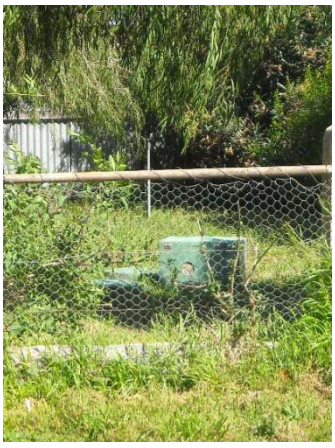
Dookie Wastewater Disposal Options



FINAL REPORT

- Version B
- 25 June 2012

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Executive Summary

There are a range of concerns associated with the current system for management of wastewater within the township of Dookie. As such, it has been identified in the Greater Shepparton City Council (GSCC) as one of five priority towns in the region where wastewater disposal improvements are needed (Smith, 2008).

The GSCC engaged Sinclair Knight Merz (SKM) to analyse wastewater disposal options for the township of Dookie. The aims of the investigation are to provide an assessment of the current on-site systems, assess land capacity to treat and contain wastewater within the township area and provide potential options to resolve the current wastewater disposal problems.

The major risks and concerns associated with the current wastewater management systems in Dookie were determined through a desktop review of relevant reports, site inspections and through a land capacity assessment. They include:

- Poor maintenance of household septic systems by residents;
- Inability for current systems to service black water and grey water loads, resulting in the disposal of grey water to the storm water drainage network;
- Community concerns as a result of odours, water logging and mosquito breeding;
- Limits on the growth potential of the town due to the need to maintain adequate effluent disposal areas on each property;
- Environmental concerns associated with groundwater recharge and contamination.

This report describes and compares a range of options for improving the wastewater disposal system in Dookie based on a range of economic, social and environmental criteria. An action list of priority options is included to addresses the main concerns associated with the current system.

The priority options include (in order of implementation timeframe):

- Groundwater monitoring to determine the scale of the environmental impacts of the current wastewater management system (approx order of cost $380/household);
- Revegetation for protection of groundwater recharge areas (approx order of $120/household).
- Development of a strategy by the GSCC to generate a long term culture of proper maintenance of septic tank systems (approx order of cost of $680/household);
- A sewerage scheme (Option 5), which would include decommissioning of existing septic systems and connection of each property to a reticulated sewerage network. Wastewater would be pumped to a lagoon based treatment system or packaged treatment plant, with effluent available for reuse. (approx order of cost of $23,625/household);

The reader should refer to Sections 1.4 and 1.5 below for qualifications in relation to the order of cost estimates.

It is recommended that further investigation of these options be conducted, in order to determine the level of community and stakeholder support and the feasibility of implementing the options.

1. Introduction

1.1. Background

The township of Dookie is located approximately 30 km to the east of Shepparton. Dookie is a small rural township with a population of 290, surrounded by productive agricultural land which is predominately used for cropping.

Wastewater disposal within Dookie is currently by septic tank – soakage systems, and in some cases, grey water from houses is discharged directly to the street stormwater drain. As a result, offensive odours and potential for environmental harm are often created. Specific environmental concerns are warranted as the Dookie catchment is a groundwater recharge area for the District's underground aquifers.

The Dookie community has identified population growth as a key goal for the township and it has been identified that the current wastewater disposal arrangement and its potential environmental impact limits the township's growth potential. It has been noted that the community has a preference for environmentally sound whole of township solutions, where feasible, to allow for controlled township growth.

The Dookie Community and District Plan lists wastewater disposal issues as a priority, and the GSCC adopted a Domestic Wastewater Management Plan (DWMP) in 2008. The DWMP listed Dookie as one of five priority towns where wastewater disposal improvements are needed.

1.2. Project objective

The GSCC engaged SKM to analyse wastewater disposal options for the township of Dookie.

The objectives of the project are to:

- assess the current on-site systems;
- assess land capacity to treat and contain wastewater within the township area;
- provide potential options to resolve the current wastewater disposal problems.

1.3. Scope of works

The scope of works has been carried out in accordance with the project objectives, as described below. Each of the components of the project is described in more detail throughout this report.

- **Desktop Study:** A range of information relevant to wastewater disposal in Dookie was collected and reviewed. This included the GSCC plans, strategic documents, community plans and relevant regulations. A summary of the desktop review is provided in Section 2.

- **Site Inspections:** Seven locations within the township were selected by GSCC for site inspection, to identify specific wastewater disposal issues within the township. The inspections were undertaken on the 14th October and attended by Sam Cherubin (SKM Project Manager), Roger Wrigley (Wrigley Dillon), and David Thomas (GSCC). Outcomes from the inspections are included in Section 3.
- **Land capability assessment:** A land capability assessment was conducted for the Dookie area, to determine the suitability of the land for irrigation with effluent along with its infiltration capacity. This was undertaken through desktop analysis and observation during site inspections. The land capability assessment is described in more detail in Section 4.
- **Options assessment:** The information obtained from the initial tasks was collated to determine wastewater collection, treatment and disposal options on individual lots as well as whole-of-township treatment and disposal options. Each option was described and a discussion of their advantages and disadvantages are included in Section 5.
- **Recommendation of preferred option:** The preferred option was determined in consultation with the GSCC, and is described in Section 6.
- **Conclusions and Recommendations:** The conclusions and project recommendations are summarised in Section 7.

1.4. Limitations of project

This is a high level investigation of options for wastewater disposal. The project is limited to a comparison of a nominated range of options, and does not include concept, functional or detailed design of the options.

An attempt has been made to estimate the order of cost of each option, with an estimate of annual operation and maintenance costs where possible and a contingency allowance of 50% built into the estimates. The estimates should not be taken as a conclusive Whole of Life cost and Net Present Value analysis has not been performed for the options considered. The estimates do not allow for any further investigations, project design and delivery costs. As this is a high level investigation, the order of costs should be considered indicative and only be used for the purpose of comparing options.

The comparison of options was undertaken using current legislative requirements. No communication has been undertaken with the relevant authorities in regard to the suitability of the options investigated.

Community consultation has not been undertaken during the investigations however the draft report was reviewed by the Dookie and District Development Forum and its comments incorporated into this final report.

1.5. Disclaimer

The cost information provided in this report provides an indicative assessment of values based on a number of broad assumptions, some of which are in accordance with the customer‘s specific instructions. SKM advise that the cost information is strictly indicative only.

SKM advises that the cost information will definitely change as additional information is developed, assessed, processed and the necessary adjustments made to the assessment of the quantities, rates and costs. It does not constitute a final cost assessment.

The SKM assessments are based on various calculations as well as our best professional judgement of current prices and taking into account the assumptions stated in the document.

SKM note the estimation of construction costs is a very problematical exercise which at best should be regarded as an indicative assessment of possibilities rather than absolute certainties. The process of making projections of cost involves a considerable number of variables which are acutely sensitive to changing conditions, variation in which may significantly affect the conclusions of the SKM assessments.

This report is confidential to Greater Shepparton City Council for the specific purpose to which it refers. No responsibility is accepted to any third party for the whole or any part of its contents. Neither the whole of the report nor any part or reference thereto may be published in any document, statement or circular or in any communications with third parties without prior written approval of SKM.

2. Desktop review

A range of information relevant to wastewater disposal in Dookie was collected and reviewed. This included the GSCC plans, strategic documents, community plans and relevant regulations. Table 2-1 provides a summary of each of the documents that were reviewed, and comments of particular relevance to the town of Dookie.

Table 2-1: Summary of Desktop Review

Information Reviewed	Description	Comments of particular relevance for this project
Dookie septic survey spreadsheet, Greater Shepparton City Council (2005)	The septic tank assessments were documented in a spreadsheet which included information on the septic systems of 102 properties which were inspected in 2005. The information included: - Lot size and number of bedrooms; - Type and size of septic tanks and whether they appear well maintained; - Details of black water and grey water disposal; - Sludge levels; - Size, type and adequacy of disposal area; - Soil type; - Summary comments.	The main outcomes that are relevant for this study were: - Majority of residences own 1,800L or 3,000L tanks; - Around 20% of inspected grease traps were unsatisfactorily maintained; - Around 70% of all properties assessed had separate grey water and black water disposal; - All soil types were classed as clay/loam; - Almost all properties used absorption trenches for disposal of effluent after tank; - None of the inspected properties had room for a second disposal area; - 12 of the inspected systems flagged issues/risks associated with systems such as bogginess, odour issues.
Dookie and District Community Plan, Greater Shepparton City Council (2003)	A Community Plan, which is based on the contributions of the participants at a Community Planning Event. It aims to provide direction and a framework for the Dookie and the community's future development. The plan covers the following areas: - Heritage and environment; - Business and industry; - Community and recreational opportunities; - Infrastructure and development; - Implementation.	The following comments from the Plan outline the Dookie Community's views on wastewater disposal: - The current method of wastewater treatment is not environmentally friendly and an inhibitor to town and district growth; - Goal: Development of a sustainable water management plan for Dookie and district that considers and addresses the impact on groundwater levels of the treatment of grey and storm water in the Dookie Township, and the provision of irrigation water for district industries.

