Hydrogeological Investigation of the Mount Lofty Ranges, Progress Report 1: hydrogeology and drilling phase 1 for Scott Creek Catchment

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Foreword

South Australia's water resources are fundamental to the economic and social wellbeing of the State. Water resources are an integral part of our natural resources. In pristine or undeveloped situations, the condition of water resources reflects the equilibrium between rainfall, vegetation and other physical parameters. Development of surface and groundwater resources changes the natural balance and causes degradation. If degradation is small, and the resource retains its utility, the community may assess these changes as being acceptable. However, significant stress will impact on the ability of a resource to continue to meet the needs of users and the environment. Degradation may also be very gradual and take some years to become apparent, imparting a false sense of security.

Management of water resources requires a sound understanding of key factors such as physical extent (quantity), quality, availability, and constraints to development. The role of the Resource Assessment Division of the Department of Water, Land and Biodiversity Conservation is to maintain an effective knowledge base on the State's water resources, including environmental and other factors likely to influence sustainable use and development, and to provide timely and relevant management advice.

Bryan Harris
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ABSTRACT

Scott Creek Catchment is the first of a number of catchments that will be used as case studies to investigate the sustainability of groundwater resources in the Mount Lofty Ranges over the next 4–5 years. This report provides a collation of background information for the Scott Creek Catchment including geological, hydrological, meteorological and surface water quality data.

Site selection criteria, drilling methods, construction details and lithological logs are presented for the first phase of drilling in this catchment. A total of nine wells (one completed in the Quaternary alluvium and eight in the fractured Woolshed Flat Shale) were drilled at strategic locations on either side of Scott Creek upstream of the weir at Scott Bottom. These wells will be used for a variety of hydraulic and hydrochemical tests to define the local hydrogeology in terms of stream–aquifer interactions and groundwater recharge and flow rates.

INTRODUCTION

The Mt Lofty Ranges (MLR) provide important surface water and groundwater resources that are utilised for stock and domestic irrigation and reticulated water supplies, both locally and to metropolitan Adelaide. Currently, the MLR are not prescribed under the *Water Resources Act 1997*. In order to ensure that current and future development of these resources are sustainable and to protect the environment, various components of the water balance need to be quantified prior to prescription.

Management of any regional groundwater resource requires careful estimates of the magnitude of all components of the groundwater budget. Vertical recharge and discharge rates, and horizontal groundwater flow velocities, are generally the most important components to be quantified. However, determining these parameters in fractured, crystalline rock aquifers is notoriously difficult due to the limited applicability of conventional (porous media) techniques to these systems. Nevertheless, several techniques developed recently for the fractured rock aquifers in the Clare Valley (Love et al., in press) offer great promise for estimating these parameters in the MLR.

The primary aims of the groundwater investigations to be undertaken by the Department of Water Land and Biodiversity Conservation (DWLBC) in the MLR are to:

- determine the sustainable yield for groundwater in fractured rock aquifers
- investigate stream–aquifer interactions and their influence on the surface water and groundwater budgets
- investigate the impact of leakage from farm dams on the surface water and groundwater budgets.

APPROACH

Groundwater Sustainable Yield

Many of the established and recently developed techniques for estimating groundwater recharge rates and flow velocities in the Clare Valley can either be directly applied or slightly modified to address similar problems in the MLR. Most of these techniques involve the use of naturally occurring or applied environmental tracers. These techniques are infinitely more useful if sampled from specially constructed nests of piezometers than from an open well with a large interval. While nests of piezometers do not currently exist in the southern and central regions of the MLR, several strategic drilling programs are planned for the next 2–3 years to facilitate this work.

Stream–Aquifer Interactions

In areas of high topographic relief such as the MLR, groundwater discharge into streams may form a large component of the catchment water balance. Conversely, many of the ephemeral creeks throughout the MLR may be a source of groundwater recharge during times of high flow. Very little is known about the relationships between surface water and groundwater systems.

We propose to investigate the importance of recharge and discharge from both ephemeral and permanent surface watercourses at several sites throughout the MLR. This will initially involve close links with the Surface Water Assessment Branch's monitoring section, particularly following installation of their proposed new gauging stations. Quantitative estimates of recharge or discharge rates will require more specialised techniques involving surface water – groundwater hydrograph comparison techniques, and chemical and isotopic tracer data from stream flow and shallow groundwater.

Leakage from Farm Dams

A study of the impact leakage from farm dams has on groundwater and surface water budgets will initially involve a desktop review of dam distribution and characteristics across the MLR. Established techniques for determining leakage rates through low permeability sediments will then be reviewed and the most suitable techniques applied to several 'typical' dams to quantify leakage.

SCOTT CREEK STUDY AREA

The Scott Creek Catchment is the first of a series of 'representative' catchments selected for investigation in the MLR. This catchment was selected based on the long record of historical stream flow at Scott Bottom, the perennial nature of Scott Creek, and the high mean annual rainfall received in the catchment compared to other catchments in the MLR.

The primary objective of groundwater investigations at Scott Creek is to characterise the hydrogeology of the fractured rock aquifers in order to:

- determine the direction and rate of groundwater flow
- determine the mechanisms and rate of groundwater recharge
- estimate the transfer of water and solutes between the groundwater and creek.

Background

The Scott Creek Catchment is ~30 km southeast of Adelaide within the Hundred of Noarlunga in the Mt Bold area of the MLR. It extends from Heathfield in the north to Scott Bottom in the south, and covers an area of ~27 km^2 (Fig. 1). Approximately 50% of the catchment is covered by native vegetation which includes the Scott Creek Conservation Park.

Historically, Scott Creek provided reliable water and food supplies for the Peramangk Aboriginal people and was on one of the major travelling routes through the ranges to the Adelaide Plains and coast. European settlers first occupied the area in 1838 and began farming adjacent to the creek. Timber cutters removed much of the original red, blue and manna gum and stringybark for use in the building industry in Adelaide. In 1850, the area was mined for copper and later silver. The Almanda Silver Mining Association was formed in 1868 and, when production ceased in 1887, the mine had produced 310 kg of silver (DEHAA, 1999).

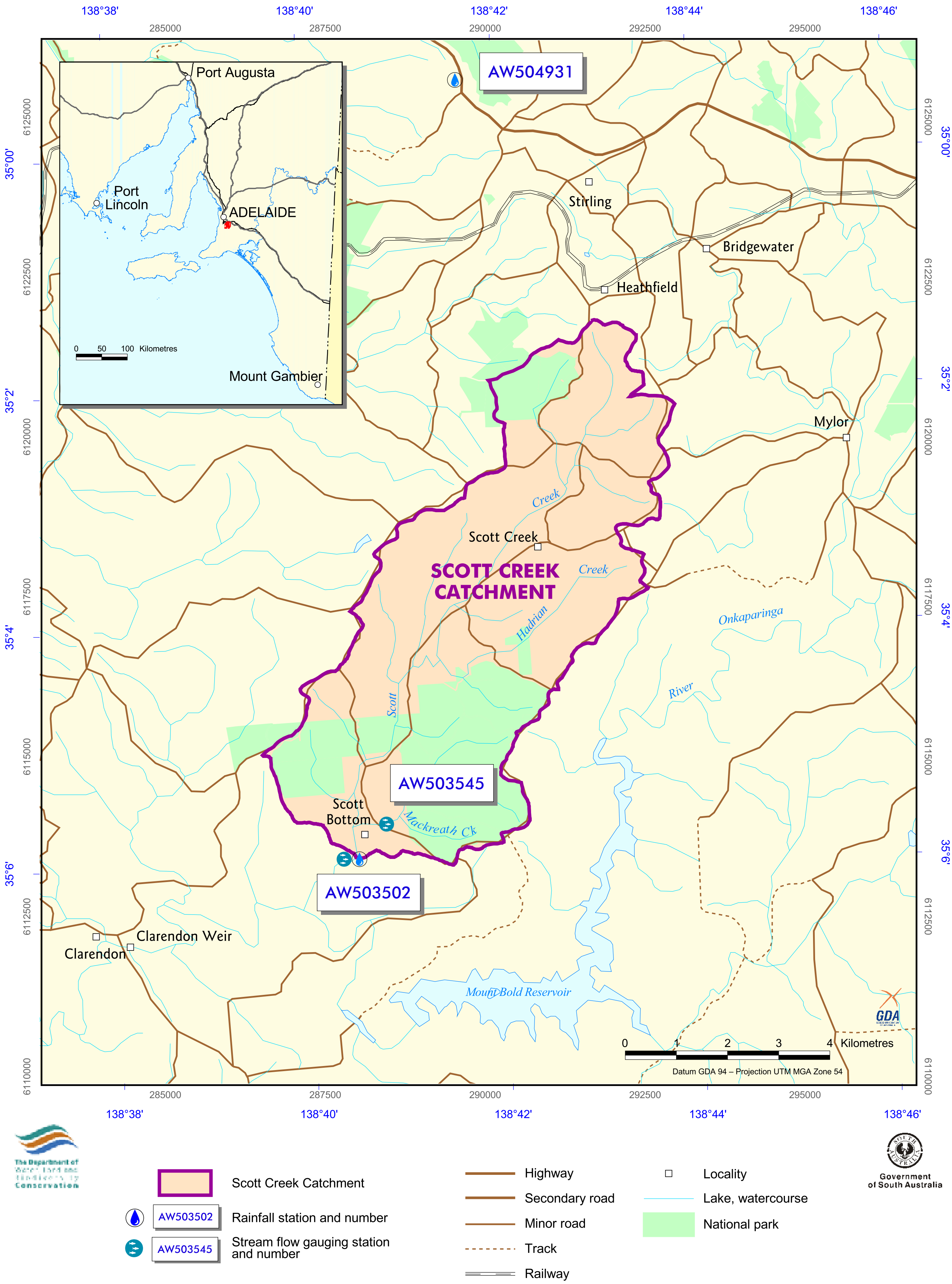
Physiography

The topography of the catchment varies from steep slopes to gently undulating land. The main channel of Scott Creek runs in a north–south direction within a steep-sloped valley. The hills are dissected by tributaries of Scott Creek and have rounded ridge tops orientated east–west. Topographic highs occur on the eastern side of the catchment with altitudes in excess of 400 m above sea level. Scott Bottom is in the lowest part of the catchment, with an elevation of 210 m above sea level.

Climate

The climate in the Scott Creek area is one of warm dry summers and cool wet winters. Average daily temperatures range from 14 to 27 ºC in summer and 8 to 14 ºC in winter, with maximum temperature in summer exceeding 38 ºC (DEHAA, 1999).

Two official rain gauging stations exist in the Scott Creek Catchment, one at Heathfield (AW504931) in the upper reaches of the catchment at an elevation of 470 m, and the



HYDROGEOLOGICAL INVESTIGATION OF THE MOUNT LOFTY RANGES,
PROGESS REPORT 1: HYDROGEOLOGY AND DRILLING

**LOCATION OF SCOTT CREEK CATCHMENT –
RAINFALL AND STREAMFLOW GAUGING STATIONS**

Figure 1

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other at Scott Bottom (AW50302) at an elevation of 210 m (Fig. 1). Both gauges are pluviometers and provide continuous recordings of rainfall. The Heathfield gauging station has records from 1985 until present, which provide a mean and median annual rainfall of 1009 and 995 mm/y, respectively. The Scott Bottom gauging station has rainfall records from 1991 until present, with mean and median annual rainfall of 804 and 764 mm/y, respectively. The majority of rainfall received in the catchment occurs during the months of June to October (Fig. 2).

The nearest evaporation recording station is operated by the Bureau of Meteorology at Mt Bold Reservoir, ~3 km southeast of Scott Bottom (Fig. 1). Class A pan evaporation data are available for this site from 1938 to the present. The mean and median annual evaporation is 1555 and 1580 mm/y, respectively. Monthly evaporation exceeds average monthly precipitation between October and May (Fig. 3).

Land Use

Native vegetation occupies ~50% of the catchment area. The main upper canopy species consist of messmate stringy bark (*Eucalyptus obliqua*), blue gum (*E. leucoxylon*), pink gum (*E. fasciculosa*) and cup gum (*E. cosmophylla*). River red gum (*E. camaldulensis*) and manna gum (*E. viminalis*) are the dominant species in some valleys. In the cooler, damper creek areas, the associated vegetation is that of the silky tea-tree (*Leptospermum lanigerum*), swamp wattle (*Acacia retinodes*), soft water fern (*Blechnum minus*), and sedge and rush species. Golden wattle (*Acacia pycnantha*), sweet bursaria (*Bursaria spinosa*), silver banksia (*Banksia marginata*), needle bush (*Hakea rostrata*), slaty sheoak (*Allocasuarina muelleriana*) and native cherry (*Exocarpos cupressiformis*) are associated with the lower canopy. The understorey consists of common heath (*Epacris impressa*), flame heath (*Astroloma conostephioides*), common fringe myrtle (*Calytrix tetragona*) and lavender grevillea (*Grevillea lavandulacea*) (DEHAA, 1999).

