HALLS CREEK WATER RESERVE
WATER SOURCE PROTECTION PLAN

Halls Creek Town Water Supply

WATER AND RIVERS COMMISSION REPORT
WRP 48
2002
WATER RESOURCE PROTECTION SERIES

Water and Rivers Commission

Government of **Western Australia**
Department of **Water**

Important information

The Halls Creek Water Reserve water source protection plan (2002, WRP no.48) was reviewed in 2012.

Please ensure you read the *Halls Creek drinking water source protection review* (2012, WRP no.123) alongside the 2002 plan to obtain all of the information about this drinking water source.

The 2012 review considers changes that have occurred in and around the Halls Creek Water Reserve since the completion of the 2002 Halls Creek water source protection plan. The addition of seven new bores will require wellhead protection zones. Additional recommendations have been prepared to ensure the ongoing protection of this public drinking water source area.

You can find the 2012 *Halls Creek drinking drinking water source protection review* at www.water.wa.gov.au > publications > find a publication > series browse > water resource protection plan; or by contacting the Department of Water on +61 8 6364 7600 or at www.water.wa.gov.au/Managing+water/Drinking+water/default.aspx.

HALLS CREEK WATER RESERVE
WATER SOURCE PROTECTION PLAN

Halls Creek Town Water Supply

Water and Rivers Commission
Policy and Planning Division

WATER AND RIVERS COMMISSION
WATER RESOURCE PROTECTION SERIES
REPORT NO WRP 48
2002

Acknowledgments

Contribution	Personnel	Title	Organisation
Program Direction	Tony Laws	Manager, Water Quality Protection	Water and Rivers Commission
Supervision	Ross Sheridan	Program Manager, Protection Planning	Water and Rivers Commission
Report Preparation	Mark Warner	Environmental Engineer	Water and Rivers Commission
Report Preparation	Adrian Tomlinson	Senior Water Resources Planner	Water and Rivers Commission
Report Preparation	Nicholas Edwards	Environmental Officer	Water and Rivers Commission
Report Preparation	Angus Davidson	Supervising Hydrogeologist	Water and Rivers Commission
Drafting	Nigel Atkinson	Drafting Contractor	McErry Digital Mapping Pty Ltd

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

Reference Details

The recommended reference for this publication is: Water and Rivers Commission 2002, *Halls Creek Water Reserve Water Source Protection Plan: Halls Creek Town Water Supply*, Water and Rivers Commission, Water Resource Protection Series No WRP 48.

ISBN 0-7309-7588-6
ISSN 1326-7442

Printed on recyclable stock
July, 2002

Cover Photograph: China Walls Creek

Foreword

Water source protection plans

Water Source Protection Plans establish the level of protection required in Water Reserves. Catchment protection of water sources is considered a fundamental part of ensuring the provision of a safe drinking water supply.

Water Source Protection 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, regulate land use, inspect premises and 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 in the Halls Creek Water Reserve 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 conditional development is allowed.

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 are defined to protect the water source from contamination in the immediate vicinity of production bores. Well-head protection zones are usually circular, with a radius of 500 metres in P1 areas and 300 metres in P2 and P3 areas. These areas do not extend outside the water reserves. Special conditions apply within these zones.

Contents

Appendices

Photographs

Figures

Summary

Halls Creek is in the Shire of Halls Creek, 300 kilometres south of Kununurra in the Kimberley region. It services pastoral, tourism and extractive industries in surrounding areas.

The Halls Creek town water supply is obtained from a Water Corporation wellfield which draws groundwater from an aquifer in the King Leopold Sandstone.

The aquifer is vulnerable to contamination from overlying land uses. Therefore, careful management of land use and development in the recharge area of the aquifer is necessary to protect the resource.

Pastoral grazing activities are the main land use in the aquifer's recharge area. These activities are not considered to pose a risk to the water source quality.

The Halls Creek Water Reserve was declared in 1982 under the *Country Areas Water Supply Act 1947*. It is proposed to modify the boundary of the reserve to only include the key groundwater recharge areas and those areas likely for expansion of the public water supply wellfield.

Due to the various land uses within the Water Reserve, the priority classification will differ across the Reserve. The direct recharge areas of the King Leopold Sandstone should be classified for Priority 1 Source Protection. The pastoral grazing activities are considered compatible with this level of protection. This area includes the stock holding facilities and the town wastewater treatment plant. These are considered to be non-conforming land uses and should employ best management practice to protect water quality. In the future these activities could be relocated to maximise groundwater protection.

The special rural zone should be classified for Priority 2 Source Protection and the remainder of the Reserve, which includes the urban area of Halls Creek, should be classified for Priority 3 Source Protection.

Signs indicating the location of the reserve should be erected and development proposals within the reserve should be assessed for impact on water quality.

1. Introduction

Halls Creek is located within the Shire of Halls Creek, 300 km south of Kununurra in the Kimberley region. It services pastoral, tourism and extractive industries in surrounding areas (see Figure 1).

The Halls Creek town water supply wellfield, operated by the Water Corporation, is located east of the town, immediately north of the Duncan Highway.

The Halls Creek Water Reserve was proclaimed under the *Country Areas Water Supply Act (1947)* in 1982 to protect water quality in the aquifer.

2. Physiography

The physiographic description of the region is taken from Laws (1990).

The area around Halls Creek consists of flat to gently undulating red and black soil plains with a general elevation of about 400m AHD. To the south-east and east the Bob Black Ranges rise from the plains to heights in excess of 460m AHD and consist of steeply dipping sandstone ridges with a general south-westerly trend. Between the ridges are low rounded hills of basalt.

The soil cover around Halls Creek is generally thin and surface runoff from summer rainstorms is rapid. Vegetation is sparse and consists of Mitchell and Flinders grasses on the black soil plains and spinifex on the red soils and on the hill slopes. Eucalypts are generally restricted to drainage lines.

The region has a tropical climate, with two distinct seasons. Heavy rains from monsoonal and cyclonic activity usually occur between December and March, and there is a dry season from April to November. The average annual rainfall for Halls Creek is 520mm but is extremely variable. The area has an average annual potential evaporation of 2500mm.

3. Hydrogeology

Davidson (1993) describes the hydrogeology of Halls Creek (see Figure 2).

The King Leopold Sandstone overlies the Moola Bulla Formation and these formations have been tightly folded into a south-westerly plunging syncline. In the centre of the syncline the Carson Volcanics form a highly sheared core of the structure, and gilgai soils commonly occur in the low-lying areas.

The main groundwater resource occurs within the King Leopold Sandstone along clearly defined ridges extending north-east from Duncan Highway to beyond the Elvire River.

Groundwater salinity is likely to be less than 1000 mg/L in both the King Leopold Sandstone and Moola Bulla Formation.

Groundwater recharge mainly occurs by rainfall infiltration and, to a lesser degree, by lateral groundwater flow from adjacent geological formations. Recharge occurs mainly in areas of cracking black soil plain and where fractured rocks and sandstone ridges outcrop. The King Leopold Sandstone aquifer is considered vulnerable to contamination infiltrating through these areas.

