



Department of Water
Government of Western Australia



Tanjannerup Creek Dam Catchment Area Drinking Water Source Protection Plan

Nannup Town Water Supply

Water Resource Protection Series

REPORT NO. 70
June 2007



Department of **Water**
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Subject of cover photograph

Tanjannerup Creek Dam

All photographs taken by Phyllis Graham

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Preface

The Department of Water has prepared this Drinking Water Source Protection Plan to assess risks to water quality within the Tanjannerup Creek Dam Catchment Area and to recommend management strategies to avoid, minimise or manage those risks. The Department is committed to protecting drinking water sources to meet public health requirements and ensure the supply of 'safe, good quality drinking water' to consumers.

The Australian Drinking Water Guidelines recommend a risk based, multiple barrier approach to protect public drinking water sources. Catchment protection is the 'first barrier', with subsequent barriers implemented at the water storage, treatment and distribution stages of a water supply system. Catchment protection requires an understanding of the catchment, the hazards and hazardous events that can compromise drinking water quality, and development of preventative strategies and operational controls to ensure the safest possible water supply.

This plan details the location and boundary of the drinking water catchment, which provides potable water to the Nannup area. It discusses existing and future usage of the water source, describes the water supply system, identifies risks and recommends management approaches to address these risks and maximise protection of the Tanjannerup Creek Dam Catchment Area.

This plan should be used to guide State and Local Government land use planning decisions. It should be recognised in the Shire of Nannup 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 water in the Tanjannerup Creek Dam Catchment Area.

The stages involved in preparing a Drinking Water Source Protection Plan are:

Stages in development of a 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 a six week public consultation period.
5	Publish Drinking Water Source Protection Plan	Final Plan published after considering advice received in submissions. Includes recommendations on how to protect the catchment.

Summary

Tanjannerup Creek, a tributary of the Blackwood River, is located 5 kilometres (km) east of Nannup in the south west of Western Australia, approximately 290 km south of Perth. Tanjannerup Creek Dam (also referred to as Tanjannerup Dam and Tanjanerup Dam), constructed on Tanjannerup Creek, is used by the Water Corporation to supply public drinking water to the town of Nannup.

Nannup is located within a sub-region recognised in the scientific community as having an extremely diverse range of flora and fauna. Prior to European settlement the area was inhabited by Aboriginal tribes of the *Nyungar* groups. The word "Nannup" is an indigenous word identifying a "stopping place".

Nannup is a regional centre, servicing the timber industry and surrounding rural properties. While the timber industry remains an important component of the district's economy recently there has been growth in tourism and cottage industries. The town of Nannup supports a resident population of approximately 900.

The climate of Nannup is temperate with warm to hot, dry summers and cool, wet winters.

Nannup Catchment Area (also known as Tanjannerup Creek Catchment Area) was proclaimed in 1960 under the *Country Areas Water Supply Act (CAWS), 1947* to ensure protection of the public drinking water source from potential contamination.

This report recommends that the boundary is revised to reflect the physical drainage area of the catchment. It is recommended that this updated boundary be re-gazetted as the Tanjannerup Creek Dam Catchment Area under the *CAWS Act, 1947* to ensure adequate protection of the water supply.

Nannup town water supply is of good quality complying with Australian Drinking Water Guidelines health, microbiological and aesthetic requirements. Raw (untreated) water from Tanjannerup Creek Dam frequently exceeds the guidelines for aluminium and manganese, colour and iron and is treated prior to supply as drinking water.

Tanjannerup Creek Dam catchment covers an area of approximately 15 square kilometres (km²). Most of the land in the catchment is under Crown ownership and is managed by the Department of Environment and Conservation as State Forest. Land use is managed for water catchment protection, conservation, recreation, timber harvesting and other regulated purposes. The Department of Water delegated responsibility for catchment surveillance and By-Law enforcement within the gazetted Catchment Area to the Water Corporation.

Approximately 39 hectares of private freehold land is located in the western portion of the catchment. Approximately 13 hectares of freehold land, managed by Department

of Environment and Conservation, also in the western portion of the catchment is managed for water catchment protection and production. The Water Corporation owns and manages the reservoir and immediate surrounds.

The private freehold land to the north and south of the reservoir is zoned Rural under the Shire of Nannup Town Planning Scheme No. 3. This land is currently covered with native vegetation and is undeveloped.

Nannup Catchment Area (Tanjannerup Dam) Drinking Water Source Protection Assessment undertaken by the Water Corporation in 2004 indicated that dam water quality is at a potential risk from contamination of pathogens, hydrocarbons, herbicides and turbidity. Control measures to manage these risks currently include signage and ad-hoc ranger surveillance.

Land use activities in the catchment have the potential to contaminate the source and this plan outlines strategies that will manage these risks. Unauthorised but popular recreational activities include fishing and marroning, picnicking, camping and off-road vehicle use, occur as a result of open access to the catchment.

It is recommended that the Tanjannerup Creek Dam Catchment Area is classified for Priority 1 source protection and that the Department of Water progress negotiated purchase of all freehold land, except land owned by the Water Corporation, for management and protection of the drinking water source.

It is recommended that a reservoir protection zone (RPZ) is established to protect the water source from contamination in the immediate vicinity of the reservoir. RPZs usually consist of a 2 km buffer area around the top water level of a reservoir, apply to Crown land only, do not extend outside the catchment area, and include the reservoir itself. Special restrictions apply in these zones.

This Drinking Water Source Protection Plan has been developed in consultation with the Water Corporation, Shire of Nannup, landowners and other relevant State government departments and stakeholders.

1 Drinking water source overview

1.1 Existing water supply system

Tanjannerup Creek Dam is located on Tanjannerup Creek, a tributary of the Blackwood River, approximately 5 km east of Nannup (refer to Figures 1 and 2). It is operated by the Water Corporation to supply public drinking water to the town of Nannup.

The dam was constructed in 1961 and consists of an earthfill wall and labyrinth weir with a fully lined chute spillway. Tanjannerup Creek Dam catchment has an area of 14.96 km² with an elevation of 214.76 m Australian Height Datum (AHD) at the reservoir at full supply level and has a storage capacity of 156 Mega Litres (ML).

Raw (untreated) water from the reservoir is gravity fed to the Nannup Water Treatment Plant. Treated water is stored in a 1000 kilolitre (kL) storage tank at Dunnet Road in Nannup. The treated water is supplied to the reticulation under gravity, with elevated services requiring the use of a booster pump.

1.2 Water treatment

Raw water from Tanjannerup Creek Dam is treated before it is supplied to Nannup Townsite as drinking water. Water is treated to remove colour and turbidity by the addition of caustic soda, alum and polyelectrolyte followed by clarification and filtration. The pH of the treated water is then adjusted by soda injection and finally the water is chlorinated. Chlorination provides a disinfection barrier against possible microbiological contamination.

It should be recognised that although treatment and disinfection are essential barriers used to ensure a safe, good quality drinking water supply, catchment management and water source protection are fundamental 'first barriers' for the protection of water quality. This approach is endorsed by the Australian Drinking Water Guidelines (ADWG) (NHMRC & NRMCC, 2004) and reflects a risk based, 'catchment to consumer' multiple barrier approach for the provision of safe drinking water to consumers.

1.3 Catchment details

1.3.1 Physiography

Tanjannerup Creek Dam catchment lies on the western edge of the Darling Plateau. The Darling Plateau consists of an undulating, dissected peneplain. Soils are predominantly gravelly pale orange soils cloaked by extensive areas of tall forest. Deep steeply sided valleys occur throughout the area, occasionally punctuated by

impressive dome shaped granite outcrops with the landscape around Nannup substantially influenced by the winding course of the Blackwood River.

In some elevated areas the soils are sands and sandy loams, and in the deeper valleys the soils are heavier alluvials.

1.3.2 Climate

The climate at Nannup is temperate, with warm to hot, dry summers and cool, wet winters. Nannup (rainfall station 9585) recorded an average annual rainfall of 829.6 millimetres (mm) during the period January 1996 to December 2006, while the long-term average annual rainfall for Nannup is 937.8 mm from 1900 to 2006. The annual rainfall range is between 1099.1 mm (1996) and 596.1 mm (2006). The total rainfall recorded in 2006 was 596.1 mm and a total of 150.5 mm has fallen in the period January to May 2007.

The closest weather station is in Bridgetown, 44 km east of Nannup. The recorded mean maximum temperature ranges from 15.7 °C in July to 29.7 °C in January; and mean minimum temperature ranges from 4.4 °C in July to 12.1 °C in January.

1.3.3 Hydrology

Tanjannerup Creek Dam catchment has an elevation of 214.76 m AHD at full supply level at the reservoir, rising to 345 m AHD at the head of the catchment.

The dam typically overflows in winter, and has low flows in summer. Streamflow data has been estimated using Donnelly River in a regression model (Cicero, 1990). Average annual streamflow from 1975 to 2005 for Tanjannerup Creek at the dam is estimated to be 1564 ML.

The average yield from Tanjannerup Dam is 173 ML/annum, with a 1 in 50 year failure criteria. Lower inflows into Tanjannerup Dam have been experienced over the last five years. However, despite this the dam has continued to overflow in winter.

1.4 Future water supply requirements

Based on current growth and demand trends, Tanjannerup Dam has adequate yield to supply Nannup until around 2014. Groundwater may supplement the town water supply after this period (Water Corporation, 2001).

Groundwater sourced from the confined Yarragadee Formation is considered an alternative source for Nannup. This option requires further investigation.

1.5 Protection and allocation

1.5.1 Existing water source protection

Nannup Catchment Area (also known as Tanjannerup Creek Catchment Area) was proclaimed in 1960 under the *Country Areas Water Supply Act, 1947* for the purpose of protecting the public drinking water source from potential contamination (refer to Figure 2). The Department of Water delegated responsibility for catchment surveillance and By-Law enforcement within the gazetted Catchment Area to the Water Corporation.