Information Reviewed	Description	Comments of particular relevance for this project
Greater Shepparton City Council Domestic Wastewater Management Plan, Greater Shepparton City Council (2008)	The Domestic Wastewater Management plan was developed for the purposes of consultation with the community and stakeholders in local domestic wastewater management. The Plan outlines the GSCC's policy context, provides a profile of septic tank systems in the area and related issues, analyses threats to domestic wastewater and provides management strategies to address the threats. The plan describes a range of risks associated with domestic wastewater management, including public health, environmental, economic and legal.	The plan identifies Dookie as one of the top five priority towns that may require a reticulated sewer service or extensions to existing reticulated sewer that service adjacent or nearby areas. Reasons why Dookie was identified as a priority township include: - Only 5 -10% of Dookie's septic systems were constructed since the 1980's; - Estimated that around 50% of wastewater is not contained on site; - Survey of properties showed that desludging was not occurring often enough; - 2/3 of septic tanks surveyed were small (1800L), and only serviced black water, with grey water discharged to the stormwater network; - Around half of the allotment sizes in the township are less than 1000m^2. The community values for Dookie were investigated through a process of community consultation. The main outcomes were: - Health protection is highly valued – complaints have been received concerning amenity (odour and visual) of open street drains, as well as health concerns related to mosquito breeding in the drains; - Economic – Development potential cannot be realized and is constrained due to the lack of disposable waste infrastructure being present and allotment size; - High values relating to Surface Water quality; - High values relating to Storm Water quality. Relevant management actions: - Development of a septic tank maintenance and management information and education program; - Review domestic wastewater information management system; - Development and review of operational policies and procedures; - Development of a compliance auditing regime; - Development of a septic tank system monitoring program for high risk areas.

Information Reviewed	Description	Comments of particular relevance for this project
Greater Shepparton City Council Housing Strategy, David Lock Associates (2011)	The *Greater Shepparton Housing Strategy 2011* forms the strategic basis for long term residential provision in Shepparton and outlying townships. The strategy will inform and guide decision making by landowners, the GSCC, service authorities and the general community about residential land and housing needs and locations.	The plan notes that the future development of unsewered townships such as Dookie will be limited by land capability, and recommends they be connected to sewered areas opportunistically.
Campaspe, Greater Shepparton and Moira Regional Rural Land Use Strategy (RRLUS), Parsons Brinkerhoff (2008)	The objective of the RRLUS is to secure and promote the future of agriculture and production in the areas of Greater Shepparton, Campaspe and Moira. The plan proposes strategies to ensure that decisions within the areas are made taking into account rural and agricultural interests.	Provides an overview of soils, climate and the agricultural context and importance of the region.
The GSCC's current requirements for installation of septic tanks, Greater Shepparton City Council (2011)	The application for a permit to install or alter a septic tank system in the Greater Shepparton Area. Information that must be provided includes: - Details of property owner, plumber, drainer - Number of fixtures to be connected, and number of residents - Detailed information on type of system, type of disposal, dimensions of all components - Land capability assessment - Site inspection with an Environmental Health Officer	Provides a context for requirements when making an adjustment or installing a new septic tank. However, for Dookie where a majority of the tanks are greater than 15 years old it doesn't provide information on how the existing condition is assessed.

Information Reviewed	Description	Comments of particular relevance for this project
Code of Practice - On-Site Wastewater Management, EPA (2008)	The Code of practice described measures to manage household wastewater in a sustainable way which minimises health and environmental risks. It includes: - Guidance of Victorian legislation and policy framework - Description of roles and responsibilities - Design and installation of suitable septic systems - Operation and maintenance of septic systems - Methods of disposal and recycling of effluent.	The Code provides information on a range of onsite and offsite options for wastewater management, as well as maintenance considerations. This information will be referenced throughout Section 4.

3. Site inspection

A site inspection of a sample of properties at Dookie was conducted on 14 October 2011. The seven properties were selected by the GSCC to give an overview of the wastewater disposal situation and issues in the township. The inspection was attended by Sam Cherubin (SKM), Roger Wrigley (Wrigley Dillon), and David Thomas (GSCC).

Figure 3-1 provides an aerial photograph of the township of Dookie, which shows the locations that were inspected. This section provides details of each of the inspections, with a summary of the investigations included in Section 3.2.

3.1. 90 Mary Street

Property Details:

- The dwelling is occupied by three adults.
- Previously there was one title with two dwellings, however subdivision became necessary and a separate title was created for each dwelling.

Septic System Details:

- When the subdivision occurred, the wastewater disposal method was altered so that the wastewater generated from each dwelling was contained within the corresponding title.
- For 90 Mary St, the only option was to continue to direct black water to septic and direct grey water to the open street drain because the onsite disposal area is not large enough to service both black water and grey water. The other title was not inspected so it is not known whether the same issue has occurred for the second title.
- The septic has a 1,800 L capacity and no baffle. It is desludged every 5 – 10 years.
- The disposal area (lawn) is approximately 85 m^2, and the system appears to have adequate capacity to dispose of the black water.
- Down pipes are connected to the street storm water drain.
- The presence of grey water has been evident in the street drain even during the recent dry years.

3.2. 4 Forer Street

Property Details:

- The property was previously associated with the Church over the road to the east, and owned by the same religious group.

Septic System Details:

- When the property was associated with the Church, wastewater was piped to the Church property.
- The house was sold by the Church and as a result, alteration of the wastewater disposal arrangement was needed.
- Due to the existing plumbing, fall of the land from rear to front and limited vacant land, an onsite treatment system was the only option for the property. An onsite aerobic wastewater treatment system (Ozzi Kleen system) was the only option due to available space at the front of the property.
- The system pumps to absorption trenches at the rear of the property.
- The absorption trenches have a high level overflow the street drain (kerb and channel).

3.3. 6 Williamson Street

Property Details:

- Two occupants live in the dwelling, and the property is large (approx 4,000 m^2) and has a lot of vacant / garden area.

Septic System Details:

- Even with large area for wastewater disposal, grey water is still discharged to the street drain (kerb and channel). The owner sometimes directs grey water to the garden using a slotted surface irrigation pipe.
- Black water is directed to a 1,800 L WCA septic tank.
- The owner has installed a sub-surface disposal system for effluent from the septic tank.

3.4. 24 Queen Street

Property Details:

- Previously vacant block with a recently constructed dwelling.
- Council had to limit the dwelling to two bedrooms to ensure the block could manage wastewater on site.

Septic System Details:

- Installation of an onsite treatment plant was a requirement of the development. A Biolytix Filter Model 6 was installed.
- Effluent is disposed of to an area of 316 m^2 via a pressurised sub-surface irrigation system.

3.5. 51 Dookie Street

Property Details:

- Leased to a family of six.

Septic System Details:

- Black water is directed to septic system and grey water is directed to a sub-surface drain previously installed in the lane at the rear of the property. The drain was installed by the GSCC to collect grey water from all properties which back on to this lane. The sub-surface drain discharges to the storm water drain.
- Both septic and grey water disposal area became overloaded. The lane became boggy and smelly and other residents complained to the GSCC.
- The GSCC required the owners to install an onsite aerobic wastewater treatment system (Ozzi Kleen system).

3.6. 36 – 38 Queen Street

Details of reserve:

- Currently the property is vacant land on two titles. The GSCC recently received an enquiry from a new owner about developing 2 x two bedroom dwellings on each title.
- The GSCC had to advise the proposed development was unlikely to receive development approval as there were limitations on the management of all wastewater on site.
- It is noted that there is limited vacant land similar to this allotment within the township.

