Recharge via leakage from alluvium			100	Station
	Onslow										(980)	Town (b)
Trealla Limestone	Yanrey	Total		3743			112					Horticultural (b)
	Wyloo											
Pisolite -	Yarraloola		Brackish to saline	163	5	0.1	82	Recharge via leakage from overlying aquifers			500	Station
Robe Pisolite		Total		163			82					
Yarraloola -	Yarraloola		Fresh to saline	5381	30	0.1	16143	Recharge via leakage from overlying aquifers			1000	Station
	Onslow										(3273)	Town
Yarraloola Conglomerate	Yanrey	Total		5381			16143					Horticultural
Birdrong Sandstone	Wyloo											

Aquifer - Subcatchment / Geological Unit	Sheet Name		Salinity (mg/L)	Groundwater Storage: Area ($m^3 \times 10^6$)	Saturated Thickness (m)	Specific Yield	Storage ($m^3 \times 10^6$)	Recharge/Safe Yield: River Length (km)	Volume (m^3/year/km)	Total (m^3/year $\times 10^6$)	Bore Yields (m^3/day) *	Potential for Supply
Lyons -	Yarraloola		Saline	550	60	0.1	3300	Recharge via leakage from overlying aquifers			1000 (4546)	Poor
Undifferentiated Lyons Group sediments and Gnuedna and Nanyarra Formations.		Total		550			3300					
Proterozoic Basement Rocks -	Yarraloola		Fresh to brackish	348	6	0.05	104	Recharge via leakage from overlying aquifers			500 (510)	Station
Fortescue Group rocks of the Hamersley Basin.		Total		348			104					
BASIN TOTAL				18765			23396			56		

* Known maximum yield in brackets.
(a) In conjunction with the Trealla aquifer
(b) In conjunction with the Alluvial aquifer

Table A4. 4: Summary of the Groundwater Resources of the Fortescue River Basin - Upland Area

Aquifer - Geological Unit	Sheet Name	Groundwater Storage: Area ($m^2 \times 10^6$)	Area x 20% ($m^2 \times 10^6$)	Saturated Thickness (m)	Specific Yield	Storage ($m^3 \times 10^6$)	Recharge: Rainfall (mm/a)	% Rainfall	Volume (m^3/year x 10^4)	Salinity	Bore Yields (m^3/day) *	Potential for Supply
Valley Fill -	Fortescue Valley - Millstream Area									Fresh - Brackish	100 - 6000 (> 5000)	Station Town
Colluvium, alluvium pisolitic limonite, Millstream Dolomite and calcrete.	Pyramid	1446		See Table 6.		4003			29			Horticultural
	Fortescue Valley - From Weelumurra Creek to the Great Northern Highway						Recharge by discharge of drainages into aquifer along valley margins.			Fresh - Saline	100 - 2000 (1440)	Station Town
	Pyramid	750		30	0.1	2250	Equivalent to 277400 m^3/year/km or					Horticultural
	Mt Bruce	1077		30	0.1	3231	172 x 10^6 m^3/year over 620 km of valley margin.					
	Roy Hill	650		30	0.1	1950						
	Fortescue Valley - Upstream of the Great Northern Highway											
	Roy Hill	4192		15	0.1	6288						
	Newman	375		15	0.1	563						
	Robertson	1875		15	0.1	2813						
	Balfour Downs	2125		15	0.1	3188						
	Hamersley Range						Recharge by discharge of drainages into aquifer along valley margins.			Fresh - marginal, some brackish.	500 - 1500 (4560)	Station Town
	Mt Bruce	780		30	0.1	2340	Equivalent to 90000 m^3/year/km or					Horticultural
	Roy Hill	330		30	0.1	990	77 x 10^6 m^3/year over 850 km of valley length.					
	Newman	510		30	0.1	1530						
	Robertson	70		30	0.1	210						
	Total	14180				29355			190			
Pisolite -	Yarraloola	1	-	10	0.1	1	325	3	0.01	Fresh - Marginal	< 500 - > 5000 (5184)	Station Town
	Pyramid	57	-	10	0.1	57	325	3	0.6			Horticultural
Robe Pisolite	Mt. Bruce	27	-	10	0.1	27	325	3	0.3			
	Roy Hill	14	-	10	0.1	14	325	3	0.1			
	-Yandi Mine	28	-	34	0.1	95	325	3	0.3			
	Total	127				194			1			

Aquifer - Geological Unit	Sheet Name	Area ($m^3 \times 10^6$)	Area x 20% ($m^3 \times 10^6$)	Groundwater Storage: Saturated Thickness (m)	Groundwater Storage: Specific Yield	Groundwater Storage: Storage ($m^3 \times 10^6$)	Recharge: Rainfall (mm/a)	Recharge: % Rainfall	Recharge: Volume (m^3/year x 10^6)	Recharge: Volume (m^3/day/km^3)	Salinity	Bore Yields (m^3/day) [a]	Potential for Supply
Brockman -	Yarraloola	263	53	20	0.02	21	325	2	0.3	4	Fresh - Marginal	< 100	Station
	Pyramid	567	113	20	0.02	45	325	2	1	4		(24)	
Brockman Iron Formation	Mt. Bruce	2159	432	20	0.02	173	325	2	3	4			
	Roy Hill	2678	536	20	0.02	214	325	2	3	4			
	Newman	558	112	20	0.02	45	325	2	1	4			
	Robertson	89	18	20	0.02	7	325	2	0.1	4			
	Total	6314				505			8				
Dolomite-	Yarraloola	113	23	25	0.1	57	300	2	0.1	3	Fresh - Marginal	50 - 2000	Station
	Pyramid	1212	242	25	0.1	606	300	2	1	3		(1637)	Town
	Mt Bruce	1778	356	25	0.1	889	300	2	2	3			Horticultural
Wittenoom Dolomite	Roy Hill	4979	996	25	0.1	2490	300	2	6	3			
	Newman	814	163	25	0.1	407	300	2	1	3			
	Robertson	1124	225	25	0.1	562	300	2	1	3			
	Balfour Downs	819	164	25	0.1	410	300	2	1	3			
	Total	10839				5420			13				
Marra Mamba -	Yarraloola	177	35	25	0.05	44	300	2.5	0.3	4	Fresh - Marginal	< 500	Station
	Pyramid	1567	313	25	0.05	392	300	2.5	2	4		(924)	
Marra Mamba Iron Formation	Mt. Bruce	1226	245	25	0.05	307	300	2.5	2	4			
	Roy Hill	2816	563	25	0.05	704	300	2.5	4	4			
	Newman	513	103	25	0.05	128	300	2.5	1	4			
	Balfour Downs	1328	266	25	0.05	332	300	2.5	2	4			
	Robertson	103	21	25	0.05	26	300	2.5	0.2	4			
	Total	7730				1933			12				
Mafic Volcanic Rocks-	Yarraloola	1445	289	10	0.05	145	300	4.5	4	7	Fresh - Marginal	< 500	Station
	Pyramid	3314	663	10	0.05	331	300	4.5	9	7	Some brackish	(1091)	
Mount Roe Basalt, Kyleena Basalt,	Mt Bruce	76	15	10	0.05	8	300	4.5	0.2	7			
Tumbiana Formation, Pillingini Tuff,	Roy Hill	365	73	10	0.05	37	300	4.5	1	7			
Nymerina Basalt, Kuruna Siltstone and	Newman	433	87	10	0.05	43	300	4.5	1	7			
Maddina Volcanics	Robertson	33	7	10	0.05	3	300	4.5	0.1	7			
	Balfour Downs	785	157	10	0.05	79	300	4.5	2	7			
	Total	6451				645			17				

Aquifer - Geological Unit	Sheet Name	Area ($m^2 \times 10^6$)	Area x 20% ($m^2 \times 10^6$)	Groundwater Storage: Saturated Thickness (m)	Groundwater Storage: Specific Yield	Groundwater Storage: Storage ($m^3 \times 10^6$)	Recharge: Rainfall (mm/a)	Recharge: % Rainfall	Recharge: Volume (m^3/year x 10^6)		Salinity	Bore Yields (m^3/day) *	Potential for Supply
Undifferentiated Proterozoic -	Yarraloola	350	70	20	0.02	28	300	2	0.4	3	Fresh -Saline	< 100	Station
	Pyramid	395	79	20	0.02	32	300	2	0.5	3		(400)	
Undifferentiated rocks from the	Mt Bruce	663	133	20	0.02	53	300	2	1	3			
Hamersley, Ashburton, Bresnahan,	Roy Hill	365	73	20	0.02	29	300	2	0.4	3			
Bangemall and Savory Basins.	Newman	3521	704	20	0.02	282	300	2	4	3			
	Robertson	2674	535	20	0.02	214	300	2	3	3			
	Balfour Downs	1361	272	20	0.02	109	300	2	2	3			
	Total	9329				746			11				
Felsic Volcanic Rocks -	Yarraloola	34	7	30	0.05	10	325	2.0	0.04	4	Fresh - Marginal	< 500	Station
	Mt Bruce	18	4	30	0.05	5	325	2.0	0.02	4			
Woongarra Volcanics	Roy Hill	16	3	30	0.05	5	325	2.0	0.02	4			
	Newman	317	63	30	0.05	95	325	2.0	0.4	4			
	Robertson	78	16	30	0.05	23	325	2.0	0.1	4			
	Total	463				139			1				
Granitic Rocks -	Newman	2217	443	38	0.05	842	250	2.0	2	3	Fresh - Saline	50 - 2000	Station
	Robertson	1486	297	38	0.05	565	250	2.0	1	3		(46)	
Various rocks of Pilbara Craton	Balfour Downs	86	17	38	0.05	33	250	2.0	0.1	3			
granitoid complex inliers.	Total	3789				1440			4				
Greenstone Rocks -	Newman	75	15	30	0.04	18	225	2	0.1	2	Fresh - Brackish	50 - 500	Station
Various rocks of Pilbara Craton	Total	75				18			0.1				
granite-greenstone inliers.													
CATCHMENT TOTAL		59297				40394			257				

* Known maximum yield in brackets.
(a) Highest yields in Cleaved Sandstone Unit of the Formation

Summary of Groundwater Resources of Valley Fill Aquifers at Millstream, Fortescue River Catchment

Aquifer - Geological Unit	Sheet Name	Salinity (mg/L)		Groundwater Storage: Area ($m^2 \times 10^6$)	Saturated Thickness (m)	Specific Yield	Storage ($m^3 \times 10^6$)	Bore Yields (m^3/day) *	Recharge: Volume (m^3/year x 10^6)	Potential for Supply
Calcrete -	Pyramid	< 500		196	11	0.15	323	100 - 10000(a)	Recharge from leakage of river flow and flood water = 17	Station Town(b) Horticultural
		500 - 1000		646	12	0.15	1163	(5500)		
Millstream Dolomite		1000-1500		334	18	0.15	902			
		1500-3000		14	18	0.15	38			
			Total	1190			2426		Recharge from leakage of streams discharging into valley over outwash fans = 12	
Alluvial -	Pyramid	< 500		123	9	0.1	111	100 - 500		
		500 - 1000		123	15	0.1	185	(588)		
Alluvium		1000-1500		10	6	0.1	6			
Kumina Conglomerate			Total	256			301			
Pisolite -	Pyramid	< 500		67	6	0.1	40	500 - 1500		
		500 - 1000		360	9	0.1	324	(1585)		
Robe Pisolite		1000-1500		256	4	0.1	102			
Poondano Formation			Total	683			467			
Yarraloola -	Pyramid	Mostly fresh minor brackish areas.		176	46	0.1	810	100 - 1000 (1610)(c)		
Yarraloola Conglomerate										
			Total	176			810			
			AREA TOTAL	2305			4003		29	

* Known maximum yield in brackets.

(a) Average from 12 water supply bores is 9600 m^3/day (Masterson and Miotti, 1992).

(b) 12 x 10^6 m^3 of groundwater required for environmental support leaves 17 x 10^6 m^3 of recharge.

(c) Yield derived from bore in adjacent catchment but very close to Millstream.

Table A4. 5: Summary of the Groundwater Resources of the Port Hedland Coast River Basin - Upland Area

Aquifer - Geological Unit	Sheet Name	Groundwater Storage: Total Area ($m^2 \times 10^6$)	Area x 20% ($m^2 \times 10^6$)	Saturated Thickness (m)	Specific Yield	Storage ($m^3 \times 10^6$)	Recharge: Rainfall (mm/a)	% Rainfall	Volume (m^3/year x 10^6)	(m^3/d/km^2)	Salinity	Bore Yields (m^3/d) *	Potential for Supply
Cliff Springs -	Pyramid	1890	378	30	0.01	113	310	2.5	2.9	4	Fresh - Marginal	<100 - 250	Station
	Roebourne	64	13	30	0.01	4	310	2.5	0.1	4		(3600)	
Cliff Springs Formation	Yarraloola	293	59	30	0.01	18	310	2.5	0.5	4			
	Total	2247	449			135			3				
Mafic Volcanic Rocks -	Yarraloola	1079	216	10	0.05	108	350	4.5	3.4	9	Fresh - Marginal	100 - 500	Station
	Pyramid	3653	731	10	0.05	365	350	4.5	11.5	9		(382)	
Mount Roe Basalt	Marble Bar	602	120	10	0.05	60	350	4.5	1.9	9			
Kyleena Basalt	Roy Hill	211	42	10	0.05	21	350	4.5	0.7	9			
Pillingini Tuff	Roebourne	403	81	10	0.05	40	350	4.5	1.3	9			
Cooya Pooya Dolerite	Dampier	125	25	10	0.05	13	350	4.5	0.4	9			
	Total	6073	1215			607			19				
Granitic Rocks -	Port Hedland	2504	501	38	0.05	952	325	2.0	3.3	4	Fresh - saline but mostly	< 50 - 2100	Station
	Roebourne	729	146	38	0.05	277	325	2.0	0.9	4	fresh - marginal.	(1150)	
Various rocks of Pilbara Craton	Dampier	527	105	38	0.05	200	325	2.0	0.7	4			
granitoid complexes.	Yarraloola	522	104	38	0.05	198	325	2.0	0.7	4			
	Pyramid	2418	484	38	0.05	919	325	2.0	3.1	4			
	Roy Hill	34	7	38	0.05	13	325	2.0	0.04	4			
	Marble Bar	5258	1052	38	0.05	1998	325	2.0	6.8	4			
	Total	11992	2398			4557			16				
Greenstone Rocks -	Port Hedland	534	107	30	0.04	128	325	2	0.7	4	Fresh - saline but mostly	50 - 500	Station
	Roebourne	1196	239	30	0.04	287	325	2	1.6	4	fresh - brackish.	(2200)	
Roebourne Group	Dampier	620	124	30	0.04	149	325	2	0.8	4			
	Yarraloola	186	37	30	0.04	45	325	2	0.2	4			
	Pyramid	1959	392	30	0.04	470	325	2	2.5	4			
	Marble Bar	621	124	30	0.04	149	325	2	0.8	4			
	Total	5116	1023			1228			7				
CATCHMENT TOTAL		25428	5086			6527			45				

* Known maximum yield in brackets.