Rural land in this catchment is currently considered as equivalent to Priority 1 as it is forested, close to the reservoir and highly vulnerable to contamination. The Department of Water is progressing negotiations for the purchase of this land. The Department's Water Quality Protection Note – *Land use compatibility in Public Drinking Water Source Areas* (see References) describes the Department's existing drinking water source protection approach explaining priority classifications and protection zones. This Drinking Water Source Protection Plan makes recommendations for priority classification areas and a special reservoir protection zone.

1.5.2 Current allocation licence

Water resource use and conservation in Western Australian country areas are administered by the Department of Water in accordance with the *Rights in Water and Irrigation (RIWI) Act, 1914*. Under this Act, the right to use and control surface and groundwater is vested with the Crown. This Act requires licensing of surface water abstraction within proclaimed Surface Water Areas (except for domestic and stock use).

The Department of Water has licensed the Water Corporation, under Surface Water Licence No. SWL69102(3), to draw 140,000 kL per annum (140 ML) from Tanjannerup Creek Dam for public water supply purposes. The current number of services supplied with drinking water in Nannup is 296.

Abstraction from Tanjannerup Creek Dam may exceed this amount on the proviso that the maximum is less than 110% of the licensed allocation (154 ML) and the average abstraction does not exceed the current allocation of 140 ML per year over a three year period.

Since 1996/97 the maximum surface water abstraction from Tanjannerup Dam of 134.9 ML occurred in 2004/05.

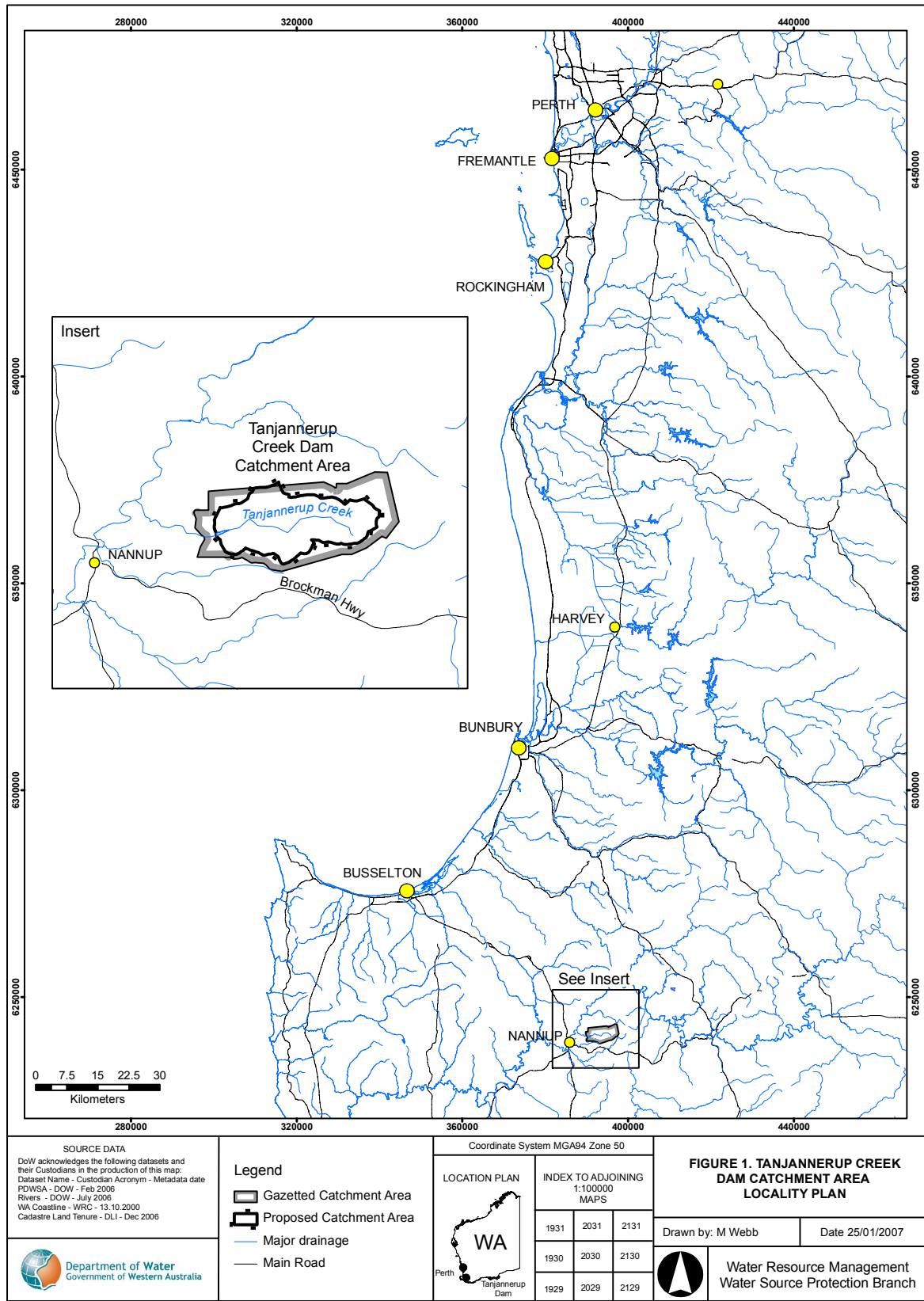


Figure 1 Tanjannerup Creek Dam Catchment Area locality map

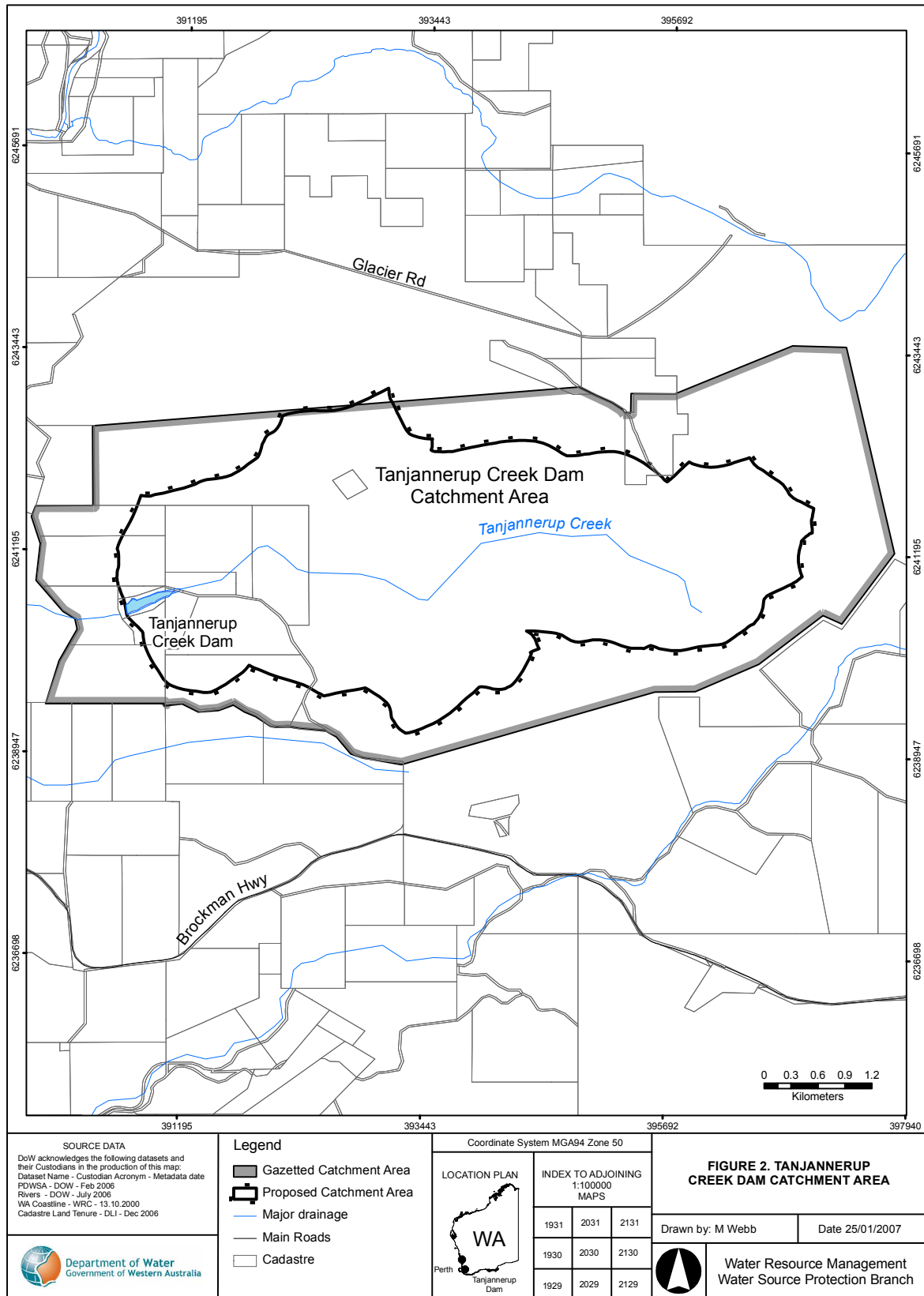


Figure 2 Tanjannerup Creek Dam Catchment Area

2 Water quality monitoring and contamination risks

The risks to water quality associated with activities in catchments include pathogen contamination, turbidity, pesticide and nutrient contamination.

The Water Corporation regularly monitors the raw water quality from the Tanjannerup Creek Dam for microbiological contamination, health related and aesthetic (non-health related) characteristics in accordance with the ADWG. The results of this monitoring are then reviewed by an intergovernmental committee, chaired by the Department of Health, called the Advisory Committee for the Purity of Water.

