Farm Water Management Plan

Example Plan

Farm Water Management Planning

Know your numbers.
Know your needs.
Know the gap.
Have a plan.

Australian Government
Department of Agriculture, Fisheries and Forestry

Future Drought Fund

SOUTHERN NSW Innovation Hub
SUSTAINABLE AGRICULTURE, LANDSCAPES AND COMMUNITIES

Corowa District Landcare

Holbrook Landcare Network

RGA RICEGROWERS' ASSOC. of Australia Inc.

RIVERINE PLAINS

Western Murray Land Improvement Group

West Hume Landcare

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

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This table of contents is an outline of some of the steps and details required to be able to come up with a realistic Farm Water Management Plan. It is not meant to be laid out exactly, however it is important to cover the 'topics' listed and document your own information in enough detail so you can come back to this plan in the future and know what you were thinking and planning. (Items with '*' are considered essential in a Farm Water Management Plan document.)

		Checklist
Part I. Weathering the dry Introduction and Drought Strategy		
1. Introduction		
1A. Property details	4	✓ *
1B. What is the purpose of this plan? What do you want this plan to be able to do?	5	✓
1C. Farm Map	5	✓ *
2. Drought Strategy		
2A. Reflections on previous drought — learnings, lessons, what would you do differently?	6	✓
2B. What is your overall strategy in the event of an oncoming drought/dry season 'Drought Strategy'?	6	✓ *
1. Do you intend to retain all stock?	6	✓
2. If not, what classes and type of stock are you going to retain?	6	✓
3. What numbers of each stock class would you like to retain?	6	✓
4. How do you plan to manage those stock with regard to feeding/watering i.e. are you going to use a stock containment/management area or sacrifice paddock?	6	✓
2C. Trigger points for action prior to or during drought.	7	✓
1. At what point do you destock? (Table with timelines)	7	✓
2. What are the ground cover trigger thresholds?	7	✓
3. When are you doing your feed audit? — Feed On Offer (FOO) and stored	7	✓
Part II. Water metrics Understanding your water needs		
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1A. Livestock Requirements	9	✓ *
1B. Garden Water Requirements	9	✓ *
1C. Household Water Requirements	10	✓ *
1D. General Farm Needs	10	✓ *

This template is produced as part of the Murray LLS 'Farm Water Management Planning' project, supported by the Southern NSW Innovation Hub through funding from the Australian Government's Future Drought Fund.

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2C. Residual or 'dead' water	15	✓ *

Part IV. Know your flow Getting the water to where and when you need it **What are your options?** (Based on Parts I, II and III above.)		
1. How long will the water last over the 'summer period'?	16	✓
2. Checking supply flow rate and trough capacity	17	✓
3. Options and actions		
Planning: Take a 'big' picture approach to plan a whole system — it can be modular and rolled out sequentially	18	✓ *
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Part I.
Weathering the dry

Introduction and Drought Strategy

Farm Water Management Planning

1. Introduction

1A. Property details

Property name:	'Wandering Park'
Location:	Willafarm
Property size:	1500 ha
Annual median rainfall:	386 mm
Enterprises:	Fat lambs, beef and mixed cropping, autumn lambing with turn off in spring
Household residents:	4
Garden area:	0.3 ha

