## Siphon Irrigation Training for Seasonal WorkersUpdated October 2014

Contents

[Siphon Irrigation Training for Seasonal Workers 1](#_Toc340662362)

 Course Outline 1

[1. Work health safety (WHS) and induction 3](#_Toc340662363)

[Working outside 3](#_Toc340662364)

[Correct siphoning handling technique to minimise back and knee strain 3](#_Toc340662365)

[Precautions for working in water 4](#_Toc340662366)

[Informing your manager if you can swim 4](#_Toc340662367)

[Experience driving various vehicles to irrigation sites 4](#_Toc340662368)

[Hazards 4](#_Toc340662369)

[Basic safety around pump stations 5](#_Toc340662370)

[On farm induction (what to expect) 5](#_Toc340662371)

[2. Irrigation 5](#_Toc340662372)

[History of Irrigation 5](#_Toc340662373)

[Why Irrigate? 6](#_Toc340662374)

[The aim of irrigation 6](#_Toc340662375)

[Parts of an Irrigation System 6](#_Toc340662376)

[Starting a siphon overview 7](#_Toc340662377)

[Practical 1 - Starting a siphon 9](#_Toc340662378)

[Timing of irrigation 9](#_Toc340662379)

[Efficient Irrigation 10](#_Toc340662380)

[3. Hydraulics 11](#_Toc340662381)

[Demonstration - Starting, monitoring and stopping an irrigation set 12](#_Toc340662382)

[Practical 2 - Starting, monitoring and stopping an irrigation set 12](#_Toc340662383)

[4. Communication 13](#_Toc340662384)

[5. Getting around 13](#_Toc340662385)

[Practical 3 13](#_Toc340662386)

[6. Trouble shooting 13](#_Toc340662387)

Acknowledgements…………………………………………………………………………………………………………………………….14

Attachement 1: Map ………………………………………………………………………………………………………………………….15

**Course Outline**

**Duration**: Ideally half a day. 1 day at the most. Aim at finishing mid-day e.g. 9AM to 2:30PM. The timing thus is 5.5hrs minus lunch (45 mins) = 4.75 hrs training. This time also includes transition time between the shed/ tent and the Field.

**Audience**: Seasonal labour including international backpackers and students

**Trainer**: Experienced Irrigator + facilitator

**Location**: Ideally on-farm. The course will require an indoor venue (shed or tent where presentation equipment can be set up) and a field site with access to head ditch, siphons, irrigation infrastructure including a pump site and walkways

**Structure**: As determined by experienced irrigator but a suggested structure is below

|  |  |  |  |
| --- | --- | --- | --- |
| Content | Location | Timing | Equipment |
| 1. **Work health safety and Induction**
	* working outside
	* Correct siphon handling technique
	* working in water
	* What to let your manager know
	* hazards
	* basic safety around pump stations
	* On farm induction (what to expect)
2. **Irrigation**
	* History of irrigation
	* Why irrigate
	* The aim of irrigation
	* Parts of the irrigation system (vocabulary)
		+ Starting a siphon (explanation and demonstration)
		+ Practical 1 – starting a siphon
	* Timing of irrigation \*F or S
	* Efficient irrigation

Morning Tea Break 1. **Hydraulics**
	* Basic hydraulics
		+ Demonstration - Starting, Monitoring and stopping an irrigation set
		+ Practical 2 - starting, monitoring and stopping a siphon set
2. **Communication**
3. **Getting around**
4. **Lunch**
5. **Practical 3**
6. **Trouble shooting**
7. **Wrap up - evaluations**
 | SSF F or SF or SF or SF or SFF or SF or SF or SFF or SF or S | 20m30m4015m15m40m10m10m30m45m15m15m | Computer, Screen + projectorSiphons (2-3). Examples of appropriate footwear and clothingDifferent sized siphons, brickie’s levelSiphons, buckets, participants watchesCopies of evaluation forms + pencils |

**F = Field S=Shed**

## Work health safety (WHS) and induction

### Working outside

Irrigation requires long hours in hot weather. There are a number of things you need to do to protect your health and safety in the sun:

* + Drink water at regular times during the day to replace fluids lost when you sweat (recommended 2-3 litres / day minimum). In hot conditions the trick is to drink before feeling thirsty!
	+ To assist with the evaporation of sweat, wear loose clothing
	+ For maximum sun protection wear a wide brim ventilated hat, SPF rated cotton long sleeve shirts with collars and long trousers
	+ Apply sunscreen regularly to protect any exposed skin. The Australian sun is much harsher than the sun in Europe.
	+ Take all necessary precautions as the effects of heat stress can lead to heat exhaustion and heat stroke – possibly a life threatening condition. The early symptoms of heat stress include muscle cramps, headaches, dizziness, fatigue, loss of coordination, nausea and a weak rapid pulse. If you feel you are experiencing these symptoms from heat stress, advise your supervisor immediately, move to a cool shaded area

### Correct siphoning handling technique to minimise back and knee strain

* + Bad posture, repetitive manual handling and heavy lifting can lead to soft tissue injuries. Symptoms of soft tissue injuries include pain, numbness, weakness, burning, tingling or loss of motion.
	+ Starting and stopping siphons is repetitive but there are some techniques you can use to minimise strain such as standing up straight and flicking the siphon with your foot. (are there others)
	+ Before lifting anything heavy:
		- Think and plan any lifting you perform
		- Make sure you have a firm footing and your feet are spaced widely apart
		- Bend your knees
		- Check the load
		- Make sure you have a secure grip on the object
		- Tighten you muscles
		- Keep your back straight
		- Lift the load securely and slowly
		- Keep the load close to your body
	+ Wear protective gloves if you are required to move irrigation pipes and siphons that are hot.
	+ There is a correct technique when moving siphons from one field to another Note to Trainer: There will be a particular process that varies from farm to farm. Usually this will involve using a siphon trailer. In most cases siphons used in a particular field will stay in that field all season and will only be collected once the last irrigation has been applied and the area has dried out before picking.
	+ If you’ve done everything correctly and still feel like you might have a soft tissue injury it is your responsibility to report that to your supervisor so they can help you.

### Precautions for working in water

* + You should wear suitable footwear, that does not cause blisters and ensures that your feet are protected from sharp stubble and other foreign material
	+ Walk on the walkways rather than in the channels.

### Informing your manager if you can swim

* + Accidents have happened in the past. If your employer doesn’t ask, you must tell your manager if you can’t swim or are not a confident swimmer at every place you work.

### Experience driving various vehicles to irrigation sites

* + There are many different types of vehicles available on the farm. In Australia you must have a license to drive different types of vehicles. If your employer doesn’t ask you must tell your manager if you have the qualifications and experience to drive each of the vehicles such as utes (automatic or manual), quad bikes, two-wheeler motor bikes or any other vehicle.

### Hazards

* + Snakes may be found in irrigation pipes and siphons, around water channels, as well as in the cotton field. Many snakes are poisonous. If you come across a snake move quickly away and let it move away. If other workers are in the vicinity, let them know where the snake has moved.
	+ If bitten by a snake, place a firm pad over the bite, bandage securely and keep the limb as still as possible. Stay as still and calm as possible. Use the communication system to get help quickly.
	+ Not all spiders in Australia are deadly. Red-back spiders are relatively common and under some circumstances can be deadly. If bitten inform your supervisor. Apply cold pack/compress to area to lessen pain and seek medical aid.
	+ If you are bitten by a spider and experience swelling, discomfort, pain, sweating, muscle spasms, dizziness or any unusual feelings inform your supervisor.

### Basic safety around pump stations

* + Keep away from moving parts i.e. belts
	+ Be aware of loose clothing, long hair or anything else that could drag you into a moving part.
	+ Check for snakes
	+ Turn off the engine before refuelling
	+ Don’t smoke around fuel
	+ Follow the safety warnings around electrical equipment.

