Introduction

The “Rainwater recovery for use in cooling towers” project undertaken at Nestlé Pakenham involved redirecting rainwater from an extensive part of existing roofs, storing this rainwater in existing on site storage, and then utilising the water in the refrigeration plants cooling towers

The objective of this project is to save approximately 5 ML of water per year. This water saving is based on an average rainfall year in Pakenham of 1000 mm. The cooling towers consume approximately 12 ML of water per year. As part of this project it was necessary to identify risks and appropriate mitigation strategies for using rainwater in the cooling towers; i.e. HACCP

Project Scope

The scope of the project is to redirect the rainwater from the Frozen food roof, part of Noodle roof and part of the Pizza roof to the existing water tanks on site for storage (approximately 1.2 ML storage). The captured rainwater will then be pumped out of the tank for use in the cooling towers on site. Instead of allowing the rainwater to go to storm water drains, the factory can capture and utilise the rainwater in a controlled way in the cooling towers that are used for cooling the ammonia condensers.

Scope Change from Project Submission

The initial project submission was to utilise water in both cooling towers and boilers. Further calculations indicated that all possible rainwater that can be harvested will be used by the cooling towers). For this reason it was decided to limit the scope to use the captured water in cooling towers only.

Physical Scope

Both existing and new equipment/components were utilised for the implementation and trial of this project with Smart Water Funding being used to purchase new equipment.

Existing Components:

- 560,000L Storage tanks x 2
- Existing Pits
- Existing storm water pipe work
- Pumps to supply cooling towers

New Components:

- Ø 2 x 1000 L first flush tank
- Ø 27,000 L Storage Tank,
- Ø Pit Pumps x 2
- Ø All required Associated pipe work
- Ø All associated Electrical and Control.

Key Activities Completed

Installation of a new 300mm diameter storm water pipe to divert rainwater from Frozen's roof area to a new first flush tank and then into a new 27,000 L staging tank with 2 pumps pumping into the main storage tank.

First Flush tank

27,000 staging tank and pumps to main tank

Installation of a new 250mm line to divert rainwater from part of Noodle roof area and part of the Pizza roof area to the new first flush tanks. This water is then pumped into a 40,000 L concrete pit with two new sump pumps used to pump the water to the main storage tanks.

Pipework, first flush tank and pumping station Noodle and Pizza roof

Pipework for pumping over to storage tank

All water in the main water tank is pumped to the 4 cooling towers on demand via a stainless steel pipe. A back flow prevention device (RPZD) has been installed where it connects with town water to ensure compliance with AS3500 and plumbing codes. Automated valves have been installed to allow the system to automatically change over from rain water to town water and back. The valves automatically switch to town water when the availability of captured rainwater is low and vice versa. All control is interfaced through a Programmable Logic Controller and CiTect graphic user interface.

Pumping system to cooling towers

Backflow prevention device

PLC control system

Results Achieved

The water re-use project at Nestle Pakenham Factory achieved the following results:

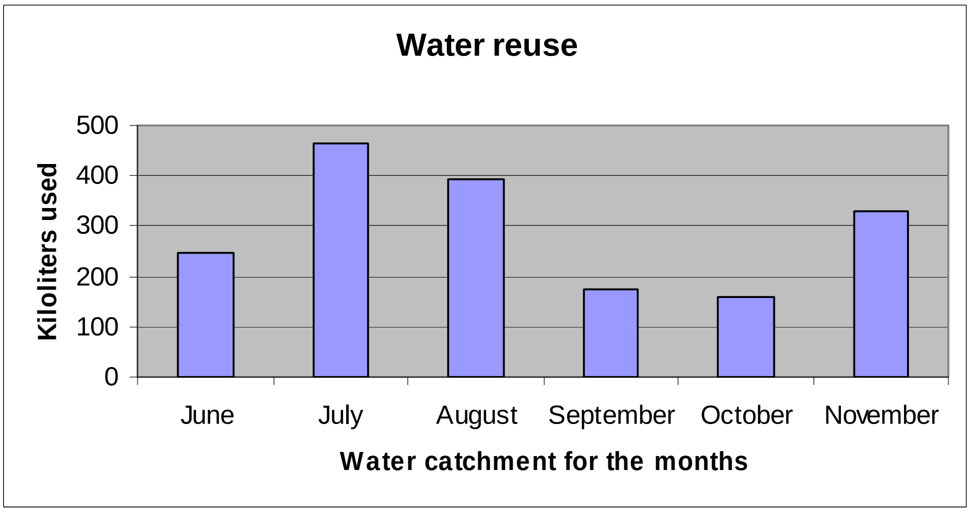
- The factory has a total roof area of approximately 20,578 m² and the catchment potential for this project is approximately 5,414m2 =5,470,000litres per year based on a rain fall 1m/year
  Rain water monitored for water quality and micro as per HACCP study. (Appendix 1)
  The capacity to store up to 1.2 ML in times of high rain fall.
- Controlling and monitoring the fully automatic system from any CiTect PC in the factory with the ability to read and analyse flow data from the rain water flow meters feeding the cooling towers at any time live.

