

WRP 51



CARNARVON WATER RESERVE WATER SOURCE PROTECTION PLAN

Carnarvon Town Water Supply



WATER RESOURCE PROTECTION SERIES

WATER AND RIVERS COMMISSION REPORT WRP 51

1999



WATER AND RIVERS
COMMISSION

WATER AND RIVERS COMMISSION
HYATT CENTRE
3 PLAIN STREET
EAST PERTH
WESTERN AUSTRALIA 6004
TELEPHONE (08) 9278 0300
FACSIMILE (08) 9278 0301
WEBSITE: <http://www.wrc.wa.gov.au>

Cover photograph: View of Rocky Pool looking upstream from the left bank.



PLEASE NOTE:

The final Carnarvon Water Reserve Water Source Protection Plan was ready for release in July 1999. However, the final plan was not released due to the formation of the Lower Gascoyne Water Resources Development Steering Committee. The Committee has now considered future options for horticulture in Carnarvon and the Water Source Protection Plan can now be finalised. If you have any questions about the outcomes of the Committee, please contact the Carnarvon office of the Water and Rivers Commission (telephone: 9941 4921).

The following report is currently being updated with regard to implementation dates. The final Water Source Protection Plan will be included with the final Lower Gascoyne River Local Area Management Plan, which is expected to be released in July 2003.

CARNARVON WATER RESERVE WATER SOURCE PROTECTION PLAN

Carnarvon Town Water Supply

Water and Rivers Commission
Policy and Planning Division

WATER AND RIVERS COMMISSION
WATER RESOURCE PROTECTION SERIES
REPORT NO WRP 51
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Acknowledgments

Contribution	Personnel	Title	Organisation
Supervision	Ross Sheridan	Program Manager, Protection Planning	Water and Rivers Commission
Report Preparation	Leith Bowyer	Water Resources Planner	Water and Rivers Commission
Report Preparation	Todd Simms	Environmental Officer	Water and Rivers Commission
Report Finalisation	Emma Monk	Environmental Officer	Water and Rivers Commission
Drafting	Nigel Atkinson	Drafting Contractor	McErry Digital Mapping

For more information contact:

Program Manager, Protection Planning
Water Quality Protection Branch
Water and Rivers Commission
3 Plain Street
EAST PERTH WA 6004

Telephone: (08) 9278 0300

Facsimile: (08) 9278 0585

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Foreword

Water Source Protection Plans

Water Source Protection Plans establish the level of protection required within Water Reserves. The plans identify sources of contamination that should be investigated and set out programs for management of the resource. Water Source Protection Plans are developed in consultation with affected landowners and industry groups and relevant Government agencies.

Proclaiming Water Reserves under the *Country Areas Water Supply Act 1947* protects the quality of water sources in country Western Australia. The Act's by-laws enable the Water and Rivers Commission to control potentially polluting activities, to regulate land use, inspect premises and to take steps to prevent or clean up pollution.

The Water and Rivers Commission aims to work pro-actively with planning agencies to incorporate water protection in the land planning process. Decisions on land use zoning and subdivision applications have a significant impact on the protection of water sources. The Commission supports the amendment of Town Planning Schemes and Development Strategies that reflect land use compatible with Water Source Protection Plans.

This Water Source Protection Plan provides a basis for establishing compatible land uses within the Water Reserve at Carnarvon and is a mechanism for practical implementation of the Commission's protection strategies. Local government decision-makers, State planning authorities and operational staff are encouraged to recognise this document as a basis for ensuring the long term protection of this groundwater resource for generations to come.

Water quality protection framework

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 that include three levels of priority classification.

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. P1 areas are managed in accordance with the principle of risk avoidance and so land development is generally not permitted.

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. Protection of public water supply sources is a high priority in these areas. P2 areas are managed in accordance with the principle of risk minimisation and so 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 sources need to 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 found.

In addition to priority classifications, wellhead protection zones and reservoir protection zones are defined to protect the water source from contamination in the immediate vicinity of production wells and reservoirs. Wellhead protection zones are usually circular, with a radius of 500 metres in P1 areas and 300 metres in P2 and P3 areas. Reservoir protection zones usually consist of a 2 kilometre buffer area around the top water level of a reservoir and include the reservoir itself. These zones do not extend outside water reserves. Special restrictions apply within these zones.



Contents

Summary	1	Glossary	14
1. Introduction	2	Appendices	
2. Physiography	2	Appendix 1. Land use compatibility in Public Drinking Water Source Areas.....	16
3. Hydrogeology	2	Appendix 2. Plates of land use within the Carnarvon Water Reserve	25
4. Existing and proposed land use	2		
5. Proposed proclaimed area	5	Figures	
6. Potential for contamination	9	Figure 1. Carnarvon locality map	3
6.1 Sand extraction	9	Figure 2. Existing Carnarvon Water Reserve	4
6.2 Water Corporation wellfield	9	Figure 3a. Part of Proposed Carnarvon Water Reserve.....	6
6.3 Pastoral activities	9	Figure 3b. Part of Proposed Carnarvon Water Reserve.....	7
6.4 Gascoyne River Catchment	9	Figure 3c. Part of Proposed Carnarvon Water Reserve.....	8
6.5 Emergencies	9		
Recommendations	10		
Implementation strategy	11		
References	13		



Summary

The town water supply for Carnarvon comes from a Water Corporation wellfield screened in the alluvium aquifer of the Gascoyne River. The aquifer is recharged by river flow in the Gascoyne River and through direct infiltration of rainfall to the aquifer. The aquifer would be vulnerable to contamination from incompatible land uses within the wellfield.

The Carnarvon Water Reserve was proclaimed in 1992 under the *Country Areas Water Supply Act 1947* for the purpose of protecting the public drinking water source.

Extensive consultation has occurred throughout the development of this plan. A draft plan was released for comment to all key stakeholders, including the Water Corporation, Shire of Carnarvon, Department of Minerals and Energy, Agriculture Western Australia, Ministry for Planning, Department of Environmental Protection, Gascoyne Development Commission, Carnarvon Growers Association and major landholders.

The comments received were addressed in the preparation of the plan.

Principal land uses in the existing Water Reserve are grazing and sand mining. Some horticulture occurs on the northern riverbank, downstream of the wellfield near Gascoyne River Bridge.

The plan proposes a modification to the Water Reserve, to exclude land downstream of the wellfield. This will exclude the horticulture land upstream of the Bridge.

The Water Reserve should be classified for Priority 1 source protection.

Each public water supply production bore should have a 500 metre radius wellhead protection zone. Activities that may pose acute pollution risks, such as storage of fuel, should be excluded from these zones.

Land use activities in the proposed Water Reserve should be managed to reduce the potential risks of water source contamination. The current land uses are compatible with Priority 1 classification.



1. Introduction

Carnarvon is a coastal town located 910 kilometres north of Perth at the mouth of the Gascoyne River (Figure 1).

Groundwater for the Carnarvon Town Water Scheme is supplied from a Water Corporation wellfield. The production bores within the wellfield abstract groundwater from a relatively shallow and largely unconfined aquifer (see Plate 1). The wellfield stretches upstream of the Gascoyne River Bridge to 55 kilometres from the river mouth (just downstream of Rocky Pool, see Figure 2).

The Carnarvon Water Reserve was proclaimed in 1992 under the *Country Areas Water Supply Act 1947* for the purpose of protecting the public drinking water source.

2. Physiography

The climate of the region is semi-arid with hot summers and warm winters. The average annual rainfall is 228 millimetres and average annual evaporation is 2,764 millimetres (Luke *et al*, 1988). The Gascoyne River catchment area is approximately 78,000 square kilometres and extends 600 kilometres inland to Three Rivers.

Runoff is generated from the eastern Carnarvon Basin within the Kennedy Range and Yilgarn Province. River flow is dependent on the highly variable rainfall of the area and hence aquifer recharge is sporadic and difficult to predict. Therefore, careful water supply management is required.

3. Hydrogeology

The floodplain of the Gascoyne River consists of sand and clay sediments deposited during river flows. These sediments occur to a depth of 60 metres and are underlain by older strata of marine origin. The aquifer is essentially unconfined, but where sandy sediments are overlain by clay, the aquifer may be locally confined. The hydrogeology of the area is described by Allen (1972) and Martin (1990).