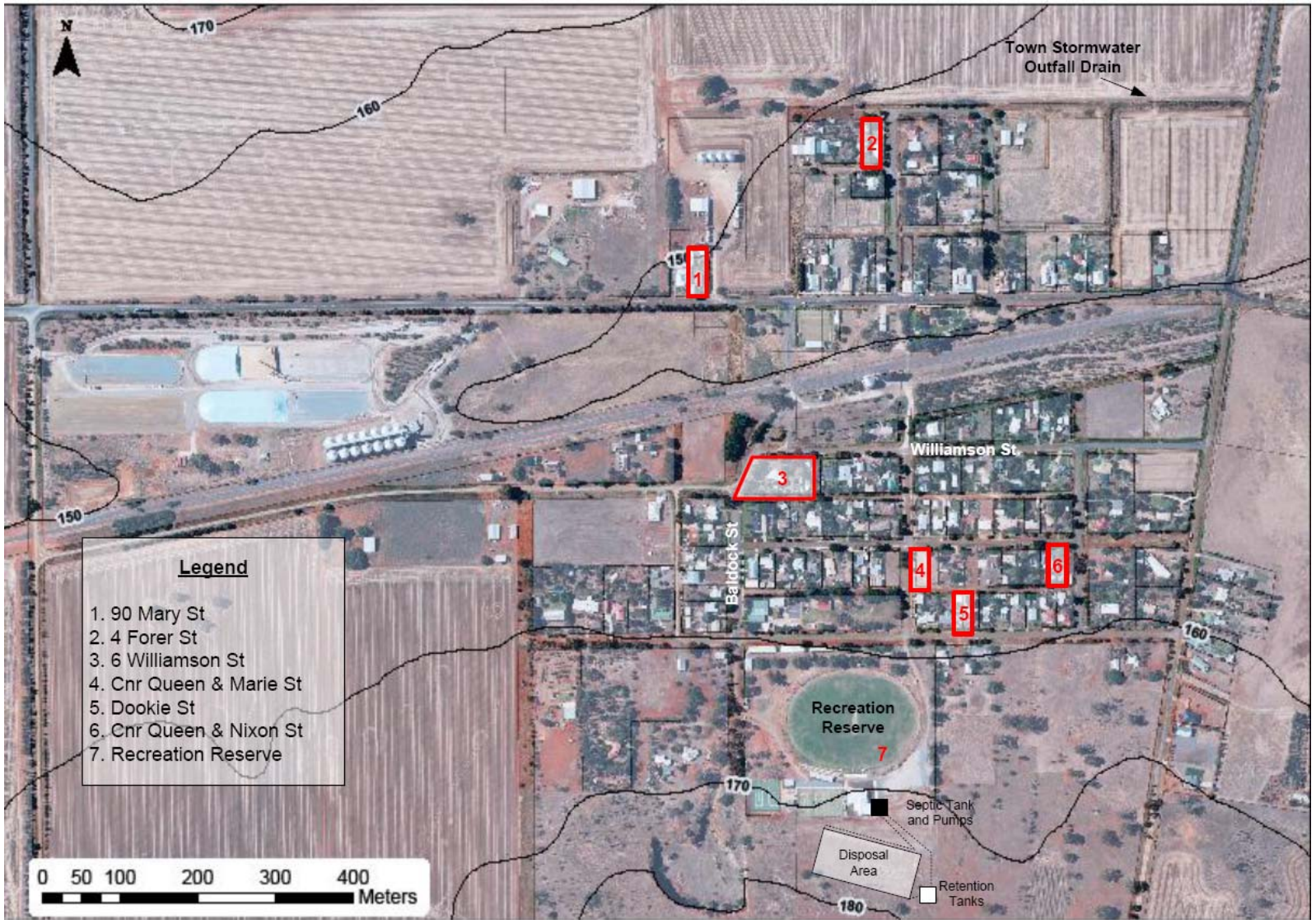
3.7. 20 – 25 Dookie Street (Recreation Reserve)

Details of reserve:

- The reserve hosts up to 8 teams of football and netball players on Grand Final day, so the loading from this day governed the size of the system.

Septic System Details:

- The wastewater disposal system was upgraded as part of a recent redevelopment.
- System consists of:
  - 3 x 3,200 L septic tanks. One tank is used exclusively for grey water from the change room showers.
  - Effluent from septic tanks is pumped to two retention tanks which discharge to 700 m of 1 to 1.2 m wide absorption trench, constructed in a terrace arrangement.
  - A slotted sub-surface drain was installed to collect any over flow from the absorption trenches and direct this back to the septic tanks.



- **Figure 3-1:Site inspection locations**

3.8. Summary of investigations

General

Inspection of the seven locations, as well as discussions with David Thomas throughout the day of the inspections provided information on the general state of wastewater disposal in the community of Dookie. This section summarises the main features, challenges and risks that were evident as a result of the inspections.

Management of black water and grey water

The septic systems of Dookie generally seem to work adequately for the treatment and disposal of black water. However, systems become overloaded if grey water is also connected. As a result, around 90% (pers comm. D Thomas) of all properties in the township direct black water to the septic system, and grey water to the storm water drainage system. All of the grey water ultimately drains (untreated) to the storm water outfall drain for the town.

There are specific environmental concerns associated with discharge of grey water, as the Dookie catchment is a groundwater recharge area for the district's underground aquifers. There is potential for contamination of groundwater as a result of the current wastewater management system.

Limits on development

Most properties cannot be developed further (e.g. extensions, pools etc) as the existing vacant area is required for wastewater disposal. The inspection of the corner of Queen St and Nixon St is an example of development being limited by the current preferred method of wastewater disposal.

Maintenance of onsite systems

A significant disadvantage for onsite treatment systems is that landowners often don't maintain them. During the site inspections, David Thomas (GSCC) estimated that 80% of onsite treatment systems in the municipality are not adequately maintained (pers. Comm.. D. Thomas), even though it is an EPA and GSCC requirement. The GSCC has limited resources to follow up on the maintenance of onsite treatment systems.

Areas of concern

Generally, the southern areas of the town which are at higher elevation have fewer wastewater issues than the northern areas, as wastewater drains freely downslope rather than soil becoming waterlogged and boggy at the base of the slope. The base of the slope and the valley floor where effluent collects is in the same area as the main road, commercial area and public space.

A particular area of concern was identified south of the railway line, where grey water that is discharged to the street ultimately drains to a storm water pit and then an open drain at the intersection of Baldock and Williamson St. This is an unsightly area and emits strong odours. On

the day of the site inspection, the accumulated grey water appeared (and smelt) very close to being anaerobic. Figure 3-2 shows a photo of this area that was taken on the day of the site inspection.

- **Figure 3-2: Grey water disposal at drain on the corner of Baldock and Williamson St**

4. Desktop Land capacity assessment

4.1. General

This section comprises a land capacity assessment of the Dookie Township, which was prepared by Roger Wrigley of Wrigley Dillon to assist with the wastewater treatment options study. The assessment includes an analysis of climate, soil characteristics, hydrology and geomorphology in the Dookie area.

Recommendations for wastewater disposal options were made by Roger Wrigley, and theses have been included with the other project recommendations in Sections 5 and 6 of this report.

4.2. Climate and Water Budget

A district water budget for the Dookie Township has been prepared as part of the land capacity assessment to show the volumes of rainfall, evaporation, temperature, crop demands and volume differential for the Dookie area. It provides an indication of the volume of infiltration and runoff that would occur in the area for different land uses. A copy of this indicative budget is provided as Appendix A, and it includes climate statistics for the Dookie Township.

An indicative annual hydraulic load for a lawn area is 634 mm. For a garden area, the load is likely to be lower and the indicative level for grapes will provide an indication that the hydraulic loading is likely to be 500 to 550mm. Both of these loadings are based on the rates of evapotranspiration (Et) and rainfall, not soil characteristics.

Assuming an area of 20 square metres, the volume of effluent which could be utilised by garden plants in the Dookie district in an average year is likely to range from 13,000 litres to 20,000 litres. For 40 square metres the volumes are doubled yielding 26,000 litres to 40,000 litres. In the wet year the volumes which could be used would decline and in the dry year they would increase. From 1997 to 2009 the annual volume of effluent which could be used on holdings in the Dookie area would have been large as long as it was well distributed. The reason for this is the low rainfall registered during that time and the relatively high rates of Et. If the application rate exceeded the rate of plant uptake runoff or groundwater recharge would result. Anecdotal evidence indicates that during the aforementioned period of drought runoff was observed. Knowledge of groundwater ingress is lacking.

During June, July and August in the average year it would be inevitable for runoff or deep percolation to occur after soil saturation. Based on the budget provided and assuming an available soil water storage capacity of 100mm saturation is most likely in August although July and September are also high risk months.

It would be very unusual to provide enough detention storage for a domestic wastewater treatment plant to preclude application in the winter months. Inevitably there will need to be reliance on soil moisture retention, a decline in household water use and an acceptance that effluent receives at least primary treatment before application and possible ingress to groundwater or runoff.

4.3. Geology, Hydrogeology and Geomorphology

Tickell (1989) maps most of the terrain serving as the foundation of Dookie as *Recent Quaternary* in origin. The map provided in Appendix B has been extracted from this source. The material is described as clay and sandy clay, colluvial deposits. Outcropping mafic igneous rock lies to the north and south of the town and this rock serves as the parent material for the colluvium which underlies the town.

Prior to the onset of dry conditions in 1997, parts of Dookie were recognised to be subject to saline groundwater discharge. This discharge resulted from groundwater recharge upslope and the presence of an elevated water table at the base of the depression where the town is located.

After more than thirteen years of drought, the focus on dryland salinity has declined. However with the rainfall in 2010 and 2011, it is assumed that there may be a local rise in water tables and consequently, a possible elevated risk of dryland salting.

Based on the terrain, in the case that the effluent and stormwater cannot be disposed of by means of evapotranspiration and there is a concurrent rise in the water table, it is likely that more surface discharge will occur. It is estimated that the direction of runoff will be to the east along the Dookie Devenish Road, where a relatively deep north south drain about 1 km from the town diverts runoff towards the north east into farming land.

4.4. General Soil Characteristics

The top of the soil catena at the Dookie Township generally consists of skeletal soil above parent mafic igneous rock. This highly fractured rock is exposed on the top and upper slopes of the Dookie hills which lie around the township. Appendix C provides a section of the district soil map which was extracted from Downes(1949). In descending order, the soil sequence passes through Dookie Clay Loam, Currawa Loam, Major Clay Loam and Cashel Clay Loam on the valley floor. Although, there is a gradual increase in clay content down slope the profiles are all generally free draining and evince bright red colouration which indicates that soils are well drained.

