Croydon Town Water Supply Scheme

DRINKING WATER QUALITY MANAGEMENT PLAN

Croydon Shire Council - Service Provider SP39

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Glossary of Terms

- ADWG 2011 - Australian Drinking Water Guidelines (2011). Published by the National Health and Medical Research Council of Australia
- E. coli - Escherichia coli, a bacterium which is considered to indicate the presence of faecal contamination and therefore potential health risk
- HACCP Hazard Analysis and Critical Control Points certification for protecting drinking water quality
- Mg/L - Milligrams per litre
- NTU - Nephelometric Turbidity Units
- MPN/100mL - Most probable number per 100 millilitres
- CFU/100mL - Colony forming units per 100 millilitres
- < Less than
- > Greater than

1.0 Service Provider

SERVICE PROVIDER NAME	Croydon Shire Council
SERVICE PROVIDER IDENTIFICATION NUMBER	SP39
SERVICE PROVIDER SIZE	Small
REGISTERED	Yes
REGISTERED ADRESS	63 Samwell Street, Croydon
WEBSITE	www.croydon.qld.gov.au
CONTACT DETAILS	Garry Pickering, Works Manager Contact phone number (07) 4748 7142
AFTER HOURS	0437 461 837

1.1 Scheme Details

Table 1.1 Listing of Drinking Water Supplies

Scheme Name	Operator (organisation)	Communities Served	Current			Projected in 10 years		
			Population served	Connections	Demand ML/d	Population served	Connections	Demand ML/d
Croydon Town Water Supply Scheme	Croydon Shire Council	Croydon Town	250	132	295.91	339	149.00	334.3783

The Croydon Shire comprises an area of 29,583 square kilometres and is located in the Gulf Savannah Region of Far North Queensland. The shire is situated in the catchments of the Norman and Gilbert River systems.

Croydon Shire Council is a registered service provider in accordance with the *Water Supply (Safety and Reliability) Act 2008* for reticulated water supply. Council owns, operates and manages the Croydon Town Water Supply Scheme.

Croydon Town Water Supply is a residential reticulated water supply scheme supplying an estimated population of 250 people influxes during the tourist season.

Source 1

Situated approximately 4.4 kilometres north-east of Croydon town is the earth wall dam which was constructed in 1994 as the town's primary bulk water supply. The dam is approximately 400m long and 16 meters deep and has a capacity of approximately 5200ML with a calculated yield of 184ML/annum. Prior to 1996, Croydon mainly obtained its water from a number of bores and from mining pits, such as Butterfly North Pit, which with time was struggling with the increase in demand.

Source 2

The new town supply bore is located approximately 80 metres below Lake Belmore Dam Wall. The bore is 168 metres deep and has a submersible pump delivering ground water to the adjacent pump station which transfers water to the Treatment Plant.

Source 3

The Butterfly North Pit is approximately 1.5km North West of Croydon and has been connected to the Town supply via a pipeline to the water treatment plant.

Annual yield from this source is predicted to be 90 ML/yr.

Source Overview

Lake Belmore Dam has a yield of 184 ML/year; however, as a result of reduced annual rainfall and subsequent reduced inflow to the dam, the source reached critical levels in 2015. A similar production 184 ML/year is expected from the newly constructed bore however due to the high fluoride level in the bore water only a maximum of 10% can be contributed to the total supply to keep within guideline limits. Butterfly North Pit will contribute to the remaining needs of the town.

Current sourcing is 60% Lake Belmore and 30% Butterfly North and 10% from the Bore.

No significant growth is expected in the next ten years and flow projections are based on a nominal population growth of *1.3% per year. (*ABS Statistics)

Butterfly North Pit was originally a gold mine in the mid to late 1980's. There were no known harmful minerals detected during mining and Council has used the pit as an emergency water source since 1994. Current water quality testing has shown no excessive minerals with the exception of Fluoride, which is monitored continually.

