Section 5

Retail Supplier

WATER TECHNOLOGIES

5.1.5

Risk Assessment
Retail Activities

WATER TECHNOLOGIES

Project: Bingara Wastewater Management
Client:
Title: Risk Assessement for Retail License Activities
Author: HL
Date (Revision): 14/09/2015 (for HACCP)
Risk Criteria: As per Tables 2.5, 2.6 & 2.7: Australian Guidelines for Water Recycling: Managing Health and Environmental Risks-phase 1 (2006)

Scheme Component	Hazard	Hazardous Event	Impact	Control Strategy	Mitigated Risk				
					Likelihood		Consequence		Risk
Golf Course Irrigation storage dam	Vector borne diseases	Vermin/mosquito invasion of irrigation storage	Potential spread of diseases	1. Steep batters to minimise potential for mosquito growth. 2. Regular inspection for evidence of vermin access, e.g. mosquito larvae, bird nests etc.	C	Possible	3	Moderate	High
	Unintended contact with recycled water	Human access into storage	Potential spread of disease. Potential drowning.	1. Wet weather storage is fenced with appropriate warning signage. 2. Safe egress point from storage. 3. Wire rope along top of bank to prevent slippage into the pond.	B	Unlikely	3	Major	Moderate
	Blue green algae	Blue green algae outbreak in storage	Inhalation or contact with blue green algae toxins	1. Low nutrient concentrations in MBR effluent (TP < 0.3 mg/L, TN < 10 mg/L) 2. Ongoing monitoring for early detection of algae outbreaks. Algae speciation will be undertaken if outbreak occurs. 3. Aerator mixing of pond will be undertaken if algae outbreak occurs. 4. If frequent outbreaks occur a permanent aerator mixer will be installed into the pond.	B	Unlikely	2	Minor	Low
	Leakage to groundwater	Leakage to groundwater	Contamination of groundwater	1. HDPE / clay lined storages. 2. Groundwater monitoring if required	B	Unlikely	3	Moderate	Moderate
	Stormwater inputs	Stormwater runoff into storage during rain events	Increased potential for overflow	1. Designed to avoid inputs from stormwater runoff (except off the banks of the dam). 2. Precautionary and emergency discharges of recycled water from the wet weather storage in less than 50% of years into a tributary adjacent to Stringybark Creek if required in extreme wet weather.	A	Rare	1	Insignificant	Low
	Uncontrolled overflow	Uncontrolled overflow from the wet weather storage during extended wet weather	Public health risk or contamination of waterways	1. To avoid emergency overflows, precautionary discharges into a tributary gully adjacent to Stringybark Creek of up to 25% of the daily flow out of the main golf course stormwater lake can occur when wet weather storage > 75% full & main golf course stormwater lake is overflowing. 2. The proposed wet weather discharge point is the overflow structure in the main stormwater lake at the golf course and allows for dilution of recycled water with stormwater before entering the natural environment. 3. The recycled water in the wet weather storage is highly treated ("Class A+") and contains relatively low concentration of BOD, turbidity, and nutrients, faecal coliforms hence the discharge poses minimal threat to the downstream environment and minimal public health risks. NOTE: Suitable for unrestricted irrigation of open spaces. 4. Proposed discharge is modelled to occur infrequently in less than 50% of years based on historic data. 5. Monitoring and inspection of water quality monitoring downstream of the discharge location to be implemented if determined necessary following overflow.	A	Rare	2	Minor	Low
	Dam wall failure	Dam wall failure	Surface runoff and flooding	1. Design of dam walls with overflow weir for controlled overflow in unlikely event. 2. Scour protection in the unlikely event of uncontrolled overflow. 3. Continuous online monitoring of storage water level with of emergency discharge as required to avoid uncontrolled overflow (start to discharge prior to flood condition).	B	Unlikely	2	Minor	Low