The aquifer is replenished during flow periods in the Gascoyne River. Recharge is by direct infiltration through coarse sands within the riverbed. The floodplain sediments beneath and adjacent to the river

are recharged by infiltration from these coarse sands. Recharge also occurs from rainfall direct on the floodplain area.

Depth to the water table varies considerably, depending on stream flow. Typically, the watertable lies approximately 2 to 3 metres below the riverbed, but the depth increases with increasing distance from the river course. Groundwater flow is away from the mound beneath the river to the north and south before turning westerly towards the coast.

Potable quality groundwater occurs in areas recharged by the Gascoyne River. The salinity of the water in the coarse sands is generally less than 500 milligrams/litre total dissolved salts. Fresh groundwater also occurs within the floodplain sediments beneath the coarse sands. However, with distance from the riverbed, the salinity increases from brackish to saline.

Historically, water quality problems were experienced from intrusion of saline groundwater into the wellfield, when the scheme supply was located at Water Supply Island, 3 kilometres above the river mouth. This occurred when aquifer storage was low and groundwater abstraction high. This caused the nearby saltwater interface to move toward the wellfield. The wellfield was re-located further upstream, away from the saltwater interface, which has reduced the salinity problems.

The unconfined aquifer of the coarse sands in the riverbed is considered vulnerable to contamination from incompatible land uses and activities in the wellfield area. This is due to the shallow depth to water and the direct recharge from river flow and rainfall.

4. Existing and proposed land use

The principal land uses within the Carnarvon Water Reserve are extensive grazing and sand mining. Some horticulture has developed on the northern river bank near the Gascoyne River Bridge.

Six mining tenements have been granted to extract river sands and gravels from the riverbed (Figures 3a and 3b). One is a mining lease (96 hectares) and others are prospecting licences (totalling 714 hectares).



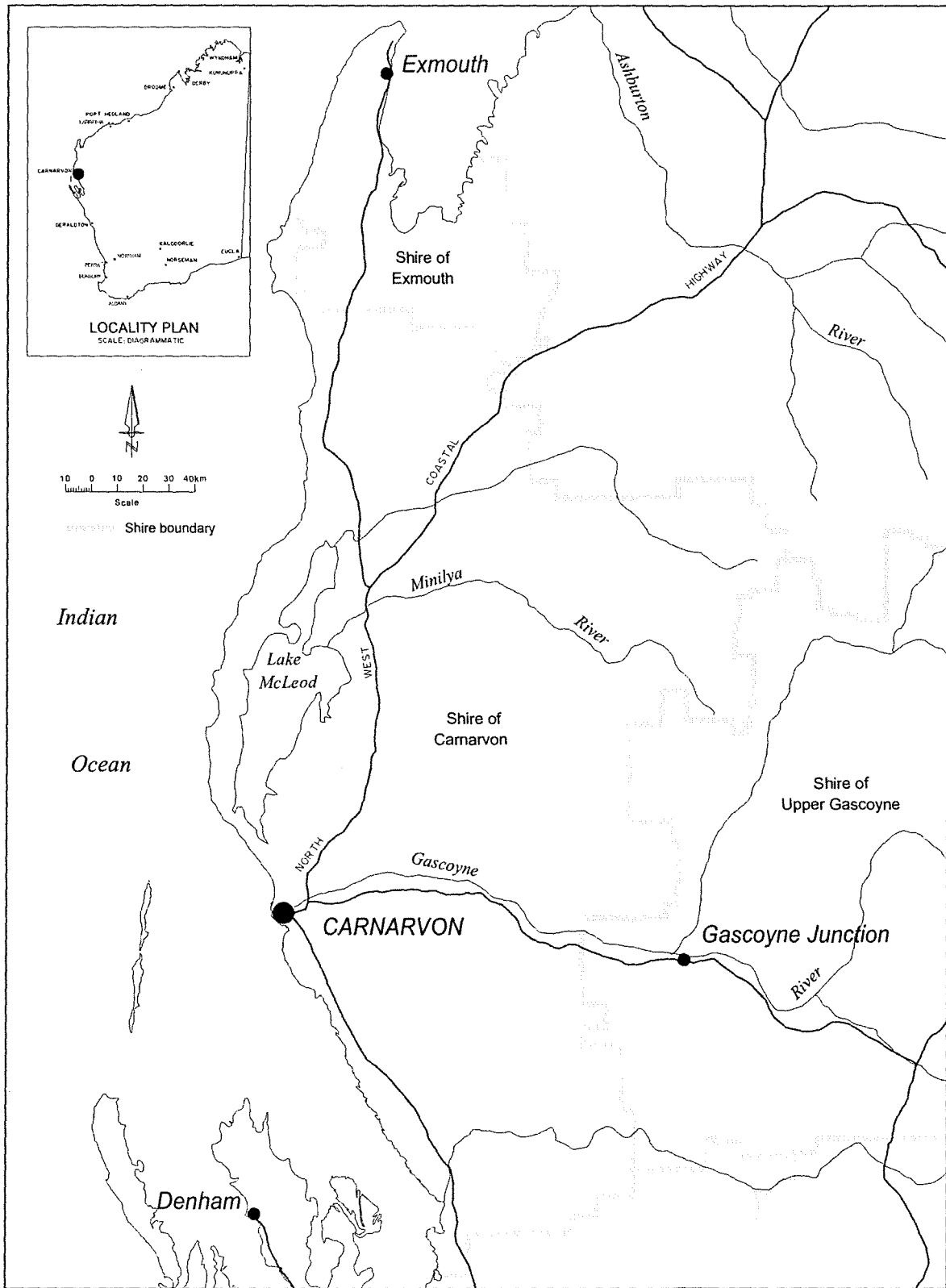
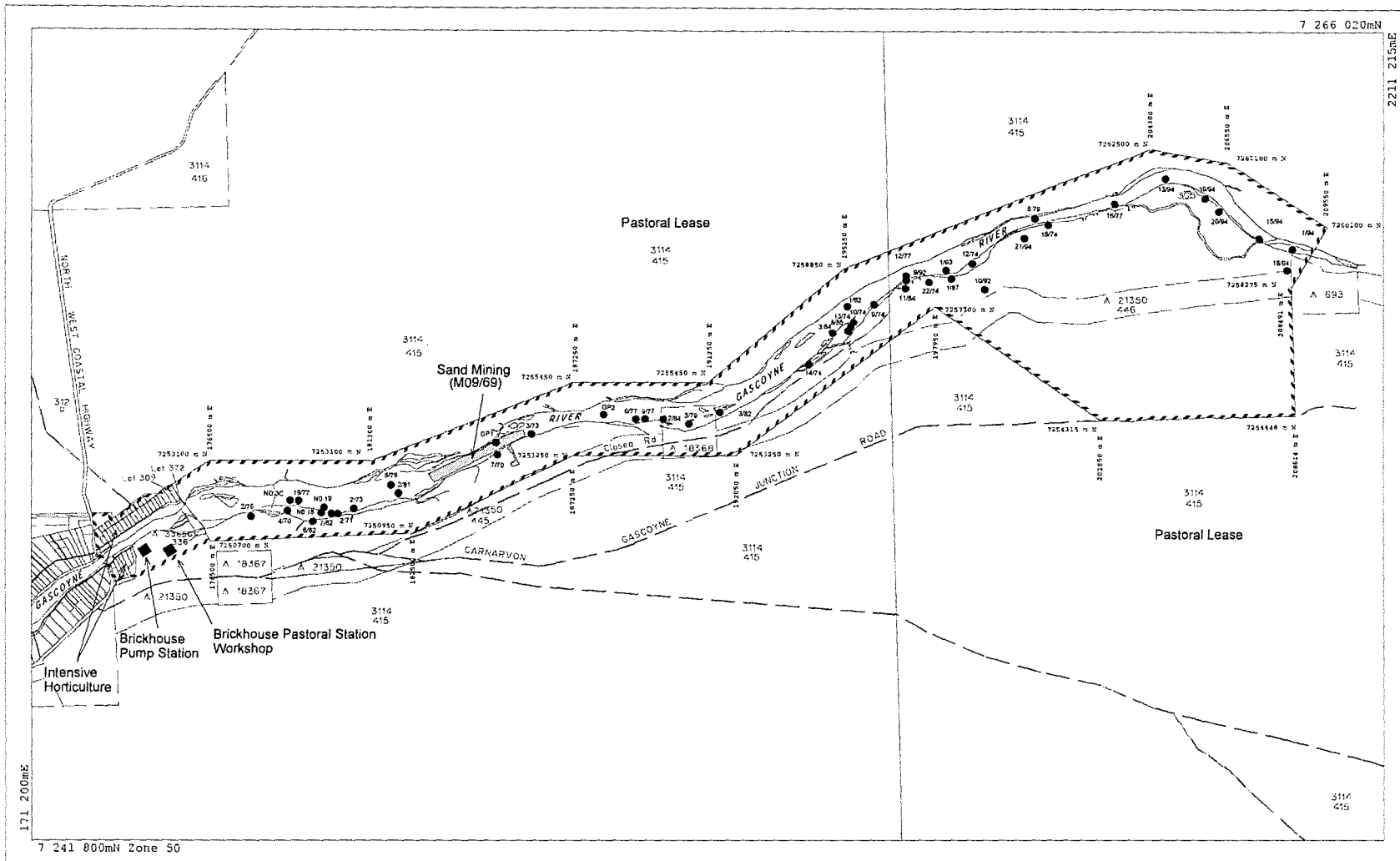





