



# HAMILTON HEALTHY SOILS GROUP

## WATERLOGGING WEBINAR

WITH CAM NICHOLSON



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The Hamilton Healthy Soils group is a collaboration of Southern Farming Systems, Grasslands Society of Southern Australia, Western District Branch and the Cavendish Best Wool Best Lamb Group.

This group is part of MLA pilot project to deliver producer skill improvement in soil knowledge over the next two years.

This group has chosen to focus on two topics to explore Soil Carbon and Waterlogging.



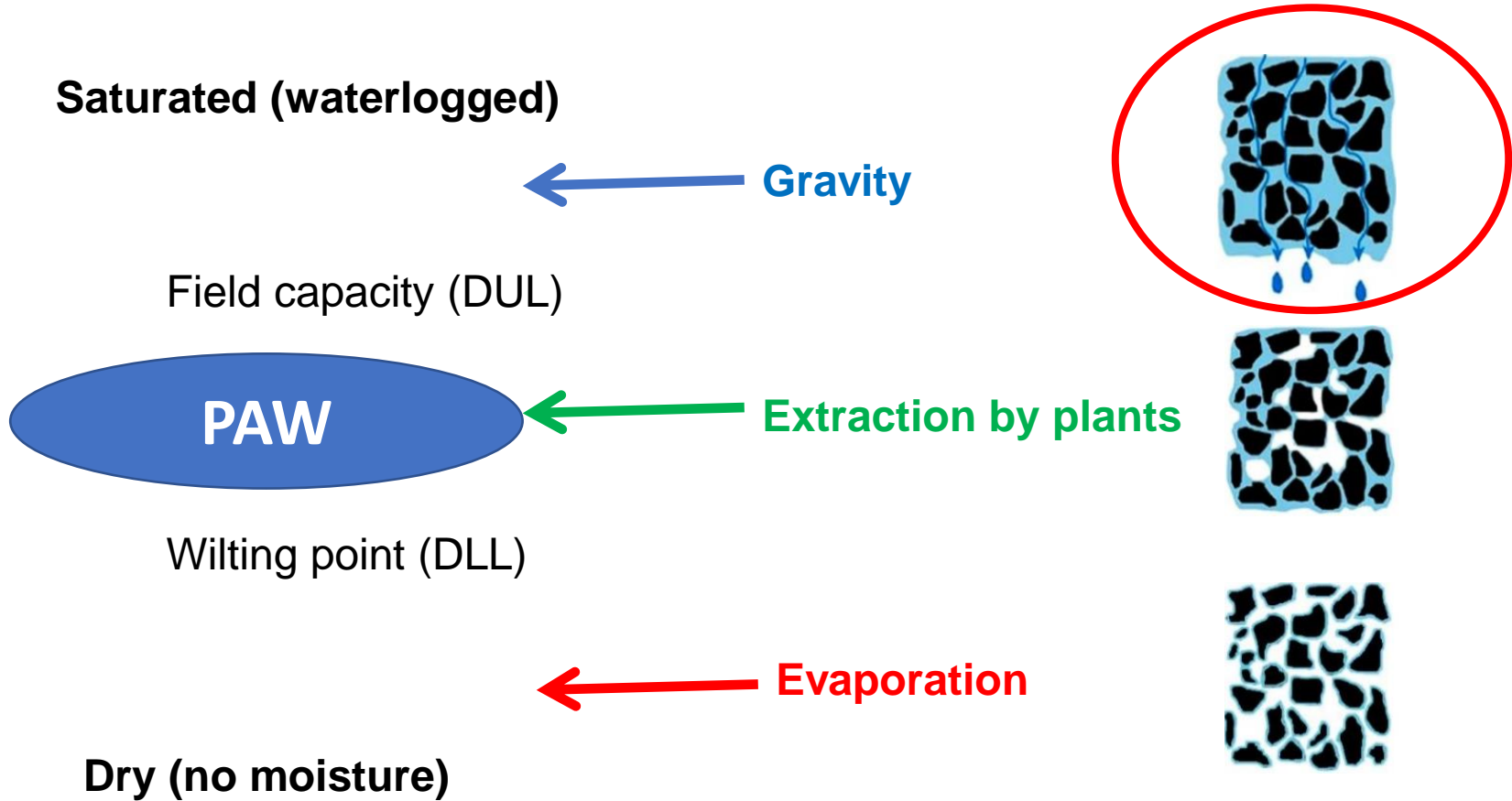
**Waterlogging:** The saturation of soil with water.