The remainder of the catchment is cleared, and primarily used for sheep and cattle grazing and horticulture. In some cleared parts of the catchment, pest plants such as boneseed (*Chrysanthemoides monilifera*), blackberry (*Rubus* spp.), gorse (*Ulex europaeus*) and broom (*Cytisus scoparius* and *Gensta monspessulana*) flourish (DEHAA, 1999).

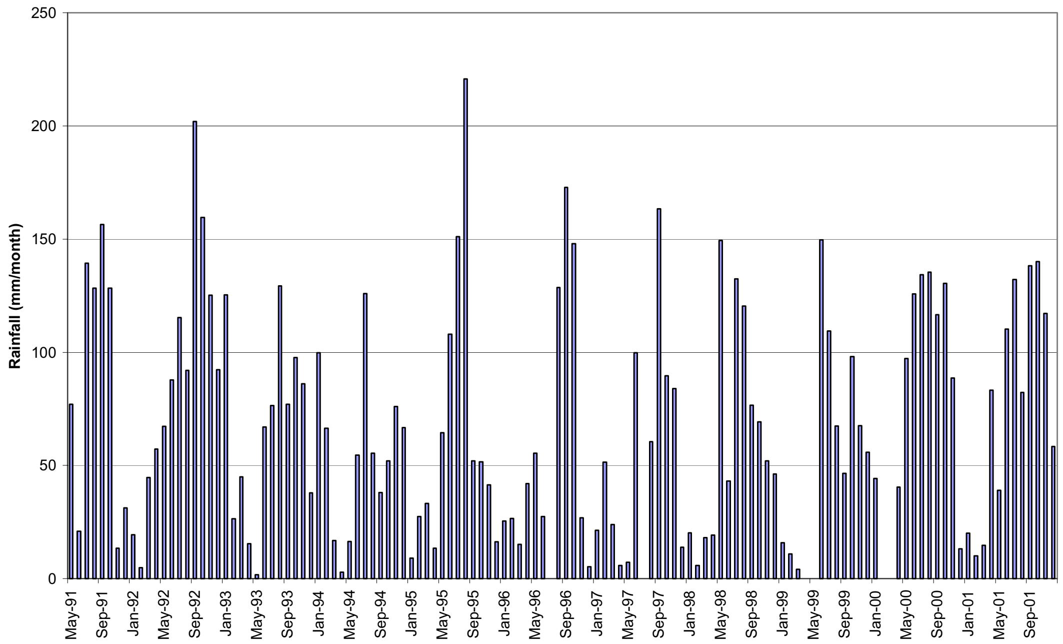


Figure 2 Monthly Rainfall at Scott Bottom

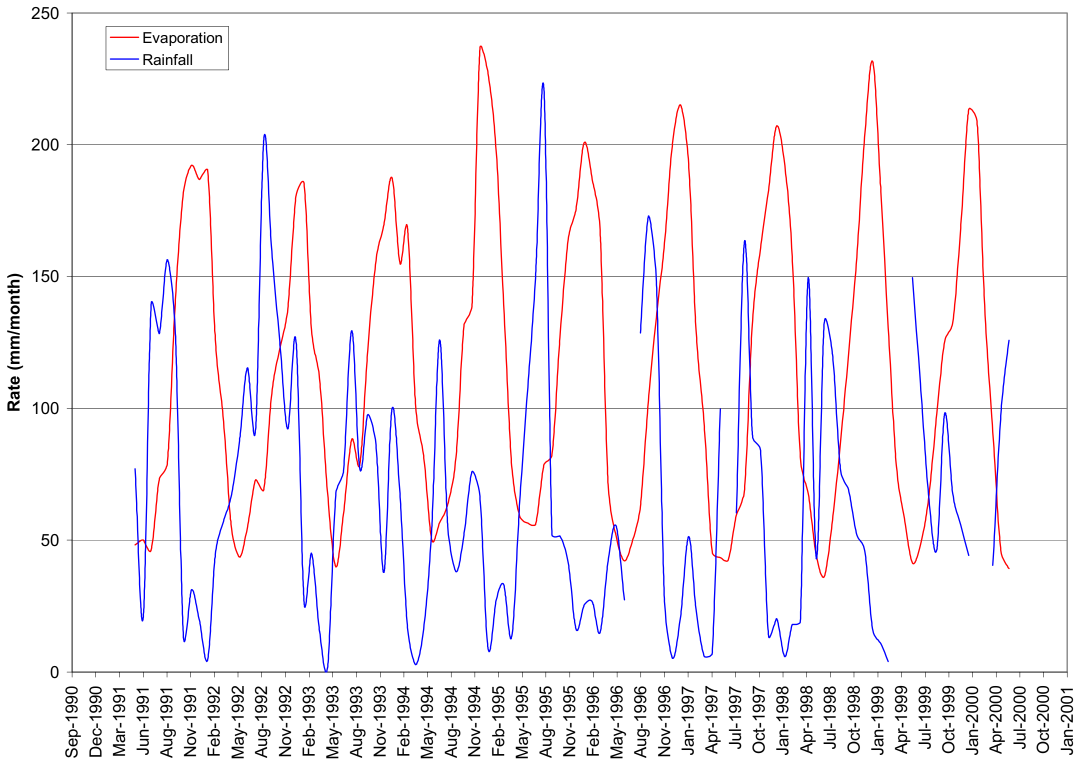


Figure 3 Monthly Evaporation (Mt Bold Reservoir) and Precipitation (Scott Bottom)

HYDROGEOLOGY

Geological Setting

The MLR form the central portion of the Adelaide Geosyncline and encompass a suite of metasedimentary and igneous rocks that range in age from Palaeoproterozoic (>1600 Ma) through to Permian (300-250 Ma) (Drexel et al., 1993; Drexel and Preiss, 1995). The region surrounding Scott Creek Catchment is structurally very complex with numerous faults and folds. Fracturing is ubiquitous in most rock types which, in the catchment, include dolomite, sandstone, shale, siltstone, mudstone and quartzite, all of Neoproterozoic age (Fig. 4). Whilst not a definitive representation of fracture characteristics throughout the catchment, roadside cuttings and a mine adit near Almanda Hill display at least three different sets of fractures with a spacing in the order of several centimetres.

A schematic east–west geological cross-section through Scott Bottom (the site for Phase 1 drilling) is presented in Figure 5. The quartzite and sandstone formations are relatively resistant to weathering compared to dolomite, siltstone and mudstone, and thus form the ridge tops and other elevated parts of the section. The valleys and depressions in the landscape are lined with softer, more weatherable rock types and are covered with a veneer of Quaternary alluvium.

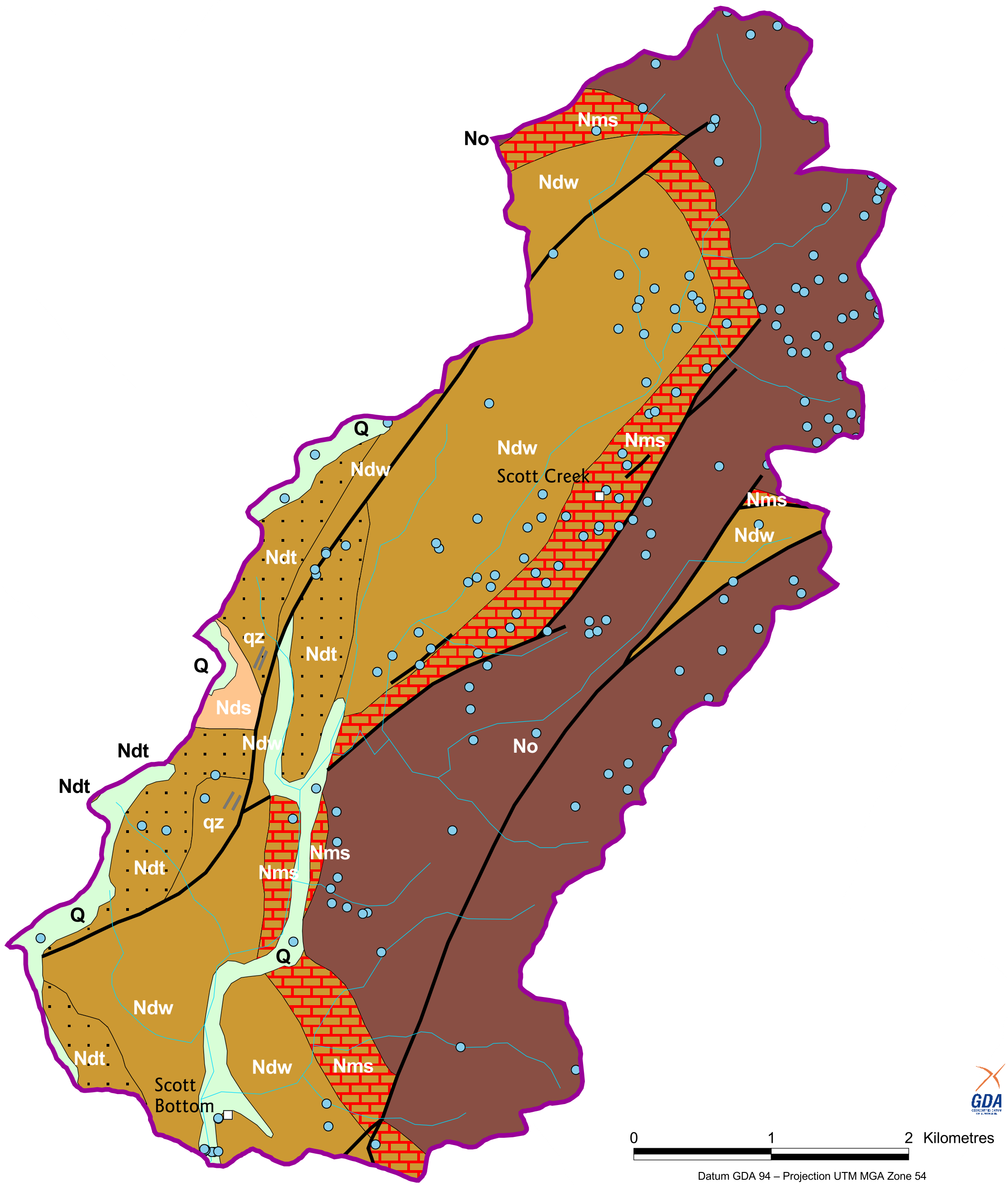
Hydrostratigraphy

Two general aquifer types form important groundwater resources in the MLR — fractured rock aquifers, and unconsolidated porous media. The fractured rock aquifers are by far the more extensive of the two types, but they are also the more diverse in terms of rock type, degree of fracturing, groundwater salinity and borehole yield. The porous media aquifers are generally localised, valley fill deposits comprising alluvium and/or colluvium including clay, silt, sand and gravel.

Whilst there are several wells completed in alluvial aquifers in the Scott Creek Catchment (Fig. 4), most wells are located in the fractured metasediments. These include the Aldgate Sandstone, Skillogalee Dolomite, Woolshed Flat Shale and Stonyfell Quartzite. The Woolshed Flat Shale dominates the area around Scott Bottom. The eastern side of the catchment is predominantly Aldgate Sandstone (and to a lesser degree Skillogalee Dolomite), and the higher topography on the western side is Stonyfell Quartzite.

Well Distribution and Yields

Approximately 150 groundwater wells exist within the Scott Creek Catchment (Fig. 4). Of these, 91% have recorded total depths of between 4 and 135 m. A histogram of well depths (Fig. 6) shows that 20% are between 70 and 90 m, 16% are between 50 and 60 m, 11% are between 60 and 70 m, 10% are between 40 and 50 m, and 10% have a depth of 100–120 m.