The King Leopold Sandstone aquifer has a relatively small storage capacity. As a result, under the influence of pumping, contaminants could move quickly along the joints and fractures towards the production bores. The aquifer is less vulnerable to contamination from adjoining features as groundwater flow from adjacent geological formations is limited.

The direction of groundwater flow has not been accurately determined however it is probably towards the Elvire River.

The south-west to north-east trending areas of King Leopold Sandstone outcrops (see figure 2) are the likely areas of future public water supply abstraction.

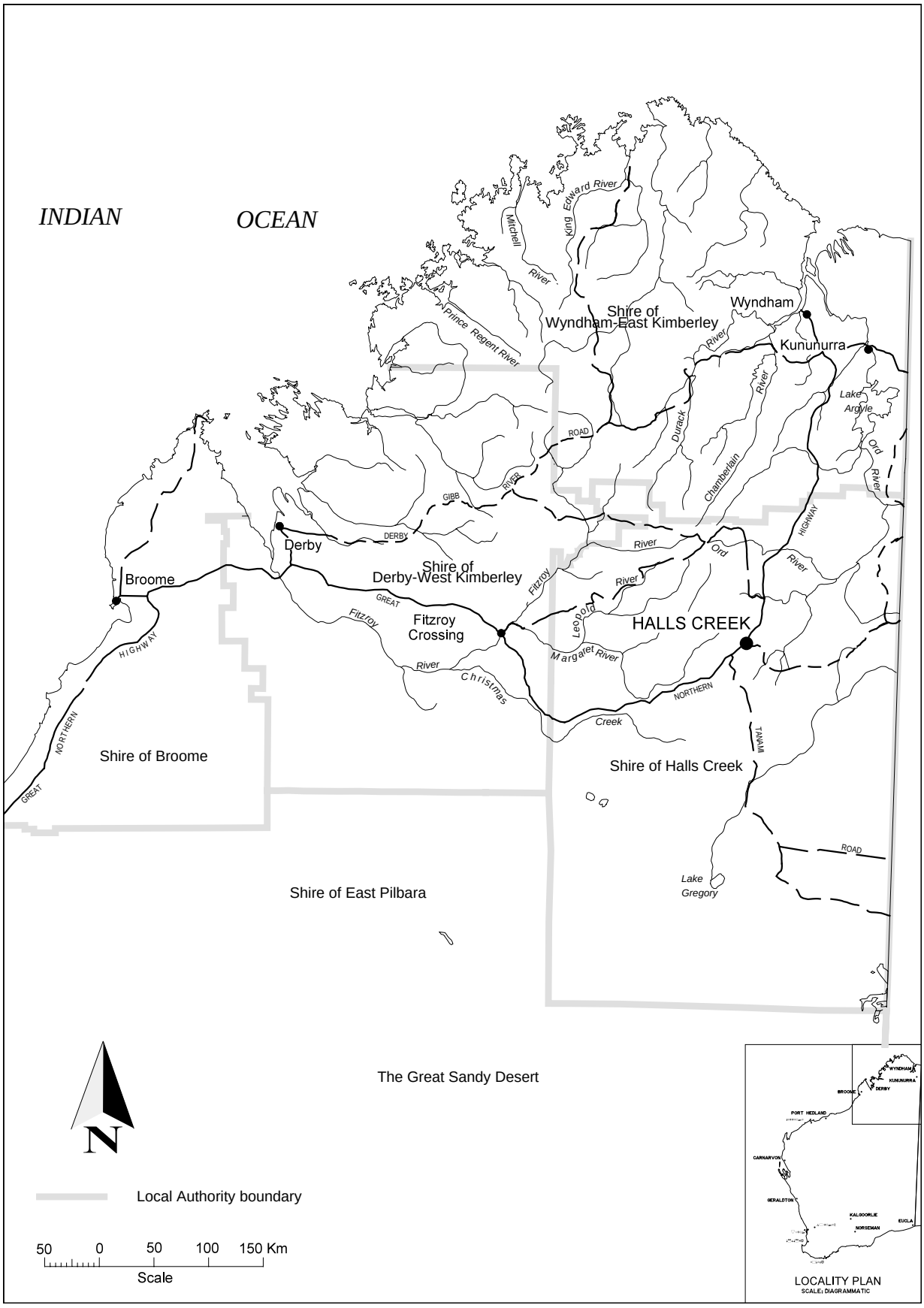
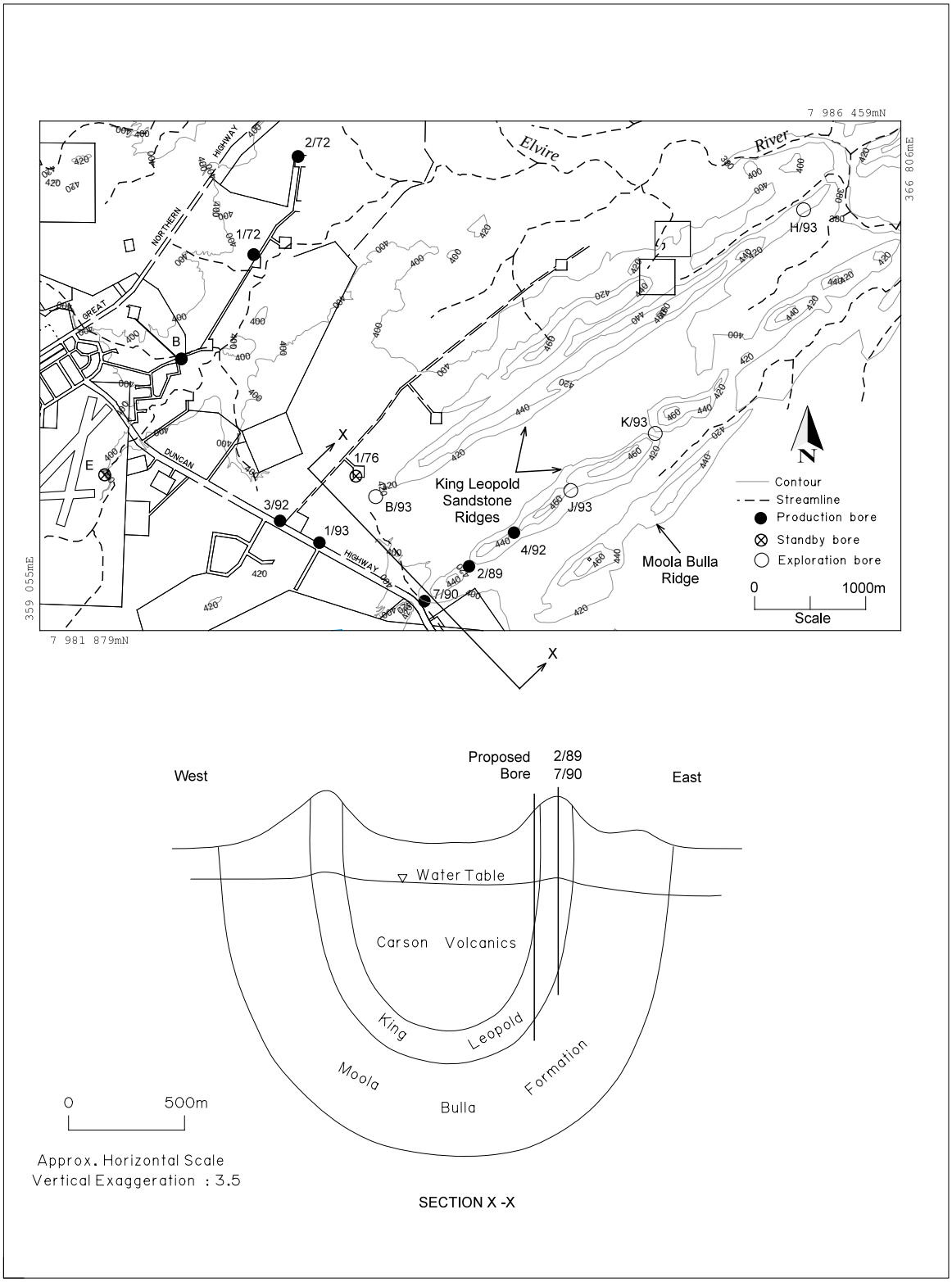