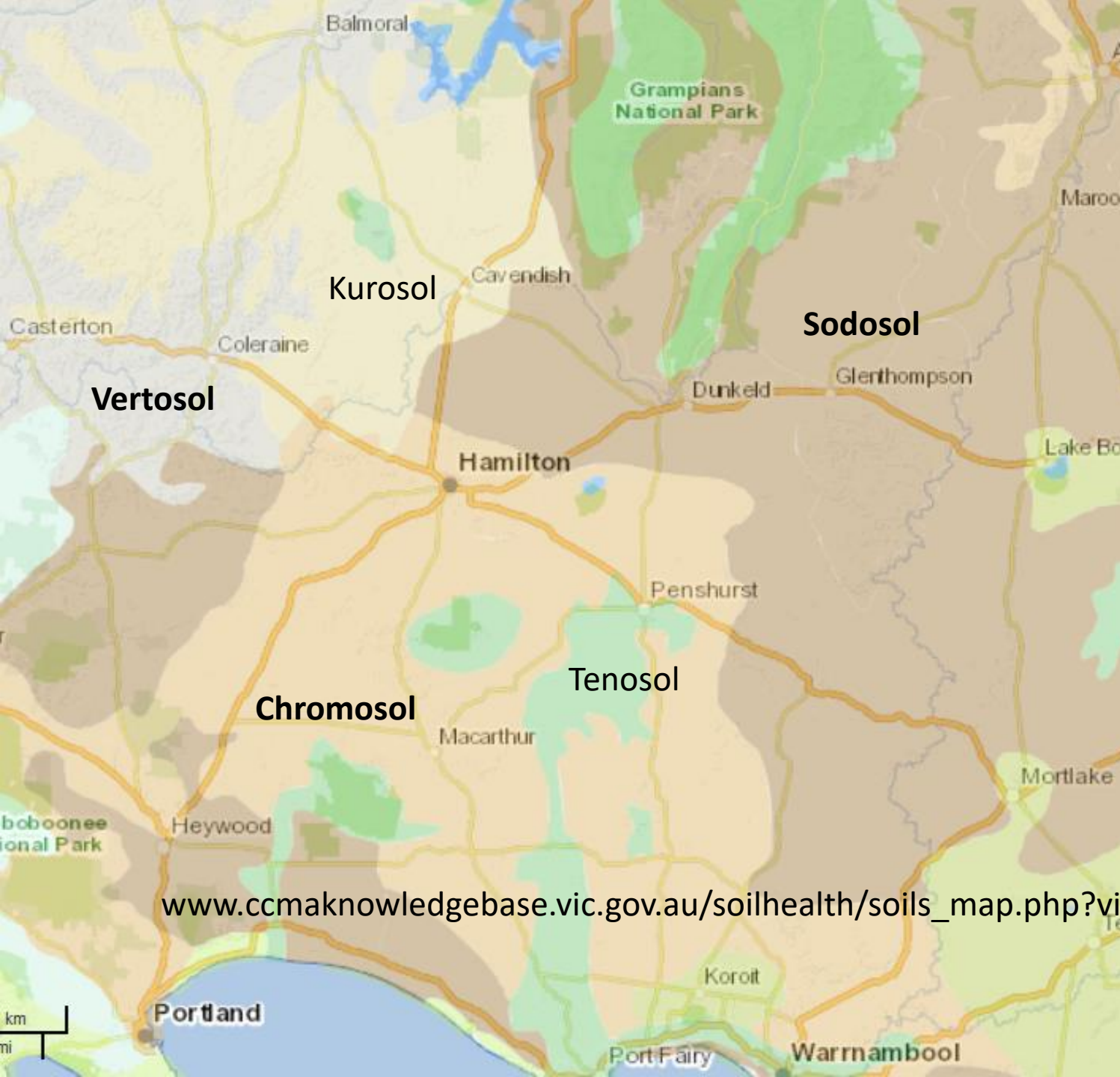
- Air spaces that occur naturally when the soil is at field capacity are replaced by water.



- **What influences the chances of waterlogging**
- **some local numbers**
- **what we might be able to do about it**

# 1. Where water is held in a soil





- ASC soil order
- Calcarosol
  - Chromosol
  - Dermosol
  - Ferrosol
  - Hydrosol
  - Kandosol
  - Kurosol
  - Lake
  - Organosol
  - Podosol
  - Rock
  - Rudosol
  - Sodosol
  - Tenosol
  - Vertosol

[www.ccmaknowledgebase.vic.gov.au/soilhealth/soils\\_map.php?view=14291\\_1df5ea5](http://www.ccmaknowledgebase.vic.gov.au/soilhealth/soils_map.php?view=14291_1df5ea5)

## Chromosols:

- texture contrast
- Surface texture ranges from loam to fine sandy loam
- clay subsoils not strongly acid (i.e. pH >5.5 in water) and are non-sodic.



## Sodosols:

- texture contrast
- Surface texture ranges from sandy loam to clay loam
- medium to heavy clay subsoils, not strongly acid (i.e. pH >5.5 in water) but (>6% ESP)



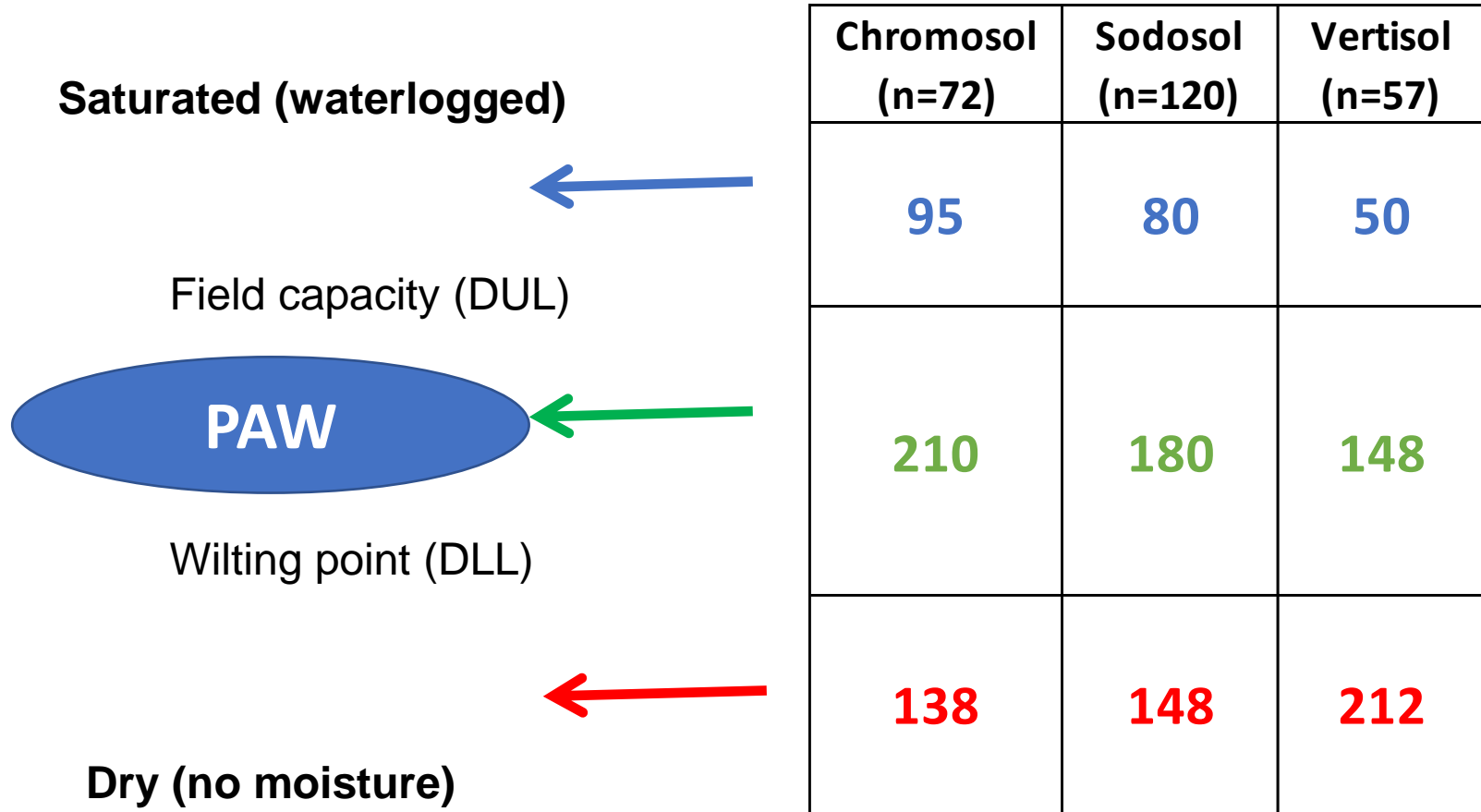
## Vertosols (cracking clays)

