ID			HAZARD				MAXIMUM RISK					RESIDUAL RISK				RISK TREATMENT		CCP ASSESSMENT						LIMITS			
Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
		Pioneer River Basin																									
PRB1	Mackay & Marian	**Pioneer River Basin**	Forestry & National Parks (some logging, some cattle grazing leases, illegal dumping, herbicides [applied under power lines & in transport and infrastructure corridors])	Inability to meet treated water quality objectives causing risk to human health	Turbidity Herbicides	Herbicides	Rare	Insignificant	Low (1)	State Government Management Practices Ergon Energy Policies MRC Nebo Rd WTP/Marian WTP - activated carbon adsorption	Reef Catchments Monitoring Program	Rare	Insignificant	Low (1)	Confident												
PRB2	Mackay & Marian	**Pioneer River Basin**	Animals (domestic & feral) - Cattle [grazing (erosion and sedimentation), dead animals in waterways & weirs, fertilizers, feedlots (manure management), direct access to waterways] - Poultry farms [dead animals, manure management] - Pig farms [dead animals, manure management] - Feral pigs [digging and wallowing (erosion and sedimentation)]	Inability to meet treated water quality objectives causing risk to human health	Turbidity Herbicides Giardia & Cryptosporidium E. coli	E. coli	Likely	Catastrophic	Extreme (20)	Reef Catchments Riparian Vegetation Fencing & Off-stream Watering Program MRC Nebo Rd WTP/Marian WTP - disinfection	MRC daily inspection of Dumbleton and Marian Weirs MRC monitoring program of raw & treated water quality (incl. E.coli, Coliforms & Entercocci)	Rare	Moderate	Low (3)	Confident		MRC to communicate with Reef Catchments about problem areas to focus on regarding Riparian Vegetation Fencing & Off-stream Watering Program in the Pioneer River Basin MRC to review Disaster Management Plan (DMP) & Incident and Emergency Response Plan (I&ERP)										
						Giarda & Crypto	Likely	Catastrophic	Extreme (20)	Reef Catchments Riparian Vegetation Fencing & Off-stream Watering Program MRC Nebo Rd WTP/Marian WTP - clarification & filtration	MRC daily inspection of Dumbleton and Marian Weirs MRC monitoring program of raw & treated water quality	Rare	Moderate	Low (3)	Confident		Review communication/notification protocols between SunWater and MRC for Mackay MRC to communicate with Reef Catchments about problem areas to focus on regarding Riparian Vegetation Fencing & Off-stream Watering Program in the Pioneer River Basin MRC to review Disaster Management Plan (DMP) & Incident and Emergency Response Plan (I&ERP)										
PRB3	Mackay & Marian	**Pioneer River Basin**	On site sewage management systems (OSSMSs) (both rural and commercial)	Inability to meet treated water quality objectives causing risk to human health	E. coli Nutrients (phosphates)	E. coli	Likely	Catastrophic	Extreme (20)	MRC Nebo Rd WTP/Marian WTP - disinfection	MRC daily inspection of Dumbleton and Marian Weirs MRC monitoring program of raw & treated water quality (incl. E.coli, Coliforms & Entercocci)	Rare	Moderate	Low (3)	Confident		MRC to review DMP and I&ERP MRC to provide information/education to septic tank users (e.g. information leaflet sent out with rates) within Pioneer River Basin										
PRB4	Mackay	**Pioneer River Basin**	Sewer pump stations (pump failure/blockage, storm events, power failure)	Inability to meet treated water quality objectives causing risk to human health	E. coli Nutrients	E. coli	Possible	Catastrophic	High (15)	All sewer pump stations are duty/standby Backup generators available MRC Pump Maintenance Program MRC Nebo Rd WTP - disinfection	MRC daily inspection of Dumbleton Weirs MRC monitoring program of raw & treated water quality (incl. E.coli, Coliforms & Entercocci) MRC sewer pump inspection once every 24 hours	Rare	Moderate	Low (3)	Confident		MRC to review DMP and I&ERP MRC to complete implementation of 24h radio telemetry monitoring system of sewer pumps in Mackay										
PRB5	Mackay & Marian	**Pioneer River Basin**	Crop cultivation (generally on river banks, pump leaks) mainly sugar cane some market gardening	Inability to meet treated water quality objectives causing risk to human health	Pesticides Herbicides Nutrients (fertilizers - nitrogen compounds) Hydrocarbons Turbidity	Herbicides	Possible	Minor	Medium (6)	Reef Catchments Reef Rescue Programs Reef Protection Act 2010 MRC Nebo Rd WTP/Marian WTP - activated carbon adsorption Landholder/Farmer Land Management Practices	Reef Catchments Monitoring Program MRC event based monitoring	Unlikely	Minor	Low (4)	Confident	Reef Rescue Programs target herbicides, sediments & nutrients	MRC to communicate with Reef Catchments about problem areas to focus on regarding Reef Rescue Programs in Pioneer River Basin										
PRB6	Mackay & Marian	**Pioneer River Basin**	Unsealed Roads	Inability to meet treated water quality objectives causing risk to human health	Turbidity Nutrients	Turbidity	Possible	Moderate	Medium (9)	MRC Nebo Rd WTP/Marian WTP - coagulation, clarification & filtration	MRC daily inspection of Dumbleton and Marian Weirs MRC turbidity monitoring of raw and treated water with grab samples and online meters	Rare	Moderate	Low (3)	Confident												
PRB7	Mackay & Marian	**Pioneer River Basin**	Hogans Pocket Waste Disposal Facility and illegal dumping (leachate and chemical runoff)	Inability to meet treated water quality objectives causing risk to human health	Toxins Hydrocarbons Nutrients	Hydrocarbons	Unlikely	Minor	Low (4)	Landfill pit is clay lined Dilution in waterways MRC Nebo Rd WTP/Marian WTP - activated carbon adsorption Hogans Pocket DERM License	MRC Landfill Monitoring Program MRC raw and treated water quality monitoring program	Rare	Minor	Low (2)	Reliable	Hogans Pocket is operated by contractor Remondis											
PRB8	Mackay & Marian	**Pioneer River Basin**	Accidental spills (fuel [fuel tankers transporting to mines], chemicals, cane bins, sugar trucks, cane trams, molasses)	Inability to meet treated water quality objectives causing risk to human health	Toxins Hydrocarbons Pesticides/Herbicides	Hydrocarbons	Rare	Moderate	Low (3)	Dilution in waterways Variable intake levels at Dumbleton Weir Emergency Services Response Program MRC Nebo Rd WTP/Marian WTP - activated carbon adsorption	MRC event based monitoring DERM event based monitoring	Rare	Minor	Low (2)	Estimate		MRC to review DMP and I&ERP										
PRB9	Mackay & Marian	**Pioneer River Basin**	Wildfire (followed by storm leading to ash runoff)	Inability to meet treated water quality objectives causing risk to human health	Turbidity Nutrients	Turbidity	Unlikely	Moderate	Medium (6)	Emergency Services Response Program Reef Catchments Fire Management Program Queensland Parks and Wildlife Service Fire Management System MRC Nebo Rd WTP/Marian WTP - coagulation, clarification & filtration	MRC event based monitoring Reef Catchments Fire Mapping Program	Rare	Minor	Low (2)	Confident		MRC to review DMP and I&ERP										
PRB10	Mackay & Marian	**Pioneer River Basin**	Illegal access to catchment (vandalism, sabotage)	Inability to meet treated water quality objectives causing risk to human health	Toxic material Organics	Toxins	Rare	Major	Medium (5)	Emergency Services Response Program MRC DMP and I&ERP MRC Nebo Rd WTP/Marian WTP - activated carbon adsorption	MRC event based monitoring	Rare	Major	Medium (5)	Estimate		MRC to review DMP and I&ERP										
PRB11	Mackay & Marian	**Pioneer River Basin**	Recreational activities in catchment	Inability to meet treated water quality objectives causing risk to human health	Hydrocarbons E. coli	E. coli	Unlikely	Catastrophic	High (10)	Dilution in waterways MRC Nebo Rd WTP/Marian WTP - disinfection Recreation Areas Management Act 2006	MRC daily inspection of Dumbleton and Marian Weirs MRC monitoring program of raw & treated water quality (incl. E.coli, Coliforms & Entercocci)	Unlikely	Minor	Low (4)	Confident												
PRB12	Mackay & Marian	**Pioneer River Basin**	Marian Sugar Mill (drainage/storm water runoff, chemical bund failures)	Inability to meet treated water quality objectives causing risk to human health	Organics Hydrocarbons Chemicals (caustic soda)	Organics	Unlikely	Moderate	Medium (6)	Dilution in waterways MRC Nebo Rd WTP/Marian WTP - activated carbon adsorption, coagulation, clarification & filtration	MRC event based monitoring	Rare	Moderate	Low (3)	Estimate												
PRB13	Mackay & Marian	**Pioneer River Basin**	Oxygen reducing material (from sugar cane farms - residues left on fields after harvest washed into waterways)	Inability to meet treated water quality objectives causing risk to human health	Oxygen reducing material Bad odours Organics	Organics	Almost Certain	Moderate	High (15)	MRC Nebo Rd WTP/Marian WTP - activated carbon adsorption, coagulation, clarification & filtration	Reef Catchments Truck Monitoring Program MRC event based monitoring	Rare	Moderate	Low (3)	Estimate	Reef Catchments Truck Monitoring Program involves GPS tracking units on each liquid-one-shot truck monitoring release and distribution											

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PRB14	Mackay & Marian	**Pioneer River Basin**	Quarries/sand mining with poorly managed excavation systems	Inability to meet treated water quality objectives causing risk to human health	Turbidity Heavy metals Hydraulic fluids	Heavy metals	Rare	Minor	Low (2)	MRC Nebo Rd WTP/Marian WTP - activated carbon adsorption, coagulation, clarification & filtration State Government Management	MRC monitoring program of raw & treated water quality	Rare	Insignificant	Low (1)	Reliable												
PRB15	Mackay & Marian	**Pioneer River Basin**	Public recreation - boating and skiing on Marian Weir Club house and recreational area on Marian Weir bank Use of 2 stroke engines for ski boats and other water craft	Inability to meet treated water quality objectives causing risk to human health	E. coli Hydrocarbons	Hydrocarbons	Likely	Minor	Medium (8)	PAC ACH - clarification Filters Alternative bore supply	MRC weekly micro monitoring for raw & treated water quality	Likely	Insignificant	Medium (5)	Reliable												
PRB16	Mackay & Marian	**Pioneer River Basin**	Algal blooms in Marian Weir	Inability to meet treated water quality objectives causing risk to human health	Algal Toxins Taste & Odour	Taste & odour	Likely	Minor	Medium (8)	PAC ACH - clarification Filters Alternative bore supply	MRC monthly algal monitoring for raw & treated water quality	Likely	Insignificant	Medium (5)	Reliable												
PRB17	Mackay & Marian	**Pioneer River Basin**	Algal blooms in Marian Weir	Inability to meet treated water quality objectives causing risk to human health	Algal Toxins Taste & Odour	Algal toxins	Likely	Major	High (16)	PAC ACH - clarification Filters Alternative bore supply	MRC monthly algal monitoring for raw & treated water quality	Likely	Insignificant	Medium (5)	Reliable												
		Mackay																									
M1	Mackay	**Raw Water Intake - Dumbleton Weir**	Storm event - rapidly changing raw water quality	Inability to meet treated water quality objectives causing risk to human health	Manganese Colour Turbidity TOC Bacteria Giardia & Cryptosporidium	Turbidity	Likely	Minor	Medium (8)	MRC Nebo Rd WTP - coagulation, clarification & filtration Online turbidimeter at weir alarmed through telemetry with automatic weir pump shutdown signal	Online turbidimeter at Dumbleton Weir MRC daily inspection of Dumbleton Weir	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**QCP**		Turbidity - online turbidimeter at weir	< 350 Operator adjustable	Turbidity spikes	
						E. coli	Likely	Catastrophic	Extreme (20)	MRC Nebo Rd WTP - disinfection Online turbidimeter at weir alarmed through telemetry with automatic weir pump shutdown signal	Online turbidimeter at Dumbleton Weir MRC daily inspection of Dumbleton Weir	Rare	Moderate	Low (3)	Certain												
						Giarda & Crypto	Likely	Catastrophic	Extreme (20)	MRC Nebo Rd WTP - coagulation, clarification & filtration Online turbidimeter at weir alarmed through telemetry with automatic weir pump shutdown signal	Online turbidimeter at Dumbleton Weir MRC daily inspection of Dumbleton Weir	Rare	Moderate	Low (3)	Certain												
M2	Mackay	**Raw Water Intake - Dumbleton Weir**	Drought and dry season - changes in water quality including increased risk of blue green algae leading to cyanotoxins being present in treated water	Inability to meet treated water quality objectives causing risk to human health	Cyanotoxins Taste and odour compounds	Toxins	Unlikely	Minor	Low (4)	MRC Blue Green Algae Management Protocols (BGAMP) Dumbleton Weir variable offtake MRC Nebo Rd WTP - activated carbon adsorption	MRC event monitoring program MRC daily inspection of Dumbleton Weir	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**QCP**		Cyanotoxins - event based - grab sampled from weir extraction point	Refer BGAMP	Refer BGAMP	
						Taste & odour	Unlikely	Minor	Low (4)	MRC Blue Green Algae Management Protocols (BGAMP) Dumbleton Weir variable offtake MRC Nebo Rd WTP - activated carbon adsorption	MRC event monitoring program MRC daily inspection of Dumbleton Weir Operator daily inspections of Nebo WTP operation	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**QCP**		Geosmin and MIB - event based - grab sampled from weir extraction point	Visually and smell acceptable in operator opinion	Taste and odours	
M3	Mackay	**Raw Water Intake - Dumbleton Weir**	Accidental fuel or chemical spills (agricultural, highway along river) Terrorist activity - contamination with toxins or hydrocarbons	Inability to meet treated water quality objectives causing risk to human health	Toxins (inc. herbicides, pesticides, and hydrocarbons)	Toxins	Rare	Major	Medium (5)	MRC Nebo Rd WTP - activated carbon adsorption MRC DMP and I&ERP	MRC daily inspections MRC Monthly or event related monitoring of Organo Nitrogen Pesticides/ Herbicides in raw water MRC Quarterly or event related monitoring of SVOC in raw water	Rare	Moderate	Low (3)	Estimate		MRC to review DMP and I&ERP										
M4	Mackay	**Raw Water Intake - Dumbleton Weir**	Stratification and turnover - decrease in water quality including increased risk of blue green algae leading to cyanotoxins being present in treated water	Inability to meet treated water quality objectives causing risk to human health	Taste and odour Turbidity Manganese Iron Nutrients Cyanotoxins	Manganese	Rare	Moderate	Low (3)	MRC Nebo Rd WTP - oxidation, coagulation, clarification & filtration	MRC daily inspections MRC monthly monitoring of manganese in raw water	Rare	Minor	Low (2)	Certain	Dumbleton Weir has been flushed clean of sediment and silt due to the high rains and river flows over the last few years											
						Toxins	Unlikely	Minor	Low (4)	MRC Blue Green Algae Management Protocols (BGAMP) Dumbleton Weir variable offtake MRC Nebo Rd WTP - activated carbon adsorption	MRC event monitoring program MRC daily inspection of Dumbleton Weir	Rare	Minor	Low (2)	Certain												
M5	Mackay	**Raw Water Intake - Dumbleton Weir**	Intake screen blockage (weed and sediment build-up) - difficult to maintain screens	Inability to meet treated water quality objectives causing risk to human health	Low flow Damage to screens	Low flow	Possible	Insignificant	Low (3)	Standby pump Pump failure switches that are alarmed Online flowmeter at pump outlet telemetry alarmed	Online flowmeter monitoring raw water pump outlet	Rare	Insignificant	Low (1)	Estimate												
M6	Mackay	**Raw Water Intake - Dumbleton Weir - Infrastructure**	Integrity, life expectancy and condition of raw water mains including valves	Inability to meet treated water quality objectives causing risk to human health	Loss of supply Dirty water Biofilms	Loss of supply	Unlikely	Moderate	Medium (6)	Additional source water from bores Dual mains MRC Reactive Maintenance Protocols	Online flowmeter monitoring raw water pump outlet	Unlikely	Minor	Low (4)	Reliable		Consider relining of mains from Dumbleton Weir Mackay										
M7	Mackay	**Raw Water Intake - Dumbleton Weir - Infrastructure**	Capacity and life expectancy of pump station and pumps including electrical issues	Inability to meet treated water quality objectives causing risk to human health	Loss of supply	Loss of supply	Rare	Moderate	Low (3)	Additional source water from bores Duty/standby pumps MRC Reactive Maintenance	MRC daily inspections Online flowmeter monitoring raw water pump outlet Online alarmed monitoring of pumps	Rare	Minor	Low (2)	Reliable												
M8	Mackay	**Raw Water Intake - Dumbleton Weir - Infrastructure**	Power back-up for pump station - loss of water supply on power failure	Inability to meet treated water quality objectives causing risk to human health	Loss of supply	Loss of supply	Rare	Moderate	Low (3)	Additional source water from bores MRC standby generators MRC Nebo Rd WTP is a priority system agreement with Ergon Energy	MRC daily inspections Online flowmeter monitoring raw water pump outlet Online alarmed monitoring of pumps	Rare	Minor	Low (2)	Confident												
M9	Mackay	**Coagulation**	Failure of chemical dosing systems	Inability to meet treated water quality objectives causing risk to human health	Poor treated water quality (incl. E. coli, Giardia & Cryptosporidium, turbidity, colour etc)	Giarda & Crypto	Unlikely	Catastrophic	High (10)	Duty/standby dosing pumps Automatic control Telemetry alarmed systems MRC Nebo Rd WTP - Filtration	Online turbidimeters, pH meters and chlorine meters	Rare	Moderate	Low (3)	Confident												
						E. coli	Unlikely	Catastrophic	High (10)	Duty/standby dosing pumps Automatic control Telemetry alarmed systems MRC Nebo Rd WTP - Disinfection	Online turbidimeters, pH meters and chlorine meters	Rare	Moderate	Low (3)	Confident												