### On farm induction (what to expect)

* + Today’s training is not an on farm induction. Your employer must give you an induction when you first start working on the farm. This should include who to report to, hazards on the farm, communication on the farm, work clothes, hygiene, protective clothing and equipment, adequate food and water, fatigue, riding a motorbike/ATV, handling chemicals on the farm, machinery operation and maintenance, irrigating, snakes, being ready for emergencies, injury reporting, workplace health and safety legalities. This would be a good time to inform your employer about your swimming and driving ability.

## Irrigation

## History of Irrigation

Irrigation has been around for as long as humans have been cultivating plants. Around 20 percent or 280 million hectares of the world’s cultivated farmland is irrigated, and this produces 40 percent of our food and fibre. Historically surface irrigation has been the most common method of irrigating agricultural land. It remains one of the most widely used form of irrigation for growing broad acre crops. It is the most common form of irrigation in Australia with 44 percent of the irrigated area using this method of irrigation.

The primary method of surface irrigating within the Australian Cotton industry is the use of siphons to apply water from a head ditch into furrows in a cotton field. The term siphon (or siphon) comes from the Ancient Greek for “pipe” or “tube”. It refers to the inverted U shaped tube which enables water to flow uphill, above the surface of the head ditch water, without pumps, powered by the fall of the liquid as it flows down the tube under the pull of gravity, and is discharged at a level lower than the surface of the head ditch. Egyptian reliefs from 1500 BC show the use of siphons to extract liquids from large storage jars.

### Why Irrigate?

Without irrigation, growers are at the complete mercy of the weather. Plants can become “stressed” if there hasn’t been enough rain, In fact, there is a term used in cotton growing called ‘moisture stress”. This is where the plants are not receiving enough water. This can lead to low yields and poor fibre quality.

Not only can the plants suffer from not having enough water, they can also be given too much water. This can lead to ‘waterlogging’ which lowers crop yields, or the waste of water which lowers production per megalitre of water applied (the water use efficiency of the crop). Adding water through irrigation therefore requires careful management.

### The aim of irrigation

The aim of irrigation is to supply water to crops when the water requirements are not satisfied by rainfall or available stored soil moisture. Water for irrigation comes from rivers or groundwater aquifers (which is pumped up to the surface via bores). Water is usually moved from a water storage via gravity through channels to head ditches and the field. This minimises the need for mechanical pumps and the cost of energy associated with pumping.

The aim is to apply water from the head ditch uniformly. Hills or beds are constructed on a downfield slope from the head ditch end to the tailwater end of a field. These are separated by furrows into which water is applied using siphons. The aim is to keep the water applied to a furrow within that furrow – water infiltrates into the crop root zone through the furrow base and walls. The crop is planted on the on the hills or beds.

### Parts of an Irrigation System

****Surface irrigation systems are generally comprised of:

* A water supply: storage dams, bores, rivers
* Water delivery systems: pipes, channels, culverts, pumps
* Water control systems: gates to control flow direction, drop structures to bring water into a channel, checks and weirs to stop water flow and increase head, computerised systems.
* Devices to measure the effectiveness of the irrigation system: soil moisture probes, pressure gauges
* Devices to apply water: siphons, layflat and cups, gated pipe

Figure 1 is a sketch of the key components of a cotton farm. More illustrations can be found in the supporting presentation

* Recycling system – tailwater channels, sumps, pumps

### Starting a siphon overview

The siphon must be **primed** (filled with water) before they will start reliably transferring water. However, once primed and positioned correctly, they will continue transferring water from the head ditch to the furrow.

The steps to starting a siphon are:

1. Place the head ditch end of the siphon beneath the water surface in the head ditch
2. Push the siphon into the water (leave the field end of the siphon open)
3. Close off the field end of the siphon with your free hand and pull this end away from the head ditch and towards the field (always leave the head ditch end submerged)
4. Repeat Step 3 until the siphon is filled with water (usually only 1 or 2 thrusts are needed depending on the amount of head available)
5. Once air is expelled you remove the seal formed by your hand so water will flow from the field end of the siphon and place it in the rotobuck (making sure the head ditch end remains submerged). Ideally the field end should be placed below the rotobuck water level (see Figure 2)

For siphons up to 75mm diameter and 4.3 meters long this is all easily done by one person without any other tools.