Livestock:	1000 dry ewes
	100 dry cows (beef cattle)
	10 grey kangaroos

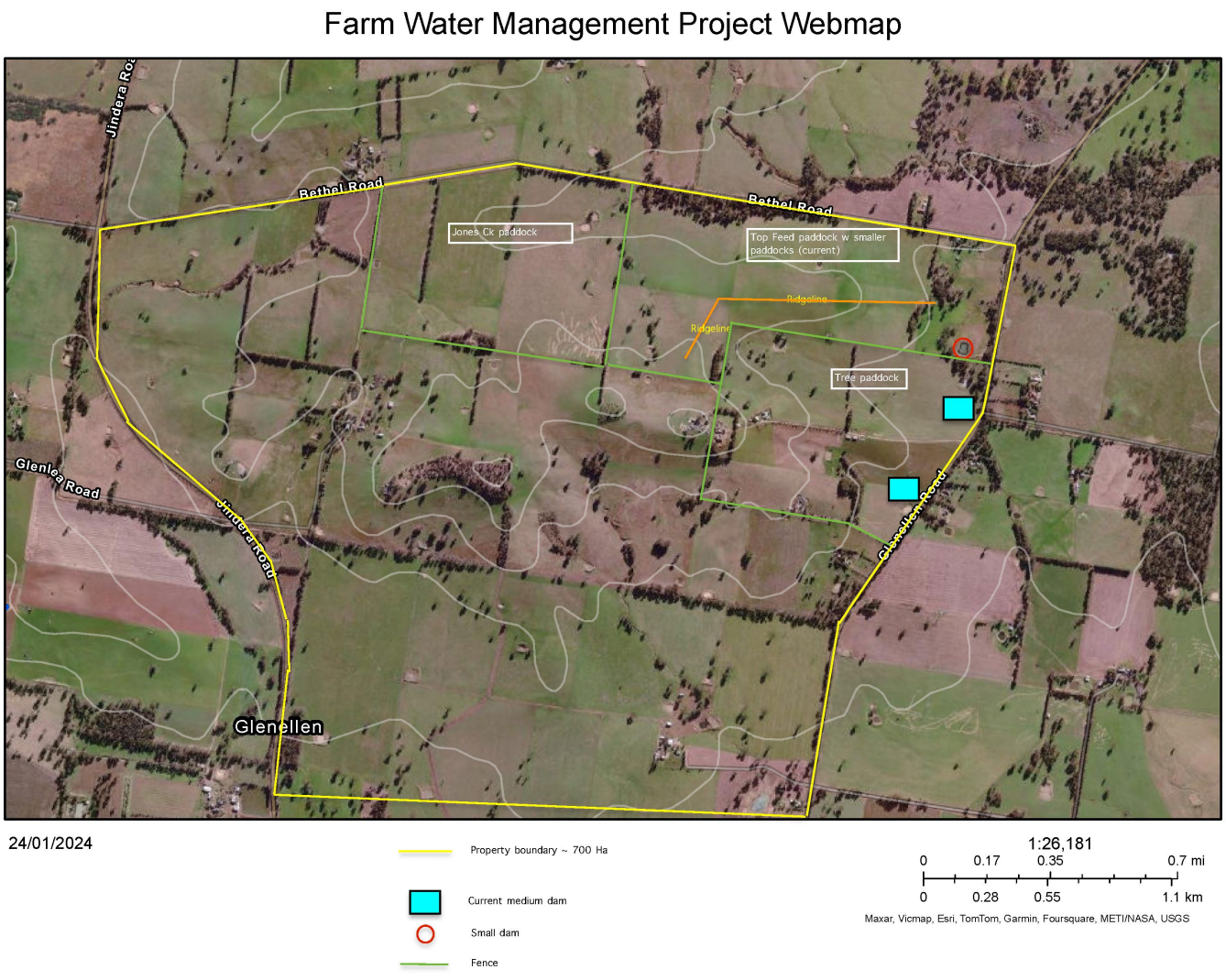
Crop:	120 ha wheat p.a.

House & shed tank:	3m dia. x 3.4m H x 2 tanks

1B. What is the purpose of this plan? What do you want this plan to be able to do?

This plan assesses the drought water requirements (2 yrs. worth) of our property and to calculate the storage capacity. I am very interested to be able to provide adequate supply of good quality water to where I need it on my property in dry times or droughts. I think it would be good to perhaps consider how I can provide water to a stock management area that I am going to set up.

1C. Farm Map



2. Drought Strategy

This will help dictate what actions you may need to take once you have done a Farm Water Budget/audit and determine the amount of water you will want to have on hand.

NOTE: (from 'Managing Drought' DPI publication) — p11. "Your drought strategy objectives should be clear and wherever possible be stated in numbers, dates or dollars." See also the '**Drought Plan – Template**' as a useful tool.

2A. Reflections on previous drought — learnings, lessons, what would you do differently?

