THE LAKE MUIR–UNICUP CATCHMENT CLARIFYING THE GEOLOGY

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INTRODUCTION

Acidic saline groundwater is threatening lakes and native vegetation within the Lake Muir–Unicup Natural Diversity Recovery Catchment. Rising groundwater now forms an extensive shallow watertable throughout the area. The groundwater moves through different geological and regolith units which influence the geochemistry of the water. Therefore, to understand the geochemistry of this water the local geology (Table 1), which is obscured by Quaternary sediments and extensive ferruginous duricrust, requires characterisation and mapping. To categorize the local geology this study has examined the drill chips from over 70 bores drilled between 2003 and 2006.

The catchment is about 700 km^2 in area and near the south coast of Western Australia, 300 km south of Perth. The Tone and Frankland rivers skirt the NW and SE corners respectively, of this, now internally draining catchment (Figure 1). The Eocene geological record suggests that (palaeo) rivers originally cut through the catchment, but the direction and location of the (palaeo) drainage is questionable. The terms palaeodrainage and palaeochannels have been redefined as inset-valley by de Broekert & Sandiford (2005) and reflect drainage (between the Early Cretaceous and Middle Eocene) in the eastern Yilgarn that has recut old valleys floors. The term inset-valley will be used here.

GEOLOGY

The catchment is mainly on the Proterozoic Albany–Fraser Orogen but its northeast corner extends onto the Archaean Yilgarn Craton. The basement consists of deformed granite and gneiss that have been deeply weathered and partly overlain by Cainozoic sediments of the Werillup and Pallinup Formations of the Eucla Basin (formerly the Bremer Basin) as defined by Clarke et al. (2003).

Table 1 Geology (after De Silva 2000, 2004; Smith 2003)

	Age	*Geological / regolith unit*	*Lithology*	*Depositional environment*
Cainozoic	Quaternary	Alluvium and colluvium	Sand and clay	
	~~	~~~~~~~~~~~~~~~~~	Unconformity ~~~~~~~~~~~~	~~~~~~~~~~~~~~
		Ferruginous duricrust	Massive duricrust to, pisolitic gravel, ferruginous sand	
	Palaeogene (Late Eocene)	Pallinup Formation	Clay to well sorted, very fine grained sand with broken spicules (3%)	? Marine, ? Estuarine
		Werillup Formation	Quartz dominated sand, silt and gravel (upward fining)	River channel
			Carbonaceous clay and silt, and lignite	Flood plain
~	~~~~~~~~~~~	~~~~~~~~~~~~~~~~~	Unconformity ~~~~~~~~~~~~	~~~~~~~~~~~~~~
	Proterozoic		Granite, gneiss	
	Archaean		Granite	

The Werillup Formation in the catchment (Figure 2) consist of poorly sorted, subangular-to-rounded, quartz-dominated gravels, sands, and silts which form many upward fining cycles between 2 and 5 m thick. It has a maximum thickness of about 68 m and is interpreted to be a river channel deposit. Laterally these sediments become carbonaceous clays and silts with thin lignite beds of a flood plain facies. The lignite has been dated by palynological analysis as Middle *Nothofagidites asperus* Zone Equivalent or Late Eocene (Milne 2003). The Pallinup Formation, where preserved, overlies the Werillup Formation (Figure 2). These sediments are well sorted, very fine-grained, rounded quartz sands with broken spicules (3%), and silts or clays with no spicules. The Pallinup Formation along the south western coast was laid down in a low-energy marine environment with high nutrient and silica supply, and normal salinities (Gammon et al. 2000).

