Department of Water
Government of Western Australia

Sovereign Hill Water Reserve
Drinking Water Source Protection Plan

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Sovereign Hill Water Reserve Drinking Water Source Protection Plan

Department of Water

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Preface

The Department of Water has prepared this Drinking Water Source Protection Plan to report on the activities and risks to water quality within the proposed Sovereign Hill Water Reserve and to recommend management strategies to minimise the identified risks.

A safe drinking water supply is critical to the well-being of the community and catchment protection is necessary to help avoid, minimise or manage risks to water quality. The Department is committed to protecting drinking water sources to ensure the continued supply of 'safe, good quality drinking water' to consumers.

The Australian Drinking Water Guidelines recommend a multiple barrier 'catchment to consumer' approach to protect public drinking water. The protection and management of drinking water catchments is the 'first barrier', with subsequent barriers implemented at the water storage, treatment and distribution stages of a water supply system. Catchment protection includes understanding the catchment, the hazards and hazardous events that can compromise drinking water quality, and developing and implementing preventive strategies and operational controls to ensure the safest possible raw water supply.

This plan details the location and boundary of the drinking water catchment, which provides potable water to the Sovereign Hill Estate. It discusses existing and future usage of the water source, describes the water supply system, identifies risks and recommends management approaches to maximise protection of the catchment.

This plan should be used to guide State and local government land use planning decisions. It should be recognised in the Shire of Gingin's Town Planning Scheme, consistent with the Western Australian Planning Commission's Statement of Planning Policy No. 2.7 - Public Drinking Water Source Policy. Other stakeholders should use this document as a guide for protecting the quality of drinking water supplied to consumers at Sovereign Hill.

Stages in development of this Plan		Comment
1	Prepare Drinking Water Source Protection Assessment	Assessment document prepared following catchment survey and preliminary information gathering from government agency stakeholders.
2	Conduct stakeholder consultation	Advice sought from key stakeholders using the assessment as a tool for background information and discussion.
3	Prepare Draft Drinking Water Source Protection Plan	Draft Plan developed taking into account input from stakeholders and any additional advice received.
4	Release Draft Drinking Water Source Protection Plan for public comment	Draft Plan released for eight week public consultation period.
5	**Publish completed Drinking Water Source Protection Plan**	**Final Plan published after considering advice received in submissions. Includes recommendations on how to protect the drinking water source.**

Summary

Sovereign Hill, a rural residential estate in the Gingin Coast region of Western Australia, obtains its drinking water supply from a Water Corporation well field that draws groundwater from within the superficial sediments of the Perth Sedimentary Basin.

The aquifer is unconfined and recharge occurs from direct infiltration of local rainfall. This means that the quality of the groundwater source needs to be protected from land uses both within, and in close proximity to the estate. Therefore careful management is required to ensure that nearby land uses do not affect the quality of water supplied. A reasonable degree of protection is in place within the estate in that clearing of natural vegetation is discouraged and commercial activities (such as horticulture and the keeping of animals) are not permitted.

The estate is unsewered, and the majority of lots are less than two hectares in area. From a water quality protection point of view this is not ideal, as lot sizes of two hectares or greater are recommended by the Department for an unsewered subdivision on special rural zoned land, and at least four hectares for rural zoned land.

Within close proximity to the estate, there is a market garden to the north, which is currently inactive. A turf farm is also located to the estate's east. As such, there may be potential for elevated levels of nutrients to enter the groundwater source from these activities.

This Plan proposes a Water Reserve be proclaimed to protect the quality of the source. The boundary and priority classifications have been determined to provide the appropriate level of protection for the drinking water source, recognising the rights of landowners to continue established approved land use activities.

The following strategies are recommended to protect the Sovereign Hill drinking water source:

- The Wellhead Protection Zone for the reserve needs to be clearly identified to ensure the appropriate level of protection for the drinking water source.
- The Water Reserve, including the Wellhead Protection Zone and Priority 1, 2 and 3 classifications, should be recognised in the Shire of Gingin's Town Planning Scheme and other applicable land use planning schemes and strategies.
- The management principles outlined in this plan should be incorporated into the Shire of Gingin's Town Planning Scheme and other applicable land use planning schemes and strategies.
- A review of the water quality monitoring program for the production bores is recommended to ensure that key parameters are being tested for; and

- Best management practices for current or approved land uses in the catchment should be implemented.

The above mentioned priority classifications areas and the Wellhead Protection Zones provide guidance on appropriate land use planning decisions to protect this drinking water resource. These priority areas and protection zones recognise established approved land uses but may constrain expansion of those uses, or development of alternative future land uses. Information on appropriate land uses within this Water Reserve can be found in the Department's *Water Quality Protection Note - Land Use Compatibility in Public Drinking water Source Areas*. In order to protect water quality, best management practice at design, construction and operational stages is recommended for existing and future land use developments.

1 Drinking water supply system

1.1 Existing water supply system

Groundwater is abstracted from the Water Corporation well field located within the Sovereign Hill estate (see Figure 1).

The well field currently consists of two production bores (1/96 and 2/96) that draw water from the local shallow unconfined aquifer (refer to Figure 2). The bores operate on a duty/standby basis with annual output shared equally between the bores.

It should be noted that the historic planning approval for Sovereign Hill was based on water being available from either a private or community owned/operated water source. As such the higher requirements for assessment and approval that apply to public water supply sources were not required. Now that the source has been made a public water supply source these requirements will need to be achieved, including:

- establishing appropriate priority areas (P1, P2 and/or P3) and protection zones to guide future land use planning decisions; and
- proclaiming of the source under the *Country Areas Water Supply Act 1947,* in order to allow by-laws to be applied to protect water quality.