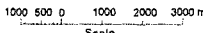


Figure 1. Carnarvon locality map



This map is in Australian Geocentric Datum 1984 and is not Geocentric Datum of Australia 1994 compliant.



 WATER AND RIVERS <small>COMMISSION</small>			LEGEND:  Existing water reserve boundary  Production bore	 Scale	INDEX TO ADJOINING 1:100000 MAPS 1549 1649 1749 1548 1648 1748 1547 1647 1747	FIGURE 2. EXISTING CARNARVON WATER RESERVE Drawn by N.J.A. Date 10/05/99 Policy and Planning Division Water Quality Protection Branch
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Currently, only one mining lease is active. Sand extraction occurs at an approximate rate of 9,000 tonnes per annum for local use and regional export. The process involves excavating an area covering about 1,500 square metres to a depth of approximately 3 metres and grinding the sand extract. The river sands are graded on-site and stored beyond the river bank.

The riverbed is recognised as an important local source of quality sand. The industry is identified and acknowledged as an important industry in Gascoyne regional economic plans.

Recent sand extraction has been confined to an area near production bore GP1 (**Plate 2**). It is understood that the better sand types and grades are located near the production bores, where the sands are well sorted and have low clay content. Sand is usually extracted from a dry riverbed. High groundwater levels in the shallow aquifer may limit the workings on occasions when production bore GP1 is not in use.

The Water Corporation has a distribution storage and pump station (Brickhouse Pump Station) within the Water Reserve. Pumps are powered by mains electricity (**Plate 1**). The workshop at the pump station is used as a maintenance centre for the wellfield and pipelines.

The Brickhouse Station pastoral lease covers a large portion of the Water Reserve. Low intensity sheep and cattle grazing occur throughout the station. A workshop, used to service equipment on the pastoral property, is also located within the Water Reserve.

A small area of land that is adjacent to the Gascoyne River Bridge and within the Water Reserve is used for horticulture (**Figure 2**). Private bores have been installed in the river and pumps are powered by petrol and diesel motors (**Plate 3**). The horticultural land is downgradient of the Water Corporation wellfield.

5. Proposed proclaimed area

Modification of the Water Reserve is proposed, as shown in **Figures 3a to 3c**. The proposed Reserve excludes the intensive horticulture area upstream of the Gascoyne River Bridge. This area is downgradient of the wellfield and there are no plans to extend the wellfield into the area. The modification also excludes the pastoral station workshops and the Water Corporation Brickhouse Pump Station.

Proposed areas for expansion of the wellfield are covered by the proposed boundary.

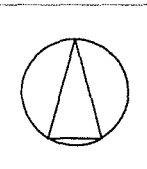
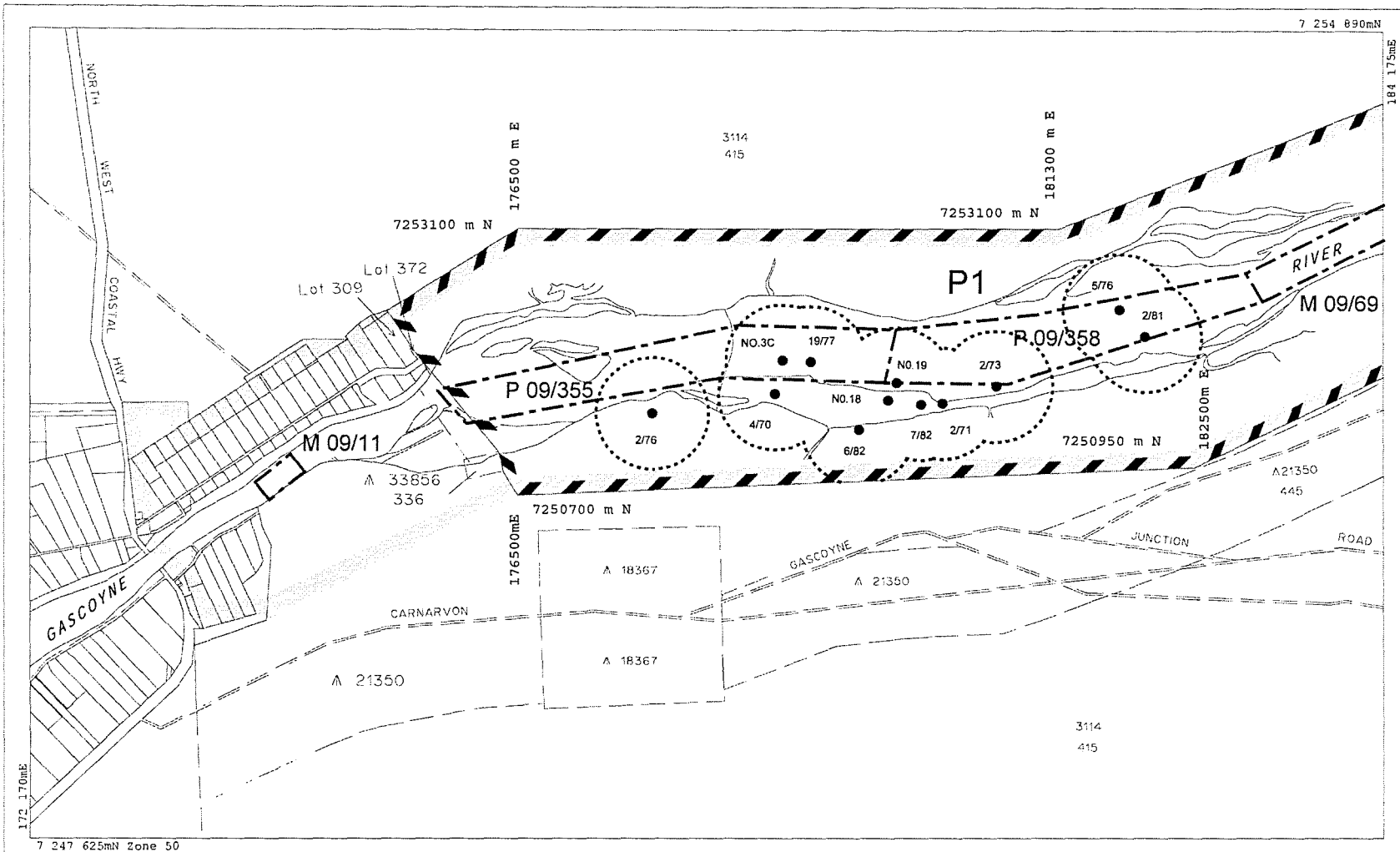
The Water Reserve should be classified as a Priority 1 source protection area. This classification is based on the following criteria:

- the water source is of strategic importance as it is the only potable water source for the town of Carnarvon;
- the groundwater is vulnerable to contamination from intensive land use as the aquifer is unconfined, has transmissive coarse sands and has a shallow depth to groundwater;
- the area covers the wellfield, which is directly recharged by river flows;
- a pastoral lease covers the majority of land;
- the current land uses are compatible with Priority 1 classification.