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Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
M10	Mackay	**Activated Carbon Adsorption**	Failure of PAC dosing into river water dosing tank	Inability to meet treated water quality objectives causing risk to human health	Taste and odour Organics Toxins	Taste & odour	Unlikely	Moderate	Medium (6)	Duty/standby feeders and dosing pumps MRC reactive repair crews	MRC daily inspections Online monitoring on SCADA DBPs monitoring	Rare	Moderate	Low (3)	Estimate	PAC system was commissioned in 2011 Organics of most concern are those which result from pesticides and this risk was captured in PRB12, PRB13 & M19		Y	Y	Y	Y	**QCP**	Possibilities for consideration: - tracking of customer complaints - establishing a taste and odour panel	Operator inspections of river water dosing tank / PAC dosing rate measured by drop tests at the screw feeder	Free of taste and odours / Achieve intended dose rate	Dose rate up to 20% out of target range	Zero dose rate or dose rate >20% from target
						Toxins	Unlikely	Moderate	Medium (6)	Duty/standby feeders and dosing pumps MRC reactive repair crews	MRC daily inspections Online monitoring on SCADA	Rare	Moderate	Low (3)	Estimate	PAC system was commissioned in 2011											
M11	Mackay	**Coagulation**	Underdosing chemicals	Inability to meet treated water quality objectives causing risk to human health	Poor treated water quality (incl. Giardia & Cryptosporidium, turbidity, colour etc)	Giarda & Crypto	Unlikely	Catastrophic	High (10)	Jar testing Daily operator inspection of coagulation MRC Nebo Rd WTP - Filtration	MRC daily inspection Online turbidimeters and pH meters MRC weekly monitoring of treated water	Rare	Moderate	Low (3)	Confident												
M12	Mackay	**Coagulation**	Overdosing chemicals	Inability to meet treated water quality objectives causing risk to human health	Poor treated water quality (incl. Giardia & Cryptosporidium, turbidity, colour etc)	Giarda & Crypto	Unlikely	Catastrophic	High (10)	Jar testing Daily operator inspection of coagulation MRC Nebo Rd WTP - Filtration	MRC daily inspection Online turbidimeters and pH meters MRC weekly monitoring of treated water	Rare	Moderate	Low (3)	Confident	Mackay experienced high aluminium levels in the treated water when Alum was used as the coagulant however since the use of ACH in 2007/2008 the levels have been reduced											
M13	Mackay	**Flocculation & Sedimentation**	Failure of sludge draw-off/removal system in sedimentation tank	Inability to meet treated water quality objectives causing risk to human health	Soluble metals	Manganese	Rare	Moderate	Low (3)	MRC Maintenance Program Automatic drawoff MRC Nebo Rd WTP - Filtration	Turbidity sensor monitoring sludge drawoff MRC daily inspection	Rare	Minor	Low (2)	Estimate												
M14	Mackay	**Flocculation & Sedimentation**	Floc carryover and poor water quality from sedimentation tank	Inability to meet treated water quality objectives causing risk to human health	Overloading of filters Filter breakthrough Giardia & Cryptosporidium Turbidity	Giarda & Crypto	Possible	Catastrophic	High (15)	Online turbidimeters telemetry alarmed MRC Nebo Rd WTP - Filtration	MRC daily inspection Online turbidimeters	Rare	Moderate	Low (3)	Estimate												
M15	Mackay	**Filtration**	Filter breakthrough	Inadequate removal of particles	Giardia & Cryptosporidium Turbidity Manganese Iron	Giarda & Crypto	Likely	Catastrophic	Extreme (20)	Online turbidimeters telemetry alarmed Automatic backwash activation CCP Procedure implemented	MRC daily inspection Online turbidimeters at filter outlet	Unlikely	Minor	Low (4)	Confident			Y	Y	Y	Y	**CCP**	Refer to risk M16 for CCP related to this risk				
M16	Mackay	**Filtration**	Filter ripening	Breakthrough of contaminants during filter bed ripening	Giardia & Cryptosporidium Turbidity Manganese Iron	Giarda & Crypto	Likely	Catastrophic	Extreme (20)	Online turbidimeters telemetry alarmed CCP Procedure implemented	MRC daily inspection Online turbidimeters at filter outlet	Rare	Moderate	Low (3)	Confident			Y	Y	Y	Y	**CCP**	Coagulation, Sedimentation and Filtration combined	Turbidity - grab sample bench analysed - online turbidimeter at filter outlet	0.15 NTU	>0.3 NTU (>0.3 NTU for 15 mins for online turbidmeter)	>1.0 NTU (>1.0 NTU for 5 mins for online turbidmeter)
M17	Mackay	**Disinfection**	Underdose or failure to dose	Inadequate disinfection (raw water chlorine demand increases)	E. coli	E. coli	Unlikely	Catastrophic	High (10)	Operator daily grab samples and bench analyses Online chlorine meter pH correction CCP Procedure implemented	MRC weekly micro monitoring Grab samples of treated water analysed for free chlorine ~~twice~~ daily Online chlorine meter analysing treated water	Rare	Moderate	Low (3)	Certain			Y	Y	Y	Y	**CCP**	Refer to risk M18 for CCP related to this risk				
M18	Mackay	**Disinfection**	Overdose	Impact on taste and odour of treated water	Chlorine Disinfection by-products Taste & odour	Free chlorine residual	Unlikely	Minor	Low (4)	Operator daily grab samples and bench analyses Online chlorine meter pH correction CCP Procedure implemented	MRC weekly micro monitoring Grab samples of treated water analysed for free chlorine ~~twice~~ daily Online chlorine meter analysing treated water	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**CCP**	Under- and over- dose combined	Free chlorine residual - grab sample bench analysed - online chlorine meter	1.2 - 1.5 mg/L	<1.0 mg/L, >2.0 mg/L <1.0 mg/L, >2.0 mg/L (for	<0.5 mg/L >5.0 mg/L
M19	Mackay	**Disinfection**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection by-products	Tri-halomethanes	Possible	Minor	Medium (6)	MRC Nebo Rd WTP - organic removal in activated carbon adsorption, coagulation, sedimentation & filtration	MRC weekly monitoring for treated water (incl Total Organic Carbon)	Unlikely	Minor	Low (4)	Estimate												
M20	Mackay	**Disinfection**	Equipment failure	Inadequate disinfection	E. coli	E. coli	Rare	Catastrophic	Medium (6)	MRC Maintenance Program Duty/standby chlorinators CCP Procedure implemented	MRC weekly micro monitoring Grab samples of treated water analysed for free chlorine daily	Rare	Minor	Low (2)	Confident			Y	Y	Y	Y	**CCP**	Refer to risk M18 for CCP related to this risk				
M21	Mackay	**Fluoridation**	Underdose or failure to dose and overdose (incl. equipment failure)	Failure to comply with regulations and contamination of treated water	Fluoride	Fluoride	Unlikely	Moderate	Medium (6)	Water Fluoridation Code of Practice 2013 Water Fluoridation Act 2008 Water Fluoridation Regulation 2008 CCP Procedure implemented	Online fluoride meters analysing treated water Grab samples of treated water bench analysed daily for fluoride	Rare	Moderate	Low (3)	Confident			Y	Y	Y	Y	**CCP**		Fluoride in treated water - online fluoride meter - grab samples bench analysed	0.7 mg/L	<0.6 mg/L, >0.8 mg/L in any one sample 0.0 mg/L for 10 consecutive samples	>1.5 mg/L in any one sample 0.0 mg/L for 14 consecutive samples <0.6 mg/L, >0.8 mg/L averaged over a quarter
M22	Mackay	**pH / Alkalinity Pre-adjustment**	Overdosing/underdosing of caustic	Impact on chemical reactions	pH Poor coagulation Poor oxidation	pH	Possible	Minor	Medium (6)	Online pH meters alarmed through telemetry	Online pH meters MRC daily inspection	Rare	Minor	Low (2)	Confident	Caustic dosing is only applied during storm and manganese events		Y	N			**OCP**					
M23	Mackay	**Oxidation**	Overdosing/underdosing of potassium permanganate	Inadequate oxidation leading to manganese residue and addition of manganese from chemical	Manganese Dirty water	Manganese	Possible	Minor	Medium (6)	Duty/standby dosing pumps Caustic dosing	MRC weekly monitoring of manganese in raw and treated water MRC event monitoring	Unlikely	Minor	Low (4)	Confident			Y	N			**OCP**					
M24	Mackay	**pH / Alkalinity Post-adjustment**	Underdose or failure to dose caustic	Corrosive water	Corrosive water	pH	Possible	Minor	Medium (6)	Online pH meters alarmed through telemetry	Online pH meters MRC daily inspection	Rare	Minor	Low (2)	Estimate												
M25	Mackay	**pH / Alkalinity Post-adjustment**	Overdose caustic	Inadequate disinfection	pH	pH	Possible	Moderate	Medium (9)	Online pH meters alarmed through telemetry	Online pH meters MRC daily inspection	Rare	Moderate	Low (3)	Estimate	Inadequate disinfection also leads to the presence of bacteria, this risk was captured in M20		Y	Y	Y	Y	**QCP**		pH - online pH meter analysing treated water	7.6 ± 0.4	7.0 - 8.2	6.5 - 8.5
M26	Mackay	**Clear Water Tanks & Balance Tanks**	Sediment becoming retrained	Increased turbidity	Turbidity Giardia & Cryptosporidium	Giarda & Crypto	Rare	Catastrophic	Medium (6)	MRC cleaning and maintenance program	MRC weekly micro and turbidity monitoring for treated water	Rare	Minor	Low (2)	Estimate		Review Nebo Rd WTP clear water tank cleaning and maintenance schedule and methodology										
M27	Mackay	**Clear Water Tanks & Balance Tanks**	Chlorine contact time - sufficient contact time provided in clear water tank and balance tanks	Short circuiting in tanks	E. coli Viruses	E. coli	Rare	Catastrophic	Medium (6)	Management of tanks SCADA alarms	Operator monitoring SCADA online monitoring	Rare	Minor	Low (2)	Confident												

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Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
M28	Mackay	**Reticulation**	Low alkalinity water dissolving cement in pipes and reservoirs	High pH which reduces effectiveness of chlorine residual	pH Poor disinfection	pH	Possible	Moderate	Medium (9)	Regular cleaning and maintenance of reservoirs (divers) Slow release chlorine tablets added to reservoirs (disinfection) During periods of low demand the chlorine dose is raised and/or the reservoir level is lowered Use of re-chlorination stations installed throughout the distribution	MRC weekly monitoring of reticulation network	Unlikely	Minor	Low (4)	Confident												
						Free Chlorine Residual	Possible	Moderate	Medium (9)	Regular cleaning and maintenance of reservoirs (divers) Slow release chlorine tablets added to reservoirs (disinfection) During periods of low demand the chlorine dose is raised and/or the reservoir level is lowered Use of re-chlorination stations installed throughout the distribution	MRC weekly monitoring of reticulation network	Unlikely	Minor	Low (4)	Confident												
M29	Mackay	**Reticulation**	Corrosion of metal pipes	Dirty water Risk to public health	Dirty water Copper Zinc Iron Lead (from packed joints) Hardness	Lead	Unlikely	Minor	Low (4)	MRC Main Replacement Program	MRC weekly monitoring of reticulation network	Unlikely	Minor	Low (4)	Confident												
M30	Mackay	**Reticulation**	Stagnant water in dead ends and inability to effectively clean mains	Build up of contaminants	Dirty water Iron Manganese Turbidity	Turbidity	Unlikely	Insignificant	Low (2)	MRC Dead End Flushing Program MRC Reactive Scouring Program (from complaints recorded)	MRC weekly monitoring of reticulation network MRC Complaint Monitoring Program	Rare	Insignificant	Low (1)	Certain		Review cleaning and maintenance schedule and program for Mackay										
M31	Mackay	**Reticulation**	Loss of pressure	Ingress of contaminants	E. coli Turbidity	E. coli	Rare	Catastrophic	Medium (6)	MRC Protocol to redirect water to affected area Disinfection	MRC weekly random reticulation pressure tests	Rare	Minor	Low (2)	Confident		Complete hydraulic model of Maakay										
M32	Mackay	**Reticulation**	Poor water quality from Port Authority - reticulation area water supply from main that passes through and is connected to the Port	Dirty water Risk to public health	Dirty water Copper Zinc Iron Lead Hardness	Lead	Unlikely	Minor	Low (4)	New main and sampling point installed by MRC to bypass the Port and have separate supply main to reticulation area	MRC weekly monitoring of reticulation network	Rare	Insignificant	Low (1)	Confident												
M33	Mackay	**Reticulation**	Connections to raw water	Drinking untreated water	E. coli Turbidity Manganese Iron	E. coli	Unlikely	Catastrophic	High (10)	Signage Contractual agreements		Unlikely	Minor	Low (4)	Uncertain	Raw water connections: - BSES - Islander Hut - Mackay Regional Botanic Gardens	Review signage and contractual agreements with raw water users in Mackay										
M34	Mackay	**Reticulation**	Underdose or no dose of chlorine	Inadequate disinfection	E. coli Manganese TOC Poor free chlorine residual	E. coli	Possible	Catastrophic	High (15)	Optimisation of online chlorine residual monitoring in the treated water outlet of Nebo Rd WTP and at rechlorination stations	MRC weekly monitoring of reticulation network	Possible	Minor	Medium (6)	Certain												
M35	Mackay	**Reticulation**	Overdose of chlorine	Impact on taste and odour of treated water	Free chlorine residual	Free chlorine residual	Unlikely	Insignificant	Low (2)	Optimisation of online chlorine residual monitoring in the treated water outlet of Nebo Rd WTP and at rechlorination stations	MRC weekly monitoring of reticulation network	Rare	Insignificant	Low (1)	Certain												
M36	Mackay	**Reticulation**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection by-products	Tri-halomethanes	Possible	Insignificant	Low (3)		MRC weekly monitoring of reticulation network	Rare	Insignificant	Low (1)	Certain												
M37	Mackay	**Reservoir**	Inadequate protection of reservoirs	Contamination of treated water from ingress at reservoir	E. coli	E. coli	Unlikely	Catastrophic	High (10)	MRC Reservoir Maintenance Program Disinfection	MRC weekly monitoring of reticulation network	Unlikely	Minor	Low (4)	Confident												
M38	Mackay	**Reservoir & Reticulation**	Vandalism & sabotage	Contamination of treated water	E. coli Turbidity Toxins	E. coli	Rare	Catastrophic	Medium (6)	Reservoirs have high fencing with locked gates Signage MRC DMP and I&ERP Disinfection	MRC periodic inspections	Rare	Catastrophic	Medium (6)	Estimate		Review security measures of all components of Mackay										
M39	Mackay	**Reticulation**	Asset Maintenance	Failure of equipment	Various	E. coli	Unlikely	Catastrophic	High (10)	MRC Maintenance Program		Unlikely	Minor	Low (4)	Estimate		Review MRC Asset Management System										
M40	Mackay	**Reticulation**	Developers construction	Poor quality of work	E. coli Turbidity	E. coli	Possible	Catastrophic	High (15)	MRC Planning Division inspections of developer works Pipe disinfection holding water for 24 hours	Microbiological sampling of water from new works	Unlikely	Minor	Low (4)	Confident												
M41	Mackay	**Raw Water Intake - Bores**	Saline intrusion into aquifer	Inability to meet treated water quality objectives causing risk to human health	Salinity Bromide/Bromate Boron Total Dissolved Solids	TDS	Possible	Minor	Medium (6)	MRC Nebo Rd WTP - coagulation & clarification	MRC weekly monitoring of reticulation network	Possible	Insignificant	Low (3)	Confident												
M42	Mackay	**Raw Water Intake - Bores**	Herbicide and pesticide leaching into aquifers from waterways and from land users e.g. sugarcane spraying	Inability to meet treated water quality objectives causing risk to human health	Herbicides Pesticides	Herbicides	Likely	Minor	Medium (8)	MRC Nebo Rd WTP - activated carbon adsorption	MRC weekly monitoring of reticulation network	Rare	Minor	Low (2)	Uncertain												
M43	Mackay	**Raw Water Intake - Bores**	Pathogens leaching into aquifers from waterways, from land users and from septic tanks located above aquifers	Inability to meet treated water quality objectives causing risk to human health	E. coli	E. coli	Possible	Catastrophic	High (15)	Chlorine dosing of groundwater MRC Nebo Rd WTP - disinfection	Regular operator inspections of chlorine dosing system and bores MRC weekly monitoring of raw water	Rare	Moderate	Low (3)	Confident												
M44	Mackay	**Raw Water Intake - Bores**	Development in the vicinity of the bores	Inability to meet treated water quality objectives causing risk to human health	E. coli Turbidity	E. coli	Possible	Catastrophic	High (15)	Chlorine dosing of groundwater MRC Nebo Rd WTP - disinfection	Regular operator inspections of chlorine dosing system and bores MRC weekly monitoring of raw water	Rare	Moderate	Low (3)	Confident												
M45	Mackay	**Raw Water Intake - Bores**	Tampering and Vandalism	Inability to meet treated water quality objectives causing risk to human health	E. coli Turbidity Toxins	Toxins	Unlikely	Major	Medium (8)	MRC Nebo Rd WTP - activated carbon adsorption MRC DMP and I&ERP	MRC weekly monitoring of raw water MRC daily inspections	Rare	Moderate	Low (3)	Estimate												
M46	Mackay	**Raw Water Intake - Bores - Infrastructure**	Low lift pumps failure	Inability to meet treated water quality objectives causing risk to human health	Loss of supply	Loss of supply	Rare	Moderate	Low (3)	Alternative water source from Dumbleton Weir MRC Reactive Maintenance Protocols	MRC daily inspections	Rare	Insignificant	Low (1)	Confident												

