## FURTHER INFORMATION

Further details on the wineries (including tours and wine tasting), information on accommodation, restaurants, antique shops, crafts and galleries, and regional produce are available from the McLaren Vale and Fleurieu Visitors Centre.

# GEOLOGY of the McLAREN VALE WINE REGION

*McLaren Vale vineyards looking south from Kay's Winery towards the Willunga escarpment.*
*(Photo 047489)*

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## INTRODUCTION

McLaren Vale, one of South Australia's major wine producing regions, is nestled in a geological province known as the Willunga Embayment, just a short drive south of Adelaide. From the sediments which were deposited in the basin-shaped embayment, soils have been derived that today nourish the McLaren Vale vineyards. The soils vary in their physical characteristics and chemical composition depending on the nature of the parent rock from which they were derived.

Experience gained over many hundreds of years has enabled the French wine industry to establish that certain regions are ideally suited, both in terms of the producing vineyards and specific vine varieties, to consistently produce high-quality wines. The favourable regions, which can often be characterised in terms of their soil and geology (known as *terroir*), have had these environmental factors recognised in locating vineyards. Thus, the *Grands Crus* vineyards of Champagne are restricted to the upper slopes of dissected tablelands along outcrops of flat-lying chalk. Likewise in Bordeaux, the great wines of the Haut-Medoc (Lafite-Rothschild, Mouton-Rothschild, Latour and Margaux) must be produced from vineyards planted on Pleistocene alluvial gravels bordering the Gironde estuary.

Similarly, the importance of *terroir* is now being recognised in McLaren Vale for producing consistent, high-quality wines. This brochure provides an overview to the geology of the region, describes the main rock types that underlie the vineyards, and introduces one of the most important issues affecting wine production — the sources and quality of water that is turned into wine.

## GEOLOGICAL HISTORY

On the present landscape, the Willunga Embayment forms a wedge-shaped depression of about 150 km$^2$ extending from near Kangarilla in the northeast to Moana on the coast, and southwards to Sellicks Beach at the foot of the ranges that form a natural boundary to McLaren Vale. McLaren Vale township, sited in the centre of the embayment, is 30 km south of Adelaide.

The embayment, part of the larger St Vincent Basin which originated about 65 million years ago, resulted from movement along the Willunga Fault, a large fracture in the Earth's crust. Rocks on the northern side of the fault subsided, eventually to fall below sea level during the period of geological time referred to as the Cainozoic (the era of modern life). The embayment so formed was then partly filled with marine limestone, deposited during several inundations by the sea, interspersed with sand and gravel eroded from the ancestral Mount Lofty Ranges. The present Gulf St Vincent, which washes the coast of the embayment, is a remnant of the flooding that deposited the sediments eons ago.

The basement rocks, on which the Cainozoic succession was deposited, are assigned to a period of geological time known as the Neoproterozoic, dated at over 600 million years old. The much younger Cainozoic Era has been subdivided into two major periods, based on widespread recognisable breaks in deposition:

- The Tertiary, which lasted for over 60 million years, is a period during which the Willunga Embayment gently but continually subsided on the eastern margin of the St Vincent Basin and was prone to frequent invasions by the sea.

- The Quaternary, which commenced about 1.8 million years ago, covers a period of widespread continental glaciations, notably in the northern hemisphere. Fluctuations in the extent of polar icecaps caused major changes in sea level and, at times, a much colder and wetter climate. These events can be interpreted in the Quaternary rocks in South Australia, by recognition of elevated shorelines and deep erosional valleys filled with alluvial sand and gravel.

The Holocene, the last 100 000 years of the Quaternary period, is the epoch during which alluvium, beach sand, gravel and dunes were deposited, and the present topography was shaped. This period was also the critical interval of geological time during which soils, so important to the growing of vines, were formed. The nature of these soils, which should be related to the underlying parent bedrock, have been modified in some places by other Holocene events, such as the deposition of secondary limestone (calcrete) from groundwater, or the introduction of transported sand. Many wine makers are now accepting the importance of soil in producing different styles of wine.

A geological sequence has been established within each of these major time periods; these comprise a succession of near-horizontal or gently southerly dipping rock layers referred to as formations. Each formation has recognisable characteristics, enabling it to be distinguished from that above and below — these include the occurrence of limestone, the proportions of sand and/or gravel, and the presence of diagnostic fossils. Each formation is given a name, normally derived from its principal constituents and/or the location where it is well exposed or was first recognised, e.g. Blanche Point Formation.

