Australian Manufacturer, B&R Enclosures Improves its Green Credentials

By Alex Burns & Simon Griffiths

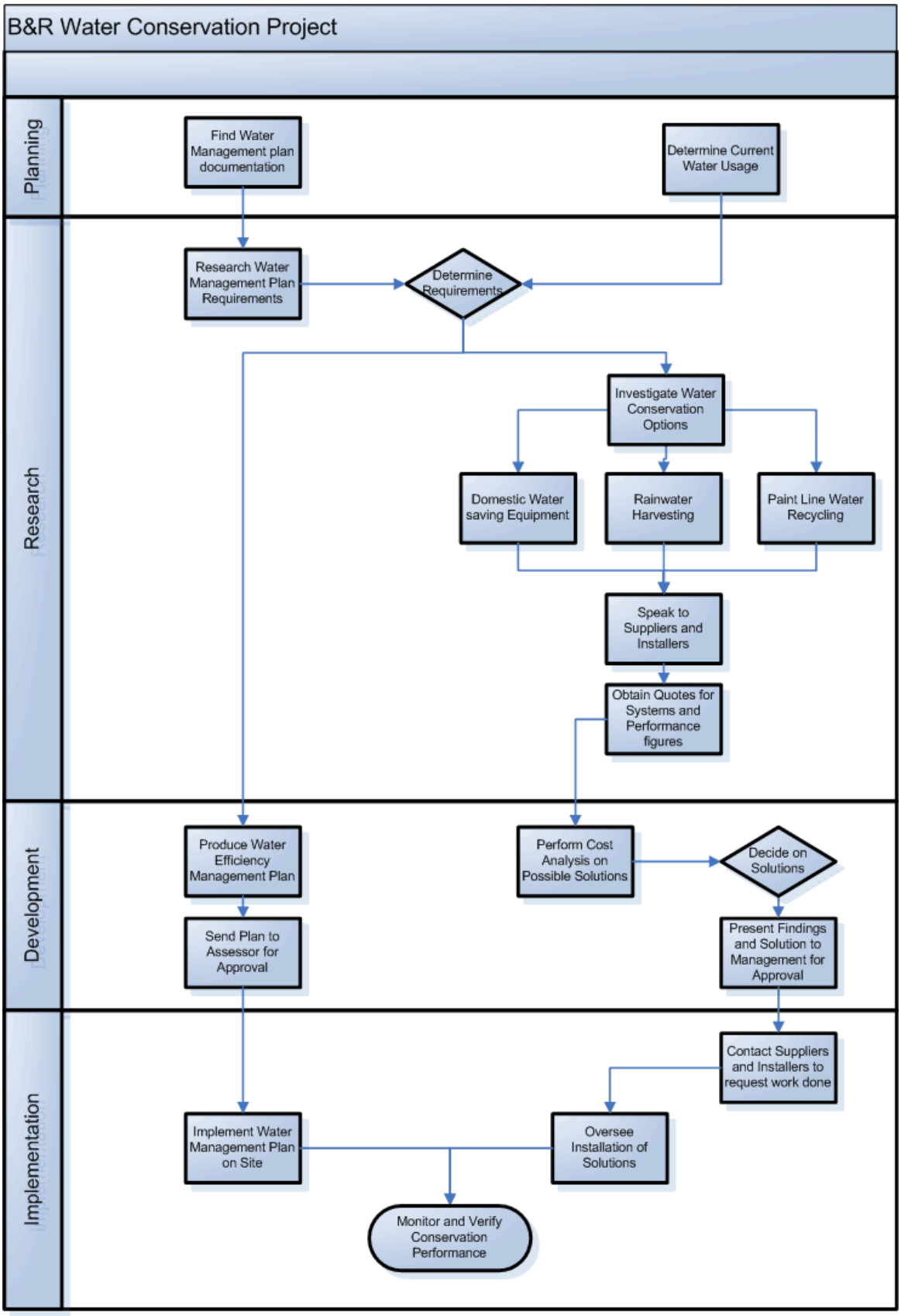
The current drought conditions in Australia and the increasing rate of global warming have forced people to look more closely at their environmental impact on the world. B&R Enclosures, Australia's largest electrical enclosure manufacturer is no exception, with the first results of its environmental policy being a dramatic reduction in the water usage in their Brisbane factory.