All siphons should be placed perpendicular to the head ditch. Placement of siphons at different angles to the flow in the head ditch causes preferential flow into some siphons that results in flow variations and uneven watering.

Changes in cross-sectional area of siphons will also affect flow rate. Walking on siphons or accidentally pushing them into the ground when starting them may cause kinks, reducing their cross-sectional area. The cross-sectional area may also vary between different brands of siphons so take care when replacing siphons or substituting ones within a set or field.

The flow rate of water into a head ditch determines how quickly water can be applied, and how much of the crop can be irrigated in a given time. It is important that the correct number of siphons are started in a set so that the water level in the head ditch remains static – the water entering the head ditch must equal the volume being applied by the siphons. Anything that alters the flow or water into or out of a head ditch will affect the head and the effectiveness of the irrigation.

If the flow of water entering a head ditch is much greater than that being applied to the field through siphons the water level in the head ditch will rise. This can result in overtopping of the head ditch and possible breaches of the head ditch. If the water level in the head ditch is falling this will lower the available head and result in siphons stopping.

There are several possible causes of water level fluctuations in a head ditch. If this is observed you should immediately contact your manager to decide on a course of action.

### Practical 1 - Starting a siphon

1. Demonstrate and have participants practice starting siphons

**Notes:**

* if different size siphons are available give them an opportunity to start all sizes
* if practical give them an opportunity to try starting siphons with different head
* set up a brickie’s level to show how head is measured (see Figure 3 below)



Figure 3 – A brickie’s level

### Timing of irrigation

Ideally the cotton crop should be planted into a seedbed which has adequate soil moisture. If there has been inadequate rainfall, irrigation may be applied prior to planting to ensure there is adequate root-zone moisture – this is referred to as a pre-irrigation.

In situations where soil moisture may be marginal following planting it may be necessary to apply an irrigation after planting to assist with establishment of the crop – this is called ‘watering up’ the crop. The number of in-season irrigations used after the crop has established varies with location, the frequency of rainfall and soil type – on average there may be a further four to five irrigations, at ten day intervals, from mid- December to late February or early March.

The time the crop really needs water the most is during January and February. This is when the temperatures and evaporative demand is highest, and the fruit on the plant (referred to as bolls) is starting to mature and fill. The timing of irrigation is crucial to achieve high yields (quantity) and high quality cotton fibres.

### Efficient Irrigation

The goal of efficient irrigation is to ensure the greatest return per megalitre of available water is achieved. This requires the minimisation of losses through evaporation, deep drainage and runoff. Efficient irrigation requires good system design and irrigation management practices.

Careful design of irrigation systems (including the slope of field) is important to ensure:

* Water travels down a field at just the right speed ensure an even infiltration into the root-zone;
* That all run-off water is collected and recycled for re-use in the next irrigation.

Care taken in the application of water via siphons is also critical to achieving an efficient irrigation.

## File:Lappo.svgHydraulics

**Siphon tubes** are basic implements used in irrigation to transfer water over a barrier (such as the bank of a raised irrigation channel. A siphon is a tube which uses air pressure and gravity to run water up over a high place and down to where you want it.

At the simplest they consist of a pipe with no working parts. To work they rely on the water level in the head ditch being at a higher level than the water level in the field being irrigated.

The water level in the head ditch is higher than the soil level in the bay or furrow so it will easily siphon using tubes. Normally one siphon is used for each furrow. The siphon is started by hand at the start of irrigation.

The purpose of a **head ditch** is to consistently deliver sufficient water at an appropriate head to the field. Management of the head ditch involves regulating flows in the system and selecting and operating siphons appropriately. Head ditch flow is regulated at the source, while head ditch levels are determined by downstream control structures. Water level should be kept constant as possible while irrigating, as fluctuations cause the siphon discharge to change leading to non-uniform application. To maintain a constant head requires the total siphon discharge in a siphon “set” (i.e. those siphons set to run at one time) equal head ditch inflow.