Table A4. 6: Summary of the Groundwater Resources of the Port Hedland Coastal Plain

Aquifer - Subcatchment / Geological Unit	Sheet Name		Salinity (mg/L)	Groundwater Storage: Area ($m^2 \times 10^6$)	Groundwater Storage: Saturated Thickness (m)	Groundwater Storage: Specific Yield	Groundwater Storage: Storage ($m^3 \times 10^6$)	Recharge/Safe Yield: River Length (km)	Recharge/Safe Yield: Volume (m^3/year/km)	Recharge/Safe Yield: Total (m^3/year $\times 10^6$)	Bore Yields (m^3/d) *	Potential for Supply
Alluvial -	Pt Hedland		<500	315	30	0.1	945	164	80000	13	1000 - 2000	Station
	& Yarrie		500-1000	713	30	0.1	2139				(6545)	Town
DeGrey River Subcatchment/			1000-1500	253	20	0.05	253					Horticultural
			1500-3000	883	15	0.05	662					
Alluvium			>3000	1095	10	0.05	548					
Colluvium		Total		3259			4547			13		
Eluvium												
Alluvial -			<500	428	20	0.1	856	148	80000	12	500	Station
			500-1000	713	15	0.1	1070				(273)	Town
Shaw River Subcatchment/			1000-1500	470	10	0.05	235					Horticultural
			1500-3000	345	5	0.05	86					
Alluvium			>3000	192	5	0.05	48					
Colluvium		Total		2148			2295			12		
Eluvium												
Alluvial -	Pt Hedland		0-500	4	4	0.05	1	50	18000	1	<100	Station
			500-1000	75	4	0.05	15					
Tabba Tabba Creek Subcatchment/			1000-1500	117	4	0.05	23					
			1500-3000	113	4	0.05	23					
Alluvium			>3000	150	4	0.05	30					
Colluvium		Total		459			92			1		
Eluvium												
Alluvial -	Pt Hedland		<500	70	14	0.1	98	30	90000	3	1000	Station
	& Roebourne		500-1000	112	12	0.1	134				(630)	Town
Turner River Subcatchment/			1000-1500	46	12	0.05	28					Horticultural
			1500-3000	112	11	0.05	62					
Alluvium			>3000	148	8	0.05	59					
Colluvium		Total		488			381			3		
Eluvium												

Aquifer - Subcatchment / Geological Unit	Sheet Name		Salinity (mg/L)	Groundwater Storage: Area ($m^2 \times 10^6$)	Saturated Thickness (m)	Specific Yield	Storage ($m^3 \times 10^6$)	Recharge/Safe Yield: River Length (km)	Volume (m^3/year/km)	Total (m^3/year $\times 10^6$)	Bore Yields (m^3/d) *	Potential for Supply
Alluvial -	Roebourne		<500	194	20	0.15	582	48	290000	14	1000-1500 (2793)	Station Town Horticultural
			500-1000	167	17	0.15	426					
Yule River Subcatchment/			1000-1500	150	17	0.05	128					
			1500-3000	251	9	0.05	113					
Alluvium			>3000	167	4	0.05	33					
Colluvium		Total		929			1282			14		
Eluvium												
Alluvial -	Roebourne		1000-1500	209	4	0.08	67	150	45000	7	< 100 - 1000	Station Town Horticultural
			1500-3000	110	4	0.08	35					
Pewah-Harding River Subcatchment/			>3000	401	4	0.08	128					
		Total		720			230			7		
Alluvium												
Colluvium												
Eluvium												
Granitoid-	Pt Hedland & Roebourne		Fresh to saline.	8393	5	0.05	2098	Recharge via leakage from alluvium			50-2000 (1637)	Station
Various rocks of Pilbara Craton granitoid complexes.												
Greenstone -	Pt Hedland & Roebourne		Fresh to saline.	708	5	0.04	142	Recharge via leakage from alluvium			50-1000 (632)	Station
Various rocks of Pilbara Supergroup												
COASTAL PLAIN TOTAL				8003			11066			49		

* Known maximum yield in brackets.

Table A4. 7: Summary of the Groundwater Resources of the DeGrey River Basin - Upland Area

Aquifer - Geological Unit	Sheet Name	Total Area ($m^3 \times 10^6$)	Area x 20% ($m^3 \times 10^6$)	Groundwater Storage: Saturated Thickness (m)	Groundwater Storage: Specific Yield	Groundwater Storage: Storage ($m^3 \times 10^6$)	Recharge: Rainfall (mm/a)	Recharge: % Rainfall	Recharge: Volume (m^3/years 10^6)	Recharge: Volume (m^3/day/km^2)	Salinity	Bore Yields (m^3/day) [A]	Potential for Supply
Calcrete -	Balfour Downs	615	-	25	0.15	2306	Recharge by river flow.				Fresh - Saline	100 - 5500	Station
	Nullagine	356	-	25	0.15	1335	Assumed to be 140000 m^3/year/km over 120 km					(218)	
Oakover Formation and undifferentiated calcrete deposits.	Total	971				3641			17				
Dolomite-	Balfour Downs	2920	584	25	0.1	1460	300	3	5	5	Fresh - Brackish	50 - 4000	Station
	Nullagine	2586	517	25	0.1	1293	300	3	5	5		(3742)	Town
Carawine Dolomite	Yarrie	165	33	25	0.1	83	300	3	0.3	5			Horticultural
Pinjan Chert Breccia	Total	5671				2836			10				
Marra Mamba -	Balfour Downs	353	71	25	0.05	88	250	2	0.4	3	Fresh - Brackish	< 500	Station
Marra Mamba Iron Formation	Total	353				88			0.4				
Hardy -	Port Hedland	6	1	30	0.02	1	300	2.0	0.01	3	Fresh - Marginal	100 - 200	Station
	Marble Bar	351	70	30	0.02	42	300	2.0	0.4	3		(200)	
Hardy Sandstone	Yarrie	160	32	30	0.02	19	300	2.0	0.2	3			
	Nullagine	545	109	30	0.02	65	300	2.0	1	3			
	Balfour Downs	18	4	30	0.02	2	300	2.0	0.02	3			
	Total	1080				130			1				
Mafic Volcanic Rocks -	Port Hedland	1079	216	10	0.05	108	300	4.5	3	7	Fresh - marginal, some	100 - 500	Station
	Marble Bar	1060	212	10	0.05	106	300	4.5	3	7	brackish.	(218)	
Maddina Basalt, Nymerina Basalt, Tumbiana	Roy Hill	1600	320	10	0.05	160	300	4.5	4	7			
Formation, Kyleena Basalt, Mount Roe	Yarrie	668	134	10	0.05	67	300	4.5	2	7			
Basalt and Pearana Basalt.	Nullagine	4308	862	10	0.05	431	300	4.5	12	7			
	Balfour Downs	3182	636	10	0.05	318	300	4.5	9	7			
	Robertson	3	1	10	0.05	0.3	300	4.5	0.01	7			
	Total	11900				1190			32				

Aquifer - Geological Unit	Sheet Name	Groundwater Storage: Total Area ($m^3 \times 10^6$)	Area x 20% ($m^3 \times 10^6$)	Saturated Thickness (m)	Specific Yield	Storage ($m^3 \times 10^6$)	Recharge: Rainfall (mm/a)	% Rainfall	Volume (m^3/year x 10^6)	(m^3/day/km^3)	Salinity	Bore Yields (m^3/day) *	Potential for Supply
Undifferentiated Proterozoic Rocks -	Roy Hill	58	12	20	0.02	5	300	2	0.1	3	Fresh -Saline	< 150	Station
	Robertson	538	108	20	0.02	43	300	2	1	3			
Undifferentiated rocks from the Hamersley,	Balfour Downs	3971	794	20	0.02	318	300	2	5	3			
Bangemall and Yeneena Basins.	Nullagine	233	47	20	0.02	19	300	2	0.3	3			
	Yarrie	160	32	20	0.02	13	300	2	0.2	3			
	Total	4960				397			6				
Felsic Volcanic Rocks -	Port Hedland	100	20	30	0.05	30	300	2.0	0.1	3	Fresh - Brackish	100 - 600	Station
	Marble Bar	290	58	30	0.05	87	300	2.0	0.3	3		(800)	
Felsic volcanic rocks of the Archaean	Yarrie	117	23	30	0.05	35	300	2.0	0.1	3			
greenstone sequence and the Proterozoic	Nullagine	707	141	30	0.05	212	300	2.0	0.8	3			
Koongaling Volcanics.													
	Total	1214				364			1				
Granitic Rocks -	Port Hedland	2359	472	38	0.05	896	300	2.0	3	3	Fresh - saline but mostly	< 500	Station
	Marble Bar	5090	1018	38	0.05	1934	300	2.0	6	3	fresh - brackish.	(2100)	
Various rocks of Pilbara Craton	Roy Hill	833	167	38	0.05	317	300	2.0	1	3			
granitoid complexes.	Yarrie	1958	392	38	0.05	744	300	2.0	2	3			
	Nullagine	3052	610	38	0.05	1160	300	2.0	4	3			
	Balfour Downs	831	166	38	0.05	316	300	2.0	1	3			
	Robertson	2	0.4	38	0.05	1	300	2.0	0.002	3			
	Total	14125				5368			17				
Mosquito Creek-	Nullagine	1708	342	20	0.04	273	300	3.0	3	5	Mostly fresh - brackish,	< 100 - 1000 (a)	Station
	Balfour Downs	138	28	20	0.04	22	300	3.0	0.2	5	some saline.	(610)	
Mosquito Creek Formation													
	Total	1846				295			3				

Aquifer - Geological Unit	Sheet Name	Groundwater Storage: Total Area ($m^2 \times 10^6$)	Groundwater Storage: Area x 20% ($m^2 \times 10^6$)	Groundwater Storage: Saturated Thickness (m)	Groundwater Storage: Specific Yield	Groundwater Storage: Storage ($m^3 \times 10^6$)	Recharge: Rainfall (mm/a)	Recharge: % Rainfall	Recharge: Volume (m^3/years 10^6)	Recharge: Volume (m^3/day/km^2)	Salinity	Bore Yields (m^3/day) *	Potential for Supply
Greenstone -	Port Hedland	1065	213	30	0.04	256	300	3.5	2	6	Fresh - saline but mostly	<500	Station
	Marble Bar	3972	794	30	0.04	953	300	3.5	8	6	fresh - brackish.	(3000)	
Various rocks from the Pilbara Craton greenstone sequence.	Roy Hill	41	8	30	0.04	10	300	3.5	0.1	6			
	Yarrie	628	126	30	0.04	151	300	3.5	1	6			
	Nullagine	940	188	30	0.04	226	300	3.5	2	6			
	Total	6646				1595			14				
CATCHMENT TOTAL		48766				15904			103				

* Known maximum yield in brackets.
(a) Highest yields in Cleaved Sandstone Unit of the Formation

Table A4. 8: Summary of the Groundwater Resources of the Sandy Desert Basin

Aquifer - Geological Unit	Sheet Name	Groundwater Storage: Area ($m^2 \times 10^6$)	Saturated Thickness (m)	Specific Yield	Storage ($m^3 \times 10^6$)	Recharge/Safe Yield: Rainfall (mm/a)	% Rainfall	Volume (m^3/year $\times 10^6$)	Salinity	Bore Yields (m^3/day) *	Potential for Supply
Broome -	Port Hedland	1575	20	0.1	3150	250	3	18	Fresh to saline	1000	Station
	Yarrie	1350	0	-	0	250	3	10		(735)	Town
	Mandora	70	20	0.1	140	250	3	1			Horticultural
Broome Sandstone	Total	2925			3290			29			
Wallal -	Port Hedland, Yarrie & Mandora	2100	94	0.1	55000	Recharge occurs by leakage through the overlying aquifers			Fresh to saline	2000 (2000)	Station Town Horticultural
Wallal Formation	Total	2100 [a]			55000			21			
Paterson	Yarrie	1550	100	0.01	1550	250	2	8	Fresh to saline	500	Station
	Nullagine	1012	100	0.01	1012	250	2	5		(528)	
Paterson Formation	Balfour Downs	82	100	0.01	82	250	2	0.4			
	Total	2562			2562			13			
	BASIN TOTAL	5487			60852			63			

* Known maximum yield in brackets.

[a] Underlies Broome Sandstone and Jarlemai Siltstone

Appendix 5: Environmental, Social, Cultural Values

Water Quality Protection

Inter-relationships between land use and water supply schemes

The development and operation of water sources involves 'using' land and water. Land is 'consumed' by inundation behind a reservoir, for roads, pipelines, well sites, treatment plants and other structures and earthworks. Water is diverted from streams or by the lowering of groundwater levels in the vicinity of wells. The construction and operation of water infrastructure may have other impacts such as those of dust, odour, vibration and noise. These impacts occur on both the natural environment and the social environment.

The following tables indicate the types of impacts that developments of water resources for public supply have on land use and conversely the impacts that land use has on water sources. This broad assessment is made for surface water and shallow groundwater and for forested, rural and urban land uses.

The tables describe:

Table	Description
A5.1	Impacts of forest land use on surface water resources.
A5.2	Impacts of surface water schemes on forest land use.
A5.3	Impacts of rural and urban land use on surface water resources.
A5.4	Impacts of surface water schemes on rural and urban land use.
A5.5	Impacts of land use on shallow groundwater resources.
A5.6	Impacts of shallow groundwater schemes on land use.

Confined aquifer wells have very little impact on land uses in their vicinity because they occupy a very small area of land and are not affected by, nor do they affect, nearby surface uses of the land. However, an operating well creates a local area of low pressure in the confined groundwater. Any other confined well within this area of low pressure will experience reduced pumping efficiency.

Note that one of the key impacts described in the tables is that of land use on the quality of water resources.

Table A5. 1: Impacts of forest land use on surface water resources.

	CONSERVATION RESERVES	TIMBER PRODUCTION	MINOR FOREST PRODUCTS (Beekeeping, charcoal, firewood, gravel)	MINING	SERVICE CORRIDORS	RECREATION	CONSERVATION OF ECOSYSTEMS
FLOW Volume (yield)	High density forest has low yield.	Higher yield from forest with reduced density from logging.	As for timber production except less intense.	Some increase in yield during mining; possible reduction after rehabilitation if vegetation very dense.	Negligible effects.	Negligible effects.	Possible reduction of water for water supply due to ecosystem maintenance.
SALINITY	Streams in conservation reserves usually fresh.	If logging spreads dieback and/or forest density is reduced, stream salinity may increase in lower rainfall areas.	As for timber production except less intense.	No risk in high rainfall areas. Risk in lower rainfall areas is being determined.	May have indirect effects in low rainfall areas through spread of dieback.	As for service corridors.	May help prevent activities which risk salinity increases.
TURBIDITY	Minimal.	Careful management needed to avoid turbidity from logging areas.	As for timber production except less intense.	Management required to avoid turbid runoff from pits and haul roads.	A serious source of turbidity.	Recreation causes little turbidity.	Nil.
CHEMICAL POLLUTION	Nil.	Minimal (chemical spills).	As for timber production except less intense.	Minor risk of fuel spills. Leachate from tailings.	Risk of transport of hazardous chemicals in catchments.	Low (litter, nutrients).	Nil.
BIOLOGICAL POLLUTION	Minimal (illegal entry)	Minimal (operators)	As for timber production except less intense.	Minimal (operators)	High risk where roads encourage human access to streams.	High risk where camping is popular and close to water.	Nil.

Table A5. 3: Impacts of rural and urban land use on surface water resources.

	PASTURE	CROPS	HORTICULTURE	RURAL INDUSTRY (e.g. abattoir, refineries)	INTENSIVE ANIMAL HUSBANDRY	SPECIAL RURAL (Hobby farms)	URBAN
FLOW VOLUME (yield)	Large yield increase compared to forested area. Irrigation may increase or reduce yield depending upon source of water.	As for pasture.	As for pasture.	Demand for industrial water supply may reduce flow.	Minor reduction in yield if water supply required.	As for intensive animal husbandry.	Increased runoff from road, and roofs, but not usually significant because urban areas are usually only a small fraction of catchment.
SALINITY FROM GROUNDWATER DISCHARGE	Clearing may cause brackish or saline streams after clearing in lower rainfall, higher soil-salt storage areas.	As for pasture.	Not usually in salinity - risk areas.	N/A	N/A	As for pasture.	N/a
TURBIDITY	High risk of turbidity if animals have direct access to stream.	High risk of turbid runoff from ploughed fields.	As for crops.	Poor management of site or process can cause severe turbidity.	Turbidity is only a risk in some cases of poor management.	Low risk of turbidity, except when there is a large number of different land owners.	Runoff from roads and verges can cause turbidity.
CHEMICAL POLLUTION	Risk of pollution from agricultural chemicals, pesticides and fertilisers.	As for pasture.	High risk of pollution from pesticides and fertilisers if their application is not controlled.	Harmful chemicals may be discharged to stream if pollution is not controlled.	Risk of pollution from high nutrient loads in effluent and runoff from site unless adequately managed.	As for pasture.	Risk of pollution from urban runoff which contains rubber, fuel and oil, spillage of poisons; drainage from rubbish disposal sites.
BIOLOGICAL POLLUTION	Risk from human and stock access to stream or reservoir.	Minimal.	Usually higher density of human habitation then crops or pasture hence higher risk.	Highly polluting effluent should be treated to acceptable standard before discharge to stream or preferably removed from catchment.	High risk if effluent not adequately treated or removed from catchment.	Relatively high density of housing using septic systems increases risk of pollution of streams. Generally higher level of human activity near streams produces significant pollution.	Disposal of sewage can present a risk of pollution. High concentration of people increases risk of people increases risk of pollution from human contact with stream water or impounded water.

Table A5. 2: Impacts of surface water schemes on forest land use.