There is a noticeable lack of dams in the district which is further evidence of relatively free draining profiles. In addition, the District is famous for well structured relatively deep soils which evince high available water content. These support the production of high yielding winter crops.

As the parent material is dominated by mafic igneous rock the soil types evince a high level of iron, calcium and magnesium. These soils are also recognised to have high phosphorus sorption capacity and high potassium levels and availability. The clay dominance of the soils will at least minimise the impact of nutrients in primary and secondary treated effluent and storm water on groundwater and receiving waters.

4.4.1. Typical Soil Profiles in Dookie Township

Downes (1949) provides a detailed study of Dookie district soil types. In the vicinity of the township four soil types are listed. These are Dookie Clay Loam, Cashel Clay Loam, Major Clay Loam and Currawa Loam. The descriptions of these soil types from Downes (1949) are provided in Table 4-1 to Table 4-4 and these are consistent with Roger Wrigley's experience of 30 years in the district and the soil map provided as Appendix C.

It is noted that within the township area there is marked disturbance after more than 140 years of settlement but as the soil is considered to have excellent properties for residential purposes the amount of soil imported or amended is not considered to be excessive.

- **Table 4-1 Dookie Clay Loam**

Depth range	Description
0-250mm	Brown to red brown friable clay loam
250-625mm	Dark red-brown to red-brown friable clay
625-1250mm	Red-brown clay with friable to small nutty structure having black inclusions (probably manganiferous)
1250-1800mm	Brown to red brown clay and also sometimes slight lime at 1750mm

- **Table 4-2 Cashel Clay Loam**

Depth range	Description
0-150mm	Very dark grey or black friable clay loam
150-500mm	Black clay, large nutty structure
500-900mm	Black clay with small limestone rubble
900-1350mm	Brown and dark-grey clay with slight lime
1350-1950mm	Yellowish brown clay

- **Table 4-3 Major Clay Loam**

Depth range	Description
0-150mm	Dark-brown friable clay loam
150-300mm	Brown to dark brown friable clay with some soft lime
300-1000mm	Brown friable clay with medium lime
1000mm-1650mm	Brown friable clay

- **Table 4-4 Currawa Loam**

Depth range	Description
0-150mm	Brown loam
150-300mm	Brown going to yellowish brown, friable clay, the texture increasing gradually with depth.
300-675mm	Brownish yellow friable clay with black probably manganiferous inclusions
675-1000mm	Brownish yellow going to yellow friable clay with black inclusions
1000-1400mm	Yellow with brown mottled friable clay with some black inclusions and slight lime
1400-1800mm	Brown with yellow mottled clay and black inclusions, not so friable with heavy lime and rubble

4.5. Engineering Properties of Soils

Table 4-5 presents the results of tests for engineering properties conducted on soil samples from the B-horizons of the aforementioned soils types. By observation, Cashel Clay Loam has the highest Plasticity Index (PI) and contains the most clay as well as having the lowest hydraulic conductivity. These results were extracted from Wood, Burns and Howe (1981).

GSCC staff indicated that they have adopted indicative rates for soils in the Dookie District of 10mm/day for the application of primary treated effluent and 30mm/day for secondary treated wastewater. Based on the tabulated results it is however possible that the recommended GSCC rates are too high for soils at lower parts of the town and too low for soils higher in the landscape. The techniques employed by local consultants for determining percolation rates yield indicative only results and GSCC must rely on these in the absence of objective evidence.

- **Table 4-5.Details of Soil Tests**

Soil Type	No. of Sites	Liquid Limit	Plastic limit %	Plasticity %	Unified soil group of sub-soil	Linear shrinkage %	Hydraulic conductivity (litres/m^2 per day)
Currawa loam	2	58	14	44	CH	17	60
Cashel clay loam	4	81	19	62	CH	19	5
Dookie clay loam	2	64	14	50	CH	19	6
Major clay loam	4	62	18	44	CH	17	20

4.6. Summary of land capacity assessment

The expectation that all wastewater generated on a property can be maintained on site is unrealistic given variations in household water use, variation in soil types, household allotment sizes, terrain and the uncertainties associated with climate. There is also a lack of reliance on the effectiveness of wastewater treatment and storage.

Minimum requirements for the treatment of black water by provision of a septic tank of at least 1800 litres in capacity are realistic but this inevitably requires offsite grey water disposal. For comparison, the minimum requirement for a combined system is 3000 litres capacity. Also, the effectiveness of wastewater treatment cannot be relied upon unless there is regular maintenance.

Alternatively, onsite wastewater treatment plants are also in operation at Dookie. Whilst the wastewater treatment plants are relatively new, it is essential that they are routinely maintained according to the manufacturers and regulatory authorities' requirements to ensure produce suitably treated wastewater for disposal. From the brief appreciation of performance of these wastewater plants, it would appear that they are achieving the required reduction in nutrient level and microbial pathogens.

There is a concern with the detention of sullage and contaminated stormwater in street drains as this generates odour and provides a breeding place for insects. Drainage enhancement appears to be warranted to at least reduce "dead storage" in the town.

5. Options Assessment

5.1. Onsite Options

This section identifies and describes advantages and disadvantages associated with options for improved onsite wastewater management in Dookie. Onsite wastewater management systems are the responsibility of the home owner to install, operate and maintain so the costs of these systems would be the responsibility of Dookie residents. The GSCC are responsible for assessing and approving applications for permits to install or alter wastewater management systems throughout the area, as well as for monitoring appropriate maintenance of the systems. For systems that are not functioning correctly, the GSCC can order for the systems to be upgraded.

5.1.1. Option 1 – Improved maintenance of septic tanks

Description of Option

The GSCC identified that it is likely that up to 90% of all household septic systems in Dookie are not being adequately maintained. This results in risks to public health, as well as aesthetic issues (such as odours). The GSCC have indicated that there are limited resources available to the GSCC for monitoring maintenance of septic tanks, and the proposed actions have been developed with this in mind. Each different type of septic system requires different maintenance to remain functional, and it is the land owner's responsibility to ensure that maintenance is being carried out in accordance with the particular septic systems manufacturer guidelines. Table 3-1 of the Victorian EPA Code of Practice for the On-Site Wastewater Management describes common maintenance requirements for septic systems.

In order to improve septic tank maintenance throughout the township, a strategy should be developed, which utilises the resources available to the GSCC to generate a long term culture of proper maintenance of septic tank systems. The strategy should include:

- Public education campaign, including annual seminars. The purpose of these campaigns will be to educate the community about how to properly maintain their septic systems and also about why it is important for them to be properly maintained;
- Incentives for home owners to maintain their systems properly;
- Introduction of maintenance and management plan as part of the septic tank permit application process, along with the requirement for septic system owners to provide evidence of regular maintenance in order to maintain their permit;
- Septic tank desludging program. This program can be tendered by GSCC and any administration associated with the program will be the responsibility of the Contractor. In addition, the costs associated with this program can be passed onto the homeowner through their rates.

Estimate Order of Cost

An order of cost estimate was prepared for the purpose of comparison of Option 1 with the other Options. It has been assumed that the GSCC would recover costs of the Option from home owners through rate increases, so the cost has been developed as a rate per household.

The cost estimate includes development and distribution of a community fact sheet, a series of three community workshops and the septic tank desludging program. Table 5-1 shows that the total cost was estimated to be $640 excl GST per household for Option 1.

- **Table 5-1 – Order of Cost Estimate for Option 1**

Item	Description	Unit	Qty	Rate	Amount (ex. GST)
1	Develop maintenance fact sheet	1	1	$1,000	
2	Print and distribute information sheet	No.	300	$3	$750
3	Community workshops (assume 3 consultants attend each of 3 workshops)	No.	3	$4,800	$14,400
4	Regular desludging (assume desludging every 2 years for all tanks in township. Total no of households = 150, so number per year = 75)	No.	75	$500	$37,500
5	GSCC administration of desludging program	%	30%	-	$11,250
				Sub Total	$63,900
				Contingency (50%)	$31,950
				Total	$95,850
				Cost per property	$640

Advantages

- Minimal expenditure required by the GSCC and home owners;
- Strategy can be developed within the constraints on the GSCC resources;
- Will provide long term benefits if implemented properly;
- Benefits would include reduction to odours, fewer waterlogged/boggy soakage trenches, and reduced nutrients in effluent outflow;
- Improving community attitudes and understanding of their septic systems will have wider social benefits.

Disadvantages

- Does not address lack of capacity to treat grey water or enable growth in the township;
- If not implemented properly, the solution may be ineffective or benefits may be short term.

5.1.2. Option 2 – Retrofit improved septic system technology

Description of option

A majority of the septic tanks within Dookie are greater than 15 years old, and hence are not employing the most current onsite system technologies. There is a range of onsite system options which would provide more effective treatment, and reduce the disposal area required for each house. The GSCC survey of septic systems indicated that a majority of households only have an 1,800L septic tank, with disposal via an infiltration trench.

