

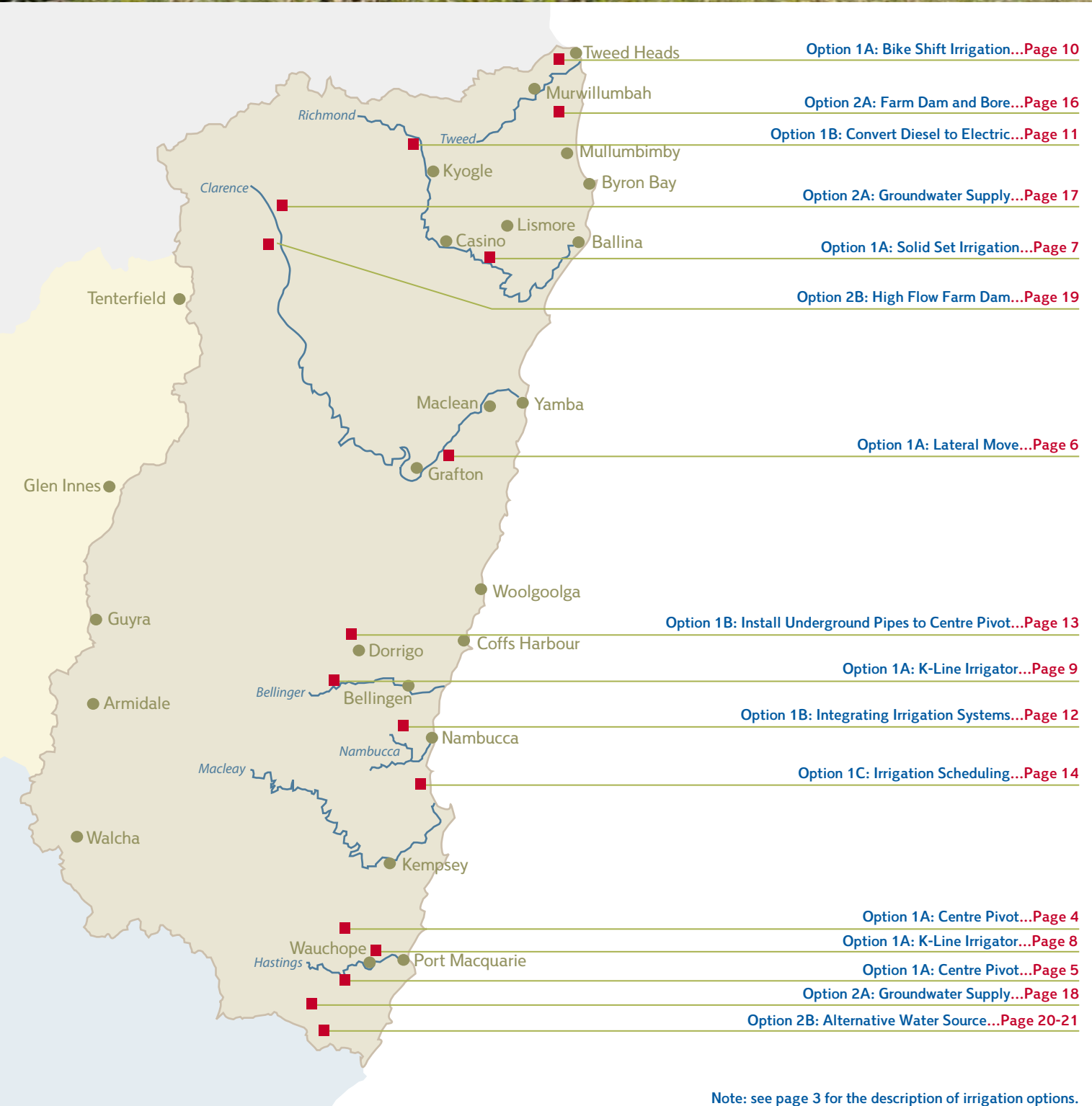
Irrigators

Caring for the rivers



Case studies of projects by farmers to improve their irrigation and adapt to water plans and climate variability

Project locations



Note: see page 3 for the description of irrigation options.

About the project



From left: Gary Creighton (Senior Irrigation Officer, NSW DPI), Dr Judy Henderson (Chair, NRCMA), Robin and Ayleen Dawes (landholders) and Ian Simpson (NRCMA Water Themes) discuss the Dawes' Irrigation and Drainage Management Plan.

Since 2001, irrigators in the Northern Rivers region have had to maintain their businesses with lower than normal river flows and with water sharing plans being developed which they feel may further impact on their ability to access irrigation water.

The Northern Rivers Catchment Management Authority (NRCMA), in conjunction with NSW Department of Primary Industries (NSW DPI), recognised that, if it was to achieve the environmental objectives of the water plans, irrigators would need to adapt their businesses.

The NRCMA Catchment Action Plan targets include W4 – Aquifer Health and River Flows; with its aim being to ensure that extractions are kept at or below a sustainable level, and environmental flows are protected and enhanced where necessary.

To achieve this target, the NRCMA recognised that encouraging efficient and productive use of water sources, and supporting the development and implementation of water sharing plans, would be important. It also acknowledged the importance for water users to be able to adapt to the potential impacts of climate variability and change. Accordingly, a program was developed to support some demonstration irrigation developments that improved irrigation efficiency, and reduced the irrigator's dependence on unreliable low flows in the river.

This booklet presents an overview of some of these projects. It explores how effective they have been and how the irrigators involved feel about their goals and achievements.