- 1.765 ML of captured rain water, in substitution of potable water, was used during a six month period in 2008. Although this figure is below that of the anticipated 2.5ML savings, it should be noted that the monitoring period in 2008 resulted in below average rain fall (see below).
- 100% of captured rain water was re-used to substitute potable water in the cooling towers.

Month	**Rainwater used for cooling tower make-up (kl)**
June	245
July	465
August	391
September	174
October	160
November	330
TOTAL	1,765

Upper Pakenham Rainfall as per Melbourne Water Web site

Month	**Pakenham Rainfall (mm)**		**Percentage of Average**
	Actual	**Five Year Average**	
June	52.8	70.1	75%
July	70	79.6	87%
August	88.4	75.2	117%
September	39.2	81.8	47%
October	37	65.9	56%
November	116.6	89	131%
TOTAL	404	461.8	87%



Issues Arising

To ensure reliable and continuous supply of water is provided to the cooling towers, potable water is used in times of low rain fall. To achieve this Nestle integrated both the rainwater re-use and the potable water systems but needed the ability to automatically switch between the systems as needed. To resolve this Nestle installed in a back flow prevention device with fully interlocked butterfly valves and PLC controls to allow the system to operate using stored rainwater any time it rains and potable water for times without rain.

Conclusion

This project successfully demonstrates that sites with large roof areas are able to capture, store and re-use rainwater for potable substitution in cooling towers. The fully automated system used by Nestle mitigates the risks associated with low rain fall and manual operation.

APPENDIX 1:

Final HACCP for Water Project

To Capture and Store Rain Water for Use in Factory Services: Cooling Tower Make-Up Water

Project risks / modifications (Summary)

- Microbial quality of captured water may interfere with biocide treatment of cooling tower water and increase risk of Legionella – monitoring and corrective action procedure to be implemented.
- Chemical Composition of water that may interfere with biocide activity of cooling tower water – roof activity management to be implemented.

1. General - Preliminary HACCP

Product	Rain water for Factory Services - Cooling Tower Make Up Water	Project No:	Smart Water
Brand:	Not Applicable		
Key Technology	Bulk Water Storage	Start date:	01/01/2007
R&D Centre:		Completion:	September 2008

