Irrigation Design Planning

Australian Government
Department of Agriculture, Fisheries and Forestry

Future Drought Fund

TAS FARM INNOVATION HUB

UNIVERSITY of TASMANIA
TIA
Tasmanian Institute of Agriculture

pinion ADVISORY

This program received funding from the Australian Government's Future Drought Fund.

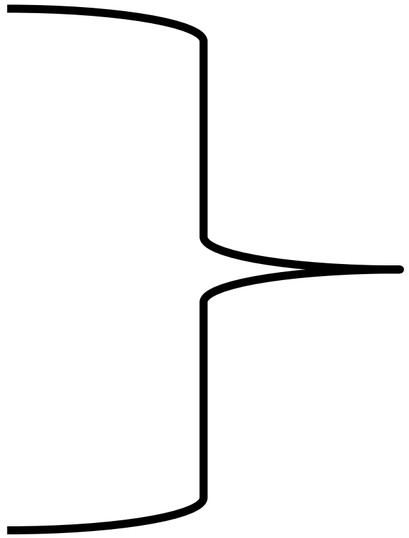
Natural resource management

1. Land suitability for irrigation
2. Land capability
3. Soils
4. Water balances

pinion ADVISORY

Land suitability for irrigation

- Is your land suitable for irrigation?
  - Topography
  - Soils
  - Drainage
  - Aspect
  - Exposure
  - Ease of cultivation



Land capability

  - Infrastructure considerations (power, pumping elevations etc….)

- Can we overcome and/or successfully manage these constraints

Land capability

- “The land capability classification is an interpretive classification based on the permanent biophysical characteristics of the land.”

- Based on a 1 to 7 rating:
  - Class 1 being land capable of supporting diverse and high frequency agricultural use.
  - Class 7 being land unsuitable for agricultural use.

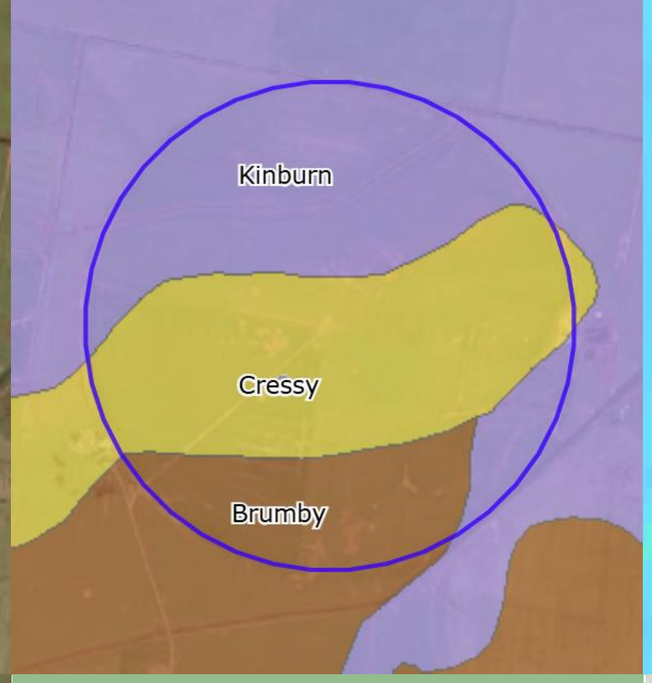
- The differences between land capability classes are based on:
  - Soil type and depth
  - Elevation
  - Slope
  - Drainage characteristics
  - Presence of rock and stone
  - Waterlogging and potential flooding issues
  - Erodibility (wind, water and mass movement)
  - Climate (rainfall, frost, heat units, chill hours)
  - Soil salinity