In the last drought 2017-2020, the biggest problem we had was not enough water storage, so we ran out of water to keep the number of stock on the farm. This meant that we did not have adequate breeding stock after the drought broke and it has taken a good few years to recover and build our number up again. We had to destock and cart water for those that we kept. Dams were not a good way to water stock so after the first couple of times we went to an improvised tank and trough system. A lot of mucking about and very time consuming.

We had reasonable fodder reserves on hand (good quality pasture hay and silage) though still had to buy in some feed. Feed was not the issue, water was.

2B. What is your overall strategy in the event of an oncoming drought/dry season 'Drought Strategy'?

1. **Do you intend to retain all stock?**

Our overall strategy for if we get a dry season emerging or onset of drought is to destock earlier and aim to retain core breeding animals.

2. **If not, what classes and type of stock are you going to retain?**

See response below in #3.

3. **What numbers of each stock class would you like to retain?**

We would prioritise our breeding cattle and a large proportion of the sheep flock and turn off all store/finished animals. Ultimately, we would look to initially reduce to 60% stocking rate this is about 60 cattle and 750 sheep.

4. **How do you plan to manage those stock with regard to feeding/watering i.e. are you going to use a stock containment/management area or sacrifice paddock?**

As said above, we would like to ensure adequate supply for this number of stock to get us through two seasons at least (more perhaps if we need/ can build a bigger storage). We would like to have a dedicated area to manage and feed stock, either a sacrifice area or management area.

2C. Trigger points for action prior to or during drought.

1. **At what point do you destock?** (Table with timelines)

See below

2. **What are the ground cover trigger thresholds?**

We are hoping to maintain 70% ground cover and that cover needs to be of a certain height/ bulk. Obviously as time goes by it will disappear, however we don't want to get into the situation of the dust blowing away and the fundamental capital of our farm, the soil, heading to the neighbours or to Victoria.

If we can assess it, we would look to have a minimum ~700 kg DM/ha at the beginning of our 'putting the drought plan into action'.

Our plan would go something like this, based on a drier than normal winter and spring – (example adapted from AWI 'Managing sheep in Droughtlots – A best Practice Guide' Case study #4 page 16):

- *Start of August – assess spring progress. If < average, early turn off of culls and any held over weaners/ hoggets. Cull any dry animals.*
- *1st Sept – assess season – if possible, cut silage/hay. Draught off cull ewes/cows and sell. Accept market price. Plan feed requirements for next 8 months – consider locking in a feed contract. Assess cattle feed available and sell any trade animals that are ready (do not be greedy – if in doubt, sell).*
- *1st Oct – Assess season. Potentially start introducing wheat rations. Ensure all feed out gear is operating properly. Ensure water supplies are operating. If not already done, do feed test on all feed on hand.*
- *1st November – If no improved outlook, start moving sheep to containment/ management pens.*

3. **When are you doing your feed audit? — Feed On Offer (FOO) and stored**

We are not so sure how to do this adequately as yet however we have started using feed quality testing and worked with a livestock officer to do simple calculations of what our feed needs are. We have attended a 'Containment Area Feed Calculation workshop and that has helped immensely in knowing how much feed we require.

Part II.
Water metrics

Understanding your water needs

Farm Water Management Planning

Farm water budget/audit

Total supply and demand from Table 9 and Table 10.

'Annual' TOTAL Farm 'drought' Water Budget — Based on 181 days of 'summer period' calculations	
Drought stocking	1000 ewes with lambs and 100 beef cattle

Storage source	Available storage (ML)	Total demand from each source (ML)	Weeks of water available (at rates of consumption)	Years of storage at drought stocking rates
Dams	4.42 ML	4.71 ML		
Domestic & other tanks	0.05 ML	0.35 ML		
Totals:	4.47 ML	5.06 ML	0	0.0

It is highly desirable in planning your farm water needs to have 2 years supply on hand.