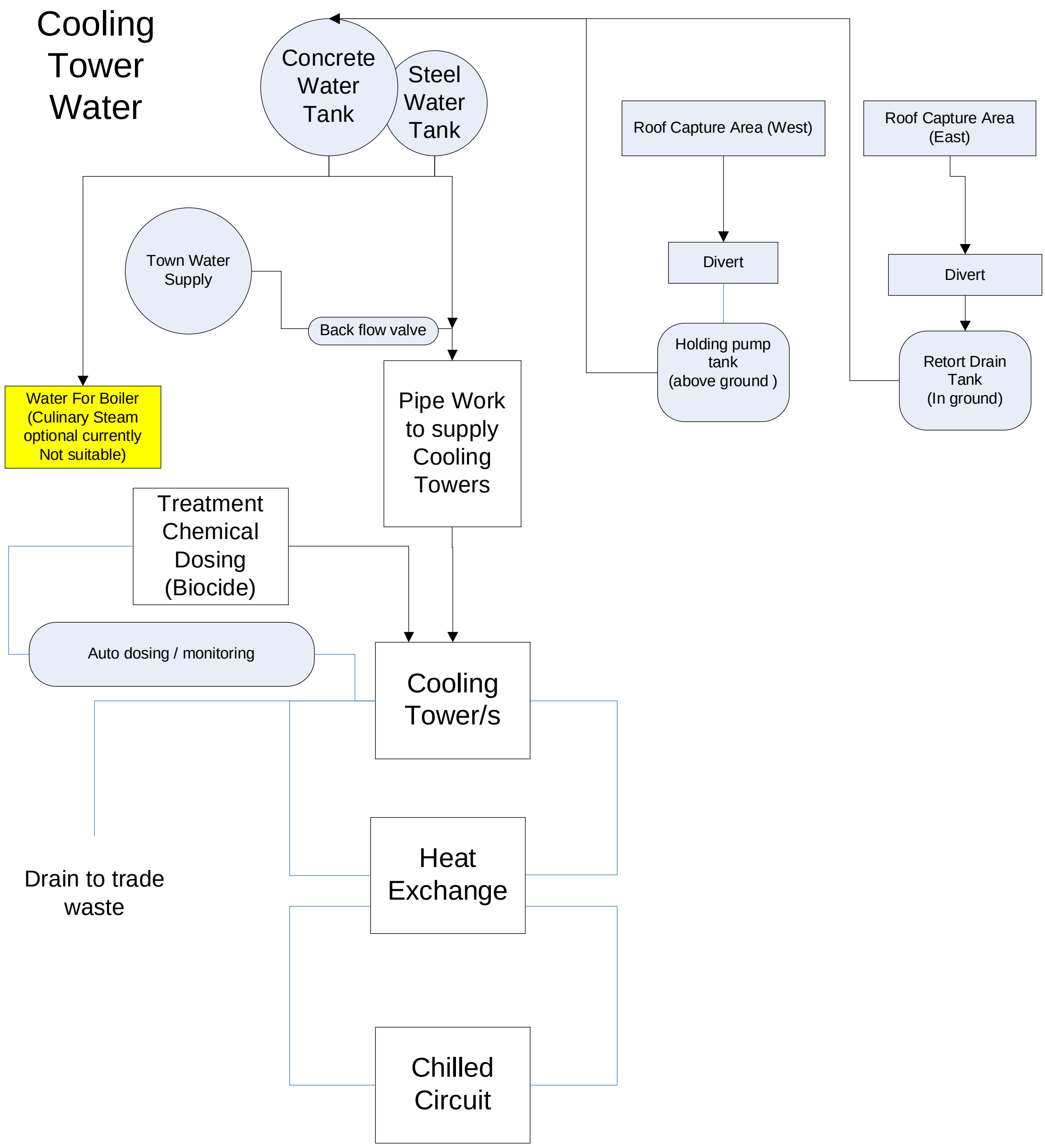
Team

Name	Dept/Company Nestle Pakenham	Position
Chris Pini (TL)	Quality Assurance	Hygienist
Andrew Koedyk	Engineering	Engineering Manager (Previous)
Bruce Warburton	Engineering	Engineering Services Manager
Jim Kelson	Engineering	Project Engineer
Geoff Young	Engineering	Engineer
Graham Ellis	Engineering	Engineering Manager (Current)

2. Process Description

Name	Factory Services: Cooling Towers (for all evaporator cooling)
Type	Factory Services
Use/Application	Water to supply cooling tower water
Target consumer	Not Applicable
Market previewed	AU
Regulatory considerations	Requirement to control Legionella in Cooling Tower Systems
Identified production site	Nestlé Pakenham

Flow Diagram
Propose (to be verified)