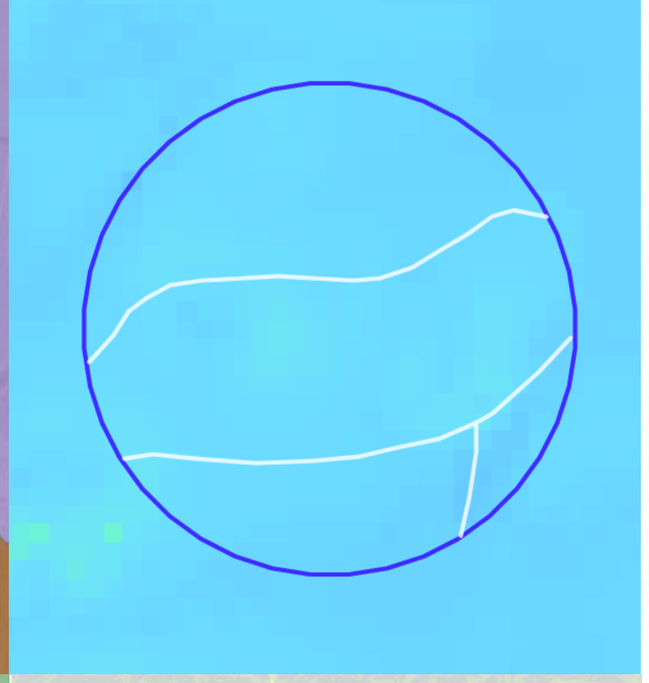
Land capability

Prime agricultural land

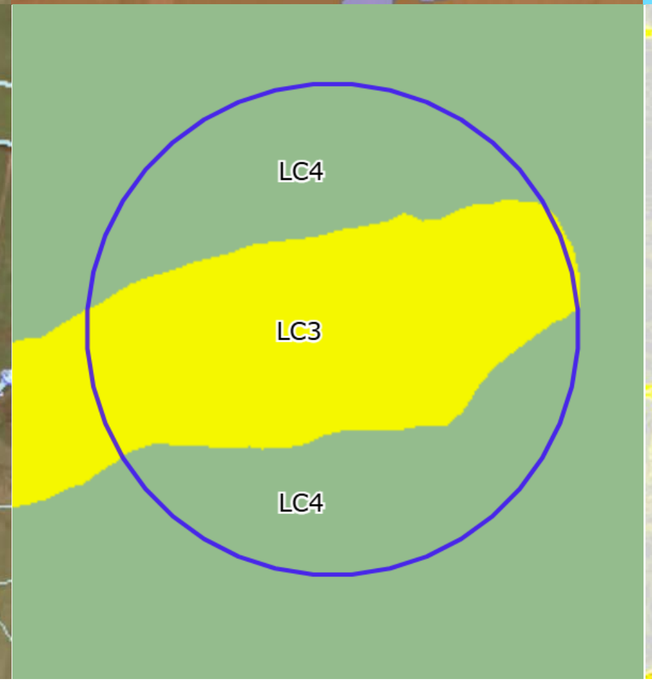
Land capability class		Limitations	Choice of crop	Frequency of cropping (per 10 years)	Conservation practices
1	Cropping	Very minor	Any	8 to 9	Very minor
2		Slight	Slight reduced	5 to 8	Minor
3		Medium	Reduced	3 to 5	Major
4		Severe	Restricted	1 to 2	Major and careful management
5	Pasture	Slight to moderate	Grazing*	-*	
6		Severe	Grazing	-	
7		Very severe to extreme	Nil or very minor agricultural value	-	

Grose C.J. (1999) Land Capability Handbook: Guidelines for the Classification of Agricultural Land in Tasmania. 2nd Edition, DPIWE, Tasmania.





Very poorly drained
Poorly drained
Imperfectly drained
Moderately well drained
Well drained
Rapidly well drained
Very rapidly well drained



Flat (0°)
Nearly Level (1°)
Gently Level (2°)
Gently Sloping (3° - 5°)
Strongly Sloping (6° - 10°)
Gently Steep (11° - 15°)
Moderately Steep (16° - 20°)
Steep (21° - 30°)
Steep (31° - 90°)

Land capability

- Land capability class directly influences the potential land use activity, land management actions, irrigation infrastructure, productivity and economic outcomes.

- Adopt practices which promote sustainable land use outcomes:
  - Appropriate balance between cropping and an extended pasture phases
  - Drainage (surface/sub-surface, cut-off and diversion drains, dealing with sodic subsoils, VRI)
  - Minimal tillage and don’t cultivate the subsoil
  - Correct irrigation scheduling
  - Correct soil fertility levels
  - Incorporate crop stubbles and green manure crops
  - Aeration

Soils

- Soils have unique properties when it comes to irrigation, such as moisture holding capacity, drainage and permeability and they determine the irrigation set up and scheduling.