B&R undertook a 6 month project to reduce water consumption in July 2008, and after running with the results has found an overall reduction of over 50%. Not only has this been good for the environment, it has also slashed water and wastewater costs with the payback period of the project being around 4 months.

A full description of the project steps is available from B&R to help any other firms that may be interested in doing similar work. This is available from their website at www.brenclosures.com.au/water-saving.htm, however the process is summarised in the flow chart below.

Dan Bridges engineering manager at B&R said "To start the project we undertook an extensive survey of the water usage on the site. In our case the paint line was by far the biggest water user, so our initial work concentrated on this."

The project was carried out by Alex Burns a student from the CEED scheme. This is a scheme that allows post-graduate students industry placements as part of their work experience. B&R's management felt that having a new set of eyes to look at the plant and it's operation would be a great advantage and there would be no preconceived ideas of how it should operate.


B&R Water Conservation Project
Planning
Research
Development
Implementation
Find Water Management plan documentation
Determine Current Water Usage
Research Water Management Plan Requirements
Determine Requirements
Investigate Water Conservation Options
Domestic Water saving Equipment
Rainwater Harvesting
Paint Line Water Recycling
Speak to Suppliers and Installers
Obtain Quotes for Systems and Performance figures
Produce Water Efficiency Management Plan
Perform Cost Analysis on Possible Solutions
Decide on Solutions
Send Plan to Assessor for Approval
Present Findings and Solution to Management for Approval
Contact Suppliers and Installers to request work done
Implement Water Management Plan on Site
Oversee Installation of Solutions
Monitor and Verify Conservation Performance

B&R's Brisbane Factory

B&R are Australia's largest manufacturer of electrical enclosures, racks, cabinets and switchboard building systems. These are manufactured from sheet steel in their Brisbane and Adelaide factories. The Brisbane factory where the project was carried out includes all the equipment to take in a coil of metal, and ship completed enclosures powdercoated to suit the application. Most of the equipment uses little water except for the paint line, which is discussed in more detail below.

B&R's Original Paint Line

The diagram above shows the paint line process diagram. Product enters the diagram on the upper right and travel through the process from stage 1 to stage 5, exiting on the upper left. The stages are described below: -

