

How to build a large (Organic) High Pressure Aeroponic system in Australia

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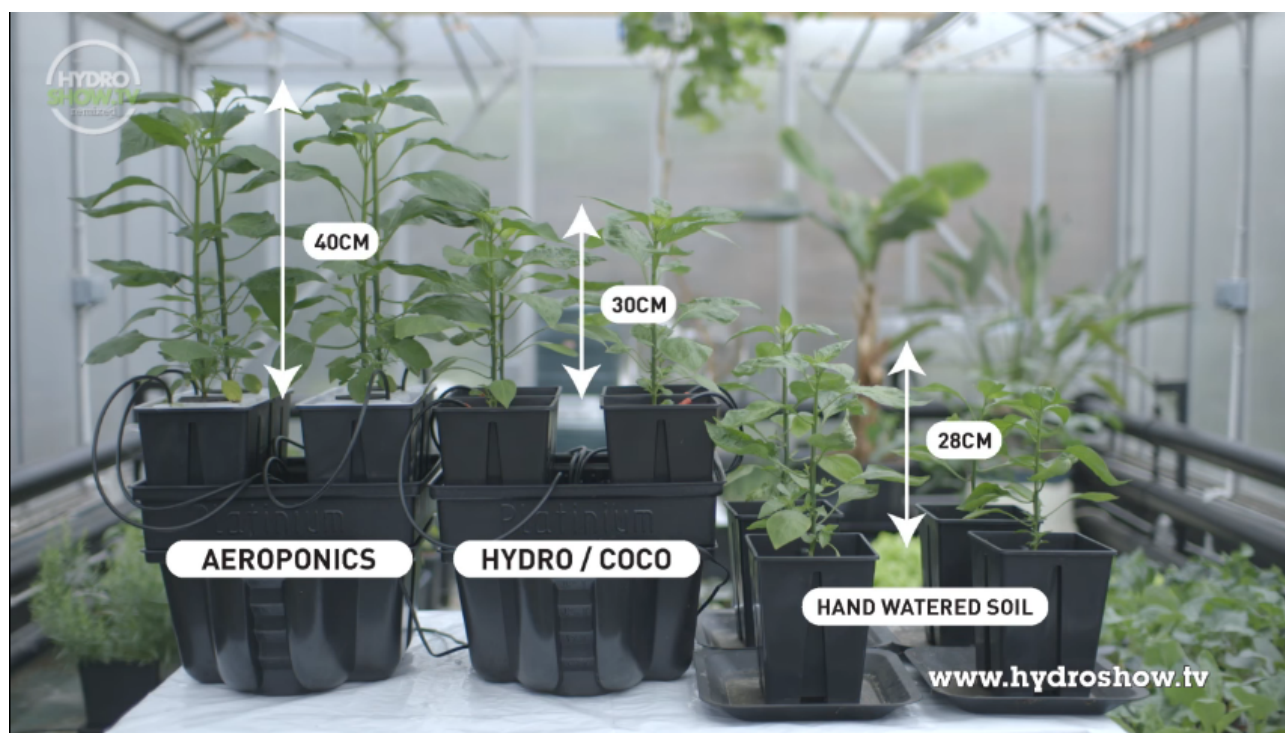
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The climate in WA is especially harsh on fruit and vegetable crops. Even a small Aeroponic or Hydroponic system will require a water chiller to keep its Reservoir temperature down.

Aeroponics (Aero-Hydroponics): Growing plants in an air or mist environment without the use of Aggregate (*Mass of fragments loosely compacted together*) mediums (*A Fluid or solid in which organic structures are placed in the middle*). Aggregate mediums are used in 'Geoponics' (Soil).

Aeroponics are conducted without the use of a growing medium, although the plants still need to be anchored. The dangling roots and lower stem of the plant hangs below and above the water-level within a reservoir or separate root container (Semi-closed environment that empties to a Reservoir).

The crown and leaves (The 'Canopy') of the upper stem extend above the Root Container.



The picture above shows a 30% increase in growth, compared to Hydroponics and Geoponics.

The nutrient-rich water solution needs to have its pH and ppm closely monitored and filtered before it enters the misting nozzles so they don't clog. The misting nozzles in 'High-pressure Aeroponics' generate 30μ to 50μ droplets in a process called '[Atomization](#)'. This is done by either forcing liquid through a small orifice with an impeller inside it, or by smashing the fluid as it exits the orifice (Impingement). Another method involves mixing the fluid with compressed air.

The combination of pressure and the nozzles orifice size causes the liquid to emerge as small ligaments. These then break up further into very small droplets or liquid particles.

An '*Electronic Tap Timer*' (Irrigation Controller / Timer) is attached **after** the *In-line* filtration unit and is set to open for 5 seconds in 3 minute intervals. At this rate, the Solenoid Valve will be open for 40 minutes per day.