Water Sharing Plans

NSW commenced a program of developing water sharing plans with the main objectives being to protect the river ecosystems, provide for town and private water supply, and to provide a more secure business environment for irrigators and other commercial extractors. Prior to this program, protection of environmental flows was piecemeal and relied on agreements between the Government water management agency and the irrigators. Many rivers had no protection and in dry conditions, the rivers could become almost completely dry.



The water sharing plans are putting into place a level of protection which is commensurate with the balance between extractive use of the water and protection of the ecosystem assets. In highly stressed streams where competition between irrigators for the available water occurs, rules are being developed to ensure that the water that is available above the environmental requirements is equitably shared.

The likely impact of these plans in highly stressed areas is that access to water may be more restricted than at present, and with some periods of no access at all.

Climate Variability

For around six years prior to 2007, NSW has been in the grip of an ongoing drought. While the North Coast region is not as badly hit as other areas in the state, it, too, has had some severe reductions of flow in the rivers. Whether this is due to natural long term cycles of drier periods, or is an early sign of climate change is hard to say, but there is no doubt that successful irrigators will have to be able to operate in this environment.



Drought conditions



High tide at Dorrigo, October 2004

Climate change scenarios for this region suggest that our rainfall may remain similar to present norms, but that it may come as monsoonal storms with long dry spells between. If so, this will mean longer periods of low flow in the rivers.

On the North Coast, irrigation is used to supplement natural rainfall, and the ongoing dry period means the more irrigation water is required at exactly the same time that river flows are falling!

Finance

Several of the participants accessed finance through the NSW Rural Assistance Authority Special Conservation loan. This funding source is specifically targeted at works which increase irrigation efficiency and have an environmental benefit. It is a low interest loan with no extra charges available to primary producers.

Approval is based on your ability to repay and it is important to note that this scheme is not aimed at drought relief.

Profitability is important. For more information about the scheme contact the Rural Assistance Authority at Orange. Phone 02 6391 3000. Web www.raa.nsw.gov.au

The Project Group

Calls for expressions of interest were made publicly and by letter, and criteria for selection developed.



All participants had completed some form of irrigation training, often the "Introduction to Irrigation Management course", and all said it was this acquired knowledge that helped them decide on appropriate actions. Many had also attended a workshop on improving irrigation security.

Another requirement was evidence of some form of integrated planning to demonstrate that the proposed action would yield the benefits expected. This was necessary to justify the investment of NRCMA funds in these activities. It is hard to justify investment of public funds if there is no plan. A well developed plan also helps with funding applications to finance houses.

What options are available?

The two basic options that are available to irrigators are to:

1. Increase irrigation efficiency as much as possible



This means that for a given amount of water, farmers can maximise their returns whilst minimising water needs; yet satisfying plant demands. This reduces operating costs, minimises storage volumes, thus reducing the costs and impacts of dams. This can be done by:

- A. Replacing older systems with more efficient irrigation systems
- B. Upgrading existing systems to increase their efficiency, and also to increase the ability to manage them more efficiently
- C. Scheduling the irrigation to apply the right amount of water at the right time to best meet the crops needs with minimum wastage or crop stress

Always remember that an irrigation system is only as efficient as the management used to operate it. There is no value in spending large amounts of money on a centre pivot system if you don't use its ability to apply the right amount of water when the crop needs it.

“a good driver in a Mini will do better than a bad driver in a Ferrari!”

This means that developing a scheduling system to know when and how much water to supply is critical to good irrigation management. Too much too often increases costs, causes crop loss through water logging and reduces the area you can irrigate with a volume of water. It may also add to groundwater problems and loss of fertiliser through leaching and runoff.

Too little too late reduces crop production leading to less return for your investment.

“Right amount, right time”

2. Reduce dependence on low flows by seeking alternate water supplies or by extracting when flows are high



Alternatives may include:

- A. Groundwater, catchment fed dams, stormwater runoff, treated effluent
- B. Building a storage which can be filled from high flows when water sources are not stressed. This water can be used when river access is restricted.

3. A third option may be to modify the balance of farm enterprise to reduce the dependence on river flows



For example, a dairy farmer might consider growing maize silage which can grow in the wet season with more rainfall input. This might be used to reduce the dependence on irrigated pasture.

These options may be used in concert, especially as improving water use efficiency reduces the costs of other options.

Pappinbarra via Wauchope

Option 1A: improved irrigation efficiency, new irrigation infrastructure

Landholders	Mick and Irene Carle
Water source	Pappinbarra Creek (high stress); Hastings River Catchment
Enterprise	185 dairy cows
Licence allocation	196 ML
Irrigated area (this project)	18 hectares
Project cost	\$101,500

The project

Mick and Irene wanted to replace the old travelling irrigators with a higher efficiency, lower labour, centre pivot and a K-line system to fill in the additional areas.

The benefits

- Labour and time saving – it took nearly all day to move three travellers, so irrigation was a full time job; the new system takes $\frac{3}{4}$ hour twice a day.
- Mick has far better management over the application rates – he knows that he can apply 5 – 6mm/day to meet crop demand.

Landholders' experience

Why did they do it?

“The old irrigation system was too time consuming – I needed to have a better system which took less time to operate and would let me spend more time on other farm activities.”



Irene Carle checking the control unit for the centre pivot, allowing for adjustment of water volume.

What is the best thing about the project?

“The pasture responds better to the improved irrigation management now possible and I have time to look after the rest of the farm.”

What was the most difficult aspect of the project?

“Getting the finance organised was difficult.”

Would you recommend this to others?