A guide on the assignment of priority areas and protection zones can be viewed in the Department's Water Quality Protection Note *Land Use Compatibility in Public Drinking Water Source Areas* at, www.water.wa.gov.au click 'Water quality', then 'Publications' and then 'Water Quality Protection Notes'.

1.2 Water treatment

The water is treated to reduce hardness and chlorinated before being supplied to the estate. Appendix A provides information on water quality in the bores prior to treatment.

1.3 Catchment details

1.3.1 Physiography

The physiography of the Sovereign Hill area is dominated by the coastal dune system of the Perth Basin, which extends along the coast from Perth to Lancelin. The aeolian and beach lime sand found in the area is known as the Safety Bay Sand.

1.3.2 Climate

Sovereign Hill has a temperate climate with hot, dry summers and mild, wet winters. The long term average annual rainfall is about 670 millimetres. Most rain results from winter cold front systems that cross the coast between May and October.

1.3.3 Hydrogeology

Sovereign Hill is located in the central part of the Perth Sedimentary Basin. The Quaternary superficial sediments in the area comprise Tamala Limestone, Ascot Formation and Safety Bay Sand. The Cretaceous chalk and calcareous mudstones of the Lancelin Formation and the interbedded sandstone layers of the Leederville Formation underlie these.

The Sovereign Hill water supply bores draw groundwater from the unconfined aquifer within the superficial sediments. Bore 1/96 is drilled about 95 metres deep and has a water level about 69 metres below the natural surface. Bore 2/96 was drilled on lower ground, to a depth of about 75 metres and has a water level about 52 metres below the natural surface.

Recharge to the aquifer is widespread across the region and results from direct infiltration of rainfall. Regional groundwater flow is south westerly. The bores predominantly capture groundwater as it flows from east of the estate towards the ocean where it discharges along the shoreline above a saltwater wedge.

The unconfined nature of the aquifer makes it vulnerable to contamination from inappropriate land uses.

1.4 Future water supply requirements

Current demand is within the capacity of the existing bores and future increases in demand are expected to be met without the need for further upgrades.

Risk assessment work undertaken at Sovereign Hill has identified existing and potential incompatible land uses in the public drinking water source area and they will need to be actively managed to prevent contamination. This will require the combined efforts of the landholders, the water service provider, the Department and agencies responsible for statutory land use planning approval, to apply the principles and recommendations set out in this plan.

There may be other options that the Water Corporation could consider for supplying potable water to the estate. These options would have varying degrees of cost, and range from drilling new bores in the unconfined aquifer (away from influence of activities of the estate and possible impacts), to ultimately a trunk-line connection to the Integrated Water Supply Scheme (which supplies the Perth metropolitan area).

1.5 Water allocation

Water resource use and conservation in Western Australia is administered by the Department of Water in accordance with the *Rights in Water and Irrigation Act 1914*. Under the Act, the right to use and control surface and groundwater is vested with the Crown. This Act requires licensing of groundwater abstraction within proclaimed groundwater areas.

Sovereign Hill is located within the Gingin Groundwater Area, which was proclaimed in 1975 under the *Rights in Water and Irrigation Act 1914* to allocate groundwater resources within its boundaries and to manage its sustainable use.

The Water Corporation is licensed to draw 200 Megalitres of water per year from the Sovereign Hill well field for the purpose of public water supply. The actual quantity of water abstracted in 2004 was approximately 45 Megalitres, and in 2005 nearly 40 Megalitres was abstracted.