- Clay throughout the profile
- cracking clay soils (shrink and swell)



# 2. Water holding capacity of a soil (mm)

Data for SW Vic, using mean values and assuming 20 cm topsoil, 70 cm subsoil



Source: Soil data for productivity improvement. Abdur Rab, AgVic

# 3. Water infiltration rate of a soil (mm/hr) ( $K_{sat}$ )

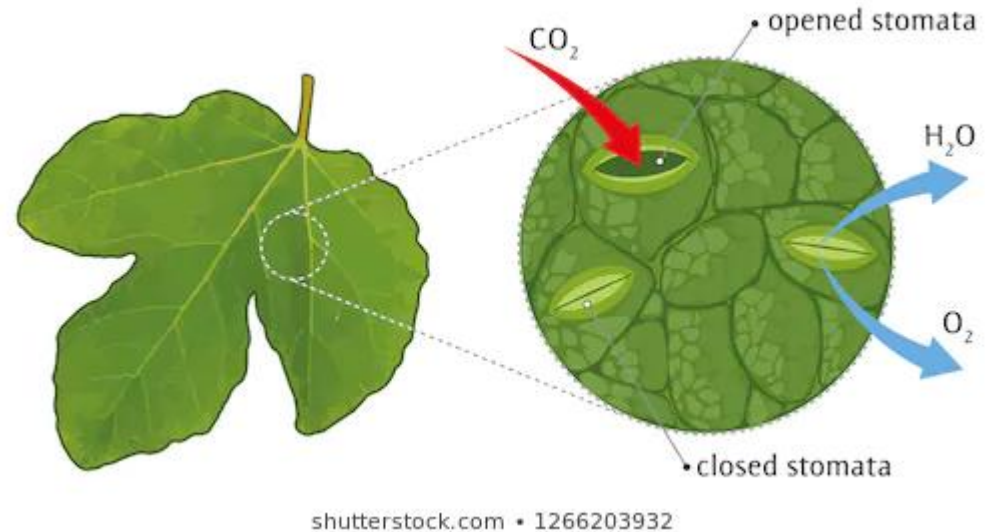
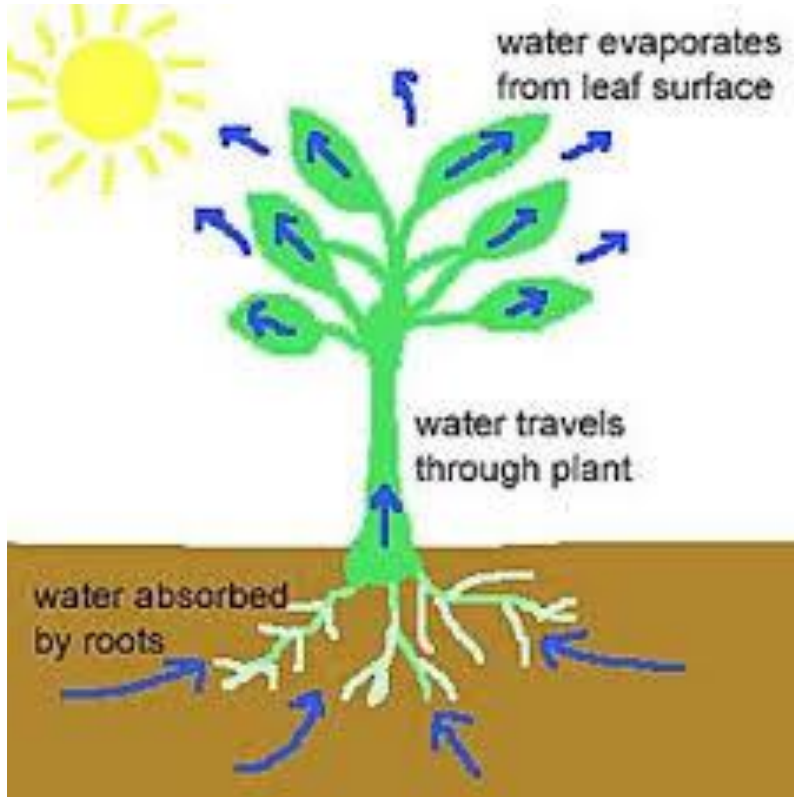
Data for SW Vic, topsoil infiltration at surface, subsoil at 20 to 30 cm



Soil type	Layer	Lowest 5% (mm/hr)	50% (mm/hr)	Highest 5% (mm/hr)
Chromosol (n=96)	Top	12	85	595
Sodosol (n=159)	Top	11	138	689
Vertisol (n=76)	Top	7	135	1576

Source: Soil data for productivity improvement. Abdur Rab, AgVic

# 4. Plant transpiration (mm/day)



Plant transpiration is a passive process.