$(60 \text{ sec}) \times (60 \text{ min} \times 24 \text{ h} = 1440 \text{ min}) = 86,400 \text{ sec}$
 $86,400 \text{ sec} / 180 \text{ secs (3 min)} = \text{switching on/off 480 times per day}$
 $(480 \times 5 \text{ sec} = 2400 \text{ sec}) / 60 \text{ sec (1 min)} = 40 \text{ minutes per day}$

Installing a Tap Flow Meter Gauge will allow you to see how many litres the pump must transfer. Better yet, an Electrical Cost Meter will allow you to see how many Watts the system uses each day.

An 'Accumulator Tank' (*pre-Pressurized Well Tank* or *Bladder Tank*) is used to store an amount of water with the maximum water pressure (Head-height) of a pump, so it only needs to turn on when the pressure drops below a certain level (80% with a Torrium 2 pressure controller). The pumps 'Electronic Pressure Controller' is a device that attaches to the outlet and provides power to the pump when the pressure drops to a certain level. Note also, that the amount of air in the tank needs to be about 70% of the pumps max kPa.

About \$6,000 AUD will be needed to build this system, but you can start with a single drum / tote.

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Root Container (Drums, Totes, Tubs, Containers w/ Lid)

- People In Plastic - [R200LMOHD – 200L Open Head Drum DG](#)
 - 500mm Dia, 825mm Height
- Clean Drum co. - [Plastic Drum – 210L](#)

The lid of a 200L Drum is 500 mm in Diameter, while the inside of the drum itself is 550mm. At least 4 Misting Heads are needed to cover the whole root zone, but having 6 will ensure that the lower plants will get sprayed. The misting heads will be attached to a circular loop of 3/8" tubing, fitted with Nozzle couplings and a Tee that leads out through the lid of the drum.

The loop is held up by fishing line fed through holes (1mm) drilled into the drum lid.

The length of tubing needed for each drum:

550mm (Outside Diameter below lid) – (Wall thickness: 3mm x 2 = 6mm) = 544 mm

544 mm x 3.14 = Inside circumference is 1708 mm (1.708 meters)

Length of tubing that is lost after being inserted into a Nozzle couplings *push-to-fit* hole:

.... x 12 (Number of Nozzle coupling holes) + 2 (Tee) =

(1708 mm + =) minus length of each Nozzle coupling + Tee fitting =

The of 3/8" tubing is cut into 6 segments,,,,, and mm.

One of the tube segments is cut again so that the 90° elbow can be attached.

Each one of these is cut in half so a Tee piece connector can be added between them.

Alternatively, offset every 2nd row by halfway. If each 2" (50.8 mm) hole is spaced 25mm apart, then the distance between the centre of each hole is 75mm. With a drum height of 825mm, but the row of holes begins 16cm below that, then there will be room for 8 rows. But after every 2nd row, the PVC pipe that is inserted has its length increased by 15mm. This reduces the number of holes that row can have.

1st and 2nd row (500mm Dia – 50mm = 450mm) x (3.14 = 1413mm)

1413mm / 75mm distance between each hole = 18 holes with 0.6mm extra spacing

3rd and 4th row (500mm Dia – 80mm = 420mm) x (3.14 = 1318.8mm)

1318.8mm / 75mm distance between each hole = 17 holes with 0.4mm extra spacing

5th and 6th row (500mm Dia – 110mm = 390mm) x (3.14 = 1224.6mm)

1224.6mm / 75mm distance between each hole = 16 holes

7th and 8th row (500mm Dia – 140mm = 360mm) x (3.14 = 1130.4mm)

1130.4mm / 75mm distance between each hole = 15 holes

Total: 132 holes (+ 19 if smaller plants are put into the lid, instead of a tree)

Remember to cut the pipe [at an angle](#), beginning 25mm from where it enters the drum. Additionally, the drum lid should be big enough to fit a tree trunk whose diameter does not exceed 300mm when fully grown. Likewise, the plant stems growing through the 2" holes must not exceed that diameter when fully grown. Or another 19 holes can be drilled into the lid instead.

Misting Nozzles

There are two basic types of misting nozzles: **Impingement** and **Impellar**.

Some **Impellar** nozzles are '*cleanable*' in that the design allows for the barrel-shaped impellar to be removed and cleaned of debris. Very high pressure (6,000 kPa and above) have an anti drip-spring, which the nozzle can function without.