Formations identified in the Willunga Embayment are shown on the map. Those on which vines are grown are discussed below and, where possible, comment is made on their influence on vine growing.

*Locations where these formations can be seen are indicated by reference numbers in the text and on the map.*

*Greyish Ngaltinga Formation clay overlying mottled Ochre Cove Sandstone. In the background, Blanche Point Formation limestone forms the cliffs of Blanche Point, at the southern end of Maslin Beach.* (Photo 047487)

## THE GEOLOGY OF THE VINEYARDS

### NEOPROTEROZOIC

The basement rocks, which crop out on all but the coastal margin of the Willunga Embayment, have not been extensively planted with vines, except near Chapel Hill on deeply weathered and bleached shale[1]. Soils developed in this region are frequently clayey and contain shaley rock fragments, and occasional quartz gravel which enhances drainage properties, assisting penetration of vine roots to fractured rocks below.

Vineyards planted in this distinctive environment occupy much of Coriole, Chapel Hill and the northern part of Edwards & Chaffey wineries. Other wineries with some vineyards in this region include B.R.L. Hardy and Tatachilla.

Several vineyards in a comparable geological environment adjacent to Barytes Road[2] are gaining the reputation of producing premium Shiraz grapes, some up to Grange quality.

### CAINOZOIC

#### Tertiary

#### *Maslin sands*

The Maslin sands (an informal term used for the combined North Maslin Sand and South Maslin Sand) form the basal part of the Cainozoic succession throughout the Willunga Embayment. These formations are composed of coarse-grained sandstone and gravel deposited from ancient river systems that drained a region now occupied by the Willunga escarpment (the hills on the southern margin of the embayment) and adjoining Mount Lofty Ranges. The sands are exposed along the northern part of the basin between Maslin Beach and Kangarilla, near the Oliverhill Winery[3], and in road cuttings along Chapel Hill Road[4]. Generally, outcrops of the sands are ochre coloured and ferruginous due to oxidation at and near the surface, in sharp contrast to the vivid red and purple-coloured unweathered sand that has been exposed in sand pits near Maslin Beach[5].

*Boulders and gravel at the base of the Maslin sands, overlying the eroded surface (unconformity) of bleached Neoproterozoic shale, Chapel Hill Road.* *(Photo 047492)*

Vineyards planted over these sands are either rooted in shallow soils containing abundant ferruginous sandstone fragments (as in the southern part of Edwards & Chaffey Winery[6]) or in much thicker soils with profiles composed mainly of transported sand. In the latter, deep penetration of vine roots allows mature vineyards near Blewitt Springs to be grown dry (i.e. without irrigation).

#### *Blanche Point Formation (including Tortachilla Limestone)*

The Blanche Point Formation is composed of sandy, pale-coloured limestone containing abundant marine fossils, including readily identifiable conical or turreted gastropods *(Turritella aldingae)*. Inland from coastal sections, near Blanche Point, the formation is poorly exposed, but may be recognised in road cuts along Field Street[7] and in benches at

*Ferruginous Maslin sands (ironstone) exposed in the Edwards & Chaffey vineyards.* *(Photo 047490)*

Maxwell Winery[8]. Fossils and fragments of limestone may be identified from auger cuttings in newly planted vineyards.

In many areas, the planting of vines over this formation may require rock breakers to penetrate hard, near-surface, superficial carbonate known as calcrete. However, in an area centred over d'Arenberg and Merrivale, extending southwards to Chalk Hill and northwards across Seaview Road to Kay's, the Blanche Point Formation is largely devoid of such hard and dense rock. Here, the soil is thick, clayey and calcareous, with good moisture retention properties, allowing the cultivation of numerous vineyards. At Kay's Winery, some rows of vines have been planted in soils containing fossiliferous limestone rubble[9].