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M47	Mackay	**Disinfection at Rechlorination Facilities**	Underdose or failure to dose	Inadequate disinfection (raw water chlorine demand increases)	E. coli	E. coli	Unlikely	Catastrophic	High (10)	Pump attendant weekly grab samples and bench analyses Online chlorine meter pH correction CCP Procedure implemented	MRC weekly micro monitoring Grab samples of treated water analysed for free chlorine daily Online chlorine meter analysing treated water	Rare	Moderate	Low (3)	Certain			Y	Y	Y	Y	**CCP**	Under- and over- dose combined	Free chlorine residual - grab sample bench analysed - online chlorine meter	1.2 - 1.5 mg/L	<0.75 mg/L, >2.0 mg/L <0.75 mg/L, >2.0 mg/L (for 1 hour for online chlorine meter)	<0.5 mg/L >5.0 mg/L
M48	Mackay	**Disinfection at Rechlorination Facilities**	Overdose	Impact on taste and odour of treated water	Chlorine Disinfection by-products Taste & odour	Free chlorine residual	Unlikely	Minor	Low (4)	Operator daily grab samples and bench analyses Online chlorine meter CCP Procedure implemented	MRC weekly micro monitoring Grab samples of treated water analysed for free chlorine daily Online chlorine meter analysing treated water	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**CCP**	Refer to risk M47 for CCP related to this risk				
M49	Mackay	**Disinfection at Rechlorination Facilities**	Equipment failure	Inadequate disinfection	E. coli	E. coli	Rare	Catastrophic	Medium (6)	MRC Maintenance Program CCP Procedure implemented	MRC weekly micro monitoring Grab samples of treated water analysed for free chlorine daily	Rare	Minor	Low (2)	Confident			Y	Y	Y	Y	**CCP**	Refer to risk M47 for CCP related to this risk				
		Marian																									
MA1	Marian	**Raw Water Intake - Marian Weir**	Storm event - rapidly changing raw water quality	Inability to meet treated water quality objectives causing risk to human health	Manganese Colour Turbidity TOC Bacteria Giardia & Cryptosporidium	Turbidity	Likely	Minor	Medium (8)	MRC Marian WTP - coagulation, clarification & filtration	MRC daily inspection of Marian Weir	Rare	Minor	Low (2)	Certain												
						E. coli	Likely	Catastrophic	Extreme (20)	MRC Marian WTP - disinfection Online turbidimeter at weir alarmed through telemetry with automatic weir pump shutdown signal	Online turbidimeter at Marian Weir MRC daily inspection of Marian Weir	Rare	Moderate	Low (3)	Certain												
						Giarda & Crypto	Likely	Catastrophic	Extreme (20)	MRC Marian WTP - coagulation, clarification & filtration Online turbidimeter at weir alarmed through telemetry with automatic weir pump shutdown signal	Online turbidimeter at Marian Weir MRC daily inspection of Marian Weir	Rare	Moderate	Low (3)	Certain												
MA2	Marian	**Raw Water Intake - Marian Weir**	Drought and dry season - changes in water quality including increased risk of blue green algae leading to cyanotoxins being present in treated water	Inability to meet treated water quality objectives causing risk to human health	Cyanotoxins Taste and odour compounds	Toxins	Unlikely	Minor	Low (4)	MRC Blue Green Algae Management Protocols (BGAMP) MRC Marian WTP - activated carbon adsorption	MRC event monitoring program MRC daily inspection of Marian Weir	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**QCP**		Cyanotoxins - event based - grab sampled from weir extraction point	Refer BGAMP	Refer BGAMP	
						Taste & odour	Unlikely	Minor	Low (4)	MRC Blue Green Algae Management Protocols (BGAMP) Marian Weir variable offtake MRC Marian WTP - activated carbon adsorption	MRC event monitoring program MRC daily inspection of Marian Weir Operator daily inspections of Marian WTP operation	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**QCP**		Geosmin and MIB - event based - grab sampled from weir extraction point	Visually and smell acceptable in operator opinion	Taste and odours	
MA3	Marian	**Raw Water Intake - Marian Weir**	Accidental fuel or chemical spills (agricultural, highway along river) Terrorist activity - contamination with toxins or hydrocarbons	Inability to meet treated water quality objectives causing risk to human health	Toxins (inc. herbicides, pesticides, and hydrocarbons)	Toxins	Rare	Major	Medium (5)	MRC Marian WTP - activated carbon adsorption MRC DMP and I&ERP	MRC daily inspections MRC Monthly or event related monitoring of Organo Nitrogen Pesticides/ Herbicides in raw water MRC Quarterly or event related monitoring of SVOC in	Rare	Moderate	Low (3)	Estimate		MRC to review DMP and I&ERP										
MA4	Marian	**Raw Water Intake - Marian Weir**	Stratification and turnover - decrease in water quality including increased risk of blue green algae leading to cyanotoxins being present in treated water	Inability to meet treated water quality objectives causing risk to human health	Taste and odour Turbidity Manganese Iron Nutrients Cyanotoxins	Manganese	Rare	Moderate	Low (3)	MRC Marian WTP - oxidation, coagulation, clarification & filtration	MRC daily inspections MRC monthly monitoring of manganese in raw water	Rare	Minor	Low (2)	Certain	Marian Weir has been flushed clean of sediment and silt due to the high rains and river flows over the last few years	Review cleaning and maintenance schedule and program for Marian scheme Re-evaluate risks after further Marian monitoring data has been captured										
						Toxins	Unlikely	Minor	Low (4)	MRC Blue Green Algae Management Protocols (BGAMP) Marian Weir variable offtake MRC Marian WTP - activated carbon adsorption	MRC event monitoring program MRC daily inspection of Marian Weir	Rare	Minor	Low (2)	Certain												
MA5	Marian	**Raw Water Intake - Marian Weir**	Intake screen blockage (weed and sediment build-up) - difficult to maintain screens	Inability to meet treated water quality objectives causing risk to human health	Low flow Damage to screens	Low flow	Possible	Insignificant	Low (3)	Standby pump Air scourer option Pump failure switches that are alarmed Online flowmeter at pump outlet telemetry alarmed	Online flowmeter monitoring raw water pump outlet	Rare	Insignificant	Low (1)	Estimate		Review cleaning and maintenance schedule and program for Marian scheme Re-evaluate risks after further Marian monitoring data has been captured										
MA6	Marian	**Raw Water Intake - Marian Weir - Infrastructure**	Integrity, life expectancy and condition of raw water mains including valves	Inability to meet treated water quality objectives causing risk to human health	Loss of supply Dirty water Biofilms	Loss of supply	Unlikely	Moderate	Medium (6)	Additional source water from bores New infrastructure MRC Reactive Maintenance Protocols	Online flowmeter monitoring raw water pump outlet	Unlikely	Minor	Low (4)	Reliable												
MA7	Marian	**Raw Water Intake - Marian Weir - Infrastructure**	Capacity and life expectancy of pump station and pumps including electrical issues	Inability to meet treated water quality objectives causing risk to human health	Loss of supply	Loss of supply	Rare	Moderate	Low (3)	Additional source water from bores Duty/standby pumps MRC Reactive Maintenance Protocols	MRC daily inspections Online flowmeter monitoring raw water pump outlet Online alarmed monitoring of pumps	Rare	Minor	Low (2)	Reliable												
MA8	Marian	**Raw Water Intake - Marian Weir - Infrastructure**	Power back-up for pump station - loss of water supply on power failure	Inability to meet treated water quality objectives causing risk to human health	Loss of supply	Loss of supply	Rare	Moderate	Low (3)	Additional source water from bores MRC standby generators	MRC daily inspections Online flowmeter monitoring raw water pump outlet Online alarmed monitoring of pumps	Rare	Minor	Low (2)	Confident												
MA9	Marian	**Coagulation**	Failure of chemical dosing systems	Inability to meet treated water quality objectives causing risk to human health	Poor treated water quality (incl. E. coli, Giardia & Cryptosporidium, turbidity, colour etc)	Giarda & Crypto	Unlikely	Catastrophic	High (10)	Duty/standby dosing pumps Automatic control Telemetry alarmed systems MRC Marian WTP - Filtration	Online turbidimeters, pH meters and chlorine meters	Rare	Moderate	Low (3)	Confident												
						E. coli	Unlikely	Catastrophic	High (10)	Duty/standby dosing pumps Automatic control Telemetry alarmed systems MRC Marian WTP - Disinfection	Online turbidimeters, pH meters and chlorine meters	Rare	Moderate	Low (3)	Confident												
MA10	Marian	**Activated Carbon Adsorption**	Failure of PAC dosing into river water dosing tank	Inability to meet treated water quality objectives causing risk to human health	Taste and odour Organics Toxins	Taste & odour	Unlikely	Moderate	Medium (6)	Duty/standby feeders and dosing pumps MRC reactive repair crews	MRC daily inspections Online monitoring on SCADA DBPs monitoring	Rare	Moderate	Low (3)	Estimate			Y	Y	Y	Y	**QCP**	Possibilities for consideration: - tracking of customer complaints - establishing a taste and odour panel	Operator inspections of river water dosing tank / PAC dosing rate measured by drop tests at the screw feeder	Free of taste and odours / Achieve intended dose rate	Dose rate up to 20% out of target range	Zero dose rate or dose rate >20% from target