2.0 Infrastructure

Figure 2.1 map of source to tap

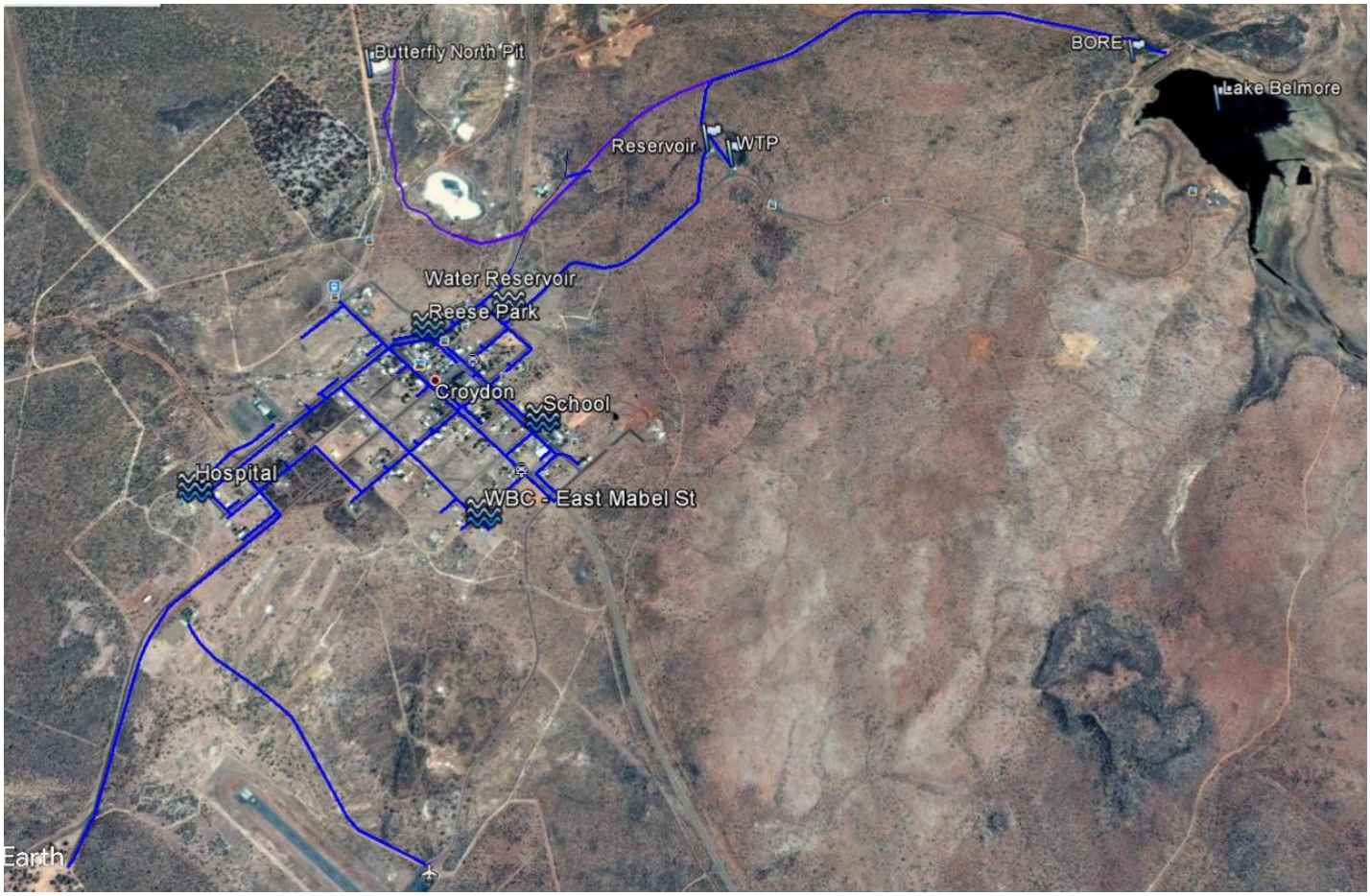


Figure 2.2 Service Schematic Layouts

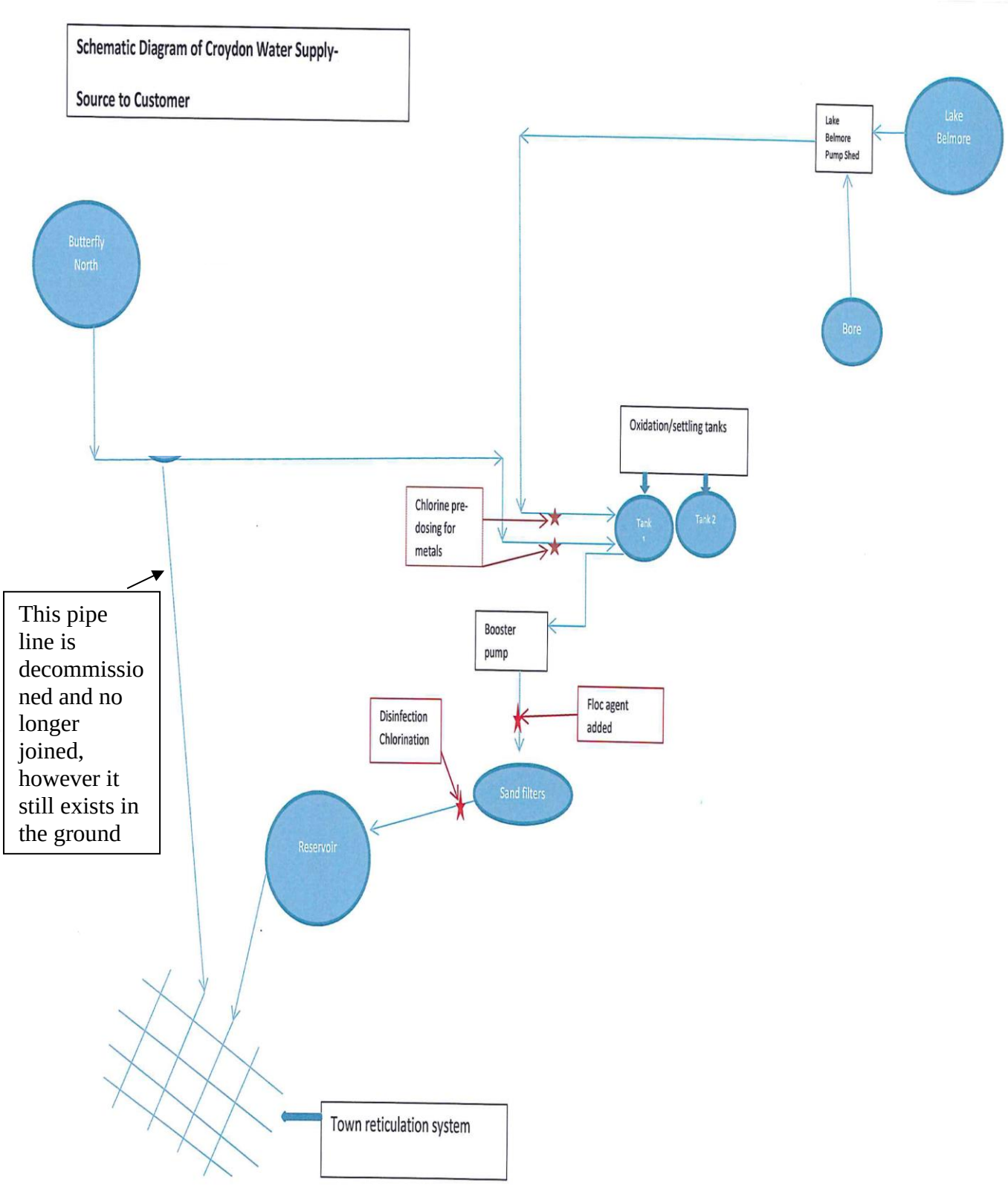
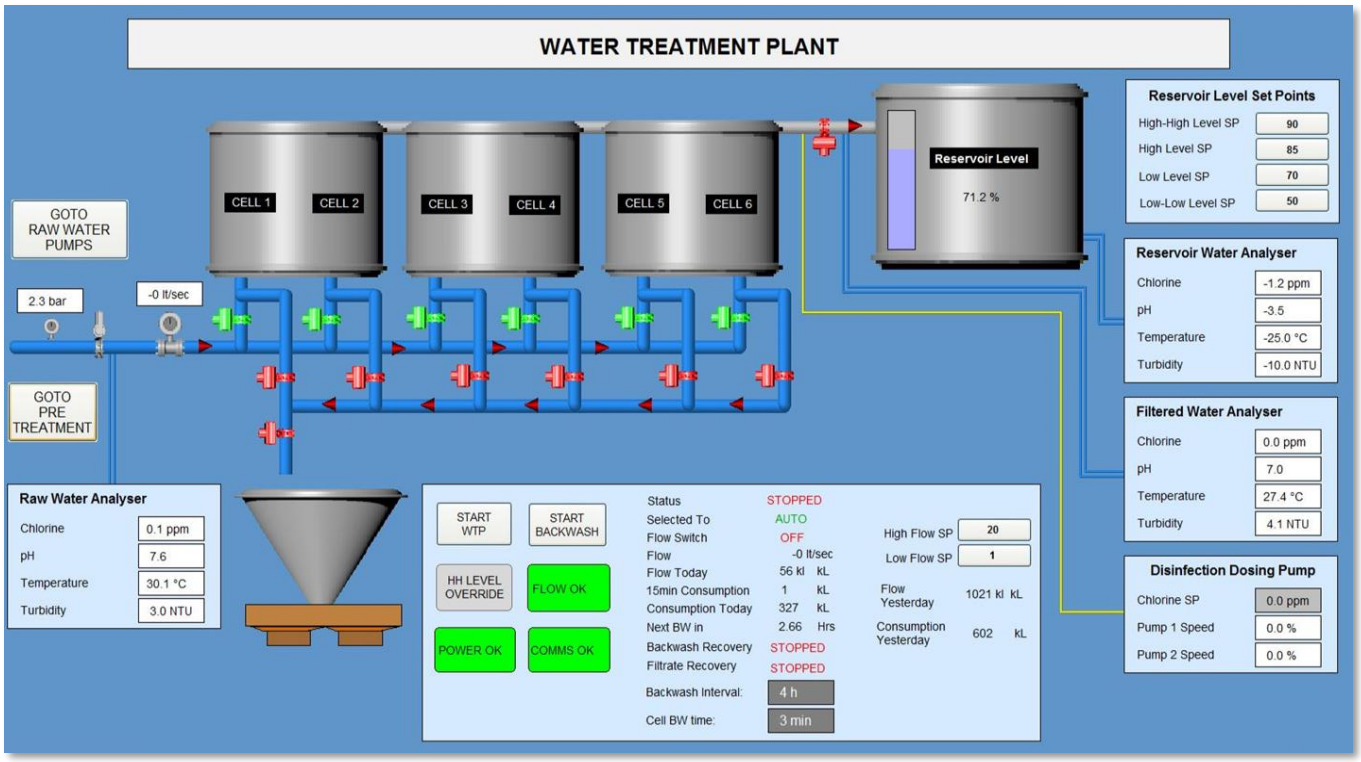
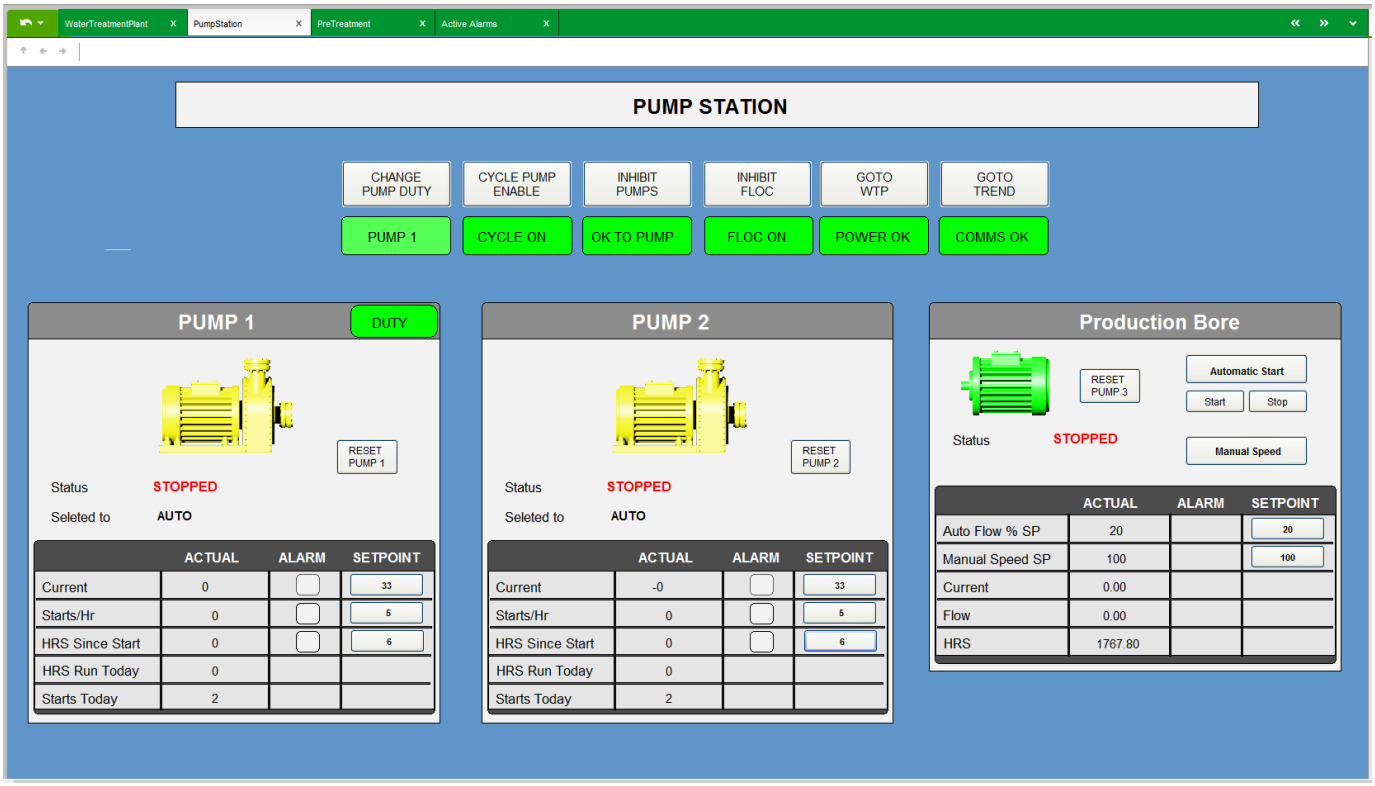