The drier the atmosphere, the greater the 'pull' of water through the plants

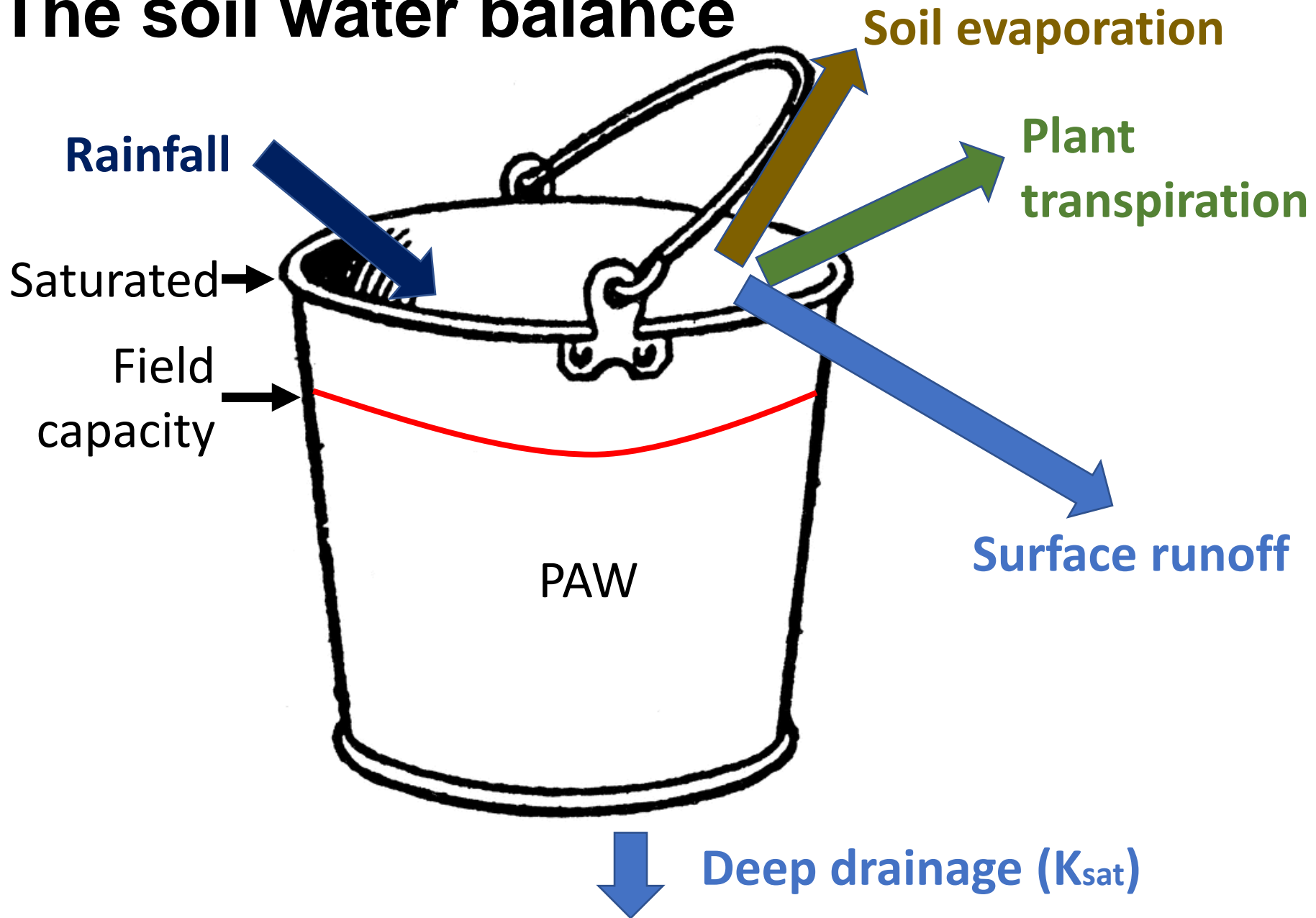
# 5. Evapotranspiration (mm/day)

Includes loss from soil surface evaporation and plant transpiration

Hamilton				Crop			
Pasture				Crop			
	Autumn	Winter	Spring		Autumn	Winter	Spring
Decile 1	100	151	164	Decile 1	51	126	206
Decile 5	150	231	246	Decile 5	94	220	246
Decile 9	202	287	304	Decile 9	160	286	308

PAW at start of autumn was on average 76 mm for pasture and 144 mm for crop

# The soil water balance

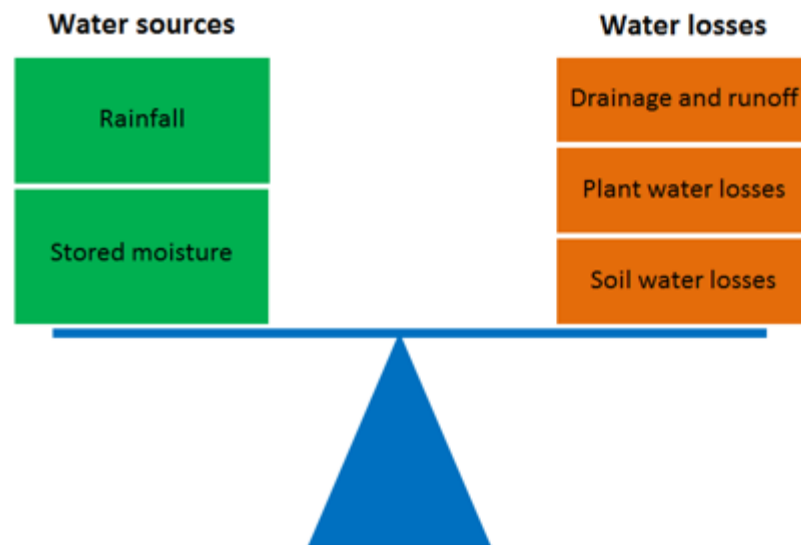


# Soil water and rainfall risk across southern Victoria

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## Soil water balance

In the soil water balance, inputs such as rainfall and irrigation, are counter-balanced by losses like drainage, runoff and evapotranspiration reducing soil water levels. Depending on the time of year, water losses or inputs will be different and the scales will tip back and forward as the profile accumulates water or is depleted



The extent to which the balance tips to-and-fro is determined by the capacity of the soil to hold water and seasonal factors such as rainfall and plant water use.