Figure 1. Halls Creek locality map



WATER AND RIVERS COMMISSION

INDEX TO ADJOINING 1:100000 MAPS

4362	4462	4562
4361	4461	4561
4360	4460	4560

FIGURE 2.
GEOLOGY OF THE HALLS CREEK WELLFIELD

Drawn by N.J.A. Date 07/06/00

Policy and Planning Division
Water Quality Protection Branch

Figure 2. Geology of Halls Creek Wellfield

4. Scheme description

Currently, the wellfield comprises eight equipped production wells (see Figure 3 and Plate 1). Bore 1/72, 2/72 and B are located in the older part of the wellfield, closer to the townsite. Bores 2/89, 7/90, 4/92 and 1/93 are the equipped bores in the new wellfield. All production bores are electrified and fitted with submersible pumps. Diesel engine powered bores E and 1/76, are maintained as standby wells and they are equipped with day storage tanks for fuel. Bore 3/92 is currently used as a standby service and will eventually be used to service the nearby cattle yards but not as a town production bore.

As soon as the new bore 5/99 is equipped and commissioned, bores B, 2/72 and 3/70 will be decommissioned, while Bores E and 1/72 will be assessed for use at a later date.

Bores 3/85 and 4/857 are diesel bores that will be used as a standby in case of power failure.

The new wellfield pumps to a 300 kL collector tank. A transfer pump station then directs water through the town reticulation to a 2500 kL ground storage tank. The old wellfield pumps directly into the town reticulation.

Water quality varies considerably. Salinities in the operating wellfield range from about 450 mg/L in the old wellfield to over 1400 mg/L in bore 3/92. This relates directly to the proximity of each bore to the recharge areas. The only treatment the water receives is disinfection by chlorination.

Further exploration drilling is planned for sites B/93, H/93, J/93 and K/93 (see Figure 2).

5. Existing and proposed land use

The majority of the land in the Water Reserve is either pastoral lease (Moola Bulla, Burks and Elvire pastoral stations) or Land Act reserve. The two most significant reserves are 23136, which is vested with the Shire of Halls Creek for the purpose of “Common”, and 38453, which is vested with the Ministry of Education for the purpose of keeping horses.

Reserve 23136 surrounds the Halls Creek townsite and is mostly undeveloped. Reserve 38453 is located to the north-east of the old wellfield. Land use activities in the immediate wellfield area are limited to the grazing of stock, particularly cattle and horses.

Agriculture Western Australia (AgWA) operates a cattle dip tank and a stock truck wash down facility on Duncan Highway (Plates 2 & 3). It is in the general vicinity of the wellfield.

The Water Corporation operates a wastewater treatment system next to production bores 7/90 and 2/89.

There is a Special Rural zone within the Water Reserve. It is south of the Duncan Highway, opposite bores 3/92 and 1/93. The urban and industrial areas of Halls Creek are also within the Water Reserve.

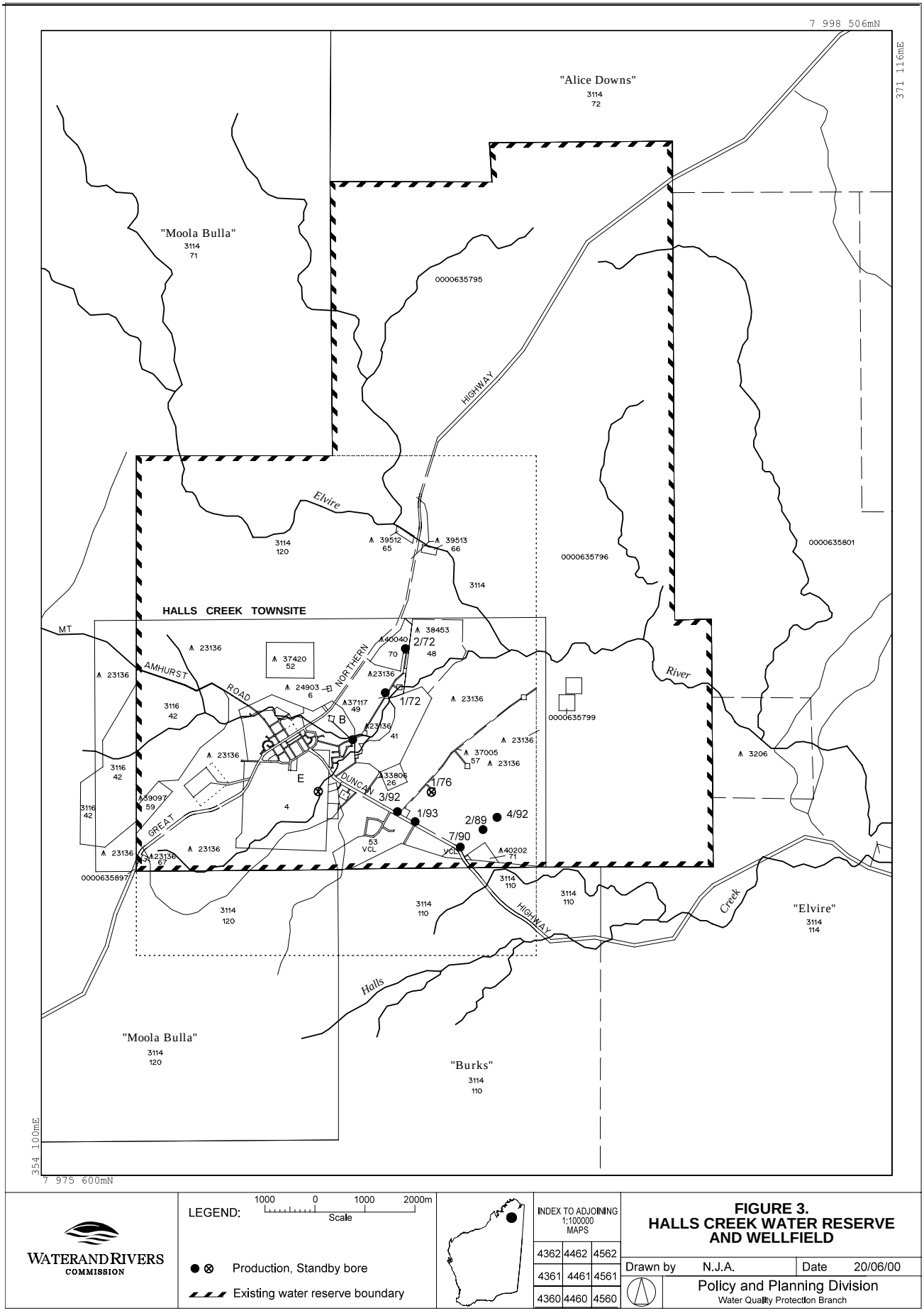


Figure 3. Halls Creek Wellfield

6. Potential for contamination

Potential contamination threats are shown in Figure 4.