- Orifice sizes
 - **Small:** 0.08mm, 0.1mm, or 0.15mm
 - **Medium:** 0.2mm, 0.5mm
 - **Large:** 0.6mm, 1mm

- CoolMist Systems Australia

- Normist Spray Nozzles

- 0.7mm | Thread: 10/24" | 100° spray
 - Nickel Brass NM70BH-U1
 - 303 Stainless Steel NM70SSH-U1
 - 0.4mm | Thread: 10/24" | 90° spray
 - Nickel Brass NM40BH-HF-U1
 - Steel NM40SS316-U1
 - 0.3mm | Thread: 10/24" | 80° spray
 - Nickel Brass NM30BH-U1
 - Steel NM30SSH-U1

- Push-in Fittings

- *For 3 Root containers with 6 misting nozzles in each*
 - **18 x** (Nickel plated Brass) Nozzle coupling for 3/8" tube with 10/24" female port
Number: 0301001
 - **5 x** Nickel plated Brass Tee for 3/8" tubing
Number: 0301004
 - **1 x** Nickel plated Brass Elbow 90° for 3/8" tubing
Number: 030100
 - **18 x** Misting heads
 - 40m of 3/8" Nylon tubing (0.375" or 9.525 mm)
 - *Rough estimate: 40m @ \$7.4547 per Meter = (\$298)*
 - Fishing line
-

Neoprene Collars & Seed Propagation

- eBay – (Pack of 65) - [EZ-CLONE 2" or 50.8mm Diameter Neoprene Cloning Collar \(Soft\)](#)
- eBay – (Pack of 65) - [EZ-CLONE 2" or 50.8mm Diameter Neoprene Cloning Collar \(Hard\)](#)
- Seedling Pot
 - Toilet ponkers, Egg Carton

Ultrasonic Foggers (Mist Maker)

Produces 1μ to 5μ droplets. Due to the displacement of available oxygen, these are best suited for propagation and early vegetative cycles. For flowering or fruit production, plants perform much better with a droplet sizes closer to 50μ (Microns).

- Amazing Amazon - [Pond Mist Maker](#) + [3 disk](#), [5 disk](#)

Pressure Tank

- Aquastream - [Uniflow Pure Water Pressure Storage Tank](#) (37.8L or 75.7L)
- Malcolm Thompson Pumps – [Graundfos GT Series](#)

In-line Filter

- H2OshopOnline - [AMIAD Semi Auto Scanaway Filter 50mm inlet/outlet \(w/ 130μ screen\)](#)
 - [AMIAD Semi-Automatic Filters .pdf](#)
 - [Blueprints.pdf](#) (Dimensional drawings)
 - H2OshopOnline - [AMIAD Tagline Super 3" Screen Filter 100 Micron Screen Element](#)

Water Chiller

- The Aquarium Shop - [Teco TK150 Aquarium Chiller](#)
- Aquarium Products - [Teco TK150 Aquarium Chiller](#)
- Guppys Aquarium Products - [Hailea HC-130A 1/15hp Chiller Marine Aquarium to 150L](#)

People to ask:

<https://www.morleyaquariums.com.au/>

<https://www.gumtree.com.au/>

Circulation Pump

- Guppys Aquarium Products - [Hailea HX-6510 Wet/Dry](#)
 - 0.11 bar (1.2m head-height) @ 480 L/h – 1 Litre per 7.5 seconds
 - Aquatuning Australia - [Watercool WCP D5](#)
 - Aquatuning Australia - [Watercool HEATKILLER® D5-TOP](#)
 - [Bridge Rectifier](#): Converts **AC** (Alternating Current) into **DC** (Direct Current).
 - PLE - [EK D5 PWM G2 Barebones Liquid Cooling Pump](#) – 12V – 1.9 A
 - PLE - [EK XTOP Revo D5 Acetal Pump Top](#) – 1.35 bar (3.9m) @ 1,500 L/h
 - [Bridge Rectifier](#): Converts **AC** (Alternating Current) into **DC** (Direct Current).
 - eBay - [Watercool HEATKILLER® WCP D5-VARIO pump motor with D5-TOP housing](#)
 - 1.4 bar pressure (3.7m head-height) @ 1,500 L/h – 1 Litre per 2.4 seconds
 - About the [Watercool WCP D5-VARIO pump](#)
 - [Bridge Rectifier](#): Converts **AC** (Alternating Current) into **DC** (Direct Current).
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Air Pump

- Guppys Aquarium Products - [Eheim Air Pump 100](#)
 - + [Check-valve](#)
 - Aquarium Products - [Fluval Q2 Air Pump](#)
 - [manual.pdf](#)
 - The Aquarium Shop - [Fluval Q2 Aquarium Air Pump Single Outlet /w adjustable flow](#)
-

Water Pump

- (Needs to be tap pressure @ 6 bar (600 kPa) = 50m or 70m head-height)
- [Converting Pump Head to Pressure and Vice Versa](#) (Scroll down to bottom of page)
 - Note: The *Torrium 2* pump controller needs be installed regardless of pump selection.
- Malcolm Thompson Pumps – [Grundfos CM Booster Pump CMB 3-6](#)
 - Cool Tech Pumps
 - [Davey Pump Range.pdf](#) (+ *Torrium 2 Controller* included)
 - HM160-19T – 600 kPa (6 bar) @ 1.8 kW (160 lpm) [\\$1,570](#)
 - HM60-10T – 690 kPa (6.9 bar) @ 0.94 kW (60 lpm) [\\$1,199](#)
 - HM90-13T – 680 kPa (6.8 bar) @ 1.4 kW (90 lpm) [\\$1,399](#)