	CONSERVATION RESERVES	TIMBER PRODUCTION	MINOR FOREST PRODUCTS (Beekeeping, charcoal, firewood, gravel)	MINING	SERVICE CORRIDORS	RECREATION	CONSERVATION OF ECOSYSTEMS
Catchment areas	Priority for conservation does not prevent use as a catchment	Imposes costs of careful management	As for timber production	Imposes costs of careful management	Prefer routes away from streamlines	May constrain particular activities in particular areas	Recognition of catchment areas has limited the clearing of native forests for agriculture.
STORAGE DAMS a) Impacts of dam and reservoir basin	Storage dams cannot be located in conservation reserves	Some loss of timber growing land in the reservoir basin, which is likely to be above average quality, due to richer soils in valley floors.	As for timber production	Some mineral may be lost under water. Dam and reservoir may constrain routes of haul roads and conveyors.	May constrain routes.	Adds tourist attraction, but active water pastimes may be restricted. Reduces lengths of wild rivers by inundation.	The total area of Murray type landform is proportionately most reduced by reservoirs, compared to other landforms.
b) Downstream impacts	Flow quantity and variation is reduced.	Nil	Nil	Nil	Nil	Flow regulation may improve value of river downstream for recreation.	Flow quantity and variation is reduced.
PIPEHEAD DAMS	Although incompatible at site of works, small size makes a compromise easier if these is a conflict.	Negligible.	As for timber production.	No impact except for especially careful management in vicinity of pipehead.	Negligible	Access usually restricted. Little impact on recreational value of downstream flows.	Creates long-lasting pool in river where previously there was only occasional flooding.
PIPELINES	Similar to roads and powerlines.	Similar to roads and powerlines.	As for timber production.	Constrain routes for haul roads.	Slightly higher costs at intersections of pipes with other services.	May be visually intrusive in landscape. May improve walking access to forest.	Similar to roads and powerlines.

Table A5. 4: Impacts of surface water schemed on rural and urban land use.

	PASTURE	CROPS	HORTICULTURE	RURAL INDUSTRY (e.g. abattoir, refineries)	INTENSIVE ANIMAL HUSBANDRY	SPECIAL RURAL (Hobby farms)	URBAN
Catchment areas	No impact on conservative farming practices. Potential for rezoning to more densely inhabited or industrial land use may be restricted.	As for pasture.	As for pasture.	Imposes cost of careful management. Industry producing toxic wastes should be excluded from catchment.	Imposes cost of careful management and possible relocation if near stream.	As for pasture and urban. Control on location of septic tanks.	Possibly extra costs for sewage and rubbish disposal. Need to keep urban development away from streams.
STORAGE DAMS a) Impacts of dam and reservoir basin	Private land would need to be resumed in reservoir basin and dam works area.	As for pasture.	As for pasture.	As for pasture.	As for pasture.	As for pasture.	As for pasture.
b) Downstream impacts	Flows greater than required for riparian rights are markedly reduced. Flooding is reduced.	As for pasture.	As for pasture.	As for pasture. If industries have used stream for water supply, special arrangements for continued use may be required.	As for pasture.	As for pasture.	As for pasture.
PIPEHEAD DAMS	As for storage dam except that required land area is very much smaller.	As for pasture.	As for pasture.	As for storage dam except that impact on downstream flows is less.	As for pasture.	As for pasture.	As for pasture.
PIPELINES	Easement required on pipeline route. Above ground pipe can give problems of access and slight loss of productive land. Below ground pipe has minimal impact.	As for pasture.	As for pasture.	Pipe route would probably avoid industrial site.	As for special rural.	As for pasture, except pipe route would probably avoid private land.	If pipeline must pass through urban land, there may be difficulty fitting in with other services.

Table A5. 5: Impacts of land use on shallow groundwater resources.

	NATURAL VEGETATION	WETLANDS	PINE FOREST	MARKET GARDEN HORTICULTURE SPECIAL RURAL	URBAN	RURAL INDUSTRY	INTENSIVE ANIMAL HUSBANDRY
VOLUME AVAILABLE YEARLY	May be limited by need to maintain native vegetation except where the depth to groundwater is sufficiently deep.	May be limited by need to maintain wetlands.	For about 10 years after clearing to plant pines, there is increased recharge. As trees grow older there is less recharge than with native vegetation.	Water available for public supply is reduced by most of the amount withdrawn for irrigation (remainder soaks back to the water table).	Increased runoff from roads and roofs increases recharge, but stormwater drainage may divert some flow away from recharging groundwater.	Water available for public supply reduced by amount drawn from groundwater by industry.	As for market gardens.
POLLUTION	No impact.	No impact unless wetlands receive drainage from urban, industrial or market garden areas.	No impact unless there is inappropriate use of chemicals.	Groundwater pollution by pesticides, fertilisers, effluent from septic tanks.	Groundwater pollution by pesticides, fertilisers, waste and leaked petroleum. Drainage from rubbish disposal sites, effluent from septic tanks.	Groundwater pollution specific to the industry may occur through waste disposal.	Groundwater pollution by effluent from treatment of wastes.

Table A5. 6: Impacts of shallow groundwater schemes on land use

	NATURAL VEGETATION	WETLANDS	PINE FOREST	MARKET GARDEN HORTICULTURE SPECIAL RURAL	URBAN	RURAL INDUSTRY	INTENSIVE ANIMAL HUSBANDRY
UNDERGROUND WATER POLLUTION CONTROL AREAS, GROUNDWATER AREAS, PUBLIC WATER SUPPLY AREAS	No impact.	Conservation value is maintained through management plans.	Plantation management may be modified to give priority to water production.	Licensing of private wells raises the awareness of the limited availability of the water resource and encourages efficient use. Management is required to prevent pollution of groundwater.	Private wells are licensed and care is taken by public authorities in siting of waste disposal and industry. Management is required to prevent pollution of groundwater.	Water Authority generally objects to industry with potential for groundwater pollution being sited in these areas. Other industries as for market gardens.	As for rural industry.
WELLS	Tree deaths may occur near wells in droughts. Yearly groundwater production plans are designed to limit this occurrence. 200 sq. m of land is required for works at well site.	Locations of wells chosen and wells operated to minimise effects on wetlands.	Viability of pines not affected by groundwater level. 200 sq. m of land is required for works at well site.	Lowers the water table in immediate vicinity. Where wells are situated close together, they may need to be deeper than if further apart. Allocation policy and management are required.	Sites for wells are usually found on public land where their impact is similar to other service installations.	Wells should not be sited in the vicinity of an industry with potential for pollution. Other industry as for market gardens.	As for rural industry.
COLLECTOR MAINS	Mains are generally buried but access is required along route. Existing roads used wherever possible.	Mains are not located in wetlands.	As for natural vegetation.	An easement is required if mains must be located on private land. Impact of main on land use is minimal.	Routes for collector mains must be found in road reserves as for other services.	Routes for mains would avoid conflict with requirements of industry.	As for rural industry.
GROUNDWATER TREATMENT PLANTS	Approx. 6 ha site required for treatment works and disposal of sludge.	N/A	As for natural vegetation.	N/A	Works would be visually obtrusive, and may be source of odour and noise for adjacent houses. Buffer zone required.	N/A	N/A

Overview of Water Source Protection Policies (DRAFT)

The Water and Rivers Commission is responsible for managing and protecting Western Australia's water resources. The Commission has developed policies for the protection of public drinking water source areas, including the draft policy: ***"Protection of Groundwater Resources Used for Drinking Water Supplies in Country Areas of Western Australia"***. This policy defines three levels of priority classification for the protection of groundwater resources.

Priority 1 (P1) source protection areas are defined to ensure that there is no degradation of the water source. P1 areas are declared over land where the provision of the highest quality public drinking water is the prime beneficial land use. P1 areas would typically include land under Crown ownership. Development is generally not permitted in P1 areas.

Priority 2 (P2) source protection areas are defined to ensure that there is no increased risk of pollution to the water source. P2 areas are declared over land where low intensity development (such as rural) already exists. Provision of public water supply is a high priority in these areas. Some development is allowed under specific guidelines.

Priority 3 (P3) source protection areas are defined to minimise the risk of pollution to the water source. P3 areas are declared over land where water supply needs co-exist with other land uses such as residential, commercial and light industrial developments. Protection of P3 areas is achieved through management guidelines rather than restrictions on land use. If the water source does become contaminated, then water may need to be treated or an alternative water source be found.

In addition to priority classification, **wellhead protection zones** are defined to protect the aquifer from contamination in the immediate vicinity of production wells. Wellhead protection zones are usually circular, with a radius of 500 metres in P1 areas and 300 metres in P2 and P3 areas. These zones do not extend outside water reserves. Restrictions apply to storage of fuels, solvents, oils and pesticides within these zones.

Table A5.7: Acceptable, Restricted and Unacceptable Land Uses (DRAFT)

This table is to be used as a guideline only. The Water and Rivers Commission should be consulted regarding any developments or changes of land use within Public Drinking Water Source Areas.
Information relating to land use and developments which are not listed in the table can be obtained from the Water and Rivers Commission.

Definitions

Acceptable	The development/land use is compatible with the management objectives of the priority classification
Unacceptable	The development/land use is incompatible with the management objectives of the priority classification
Restricted	The development/land use may be compatible with the management objectives of the priority classification with appropriate site management practices *Restricted activities should be referred to the Commission for assessment on a case specific basis*

AGRICULTURE - ANIMALS

Development	Priority 1	Priority 2	Priority 3
Animal Husbandry (extensive)	Unacceptable	Restricted	Acceptable
Animal Husbandry (intensive)	Unacceptable	Unacceptable	Restricted
Apiary	Acceptable	Acceptable	Acceptable
Aquaculture	Unacceptable	Restricted	Restricted
Dairy Farming	Unacceptable	Restricted	Restricted
Feedlots	Unacceptable	Unacceptable	Restricted
Livestock grazing (extensive)	Restricted	Acceptable	Acceptable
Livestock grazing (intensive)	Unacceptable	Unacceptable	Acceptable
Piggery	Unacceptable	Unacceptable	Unacceptable
Poultry farming (housed)	Unacceptable	Restricted	Restricted
Stables	Unacceptable	Restricted	Acceptable
Stockholding and saleyards	Unacceptable	Unacceptable	Restricted

AGRICULTURE - PLANTS

Development	Priority 1	Priority 2	Priority 3
Broad acre cropping	Restricted	Acceptable	Acceptable
Floriculture (extensive)	Unacceptable	Restricted	Acceptable
Floriculture (intensive)	Unacceptable	Unacceptable	Restricted
Horticulture	Unacceptable	Unacceptable	Restricted
Hydroponic Horticulture	Unacceptable	Restricted	Restricted
Orcharding	Unacceptable	Restricted	Acceptable
Potted Nurseries	Unacceptable	Restricted	Acceptable
Silviculture	Restricted	Restricted	Acceptable
Turf Farms	Unacceptable	Unacceptable	Restricted
Viticulture	Unacceptable	Restricted	Acceptable

DEVELOPMENT - COMMERCIAL

Development	Priority 1	Priority 2	Priority 3
Aircraft Servicing	Unacceptable	Unacceptable	Restricted[6]
Amusement Centre	Unacceptable	Unacceptable	Acceptable[6]
Automotive business	Unacceptable	Unacceptable	Restricted[6]
Boat Servicing	Unacceptable	Unacceptable	Restricted[6]
Caravan and trailer hire	Unacceptable	Unacceptable	Restricted[6]
Carpark	Unacceptable	Restricted	Acceptable
Consulting rooms	Unacceptable	Unacceptable	Acceptable[6]

DEVELOPMENT - COMMERCIAL (continued)

Development	Priority 1	Priority 2	Priority 3
Cottage Industries	Restricted	Restricted	Acceptable
Drive in take-away food shop	Unacceptable	Unacceptable	Acceptable[6]
Drive in theatre	Unacceptable	Unacceptable	Acceptable[6]
Dry Cleaning Premises	Unacceptable	Unacceptable	Restricted[6]
Farm supply centre	Unacceptable	Restricted	Restricted
Fuel depot	Unacceptable	Unacceptable	Restricted
Garden Centre	Unacceptable	Restricted	Acceptable
Local shop	Unacceptable	Restricted	Acceptable
Market	Unacceptable	Unacceptable	Acceptable[6]
Milk depot	Unacceptable	Unacceptable	Restricted
Restaurant	Unacceptable	Unacceptable	Acceptable
Service Station	Unacceptable	Unacceptable	Restricted
Transport Depot	Unacceptable	Unacceptable	Restricted
Veterinary Clinic/hospital	Unacceptable	Restricted	Restricted
Wrecking vehicles and machinery	Unacceptable	Unacceptable	Restricted

DEVELOPMENT - INDUSTRIAL

Development	Priority 1	Priority 2	Priority 3
General Industry	Unacceptable	Unacceptable	Restricted[6]
Heavy Industry	Unacceptable	Unacceptable	Unacceptable
Light Industry	Unacceptable	Unacceptable	Restricted[6]
Power Stations	Unacceptable	Unacceptable	Unacceptable

DEVELOPMENT - URBAN

Development	Priority 1	Priority 2	Priority 3
Aged and dependent persons accommodation	Unacceptable	Unacceptable	Acceptable[6]
Amenity building	Unacceptable	Restricted	Acceptable
Airports or landing grounds	Unacceptable	Unacceptable	Restricted[6]
Cemetery	Unacceptable	Unacceptable	Restricted
Civic building	Unacceptable	Restricted	Acceptable[6]
Club	Restricted	Restricted	Acceptable[6]
Community hall	Restricted	Restricted	Acceptable
Family Day Care Centre	Unacceptable	Restricted	Acceptable[6]
Funeral parlour	Unacceptable	Unacceptable	Acceptable[6]
Health Centre	Unacceptable	Unacceptable	Acceptable[6]
Hospital	Unacceptable	Unacceptable	Restricted[6]
Medical centre	Unacceptable	Unacceptable	Acceptable[6]

EDUCATION/RESEARCH

Development	Priority 1	Priority 2	Priority 3
Education Centres	Restricted	Restricted	Acceptable[6]
Primary/Secondary Schools	Unacceptable	Unacceptable	Acceptable[6]
Scientific Research	Restricted	Restricted	Acceptable
Universities	Unacceptable	Unacceptable	Restricted[6]

MINING AND MINERAL PROCESSING

Development	Priority 1	Priority 2	Priority 3
Extractive Industries	Restricted[2]	Restricted[2]	Restricted[2]
Mining/Mineral Exploration	Restricted[4]	Restricted[4]	Restricted[4]
Tailings Dams	Unacceptable	Unacceptable	Restricted

PROCESSING OF ANIMALS/ANIMAL PRODUCTS

Development	Priority 1	Priority 2	Priority 3
Abattoirs	Unacceptable	Unacceptable	Restricted
Cheese/butter factory	Unacceptable	Restricted	Restricted
Composting (using sewage sludge and animal products)	Unacceptable	Unacceptable	Restricted
Fish Processing	Unacceptable	Unacceptable	Restricted
Tannery	Unacceptable	Unacceptable	Unacceptable
Woolscourer	Unacceptable	Unacceptable	Unacceptable

PROCESSING OF PLANTS\PLANT PRODUCTS

Development	Priority 1	Priority 2	Priority 3
Breweries	Unacceptable	Unacceptable	Restricted
Composting (not using sewage sludge or animal products)	Unacceptable	Restricted	Restricted
Vegetable/food processing	Unacceptable	Unacceptable	Restricted
Wineries	Unacceptable	Unacceptable	Restricted

SUBDIVISION

Subdivision of land to lots of any size is unacceptable within Priority 1 areas

Development	Priority 1	Priority 2	Priority 3
Kennel Subdivisions	Unacceptable	Restricted	Restricted
Rural with a minimum lot size of 4 ha (unsewered)	Unacceptable	Acceptable	Acceptable
Rural with a minimum lot size of 1 ha (unsewered)	Unacceptable	Unacceptable	Acceptable
Special rural with a minimum lot size of 2 ha (unsewered)[5]	Unacceptable	Acceptable	Acceptable
Special rural with a minimum lot size of 1 ha (unsewered)[5]	Unacceptable	Unacceptable	Acceptable
Urban Residential	Unacceptable	Unacceptable	Acceptable[6]

SPORT AND RECREATION

Development	Priority 1	Priority 2	Priority 3
Equestrian Centre	Unacceptable	Restricted	Acceptable
Golf Courses	Unacceptable	Unacceptable	Restricted
Irrigated Recreational Parks	Unacceptable	Restricted	Restricted
Motor sports	Unacceptable	Unacceptable	Restricted
Public Swimming Pools	Unacceptable	Restricted	Restricted
Recreational activities (active)	Unacceptable	Restricted[3]	Restricted[3]
Recreational activities (passive) eg. horse riding, bush walking	Acceptable	Acceptable	Acceptable

STORAGE OF DESIGNATED SUBSTANCES

Development	Priority 1	Priority 2	Priority 3
Above ground storage of designated substances	Restricted	Restricted	Restricted
Bulk Chemical Storage	Unacceptable	Unacceptable	Unacceptable
Underground Storage Tanks	Unacceptable	Unacceptable	Restricted