Wastewater treatment plant

The Halls Creek wastewater treatment plant is located less than 500 metres south and east of bores 2/89 and 7/90. The depth to the water table near these bores is about 50 metres. The treatment plant consists of two primary treatment and two polishing ponds as well as a recently built evaporation pond.

The treatment system could pose a contamination risk to groundwater from bacteria and nutrients. This could come from pond and pipe leakages and system overflows.

The evaporation pond has been sized to contain rainfall runoff generated by a 1 in 50-year storm, as well as normal plant operations. Before the construction of the evaporation pond, treated effluent was discharged via an excavated channel to an ephemeral watercourse.

Golder Associates conducted a geotechnical investigation in 1997 to determine impacts the treatment plant might have on groundwater quality in the area. Several monitoring bores were drilled around the ponds, water samples taken and the results assessed. It was determined that, while groundwater flow was towards the production wells, there was no evidence of any seepage from the ponds reaching the groundwater.

Golder Associates considered the operation of the plant posed little or no risk to water resources because the ponds were constructed using impermeable clay. The potential for any leakage reaching the King Leopold Sandstone is considered to be small.

Groundwater quality monitoring is undertaken as a condition of the Department of Environmental Protection's licence for the treatment plant.

Fuel storage at production bores

Most production bores use electric pumps. The diesel powered bores, E and 1/76 are used as standby only and have been equipped with one day fuel tanks only. These tanks have not been bunded although the potential leakage of fuel from tanks and delivery lines poses a risk of hydrocarbon contamination to the aquifer. The tanks and delivery lines need to be bunded to ensure capture of any leaks. Also, the wellheads and fuel system should be fenced from livestock intrusion and vandalism.

Accidental road spillage

The Duncan Highway (Plate 4) traverses the Halls Creek Water Reserve and runs adjacent to several operational production bores. Accidental spillage of contaminants from road transport using this road could pose a threat to the groundwater system.

Cattle dip tank and stock truck wash down facilities

The cattle dip tank and stock truck wash down facility are adjacent to bore 7/90. Effluent from the stock truck wash down facility is pumped to an evaporation pond. Appropriate management and operation of this pond will reduce the risks from this facility.

The contents of the dip tank (10 kL) are periodically emptied (every 1 to 2 years, depending on usage and build up of organic matter) into the evaporation pond. The dip chemical Amitraz, is rapidly inactivated in a matter of days when exposed to sunlight and heat, and has a half life in soil of less than one day.

There is the possibility that the dip tank will also be used for horses. In this case, the dip chemical will be changed to Bayticol. The operation and management of this site should be assessed to ensure risks to water quality are effectively managed.

Townsite

The majority of urban lots in the Water Reserve are connected to sewer thereby removing a significant contaminant threat to the unconfined aquifer system. Remaining septic tank systems and other urban land use activities, such as the commercial areas and the Shire depot, pose a threat to groundwater quality from nutrient, bacteriological and chemical contamination.

The commercial areas and Shire depot require good management to ensure they do not cause any groundwater contamination. The Water and Rivers Commission has various Water Quality Protection Notes that provide guidelines on a number of potentially contaminating activities such as mechanical servicing and fuel storage.

Special rural area

The special rural area is located south of the Duncan Highway, near bores 3/92 and 1/93. Septic systems are used in this area and pose a potential threat to the groundwater quality in the unconfined aquifer system.

Some land uses within special rural areas can impact upon the quality of the groundwater resources. Appropriate management of land use activities within the special rural subdivision are required to minimise risk of groundwater contamination.