- HM90-11T – 585 kPa (5.8 bar) @ 1.05 kW (90 lpm) [\\$1,339](#)
- HM60-08T – 575 kPa (5.7 bar) @ 0.72 kW (60 lpm) [\\$1,040](#)
- [Stratco Pump Range](#)

“Torrium 2” Automatic Pressure Controller for Water Pump

- Cool Tech Pumps - [Davey Torrium2 TT70/S Pressure Controller with "Plug and Play" Leads](#)
- Pumps2You - [Davey TT70 Torrium®2 Replacement Controller](#)
- The Farm Store - [Torrium 2 Controller](#)

Electrical Connections

- Power Cord (Extension Leads)
 - Bunnings - [HPM 20m 15A Caravan Extra Heavy Duty Extension Cable](#)
- Powerboard
 - Bunnings - [Arlec Individually Switched Surge Protected 6 Outlet Powerboard](#) (Black)
 - Bunnings - [Arlec 1.8m White 6 Outlet Surge Protect Powerboard](#)
- Protective cover
 - Bunnings - [Excalibur 6 Outlet Outdoor Safety Box](#)
 - Bunnings - [Excalibur Red IP55 Outdoor Extension Lead Safety Box](#)
 - Bunnings - [Ampfibian X1 Weatherproof Connector Protector](#)
- Calculating power usage
 - Bunnings - [Arlec Energy Cost Electrical Meter](#)

Backup Power Supply

- ***Automatic Transfer Switches***

These can only be used with an “Automatic-Start” (2-Wire) Generator.

Those with “Remote-Start” will need to have their control panel ‘hot-wired’ to the ATS.

- EATON - [ATC-900 Controller](#) – ([Manual](#))
- SmartGen – [Automatic Transfer Switches](#)

If using batteries, their Voltage (Total charge) can be measured by a [PentaMetric](#) by placing a shunt between the batteries Negative wire and combiner box. This device can turn on a Relay once the batteries charge drops to a set level. This activates the ATS, giving the batteries time to recharge.

This ATS will only combine two power supplies (*Primary and Back-up*)

- Latronics - [High Speed Automatic AC Transfer Switch \(ACTS40\)](#)

Solenoid Valve + Timer

- [General Purpose \(Normally Closed\) Differential Solenoid Valve \(Brass\)](#) – ½" (12.7mm) 24v
 - + [10mm Tube x 1/2" BSPT Screw Thread St. Union](#) – SKU: YPC10-04
- [Digital Timer \(0.1sec-99 hrs On/Off\) 10-28 Volts AC/DC](#)
 - [Tutorial on how to Wire a DIN plug](#)
 - [Manual.pdf](#)
- [Bridge Rectifier](#): Converts **AC** (*Alternating Current*) into **DC** (*Direct Current*).

About Solenoid Valves and their Cable and Plug types

DIN Connector cables plug into an interface to connect devices together.

The **DIN 43650** (*EN 175301-803*) (a.k.a **MPM** or **Sugercube** connectors) are the plugs used with Solenoid valves. They are 3-pin electrical plugs with earth-contacts.

These are available in three versions, the main difference being the pin spacing.

- **Form A**: Blocky U-shaped pins facing upwards towards the centre. Separated by 18mm spacing.
- **Form B**: These have two different sizes, ranging from 11mm which have 3 flat (Blades) pins and 10mm with 1 flat pin and 2 U-shaped pins on the bottom, their top-ends facing outwards.
- **Form C**: Has flat bladed pins that are either 8mm or 9.4mm apart.

M12 and M8 Cable Connectors

Used for **(I)** Industrial, **(C)** Control, and **(S)** Systems or **ICS** for short. These 8 cable types were first introduced at the Hannover Fair in 1985. They come in 3, 4, 5, 8, and 12 pin variations, with the 4-pin being the most common (Note that the **M8** only has the 3, 4, 8 pin varieties).

The A-code **M12** connectors are **Micro DC** 'Micro Direct Current' (**MDC**) or 'Micro-change' for short, are used for sensors, transmitters, and powering instruments.

An **MDC receptacle** is a 'Field Wireable Bulkhead' (No soldering required for connecting wires) that provides a mating point for **M12** cables.

The **M12** wires may be connected to the **DIN 43650** connectors / sockets.

- Example: [ProductsForAutomation - DIN 43650 to MDC](#)

Reservoir (Esky)

- Bunnings - [Esky Arctic Pro Cooler – 120L](#)
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Nutrients

- GrowRoom - [Canna Bio Vega 1L](#)
 - GrowRoom - [Canna Bio Flores 1L](#)
-

Biological Control (*Insects & disease*)