A water quality summary for the Tanjannerup Creek Dam from 2002 to 2007 is presented in Appendix A. For more information on water quality, see the Water Corporation's most recent Drinking Water Quality Annual Report at <www.watercorporation.com.au> > Water > Water Quality > access the most recent Annual Report.

A wide range of chemical, physical and microbiological properties can impact on water quality and therefore affect the provision of safe, good quality, aesthetically acceptable drinking water to consumers.

The water quality in Tanjannerup Creek Dam is potentially at risk from activities occurring in the catchment including public access, illegal fishing, marroning, swimming, trail bike riding and camping.

It should be recognised that although treatment and disinfection by chlorination are essential barriers used to ensure good quality drinking water, catchment management and water source protection are fundamental 'first barriers' for the protection of water quality. This approach is endorsed by the Australian Drinking Water Guidelines (ADWG) and reflects a multiple barrier 'catchment to consumer' risk based approach for the provision of safe drinking water to consumers.

2.1 Microbiological contaminants

Pathogens are types of micro-organisms that are capable of causing diseases. These include bacteria (such as *Escherichia coli*), protozoa (such as *Cryptosporidium* and *Giardia*) and viruses. In water supplies the pathogens of concern that can cause illness, such as stomach upset, diarrhoea and even death, are mostly found in the faeces of humans and domestic animals. Thermotolerant coliform counts are a way of measuring these pathogens and are an indicator of faecal contamination.

Pathogen contamination of a drinking water source is influenced by the existence of pathogen carriers (ie humans and domestic animals, such as dogs or cattle); their subsequent transfer to and movement in the water source; and the ability of the pathogen to survive in the water source.

Pathogens may enter a water source through activities involving direct contact of people and domestic animals with the main water body or its tributaries (such as fishing, marroning and swimming), primarily through the direct transfer of faecal material (even a very small amount can cause contamination), or indirectly through runoff moving faecal material into the water.

There are a number of pathogens that are commonly known to contaminate water supplies worldwide. These include bacteria (eg *Salmonella*, *Escherichia coli* and *Cholera*), protozoans (eg *Cryptosporidium*, *Giardia*) and viruses. The percentage of humans in the world that carry various pathogens varies. For example, it is estimated that between 0.6 to 4.3 per cent of people are infected with *Cryptosporidium* worldwide, and 7.4 per cent with *Giardia* (Geldreich, 1996).

The ability of pathogens to survive in surface water differs between species. For example, *Salmonella* may be viable for two to three months, *Giardia* may still infect after one month in the natural environment (Geldreich, 1996) and *Cryptosporidium* oocysts (cells containing reproductive spores) may survive weeks to months in freshwater (NHMRC & NRMCC, 2004).

The effect on people consuming drinking water that is contaminated with pathogens is considerably varied, ranging from mild illness (such as stomach upset or diarrhoea) to death. This was the case in Walkerton, Canada in 2000, where seven people died due to the contamination of a pathogenic strain of *Escherichia coli* and *Campylobacter* in the town water source and supply (NHMRC & NRMCC, 2004b). Preventing the introduction of pathogens into the water source is the most effective barrier in avoiding this public health risk.

Microbiological testing of raw water samples from Tanjannerup Creek Dam has been conducted on a regular basis since 1997. *Escherichia coli* counts are used as an indicator of the degree of recent faecal contamination of the raw water from warm-blooded animals. A count less than 20 most probable number (MPN) per 100 mL is typically associated with low levels of faecal contamination and is used as a microbiological contamination benchmark of the raw water (WHO, 1996).

During the reviewed period of January 2002 to June 2007, positive *Escherichia coli* counts were recorded in 92.8% of samples. Approximately 24.3% of these samples had *Escherichia coli* counts greater than 20 MPN/100mL.

The raw water is treated then disinfected with chlorine to ensure the microbiological quality of the drinking water supplied to consumers. After treatment the drinking water complies with ADWG microbiological requirements with one positive detection of thermotolerant coliforms in Nannup Town Water Supply since 1999. Refer to Appendix A for more detail.

2.2 Health related characteristics

Land use activities within the catchment can directly influence the effectiveness of water treatment. For example, off road driving and driving on unauthorised tracks contributes to erosion and the uprooting of vegetation. Erosion results in the mobilisation of soil particles, which are released into the air and tributaries, increasing the turbidity of the main water body. The problem is, pathogens can adsorb onto these soil particles and may be shielded from the effects of disinfection. Increased turbidity also impacts upon other environmental constituents, ie smothering riparian vegetation and reducing light transfer within the water column which affects plant growth.

A number of chemicals (organic and inorganic) are of concern in drinking water from a health perspective because they are potentially toxic to humans. Chemicals usually occur in drinking water sources attached to suspended material such as soil particles and may result from natural leaching from mineral deposits or from different land uses (NHMRC & NRMMC, 2004b).

Pesticides include agricultural chemicals such as insecticides, herbicides, nematicides, rodenticides and miticides. Contamination of a drinking water source by pesticides may occur as a result of accidental spills, incorrect or over use and leakage from storage areas. In such cases, prompt action is required to notify relevant authorities and clean up the spill.

Nutrients (such as nitrogen) can enter drinking water supplies from leaching of fertiliser, septic tanks, and from faeces of domestic animals (such as cattle grazing on the land). Nitrate and Nitrite (ions of Nitrogen) can be toxic to humans at high levels, with infants less than 3 months old being most susceptible (NHMRC & NRMMC, 2004).

Hydrocarbons (fuels, oils and solvents) are potentially toxic to humans, and harmful by-products may be formed when they are combined with chlorine in water treatment processes. Hydrocarbons can occur in water supplies from pollution events from vehicle accidents, refuelling and leakage from storage areas.

The raw water from Tanjannerup Dam is analysed for health related chemicals, including inorganics, heavy metals, industrial hydrocarbons and pesticides.

Samples taken in the dam, pre and post treatment for pesticides, metals and hydrocarbons have shown levels well below guideline limits. Nannup town water supply is of good quality complying with ADWG health requirements. Refer to Appendix A for a summary of the water quality data.

2.3 Aesthetic characteristics

Impurities in drinking water can affect the aesthetic qualities of water such as appearance, taste, smell and 'feel'. Such impurities are not necessarily hazardous to

human health, for example water that is cloudy and has a distinctive colour may not be harmful (NHMRC & NRMCC, 2004b).

Iron and dissolved organic matter can affect the colour and appearance of water and salinity can affect the taste. The ADWG have set limits on water quality characteristics to meet aesthetic requirements of consumers.

Raw water from Tanjannerup Dam consistently exceeds the ADWG aesthetic guidelines for colour and iron.

Some properties such as pH can contribute to the corrosion and encrustation of pipes. The ADWG also sets out aesthetic guidelines for these types of water quality characteristics.

Turbidity is caused by the presence of fine suspended matter in water such as clay, silt, organic matter and microscopic organisms. A high level of turbidity causes a murky appearance, and can reduce the effectiveness of disinfection processes. Turbidity and manganese concentrations occasionally exceed the guidelines. After treatment Nannup town water supply is of good quality complying with ADWG aesthetic requirements. Refer to Appendix A.

3 Land use assessment

3.1 Existing land uses and activities

Land use and tenure in Tanjannerup Creek Dam catchment, which lies in the administrative boundary of the Shire of Nannup, are shown in Figure 3 and outlined below. The water quality in Tanjannerup Creek Dam is potentially at risk from activities occurring in the catchment including public access, fishing, marroning, trail bike riding and camping.

Recommendations for identified recreational activities in the catchment are discussed in table 1 and are guided by Statewide Policy No.13 – *Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land*.

3.1.1 Crown Land

The catchment is covered predominately by State forest which is vested in the Conservation Commission of Western Australia and managed by the Department of Environment and Conservation (DEC) on its behalf. Managed uses include water catchment protection, conservation, recreation, timber production and other regulated purposes.

State forest within the catchment area has been cut to a mosaic of silvicultural objectives. Timber harvesting within the timber production area of the catchment last occurred in the 1980s and early 1990s. These areas may be scheduled for further thinning within a 15 to 25 year period. Large areas of the catchment adjacent to the dam and stream reserves have not been cut since the 1920s and will remain uncut within informal reserves.

3.1.2 Freehold Land

Freehold land held in the name of the Conservation and Land Management (CALM) Executive Body and managed by DEC (Lot 2), Water Corporation (Lot 1) and private land (lots 25, 26 and 28), covers approximately 60.67 hectares (0.61 km²) in the western portion of the catchment. Refer to Figure 3. The Water Corporation owns and manages the dam and immediate surrounds, and DEC managed freehold land is managed for water production.

Private land (approximately 39 hectares) to the north and south of the reservoir is zoned Rural. The Shire of Nannup's draft Town Planning Scheme No 3 proposes to zone land holdings within Tanjannerup Creek Dam Catchment Area as agricultural with a special control area called the "Public Drinking Water Source Area". The land is currently covered with native vegetation and undeveloped.

Recommendations for identified recreational activities in the catchment are discussed in table 1 and are guided by Statewide Policy No.13 – *Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land*.

3.2 Proposed land uses and activities

The catchment land uses and activities identified in this plan are not expected to change in the short term however there is the potential for intensification of land use on private land under the proposed agriculture zoning. Future land use activities should be consistent with Department of Water’s Water Quality Protection Note – *Land use compatibility in Public Drinking Water Source Areas* and Statement of Planning Policy No. 2.7 – *Public Drinking Water Source Policy*.