TOURISM ACCOMMODATION

Development	Priority 1	Priority 2	Priority 3
Bed and Breakfast	Unacceptable	Restricted	Acceptable
Caravan Parks	Unacceptable	Unacceptable	Restricted[6]
Holiday accommodation	Unacceptable	Restricted	Acceptable[6]
Motel lodging house, hostels	Unacceptable	Unacceptable	Acceptable[6]

WASTE TREATMENT AND MANAGEMENT

Development	Priority 1	Priority 2	Priority 3
Deep well injection of effluent	Unacceptable	Unacceptable	Unacceptable
Municipal Landfills	Unacceptable	Unacceptable	Restricted
Recycling depot	Unacceptable	Unacceptable	Restricted
Refuse transfer stations	Unacceptable	Unacceptable	Restricted
Sewers	Unacceptable	Restricted	Restricted
Tyre Storage	Unacceptable	Unacceptable	Unacceptable
Wastewater Treatment Plants	Unacceptable	Unacceptable	Restricted
Water Treatment Plants	Restricted	Restricted	Restricted

OTHER DEVELOPMENTS

Development	Priority 1	Priority 2	Priority 3
Caretakers house	Restricted	Restricted	Acceptable
Construction Projects	Restricted	Restricted	Restricted
Forestry	Restricted[1]	Acceptable	Acceptable
National Parks	Acceptable	Acceptable	Acceptable
Nature Reserves	Acceptable	Acceptable	Acceptable
Radio and TV installation	Restricted	Restricted	Restricted
Major Transport Routes	Unacceptable	Restricted	Acceptable

1: Restrictions apply to fertiliser application rates with strict controls on the application of pesticides and field operations
2: Restrictions apply to the storage of fuels and chemicals with strict guidelines for rehabilitation
3: Restrictions on the use of fuels or chemicals apply
4: Subject to conditions placed on lease
5: Note: Special rural development requires appropriate provisions in the town planning scheme text
6: Must be connected to deep sewerage

Appendix 6: Existing Town Water Supply Statistics

Table A6.1: West Pilbara Water Supply Statistics

Karratha			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	2428	2846948	-
82/83	2580	3143402	-
83/84	2653	2734367	3246634
84/85	2771	2578832	3126874
85/86	3203	2844245	3521226
86/87	3491	3130497	-
87/88	3584	3594586	4145088
88/89	3588	3178896	-
89/90	3584	2663336	3387007
90/91	3587	2910045	3585484
91/92	3587	2771129	3548164
92/93	3634	2551870	3199304
93/94	3681	2582779	3424045
Roebourne			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	326	167936	247912
82/83	338	373426	524516
83/84	333	328799	442148
84/85	354	283791	418102
85/86	359	349575	476351
86/87	359	332625	-
87/88	355	426846	487150
88/89	353	369199	-
89/90	357	389051	469469
90/91	355	387264	471732
91/92	351	363399	457326
92/93	351	251375	401797
93/94	352	368620	431236
Wickham			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	677	1098507	-
82/83	692	1309199	-
83/84	719	1238401	1028386
84/85	747	1016319	1255945
85/86	766	1012836	1197975
86/87	763	843209	-
87/88	768	916074	1107560
88/89	770	775263	-
89/90	773	774790	950217
90/91	791	683457	765114
91/92	773	570970	629999
92/93	774	460030	567322
93/94	775	473056	580308

Point Samson			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	61	47483	-
82/83	66	47383	-
83/84	63	43995	55466
84/85	75	43919	52906
85/86	70	43625	60524
86/87	71	43461	-
87/88	73	71085	52980
88/89	73	54134	-
89/90	72	52863	70852
90/91	70	56452	62181
91/92	71	58449	62258
92/93	72	46861	53687
93/94	80	49301	53404
Dampier			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	16	3467033	-
82/83	47	3471	-
83/84	99	119530	-
84/85	103	242230	-
85/86	134	162696	-
86/87	170	186846	-
87/88	200	224341	224341
88/89	226	214387	-
89/90	307	213954	1373875
90/91	320	266785	*4183390*
91/92	338	269384	1252568
92/93	344	258063	*4657216*
93/94	344	295292	*4695184*
Supply Main			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
90/91			*4183390*
91/92			2367855
92/93		3551736	*4657216*
93/94		3981545	*4695184*
TOTAL			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	3508	7627907	247912
82/83	3723	4876881	524516
83/84	3867	4465092	4772634
84/85	4050	4165091	10772606
85/86	4532	4412977	11355500
86/87	4854	4536638	10528516
87/88	4980	5232932	11037147
88/89	5010	4591879	10720000
89/90	5093	4093994	9520000
90/91	5123	4304003	8753684
91/92	5120	4033331	8381325
92/93	5175	7119935	8879326
93/94	5232	7750593	9184177

Italics: Delivery figures for Dampier include Supply Main delivery figures

Table A6.2: Onslow Water Supply Statistics

TOTAL			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	152	167936	247912
82/83	159	162899	237318
83/84	165	151694	197330
84/85	186	146761	213765
85/86	219	197393	254545
86/87	245	222984	266047
87/88	289	234733	271963
88/89	256	236091	298972
89/90	264	254299	306725
90/91	270	275720	314217
91/92	273	262371	302320
92/93	280	223982	277112
93/94	291	279381	357000

Table A6.3: Tom Price Water Supply Statistics

TOTAL						
YEAR	Total no of Services	Total Consumption (kL pa)	Southern Fortescue (kL pa)	Hardey River (kL pa)	Mt Lionel (kL pa)	Total Water Delivered (kL pa)
82/83	151	38170	-	-	-	-
83/84	230	420233	-	-	-	-
84/85	320	326544	-	-	-	-
85/86	366	479983	-	-	-	-
86/87	477	441560	-	-	-	-
87/88	565	433776	3560000	1663000	840000	6063000
88/89	635	481294	3123000	2220000	591000	5934000
89/90	868	659929	3787000	2141000	803000	6731000
90/91	924	770817	4454000	2157000	961000	7572000
91/92	1012	764830	4680000	1660000	521000	6861000
92/93	1021	804875	5282000	1709000	630000	7621000
93/94	1029	732252	-	-	-	
Licensed Capacity			4693000	2251000	1103000	8047000

Table A6.4: Paraburdoo Water Supply Statistics

TOTAL						
YEAR	Total no of Services	Total Consumption (kL pa)	Mine Wellfield (kL pa)	Town Wellfield (kL pa)	4 East NW Dewatering (kl pa)	Total Water Delivered (kL pa)
82/83	63	23686	-	-	-	-
83/84	112	153826	-	-	-	-
84/85	143	196946	-	-	-	-
85/86	181	260649	-	-	-	-
86/87	258	255621	-	-	-	-
87/88	329	343113	1169000	2131000	-	3300000
88/89	389	368239	968000	2273000	-	3241000
89/90	545	444739	1158000	2215000	-	3373000
90/91	569	532552	1360000	1881000	-	3241000
91/92	671	498070	1078000	1601000	-	2679000
92/93	679	521033	410000	1085000	1964000	3459000
93/94	678	586068	-	-	-	-
Licensed Capacity						4300000

Table A6.5: Pannawonica Water Supply Statistics

TOTAL			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
89/90	-	-	606787
90/91	-	-	647973
91/92	-	-	574214
92/93	-	-	-
93/94	-	-	-

Table A6.6: Port Hedland Water Supply Statistics

Port Hedland			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	1116	2935088	-
82/83	1115	2853607	-
83/84	1096	2722342	-
84/85	1137	1024975	2786217
85/86	1140	2846439	-
86/87	1218	2861413	3138610
87/88	1227	2595021	2825483
88/89	1219	2488508	2779376
89/90	1228	2542457	2883510
90/91	1232	2769502	*3102305*
91/92	1229	2605346	1960388
92/93	1248	2615514	1599705
93/94	1280	2632579	1886438
South Hedland			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	2062	1900313	-
82/83	2117	1918817	-
83/84	2176	2069495	-
84/85	2276	2175516	-
85/86	2386	2174358	-
86/87	2468	2130691	2333343
87/88	2489	2507006	2705145
88/89	2518	2619724	2358760
89/90	2530	2810834	2523281
90/91	2523	2839548	2561841
91/92	2485	2869151	2481222
92/93	2508	2792496	2353388
93/94	2520	2951751	2527087
BHP			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
90/91			*3102305*
91/92			1075296
92/93			825872
93/94			1011548
Wedgefield			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	199	176699	-
82/83	-	140583	-
83/84	200	146011	-
84/85	212	166239	-
85/86	211	177398	-
86/87	216	186809	274047
87/88	216	184746	218057
88/89	222	168093	214930
89/90	231	172657	209778
90/91	233	197531	245514
91/92	242	186795	300723
92/93	249	188663	4911588
93/94	254	213081	261419

Finucane Island			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
90/91			814848
91/92			1014848
92/93			1008210
93/94			840226
Supply Main			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
90/91			33631
91/92			25410
92/93			20030
93/94			24618
TOTAL			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	3377	5012100	-
82/83	3232	5056279	6071250
83/84	3472	5027048	5808275
84/85	3625	5150531	5756303
85/86	3737	5422696	5995016
86/87	3902	5494345	6069681
87/88	3932	5286773	5748685
88/89	3959	5276325	5353066
89/90	3989	5525948	5616569
90/91	3988	5806581	9860444
91/92	3956	5661292	6857887
92/93	4005	5596673	10718793
93/94	4054	5797411	6551336

Italics: Delivery figures for Port Hedland include BHP delivery figures

Table A6.7: Marble Bar Water Supply Statistics

TOTAL			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	91	97771	107771
82/83	91	130693	140693
83/84	92	136954	160473
84/85	98	123700	145180
85/86	95	116270	151729
86/87	103	107914	139808
87/88	104	117100	148697
88/89	126	106991	121043
89/90	123	100574	131903
90/91	123	131302	180313
91/92	123	123851	162817
92/93	123	129491	162234
93/94	124	129396	142982

Table A6.8: Nullagine Water Supply Statistics

TOTAL			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	26	26763	26763
82/83	26	27882	33871
83/84	28	27882	33871
84/85	29	30212	41565
85/86	30	30370	39937
86/87	29	24855	29947
87/88	31	37823	46965
88/89	34	38654	56703
89/90	42	47804	65044
90/91	42	35687	40476
91/92	44	22908	32947
92/93	44	34837	35191
93/94	46	43371	49925

Table A6.9: Wittenoom Water Supply Statistics

TOTAL			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
81/82	138	121855	194805
82/83	136	89804	133541
83/84	131	72178	109179
84/85	128	66468	103105
85/86	128	65610	104051
86/87	118	49473	79724
87/88	101	51937	75865
88/89	92	55870	86220
89/90	89	47718	91740
90/91	81	40936	80504
91/92	79	37370	69043
92/93	78	32203	84563
93/94	76	37042	92740

Table A6.10: Newman Water Supply Statistics

TOTAL			
YEAR	Total no of Services	Total Consumption (kL pa)	Total Water Delivered (kL pa)
90/91	1579	406147	-
91/92	1664	1293344	1801776
92/93	1677	1410475	-
93/94	1689	1433167	-

Tablec A6.11: Telfer Water Supply Statistics			
	TOTAL		
Borefield	1995 Delivery (kL pa)	Total Potable (kL pa)	Total Raw (kL pa)
Wilki/Glen	*285439*		
Gardens	*8497*		
Wilki South	*7292*	*301228*	
Passmore Fault	967976		
Campsandstone	877900		
West Dome	2758955		
Punta Punta	1177206		
Pit 13	-		
Staggers	1243233		7025270

Italics: Potable Water

Appendix 7: Water Entitlement Agreements

Table A7. 1: West Pilbara Scheme - Water Entitlements

Table A7. 2: East Pilbara Scheme - Water Entitlements

Current Water Entitlement Agreements

During the late 1960's and 1970's several agreements with the large companies operating in the Pilbara were entered into with the State. These agreements entitled the companies to an agreed quantity of water, either on a daily or annual basis. The agreed quantity of water to be supplied to the companies, in all cases, was for domestic as well as industrial purposes. These agreements apply to both the West Pilbara Water Supply Scheme and the Port Hedland Scheme.

West Pilbara

Hamersley Iron Pty Ltd

This agreement was made on the 10/11/69. The agreement with Hamersley is for the Water Corporation to supply 13 640 kL/d to the Karratha and Dampier areas. In a letter dated 19 November 1969, Hamersley Iron agree that the quota is to supply industrial, domestic and domestic needs of a consequential growth up to 5%. Hamersley have an additional entitlement of 9090 kL/d from Millstream to the Yannery Tank. In a letter dated 11 December 1970, Hamersley Iron in paragraphs 3 & 4 refer to the possibility of developing alternative sources and restrictions respectively.

Robe River

This agreement was made on the 13/7/76. The agreement with Robe River is for the Water Corporation to supply 11 820 kL/d to the Cape Lambert and Wickham areas. Robe Rivers' entitlement can be increased to 18 185 kL/d subject to Robe meeting the deferred capital expenditure on works, provided in the agreement. Clause B of the agreement refers to water supplied for both industrial and domestic use and Clause H, paragraphs 12 & 13, refer to restrictions and alternative sources respectively.

Woodside Offshore Petroleum Pty Ltd

This agreement was made on the 16/8/79. The agreement with Woodside is for the Water Corporation to supply 4225 kL/d to the Karratha and Burrup Peninsula areas for domestic and industrial purposes (refer to clause 18 (1)). However in 1985 Woodside submitted a variation to the agreement which stated that their revised water requirement was 3172 kL/d. The Water Corporation have indicated that this is the figure that they are working on, although Financial Planning suggest that since it appears that Woodside has paid for an allocation of 4225 kL/d then that should be their entitlement.

East Pilbara

BHP - Mount Newman Mining Company

The most recent agreement with BHP - Mount Newman is for the Water Corporation to supply 24 909 kL/d to a maximum of 5 680 000 kL in any financial year. This agreement was made in October 1977. The letter sent by the Minister for Industrial Development on 24 September 1977 referred to industrial and domestic water requirements and restrictions in paragraphs (d) & (g) respectively.

BHP - Goldsworthy

The agreement with BHP - Goldsworthy is for the Water Corporation to supply 2100 kL/d to Finucane Island. This agreement was made on the 5/8/86.

Percentage of Entitlement Used

The quantity of water consumed for industrial purposes, can, and is metered by the Water Corporation. However, the quantity of water used for domestic purposes by each of the companies is very difficult to measure, further complicated by the fact that some of the companies are selling their houses to their employees. The quantity of water used for domestic purposes has been estimated from the number of accommodation units. The quantity of water estimated to have been used by the companies is shown in Table A7. 1 and Table A7. 2. It would appear that current usage is just under 50% of their combined entitlement.

In Port Hedland BHP - Goldsworthy are relocating employees who were living in 50 houses on Finucane Island to the mainland. This could have implications on BHP - Goldsworthy's entitlement at Finucane Island. This issue is currently being considered by Financial Planning Branch.

What percentage of each companies entitlement is used, needs to be closely monitored, to ensure that as demand increases the Water Corporation does not find itself in any difficult legal battles.

Table A7. 1: West Pilbara Scheme - Water Entitlements

Company	Entitlement		93/94 Usage (kL pa)		
	(kL/d)	(kL pa)	Industrial	Domestic	Total
Hamersley Iron	13 640	4 978 600	2 327 040	700 000	3 027 040
Robe River Assoc	11 820	4 314 300	295 404	600 000	895 404
Woodside	4 225	1 542 125	760 331	400 000	1 160 331
	29 685	**10 835 025**	**3 382 775**	**1 700 000**	**5 082 775**

Table A7. 2: East Pilbara Scheme - Water Entitlements

Company	Entitlement		Current Usage	
	(kL/d)	(kL pa)	(kL/d)	(kL pa)
BHP - Mt Newman	24 909	5 680 000	10 737	1 850 000
BHP - Goldsworthy	2 100	766 500	4 714	1 150 000
	27 009	**6 446 500**	**15 451**	**3 000 000**

Appendix 8: Department of Resources Development Potential Growth Scenarios

DEPARTMENT OF RESOURCES DEVELOPMENT

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FACSIMILE MESSAGE

To	:	RICHARD FORREST
Title	:	SENIOR ENGINEER
Organisation	:	WATER AUTHORITY
Fax	:	420 3174

From	:	PAUL PLATT
Title	:	SENIOR PROJECT OFFICER
DRD File	:	RO 15/95V1
Fax	:	327 5500
Date	:	3 JULY 1995
Total Pages	:	2

Richard,

DRAFT WEST PILBARA WATER RESOURCES REVIEW

Thank you for providing DRD with a copy of the above report. The report contains valuable information regarding water resources in the West Pilbara, their relative costs and development strategies.