Figure 2.3 Treatment Plant Schematic





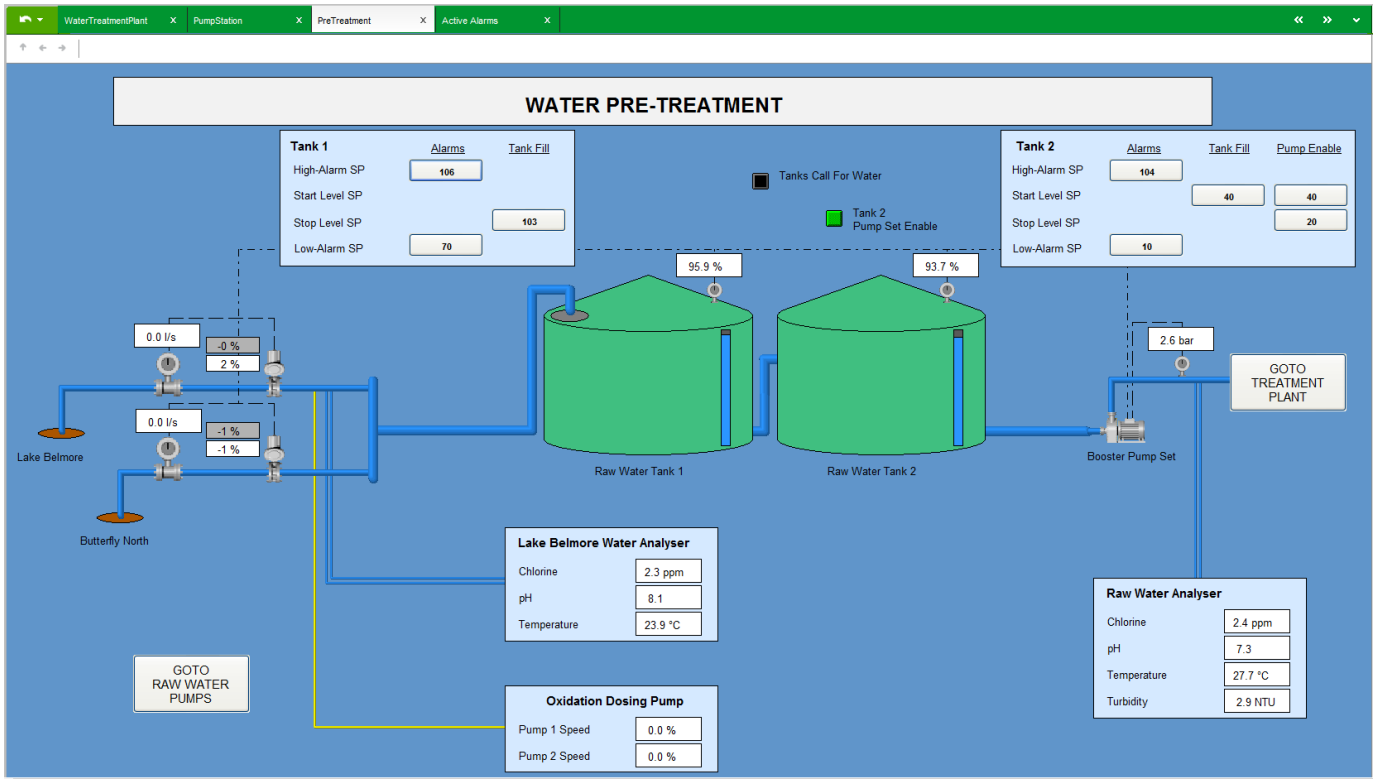
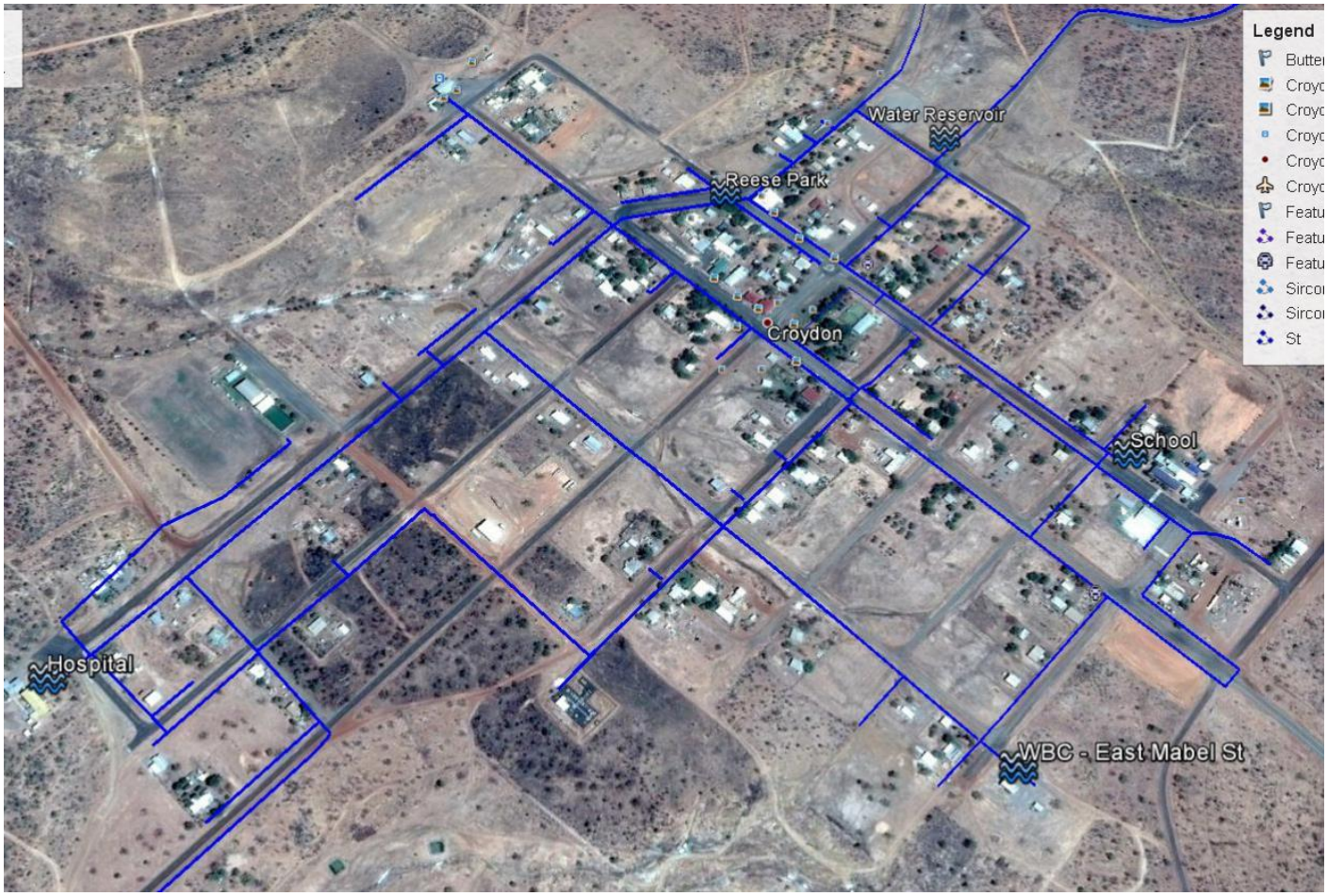


Figure 2.4 Reticulation sampling map



2.2 Infrastructure, Treatment, Disinfection

Currently Croydon town is serviced by a reticulated water supply that is sourced from two (2) sources Lake Belmore Dam and Butterfly North Pit. The water is transferred from the dam and bore to the treatment plant via the pump station located adjacent to the dam wall; this is done by the rising main in 150mm U PVC Blue Brute Class 12 and is 3.37km long. Butterfly North Pit is pumped direct to the plant by U PVC Blue Brute Class 12 and is approximately 1.5km in length. .

Treatment

(a) Pre-treatment
- The pre chlorination is dosed at the back of the Plant where Lake Belmore Dam and Butterfly North waters are mixed in two (2) retention tanks. In these tanks the metals such as iron, aluminium & manganese are oxidised and converted from soluble to particulate form prior to entering the plant.
- Water is pumped from retention tanks through plant.

(b) Treatment
- Flocculation is achieved by dosing with aluminium hydrochloride and mixing occurs in the detention tank. The sand filters have been designed with a flocculation zone above the layered filter sand to allow establishment of a “floc blanket” to trap floc with entrained solids.
- Filtration is achieved by direct filtration (i.e. no clarification) using pressurized slowly to medium rate sand filters (6 cells) with automated backwash.
- Water is constantly analysed during the process for turbidity chlorine and ph.
- Disinfection by chlorination is achieved by dosing sodium hypo chlorite.

Reservoir Storage

Clearwater reservoir storage consists of a single 1.8ML precast concrete on-ground sealed reservoir on elevated terrain, BWL 150.2m.

Telemetry

A telemetry system (Welcon) was installed in conjunction with the water treatment plant and enables controls. For example:
- stop/start
- adjustment of set-points
- pumps on/off
- flow rate
- treatment plant operations
- reservoir levels
- power chemical flow alerts
- alarm paging system

Recently an upgrade of the telemetry includes additional telephone notifications. Remote management of pumps, set points etc. can be undertaken from any connected computer.

Remote Telemetry Units (RTU’s) are located at:
- Lake Belmore Dam Pump Station
- Water Treatment Plant
- 1.8ML Reservoir

The base station is located in the Administration office at the Croydon Shire Office. There are plans to relocate to the Water Treatment Plant Office.

Reticulation

The reticulated pipe work varies in diameter from 63mm up to 250mm with the majority of reticulation pipe work installed in about 1968 (i.e. approximately 40 years old). The rising main from Lake Belmore Dam, the water treatment plant and the ground level reservoir was constructed in 1995.

The rising main from the new town supply bore to the Belmore Dam pump station was constructed in 2014. The new sections of rising main from the Butterfly North source were constructed in 2016.

Council commenced installation of water meters in 2009 and completed installation of all water meters in 2010.

2.3 Distribution/Reticulation

Table 2.3.1 Infrastructure Details

Column 1 Component		Column 2 Scheme 1
Sources	**Name Source 1**	**Belmore Dam**
	Type	*Surface water dam*
	% of supply	60%
	Reliability	Supply is impacted by dry weather
	Water quality issues	Iron, manganese, medium to high alkalinity.
	Name Source 2	**Bore (near Lake Belmore)**
	Type	Sub artesian bore, totally insulated from any surface sources and insulated from the dam.
	% of supply	10%
	Reliability	Recharged by groundwater
	Water quality issues	Fluoride & Arsenic levels which requires blending with Lake Belmore only
	Name Source 3	**Butterfly North Pit**
	Type	Open water storage pit
	% of supply	30%
	Reliability	Recharged by groundwater
	Water quality issues	Fluoride which requires blending with Lake Belmore only.
Sourcing Infrastructure Lake Belmore	Type (pumped/gravity/equipped bore/etc.)	Two Grundfos centrifugal pumps (80x50-200, 18.5 kW) with duty point of 16L/s at 61m head.
	Description	- Floating intake secured to the floor, screened, intake is 1m below surface (single fixed off take). - Only one pump operates at any time. - The pump station is located adjacent to the dam wall. - Remote telemetry units operate pumps on/off and flow rate.
Sourcing Infrastructure Bore	Description	The bore is cased with 300mm pvc and is168m deep, it is tested at 11.75l/s and sustainable at 4l/s. Equipped with a Gundfos SP30-8 4in submersible pump.
Sourcing Infrastructure Butterfly North Pit	Description	Wilo 22kW submersible pump on floating pontoon which is operated by a variable speed drive.
Are there any sources that **do not** undergo treatment prior to supply?	No	
Treatment Plant	Name	Croydon WTP
	Process	Pre-chlorination at WTP via retention tanks flocculation sand filtration
	Design Capacity (24 hr operation)	1.03ML/d
	Daily flow range	0.2 - 0.6 ML/d
	Chemicals added	Sodium hypochlorite Aluminium hydrochloride
	Standby chemical dosing facilities (Y/N)	Yes
	Water sourced from and %	Lake Belmore 45% Butterfly North 45% and Bore 10%
	% of average day demand provided	100%
	% of scheme supply Distribution area supplied	100% of scheme supply area