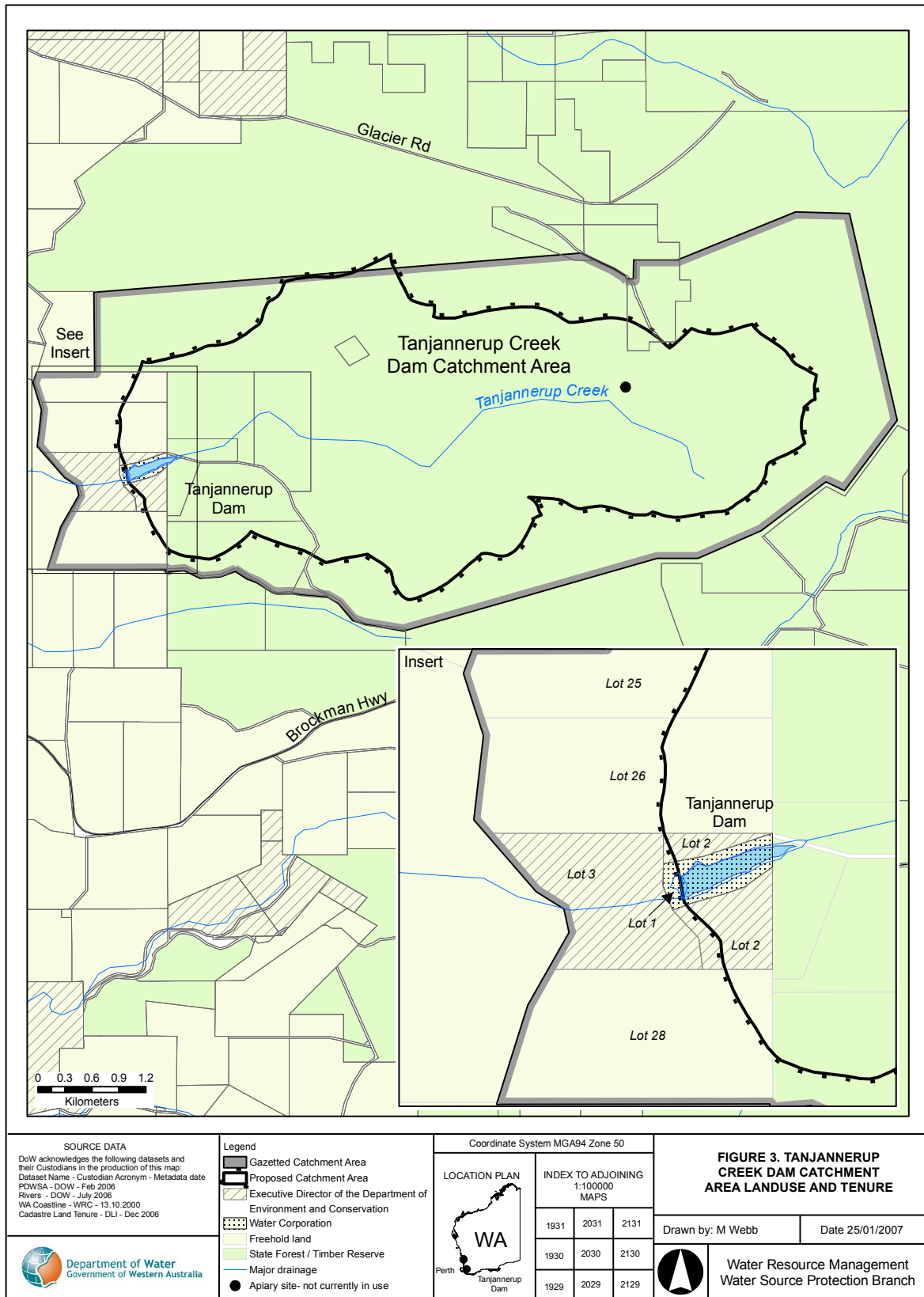


Figure 3 Land use and activities in the Tanjannerup Creek Dam Catchment Area

4 Catchment protection strategy

4.1 Protection objectives

The objective of water source protection in the Tanjannerup Creek Dam catchment is to ensure there is no degradation of the water source and to preserve water quality at its current level and where practical, achieve an improvement, so as to provide a safe drinking water supply.

This protection objective is consistent with the objectives of Priority 1 source protection areas.

The strategies used to protect the proposed Tanjannerup Creek Dam Catchment Area in this plan recognise the rights of existing and approved land uses and activities. However the catchment should be managed so that the quality of the water from the State forest area is maintained and the risk to water quality from private land is avoided. The minimisation of risks to water quality for public supply is imperative for the protection of public health.

4.2 Proclaimed area

The Nannup Catchment Area (Tanjannerup), approximately 26 km², was proclaimed in 1960 under the *Country Areas Water Supply Act, 1947*. However this proclaimed area extends outside the actual physical catchment area which drains into the dam. The catchment boundary has been redefined based on the physical drainage area and the most recent contour information. It is recommended that the existing catchment boundary be de-proclaimed and the new catchment boundary proclaimed as Tanjannerup Creek Dam Catchment Area under the *Country Areas Water Supply Act, 1947* to ensure appropriate protection of the water supply source. Refer to Figures 2 and 3.

4.3 Priority classifications

The protection of Public Drinking Water Source Areas (PDWSAs) relies on statutory measures available in water resource management and land use planning legislation. The Department's policy for the protection of PDWSAs includes three risk management based priority classifications. These source protection areas are determined through the Drinking Water Source Protection Plan process. The Department's Water Quality Protection Note – *Land Use Compatibility in Public Drinking Water Source Areas* outlines activities that are acceptable, compatible with conditions or incompatible with the different Priority areas and provides more information on how priorities are determined.

Priority classification areas have not previously been assigned to the Tanjannerup Creek Dam Catchment Area.

4.3.1 Priority 1 areas

The proposed priority classification for the Tanjannerup Creek Dam Catchment Area is Priority 1. Priority 1 source protection areas are defined to ensure that there is no degradation of the water source and are declared over land where the provision of high quality public drinking water is the prime beneficial land use.

It is proposed that the entire proclaimed catchment area be managed for Priority 1 source protection. This classification is appropriate as:

- water from Tanjannerup Creek Dam is the primary source of drinking water for the town of Nannup and should be afforded the highest feasible level of protection;
- the existing water quality is of a high standard and therefore should be maintained by assigning a high level of protection;
- the land is predominantly under Crown ownership;
- retention time in the dam is short so there is little water quality improvement during storage; and
- existing land uses are generally considered compatible with Priority 1 source protection objectives.

The Priority area is shown in Figure 4.

4.4 Reservoir Protection Zone

In addition to priority classification, Reservoir Protection Zones (RPZs) are defined to protect the water from contamination in the immediate vicinity of drinking water reservoirs. It is proposed to protect Tanjannerup Creek Dam reservoir from immediate risks to water quality including human contact, by amending the current legislation to allow a RPZ in country areas. This RPZ is a key barrier in the multiple barrier 'catchment to consumer' risk based approach to drinking water source protection in accordance with the ADWG.

The RPZ is an area extending two kilometres out from the top water level of the reservoir and includes the reservoir itself. It does not extend outside the catchment area. This area is shown for Tanjannerup Creek Dam Catchment Area in Figure 4.

Unauthorised entry into the RPZ would be prohibited, with the exception of private land and public roads, under the proposed legislation. Special approval may be sought from the Water Corporation for access to the proposed RPZ in the catchment, however access is usually not supported due to the significance of the resource for the provision of safe, good quality, reasonable cost drinking water to consumers.

Liaison with the relevant landowners within the RPZ will be ongoing to negotiate purchase of freehold land.

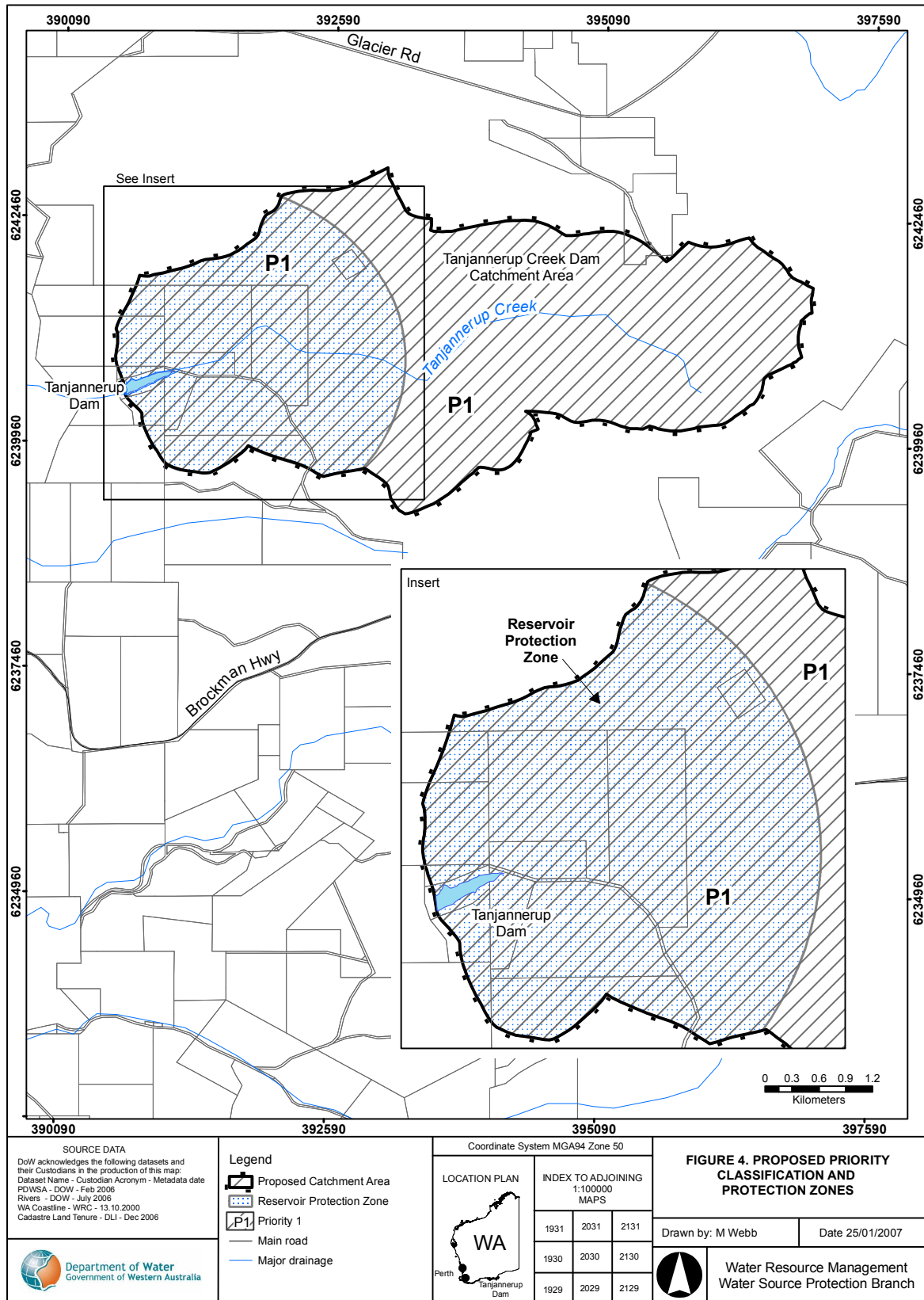


Figure 4 Proposed priority classifications for Tanjannerup Creek Dam Catchment Area