Each production bore should have a 500 metre radius wellhead protection zone. Wellhead protection zones are declared over the immediate area around bores and special restrictions apply to limit groundwater pollution risks.



This map is in Australian Geocentric Datum 1984 and is not Geocentric Datum of Australia 1994 compliant.



LEGEND:
 - - - Existing water reserve boundary
 - - - Proposed water reserve boundary
 ● 500m wellhead protection zone
 - - - Mining tenement

Scale
 0 150 300 600 900 m

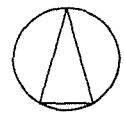
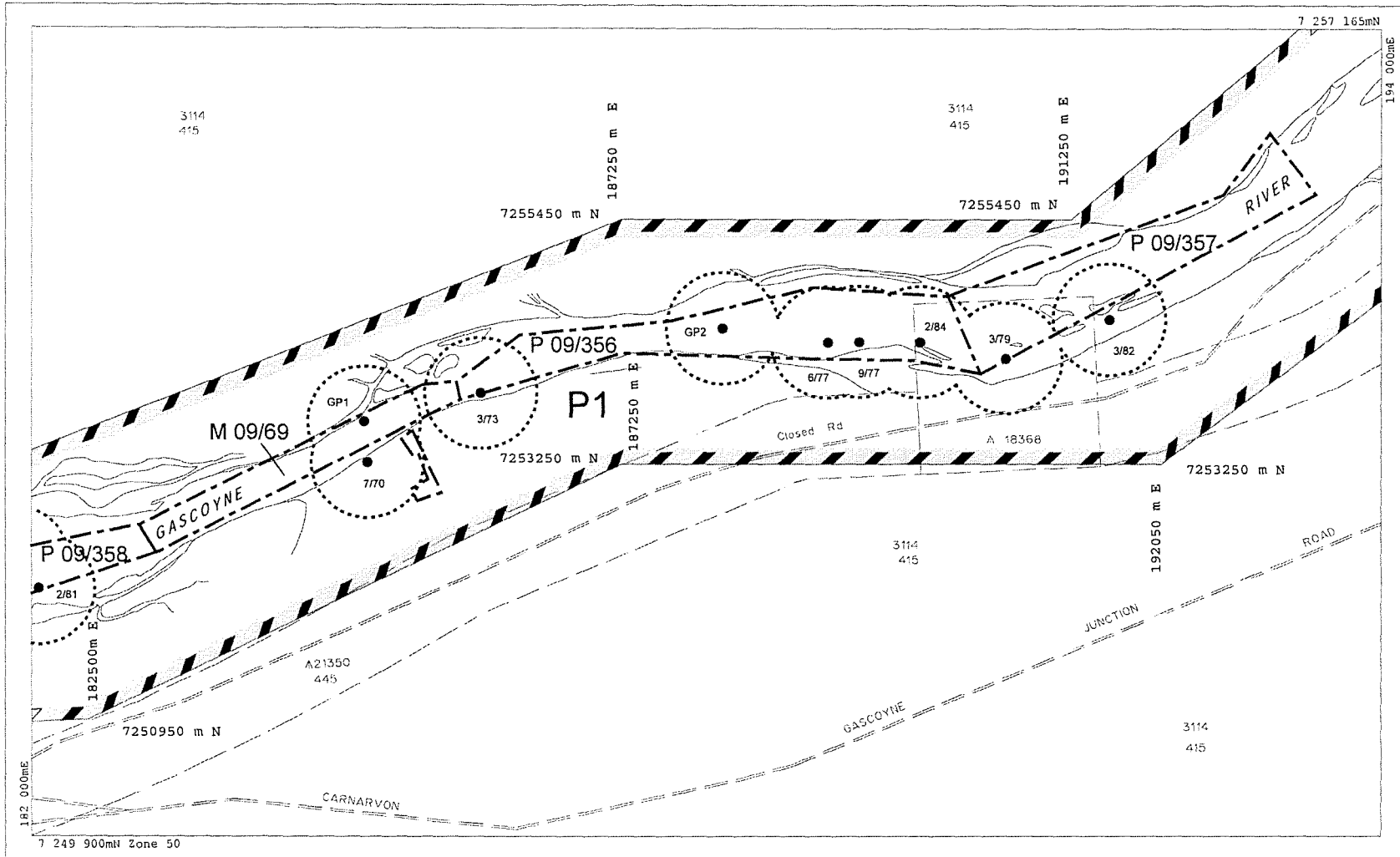
INDEX TO ADJOINING 1:100000 MAPS		
1549	1649	1749
1548	1648	1748
1547	1647	1747

FIGURE 3a.
PART OF PROPOSED CARNARVON
WATER RESERVE

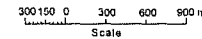
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Policy and Planning Division
 Water Quality Protection Branch

This map is in Australian Geocentric Datum 1984 and is not Geocentric Datum of Australia 1994 compliant.



- LEGEND:**
- Existing water reserve boundary
 - Proposed water reserve boundary
 - Production bore & 500m wellhead protection zone
 - Mining tenement



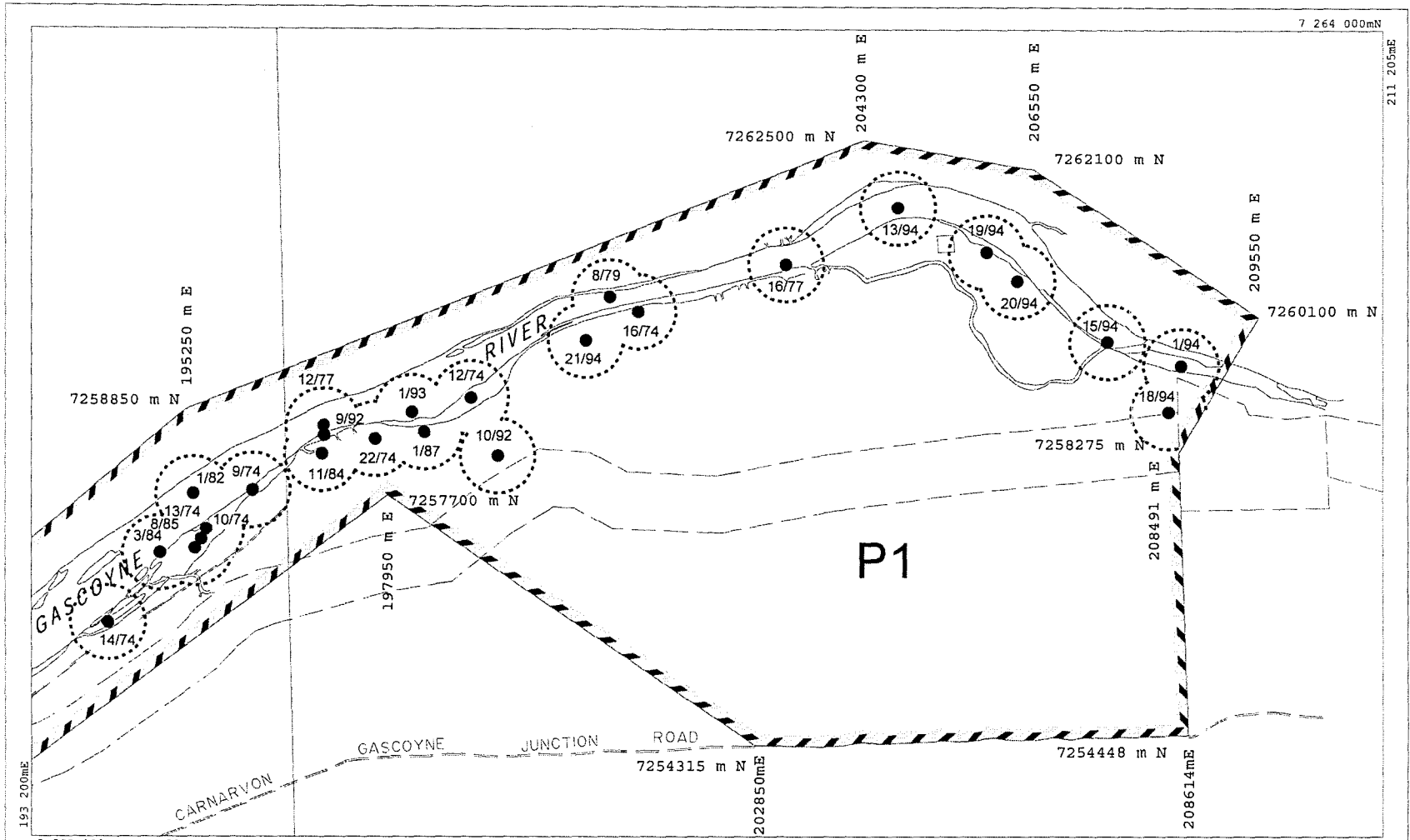
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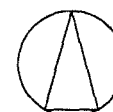