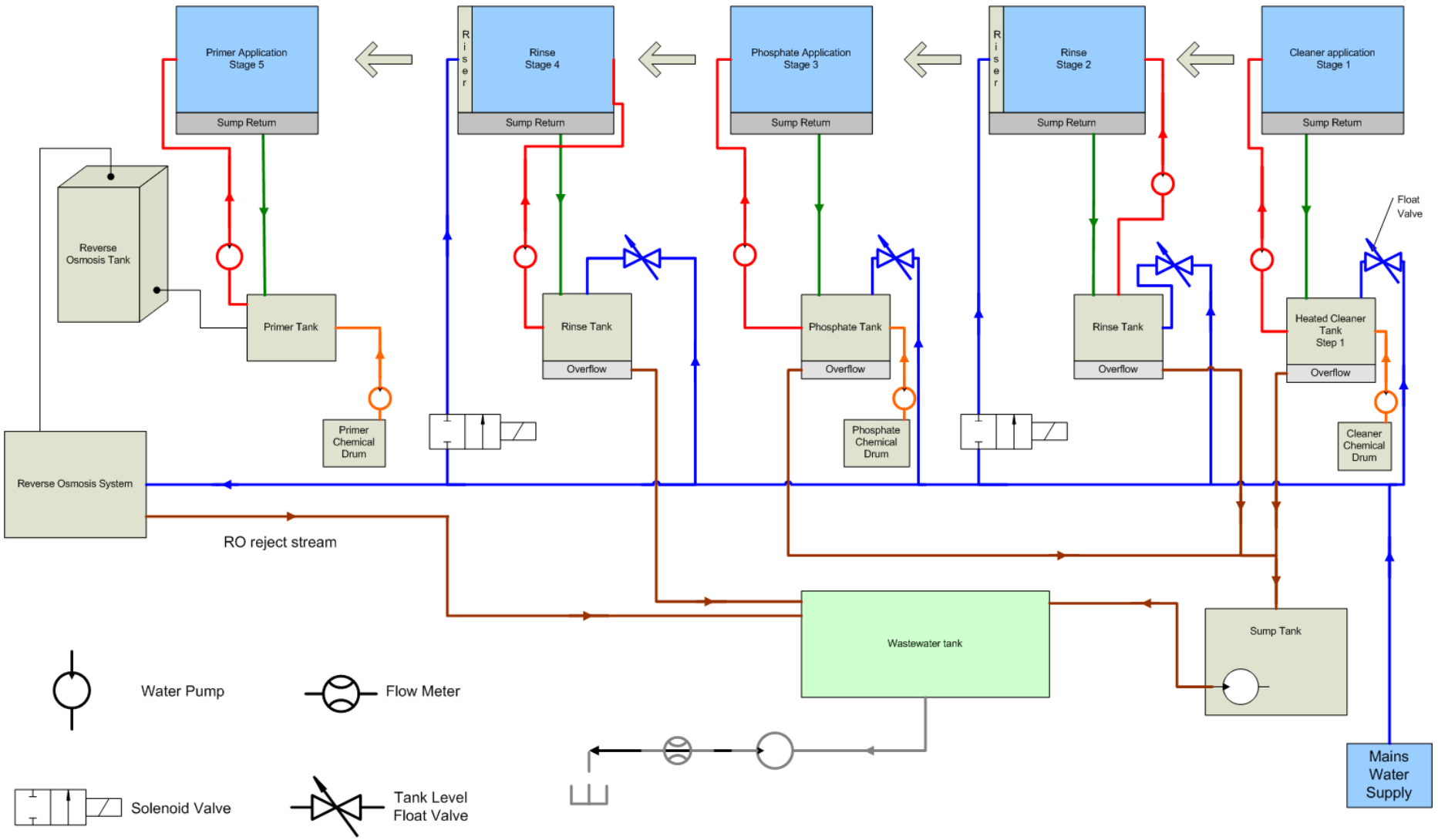
Stage 1: Alkaline Cleaner – to clean the rust preventatives off the metal surfaces. This is an alkaline cleaner diluted with water, heated, and then sprayed onto the metal surfaces. Water is used for dilution and make-up and is added to the tank via a float actuated valve system.

Stage 2: Freshwater rinse
This stage washes the excess cleaner from stage 1 off the metal parts. It uses a series of spray nozzles to do this. Water is recirculated via a rinse tank on all but the final set of spray nozzles which use mains water to ensure that the product leaving to stage 3 is clear of contaminants. Mains water is also continuously added to the rinse tank to ensure that contaminants do not build up, and the overflow caused by this is piped to a sump and on to a wastewater tank for treatment.

Stage 3: Phosphate Application
This stage sprays an acid etch phosphate onto the metal, to roughen the surface, increasing the powder coat's adhesion and apply a metallic phosphate coating that acts a corrosion prevention barrier.
Water is used for dilution and make-up and is added to the tank via a float valve top up system.

Stage 4: Freshwater rinse
This stage is identical to that outlined in stage 2 and is used to rinse of excess phosphate.

