Report on the site at Yarra Flats being proposed for a Treetops development

Prepared by Emeritus Professor Robert White, 24 June 2021

My address is Apt 108/1 Westley Ave, Ivanhoe Vic. 3079

Statement of skills and experience – Emeritus Professor Robert E White

Robert White is Emeritus Professor of Soil Science in the University of Melbourne, where he held the Chair of Soil Science from 1994 to 2003. Previously he was Professor of Soil Science and Director of the Fertilizer and Lime Research Centre at Massey University, New Zealand. He has extensive experience in soil science nationally and internationally, having worked in CSIRO and universities and been a private consultant in the viticulture industry from 2004. His main experience is in soil, water and nutrient management in countries as diverse as Australia, USA, UK, NZ, China and southern Africa, where he has led national and international research teams. He has received several awards for his research and authorship, including the JK Taylor and JA Prescott awards and the Prix Agronomique of IMPHOS, and is an honorary life member Soil Science Australia and life member of the International Union of Soil Sciences. He is the author of the international textbook *Principles and Practice of Soil Science*, first published in 1979 and now in its 4th edition, *Soils for Fine Wines* (2003), *Understanding Vineyard Soils* (2009), now in its 2nd edition, and *Healthy Soils for Healthy Vines* (2019), co-authored with Dr Mark Krstic. He also co-edited the four volumes of Earthscan's *Soil Science*, published in 2009.

Oral instructions

The Riverland Conservation Society of Heidelberg Inc. asked me to provide them with a report on the soil conditions of the proposed Treetops site and to give my opinion on the possible effect of these conditions on the health of trees at the site.

Scope of the report

As indicated above, I have had long experience of soil properties and behaviour in many different environments. My report is the result of a visit to the site at Yarra Flats in March this year when penetrometer measurements were made, the soil was examined in pits and samples were taken for analysis. These samples were obtained at a depth of 40 to 50 cm, as this would be most relevant for assessing any constraints on tree root growth. The samples were sent to the SWEP laboratory in Melbourne and the results returned to me for interpretation. The SWEP laboratory is NATA accredited for quality control and registered with the Australian Soil and Plant Analysis Council for adoption of standard analytical methodology.

Observations on the soil at Yarra Flats

Site 1

Pit dug to 50 cm and soil at this depth sampled for analysis. The soil profile looked uniform and the soil texture was silty loam. The soil colour was a uniform brown and there was no evidence of historic waterlogging (which might occur during wet winters). The soil structure was friable and the aggregates broke apart easily. There was evidence of fine roots growing into the aggregates. Approximately 500 g soil was collected for analysis.

Penetrometer measurements were made around the pit, avoiding any tracks. I estimate the soil to have been around 10% moisture content.

The readings (in MPa) at the maximum soil depth (cm) of penetration (unless otherwise stated) were as follows.

20 cm depth	4.2 MPa
20 cm	3.8
18 cm	4.1
16 cm	3.8
17 cm	4.0

(Note – 1 MPa = 10 bars = 150 psi)

Site 2

Pit dug to 50 cm as before. The soil profile again was uniform in colour and silty loam texture down to 50 cm. There was no evidence of waterlogging. The soil structure was friable and the aggregates broke apart easily. There was evidence of fine roots growing into the aggregates. Approximately 500 g soil was collected for analysis.

Penetrometer measurements were made around the pit, avoiding any tracks. I estimate the soil to have been around 10% moisture content.

The readings at the maximum soil depth (cm) of penetration were as follows.

10 cm depth	3.2 MPa
20 cm	3.8
14 cm	4.2
17 cm	4.0
50 cm (at base of pit)	4.5

Site 3

Pit dug to 50 cm. The soil profile again was uniform in colour and a darker brown (more organic matter) than the other two sites. The soil texture was a fine sandy loam down to 50 cm. There was no evidence of waterlogging. The soil structure was friable and the aggregates broke apart easily. There was evidence of fine roots growing into the aggregates. Approximately 500 g soil was collected for analysis.

Penetrometer measurements were made around the pit, avoiding any tracks. I estimate this soil to have been around 15% moisture content.

The readings at the maximum soil depth (cm) of penetration were as follows.

22 cm depth	3.8 MPa
20 cm	4.0
22 cm	3.2
30 cm	4.2
27 cm	4.0
20 cm	4.5
50 cm (at base of pit)	4.2

Comments on the soil in the field

The soils were formed in river alluvium and appeared to be young. Judging from the profiles, they were well drained.

The penetrometer measurements at each site were quite uniform and consistently high. The maximum value to allow good root growth is 2 MPa (300 psi) at the soil's field capacity, which in this soil, based on its texture, is estimated to be between 25 and 30% water content.

As a soil dries out, the penetrometer resistance increases, but for good root growth it should not exceed 3 MPa at the permanent wilting point (PWP). The moisture content of these soils was judged to be above the PWP (based on the condition of the vegetation), so that the penetrometer values >3 MPa, as occurred at these sites, are considered to be too high for healthy root growth.

Soil analyses

The soil samples were analysed by the SWEP laboratory for pH, total soluble salts (TSS), organic matter (OM), cation exchange capacity (CEC) and exchangeable cations Ca, Mg, K and Na.

The results were consistent for the three sites. Soil pH was low (<5.5 in $CaCl_2$). For best plant growth this pH should be >5.5.

TSS were low and should not cause any problems.

Soil OM was low as would be expected for soil at 40-50 cm depth, except for site 2 where OM was 2.72%.

CEC was in the medium range for a silty-sandy loam (10-16 cmols charge (+)/kg soil.

Exchangeable Na percentage (ESP) was <6 at the three sites, although nudging up towards 6 (being 5.5) at site 1.

The Ca/Mg ratio was less than 2 at all sites. The ideal range for this ratio is 2-4. The combination of a raised ESP and low Ca/Mg ratio could predispose to an unstable aggregate structure in the subsoil, which could lead to compaction and poor drainage. These chemical conditions – an ESP approaching 6 and Ca/Mg ratio <2 - are consistent with the high penetrometer readings (indicating compaction) at all the sites tested.

General comment

The tendency of the soil to compact and adversely affect tree growth would be exacerbated if there was much traffic over the site when the soil was wet.

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel.

Robert E White

24 June 2021