1549	1649	1749
1548	1648	1748
1547	1647	1747

**FIGURE 3b.
PART OF PROPOSED CARNARVON
WATER RESERVE**

Drawn by N.J.A. Date 10/05/99
Policy and Planning Division
Water Quality Protection Branch

This map is in Australian Geocentric Datum 1984 and is not Geocentric Datum of Australia 1994 compliant.



 WATER AND RIVERS COMMISSION			LEGEND:  Existing water reserve boundary  Proposed water reserve boundary  Production bore & 500m wellhead protection zone	300 150 0 300 600 900 1200 m Scale	INDEX TO ADJOINING 1:100000 MAPS 1549 1649 1749 1548 1648 1748 1547 1647 1747	FIGURE 3c. PART OF PROPOSED CARNARVON WATER RESERVE Drawn by N.J.A. Date 10/05/99 Policy and Planning Division Water Quality Protection Branch
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6. Potential for contamination

The potential contamination threats in the proposed water reserve are from sand mining, wellfield operations and pastoral activities. Hydrocarbons, micro-organisms and nitrate are possible resultant contaminants. These possible contaminating sources are not considered an immediate threat to the water source, due to the reasons described below.

6.1 Sand extraction

Sand extraction occurs within the capture zones of the production bores. Mining controls are imposed on the operator to ensure impacts to riverbed and fringing vegetation are minimised and no damage to public wellfield infrastructure and water source occurs.

Most of the sand extraction to date has been within the capture zone of production bore GP1.

Some of the equipment operating on-site requires refuelling from a small storage tank. A small power unit is used to power plant equipment. There is no temporary bunding structure to prevent spillage of fuel from refilling or leaks from tank or tank fittings. Any storage of fuels on the riverbed could pose a risk to water quality. Accidental spillage of fuel poses a contamination threat, particularly as there is no natural confining barrier to the aquifer.

Storage of fuel should not occur in any wellhead protection zone, and refuelling of plant equipment should be carried out in accordance with Water and Rivers Commission requirements.

6.2 Water Corporation wellfield

The Water Corporation operates the wellfield infrastructure associated with delivering the public water to the town of Carnarvon. The Water Corporation operating activities within the wellfield are carried out in accordance with their Wellfield Management Plan. Protection of wellheads is considered in the Wellfield Management Plan. The Water Corporation bore turbines and submersibles are powered by electric pumps and present little risk to groundwater quality.

Mobile diesel backup generators are employed during power failure. This occurrence is rare and poses little risk to water quality.

6.3 Pastoral activities

The pastoral activities within the Water Reserve pose a low risk to aquifer water quality. The risk would come from nutrient and micro-organism contamination from animal faeces and urine. Existing fences, stock control crossings and station management assist in reducing stock access to the wellfield.

There are two underground fuel storage tanks at the pastoral station workshop. These are downgradient of the wellfield and therefore do not pose a risk to the public water source.

6.4 Gascoyne River Catchment

It is acknowledged that a large portion of the aquifer recharge is supplied by river flow. However, due to the large and infrequent nature of flows, any contaminants would be considerably diluted.

Any major developments in the catchment should be examined to ensure adequate protection for water quality.

Accordingly, it is not considered appropriate to proclaim a water reserve over the whole catchment.

6.5 Emergencies

Escape of chemicals during unforeseen incidents and use of chemicals during emergency response can cause groundwater contamination. The Carnarvon Local Emergency Management Advisory Committee, through the Karratha Emergency Management District, should be familiar with the location and purpose of the Carnarvon Water Reserve. A locality plan should be provided to the Fire and Rescue Services headquarters for the HAZMAT Emergency Advisory Team. Local organisational issues regarding who should have an advisory role to any HAZMAT incident in the Carnarvon Water Reserve need to be resolved.

Personnel who deal with WESTPLAN – HAZMAT incidents within the area should be given ready access to a locality map of the Water Reserve. These personnel should receive training to ensure an understanding of the potential impacts of spills on the groundwater resource.



Recommendations

1. The proposed modifications to the Carnarvon Water Reserve should be gazetted under the *Country Areas Water Supply Act 1947*.
2. Planning strategies should incorporate the management principles outlined in the Water and Rivers Commission's *Land Use Compatibility in Public Drinking Water Source Areas (Appendix 1)* and reflect the Priority 1 classification given to the Water Reserve.
3. Development proposals within the Water Reserve which are classified as 'restricted' or 'incompatible' (refer to **Appendix 1**) should be referred to the Commission for assessment. Development proposals in the Gascoyne River catchment area, upstream of the Water Reserve, that may have the potential to impact on the public groundwater supplies should also be referred to the Commission.
4. Signs should be erected along the boundaries of the Water Reserve to define the reserve and promote public awareness of the need to protect water quality.
5. Incidents covered by WESTPLAN – HAZMAT in the Carnarvon Water Reserve should be addressed through the following measures:
 - The Carnarvon Local Emergency Management Advisory Committee (through the Karratha Emergency Management District) being familiar with the location and purpose of the Carnarvon Water Reserve.
 - The locality plan for the Carnarvon Water Reserve being provided to the Fire and Rescue Services headquarters for the HAZMAT Emergency Advisory Team.
 - The HAZMAT Emergency Advisory Team must receive water quality protection advice during incidents in the Carnarvon Water Reserve.
 - Personnel dealing with WESTPLAN – HAZMAT incidents in the area given ready access to a locality map of the Water Reserve and training to understand the potential impacts of spills on the groundwater resource.
6. A management plan should be prepared to address storage and handling of fuel at the sand mining operation. Storage of fuel should not occur in any wellhead protection zone, and refuelling of plant equipment should be carried out in accordance with Water and Rivers Commission requirements. Sand mining operators should immediately report any spillage of fuel and oil.
7. The annual environmental report outlining the operations, environmental management and rehabilitation work associated with sand mining within the Water Reserve should be referred to the Water and Rivers Commission for comment.
8. A surveillance program should be established to identify and respond to any incompatible land uses or potential contaminant threats within the proposed Water Reserve.
9. Implementation of these recommendations should be reviewed one year after this plan is endorsed. A full review of this protection plan should be undertaken approximately every five years.



Implementation Strategy

No.	Description	Implemented by	Timing
1.	Gazettal of reserve.	Program Manager, Protection Planning (WRC).	On completion of protection plan.
2.	Incorporation into land planning strategies.	Shire of Carnarvon.	Ongoing.
3.	Referral of development proposals: i. WRC to provide the Shire of Carnarvon with guidelines for referral of development proposals. ii. referral of development proposals.	i. Program Manager, Assessment and Advice (WRC). ii. Shire of Carnarvon, Ministry for Planning, Department of Environmental Protection, Department of Minerals and Energy, Gascoyne Development Commission.	i. 1999-2000 ii. Ongoing.
4.	Erection of signs: i. development of guidelines for signage. ii. determine number and location of signs required. iii. erect signs.	i. Program Manager, Protection Planning (WRC). ii. Regional Manager, Mid-West Gascoyne Region (WRC) / Regional Business Manager, Mid-West Region (WC). iii. Regional Manager, Mid-West Gascoyne Region (WRC) / Regional Business Manager, Mid-West Region (WC).	i. 1999-2000 ii. 1999-2000 iii. To be determined.