EPA approved alternatives and methods to increase the effectiveness and capacity of such systems include:

- Installation of a second tank to effectively treat increased load, and include grey water;
- Aerobic biological filter, (including wet composting, vermiculture);
- Aerated treatment (including cycles of aerobic and anaerobic digestion);
- Biological filters (including wet composting, vermiculture);
- Membrane filtration;
- Reed beds;
- Sand filters;
- Trickling filters (including packed media, packed bed reactors);
- Dry composting.

It is proposed that a customised solution for each septic system within Dookie be provided, based on the particular constraints at each property. That is, each property would be assessed separately to determine a solution that is most appropriate for the particular volume of wastewater, size of disposal area, and soil characteristics.

Estimate Order of Cost

An order of cost estimate was prepared for the purpose of comparison of Option 2 with the other Options. It has been assumed that the GSCC would recover costs of the Option from home owners through rate increases, so the cost has been developed as a rate per household.

The cost estimate is based on retrofit of a modern wastewater treatment system to each household in the Dookie Township. Table 5-2 shows that the total cost was estimated to be $17,250 excl. GST and operation and maintenance costs per household.

- **Table 5-2 – Order of Cost Estimate for Option 2**

Item	Description	Unit	Qty	Rate	Amount (ex. GST)
1	Average assumed cost per household for retrofit of a modern wastewater treatment system (such as aerobic), including on-site disposal and connection to or decommissioning of current septic tanks	No.	150	$11,500.00	$,725,000.00
Exclusions	Does not include cost for removal of existing septic tanks	N/A	N/A	N/A	N/A
				Sub Total	$1,725,000
				Contingency (50%)	$862,500
				Total	$2,587,500
				Capital Cost per property	$17,250
				Estimated annual maintenance costs	$1,000

Advantages

- If implemented successfully, should address public health and environmental issues;
- Should enable growth of township, through reduction of disposal area requirements.

Disadvantages

- May not be possible to effectively treat all black water and grey water, even with improved technology, due to the limited disposal areas for some properties;
- Does not address maintenance issues – for new technology systems to be effective, proper maintenance is required. It is common for these treatment systems to require quarterly inspections undertaken by the GSCC to satisfy EPA requirements. It is noted that this cost can be passed onto the owner by the GSCC;
- Will require significant commitment from the GSCC to ensure that each house is properly inspected and a suitable solution is implemented.
- Significant investment required by home owners to fund the scheme. May require government funding in order to reduce the costs to a reasonable amount.

5.1.3. Option 3 – Retrofit household reuse of grey water

Description of option

The GSCC septic tank assessments (2005) and recent site inspections indicated that the septic systems of Dookie can adequately service the black water loads, however cannot service grey water loads. As a result, a significant amount of household grey water is discharged directly to the storm water drainage network.

This option involves retrofit of grey water reuse systems to all houses within the township that have septic systems that are unable to service grey water. The Victorian EPA Code of Practice for the On-Site Wastewater Management includes guidelines for the reuse of grey water, and describes approved treatment options for different forms of reuse.

The Code of Practice explains that manual bucketing or diverting untreated household grey water for sub-surface irrigation can be undertaken without a permit. However, there would only be a demand for the grey water during dry summer months, so during winter the grey water would still be discharge to the storm water network.

For grey water to be used within the home, such as for toilet flushing or washing machine, advanced secondary treatment and disinfection would be required. A GSCC permit is required for approval of such systems prior to installation, and for approval of the operation and maintenance of the system. This option proposes to provide an EPA approved grey water treatment system to all properties within Dookie, to enable recycling of the grey water for toilet flushing, washing machine use and garden watering. Any excess grey water would be discharged to the storm water network, however it is noted that this practice is not approved by the EPA.

Estimate Order of Cost

An order of cost estimate was prepared for the purpose of comparison of Option 3 with the other Options. It has been assumed that the GSCC would recover costs of the Option from home owners through rate increases, so the cost has been developed as a rate per household.

The cost estimate is based on retrofit of RootZone Greywater treatment system to each household in the Dookie Township. This system is listed by the Victorian EPA as an approved system for treatment of grey water for garden, toilet and laundry use (www.epa.vic.gov.au/water/wastewater/onsite.asp). Table 5-3 shows that the total cost was estimated to be $15,000 excl. GST and operation and maintenance costs per household.

- **Table 5-3 – Order of Cost Estimate for Option 3**

Item	Description	Unit	Qty	Rate	Amount (ex. GST)
1	Supply and installation of RootZone Greywater treatment system, to treat water for reuse in garden, toilet and laundry.	No.	150	$10,000	$1,500,000.00
Exclusions	Does not include cost for removal of existing septic tanks	N/A	N/A	N/A	N/A
				Sub Total	$1,500,000
				Contingency (50%)	$750,000
				Total	$2,250,000
				Cost per property	$15,000
				Estimated annual maintenance costs	$1,000

Advantages

- If implemented successfully, this option should address public health and environmental issues associated with discharge of grey water to the storm water system, and water logging of disposal areas. The scheme may require government funding in order to reduce the costs to a reasonable amount;
- Should enable growth of township, through reduction of disposal area requirements;
- Will also reduce the volume of mains water demand throughout the township.

Disadvantages

- Costly option, since grey water treatment systems would need to be retrofit to existing houses, and plumbed. A significant level of treatment would also be required, in order to meet EPA requirements for in-house recycling;
- Success of the system would rely on proper operation and maintenance of the system by residents.
- Any excess grey water that is not reused would be discharged to the storm water network. This is most likely to occur during the winter months when outdoor use would be minimal.
- Public perception of grey water reuse may be a barrier to the successful implementation of this option.

5.2. Whole of Town System Options

There are also options available for treatment and disposal of waste water on a whole of township scale. For implementation of a centralised treatment system, Goulburn Valley Water (GVW) would be responsible for implementation, operation and maintenance of the system. An EPA Works

Approval would be required for any whole-of-town treatment system and it would be GVW's responsibility to obtain this.

GVW has indicated that they would be supportive of centralised wastewater management for the township of Dookie, provided that there is sufficient community support for the scheme. GVW would propose that funding for implementation of a centralised scheme would be from residents, or as part of funding grants. The scheme would then become part of GVW's existing system of tariffs.

5.2.1. Option 4 – Common Effluent Disposal Scheme

Description of option

An option for improving the system of waste water treatment and disposal throughout Dookie is to retain the existing onsite septic systems for capture and storage of solids, however dispose of septic tank effluent via a combined reticulation system rather than using household scale soakage trenches. The effluent would drain to a lagoon system or wastewater treatment plant at a low point in the township for treatment. The treatment system should be designed to accommodate future growth of the township. The effluent would be disposed of by evaporation and reuse.

As part of this option, there would be potential to reuse the wastewater from the treatment lagoon on local horticultural lands. Scott Feldman of Gentle Annie Vineyard has expressed an interest in accessing effluent for subsurface irrigation of a 65Ha vineyard located approximately 4km east of the Dookie Township. He has explained that the average irrigation requirement is 160ML/year, and he could accommodate storage for the water on his property if necessary. In order to reuse the water for purposes such as this, the water would require treatment to a suitable standard. An estimate of the volume of wastewater generated from the current township was calculated to be 20ML/year, based on a rate of generation per person of 180L/day (EPA, 2008). Hence the volume generated from the town is far lower than the demand from Gentle Annie Vineyard. Investigation of the economics of this potential effluent reuse option would be required to determine its feasibility. Other issues would also need to be considered including the need for GVW owned and operated reuse, in the event the vineyard ceases to operate, and a reuse agreement.

This indicates that there is a potential wastewater market in the areas surrounding Dookie, which would improve the economic viability of a decentralised wastewater management scheme. The beneficial use of treated effluent would be consistent with the Dookie and District Community Plan 2003.

Estimate Order of Cost

An order of cost estimate was prepared for the purpose of comparison of Option 4 with the other Options. It has been assumed that the GSCC would recover costs of the Option from home owners through rate increases, so the cost has been developed as a rate per household.

The cost estimate is based on the construction of a drainage network, pump station, 20 ML storage lagoon, effluent disposal and reuse scheme, and connection of households to the scheme. Table 5-4 shows that the total cost was estimated to be $22,175 excl. GST and operation and maintenance costs per household. The cost estimate does not account for property owners needing to renew / relocate their septic tanks to develop their property as they desire.

- **Table 5-4 – Order of Cost Estimate for Option 4**

Item	Description	Unit	Qty	Rate	Amount (ex. GST)
1	Supply and install DN150 pipe	m	5,000	$100	$500,000
2	Supply and install DN225 pipe	m	1,000	$130	$130,000
3	Bore under railway line	Item	1	$40,000	$40,000
4	Construct manholes	No.	25	$1,500	$37,500
5	Construct lift pump station	Item	1	$50,000	$50,000
6	Construct sewer outfall pump station	Item	1	$175,000	$175,000
7	DN150 sewer outfall rising main	m	1,000	$110	$110,000
8	Construct 8 ML treatment lagoon	Item	1	$200,000	$200,000
9	Construct 15 ML winter storage lagoon	Item	1	$300,000	$300,000
10	Effluent disposal pump station	Item	1	$100,000	$100,000
11	Power supply to irrigation pump station	Item	1	$50,000	$50,000
12	Construct effluent disposal / reuse system	Ha	2.5	$50,000	$125,000
13	Land acquisition for treatment and reuse site	Ha	5	$7,500	$37,500
13	Other construction costs	Item	1	$100,000	$100,000
14	Domestic plumbing to connect to the scheme	No.	150	$1,750	$262,500
				Sub Total	$2,217,500
				Contingency (50%)	$1,108,750
				Total	$3,326,250
				Cost per property	$22,175

Advantages

- By retaining the solids onsite, the gradient of the reticulation pipe work can be minimised which would reduce costs as compared with a complete sewerage system.
- This solution would address the key public health and environmental issues associated with discharge of grey water to the storm water system, and water logging of disposal areas throughout the township.