Stage 5: Pure water powder coat preparation
This final stage uses mains water that has been filtered through a Reverse Osmosis (RO) system. This removes salts and contaminants from the mains water, which helps to increase the life of the product in more arduous conditions. This water is sprayed on to the metal surfaces in a similar way to previous rinse stages. We also apply a chemical primer to this RO treated water, which helps to improve powder coat adhesion.


Primer Application Stage 5
Sump Return
Riser
Rinse Stage 4
Sump Return
Phosphate Application Stage 3
Sump Return
Riser
Rinse Stage 2
Sump Return
Cleaner application Stage 1
Sump Return
Float Valve
Reverse Osmosis Tank
Primer Tank
Rinse Tank
Overflow
Phosphate Tank
Overflow
Rinse Tank
Overflow
Heated Cleaner Tank Step 1
Overflow
Primer Chemical Drum
Phosphate Chemical Drum
Cleaner Chemical Drum
Reverse Osmosis System
RO reject stream
Wastewater tank
Sump Tank
Mains Water Supply
Water Pump
Flow Meter
Solenoid Valve
Tank Level Float Valve

Testwork

As it was identified that the paintline was B&R's biggest water user, they then had to see where it was being used. To do this various tests were performed: -

- Test water rinse sections to benchmark flowrates against each other, and against published performance data. This was done by simply timing how long it took for a known volume to flow out of the overflow.
- Inspect, clean and if necessary replace components
    - Spray nozzles – inspect for blockages, corrosion and leaks.
    - Pumps – check operating parameters are within the manufacturers recommended bands.
    - Reverse osmosis – check membrane and pump pressures are within manufacturers recommendations. Check to ensure that reject stream ratio is correct.
    - Piping – inspect for damage.

In B&R's case considerable water savings have actually been a result of these very simple inspection and maintenance procedures.

Stage 1 & 3 Chemical Tank Float Valves

The chemical tanks are used for makeup of cleaning chemicals in stage 1, and phosphate in stage 3. The made up solutions are then circulated into the paintline where they are sprayed onto the metal surfaces. Water is added to keep contaminant levels low, and to ensure correct operation of the pumps that drive the spray system. Control on this water addition system is via a float valve, so is set as a function of liquid level in the tank.

On closer inspection it was found that there was a hysteresis (time based) effect which meant that clean water was being added to the system to compensate for water circulated into the spray and collection systems. When this water returned there was an overflow of between 50 and 100 litres of the dilute chemical solution. This wasted both water and chemical, and made treating the waste difficult.

To solve this problem the float valves were recalibrated to take into account the volume that was being sent to the spray and collection systems. The end result of this was: -

- A water saving of over 500 litres for every ON/OFF cycle.
- A reduction in chemical usage to around 50% of the previous.
- A stabilisation of pH levels sent to the wastewater tank. This means that there is now no additional neutralisation of the waste, reducing chemical usage again.

Rinse Water Backflow System

Each stage in the process originally received its own supply of mains water. This was originally set up to ensure that water in every stage was free of contaminant that may effect the process operation of the stage, and therefore the final result of the product. However on testing it was found that the water quality in the rinse stages (2 & 4) was sufficiently high to be used as the feed streams for the prior stages (1 & 3), so a backflow system was implemented.

Although the backflow system has only been running a few months, which may not be long enough to get definitive results, the saving in water usage per day is around 6000 litres.

Mains Water Inlet Valve Logic (stages 2 & 4)

If the paint line is stopped for any reason, wash water must continue to circulate. This prevents any corrosion on the metal surfaces, which have at this stage been stripped of their protective coatings.

In these situations where the line is stopped, there are no new contaminants entering the system, however we were continuing to introduce mains water. By changing the logic on the control valve so that mains water was shut down and water was recirculated only as the line was stopped, a saving of around 4200 litres per day was made.