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						Toxins	Unlikely	Moderate	Medium (6)	Duty/standby feeders and dosing pumps MRC reactive repair crews	MRC daily inspections Online monitoring on SCADA	Rare	Moderate	Low (3)	Estimate												
MA11	Marian	**Coagulation**	Underdosing chemicals	Inability to meet treated water quality objectives causing risk to human health	Poor treated water quality (incl. Giardia & Cryptosporidium, turbidity, colour etc)	Giarda & Crypto	Unlikely	Catastrophic	High (10)	Jar testing Daily operator inspection of coagulation MRC Marian WTP - Filtration	MRC daily inspection Online turbidimeters and pH meters MRC weekly monitoring of treated water	Rare	Moderate	Low (3)	Confident												
MA12	Marian	**Coagulation**	Overdosing chemicals	Inability to meet treated water quality objectives causing risk to human health	Poor treated water quality (incl. Giardia & Cryptosporidium, turbidity, colour etc)	Giarda & Crypto	Unlikely	Catastrophic	High (10)	Jar testing Daily operator inspection of coagulation MRC Marian WTP - Filtration	MRC daily inspection Online turbidimeters and pH meters MRC weekly monitoring of treated water	Rare	Moderate	Low (3)	Confident												
MA13	Marian	**Flocculation & Sedimentation**	Failure of sludge draw-off/removal system in sedimentation tank	Inability to meet treated water quality objectives causing risk to human health	Soluble metals	Manganese	Rare	Moderate	Low (3)	MRC Maintenance Program Automatic drawoff MRC Marian WTP - Filtration	Turbidity sensor monitoring sludge drawoff MRC daily inspection	Rare	Minor	Low (2)	Estimate												
MA14	Marian	**Flocculation & Sedimentation**	Floc carryover and poor water quality from sedimentation tank	Inability to meet treated water quality objectives causing risk to human health	Overloading of filters Filter breakthrough Giardia & Cryptosporidium Turbidity	Giarda & Crypto	Possible	Catastrophic	High (15)	Online turbidimeters telemetry alarmed MRC Marian WTP - Filtration	MRC daily inspection Online turbidimeters	Rare	Moderate	Low (3)	Estimate												
MA15	Marian	**Filtration**	Filter breakthrough	Inadequate removal of particles	Giardia & Cryptosporidium Turbidity Manganese Iron	Giarda & Crypto	Likely	Catastrophic	Extreme (20)	Online turbidimeters telemetry alarmed Automatic backwash activation CCP Procedure implemented	MRC daily inspection Online turbidimeters at filter outlet	Unlikely	Minor	Low (4)	Confident			Y	Y	Y	Y	**CCP**	Refer to risk MA16 for CCP related to this risk				
MA16	Marian	**Filtration**	Filter ripening	Breakthrough of contaminants during filter bed ripening	Giardia & Cryptosporidium Turbidity Manganese Iron	Giarda & Crypto	Likely	Catastrophic	Extreme (20)	Online turbidimeters telemetry alarmed CCP Procedure implemented	MRC daily inspection Online turbidimeters at filter outlet	Rare	Moderate	Low (3)	Confident			Y	Y	Y	Y	**CCP**	Coagulation, Sedimentation and Filtration combined	Turbidity - grab sample bench analysed - online turbidity meter	0.15 NTU	<0.3 NTU (for 15 minutes for online turbidity meter)	>1.0 NTU (for 5 minutes for online turbidity meter)
MA17	Marian	**Disinfection (at WTP)**	Underdose or failure to dose	Inadequate disinfection (raw water chlorine demand increases)	E. coli	E. coli	Unlikely	Catastrophic	High (10)	Operator daily grab samples and bench analyses Online chlorine meter pH correction CCP Procedure implemented	MRC weekly micro monitoring Grab samples of treated water analysed for free chlorine daily Online chlorine meter analysing treated water	Rare	Moderate	Low (3)	Certain			Y	Y	Y	Y	**CCP**	Refer to risk MA20 for CCP related to this risk				
MA18	Marian	**Disinfection (at WTP)**	Overdose	Impact on taste and odour of treated water	Chlorine Disinfection by-products Taste & odour	Free chlorine residual	Unlikely	Minor	Low (4)	Operator daily grab samples and bench analyses Online chlorine meter pH correction CCP Procedure implemented	MRC weekly micro monitoring Grab samples of treated water analysed for free chlorine daily Online chlorine meter analysing treated water	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**CCP**	Refer to risk MA20 for CCP related to this risk				
MA19	Marian	**Disinfection (at WTP)**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection by-products	Tri-halomethanes	Possible	Minor	Medium (6)	MRC Marian WTP - organic removal in activated carbon adsorption, coagulation, sedimentation & filtration	MRC weekly monitoring for treated water (incl Total Organic Carbon)	Unlikely	Minor	Low (4)	Estimate												
MA20	Marian	**Disinfection (at WTP)**	Equipment failure	Inadequate disinfection	E. coli	E. coli	Rare	Catastrophic	Medium (6)	MRC Maintenance Program Duty/standby chlorinators CCP Procedure implemented	MRC weekly micro monitoring Grab samples of treated water analysed for free chlorine daily	Rare	Minor	Low (2)	Confident			Y	Y	Y	Y	**CCP**	Under- and over- dose combined	Free chlorine residual - grab sample bench analysed - online	1.8 mg/L	<1.3 mg/L >2.0 mg/L	<0.5 mg/L >5.0 mg/L
MA21	Marian	**Fluoridation**	Underdose or failure to dose and overdose (incl. equipment failure)	Failure to comply with regulations and contamination of treated water	Fluoride	Fluoride	Unlikely	Moderate	Medium (6)	Water Fluoridation Code of Practice 2013 Water Fluoridation Act 2008 Water Fluoridation Regulation 2008 CCP Procedure implemented	Online fluoride meters analysing treated water Grab samples of treated water bench analysed daily for fluoride	Rare	Moderate	Low (3)	Confident			Y	Y	Y	Y	**CCP**		Fluoride in treated water - grab samples bench analysed - online fluoride meter	0.7 mg/L	<0.6 mg/L, >0.8 mg/L in any one sample 0.0 mg/L for 10 consecutive samples	>1.5 mg/L in any one sample 0.0 mg/L for 14 consecutive samples <0.6 mg/L, >0.8 mg/L averaged over a quarter
MA22	Marian	**pH / Alkalinity Pre-adjustment**	Overdosing/underdosing of caustic	Impact on chemical reactions	pH Poor coagulation Poor oxidation	pH	Possible	Minor	Medium (6)	Online pH meters alarmed through telemetry	Online pH meters MRC daily inspection	Rare	Minor	Low (2)	Confident	Caustic dosing is only applied during storm and manganese events		Y	N			**OCP**					
MA23	Marian	**Oxidation**	Overdosing/underdosing of potassium permanganate	Inadequate oxidation leading to manganese residue and addition of manganese from chemical	Manganese Dirty water	Manganese	Possible	Minor	Medium (6)	Duty/standby dosing pumps Caustic dosing	MRC weekly monitoring of manganese in raw and treated water MRC event monitoring	Unlikely	Minor	Low (4)	Confident			Y	N			**OCP**					
MA24	Marian	**pH / Alkalinity Post-adjustment**	Underdose or failure to dose caustic	Corrosive water	Corrosive water	pH	Possible	Minor	Medium (6)	Online pH meters alarmed through telemetry	Online pH meters MRC daily inspection	Rare	Minor	Low (2)	Estimate												
MA25	Marian	**pH / Alkalinity Post-adjustment**	Overdose caustic	Inadequate disinfection	pH	pH	Possible	Moderate	Medium (9)	Online pH meters alarmed through telemetry	Online pH meters MRC daily inspection	Rare	Moderate	Low (3)	Estimate	Inadequate disinfection also leads to the presence of bacteria, this risk was captured in MA20		Y	Y	Y	Y	**QCP**		pH - online pH meter analysing treated water	7.6 ± 0.4	7.0 - 8.2	6.5 - 8.5
MA26	Marian	**Clear Water Tanks & Balance Tanks**	Sediment becoming retrained	Increased turbidity	Turbidity Giardia & Cryptosporidium	Giarda & Crypto	Rare	Catastrophic	Medium (6)	MRC cleaning and maintenance program	MRC weekly micro and turbidity monitoring for treated water	Rare	Minor	Low (2)	Estimate												
MA27	Marian	**Clear Water Tanks & Balance Tanks**	Chlorine contact time - sufficient contact time provided in clear water tank and balance tanks	Short circuiting in tanks	E. coli Viruses	E. coli	Rare	Catastrophic	Medium (6)	Management of tanks SCADA alarms	Operator monitoring SCADA online monitoring	Rare	Minor	Low (2)	Confident												
MA28	Marian	**Marian weir intake infrastructure**	Failure of lay flat within intake sleeve	Failure of equipment	Reduced raw water flow	Low flow	Likely	Minor	Medium (8)	Back up pump Small turnaround to fix/repair	Daily operator checks Telemetry SCADA alarms	Unlikely	Minor	Low (4)	Reliable												
MA29	Marian	**Marian weir intake infrastructure**	Power outage	Failure of equipment	Loss of supply	Loss of supply	Likely	Major	High (16)	Location for generator to be plugged in Reservoir storage	Daily operator checks Telemetry SCADA alarms	Possible	Minor	Medium (6)	Uncertain		Develop incident response procedure for power outage of Marian weir intake infrastructure										
MA30	Marian	**Marian weir intake infrastructure**	Flood debris damage to structure	Failure of equipment	Loss of supply	Loss of supply	Rare	Major	Medium (5)	Back up pump Small turnaround to fix/repair Reservoir storage Bores	Daily operator checks Telemetry SCADA alarms	Rare	Minor	Low (2)	Uncertain	Unchanged due to lack of data and unpredictability											
MA31	Marian	**Alternative Source Water - Marian and Mirani Bores**	Bedrock minerals leaching in groundwater	Inability to meet treated water quality objectives causing risk to human health	Minerals	Hardness	Possible	Minor	Medium (6)	Treated bore water only used as a backup when Marian WTP is not operational. Ability to treat bore water (as alternative to weir intake) at WTP.	MRC weekly cation monitoring for raw and treated water	Unlikely	Minor	Low (4)	Confident												

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MA32	Marian	**Alternative Source Water - Marian and Mirani Bores**	Agricultural run-off and herbicide leaching into aquifers from waterways and from land users e.g. sugarcane spraying	Inability to meet treated water quality objectives causing risk to human health	Herbicides Nitrate	Herbicides	Unlikely	Minor	Low (4)	Treated bore water only used as a backup for when Marian WTP is not operational. Ability to treat bore water (as alternative to weir intake) at WTP.	Reef Catchments Monitoring Program	Rare	Minor	Low (2)	Uncertain		Investigate possibility of formal agreement between Reef Catchments and MRC regarding sharing of information and communications for Marian										
						Nitrate	Unlikely	Moderate	Medium (6)	Customer notifcations if health value is exceeded	Reef Catchments Monitoring Program	Rare	Moderate	Low (3)	Estimate		Investigate possibility of formal agreement between Reef Catchments and MRC regarding sharing of information and communications for Marian Review of water quality monitoring program for Marian										
MA33	Marian	**Alternative Source Water - Marian and Mirani Bores**	Pathogens leaching into aquifers from waterways and from land users e.g. cattle	Inability to meet treated water quality objectives causing risk to human health	E. coli Giardia & Cryptosporidium	E. coli	Rare	Catastrophic	Medium (6)	Chlorine dosing of groundwater when Marian WTP is not operational. Treated bore water only used as a backup for Marian WTP. Ability to run bore water through WTP.	Regular operator inspections of chlorine dosing systems and bores MRC weekly micro monitoring for raw and treated water	Rare	Minor	Low (2)	Confident			Y	Y	Y	Y	**CCP**	Refer to risk MA35 for CCP related to this risk				
						Giarda & Crypto	Rare	Catastrophic	Medium (6)		Regular operator inspections of bores MRC weekly micro monitoring for raw and treated water	Rare	Minor	Low (2)	Confident												
MA34	Marian	**Disinfection (of Marian and Mirani bores when used as emergency supply)**	Underdose or failure to dose	Inadequate disinfection (treated water chlorine demand increases)	E. coli	E. coli	Unlikely	Catastrophic	High (10)	CCP Procedure implemented	MRC monthly micro monitoring at Marian and Mirani Reservoir when bores operating Grab samples of treated water analysed	Rare	Moderate	Low (3)	Certain			Y	Y	Y	Y	**CCP**	Refer to risk MA35 for CCP related to this risk				
MA35	Marian	**Disinfection (of Marian and Mirani bores when used as emergency supply)**	Overdose	Impact on taste and odour of treated water	Chlorine Disinfection by-products Taste & odour	Free chlorine residual	Unlikely	Moderate	Medium (6)	CCP Procedure implemented	MRC monthly micro monitoring at Marian and Mirani Reservoir when bores operating Grab samples of treated water analysed for free chlroine daily when bores operating	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**CCP**	Under- and over- dose combined	Free chlorine residual - grab sample bench analysed	1.5 mg/L (Marian Bores) 1.2 mg/L (Mirani Bores)	<1.3 mg/L, >2.0 mg/L (Marian Bores) <0.6 mg/L, >2.0 mg/L (Mirani Bores)	<0.5 mg/L >5.0 mg/L
MA36	Marian	**Disinfection (of Marian and Mirani bores when used as emergency supply)**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection by-products	Tri-halomethanes	Possible	Minor	Medium (6)		MRCmonthly monitoring at Marian and Mirani Bores when bores operating (incl Total Organic Carbon)	Unlikely	Minor	Low (4)	Estimate												
MA37	Marian	**Disinfection (of Marian and Mirani bores when used as emergency supply)**	Equipment failure	Inadequate disinfection	E. coli	E. coli	Rare	Catastrophic	Medium (6)	MRC Maintenance Program CCP Procedure implemented	MRC monthly micro monitoring at Marian and Mirani Bores when bores are operating Grab samples of treated water analysed for free chlorine daily when bores are operating	Rare	Minor	Low (2)	Confident												
MA38	Marian	**Reticulation**	Long retention/contact time in system	Inability to meet treated water quality objectives causing risk to human health	Iron Inadequate disinfection i.e. possible presence of bacteria due to low chlorine residual	E. coli	Likely	Catastrophic	Extreme (20)	Regular cleaning and maintenance of reticulation (air scouring) and reservoirs (divers) Cleaning and maintenance of bores (when production diminishing)	MRC weekly monitoring of reticulation network	Possible	Moderate	Medium (9)	Confident		Re-evaluate risk after further Marian monitoring data has been captured Review cleaning and maintenance schedule and program for Marian										
MA39	Marian	**Reservoir**	Contamination through vents and animal access e.g. green tree frogs	Inability to meet treated water quality objectives causing risk to human health	E. coli	E. coli	Likely	Catastrophic	Extreme (20)	Regular cleaning and maintenance of reservoirs (divers)	MRC monthly micro monitoring at Marian and Mirani Bores when bores are operating Grab samples of treated water analysed for free chlorine daily when bores are operating	Possible	Moderate	Medium (9)	Confident		Re-evaluate risk after furtherMarian monitoring data has been captured Review cleaning and maintenance schedule and program for Marian										
MA40	Marian	**Reticulation**	Developers construction	Poor quality of work	E. coli Turbidity	E. coli	Possible	Catastrophic	High (15)	MRC Planning Division inspections of developer works Pipe disinfection holding water for 24 hours	Microbiological sampling of water from new works	Unlikely	Minor	Low (4)	Confident												

ID			HAZARD				MAXIMUM RISK					RESIDUAL RISK				RISK TREATMENT		CCP ASSESSMENT						LIMITS			
Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
		O'Connell River Basin																									
ORB1	Bloomsbury	**O'Connell River Basin**	Forestry & National Parks (some logging, some cattle grazing leases, illegal dumping, herbicides [applied under power lines & in transport and infrastructure corridors])	Inability to meet treated water quality objectives causing risk to human health	Turbidity Herbicides	Herbicides	Rare	Insignificant	Low (1)	State Government Management Practices Ergon Energy Policies	Reef Catchments Monitoring Program	Rare	Insignificant	Low (1)	Confident												
ORB2	Bloomsbury	**O'Connell River Basin**	Animals (domestic & feral) - Cattle [grazing (erosion and sedimentation), dead animals in waterways & weirs, fertilizers, feedlots (manure management), direct access to waterways] - Poultry farms [dead animals, manure management] - Pig farms [dead animals, manure management] - Feral pigs [digging and wallowing (erosion and sedimentation)]	Inability to meet treated water quality objectives causing risk to human health	Turbidity Herbicides Giardia & Cryptosporidium E. coli	E. coli	Likely	Catastrophic	Extreme (20)	Reef Catchments Riparian Vegetation Fencing & Off-stream Watering Program MRC Bloomsbury WTP - Disinfection		Rare	Moderate	Low (3)	Confident												
						Giarda & Crypto	Likely	Catastrophic	Extreme (20)	Reef Catchments Riparian Vegetation Fencing & Off-stream Watering Program MRC Bloomsbury WTP - Filtration		Rare	Moderate	Low (3)	Confident												
ORB3	Bloomsbury	**O'Connell River Basin**	Crop cultivation (generally on river banks, pump leaks) mainly sugar cane some market gardening	Inability to meet treated water quality objectives causing risk to human health	Pesticides Herbicides Nutrients (fertilizers - nitrogen compounds) Hydrocarbons Turbidity	Herbicides	Possible	Minor	Medium (6)	Reef Catchments Reef Rescue Programs Reef Protection Act 2010 Landholder/Farmer Land Management Practices	Reef Catchments Monitoring Program MRC event based monitoring	Unlikely	Minor	Low (4)	Confident	Reef Rescue Programs target herbicides, sediments & nutrients												
ORB4	Bloomsbury	**O'Connell River Basin**	Unsealed Roads	Inability to meet treated water quality objectives causing risk to human health	Turbidity Nutrients	Turbidity	Possible	Moderate	Medium (9)	MRC Bloomsbury WTP - filtration	MRC daily inspections MRC turbidity monitoring	Rare	Moderate	Low (3)	Confident												
ORB5	Bloomsbury	**O'Connell River Basin**	Wildfire (followed by storm leading to ash runoff)	Inability to meet treated water quality objectives causing risk to human health	Turbidity Nutrients	Turbidity	Rare	Moderate	Low (3)	Emergency Services Response Program Reef Catchments Fire Management Program Queensland Parks and Wildlife Service Fire Management System MRC Bloomsbury WTP - filtration	MRC event based monitoring Reef Catchments Fire Mapping Program	Rare	Minor	Low (2)	Confident	Reef Rescue Programs target herbicides, sediments & nutrients											
ORB6	Bloomsbury	**O'Connell River Basin**	Illegal access to catchment (vandalism, sabotage)	Inability to meet treated water quality objectives causing risk to human health	Toxic material Organics	Toxins	Rare	Major	Medium (5)	Emergency Services Response Program MRC DMP and I&ERP MRC Bloomsbury WTP - filtration	MRC event based monitoring	Rare	Major	Medium (5)	Estimate		Review secutiry measures for access to water source. Review communication/notification protocols between SunWater and MRC for Prosperpine WSS.										
		Bloomsbury																									
B1	Bloomsbury	**Source Water - Bores**	Leaching from O'Connell River into aquifers	Inability to meet treated water quality objectives causing risk to human health	Manganese Iron	Manganese	Almost Certain	Moderate	High (15)	MRC Bloomsbury WTP commissioned in October 2010 Oxidation through chlorine dosing Duty/Standby chlorinators, filters and pumps	MRC quarterly monitoring of raw water Online free chlorine residual monitoring of WTP outlet	Unlikely	Minor	Low (4)	Reliable		Re-evaluate risk after further monitoring data has been captured at Bloomsbury WTP										
B2	Bloomsbury	**Source Water - Bores**	Leaching from O'Connell River into aquifers and bore location in organic material	Inability to meet treated water quality objectives causing risk to human health	Organics (Taste & Odour) Low dissolved oxygen Manganese	DO	Likely	Minor	Medium (8)	MRC Bloomsbury WTP commissioned in October 2010 Oxidation through chlorine dosing Duty/Standby chlorinators	MRC quarterly monitoring of raw water Online free chlorine residual monitoring of WTP outlet	Unlikely	Minor	Low (4)	Reliable	Increase in river flows and changing river conditions have assisted with reduction of this hazard	Re-evaluate risk after further monitoring data has been captured at Bloomsbury WTP										
B3	Bloomsbury	**Source Water - Bores**	Stormwater event in O-Connell River	Inability to meet treated water quality objectives causing risk to human health	E. coli Giardia & Cryptosporidium	E. coli	Possible	Catastrophic	High (15)	MRC Bloomsbury WTP commissioned in October 2010 Disinfection through chlorine dosing Duty/Standby chlorinators	MRC fortnightly monitoring of reticulation network	Rare	Minor	Low (2)	Estimate		Re-evaluate risk after further monitoring data has been captured at Bloomsbury WTP	Y	Y	Y	Y	**CCP**	Refer to risk B7 for CCP related to this risk				
						Giarda & Crypto	Possible	Catastrophic	High (15)	MRC Bloomsbury WTP commissioned in October 2010 filtration	MRC fortnightly monitoring of reticulation network	Rare	Minor	Low (2)	Estimate		Continuation of monitoring to collect more data from Bloomsbury WTP Re-evaluate risk after further monitoring data has been captured at Bloomsbury WTP Review Bloomsbury bore access for sampling of raw water										
B4	Bloomsbury	**Source Water - Bores**	Herbicide leaching into groundwater from waterways and from land users e.g. sugarcane spraying	Inability to meet treated water quality objectives causing risk to human health	Herbicides	Herbicides	Unlikely	Minor	Low (4)	MRC Bloomsbury WTP commissioned in October 2010 - oxidation & filtration	Reef Catchments Monitoring Program	Rare	Minor	Low (2)	Uncertain												
B5	Bloomsbury	**Reticulation**	Sediments and biofilms on pipes	Inability to meet treated water quality objectives causing risk to human health	Turbidity Manganese	Turbidity	Possible	Moderate	Medium (9)	MRC Bloomsbury WTP commissioned in October 2010 - filtration	MRC fortnightly monitoring of reticulation network	Unlikely	Moderate	Medium (6)	Estimate	Considered that the hazard will be removed with the higher quality drinking water being produced from the new WTP	Re-evaluate risk after further monitoring data has been captured at Bloomsbury WTP Review cleaning and maintenance schedule and program for Bloomsbury Consider investigative monitoring of Bloomsbury system looking at pipe/biofilm integrity and system operation										
B6	Bloomsbury	**Disinfection**	Underdose or failure to dose	Inadequate disinfection (treated water chlorine demand increases)	E. coli	E. coli	Unlikely	Catastrophic	High (10)	Operator daily grab samples and bench analyses Online chlorine meter pH correction CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed for free chlorine weekly Online chlorine meter analysing treated	Rare	Moderate	Low (3)	Certain			Y	Y	Y	Y	**CCP**	Refer to risk B7 for CCP related to this risk				
B7	Bloomsbury	**Disinfection**	Overdose	Impact on taste and odour of treated water	Chlorine Disinfection by-products Taste & odour	Free chlorine residual	Unlikely	Minor	Low (4)	Operator daily grab samples and bench analyses Online chlorine meter pH correction CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed for free chlorine weekly Online chlorine meter analysing treated	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**CCP**	Under- and over- dose combined	Free chlorine residual - grab sample bench analysed - online chlorine meter	1.0 mg/L	<0.6 mg/L >2.0 mg/L	<0.5 mg/L >5.0 mg/L
B8	Bloomsbury	**Disinfection**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection by-products	Tri-halomethanes	Possible	Minor	Medium (6)	MRC Bloomsbury WTP - organic removal in oxidation & filtration	MRC monthly monitoring of treated water	Unlikely	Minor	Low (4)	Estimate												
B9	Bloomsbury	**Disinfection**	Equipment failure	Inadequate disinfection	E. coli	E. coli	Rare	Catastrophic	Medium (6)	MRC Maintenance Program Duty/standby chlorinators CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed for free chlorine weekly	Rare	Minor	Low (2)	Confident												