(continued)

No.	Description	Implemented by	Timing
5.	Incidents covered by WESTPLAN – HAZMAT in the Carnarvon Water Reserve should be addressed through the following measures: <ol style="list-style-type: none"> i. The Carnarvon Local Emergency Management Advisory Committee (through the Karratha Emergency Management District) being familiar with the location and purpose of the Carnarvon Water Reserve. ii. The locality plan for the Carnarvon Water Reserve being provided to the Fire and Rescue Services headquarters for the HAZMAT Emergency Advisory Team. iii. The HAZMAT Emergency Advisory Team must receive water quality protection advice during incidents in the Carnarvon Water Reserve. iv. Personnel dealing with WESTPLAN – HAZMAT incidents in the area given ready access to a locality map of the Water Reserve and training to understand the potential impacts of spills on the groundwater resource. 	<ol style="list-style-type: none"> i. Carnarvon Local Emergency Management Advisory Committee (through WRC Mid-West Gascoyne Region). ii. Program Manager, Protection Planning (WRC). iii. Regional Manager, Mid-West Gascoyne Region (WRC) and Regional Business Manager, Mid-West Region (WC) to resolve responsibilities. iv. Carnarvon Local Emergency Management Advisory Committee. 	<ol style="list-style-type: none"> i. 1999-2000 ii. 1999-2000 iii. Resolve responsibilities as soon as possible. Advice provision - ongoing. iv. 1999-2000
6.	<ol style="list-style-type: none"> i. Prepare management plan for fuel/oils storage, refuelling and spillages for sand mining operations and submit to WRC. ii. Report spillages to Asset Manager, Carnarvon Business Unit (WC). 	<ol style="list-style-type: none"> i. Sand mining companies operating within the Water Reserve, in consultation with Water Quality Protection Branch (WRC). ii. Sand mining companies. 	<ol style="list-style-type: none"> i. 1999-2000 ii. As soon as spillage is discovered.
7.	Sand mining operator's annual environmental reports to be referred to WRC.	Department of Minerals and Energy.	Ongoing.
8.	Surveillance program: <ol style="list-style-type: none"> i. develop guidelines for surveillance of Water Reserves. ii. implement surveillance program. 	<ol style="list-style-type: none"> i. Program Manager, Protection Planning (WRC). ii. Regional Manager, Mid-West Gascoyne Region (WRC) / Regional Business Manager Mid-West Region (WC). 	<ol style="list-style-type: none"> i. 1999-2000 ii. On completion of surveillance guidelines.
9.	Review of this plan and recommendations.	Water Quality Protection Branch (WRC).	<ol style="list-style-type: none"> i. Initial review – 2000-01. ii. Full review – 2004-05.

References

Allen, A. D. 1972, *Results of Investigation into Groundwater Resources along the Lower Gascoyne River for Carnarvon Irrigation and Town Water Supplies*, Geological Survey of Western Australia, Record No. 1972/9.

Luke, G. J., Burke, K. L. & O'Brien, T. M. 1988, *Evaporation Data for Western Australia*, Western Australian Department of Agriculture, Technical Report No. 65.

Martin, M. W. 1990, *Groundwater Resources of the Older Alluvium, Gascoyne River, Carnarvon, Western Australia*, Geological Survey of Western Australia Report.



Glossary

Abstraction	Pumping groundwater from an aquifer.
Allocation	The quantity of groundwater permitted to be abstracted by a well licence, usually specified in kilolitres/year (kL/a).
Alluvium (alluvial)	Detrital material which is transported by streams and rivers and deposited.
Aquifer	A geological formation or group of formations able to receive, store and transmit significant quantities of water.
Bore	A narrow, lined hole drilled to monitor or withdraw groundwater.
Catchment	The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
Confined Aquifer	An aquifer that is confined between shale and siltstone beds and therefore contains water under pressure.
Diffuse Source Pollution	Pollution originating from a widespread area, e.g. urban stormwater runoff, agricultural runoff.
Effluent	The liquid, solid or gaseous wastes discharged by a process, treated or untreated.
Groundwater	Water which occupies the pores and crevices of rock or soil.
Hydrogeology	The study of groundwater, especially relating to the distribution of aquifers, groundwater flow and groundwater quality.
Leaching / Leachate	The process by which materials such as organic matter and mineral salts are washed out of a layer of soil or dumped material by being dissolved or suspended in percolating rainwater; the material washed out is known as leachate. Leachate can pollute groundwater and waterways.
m AHD	Australian Height Datum. Height in metres above Mean Sea Level +0.026 m at Fremantle.
Nutrient Load	The amount of nutrient reaching the waterway over a given time (usually per year) from its catchment area.
Nutrients	Minerals dissolved in water, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorus (phosphate) which provide nutrition (food) for plant growth. Total nutrient levels include the inorganic forms of an element plus any bound in organic molecules.
Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.



Point Source Pollution	Specific localised source of pollution, e.g. sewage or effluent discharge, industrial waste discharge.
Pollution	Water pollution occurs when waste products or other substances, e.g. effluent, litter, refuse, sewage or contaminated runoff, change the physical, chemical, biological or thermal properties of the water, adversely affecting water quality, living species and beneficial uses.
Public Water Source Area	(PWSA) As for UWPCA, but allowing the taking of groundwater for public supplies.
Recharge	Water infiltrating to replenish an aquifer.
Recharge Area	An area through which water from a groundwater catchment percolates to replenish (recharge) an aquifer. An unconfined aquifer is recharged by rainfall throughout its distribution. Confined aquifers are recharged in specific areas where water leaks from overlying aquifers, or where the aquifer rises to meet the surface.
Runoff	Water that flows over the surface from a catchment area, including streams.
Saltwater Intrusion	The inland intrusion of saltwater into a layer of fresh groundwater.
Scheme Supply	Water diverted from a source (or sources) by a water authority or private company and supplied via a distribution network to customers for urban, industrial or irrigation use.
Storage Reservoir	A major reservoir of water created in a river valley by building a dam.
Stormwater	Rainwater that has run off the ground surface, roads, paved areas, etc. and is usually carried away by drains.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes including drinking and discharge to the environment.
Unconfined Aquifer	An aquifer containing water, the upper surface of which is lower than the top of the aquifer. The upper surface of the groundwater within the aquifer is called the watertable.
Underground Water Pollution Control Area	(UWPCA) An area defined under the Metropolitan Water Supply Sewerage and Drainage Act, in which restrictions are put on activities that may pollute the groundwater.
Wastewater	Water that has been used for some purpose and would normally be treated and discarded. Wastewater usually contains significant quantities of pollutant.
Water Quality	The physical, chemical and biological measures of water.
Watertable	The upper saturated level of the unconfined groundwater.
Wellfield	A group of bores to monitor or withdraw groundwater.



Appendix 1

Land use compatibility in Public Drinking Water Source Areas



LAND USE COMPATIBILITY IN PUBLIC DRINKING WATER SOURCE AREAS

Purpose

To provide information on land use and activities that may impact on the quality of the State's water resources.

These notes provide a basis for developing formal guidelines in consultation with key stakeholders.

Scope

These notes apply to proposed and existing land use within Public Drinking Water Source Areas (PDWSAs).

PDWSAs include Underground Water Pollution Control Areas, Water Reserves and public water supply catchment areas declared under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, and the *Country Areas Water Supply Act 1947*.

Preamble

The following notes reflect the Commission's current position. They are recommendations only, and may be varied at the discretion of the Commission.

Overview of Protection Framework

The Water and Rivers Commission is responsible for managing and protecting Western Australia's water resources. The Commission has policies for the protection of public drinking water source areas that include three levels of priority classification of lands within PDWSAs.

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. P1 areas are managed in accordance with the principle of **risk avoidance** and so land development is generally not permitted.