- Fishpond.com.au - [API Stress Zyme 240ml](#) (\$31.34)
-

pH and ppm Measurement / Adjustment

- pH Meter
 - [HM Digital PH-200](#)
 - [manual.pdf](#)
 - TDS (*Total Dissolved Solids*) Digital Meter
 - [HM Digital COM-100](#)
 - [manual.pdf](#)
 - Calibration and Storage Solutions
 - Hydroponic Solutions - [HY-GEN](#)
 - HydroponicXpress – [HY-GEN pH Electrode Storage Solution \(250mL\)](#)
 - ibrew - [pH 7.01 Buffer sachet \(20mL\)](#)
 - ibrew - [Hanna pH probe Storage Solution](#)
 - Dosing pump to automatically adjust pH
 - Aquarium Online Supplies - [EHEIM Autoliquid Liquid Doser](#)
-

Insulation Blankets

Plumbing Parts + (*Tools & Accessories*)

Be warned that **BSP** "[British Standard Pipe](#)" (a.k.a. "Whitworth 55°" thread form) can mean either a **BSPT** "[British Standard Pipe Taper](#)" or a **BSPP** "British Standard Pipe Parallel" thread type. The difference is that a BSPT thread (The spiral-like pattern) is angled slightly inward, giving it a subtle cone shape. This gives the thread a better seal against high pressures, but it shouldn't be joined with a BSPP or NPT fitting (*Cross-threading*). The reason is that, while it may appear to be tight, only a couple of threads will be engaging.

NPT "[National Pipe Thread](#)" is another thread type that's good for high pressure seals (*Mainly gas*). It also has a cone-like thread, but unlike BSPT which has a crest (The width and height of each tooth) of 55°, the **NPT** thread has a crest of 60°. It requires less sealant than BSPT (*Two turns of plumbers tape*) but any more than that and there is the risk of leakage.

BSPP is the most popular type of thread in Australia and when paired with a '*Bonded Seal Ring*' or '*O-ring*', no thread sealant is required.

Inside Dia. (ID)	BSP	Outside Dia. (OD) BSPT	Outside Dia. (OD) BSPP
6mm	1/8"	9.728 mm	8.6 mm
8mm	1/4"	13.157 mm	11.9 mm
10mm	3/8"	16.662 mm	14.7 mm
15mm	1/2"	20.995 mm	18.3 mm
15.8mm	5/8"	22.5 mm	20.6 mm
20mm	3/4"	26.441 mm	23.9 mm
25mm	1"	33.249 mm	29.7 mm
32mm	1 1/4"	41.91 mm	38.6 mm

Tools & Accessories

- 1 x [Hose Cutter](#)
- 2 x [Craftright 250mm Adjustable Wrench](#)

Draining Root Containers to Nutrient Reservoir

- Hose / Tubing (18mm ID) for Draining Root Containers to Nutrient Reservoir
 - [Nylex 18mm x 18m Heavyweight Garden Hose](#)
 - (Can be used for Manifold connections instead of Reinforced Pressure Hose)
- 3 x Tank Fittings (½") 15mm (*a.k.a Skin or Bulkhead Fitting*) to drain the Root Containers
 - Bunnings - [Holman 15mm Female Tank Fitting](#)
 - Hills Irrigation - [HANSEN 15mm Female Tank Fitting](#)
- 2 x Tee with 19mm barb and a 15mm Male thread
 - Bunnings - [Pope 19mm Barbed Tee with a 15mm BSP Male Thread](#)
 - Hills Irrigation – [19mm barb x 15mm Tee](#)
- 1 x 90° Elbow (19mm barb to 15mm Male BSP thread)
 - Bunnings - [Pope 19mm Male Barbed Threaded Elbows - 5 Pack](#)
 - Hills Irrigation – [19mm x 15mm BSP Male Elbow](#)
- 1 x 19mm barb Tail to 20mm BSP thread (20mm – ¾" in decimal is [0.75](#))
 - Bunnings - [Pope 19mm Tail x 20mm BSP Male Director](#)
 - Hills Irrigation – [19mm Barb x 20mm BSP Male POLY DIRECTOR](#)
- 1 x 90° Elbow M/F 20mm (¾" Male – ¾" Female)
 - Bunnings - [Philmac ¾" M x ¾" F Threaded BSPT Pipe Elbow \(Tapered\)](#)
 - Hills Irrigation - [HANSEN 20mm M/F ELBOW](#)
- 1 x Hills Irrigation - [HANSEN 20mm BARREL UNION](#)
- 1 x 20mm Nipple (¾" or 0.75")
 - Bunnings - [Garden Rain 0.75" Poly Irrigation Nipple](#)
 - Hills Irrigation - [HANSEN 20mm POLY NIPPLE](#)
- 1 x Tank Fitting 20mm
 - Bunnings - [Holman 20mm Female Tank Fitting](#)
 - Hills Irrigation - [HANSEN 20mm FEMALE TANK FITTING](#)