1. I have some further comments regarding the report which includes feedback from John Prior. As outlined in my memo of the 30 January 1995 to P. Goodall, the water demand scenarios are very sensitive to Mineralogy's Fortescue Magnetite Project. Graph 2 in the draft report, showing historical and future water demand illustrates the large differences between the low and medium growth scenarios due to Mineralogy's project. The latest advice from Mineralogy is that it will supply its own water from desalination.

   In light of the above information, DRD considers that the high and medium water demands should be reduced by an amount which approximates Mineralogy's project water demand i.e. 15 Mm^3 pa. The water demand scenario would therefore be;

Low	8 Mm^3 pa
Medium	15 Mm^3 pa
High	30 Mm^3 pa

   As discussed with you this morning the lower water demand scenarios favour groundwater sources. Therefore further economic costing would be appropriate when more accurate information on water treatment/hydrological for the Harding Dam/Millstream water resource is available.

2. Comments on WAWA's ability to fulfil its current water supply commitments as covered in specific State Agreements and the consequential impact on extra demand would be useful information.

3. Include some preliminary estimates on lead times to develop the water resources described in the draft report i.e. design, approval, construction.

4. A schematic plan for the Pilbara water supply reticulation scheme showing capacities in each section , and upgrades required to achieve design yields, would be useful.

5. Could the report include a table showing upfront capital cost and operating costs (assuming maximum utilisation of the water resource) for each water resource.

6. The water demand split between the proposed Maitland Estate, the Burrup Peninsula and Cape Lambert appears biased to the Maitland Estate. Could the report either re-assess the water demand split (40%, 40%, 20% respectively) or include a statement qualifying the relative costs of supply to each area.

7. Does WAWA have any restrictions on the distribution of the report.

I hope the above comments on the draft report are useful and broaden its potential use.

Yours sincerely

Paul Platt

Paul Platt
SENIOR PROJECT OFFICER

DEPARTMENT OF
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Peter Goodall
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LEEDERVILLE WA 6902

Dear Mr Goodall

RE: WEST PILBARA WATER SUPPLY REVIEW

In regard to the above, I have reviewed the water consumption figures in your letter of 13 January 1995 for various growth scenarios.

The revised industry growth scenarios proposed for the Pilbara area with corresponding water consumption figures are shown in Table 1 below. The estimated water consumption figures are ±20% depending on which projects proceed. The medium growth scenario is sensitive to the Fortesque magnetite mining and primary processing project and will need to be reviewed as more information is available.

TABLE 1: GROWTH SCENARIOS

GROWTH SCENARIO	WATER CONSUMPTION (Mm^3 pa by 2025)
Low	8
Medium	30
High	43

The growth scenarios are based on the number and type of industry processing projects outlined in Appendix 1 and Appendix 2. The water demand assumptions for each industry type and process is shown in Appendix 3.

If you have any queries please contact me on 327 5936.

Paul Platt
SENIOR PROJECT OFFICER

30 January 1995 (PAPL0016:AN)

Enc

Appendix 1 : Growth Scenarios

Low Growth Scenario

Industry	Comments	Water Consumption (Mm^3 p.a.)
Iron Ore Processing	Only a few industries go ahead.	4
Petroleum Processing	Only a few industries go ahead.	3
Power Intensive Industry	Only one of the industries goes ahead.	1
Total		**8**

Medium Growth Scenario

Industry	Comments	Water Consumption (Mm^3 p.a.)
Iron Ore Processing	Many of the industries go ahead.	20
Petroleum Processing	Most of the industries go ahead.	7
Power Intensive Industry	A few of the industries go ahead.	3
Total		**30**

High Growth Scenario

Industry	Comments	Water Consumption (Mm^3 p.a.)
Iron Ore Processing	Vertical Integration and horizontal expansion of the industry.	28
Petroleum Processing	Most of the industries go ahead.	9
Power Intensive Industry	Most of the industries go ahead.	6
Total		**43**

Notes to accompany Appendix 1,Appendix 2 and Appendix 3:

1. Water consumption figures include domestic as well as industrial.

2. Assume seawater is used as a cooling water and for some primary ore processing.

3. Water consumption figures very sensitive to Fortescue magnatite primary processing project.

4. The key feedstocks of iron ore, natural gas and salt are available at (or in close poroximity to Karratha, Cape Lambert and Port Hedland. Karratha/Cape Lambert may be more attractive for Petrochemicals, being closer to the current source of natural gas.

5. Workforce numbers indicative only. Actual numbers will vary dependant upon process technology, product line, shift arrangements etc.

6. No committments have been made to construct projects.

Appendix 2:

IRON ORE PROCESSING
GROWTH ASSUMPTIONS FOR PILBARA WATER DEMAND FORECASTS

IRON ORE PROCESSING
PROJECTS
GROWTH SCENARIOS (1995 TO 2025)

PROJECT TYPE	LOW GROWTH	MEDIUM GROWTH	HIGH GROWTH
PRIMARY PROCESSING		1	1
PELITISED IRON	1	2	4
SINTERED IRON		1	1
DRI/HBI	1	2	3
MINI STEEL			2
IRON CARB			1

ASSUMPTIONS:

LOW GROWTH	ONLY A FEW INDUSTRIES GO AHEAD
MEDIUM GROWTH	MANY OF THE INDUSTRIES GO AHEAD (CURRENTLY AT PRE OR FEASIBILITY STAGE)
HIGH GROWTH	VERTICAL AND HORIZONTAL INTEGRATION AND EXPANSION OF THE INDUSTRIES(STEEL STUDY REPORT JUNE 1992)

P.PLATT WATERPRO
JAN95

PAPL0001.XLS

Appendix 3:

POTENTIAL INDUSTRIAL AND COASTAL WATER DEMAND ASSUMPTIONS IN THE PILBARA

Process	Capacity (Mt/a)	Location	Industrial Water Usage (Mm^3 p.a.)	Estimated Workforce (people)	Consequential Population (people)	Domestic Water Usage (Mm^3 p.a.)	Possible Timeframe
Iron Ore Processing							
Primary Ore Processing	5	Good prospects at Karratha, Cape Lambert and Port Hedland	7.0	150	500	0.13	good prospects in short term (4 - 10 years)
Pelitised Iron	5		1.6	140	450	0.12	
Sintered Iron	5		2.6	140	450	0.12	
Direct Reduced Iron	2		2.6	150-220	500-700	0.13-0.18	
Mini Steel Mill	1		0.5	600	2000	0.52	
Iron Carbide	1		1.4				
Petroleum Processing							
Methanol	0.80	Karratha appears to offer better prospects for a major complex	3.5	170	500	0.13	good prospects in medium term (5 - 15 years)
Ammonia/Urea	0.25		0.5	200	600	0.16	
Ethane Extraction	0.20		0.25	10 - 20	30 - 60	0.008 - 0.016	
Chlor-Alkali Plant	0.22		4.0 to 8.0	350	1000	0.27	
Ethane Cracker	0.145		< 0.1	35	100	0.027	
EDC/VCM Plant	0.10		0.01	15	50	0.015	
Sodium Cyanide	0.015		< 0.1	10	30	0.008	
LNG Expansion	4		0.3	10	30	0.008	2002
Power Intensive Industry							
Fe-Mn	0.01		1.3	200	600	0.16	prospects uncertain and may depend upon synergies with other developments
Si-Mn	0.024						
Fe-Si	0.023						
Si metal	0.015			150	500	0.13	
Titanium	0.05		4.0	300	900	0.24	
Al	0.10		6.0	600	2000	0.52	

PORT HEDLAND WATER SUPPLY SCHEME

PROJECTED ADDITIONAL WATER DEMAND BY 2025

Growth Scenario	2025 Water Demand (GL pa)
Low	3
Medium	10
High	27

PROJECTED WATER DEMANDS

Growth Rate	2025 Water Demand (GL pa)	Average Day Peak Week (ML/d)
-	Currently 6.6	Currently 28
Low	10	45
Medium	17	80
High	34	160

B.1 POTENTIAL INDUSTRIAL DEVELOPMENT

Three broad categories of industry that could be developed in the East Pilbara (Port Hedland) area have been identified, namely:

- downstream iron ore processing;
- downstream petroleum (gas) processing; and
- power intensive industries.

Growth scenarios for these industries for the thirty year period 1995 to 2025 have been estimated based upon discussions with Peter Goodall of the Water and Rivers Commission.

B.2 DOWNSTREAM IRON ORE PROCESSING

Estimated low, medium and high growth scenarios for projects incorporating the iron ore processing industry are given in Table B-1.

TABLE B-1
DOWNSTREAM IRON ORE PROCESSING PROJECTS
GROWTH SCENARIOS 1995 to 2025

Project Type	Growth Scenario		
	Low	Medium	High
Primary Processing	0	0	1
Pelletised Iron	0	1	2
Sintered Iron	0	1	1
Direct Reduced Iron/HBI	1	1	1
Mini Steel Mill	0	0	1

Using total estimated potable water demands for downstream iron ore processing projects (Public Works Department, 1981) the range of water demands can be defined as presented in Table B-2.

TABLE B-2

DOWNSTREAM IRON ORE PROCESSING PROJECTS
ESTIMATED WATER DEMANDS (GL pa)

Project Type	Low Growth		Medium Growth		High Growth	
	Industrial	Domestic	Industrial	Domestic	Industrial	Domestic
Primary Processing	-	-	-	-	7.0	0.13
Pelletised Iron	-	-	1.6	0.12	3.2	0.24
Sintered Iron	-	-	2.6	0.12	2.6	0.12
Direct Reduced Iron/HBI	2.6	0.16	2.6	0.16	2.6	0.16
Mini Steel Mill	-	-	-	-	0.5	0.52
	2.6	0.16	6.8	0.40	15.9	1.17
	2.8		7.2		17.1	

B.3 DOWNSTREAM PETROLEUM PROCESSING

Raw materials for the downstream petroleum processing industry typically include natural gas and water. As natural gas would be supplied by pipeline from the Dampier/Karratha area, downstream petroleum processing industries are more likely to be established in this area than in the Port Hedland area. As such, it is concluded that growth of the downstream petroleum processing industry in the Port Hedland area is not likely.

The adopted potable water demands for the downstream petroleum processing industry for the thirty year period 1995 to 2025, are given in Table B-3.

TABLE B-3

DOWNSTREAM PETROLEUM PROCESSING PROJECTS
ESTIMATED WATER DEMANDS

Growth Scenario	2025 Water Demand (GL pa)
Low	0
Medium	1
High	4

B.4 POWER INTENSIVE INDUSTRIES

As with the downstream petroleum processing industry, natural gas (power) which is an essential raw material for the power intensive industries would be supplied by pipeline from the Dampier/Karratha area. Although depending upon the availability of other raw materials, the power intensive industries are also more likely to be established in the Dampier/Karratha area than in the Port Hedland area.

The adopted potable water demands for the power intensive industries, for the thirty year period 1995 to 2025, are given in Table B-4.

TABLE B-4

POWER INTENSIVE INDUSTRIES
ESTIMATED WATER DEMANDS

Growth Scenario	2025 Water Demand (GL pa)
Low	0
Medium	1
High	3

Appendix 9: Existing Town Water Supply Schematics

Figure A9. 1: West Pilbara Water Supply Scheme

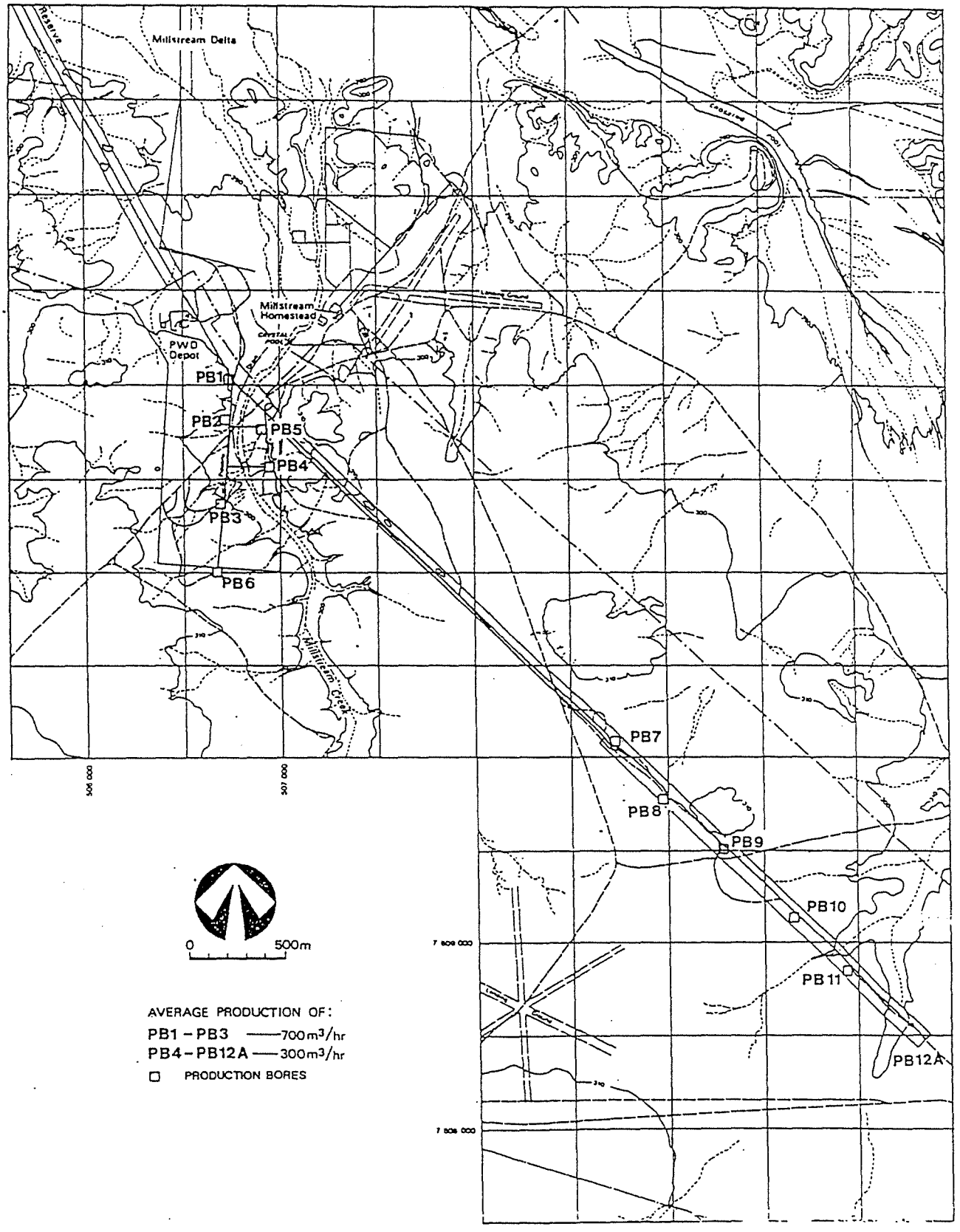
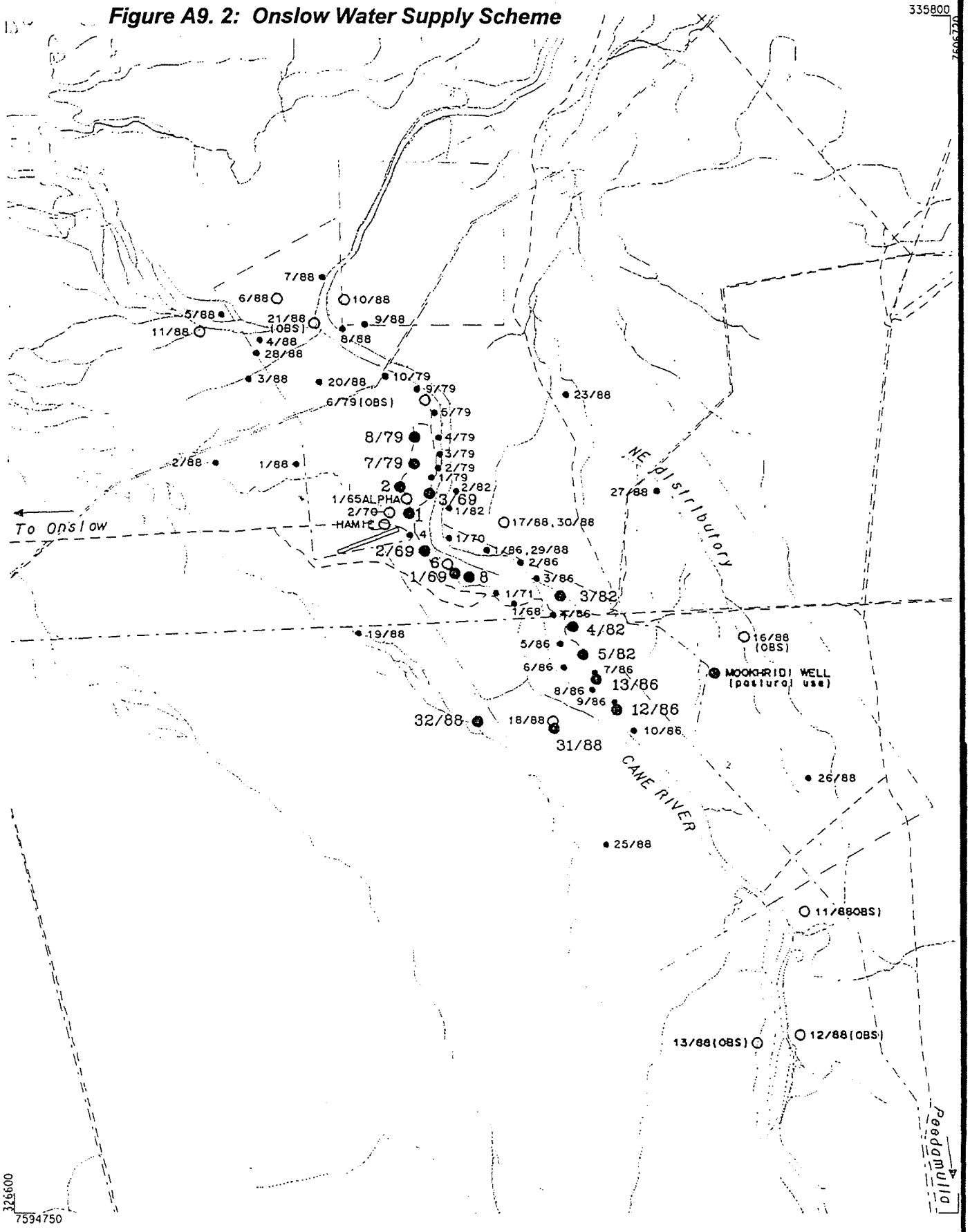