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. Protection of public water supply sources is a high priority in these areas. P2 areas are managed in accordance with the principle of **risk minimisation** and so 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 sources need to 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 found.

In addition to priority classifications, **well-head protection zones** and **reservoir protection zones** are defined to protect the water source from contamination in the immediate vicinity of production wells and reservoirs. Well-head protection zones are usually circular, with a radius of 500 metres in P1 areas and 300 metres in P2 and P3 areas. Reservoir protection zones usually consist of a 2 kilometre buffer area around the top water level of a reservoir and include the reservoir itself. These zones do not extend outside water reserves. Special restrictions apply within these zones.

Tables showing Land Use Compatibility with the Commission's PDWSA protection strategy

These tables should be used as a guideline only. More detailed information on the Commission's requirements in the form of activity guidelines or notes is available for some land uses. These can be found on the 'Protecting Water' web page on the Commission's internet site (www.wrc.wa.gov.au). Alternately information relating to land use and development within PDWSAs including those not listed in the tables, can be obtained from the Commission's Water Quality Protection Branch.

The Commission recognises that many activities were established before the introduction of these tables. The Commission will negotiate with the operators of such activities to develop appropriate management practices to minimise the impact on water resources.

These tables do not replace the need for assessment by the Commission. Please consult the Commission for advice on any land use proposals in Public Drinking Water Source Areas that may impact on water resources.

Definitions used in the following tables

<i>Compatible</i>	The land use is compatible with the management objectives of the priority classification.
<i>Incompatible</i>	The land use is incompatible with the management objectives of the priority classification.
<i>Restricted</i>	The land use may be compatible with the management objectives of the priority classification, with appropriate site management practices. All restricted developments / activities should be referred to the Commission for assessment on a case specific basis.
<i>Extensive</i>	Where limited additional inputs are required to the land to support the desired land use. eg supplementary animal feed only during seasonal dry periods.
<i>Intensive</i>	Where regular additional inputs are required to support the desired land use. eg irrigation, fertilisers and non forage animal feed dominates.



More information

We welcome your comment on these notes. They will be updated from time to time as comments are received or activity standards change. The Commission is progressively developing Water Quality Protection Notes and Guidelines covering land uses described in the attached tables. Advice on available guidance documents may be obtained by contacting the Commission.

If you wish to comment on the notes or require more information, please contact the Commission's Water Quality Protection Branch at the Hyatt Centre in East Perth.

Phone: (08) 9278 0300 (business hours) or Fax:(08) 9278 0585



Tables showing Land use compatibility with PDWSA protection objectives

AGRICULTURE - ANIMALS

Land use	Priority 1	Priority 2	Priority 3
Animal saleyards and stockyards ¹⁴	Incompatible	Incompatible ⁷	Restricted ⁷
Apiaries on Crown land	Restricted	Restricted	Restricted
Aquaculture eg. crustaceans, fish, algae farms	Incompatible	Restricted	Restricted
Dairy sheds	Incompatible	Incompatible ^{11,15}	Restricted ¹⁵
Feedlots	Incompatible	Incompatible	Restricted
Livestock grazing - pastoral leases	Restricted	Compatible	Compatible
Livestock grazing - broad acre (extensive)	Incompatible	Restricted ¹¹	Compatible
Livestock grazing (intensive)	Incompatible	Incompatible	Restricted ¹¹
Piggeries	Incompatible	Incompatible	Incompatible
Poultry farming (housed)	Incompatible	Restricted	Restricted
Stables	Incompatible	Restricted	Compatible

AGRICULTURE - PLANTS

Land use	Priority 1	Priority 2	Priority 3
Broad acre cropping i.e. non-irrigated	Incompatible	Restricted ¹	Compatible
Floriculture (extensive)	Incompatible	Restricted	Compatible
Floriculture (intensive)	Incompatible	Incompatible	Restricted
Horticulture- hydroponic	Incompatible	Restricted	Restricted
Horticulture - market gardens	Incompatible	Incompatible	Restricted
Orchards	Incompatible	Restricted	Compatible
Nurseries (potted plants)	Incompatible	Restricted	Compatible
Silviculture (tree farming)	Restricted	Restricted	Compatible
Turf farms	Incompatible	Incompatible	Restricted
Viticulture (wine & table grapes)	Incompatible	Restricted	Compatible

DEVELOPMENT - COMMERCIAL

Land use	Priority 1	Priority 2	Priority 3
Aircraft servicing	Incompatible	Incompatible	Restricted ⁶
Airports or landing grounds	Incompatible	Incompatible	Restricted ⁶
Amusement centres	Incompatible	Incompatible	Compatible ⁶
Automotive businesses	Incompatible	Incompatible	Restricted ⁶
Boat servicing	Incompatible	Incompatible	Restricted ⁶
Catteries	Incompatible	Compatible	Compatible
Caravan and trailer hire	Incompatible	Incompatible	Restricted ⁶
Consulting rooms	Incompatible	Incompatible ⁷	Compatible ⁶
Concrete batching and cement products	Incompatible	Incompatible	Restricted
Cottage Industries	Restricted	Restricted	Compatible
Dog kennels	Incompatible	Restricted	Restricted
Drive in / take-away food shops	Incompatible	Incompatible	Compatible ⁶
Drive -in theatres	Incompatible	Incompatible	Compatible ⁶



Land use	Priority 1	Priority 2	Priority 3
Dry cleaning premises	Incompatible	Incompatible	Restricted ⁶
Farm supply centres	Incompatible	Incompatible ⁷	Restricted
Fuel depots	Incompatible	Incompatible	Restricted
Garden centres	Incompatible	Incompatible	Compatible
Laboratories (analytical , photographic)	Incompatible	Incompatible	Restricted ⁶
Markets	Incompatible	Incompatible	Compatible ⁶
Mechanical servicing	Incompatible	Incompatible	Restricted ⁶
Metal production / finishing	Incompatible	Incompatible	Incompatible
Milk transfer depots	Incompatible	Incompatible	Restricted
Pesticide operator depots	Incompatible	Incompatible	Incompatible
Restaurants and taverns	Incompatible	Incompatible	Compatible ⁶
Service stations	Incompatible	Incompatible	Restricted ⁶
Shops and shopping centres	Incompatible	Incompatible ⁷	Compatible ⁶
Transport depots	Incompatible	Incompatible	Restricted
Vehicle parking (commercial)	Incompatible	Incompatible	Compatible
Vehicle wrecking and machinery	Incompatible	Incompatible	Restricted
Veterinary clinics / hospitals	Incompatible	Incompatible ⁷	Restricted ⁶

DEVELOPMENT - INDUSTRIAL

Land use	Priority 1	Priority 2	Priority 3
Heavy Industry	Incompatible	Incompatible	Incompatible
Light or general Industry	Incompatible	Incompatible	Restricted ⁶
Power Stations	Incompatible	Incompatible	Incompatible

DEVELOPMENT - URBAN

Land use	Priority 1	Priority 2	Priority 3
Aged and dependent persons group dwellings	Incompatible	Incompatible	Compatible ⁶
Cemeteries	Incompatible	Incompatible	Restricted
Civic buildings	Incompatible	Restricted ⁷	Compatible ⁶
Clubs -sporting or recreation	Incompatible	Restricted	Compatible ⁶
Community halls	Incompatible	Restricted ⁷	Compatible
Family day care centres	Incompatible	Incompatible ⁷	Compatible ⁶
Funeral parlours	Incompatible	Incompatible	Compatible ⁶
Health centres	Incompatible	Incompatible	Compatible ⁶
Hospitals	Incompatible	Incompatible	Restricted ⁶
Medical centres	Incompatible	Incompatible	Compatible ⁶
Toilet blocks and change rooms	Incompatible ⁷	Restricted	Compatible

EDUCATION / RESEARCH

Land use	Priority 1	Priority 2	Priority 3
Community education centres	Restricted ⁷	Restricted ⁷	Compatible ⁶
Primary / Secondary Schools	Incompatible	Incompatible	Compatible ⁶
Scientific Research	Restricted	Restricted	Compatible
Tertiary Education Facilities	Incompatible	Incompatible	Restricted ⁶