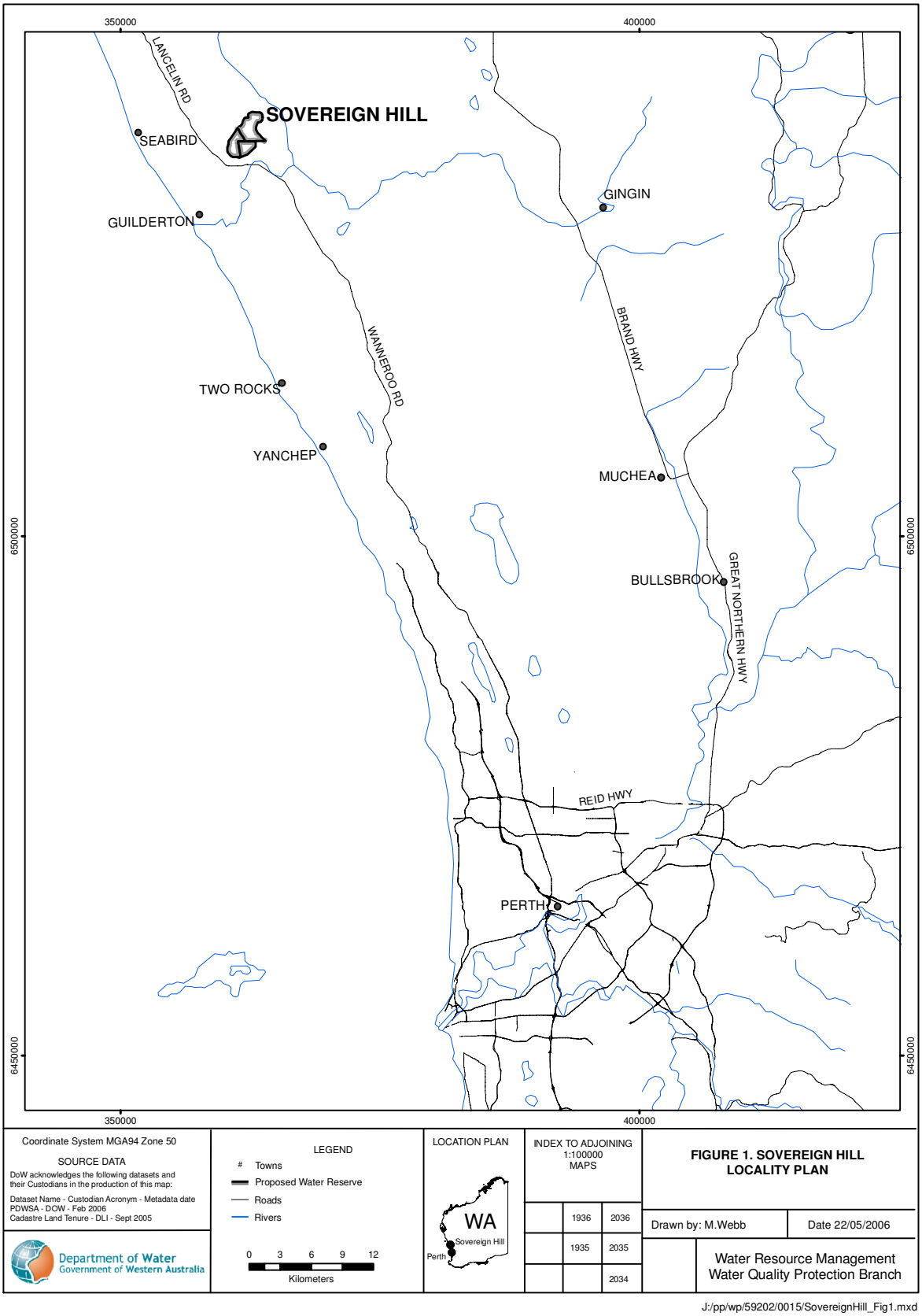

Figure 1. Sovereign Hill locality map

2 Water quality

The quality of raw water from the Sovereign Hill bores is monitored in accordance with the *Australian Drinking Water Guidelines (ADWG)* and the program set out in the Sovereign Hill Water Resource Management Operation Strategy (Miotti, 2003). It is regularly monitored for microbiological contamination, health related chemicals and aesthetic chemicals and parameters.

Historically, water has been of good quality, generally meeting ADWG values. Salinity from the well field is typically 550 mg/L Total Dissolved Solids (TDS).

No significant salinity trends are evident and raw water quality, with the exception of calcium carbonate (Hardness (CaCO3)), is within guideline values. Groundwater in the superficial aquifer in this area is naturally hard and is not a result of land use impacts. Fluoride is below the Health Department guideline recommended for Sovereign Hill.

Quality in Bore 2/96 is slightly better than Bore 1/96. This was evident when the bores were installed and has remained the case throughout their operation. The higher nitrate content in Bore 1/96 is possibly influenced by the (currently inactive) pre-existing large horticultural enterprise about 500 metres to the north east. Water from Bore 1/96 also has more calcium carbonate (hardness) and sodium chloride, which accounts for its consistently higher salinity. There is no evidence of pesticides in either bore.

A monitoring well (MW1) drilled in the very north east corner of the estate could be reopened, if it remains serviceable, as a sampling point to provide early warning of any changes in water quality.

The water is treated to reduce hardness and chlorinated before being supplied to the estate. Summary details of raw water quality from the well field are shown in Appendix A.

3 Land use and contamination risk

3.1 Existing land uses

Land uses and activities within close proximity of Sovereign Hill estate are shown in Figure 2.

The production bores, Bore 1/96 and Bore 2/96, are located within the estate where the only permitted land use is rural residential. The immediate recharge area for the bores extends to the north and east of the estate. The market garden to the north of the estate is currently not operational, although it is understood that operations may resume in the future. Dryland farming (pastoral grazing) occurs immediately to the east, and a turf farm operates beyond that.

3.2 Proposed land uses

Future development proposals near Sovereign Hill need to be considered and based on pro-active drinking water source protection, with sustainable water use planning being considered concurrently with, and as a key part of, statutory land use planning processes. This means that the Shire of Gingin's Town Planning Scheme needs to both incorporate and be aligned with the management principles in this Plan. Appropriate consideration of water source protection and, where required, consultation at an early stage by proponents preparing development proposals also needs to be undertaken.

3.3 Potential water quality risks

The potential risks to groundwater quality associated with established activities in the recharge areas include chemical or fuel spills; pesticides; and pathogen or nutrient contamination from fertilisers, septic tanks and other sources. Pathogens are the most significant risk to public health, as only very small numbers can have considerable impact. In general, when pathogens are present they are at low (and therefore difficult to detect) levels. Water can be contaminated through contact with human and animal waste. The risks are reduced however, in groundwater systems, where residence time and the filtering effects of soil help to mitigate the threat.

Table 1 sets out the potential water quality risks associated with the land uses and recommends strategies for managing those risks. The strategies balance the need to protect water quality for the community in the long term, with the rights of landholders to continue to use land for permitted land uses.

Sovereign Hill estate is unsewered, and the majority of lots present are less than two hectares in area, with the dwellings present typically making use of conventional septic tanks and leach drain systems. These lot sizes, in an unsewered subdivision,

are not recommended current practice due to the potential risk for pathogens and high levels of nutrients entering the water source, particularly from septic tanks.

The Department recommends a minimum lot size of two hectares for special rural and four hectares for rural lots. Given the smaller than recommended lot sizes at Sovereign Hill estate, activities within this development have a greater potential risk to groundwater quality. This is mitigated to some extent however, by development and activities being limited under Special Provisions that the Gingin Shire has set for Rural Residential Zones. Additionally, commercial operations are not permitted and clearing of natural vegetation is discouraged.

Bore 1/96 in the north of the estate appears to have concentrations of nitrogen (nitrate and nitrite) above levels that naturally occur in the region's groundwater system – refer to Appendix A. Elevated nutrient levels are often indicative of fertiliser use associated with horticulture. Whilst raw water data for Bore 1/96 over the last four years has shown occasional peak levels of nitrogen, in general the nitrogen present is well below levels of concern as per the Australian Drinking Water Guidelines (ADWG). (Note- Peaks in nitrogen levels do not represent water supplied to consumers, as the water is treated prior to supply in order to meet ADWG compliance.)