Geology

QUATERNARY

- Callabona Clay, Pooraka Formation (Q)

ADELAIDEAN

- Saddleworth Formation (Nds)
- Stonyfell Quartzite (Ndt)
- Woolshed Flat Shale (Ndw)
- Skillogalee Dolomite (Nms)
- Aldgate Sandstone (No)
- Fault

- Scott Creek Catchment
- Water well
- Watercourse
- Locality

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SURFACE GEOLOGY WITH EXISTING WATER WELL LOCATIONS – SCOTT CREEK CATCHMENT

Figure 4

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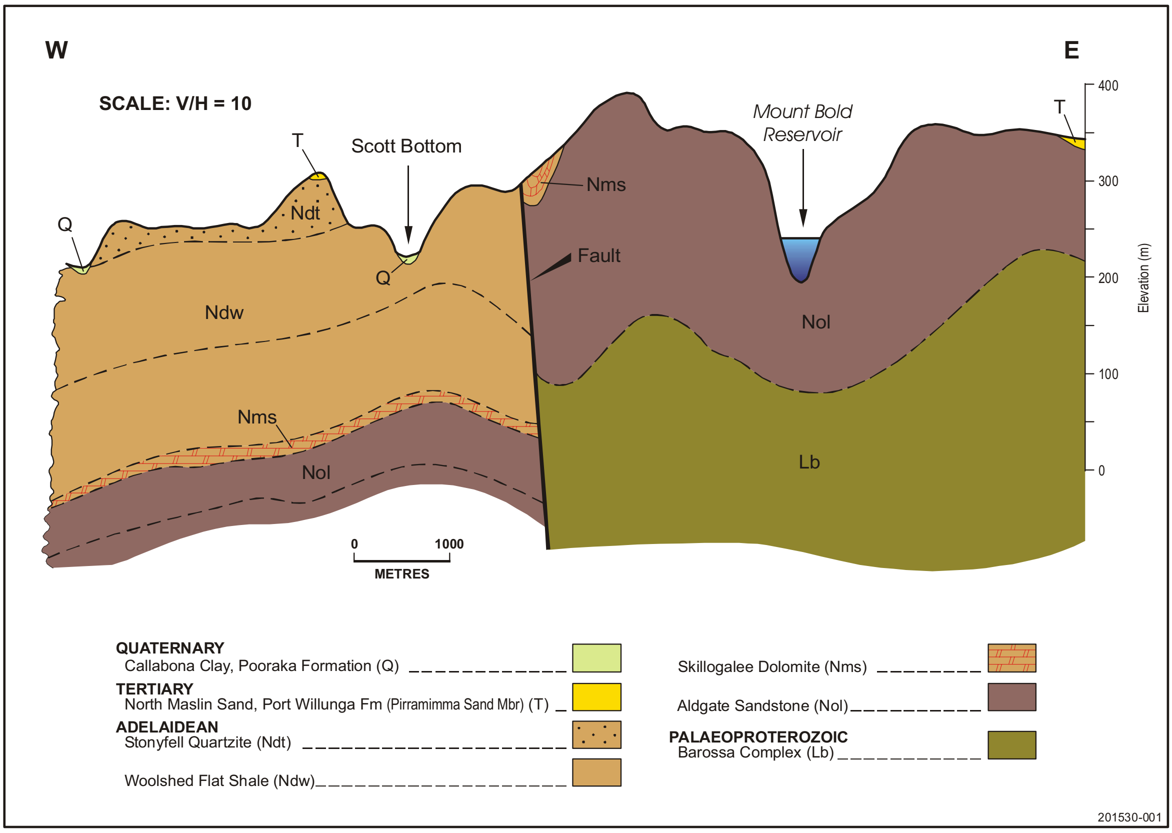


Figure 5 Schematic geological cross section constructed East-West through Scott Bottom Weir

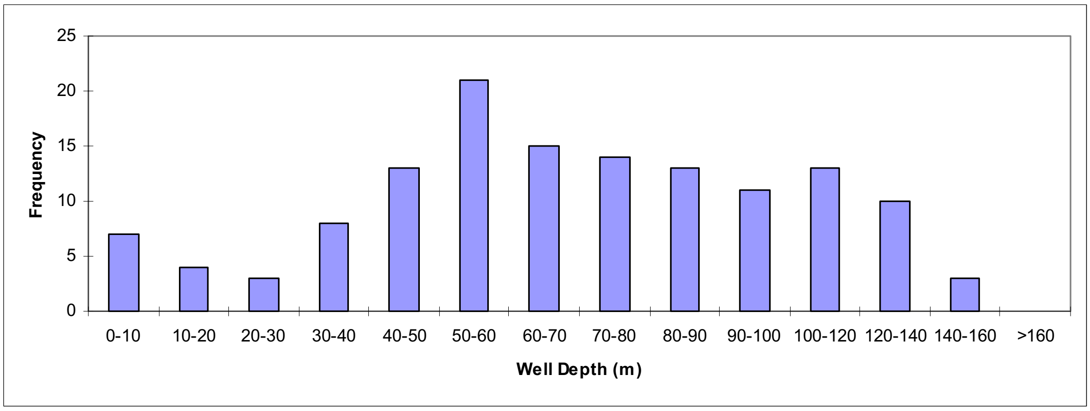


Figure 6 Histogram of water well depths, Scott Creek Catchment

Of the existing wells, 54% have recorded yields. These range from 0.02 to 25 L/s, with 29% having yields <1 L/s, 24% having yields of 1-2 L/s and 21% having yields of 2–3 L/s (Fig. 7). The remaining 26% of wells have yields >3 L/s. It should be noted that these yields are generally estimated by the well driller during airlifting, and therefore will have large uncertainties.

Less than 10% of the existing wells have both completion details and associated yields. A comparison plot of yield versus depth over the production zone (Fig. 8) does not show any obvious trends such as increased yield with well depth. This suggests that the well yields probably depend on the number and characteristics of fractures intersected.

Monitoring Wells

There are no existing DWLBC observation wells within the Scott Creek Catchment. The nearest observation wells are in the Cox Creek Catchment ~14 km northeast of the Scott Bottom gauging station. These wells will not be used to illustrate groundwater level trends for the current study (Scott Creek) because the stratigraphy and structural geology is too spatially variable, and therefore groundwater responses at one site may be completely different several kilometres away.

Groundwater Salinity and Chemistry

Groundwater salinity data is available for 62% of the existing wells. A map of the spatial distribution of salinity in the catchment (Fig. 9) indicates that the freshest groundwater occurs on the edges (ridge tops) of the catchment. Conversely, groundwater salinity is generally highest in the centre of the catchment near the Scott Creek main channel. These trends in spatial salinity distribution may reflect different recharge rates, varying degrees of water–rock interaction in the soil zone and aquifer, or back diffusion of salts induced by land clearing. A histogram of groundwater salinity (Fig. 10) reveals that 95% of the wells have an electrical conductivity (EC) <1500 µS/cm, and 40% have an EC <500 µS/cm. There appears to be no direct correlation between groundwater salinity and well depth over the production zone (Fig. 11).

There is currently no existing groundwater chemistry data recorded in the State's groundwater database (SA_Geodata) for wells in the Scott Creek Catchment. Groundwater major ion compositions are dependent on a number of factors including soil type, topography, rainfall source and local geology. Therefore, groundwater chemistry from nearby catchments cannot be considered representative of this catchment.

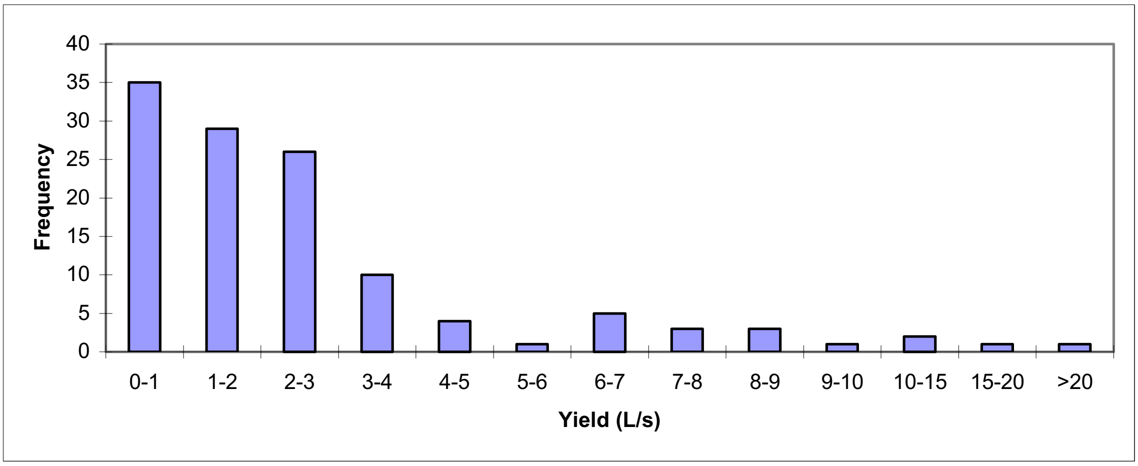


Figure 7 Histogram of water well yields, Scott Creek Catchment

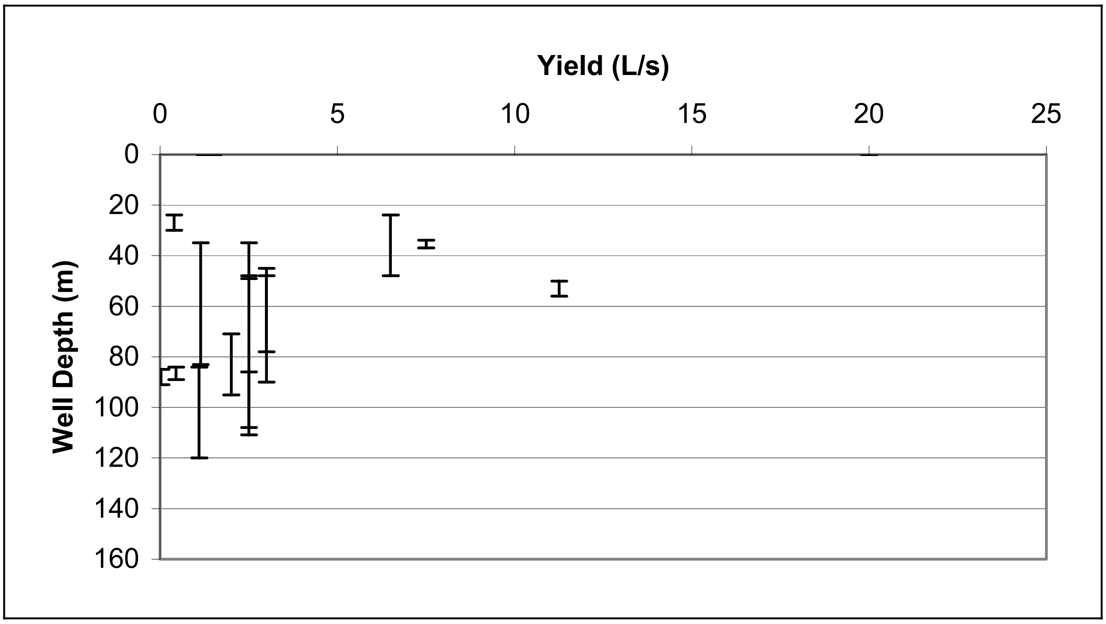
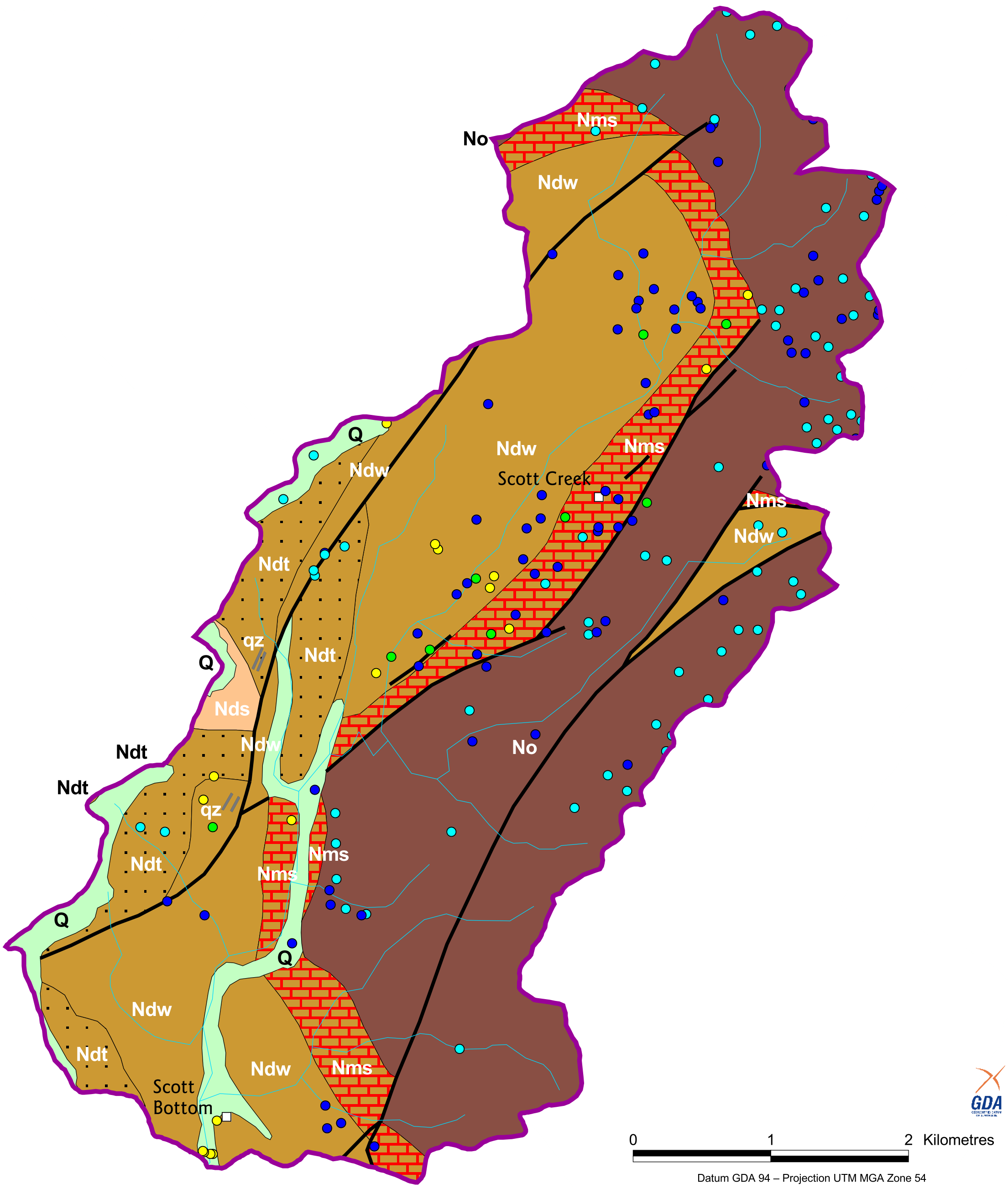