MINING AND MINERAL PROCESSING

Land use	Priority 1	Priority 2	Priority 3
Extractive industries (sand mining, quarries)	Restricted ²	Restricted ²	Restricted ²
Mineral exploration	Restricted ⁴	Restricted ⁴	Restricted ⁴
Mining	Restricted ⁴	Restricted ⁴	Restricted ⁴
Mineral processing	Incompatible	Incompatible	Restricted ⁴
Tailings dams	Incompatible	Incompatible	Restricted ⁴

PROCESSING OF ANIMALS / ANIMAL PRODUCTS

Land use	Priority 1	Priority 2	Priority 3
Animal product rendering works	Incompatible	Incompatible	Incompatible
Abattoirs	Incompatible	Incompatible	Incompatible
Dairy product factories	Incompatible	Incompatible	Restricted ⁶
Food Processing	Incompatible	Incompatible	Restricted ⁶
Tanneries	Incompatible	Incompatible	Incompatible
Wool-scourers	Incompatible	Incompatible	Incompatible

PROCESSING OF PLANTS / PLANT PRODUCTS

Land use	Priority 1	Priority 2	Priority 3
Breweries	Incompatible	Incompatible	Restricted ⁶
Composting / soil blending (commercial)	Incompatible	Incompatible	Restricted
Vegetable / food processing	Incompatible	Incompatible	Restricted ⁶
Wineries	Incompatible	Incompatible	Restricted

SUBDIVISION

Land use	Priority 1	Priority 2	Priority 3
Rural subdivision to a minimum lot size of 4 ha	Incompatible	Compatible	Compatible
Rural subdivision to a lot size less than 4 ha	Incompatible	Incompatible	Incompatible
Special rural subdivision to a minimum lot size of 2 ha	Incompatible	Restricted ^{8,9}	Restricted ⁸
Special rural subdivision to a lot size between 1 and 2 ha	Incompatible	Incompatible	Restricted ^{8,9}
Special rural subdivision to a lot size less than 1 ha	Incompatible	Incompatible	Incompatible
Urban subdivision	Incompatible	Incompatible	Compatible ⁶
Industrial subdivision	Incompatible	Incompatible	Restricted ⁶

Note: Subdivision of lots to any size within Priority 1 areas is incompatible

SPORT AND RECREATION

Land use	Priority 1	Priority 2	Priority 3
Equestrian centres	Incompatible	Incompatible	Compatible
Golf courses	Incompatible	Incompatible	Restricted ¹
Motor sports ie permanent racing facilities	Incompatible	Incompatible	Restricted
Public swimming pools	Incompatible	Incompatible	Restricted



Land use	Priority 1	Priority 2	Priority 3
Recreational parks -irrigated	Incompatible	Incompatible	Restricted ¹
Rifle ranges	Incompatible	Restricted	Compatible

STORAGE/ PROCESSING OF TOXIC AND HAZARDOUS SUBSTANCES (THS)

Land use	Priority 1	Priority 2	Priority 3
Above ground storage of THS	Restricted	Restricted	Restricted
Underground storage tanks for THS	Incompatible	Incompatible	Restricted

TOURISM ACCOMMODATION

Land use	Priority 1	Priority 2	Priority 3
Bed and breakfast accommodation	Incompatible	Restricted ¹⁶	Compatible
Caravan parks	Incompatible	Incompatible	Restricted ⁶
Farm stay accommodation	Incompatible	Restricted ¹⁶	Compatible
Motels, hotels, lodging houses, hostels	Incompatible	Incompatible	Compatible ⁶

WASTE TREATMENT AND MANAGEMENT

Land use	Priority 1	Priority 2	Priority 3
Injection of liquid wastes into ground water	Incompatible	Incompatible	Incompatible
Landfills -Class I, II or III	Incompatible	Incompatible	Restricted
Landfills -Class IV and V	Incompatible	Incompatible	Incompatible
Recycling depots	Incompatible	Incompatible	Restricted
Refuse transfer stations	Incompatible	Incompatible	Restricted
Sewers (gravity)	Incompatible	Incompatible	Compatible
Sewers (pressure mains)	Incompatible	Restricted	Compatible
Sewage pump stations	Incompatible	Restricted	Restricted
Used tyre storage / disposal facilities	Incompatible	Incompatible	Incompatible
Wastewater treatment plants	Incompatible	Incompatible	Restricted
Water treatment plants	Restricted	Restricted	Restricted

OTHER DEVELOPMENTS

Land use	Priority 1	Priority 2	Priority 3
Caretaker's housing	Incompatible ⁷	Restricted	Compatible
Communications receivers / transmitters	Restricted	Restricted	Restricted
Construction projects (not shown elsewhere)	Restricted	Restricted	Restricted
Forestry	Restricted ¹	Compatible	Compatible
Major transport routes	Incompatible	Restricted ¹⁰	Compatible
National and Regional Parks ¹³	Compatible	Compatible	Compatible
Nature reserves	Compatible	Compatible	Compatible



Table reference notes:

1. Restrictions include fertiliser and pesticide application.
2. Restrictions include the storage of fuels and chemicals, the depth of mining in relation to the water table with strict guidelines for rehabilitation.
3. Restrictions include the storage and use of fuel and other chemicals.
4. Subject to conditions placed on the mining lease and / or environmental approval.
5. Special rural development must have appropriate provisions under the Town Planning Scheme, to prevent introduction of land uses and practices that pose an unacceptable risk to water resources.
6. Must be connected to deep sewerage, except where exemptions apply under the current Government Sewerage Policy.
7. Only permitted if this use is incidental to the overall land use in the area and consistent with planning strategies.
8. Lots should only be created where land capability allows on-site soakage disposal of treated wastewater. Restrictions apply to siting of wastewater disposal systems in areas with poor land capability and / or a shallow depth to groundwater, animals are held or fertiliser is applied. Alternative wastewater treatment systems, where approved by the Health Department, may be appropriate if well maintained.
9. An average rather than minimum lot size may be acceptable if the proponent can demonstrate that the water quality objectives of the source protection area are met, and caveats are placed on titles of larger blocks stating that further subdivision cannot occur.
10. Restrictions include road design, construction and the types of goods that may be carried.
11. May be permitted if animal stocking levels (number of animals per hectare) are consistent with source protection objectives.
12. May be permitted if the type, volume and storage mechanisms for chemicals are compatible with water quality protection objectives.
13. Visitor and management infrastructure and facilities must be appropriately sited and maintained.
14. This does not include on-farm / pastoral lease stock-yards used for animal husbandry
15. Waste management practices must be compatible with source protection objectives.
16. Restrictions apply on density of accommodation in Priority 2 areas



Appendix 2

Plates of land use within the Carnarvon Water Reserve

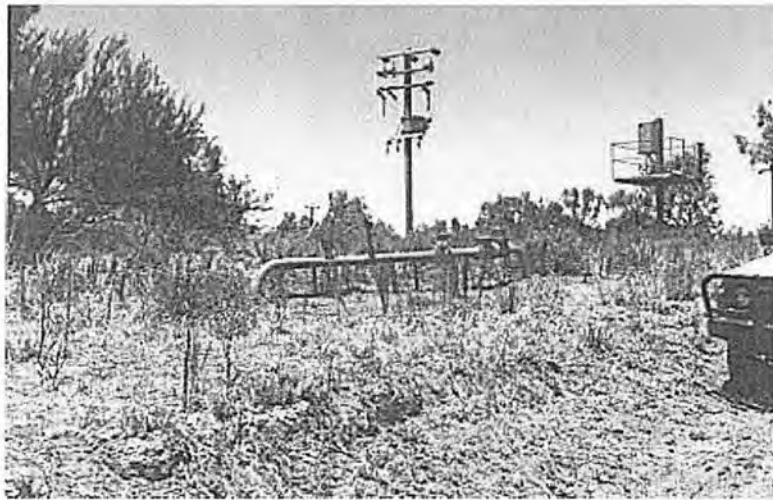


Plate 1. Water Corporation operated electric production bore, situated on the river bank in the Water Reserve.



Plate 2. GP1 production bore and sand mining operations.