**There is a year-round competition of water supply and demand**

Source: Resource manual rainfall & SW probabilities 1960 to 2015

# The soil water balance (end of August)

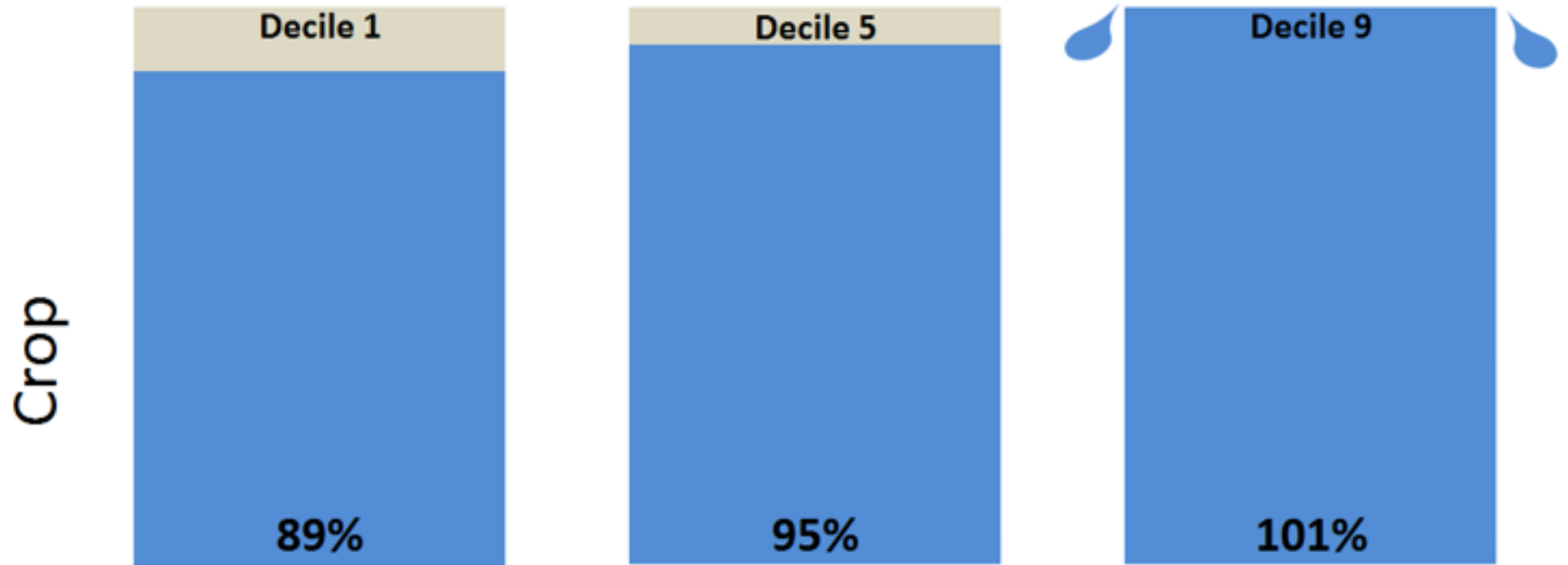
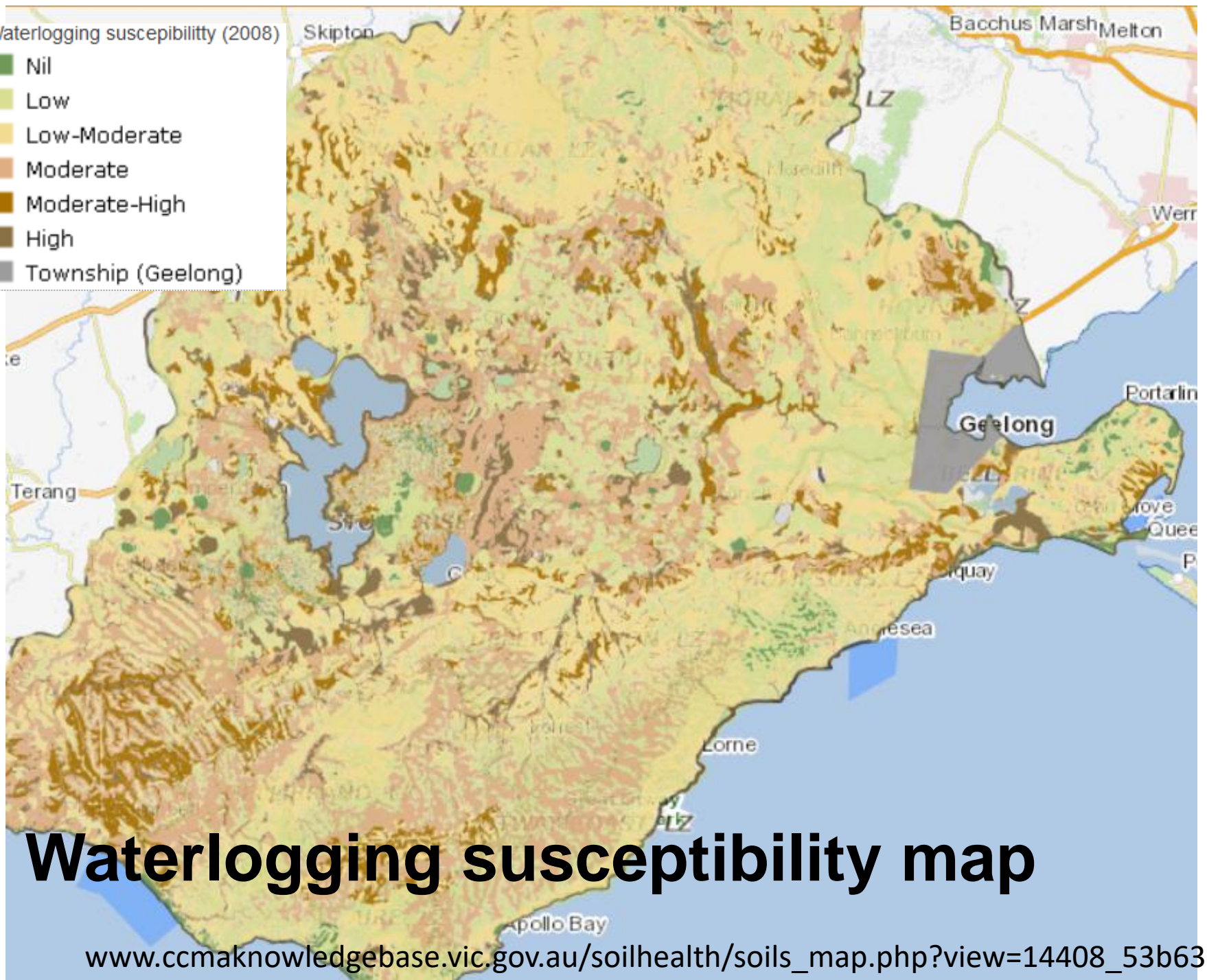


Figure 20. PAW at Hamilton in a decile 1 year (left), median year (centre) and decile 9 year (right).