Whether you have 'adequate supply', or a 'deficit' is calculated by:

Adequate/deficit = Total available storage (ML) – (2 x total annual demand) (ML)

Total available storage (ML)	Total annual demand (ML)	Total demand for 2 years (ML)	Supply - demand	Adequate (+ve) or deficit (-ve) (ML)
4.47 ML	5.06 ML	2 x 5.06 = 10.1 ML	4.47 – 10.1	–5.6 ML

1. Quantifying Farm Water Requirements

1A. Livestock Requirements

How much water does the livestock use in summer (October to March – 181 days)?
(Refer to Farm Water AgGuide Appendix 3, Table 27, p.125)

Total daily water requirement (L) = daily requirement per head (L) x number of stock

Table 1 Livestock Water Requirements

Livestock type	Number	Daily water requirement (L)	No. days in summer	Total water required for summer (L)
Dry ewes	1000	10	181	1,810,000 (1.81 ML)
Beef cattle	100	98	181	1,773,800 (1.77 ML)
Kangaroo	10	1	181	1,810 (0.018 ML)
Total livestock requirement:				3,585,610 (3.6 ML)

1B. Garden Water Requirements

How much water does the garden use in summer?
Range 10,000–30,000 L/ha/day (1-3 L/m², Farm Water AgGuide Table 11, p.16)

Total water required = area (Ha) x daily required (L) x No. summer days

Table 2 Garden Water Requirements

Example garden area (Ha)	Daily water requirement (L/Ha)	No. days in summer	Total water required for summer (L)
0.3	20,000	181	1,086,000 (1.086 ML)

1C. Household Water Requirements

How much water does the household use in summer?
(Refer to Farm Water AgGuide Tables 11, 12, p.16)

Table 3 Household Water Requirements

Example household		Daily water requirement (L/person)	No. days	Total water required for summer (L)
No. residents:	4	180	365	262,800 (0.26 ML)
Evaporative air con		500	181	90,500 (0.09 ML)
Other				
Total:				353,300 (0.35 ML)

1D. General Farm Needs

(Refer to Farm Water AgGuide Table 17, p.24)
Spraying – e.g. first application requires 100 L/ha, second application requires 70 L/Ha.

Table 4 Spraying Water Requirements

	Application rate (L/Ha)	Crop Area (Ha)	Total water required per application (L)
Spray 1	100	120	12,000
Spray 2	70	120	8,400
Total:			20,400 L (0.02 ML)

Firefighting – 10 000 L/Ha home yard. See Farm Water AgGuide Table 17, p.24.

Table 5 Firefighting Water Requirements

Firefighting	Recommended storage rate or L/area	Home yard area (Ha)	Total water to store (L)
Buildings	10,000	x 2	20,000
House yard	17 L/m^2	0.3 (3000m^2)	Included in above for this example only
Total:			20,000 L

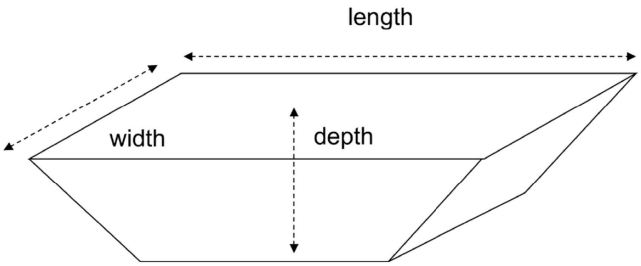
Part III.
From drop to data
Determining water storage capacity and losses — dams and tanks

Farm Water Management Planning

Rectangular Dam

Calculate the capacity of the rectangular dam:

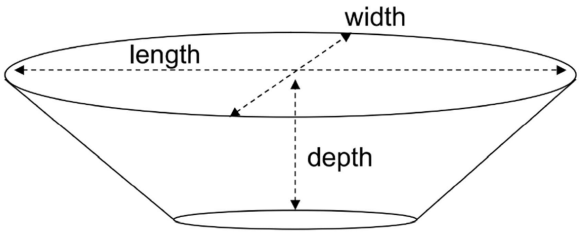
- ***Surface area (m²) = width × length***
- ***Volume (m³) = 0.4 × surface area × depth***



Circular Dam

Calculate the capacity of the round dam:

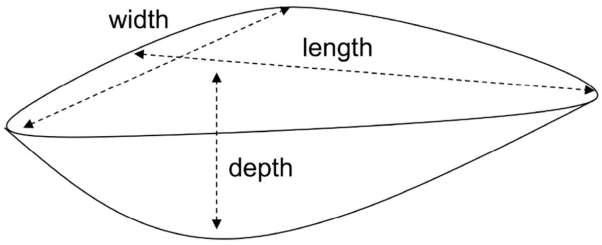
- ***Surface area (m²) = 0.8 × width × length***
- ***Volume (m³) = 0.4 × surface area × depth***



Triangular Dam (or gully dam)

Calculate the capacity of the triangular dam:

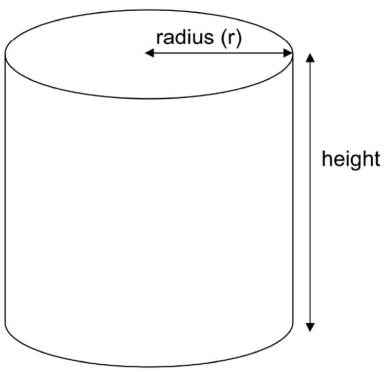
- ***Surface area (m²) = (width x length) ÷ 2***
- ***Volume (m³) = 0.4 × surface area × depth***



Estimating Tank Capacity

Calculate the capacity of the tanks:

- ***Surface area (m²) = π × r²***
  (π = 3.14, r² = r × r, where 'r' = radius)
- ***Volume (m³) = π r² × height***



1. Estimating Farm Water Storage Capacity

Table 6A Example farm dams

Water storage name	Width (m)	Length (m)	Depth (m)	Surface area (m²)	Approx volume (m³)	Water storage capacity (ML)
Dam 1 – square	35	35	3	1,225	1,470	1.47
Dam 2 – gully	25	45	4	562.5	900	0.9
Dam 3 – round	40	40	4	1,280	2,048	2.05
Other water storage:						
Total water storage:						4.42 ML

Table 6B Example farm tanks

Tank storage name	Radius (m)	Height (m)		Surface area (m²)	Approx volume (m³)	Water storage capacity (ML)
Tank 1	1.5	3.4		7.1	24	0.024
Tank 2	1.5	3.4		7.1	24	0.024
Other tank storage:						
Total tank storage:						0.048 ML
Total water and tank storage:						4.47 ML

2. Quantifying Losses from Dams

2A. Example Evaporation Loss

Your location: Deniliquin	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mean daily evaporation (mm)	9.6	8.8	6.6	3.9	2.0	1.3	1.3	2.0	3.3	5.2	7.5	9.2
Decile 1 monthly drought rainfall (mm)	1.5	0.5	0.8	2.5	6.9	12.3	9.2	9.2	10.5	9.7	4.4	2.4

Note: Data can be sourced from:

Bureau of Meteorology or nearest weather station.

From the table above, determine the average (mean) daily summer evaporation (mm) in your location

Average daily summer evaporation = (sum daily mm for October to March) ÷ 6

Average daily summer evaporation = 46.9 mm ÷ 6 = 7.8 mm/day

Average summer drought rainfall = 19.3 mm for months October to March

Average daily drought rainfall = 19.3 mm ÷ 181 = 0.11 mm/day

Net daily drought evaporation = 7.8 - 0.11 = 7.7 mm/day

In Table 7A below, calculate the summer evaporation loss using this formula:

Evaporation loss (L) = surface area (m²) × (average daily evaporation (mm) - average daily drought rain) × no. days

Table 7A Example farm dam evaporation

Dam	Surface area (m²) (from Table 6)	No. days	Daily evaporation – daily rain (mm)	Total evaporation loss (L)
Dam 1 – square	1,225	181	7.7	1,707,283
Dam 2 – rectangle	563	181	7.7	784,653
Dam 3 – round	1,280	181	7.7	1,783,936
Total:				4,275,872 L

2B. Seepage Loss

Estimate the seepage loss from the dams over summer.

Note: Seepage loss will depend on the material on which a dam is located and built and the quality of construction. Maximum acceptable loss is 5 mm/day — if your losses are above this, the dam needs attention.