Connecting the Nutrient Reservoir to the Water Pump Inlet

- **1 x Tank Fitting 25mm (1")**
 - Bunnings - [Holman 25mm Female Tank Fitting](#)
 - Hills Irrigation - [HANSEN 25mm FEMALE TANK FITTING](#)
- **1 x 25mm Nipple (1")**
 - Bunnings - [Garden Rain 1" \(25mm\) Poly Irrigation Nipple](#)
 - Hills Irrigation - [HANSEN 25mm POLY NIPPLE](#)
- **1 x Threaded Union Fitting to disconnect the Nutrient Reservoir for cleaning (1" or 25mm)**
 - Hills Irrigation - [HANSEN 25mm BARREL UNION](#)
 - [Hardy Spicer](#)
- **2 x Tail (Director) 19mm Barb to 25mm (1") Male BSP Thread**
 - Bunnings - [Pope 19mm Tail x 25mm BSP Male Director](#)
 - Hills Irrigation – [19mm x 25mm BSP Male POLY DIRECTOR](#)
- **1 x Reducing Bush – 1" Female to 1 ¼" Male (25mm to 32mm – *In decimal: 1" to 1.5"*)**
 - Bunnings - [Garden Rain 1 1/4 x 1" Poly Irrigation Reducer Bush](#)
 - Hills Irrigation - [HANSEN 32mm x 25mm Reducing Bush](#)
- **Hose / Tubing (18mm OD) to connect the Reservoir onto the Pumps inlet**
(Alternative)
 - Bunnings - [Kinetic 19mm x 5m Reinforced Pressure Hose \(19.05 mm ID\)](#)

Connecting the Water Pump Outlet to the Tap-Manifold (Pressure Tank)

- **1 x 32mm (1 – ½" or 1 – 8/16") Male thread to 1" (25mm) Female reducing bush**
 - Bunnings - [Philmac 1 - 1 / 2 x 1" Threaded BSP Pipe Bush](#)
 - Hills Irrigation - [HANSEN 32mm x 25mm Reducing Bush](#)
- **1 x Threaded Union Fitting to disconnect the tube from the Water Pump Outlet**
 - Hills Irrigation - [HANSEN 25mm BARREL UNION](#)
- **1 x Tail (Director) 19mm Barb to 25mm Male BSP Thread**
 - Bunnings - [Pope 19mm Tail x 25mm BSP Male Director](#)
 - Hills Irrigation - [19mm x 25mm BSP Male POLY DIRECTOR](#)
- **Hose / Tubing (18mm ID) to connect Pumps outlet to Manifold**

Tap Manifold

- **1 x** Manifold with 4 outlets – (1) Pump (2) Pressure Tank (3) In-Line Filter (4) Drain
 - Bunnings - [Holman 3 Way Brass Manifold](#) (¾" – 20mm thread) – 3 male : 1 female
- **3 x** Female To Female ¾" (20mm) Coupling
 - Bunnings - [Garden Rain 20mm Female To Female Rural Poly Irrigation Coupling](#)
- **3 x** Tail (*Director*) 19mm Barb to 20mm Male BSP Thread
 - Bunnings - [Pope 19mm Tail x 20mm BSP Male Director](#)
 - Hills Irrigation – [19mm Barb x 20mm BSP Male POLY DIRECTOR](#)
 - **x 1** (*In-Line Filter Inlet*)
 - **x 1** (*Pump outlet*)
 - **x 1** (*Drain*)
- **8 x** Hose Clamp
 - Bunnings - [Prime 13-20mm Solid Band Hose Clamp](#)
 - **x 4** (*Connecting the In-Line Filter Inlet + flushing valve to the Nutrient Reservoir*)
 - **x 2** (*Connecting Pump Outlet to Manifold*)
 - **x 2** (*Connecting Nutrient Reservoir to Pump Inlet*)
- Nipple / Raiser 30cm long (32mm – 1 ½" BSP Male thread) to Pressure Tank
 - **2 x** Bunnings - [Kinetic 20 x 150mm Brass Plain All Thread](#)
 - **1 x** Bunnings - [Kinetic 20mm Brass Threaded Hexagon Socket](#)

Connecting the In-Line Filter to the Tap-Manifold (Pressure Tank)

- **1 x** 50.8mm (2") to 25mm (1") reducing bush
 - Hills Irrigation - [HANSEN 50mm x 25mm REDUCING BUSH](#)
- **1 x** Nipple (25mm – 1") for attaching the Union fitting
 - Hills Irrigation - [HANSEN 25mm Poly Nipple](#)
 - [Bunnings](#) (*Alternative*)
 - 50.8mm (2") to 1–¼" Reducing Bush - [Philmac 2" x 1-1/2" Threaded BSP Bush](#)
 - 1–¼" to 1" Reducing Bush - [Philmac 1 - 1 / 2 x 1" Threaded BSP Pipe Bush](#)
 - Nipple (25mm) - [Garden Rain 1" Poly Irrigation Nipple](#)
- **1 x** Threaded Union Fitting to disconnect the In-line Filter from the Manifold
 - Hills Irrigation - [HANSEN 25mm BARREL UNION](#)
- **1 x** 19mm barb tail to 25mm Male BSP Thread (Connecting the hose from the manifold)
 - Bunnings - [Pope 19mm Tail x 25mm BSP Male Director](#)

- Hills Irrigation - [19mm x 25mm BSP Male POLY DIRECTOR](#)