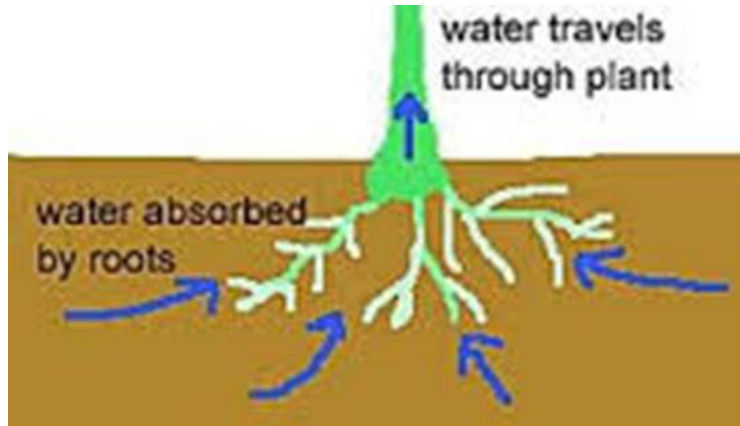
Waterlogging susceptibility (2008)

- Nil
- Low
- Low-Moderate
- Moderate
- Moderate-High
- High
- Township (Geelong)



# Waterlogging susceptibility map

# Impact of waterlogging



**Most plant roots require oxygen to take up water, nutrients and to grow**



# Impact of waterlogging

## When waterlogged:

- Nutrient uptake slows/stops
- Fine roots are pruned
- Nitrogen is lost (denitrification)
- Changed soil biota
- Soil strength declines



## Basalt soil pug when soil strength is:

- $<0.7$  MPa for dairy cattle
- $<0.4$  MPa for sheep

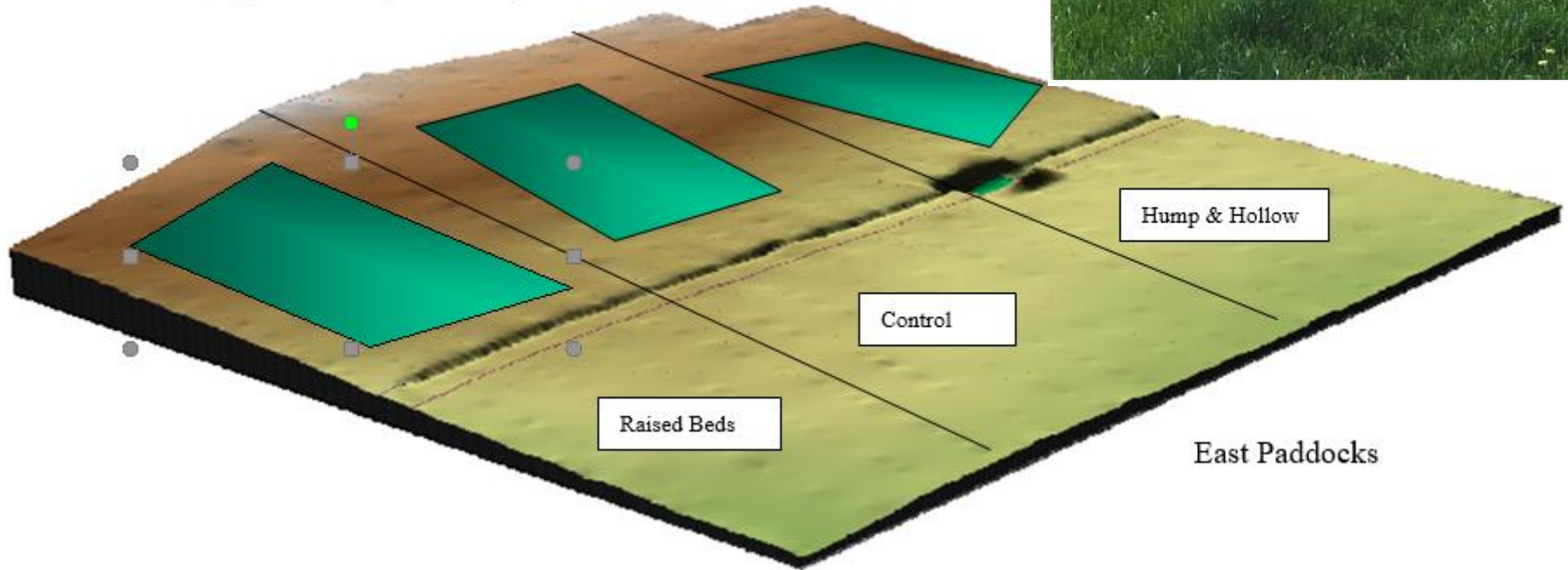
Source: Nie & Ward, 2001

# Impact of waterlogging

Darren Evans, Derrinallum (2007)