Figure 8 Well yield versus depth, Scott Creek Catchment. Error bars represent production zone intervals



Geology

QUATERNARY

- Callabona Clay, Pooraka Formation (Q)

ADELAIDEAN

- Saddleworth Formation (Nds)
- Stonyfell Quartzite (Ndt)
- Woolshed Flat Shale (Ndw)
- Skillogalee Dolomite (Nms)
- Aldgate Sandstone (No)
- Fault

Electrical conductivity (EC) (uS/cm)

- Less than 500
- 500 to 1500
- 1500 to 2500
- Greater than 2500

- Scott Creek Catchment
- Watercourse
- Locality

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HYDROGEOLOGICAL INVESTIGATION OF THE MOUNT LOFTY RANGES,
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SPATIAL DISTRIBUTION OF GROUNDWATER SALINITY AS EC OVERLYING SURFACE GEOLOGY – SCOTT CREEK CATCHMENT

Figure 9

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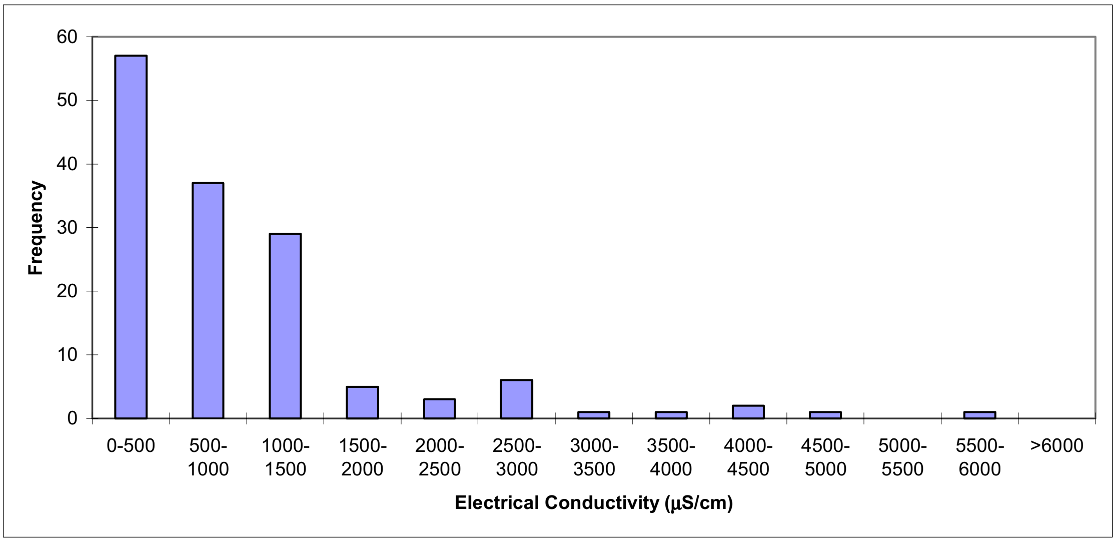


Figure 10 Histogram of groundwater salinity as EC, Scott Creek Catchment

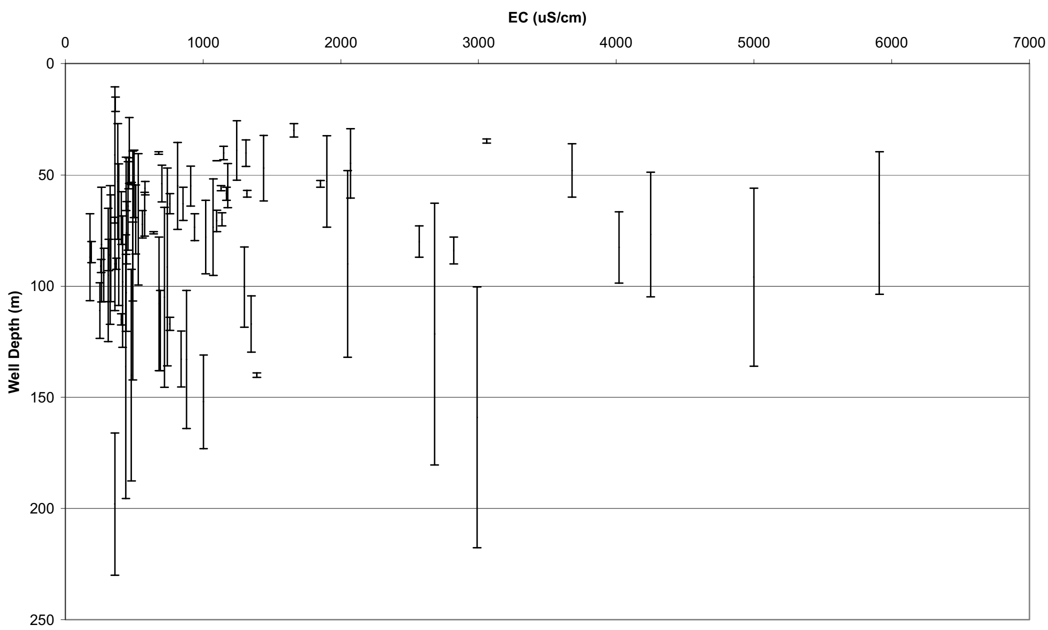


Figure 11 Groundwater salinity (EC) versus well depth, Scott Creek Catchment. Error bars represent production zone intervals

SURFACE HYDROLOGY

Streamflow

Scott Creek is a perennial stream and a tributary to the Onkaparinga River, which confluents downstream of the Mt Bold Reservoir and upstream of the Clarendon Weir (Fig. 1).

Two streamflow gauging stations exist in Scott Creek Catchment; one at Scott Bottom (AW503502) and one on Mackreath Creek (AW503545), the latter a tributary of Scott Creek (Fig. 1). The hydrometric operating status of both stations is continuous recording of flow and composite salinity (as EC).

Streamflow records exist for Scott Bottom from 1971 until the present (Fig. 12). The mean and median annual streamflow of Scott Creek measured at this site are 3710 and 3840 ML/y, respectively (based on 1970–2001 data). The mean is slightly less than the median which may be attributed to the very dry year in 1982 when only ~620 ML were recorded.

The Mackreath Creek gauging station was installed at the end of 1999, but 2001 is the only full calendar year for which flow data are continuous. The annual flow in Mackreath Creek for 2001 was 389 ML. The annual flow in Scott Creek for the same year was 4339 ML, which is higher than the mean and median flows presented above. This can be attributed to the above-average annual rainfall of 945 mm (AW503502) received in 2001, which also resulted in a higher flow in Mackreath Creek than may be expected for an average rainfall year.

As the stream flow in Scott Creek is perennial, baseflow is assumed to dominate during the summer months. A preliminary estimate of baseflow for Scott Creek is 1500 ML/y based on 35% of modelled surface runoff using WATERCRESS (K. Teoh, DWLBC, pers. comm., 2002). The modelled median runoff estimate for Scott Creek Catchment is 158 mm/y (McMurray, 2001). Streamflow hydrographs (Figs 13, 14) for Scott Creek show typical low flows during November through to May, with increasing flows in conjunction with increased rainfall from June to October. Maximum flow rates are generally observed around August.

Mackreath Creek is ephemeral, with flows for 2001 occurring between June and November which correspond to the high rainfall months (Figs 15, 16).

Surface Water Quality

The Scott Bottom gauging station provides water quality data using automated flow proportional sampling equipment. A 500 mL sample is collected every unit of flow for a seven-day period and is added to a composite collection tub. After seven days, the tub is stirred and a sample taken by Water Data Services Pty Ltd for water quality analysis. The unit of flow varies depending on seasonal influences. Water quality parameters analysed include salinity, colour, turbidity, soluble and total cation and anion concentrations, heavy metals, coliforms, organic carbon, herbicides and pesticides.

Historical salinity (as EC) of Scott Creek flow ranges from a minimum of 110 µS/cm to a maximum of 2800 µS/cm, with mean and median values of 1155 and 1160 µS/cm,