“Yes - make sure the K-line system is carefully planned and operated and that you fully understand the optimum management of the whole irrigation system.”



Farm walk on Mick Carle's property to look at the centre pivot.

Brombin via Wauchope

Option 1A: improved irrigation efficiency, more efficient irrigation system

Landholders	Leo, Susan and Luke Cleary
Water source	Middle Hastings River (high stress)
Enterprise	270 dairy cows. Construction of a new dairy will expand up to 300 within 12 months
Licence allocation	453 ML
Irrigated area (this project)	102 hectares
Project cost	\$168,410

The project

Leo needed to upgrade his irrigation efficiency by replacing the old travelling irrigator with a centre pivot and some bike shift and solid set to cover all his pastures.

The benefits

- Improved water use efficiency and uniformity of application
- Ability to apply low rates of irrigation if required by scheduling to meet crop demand and anticipated storm events
- Reduced labour and management (previous travelling irrigator system was very labour intensive compared to the centre pivot)
- Reduced wastage from leakage

Landholders' experience

Why did they do it?

- To improve the management and as a labour saving - "I can now apply as low as 6mm over the area in 16 hours with the flick of a button. The travelling irrigator was limited to applying more than 25mm and would take 5 days to do that. This gives more flexibility!"
- The system is more water efficient - in keeping with community expectations - and it allows us to manage water usage when restrictions are in place on the river.

What is the best thing about the project?

"This system allows me to apply smaller quantities of water and adjust for changes in climate conditions thus taking advantage of rainfall and avoiding over watering. The old travellers couldn't do this!"



Special foot valve and screen that allows operation in shallow water without sucking air. The device incorporates radial vanes which prevent the inflowing water spinning and developing a vortex.



Installing the mainline and the controls and power line to the central pylon.

What was the most difficult aspect of the project?

"Finalising the decision to invest, and making sure the surface drainage wouldn't limit production under the new system, was difficult."

Would you recommend this to others?

"Yes – for the dairy industry this greatly improves the grazing and water management. The operation is now simple and leaves time for other farming activities."

Swan Creek, near Grafton

Option 1A: improved irrigation efficiency, new irrigation infrastructure

Landholders	Cedric (Ric) and Patricia Green
Water source	Swan Creek (medium stress); Clarence River Catchment
Enterprise	Dairying, currently milking 120 head
Licence allocation	430 ML
Irrigated area (this project)	72 hectares
Project cost	\$78,100

The project

Ric wanted to replace the expensive to operate, inefficient travelling irrigator with an 170 metre long lateral move system.

The benefits

- Improved water use efficiency and uniformity of application.
- Ability to apply low rates of irrigation if required by scheduling to meet crop demand and anticipated storm events.
- Reduced labour and management (previous irrigation supply was portable aluminium pipes to traveller guns).
- Reduced leakage, especially in the old portable mainline.



The control panel which allows Ric to set different irrigation rates as well as control direction of travel.

Landholders' experience

Why did they do it?

- Energy saving – “The old travellers were high pressure, high cost and difficult to operate in windy conditions. The lateral move is low pressure and much better in windy conditions; there is a good saving in costs”.
- Labour saving – “I used to have to move the irrigators four or five times in each irrigation plot; there is only one move for each plot now”.
- The system is more water efficient - in keeping with community expectations.



Ric Green with the lateral move irrigator. Beside him is the guide wheel which runs along a furrow cut in the ground to keep the irrigator on line. The control panel behind him allows him to set different irrigation rates as well as control direction of travel. Each tower has its own built in jack which makes swinging the wheels around to allow end towing very easy.

What is the best thing about the project?

“This system enables me to apply smaller quantities of water when rain is possible, avoiding over watering. The old travellers were not able to do this and storms after irrigation frequently led to crop water-logging.”

What was the most difficult aspect of the project?

“The biggest challenge was deciding the best system for my operation and farm. There are lots of different units available. I also had to plan how to deal with a flood on the area.”

Would you recommend this to others?

“Yes – The new irrigation system gives me more options for other irrigated ventures.”

Option 1A: increase irrigation efficiency, more efficient irrigation system

Landholders	Robyn Chappell
Water source	Richmond Tidal Pool; Richmond River catchment
Enterprise	440 cow dairy
Licence allocation	109 ML
Irrigated area (this project)	28 hectares
Project cost	\$135,000 (some funding from RAA Community Environment Fund)

The project

To make her workload more manageable and to increase water use efficiency, Robyn wanted to replace the hard hose travelling irrigator with an automated solid set system on the pastures further from the dairy.

The benefits

- Reduced labour and management.
- Improved irrigation management, better matching pasture needs.
- Increased water use efficiency and uniformity of application.
- Reduced demand on the water source.
- Higher productivity for water extracted from the river.
- Reduced operating cost.



Skid mounted electric pump unit which can be moved out of flood zone.



Electric control valves on mainline and laterals.

Landholders' experience

Why did they do it?

- Since the purchase of the neighbouring property, Robyn needed to reduce the labour component of irrigation so she could manage it without increased labour.
- She needed to ensure the system is simple to operate and maintain

What is the best thing about the project?

"I can sleep through the night now, with the automation turning off the irrigation at the right time, and I have saved labour, time, water and money. It has reduced my operating costs by 25%."

What was the most difficult aspect of the project?

"It was hard to commit to the costs with the current dairy industry outlook; and determining what had to be done by whom and to what standard was difficult."

Would you recommend this to others?

"Yes – this system is much better than the previous irrigator, however you need to be careful not to over commit financially."