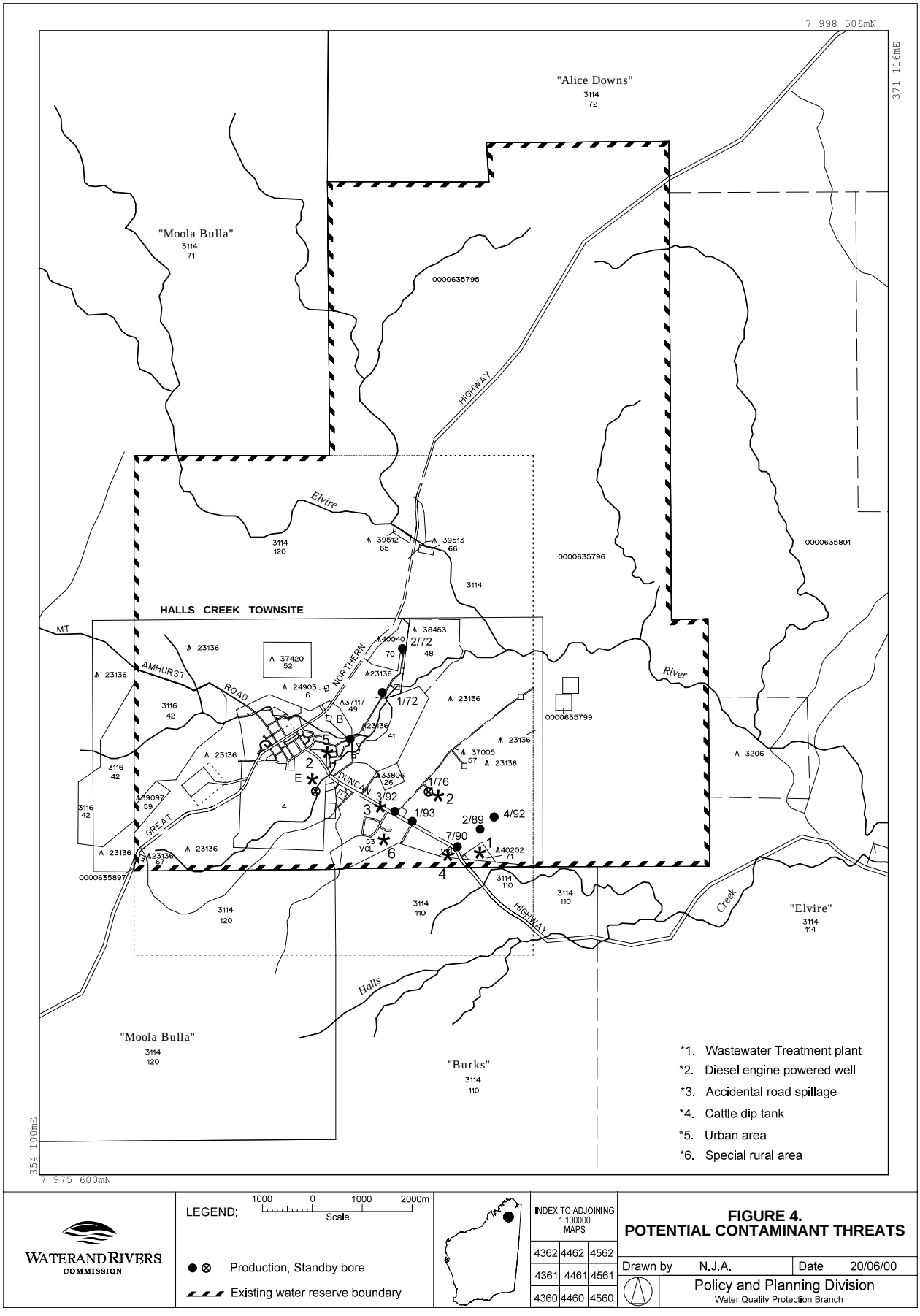


Figure 4. Potential contamination threats

7. Proposed proclaimed area

The existing Water Reserve was gazetted in 1982. It is proposed to modify the existing Water Reserve boundary to that shown in Figure 5.

The boundary of the current Water Reserve has been assessed and significantly amended. The areas north of Great Northern Highway and the Elvire River have been removed, as they do not cover existing wellfield recharge areas or proposed public water supply abstraction areas.

The boundaries on the southern side of the Water Reserve are proposed to be extended south of the Duncan Highway to include areas where the King Leopold Sandstone outcrops and could contribute groundwater recharge to the existing wellfield and its future extensions.

It is proposed to classify the Reserve for three levels of protection.

The outcrops of King Leopold Sandstone are proposed to be classified for Priority 1 (P1) source protection.

This is warranted as contaminants could infiltrate directly into the aquifer in areas where the King Leopold Sandstone outcrops. These areas are considered to be more vulnerable and should be afforded greater protection. The proposed P1 area encompasses all outcrop ridges to the north of the Duncan Highway as well as an area to the south of the highway where the ridges extend but are not exposed. The P1 area is likely to be the area for future expansion of the wellfield.

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.

Where the King Leopold Sandstone underlies the special rural zone, it is proposed that the reserve be classified for Priority 2 (P2) source protection.

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.

It is proposed to classify the remainder of the reserve for Priority 3 (P3) source protection as the land already includes urban and associated uses. Also, this areas is not a key recharge area for the King Leopold Sandstone. A P3 classification is considered to be adequate to protect groundwater in this area. This classification is compatible with existing and future development in the vicinity of the town site.

P3 source protection areas are defined to minimise the risk of pollution to the water source. P3 source protection areas are declared over land where water supply sources needs co-exist with other land uses, including tourist accommodation. If the water source does become contaminated, then the water may need to be treated or an alternative water source found.

Circular wellhead protection zones of 500 metres radius in P1 areas and 300 metres radius in both P2 and P3 areas should be established around each production bore.

8. Management of potential water quality risks

The objective of this plan is to protect these water sources in the interest of providing safe drinking water to Halls Creek, however the rights of existing approved land uses to continue in the Halls Creek Water Reserve is recognised.

The existing priority classifications of the Halls Creek Water Reserve have been reviewed to ensure consistency with the Commission's current framework

for public drinking water source protection. Some existing priority classifications have been modified to better reflect land tenure, land use and zoning, while maintaining an appropriate level of protection for the drinking water source.

The proposed water source protection planning for the area recognises the rights of landowners to continue established, approved land use activities. The Commission will encourage non-conforming land uses to adopt best management practices to minimise risk to water resources, through industry based guidelines.

The proposed priority classifications will ensure future development within the Halls Creek Water Reserve is consistent with the objectives for water source protection in the area.

8.1 Protection objectives

Experience in Western Australia and overseas shows the link between groundwater quality and land uses in the catchment. Groundwater is a valuable resource which, if contaminated or polluted, is very expensive, and sometimes impossible, to clean up. Therefore it is essential that the activities with the lowest contamination risk occur above the most important groundwater sources.

In Western Australia, a large number of cities and towns rely on groundwater sources for public drinking water supply. In some country regions, groundwater is the sole water supply source for drinking purposes. These resources may also be limited in quantity and to ensure a continued water supply, appropriate water quality protection is required to avoid the source becoming polluted.

Sources of groundwater contamination are referred to as either point sources or diffuse sources. Point sources of contamination refer to cases where contamination is localised and is centred on one or more identifiable structures (e.g. sewage or effluent discharge). Diffuse sources of contamination refer to cases where contamination originates from a widespread area and cannot be ascribed to a sole source (e.g. agricultural runoff). Both point sources and diffuse sources of contamination are of comparable significance and concern, and may detrimentally affect the chemical and microbiological quality of groundwater.

A number of chemicals, both organic and inorganic, and including some pesticides, are of concern in drinking water from a health perspective because some are toxic to humans and some are suspected of causing cancer (NHMRC & ARMCANZ, 1996). Nitrates are of particular concern if found in drinking water. The national guideline limit for nitrate in drinking water is 50 mg/L to protect bottle fed babies under 6 months of age.

The most common and widespread health risk associated with drinking water is contamination, either directly or indirectly, by human or animal excreta, and with the micro-organisms contained in faeces. Drinking water should not contain organisms capable of causing disease.

There are a number of barriers in a water distribution system that may be put in place to ensure the safety of drinking water. The primary barrier is to protect against the risk of contamination in the first instance.

The Commission's priority classification system, associated water quality objectives and ultimate land use controls aim to avoid, minimise or manage the risk of groundwater contamination, depending on the vulnerability of the source to contamination, the strategic nature of the source and the existing land use in the area.

Groundwater quality monitoring of the source should recognise potential contamination risks from land use and ensure key characteristic parameters are included.

8.2 Best management practices

There are opportunities to significantly reduce risks to water quality by carefully considering site design and management practices. The adoption of best management practices for land use activities is encouraged to help protect water quality.

Education (e.g. signs and informative material) is a key mechanism to highlight water quality protection measures to people.

On freehold land the Commission aims to inform landowners and managers on protection of public drinking water sources through environmental management guidelines and other informative material. The Commission recommends the use of best management practice for water quality protection through the provision of management advice.

8.3 Land use planning

Establishing appropriate protection mechanisms in statutory land use planning processes is essential to secure the long term protection of water sources.

It is appropriate that the proposed Water Reserve and priority classifications be recognised in the Shire of Halls Creek's Local Rural Strategy and subsequently in the Town Planning Scheme.

8.4 Emergency response

Escape of chemicals during unforeseen incidents and use of chemicals during emergency response can cause groundwater contamination. A locality plan should be provided to the Fire and Rescue Services headquarters for the HAZMAT Emergency Advisory Team. The Water and Rivers Commission should have an advisory role in any HAZMAT incident in the Shire of Halls Creek Water Reserve.

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

8.5 Land use, potential water quality risks and recommended strategies

The table on page 21 details the existing land uses in the Water Reserve, the potential water quality risks and leads through a discussion to a recommended strategy to mange the risk.