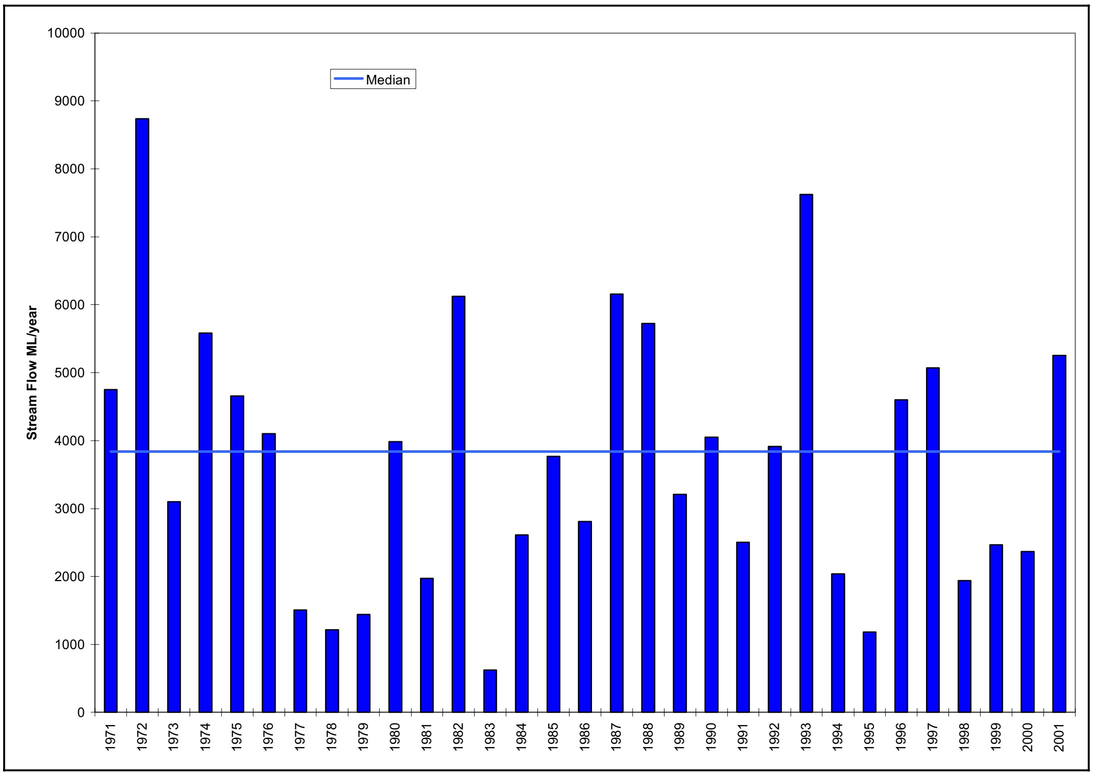


Figure 12 Annual Stream Flow for Scott Creek at Scott Bottom

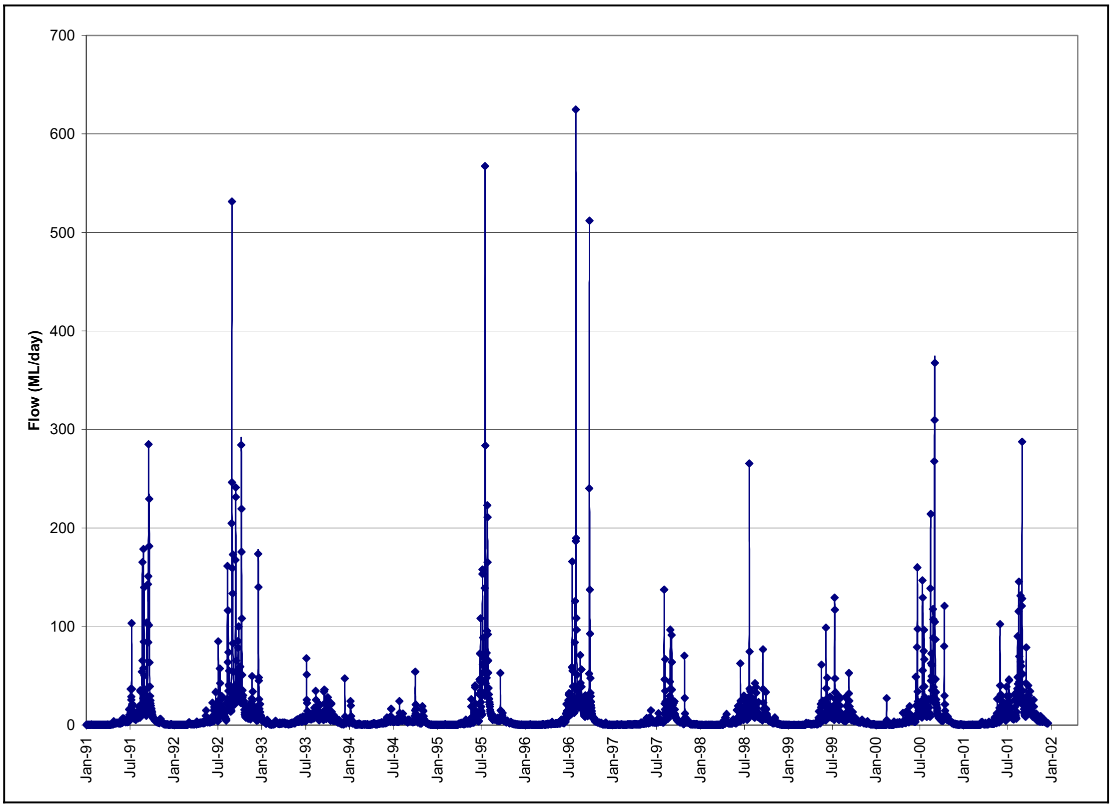


Figure 13 Daily stream flow for Scott Creek at Scott Bottom, 1991-2002

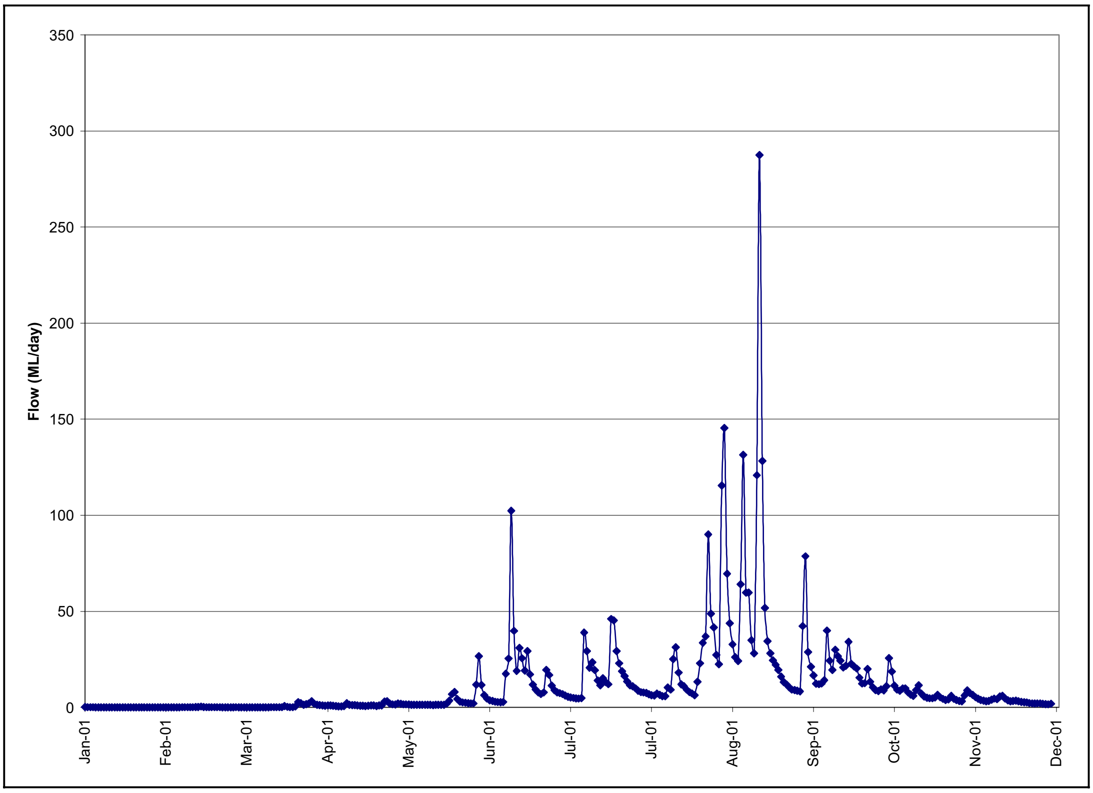


Figure 14 Daily stream flow for Scott Creek at Scott Bottom, 2001

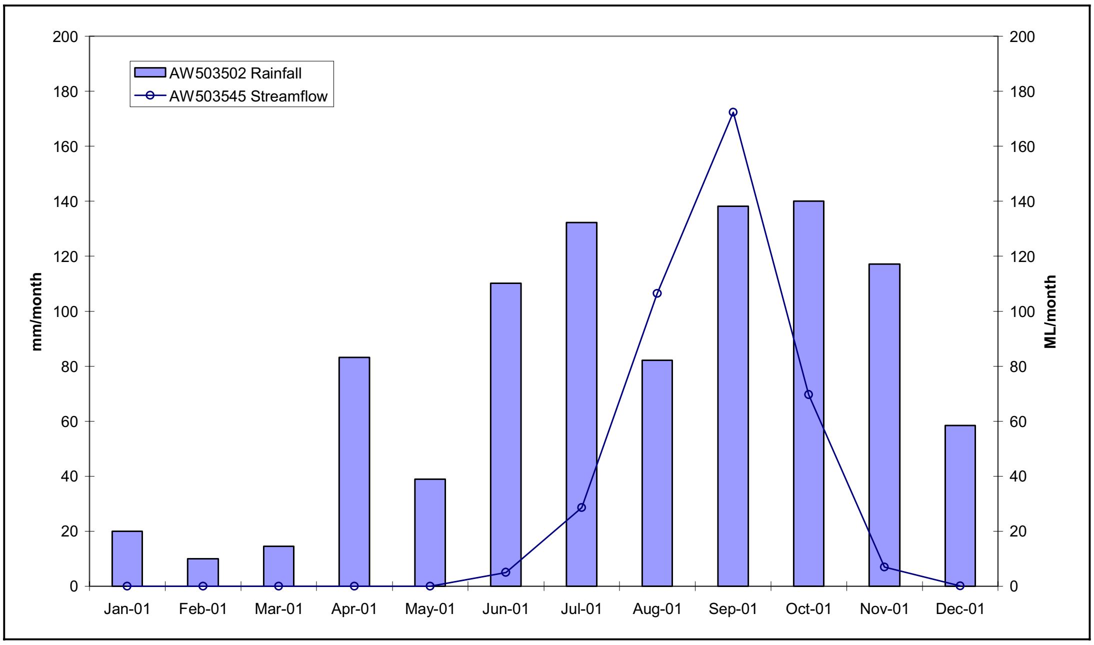


Figure 15 Monthly streamflow and rainfall, Mackreath Creek 2001

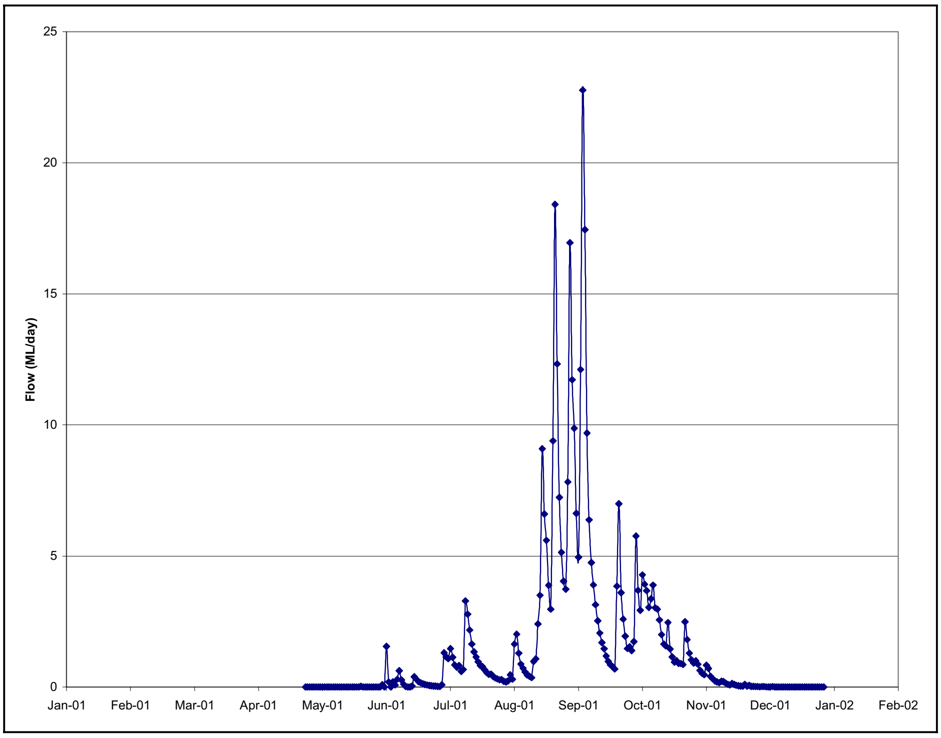


Figure 16 Daily streamflow, Mackreath Creek 2001

respectively (years 1972 to 2000). EC peaks during the summer months and is at its lowest during winter (Fig. 17). Given that the salinity of rainfall and surface runoff are generally orders of magnitude below the salinity of groundwater, the seasonality of streamflow EC depicted in Figure 17 most likely reflects the varying contributions of baseflow and surface runoff to the creek at different times of the year.

The relationship between streamflow rate and chloride concentration in Scott Creek at Scott Bottom is provided in Figure 18. The low stream flows are associated with high chloride concentrations and are indicative of a dominant baseflow. Conversely, high flows generally have relatively low chloride concentrations which reflect predominantly surface run-off. A plot of EC versus chloride concentration of stream samples reveals an almost linear trend (Fig. 19), except at high concentrations where the slope tends to gradually decrease. This suggests that chloride concentration has a decreasing contribution to the EC of the stream as EC increases (i.e. as stream flow rate increases, Fig. 18). These trends will be further investigated in a subsequent report on groundwater – surface water interactions in the Scott Creek Catchment.

Water Use

Both surface water and groundwater are used in the Scott Creek Catchment for stock and domestic purposes, and to a lesser extent for irrigated horticulture. There are currently no restrictions on the volume or timing of surface water diversions from Scott Creek nor groundwater extraction from the underlying aquifers (J. Lenz, DWLBC, pers. comm., 2002). As a result, there is currently a very poor understanding of the amounts and distribution of water usage throughout the catchment.