Figure A9. 2: Onslow Water Supply Scheme



200 0 200 400 600 800 1000metres
SCALE

Water AUTHORITY

LEGEND:
- Production Wells
- Observation Wells
- Exploratory Holes
- Fence
- Track

INDEX TO ADJOINING 1:100000 MAPS

1855	1955	2055
1854	1954	2054
1853	1953	2053

FIGURE 1.
CANE RIVER WELLFIELD
ONSLOW TOWN WATER SUPP

Drawn by D.R.A | Date 27/0

Groundwater and Environment Bran
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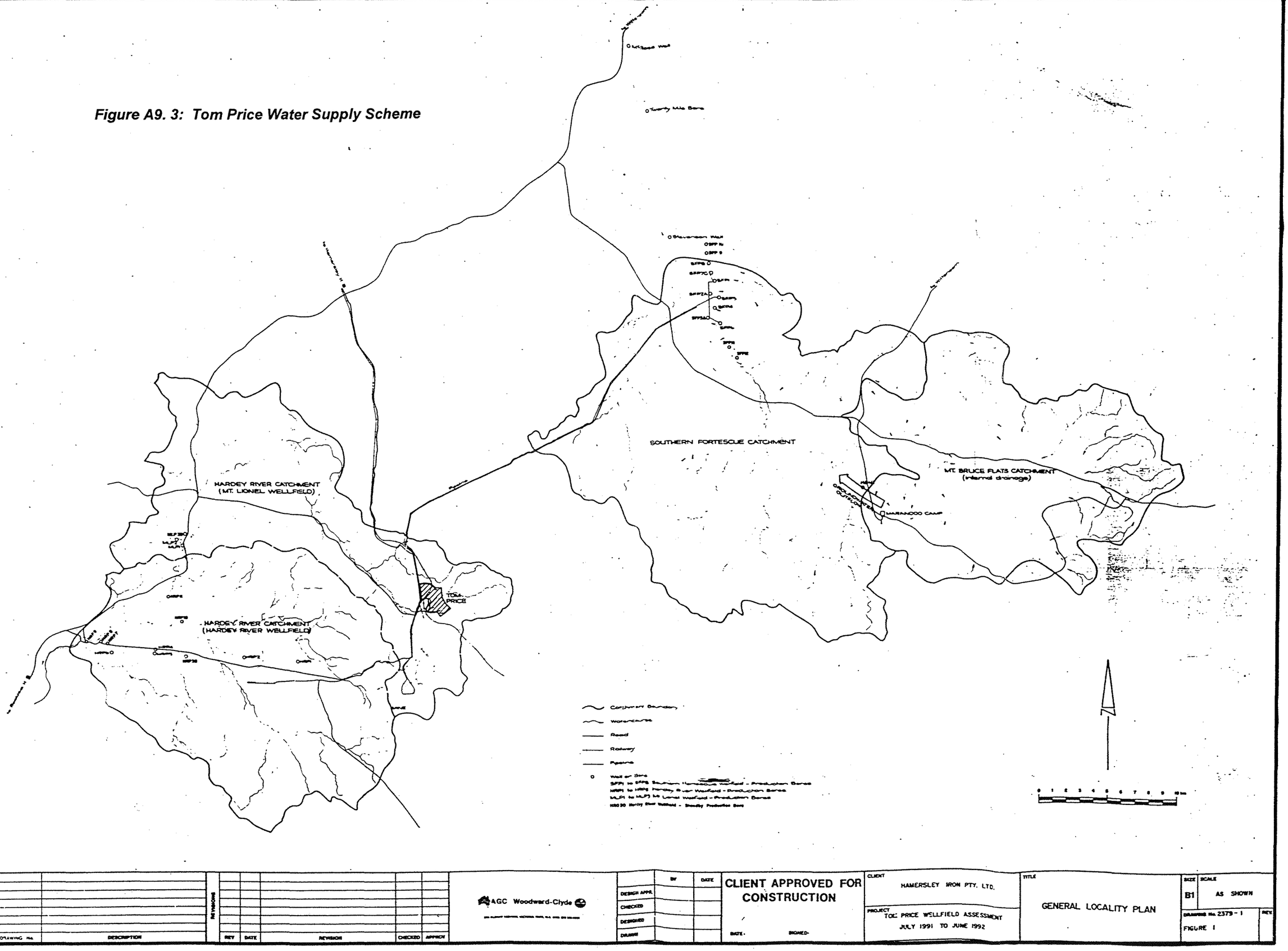
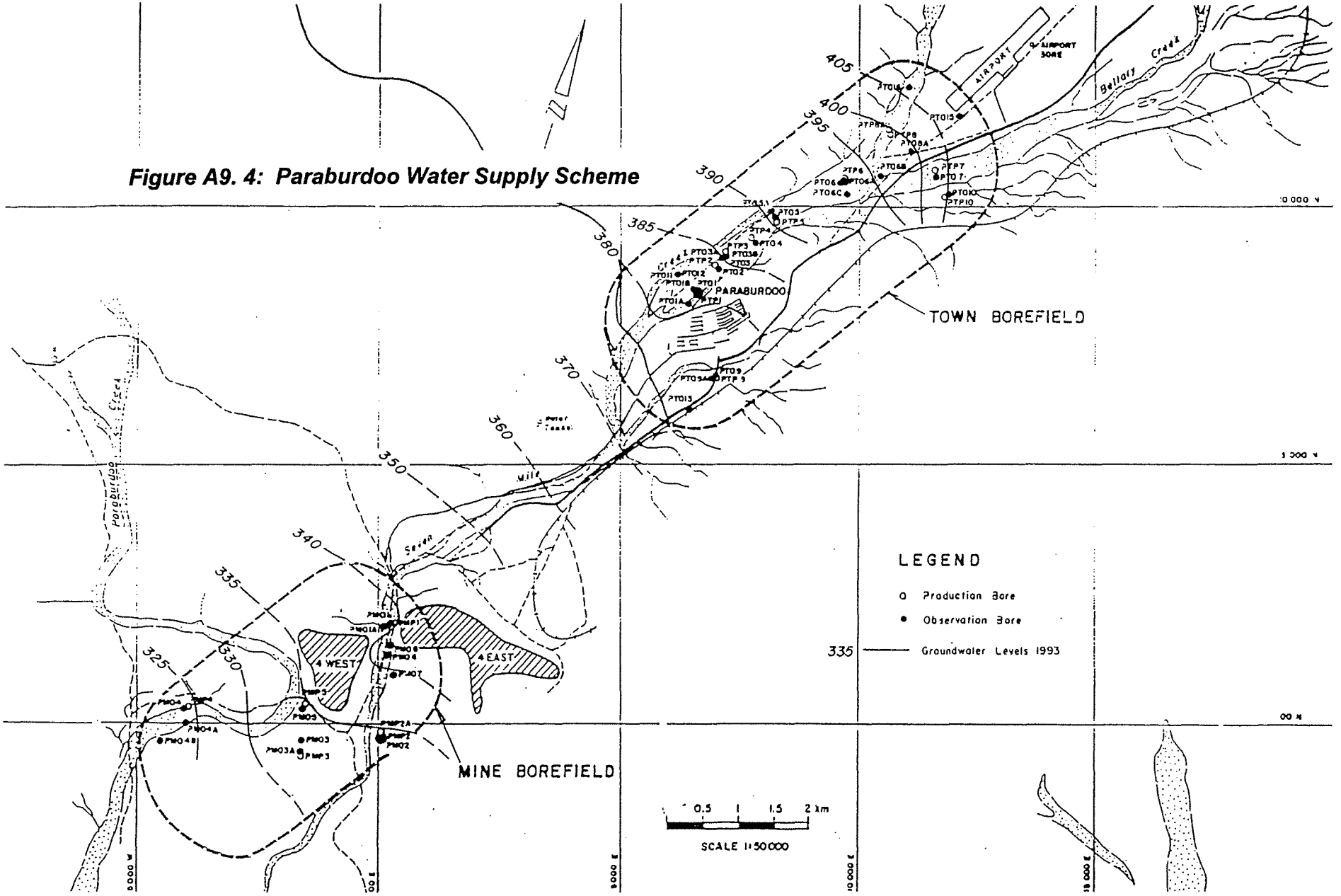
Figure A9. 3: Tom Price Water Supply Scheme



REFERENCE DWG'S			REVISIONS						AGC Woodward-Clyde		BY	DATE	CLIENT APPROVED FOR CONSTRUCTION	CLIENT: HAMERSLEY IRON PTY. LTD.	TITLE: GENERAL LOCALITY PLAN	SIZE: B1	SCALE: AS SHOWN
DRAWING No.	DESCRIPTION		REV	DATE	REVISION	CHECKED	APPROVED			DESIGN APPR.			DATE:	SIGNED:	PROJECT: TOM PRICE WELLFIELD ASSESSMENT JULY 1991 TO JUNE 1992		DRAWING No. 2379 - 1 FIGURE 1	REV
										CHECKED								
										DESIGNED								
										DRAWN								

Figure A9. 4: Paraburdoo Water Supply Scheme

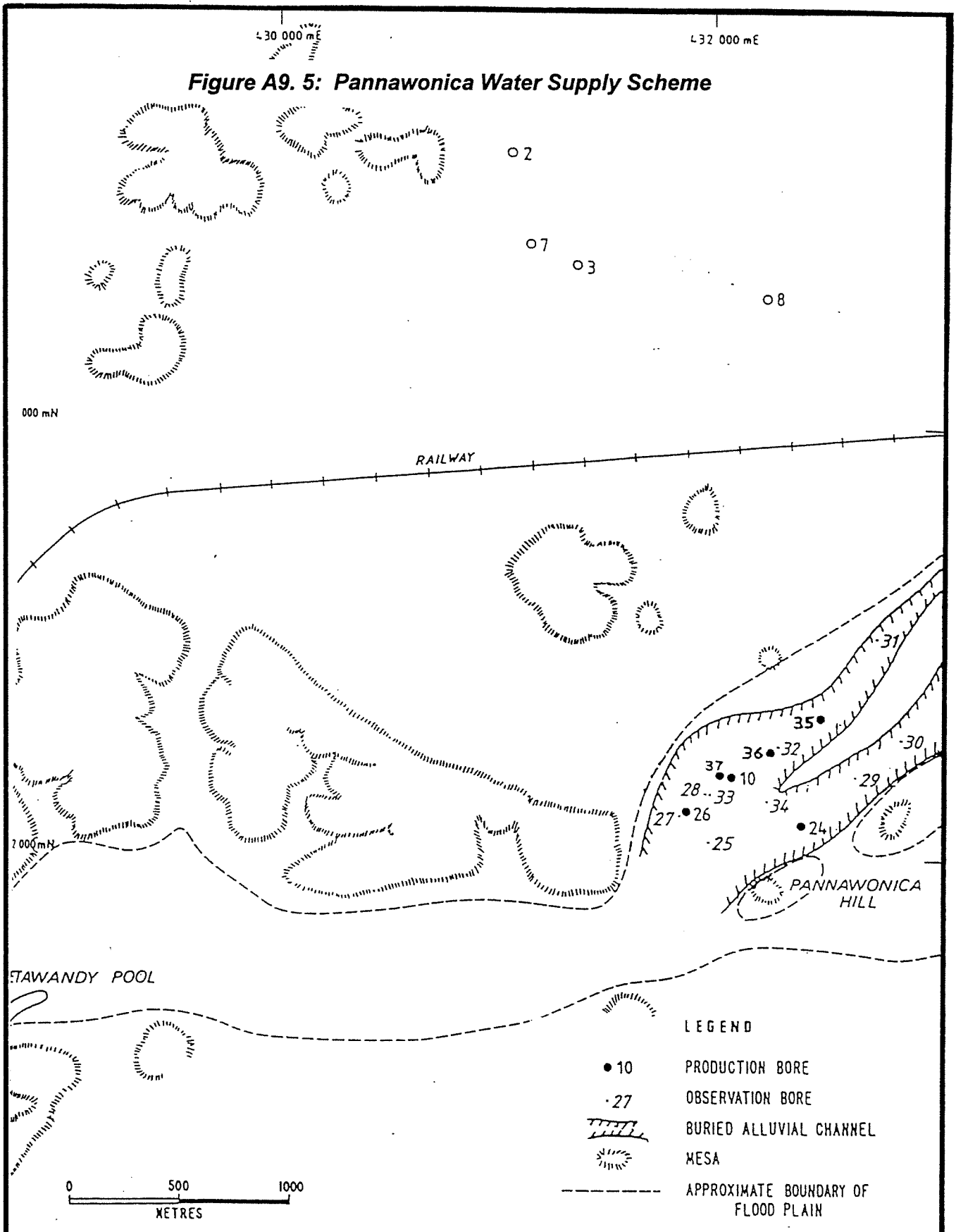


REVISION			

AGC Woodward-Clyde

PARABURDOO WELLFIELD ASSESSMENT
JULY 1992 TO JUNE 1993
TOWN AND MINE WELLFIELD WATER LEVELS - 1993

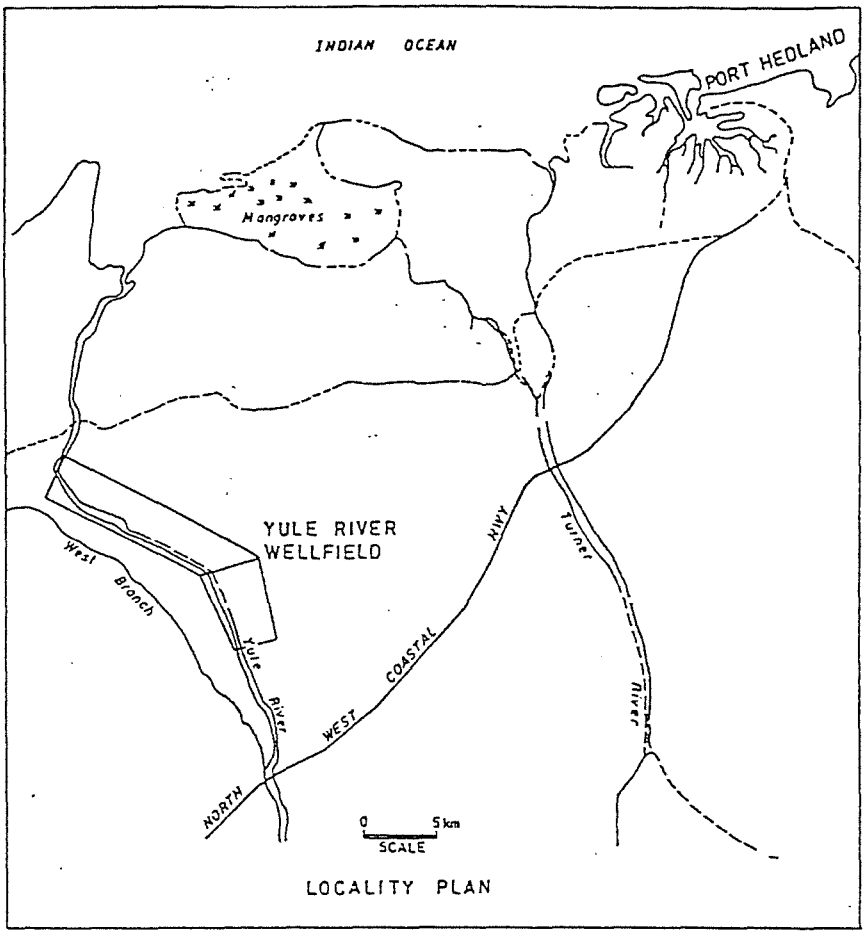
Figure A9. 5: Pannawonica Water Supply Scheme