*Vines near Kay's Winery planted in fossiliferous limestone rubble derived from Blanche Point Formation.* *(Photo 047491)*

#### Quaternary

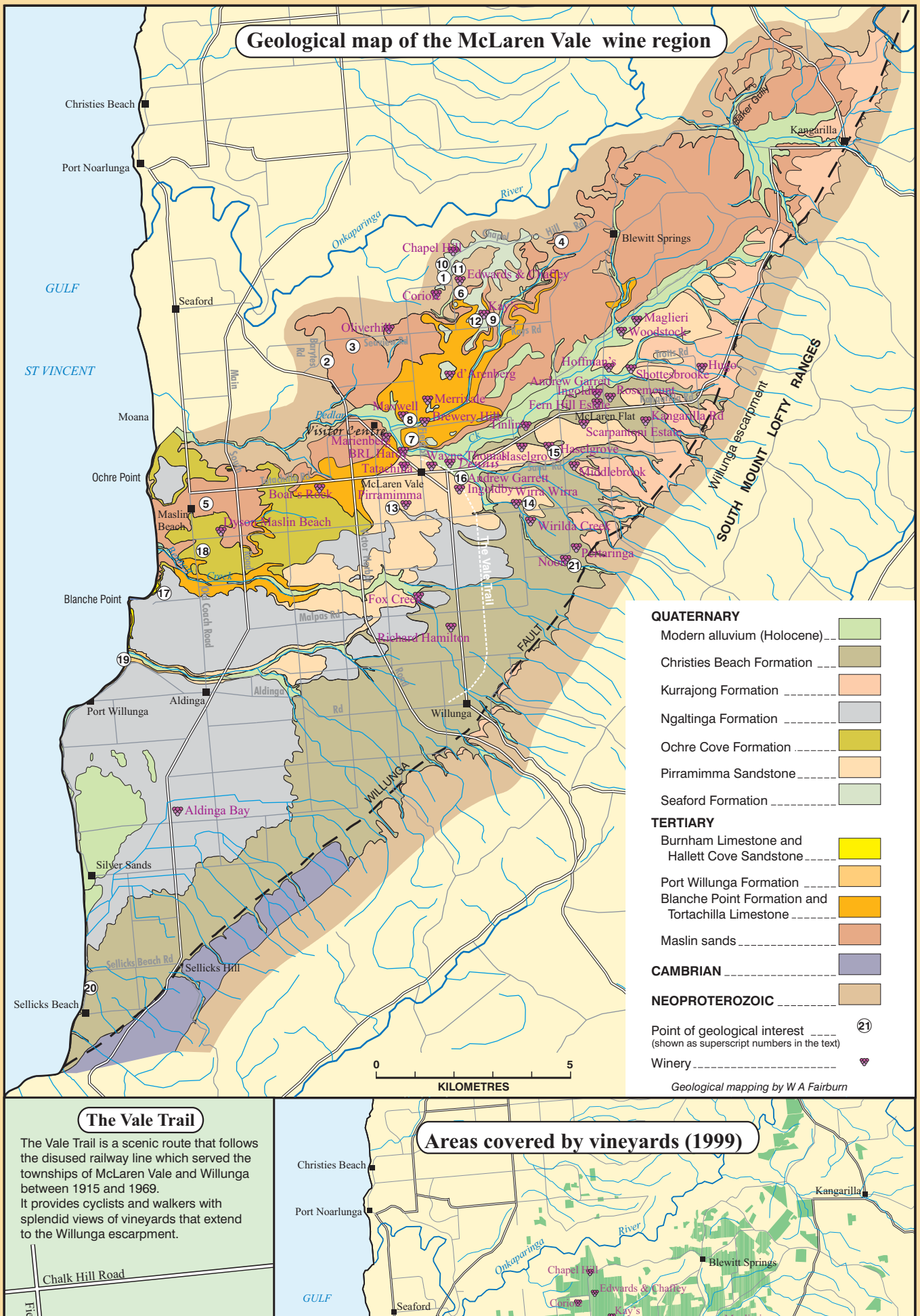
#### *Seaford Formation*

The Seaford Formation is a grey-white pebbly sandstone. It forms localised cappings, seldom more than a few metres thick, on older rock formations near Chapel Hill[10], the northern part of Edwards & Chaffey[11], and adjoining the access road to Kay's[12]. Soils produced over this formation contain abundant quartz pebbles similar to the Medoc soils at Bordeaux (France).