Soil texture	RAW (mm/10cm)	Infiltration rate (mm/hr)	
		Average	Well structured
Sand	3	50	-
Sandy loam	7	20	45
Clay loam	8	20	40

(adapted from “Soil Heath for Farming in Tasmania”, Bill Cotching)

- Degraded soils and sloping ground would require a different approach to scheduling.
  - Typically, lower volumes of irrigation water applied on a more frequent basis.

Soils

- Consider a summer irrigation scheduling for a grass-based pasture (20cm root zone) on a sandy loam soil (RAW = 14mm/20cm) with a system set up to apply 15mm.

Month	Nov	Dec	Jan	Feb	Mar
Daily ET_0 (mm/day) (Northern midlands)	4-5	5-6	6-7	6-7	3-4
Irrigation frequency (days/15mm applied)	5-6	4-5	3-4	3-4	5-6

- Are we getting the pasture irrigation scheduling right?

Pasture species	Grazing Trigger	Rotation Length (days)	Pasture growth rate (kg DM/ha/day)
Ryegrass	2½ to 3 leaf stage or canopy closure	20-25	70-80
White clover	15-20cm height	25*	

Water balances

- A water balance is used to calculate an enterprises' irrigation water requirements.

- Driven by:
  - Rainfall (how much and when does it fall)
  - Evapotranspiration rates
  - Crop factor (a measure of a plants water use efficiency)
  - Can be corrected for best practice irrigation.

- For a single water source also consider other water uses, such as frost protection measures for vines, stockwater or dairy wash downs.

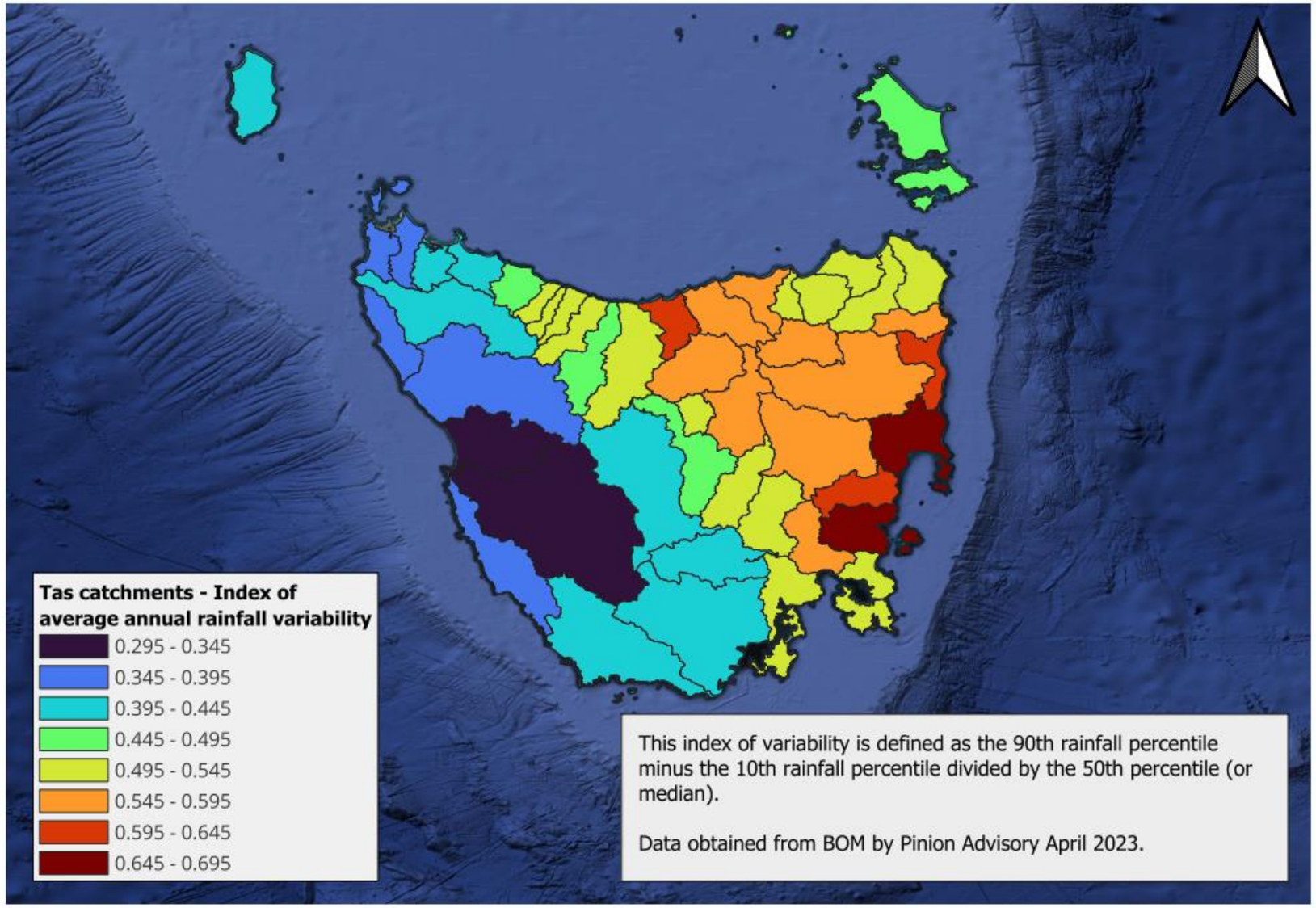
- Used to guide water purchases and/or entitlements and seasonal irrigation scheduling.