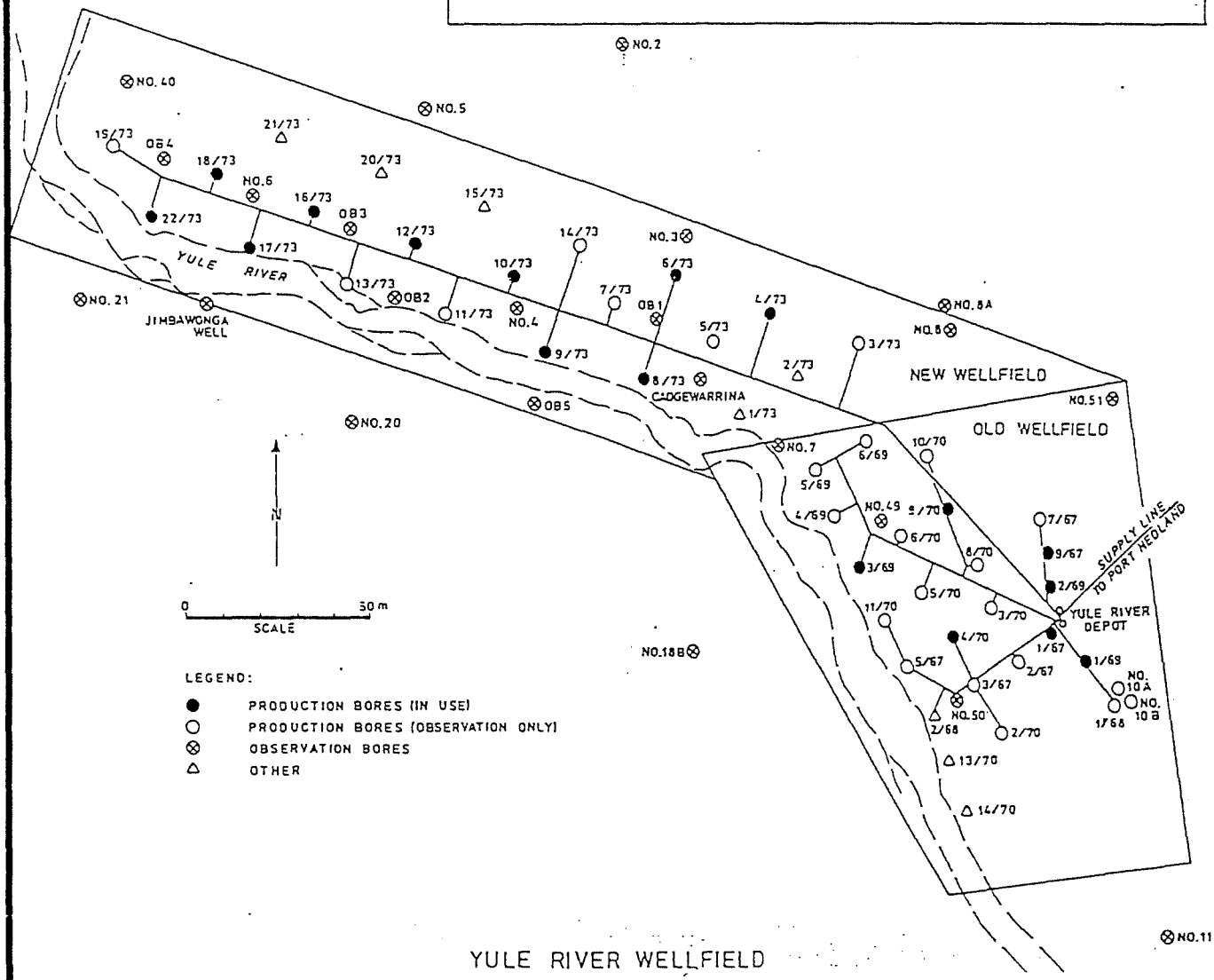


CRRIA – PANNAWONICA

BORE LOCATION PLAN

Figure A9. 6: Port Hedland Water Supply Scheme





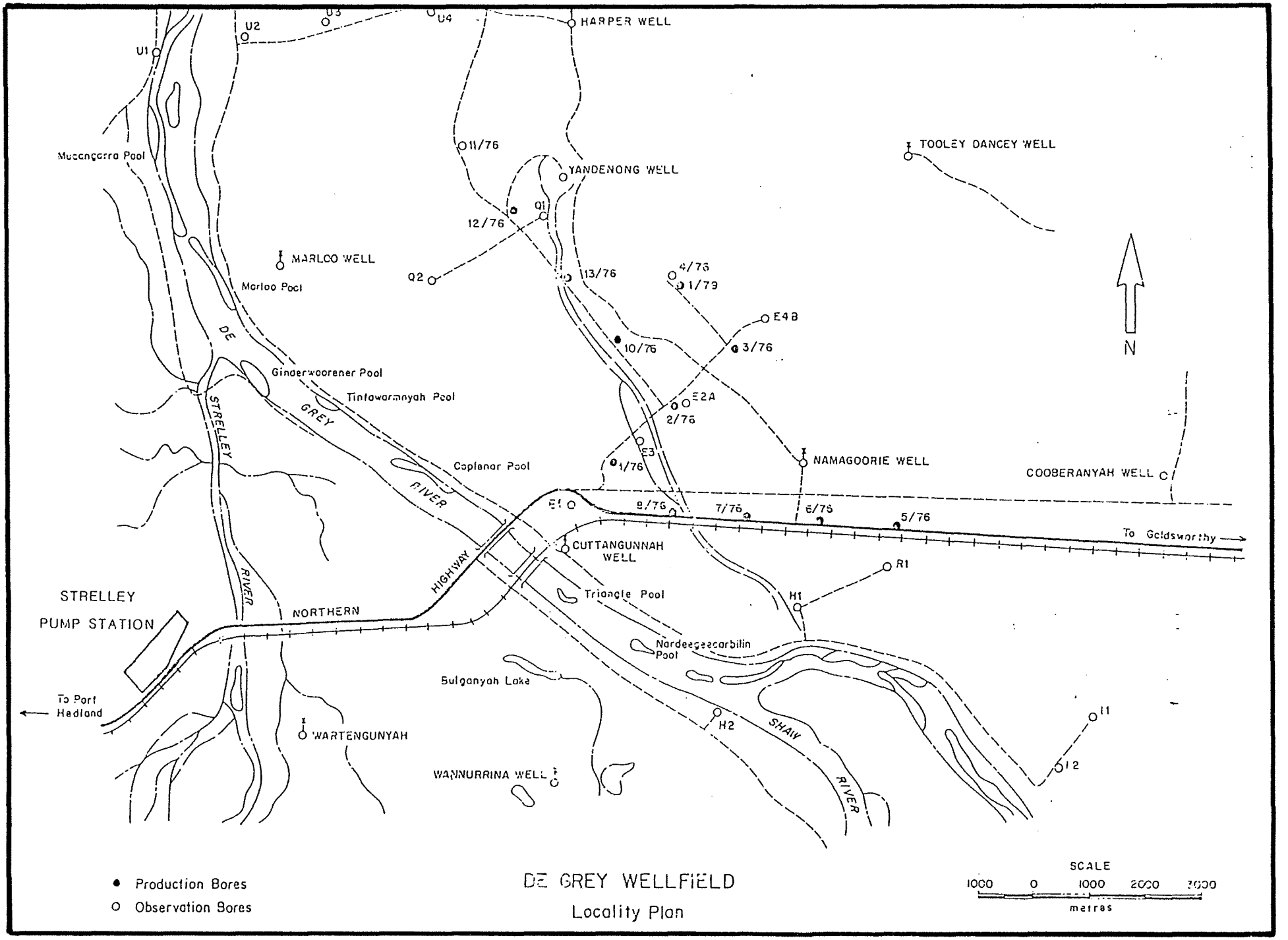

U1
U2
U3
U4
HARPER WELL
Mucangarra Pool
11/76
YANDENONG WELL
TOOLEY DANCEY WELL
12/76
Q1
Q2
MARLOO WELL
Marloo Pool
13/76
4/76
1/79
E4B
10/76
3/76
N
DE
Ginderwoorener Pool
Tintawarmnyah Pool
STRELLEY
GREY
RIVER
E2A
2/76
E3
1/76
NAMAGOORIE WELL
COOBERANYAH WELL
Coplenar Pool
E1
9/76
7/76
6/75
5/76
To Goldsworthy
CUTTANGUNNAH WELL
R1
H1
HIGHWAY
Triangle Pool
STRELLEY PUMP STATION
NORTHERN
RIVER
Nardeegaecarbilin Pool
Bulganyah Lake
To Port Hedland
WARTENGUNYAH
H2
SHAW
RIVER
I1
I2
WANNURRINA WELL
Production Bores
Observation Bores
DE GREY WELLFIELD
Locality Plan
SCALE
1000 0 1000 2000 3000
metres