Column 1 Component		Column 2 Scheme 1
	Bypasses / Variations	Bypasses have been built into the system. Lake Belmore water can be pumped through the Butterfly North pipeline directly to the WTP bypassing the settling tanks. If this was to occur pre-chlorination happens at Lake Belmore Variation – chlorine agent dosing can be undertaken at Lake Belmore.
Are there any sources that **do not** undergo disinfection prior to supply?	No	
Disinfection	Location	Chlorine injection is prior to entering the oxidation tanks and is the final treatment step post WTP.
	Type	Sodium hypochlorite
	Dose rate	3.0 (exiting the WTP)
	Target residual levels	2.5mg/L in the reservoir, between 0.5-1mg/L in the reticulation
	Duty/standby	Yes
	Dosing arrangements	Residual analyser
	Alarms	Yes, failure, low and high residual
	Auto shut-off arrangements	Yes (if no chlorine flowing whole plant shuts off)
Distribution and Reticulation System	Pipe material	AC (55%, 5.2km), PVC (23%, 2.1km), Poly (22%, 2km)
	Age range	Original AC built 1968 52% (25-30yrs), 39% (10-15yrs), 9% (0-10yrs)
	Approx. % of total length	100% (14.73km)
	Areas where potential long detention periods could be expected	Limited dead ends (some low use areas being addressed in Council works project)
	Areas where low water pressure (e.g. < 12 m) could be expected during peak or other demand periods)	Gravity feed, no elevated areas in town, system pressure in mains is fairly regular.
Reservoirs A	**Ground (No)**	One precast concrete on-ground sealed reservoir on elevated terrain
	Name	Croydon Ground Level Reservoir
	Capacity (ML)	1.8ML
	Roofed (Y/N)	Y
	Vermin-proof (Y/N)	Y (sealed hatch)
	Runoff directed off roof (Y/N)	N, sealed flat top roof

2.4 Key Stakeholders

Table 2.4.1 Stakeholders involved in the management of drinking water quality

Organisation	Contact Name and Details	Relevance to management of drinking water quality	How the stakeholder is engaged in the DWQMP
Welcon Technologies (Townsville)	Townsville Branch	Maintenance of telemetry	Installed and maintained Remote Telemetry Unit/s
Aeramix Pty Ltd	Melbourne based	Maintenance	Upgrade of water treatment plant
Cairns Regional Council	Water and Waste Laboratory Services	Microbial and chemical water quality sampling	Samples sent once per month
Department of Energy and Water Supply	Dr Pushpa Ginige Senior Engineer	Regulator for drinking water quality	Reporting incidents, approving DWQMP.
Queensland Health	Public Health Unit (Cairns)	Advice and incident management guidance	As required, conduct periodic visits, may provide advice on incident management
Vulnerable Users	Croydon Hospital Croydon State School Children Services Local Businesses Queensland Police Service Caravan Park General Public	Consumers	Advised when incidents occur
Major landholders in the catchment	Tom Pickering – The Maid Peter Kennedy – Alehvale	Properties activities could impact on water quality	Contacted where a concern, as necessary. Lease hold conditions apply.

3.0 Identify Hazards and Hazardous Events

3.1.1 Water Quality Information

Raw water quality data was obtained through the 'Snapshot Monitoring Program' implemented by the Queensland Water Supply Regulator and Queensland Health to support service providers in the preparation of the Drinking Water Quality Management Plan. A summary of these results is detailed below.

Treated water quality data provided in this section was performed by Croydon Shire Council for drinking water quality quarterly reporting purposes.

Summary Water Quality Data

Scheme name	Scheme component	Parameter	Units	Frequency of sampling	Total No. samples collected	No. of samples in which parameter was detected	No. of samples exceeding water quality criteria	Min	Max	Average (Mean)	Drinking Water Guidelines	Laboratory Name
CROYDON TOWN SUPPLY	Reticulation 2016 (5 test locations)	E.coli	CFU/100mL	Monthly	40	40	0	0	<1	<1	<1	Cairns Regional Council Laboratory
		Heterotrophic Plate Count	CFU/mL	Monthly	40	0	0	<1	>300	52.55		Cairns Regional Council Laboratory
	Reticulation at Reservoir Tank (2012 to 2016)	Chlorine Free	mg/l	Daily	577	577	0	0.06	4	2.03	*>5*	Croydon Shire Council
		Chlorine Total	mg/l	Daiy	573	573	0	0.28	4.8	2.2	*>5*	Croydon Shire Council
		Fluoride	mg/l	Daily	402	402	0	0.6	1.52	1.06	>1.5	Croydon Shire Council
		pH	1-14	Daily	573	573	0	6.35	8.15	7.25		Croydon Shire Council
		Turbidity	Ntu	Daily	461	461	0	0.01	1.39	0.7		Croydon Shire Council
		EP131A Pesticide Organochlorine Pesticides (ult)		6 monthly	2	0	0	60.5	90.3	75.4	42-143	Cairns Regional Council Laboratory
		EP234A Organophosphate Pesticides (ult)		6 monthly	2	0	0	94.8	108	101.4	14-166	Cairns Regional Council Laboratory
	Source water-Lake Belmore 2016	**Aluminium**	mg/l	6 monthly	**2**		0	0.01	0.031	0.02		Cairns Regional Council Laboratory

	Arsenic	mg/l	6 monthly	**2**	2	0	0.004	0.011	0.0075	<0.01	Cairns Regional Council Laboratory
	Cadmium	mg/l	6 monthly	**2**	2	0	1E-04	2E-04	0.00015	<.002	Cairns Regional Council Laboratory
	Chromium	mg/l	6 monthly	**2**	2	0	0.001	0.001	0.001	<.05	Cairns Regional Council Laboratory
	Copper	mg/l	6 monthly	**2**	2	0	0.001	0.018	0.0095	<2	Cairns Regional Council Laboratory
	Iron	mg/l	6 monthly	**2**		0	0.874	0.946	0.91		Cairns Regional Council Laboratory
	Lead	mg/l	6 monthly	**2**	2	0	0.002	0.002	0.002	<.01	Cairns Regional Council Laboratory
	Manganese	mg/l	6 monthly	**2**	2	0	0.069	0.094	0.0815	<.5	Cairns Regional Council Laboratory
	Nickel	mg/l	6 monthly	**2**	2	0	0.001	0.001	0.001	<.02	Cairns Regional Council Laboratory
	Zinc	mg/l	6 monthly	**2**		0	0.001	0.043	0.22		Cairns Regional Council Laboratory
	Fluoride	mg/l	6 monthly	**2**	2	0	0.048	0.25	0.149	<1.5	Cairns Regional Council Laboratory
Source Water-Butterfly North 2016	**Aluminium**	mg/l	6 monthly	**2**		0	0.058	0.189	0.1235		Cairns Regional Council Laboratory
	Arsenic	mg/l	6 monthly	**2**	2	0	0.003	0.004	0.0035	<0.01	Cairns Regional Council Laboratory

	Cadmium	mg/l	6 monthly	**2**	2	0	1E-04	2E-04	0.00015	<.002	Cairns Regional Council Laboratory
	Chromium	mg/l	6 monthly	**2**	2	0	0.001	0.001	0.001	<.05	Cairns Regional Council Laboratory
	Copper	mg/l	6 monthly	**2**	2	0	0.003	0.007	0.005	<2	Cairns Regional Council Laboratory
	Iron	mg/l	6 monthly	**2**		0	0.023	0.038	0.0305		Cairns Regional Council Laboratory
	Lead	mg/l	6 monthly	**2**	2	0	0.001	0.001	0.001	<.01	Cairns Regional Council Laboratory
	Manganese	mg/l	6 monthly	**2**	2	0	0.001	0.117	0.059	<.5	Cairns Regional Council Laboratory
	Nickel	mg/l	6 monthly	**2**	2	0	0.001	0.005	0.003	<.02	Cairns Regional Council Laboratory
	Zinc	mg/l	6 monthly	**2**		0	0.007	0.009	0.008		Cairns Regional Council Laboratory
	Flouride	mg/l	6 monthly	**2**	2	2	1.6	1.8	1.7	<1.5	Cairns Regional Council Laboratory
Source water-Bore 2016	**Aluninium**	mg/l	6 monthly	1		0	0.008	0.008	0.008		Cairns Regional Council Laboratory
	Arsnec	mg/l	6 monthly	1	1	1	0.033	0.033	0.033	<0.01	Cairns Regional Council Laboratory
	Cadmium	mg/l	6 monthly	1	1	0	1E-04	1E-04	0.0001	<.002	Cairns Regional Council Laboratory

	Chromium	mg/l	6 monthly	1	1	0	0.001	0.001	0.001	<.05	Cairns Regional Council Laboratory
	Copper	mg/l	6 monthly	1	1	0	0.001	0.001	0.001	<2	Cairns Regional Council Laboratory
	Iron	mg/l	6 monthly	1		0	1.55	1.55	1.55		Cairns Regional Council Laboratory
	Lead	mg/l	6 monthly	1	1	0	0.001	0.001	0.001	<.01	Cairns Regional Council Laboratory
	Manganese	mg/l	6 monthly	1	1	0	0.235	0.235	0.235	<.5	Cairns Regional Council Laboratory
	Nickel	mg/l	6 monthly	1	1	0	0.001	0.001	0.001	<.02	Cairns Regional Council Laboratory
	Zinc	mg/l	6 monthly	1		0	0.005	0.005	0.005		Cairns Regional Council Laboratory
	Flouride	mg/l	6 monthly	1	1	1	3.9	3.9	3.9	<1.5	Cairns Regional Council Laboratory

Table 3.1 Water Quality Complaints

Year	Number of water quality complaints	Water quality complaints per 1000 connections	Main reasons for complaints	Likely sources/causes of problems	Resolution of problem

Water Quality Analysis Discussion

E. coli monitoring

All E. coli and chlorine sampling was performed Croydon Shire Council and sent to Cairns Regional Council laboratory for analysis.