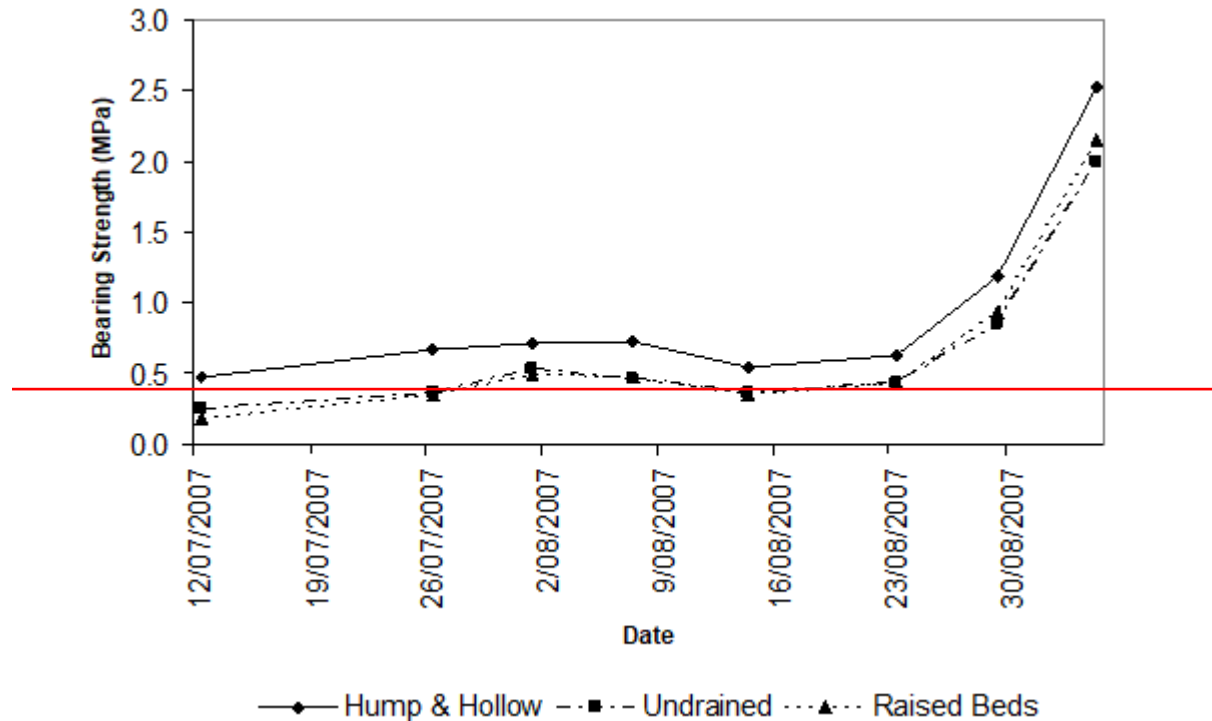


West (experimental paddocks)



- Abundant annual ryegrass (15 kg/ha) and Crusader Italian ryegrass (10 kg/ha)
- 634 mm rainfall (decile 8)

# Impact of waterlogging



2007	Runoff (mm)	P loss (kg/ha)	N loss (kg/ha)	Pugging depth (mm)	Pasture yield (t/ha)
Humps & hollows	26.7	0.4	2.1	12	11.71
Undrained	17.4	0.1	0.9	24.2	10.65
Raised beds	47.1	0.5	6.3	27.4	9.07

# Impact of waterlogging

Troy Missen (2010-2013)



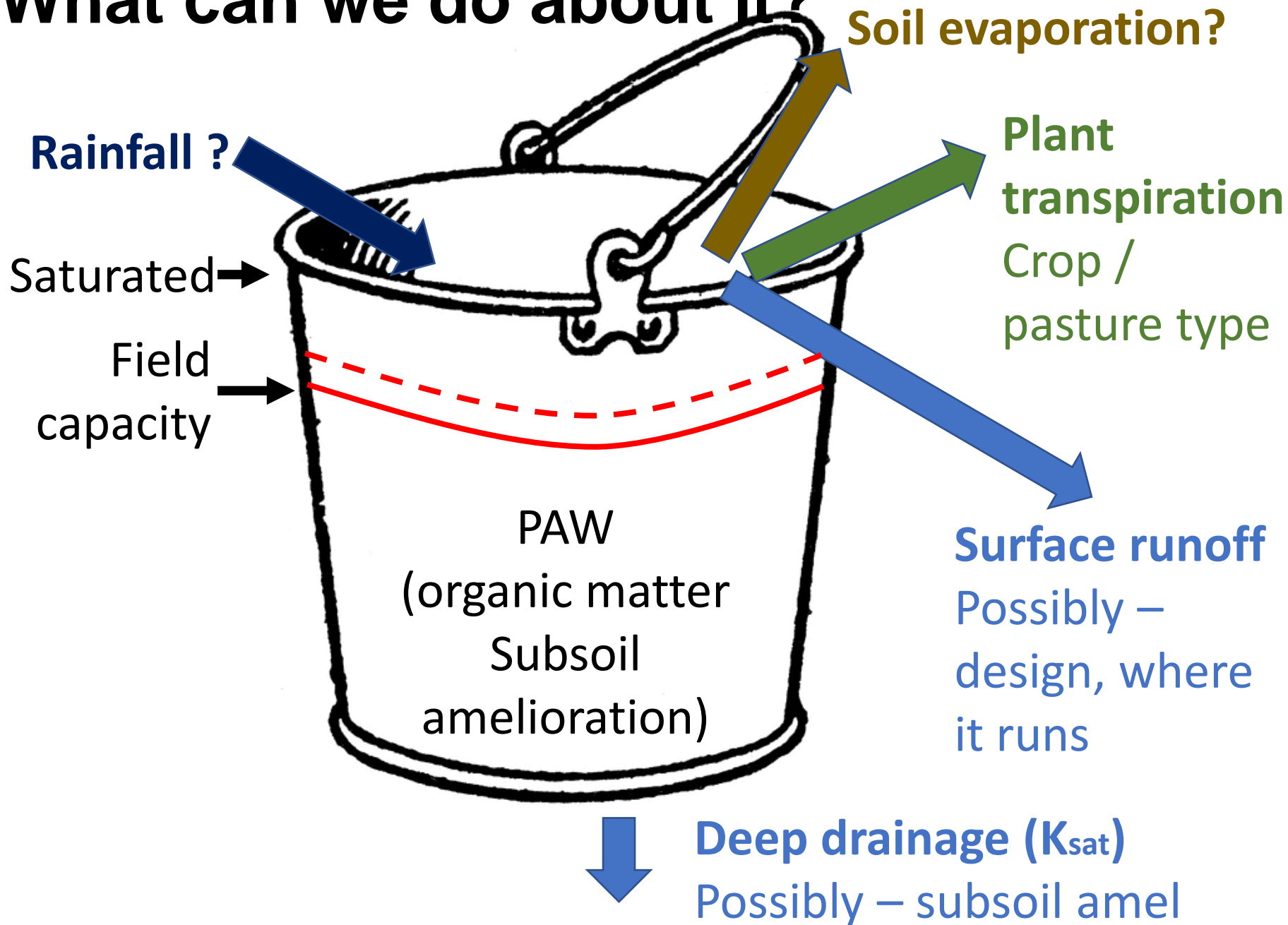
Saturated infiltration rates in July 2011 after winter grazing in August 2010.