Figure A9. 7: Marble Bar Water Supply Scheme

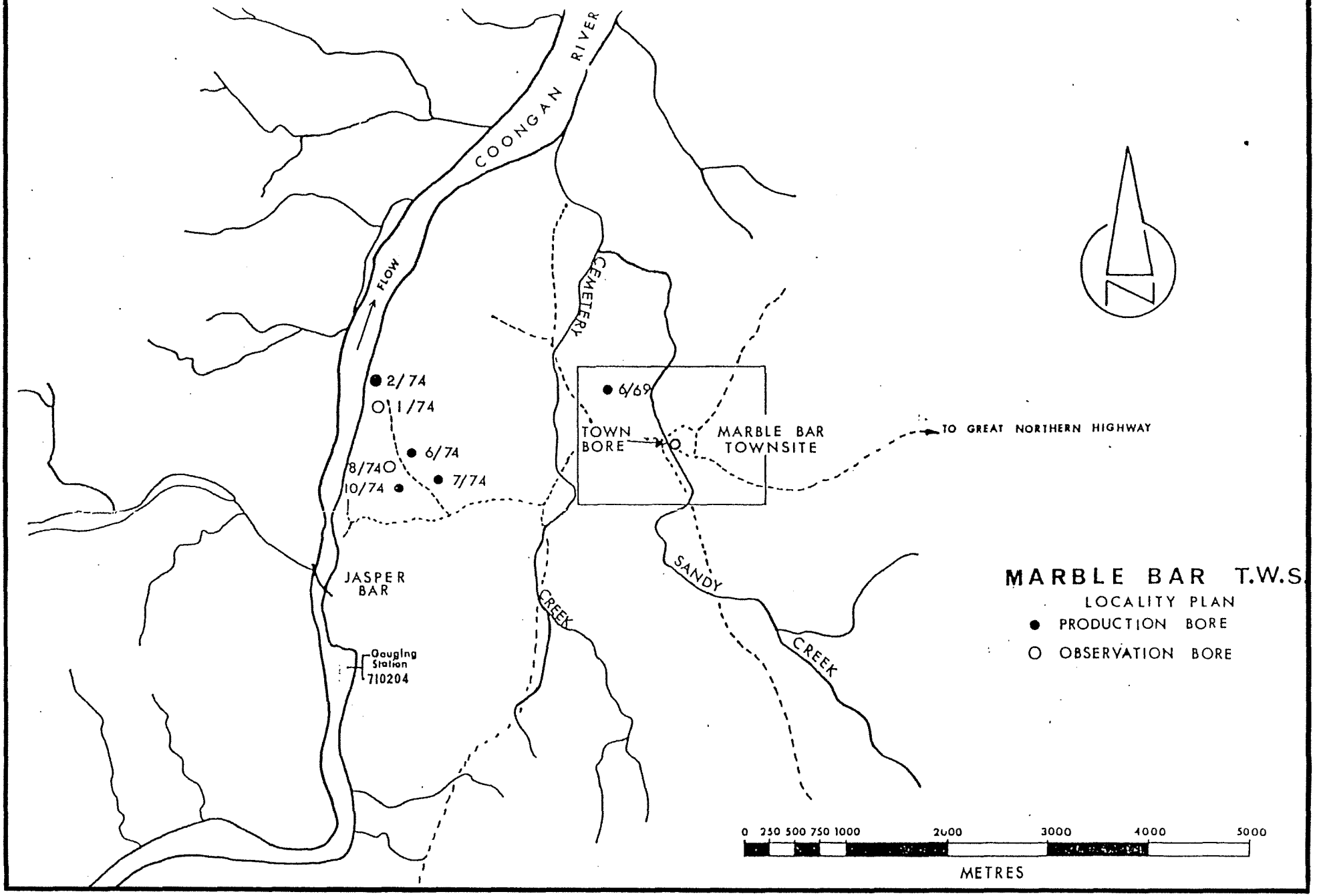


Figure A9. 8: Nullagine Water Supply Scheme

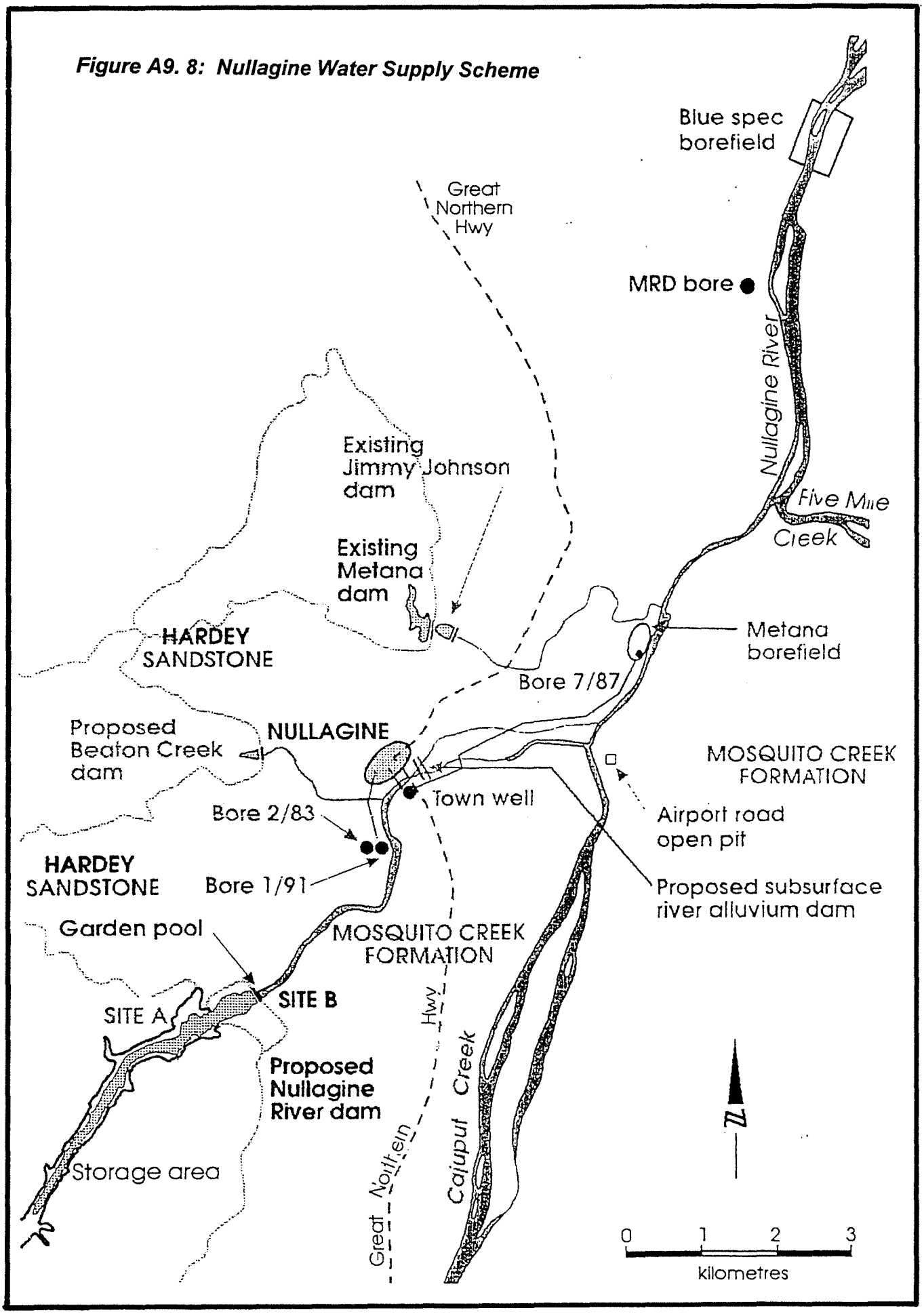


Figure A9. 9: Wittenoom Water Supply Scheme

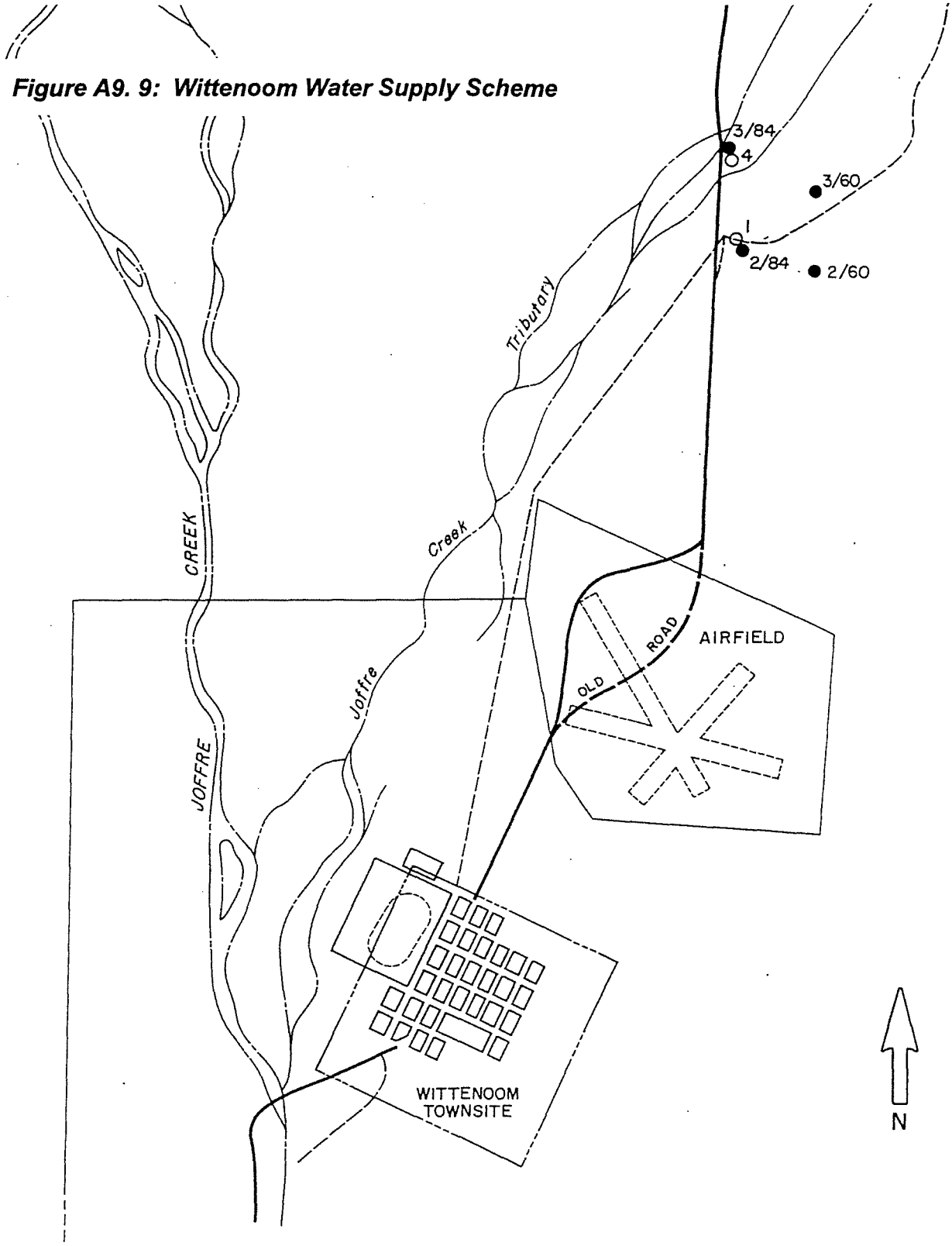


Figure A9. 10: Newman Water Supply Scheme

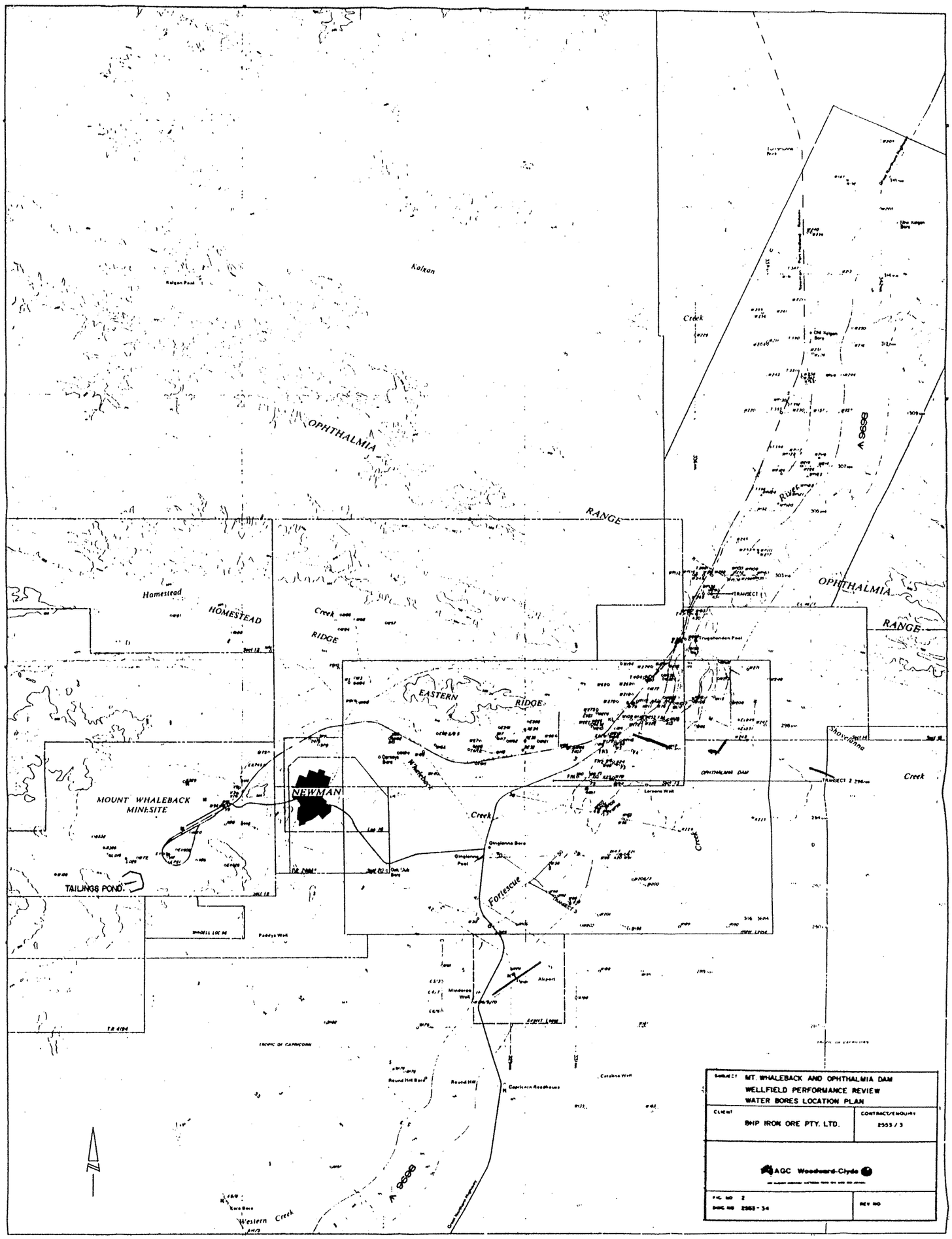


Figure A9. 11: Goldsworthy Water Supply Scheme

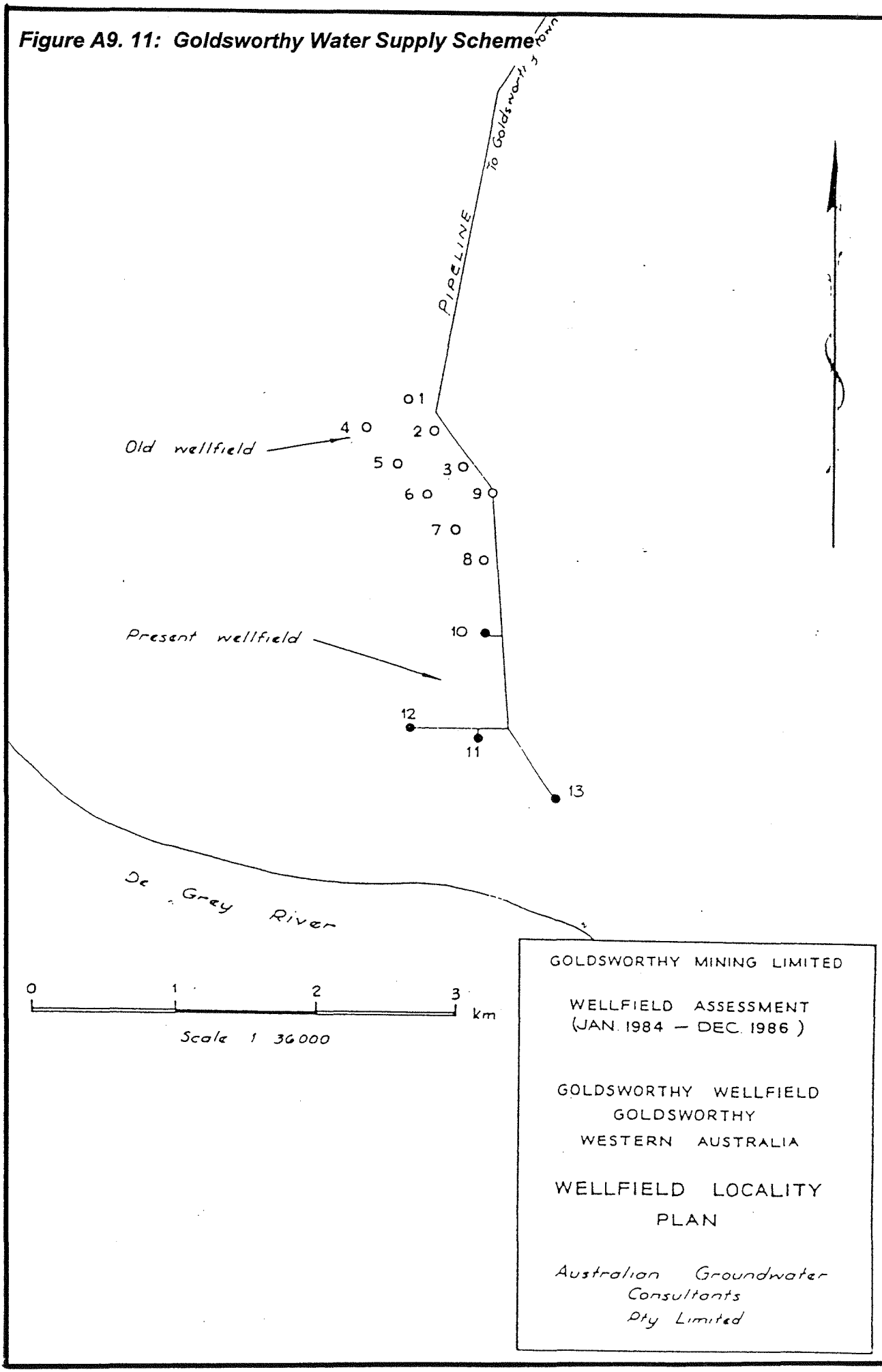
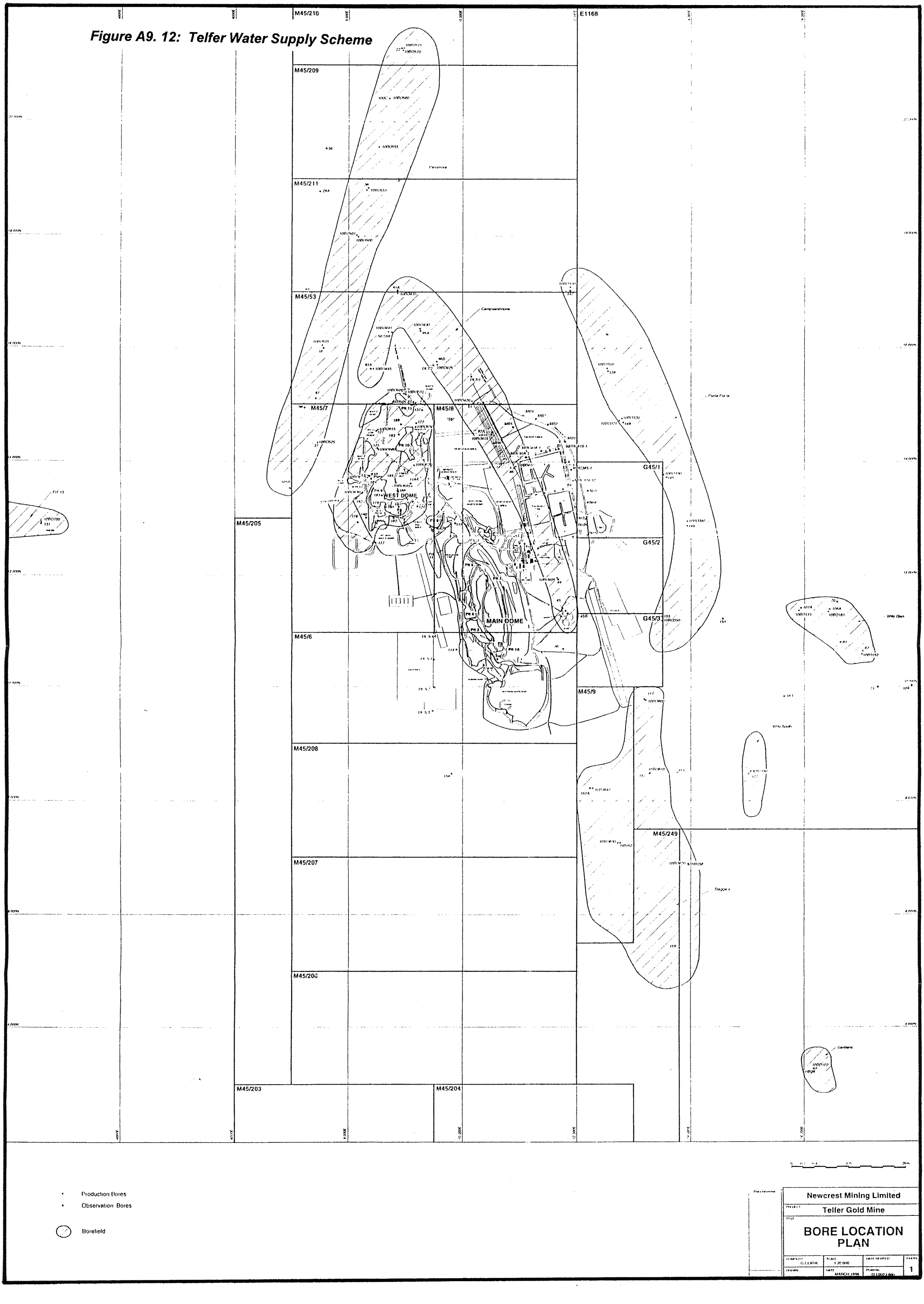


Figure A9. 12: Telfer Water Supply Scheme



Appendix 10: Summary of the Region's Allocations and Demands

Table A10. 1: Licensed Groundwater and Surface Water Allocations for the Pilbara Region

Table A10.1: Licensed Groundwater and Surface Water Allocations for the Pilbara Region

All volumes in thousands of cubic metres per annum (1000 m3 = 1 million litres = 1 ML)

LICENSED WATER USAGE										
Available	Water Supply	Parks & Gardens	Domestic	Agriculture	Industry	Mining	Mining Activities	Other	Total Allocation	Unallocated
1 161 500	40 697	92	37.5	231	6 569	23 980	41 868	883.5	114 358	1 047 142