#### *Pirramimma Sandstone*

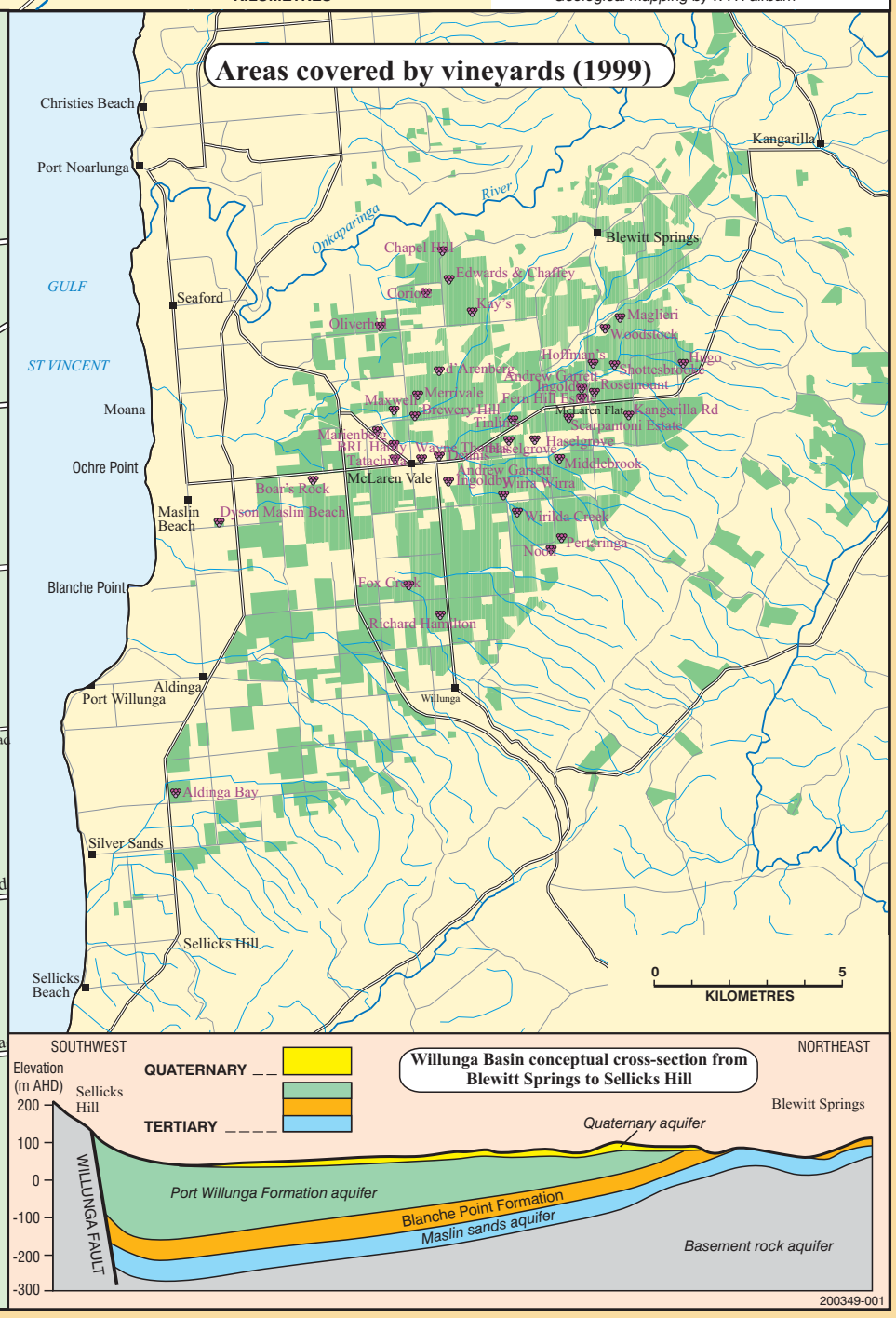
The Pirramimma Sandstone is a fine-grained, buff-coloured, calcareous sandstone, originally described from a bore near the Pirramimma Winery. It extends throughout the central part of the Willunga Embayment from near Kangarilla to southwest of McLaren Vale; outcrops can be seen at Pirramimma[13] and Wirra Wirra[14] Wineries, in excavations at Haselgrove Winery[15], and along the northern part of The Vale Trail near Kangarilla Road[16].

Superficial loose sand is developed in the soil profile as the sandstone is weakly consolidated and crumbles easily. It is extensively cultivated with vines in the region of Wirra Wirra and Pirramimma, between Sand Road and Kangarilla Road near Haselgrove and Scarpantoni Estate, and on a prominent ridge south of Woodstock and east of Maglieri where Marienberg also has some production. Mature vines can be grown with minimal irrigation in selected areas due to deep penetration of roots in the sand.