In Table 7 below, calculate the summer seepage loss in L using this formula:

Seepage loss (L) = surface area (m²) × seepage (mm) × no. days

Table 7B Example farm dam seepage
Assumed seepage rate for this activity: 1 mm per day

Dam	Surface area (m²) (from Table 6)	No. days	Summer seepage (mm)	Summer seepage loss (L)
Dam 1 – square	1,225	181	181	221,725
Dam 2 – rectangle	563	181	181	101,903
Dam 3 – round	1,280	181	181	231,680
Total:				555,308 L

2C. Residual or 'dead' water

Sometimes a portion of water in a dam cannot be retrieved. This is referred to as residual or 'dead' water.

In Table 8, estimate the residual water in the dams.

Table 8 Example residual water

Dam	Total volume (m³) (from Table 6)	Residual water (%)	Residual water (m³)	Residual water (L)
Dam 1 – square	1,470	5%	73.5	73,500
Dam 2 – rectangle	900	5%	45	45,000
Dam 3 – round	2,048	5%	102.4	102,400
Total:				220,900 L

Part IV.
Know your flow

Getting the water to where and when you need it

What are your options? (Based on Parts I, II and III above.)

Farm Water Management Planning

1. How long will the water last over the 'summer period'?

Table 9

Water usage over summer		Example farm	
No. of days in summer		181	**A**
Livestock	(Table 1)	3,585,110	
Garden	(Table 2)	1,086,000	
Household	(Table 3)	353,300	
General farm needs	(Table 4)	20,400	
Firefighting	(Table 5)	20,000	
Total summer usage:		5,064,810 L	**B**
Daily summer water consumption:	(B ÷ A)	27,982 L	**C**

Table 10

Total storage capacity (Litres)	(Table 6)	4,470,000 L	**D**
Less evaporation losses	(Table 7A)	4,275,872	**E**
Less estimated seepage losses	(Table 7B)	555,308	**F**
Less residual water	(Table 8)	220,900	**G**
Available water:	(D - E - F - G)	-582,080 L	**H**
Days water will last:	(H ÷ C)	0	

2. Checking supply flow rate and trough capacity

Water must be supplied at least at the rate of stock and domestic usage. This sets the minimum flow rate that the pump and the pipework have to deliver. For our calculations, it is considered advisable to ensure all stock can be watered in a 4 hr (240 min) period. This allows for a fast steady stream of water for stock, and reduces the chances of fighting and dominance around troughs that can cause damage — i.e. broken valves, pipes kicked etc. The system needs to be able to meet this peak flow.

(Refer to Farm Water AgGuide Table 21, p.96)

Table 11

Peak flow rate for 4 hr watering (L/ min)					Trough capacity (L)	
Stock type	**Number of stock**	**Daily intake (L/head)**	**Total daily requirement (L)**	**Flow rate required (L/min)**	**Volume (L/head)**	**Trough capacity required (L)**
	A	B	A × B = C	C ÷ 240 min	D	A × D
Dry Ewes	1000	10	10,000	42	1	1,000
Dry cows (beef)	100	98	9,800	41	5	500
Total:			19,800 L	83 L/min		1,500 L

3. Options and actions

Planning: Take a 'big' picture approach to plan a whole system — it can be modular and rolled out sequentially.

We have a deficit to reach 2 years of storage capacity. For us this is a reasonable period to aim for initially. This deficit is 5.6 ML i.e. 5,600,000 litres.

At this point in time, we are focussed on setting up a 'drought' management system. As we have several key dams across the property, we will be able to set up a few systems. However, working on the eastern part of the property nearer to the house will be the first system set up. In this area there are well vegetated creek lines, and good catchment.

The calculations for harvestable rights (from the Water NSW site calculator) on our 1500-ha property in our location (eastern zone) indicates we have up to 67.5 ML dam storage capacity. As such we have ample room for new storages or enlarging old ones.