The discussion and recommended strategies balance the need to protect water quality for the community in the long-term, with the rights of land holders to continue to utilise land for currently approved purposes.

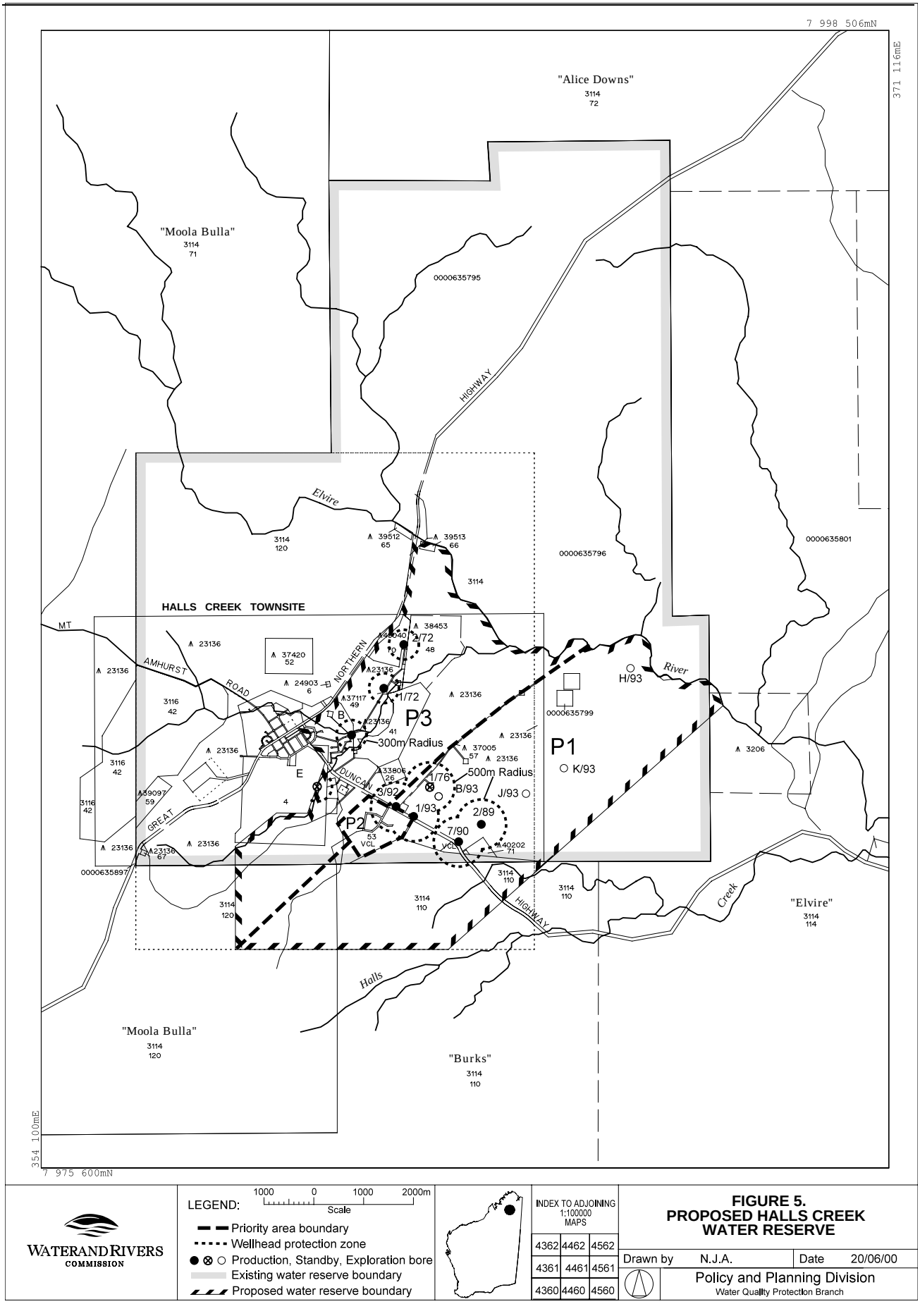


Figure 5. Proposed Halls Creek Water Reserve

Recommendations

1. The Halls Creek Water Reserve boundary should be amended as shown in **Figure 5**.

2. The Town Planning Scheme should recognise the Halls Creek Water Source Protection Plan and support land uses compatible with the priority classifications. Also, planning strategies should incorporate the management principles outlined in the Water and Rivers Commission's *Land Use Compatibility within Public Drinking Water Source Areas* (see Appendix 1) and reflect the Priority classifications given to the Water Reserve.

3. Development proposals in the Water Reserve that are likely to impact on water quality should be referred to the Water and Rivers 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 Halls Creek Water Reserve should be addressed through the following measures:

- The Halls Creek Local Emergency Management Advisory Committee (through the Broome Emergency Management District) being familiar with the location and purpose of the Halls Creek Water Reserve.
- The locality plan for the Halls Creek Water Reserve being provided to the Fire and Rescue Services headquarters for the HAZMAT Emergency Advisory Team.
- The Water and Rivers Commission advising the HAZMAT Emergency Advisory Team during incidents in the Halls Creek 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 surveillance program should be established to identify any incompatible land uses or potential contaminant threats within the Halls Creek Water Reserve, especially within the special rural area.

7. The program of water quality monitoring for production bores should be reviewed in light of contamination risks within the Halls Creek Water Reserve.

8. Monitoring of groundwater quality at the Wastewater Treatment Plant should continue as required by the Department of Environmental Protection's licence.

9. The operation and management of the Agriculture Western Australia stock handling facility should be reviewed to ensure water quality protection objectives are being met.

10. Bunding and security of fuel storage and transfer systems at bores E and 1/76 should be upgraded.

Implementation strategy

No	Description	Implemented by	Timing
1.	Gazettal of the revised Halls Creek Water Reserve.	Program Manager, Protection Planning (WRC).	On completion of final plan
2.	Incorporation into land planning strategies.	Shire of Halls Creek, Ministry for Planning.	Ongoing
3.	Referral of all development proposals within the Water Reserve to the WRC.	Shire of Halls Creek, Ministry for Planning, Department of Environmental Protection, Department of Minerals and Energy and other statutory agencies.	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, North-West Region (WRC) / Regional Business Manager, North West (WC). (iii) Regional Manager, North-West Region (WRC) / Regional Business Manager, North West (WC).	 (i) 2002 (ii) 2002 (iii) to be determined
5.	Surveillance program: (i) Develop guidelines for the surveillance of Water Reserves. (ii) Consider delegation of surveillance and by-law enforcement to Water Corporation. (iii) Implement the surveillance program.	 (i) Program Manager, Protection Planning (WRC). (ii) WRC and WC. (iii) Regional Manager, North-West Region (WRC) / Regional Business Manager (WC).	 (i) 2002/2003 (ii) 2002/2003 (iii) Ongoing