4.5 Land use planning

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 appropriate that the Tanjannerup Creek Dam Catchment Area, RPZ and protection classifications be recognised in the Shire of Nannup's Town Planning Scheme. Any development proposals within the Tanjannerup Creek Dam Catchment Area that are inconsistent with advice within the Department of Water's Water Quality Protection Note – *Land Use Compatibility in Public Drinking Water Source Areas* or recommendations in this plan should be referred to the Department of Water for advice and recommendations.

The Department of Water's protection strategy for PDWSAs provides for lawfully established and operated developments to continue within catchments despite their location or facilities posing a perceived level of risk to water quality which would not be accepted for new developments. The Department may negotiate with landowners/operators on measures to improve these facilities or processes to lessen the level of water contamination risk.

In critical areas close to water sources, the Department may make an offer to purchase land or development rights where the level of contamination risk is considered significant enough to potentially compromise the quality of water resources.

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.

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 catchment. A brochure will be produced once this Plan is endorsed, describing the Tanjannerup Creek Dam Catchment Area, 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 drinking water source and its protection.

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 PDWSAs, an important water quality protection mechanism. Surveillance is also important in raising the general level of awareness of the need to protect water quality.

Signs are erected around Tanjannerup Creek Dam Catchment Area 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 is continued.

4.8 Emergency response

Escape of chemicals during unforeseen incidents and the use of chemicals during emergency responses can result in water contamination. The Shire of Nannup's Local Emergency Management Committee (LEMC) through the South West Emergency Management District should be familiar with the location and purpose of the Tanjannerup Creek Dam Catchment Area. 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 Tanjannerup Creek Dam Catchment Area.

Personnel who deal with WESTPLAN – HAZMAT (Western Australian Plan for Hazardous Materials) incidents within the area should have access to a map of the Tanjannerup Creek Dam Catchment Area. These personnel should receive training 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 in the Tanjannerup Creek Dam Catchment Area and recommends protection strategies to minimise these risks.

Following publication of the final Tanjannerup Creek Dam Catchment Area Drinking Water Source Protection Plan, an implementation strategy will be drawn up based on the recommendations in Table 1. It will describe timeframes and funding sources for the recommended protection strategies and identify responsible stakeholders. This is reflected in the Recommendations section of this plan.

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			
State Forest, DEC managed and Water Corporation Freehold Land					
Roads Unsealed Use and construction	Hydrocarbons and chemical spills from vehicles and machinery	Medium	<p>The catchment contains several logging roads and many minor tracks which are managed by DEC and the Forest Products Commission (FPC). Ellis Creek Road, a major gravel logging and access road passes through the back of the catchment > 4 km from the reservoir.</p> <p>The tracks provide access to the State forest and the reservoir. Road condition suggests usage is greatest near the reservoir with erosion providing a source of turbidity.</p> <p>The catchment is in a Disease Risk Area (DRA) monitored by DEC with signage discouraging access. Signs are often removed.</p> <p>Roads and tracks are necessary for forest management. It is essential they are maintained to minimise the risk of erosion.</p>	<ul style="list-style-type: none"> • DEC management of State forest roads and tracks. • WESTPLAN – HAZMAT emergency response. • Permit required from DEC for vehicle access into the DRA. • Detention time. • Water quality monitoring. • Signage (not always in place). • DEC (DRA) and Water Corporation surveillance. 	<p><i>Accepted as necessary for forest management, requires best management practices.</i></p> <ul style="list-style-type: none"> • Establish Reservoir Protection Zone (RPZ). • DoW to purchase DEC managed freehold land in the RPZ. • Use signage to promote awareness that off-road driving is not permitted. • Undertake surveillance. • Review the road network to identify roads not essential for forest operations and management or transport thoroughfare. Close and rehabilitate tracks no longer required. • Install gate on roads that provide public access to RPZ. • Maintain roads/tracks to
	Turbidity from erosion of unsealed roads and tracks	Medium			
	Roads and tracks also provide public access to the waterbody and catchment, which increases all associated risks: <ul style="list-style-type: none"> • rubbish dumping • wild fires and • pathogen contamination 	Medium			

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Roads Unsealed Use and construction (continued)					<p>minimise risk to water quality.</p> <ul style="list-style-type: none"> • Ensure sumps and runoff control measures are adequate. • Install gates on roads that currently provide public access.
Stream Line Management	Herbicides from weed control	Medium	The Water Corporation conducts blackberry control along stream lines close to the reservoir using herbicides approved for use in PDWSAs under the Department of Health PSC 88 <i>Use of Herbicides in Water Catchment Areas</i> .	<ul style="list-style-type: none"> • Water Corporation management. • PSC 88. 	<p><i>Acceptable activity with conditions</i></p> <ul style="list-style-type: none"> • Establish RPZ. • Maintain riparian vegetation and buffers. • Liaise closely with Department of Environment and Conservation to ensure that specific guidelines related to water quality protection are incorporated into the burning prescription. • Ensure protocols are put in place for effective communication between agencies managing the catchment. • Ensure that firebreaks required on an ongoing basis are constructed to minimise soil disturbance.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Stream Line Management <i>(continued)</i>					<ul style="list-style-type: none"> • Reduce fuel loads by appropriate prescribed burning. • Ensure land is managed with water quality protection objectives.
Timber Production Native forest	<p>Turbidity from erosion and runoff</p> <p>Hydrocarbons from fuel spills and leaks from forestry vehicles</p> <p>Turbidity from fires/burning</p> <p>Pathogens from human activity</p> <p>Nutrients from fertilising prior to replanting</p>	<p>Medium</p> <p>Low</p> <p>Low</p> <p>Medium</p> <p>Low</p>	<p>Timber harvesting within areas of the catchment last occurred in the 1980s and early 1990s. These areas may be scheduled for further thinning within a 15 to 25 year period. Large areas of the catchment adjacent to the dam and stream reserves will remain uncut.</p> <p>FPC operates in accordance with the <i>Contractors' Timber Harvesting Manual</i> (FPC, 2003) and the <i>Code of Practice for Timber Harvesting in Western Australia</i> (CALM, 1999) under a Forest Management Plan, which includes guidelines for protection of water. The FPC also operates in accordance with an Environmental Management System (EMS). FPC operations and activities are regulated by DEC.</p> <p>The impact of hardwood harvesting on water quality can be minimised through proper management (including vegetation buffers along stream beds and retaining</p>	<ul style="list-style-type: none"> • DEC and Water Corporation surveillance. • FPC Codes of Practice and EMS. • Detention time. • Water quality monitoring. • DEC's requirement under the Forest Management Plan 2004-2013. 	<p><i>Acceptable with best management practices</i></p> <ul style="list-style-type: none"> • Establish RPZ. • Review DEC harvesting plans during the planning phase to ensure water quality protection objectives are included. • Ensure timber production activities are carried out in accordance with the relevant forestry codes and manuals. • Fertiliser should not be applied by aerial spraying.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Timber Production Native forest (continued)			understorey vegetation during timber harvesting). The <i>Conservation and Land Management Act 1984</i> recognises water catchment protection as a statutory purpose of State forest.		
Resource Harvesting • Apiarists Wildflower picking • Seed collection	Pathogens from human activity	Medium	Activities and numbers are effectively managed by DEC through the issuing of licences under the <i>Forest Management Regulations 1993</i> (Apiarists) and the <i>Wildlife Conservation Regulations 1970</i> (Flora). There are currently no permitted apiary sites or permitted pickers operating in the catchment. There is however the potential for unauthorised activity.	<ul style="list-style-type: none"> • DEC (DRA) and Water Corporation surveillance. • DEC resource harvesting licensing restrictions. • Detention time. • Water quality monitoring. • DEC applies conditions for Resource Harvesting to address water quality protection objectives. 	<ul style="list-style-type: none"> • Establish RPZ. • Activities to be restricted to outside proposed RPZ and away from feeder streams. • DEC to continue to apply conditions for apiarists, wildflower picking and seed collection licences that requires adherence to water quality objectives. • Where appropriate, direct these activities to areas outside the catchment.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Firewood collection	Pathogens from human and domestic animal activity	Medium	<p>Firewood collection is not authorised in the catchment as it is a DRA. The DRA is monitored by DEC with limited signage discouraging access.</p> <p>Enforcement of the <i>Forest Management Regulations</i> 1993 is rare.</p> <p>Some illegal collection of firewood is however likely to occur in the catchment with the potential for people to be close to tributaries.</p> <p>Hydrocarbon waste from machinery is associated with public firewood collection.</p> <p>Increase in disease has implications for loss of filtering vegetation.</p>	<ul style="list-style-type: none"> • DEC (DRA) and Water Corporation surveillance. • Signage (limited). • Detention time. • Designated firewood collection points outside the catchment. • Water quality monitoring. • DEC operates a managed permit system for firewood collection. 	<p><i>Incompatible activity</i></p> <ul style="list-style-type: none"> • Establish RPZ. • Firewood collection to be prohibited in the RPZ and wider catchment. • DEC to continue to manage a permit system for non-commercial firewood collection by the public in areas outside the RPZ. • Upgrade signage. • Undertake surveillance.
	Waste dumping	Low			
	Hydrocarbons from machinery	Low			
Feral animals and hunting	Pathogens from faecal contamination / carcasses	High	<p>There is the potential for pathogen contamination of tributaries and the reservoir from animal carcasses, uneaten baits, faeces and wallowing. Pigs occur in the catchment with reintroduction by hunters known to occur. Pig hunting is a popular local recreational activity with hunters using dogs.</p>	<ul style="list-style-type: none"> • DEC (DRA) and Water Corporation surveillance. • Detention time. • 1080 Baiting program. • Water quality monitoring. 	<p><i>Unacceptable activity</i></p> <ul style="list-style-type: none"> • Establish RPZ. • Catchment to remain closed to hunting through CAWS Act By-laws. • Place signage throughout catchment indicating hunting is illegal. • Undertake surveillance and
	Turbidity from wallowing	Medium			
	Pathogens from human and domestic animal	Medium			