It is noted that recently the market garden operations, on Lot 5712 (on Plan 207685) to the north of the estate, have been suspended. Lot 5712 is located up gradient of Bore 1/96, and groundwater flows in a south-westerly direction through this lot to the bore. Therefore, there would need to be careful monitoring and management of nutrients, in order to contain the potential risk to scheme water quality, if horticultural land use resumes. In consultation with the landowner, other land uses should be considered for this land, in order to provide greater protection of water quality. This may be consistent with the current zoning or be achieved through a change in zoning. The Department will discuss this and other options with the landowner and Shire.

Dryland farming activities to the east of Sovereign Hill poses a low threat, as land uses are determined to be compatible with the water quality objectives for a rural environment. There is some potential however, for elevated levels of nutrients to enter the groundwater source as a result of the turf farm operations immediately to the east of the dryland farm. The Department of Water Licence to Take Water for the turf farm operations stipulates careful monitoring, and appropriate practices to prevent and reduce the risk of elevated nutrients entering the groundwater source.

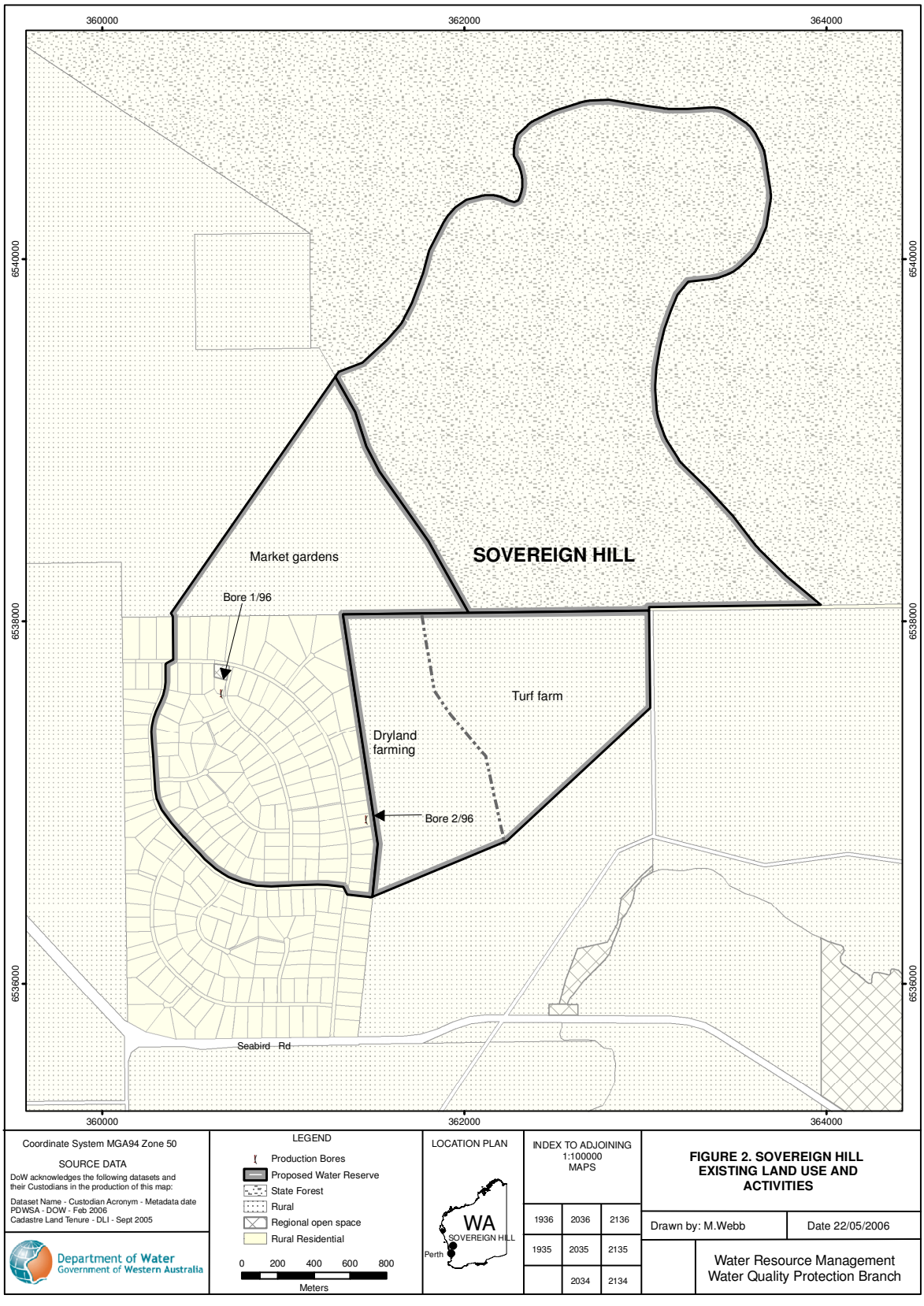

Figure 2. Sovereign Hill land use and activities

4 Catchment protection strategy

4.1 Protection objectives

The objective of this Plan is to protect drinking water quality for public health, while recognising current land use rights. The measures and management practices recommended 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.

The priority classifications and protection zones (see Figure 3), for Sovereign Hill Water Reserve, have been determined to ensure consistency with the Department's current framework for public drinking water source protection. These classifications reflect land tenure and zoning and aim to provide the appropriate level of protection for the drinking water source, while recognising the rights of landowners to continue established, approved land use/activities. The Department will encourage existing non-conforming land uses to adopt best management practices to minimise the risk to water resources, by means of industry based guidelines.