Movable pump installation on river bank.



Robyn Chappell inspects her new irrigation system.

Wauchope

Option 1A: increase efficiency, more efficient irrigation system

Landholders	Chris and Anne Eggert, Eggert Agripartnership
Water source	Hastings River, near Wauchope
Enterprise	Certified organic dairy, milking up to 500
Licence allocation	69 ML
Irrigated area (this project)	Up to 32 hectares of alluvial flats
Project cost	\$91,750

The project

Chris wanted to make the irrigation easier and more efficient by replacing the travelling irrigator with a towable K-line system.

The benefits

- Greater coverage of pasture due to flexibility of system.
- Reduced application rate and greater control of volume applied.
- More effective use of rainfall events since appropriate volumes of water can be applied to allow for probable rainfall events and 'top up' after a light rainfall event.
- Fewer problems with townspeople complaining about my irrigation.
- Improved and easier maintenance – time and cost.
- Greater control over irrigation application and uniformity.
- Lower labour costs.



Chris Eggert with a pod on the K-Line irrigation system.

Landholders' experience

Why did they do it?

- Location close to town – aesthetics and poor local perceptions of irrigation efficiency.
- Improved water use efficiency.
- Lower labour and maintenance costs and easier management.
- Allowed more pasture area to be irrigated with allocation.
- Irrigation system requirements better matched the flow rates available from the bores.



Chris and his son, Lachlan, check the operation of the K-line system.

What is the best thing about the project?

"The new system has reduced the demands on my time for maintenance and operation, and I'm getting better water management and uniformity."

What was the most difficult aspect of the project?

"It wasn't too bad – probably getting necessary approvals and dealing with inclement weather were the biggest problems."

Would you recommend this to others?

"Yes, but I regret trying to save a bit by not replacing the mainline because it now limits my flexibility."

Option 1A: improved irrigation efficiency, more efficient irrigation system

Landholders	Warwick and Kaylene Marks
Water source	Yarran Creek, near Dorrigo. Zone 1 - Upper Nymboida River of the Dorrigo Plateau Water (high stress)
Enterprise	Milking 160 Jersey cows
Licence allocation	20 ML
Irrigated area (this project)	12 hectares
Project cost	\$15,600

The project

Warwick and Kaylene replaced a travelling irrigator with a K-Line irrigation system.



K-line in operation.

The benefits

- Improved water use efficiency and uniformity of application.
- Ability to apply low rates of irrigation if required by scheduling to meet crop demand and anticipated storm events.
- Reduced labour and management (previous irrigation supply was portable aluminium pipes to traveller guns).
- Reduced wastage from mainline leakage.
- Reduced operating costs due to lower operating pressure and volumes applied.
- Fertiliser costs are down – “I now irrigate and fertigate (apply fertiliser through the irrigation system) my irrigated pastures then graze them, then irrigate again and graze. Feed utilisation is much better.”



K-line pod on poly line.

Landholders' experience

Why did they do it?

“We identified unreliable access to water as a major threat to our business, so we needed to improve our irrigation efficiency to increase our productivity per mega-litre. We also needed to reduce the labour involved.”

What is the best thing about the project?

“My labour time is less and I have much better control over the irrigation. And the finer droplet size is far less damaging to the soil and crop.”

What was the most difficult aspect of the project?

“It was hard work installing the irrigation mains myself’.”

Would you recommend this to others?

“Yes, our costs are greatly reduced, we can easily apply small amounts of water often and soil health is improved.”



Warwick Marks with some of his Jersey cows.

Tweed Heads

Option 1A: improved irrigation efficiency, more efficient irrigation system

Landholders	Robin and Ayleen Dawes
Water source	Piggabeen Creek (high stress); Tweed River catchment
Enterprise	45 dairy cows
Licence allocation	97ML
Irrigated area (this project)	20 Ha
Project cost	\$27,400

The project

Robin replaced an existing small travelling irrigator and portable spray lines with a bike shift system and a medium pressure solid set irrigation system with a new pump and underground mainlines.

The benefits

- This has improved his irrigation management and water use efficiency.
- Greatly reduced the time spent on moving and setting up his irrigation.
- Reduced leakage from portable mainline increases efficiency.
- Can now apply small volumes of water to minimise extraction when the creek is low.

Landholders' experience

Why did they do it?

- Because the old irrigation system was too difficult and time consuming for him to manage.

What is the **best thing** about the project?

"I have much better control over the irrigation and the saved time allows me to better manage the rest of the farm."

What was the **most difficult** aspect of the project?

"It was difficult getting the finance organised, and it took a lot of my time to finish the project since I did most of the work myself."

Would you **recommend this** to others?

"Yes, definitely; I should have committed to do this years ago."



Robin Dawes beside one of the moveable bike shift sprinklers.



The small springfed dam that supplies the irrigation water.



A bike shift sprinkler in action – a number of these are connected to a pattern of hydrants in the paddock and rapidly moved with a quad bike.

Option 1B: increase efficiency, increase system flexibility and ease of management

Landholders	Les Hellyar
Water source	Richmond River, Upper Kyogle area management zone; Fawcetts Creek (high stress)
Enterprise	80 cows
Licence allocation	50 ML (Richmond River) plus a further 136 ML on an adjoining property
Irrigated area (this project)	10 hectares
Project cost	\$17,750

The project

Les Hellyar has converted one of his diesel powered, portable aluminium mainline irrigation systems to electric power with an underground mainline system.