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Waste Water Treatment Plant	Trace contaminants in MBR effluent feed water	Trace contaminants following MBR treatment	Potential impacts on recycled water uses	1. Majority residential catchment hence there is a low likelihood of significant trace contaminants being present in recycled water. Refer to sewerage wastewater generation risk assessment table. 2. Customer supply contracts, recycled water use agreements and ongoing awareness and education through information provided with rates notices and via the LL and VWS websites. 3. Detailed annual recycled water quality monitoring for trace contaminants. 4. If contaminants are detected a source control investigation will be undertaken through analysis of trade waste and raw wastewater data and SPS and PSU pump data. 5. Refer to controls in sewerage risk assessment.	B	Unlikely	2	Minor	Low
	Poor water quality from MBR	MBR blower failure, shock loads, membrane failure etc.	Poor quality to downstream disinfection (UV and chlorine)	1. Continuous online monitoring and alarms on critical MBR process parameters MLSS, DO, Permeate Turbidity, transmembrane pressure. 2. Shutdown of plant on MBR permeate turbidity of 0.5 NTU (required to claim virus log removal value of 1) with operator attention required to rectify and restart plant as this is a CCP. (Shut down of plant includes shutdown of recycled water pumps to residential network.)	B	Unlikely	2	Minor	Low
	Pathogen break through from MBR membranes	Rupture of membrane fibres	Non-compliant recycled water	1. Use USEPA accredited microfiltration membranes. 2. Continuous online monitoring of MBR permeate turbidity with alarms and automatic shutdown (CCP as below) 3. Continuous online monitoring and alarms on transmembrane pressure. 4. Membrane chemical cleaning in line with manufacturer requirements to maximise membrane life. 5. Design flux, TMP and other process parameters as per manufacturer recommendations to maximise membrane life. **CCP1 :** turbidity does not exceed any of the following: 0.2 NTU more than 5% of the time within a 24-hour period and 0.5 NTU at any time. **Response:** If CCP not met (checked as above), membrane tanks taken out of service until problem rectified (as above)	B	Unlikely	2	Minor	Low
	Inadequate pathogen inactivation due to low UV dose	Inadequate UV dose caused by lamp failure, reactor fouling, high flow, poor feed water quality	Non-compliant recycled water	1. Use USEPA accredited UV disinfection system. 2. Continuous online monitoring of UV intensity and UV lamp faults with alarms and automatic shutdown. 3. Continuous online monitoring of flow through the UV reactor with alarms and automatic shutdown. 4. UV unit to include self-cleaning functions. 5. Design and operation of UV unit as per manufacturer recommendations. 6. Replace UV lamps every 12 months. **Validation of Log Removals:** Validation based on compliance of unit with log-removal requirements at flow rate of 120 m3/h and UVT > 65% (expected to be suitable for Stage 3 flows) from USEPA (2006)Ultraviolet Disinfection GuidanceManual for LT2 ESWTR report Units provided: Duty/ Standby Xylem Wedeco LBX850e **CCP1:** Online monitoring that UVT > 65% **CCP2:** Online monitoring of UV intensity, checking that this matches requirement at the flow/UVT measured (flow paced adjustment) **Response:** If CCP not met (checked as above), filtrate pumps (feeding UV) are shutdown. Operator then initiates Duty/ Standby changeover of the UV units.	B	Unlikely	4	Major	High