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

4.2 Proclaimed area

The proposed Sovereign Hill Water Reserve is shown in Figure 3. It covers the northern sector of the estate, part of horticultural area, State forest to the north east and farmland east of the estate.

The Reserve includes the immediate recharge area of the unconfined aquifer and extends about 2 kilometres east to provide adequate cover of the up gradient capture zone for the well field. It also covers a portion of the State Forest to the north east that will provide a protection buffer for water quality and could potentially be used to site future production bores.

4.3 Priority classifications

Land within Public Drinking Water Source Areas is assigned a Priority 1, Priority 2 and/or Priority 3 classification. The underlying aim of this is to prioritise areas to protect water quality taking into account land use information, including zoning and ownership, the importance of the water source and the vulnerability of the water body. In general, State managed (public) land and strategically important private land is identified as Priority 1, and private rural and special rural land as Priority 2. Priority 3 classification usually applies to industrial/commercial and urban zoned land that may be present. Wellhead Protection Zones of 500 metres are applied in Priority 1 areas and in Priority 2/3 areas they are 300 metres from the abstraction bore.

An explanation of the priority classification system and the detail of land use compatibility within each priority classification is provided in the Department's Water Quality Protection Notes *Land Use Compatibility in Public Drinking Water Source Areas* and *Overview on Protecting our Public Drinking Water Source Areas*. These can be found at, www.water.wa.gov.au click 'Water quality', 'Publications' and then 'Water Quality Protection Notes'.

It is proposed to classify the estate area within the Reserve and the market garden area for Priority 3 classification, the dryland farming and turf farm areas as Priority 2 and the State Forest as Priority 1.

Justification for classifying the estate and the market garden areas as Priority 3 is based on:

- the approved land uses have given rise to using management guidelines for water quality protection; and
- the aquifer is vulnerable to contamination, which may lead to degradation in quality in the long term, requiring use of an alternative water source.

Priority 2 classification of the dryland and turf farms is compatible with current allowable land uses. The uses permitted in State forest are suited to Priority 1 classification, which affords the highest level of protection to public drinking water by recognising it as a prime beneficial use of the land. This should ensure there is no degradation of water quality because the area is managed in accordance with the principle of risk avoidance, where land development is generally not permitted.

The Shire of Gingin's Town Planning Scheme needs to reflect the priority classifications assigned to the estate's water source, so that statutory land use planning processes are fully linked to this plan.

4.4 Protection zones

Wellhead protection zones are defined around each bore (500 metres radius in Priority 1 areas, and 300 metres radius in Priority 2 and 3 areas) in which activities are to be managed to maximise protection against contamination in the immediate vicinity of the production bores. These zones do not extend outside the boundary of the proposed Water Reserve.

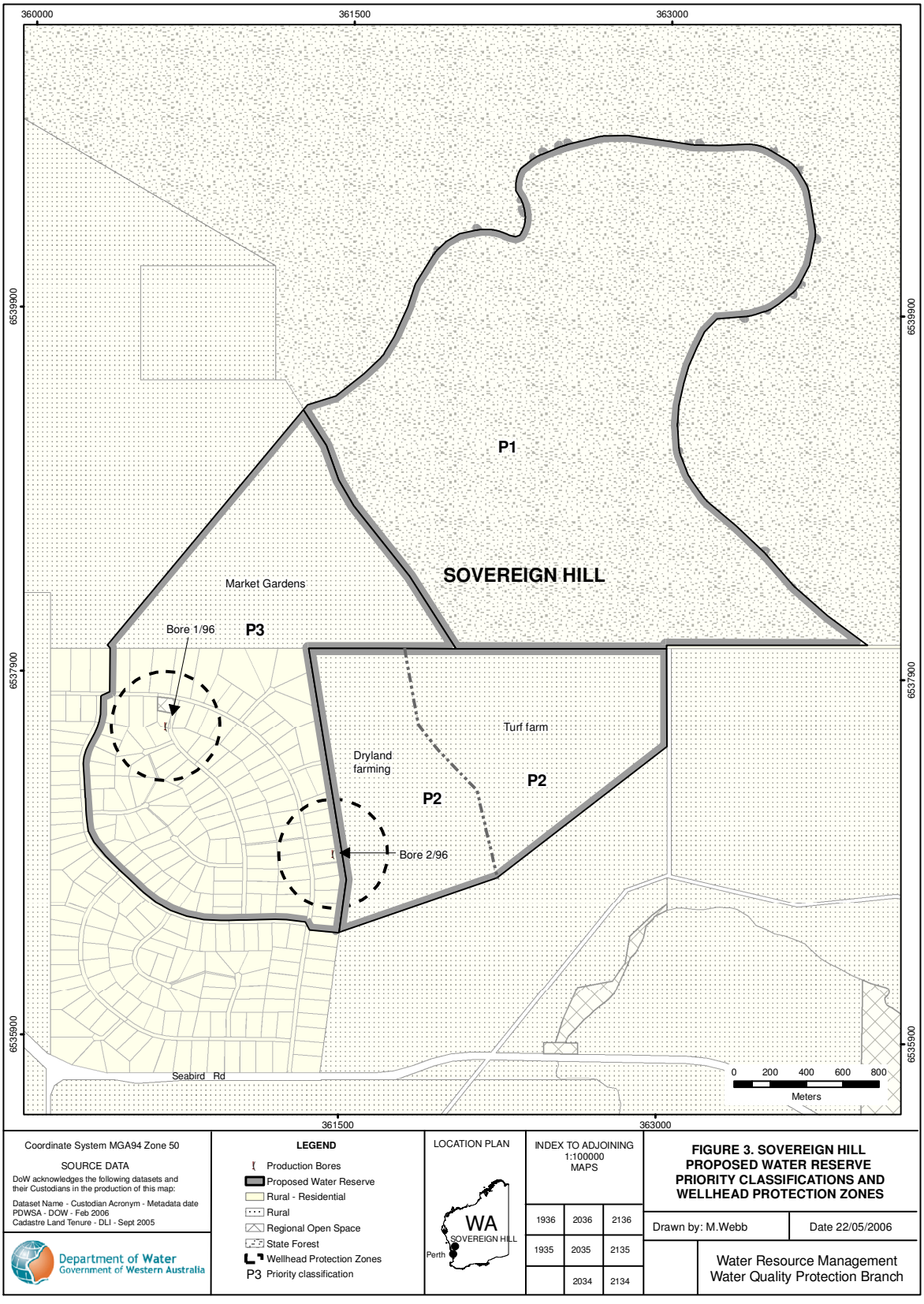

Figure 3. Sovereign Hill Water Reserve priority classifications and protection zones