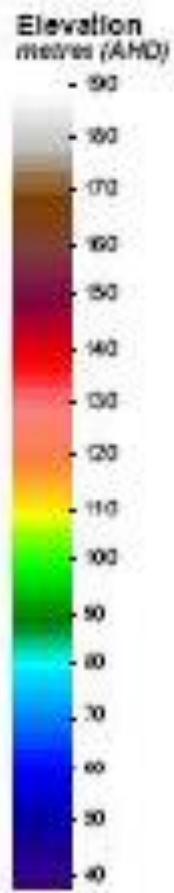
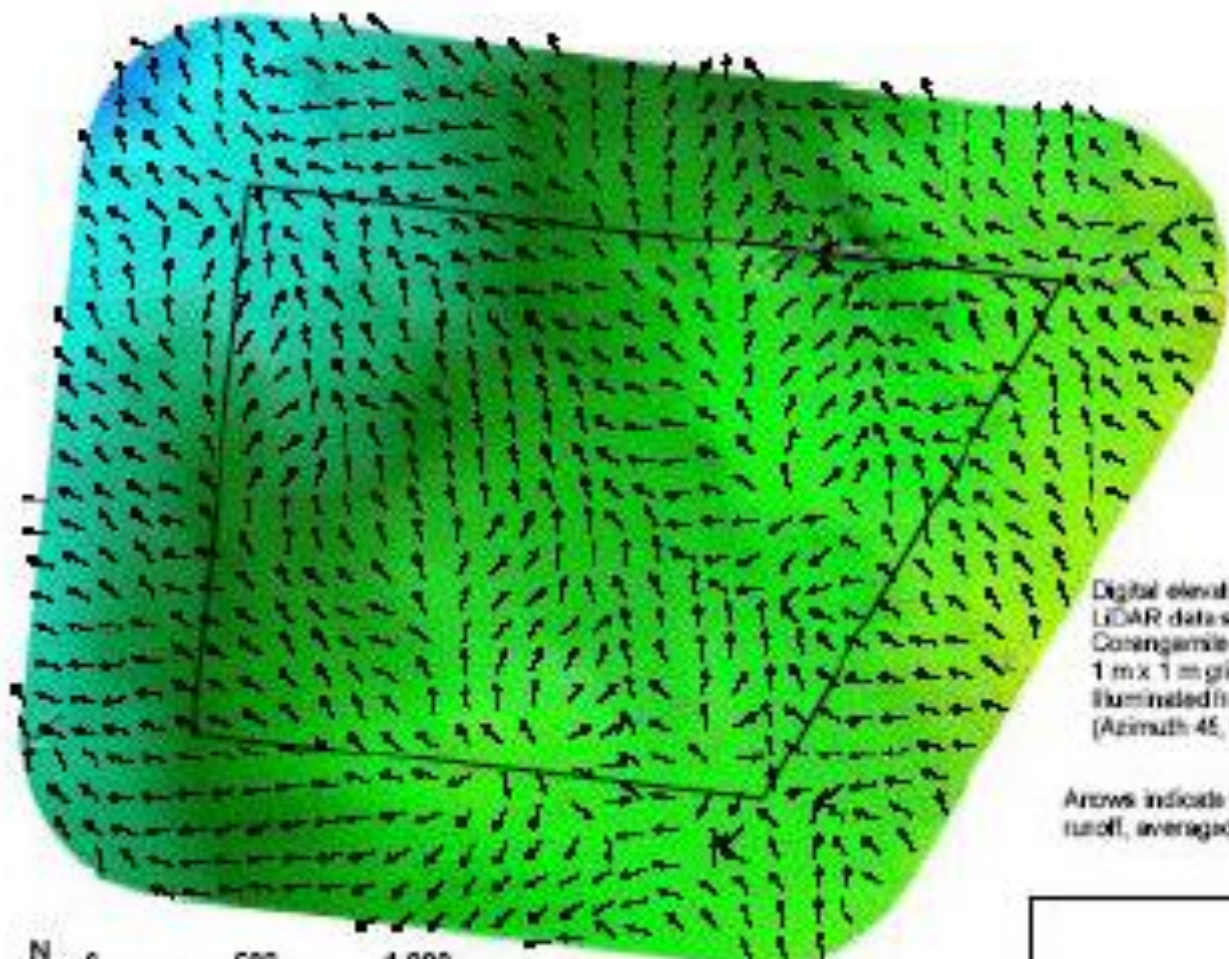
Core depth (cm)	Infiltration (cm/hr)		Significance
	No winter grazing	Winter grazing	
0 - 10	1.4	2.6	NS
10 - 20	1.4	0.7	NS
20 - 30	0.1	0.8	NS

Establishment of canola (2010), wheat (2011), barley (2012) and canola (2013).

Year	2010	2011	2012	2013
No grazing	40	79	236	57
Winter grazing only	33	88	239	55
LSD (p=0.05)	NS	NS	NS	NS

# What can we do about it?





Digital elevation model created using LIDAR data supplied by the Coonangmie CMA, 2004. 1 m x 1 m grid. Illuminated from the north east, (Azimuth 45, Inclination 45).

Arrows indicate the direction of runoff, averaged over each hectare.



Map projection:  
ABG Zone 55, AGD 1966  
Created by:  
Peter Dalrymple, July 2010

Water for Growth project  
Winchelsea - Inverleigh  
Property RBW

**Agriculture**

# Notes

**Managing wet soils: what are your best options?**

*David Hopkins, Colac*

February 2002  
AG0956  
ISSN 1329-8062



**Agriculture**

# Notes

**Managing wet soils: surface drainage**

*Frank Mickan, Ellinbank*

Updated: February 2006  
AG0946

ISSN 1329-8062  
Note Number: AG0946

Published: October 2005

Updated: July, 2006



**Agriculture**

# Notes

**Managing wet soils: grazing techniques**

*Frank Mickan, Ellinbank*

Updated: February 2006



**Agriculture**

# Notes

**Managing Wet Soils: Mole Drainage**

Updated: January 2006  
AG0944  
ISSN 1329-8062



**Agriculture**

# Notes

**Managing wet soils: renovation of damaged pastures and soils**

*Ashleigh Michael, Maffra and Graeme Ward, Warrnambool*



# In summary

## **The likelihood of waterlogging is a combination of:**

- Soil type (PAWC, above field capacity space, subsoil Ksat)
- Climate (rainfall  $V$  evapotranspiration)
- Surface topography (slope)

## **The impact of waterlogging depends on:**

- Plants being grown
- When livestock are grazed and what type (sheep, cattle)
- Soil biological activity

## **What we can do about it:**

- Avoid grazing / machinery at high risk times
- Surface drainage
- Improving soil characteristics (Ksat, bucket size)



THANK YOU FOR  
WATCHING THIS  
WEBINAR.

FOR MORE  
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