There has been one (1) exceedance of ADWG health guideline values. This was in May 2015 and was investigated and reported as a sampling error by Council Director of Engineering Services, Ray Kirkman.

Table 3.1 Water quality complaints

For the past 2 years there have been no water quality complaints in Croydon. The Internal complaints system (InfoXpert) maintains a record of complaints.

3.1.2 Catchment Characteristics

There are native title restrictions on the use of the dam. Tagalaka indigenous community have native title rights over the eastern side of the dam and restrict access to the dam catchment. Cattle are grazing in the remainder of the catchment but do not have access to the dam. The dam area is fenced. The dam is owned by Croydon Shire Council.

Figure 3.1 Catchment map of Lake Belmore Dam, Croydon

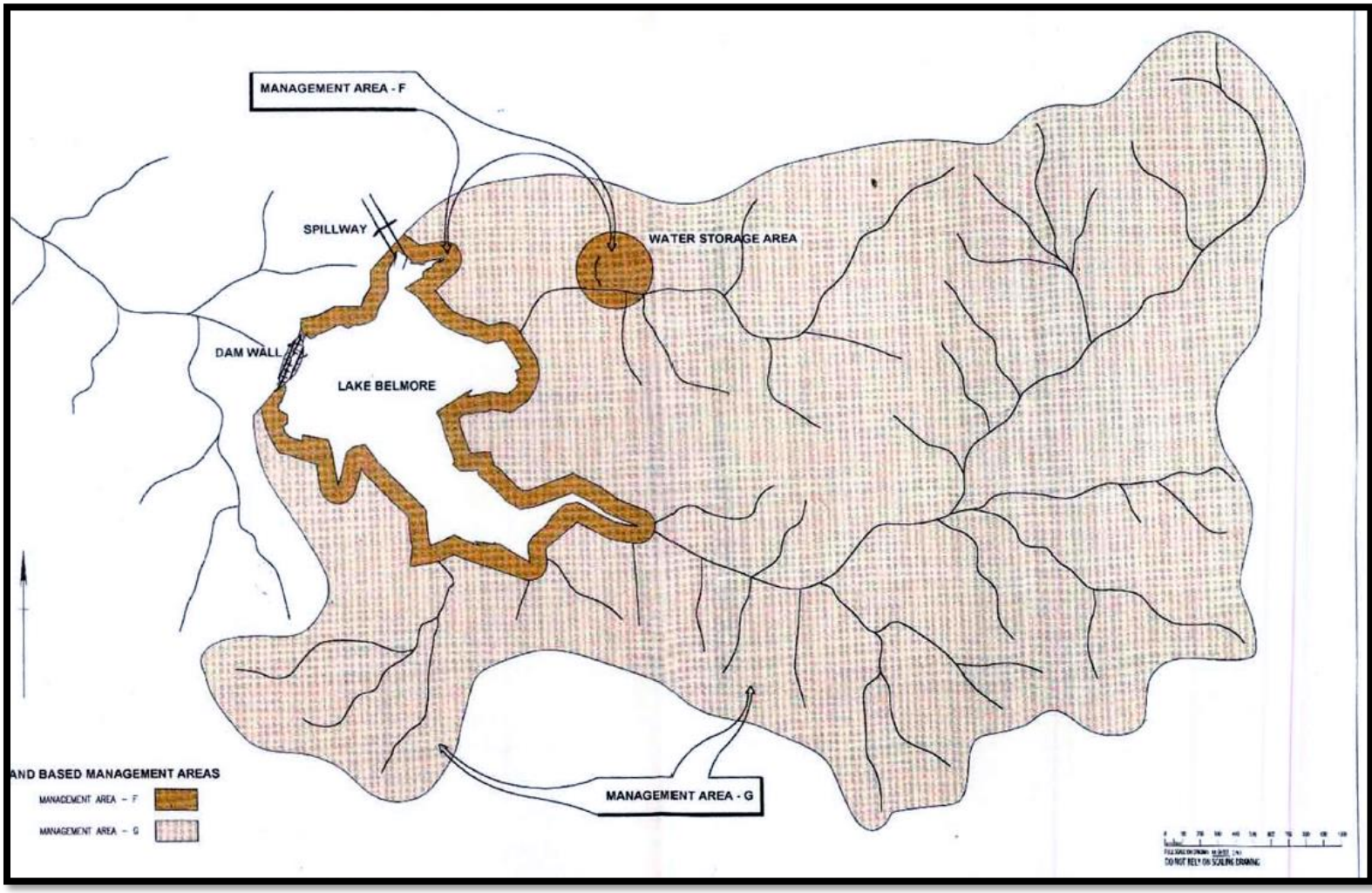


Table 3.1 Catchment Characteristics

Catchment Characteristic	Bore (near Lake Belmore)	Lake Belmore Dam	Butterfly North Pit
Area	Unknown recharge area	Dam catchment area 1,660 hectares	
Topography	Not applicable	Open scrub	Open cut mine pit
Main geological features	Sub-artesian from deep aquifer, under a deep rock exclusion layer. Not connected to dam or upper aquifer (above the deeper sub artesian aquifer).	A small sub catchment, high in the Norman River catchment zone.	Open cut mine, ground water recharge. Not connected to any other water source.
Soil type	Croydon volcanic group grey welded TUFF	Rocky sandstone based soils	Rocky sandstone based soils
Monthly rainfall (average, max, min)	Not applicable	Distinct wet and dry seasons. Minimum year 350mm Maximum year 1560mm Minimum year wet season 85% Minimum year dry season 15% Maximum year wet season 85% Maximum year dry season 15%	Distinct wet and dry seasons. Minimum year 350mm Maximum year 1560mm Minimum year wet season 85% Minimum year dry season 15% Maximum year wet season 85% Maximum year dry season 15%
Incidence of flooding and bushfire	Not applicable	Flooding event annually (but not in the town or in the catchment). Bushfires – fire zone protects dam, catchment area, reservoir and the water treatment plant. Council maintains a clear zone area around the WTP and reservoir.	Not applicable
Predominant vegetation types	Not applicable	Dry sclerophyll, open shrub forest	Dry sclerophyll, open shrub forest
Predominant land use	Not applicable	Cattle grazing (potential for protozoa from cattle faeces in catchment area)	Ex open cut mine.
Urban settlements and population	Not applicable	None	None
Industrial, mining	Not applicable	Dis-used gold mine shafts (arsenic extraction not used in this area).	Dis-used open cut mine pit
Recreational activities	Not applicable	Dam used for human recreational purposes e.g. fishing, boating, swimming,	Not applicable
Planned future activities which may impact on water quality	None	None	None
Bore details – depth, aquifer description, aquifer depth and thickness, confined/unconfined, fast or slow response to events on surface	Bore depth 168m Aquifer description – Fractured Bassalt, Depth 36m thickness 132meters. Auqifer Confined Slow response to events on surface	Not applicable	Not applicable
Bore head details to prevent contamination	Fenced and raised	Not applicable	Not applicable

3.2 Risk Assessment Methodology

Hazards were initially identified through inspection, water quality testing data and historical results. The prototype risk tables were reviewed through a workshop with internal stakeholders and further reviewed by other key stakeholders.
For each hazard and hazardous event the likelihood and consequence were assessed using the following tables:

Table 6: qualitative measures of likelihood

Likelihood	Description
1: Almost certain	Occurs more often than once per week (52/yr.)
2: Likely	Occurs more often than once per month (12/yr.) and up to once per week (52/yr.)
3: Possible	Occurs more often than once per year and up to once a month (12/yr.)
4: Unlikely	Occurs more often than once every five years and up to once per year
5: Rare	Occurs less than or equal to once every five years

Table 7: qualitative measures of consequence or impact

Consequence	Description
A: Catastrophic	Potential acute health impact, declared outbreak expected
B: Major	Potential acute health impact, no declared outbreak expected
C: Moderate	Potential widespread aesthetic impact or repeated breach of chronic health parameter, isolated and promptly managed breach of a health guideline value
D: Minor	Potential local aesthetic, isolated exceedance of chronic health parameter, potential environmental hazard with no evidence of impact on water quality
E: Insignificant	Isolated exceedance of aesthetic parameter with little or no disruption to normal operation

Risks levels were assigned for the maximum risk for unmanaged source water and then for residual risk where preventative measures are applied.

Table 8: qualitative risk analysis matrix—level of risk

Consequence (**numbers are indicative of relative weightings**)					
Likelihood	E: Insignificant	D: Minor	C: Moderate	B: Major	A: Catastrophic
1: Almost certain	Medium (6)	High (10)	High (15)	Extreme (20)	Extreme (25)
2: Likely	Medium (5)	Medium (8)	High (12)	High (16)	Extreme (20)
3: Possible	Low (3)	Medium (6)	Medium (9)	High (12)	High (15)
4: Unlikely	Low (2)	Low (4)	Medium (6)	Medium (8)	High (10)
5: Rare	Low (1)	Low (2)	Low (3)	Medium (5)	Medium (6)

For each risk the degrees of uncertainty were evaluated according to the following table.

Table 9: Examples of degrees of uncertainty

Uncertainty	**Description**
Certain	There is five years of continuous monitoring data, which has been trended and assessed, with at least daily monitoring. The processes involved are thoroughly understood
Confident	There is five years of continuous monitoring data, which has been collated and assessed, with at least weekly monitoring or for the duration of seasonal events. There is a good understanding of the processes involved.
Reliable	There is at least a year of continuous monitoring data available, which has been assessed and there is a good understanding of the processes involved.
Estimate	There is limited monitoring data available and there is a reasonable understanding of the processes involved.
Uncertain	There is limited or no monitoring data available and the processes are not well understood.