## The Vale Trail

The Vale Trail is a scenic route that follows the disused railway line which served the townships of McLaren Vale and Willunga between 1915 and 1969.
It provides cyclists and walkers with splendid views of vineyards that extend to the Willunga escarpment.





### *Ochre Cove Formation*

The Ochre Cove Formation consists of red and yellow mottled sandstone which is well exposed in the coastal cliffs near Blanche Point[17], in the higher terraces of some of the sandpits, and along the Old Coach Road near Maslin Beach[18].

Until the 1990s, ground underlain by this formation had not been extensively cultivated with vines, the only significant production being from the Dyson Maslin Beach vineyards. Since irrigation water from the Christies Beach Wastewater Treatment Plant has become available, vineyards have been planted adjacent to Tatachilla Road in this formation by B.R.L. Hardy.

### *Ngaltinga Formation*

The Ngaltinga Formation is composed of grey-green clay that caps the coastal cliffs at Blanche Point and Port Willunga[19], and underlies the flat-lying land between Aldinga and Sellicks Beach. Until the late 1990s, vineyard plantation was limited because of perceived poor drainage characteristics. This factor, however, implies good moisture retention properties, as exemplified by the construction of water storage ponds at the Aldinga Water Treatment Plant.

Producing vineyards planted on the Ngaltinga Formation include those around the Aldinga Bay Winery and parts of those at Pirramimma and Fox Creek.

### *Kurrajong Formation*

The Kurrajong Formation, which is largely composed of pebbly and sandy clay with associated talus-like breccia, crops out along the foot of the Willunga escarpment south of Kangarilla and northwest of the Noon Winery. Small dams in this formation indicate its good water retention properties.

Vineyards cultivated on the Kurrajong Formation are located near the Hugo Winery, adjacent to Trotts Road, and between the Pertaringa and Kangarilla Road Wineries.

### *Christies Beach Formation*

The Christies Beach Formation consists of reddish brown to chocolate-brown clay and loam with abundant discontinuous lenses of gravel. Soils overlying the formation characteristically contain numerous, small, flat pebbles of basement rock. The formation is exposed in cliffs at Sellicks Beach[20] and in a steep-sided gully, provided with a walkway, adjacent to the Noon Winery[21]. It provides good drainage and water retention properties, amenable to development of vine rootlets and their wide lateral growth in the gravel lenses, both of which are virtues in vine cultivation.

Wineries with some production from this formation include Fern Hill Estate, Fox Creek, Ingoldby, Middlebrook, Noon, Pertaringa, Richard Hamilton, Ryecroft, Wirilda Creek and Wirra Wirra.

### *Modern alluvium*

Vines are cultivated on Holocene alluvium, deposited on the flood plains of major creeks. Typically, alluvium can vary widely in character from silty clay, to sand and gravel, depending on the maturity of drainage and localised effects of sediment intake from tributary creeks. Dry cultivation or minimal irrigation is practiced in some locations.

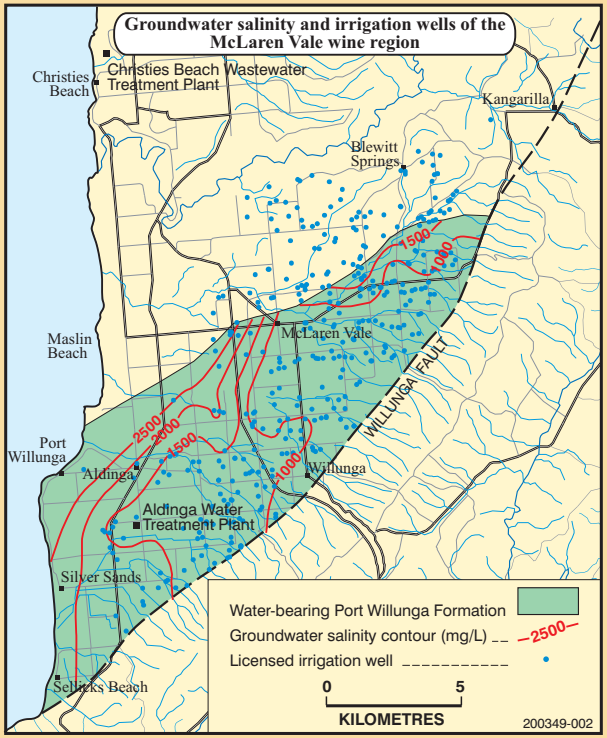
Vineyards extend along Pedlar Creek from west of the Dennis Winery to Maglieri, in Baker Gully and Bennett Creek. Wineries with production from such vineyards include Brewery Hill, d'Arenberg, Dennis, Hoffman's, Maglieri, Shottesbrooke, Tinlin's and Woodstock.