6.	Incidents covered by WESTPLAN – HAZMAT in the Halls Creek Water Reserve should be addressed through the following measures: (i) The Halls Creek Local Emergency Management Advisory Committee (through the Broome Emergency Management District) being familiar with the location and purpose of the Halls Creek Water Reserve. (ii) The locality plan for the Halls Creek Water Reserve being provided to the Fire and Rescue Services headquarters for the HAZMAT Emergency Advisory Team. (iii) The Water and Rivers Commission advising the HAZMAT Emergency Advisory Team during incidents in the Halls Creek 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.	(i) Halls Creek Local Emergency Management Advisory Committee (through WRC North-West region) (ii) WRC (North-West region) (iii) WRC (iv) Halls Creek Local Emergency Management Advisory Committee	(i) ASAP (ii) 2002 (iii) Ongoing (iv) Ongoing
7.	Review monitoring program.	Water Corporation.	Ongoing
8.	Monitoring of groundwater quality at the Wastewater Treatment Plant should continue as required by the Department of Environmental Protection's licence.	Water Corporation & Department of Environmental Protection.	Ongoing
9.	Review operation and management of Agriculture Western Australia stock holding facility.	WRC in consultation with Agriculture Western Australia	2002/2003
10.	Upgrade bunding and security of fuel storage and transfer systems at bores E and 1/76.	Water Corporation	ASAP
11.	Review of this plan and recommendations.	Water Quality Protection Branch (WRC).	(i) Review implementation plan annually (ii) Full review after 5 years

References

Davidson, W. A, 1992, *Halls Creek town water supply drilling investigation 1992*, Geological Survey of Western Australia, Hydrogeology Report No. 1992/47.

Davidson, W. A, 1993, *Halls Creek town water supply groundwater investigation 1993*, Geological Survey of Western Australia, Hydrogeology Report No. 1993/22.

Golder Associates 1997, *Geotechnical Investigations, Evaporation Pond, Wastewater Treatment Plant, Halls Creek,* Report No. 97640147.

Golder Associates 1997, *Hydrogeological Investigations, Halls Creek Wastewater Treatment Plant, Halls Creek,* Report No. 97640147-B.

Harasymow, R. J, 1994, *Halls Creek groundwater scheme review*, Water Authority of Western Australia, Water Resources Directorate Report No. WG206, Nov. 1994.

Holmes David, 1995, *Kimberley Towns Groundwater Protection Plans – Broome, Derby, Fitzroy Crossing, Hall's Creek, Kununurra.* Draft Summary Reports, Water Authority of Western Australia, June 1995.

Laws, A. T, 1990, Halls Creek town water supply hydrogeological investigation May 1990, Geological Survey of Western Australia, Hydrogeology Report No. 1990/23.

Water Corporation 1999, *Halls Creek Water Source Review*, Water Corporation, Infrastructure Planning Branch Report No. A4-743.

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 Drinking Water Source Area	(PDWSA) An area proclaimed for the management and protection of water used for public drinking water supply.
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 which 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.
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.

Appendices

Appendix 1. Land use compatibility in Public Drinking Water Source Areas
Appendix 2. Photographs of land use within the Halls Creek Water Reserve

Appendix 1

Land use compatibility in Public Drinking Water Source Areas

LAND USE COMPATIBILITY IN PUBLIC DRINKING WATER SOURCE AREAS

Purpose

These notes provide the Commission's views on practices and activities related to the quality of the State's water resources. They are recommendations only, and may be varied at the discretion of the Commission.

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

Scope

These notes apply to 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*.

The notes are not intended to override the statutory role and policy of other State or local government authorities. Project proponents will need to fulfil their legal responsibilities including those covering land use planning, environmental, health and building permit matters.

PDWSA 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 conditional development is allowed.

Priority 3 (P3) source protection areas are defined to **manage 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** for land use activities. 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 conditions 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). Alternatively 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 activity 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

Compatible	The land use is compatible with the management objectives of the priority classification.
Conditional	The land use can be compatible with the management objectives of the priority classification, with appropriate site management practices. All conditional developments / activities should be referred to the Commission for assessment on a case specific basis.
Incompatible	The land use is incompatible with the management objectives of the priority classification. Any such development proposals received may be referred for formal Environmental Impact Assessment under Environmental Protection Act,
Extensive	Where limited additional inputs are required to support the desired land use. eg supplementary animal feed only during seasonal dry periods.
Intensive	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 following 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.
E-mail: use the {feedback} section at our Internet address (http://www.wrc.wa.gov.au) citing the topic and version.

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]	Conditional[7]
Apiaries on Crown land	Conditional	Conditional	Conditional
Aquaculture eg. crustaceans, fish, algae	Incompatible	Conditional	Conditional
Dairy sheds	Incompatible	Incompatible [11,15]	Conditional [15]
Feedlots	Incompatible	Incompatible	Conditional
Livestock grazing - pastoral leases	Conditional	Compatible	Compatible
Livestock grazing - broad acre (extensive)	Incompatible	Conditional [11]	Compatible
Livestock grazing (intensive)	Incompatible	Incompatible	Conditional [11]
Piggeries	Incompatible	Incompatible	Incompatible
Poultry farming (housed)	Incompatible	Conditional	Conditional
Stables	Incompatible	Conditional	Compatible

AGRICULTURE - PLANTS

Land use / practices	Priority 1	Priority 2	Priority 3
Broad land cropping i.e. non-irrigated	Incompatible	Conditional [1]	Compatible
Floriculture (extensive)	Incompatible	Conditional	Compatible
Floriculture (intensive)	Incompatible	Incompatible	Conditional
Horticulture- hydroponics	Incompatible	Conditional	Conditional
Horticulture - market gardens	Incompatible	Incompatible	Conditional
Orchards	Incompatible	Conditional	Compatible
Nurseries (potted plants)	Incompatible	Conditional	Compatible
Silviculture (tree farming)	Conditional	Conditional	Compatible
Soil amendment (clean sand, loam, clay, peat)	Incompatible	Conditional	Compatible
Soil amendment (industry byproducts & biosolids),	Incompatible	Incompatible	Conditional
Turf farms	Incompatible	Incompatible	Conditional
Viticulture (wine & table grapes)	Incompatible	Conditional	Compatible

DEVELOPMENT – COMMERCIAL

Land use	Priority 1	Priority 2	Priority 3
Aircraft servicing	Incompatible	Incompatible	Conditional [6]
Airports or landing grounds	Incompatible	Incompatible	Conditional [6]
Amusement centres	Incompatible	Incompatible	Compatible [6]
Automotive businesses	Incompatible	Incompatible	Conditional [6]
Boat servicing	Incompatible	Incompatible	Conditional [6]
Catteries	Incompatible	Compatible	Compatible
Caravan and trailer hire	Incompatible	Incompatible	Conditional [6]
Chemical manufacture / formulation	Incompatible	Incompatible	Conditional [6]
Consulting rooms	Incompatible	Incompatible[7]	Compatible [6]
Concrete batching and cement products	Incompatible	Incompatible	Conditional
Cottage Industries	Conditional	Conditional	Compatible
Dog kennels	Incompatible	Conditional	Conditional
Drive in / take-away food shops	Incompatible	Incompatible	Compatible [6]
Drive -in theatres	Incompatible	Incompatible	Compatible [6]
Dry cleaning premises	Incompatible	Incompatible	Conditional [6]
Dye works	Incompatible	Incompatible	Conditional [6]
Farm supply centres	Incompatible	Incompatible[7]	Conditional
Fertiliser manufacture / bulk storage depots	Incompatible	Incompatible	Conditional
Fuel depots	Incompatible	Incompatible	Conditional
Garden centres	Incompatible	Incompatible	Compatible
Laboratories (analytical , photographic)	Incompatible	Incompatible	Conditional [6]
Markets	Incompatible	Incompatible	Compatible [6]
Mechanical servicing	Incompatible	Incompatible	Conditional [6]
Metal production / finishing	Incompatible	Incompatible	Incompatible
Milk transfer depots	Incompatible	Incompatible	Conditional