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
	presence – hunting/trapping 1080 Baiting	Low	DEC implementing feral animal control programs on land managed by DEC. 1080, a naturally occurring chemical that does not pose a risk to water quality, is used to control foxes. Baits are generally not placed within 100 m of watercourses or reservoirs. There is currently no formal pig control program in the area.	<ul style="list-style-type: none"> • DEC implements feral animal control program for DEC managed land. • CAWS Act By-laws. 	<p>By-law enforcement.</p> <ul style="list-style-type: none"> • Control feral animals through management programme. • Statewide Policy No 13 - <i>Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land.</i>
Fire Management • Controlled Burns	<p>Turbidity from erosion of fire breaks and stripping of vegetation due to fire</p> <p>Chemical contamination from fuel spills</p> <p>Carbon and nutrient contamination</p> <p>Pathogens from loss of filtering vegetation</p>	<p>Low</p> <p>Low</p> <p>Low</p> <p>High</p>	<p>Fire management in the State forest is the responsibility of DEC. Water quality issues are considered in fire management operations. Prescribed burning is conducted in the catchment, with fire regimes determined through consideration of a number of factors including biodiversity requirements, maintenance of ecosystem health and productive capacity, conservation of soil, water and catchment values, regeneration and protection of native forests and plantations, and protection of human life and community assets.</p> <p>Prescribed burning within the catchment is undertaken in accordance with the <i>Forest Management Plan 2004-2013</i>.</p>	<ul style="list-style-type: none"> • DEC fire management. • Water Corporation surveillance. • Detention time. • Water quality monitoring. 	<p><i>Accepted as a necessary activity in forest management</i></p> <ul style="list-style-type: none"> • Establish RPZ. • Develop specific objectives and guidelines related to water quality objectives and liaise with DEC to ensure that they are incorporated into burning prescriptions. • Identify appropriate water sources for fire management, which may include specific points for accessing watercourses and the creek.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Wildfires	Turbidity from erosion from fire breaks and stripping of vegetation due to fire	Low	<p>Fire management in the State forest is the responsibility of DEC. Water quality issues are considered in fire management operations. The Water Corporation adheres to post event management procedures.</p> <p>Large wildfires in the catchment are rare. Streamline and reservoir buffers should be considered before application of chemical fire suppressors. Avoiding contamination of waterways is a priority.</p> <p>All transient public access in the catchment increases risk of wildfires eg camping, bushwalking, picnicking, fishing, marroning.</p>	<ul style="list-style-type: none"> • DEC Fire management regime. • Consideration of drinking water values by DEC in determining strategies for fire suppression. • Water Corporation participation during major fires and post fire management and monitoring. • Detention time. • Water quality monitoring. 	<ul style="list-style-type: none"> • Establish RPZ. • Enforce RPZ to exclude people from the catchment – refer to photograph 6. • Identify appropriate water sources for fire management, which may include specific points for accessing watercourses and the creek. • Ensure that firebreaks required on an ongoing basis are constructed to minimise soil disturbance. • Emergency firebreaks should be rehabilitated.
	Carbon and nutrient contamination from fly ash	Low			
	Chemicals from fire fighting foam	Low			
	Hydrocarbons from water point use and contamination of water body	Low			
	Chemicals from decomposition of vegetation, breakdown of soils/geological formation	Low			
	Pathogens from decaying carcasses, human presence	High			
Pathogens from loss of filtering vegetation	High				

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Illegal rubbish dumping	Leaching of contaminants <ul style="list-style-type: none"> • Pathogens • Chemicals • Nutrients 	Medium Low Low	Currently dumping rates in the catchment are low with identified rubbish removed by Rangers. The local refuse site now requires rubbish to be sorted, and this may have an impact on illegal dumping levels in the area.	<ul style="list-style-type: none"> • DEC and Water Corporation surveillance. • Detention time. • Water quality monitoring. 	<i>Unacceptable activity</i> <ul style="list-style-type: none"> • Establish RPZ. • Place signage throughout catchment indicating dumping is illegal. • Ongoing removal of rubbish – refer to photograph 3. • Undertake surveillance.
Illegal drug crops	Pathogens from Human and animal activity	Medium	Cannabis growing is known to occur in the area with crops removed when identified	<ul style="list-style-type: none"> • DEC and Water Corporation surveillance. • Detention time. • Water quality monitoring. 	<i>Unacceptable activity</i> <ul style="list-style-type: none"> • Establish RPZ. • Undertake surveillance. • WC to liaise with local police.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Recreation - State Forest, DEC managed and Water Corporation Freehold Land					
Off-road driving (away from public roads) <ul style="list-style-type: none"> • 4WDs • Motorcycles • Unlicensed cars 	Pathogens from human activity Turbidity from erosion of unsealed roads and tracks Hydrocarbon contamination from fuel spills from refuelling and vehicles accidents	Medium Medium Medium	Off-road driving in the catchment is common with vehicles frequently and easily accessing the reservoir banks from the south and east. The reservoir banks are muddy and susceptible to erosion. The majority of off-road driving is related to fishing and marroning – this access is not likely to be frequent. There is some fencing along the southern boundary of land vested in Water Corporation and a gate at the western end, restricting vehicle access near the dam wall. Access elsewhere is unrestricted with limited signage providing an ineffective deterrent. Off-road driving is not permitted on land managed by DEC without a permit. Refuelling in the catchment would not be common due to the proximity to Nannup.	<ul style="list-style-type: none"> • Water Corporation surveillance. • Limited signage and fencing. • Detention time. • Water quality monitoring. • DEC permit. 	<i>Unacceptable activity</i> <ul style="list-style-type: none"> • Establish RPZ. • Use signage to promote awareness that off-road driving is not permitted. • Undertake surveillance to control off-road driving in the catchment – refer to photograph 4.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Horse riding	<p>Pathogen contamination from people and animals remaining in the catchment for extended periods and being in contact with waterbodies (for watering horses) resulting in faecal contamination.</p> <p>Turbidity from the use of horses and vehicles on unsealed roads and tracks. Horses compact ground, contributing to increased overland run-off and thus turbidity.</p>	<p>Medium</p> <p>Low</p>	<p>Direct contact of animals with waterways and the waterbody poses the greatest risk. Horse riding is not permitted in the DRA without a permit from DEC. No formal groups are currently operating and individual activities are rare, if at all.</p> <p>No designated trails or roads available for horse riding</p>	<ul style="list-style-type: none"> • DEC and Water Corporation surveillance. • Detention time. • Water quality monitoring. • Statewide Policy No 13 - <i>Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land.</i> 	<p><i>Incompatible</i></p> <ul style="list-style-type: none"> • Establish RPZ. • Horse riding is not permitted in the DRA without a permit from DEC. • Statewide Policy No 13 - <i>Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land.</i> • Use signage to indicate that horse riding is not permitted.
Swimming	<p>There is a high risk of pathogen contamination associated with swimming, through direct contact of humans, pet dogs or horses with the</p>	High	<p>Human or animal contact with water involves an immediate threat to water quality with the potential for <i>Cryptosporidium</i> contamination.</p> <p>Swimming in the reservoir is prohibited. Some swimming may occur, mainly during summer. The</p>	<ul style="list-style-type: none"> • Limited signage and fencing. • Water Corporation surveillance. • Water quality monitoring. 	<p><i>Unacceptable activity</i></p> <ul style="list-style-type: none"> • Establish RPZ. • Statewide Policy No 13 - <i>Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land.</i>