- This option will enable some growth of township, through reduction of household disposal area requirements.
- There are opportunities for reuse of wastewater effluent, which would improve the economic viability of a decentralised wastewater management scheme. If the water is treated to the necessary quality of reclaimed water, it could be reused for municipal irrigation, such as for the irrigation of public parks and gardens.
- Responsibility of the decentralised scheme, apart from maintenance of septic tanks, would be transferred to GVW (and GVW has indicated that they would be generally supportive of such a scheme).

Disadvantages

- Household maintenance of septic systems will still be an issue, since solids are to be retained on site.
- Decentralised wastewater management schemes (and reuse schemes) require additional statutory approvals.
- This would be a medium capital cost option and may only be viable with Government support / funding through the Essential Services Commission.
- The development potential for the town will still be limited, as septic tanks will remain, and there can be no construction within 2 m of a septic tank. Property owners may need to renew and relocate their septic tank in order to develop their property.

5.2.2. Option 5 – Sewerage System

Description of option

Another decentralised option is for the town of Dookie to be converted to a complete sewered system. This would involve decommissioning and disconnecting or removing all existing septic system infrastructure, and retrofitting a new sewer network for the town. Typically, a lagoon based treatment system or package wastewater treatment plant would be installed to treat and store all black water and grey water generated from the town. Similar to Option 4, the treated effluent would be available for reuse following treatment.

Estimate Order of Cost

An order of cost estimate was prepared for the purpose of comparison of Option 5 with the other Options. It has been assumed that the GSCC would recover costs of the Option from home owners through rate increases, so the cost has been developed as a rate per household.

The cost estimate is based on the connection costs for similar sewerage schemes for small towns that have been recently implemented by North East Water. Table 5-5 shows that the total cost was estimated to be $23,625 excl. GST and operation and maintenance costs per household. The cost estimate does not account for decommissioning (e.g. removal) of existing septic tanks.

- **Table 5-5 – Order of Cost Estimate for Option 5**

Item	Description	Unit	Qty	Rate	Amount (ex. GST)
1	Assumed cost of scheme per household, based on similar schemes that have been constructed recently in nearby towns by North East Water	No.	150	$21,000	$3,150,000
2	Domestic plumbing to connect to the scheme	No.	150	$1,750	$262,500
				Sub Total	$3,412,500
				Contingency on connections (already built in to item 1) (50%)	$131,250
				Total	$3,542,750
				Cost per property	$23,625

Advantages

- This solution would address the key public health and environmental issues associated with discharge of grey water to the storm water system, and water logging of disposal areas throughout the township.
- This option will enable growth of township, through reduction of household disposal area requirements.
- There are opportunities for reuse of wastewater effluent, which would improve the economic viability of a decentralised wastewater management scheme.
- There will be no household maintenance of wastewater infrastructure required, which addresses one of the key issues associated with the current septic systems.
- Responsibility of the decentralised scheme would be transferred to GVW (and GVW has indicated that they would be generally supportive of such a scheme).

Disadvantages

- This would be an expensive option, and would require significant changes to infrastructure throughout the township, and may only be viable with Government support.
- Decentralised wastewater management schemes require additional statutory approvals.

5.3. Environmental Options

In addition to the proposed onsite and offsite wastewater management options, two options specifically relevant to environmental outcomes were identified as part of this investigation.

It is noted that these options do not provide a complete solution to the current situation identified at Dookie. However, it will provide GSCC will greater confidence in preferred option selection.

5.3.1. Option 6: Groundwater monitoring

There is a linkage between the discharge of domestic effluent, rainfall- runoff, evapotranspiration stormwater and groundwater. It is recommended that monitoring of groundwater impacts take place in the vicinity of the town to determine the scale of the environmental impacts of wastewater management.

If it can be demonstrated that groundwater quality is compromised by wastewater it will provide further impetus for improvement of the wastewater management system. For example, this information could be used by GVW to build a business case for a whole-of-town option in an attempt to obtain government funding.

Estimate Order of Cost

An order of cost estimate was prepared for the purpose of comparison of Option 6 with the other Options. It has been assumed that the GSCC would recover costs of the Option from home owners through rate increases, so the cost has been developed as a rate per household.

The cost estimate is based on installation and monitoring of 4 groundwater bores. Table 5-6 shows that the total cost was estimated to be $380 per household.

- **Table 5-6 – Order of Cost Estimate for Option 6**

Item	Description	Unit	Qty	Rate	Amount (ex. GST)
1	Installation of groundwater monitoring bores	no	4	$3,000	$12,000
2	Groundwater monitoring	Item	1	$30,000	$30,000
				Sub Total	$42,000
				Contingency (50%)	$15,000
				Total	$57,000
				Cost per property	$380

5.3.2. Option 7: Planting for protection of groundwater recharge areas

During years of average to high rainfall, parts of Dookie are recognised to be subject to saline groundwater discharge. This discharge results from groundwater recharge upslope and the presence of an elevated water table at the base of the depression where the town is located. Based on the topography of the town, if the effluent and stormwater cannot be disposed of by means of evapotranspiration and water tables rise, it is likely that more surface discharge will occur.

GSCC can work with the community to replant vegetation upslope of Dookie Township for protection of groundwater recharge areas to assist water table control and provide for greater

exploitation of relatively deep soil profiles. Planting in the town needs to be more targeted to avoid disturbance of services.

Estimate Order of Cost

An order of cost estimate was prepared for the purpose of comparison of Option 7 with the other Options. It has been assumed that the GSCC would recover costs of the Option from home owners through rate increases, so the cost has been developed as a rate per household.

The cost estimate is based on planting of around 500 seedlings, as well as the GSCC administration of the scheme. Table 5-7 shows that the total cost was estimated to be $120 per household.

- **Table 5-7 – Order of Cost Estimate for Option 7**

Item	Description	Unit	Qty	Rate	Amount (ex. GST)
1	GSCC administration of program	Item	1	$10,000	$10,000
2	Plants and planting (assuming 500 seedlings)	No	500	$10	$5,000
				Sub Total	$15,000
				Contingency (50%)	$2,500
				Total	$17,500
				Cost per property	$120

5.4. Assessment of options

Each of the options has been compared using the matrix shown in Table 5-8. The matrix has been developed to compare the options based on a range of criteria considered to be important in the selection of options.

It should be noted that the relative importance of each criteria has not been weighted, and the final selection of the preferred option/s will depend on stakeholder preferences and the relative importance of each criteria.

- **Table 5-8: Assessment matrix for comparison of the options**

	Onsite system			Whole of town system		Environmental	
Criteria	**Option 1: Improved maintenance of septic tanks**	**Option 2:Retrofit improved septic system technology**	**Option 3:Retrofit household reuse of grey water**	**Option 4:Common effluent disposal scheme**	**Option 5: Sewerage scheme**	**Option 6: Groundwater monitoring**	**Option 7: Planting for protection of groundwater recharge areas**
Complete solution?	No	Yes	Yes	Yes	Yes	No	No
Relative capital cost (high, medium, low, N/A)	Low cost, only for GSCC resources	Moderate cost for retrofit required for most properties	Moderate cost for retrofit required for most properties	Moderate cost for drainage infrastructure and lagoons or treatment plant	High cost for treatment plant and sewer connections	Low	Low
Operational cost	No additional operational costs to GSCC or residents	New systems may require additional operational costs	No significant impact to operational costs	GVW connection costs and ongoing service charge for operation and maintenance of the system	GVW connection costs and ongoing service charge for operation and maintenance of the system	Low	None
Environmental	Likely to improve environmental concerns	Increased certainty for improving environmental concerns	Increased certainty for improving environmental concerns	Complete solution to environmental concerns	Complete solution to environmental concerns	Improve understanding of environmental impacts	Reduce dry land salinity concerns
Social	Low cost to home owners, improved education for community	New technologies may improve community understanding, may allow for township growth	Grey water recycling may improve community understanding, may allow for township growth	Community support would be important in funding scheme, would enable township growth	Community support would be important in funding scheme, would enable township growth	May assist in building a case for further investment	Community likely to support strategy, visible method that GSCC can implement readily
Approvals	N/A	GSCC	GSCC	GSCC and other authority approvals required	GSCC and other authority approvals required	Goulburn-Murray Water may be required	Land owner / manager
Maintenance requirements for residents	Adequate maintenance required for functionality	Adequate maintenance required for functionality	Adequate maintenance required for functionality	Reduced maintenance requirements, however routine septic desludging still required	No maintenance required by residents	No maintenance required by residents	No maintenance required by residents
Maintenance requirements for GSCC	GSCC only responsible for monitoring resident's maintenance	GSCC only responsible for monitoring resident's maintenance	GSCC only responsible for monitoring resident's maintenance	GSCC/GVW responsible for drainage and lagoon maintenance	GVW responsible for all maintenance	Low maintenance requirements	Low maintenance requirements
Potential revenue	None	None	Savings to home owners through grey water recycling	Possible sale to local irrigators (GVW revenue)	Possible sale to local irrigators (GVW revenue)	None	None

6. Preferred option

6.1. Detailed description of preferred option

It is recommended that a combination of Option 1, Option 5 and both environmental Options (Options 6 and 7) are implemented in the township of Dookie, in order to improve the wastewater management system for the town. A combination of these options would address each of the major risks and concerns associated with the current system (refer Section 3.2). Option 5 (sewerage scheme) is recommended as it is preferred over Option 4 by the Dookie and District Development Forum. The draft of this report, which recommended Option 4, was reviewed by the Forum and feedback to GSCC, dated 26 April 2012, indicated a preference for Option 5.