Table 3.3 Defined Acceptable Risk Levels

Level of residual risk considered acceptable: Low level risks and those medium level risks with a score of Medium 5 and 6 are considered acceptable. For some hazards where an acceptable residual risk is achieved, there may be further actions that can be taken to improve risk management outcomes.

Low Risk (acceptable) – manage for continuous improvement
Medium Risk 5 and 6 (acceptable) – implement longer term risk reduction measures may be implemented within a reasonable timeframe.
Medium Risk 8 and 9 (unacceptable) – Implement short term measures, longer term risk reduction measures may be implemented within a reasonable timeframe.
High Risk (unacceptable) – Implement short term measures immediately. Longer term risk reduction measures need to be a priority.
Extreme Risk (unacceptable) – Implement short term measures immediately, implementation of longer term risk reduction measures given top priority

3.2.1 Hazard identification and risk assessment team

Table 3.4 Hazard Identification and Risk Assessment Team

Typical job title for key personnel	What role did each person play on the team?	What expertise and system knowledge did the person bring?
Ashley Boland	Hazard identification, risk assessment, preventative measure description	Years' experience – 5 years Role – Water & Utilities Officer
Garry Pickering	Hazard identification, risk assessment, preventative measure description	Years' experience – 3 years Role – Works Manager
Pushpa Ginige	Advisor	Senior Engineer, Department of Water and Energy Supply
Ted Aldred	Advisor	Manager Assessment and Compliance, Department of Water and Energy

Table 3.5 (Modified) Hazards Identification Scheme Croydon

Stage	Sources of hazard	Hazard	Comments
Lake Belmore and Butterfly North Pit	Catchment runoff	Bacteria	Filtration, chlorination
		Chemicals	Sodium hypo, flocculation, continued monitoring
		Fe, Mn and Metals	Pre-chlorination
		Protozoa	Filtration
		Blue Green Algae	Filtration, backwashing filters regularly, continued monitoring
	Natural disasters	Loss power supply	Emergency procedures, carting water
	Intake	Foreign Materials	Monitoring and testing
Bore	Underground Water Supply	High Fluoride	Blend with dam only to reduce fluoride
	Underground Water Supply	Arsenic	Chlorination and blending
Butterfly North Pit	Underground water supply	High fluoride	Blending with other sources.
Sourcing Infrastructure Water Treatment Plant & Reservoir	Pump failure	Loss of supply	Telemetry notification, inspections, backups
	Power failure	Loss of supply	Regular checks, maintenance, carting water
WTP	Pre -Chlorine dosing failure	Loss of disinfection/oxidisation (metals) and overdosing	Telemetry notification, inspections, backups, flushing, manual dosing
	Post - Chlorine dosing failure	Excessive disinfection (bacteria) and loss of disinfection	Telemetry notification, inspections, backups, flushing
	Coagulant failure	Turbidity breakthrough	Telemetry notification, inspections, backups, flushing
Reticulation	Mains break	Loss of supply	Mains network O&M procedures, isolation of mains break
	Backflow	Commercial and household contamination	Meters on all connections and backflow prevention
	Dead ends	Stagnant water, loss of chemicals, bacteria	Flushing and testing
	Chlorine	Over/under dosing	
Reservoir	Reservoir contamination	Bacteria and chemical	Annual cleaning and testing, sealed concrete reservoir
	Backflow	Microbiological/chemical	Back flow prevention devices in mains
	Chlorine	Over/under dosing	
Whole system	Staff resource issues	Loss of skilled operators	Succession management/planning
	Vandalism/unauthorised access	Microbiological/chemical	Regular inspection of fences, locks
	Loss of communications	Loss of supply	Operate manually, inspections
	Supplier unable to provide chlorine	Chlorine stock supplies run-out/no disinfection (bacteria)	1 month supply kept on site, alternative supplier available

Table 3.6 Hazard Identification and Risk assessment

1	2	3	4	5	6	7	8	9	10	11	12	13
Scheme Component /	**Hazardous Events**	**Hazard**	**Maximum Risk**			**Existing Preventive Measures / Barriers.**	**Residual risk**			**Level of Risk Acceptable (y/n)**	**Uncertainty**	**Comments/ Proposed Further Risk Reduction Actions**
			Consequence	**Likelihood**	**Risk level**		**Consequence**	**Likelihood**	**Risk level**			
Lake Belmore Butterfly North Pit	Catchment runoff due to flooding	Bacteria	B	2	High 16	Filtration, chlorination, catchment management, boil water notice if the treatment or disinfection fails.	B	5	Med 5	Y	Reliable	Dam quality monitoring has been undertaken monthly for over 10 years, raw water quality shows very low total plate counts
	Contaminants from the catchment	Chemicals (pesticides, spillage, petrochemical)	B	5	Med 5	Control of illegal camping. Small recreational spillage would dilute into the dam. Offtake is on the other side of the dam from the public access.	C	5	Low 3	Y	Reliable	Recreational boating in the dam. No evidence of pesticide use in the catchment. Testing 6 monthly basis with results within limits
	Wet weather flows	Fe, Mn and other metals	C	3	Med 9	Pre-chlorination, filtration and six monthly monitoring.	D	5	Low 2	Y	Reliable	Raw water has not exceeded Mn health values. See attached samples.
	Wet weather flows	Protozoa	A	2	Extreme 20	Flocculation and filtration measures, stock and domestic animals excluded by fencing.	B	5	Med 9	N	Reliable	Council pest management operations/controls existing stock fencing inspections. Liaise with stakeholders.
	Blue Green Algae	Toxins	A	3	High 15	Regular visual inspection, flocculation and filtration	E	5	Low 1	Y	Reliable	Low nutrients in the dam to support algal growth, no evidence of algal growth in the dam over 15 years
	Foreign materials and debris at intakes	surface pollutants, macro contaminants	C	3	Med 9	Intake 1 m below the surface, exclusion zone for recreational access to the sourcing infrastructure, screening	E	4	Low 2	Y	Certain	Visual water surface inspection, normal testing operations, visual water quality

Bore Butterfly North Pit	High Fluoride	High Fluoride	A	1	Extreme 25	Blend with dam water to reduce concentration of fluoride	A	5	Medium 6	Y	Reliable	Monitor blended water for fluoride concentration
Bore	Underground Water Supply	Arsenic	A	1	Extreme 25	Pre chlorination and blending with other arsenic free sources. There is a usage restriction of 10% bore and 90% other water sources.	E	5	Low 1	Y	Reliable	Telemetry controls and alarms are in place. Further fail safe measures are being explored.
Sourcing infrastructure and Water Treatment Plant	Pump failure	Loss of supply	A	4	High 10	Dual pumps that are used individually, standard maintenance and inspection, telemetry, swap to alternate supply	D	5	Low 2	Y	Reliable	Replacement pumps available.
Sourcing infrastructure and Water Treatment Plant and Reservoir	Power Failure	Loss of supply	B	3	High 12	Telemetry notification, inspections, Backup generators, regular checks, maintenance of plant, reservoir is gravity fed can supply up to 5 days	D	3	Medium 6	Y	Reliable	Backup generator on hand.
WTP failure	Pre-chlorination failure	Metals removal and overdosing of chlorine	B	2	High 16	Water is constantly analysed. Duty stands by dosing pumps in place, dosing pump inspection, telemetry alarms and mains flushing.	D	5	Low 2	Y	Reliable	Backup chlorinators on hand
	Post - chlorination failure	Bacteria and Viruses and overdosing/under dosing of chlorine	A	1	Extreme 25	Over and under dosing detected through daily chlorine testing exiting the WTP, monitoring chlorine consumption daily, dosing pump inspection, telemetry alarms, mains	C	4	Medium 6	Y	Reliable	Backup chlorinators on hand

						flushing and liaising with Qld Health						
	Coagulant failure	Turbidity breakthrough (flocculent and protozoa remain)	A	1	Extreme 25	Alarms and daily inspection, reservoir can be drained and refilled, Filter backwashing automatic on a timer or if pressure rises, can isolate affected components (6 filter units), duty and standby dosing pump.	B	5	Med 5	Y	Reliable	Low turbidity in raw water, manual backwash possible. Backup dosing pump.
Reticulation and mains	Mains breaks	Foreign contaminants	C	3	Medium 9	Procedure for Mains Network Operating & Maintenance Procedures Manual for sections isolated and flushed after repairs, regular flushing program including dead ends, residual chlorine monitored.	E	5	Low 1	Y	Certain	
	Backflow	commercial and household contamination	C	4	Medium 6	Meters on all connections including backflow prevention	C	5	Low 3	Y	Reliable	
	Dead Ends	Stagnant water, loss of chemicals, bacteria	B	2	High 16	Regular flushing, testing and monitoring and stakeholder liaison	D	4	Low 4	Y	Reliable	Mains upgrade program
	Chlorine	Over/under dosing	B	1	Extreme 20	Regular testing, flushing, continued monitoring at WTP and reservoir	C	5	Low 3	Y	Reliable	
	Arsenic	High levels	B	1	Extreme 20	Monthly testing of reticulation and blending of source waters	C	4	Med 6	Y	Estimate	Improvement Program to implement regular monthly testing
	Disinfection by-products	Chlorates, THMs	D	2	Medium 8	Investigate implementing sampling frequencies	D	2	Med 8	Y	Uncertain	Improvement program

Reservoir	Reservoir contamination	Bacterial and chemical	B	2	High 16	Sealed concrete reservoir, locked hatch elevated 50 mm above the roof with a rubber seal, annual cleaning of the reservoir (de sludge), chlorine residual maintained at 2.0 to 2.5 mg/L, fine mesh on air vent	B	5	Med 5	Y	Certain	Water quality samples taken from the reservoir monthly for lab analysis and daily chlorine levels, tank in good condition
	Chlorine	Over/under dosing	C	3	Medium 9	Daily testing, continued monitoring at WTP and reservoir, main flushing, manual dosing, drain reservoir	E	5	Low 1	Y	Certain	
Whole of system	Vandalism/unauthorised access	Microbiological/chemical/ loss of supply	B	3	High 12	Fences, regular maintenance inspection of fences, locks at WTP, reservoir, pump stations, distant from residential areas, daily monitoring	B	5	Med 5	Y	Reliable	No current problems,
	Supplier unable to provide chemicals	Chlorine stock supplies run-out/no disinfection (bacteria), flocculent	A	2	Extreme	6 month supply kept on site of flocculent and 1 month supply for chlorine, alternative supplier available, nearby councils share stock if shortages occur	A	5	Med 6	Y	Certain	Problems not encountered up to now. Boil water notice proposed if occurs.
	Loss of skilled operators	Unable to operate plant.	B	5	Med 5	Current telemetry allows operation on automatic with monitoring by Welcon Technologies. Train other staff members in operations and testing. Cert 3 operators in	D	5	Low 2	Y	Reliable	FNQROC is investigating operator resource sharing between Councils

						neighbouring towns.						
	Sample transport failure	Unable to send test samples or perform testing	C	4	Med 6	If transport does not go if possible then re-sample and resend following week. Alternatively samples can be transported to Cairns by staff.	D	4	Low 4	Y	Certain	
	Loss of communication	Unable to get telemetry notifications	A	3	High 15	Plant can be operated manually, increased inspections and testing. Satellite phones for telecommunications. Operation and Maintenance Procedure Manuals and plans available in hard copy.	D	3	Medium 6	Y	Reliable	Reviewing O & M Procedures and plans.