Connecting the In-Line Filter (Exhaust / Flushing valve) to the Nutrient Reservoir

- 1 x 32mm (1 – ½" or 1 – 8/16") Male thread to 1" (25mm) Female reducing bush
 - Bunnings - [Philmac 1 - 1 / 2 x 1" Threaded BSP Pipe Bush](#)
 - Hills Irrigation - [HANSEN 32mm x 25mm Reducing Bush](#)
- 1 x Threaded Union Fitting to disconnect the Nutrient Reservoir for cleaning (1" or 25mm)
 - Hills Irrigation - [HANSEN 25mm BARREL UNION](#)
 - [Hardy Spicer](#)
- 2 x 19mm barb tail to 25mm Male BSP Thread
 - Bunnings - [Pope 19mm Tail x 25mm BSP Male Director](#)
 - Hills Irrigation - [19mm x 25mm BSP Male POLY DIRECTOR](#)
- 1 x 25mm Female Tank Fitting
 - Bunnings - [Holman 25mm Female Tank Fitting](#)
 - Hills Irrigation - [HANSEN 25mm FEMALE TANK FITTING](#)

Connecting the Solenoid Valve to the In-Line Filter

- 1 x 50.8mm (2") to 25mm (1") reducing bush
 - Hills Irrigation - [HANSEN 50mm x 25mm REDUCING BUSH](#)
 - [Bunnings](#) (Alternative)
 - 50.8mm (2") to 1–¼" Reducing Bush - [Philmac 2" x 1-1/2" Threaded BSP Bush](#)
 - 1–¼" to 1" Reducing Bush - [Philmac 1 - 1 / 2 x 1" Threaded BSP Pipe Bush](#)
 - Nipple (25mm) - [Garden Rain 1" Poly Irrigation Nipple](#)

Connecting the Nylon Tubing to Solenoid Valve

- ½" (15mm) Male thread BSP to 3/8" tube (10mm) Push-to-fit connector
 - [10mm Tube x 1/2" BSPT Screw Thread St. Union](#) – SKU: YPC10-04

PVC pipes for inserting into the Holes of each Drum / Tote

- [PVC pipe](#) (2" or 50.8mm) for putting into the holes.
 - 37m = \$261.96
 - [Caulking Gun](#) to use with sealant to fix the PVC pipes in place

Connecting Nutrient Reservoir to Water Chiller

- **1 x 3m of Copper Tube – ½" (15mm) – (Annealed)**
Note that, while it says 15mm (Refers to pipe fitting), the pipe is actually 12.7mm OD
 - Bunnings - [Kembla 1/2" x 3m Annealed Copper Tube](#)
- **2 x Push-to-Fit (Compression fitting) for ½" Copper with a ¾" (20mm) Male BSP thread**
 - Bunnings - [SmarteX P 16mm x 3 / 4" Push Fit Brass Pex Male Connector](#)

Even if a filter was placed between the Reservoir and Water chiller, the nutrients and bio-mass would still erode the internals of a chiller. It's for this reason that clean water (Reverse Osmosis) is passed through a copper tube in a closed-loop. This allows the chiller to draw heat from the reservoir while keeping its own clean water separate.

- **2 x Tank Fittings**
 - Bunnings - [Holman 20mm Female Tank Fitting](#)
 - Hills Irrigation - [HANSEN 20mm Female Tank Fitting](#)
- **2 x Nipple (20mm – ¾" in decimal is 0.75")**
 - Bunnings - [Garden Rain 0.75" Poly Irrigation Nipple](#)
 - Hills Irrigation - [HANSEN 20mm Poly Nipple](#)
- **2 x Barrel Union**
 - Hills Irrigation - [HANSEN 20mm BARREL UNION](#)
- **2 x 90° Elbow (20mm Male to 20mm Female)**
 - Bunnings - [Garden Rain 0.75" Poly Irrigation M/F Elbow](#)
 - Hills Irrigation - [HANSEN 20mm Poly Threaded Male and Female Elbow](#)
- **2 x 19mm barb tail to 20mm Male BSP Thread**
 - Bunnings - [Pope 19mm Tail x 20mm BSP Male Director](#)
 - Hills Irrigation – [19mm Barb x 20mm BSP Male POLY DIRECTOR](#)

Attaching the Circulation Pump in between the Reservoir and water chiller

- **Hose to Water Chiller**
 - The 19mm OD hose should fit onto the Water Chiller's ¾" barbed outlet
- **Attaching the hose to the Circulation Pump's Outlet (*Hole on the side*)**
 - Hills Irrigation - [19mm x 15mm BSPM POLY DIRECTOR](#)
 - Hills Irrigation - [HANSEN 15mm BARREL UNION](#)
 - Hills Irrigation - [TEFEN ¼" \(6mm\) x ½" \(15mm\) Bush](#)
 - Hills Irrigation - [TEFEN ¼" \(6mm\) Nipple](#)