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Inadequate pathogen die off due to low CT in chlorine contact tank	Inadequate CT due to low chlorine concentration, high flow, low level in CCT, high COD, high temperature, incorrect pH	Non-compliant recycled water	1. Chlorine contact tank designed with baffles with conservative assumption of baffling factor 0.3 in design (expect will achieve 0.5) 2. Continuous online monitoring of free chlorine residual, pH and temperature at outlet of the CCT with alarms and automatic shutdown. 3. Continuous online monitoring of flow and water level in the CCT with alarms and automatic shutdown. **Validation:** Measurement of a 2 mg/L chlorine residual on discharge from the chlorine contact tank (online measurement) CT of 18 mg.min/L selected for 4-log virus removal with free chlorine (considering residual ammonia/ organics.) Additional 13 mg/L allowed in chlorine dosing to achieve breakpoint under maximum ammonia /organic conditions. Total chlorine dose of 15 mg/L to achieve residual requirement (basis of design for chlorine dosing) **CCP1:** 2-3 mg/L Cl residual measured on outlet of chlorination tanks. **CCP2:** Flow to Chlorine contact tanks < 80 m3/h to ensure residence time is achieved	B	Unlikely	4	Major	High
High salt concentration	High salt concentration in recycled water	Non-compliant recycled water	1. Continuous online monitoring of EC/TDS in treated water to irrigation and recycled water network. 2. If there is persistent high TDS in MBR permeate then a source control investigation will be undertaken through review of catchment raw wastewater quality and trade waste data.	B	Unlikely	2	Minor	Low
Process chemicals	Spillage of chemicals used in the process	Potential OH&S and public health impacts. Potential environmental impacts.	1. Appropriate bunding and separation in chemical storage and delivery areas. 2. Standard operating procedures to be developed for use of all chemicals. 3. MSDS of all chemicals maintained onsite. 4. Emergency Response Plan for chemical spillages.	B	Unlikely	2	Minor	Low
Metals, organic chemicals and other potential trace contaminants	Presence of excessive amounts of metals, organic chemicals and other trace contaminants in treated water	Potential OH&S, public health and environmental impacts.	1. Prevention strategy based around Trade Waste Agreements, Residential Supply Agreements, ongoing awareness and education at each billing cycle. 2. Predominately residential catchment, hence the likelihood of significant levels of contaminants is low. 3. Detailed annual monitoring of treated recycled water quality for trace contaminants at NATA accredited laboratory. 4. If contaminants are detected a source control investigation will be undertaken through review of catchment raw wastewater and trade waste data.	C	Possible	2	Minor	Moderate
membrane chemical cleaning wastewater or UV acid clean wastewater	Management of chemical contaminated wastewater	Potential impacts on recycled water quality if inappropriately managed	1. Capacity to recirc from membrane tanks after cleaning to head of the plant 2. Low usage of chemicals in process, neutralization within process considered adequate. 3. Can wait till min level is reached in Equal Tank or WWTP balance tank before feeding plant after the CIP return. 4. If process impacts are observed on the MBR then offsite disposal of chemical wastewater will be undertaken by licensed waste contractor.	C	Possible	3	Moderate	High

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					Hazard Likelihood		Consequence		Risk
Treated Water Storage Tanks	Vector borne diseases	Vermin access to recycled water storage tank	Non-compliant recycled water	1. Storage tank constructed to potable water standards with vermin screens on all tank openings and overflows. 2. Monitoring and inspection for evidence of vermin access as required 3. If observed contaminated water will be wasted, or if appropriate, chemical treatment of the storage	B	Unlikely	3	Moderate	Moderate
	Insufficient Recycled water	Low Levels in Recycled water tanks caused by: • Consecutive peak day demands for recycled water; • Recycled water demand > treatment capacity and onsite storage capacity; • Maintenance of the treatment plant ; • failure of treatment plant or automatic system down due to the detection of non-compliant recycled water.	Interruption of recycled water supply to customers	1. Continuous online tank level monitoring with emergency potable water back up from Sydney Water network initiated by a low level in the recycled water storage tank. Note: Until process proving is conducted on the permanent wastewater plant, all supply to the network will be potable water (as currently) 2. Automatic shutdown of open space irrigation systems during emergency backup periods to ensure open space irrigation does not occur (consuming large volume of recycled water) and customer recycled water supply is not interrupted. 3. Significant capacity provided for maintenance, including D/S (100% redundancy) in membrane system, D/S (100%) in UV system	B	Unlikely	1	Insignificant	Low
	Cross Connection	Cross connection with the Sydney Water potable water network	Contamination of potable water supply	1. The potable water emergency top up will be provided using a 300 mm (minimum) air gap above the top water level in the recycled water tank to avoid cross connection issues.	A	Rare	3	Moderate	Low