ID			HAZARD				MAXIMUM RISK					RESIDUAL RISK				RISK TREATMENT		CCP ASSESSMENT						LIMITS			
Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
		Plane Creek Basin																									
PCB1	Sarina	**Plane Creek Basin**	Animals (domestic & feral) - Cattle [grazing (erosion and sedimentation), dead animals in waterways & weirs, fertilizers, feedlots (manure management), direct access to waterways] - Poultry farms [dead animals, manure management] - Pig farms [dead animals, manure management] - Feral pigs [digging and wallowing (erosion and sedimentation)]	Inability to meet treated water quality objectives causing risk to human health	E. coli Turbidity Nutrients	E. coli	Likely	Catastrophic	Extreme (20)	Reef Catchments Riparian Vegetation Fencing & Off-stream Watering Program MRC Sarina WTP - disinfection	MRC daily inspection of Plane Creek Weir MRC monthly monitoringof raw & treated water quality (incl. E.coli, Coliforms & Entercocci)	Rare	Moderate	Low (3)	Confident											
PCB2	Sarina	**Plane Creek Basin**	On site sewage management systems (OSSMSs) (both rural and commercial)	Inability to meet treated water quality objectives causing risk to human health	E. coli Nutrients (phosphates)	E. coli	Likely	Catastrophic	Extreme (20)	MRC Sarina WTP - disinfection	MRC daily inspection of Plane Creek Weir MRC monthly monitoring of raw & treated water quality (incl. E.coli, Coliforms & Entercocci)	Rare	Moderate	Low (3)	Confident												
PCB3	Sarina	**Plane Creek Basin**	Crop cultivation (generally on river banks, pump leaks) mainly sugar cane some market gardening	Inability to meet treated water quality objectives causing risk to human health	Pesticides Herbicides Nutrients (fertilizers - nitrogen compounds) Hydrocarbons Turbidity	Herbicides	Possible	Minor	Medium (6)	Reef Catchments Reef Rescue Programs Reef Protection Act 2010 MRC Sarina WTP - activated carbon adsorption Landholder/Farmer Land Management Practices	Reef Catchments Monitoring Program MRC event based monitoring	Unlikely	Minor	Low (4)	Confident	Reef Rescue Programs target herbicides, sediments & nutrients											
PCB4	Sarina	**Plane Creek Basin**	Unsealed Roads	Inability to meet treated water quality objectives causing risk to human health	Turbidity Nutrients	Turbidity	Possible	Moderate	Medium (9)	MRC Sarina WTP - coagulation, clarification & filtration	MRC daily inspection of Plane Creek Weir MRC turbidity monitoring of WTP inlet and treated water with grab samples and online meters	Rare	Moderate	Low (3)	Confident												
PCB5	Sarina	**Plane Creek Basin**	Accidental spills (fuel [fuel tankers transporting to mines], chemicals, cane bins, sugar trucks, cane trams, molasses)	Inability to meet treated water quality objectives causing risk to human health	Toxins Hydrocarbons Pesticides/Herbicides Various	Hydrocarbons	Rare	Major	Medium (5)	Variable intake levels at Plane Creek Weir Emergency Services Response Program MRC Sarina WTP - activated carbon adsorption	MRC event based monitoring DERM event based monitoring	Rare	Moderate	Low (3)	Estimate												
PCB6	Sarina	**Plane Creek Basin**	Wildfire (followed by storm leading to ash runoff)	Inability to meet treated water quality objectives causing risk to human health	Turbidity Nutrients	Turbidity	Rare	Moderate	Low (3)	Emergency Services Response Program Reef Catchments Fire Management Program Queensland Parks and Wildlife Service Fire Management System MRC Sarina WTP - coagulation, clarification & filtration	MRC event based monitoring Reef Catchments Fire Mapping Program	Rare	Minor	Low (2)	Confident												
PCB7	Sarina	**Plane Creek Basin**	Illegal access to catchment (vandalism, sabotage)	Inability to meet treated water quality objectives causing risk to human health	Toxic material Organics	Toxins	Rare	Major	Medium (5)	Emergency Services Response Program MRC DMP and I&ERP MRC Sarina WTP - activated carbon adsorption	MRC event based monitoring	Rare	Moderate	Low (3)	Estimate												
PCB8	Sarina	**Plane Creek Basin**	Recreational activities in catchment	Inability to meet treated water quality objectives causing risk to human health	Hydrocarbons E. coli	Hydrocarbons	Unlikely	Moderate	Medium (6)	Dilution in waterways MRC Sarina WTP - activated carbon adsorption Recreation Areas Management Act 2006		Unlikely	Minor	Low (4)	Estimate												
						E. coli	Unlikely	Catastrophic	High (10)	Dilution in waterways MRC Sarina WTP - disinfection Recreation Areas Management Act 2006		Rare	Moderate	Low (3)	Confident												
PCB9	Sarina	**Plane Creek Basin**	Oxygen reducing material (from sugar cane farms - residues left on fields after harvest washed into waterways)	Inability to meet treated water quality objectives causing risk to human health	Oxygen reducing material Bad odours Organics	Organics	Unlikely	Moderate	Medium (6)	MRC Sarina WTP - activated carbon adsorption, coagulation, clarification & filtration	Reef Catchments Truck Monitoring Program MRC event based monitoring	Rare	Moderate	Low (3)	Estimate	Reef Catchments Truck Monitoring Program involves GPS tracking units on each liquid-one-shot truck monitoring release and distribution											
PCB10	Sarina	**Plane Creek Basin**	Algal blooms in Middle Creek Dam	Inability to meet treated water quality objectives causing risk to human health	Algae Algal toxins	Algal toxins	Possible	Major	High (12)	Sarina Landcare Catchment Management Association - Algal Project MRC DMP and I&ERP MRC Sarina WTP - activated carbon adsorption	MRC event based monitoring	Rare	Major	Medium (5)	Estimate	Medium risk addressed in QCP targets	Formalise procedure for inspecting for Algae before releasing water from Middle Creek Dam.	Y	Y	Y	Y	**QCP**	Refer to risk S6 for QCP related to this risk				
		Sarina																									
S1	Sarina	**Source Water - Bores - Bally Keel & Marwood**	Saline intrusion into aquifer	Inability to meet treated water quality objectives causing risk to human health	Salinity Bromide/Bromate Boron Total Dissolved Solids	TDS	Possible	Minor	Medium (6)	Dilution through blending in reticulation system Ability to selectively use bore as source water supply	MRC monitoring of source water	Possible	Insignificant	Low (3)	Confident	Mackay and Sarina are to be connected by pipeline that will allow Sarina to be supplied with drinking water from Mackay											
S2	Sarina	**Source Water - Bores - Armstrong Beach**	Bedrock minerals leaching in groundwater	Inability to meet treated water quality objectives causing risk to human health	Minerals	Hardness	Possible	Minor	Medium (6)	Dilution through blending in reticulation system Ability to selectively use bore as source water supply	MRC monitoring of source water	Unlikely	Minor	Low (4)	Confident												
S3	Sarina	**Source Water - Bores - Bally Keel & Marwood**	Herbicide leaching into aquifers from waterways and from land users e.g. sugarcane spraying	Inability to meet treated water quality objectives causing risk to human health	Herbicides Nitrate	Herbicides	Unlikely	Minor	Low (4)	Dilution through blending in reticulation system Ability to selectively use bore as source water supply	Reef Catchments Monitoring Program	Rare	Minor	Low (2)	Uncertain												
						Nitrate	Unlikely	Moderate	Medium (6)	Dilution through blending in reticulation system Ability to selectively use bore as source water supply Customer notifcations if health value is exceeded	Reef Catchments Monitoring Program	Rare	Moderate	Low (3)	Estimate		Investigate possibility of formal agreement between Reef Catchments and MRC regarding sharing of information and communications for Sarina Review of water quality monitoring program for Sarina										
S4	Sarina	**Source Water - Bores**	Pathogens leaching into aquifers from waterways and from land users e.g. cattle	Inability to meet treated water quality objectives causing risk to human health	E. coli	E. coli	Rare	Catastrophic	Medium (6)	Chlorine dosing of groundwater	Regular operator inspections of chlorine dosing systems and bores MRC monthly monitoring of source water	Rare	Minor	Low (2)	Confident			Y	Y	Y	Y	**CCP**	Refer to risk S22 for CCP related to this risk				

ID			HAZARD				MAXIMUM RISK					RESIDUAL RISK				RISK TREATMENT		CCP ASSESSMENT						LIMITS			
Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
S5	Sarina	**Raw Water Intake - Plane Creek Weir**	Storm event - Rapidly changing raw water quality	Inability to meet treated water quality objectives causing risk to human health	Colour Turbidity TOC Grass/weeds	Turbidity	Likely	Minor	Medium (8)	Online turbidimeter at Sarina WTP inlet alarmed via telemetry with automatic bore pump shutdown Online turbidimeters at Sarina WTP filters outlet alarmed via telemetry with automatic bore pump shutdown MRC Sarina WTP - coagulation, clarification & filtration	Online turbidimeter at Sarina WTP inlet	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**QCP**	Turbidimeter at raw water inlet of Sarina WTP	Turbidity - online at raw water inlet to WTP	<50	50 Shutdown bore pumps	50
S6	Sarina	**Raw Water Intake - Plane Creek Weir**	Drought and dry season - Changes in water quality including increased risk of blue green algae leading to cyanotoxins being present in treated water	Inability to meet treated water quality objectives causing risk to human health	Cyanotoxins Taste and odour compounds Filter blocking algae	Taste & Odour	Possible	Minor	Medium (6)	Flush Plane Creek Weir through release from Middle Creek Dam MRC Blue-Green Algae Management Protocols MRC Sarina WTP - activated carbon adsorption	MRC daily inspection of Plane Creek Weir MRC event monitoring program	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**QCP**		Visual monitoring of algal growth in Plane Creek Weir	Visually acceptable		
						Toxins	Possible	Moderate	Medium (9)	Flush Plane Creek Weir through release from Middle Creek Dam MRC Blue-Green Algae Management Protocols MRC Sarina WTP - activated carbon adsorption	MRC daily inspection of Plane Creek Weir MRC event monitoring program	Rare	Moderate	Low (3)	Certain												
S7	Sarina	**Raw Water Intake - Plane Creek Weir**	Accidental fuel or chemical spills (agricultural, highway along river) Terrorist activity - Contamination with toxins or hydrocarbons	Inability to meet treated water quality objectives causing risk to human health	Toxins (inc. herbicides, pesticides, and hydrocarbons)	Toxins	Rare	Moderate	Low (3)	MRC Sarina WTP - activated carbon adsorption MRC DMP and I&ERP	MRC daily inspection of Plane Creek Weir MRC event monitoring program	Rare	Minor	Low (2)	Estimate		MRC to review DMP and I&ERP										
S8	Sarina	**Raw Water Intake - Plane Creek Weir**	Intake screen blockage inside pump well from debris (weeds/logs) or sediment	Inability to meet treated water quality objectives causing risk to human health	Low flow	Low flow	Possible	Insignificant	Low (3)	Standby pump Pump failure switches that automatically shutdown Sarina WTP	Flowmeter monitoring pump output alarmed through telemetry	Rare	Insignificant	Low (1)	Certain												
S9	Sarina	**Raw Water Intake - Infrastructure**	Capacity and life expectancy of pump station and pumps including electrical issues	Inability to meet treated water quality objectives causing risk to human health	Loss of supply	Loss of supply	Rare	Moderate	Low (3)	Additional source water from bores Duty/standby pumps MRC Reactive Maintenance	MRC daily inspections Online flowmeter monitoring raw water pump outlet Online alarmed monitoring of pumps	Rare	Minor	Low (2)	Reliable												
S10	Sarina	**Raw Water Intake - Infrastructure**	Capacity, integrity and life expectancy of mains from pump station to plant	Inability to meet treated water quality objectives causing risk to human health	Sediment Loss of supply	Loss of supply	Rare	Insignificant	Low (1)	Alternative drinking water sources - bores - Mackay interconnection MRC mains repair	Flowmeter monitoring Sarina WTP inlet	Rare	Insignificant	Low (1)	Certain												
S11	Sarina	**Raw Water Intake - Infrastructure**	Power back-up for pump station - loss of water supply on power failure	Inability to meet treated water quality objectives causing risk to human health	Loss of supply	Loss of supply	Rare	Insignificant	Low (1)	Alternative drinking water sources - bores - Mackay interconnection MRC generators	Telemetry alarm activated in a power failure	Rare	Insignificant	Low (1)	Certain												
S12	Sarina	**Raw Water Intake - Infrastructure**	Weir well failure - flooding of well	Inability to meet treated water quality objectives causing risk to human health	Loss of supply	Loss of supply	Rare	Insignificant	Low (1)	Alternative drinking water sources - bores - Mackay interconnection MRC repair crew	Flowmeter monitoring Sarina WTP inlet telemetry alarmed Pump failure telemetry alarm	Rare	Insignificant	Low (1)	Certain												
S13	Sarina	**Coagulation**	Failure of chemical dosing systems	Inability to meet treated water quality objectives causing risk to human health	Poor treated water quality (incl. E. coli, Giardia & Cryptosporidium, turbidity, colour etc)	Giarda & Crypto	Unlikely	Catastrophic	High (10)	Alternative drinking water sources - bores - Mackay interconnection MRC Sarina WTP manual start-up and automatic shutdown at high reservoir level MRC Sarina WTP - Coagulation, clarification & filtration	Online turbidimeters at Sarina WTP filters outlets	Rare	Moderate	Low (3)	Reliable												
S14	Sarina	**Coagulation**	Underdosing chemicals	Inability to meet treated water quality objectives causing risk to human health	Poor treated water quality (incl. E. coli, Giardia & Cryptosporidium, turbidity, colour etc)	Giarda & Crypto	Unlikely	Catastrophic	High (10)	Jar testing Daily operator inspection of coagulation MRC Sarina WTP - Coagulation, clarification & filtration	Online turbidimeters at Sarina WTP filters outlets	Rare	Moderate	Low (3)	Confident												
S15	Sarina	**Coagulation**	Overdosing chemicals	Inability to meet treated water quality objectives causing risk to human health	Poor treated water quality (incl. E. coli, Giardia & Cryptosporidium, turbidity, colour etc)	Giarda & Crypto	Unlikely	Catastrophic	High (10)	Jar testing Daily operator inspection of coagulation MRC Sarina WTP - Coagulation, clarification & filtration	Online turbidimeters at Sarina WTP filters outlets Flowmeter monitoring Sarina WTP inlet telemetry alarmed	Rare	Moderate	Low (3)	Confident	Plane Creek Weir pumps are fixed speed											
S16	Sarina	**Flocculation & Sedimentation**	Failure of mixers in flocculation zone of clarifier	Inability to meet treated water quality objectives causing risk to human health	Poor treated water quality (incl. E. coli, Giardia & Cryptosporidium, turbidity, colour etc)	Giarda & Crypto	Unlikely	Catastrophic	High (10)	Alternative drinking water sources - bores - Mackay interconnection MRC repair crews Duty/standby mixers MRC Sarina WTP - Coagulation, clarification &	Online turbidimeters at Sarina WTP filters outlets	Rare	Moderate	Low (3)	Reliable	Mixers are not essential to the treatment process of Sarina WTP as they are only used in poor water quality events, out of these events adequate mixing is provided in the flash mixing tank											