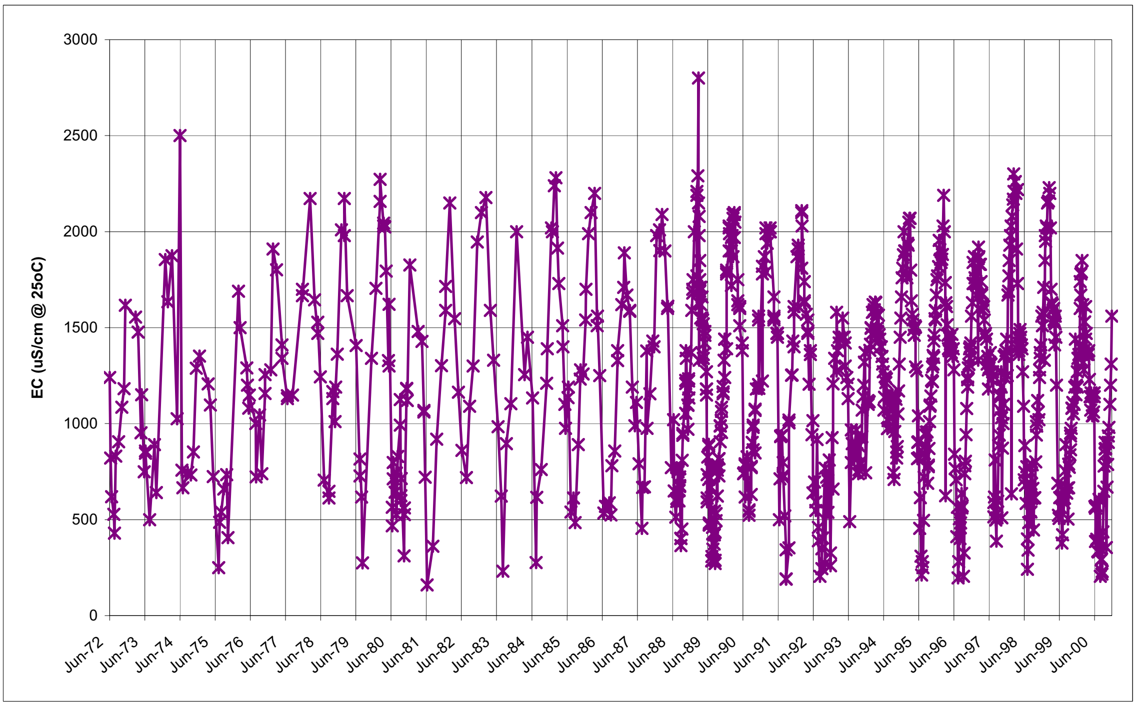


Figure 17 Salinity of Scott Creek at Scott Bottom

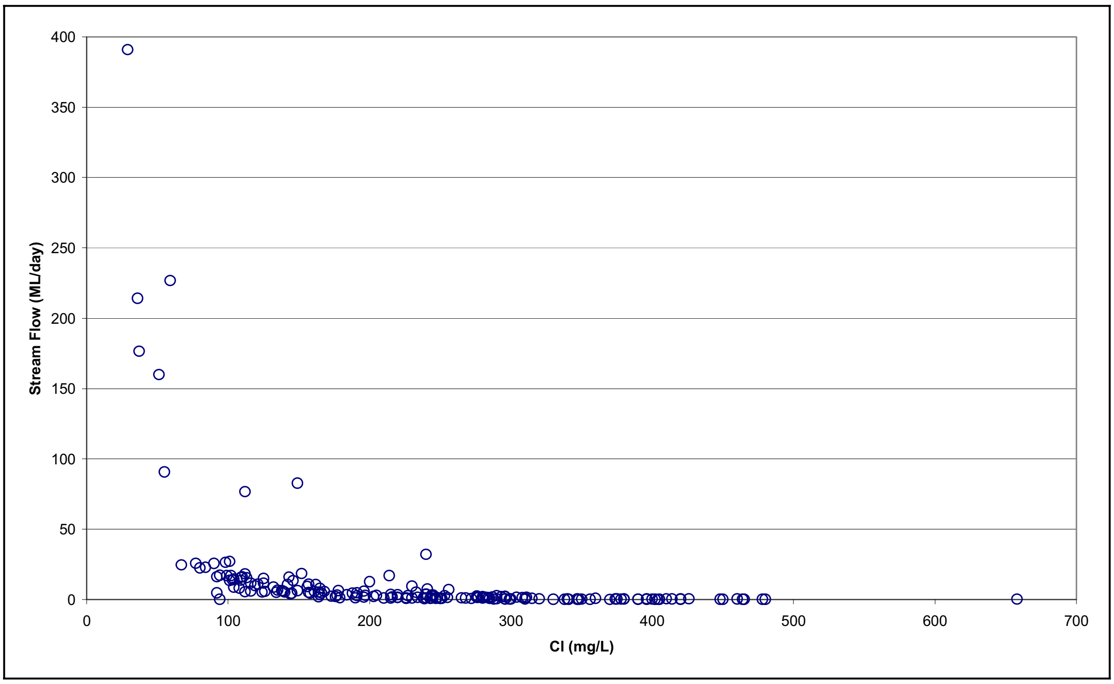


Figure 18 Chloride concentration of grab samples from stream flow, Scott Creek at Scott Bottom

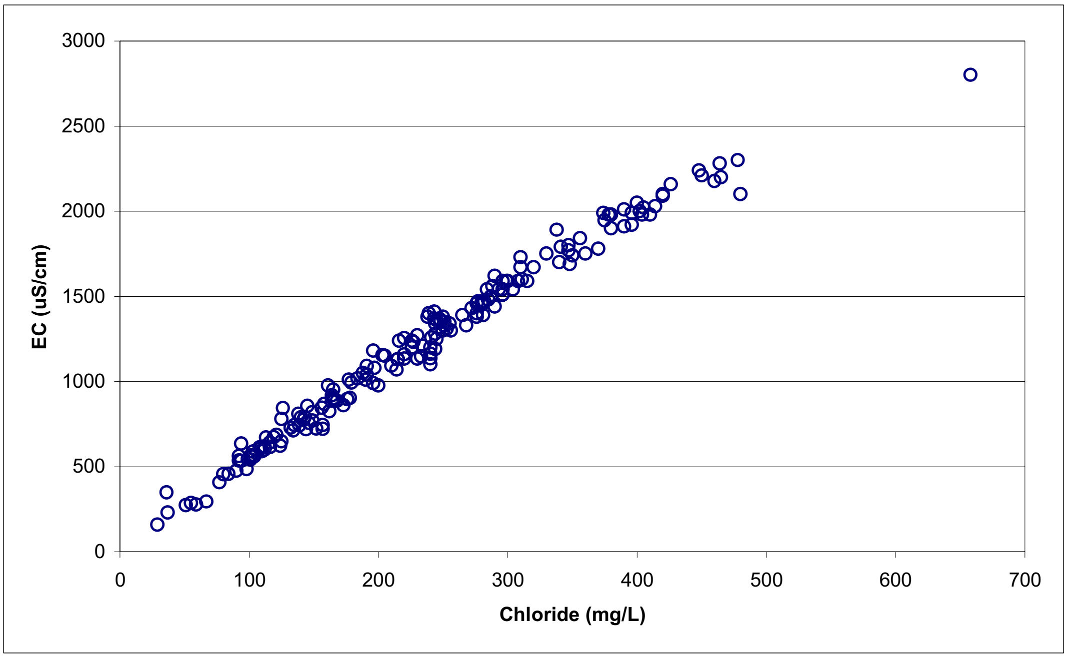


Figure 19 Salinity versus chloride concentration, Scott Creek at Scott Bottom

DRILLING PHASE 1

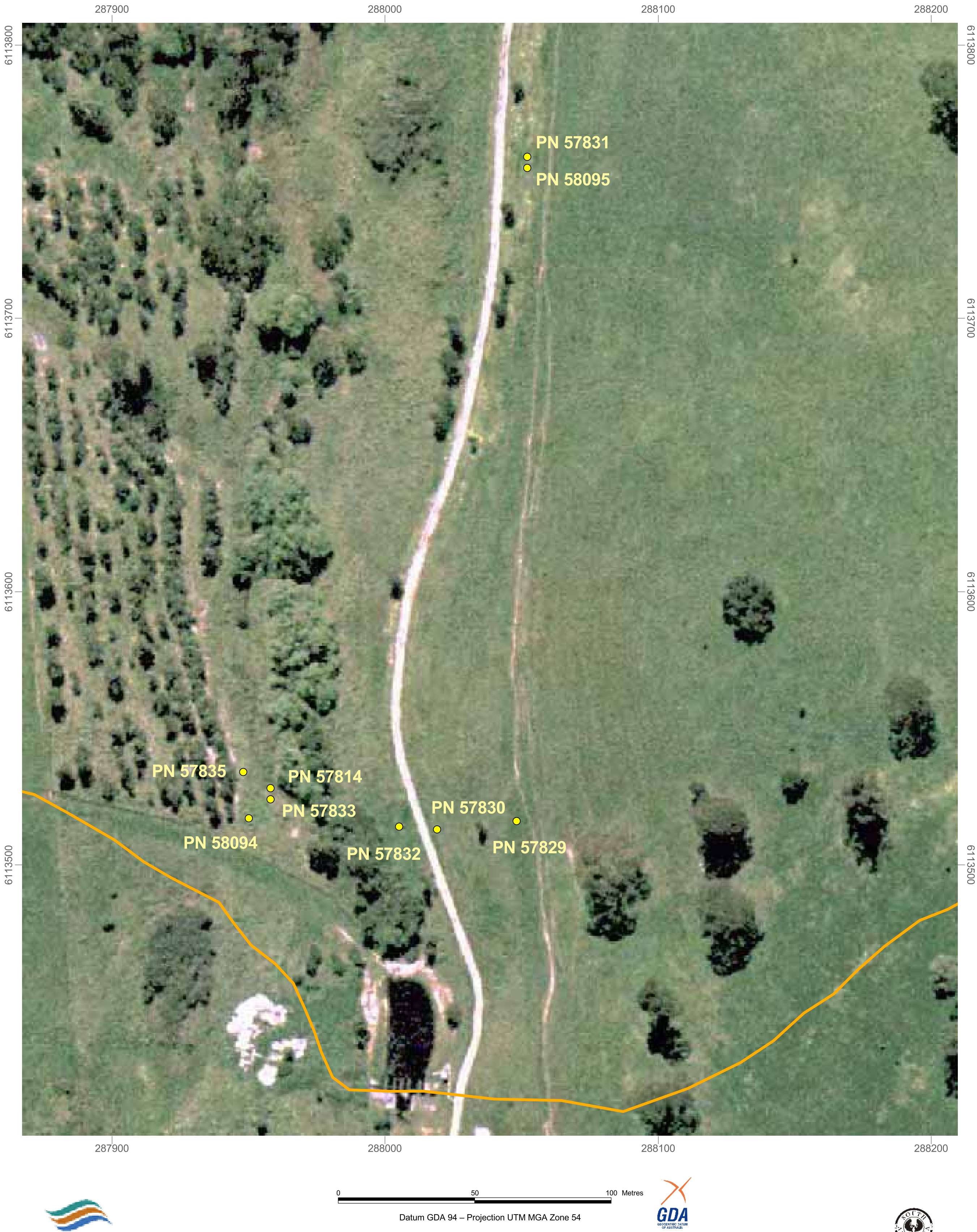
The aim of the first drilling program for the Scott Creek Catchment was to establish a research site consisting of one deep ‘control’ well and six shallower wells near the Scott Bottom gauging station. This location will allow direct comparison of groundwater dynamics with stream flow characteristics at the weir, as well as ease of access for field investigations because the land is Crown land. The positions of individual wells were determined by assuming that the direction of groundwater flow would follow the topographic gradient (Fig. 5). Several lengths of core were to be taken from the control hole to enable mapping of fracture density and orientation, as well as mineralogical and petrographic assessment.

The nearest existing wells to the site are ~1 km north east of the Scott Bottom gauging station (Fig. 4). Well 6627-0-4270 was drilled in 1970 and has a current depth of 106 m and yield of 2 L/s. Well 6627-0-4941 was drilled in 1956 and has a current depth of 74 m and yield of 0.2 L/s.