4.0 Operation and maintenance procedures

Table 4.1 Operation and Maintenance Procedure Documentation

Documented Operational Procedures (2009SAMP)

- Operators Manual for Croydon Water Treatment Plant (undated, prepared by Heal Group of Companies)
- Operations Manual WTP Control and Telemetry (02/03/2005, Welcon)
- Water Treatment Plant Operators Log Sheet 1 – Test Results
- Water Treatment Plant Operators Log Sheet 2 – Mechanical Log

Procedure documents are reviewed annually or as required.

Procedures are maintained in Croydon Shire Council record system.

Documented procedure	Version date	Position responsible for maintaining the procedure and ensuring it is implemented	Process for implementing the procedure (Activity and Frequency)	Comments (including where procedures are inadequate or need updating)
Local Disaster Management Plan	V1	CEO	Annually	Annual review December each year
Operating and maintenance manual	V1	Water Officer	Daily routine and inspections	Last reviewed January 2017. Regular 12 monthly review
Procedure for cleaning spillway fence	V1	Water officer/ WH&S advisor	Wet season maintenance	After significant event a review is needed
Incident reporting		Works Manager	As required	According to the regulators instructions
Sample collection procedure for water	V1	Water Officer	See monitoring program	Inclusion of all site, review required for procedure, February yearly
Water quality results record keeping	N/A	Information Management Officer	Normal operating procedures	
Logbook	N/A	Water Officer	Refer to procedure documents	Record of site maintenance and inspections undertaken

Section 4.1 Management of Incidents and Emergencies

4.1 Employee awareness and training

- Written notices can be delivered to consumers in a short time frame to advise of water quality issues, etc., and appropriate action to be taken should the need arise (e.g. Boil water notice).

All managers and coordinators are responsible for ensuring their team members have the appropriate skills and knowledge to ensure the safety of the drinking water.

This is achieved by:

- Ensuring at least one operator has a formal qualification related to the water industry (e.g.: certificate II or III in Water Industry Operations)
- Ensuring staff involved in drinking water management who do not have a formal qualification are supervised by staff with formal qualification.
- Providing after hours contact details for staff responsible for water quality management in the phone directory including afterhours details
- Conducting an emergency response simulation exercise annually through the LDMG (Local Disaster Management Group) followed by a review of the emergency response procedures. This may include a water contamination but not necessarily.
- Weekly toolbox and supervisors meetings may include water issues as they arise.
- Convening a 'debrief' with appropriate staff following all level 2 and above incidents.
- Developing and implementing induction procedures for all new water related staff (checklist record retained in the employee file), including:
    - Role and site specific inductions include WHS and regulatory responsibilities
    - Familiarisation with any emergency response levels contained in table 4.2 and the employees responsibilities under the plan
    - Familiarisation with the incident and emergency levels and the appropriate actions for that issue and the employee's responsibilities.
    - Appropriate training requirements to ensure employees are able to fulfil the responsibilities of their role.

4.2 Long term incident management and implications for the DWQMP

All incident reports and operational records are reviewed by the Acting Works Manager and Water Officer to ensure the following:

- Ensure timely responses and notification to the regulator have been achieved
- Incidents have been appropriately investigated

The Acting Works Manager is also responsible for considering the findings of incident investigations and determines whether there are any long term improvement actions needed to prevent the reoccurrence of the incident in the future (e.g.: need for system and operational improvements) and how these might be achieved.

4.3 Incident and Emergency Levels

Table 4.2 Incident / Emergency levels

Incident / Emergency level	Description of level	Incident response, investigation and management Summary of actions to be taken	Position/s responsible for Action/s
Level 5	*Any of the following events* • *Widespread outbreak of waterborne disease* • *Declared disaster* • *Localised emergency impacting on water quality (e.g.: industrial spill, accidents)* • *Terrorist or deliberate contamination threat* *Incident requires coordination across the provider (Council) departments and is likely to require external resourcing and support from agencies, such as Queensland Health, local disaster management groups, emergency responders QFRS, Police, and Office of the Water Supply Regulator.* *Incident Response measures and Disaster Management Plans activated*	• *Notify WSR immediatly* • *Notify CEO* • *Coordinate notification, investigation and response of water related aspects as defined in the Emergency Response / Disaster Management Plan or as directed by relevant agenciesc* • *coordinate with emergency services and Government offices* • *commence investigations including laboratory results* • *secure and distribute emergency supplies if requiredConsider what community notification / messaging is needed (e.g.: do not drink alert, boil water or bottled/emergency water distribution* • *Instigate immediate remediation actions, including isolation of the affected area, where possible* • *Coordinate community messaging with Emergency Response process. Issue boil water, do not drink alerts as required (template Appendix ERP)* • *Emailed to all council contacts and flyers placed in all local post office boxes or hand delivered to residences*	*DES* *Director of Engineering Services*
Level 4	*Any of the following* • *High level of E. coli in the reticulation greater than 3CFU* • *OR E coli detection with extenuating knowledge* • *OR repeat detection* • *Detection of a pathogen in reticulation.* • *Failure of infrastructure (e.g.: severe or emergency level supply restrictions required to ensure continuity of supply or supply disruption to over 50 customers for over 3 hours)* • *An event that is likely to have resulted in the delivery of contaminated water to customers or where the delivery of contaminated water cannot be prevented.* • *Gross exceedance of ADWG health guideline values for a chemical parameter (e.g. value of exceedance is more than five times the ADWG health guideline limit).)* • *Total chlorine level exceed 5mg/l in reservoir/reticulation*	• *Report detection to WSR immediately by phone,* • *Notify CEO* • *Commence investigation to determine cause* • *Arrange for re-samples to be taken where required* • *Instigate immediate remediation actions, including isolation of the affected area, where possible* • *Review associated laboratory reports and operational records* *Coordinate notification, investigation and response of water related aspects* • *undertake community notification as appropriate (e.g.: do not drink alert, boil water or bottled/emergency water distribution* ***For detailed response actions and information refer to Level 4 incident response procedures***	*Water Officer* *DES* *Emergency Incident Manage (if appointed by CEO)*

	Incident may require coordination across the provider (Council) departments and may require external resources and support. *Drinking Water Incident Response activated* *May require Disaster Management Plans to be activated*		
Level 3	*Any of the following* • *Low level of E.coli in reticulation 1-3 CFU* • *Minor exceedance of ADWG health guideline value for chemical parameter (e.g.: value of exceedance is close to health guideline value).* • *Detection of a parameter with no guideline value in the ADWG* *Incident likely to be managed within the providers resources. Drinking Water Incident Response activated*	• *Notify the CEO* • *Report detection to WSR immediately by phone* • *Arrange for re-samples to be taken* • *Specifically for E.coli detections, determine chlorine residuals at initial site and potentially affected areas* • *Instigate remediation where possible* • *Commence investigation to determine cause* • *Review associated laboratory reports and operational records.* • *Coordinate notification, investigation and response of water related aspects* ***For detailed response actions and information refer to Level 3 incident response procedures***	*Water Officer* *DES*
Level 2	*Any of the following* • *An event, including failure of infrastructure or source supply, where the quality of the drinking water is unlikely to affect public health or the water has not and will not be delivered to customers* • *Exceedances of ADWG aesthetic guideline (e.g.: turbidity exceeds 1.0NTU – chlorine free levels above 4mg/L in reservoir)* *Incident likely to be managed within the team responsible for drinking water operations and management.. Customer complaints may result*	• *Complaints recorded in InfoXpert Customer Complaints module* • *Notify CEO* • *Notify Water Officer of complaints* • *Co-ordinate investigation of complaints as per Customer Service Standards Procedure, including obtaining water samples where required* *For detailed response actions and information refer to Level 2 incident response procedures.*	*Customer service section* *DES* *Water Officer*
Level 1	Exceedances of operational limits : Incident can be managed within the water operations team. An incident is not declared and the can be managed by local team with the support of the Water Officer. Managed through normal documented operational procedures	Operational monitoring and responses recorded in operational logs and reviewed by Water Officer on a weekly basis.	Water Section

4.4 Risk Management Improvement Program

Priorities are based on 1 being highest and 5 the lowest.