Options:

1. a. Increase size of two current dams (in 'Tree' paddock) as location is good and it seems the location would work for efficient management of stock in drought times. These dams currently hold around 3 ML, and we would anticipate enlarging to hold around 5-6ML each depending on assessment. (= increase of ~5ML?)

b. Fence out the dams (use 'Enhanced Dams' guides from ANU) to protect water quality and prevent stock entering. Potentially 1 x hardened access for 'holiday' back up in case of pump and tank failure.

c. Install pump to move water to productive paddocks ('Top Feed' – already in 3 sections) over a small ridge approx. 55 m head). This would involve the install of a pump and big tank (50-150,000 L?) and troughs. This system would service both 'Top Feed' and 'Tree' paddocks.

2. a. Install new dam in 'Jones CK' paddock as this only has a small one on a minor gully. Previously this paddock was watered from a small creek that was reasonably reliable but dried up last drought. It seems there is good runoff area for flow to be collected in a big dam (don't know why this wasn't set up years ago?). New dam size ~5-8 ML (increase overall capacity of ~6-7ML?)

b. Fence out this new dam and get ground cover going to protect dam from silting and get good water quality.

c. Install pump and medium size tank (to allow for a few days' supply) and troughs.

d. This is a big paddock, so probably divide into 3 and install troughs (2-3 per paddock).

e. Retain small old dam as back up.

3. Part of the overall plan would be to establish a stock management area so that before conditions get tight, we can protect ground cover and prevent erosion and damage. The location of this area of XXX ha with water supplied to troughs. It would make sense to locate this near or in 'Tree' paddock and perhaps need to install additional tank on ridge for gravity feed from water pumped from enlarged dams (see 1 above).

Options continued:

4. Note: One of the areas in 'Jones' could be classed as an 'erosion control dam' so it is possible this may not contribute to our harvestable rights allocation, however we need to check on any conditions around this. But given we have up to 67 ML, this issue may not be required at the moment.

5. In any of these above options we will investigate installing remote monitoring for the tanks and pump operation. This is particularly the case for the tank holding water from 'Tree' paddock and servicing the 'Top Feed' paddock. Also, this would be good to do for 'Jones' as it is further from the house and not as easily monitored.

6. **General:**

    a. With any of the pump, tank and trough set ups, we will need to ensure that correct pipe diameters are used to make sure 'peak flow' can be maintained, especially in scenarios where cattle will be in the paddocks.

    b. Where tanks are plumbed, we will use a 2-outlet system, where there will be one outlet halfway up the tanks and another at the base. The primary outlet will be the halfway outlet. This is a safeguard in case of leaks in the system and protects half the storage capacity of those tanks.

Financial options:

The final costing for the proposed works is considerable. We are in a reasonably solid financial position; however, it makes sense to take advantage of the low interest loans outlined by the Rural Financial Counsellor.