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
	waterbody Turbidity due to erosion of reservoir banks	Medium	reservoir is easily accessible with limited signage and fencing near the dam wall. The effectiveness of the existing preventive strategies in minimising risk is low. Swimming activities at the reservoir is likely to be low due to the proximity of Barrabup Pool and the town swimming hole on Nursery Road. Detention time can not be considered an effective barrier for reducing the risk associated with direct contact with the water body.	<ul style="list-style-type: none"> Statewide Policy No 13 - <i>Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land.</i> 	<ul style="list-style-type: none"> Increase public awareness that swimming is prohibited under the CAWS Act By-laws. Use signage to indicate that swimming is not permitted. Undertake surveillance and By-law enforcement.
Fishing and Marroning	Pathogens from human and animal activity, contact with water and use of bait Turbidity from erosion of dam/stream banks	High Medium	Human or animal contact with water involves an immediate threat to water quality with the potential for <i>Cryptosporidium</i> contamination. Fishing for perch and marroning occurs in the reservoir regularly, particularly at the back of the reservoir. The reservoir is easily accessible with limited signage and fencing only near the dam wall. Detention time can not be considered an effective barrier for reducing the risk associated with	<ul style="list-style-type: none"> Limited signage and fencing. Water Corporation surveillance. Water quality monitoring. Statewide Policy No 13 - <i>Policy and Guidelines for Recreation within Public Drinking Water Source Areas on</i> 	<p><i>Unacceptable activity</i></p> <ul style="list-style-type: none"> Establish RPZ. Increase public awareness that fishing and marroning are prohibited under the CAWS Act By-laws. Statewide Policy No 13 - <i>Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land.</i> Delegation of FRM Act powers to WC Rangers.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
			<p>direct contact with the water bodies.</p> <p>The Department of Fisheries is responsible for management of fishing and marroning.</p> <p>Illegal under CAWS Act and <i>Fish Resources Management Act, 1994</i> (FRM) to undertake fishing and marroning. Penalties apply.</p>	<i>Crown Land.</i>	<ul style="list-style-type: none"> Place signs throughout the catchment indicating that fishing and marroning are not permitted. Undertake surveillance and By-law enforcement.
Picnicking, camping and dogs	<p>Pathogens from human and domestic animal activity</p> <p>Turbidity from erosion by vehicles</p>	<p>High</p> <p>Medium</p>	<p>There is no designated camping or picnic sites in the catchment. Informal activity occurs regularly on the reservoir banks, particularly at the back of the reservoir where there are 3 unauthorised camp sites.</p>	<ul style="list-style-type: none"> Limited signage and fencing. Water Corporation and DEC surveillance. Detention time. Water quality monitoring. Statewide Policy No 13 - <i>Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land.</i> 	<p><i>Incompatible</i></p> <ul style="list-style-type: none"> Prohibit dogs through education, signs and promotional material. Statewide Policy No 13 - <i>Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land.</i> Undertake surveillance and By-law enforcement.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Rural land					
Native forest	Access on private land in close proximity to reservoir	High	The private land in the catchment is currently forested and undeveloped. There is the potential for intensification of land use consistent with the proposed Agriculture – Intensive zoning. The area has been identified as a Special Control Area under the Shire of Nannup Draft Town Planning Scheme No. 3.	<ul style="list-style-type: none"> • Town Planning Scheme. • Development applications managed by LGA • Minimum private use 	<ul style="list-style-type: none"> • DoW to purchase all private land in the catchment. • Landowners can continue minimal activities with best management practices. • Ensure land is managed with water quality protection objectives.
Fire Management	Turbidity from erosion of fire breaks and stripping of vegetation due to fire	Medium	Fire management on private land is the responsibility of the landholders. Following major burns, the Water Corporation initiates post event management procedures.	<ul style="list-style-type: none"> • Landholder fire management. • Water Corporation participation during major fires and post fire management. • Detention time. • Water quality monitoring. 	<p><i>Accepted as a necessary activity in proper forest management</i></p> <ul style="list-style-type: none"> • Establish specific criteria to ensure the burning programme adheres to water quality objectives. • Ensure land is managed with water quality protection objectives.
	Chemical contamination from fly ash	Low			
	Pathogens from loss of filtering vegetation	High			

5 Recommendations

The following recommendations outline how this Plan should be implemented. An implementation strategy detailing specific on the ground actions, responsible parties and funding sources will be developed after this Plan is finalised.

- 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 The existing boundary of the Nannup Catchment Area, gazetted in 1960, should be de-proclaimed and the boundary of the Tanjannerup Creek Dam Catchment Area proposed in the plan should be proclaimed under the *Country Areas Water Supply Act, 1947* (*Department of Water*).
- 3 A reservoir protection zone (RPZ) should be established when the current legislation is amended (*Department of Water*).
- 4 The Department of Water should purchase the following freehold land within the RPZ and manage it for Priority 1 source protection:
 - the portion of Lot 2 freehold land that falls within the RPZ, currently held in the name of the CALM Executive Body and managed by Department of Environment and Conservation;
 - freehold land that lies within the RPZ to the north of the dam, Lot 26 and a portion of Lot 25, zoned Rural and currently covered with native vegetation and undeveloped; and
 - freehold land to the south of the dam, approximately 4 hectares of Lot 28 that lies within the RPZ, zoned Rural and currently covered with native vegetation and undeveloped. Refer to Figure 3 (*Department of Water*).
- 5 Prepare an implementation strategy for this Plan describing responsible stakeholders, timeframes and funding sources for the recommended protection strategies (*Department of Water and applicable stakeholders*).
- 6 The Nannup Town Planning Scheme should incorporate the recommendations of this Plan and reflect the identified Tanjannerup Creek Dam Catchment Area boundary, the Priority 1 classifications and RPZ (*Shire of Nannup, Department for Planning and Infrastructure*).
- 7 All development proposals within the Tanjannerup Creek Dam Catchment Area 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 (*Shire of Nannup, Department for Planning and Infrastructure*).
- 8 Incidents covered by WESTPLAN – HAZMAT in the Tanjannerup Creek Dam Catchment Area should be addressed through the following:

- the Shire of Nannup LEMC are familiar with the location and purpose of the Tanjannerup Creek Dam Catchment Area;
- the locality plan for the Tanjannerup Creek Dam Catchment Area 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 Tanjannerup Creek Dam Catchment Area; and
- personnel dealing with WESTPLAN – HAZMAT incidents in the area have ready access to a locality map of the Tanjannerup Creek Dam Catchment Area and training to understand the potential impacts of spills on drinking water quality

(Department of Water, Water Corporation).

- 9 Pursuant to Section 13 (1) of the *Water and Rivers Commission Act 1995*, the Department of Water should continue delegating responsibility for surveillance and enforcement in the Tanjannerup Creek Dam Catchment Area to the Water Corporation (*Water Corporation*).
- 10 A catchment surveillance program should be implemented to identify any incompatible land uses or potential threats within the Tanjannerup Creek Dam Catchment Area (*Water Corporation*).
- 11 Recreation occurs frequently within the Tanjannerup Creek Dam Catchment Area during long weekends, school holiday periods and marron season. It is recommended that surveillance should focus on these periods when recreational activities are occurring (*Water Corporation, Department of Fisheries*).
- 12 Signs should be erected and maintained along the boundary of the Tanjannerup Creek Dam Catchment Area and RPZ 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*).
- 13 A review of this Plan should be undertaken after five years (*Department of Water*).

Appendices

Appendix A – Water quality

The information provided in this appendix was developed by the Water Corporation's Water Quality Branch.

The Water Corporation has monitored the raw (source) water quality from Tanjannerup Creek Dam in accordance with the Australian Drinking Water Guidelines (ADWG) and interpretations agreed to with the Department of Health. The raw water is regularly monitored for:

a. Aesthetic related characteristics– (Non-Health Related)

b. Health related characteristics

- Health Related Chemicals
- Microbiological Contaminants

Following is data representative of the quality of raw water in Tanjannerup Creek Dam. In the absence of specific guidelines for raw water quality, the results have been compared with ADWG values set for drinking water, which defines the quality requirements at the customers tap. Results that exceed ADWG have been shaded to give an indication of potential raw water quality issues associated with this source.

It is important to appreciate that the raw water data presented does not represent the quality of drinking water distributed to the public. Barriers such as storage and water treatment, to name a few, exist downstream of the raw water to ensure it meets the requirements of ADWG. For more information on the quality of drinking water supplied to Nannup refer to the most recent Water Corporation Drinking Water Quality Annual Report at

http://www.watercorporation.com.au/W/waterquality_annualreport.cfm?uid=2377-9937-9579-7091.

Aesthetic related characteristics

The values are taken from ongoing monitoring for the period January 2002 to June 2007. All values are in milligrams per litre (mg/L) unless stated otherwise. Any water quality parameters that have been detected are reported, those that have on occasion exceeded the ADWG are shaded.

Table 2 Aesthetic related detections for Tanjannerup Creek Dam

Parameter	Units	ADWG Aesthetic Guideline Value*	Nannup Tanjannerup Dam	
			Range	Median
Aluminium unfiltered	mg/L	NA	0.02 - 1.1	0.33
Chloride	mg/L	250	64 - 98	85.5
Colour - True	TCU	15	<1 - 95	55
Conductivity at 25°C	mS/m	NA	22 - 120	34
Hardness as CaCO ₃	mg/L	200	24 - 38	33
Iron unfiltered	mg/L	0.3	0.012 - 3.6	1.0
Manganese unfiltered	mg/L	0.1	<0.002 - 0.24	0.055
pH	-	6.5 - 8.5	6.25 - 7.25	6.88
Sodium	mg/L	180	36 - 55	48.5
Sulphate	mg/L	250	7 - 16	9.75
TFSS	mg/L	500	158 - 217	192
Turbidity	NTU	5	0.1 - 9.2	3.4

* An aesthetic guideline value is the concentration or measure of a water quality characteristic that is associated with good quality water.

Health related characteristics

Health parameters

Raw water from Tanjannerup Creek Dam is analysed for health related chemicals including inorganics, heavy metals, industrial hydrocarbons and pesticides. Health related water quality parameters that have been measured at detectable levels in the source between January 2002 and June 2007 are summarised in the Table 3. Any parameters that have on occasion exceeded the ADWG are shaded.

Table 3 Health related detections for Tanjannerup Creek Dam

Parameter	Units	ADWG Health Guideline Value*	Nannup Tanjannerup Dam	
			Range	Median
Barium [†]	mg/L	0.7	0.019 - 0.03	0.03
Boron [†]	mg/L	4	0.02 - 0.03	0.03
Nitrate as nitrogen [†]	mg/L	11.29	0.027	0.027
Nitrite as nitrogen [†]	mg/L	0.91	0.009	0.009
Nitrite plus nitrate as N	mg/L	11.29	<0.05 - 0.085	<0.05

* 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 (NHMRC & ARMCANZ, 1996).