ID			HAZARD				MAXIMUM RISK					RESIDUAL RISK				RISK TREATMENT		CCP ASSESSMENT						LIMITS			
Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
S17	Sarina	**Flocculation & Sedimentation**	Failure of sedimentation tank including failure of scraper leading to sludge build-up and failure of sludge draw-off/removal system	Inability to meet treated water quality objectives causing risk to human health	Soluble metals (incl. iron, manganese, aluminium)	Manganese	Rare	Minor	Low (2)	MRC daily inspections MRC Maintenance Program	MRC monthly monitoring of treated water	Rare	Insignificant	Low (1)	Confident	One sludge blanket upflow clarifier											
S18	Sarina	**Flocculation & Sedimentation**	Failure of sedimentation tank including loss of sludge blanket and sludge overflow	Inability to meet treated water quality objectives causing risk to human health	Overloading of filters Filter breakthrough Giardia & Cryptosporidium Turbidity	Giarda & Crypto	Possible	Catastrophic	High (15)	MRC daily inspections Online turbidimeters at filters outlets telemetry alarmed with automatic Sarina WTP shutdown MRC Sarina WTP - Coagulation, clarification & filtration	Online turbidimeters at Sarina WTP filters outlets	Rare	Moderate	Low (3)	Confident												
S19	Sarina	**Filtration**	Filter breakthrough	Inadequate removal of particles	Giardia & Cryptosporidium Turbidity Manganese Colour	Giarda & Crypto	Likely	Catastrophic	Extreme (20)	Online turbidimeters at filters outlets telemetry alarmed with automatic Sarina WTP shutdown Filter backwash on regular schedule and when filter breakthrough occurs CCP Procedure Implemented	MRC daily inspections Online turbidimeters at Sarina WTP filters outlets	Unlikely	Minor	Low (4)	Confident			Y	Y	Y	Y	**CCP**	Refer to risk S20 for CCP related to this risk				
S20	Sarina	**Filtration**	Filter ripening	Breakthrough of contaminants during filter bed ripening	Turbidity Manganese Colour	Turbidity	Likely	Minor	Medium (8)	MRC daily inspections Online turbidimeters at filters outlets telemetry alarmed with automatic Sarina WTP shutdown	Online turbidimeters at Sarina WTP filters outlets	Unlikely	Minor	Low (4)	Confident			Y	Y	Y	Y	**CCP**	Coagulation, Sedimentation and Filtration combined	Turbidity - grab sample bench analysed - online turbidity meter	0.3 NTU	> 0.3 NTU (>0.3 NTU for 15 mins for online turbidity meter)	>1 NTU (> 1.0 NTU for 5 mins for online turbidity meter)
S21	Sarina	**Disinfection**	Underdose or failure to dose	Inadequate disinfection - raw water chlorine demand increases	E. coli	E. coli	Possible	Catastrophic	High (15)	Daily grab samples of treated water bench tested at WTP	MRC monthly micro monitoring Grab samples of treated water analysed for free chlorine daily when operating Online chlorine meter analysing treated water	Rare	Moderate	Low (3)	Confident			Y	Y	Y	Y	**CCP**	Refer to risk S22 for CCP related to this risk				
S22	Sarina	**Disinfection**	Overdose	Impact on taste and odour of treated water	Chlorine Taste & odour Disinfection by-products	Free chlorine residual	Unlikely	Minor	Low (4)	Daily grab samples of treated water bench tested at WTP	MRC monthly micro monitoring Grab samples of treated water analysed for free chlorine daily when operating Online chlorine meter analysing treated water	Unlikely	Insignificant	Low (2)	Confident			Y	Y	Y	Y	**CCP**	Under- and over- dose combined	Free chlorine residual - grab sample bench analysed - online chlroine meter	1.5 - 2.5 mg/L (Alligator Creek) 1.0 - 2.0 mg/L (Armstrong Beach, Bally Keel Bore) 1.5 - 2.0 mg/L (Sarina Bores) 1.5 - 2.5 mg/L (Sarina WTP)	<1.0, >2.5 mg/L (Alligator Creek, Sarina Bores) <1.0, >2.0 mg/L (Armstrong Beach) <1.0, >2.1 mg/L (Bally Keel Bore) <1.0, >2.6 mg/L (Sarina	<0.5 mg/L >5.0 mg/L (at all sample points)
S23	Sarina	**Disinfection**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection-products	Tri-halomethanes	Unlikely	Minor	Low (4)	MRC Sarina WTP - organic removal in activated carbon adsorption, coagulation, sedimentation & filtration	MRC monthly monitoring for treated water (incl Total Organic Carbon)	Rare	Minor	Low (2)	Estimate												
S24	Sarina	**Disinfection**	Equipment failure	Inadequate disinfection	E. coli	E. coli	Rare	Catastrophic	Medium (6)	MRC Maintenance Program (6 monthly) New chlorination system being installed Duty/standby chlorinators Alternative water	MRC monthly micro monitoring Daily inspections Grab samples of treated water analysed for free chlorine twice daily	Rare	Minor	Low (2)	Confident												
S25	Sarina	**Fluoridation**	Underdose or failure to dose and overdose (incl. equipment failure)	Failure to comply with regulations and contamination of treated water	Fluoride	Fluoride	Rare	Moderate	Low (3)	Water Fluoridation Code of Practice 2013 Water Fluoridation Act 2008 Water Fluoridation Regulation 2008	Online fluoride meters analysing treated water Grab samples of treated water bench analysed daily for fluoride when operating	Rare	Minor	Low (2)	Confident			Y	Y	Y	Y	**CCP**		Fluoride in treated water for Sarina WTP treated water and Marwood Bores treated water - grab samples bench analysed - online fluoride meter	0.7 mg/L	<0.6, >0.8 mg/L in any one sample 0.0 mg/L for 14 consecutive samples 0.0 mg/L for 10 consecutive samples	>1.5 mg/L in any one sample <0.6, >0.8 mg/L averaged
S26	Sarina	**Clear Water Tank**	Chlorine contact time	Inadequate disinfection	E. coli Viruses	E. coli	Rare	Catastrophic	Medium (6)	Management of tanks SCADA alarms Sufficient contact time is provided with baffle in clear water tank	Operator monitoring SCADA online monitoring of free chlorine residual	Rare	Minor	Low (2)	Confident												
S27	Sarina	**Clear Water Tank**	Sediment becoming retrained	Increased turbidity	Turbidity Giardia & Cryptosporidium	Turbidity	Rare	Moderate	Low (3)			Rare	Minor	Low (2)	Estimate												
						Giarda & Crypto	Rare	Catastrophic	Medium (6)	MRC cleaning and maintenance program		Rare	Minor	Low (2)	Estimate		Review Sarina WTP clear water tank cleaning and maintenance schedule and methodology										
S28	Sarina	**Reticulation**	Loss of supply due to catastrophic main break, loss of pressure	Public health issue due to lack of potable water	Loss of supply	Loss of supply	Possible	Moderate	Medium (9)	Alternative sources Disinfection		Rare	Moderate	Low (3)	Confident												
S29	Sarina	**Reticulation**	Lack of adequate chlorine residual due to water age, low flow and dead ends and inability to effectively clean mains	Ineffective disinfection Build up of contaminants	E. coli Dirty water Iron Manganese Turbidity	E. coli	Unlikely	Catastrophic	High (10)	MRC Dead End Flushing Program MRC Reactive Scouring Program (from complaints recorded)	MRC weekly monitoring of reticulation network MRC monitoring of complaints	Rare	Minor	Low (2)	Certain		Review cleaning and maintenance schedule and program for Sarina										
S30	Sarina	**Reticulation**	Loss of pressure in power outages	Ingress of contaminants	E. coli Turbidity	E. coli	Rare	Catastrophic	Medium (6)	MRC Protocol to redirect water to affected area Disinfection	MRC weekly random reticulation pressure tests	Rare	Minor	Low (2)	Confident		Complete hydraulic model of Sarina										
S31	Sarina	**Reticulation**	Underdose or no dose of chlorine	Inadequate disinfection	Poor free chlorine residual	Free chlorine residual	Almost Certain	Moderate	High (15)		MRC weekly monitoring of reticulation network	Possible	Minor	Medium (6)	Certain												
S32	Sarina	**Reticulation**	Overdose of chlorine	Impact on taste and odour of treated water	Free chlorine residual	Free chlorine residual	Rare	Insignificant	Low (1)	Optimisation of chlorine residual in treated water outlet of Sarina WTP	MRC weekly monitoring of reticulation network	Rare	Insignificant	Low (1)	Certain												
S33	Sarina	**Reticulation**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection by-products	Tri-halomethanes	Rare	Insignificant	Low (1)		MRC weekly monitoring of reticulation network	Rare	Insignificant	Low (1)	Certain												

ID			HAZARD				MAXIMUM RISK					RESIDUAL RISK				RISK TREATMENT		CCP ASSESSMENT						LIMITS			
Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
S34	Sarina	**Reticulation**	Asset Maintenance	Failure of equipment	Various	E. coli	Unlikely	Catastrophic	High (10)	MRC Maintenance Program Disinfection	MRC weekly monitoring of reticulation network	Unlikely	Minor	Low (4)	Estimate		Review MRC Asset Management System										
S35	Sarina	**Reservoirs**	Inadequate protection of reservoirs	Contamination of treated water from ingress at reservoir	E. coli	E. coli	Unlikely	Catastrophic	High (10)	MRC Reservoir Maintenance Program Disinfection	MRC monthly monitoring of reservoirs	Unlikely	Minor	Low (4)	Confident												
S36	Sarina	**Reservoir & Reticulation**	Vandalism & sabotage	Contamination of treated water	E. coli Turbidity Toxins	E. coli	Rare	Catastrophic	Medium (6)	No access ladders to reservoirs Signage MRC DMP and I&ERP Disinfection	MRC periodic inspections	Rare	Catastrophic	Medium (6)	Estimate		Review security measures of all components of Sarina										
S37	Sarina	**Reticulation**	Developers construction	Poor quality of work	E. coli Turbidity	E. coli	Possible	Catastrophic	High (15)	MRC Planning Division inspections of developer works Pipe disinfection holding water for 24 hours	Microbiological sampling of water from new works	Unlikely	Minor	Low (4)	Confident												
S38	Sarina	**Activated Carbon Adsorption**	Failure of PAC dosing system	Inability to meet treated water quality objectives causing risk to human health	Taste and odour Organics Toxins	Taste & odour	Unlikely	Moderate	Medium (6)	MRC reactive repair crews	MRC daily inspections	Rare	Moderate	Low (3)	Estimate			Y	Y	Y	Y	**QCP**	Possibilities for consideration: - tracking of customer complaints - establishing a taste and odour panel	Operator inspections of dosing	Free of taste and odours / Achieve intended dose rate – treated water is visibly black in colour from PAC dosing		Zero dose rate – no black colouration of treated water
						Toxins	Unlikely	Moderate	Medium (6)	MRC reactive repair crews	MRC daily inspections	Rare	Moderate	Low (3)	Estimate												