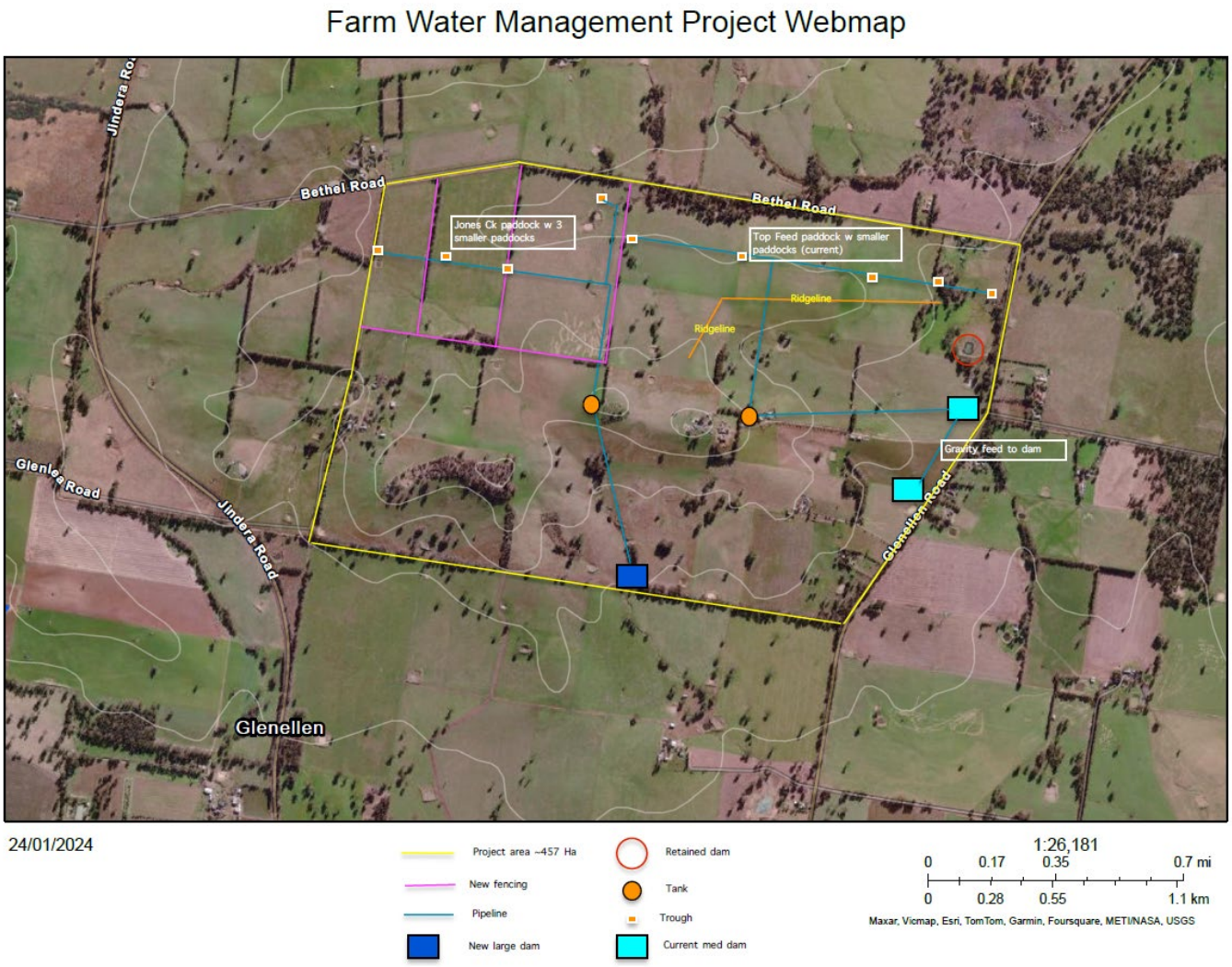
In particular, the 'Drought Infrastructure Fund' loan that is a 2.5% fixed interest and up to $1 million over 20 years. Our initial estimate would be our first section of the system could cost around $80,000–$110,000. The addition of extra 'modules' to secure water supply for additional areas of the farm could also be undertaken once we have completed and perhaps learnt from the first section. Costs estimates include:

Estimated costings example

Item	Per-item cost $	Total cost $
Dam construction	12,500	25,000
2x large (150-200,000L) tanks	20,000	40,000 (installed)
Fencing and gates	@ ~ $10/m + install	10,000
Blue Line 2"m polly	3000m =	10,000
15 concrete troughs	@ ~ 1000	15,000
Fittings and joiners		2,000
Pipe installation – DIY or contractor		$???
Remote monitoring for tanks x 2	3000	6,000
Solar pumps and panels		~ 12,000

Farm map with options set out:

Insert map with layout of proposed options – new dams, enlarged/ renovated dams, note actions on existing redundant dams (left open for backup, 'wet-land etc), likely route of pipes, location of pumps, tanks and troughs. Indicate where any new fencing may go.



Next steps:

a. Get final design specifications – get Willafarm 'Irrigation and Pump Supplies' Phillip to help finalise technical specs for pumps, pipes etc.

b. Get dam construction & renovation quote from Greg Jones Excavation and Earth Moving – local dam builder with good reputation.

c. Contact Rural Financial Counsellor to assist with loan application.

d. Discuss finances with the accountant to ensure serviceability and the best way to structure loans and decide how much – full or part funding.