The benefits

- The diesel pump does not have to be moved from one property to another.
- The irrigation system can be operated at optimum times without unnecessary limits due to noise controls. This allows night time irrigation with increased efficiency.
- The irrigation system is a lot cheaper to run (\$450 for electric compared with \$2,500 for diesel).
- It allows improved management and labour utilisation since the system is easier to operate and can be automated. There is no longer any fuel to be carted.

Landholders' experience

Why did they do it?

- The original irrigation pump was a diesel since it was located a long way from electric power.
- Because he was located adjacent to the village, local noise limits prevented him from pumping at night.
- This meant irrigation was not able to be applied at the most efficient time. He operating costs were also very high which discouraged effective use.

What is the best thing about the project?

"It's so much easier to manage. It uses less water and I can irrigate at night without upsetting the neighbours."

What was the most difficult aspect of the project?

"Deciding whether the development was worth the expenditure was a big decision."

Would you recommend this to others?

"Yes, I'm way in front since the development was completed."



The electric pump unit which replaced the diesel pump. It is skid mounted to allow it to be hauled above flood level.



The control unit for the electric pump.



Les Hellyar surveys the steep bank of the Richmond River from which he pumps water.

Bowraville

Option 1B: improved irrigation efficiency, upgrading existing system

Landholders	Allan and Margaret Usher
Water source	North Arm Nambucca River
Enterprise	330 to 400 cow dairy
Licence allocation	135 ML
Irrigated area (this project)	35 hectares
Project cost	\$29,500

The project

Allan and Margaret upgraded the existing electric pumping unit and interconnected its mainline to the existing diesel operated irrigation system. This means the diesel pump can be scrapped. They also replaced some portable pipeline with underground mains.

The benefits

- Improved water use efficiency and pump efficiency.
- Reduced labour and management by having only one pumping unit instead of two.
- Reduced wastage from leakage.
- Reduced operating costs with electricity cheaper than diesel.

Landholders' experience

Why did they do it?

- Operating cost using diesel was too high. The use of electricity has many advantages including allowing automatic control.
- The installation of underground mains and connection the two systems together will greatly improve management and labour costs as well as reduce water losses through leakage of the old portable mainline.



Allan Usher at the pump site.

What is the best thing about the project?

“Labour is expensive and limited, and the new system allows us to produce more with less labour – this is the key to survival in the dairy industry.”

What was the most difficult aspect of the project?

“Making the decisions about what did I needed to do, how to do it and justifying the overall cost was difficult.”

Would you recommend this to others?

“Yes – but how many in the dairy industry can afford it, particularly when costs are so high in the industry and returns so low!”



Allan's irrigated dairy pastures

Option 1B: improved irrigation efficiency, upgrading existing system

Landholders	Greg and Carmel Billings
Water source	Bielsdown Creek (Zone 2, high stress); Clarence River Catchment
Enterprise	330 cow dairy and 40 hectares potatoes
Licence allocation	403 ML
Irrigated area (this project)	30 hectares (by pivot)
Project cost	\$30,000 for mainlines etc. plus \$95,000 for centre pivot



Aerial photo showing pad locations and mainline.

The project

Greg installed a centre pivot allowing two 15 hectare circles to be irrigated. He installed an underground mainline to these pads. This replaced two travelling irrigators.

The benefits

- Improved water use efficiency and uniformity of application.
- Ability to apply low rates of irrigation if required by scheduling to meet crop demand and anticipated storm events.
- Reduced labour and management (previous irrigation system was portable aluminium pipes to travelling irrigators).
- Reduced wastage from leakage.



The centre pivot is located on a steep hillside which it handles easily. The track up the hill is too steep for a car. Gates are established in any fences it has to cross.

Landholders' experience

Why did they do it?

- Labour saving - "I can now apply 12mm over the area in 48 hours where it used to take 5 days with both the old travellers – I should have done this years ago!"
- The system is more water efficient - in keeping with community expectations.



Greg Billings sets the travel speed of the centre pivot. It can apply anything from 5 to 100 mm at each pass.

What is the best thing about the project?

"This system enables me to apply smaller quantities of water when rain is likely, avoiding over-watering. The old travellers were not able to do this and storms frequently led to crop water logging."

What was the most difficult aspect of the project?

"It was difficult trying to find sites for the centre pivot pads in the hilly country to maximise the irrigation area."

Would you recommend this to others?

"Yes – I intend to install another similar centre pivot and dispose of 2 more travellers."

Stuarts Point

Option 1C: improved irrigation efficiency, incorporating scheduling into the irrigation management

Landholders	Chris and Sue Nelson
Water source	Stuarts Point coastal groundwater system - has a gazetted groundwater management plan.
Enterprise	Avocadoes
Licence allocation	453 ML
Irrigated area (this project)	102 hectares
Project cost	\$134,500

The project

Chris wanted to install automatic irrigation system on micro under-tree sprinklers which will ultimately be controlled by a computer based soil moisture monitoring system. The groundwater used for irrigation comes from the coastal aquifer on which the plantation is located.

The benefits will be

- Improved water use efficiency and uniformity of application
- Able to apply low rates of irrigation if required by scheduling to meet crop demand.
- Reduced labour and management by remotely controlling the system through the internet.
- The system will be able to apply fertiliser through the irrigation which will reduce losses and potential contamination of groundwater.

Landholders' experience

Why did they do it?

- Labour saving because he owns a second property located some distance away. This is why remote control and monitoring is necessary.
- The low field capacity of the sandy soil means that irrigation has to be closely monitored and applied in small quantities frequently.