- Along with the land capability and soil type information used to determine the irrigation infrastructure design requirements, such as the sizing of dams, pipelines, pump, selection of pivots/travellers/solid set system and nozzle packs etc…

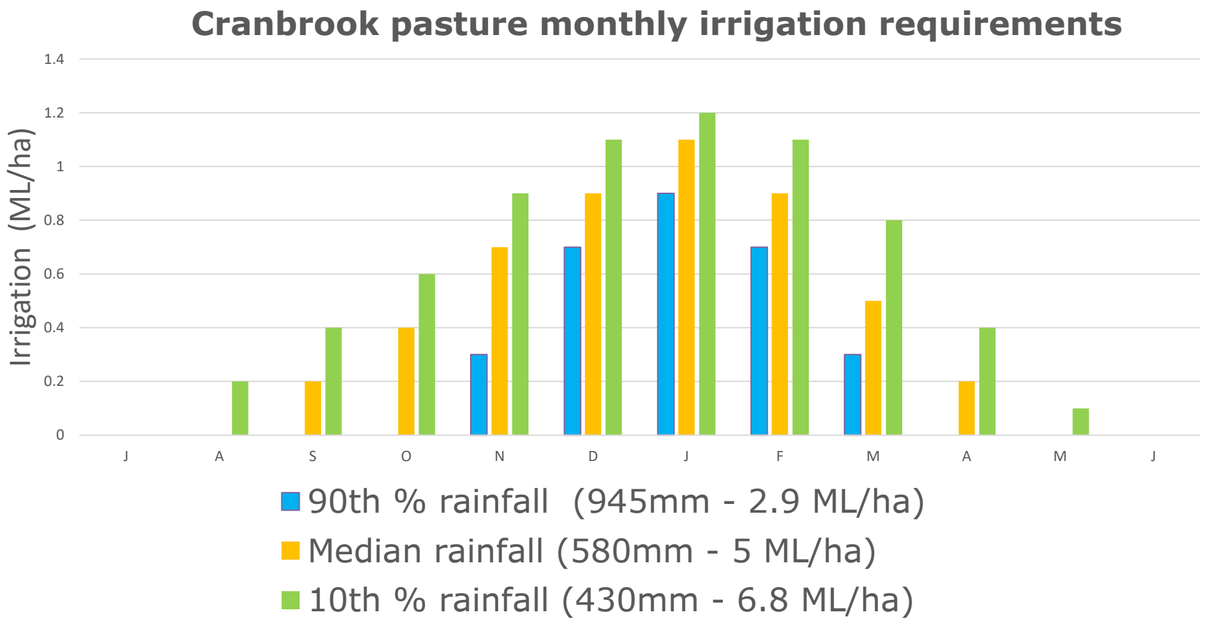
Water balances

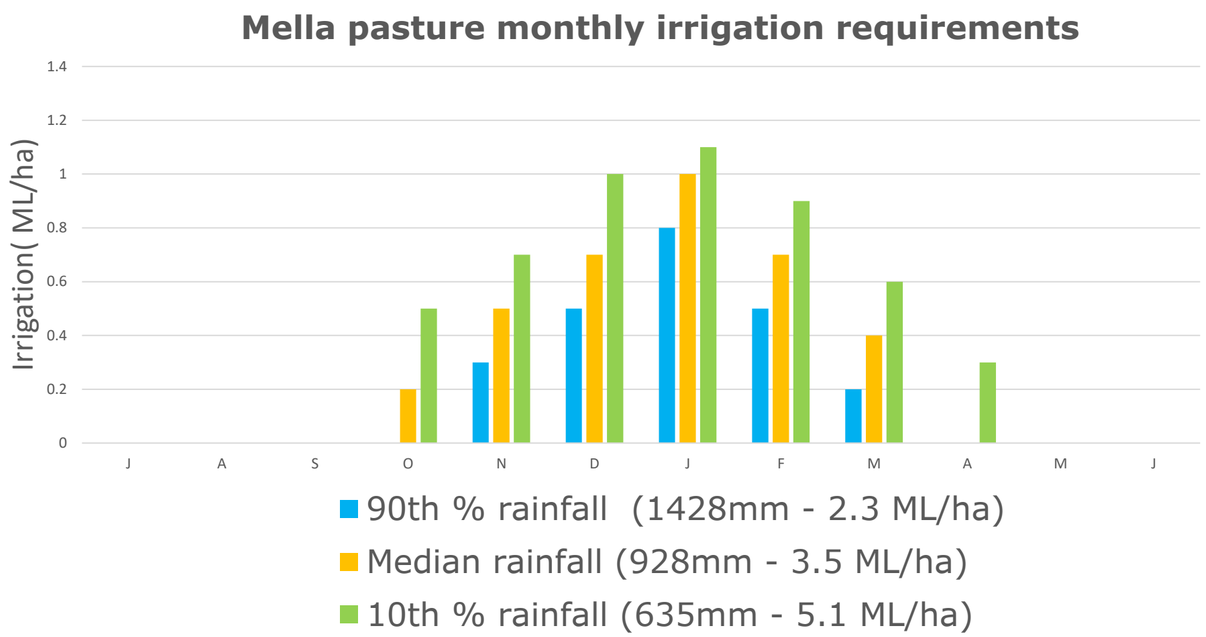
Median rainfall conditions	Climatic Data (mm)												
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	TOTAL
A: Evaporation (mm)	36	49	70	98	118	141	154	120	105	64	40	31	1025
B: Rainfall (mm)	39	42	42	48	37	43	45	37	35	48	50	51	578
C: Effective Rainfall (mm) (*C = B x 0.7*)	28	29	29	33	26	30	32	26	24	34	35	36	405
D: Monthly Deficit (mm) (*D = A - C*)	8	20	41	64	92	111	122	94	81	31	5	-5	620
Median rainfall conditions	**Estimated Water Requirement - Pasture (best practice management)**												
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	TOTAL
E: Crop Factor	0.4	0.5	0.7	0.75	0.85	0.9	0.9	0.9	0.85	0.75	0.65	0.5	
F: Estimate ET (*F = A x E*)	14.2	24.6	49.0	73.3	100.1	126.6	138.3	107.8	89.0	48.3	26.1	15.5	812.8
G: Irrigation Requirement (mm) (G = F - C)	0.0	0.0	20.0	40.0	74.4	96.7	106.8	81.7	64.8	14.7	0.0	0.0	499.0
H: Irrigation Requirement (ML/ha)	0.0	0.0	0.2	0.4	0.7	1.0	1.1	0.8	0.6	0.1	0.0	0.0	5.0

Water balances



Water balances





East coast
- A relatively even spread of rainfall throughout the year.
- 180-200 day irrigation season in a median rainfall year.

Far north west
- Winter/spring dominant rainfall pattern.
- 150-180 day irrigation season in a median rainfall year.

Where to from here?

- Get familiar with and use the LIST:

https://maps.thelist.tas.gov.au/listmap/app/list/map

https://www.youtube.com/watch?v=ETTZ6AcQI0

- Read Bill Cotching's "Soil health for farming in Tasmania" book:

https://figshare.utas.edu.au/articles/book/Soil_health_for_farming_in_Tasmania/23247812

- Tasmanian Soil Extension Program (soil fertility and land drainage guides):

https://nrmnorth.org.au/sustainableagriculture/tasmanian-soil-extension-program

- Climate data (rainfall, evapotranspiration, temperature, wind and humidity)

https://weatherwise.swansystems.com.au

- Farming Forecaster:

https://farmingforecaster.com.au/

THANK YOU

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