Drilling at Scott Bottom commenced in March 2002. The first of the six shallow wells, initially planned to be completed as nests of multi-level piezometers, was drilled on the western side of the creek immediately upstream of the weir (PN 57814, Fig. 20) using rotary air techniques. This resulted in the return of alluvial gravels and boulders and subsequent collapse of the hole from its original depth of 9 m back to 5.7 m. Well PN 57814 was finally completed with surface casing to 3.2 m and then slotted PVC casing between 3.2 and 5.7 m. A replacement well (PN 57833) was drilled immediately south of PN 57814 using rotary mud techniques until surface casing could be set at ~11 m depth. The remaining five shallow wells (two on the western side of the creek and three on the eastern side) were also drilled initially with mud to set surface casing, then with a rotary A43 hammer to the completion depth. With the exception of PN 57814 which was completed in the alluvial gravels, all shallow wells were drilled to 50–60 m depth and completed as open holes in the Woolshed Flat Shale.

The first attempt at the control well (PN 57831, Fig. 20) began with rotary mud drilling to 35 m. A core was cut from 10.2 to 12.4 m. Surface casing was set to ~10 m. The hole collapsed from an intensely weathered section and the final depth was recorded at 13.5 m. The second attempt at drilling the control well (PN 58095) was successful, however surface casing had to be installed to ~43 m depth to avoid collapse from several weathered sections. The final depth was 165 m, and only the Woolshed Flat Shale was encountered. Three attempts were made to core the control well, at intervals 89.2–90.2 m, 134.9–136.1 m and 152.2–153.1 m. All attempts resulted in damaged equipment and hence deformed pieces of core. Whilst fracture orientations could not be mapped, some pieces of core will be used for mineralogical assessment at a later date.

Drillhole locations and construction details from Phase 1 are summarised in Table 1, and detailed lithological logs are contained in Appendix 1.



The Department of Water Land and Biodiversity Conservation

Government of South Australia

PN 57832 Well and permit number (shown yellow)

Scott Creek Catchment

HYDROGEOLOGICAL INVESTIGATION OF THE MOUNT LOFTY RANGES,
PROGESS REPORT 1: HYDROGEOLOGY AND DRILLING

LOCATION OF WELLS DRILLED DURING PHASE 1 AT SCOTT BOTTOM

Figure 20

PIRSA Publishing Services 201530_005

Table 1. Location and construction details of wells drilled at Scott Bottom March–April 2002

Permit no.	Unit no.	Obs. no.	Easting[1]	Northing[1]	Geological unit	Final depth (m)	Production zone (m)	SWL (m) at 17 May 2002
57814	662710649	NOA34	0287958	6113528	A	5.7	3.2-5.7	1.16
57833	662710650	NOA35	0287958	6113524	WFS	52.6	11-52.6	Artesian
57835	662710651	NOA36	0287948	6113534	WFS	52.6	11-52.6	Artesian
58094	662710652	NOA37	0287950	6113517	WFS	52.6	11-52.6	0.145
57829	662710653	NOA38	0288048	6113516	WFS	58.2	11.5-58.2	Artesian
57830	662710654	NOA39	0288019	6113513	WFS	53	8.6-53	Artesian
57832	662710655	NOA40	0288005	6113514	WFS	52.6	11.7-52.6	Artesian
57831	662710656	NOA41	0288052	6113759	WFS	13	9.8-13	1.455
58095	662710657	NOA42	0288052	6113755	WFS	165	43-165	0.19

WFS = Woolshed Flat Shale (Proterozoic, Burra Group), A = Alluvium (Quaternary).

1. approximate coordinate which will be refined at a later date.

CONCLUSIONS AND FUTURE WORK

Scott Creek Catchment is the first in a series of catchments that are to be used as case studies for the MLR Hydrogeologic Assessment. This report is a collation of background surface water, groundwater and hydrogeologic information that will be continually used and referred to over the course of groundwater and surface water investigations in Scott Creek Catchment.

A total of nine groundwater wells were drilled and completed in the first phase of drilling at Scott Bottom. These will facilitate numerous field trials and experiments to estimate groundwater recharge and flow rates in the fractured rock aquifers, and enable comparison of groundwater and stream dynamics for the purpose of investigating stream–aquifer interactions. Techniques to be employed at the site will include down-hole geophysics, hydraulic tests, well chemistry profiling, and natural and applied tracer tests.

Coring of the control well at this site was unsuccessful due to technical difficulties. Therefore, the second phase of drilling at Scott Bottom should include the collection of a continuous diamond-drilled core from the site. The information that could be obtained on fracture characteristics and aquifer geochemistry from such a core would be extremely valuable for characterising the hydrogeology of the site.

SHORTENED FORMS

Measurement

Name of unit	Symbol	Definition in terms of other metric units	
Centimetres	cm	10^{-1} m	length
Day	d		time interval
Degrees Celsius	°C		temperature
Gram	g		mass
Kilogram	kg	10^{3} g	mass
Kilometre	km	10^{3} m	length
Litre	L	10^{-3} m^3	volume
Litres per second	L/s		
Megalitre	ML	10^{6} m^3	volume
Microsiemens	µS		
Microsiemens per centimetre	µS/cm		
Millilitres	mL	10^{-3} L	
Megalitres per year	ML/y		
Metre	m		length
Millimetre	mm	10^{-3} m	length
Millimetres per year	mm/y		
Siemens	S		electric conductance
Second	s		time interval
Year	y		time interval

General

Shortened form	Description
AHD	Australian height datum
DEHAA	Department of Environment Heritage and Aboriginal Affairs (currently DEH)
DWLBC	Department of Water, Land and Biodiversity Conservation
EC	electrical conductivity
Ma	million years before present
MLR	Mt Lofty Ranges
PN	permit number
SWL	standing water level

REFERENCES

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APPENDIX 1 LITHOLOGICAL LOGS

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

The Department of Water, Land and Biodiversity Conservation

PROJECT: Scott Creek

PERMIT No. 57814

UNIT No.

Hundred: Noarlunga **Sec:** 286

Coordinates:

Location: 100 m NW Scott Bottom Weir El. Surface (m) El. Ref. Point (m) Datum:

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m) From	INTERVAL (m) To	SUPPLY L/sec	SUPPLY Test length	SUPPLY Method	TOTAL DISSOLVED SOLIDS mg/L	TOTAL DISSOLVED SOLIDS Analysis No.
	5-9	1.16			2-3		Airlift		

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
0	1		Alluvium	White to pale grey fine sand. Well sorted. Non-calcareous.	Quaternary		142	0	3.2
1	3			Light reddish orange clayey sand. <5%quartz to 6mm and other alluvial deposits. Non-calcareous.					
3	6			Light reddish orange clayey sand. <5% quartz to 6mm. Mixed alluvial gravels up to 30mm including angular quartz, ferruginised medium grain sandstone and siltstone.					
6	9			As above with more siltstone gravel.					

REMARKS:

Well collapsed at gravel layer to a final depth of 5.7m.

DRILL TYPE: Rotary

COMPLETED:

DRILL FLUID: Air

LOGGED BY: J James-Smith &G.Harrington

DATE: 14/3/02

SHEET 1 OF 1

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Scott Creek

PERMIT No. 5782

UNIT No.

Hundred: Noarlunga **Sec:** 286

Coordinates:

Location: 100 m NE Scott Bottom Weir El. Surface (m) El. Ref. Point (m) Datum:

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	13-15 17-18 24-25 35 major	Flowing			1		Airlift		

DEPTH (m)		GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING		
From	To						Diam (mm)	From (m)	To (m)
0	1		Alluvium	Light brown to pale grey sandy clay. Well sorted. Non-calcareous.	Quaternary		232	0	11.5
1	3			Light brown gravelly clay. Gravel to 40 mm comprising angular quartz and siltstone. Non-calcareous.					
3	7			Light brown gravelly clay. Gravel to 50 mm angular quartz and siltstone. Non-calcareous.					
7	10		Woolshed Flat Shale	Grey weathered siltstone. Very soft and laminated. Minor iron staining.	BURRA GROUP Proterozoic				
10	58			Dark grey siltstone. Laminated, low grade metamorphism. Disseminated with pyrite. White quartzite. Rare pyrite aggregates to 2mm.					

REMARKS

Artesian well.
Driller dropped hammer bit down the well. May be left there if not recoverable.

DRILL TYPE: Rotary	**COMPLETED:**
DRILL FLUID: Air	**LOGGED BY:** J James-Smith
DATE: 15/3/02	**SHEET** 1 OF 1

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Scott Creek

PERMIT No. 5780

UNIT No.

Hundred: Noarlunga **Sec:** 286

Coordinates:

Location: 100m N Scott Bottom Weir | El. Surface (m) | El. Ref. Point (m) | Datum:

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	13-16 22-25 30-34	Flowing			1		Airlift		

DEPTH (m)		GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING		
From	To						Diam (mm)	From (m)	To (m)
0	1		Alluvium	White to pale grey fine sand to 0.2mm. Well sorted. Non-calcareous.	Quaternary		157	0	8.6
1	3			Dark grey clay with minor sand <5% quartz to 0.2mm.					
3	4.5			Grey gravelly clay. Gravel to 20 mm comprising angular quartzite and siltstone.					
4.5	6.5			Light reddish orange very sandy clay. Medium sand and other alluvial deposits to 6 mm. Non calcareous. Minor gravel including angular quartzite.					
6.5	7		Woolshed Flat Shale	Dark grey weathered siltstone. Laminated.	BURRA GROUP Proterozoic				
7	53			Dark grey siltstone. Laminated, low grade metamorphism. White quartzite. Rare pyrite aggregates to 2mm.					

REMARKS:

Artesian well.

DRILL TYPE: Rotary	**COMPLETED:**
DRILL FLUID: Mud/Air	**LOGGED BY:** J James-Smith
DATE: 23/3/02	**SHEET** 1 OF 1

The Department of Water, Land and Biodiversity Conservation	RESOURCE ASSESSMENT – GROUNDWATER **WATER WELL LOG**	**PROJECT: Scott Creek**
		PERMIT No. 5783
		UNIT No.
Coordinates: Location: 300m N Scott Bottom Weir	El. Surface (m) El. Ref. Point (m) Datum:	**Hundred: Noalung** **Sec:** 286

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m) From	INTERVAL (m) To	SUPPLY L/sec	SUPPLY Test length	SUPPLY Method	TOTAL DISSOLVED SOLIDS mg/L	TOTAL DISSOLVED SOLIDS Analysis No.
	5.5	1.45							

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
0	3		Alluvium	Light olive gravelly clay. 40% gravel 0.5-2 mm comprising sandstone, quartz, dark grey weathered siltstone. Interlayered light grey and orange clay 2mm thick highly calcareous. Quartz to 5 mm. White calcite nodules 0.5-2 mm.	Quaternary		157	0	9.8
3	6			Light olive clay gravel. Numerous white calcite nodules 1-4 mm clusters to 12 mm. Dark grey laminated siltstone. Fine grained brown sandstone. Iron staining on siltstone and shale.					
6	9			Yellowish orange clayey gravel. Gravels comprise 50% dark grey to black shale with iron stains on broken faces. Red calcareous sandy clay. Light grey weathered shale. White calcite nodules 0.5-3 mm					
9	10.3		Woolshed Flat Shale	CORE: Predominantly fine grained, light grey shale/siltstone, some medium grained, white- light grey layers. Pyrite throughout. Fractures often contain calcite (effervescent on HCl). Highly weathered fracture zone 11.72-11.84 very little mineralisation, almost phyllitic.	BURRA GROUP Proterozoic	10.3-12.4			
12.4	13.5			Dark grey siltstone. Quartzite. Minor pyrite.					

REMARKS: Control hole – 1st attempt	**DRILL TYPE:** Rotary	**COMPLETED:**
	DRILL FLUID: Mud/Air	**LOGGED BY:** J James-Smith &G Harrington
	DATE:	**SHEET** 1 OF 1

The Department of Water, Land and Biodiversity Conservation

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Scott Creek

PERMIT No. 5783

UNIT No.