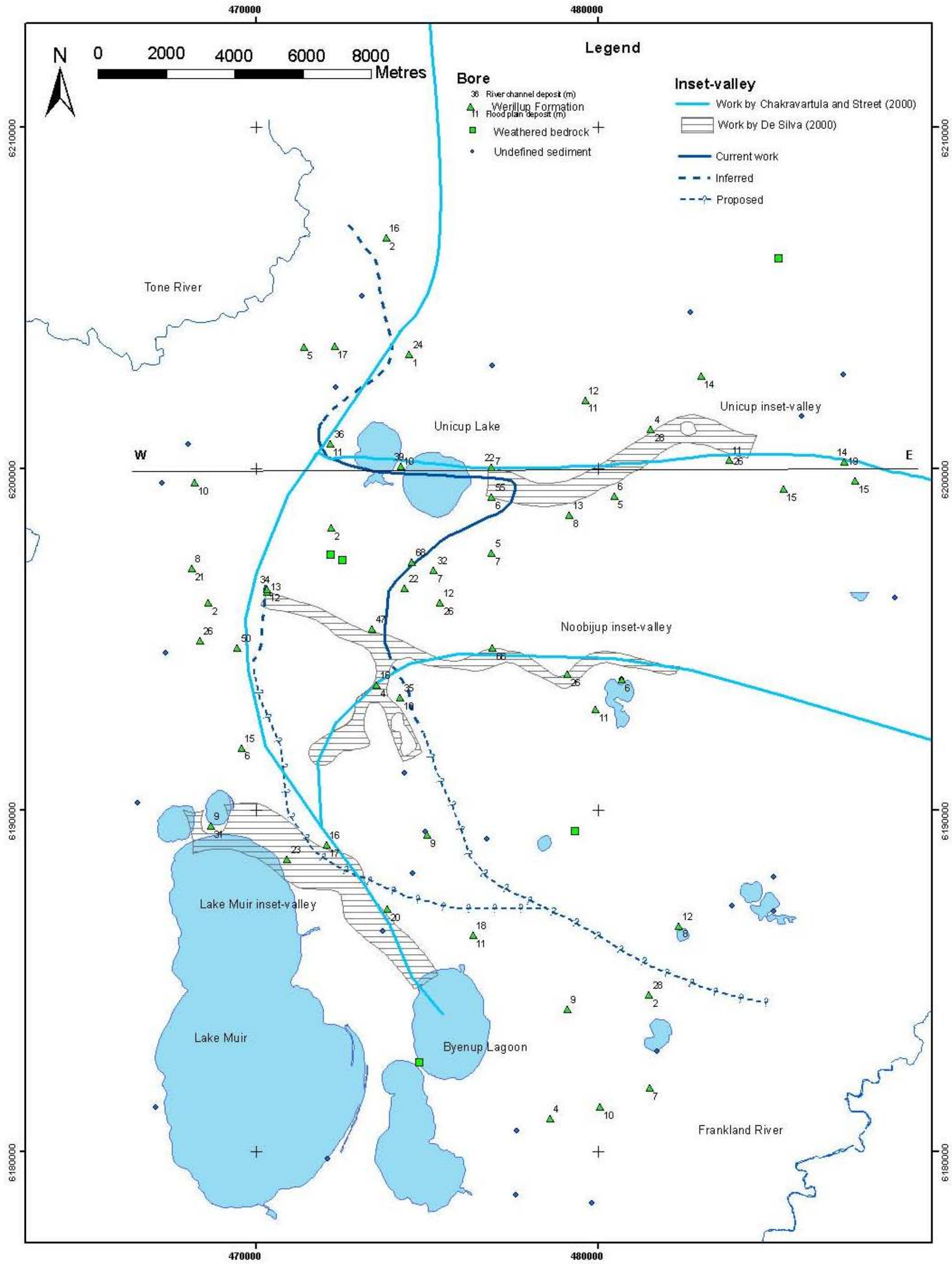

Figure 1 The Lake Muir–Unicup Catchment showing the location of the inset-valleys proposed by previous work (Chakravartula & Street 2000; De Silva 2000) and the position of the inset-valleys defined by this study