† Water quality data observed from 3 or less sampling occasions

Microbiological Contaminants

Microbiological testing of raw water samples from Tanjannerup Creek Dam is currently conducted on a weekly basis. *Escherichia coli* counts are used as an indicator of the degree of recent faecal contamination of the raw water from warm-blooded animals. A count less than 20 most probable number (MPN) per 100 mL is typically associated with low levels of faecal contamination and is used as a microbiological contamination benchmark of the raw water (WHO, 1996). As such, counts less than 20 MPN are seen as being an indication of raw water that has not been recently contaminated with faecal material.

During the reviewed period of January 2002 to June 2007, positive *Escherichia coli* counts were recorded in 92.8% of samples. Approximately 24.3% of these samples had *Escherichia coli* counts greater than 20 MPN/100mL.

Appendix B – Photographs



Photograph 1 Tanjannerup Creek Dam



Photograph 2 Signage and fencing at entry to Tanjannerup Creek Dam



Photograph 3 *Rubbish within the Reservoir Protection Zone*



Photograph 4 *Unauthorised vehicle activity within the Reservoir Protection Zone*



Photograph 5 *Controlled burn of Tanjannerup Creek riparian vegetation within the Reservoir Protection Zone*



Photograph 6 *Illegal camp site within the Reservoir Protection Zone*

Glossary

ADWG	The Australian Drinking Water Guidelines, outlining guideline criteria for the quality of drinking water in Australia.
Aesthetic guideline	Australian Drinking Water Guidelines value which is the concentration of measure of a water quality characteristic that is associated with acceptability of water to the consumer eg appearance, taste and odour (NHMRC & NRMCC, 2004).
AHD	Australian Height Datum is the height of land in metres above mean sea level. For example this is +0.026 m at Fremantle.
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
Catchment	The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
CALM	The Western Australian Department of Conservation and Land Management, operational from March 1985 to June 2006.
CAWS	<i>Country Areas Water Supply Act, 1947</i>
Dam	A reservoir, dam, tank, pond or lake that forms part of any public water supply works.
DEC	The Department of Environment and Conservation (Western Australia) was established on 1 July 2006, bringing together the Department of Environment (DoE) and the Department of Conservation and Land Management (CALM).
DRA	Dieback Disease Risk Area
Effluent	The liquid, solid or gaseous wastes discharged by a process, treated or untreated.
EMS	Environmental Management System
FMP	The Forest Management Plan 2004-2013, which came into effect on 1

January 2004, provides for increased protection of forest values and better forest management in the State's south-west.

FRM	<i>Fish Resources Management Act, 1994</i>
ha	Hectares (a measure of area)
HAZMAT	Hazardous Materials
Health guideline	Australian Drinking Water Guideline value which is the concentration of 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 (NHMRC & NRMCC 2004).
kL	Kilolitres (1000 litres)
km	Kilometres (1000 metres)
km²	Square kilometres (a measure of area)
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.
LEMC	Local Emergency Management Committee
LGA	Local Government Authority
m	Metres
mg/L	Milligrams per litre (0.001 grams per litre)
ML	Megalitres (1 000 000 litres)
mm	Millimetres
MPN	Most probable number (a measure of microbiological contamination)
NHMRC	National Health and Medical Research Council
NRMCC	Natural Resource Management Ministerial Council
NTU	Nephelometric turbidity units are a measure of turbidity in water.
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.
Pathogen	A disease producing organism. Disease producing organisms that can cause disease through the consumption of water which include bacteria (such as <i>Escherichia coli</i>), protozoa (such as <i>Cryptosporidium</i> and <i>Giardia</i>) and viruses.
Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.
pH	A logarithmic scale for expressing the acidity or alkalinity of a solution. A pH below 7 indicates an acidic solution and above 7 indicates an alkaline solution.
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 <i>Metropolitan Water Supply Sewerage and Drainage Act, 1909</i> and the <i>Country Areas Water Supply Act, 1947</i> .
Reservoir	A reservoir, dam, tank, pond or lake that forms part of any public water supply works.
Reservoir Protection Zone (RPZ)	A Reservoir Protection Zone is a buffer measured from the high water mark of a drinking water reservoir, and inclusive of the reservoir (usually two km). This is referred to as a 'Prohibited Zone' under the <i>Metropolitan Water Supply, Sewerage and Drainage Act By-laws 1981</i> .
RIWI	<i>Rights in Water and Irrigation (RIWI) Act, 1914</i>
Run-off	Water that flows over the surface from a catchment area, including streams.
Scheme supply	Water diverted from a source or sources by a water authority of private company and supplied via a distribution network to customers for urban, industrial or irrigation use.
TCU	True colour
TDS	Total dissolved salts, a measurement of ions in solution, such as salts in water.
TFSS	Total Filterable Solids by Summation

Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes including drinking and discharge to the environment.
Water quality	The physical, chemical and biological measures of water.
Water Reserve	An area proclaimed under the <i>Country Areas Water Supply Act, 1947</i> or the <i>Metropolitan Water Supply Sewerage and Drainage Act, 1909</i> for the purposes of protecting a drinking water supply.
WESTPLAN HAZMAT	Western Australian Plan for Hazardous Materials

References and further reading

- Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) & Australian and New Zealand Environment and Conservation Council (ANZECC) 1996, *Draft Rural Land Uses and Water Quality – A Community Resource Document*, ARMCANZ & ANZECC, Canberra.
- Cicero, C 1990, *Tanjannerup Creek Dam – Estimation of Yield*, Report No. WS70, Water Corporation.
- Conservation Commission of Western Australia, *Forest management plan 2004–2013* 2003, Conservation Commission of Western Australia, Perth.
available <<http://www.naturebase.net/content/view/2333/1184/>>
- Department of Conservation and Land Management 1999, *Code of Practice for Timber Harvesting in Western Australia*, Department of Conservation and Land Management, Perth.
- Department of Health 2007, *Use of Herbicides in Water Catchment Areas*, Circular No: PSC 88, February 2007, Department of Health, Perth.
- Department of Water Various dates, *Water Quality Protection Notes – Various titles*, Department of Water, Perth, available <<http://drinkingwater.water.wa.gov.au> > Publications > Water Quality Protection Notes.
- Forest Products Commission 2003, *Contractor's Timber Harvesting Manual for South West Native Forests in Western Australia*, Forest Products Commission, Perth.
- Geldreich E.E. 1996, *Pathogenic Agents in Freshwater Resources*, Hydrological Processes, Volume 10, pp 315-333, 1996.
- Government of Western Australia 1914, *Rights in Water and Irrigation Act*, Reprinted under the *Reprints Act 1984* as at 4 July 2006, available <<http://www.slp.wa.gov.au/statutes/swans.nsf>>.
- Government of Western Australia 1947, *Country Areas Water Supply Act*, reprinted under the *Reprints Act 1984* as at 7 April 2006, available <<http://www.slp.wa.gov.au/statutes/swans.nsf>>.
- Hrudey, SE & Hrudey, EJ 2004, *Safe Drinking Water – Lessons from Recent Outbreaks in Affluent Nations*, IWA Publishing, London.
- National Health and Medical Research Council (NHMRC) & Natural Resource Management Ministerial Council (NRMMC) 2004, *National Water Quality Management Strategy: Australian Drinking Water Guidelines*, Australian Government, Canberra, available <www.nhmrc.gov.au/publications/synopses/eh19syn.htm>.

- NHMRC & NRMMC 2004b, *Water Made Clear – A consumer guide to accompany the Australian Drinking Water Guidelines 2004*, Australian Government, Canberra.
- State Emergency Management Committee 2005, *Policy Statement No.7 Western Australian Emergency Management Arrangements*, Government of Western Australia, Perth.
- Water and Rivers Commission 2000, *Statewide Policy No.2 – Pesticide Use in Public Drinking Water Source Areas*, Water and Rivers Commission, Perth, available <www.water.wa.gov.au> > Policies > Statewide Policies.
- Water and Rivers Commission 2003, *Statewide Policy No.13 – Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land*, Water and Rivers Commission, Perth, available <www.water.wa.gov.au> > Policies > Statewide Policies.
- Water Corporation 2004, *Nannup Catchment Area (Tanjanerup Dam) Drinking Water Source Protection Assessment – Nannup Town Water Supply*, Water Corporation, Perth.
- Water Corporation 2005, *SG097 Nannup Catchment Management Strategy*, Water Corporation, Perth.
- Water Corporation 2006, *SG097 Source Protection Operations Manual*, Water Corporation, Perth.
- Water Corporation annual report –
<www.watercorporation.com.au> Publications > Annual Reports > [Annual Report 2006](#)>.
- Western Australian Planning Commission 1997, *State Planning Strategy*, State Government of Western Australia, Perth, available <www.wapc.wa.gov.au/Publications/52.aspx>.
- Western Australian Planning Commission 2003, *Statement of Planning Policy No. 2.7 – Public Drinking Water Source Policy*, Government Gazette WA, 10 June 2003, pp. 2077-82, Government of Western Australia, Perth, available <www.wapc.wa.gov.au/Publications/149.aspx>.
- Western Australian Planning Commission 2006, *State Planning Policy No. 2.9 - Water Resources*, Government Gazette WA, 19 December 2006, pp. 5707-22 Government of Western Australia, Perth, available <<http://www.wapc.wa.gov.au/Publications/1281.aspx>>.
- World Health Organisation 1996, *Guidelines for Drinking-Water Quality – Volume 2 – Health Criteria and Other Supporting Information*, 2nd edn, World Health

Organisation, Geneva, available
<www.who.int/water_sanitation_health/dwq/en/2edvol2p1.pdf>.

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