Drilling and installing groundwater system into the sandy soil profile under the orchard. Roots only extend into the very shallow top grey layer which severely limits water available to the crop.

What is the best thing about the project?

“My expectation is that I can to manage the two properties without sacrificing irrigation efficiency or demanding too much of my time.”

What was the most difficult aspect of the project?

“I’m having trouble getting the works completed. This may be made more tricky because of the new cutting edge technology that’s needed.”

Would you recommend this to others?

“Yes – The concept is great and when completed will make my life much easier.”



Containers distributed under the trees are used to test for even spread of irrigation flows.

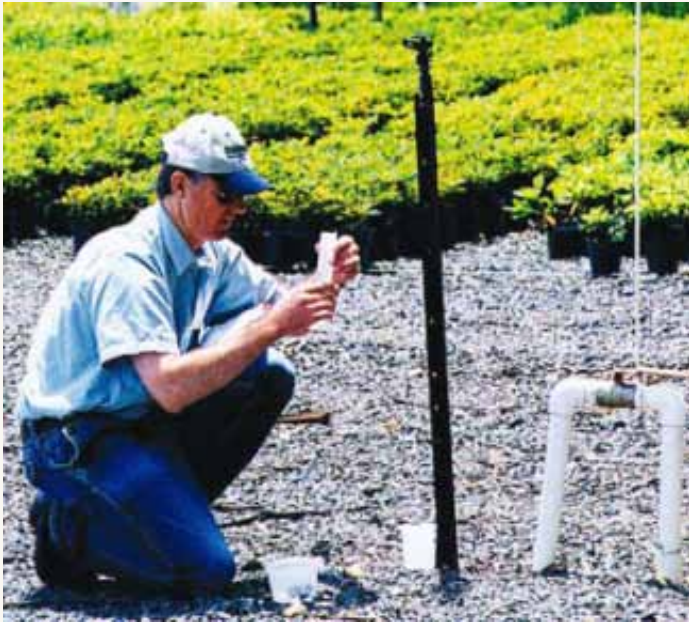
The concept for Chris Nelson’s automatic irrigation system is that the computer will monitor soil moisture across the avocado block and switch on the micro irrigation system as needed to maintain optimum soil moisture levels. The system will be connected through the internet so that Chris can monitor and override the computer if he wishes to, even when he is on the distant property. The internet will also let the computer notify Chris if there are problems. This is important in this case especially since the sandy soil of the shallow root zone has a very low field capacity and irrigation can be as frequent as daily during hot weather.

Fully automatic systems such as this have been developed in viticulture and other intensive irrigation industries. A similar system is used in Mildura to distribute treated effluent water to irrigated tree plantation blocks to optimise growth and minimise risk of groundwater contamination.

The importance of irrigation scheduling

What is scheduling?

It is applying the right amount of water at the right time to suit the crop or pasture.



How can you do this?

Traditionally farmers have judged irrigation timing by looking for signs of stress in their crop. Unfortunately, this is far too late and reduced production results.

Irrigating regularly every so many days can be better, but if it is cooler than normal or there is significant rain, or if it is much hotter or windier than normal then the crop may stress from over or under irrigation.

There are two basic approaches to scheduling:

1. Monitor what is actually happening in the soil;
2. Model or estimate what is happening by monitoring the weather impacts on the crop.

1. Monitoring the crop demand on the soil water –

This technique involves measuring the soil moisture levels with a range of different technologies. These can be as simple as a moisture probe, right up to the sophistication (and cost) of a capacitance probe which measures the soil moisture at different depths in the root zone and clearly shows when the crop is in need of irrigation. Here are some of these tools:

Tensiometers operate like plant roots and measure how hard the plant has to suck to extract water from the soil.

Gypsum blocks are buried in the rootzone and measure how much water is in the soil. They do this by measuring changes in the electrical conductivity.

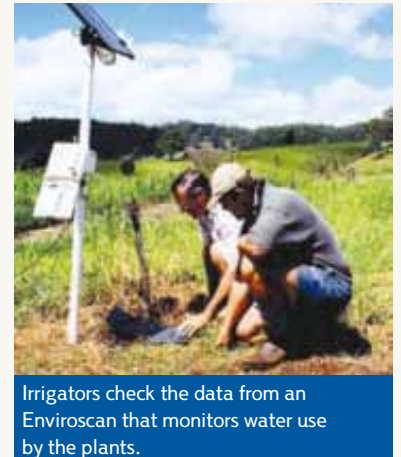
'**Aquaflex**'™ is a flexible strip buried in the rootzone which monitors the soil moisture over a volume of soil so giving an average reading of soil moisture. These can be very useful in shallow rooted pasture.

The **Capacitance Probe** measures soil moisture by monitoring the electrical capacitance of the soil around the probe. Portable versions which can be used at a number of sites can be very useful for monitoring high value crops on a range of soil types.

2. Modelling the rate of plant water use –

Critical factors that you need to know for scheduling are:

- the depth of the root zone of the crop
- the soil moisture holding capacity of the soil in the root zone which is dependent on soil type and condition. These two give the amount of water available to the plant
- the rate of transpiration (or use) of water by the plants



Irrigators check the data from an Enviroscan that monitors water use by the plants.

If records of rainfall and evaporation are kept, it is possible to calculate how much water the crop uses and, therefore, how much is left in the root zone.



A nursery irrigator measures his daily evaporation to calculate his irrigation requirement. For most purposes, evaporation readings from the Bureau of Meteorology are acceptable.