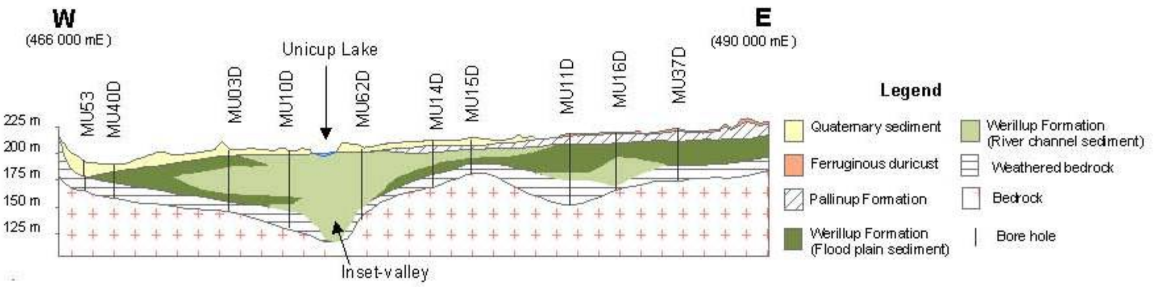

Figure 2 Cross section 6 200 000 mN showing the geological and regolith units

INSET-VALLEY

There is limited knowledge available on the Palaeogene rivers that would have cut inset-valleys in the south west corner of Western Australia. Previous work in the Lake Muir–Unicup Catchment has suggest that the inset-valleys were mainly WNW-trending (Chakravartula & Street 2000; De Silva 2000, 2004; Smith 2003) with a south trending arm (Chakravartula & Street 2000; Figure 1). Based on limited coal and groundwater exploration drilling, three inset-valleys (Unicup, Noobijup and Lake Muir) were proposed (De Silva 2000, 2004; Smith 2003). Combining the groundwater exploration bores with airborne geophysical surveys Chakravartula & Street (2000) mapped two inset-valleys over 50 km long, following a similar path to the Unicup and Noobijup inset-valleys to join a south trending inset-valley located west of Unicup Lake.

WNW-trending inset-valleys, if present, would have cut across the Albany–Fraser Orogen onto the Yilgarn Craton. However, Beard (1999) notes there are no obvious gaps in the watershed between the southern boundary of the Blackwood River (west flowing) catchment and the northern boundaries of the south flowing Tone and Frankland rivers. This would suggest that the predecessors of the current Tone and Frankland rivers originally formed as a result of uplift of the Yilgarn Craton some time between the Early Cretaceous (Beard 1999) and Middle Eocene (de Broekert 2005) and flowed predominately south.

This study supports the south flowing river hypothesized by Beard (1999) although west-east meanders are present. In the north of the catchment, lithological interpretation of drill chips has identified thick sequences of fluvial deposits (up to 39 m) in two bores west of Unicup Lake (Figures 1, 2). This thickness increases to 55 m just east of the lake before increasing to over 68 m south of the lake. Further south, sequences of between 35 and 47 m thick have been logged. A short section of a second channel is inferred trending south, cutting the west edge of the Noobijup inset-valley.

In the south of the catchment the inset-valley has not been identified. Quartz dominated river sands are up to 28 m thick which is less than around Unicup Lake. The river sands tend to be associated with food plain sediment up to 31 m thick north of Lake Muir. Using the known thicknesses of the river sands (Figure 1) it is proposed that the inset-valley trended in a south east direction toward the now Frankland River. The proposed extension of the second channel trends south toward Lake Muir before swinging south east to join the main proposed inset-valley.

CONCLUSIONS

Current mapping of the geology has identified the inset-valley under and to the south of Unicup Lake. This inset-valley is dominated by thick sequences of river channel deposits. The west-east section of this valley is coincidental with parts of the valley defined using geophysics (Chakravartula & Street 2000). However, the south arm was not defined by geophysical interpretation, although Chakravartula & Street (2000) mapped a south flowing channel toward the west. The Unicup inset-valley and most of the Noobijup inset-valley (De Silva 2000, 2004) coincide with thick sequences of flood plain sediment. The location of the inset-valley in the south of the catchment still needs to be resolved.

Geological and regolith units of different mineralogical composition will influence the geochemistry of groundwater moving through it. The next stage of this project is to incorporate this geology into the groundwater geochemistry analysis and identify variations in geochemistry. Mapping of the geochemical characteristics will allow areas at risk to be identified. This knowledge will give a better understanding of how the catchment can be managed to help maintain healthy lakes and native vegetation.

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