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Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
		Proserpine																									
PB1	Midge Point	**Proserpine Basin**	Forestry & National Parks (some logging, some cattle grazing leases, illegal dumping, herbicides [applied under power lines & in transport and infrastructure corridors])	Inability to meet treated water quality objectives causing risk to human health	Turbidity Herbicides	Herbicides	Rare	Insignificant	Low (1)	State Government Management Practices Ergon Energy Policies	Reef Catchments Monitoring Program	Rare	Insignificant	Low (1)	Confident												
PB2	Midge Point	**Proserpine Basin**	Animals (domestic & feral) - Cattle [grazing (erosion and sedimentation), dead animals in waterways & weirs, fertilizers, feedlots (manure management), direct access to waterways] - Poultry farms [dead animals, manure management] - Pig farms [dead animals, manure management] - Feral pigs [digging and wallowing (erosion and sedimentation)]	Inability to meet treated water quality objectives causing risk to human health	Turbidity Nutrients E. coli Giardia & Cryptosporidium	E. coli	Likely	Catastrophic	Extreme (20)	Reef Catchments Riparian Vegetation Fencing & Off-stream Watering Program Disinfection		Rare	Moderate	Low (3)	Confident												
						Giarda & Crypto	Likely	Catastrophic	Extreme (20)	Reef Catchments Riparian Vegetation Fencing & Off-stream Watering Program		Rare	Moderate	Low (3)	Confident												
PB3	Midge Point	**Proserpine Basin**	Crop cultivation (generally on river banks, pump leaks) mainly sugar cane some market gardening	Inability to meet treated water quality objectives causing risk to human health	Pesticides Herbicides Nutrients (fertilizers - nitrogen compounds) Hydrocarbons Turbidity	Herbicides	Possible	Minor	Medium (6)	Reef Catchments Reef Rescue Programs Reef Protection Act 2010 Landholder/Farmer Land Management Practices	Reef Catchments Monitoring Program MRC event based monitoring	Unlikely	Minor	Low (4)	Confident	Reef Rescue Programs target herbicides, sediments & nutrients												
PB4	Midge Point	**Proserpine Basin**	Unsealed Roads	Inability to meet treated water quality objectives causing risk to human health	Turbidity Nutrients	Turbidity	Possible	Moderate	Medium (9)		MRC inspections MRC turbidity monitoring	Rare	Moderate	Low (3)	Confident												
PB5	Midge Point	**Proserpine Basin**	Wildfire (followed by storm leading to ash runoff)	Inability to meet treated water quality objectives causing risk to human health	Turbidity Nutrients	Turbidity	Rare	Moderate	Low (3)	Emergency Services Response Program Reef Catchments Fire Management Program Queensland Parks and Wildlife Service Fire Management System	MRC event based monitoring Reef Catchments Fire Mapping Program	Rare	Minor	Low (2)	Confident												
PB6	Midge Point	**Proserpine Basin**	Illegal access to catchment (vandalism, sabotage)	Inability to meet treated water quality objectives causing risk to human health	Toxic material Organics	Toxins	Rare	Major	Medium (5)	Emergency Services Response Program MRC DMP and I&ERP	MRC event based monitoring	Rare	Major	Medium (5)	Estimate		MRC to review DMP and I&ERP										
PB7	Midge Point	**Proserpine Basin**	Turnover/stratification in Peter Faust Dam	Inability to meet treated water quality objectives causing risk to human health	Manganese Iron Low dissolved oxygen	Manganese	Possible	Minor	Medium (6)	Oxidation through chlorine dosing	MRC quarterly monitoring of treated water	Possible	Minor	Medium (6)	Reliable												
		Midge Point																									
MP1	Midge Point	**Source Water - Bores**	Stormwater event in Proserpine River	Inability to meet treated water quality objectives causing risk to human health	E. coli	E. coli	Possible	Catastrophic	High (15)	Disinfection through chlorine dosing	MRC monthly monitoring of reticulation network	Rare	Minor	Low (2)	Estimate	Midge Point has no bore license in place is a Water Supply contract with SunWater	Re-evaluate risk after further Midge Point monitoring data has been captured	Y	Y	Y	Y	**CCP**	Refer to risk MP6 for CCP related to this risk				
MP2	Midge Point	**Source Water - Bores**	Vandalism & tampering of bores	Inability to meet treated water quality objectives causing risk to human health	Toxic material Infrastructure damage	Toxins	Rare	Major	Medium (5)	6 ft high fencing surrounding assets Barbed wire on top of fence Bores capped to prevent access	MRC regular inspections	Rare	Major	Medium (5)	Estimate		Review security measures around Midge Point bores										
MP3	Midge Point	**Reticulation**	Long retention/contact time in supply pipe	Inability to meet treated water quality objectives causing risk to human health	High pH (corrosion of pipe) Manganese Inadequate disinfection i.e. possible presence of bacteria due to low chlorine residual	E. coli	Likely	Catastrophic	Extreme (20)	Regular cleaning and maintenance of reticulation (air scouring) and reservoirs (divers) Slow release chlorine tablets added to reservoirs Cleaning and maintenance of bores (when production diminishing)	MRC monthly monitoring of reticulation network	Possible	Moderate	Medium (9)	Confident	Long contact/retention time of around 3 days in 37 km pipe	Re-evaluate risk after further Midge Point monitoring data has been captured Review cleaning and maintenance schedule and program for Midge Point Consider investigative monitoring of Midge Point system looking at pipe/biofilm integrity and system operation										
MP4	Midge Point	**Reservoir**	Contamination through vents and animal access e.g. green tree frogs	Inability to meet treated water quality objectives causing risk to human health	E. coli	E. coli	Likely	Catastrophic	Extreme (20)	Regular cleaning and maintenance of reservoirs (divers) Slow release chlorine tablets added to reservoirs	MRC monthly monitoring of reticulation network	Possible	Minor	Medium (6)	Confident		Re-evaluate risk after furtherMidge Point monitoring data has been captured Review cleaning and maintenance schedule and program for Midge Point Consider investigative monitoring of Midge Point system looking at pipe/biofilm integrity and system operation										
MP5	Midge Point	**Disinfection**	Underdose or failure to dose	Inadequate disinfection (treated water chlorine demand increases)	E. coli	E. coli	Unlikely	Catastrophic	High (10)	CCP Procedure implemented	MRC quarterly micro monitoring Grab samples of treated water analysed for free chlorine weekly Online chlorine meter analysing treated water	Rare	Moderate	Low (3)	Certain			Y	Y	Y	Y	**CCP**	Refer to risk MP6 for CCP related to this risk				
MP6	Midge Point	**Disinfection**	Overdose	Impact on taste and odour of treated water	Chlorine Disinfection by-products Taste & odour	Free chlorine residual	Unlikely	Minor	Low (4)	CCP Procedure implemented	MRC quarterly micro monitoring Grab samples of treated water analysed for free chlorine weekly	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**CCP**	Under- and over- dose combined	Free chlorine residual - grab sample bench analysed	1.2 - 1.5 mg/L	<0.75 mg/L >2.0 mg/L	<0.5 mg/L >5.0 mg/L
MP7	Midge Point	**Disinfection**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection by-products	Tri-halomethanes	Possible	Minor	Medium (6)	CCP Procedure implemented	MRC quarterly monitoring for treated water (including Total Organic Carbon)	Unlikely	Minor	Low (4)	Estimate												
MP8	Midge Point	**Disinfection**	Equipment failure	Inadequate disinfection	E. coli	E. coli	Rare	Catastrophic	Medium (6)	CCP Procedure implemented	MRC quarterly micro monitoring Grab samples of treated water analysed for free chlorine weekly	Rare	Minor	Low (2)	Confident												
		Koumala																									
K1	Koumala	**Source Water - Bores**	Bedrock minerals leaching in groundwater	Inability to meet treated water quality objectives causing risk to human health	Minerals	Hardness	Likely	Insignificant	Medium (5)		MRC monthly monitoring of bore water	Possible	Insignificant	Low (3)	Confident												
K2	Koumala	**Source Water - Bores**	Agricultural run-off and herbicide leaching into aquifers from waterways and from land users e.g. sugarcane spraying	Inability to meet treated water quality objectives causing risk to human health	Herbicides Nitrate	Herbicides	Unlikely	Moderate	Medium (6)		Reef Catchments Monitoring Program	Rare	Minor	Low (2)	Uncertain												
						Nitrate	Unlikely	Moderate	Medium (6)	Customer notifcations if health value is exceeded	Reef Catchments Monitoring Program	Rare	Moderate	Low (3)	Estimate		Investigate possibility of formal agreement between Reef Catchments and MRC regarding sharing of information and communications for Koumala Review of water quality monitoring program for Koumala										

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Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
K3	Koumala	**Source Water - Bores**	Pathogens leaching into aquifers from waterways and from land users e.g. cattle	Inability to meet treated water quality objectives causing risk to human health	E. coli Giardia & Cryptosporidium	E. coli	Rare	Catastrophic	Medium (6)	Chlorine dosing of groundwater	Regular operator inspections of chlorine dosing system and bore MRC monthly monitoring of bore	Rare	Minor	Low (2)	Confident			Y	Y	Y	Y	**CCP**	Refer to risk K6 for CCP related to this risk				
						Giarda & Crypto	Rare	Catastrophic	Medium (6)		Regular operator inspections of bore MRC monthly monitoring of bore	Rare	Minor	Low (2)	Confident												
K4	Koumala	**Reservoir**	Contamination through vents and animal access e.g. green tree frogs	Inability to meet treated water quality objectives causing risk to human health	E. coli Turbidity	E. coli	Unlikely	Catastrophic	High (10)	Disinfection through chlorine dosing at bores and residual in reservoir. Inspection, cleaning and maintenance at Koumala Reservoir.		Rare	Moderate	Low (3)	Estimate												
K5	Koumala	**Disinfection**	Underdose or failure to dose	Inadequate disinfection (treated water chlorine demand increases)	E. coli	E. coli	Unlikely	Catastrophic	High (10)	CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed	Rare	Moderate	Low (3)	Certain			Y	Y	Y	Y	**CCP**	Refer to risk K6 for CCP related to this risk				
K6	Koumala	**Disinfection**	Overdose	Impact on taste and odour of treated water	Chlorine Disinfection by-products Taste & odour	Free chlorine residual	Unlikely	Minor	Low (4)	CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed for free chlorine twice weekly Online chlorine meter analysing treated water	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**CCP**	Under- and over- dose combined	Free chlorine residual - grab sample bench analysed - online chlorine meter	1.0 - 1.5 mg/L	<0.8 mg/L >2.0 mg/L	<0.5 mg/L >5.0 mg/L
K7	Koumala	**Disinfection**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection by-products	Tri-halomethanes	Possible	Minor	Medium (6)	CCP Procedure implemented	MRC monthly monitoring for treated water (including Total	Unlikely	Minor	Low (4)	Estimate												
K8	Koumala	**Disinfection**	Equipment failure	Inadequate disinfection	E. coli	E. coli	Rare	Catastrophic	Medium (6)	CCP Procedure implemented	MRC monthly micro monitoring	Rare	Minor	Low (2)	Confident												
		Eton																									
E1	Eton	**Source Water - Bores**	Saline intrusion into aquifer	Inability to meet treated water quality objectives causing risk to human health	Salinity Bromide/Bromate Boron Total Dissolved Solids	TDS	Possible	Minor	Medium (6)		MRC monthly monitoring of treated water	Possible	Insignificant	Low (3)	Confident												
E2	Eton	**Source Water - Bores**	Bedrock minerals leaching in groundwater	Inability to meet treated water quality objectives causing risk to human health	Minerals	Hardness	Possible	Minor	Medium (6)		MRC monthly monitoring of treated water	Unlikely	Minor	Low (4)	Confident												
E3	Eton	**Source Water - Bores**	Herbicide leaching into aquifers from waterways and from land users e.g. sugarcane spraying	Inability to meet treated water quality objectives causing risk to human health	Herbicides	Herbicides	Unlikely	Minor	Low (4)		Reef Catchments Monitoring Program	Rare	Minor	Low (2)	Uncertain												
E4	Eton	**Source Water - Bores**	Pathogens leaching into aquifers from waterways and from land users e.g. cattle	Inability to meet treated water quality objectives causing risk to human health	E. coli Giardia & Cryptosporidium	E. coli	Rare	Catastrophic	Medium (6)	Chlorine dosing of groundwater	Regular operator inspections of chlorine dosing system and bore MRC monthly monitoring of treated	Rare	Minor	Low (2)	Confident			Y	Y	Y	Y	**CCP**	Refer to risk E8 for CCP related to this risk				
						Giarda & Crypto	Rare	Catastrophic	Medium (6)		Regular operator inspections of bore MRC monthly monitoring of treated	Rare	Minor	Low (2)	Confident												
E5	Eton	**Reticulation**	Long retention/contact time in system	Inability to meet treated water quality objectives causing risk to human health	Iron Inadequate disinfection i.e. possible presence of bacteria due to low chlorine residual	E. coli	Likely	Catastrophic	Extreme (20)	Regular cleaning and maintenance of reticulation (air scouring) and reservoirs (divers) Slow release chlorine tablets added to reservoirs Cleaning and maintenance of bores (when production diminishing)	MRC fortnightly monitoring of reticulation network	Possible	Moderate	Medium (9)	Confident		Re-evaluate risk after further Eton monitoring data has been captured Review cleaning and maintenance schedule and program for Eton									
E6	Eton	**Reservoir**	Contamination through vents and animal access e.g. green tree frogs	Inability to meet treated water quality objectives causing risk to human health	E. coli	E. coli	Likely	Catastrophic	Extreme (20)	Regular cleaning and maintenance of reservoirs (divers) Slow release chlorine tablets added to reservoirs	MRC fortnightly monitoring of reticulation network	Possible	Minor	Medium (6)	Confident		Re-evaluate risk after further Eton monitoring data has been captured Review cleaning and maintenance schedule and program for Eton	Y	Y	Y	Y	**CCP**		Free chlorine residual - grab sample bench analysed	1.0 mg/L	≤0.8 mg/L ≥1.5 mg/L	≤0.5 mg/L ≥5.0 mg/L
E7	Eton	**Disinfection**	Underdose or failure to dose	Inadequate disinfection (treated water chlorine demand increases)	E. coli	E. coli	Unlikely	Catastrophic	High (10)	CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed for free chlorine twice weekly Online chlorine meter analysing treated water	Rare	Moderate	Low (3)	Certain			Y	Y	Y	Y	**CCP**	Refer to risk E8 for CCP related to this risk				
E8	Eton	**Disinfection**	Overdose	Impact on taste and odour of treated water	Chlorine Disinfection by-products Taste & odour	Free chlorine residual	Unlikely	Minor	Low (4)	CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed for free chlorine twice weekly	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**CCP**	Under- and over- dose combined	Free chlorine residual - grab sample bench analysed - online	0.7 mg/L	<0.6 mg/L >2.0 mg/L	<0.5 mg/L >5.0 mg/L
E9	Eton	**Disinfection**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection by-products	Tri-halomethanes	Possible	Minor	Medium (6)	CCP Procedure implemented	MRC monthly monitoring for treated water (including Total	Unlikely	Minor	Low (4)	Estimate												
E10	Eton	**Disinfection**	Equipment failure	Inadequate disinfection	E. coli	E. coli	Rare	Catastrophic	Medium (6)	MRC Maintenance Program CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed	Rare	Minor	Low (2)	Confident												
		Calen																									
C1	Calen	**Source Water - Bores**	Bedrock minerals leaching in groundwater	Inability to meet treated water quality objectives causing risk to human health	Minerals	Hardness	Almost Certain	Moderate	High (15)	Ion exchange softener Softener bypass for dilution/blending of softened and unsoftened water	MRC quarterly monitoring of source water	Rare	Moderate	Low (3)	Certain												
C2	Calen	**Source Water - Bores**	Pathogens leaching into aquifers from waterways and from land users e.g. cattle Stormwater event	Inability to meet treated water quality objectives causing risk to human health	E. coli Giardia & Cryptosporidium	E. coli	Possible	Catastrophic	High (15)	Disinfection through chlorine dosing	MRC fortnightly monitoring of reticulation network	Unlikely	Minor	Low (4)	Estimate		Re-evaluate risk after further Calen monitoring data has been captured	Y	Y	Y	Y	**CCP**	Refer to risk C8 for CCP related to this risk				
						Giarda & Crypto	Possible	Catastrophic	High (15)		MRC fortnightly monitoring of reticulation network	Unlikely	Minor	Low (4)	Estimate		Review of water quality monitoring program for Calen Re-evaluate risk after further Calen monitoring data has been captured									
C3	Calen	**Source Water - Bores**	Softener operation -sodium addition -calcium & magnesium removal	Inability to meet treated water quality objectives causing risk to human health	Salinity (sodium)	TDS	Likely	Minor	Medium (8)	Softener bypass for dilution/blending of softened and unsoftened water	MRC fortnightly monitoring of reticulation network	Unlikely	Minor	Low (4)	Certain	High salinity is a consequence of using the ion exchange softener to address the groundwater hardness assessed in C1	Review operation of Calen softener and establish a periodic review schedule Re-evaluate risk after further Calen monitoring data has been captured									
C4	Calen	**Source Water - Bores**	Agricultural run-off leaching into aquifers from waterways and from land users e.g. sugarcane spraying	Inability to meet treated water quality objectives causing risk to human health	Nitrate	Nitrate	Unlikely	Moderate	Medium (6)	Customer notifications if health value is exceeded	MRC fortnightly monitoring of reticulation network	Rare	Moderate	Low (3)	Estimate		Re-evaluate risk after further Calen monitoring data has been captured Review cleaning and maintenance schedule and program for Calen scheme									

ID			HAZARD				MAXIMUM RISK					RESIDUAL RISK				RISK TREATMENT		CCP ASSESSMENT						LIMITS			
Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
C5	Calen	**Reticulation**	Sediments and biofilms in pipes	Inability to meet treated water quality objectives causing risk to human health	Turbidity Manganese	Turbidity	Possible	Moderate	Medium (9)		MRC fortnightly monitoring of reticulation network	Unlikely	Moderate	Medium (6)	Estimate		Re-evaluate risk after further Calen monitoring data has been captured Review cleaning and maintenance schedule and program for Calen										