Such systems can be as simple as adding rainfall (from your rain gauge) and subtracting evaporation (from the weather info), corrected by a crop coefficient (from NSW DPI) which suits your crop and its stage of growth, from the estimated soil water available in the root zone.

More sophisticated systems can be based on computer models. They can be calibrated and integrated with actual soil measurements. Many programs are available from various research and commercial bodies.

Whichever system you decide to use, you must measure how much water you use. Without that information, you are merely guessing about your irrigation performance.

For more information, please contact the Irrigation Officer at NSW Department of Primary Industries.

Burringbar

Option 2A: alternate water supply, catchment dam and groundwater bore

Landholders	Rob and Sue Harnett
Water source	Burringbar Creek; Brunswick River Catchment
Enterprise	80 dairy cows
Licence allocation	156 ML
Irrigated area (this project)	26 hectares
Project cost	\$30,000

The project

Rob and Sue wanted to reduce their dependence on Burringbar Creek by collecting stormwater from the local township into a dam equipped with an irrigation pump, developing a bore for supplementary groundwater, and connecting electric power to both.

The benefits

- Reduced potential for contamination of the river by urban stormwater.
- Reduced extraction stress on the river – especially at the environmentally sensitive low flow periods.
- More reliable water supply for the dairy pasture and less sensitivity to flow access restrictions.
- Improved irrigation management and reduced labour and time to irrigate.
- Greater ability to budget irrigation with a known volume of water available.



The dam which collects the stormwater. This used to be a swampy depression which was a hazard to the dairy cows.

Landholders' experience

Why did they do it?

- The development of an Irrigation and Drainage Management Plan for the farm identified access to the river for irrigation as a critical weakness.
- This was highlighted by restrictions to water access during critical pasture growth periods over the last few years.
- Management and operation of the irrigation was labour intensive and inefficient with the pump on Burringbar Creek located well away from the pasture and dairy.



The village which supplies the stormwater runoff is to the right and the bore is located by the 2 tanks in the paddock visible just above Rob Harnetts head. Currently a travelling irrigator applies the water to the pastures in the background.

What is the best thing about the project?

"It's enabled us to keep our pasture right through the current dry spell. It's so much easier and quicker to apply the right amount of irrigation. Also our herd health has improved with less mastitis and lower risk of botulism from poor water quality in what used to be swampy drain."

What was the most difficult aspect of the project?

"It was tricky getting it all developed while keeping the dairy in production."

Would you recommend this to others?

"Definitely!! The irrigation plan was critical; initially we were a bit sceptical about its value, but now feel we couldn't operate without it. It was important in managing the development and is now regularly used to make our irrigation and business management decisions."

Old Bonalbo

Option 2A: alternative water supply, groundwater

Landholders	Andrew and Andrea Harwood
Water source	Upper Duck Creek (high stress); Clarence catchment
Enterprise	120 dairy cows, but now changed to soyabean and maize cropping, and building up to beef / cropping in 5 years
Licence allocation	203 ML
Irrigated area (this project)	50 hectares
Project cost	\$18,000

The project

The Harwoods needed to secure and improve their water supply by developing a bore which tops up an enhanced storage. Irrigation is now pumped from the storage. Both bore and storage are equipped with pumps.

The benefits

- Reduced dependency on low flows from Bean Creek.
- Helps protect low flows (he is a major licence holder on the creek).
- Increased security for the irrigation enterprise with less likelihood of access restrictions under the water sharing plans.
- The increased reliability for irrigation allows him to change his enterprise to suit his needs (reduced labour requirement).



This small bore with submersible pump 'tops up' the storage since flow rates are too low to use directly in the irrigation pump.

Landholders' experience

Why did they do it?

- Andrew's Irrigation and Drainage Management Plan identified the sensitivity of his enterprise to water availability. Pasture production was critical to maintaining his milk contract.
- The new system enabled better management control of the irrigation system to make maximum use of the limited water supply.



Andrew Harwood stands by the control panel for his irrigation pump. The pump draws from a storage developed in a depression.

What is the best thing about the project?

"It's much easier to manage and reduces stress on Bean Creek. I can also change my enterprise if I wish."

What was the most difficult aspect of the project?

"It was difficult getting the licence for the bore and works."

Would you recommend this to others?

"Yes – we feel the property is now drought proofed and we have much better water security."



This is the storage that 'bulks up' the bore water to allow efficient irrigation.

Comboyne

Option 2A: Alternative water sources (bores) and Option 1A - increase irrigation efficiency, more efficient irrigation system

Landholders	Gordon and Margaret Burch
Water source	Thorne River (high stress), Hastings River catchment
Enterprise	Avocado plantation
Licence allocation	20 ML plus 13 ML harvestable right
Irrigated area (this project)	6.5 hectares of established trees and a further 13.5 hectares of new trees
Project cost	\$89,000

The project

Gordon needed to upgrade water supply system by constructing a bore, with electric power, and installing header tanks to bulk up the water and supply operating pressure. He also replaced some existing inefficient micro irrigation.

The benefits

- He can now schedule the irrigation on a reliable daily cycle because of the increased security of access. In a dry year he is able to make optimum use of the limited water to minimise crop stress. This was not possible with the original system.
- The automation of the system has reduced the labour input considerably
- The design of the new system allows a much more even distribution of the irrigation

Landholders' experience

Why did they do it?

- The limited water supply was unable to meet average demand
- The new bore plus existing bore and dam supply can meet average demand – but it's still not adequate for dry years.
- Previously in dry years, the crop suffered large losses and the stress resulted in reduced crop health which reduced yields in following years.
- It was felt that a bore would give a better return than more dams since dams are difficult to construct and seal in the red kraznozem soils of the Comboyne.