The aim is to achieve a steady flow rate onto the field through the use of **siphon tubes** transferring water over a head ditch bank onto the field. Figure 2 is a cross section of a siphon applying water from a head ditch for both submerged and free flow.

Normally one siphon is used for each furrow, although other combinations may be used on different fields – for example, doubling up siphons to increase flow rate in a furrow or applying water through siphons in every second furrow. Each siphon in an irrigation set is started by hand at the start of irrigation.

Figure 2 shows that the head for a siphon operating with submerged flow is greater than the head of a siphon operating with free flow (ho is greater than h1). For the same sized siphon the greater the head the greater the volume of flow.



**Figure 2** Comparison of head for a siphon operating with submerged flow (upper image) and free flow (lower image)

### Demonstration - Starting, monitoring and stopping an irrigation set

In this exercise demonstrate and explain:

* + good handling and starting techniques before they start
	+ how siphons are placed and handled so there is an even flow of water
	+ use of brickie’s level to monitor head height
	+ how to check rotobucks and maintain as necessary
	+ how to monitor irrigation progress and when to stop siphons

### Practical 2 - Starting, monitoring and stopping an irrigation set

* + Get participants to start a siphon set
	+ Once siphon set is underway you might like to get them to check flow rates with bucket and stop watch
	+ Provide opportunity for them to stop siphons
	+ Use problems as learning opportunities (particularly if they relate to water level in head ditch rising or falling or water not running down furrows evenly)

## Communication

* If you are unsure ask your supervisor
* What to do you do if you have been told and still don’t understand?
	+ Paraphrase or rephrase the speakers words in your own words
	+ Paraphrase the speakers words back to them as a question
	+ Demonstrate - Is this what you mean?

## Getting around

Chances are when you arrive on farm you will be given a map. You will need to use this to get around and follow instructions.

* When you get the map look for the main landmarks to orientate the map.
* Look at the legend to understand the map markings.
* Each field will be numbered as will each pump, bore, supply channel, tailwater return channel, road and watercourse.
* Discuss the abbreviations on the map and what they mean (e.g. RES = reservoir, F=Field)
* Looking at the map identify some of the fields in which the group has already worked.

### Practical 3

This is an opportunity to revisit any of the activities participants have had difficulty with and to correct any problems with technique. (If any fundamental practical activities have not yet been included in the practical section please include here)

## Trouble shooting

**Scenario 1: An irrigation set is underway but the water level in head ditch is rising**

Risk: Overtopping of head ditch and head ditch break possible

Cause:

* Insufficient siphons running (some could be blocked)
* Increased flow coming from elsewhere in irrigation system

Action: Contact manager

Solutions:

* Check all siphons operating properly
* Increase number of siphons operating
* Inspect and adjust pump settings

**Scenario 2: An irrigation set is underway but the water level in head ditch level falling**

Risk: Siphons will stop and irrigation will be terminated

Cause:

* Too many siphons operating
* Head ditch has been breached
* Pump has stopped working or working below capacity

Action: Contact manager

Solutions:

* Check for head ditch breach
* Check pump operating
* Reduce number of siphons

**Scenario 3: An irrigation set is underway but the water is not advancing down furrows evenly**

Risk: Excessive tailwater produced if irrigation left running until all furrows through

Cause:

* Wheel track furrows running water faster than non-wheel track furrows
* Uneven flows from some siphons

Action: Contact manager

Solutions:

* Check all siphons flowing – restart any that have stopped
* Stop siphons early in furrows where flow is too fast

## Acknowledgements

## Cotton Australia would like to sincerely thank and acknowledge Lance Pendergast, Graham Harris (Queensland Department of Agriculture, Forestry and Fisheries)), Nathaniel Phillis, Geoff Dunlop, Mitch Abbo and Rebecca Fing (House Paddock Consulting) for their assistance in developing this material.

Attachment 1: Map