- **Connecting the hose from the Reservoir to the Circulation Pump Inlet**

(The hole in the middle)

- 1 x Hills Irrigation - [19mm x 15mm BSPM POLY DIRECTOR](#)
- 1 x Hills Irrigation - [HANSEN 15mm BARREL UNION](#)
 - The Barrel Union is not placed directly on the Pump Inlet, but after 15cm or 20cm of hose, so the tube can be attached underwater. For this, another Director is needed. Water is poured into the hose attached to the pump Inlet while the reservoir is elevated. Once you are able to have the stream of water loop around into the same container, lower the reservoir so any bubbles remaining in the copper coil rise to the top. Then fasten the two ends together.
- 2 x Hills Irrigation - [19mm x 15mm BSPM POLY DIRECTOR](#)
- Hills Irrigation - [TEFEN ¼" \(6mm\) x ½" \(15mm\) Bush](#)
- Hills Irrigation - [TEFEN ¼" \(6mm\) Nipple](#)

Connecting the other hole on the reservoir straight to the Water Chiller

- A length of 18mm wide hose will connect the other barb of the Chiller to the 2nd Tank Fitting

Connecting Air Pump to Nutrient Reservoir

- 1 x Tank Fitting ½" (15mm)
 - Bunnings - [Holman 15mm Female Tank Fitting](#)
 - Hills Irrigation - [HANSEN 15mm Female Tank Fitting](#)
- 2 x Push-to-fit (*Compression fitting*) ½" (15mm) BSP to 8mm or ¼" hose
 - [Hardy Spicer](#)

(Alternatively)

- 1 x Hills Irrigation - [HANSEN 15mm Female Tank Fitting](#)
- 2 x Hills Irrigation - [TEFEN 3/8" \(10mm\) x ½" \(15mm\) BUSH](#)
- 2 x Hills Irrigation - [TEFEN 8mm x 3/8" \(10mm\) Hose Tail \(Director\)](#)

Insulating Pipes

- Bunnings - [K-Flex 9 x 19mm x 1m Elastomeric Pipe Insulation - Suits 3/4" Pipe](#)
 - (Tubes from Nutrient Reservoir to Water Chiller)
 - (Tubes Between Root containers to Nutrient Reservoir)
 - (Tube from Nutrient Reservoir to Pump Inlet)
 - (Tube from Pump Outlet to Manifold)
 - (Tube from Manifold to In-line Filter)
 - Bunnings - [K-Flex 13 x 13mm x 1m Elastomeric Pipe Insulation - Suits 1/2" Pipe](#)

- ¼" Tube from Air Pump to Nutrient Reservoir

Insulating Root Containers

- Bunnings – [Aluminium Tape \(15mm wide – 50m long\)](#)
- Foil Insulation
 - <https://www.bunnings.com.au/our-range/building-hardware/building-construction/insulation/foil>

Plant Seeds (Heirloom)

- **Heirloom Seeds:** The seed of a plant that has been carefully cultivated and passed down through many generations. **Heirloom:** A valuable object that has belonged to a family for several generations.
 - [The Diggers Club](#) (*Heritage Nursery Seed Shop* – Canberra, New South Wales)

Watermelon	MOON AND STARS Red	25 Seeds	\$4.95
Tomato	COSTOLUTO GENOVESE	25 Seeds	\$4.95
Tomato	CHRISTMAS GRAPES	25 Seeds	\$3.95
Tomato	TOMATO TEN COLOUR HEIRLOOM MIX	40 Seeds	\$6.95
Strawberry	BUSH ALPINE	300 Seeds	\$4.25
Berry	TAYBERRY	In pot	\$12.95
Dwarf Tree	DWARF APPLE DUKE OF CLARENCE	In pot	\$29.95
Cucumber	CUCUMBER LEMON	40 Seeds	\$4.95
Cucumber	CUCUMBER CRYSTAL APPLE	30 Seeds	\$4.95
Cucumber	CUCUMBER JAPANESE CLIMBING ORGANIC	30 Seeds	\$4.95
Passionfruit	PASSIONFRUIT PURPLE	30 Seeds	\$4.95

- Other Suppliers of Heirloom Seeds
 - [Green Harvest](#) (Sunshine Coast Hinterland, Queensland, Australia)
 - [Reimer Seeds](#) (Mount Holly – North Carolina, America)
 - [Attitude Seed Bank](#) (Products will need to be shipped with random items, such as Mugs, Wallets, and bags, ect to remain undetected)

World of Seeds AUTO Pakistan Ryder	3 Seeds	\$50.84
World of Seeds Landraces Ketama	3 Seeds	\$38.12

‘Plant Blankets’ to protect them from sunlight and frostbite.

Shade-cloth to lay beneath the plants so they don’t get burned by the hot-tin.

PVC piping for putting into the holes for plants.

Fishing-line to hold the misting nozzles.

If using drums, the next row of 2" (50.8 mm) holes need to be off-set by 0.101146469° from the centre of the drum. For a 500mm Dia drum, this is 0.44133mm