Table 4.3 Risk Management Improvement Program

IP item	Action	Priority	Description Describe the deliverable and the scope	Target date/s or Completion date/s	Estimated cost (not required by OWSR but important for DWSP)	Responsibility	Completed
1	Testing frequencies for Chlorates	1	Implement a more standardised testing frequency for chlorates	June 2017	$2,000	Water Officer	Yes
2	Bore repairs and testing	1	Carry out repairs to the bore, implement a thorough testing period to verify water quality. Adjust the DWQP to include the bore usage and submit the updated plan to the regulator for approval prior to use for town supply.	December 2016	$10,000	Water Officer and Acting Works Manager	Yes
3	Develop & Review Operation and Maintenance Procedure Manual	2	Mains Network O & M Procedure and operations manual	JUNE 2017	$30,000.00	WATER OFFICER AND WORKS MANAGER	
4	Capital works to install interconnected mains	2	Works project – Eliminate Reticulation dead ends.	JUNE 2020	$160,000.00	WATER OFFICER AND WORKS MANAGER	
53	Drinking Water Quality Management Plan	3	Review of DWQMP	ANNUALLY FEBRUARY	$3,000.00	WATER OFFICER AND WORKS MANAGER	
6	Arsenic testing	1	Implement regular monthly laboratory testing of reticulation water	Review December 2017	Operating costs	Water Officer	
7	Disinfection by-product testing	3	Investigate regular testing frequencies and limits	Review December 2017	TBA	Water Officer	
8	Alternate power supply upgrade	1	Emergency generator capability	December 2016	$50,000	Water Officer and Acting Works Manager	Yes

4.5 Service Wide Support – Information Management

Overview of Records Keeping

WTP logs are kept in hardcopy at the WTP by the Water Officer.

Incident records are generated via our WH&S system and follow that process. Incident records are stored electronically.

Customer complaints are recorded in InfoXpert which is maintained electronically by our Information Management Officer.

Procedure documents are stored in InfoXpert and also on Council's servers.

Staff training records are stored on each employees personnel file in hard copy and also electronically in PCS and on our server.

Document Control
Document control is part of our records management system monitored by our Information Management Officer and Business Manager where each version is numbered or dated. Access to water quality data is available to all operational staff including CEO, Acting Works Manager, Water Officer and Croydon Shire Council IT Officer. Records are retained in accordance with the State Archive relevant record keeping requirements.

Processes for Reporting
Water sample collection and testing records are held in InfoXpert. Water details are reported to Council Meetings in a separate monthly report. Water details are also reported and discussed at the Council Management/Leadership meetings. Daily water consumption readings are stored on Council server.

Processes for Incident and non-routine reporting
Any incidents are reported internally via our WH&S system. Where an incident has to be reported externally to the regulatory authorities this is delegated by the CEO to Acting Works Manager. All records of responses and communications including emails are recorded in InfoXpert.

- Croydon Shire Council utilises InfoXpert as its records management system (recording incoming and outgoing correspondence, emails, etc. with external persons/organisations)
- Improvement of information collection and management within the water supply operations area. WTP log sheets, water quality monitoring results, bulk meter readings etc., has been effected to be consistently completed.
- There is demonstrated need for Council to implement formal internal reporting processes to assist with collating and reporting of CSS performance data for the annual report.
- Council utilises InfoXpert records management to monitor and record incoming complaints and responses (including timeliness).
- Council currently does not conduct inspections nor maintain a register of backflow prevention devices throughout Croydon.

Table 4.6 Summary of Water Quality Management Information

Information/ Document	Format (hardcopy / electronic)	Where stored (at WTP / on electronic system / other)	Position Responsible / Business Unit	Comments
Chlorine supply orders	Electronic in PCS	Electronic system in Shire Office	Water Officer	
Daily log	Electronic	WTP	Water Officer	
Daily bulk meter	Electronic	Electronic system at WTP	Water Officer	
Water quality records	Electronic in InfoXpert	Electronic system in Shire Office	Water Officer	
Laboratory samples	Electronic in InfoXpert	Electronic system in Shire Office	Water Officer	
Operating procedures	Hard copy and electronic	WTP – Electronic system in Shire Office	Water Officer	

5.0 Operational and Verification Monitoring Programs

5.1 Operational Monitoring

Table 5.1 Operational monitoring

Monitoring that is done on a daily basis.

- Daily operational water quality monitoring is undertaken by Council's Water Officer.
- Bacteriological samples are collected by Council's Water Officer and forwarded to external laboratories for analysis on a monthly basis.
- Standard Water (chemical) Analysis – samples are collected by Council's Water Officer and forwarded to external laboratories for analysis this is six monthly testing.
- Future water quality monitoring and reporting will need to be undertaken in accordance with the Australian Drinking Water Guidelines 2011.
- **For exceedance of target levels refer to the Incident and Emergency level chart for action Table 5.4**

Process step/location/critical control point	Parameter	Associated Hazard	Sampling			Target values	Operational response
			Frequency	Method			
WTP	Chlorine	Bacteria Under/Overdosing Mineral removal	constant	Telemetric analysis		1.5 -2.5	Alarm to water officer, operator adjustment. Automatic plant shut down if no chlorine
	PH		Daily	Analyser's		6.5 – 8.5	Flushing mains
	Turbidity		Daily	Analyser's		<1	Flushing mains
	Anions	Fluoride	Daily and Monthly	Daily Analyser's and monthly Manual sample collection, transport to Normanton airfield, sent to Cairns for laboratory testing		<1.5	Adjust blending ratios of dam, bore and Butterfly North Pit
	Heavy Metals	Aluminium - Arsenic - Cadmium - Chromium - Copper - Iron - Lead - Manganese - Nickel - Zinc	6 monthly at laboratory Weekly for iron, manganese and aluminium by water officer	Manual sample collection, transport to Normanton airfield, sent to Cairns for laboratory testing		Cadmium mg/L 0.0001 - Chromium mg/L 0.0001 - Copper mg/L 0.001 - Iron mg/L 0.001 - Lead mg/L 0.0001 - Manganese mg/L 0.0001 - Nickel mg/L 0.0001	adjust chemical dosing as required, adjust source blending as required

						- Zinc mg/L 0.001	
Lake Belmore, Bore and Butterfly North	Heavy Metals	Aluminium - Arsenic - Cadmium - Chromium - Copper - Iron - Lead - Manganese - Nickel - Zinc	6 monthly laboratory testing Weekly for iron, manganese at retention tanks by water officer	Manual sample collection, transport to Normanton airfield, sent to Cairns for laboratory testing		Cadmium mg/L 0.0001 - Chromium mg/L 0.0001 - Copper mg/L 0.001 - Iron mg/L 0.001 - Lead mg/L 0.0001 - Manganese mg/L 0.0001 - Nickel mg/L 0.0001 - Zinc mg/L 0.001	adjust chemical dosing as required, adjust source blending as required
	Anions	Fluoride	6 Monthly laboratory testing	Manual sample collection, transport to Normanton airfield, sent to Cairns for laboratory testing		<1.5	Adjust blending ratios of dam, bore and Butterfly North Pit. Flushing Community alerts if required
	Fences/buildings	Animal control hazards Vandalism Animal contamination	Monthly	Manual inspection of facilities and fencing for damage or breaks		Nil broken fences and damaged buildings	Carry out repairs and testing to ensure no contamination
Butterfly North	Anions	Fluoride	Monthly	Manual sample collection, transport to Normanton airfield, sent to Cairns for laboratory testing. Daily monitoring at WTP on the treated water to ensure compliance.		<1.5	Adjust blending ratios of dam, bore and Butterfly North Pit

5.2 Verification Monitoring

Table 5.2 Verification Monitoring

All water quality monitoring: list parameters, location of monitoring and lab used Include E coli, metals, etc.

For exceedance of target levels refer to the Incident and Emergency level chart for action Table 5.4

Parameter	ADWG &/or Regulation Value	Associated Hazard	Frequency	Analysing Authority	Response to Exceedances
			In distribution system		
E.coli	Nil detect	Bacteria	Monthly	Cairns Regional Water Laboratory Services	Refer to incident management Plan Notify OWSR and complete incident reporting forms Follow operational procedure for flushing mains
PH	6.5-8.5	Alkalinity and acidity	weekly	Daily by water officer. Monthly by Cairns Regional Water Laboratory	Chemical configuration or addition
Turbidity	<1NTU	Pathogens	weekly	Daily by water officer. Monthly by Cairns Regional Water Laboratory	Flushing, Chemical dosing configuration, Coagulation checking and adjusting, Filtering system check Boiled drinking water notification
Total Chlorine and residual chlorine		Bacteria, THM	weekly	Analysis at Water treatment plant	Flushing, Chemical dosing configuration, Coagulation checking and adjusting, Filtering system check Boiled drinking water notification
Pesticides	Various / No guideline value	Pesticides	6 monthly	Cairns Regional Water Laboratory	Flushing, Chemical dosing configuration, Coagulation checking and adjusting, Filtering system check Boiled drinking water notification
Heavy Metals	- Cadmium mg/L 0.0001 - Chromium mg/L 0.0001 - Copper mg/L 0.001	Heavy metals: - Aluminium - Arsenic - Cadmium - Chromium - Copper - Iron - Lead	6 monthly Monthly for Arsenic Weekly/Bi-weekly for Manganese, Aluminium and Iron	Cairns Regional Water Laboratory	Flushing, Chemical dosing configuration, Coagulation checking and adjusting, Filtering system check Boiled drinking water notification Investigations into metal exceedance

Parameter	ADWG &/or Regulation Value	Associated Hazard	Frequency	Analysing Authority	Response to Exceedances
			In distribution system		
	- Iron mg/L 0.001 - Lead mg/L 0.0001 - Manganese mg/L 0.0001 - Nickel mg/L 0.0001 - Zinc mg/L 0.001	- Manganese - Nickel - Zinc			
Anions	Fluoride 1.5 mg/L	Fluoride	Monthly	Operator daily via analyser's Monthly and six monthly via Cairns Regional Water Laboratory 6 monthly	Blending with Lake Belmore Check pumping flows from each source Public notice if required

Distribution system is tested at the follow locations:

1- Cnr of Aldridge and Elizabeth Street
2- Corner of Sircom and Gardener Street
3- Croydon State School- cnr Francis and Brown Street
4- WBC- cnr William and Mable Street
5- Reese Park- cnr Brown and Sircom Street

Source testing is at the following:

1- Lake Belmore pump shed for Lake Belmore and the Bore (when operational)
2- Butterfly North raw water pipe at the Water Treatment Plant prior to oxidation tanks