Options 6 and 7 are focused on the specific environmental concerns associated with dryland salinity and groundwater recharge, and should be implemented as a matter of priority. These options are readily implemented and, in the case of Option 7, could provide benefits in the short-term. In the case of Option 6, the installation of groundwater monitoring bores is often part of preliminary investigations in the planning for a sewerage scheme. The GSCC could begin by implementing these as soon as practical, as they are low cost and do not require additional approvals or significant planning/consultation.

Similarly, Option 1 could be implemented as soon as practical in order to provide improvements within a short timeframe. As described in Section 5.1.1, the purpose of Option 1 is to improve the maintenance of the existing septic tanks throughout the township. This will require a strategy to be developed by the GSCC, which utilises the resources available to the GSCC to generate a long term culture of proper maintenance of septic tank systems. In particular, improving the frequency of desludging of the tanks will be required if it is undertaken in combination with implementing Option 4.

Option 5 proposes to a complete sewerage scheme which would involve enable residents to decommission their existing onsite septic systems. The sewerage scheme would collect all black and grey water generated by properties connected to the scheme. Storm water would continue to discharge to the storm water network. It is likely the sewerage scheme would be in the form of a Modified Conventional Sewerage scheme. This type of scheme is less costly than a conventional scheme as compromises are made to reduce the capital cost, such as reducing the number of manholes by increasing the spacing. This type of scheme has become viable over the last 20 years or so as technologies and maintenance equipment has improved. The wastewater would drain to a treatment system most likely comprising a treatment lagoon and winter storage lagoon. The purpose of the winter storage lagoon is to store treated effluent during the winter months so it is available for reuse during the irrigation season. Ideally, the treatment system would be located at a low point in the vicinity of the township. As described in Section 5.2.1, there are third party reuse

opportunities for the wastewater including subsurface irrigation on a local vineyard, or irrigation of public open spaces, if the wastewater is treated to an adequate level of quality. Option 5 would require a significant level of community consultation, funding, approvals and design prior to implementation, hence is a longer term option for Dookie. Implementation would be through GVW, and would be funded by landowners and the government.

Section 5 describes the advantages and disadvantages associated with each of the options. Through implementing Options 1, 5, 6, and 7 concurrently, a complete wastewater solution can be found, which addresses all the concerns associated with the current system. This section describes in more detail how the preferred solution would address the key criteria included in Table 5-1.

6.2. Capital Cost

The capital cost estimate for implementing all of the recommended options is included in Table 6-1.. It is expected that the complete scheme would only be viable with Government support. However, the less expensive options could be implemented readily without seeking additional funding.

- **Table 6-1: Combined Order of Cost Estimate for Recommended Options**

Option	Capital cost per household (excl. GST)
Option 6: Groundwater monitoring	$380
Option 7: Planting for protection of groundwater recharge areas	$120
Option 1: Improved maintenance of septic tanks	$640
Option 5:Sewerage scheme	$23,625
TOTAL	$24,765

Note: The order of cost estimate for Option 5 excludes operation and maintenance costs.

6.3. Operational Cost

There would also be operational and maintenance costs associated with the sewerage scheme. This would include operations of pump stations and treatment facilities, as well as regular maintenance.

GVW would be responsible for the scheme operation and maintenance costs, and would charge connected properties a connection fee and ongoing service charge for capital, operation and maintenance of the system.

6.4. Environmental

The environmental concerns associated with the current scheme result from septic systems that are not properly maintained, and which also do not have the capacity to service all of the black water and grey water effluent. As a result, grey water effluent is being discharged to the storm water drainage system and causing a variety of environmental concerns including odours, water logging,

potential groundwater contamination and mosquito breeding. Implementing Option 1 would address the issue of poor septic system maintenance, while Option 5 would remove all grey water from the township and allow decommissioning of septic tanks. Implementation of Options 6 and 7 would specifically address dryland salinity and groundwater recharge concerns, and should be implemented as a matter of priority.

6.5. Social

Implementation of Option 1 would improve the community understanding of wastewater treatment, and hence improve community attitudes. Social benefits would result from eliminating areas of effluent stagnation which cause aesthetic issues such as odours and waterlogging. Option 5 would address the social concerns of the Dookie community, improving growth potential, allowing residents to develop their properties and improve the aesthetics and amenity of the township.

6.6. Statutory Authority approval

Adequate maintenance of household septic systems is already a requirement of the EPA and the GSCC, so implementation of Option 1 would improve compliance throughout the township. The implementation of a centralised scheme would require other EPA approvals to be met, including Works Approval for the implementation of a treatment system and the level of treatment required for various methods of reuse. Other authority approvals such as Department of Sustainability and Environment may be required. Goulburn Valley Water would require GSCC approval to implement the scheme.

6.7. Maintenance requirements for residents

Under Option 1, residents would still be required to maintain their onsite septic systems for the collection of solids, which would be collected by a contractor. So it will be important to encourage a culture of proper maintenance throughout the township. There would be less maintenance requirements than for Options 2 and 3, which propose retrofit of new systems to the households.

Under Option 5, existing septic systems would be decommissioned once properties connect to the sewerage scheme. Residents connected to the scheme would not have any operation and maintenance responsibilities however would be charged by Goulburn Valley Water for operation and maintenance of the scheme.

6.8. Maintenance requirements for GSCC

Under Option 5, Goulburn Valley Water would be responsible for maintenance of the sewerage scheme and treatment system..

6.9. Maintenance requirements for Third Party Reuse

Under Option 5, if effluent from the treatment system was provided to third parties for reuse / irrigation on their properties, the third party would be responsible for maintenance of any infrastructure on their property. This would also apply to GSCC if it were to use effluent for irrigation of any parks, gardens or open space.

6.10. Potential revenue

As part of Option 5, there would be potential to reuse the effluent from the treatment system on local horticultural lands. Scott Feldman of Gentle Annie Vineyard has expressed an interest in accessing effluent for subsurface irrigation of a 65 Ha vineyard located approximately 4 km east of the Dookie Township. He has explained that the average irrigation requirement is 160ML/year, and he could accommodate storage for the water on his property if necessary. This indicates that there is a potential wastewater market in the areas surrounding Dookie, which would improve the economic viability of a centralised wastewater management scheme.

7. Conclusions and Recommendations

There are a range of concerns associated with the current system for management of wastewater within the township of Dookie. It has been identified in the GSCC Domestic Wastewater Management Plan (DWMP) as one of five priority towns where wastewater disposal improvements are needed.

The major risks/concerns associated with the current wastewater management systems include:

- Poor maintenance of household septic systems by residents;
- Inability for current systems to service black water and grey water loads, resulting in the disposal of grey water to the storm water drainage network;
- Community concerns as a result of odours, water logging and mosquito breeding;
- Limits on the growth potential of the town due to the need to maintain adequate effluent disposal areas on each property;
- Environmental concerns associated with groundwater recharge and contamination.

Throughout this investigation, SKM has conducted a desktop review of information, assessed the current on-site systems, assessed land capacity to treat and contain wastewater within the township area, and has provided solution options to resolve the current wastewater disposal problems. A range of potential solutions were described and compared based on a range of economic, social and environmental criteria. SKM issued a draft report to GSCC. This was reviewed by GSCC and the Dookie and District Development Forum and feedback provided to SKM. This final report incorporates feedback from the review process. An action list of priority options was identified to addresses the main concerns associated with the current system without being prohibitively expensive.

The priority options include (in order of implementation timeframe):

- Groundwater monitoring to determine the scale of the environmental impacts of the current wastewater management system (Option 6);
- Re vegetation for protection of groundwater recharge areas (Option 7).
- Development of a strategy by the GSCC to generate a long term culture of proper maintenance of septic tank systems (Option 1);
- A sewerage scheme (Option 5), which would include decommissioning of existing septic systems and connection of each property to a reticulated sewerage network. The scheme would also include a lagoon based treatment system or packaged treatment plant, with effluent available for reuse. It is recommended that stakeholder consultation be commenced to assess the level of support for the scheme from the community and organisations such as Goulburn

Valley Water, University of Melbourne and Dookie and District Development Forum. GSCC and Dookie and District Development Forum acknowledge that Option 5 is the most expensive option and long term goal, that may only be viable with Government support, however consider the community needs to be given this option in order to make a decision to move forward.