The small bore with submersible pump and pressure system.

What is the best thing about the project?

“Once I had my finance secured and was happy with the design I could proceed confidently.”

What was the most difficult aspect of the project?

“Looking for groundwater is always risky, and finding a reliable contractor was difficult.”

Would you recommend this to others?

“Yes, but get good advice and plan your project carefully allowing for longer term issues such as the impacts of climate change and increased climate variability, and possible changes in land use needs and water access.”



Part of the avocado plantation showing one of the header tanks used to pressurise the micro system and one of the small dams.

Option 2B: Alternate water source, high flow dam

Landholders	Tim and Louise Dougherty
Water source	Paddy's Flat, Upper Clarence River (high stress)
Enterprise	Pecan plantation (10ha) plus beef cattle
Licence allocation	65 ML
Irrigated area (this project)	10 hectares currently planted
Project cost	\$22,000

The project

Tim and Louise want to improve their water security by constructing an earth dam off the floodplain of the Clarence River to be filled from high flow.

The benefits

- Greater water security, especially in spring when flowering and nut set are critical.
- The location of the dam allows the irrigation pump to be converted to electricity with reduced operating costs and increased management benefits.
- Irrigation is no longer threatened by flood events since the dam and pump are well above flood levels.



Looking down onto the dam walls shortly after completion.

What is the **best thing** about the project?

"We feel our water supply is much more secure."

What was the **most difficult** aspect of the project?

"The biggest challenge was locating the best dam site."

Would you **recommend this** to others?

"Yes - the storage will soon pay for itself because of the increased overall yield of the crop."



Downstream of dam wall showing the bypass trickle pipe outlet.

Landholders' experience

Why did they do it?

- Tim recognised that insecure water access because of low flows and possibly exacerbated by the water sharing plans during the critical flowering and nut set period was a major risk to the enterprise.
- The original diesel pump is still used to fill the dam from high flows, but does not have to be relocated before every high flow as was required before.



Dam wall looking downstream. Internal excavation increases stored volume.

Comboyne

Option 2B: Alternative water source - gully water storage which will be topped up from high flows from the Thorne River

Landholders	Mike, Jenny and Ben Hurrell
Water source	Thorne River (high stress), Hastings River catchment
Enterprise	500 dairy cows
Licence allocation	197 ML
Irrigated area (this project)	32 hectares
Project cost	\$160,000

Landholders' experience

Why did they do it?

- We identified access to the river for irrigation under future water management plans as a critical weakness on our property.
- This development was designed to secure critical water access for irrigation and to allow compliance with the rules of the proposed water sharing plans.

The project

The Hurrells have constructed a 70 ML storage to increase the security of the irrigation supply. Currently irrigating 25 hectares with bike shift and 20 hectares with a big gun irrigator and plan to convert from travelling irrigator to centre pivot.

The benefits

- Reduced extraction stress on the river – especially at the environmentally sensitive low flow periods.
- More reliable water supply for the irrigated pasture for the dairy enterprise.
- Greater security for irrigation supply.
- Improved management and labour utilisation.



Ben Hurrell pumping down water from the spring under the dam wall.



Checking the spillway width to ensure flood flows can be released.



Mike and Ben Hurrell looking at the new storage dam as it begins to fill.

What is the **best thing** about the project?

“We have much more reliable access to water.”

What was the **most difficult** aspect of the project?

“Getting approvals was tricky, and then we had an unexpected problem with a spring under the dam wall, so we ran over budget.”

Would you **recommend this** to others?

“Yes, but plan it carefully and check out all bureaucratic requirements of agencies and councils. Be aware of possible pitfalls when doing earthwork constructions.”



The excavator is working on sealing the spring while the bulldozer and roller compact the dam wall. This will ensure a secure dam.

So you're an irrigator?

irrigate *v.tr* supply water to (land) by means of channels, or of a stream [based on Latin *irrigatus* 'watered']

Do you...



Apply the right amount of water at the right time to get maximum growth from your crop or pasture?

- o You need to monitor the rate at which plants use the moisture available in the soil, and then apply just enough to refill the profile with moisture. Apply too much and it drains away below the crop and leaches out some of your expensive fertiliser, as well as waterlogging the crop unnecessarily; too little or too late and your crop may stress. How can you do this? There are many ways to keep track of plant needs, some simple to use and some very sophisticated. See the section inside on scheduling.



Maintain and manage your irrigation system to minimise wastage and leaks?

- o There doesn't seem to be much point using expensive energy to pump water from a water source and then let it go to waste because of leaks in the system. Leaks can also reduce the operating pressure of a system so it doesn't apply the water evenly leading to patchy crops.



Check your pump to ensure it still operates at the correct pressure?

- o Like all machinery, pumps wear out and corrode. The fine clearances inside erode and the pump can no longer operate at its most efficient. This means more power is used and less water delivered at lower pressure. Your irrigation system no longer does what it was designed to do. This increases costs and reduces crop yields. Check your operating pressure and flows regularly.



Check your sprinkler performance?

- o Sprinkler nozzles also wear with use, especially if there is sediment in the water. Enlarged nozzles will lower pressure and performance.



Plan ahead for possible restrictions in access to water when you need it?

- o Even if weather patterns return to 'normal', many irrigators suffer restrictions at critical times. If you depend on irrigation, you should explore how you can best minimise these impacts. There are many alternatives which may suit you. See some of the examples inside.

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