Town Water Supply of water (also used for process water)		B	Pathogenic Organisms Hazard for potable water, cooling tower water treated with biocide.	Incoming Potable water if not treated or contaminated	No	-	**Monitoring point:** Chlorination of Potable water. Monitoring of indicator organisms. Potable water standards. Minimal contamination in catchments, disinfection, Australian drinking water guidelines.	Routine Monitoring of potable water (Town Supply) for indicator Organisms	Monitoring as part of potable water: Site monitoring of Cl^- daily Monthly Micro sample Supplier monitors for bacteria and chlorination .	Coliforms Not Detected/100mL E.coli Not Detected/100mL Total Plate Count Max 100/mL Residual Chlorine	Investigate & Rectify Chlorination & bacterial levels in Town Supply Water. Procedure for control of Potable Water
Town Water Supply of water		C	Nil (Sensory only)				**Monitoring point:** Sensory only. Water supplier to control Food Safety Hazards of Chemical.	Sensory Evaluation of Water. Annual Water composition (Minerals)	Weekly/ Annual	N/a	-
Town Water Supply of water for boiler and		P	Solids - clay, silt, plankton	-	No	-	**Monitoring point:** TDS & Turbidity & pH monitoring also	Boiler Operation Parameters	TDS & Turbidity & pH (in line meter with	See boiler operating parameters	Boiler operator Contact Southeast

cooling tower							SE water measure		alarm) Daily records plus Nalco monitoring. SE water Monitoring		Water.
Rain Water Capture	First Flush to Storm water	B / C / P	Particulate Matter, Dust or food residues, Bacteria	Particulate matter and nutrient are risk factors for cooling tower management (bacteria). Origin from debris colleted on roof.	No	-	Divert to drain by default (failsafe). Sufficient water diverted to drain to remove particulate matter.	Verify function of divert, plus verify volume of divert sufficient. Initial verification then biannual. (PM03)	Biannual monitoring of turbidity of first water diverted to storage tank after volume to drain.	Adjust first flush system. Clean divert tank.	Increase divert volume, filtration may be required at the exit of storage tank if particulate matter too high. To be reviewed at installation

Rain Water Capture	Roof Capture of rain water	P	Asbestos (OH&S)	From Roofing Material. Potential to become airborne if persist through to cooling tower	No		Asbestos register and management system			No Asbestos exposed capture area. Nil Asbestos in captured water.	
Storage	Steel Water Tank /Concrete Water Tank	B	Biofilm formation / Slime / Algae in water accumulated in roof	Nutrients in water and bacteria from environment, Algae, Slime, biofilm may interfere with biocide activity			-	-	3 Monthly TPC from storage tank	-	Disinfection (chlorination) may be required. Tank sealed away from sunlight. Monitoring of bacteria levels in storage- see below -

Cooling Tower Water	Chemical Components of Make-Up Water	C / P	Detergents, Hydrophobic chemicals (lubricants etc) may interfere with biocide for cooling towers	Chemicals persisting from processes conducted on roof, HVAC cleaning, lubricants, pesticides		-	First Flush system to flush to drain the first rain from roof. Routine analysis of water captured water from the roof for contaminants	Verify the first flush diverts sufficient rain water to ensure removal of >90 contaminants.	-	-	-
Requirements of water for cooling towers	Biocide Treatment of tower water circuit	B	Legionella bacteria	Commonly present in water, environment. Likely to be present in rainwater capture from roof.			**Monitoring point:** Microbial levels of top up water levels to be as per AS 3666.3:2000 Chemical dosing of cooling towers Biocides / Corrosion inhibitors Basin temperature and operating control of cooling towers (Refer to the QMS)	Review of microbiology and water quality, weekly.	Levels of Indicator Bacteria in Water. Weekly monitor the level of Heterotrophic bacteria in tank water.	Heterotrophic Plate count (HPC) <100000 cfu/g AS 4276.3.1 using the 35°C/37°C Method Legionella <10 cfu/mL	If water in storage tank has a HPC >100,000, retest & sample cooling tank sump immediately & increase biocide. If re-test >10^4 chlorinate tank water or DUMP to storm water

											drain. See Cooling Tower procedures

Monitoring Scheme

B = Biological (including bacteria, algae, mould, yeast)
C = Chemical
P = Physical