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Scheme Component	Hazard	Hazardous Event	Impact	Control Strategy	Mitigated Risk				
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Treated Water Storage Tanks	Decay of free chlorine residual during storage	Loss of adequate free chlorine residual due to equipment failure, high temperature, long detention time or high COD	Non-compliant recycled water	1. Sodium hypochlorite dosing provided at inlet to treated water tank 2. Sodium hypo dosing and free chlorine residual monitoring provided on discharge from recycled water pumps to recycled water network 3. Sodium Hypo dosing and free chlorine residual monitoring provided on the outlet from treated water tank to irrigation (overflow discharge). 4. Sodium hypo dosing on recycled water supply to recycled water network is normally based on compound dosing control for a preset network supply chlorine residual (adjusted seasonally). This is a CCP. Limits of low, high at CCP alarm Limits of very low / very high at CCP shutdown the pumps until concern rectified. 5. Monitoring of free chlorine at furthest point in the network to inform chlorine residual setpoints for network supply (including based on seasonal variability) 6. Sodium hypo dosing on irrigation supply water to be a fixed rate when flow measured to irrigation (compound difficult to control due to intermittent discharge. High/Low level chlorine alarms will be set on the discharge to alert the operator to consider increase in the dosing setpoint. Achieving a residual in the irrigation storage not as critical and this is not a CCP.	B	Unlikely	3	Moderate	Moderate
	Blue green algae	Blue green algae growth in recycled water storage tank	Non-compliant recycled water	1. Low nutrient levels in water. 2. TW Storage tank covered to prevent sunlight access and algae growth. 3. Inspection and monitoring of recycled water storage tank.	A	Rare	2	Minor	Low
	Unintended contact with recycled water in storage	Human access to storage	Potential public health impacts	1. TW Storage located inside the fenced and secure WWTP site. 2. Warning signage around the perimeter of the site and on each storage tank. 3. CCTV recording at the WWTP site. 4. Lockable manhole access points.	B	Unlikely	2	Minor	Low
	Tank failure	Tank failure	Flooding, contamination of surface water	1. Tank constructed from steel panel tanks with civil/structural engineer certification for tank and footings. 2. Quality assurance in construction. 3. Bollard fence around tanks if there is a risk of vehicular or machinery damage.	B	Unlikely	2	Minor	Low
	Tank materials	Dissolution of trace metals into recycled water	Non-compliant recycled water	1. Ensure all tank materials are compatible for use with potable water. 2. Sampling and analysis of water for trace contaminants as deemed necessary.	A	Rare	2	Minor	Low
Recycled Water Supply System	Cross connections	Cross connection with the Sydney Water potable water network	Contamination of potable water supply	1. Only approved contractors or staff that have undergone induction can perform work on water utility infrastructure. 2. Potable water reticulation network designed, constructed and tested in accordance with WSAA and Sydney Water standards. 3. Recycled water reticulation networks to be designed, constructed and tested in accordance with WSAA standards. 4. Water pressure in recycled water network to be maintained a minimum of 50 kPa below pressure in the potable network. 5. Quality assurance, inspection and pressure testing during construction. 6. Ongoing monitoring of water pressure and electrical conductivity in both networks during operation to assist with detection of cross connections. 7. Unique pipe materials in each water network. Class A+ Recycled Water network will use lilac striped HDPE pipe. 8. Minimum pipe separation distances to be maintained in common trenches. 9. Identification tape and signage on all trenches. 10. Compliance audits will be undertaken prior to introducing recycled water to the network. 11. Penalties will apply for failure to comply with all plumbing regulations.	B	Unlikely	3	Moderate	Moderate

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		Cross connection with potable water line on private property	Potential use of recycled water for potable uses inside the affected property (up to say 6 EP)	1. All plumbing work on private property to be undertaken by Licensed plumber in compliance with AS3500 and the NSW Plumbing Code. 2. Plumbing inspection & approvals during house construction by Wollondilly Council. 3. Dual check valve to be located at the potable water connection point for each property on both potable and recycled water networks. 4. Residential Customer Supply Contracts outlining responsibilities under the scheme. 5. Ongoing customer awareness and education with information provided at each billing cycle and on the LL and VWS websites	C	Possible	3	Moderate	High