Land use	Priority 1	Priority 2	Priority 3
Pesticide operator depots	Incompatible	Incompatible	Incompatible
Restaurants and taverns	Incompatible	Incompatible	Compatible [6]
Service stations	Incompatible	Incompatible	Conditional [6]
Shops and shopping centres	Incompatible	Incompatible[7]	Compatible [6]
Transport & municipal works depots	Incompatible	Incompatible	Conditional
Vehicle parking (commercial)	Incompatible	Incompatible	Compatible
Vehicle wrecking and machinery	Incompatible	Incompatible	Conditional
Veterinary clinics / hospitals	Incompatible	Incompatible[7]	Conditional [6]
Warehouses	Incompatible	Incompatible[7]	Conditional [6]

DEVELOPMENT - INDUSTRIAL

Land use	Priority 1	Priority 2	Priority 3
Heavy Industry	Incompatible	Incompatible	Incompatible
Light or general Industry	Incompatible	Incompatible	Conditional [6]
Power Stations / Gasworks	Incompatible	Incompatible	Incompatible
Petroleum refineries	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	Conditional
Civic buildings	Incompatible	Conditional[7]	Compatible [6]
Clubs - sporting or recreation	Incompatible	Conditional	Compatible [6]
Community halls	Incompatible	Conditional[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	Conditional [6]
Medical, veterinary, dental centres	Incompatible	Incompatible	Compatible [6]
Toilet blocks and change rooms	Incompatible[7]	Conditional	Compatible

EDUCATION / RESEARCH

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

EXPLORATION, MINING AND MINERAL PROCESSING

Land use	Priority 1	Priority 2	Priority 3
Extractive industries (sand, clay, peat and rock)	Conditional [2]	Conditional [2]	Conditional [2]
Mineral and energy source exploration	Conditional [4]	Conditional [4]	Conditional [4]
Mining	Conditional [4]	Conditional [4]	Conditional [4]
Mineral processing	Incompatible	Incompatible	Conditional [4]
Oil or gas extraction / decontamination for transport	Conditional [4]	Conditional [4]	Conditional [4]
Tailings dams	Incompatible	Incompatible	Conditional [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	Conditional [6]
Food Processing	Incompatible	Incompatible	Conditional [6]
Manure stockpiling / processing facilities	Incompatible	Incompatible[7]	Conditional
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	Conditional [6]
Composting / soil blending (commercial)	Incompatible	Incompatible	Conditional
Forestry product processing- pulp & paper, timber preservation, or wood fibre works	Incompatible	Incompatible	Conditional
Vegetable / food processing	Incompatible	Incompatible	Conditional [6]
Wineries	Incompatible	Conditional [15, 18]	Conditional [15]

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	Conditional [8,9]	Conditional [8]
Special rural subdivision to a lot size between 1 and 2 ha	Incompatible	Incompatible	Conditional [8,9]
Special rural subdivision to a lot size less than 1 ha	Incompatible	Incompatible	Incompatible [9]
Urban subdivision	Incompatible	Incompatible	Compatible [6]
Industrial subdivision	Incompatible	Incompatible	Conditional [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	Conditional [1]
Motor sports i.e. permanent racing facilities	Incompatible	Incompatible	Conditional
Public swimming pools	Incompatible	Incompatible	Conditional
Recreational parks -irrigated	Incompatible	Incompatible	Conditional [1]
Rifle ranges	Incompatible	Conditional	Compatible

STORAGE/ PROCESSING OF TOXIC AND HAZARDOUS SUBSTANCES (THS)

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

TOURISM ACCOMMODATION

Land use	Priority 1	Priority 2	Priority 3
Bed and breakfast accommodation	Incompatible	Conditional [6]	Compatible
Caravan parks	Incompatible	Incompatible	Conditional [6]
Farm stay accommodation	Incompatible	Conditional [16]	Compatible
Motels, hotels, lodging houses, hostels, resorts	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	Conditional
Landfills -Class IV and V	Incompatible	Incompatible	Incompatible
Recycling depots	Incompatible	Incompatible	Conditional
Refuse transfer stations	Incompatible	Incompatible	Conditional
Sewers (gravity)	Incompatible	Incompatible	Compatible
Sewers (pressure mains)	Incompatible	Conditional	Compatible
Sewage pump stations	Incompatible	Conditional	Conditional
Used tyre storage / disposal facilities	Incompatible	Incompatible	Incompatible
Wastewater treatment plants	Incompatible	Incompatible	Conditional
Wastewater application to land	Incompatible	Incompatible [17]	Conditional

OTHER DEVELOPMENTS

Land use	Priority 1	Priority 2	Priority 3
Caretaker's housing	Incompatible[7]	Conditional	Compatible
Drinking water treatment plants	Conditional	Conditional	Conditional
Communications receivers / transmitters	Conditional	Conditional	Conditional
Construction projects (not shown elsewhere)	Conditional	Conditional	Conditional
Drinking water treatment plants	Conditional	Conditional	Conditional
Forestry	Conditional [1]	Compatible	Compatible
Major transport routes	Incompatible	Conditional [10]	Compatible
Construction /Mining camps,	Conditional	Conditional	Conditional
Prisons	Incompatible	Incompatible	Conditional [6]
National and Regional Parks [13]	Compatible	Compatible	Compatible
Nature reserves	Compatible	Compatible	Compatible

Table reference notes:

1. Conditions may limit fertiliser and pesticide application.

2. Conditions cover the storage of fuels and chemicals, the depth of excavation in relation to the water table with specified guidelines for rehabilitation.

3. Conditions cover the storage and use of fuel and other chemicals.

4. Conditions placed via the Department of Minerals and Energy lease and / or Environment Minister's /Department of Environmental Protection 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. May be accepted if this facility is necessary to support acceptable land use in the area and is consistent with State and local government planning strategies.

8. Lots should only be created where land capability allows effective on-site soakage disposal of treated wastewater. Conditions apply to siting of wastewater disposal systems in areas with poor land drainage 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 accepted with maintenance requirements.

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 specified blocks stating that further subdivision cannot occur.

10. Conditions cover 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. Conditions apply on density of accommodation in Priority 2 areas.

17. May be permitted if the quantity and quality are compatible with water quality protection objectives.

18. Size of annual grape crush does not exceed 500 tonnes and grapes sourced from operator's vineyards within the P2 area.

Appendix 2

Photographs of land use within the Halls Creek Water Reserve

Plate 1: Bore 3/92

Plate 2: Stock crate wash-down

Plate 3: Cattle dip tank

Plate 4: Duncan Highway