It is recommended that further investigation of these options be conducted, in order to determine the level of community and stakeholder support and the feasibility of implementing the options.

8. References

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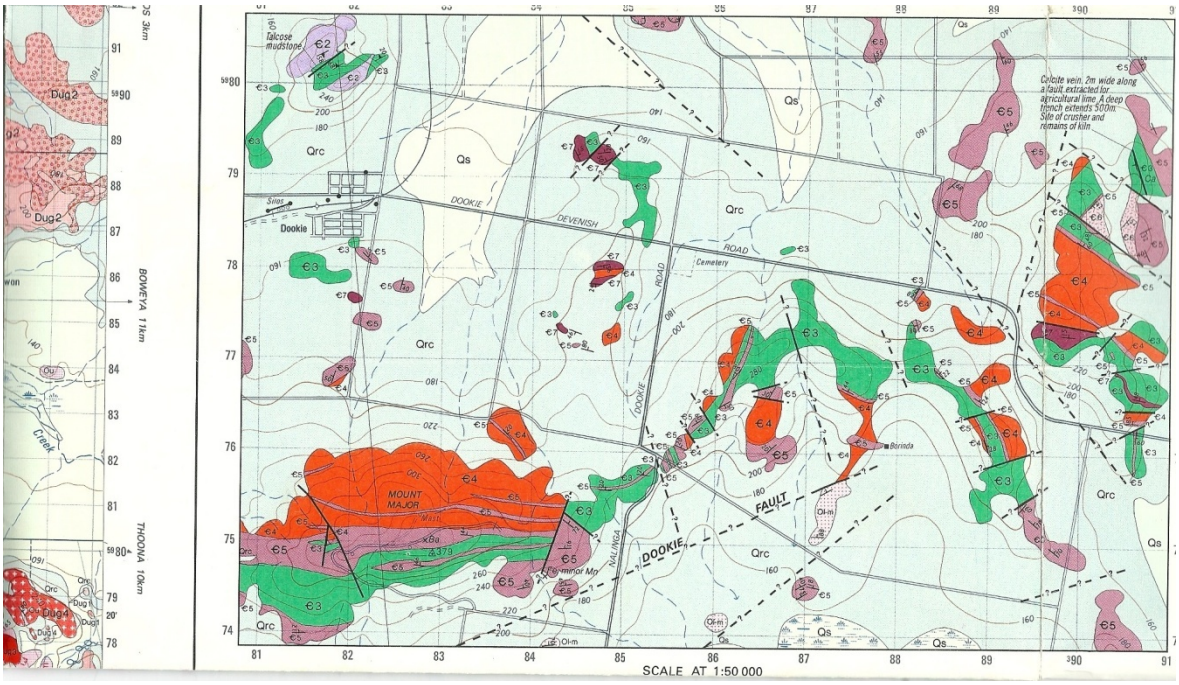
Appendix A: Dookie Water Budget

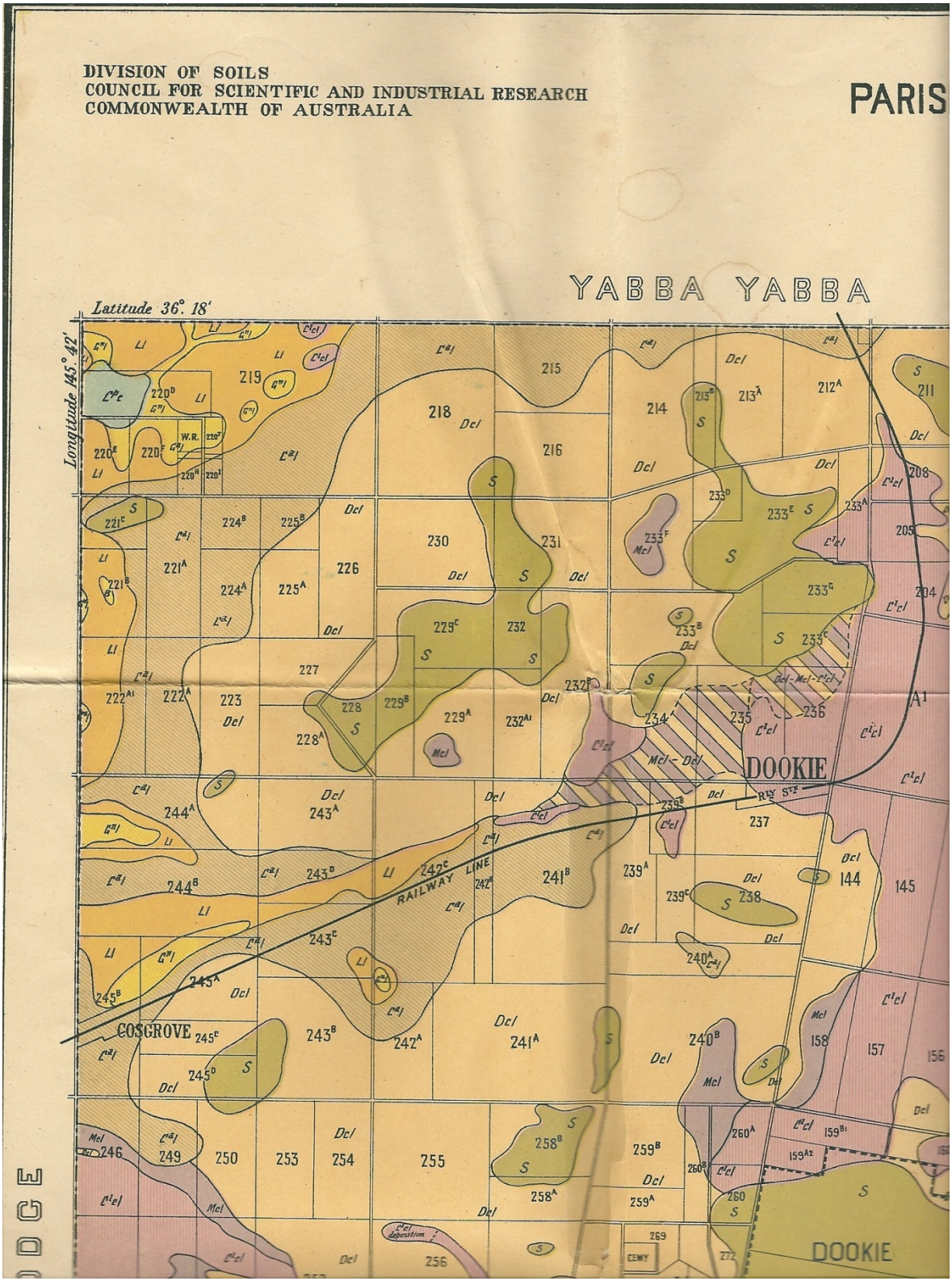
Climate Statistics for Dookie

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Comments
Average monthly rainfall (mm)	35.3	34.0	38.7	41.5	52.3	58.3	55.0	57.2	50.3	53.7	39.4	35.8	551.5
Average Monthly evap (mm)	260.4	223.3	176.7	96	55.8	33.0	37.2	58.9	87.0	130.2	192.0	254.2	1604.7
Mean number of rain days	3.3	3.1	3.9	4.9	6.7	8.1	8.7	9.1	7.3	6.8	4.9	4.1	70.9
Average Max Temp oC	29.8	29.7	26.0	21.2	16.5	13.6	12.5	13.7	16.4	20.4	23.5	27.2	20.9
Average monthly min <5^{o}C						X	X	X					
Crop factors													
Grapes	0.7	0.65	0.55	0.45	0.35	-	-	-	0.25	0.45	0.6	0.7	Values from Doorenbos & Pruitt FAO 168
Pasture	0.7	0.7	0.7	0.6	0.5	0.45	0.4	0.45	0.55	0.65	0.7	0.7	II II
Grape ave evapotranspiration	182.2	145.1	97.2	43.2	19.5	-	-	-	21.8	58.6	115.2	177.9	
Differential (mm)	146.9	111.1	58.5	1.7	-32.8	-58.3	-55.0	-57.2	-36.9	4.9	75.6	142.1	Water req. 540.8 mm
Pasture ave evapotranspiration	182.2	156.3	123.7	57.6	27.9	14.9	14.9	26.5	47.9	84.6	134.4	173.6	
Differential	146.9	122.3	85.0	16.1	-24.4	-43.4	-40.1	-30.7	-2.4	30.9	95	137.8	Water req. 634mm

Appendix B: Dookie Geological Map



Appendix C: Soil Map of the Dookie Area


DIVISION OF SOILS
COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
COMMONWEALTH OF AUSTRALIA
PARIS
YABBA YABBA
Latitude 36° 18'
Longitude 145° 42'
DOOKIE
RAILWAY LINE
COSGROVE
DOOKIE