4.5 Land use planning

Establishing appropriate protection mechanisms in statutory land use planning processes is essential to secure the long term protection of water sources. This means that future development proposals can be considered and based on pro-active drinking water source protection, with sustainable water use planning being considered concurrently with, and as a key part of, statutory land use planning processes.

It is recognised under the *State Planning Strategy* (Western Australian Planning Commission, 1997) that the establishment of appropriate protection mechanisms in statutory land use planning processes is necessary to secure the long-term protection of drinking water sources. As outlined in *Statement of Planning Policy No.2.7: Public Drinking Water Source Policy* (Western Australian Planning Commission, 2003) it is therefore appropriate that the Sovereign Hill Water Reserve Wellhead Protection Zones and priority classifications be recognised in the Shire of Gingin's Town Planning Scheme. Any development proposals located within this area, or deemed likely to affect the protection objectives of the Sovereign Hill Water Reserve should be referred to the Department of Water for advice and recommendations.

4.6 Best management practices

There are opportunities to significantly reduce risks to water quality by carefully considering design and management practices. The adoption of best management practices for land uses will continue to be encouraged to help protect water quality. On freehold land, the Department of Water aims to work with landowners to achieve best management practices for water quality protection through the provision of management advice, and assistance to seek funding if required.

Guidelines are available for many land uses in the form of industry codes of practice, environmental guidelines or Water Quality Protection Notes. These documents will help managers reduce the risk of their operations causing unacceptable environmental impacts and are recommended as best practice for water quality protection. Many of these documents may be accessed at our website www.water.wa.gov.au where you click 'Water quality', 'Publications' and then 'Water Quality Protection Notes'.

Examples that may be relevant to land use and activities within and near the Sovereign Hill Water Reserve include:

- Water and Rivers Commission, 1998, Water Quality Protection Note: *Nutrient and Irrigation Management Plan,* Water and Rivers Commission.
- Water and Rivers Commission, 2000, Statewide Policy No. 2 *Pesticide Use in Public Drinking Water Source Areas,* Water and Rivers Commission.

Education and awareness (eg signage and information material) is a key mechanism for water quality protection, especially for those people visiting the area who are unfamiliar with the Sovereign Hill Water Reserve. A brochure has been produced describing the Sovereign Hill Water Reserve, its location and the main threats to water quality protection. This brochure will be made available to the community and will serve to inform people in simple terms about the importance of protecting their drinking water source.

4.7 Surveillance and By-law enforcement

The quality of public drinking water sources within country areas of the State is protected under the *Country Areas Water Supply Act (1947)*. Declaration of these areas allows existing By-laws to be applied to protect water quality.

The Department of Water considers By-law enforcement, through on-ground surveillance of land use activities in Public Drinking Water Source Areas as an important water quality protection mechanism. Surveillance is also important in raising the general level of awareness about protecting water quality.

Signs are erected to educate the public and to advise of activities that are prohibited or regulated. This Plan recommends delegation of surveillance and By-law enforcement to the Water Corporation.

4.8 Emergency response

Escape of chemicals during unforeseen incidents and use of chemicals during emergency responses can result in water contamination. The Shire of Gingin's Local Emergency Management Advisory Committee (LEMAC) through the Northam Emergency Management District should be familiar with the location and purpose of the Sovereign Hill Water Reserve. A locality plan should be provided to the Fire and Rescue Services headquarters for the Hazardous Materials Emergency Advisory Team (HAZMAT). The Water Corporation should have an advisory role to any HAZMAT incident in the Sovereign Hill Water Reserve.

Personnel who deal with WESTPLAN – HAZMAT (Western Australian Plan for Hazardous Materials) incidents within the area should have access to a map of the Sovereign Hill Water Reserve to ensure an adequate understanding of the potential impacts of spills on the water resource.

4.9 Recommended protection strategies

Table 1 identifies the potential water quality risks associated with existing land uses and recommends protection strategies to minimise these risks.

Table 1 Land use, potential water quality risks and recommended strategies

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	**Management priority**			
Horticulture	Fertiliser and pesticide use on crops Contamination from hydrocarbons and other chemicals Nutrients and bacteria from ablution facilities and septic tanks	High Medium Low-medium	Market garden enterprises are upgradient of well field and pose a risk to scheme water quality. *NB This activity is currently suspended.* Turf farm – are upgradient of well field and pose a risk to scheme water.	Best management practices	*Maintain existing planning controls, with best management practices/conditions* SPECIFIC MEASURES • Continuation of current activities, with best management practices implemented that are based on rigorous monitoring, and guidance of the Department's and Water Corporation staff. • Restrict intensification of land uses through planning approval process. • Support changes in land use within existing approvals that reduce groundwater contamination risks.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	**Management priority**			
Rural residential development and estate activities	Nutrients and pathogens from septic tanks. Fertiliser and pesticide use on gardens. Nutrients and micro-organism contamination from animal excreta	High Medium	Unsewered lots of one to two hectares create a subdivision density that may compromise scheme water quality. Land planning zoning provisions limit clearing of natural vegetation. Commercial operations related to horticulture and keeping of animals is not permitted. Commercial operations including horticulture and keeping of animals, or activities that hold/discharge chemicals are not permitted.	Rural residential zoning special provisions enacted by the shire	*Acceptable activity – based on the following specific measures* SPECIFIC MEASURES • Ensure the Shire of Gingin's Special Provisions for the Rural Residential Zone adequately control development. • Encourage landowners to adopt best management practices for permitted activities – as per relevant Water Quality Protection Notes by the Department. • Support the use of appropriate alternative wastewater systems - to reduce levels of nutrients and pathogens. • Oppose land use intensification via planning approval processes. • Support changes to existing planning approval protocols that reduce groundwater contamination risks. • Promote water quality protection- by establishing priority classification areas/wellhead protection zones, appropriate signage information pitched to local residents