Hundred: Noarlunga **Sec:** 286

Coordinates:

Location: 100m N Scott Bottom Weir El. Surface (m) El. Ref. Point (m) Datum:

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	42-43m	Flowing							

DEPTH (m)		GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING		
From	To						Diam (mm)	From (m)	To (m)
0	1		Alluvium	White to pale grey fine sand 0.06-0.2 mm. Well sorted. Non-calcareous.	Quaternary		142	0	11.7
1	3			Dark reddish orange very sandy clay. Angular quartz to 0.5 mm. Minor white calcite.					
3	4.5			Light olive sandy clay. Well sorted quartz to 0.5 mm. Grey to orange clay.					
4.5	5.5			Light reddish brown clayey gravel. Medium gravel to 20 mm comprising quartzite, siltstone, white, orange and maroon stained very fine grained sandstone.					
5.5	7		Woolshed Flat Shale	Grey weathered siltstone. Laminated, minor iron staining. Some quartzite.	BURRA GROUP Proterozoic				
7	7.5			As above with weathered orange to light olive laminated clay.					
7.5	8.5			Grey weathered siltstone. Very soft. Laminated.					

REMARKS:

DRILL TYPE: Rotary	**COMPLETED:**
DRILL FLUID: Air	**LOGGED BY:** G Harrington
DATE: 4/4/02	**SHEET** 1 OF 2

The Department of Water, Land and Biodiversity Conservation

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

CONTINUATION SHEET

PROJECT: Scott Creek

PERMIT No. 57832

UNIT No.

Hundred: Noarlunga **Sec:** 286

DEPTH (m)		GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING		
From	To						Diam (mm)	From (m)	To (m)
8.5	11.5			Dark grey laminated siltstone. Minor quartzite.					
11.5	14.5			Medium grainded dark grey laminated siltstone, soft and friable sections (appearing with light grey clay), very minor pyrite, occasional quartzite.					
14.5	18			As above although less quartz and no pyrite observed.					
18	21			Dark grey siltstone. Major quartz zone at 19-21 m (?). Pyrite cubes and flecks to 3 mm associated with quartz.					
21	24			Dark grey siltstone. 20% quartz, cubic pyrite throughout, other creamish white coloured nodules. Non-calcareous.					
24	27			50-60% dark grey siltstone. 40-50% quartzite.					
27	30			50% dark grey siltstone. 50% quartzite. Occasional pyrite flecks.					
30	33			60-70% dark grey siltstone. 30-40% quartzite.					
33	36			70-80% dark grey siltstone. 20-30% quartzite.					
36	39			As above.					
39	42			90-95% dark grey siltstone. 5-10% quartzite. Small pyrite cubes.					
42	45			80-85% dark grey siltstone. 15-20% quartzite.					
45	52.5			70-80% dark grey siltstone. 15-20% quartzite. Minor pyrite.					

The Department of Water, Land and Biodiversity Conservation

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Scott Creek

PERMIT No. 5783

UNIT No.

Hundred: Noarlunga **Sec:** 286

Coordinates:

Location: 100m NW Scott Bottom Weir El. Surface (m) El. Ref. Point (m) Datum:

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m) From	INTERVAL (m) To	SUPPLY L/sec	SUPPLY Test length	SUPPLY Method	TOTAL DISSOLVED SOLIDS mg/L	TOTAL DISSOLVED SOLIDS Analysis No.
	14-15 19-21	Flowing							

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
0	1		Alluvium	White to pale grey fine sand 0.06 – 0.2 mm. Well sorted. Non-calcareous.	Quaternary		142	0	11
1	3			Light reddish orange sandy clay. <5% quartz to 6mm and other alluvial deposits. Non-calcareous.					
3	3.5			Olive and grey clayey sand. <10% to 0.6mm.					
3.5	4.5			Light reddish orange gravelly clay. Mixed alluvial gravels including angular quartz, sandstone and siltstone to 30 mm.					
4.5	7			Light reddish orange gravelly clay. Mixed alluvial gravels including angualr quartz, sandstone and siltstone to 30 mm.					
7	8			Light reddish orange alluvial gravels. Finer than above. 50% quartz 1-10 mm. Angular and some sub-rounded. Ferruginised medium grained sandstone.					

REMARKS:

DRILL TYPE: Rotary	**COMPLETED:**
DRILL FLUID: Mud/Air	**LOGGED BY:** J James-Smith
DATE: 6/4/02	**SHEET** 1 OF 2

The Department of Water, Land and Biodiversity Conservation

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

CONTINUATION SHEET

PROJECT: Scott Creek

PERMIT No. 57833

UNIT No.

Hundred: Noarlunga **Sec:** 286

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
8	11		Woolshed Flat Shale	50% Dark grey siltstone. Laminated. Minor soft and friable and weathered. Minor iron stain. Very minor pyrite associated with siltstone. 50% white to pink to orange quartzite and orange sandstone.	BURRA GROUP Proterozoic				
11	16			90% dark grey siltstone. Laminated. Low grade metamorphism. 10% quartzite. Very minor quartzite disseminated in siltstone.					
16	22			80% dark grey siltstone. Minor micaceous and phylitic. 20% quartzite. Minor pyrite aggregates to 2 mm.					
22	25			As above. Very minor pyrite only associate with quartzite.					
25	36			As above with pyrite in small aggregates/cubes to 3 mm.					
36	52			As above with 70% dark grey siltstone and 30% quartzite.					

The Department of Water, Land and Biodiversity Conservation

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Scott Creek

PERMIT No. 57835

UNIT No.

Hundred: Noarlunga **Sec:** 286

Coordinates:

Location: 100m NW Scott Bottom Weir | El. Surface (m) | El. Ref. Point (m) | Datum:

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	40-42	Flowing							

DEPTH (m)		GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING		
From	To						Diam (mm)	From (m)	To (m)
0	0.5		Alluvium	White to pale grey fine sand. 0.06-0.2 mm well sorted. Non-calcareous.	Quaternary		142	0	11
0.5	1.5			Light reddish orange sandy clay. <5% quartz to 6 mm and other alluvial deposits. Non calcareous.					
1.5	4			Light olive brown sticky clay. Cuttings were contaminated with fine siltstone from mud pit re-circulation.					
4	5			Medium alluvial gravel comprising white quartz, rounded red claystone, dark red friable sandstone, fine grained yellow sandstone, quartzite fragments and banded light grey and red siltstone.					
5	6			As above with lower clay content, light orange micaceous quartzite, dark red claystone and phyllitic light olive siltstone.					
6	7			As above although predominance of weathered dark grey siltstone and finer gravel (possibly due to change of bit to button roller bit)					

REMARKS:

DRILL TYPE: Rotary	**COMPLETED:**
DRILL FLUID: Mud/Air	**LOGGED BY:** J James-Smith & G Harrington
DATE: 8/4/02	**SHEET** 1 OF 2

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

CONTINUATION SHEET

The Department of Water, Land and Biodiversity Conservation

PROJECT: Scott Creek

PERMIT No. 57835

UNIT No.

Hundred: Noarlunga **Sec:** 286

DEPTH (m)		GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING		
From	To						Diam (mm)	From (m)	To (m)
7	11		Woolshed Flat Shale	Dark grey siltstone, phyllitic in parts with abundance of white and pale yellow quartz, plus other crushed alluvial gravel (possible contamination from recycled mud).	BURRA GROUP Proterozoic				
11	30			Dark grey meta siltstone. Laminated in parts. Minor quarzite (<10%) and trace fine pyrite.					
35	40			As above, although increasingly larger pyrite to 5 mm in quartzite.					
40	52.5			As above. Quartzite 10-15%.					

The Department of Water, Land and Biodiversity Conservation

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

PROJECT: Scott Creek

PERMIT No. 58094

UNIT No.

Hundred: Noarlunga **Sec:** 286

Coordinates:

Location: 100m NW Scott Bottom Weir El. Surface (m) El. Ref. Point (m)

Datum:

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	16-21	0.145							

DEPTH (m)		GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING		
From	To						Diam (mm)	From (m)	To (m)
			Alluvium	Offsider collected samples 0-11. The interval of 3-6 m missing, therefore assumed as for hole PN57835.	Quaternary		142	0	11
11	17		Woolshed Flat Shale	Dark grey siltstone, phyllitic in parts and laminated. 30% quartzite. Very minor pyrite flecks.	BURRA GROUP Proterozoic				
17	20			As above. Slightly more disseminated pyrite.					
20	35			As above. 40% quartzite.					
35	41			As above. 60% quartzite.					
41	52.7			As above. Slightly more pyrite.					

REMARKS:

DRILL TYPE: Rotary	**COMPLETED:**
DRILL FLUID: Mud/Air	**LOGGED BY:** J James-Smith
DATE: 10/4/02	**SHEET** 1 OF 1

RESOURCE ASSESSMENT – GROUNDWATER
WATER WELL LOG

The Department of Water, Land and Biodiversity Conservation

PROJECT:

PERMIT No. 58095

UNIT No.

Hundred: Noarlunga **Sec:** 286

Coordinates:

Location: 300m N Scott Bottom Weir El. Surface (m) El. Ref. Point (m) Datum:

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	44-45 58-52	0.19			0.5 2.5		Airlift		

DEPTH (m)		GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING		
From	To						Diam (mm)	From (m)	To (m)
0	3		Alluvium	Light olive gravelly clay. 40% gravel. 0.05 – 2 mm sandstone, quartz and dark grey weathered siltstone. Calcareous white nodules to 10 mm.	Quaternary		142	0	43
3	6			Light olive clayey gravel, white calcite nodules to 5mm and clusters to 10 mm. Dark grey laminated siltstone. Fine grained brown sandstone. Minor iron staining.					
6	9			Yellow orange clayey gravel. Gravels comprise 50% dark grey to black shale with iron stains on broken faces. Red calcareous sandy clay. Light grey weathered shale. White calcareous calcite nodules 0.5-3 mm					
9	12		Woolshed Flat Shale	Dark grey weathered siltstone. Minor quartzite. Some iron staining. Laminated and friable. Minor white calcareous calcite nodules.	BURRA GROUP Proterozoic				

REMARKS:

Control Hole #2

DRILL TYPE: Rotary	**COMPLETED:**
DRILL FLUID: Air	**LOGGED BY:** J James-Smith & G Harrington
DATE:	**SHEET** 1 OF 3

The Department of Water, Land and Biodiversity Conservation

RESOURCE ASSESSMENT – GROUNDWATER

WATER WELL LOG

CONTINUATION SHEET

PROJECT: Scott Creek

PERMIT No. 58095

UNIT No.

Hundred: **Sec:**

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING Diam (mm)	CASING From (m)	CASING To (m)
12	30			Dark grey weathered siltstone. Laminated and friable. Minor iron staining. Minor quartzite. Rare pyrite aggregates. Soft medium grey weathered siltstone which effervesces with HCl (possible product of bit?).					
30	43			Dark grey weathered siltstone. 30% quartzite with minor white calcite. Minor pyrite disseminated on some siltstone. Small pyrite aggregates to 2 mm. Siltstone is laminated and friable. Very minor iron staining.					
43	57			Alternatively light and dark grey laminated siltstone.					
57	62			Dark grey siltstone with quartz throughout, including some transparent, white and light olive green colour with mica. Minor pyrite. White quartz beds.					
62	66.5			Predominantly quartz 70-80%. Including white, light grey and light olive green coated. 20-30% dark grey siltstone. Pyrite throughout.					
66.5	71			As above, although possible more grey siltstone (30-40%), pyrite throughout especially with quartzite.					
71	75.5			Dark grey siltstone <10%. White quartzite 30-40%. Light olive green siltstone comprising fine saccharoidal quartz (40-50%).					
75.5	80			Return of dark grey siltstone. Light and dark siltstone 50-60%. Light olive siltstone 30-40%. White quartzite <10%. Fine pyrite throughout.					
80	84			90-95% dark grey siltstone. Some lighter beds, minor quartzite and pyrite.					

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DEPTH (m)		GRAPHIC LOG	ROCK/SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/Age	Depth Core Sample	CASING		
From	To						Diam (mm)	From (m)	To (m)
84	89.2			95% dark grey siltstone. Minor quartzite and pyrite.					
89.2	90.2			CORE: 26 pieces. Laminated siltstone (dark grey) possibly numerous fractures, pyrite on bedding fractures not mappable.					
90	103			As above (84-89 m).					
103	107.5			Dark grey laminated siltstone, minor quartzite (<5%) and traces of disseminated pyrite.					
107.5	112			Dark grey siltstone, minor pyrite and rare quartzite.					
112	116.5			As above, possibly more quartzite.					
116.5	121			As above, no quartzite, minor pyrite.					
121	130.5			As above. Large pyrite cubes to 5mm.					
130.5	135			Predominantly dark grey meta siltstone, minor quartz and pyrite.					
134.9	136.1			CORE: too many damaged pieces for detailed mapping.					
134.9	165			As above (130.5-135).					