## WATER FOR WINE

Most vineyards in the Willunga Embayment are dependent to a large extent on supplementary irrigation from underground water ('groundwater') as the rainfall is sometimes insufficient and irregular for optimum vine growth. The most important sources of groundwater are the Maslin sands and Port Willunga Formation aquifers. Recently, an increasing number of wells have been targeting fractured basement rocks to provide useful supplies of water, particularly to the east of the Willunga Fault.

Infiltration of rainfall through the surface soils is the main source of replenishment for these aquifers. Some replenishment also occurs from streams flowing across the vale, and from lateral inflow of deeper groundwater systems contained in the surrounding basement rocks, particularly in the north and east. Groundwater generally flows from the northeast corner of the embayment and discharges some distance offshore where the aquifers crop out on the seabed. Ironically, this is also a potential source of saline water invasion back into the aquifer system if the potentiometric head of the fresh water is lowered by excessive pumping.

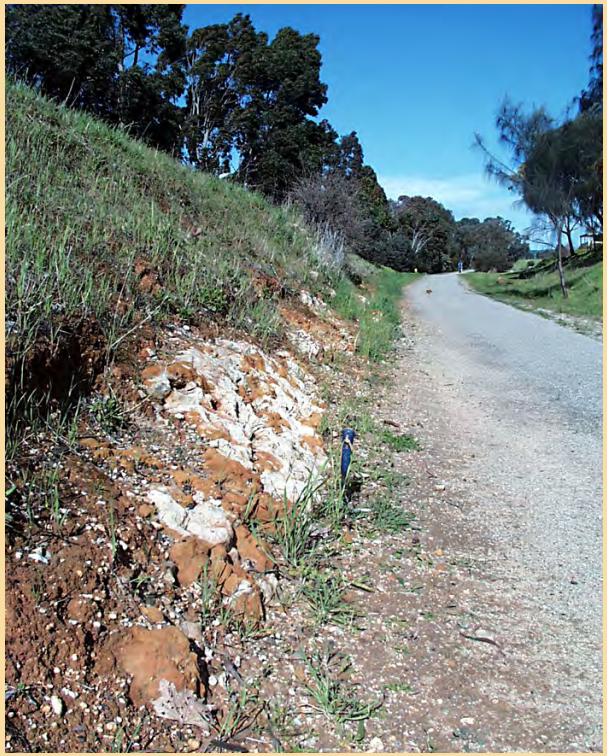
Under the current groundwater extraction regime, water levels in bores are declining and in some localities water quality is deteriorating. In the Port Willunga Formation, groundwater salinities are increasing by as much as 20 mg/L per year, which means that within 10 years some parts of the aquifers will contain water that is too salty for irrigating vines. It is therefore considered that the current level of use is slightly above the long-term sustainable yield of the aquifers in the embayment.




Options are being explored by PIRSA to address this mismatch between groundwater use and natural recharge to meet the existing irrigation demand and provide for future expansion in horticultural activities throughout the embayment. One option being vigorously pursued is to use recycled water from the Christies Beach Wastewater Treatment Plant which up to now has been discharged to the marine environment. Some re-use of this water during the summer is already planned but there is an opportunity to store the water produced during winter (when irrigation is not required) from the treatment plant in the aquifers. The stored water could then be withdrawn again to meet the summer irrigation demand.

Other options include harvesting the excess natural stream flows and urban stormwater for re-use, and transferring any winter surplus water from reservoirs in the Mount Lofty Ranges for storage in the aquifers.

If the economics of establishing the necessary infrastructure to support such proposals prove favourable, there is significant potential to increase the volume of water available for irrigation, and permit sustainable increases in the area under irrigation.



*Pirramimma Sandstone outcrop along The Vale Trail near Kangarilla Road.* (Photo 047488)

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