Reduction of Mains Water into the Line

With the introduction of the rinse water backflow system, the only places that mains water enters into the system are now in the rinse stages (2 & 4) and via the RO system. The further reduction of water flows is limited by the ability to keep contaminant concentrations from the metal surfaces within acceptable levels.

To test the effect of flow reduction on the stability of contaminant levels, the resistivity of the fluid in the rinse tank was measured and logged periodically at different mains water flow rates. To do these tests the water flow was set to remain constant over a 24 hour period. The measurements taken were then compared to baseline figures for the flow of mains water. A change in resistivity over time indicated a change in electrical conductance of the fluid resulting from contaminants building up. This test was then repeated at different water flow rates to see at what flow a change in the resistivity was noticeable, and from this we implied the minimum flow possible for stable operation.

The results of these tests were that the mains water flow could be safely, dramatically reduced even in our worst case operating conditions.

Recycling Systems

Having now reduced the plant flow, further reductions by incorporating a recycling system into the plant, based on the revised, lower water flows have become more viable. These are now being considered.

Rainwater Harvesting

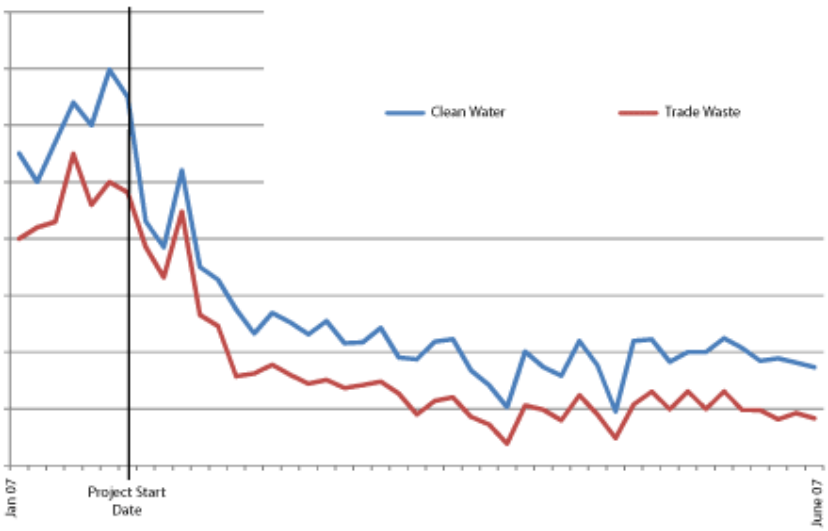
By looking at the rainfall in the local area of the plant (available from the Australian Bureau of Meteorology), the water flow required and the cost of water supplied from the mains, B&R were able to calculate the payback period of different tank system configurations, varying the number and size of the tanks. In this case payback was from 3.9 years to 9.9 years, depending on the system. None of these systems were capable of allowing B&R to 'disconnect' their factory from mains supply, as historically the period from March to August has very little rainfall in the local area. These payback period figures did not include the potential for flow reduction if a water recycling stream was installed on the paint line, so would need to be re-evaluated if this system comes online.

Another factor that may need to be taken into account would be whether the water quality was sufficiently high for use in our paint line, and if not, what additional equipment would need to be installed as a pre-treatment step.

Results

Water Usage

Water usage in the plant has been monitored to ensure that there has been a consistent reduction and the benefits that have been achieved are long term. The results are shown in the following graph:



It is clear that there is a long term reduction in the flow of both water and waste. Although this does not show that the chemical contaminant flow in the waste was also reduced.

Eco Friendly for Ecology and Economy

The great news is that this project was not only good for the environment, but actually saved B&R a significant amount of money too. The following shows the percentage reduction B&R expect on their utility bills: -

- Water – 72% reduction in cost
- Waste – 79% reduction in cost

The pay back period for the whole project was an incredible **4 months**.

Conclusion

Judging by the results B&R achieved, this is a project that any company could do, without major capital expenditure. It is good for the environment, and good for the company's bottom line.