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Recycled Water Supply System cont...	Unintended or inappropriate uses of recycled water	Unintended uses of recycled water like swimming pool top up, drinking from outdoor taps, ingestion from excessive spray drift etc.	Potential use of recycled water for potable uses	1. Residential customer supply contracts and recycled water use agreements. 2. Ongoing awareness and education with information provided at each billing cycle and on the VWS and LL websites. 3. Appropriate identification and signage to be installed by plumbing contractor and verified during construction and plumbing inspection.	B	Unlikely	3	Moderate	Moderate
	Loss of chlorine residual	Loss of chlorine residual due to long detention time, high temperature, high COD	Non-compliant recycled water	1. As above under degradation in TWS, chlorine residual in supply to the recycled network is a CCP. 2. Chlorine dosing regime will be calibrated for each season to ensure the minimum required free chlorine residual is maintained at the furthest point in the reticulation system. 3. Adjustment of residual at RW network chlorine CCP will also account for expansion of the RW network 4. Sampling regime of free chlorine throughout the reticulation system and in select private dwellings.	B	Unlikely	3	Moderate	Moderate
	Pipe breakage	Pipe breakage due to excavation or machinery that leads to surface runoff of recycled water	Potential contamination of surface waters	1. PE100 PN16 HDPE pipe with welded joints and fittings. 2. Quality assurance and pressure testing during construction. 3. Above ground signage and identification tape in all trenches. 4. Register all work as executed plans with dial before you dig service Customer fault reporting and response procedures in customer service. 5. Emergency Response Plan for main breaks.	B	Unlikely	2	Minor	Low
Indoor uses on private lots for toilet flushing and washing machine cold water	Pathogens	Unintended uses	Potential public health impacts	1. Class A+ recycled water 2. Voluntary laundry washing machine cold water supply to be hard plumbed. 3. Residential customer supply contracts and recycled water use agreements. 4. Ongoing awareness and education with information provided at each billing cycle and on the LL and VWS websites 5. Appropriate identification and signage to be installed by plumbing contractor and verified during construction and plumbing inspection.	B	Unlikely	1	Minor	Low
outdoor recycled water uses on private lots, i.e. irrigation and wash-down	Pathogens	Human contact and ingestion of spray drift or surface runoff	Potential public health impacts	1. Customer supply contracts, recycled water use agreements and ongoing customer education and awareness. 2. Appropriate signage 3. Class A+ recycled water	B	Unlikely	1	Insignificant	Low
	Nutrients	Excessive nutrient loads in irrigation	Potential contamination of soil and groundwater	1. Recycled water contains low nutrients of TN<10 mg/L & TP<0.3mg/L and under normal irrigation rates and recycled water availability should not result in excessive nutrient impacts. 2. Soil monitoring will be undertaken as required. 3. If required customers will be advised to reduce irrigation rates or other management measure as per the recycled water supply agreement.	B	Unlikely	2	Minor	Low
	Salinity	Irrigation with high salt recycled water	Reduction in plant growth and poor appearance	1. System will maintain TDS at < 1000 mg/L via regular purge of water to irrigation. 2. Irrigation at 1000 mg/L TDS is unlikely to result in vegetation impacts, except for some specific species that may have very low tolerance to salt. 3. Customer supply contracts and recycled water use agreements will advise customers not to irrigate specific plants with very low tolerance to salt.	A	Rare	2	Minor	Low

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Outdoor recycled water uses on private lots and for puiblic open space irrigation, i.e. irrigation of gardens, irrigation of public spaces and outside wash-down cont...	SAR	Irrigation with high SAR recycled water	Potential impacts on soil structure	1. Soil monitoring of Exchangeable Sodium Percent will be undertaken as required 2. If required customers will be required to reduce irrigation rates or undertake a gypsum application based on the recycled water use agreement. 3. If required the SAR of the recycled water supply will be reduced to <5 through by addition of calcium and magnesium and/or by reducing sodium inputs.	B	Unlikely	2	Minor	Low
	pH	Irrigation with low or high pH recycled water	Long term pH impacts on soil	1. pH expected between 6.5 and 8.5 as per potable water standards.	B	Unlikely	2	Minor	Low
		wash-down with high or low pH recycled water	Potential corrosion of private assets	2. Continuous online monitoring and alarms at RW pump discharge Very high / very low pH will shutdown RW pumps. 3. Ability for temporary dosing of lime to activated sludge tanks to correct pH 3. Future implementation of pH correction if deemed necessary	B	Unlikely	2	Minor	Low
	Chlorine	Irrigation using recycled water with high chlorine concentration	Potential impacts on vegetation and soil microorganisms	1. Maximum free residual chlorine concentration of 2 mg/L. 2. As discussed above: - CCP on recycled water chlorine, as discussed above, with shutdown on very high/very low. - Seasonal adjustment of residual requirements to ensure appropriate dosing for level in the network.	B	Unlikely	2	Minor	Low
	Trace metals, organic chemicals and other potential trace contaminants	Trace contaminants present during irrigation	Potential impacts on soil and vegetation	1. Majority residential catchment hence there is a low likelihood of significant trace contaminants being present in recycled water. 2. Recycled water quality monitoring for trace contaminants as required 3. If contaminants are detected a source control investigation will be undertaken through analysis of trade waste and raw wastewater data.	B	Unlikely	3	Moderate	Moderate
Open Space Irrigation System (including Wilton Oval)	Unintended uses or human contact with recycled water	Unintended uses or human contact with recycled water	Potential health impacts	1. Irrigation management plans to be developed for irrigation on any open public space area 2. Irrigation of high quality "Class A+" recycled water only 3. No above ground taps or fixtures in public open space irrigation areas. 4. Appropriate warning signage in all open space irrigation areas. 5. Lockable irrigation valves pits and controllers etc. 6. Irrigation controllers with rain sensor override to prevent irrigation during rainfall.	B	Unlikely	3	Moderate	Moderate