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	**Management priority**			
Dryland farming (pastoral grazing)	Nutrients and micro-organism contamination from animal excreta	Medium	Low density activity that is compatible with scheme water quality objectives.	None	*Acceptable activity – based on the following specific measures* SPECIFIC MEASURES • Ensure Town Planning Scheme adequately controls development. • Restrict intensification of land use through planning approval process. • Promote water quality protection.

5 Recommendations

1 Implement the recommended protection strategies as detailed in *Table 1: Land use, potential water quality risks and recommended strategies* of this Plan *(Applicable stakeholders).*

2 Proclaim the Sovereign Hill Water Reserve under the *Country Areas Water Supply Act, 1947 (Department of Water).*

3 Prepare an implementation strategy for this Plan describing responsible stakeholders and timeframes for the recommended protection strategies *(Department of Water, Appropriate Stakeholders).*

4 The Shire of Gingin should incorporate the management principles outlined in this plan in its Town Planning Scheme (currently Number 9). In particular, the scheme should reflect the levels of drinking water source protection assigned as Priority 1, 2 and 3 as well as the Wellhead Protection Zone (*Shire of Gingin*).

5 All development proposals within the Sovereign Hill Water Reserve that are likely to impact on water quality and/or quantity, or are inconsistent with *Water Quality Protection Note – Land use compatibility in Public Drinking Water Source Areas* or *Statement of Planning Policy No.2.7 – Public Drinking Water Source Policy* should be referred to the Department of Water for advice and recommendations (*Department for Planning and Infrastructure, Shire of Gingin, Developers).*

6 Incidents covered by WESTPLAN – HAZMAT in the Sovereign Hill Water Reserve should be addressed through the following (*Department of Water, Water Corporation)*:

- The Shire of Gingin's LEMAC are familiar with the location and purpose of the Sovereign Hill Water Reserve.
- The locality plan for the Sovereign Hill Water Reserve is provided to the Fire and Rescue headquarters for the HAZMAT Emergency Advisory Team.
- The Water Corporation provides an advisory role during incidents in the Sovereign Hill Water Reserve.
- Personnel dealing with WESTPLAN – HAZMAT incidents in the area have ready access to a locality map of the Sovereign Hill Water Reserve and training to understand the potential impacts of spills on drinking water quality.

7 Surveillance should be undertaken to identify any incompatible land uses or potential threats within the Sovereign Hill Water Reserve. The Department of Water should consider delegating responsibility for the surveillance and enforcement to the Water Corporation (*Water Corporation, Department of Water).*

8 Signs should be erected along the boundary of the Sovereign Hill Water Reserve to define the location and promote awareness of the need to protect drinking water quality. Signs should include an emergency contact telephone number (*Water Corporation*).

9 A review of this Plan should be undertaken at least every five years (*Department of Water*).

10 The water quality monitoring program for the production bores should be reviewed to ensure key characteristic parameters are included. Water quality analysis results should continue to be routinely reviewed to detect any trends of concern. (*Water Corporation*)

11 If still serviceable, Monitoring Well MW1 in the northeast of the estate could be reopened in order to provide early warning if elevated levels of nutrients (particularly nitrate and sulfate) occur at any stage. If this well proves not to be serviceable then a replacement monitoring well should be considered. The likely future use of the market garden on Lot 5712 (on Plan 207685) may impinge on this recommendation. (*Water Corporation*)

12 While the market garden is not operational on Lot 5712 (on Plan 207685) to the north of the estate, opportunities to change its future land use (in order to reduce the risk of water source contamination) should be progressed in consultation with the landowner. (*Shire of Gingin; Department of Planning and Infrastructure/Western Australian Planning Commission; Landowner; and Department of Water*)

Appendices

Appendix A . Water quality

Health parameters

Raw water from Sovereign Hill borefield is analysed, by Water Corporation, for health related chemicals. Health related chemicals include inorganics, heavy metals, industrial hydrocarbons and pesticides. Health related water quality parameters that have been measured at detectable levels in the sources up to April 2005 are summarised in the following table. All values are in milligrams per litre (mg/L). Monitoring is ongoing.

Parameter	**Range of monitored values Min-Max Median**			**AWDG Health Guideline Value ^**
	Bore 1/96	**Bore 2/96**	**Bore Raw Water (mixed)**	
Metals				
Arsenic	ND - 0.003 0.0015	ND*	NT	0.007mg/L
Barium	ND*	NT	0.04 - 0.075 0.056	0.7 mg/L
Boron	ND*	NT	ND - 0.02 ND	4 mg/L
Inorganic				
Fluoride	ND - 0.1 0.05	ND*	NT	1.5 mg/L
Nitrate + Nitrite (as N)	2.3 - 11.0 3.9	2 - 3.2 2.9	NT	11.3 mg/L
^A health guideline value is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption.				
ND is Not Detected	NT is Not Tested		*One test result only	

The raw water from Sovereign Hill bores complies with Australian Drinking Water Guidelines (ADWG) health guidelines.

