Objective 1

Describe trends and variability of soil hydraulic properties of the region.

Methods

- Soil hydraulic parameters such as saturated hydraulic conductivity and soil water holding capacity were identified for measurement based on relevance to irrigation and water management applications. (Attachment 1: Chapter 2)

- Soil types and sampling sites in the SIR were selected for measurement using the existing regional soil maps. (Attachment 1: Chapter 3)

- Soil hydraulic properties were measured for 34 soil types at 79 sites in the SIR. In situ measurements of saturated hydraulic conductivity were made at Horizons A, B1 and B2. Final infiltration rate was measured at the top of Horizon B1. Soil water capacities of Horizons A and B1 were determined in the laboratory on undisturbed soil cores. In addition, a number of soil physical and chemical properties of Horizons A and B1 were measured in laboratory. Measured soil physical and chemical properties of Horizons A and B1 included bulk density, particle size distribution, organic matter content, pH, EC and exchangeable cations. (Attachment 1: Chapters 4 and 5)

- Measured soil physical, chemical and hydraulic properties were analysed to determine mean and variability measures for each soil type and soil group. Trends with respect to soil groups, soil horizons and irrigation districts were observed, and variability within soil groups and within soil types was examined. (Attachment 1: Chapters 6, 7, 8 and 9)

Results

Soil Physical Properties

- Clay content of Horizon A showed an increasing trend from Group 1 to 5. However, difference in texture was not found statistically significant between Groups 1 and 2, between Groups 3 and 4, or between Groups 5 and 6.

- Horizon B1 showed relatively large variability of clay content within soil groups than did Horizon A. Within-soil-group variability of clay content was due to both between-soil-type variability and within-soil-type variability. Variability at a paddock scale can be quite high and in some cases similar to within-soil-type variability.

- Average bulk density of Horizon B1 showed a decreasing trend with soil group except Group 6. Overall, Horizon B1 has higher average bulk density than Horizon A. Except Group 5, organic matter content of Horizon A showed a decreasing trend with soil group.

Soil Chemical Properties

- Horizon B1 generally has higher pH, exchangeable Na and ESP than Horizon A for all soil groups. Group 5 has the highest average exchangeable Ca, Mg, Na and K. Group 2 has the highest average ESP of Horizon A, and Group 5 has the highest average ESP of Horizon B1.

Saturated Hydraulic Conductivity

- Saturated hydraulic conductivity (Ksat) of all soil horizons decreases from Group 1 to Group 6 except Groups 2 and 5. However, difference in Ksat of Horizons B1 and B2 was not found statistically significant between Groups 4 and 5, or between Groups 5 and 6.

- Ksat of Horizon A is generally one order of magnitude or more greater than that of Horizons B1 and B2. Ksat of Horizons B1 and B2 are similar for all soil groups. However, Ksat of Horizon B1 tends to be slightly lower than that of Horizon B2 for Groups 2 and 3, indicating that Horizon B1 is the more restricting layer.

- Ksat of Horizons A, B1 and B2 is reasonably well defined between upper and lower quartiles for Groups 2, 4, 5 and 6, and it is recommended that the average values of these groups could be used as indicative values for practical applications. For Groups 1 and 3, however, Ksat is quite variable, due to both between-soil-type variability and within-soil-type variability. It is suggested that soil types of Groups 1 and 3 should be considered individually. It is noted that even at a paddock scale, variability can be quite high, in some cases a paddock can cover much of the within-soil-type variability.

- Some spatial trends of Ksat have been found across the three irrigation districts in SIR – Murray Valley (MV), Goulburn Valley (GV) and Rochester (RO). MV District has the highest Ksat of Horizons A and B1 among Group 1 soils. MV District has the lowest Ksat of Horizons B1 among soils of each of the Groups 3, 5 and 6. On the other hand, GV District generally has the highest Ksat among soils of each of the Groups 2, 3, 4, 5 and 6.

Final Infiltration Rate

- Final infiltration rate (FIR) of Horizon B1 is reasonably well defined for soil groups except Group 1. FIR is quite variable in Group 1. A few large values of FIR were observed in Groups 2 and 3, even though FIR is well defined between lower and upper quartiles.

- FIR of Horizon B1 decreases from Group 1 to Group 6 except Group 2. However, the difference in FIR of Horizon B1 was not found statistically significant between Groups 4 and 5, or between Groups 5 and 6.

- FIR of Horizon B1 is generally lower than the saturated hydraulic conductivity of Horizon B1. It is suggested that the upper part of Horizon B1 is more permeable than further down, because the FIR measurement allowed longer time for water to penetrate down the soil profile more deeply.

- MV District has the highest FIR among Group 1 soils, while RO District has the highest FIR among soils of each of the Groups 2, 3 and 4.

Soil Water Capacity

- The soil water retention characteristic of Horizons A and B were measured for 32 soil types at 61 sites in the SIR.

- Available water capacities of Horizons A and B1 are reasonably well defined for Groups 3, 4, 5 and 6, while Groups 1 and 2 are much more variable.

- Available water capacities of Horizon A decrease from Group 1 to Group 5. This pattern does not hold for Horizon B1. The soil water capacities of Horizon A are greater than that of Horizon B for Groups 1, 2 and 3, while the reverse is true for Groups 4, 5 and 6.

Conclusions

- The project results have built up a picture of the trends and variability of properties of soils in the SIR. Although some useful trends with respect to soil groups, soil horizons and irrigation districts have been identified, overall it is found that soil hydraulic properties are highly variable. This is particularly so for Groups 1 and 3, each comprising highly dissimilar soil types. It is therefore suggested that hydraulic property values of individual soil types should be used. Group values should be used as an indication for only those soil types which have not been directly measured.

- A number of soil types that cover a large area, such as Lemnos loam and Wanalta loam, have high within-soil-type variability. For these soil types, further measurements may be required to better quantify the soil hydraulic properties at paddock scale. It is noted that even at a paddock scale, variability can be quite high. In some cases, variability within a paddock covers large part of the within-soil-type variability.