ID			HAZARD				MAXIMUM RISK					RESIDUAL RISK				RISK TREATMENT		CCP ASSESSMENT						LIMITS			
Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
C6	Calen	**Reservoir**	Contamination through vents and animal access e.g. green tree frogs	Inability to meet treated water quality objectives causing risk to human health	E. coli	E. coli	Likely	Catastrophic	Extreme (20)	Regular cleaning and maintenance of reservoirs (divers) Slow release chlorine tablets added to reservoirs	MRC fortnightly monitoring of reticulation network	Likely	Minor	Medium (8)	Confident		Re-evaluate risk after further Calen monitoring data has been captured Review cleaning and maintenance schedule and program for Calen										
C7	Calen	**Disinfection**	Underdose or failure to dose	Inadequate disinfection (treated water chlorine demand increases)	E. coli	E. coli	Unlikely	Catastrophic	High (10)	CCP Procedure implemented	MRC quarterly micro monitoring Grab samples of treated water analysed for free chlorine weekly Online chlorine meter analysing treated water	Rare	Moderate	Low (3)	Certain			Y	Y	Y	Y	**CCP**	Refer to risk C8 for CCP related to this risk				
C8	Calen	**Disinfection**	Overdose	Impact on taste and odour of treated water	Chlorine Disinfection by-products Taste & odour	Free chlorine residual	Unlikely	Moderate	Medium (6)	CCP Procedure implemented	MRC quarterly micro monitoring Grab samples of treated water analysed for free chlorine weekly	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**CCP**	Under- and over- dose combined	Free chlorine residual - grab sample bench analysed - online	1.2-1.5 mg/L	<0.75 mg/L >2.0 mg/L	<0.5 mg/L >5.0 mg/L
C9	Calen	**Disinfection**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection by-products	Tri-halomethanes	Possible	Minor	Medium (6)	CCP Procedure implemented	MRC quarterly monitoring for treated water (including Total	Unlikely	Minor	Low (4)	Estimate												
C10	Calen	**Disinfection**	Equipment failure	Inadequate disinfection	E. coli	E. coli	Rare	Catastrophic	Medium (6)	MRC Maintenance Program CCP Procedure implemented	MRC quarterly micro monitoring Grab samples of treated water analysed	Rare	Minor	Low (2)	Confident												
		Finch Hatton																									
F1	Finch Hatton	**Source Water - Bores**	Bedrock minerals leaching in groundwater	Inability to meet treated water quality objectives causing risk to human health	Minerals	Hardness	Possible	Minor	Medium (6)		MRC monthly monitoring of treated water	Unlikely	Minor	Low (4)	Confident												
F2	Finch Hatton	**Source Water - Bores**	Agricultural run-off and herbicide leaching into aquifers from waterways and from land users e.g. sugarcane spraying	Inability to meet treated water quality objectives causing risk to human health	Herbicides Nitrate	Herbicides	Unlikely	Minor	Low (4)		Reef Catchments Monitoring Program	Rare	Minor	Low (2)	Uncertain												
						Nitrate	Unlikely	Moderate	Medium (6)	Customer notifcations if health value is exceeded	Reef Catchments Monitoring Program	Rare	Moderate	Low (3)	Estimate		Investigate possibility of formal agreement between Reef Catchments and MRC regarding sharing of information and communications for Finch Hatton Review of water quality monitoring program for Finch Hatton										
F3	Finch Hatton	**Source Water - Bores**	Pathogens leaching into aquifers from waterways and from land users e.g. cattle and nearby toilet blocks and septic tank	Inability to meet treated water quality objectives causing risk to human health	E. coli Giardia & Cryptosporidium	E. coli	Rare	Catastrophic	Medium (6)	Chlorine dosing of groundwater	Regular operator inspections of chlorine dosing system and bore MRC monthly monitoring of treated	Rare	Minor	Low (2)	Confident		Investigate risks associated with the potential contamination of the Finch Hatton bore by nearby toilet block and septic tank and implement improvement actions if identified	Y	Y	Y	Y	**CCP**	Refer to risk F7 for CCP related to this risk				
						Giarda & Crypto	Rare	Catastrophic	Medium (6)		Regular operator inspections of bore MRC monthly monitoring of treated	Rare	Minor	Low (2)	Confident												
F4	Finch Hatton	**Reticulation**	Long retention/contact time in system	Inability to meet treated water quality objectives causing risk to human health	Iron Inadequate disinfection i.e. possible presence of bacteria due to low chlorine residual	E. coli	Likely	Catastrophic	Extreme (20)	Regular cleaning and maintenance of reticulation (air scouring) and reservoirs (divers) Slow release chlorine tablets added to reservoirs Cleaning and maintenance of bores (when production diminishing)	MRC monthly monitoring of reticulation network	Possible	Moderate	Medium (9)	Confident		Re-evaluate risk after further Finch Hatton monitoring data has been captured Review cleaning and maintenance schedule and program for Finch Hatton										
F5	Finch Hatton	**Reservoir**	Contamination through vents and animal access e.g. green tree frogs	Inability to meet treated water quality objectives causing risk to human health	E. coli	E. coli	Likely	Catastrophic	Extreme (20)	Regular cleaning and maintenance of reservoirs (divers) Slow release chlorine tablets added to reservoirs	MRC monthly monitoring of reticulation network	Possible	Minor	Medium (6)	Confident		Re-evaluate risk after further Finch Hatton monitoring data has been captured Review cleaning and maintenance schedule and program for Finch Hatton										
F6	Finch Hatton	**Disinfection**	Underdose or failure to dose	Inadequate disinfection (treated water chlorine demand increases)	E. coli	E. coli	Unlikely	Catastrophic	High (10)	CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed for free chlorine daily Online chlorine meter analysing treated water	Rare	Moderate	Low (3)	Certain			Y	Y	Y	Y	**CCP**	Refer to risk F7 for CCP related to this risk				
F7	Finch Hatton	**Disinfection**	Overdose	Impact on taste and odour of treated water	Chlorine Disinfection by-products Taste & odour	Free chlorine residual	Unlikely	Moderate	Medium (6)	CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed for free chlorine daily Online chlorine meter	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**CCP**	Under- and over- dose combined	Free chlorine residual - grab sample bench analysed - online	1.0 mg/L	<0.6 mg/L >2.0 mg/L	<0.5 mg/L >5.0 mg/L
F8	Finch Hatton	**Disinfection**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection by-products	Tri-halomethanes	Possible	Minor	Medium (6)	CCP Procedure implemented	MRC monthly monitoring for treated water (including Total	Unlikely	Minor	Low (4)	Estimate												
F9	Finch Hatton	**Disinfection**	Equipment failure	Inadequate disinfection	E. coli	E. coli	Rare	Catastrophic	Medium (6)	MRC Maintenance Program CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed	Rare	Minor	Low (2)	Confident												
		Gargett																									
G1	Gargett	**Source Water - Bores**	Bedrock minerals leaching in groundwater	Inability to meet treated water quality objectives causing risk to human health	Minerals	Hardness	Possible	Minor	Medium (6)		MRC monthly monitoring of treated water	Unlikely	Minor	Low (4)	Confident												
G2	Gargett	**Source Water - Bores**	Agricultural run-off and herbicide leaching into aquifers from waterways and from land users e.g. sugarcane spraying	Inability to meet treated water quality objectives causing risk to human health	Herbicides Nitrate	Herbicides	Unlikely	Minor	Low (4)		Reef Catchments Monitoring Program	Rare	Minor	Low (2)	Uncertain												
						Nitrate	Unlikely	Moderate	Medium (6)	Customer notifcations if health value is exceeded	Reef Catchments Monitoring Program	Rare	Moderate	Low (3)	Estimate		Investigate possibility of formal agreement between Reef Catchments and MRC regarding sharing of information and communications for Gargett Review of water quality monitoring program for Gargett										
G3	Gargett	**Source Water - Bores**	Pathogens leaching into aquifers from waterways and from land users e.g. cattle	Inability to meet treated water quality objectives causing risk to human health	E. coli Giardia & Cryptosporidium	E. coli	Rare	Catastrophic	Medium (6)	Chlorine dosing of groundwater CCP Procedure implemented	Regular operator inspections of chlorine dosing system and bore MRC monthly monitoring of treated	Rare	Minor	Low (2)	Confident			Y	Y	Y	Y	**CCP**	Refer to risk G7 for CCP related to this risk				
						Giarda & Crypto	Rare	Catastrophic	Medium (6)		Regular operator inspections of bore MRC monthly monitoring of treated	Rare	Minor	Low (2)	Confident												
G4	Gargett	**Reticulation**	Long retention/contact time in system	Inability to meet treated water quality objectives causing risk to human health	Iron Inadequate disinfection i.e. possible presence of bacteria due to low chlorine residual	E. coli	Likely	Catastrophic	Extreme (20)	Regular cleaning and maintenance of reticulation (air scouring) and reservoirs (divers) Slow release chlorine tablets added to reservoirs Cleaning and maintenance of bores (when production diminishing)	MRC monthly monitoring of reticulation network	Possible	Moderate	Medium (9)	Confident		Re-evaluate risk after further Gargett monitoring data has been captured Review cleaning and maintenance schedule and program for Gargett										

ID			HAZARD				MAXIMUM RISK					RESIDUAL RISK				RISK TREATMENT		CCP ASSESSMENT						LIMITS			
Risk ID	Scheme	Process Step	Hazardous Event & Source of Hazardous Event	Description of Risk	Potential Hazards & Source of Hazard	Limiting Hazard	Likelihood	Conseq.	Residual Risk	Preventative Measures (including treatment process steps)	Monitoring (of implementation of preventive measures - including sampling)	Likelihood	Conseq.	Residual Risk	Uncertainty Certain Confident Reliable Estimate	Comments	Action / Task	Q 1	Q 2	Q 3	Q 4	CCP / OCP / QCP?	Comments	Monitoring	Target	Action Limit	Critical Limit
G5	Gargett	**Reservoir**	Contamination through vents and animal access e.g. green tree frogs	Inability to meet treated water quality objectives causing risk to human health	E. coli	E. coli	Likely	Catastrophic	Extreme (20)	Regular cleaning and maintenance of reservoirs (divers) Slow release chlorine tablets added to reservoirs	MRC monthly monitoring of reticulation network	Possible	Moderate	Medium (9)	Confident		Re-evaluate risk after further Gargett monitoring data has been captured Review cleaning and maintenance schedule and program for Gargett	Y	Y	Y	Y	**QCP**		Free chlorine residual (Gargett Reservoir outlet) - online chlorine meter	1.0 mg/L	≤0.8 mg/L ≥1.5 mg/L For longer than 15	≤0.5 mg/L ≥5.0 mg/L For longer than 15 minutes
G6	Gargett	**Disinfection**	Underdose or failure to dose	Inadequate disinfection (treated water chlorine demand increases)	E. coli	E. coli	Unlikely	Catastrophic	High (10)	CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed for free chlorine daily Online chlorine meter analysing treated water	Rare	Moderate	Low (3)	Certain			Y	Y	Y	Y	**CCP**	Refer to risk G7 for CCP related to this risk				
G7	Gargett	**Disinfection**	Overdose	Impact on taste and odour of treated water	Chlorine Disinfection by-products Taste & odour	Free chlorine residual	Unlikely	Moderate	Medium (6)	CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed for free chlorine daily Online chlorine meter	Rare	Minor	Low (2)	Certain			Y	Y	Y	Y	**CCP**	Under- and over- dose combined	Free chlorine residual - grab sample bench analysed - online	1.0 mg/L	<0.6 mg/L >2.0 mg/L	<0.5 mg/L >5.0 mg/L
G8	Gargett	**Disinfection**	Interaction of chlorine with organics	Generation of disinfection by-products	Disinfection by-products	Tri-halomethanes	Possible	Minor	Medium (6)	CCP Procedure implemented	MRC monitoring for treated water (including Total	Unlikely	Minor	Low (4)	Estimate												
G9	Gargett	**Disinfection**	Equipment failure	Inadequate disinfection	E. coli	E. coli	Rare	Catastrophic	Medium (6)	MRC Maintenance Program CCP Procedure implemented	MRC monthly micro monitoring Grab samples of treated water analysed	Rare	Minor	Low (2)	Confident												
		General																									
GL1	Water Services	**General**	Security	Contamination of treated water	E. coli	E. coli	Likely	Catastrophic	Extreme (20)	Infrastructure located in fenced enclosures Enclosures access through locked gates Some buildings are security alarmed Disinfection in all	MRC Regular Inspections	Unlikely	Moderate	Medium (6)	Confident	Security in place varies from site to site and scheme to scheme	Review security measures of all components of all schemes										
GL2	Water Services	**General**	Operator error	Incorrect operation, analysis methodology, data recording and reporting	Various	Untrained operator	Rare	Moderate	Low (3)	Standby operators Operator on the job training		Rare	Moderate	Low (3)	Reliable		Review O&M Manuals for schemes systems Review cross-training of standby operators										
GL3	Water Services	**General**	Information Management System (incl. lack of communication) Delay in response or lack of adequate information Lack of response to exceedance (incl. lack of resources) Lack of clear roles and	Incident occurs and correct responsible persons not informed &/ lack of resources/information to address incident leading to compromised water quality	Delayed/inadequate response to incident/event	Communication failure	Possible	Catastrophic	High (15)	CCP Procedures MRC Communication protocols Information Management System Statistical Management System (MonitorPro)		Rare	Major	Medium (5)	Confident		Review MRC Asset Management System Gap analysis of information management and communication protocols										
GL4	Water Services	**General**	Inadequate maintenance due to lack of resources and scheduling e.g. calibrations & failure of critical monitoring devices Lack of suitably trained specialized contractors e.g. divers Availability of spares - Asset Management System	Failure of equipment No available spares Delay in response Incorrect readings/operations	Inability to meet treated water quality objectives & continuous supply	Equipment failure	Possible	Catastrophic	High (15)	Current preventative maintenance program		Rare	Major	Medium (5)	Estimate	Not every asset has been listed in the MRC Asset Management System	Review MRC Asset Management System Review maintenance schedules within asset management system										
GL5	Water Services	**General**	Inappropriate quality or unknown specification of materials used in treatment resulting in release of contaminants into treated water, inefficient or no treatment	Potential for compromised water quality	Contamination	Toxins	Unlikely	Moderate	Medium (6)	Contract with suppliers MRC purchasing policies and practices Chemical specifications	Certificate of analysis from suppliers	Rare	Insignificant	Low (1)	Confident		Review of specifications and supply sources for all critical chemical suppliers and other suppliers										
GL6	Water Services	**General**	Skill/knowledge gaps due to staff turn over	Incorrect operation, analysis or data recording/reporting	Inability to meet treated water quality objectives Poor communication	E. coli	Unlikely	Catastrophic	High (10)	Existing training and cultural change programs	Annual performance reviews Skills gap reviews	Rare	Minor	Low (2)	Estimate		Review list of SOPs and SOPs to investigate possible revisions and additional SOPs that me be produced.										
GL7	Water Services	**General**	Site wide power failure Local power failure (e.g. Loss of switchboard)	Inability to meet treated water quality objectives causing risk to human health	Loss of supply	Loss of supply	Possible	Minor	Medium (6)	MRC have standby generators and have protocols in place to hire more generators when required MRC Nebo Rd WTP is on the priority list for power supply with Ergon Energy Reservoirs storage		Rare	Minor	Low (2)	Confident												
GL8	Water Services	**General - Reticulation**	Main breaks - both water and sewer	Contamination of treated water with external material and disturbance of pipe biofilms	E. coli Turbidity Manganese Iron	E. coli	Rare	Catastrophic	Medium (6)	Dilution in network MRC Main Repair Crews Disinfection	MRC Monitoring Program	Rare	Minor	Low (2)	Confident												
GL9	Water Services	**General - Reticulation**	Cross connections - greywater systems, rainwater tanks, sewerage, storm water, tanker connections, illegal connections	Contamination of treated water	E. coli Turbidity Chemicals	E. coli	Rare	Catastrophic	Medium (6)	All meters have backflow checks incorporated Dilution in network AS/NZS 3500 Plumbing and Drainage Disinfection	MRC Annual Backflow Prevention Device Inspection Program	Rare	Minor	Low (2)	Confident												
GL10	Water Services	**General - Reticulation**	Backflow from commercial properties (eg. hospitals, laboratories, abattoirs)	Contamination of treated water	E. coli Turbidity Toxins	Toxins	Rare	Moderate	Low (3)	All meters have backflow checks incorporated Dilution in network AS/NZS 3500 Plumbing and Drainage Disinfection	MRC Annual Backflow Prevention Device Inspection Program Trade Waste License Monitoring Requirements	Rare	Minor	Low (2)	Confident												
						E. coli	Rare	Catastrophic	Medium (6)	All meters have backflow checks incorporated Dilution in network AS/NZS 3500 Plumbing and Drainage Disinfection	MRC Annual Backflow Prevention Device Inspection Program Trade Waste License Monitoring Requirements	Rare	Minor	Low (2)	Confident												
GL11	Water Services	**General - Reticulation**	Contamination of spare pipes and reticulation equipment (eg. spraying of herbicides near stockpiles, animal waste)	Contamination of treated water	E. coli Toxins	E. coli	Rare	Catastrophic	Medium (6)	MRC inspection prior to installation Disinfection		Rare	Minor	Low (2)	Confident												
GL12	Water Services	**General - Reticulation**	Construction of new mains	Contamination of treated water	E. coli Toxins	E. coli	Possible	Catastrophic	High (15)	MRC Main Crews operating procedures Disinfection at	MRC New Main Monitoring Protocol	Unlikely	Minor	Low (4)	Confident		Review new main installation operating procedures (incl. the SOPs are being enforced)										
GL13	Water Services	**General - Reticulation**	Use of tools and equipment in both sewer and water systems	Contamination of treated water	E. coli	E. coli	Possible	Catastrophic	High (15)	Mackay have separate sewer and water tools Disinfection		Unlikely	Minor	Low (4)	Confident												