Aesthetic water quality data

Aesthetic water quality analyses for raw water from Sovereign Hill are summarised in the following table. The values are taken from ongoing raw water monitoring by Water Corporation up to October 2005. The values are in milligrams per litre (mg/L) unless stated otherwise. Compliance with the aesthetic water quality guidelines of the Australian Drinking Water Guidelines (ADWG) is not mandatory. The only parameter that has exceeded the relevant ADWG value is Hardness ($CaCO_3$) for Bore 1/96.

Parameter	Range of monitored values Min-Max Median		AWDG Health Guideline Value ^
	Bore 1/96	**Bore 2/96**	
Salinity (TFSS less CO_2)	575 - 698 610	420 - 450 435	1 000 mg/L
Hardness ($CaCO_3$)	255 - 308 272.5	169 - 190 176	200 mg/L
Turbidity	ND - 2.4 0.2	ND - 0.4 ND	5 NTU
pH	7.3 - 7.6 7.4	7.6 - 7.7 7.7	6.5-8.5
Colour	ND - 1 ND	ND - 1 ND	15 TCU
Iron (unfiltered)	ND - 0.035 ND	0.004 - 0.2 0.012	0.3 mg/L
Manganese (unfiltered)	ND - 0.016 0.009	ND - 0.002 ND	0.1 mg/L
Aluminium (unfiltered)	ND - 0.018 ND	ND	0.2 mg/L
^A health guideline value is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption.			
ND is Not Detected	NT is Not Tested	*One test result only	

Microbiological analysis

Microbiological testing is undertaken by means of thermotolerant coliform counts. These counts are used as an indicator of the degree of faecal contamination of the raw water from warm-blooded animals. A count less than 20 coliform forming units (cfu) per 100 millilitres (mL) is typically associated with low levels of faecal contamination and is used as a microbiological contamination benchmark (World Health Organisation, 1996).

Microbiological testing of the raw water from the Sovereign Hill borefield has been conducted on a monthly basis since January 2001**,** by Water Corporation. The raw water was sampled 63 times with no positive thermotolerant coliform counts recorded.

Appendix B . Photographs

Photo 1 Sovereign Hill Bore 1/96

Photo 2 Sovereign Hill 2/96 (Dryland farming in background)

Glossary

Abstraction	The pumping of groundwater from an aquifer.
ADWG	The Australian Drinking Water Guidelines, outlining guideline criteria for the quality of drinking water in Australia.
Aesthetic guideline	NHMRC guideline level ascribed to acceptable aesthetic qualities of drinking water such as taste, smell, colour and temperature.
Allocation	The quantity of water permitted to be abstracted by a licence, usually specified in kilolitres per year (kL/a).
ANZECC	Australian and New Zealand Environment Conservation Council.
Aquifer	A geological formation or group of formations able to receive, store and transmit significant quantities of water.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand.
Bore	A narrow, lined hole, also known as a well, drilled to monitor or draw groundwater.
Borefield	A group of bores 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.
CAWS Act	Country Areas Water Supply Act 1947
CFU	Coliform forming units is a measure of pathogen contamination in water.
Diffuse source	Pollution originating from a widespread area eg urban stormwater runoff, agricultural infiltration.
Effluent	The liquid, solid or gaseous wastes discharged by a process, treated or untreated.
GL	Gigalitres (1000 000 000 litres)
ha	Hectares (a measure of area)
HAZMAT	Hazardous materials

Hydrogeology	The study of groundwater, especially relating to the distribution of aquifers, groundwater flow and groundwater quality.
kL	Kilolitres (1000 litres)
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.
LEMA	Local Emergency Management Authority
m	Metres
mg/L	Milligrams per litre (0.001 grams per litre)
ML	Megalitres (1 000 000 litres)
NHRMC	National Health and Medical Research Council.
NTU	Nephelometric turbidity units are a measure of turbidity in water.
Nutrient load	The amount of nutrient reaching the waterway over a given timeframe (usually per year) from it's catchment area.
Nutrients	Minerals dissolved in water, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorous (phosphate) which provide nutrition (food) for plant growth. Total nutrient levels include the inorganic forms of an element plus any bound in organic molecules.
P1	Priority 1 - priority classification for land use with respect to protecting a drinking water source
P2	Priority 2 - priority classification for land use with respect to protecting a drinking water source
P3	Priority 3 - priority classification for land use with respect to protecting a drinking water source
Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.
Point source pollution	Pollution originating from a specific localised source, eg sewage or effluent discharge, industrial waste discharge.

Pollution	Water pollution occurs when waste products or other substances, eg 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)	Includes all underground water pollution control areas, catchment areas and water reserves constituted under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* and the *Country Areas Water Supply Act 1947*.
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 it's distribution. Confined aquifers are recharged in specific areas where water leaks from overlying aquifers, or where the aquifer rises to meet the surface.
RIWI Act	*Rights in Water Irrigation Act 1914*
Run-off	Water that flows over the surface from a catchment area, including streams.
Stormwater	Rainwater which has run off the ground surface, roads, paved areas etc. and is usually carried away by drains.
TDS	Total dissolved salts, a measurement of ions in solution, such as salts in water.
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 in which the upper surface of water is lower than the top of the aquifer itself. 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.

Water Reserve	An area proclaimed under the *Country Areas Water Supply Act 1947* or the *Metropolitan Water Supply Sewerage and Drainage Act 1909* for the purposes of protecting a drinking water supply.
Watertable	The upper saturated level of the unconfined groundwater.
Well field	A group of bores to monitor or withdraw groundwater.
Wellhead	The top of a well (or bore) used to draw groundwater. A wellhead protection zone (WHPZ) is usually declared around wellheads in drinking water areas to protect the water source from contamination.
WHPZ	Wellhead Protection Zone

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