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Open Space Irrigation System (including Wilton Oval) cont...	Spray drift during irrigation	Spray drift onto sensitive receptor	Potential ingestion of recycled water	1. Irrigation of high quality "Class A+" recycled water only – not of concern 2. Signage 3. Education / Irrigation management plan	B	Unlikely	2	Insignificant	Low
	Irrigation during wet weather or over-irrigation	Irrigation during wet weather resulting in surface runoff or deep percolation of effluent	Contamination of surface and/or groundwater	1. Irrigation management plan that restricts irrigation to outside rainfall events. 2. Site based storm water runoff and environmental controls.	A	Rare	2	Minor	Low
	Stormwater runon	Stormwater runon	Stormwater running onto irrigation areas from up gradient	1. Stormwater diversion drains to divert all up gradient stormwater runoff around effluent irrigation areas. 2. Appropriate buffers to waterways, ponds, stormwater drains. 3. Irrigation controls as per above and irrigation management plan.	A	Rare	2	Minor	Low
	Irrigation rates and scheduling	Inappropriate irrigation scheduling	Increased risk of surface and ground water contamination	Irrigation scheduling will use programmable irrigation controllers to control irrigation frequency, time and duration. Irrigation rates will be calibrated to ensure no ponding. 2. Irrigation rates will be seasonally adjusted in the irrigation controller to match seasonal irrigation demand. 3. Low long term average irrigation rate of approximately 0.9 mm/day (3.2 ML/ha/year), hence low risk of groundwater contamination. 4. Geotechnical investigation indicated that no groundwater was encountered within 20 m of the surface. 5. The primary rock type intersected during bore construction was recorded to be sandstone which minimises percolation of effluent to deep groundwater. 6. High quality effluent with low nutrients and pathogens (reducing impact if this does occur) 7. There is only one registered groundwater bore within close proximity to the site and a further 17 registered groundwater bores within 3 to 5 km of the site. Water bearing zones were recorded at depths of between 26 m and 194 m below ground level.	B	Unlikely	2	Minor	Low
	Nitrogen	Excessive nitrogen load resulting in leaching of nitrate from irrigation areas	Contamination of groundwater	1. Irrigation of recycled water with total nitrogen concentration of median <10mg/L. 2. MEDLI modelling indicates all nitrogen applied in irrigation is taken up by vegetation. 3. MEDLI modelling indicates negligible nitrate concentration in deep drainage.	B	Unlikely	2	Minor	Low
	Phosphorus	Excessive phosphorous load resulting in leaching of phosphate from irrigation area	Contamination of groundwater	1. Irrigation of recycled water with total phosphorus concentration of median <0.3 mg/L and low average irrigation rates of around 0.9 mm/day (3.2 ML/ha/year). 2. MEDLI modelling indicates the majority of phosphorus applied in irrigation is taken up by vegetation. 3. MEDLI modelling indicates negligible phosphate concentration in deep drainage. 4. MEDLI modelling predicted Phosphorus adsorption into soil at a low rate of 0.3 kg/ha/year. 5. Critical P-sorption life of the soil is conservatively estimated to be >6000 years based on an assumed critical P-sorption capacity of 2000 kg/ha.	B	Unlikely	2	Minor	Low
	Effluent Salinity	Impacts on plant growth due to salinity	Reduction in plant growth and water and nutrient uptake rates	1. TDS to be limited to 1000 mg/L with regular purge from the system for irrigation. This is not expected to have any impact on the health of plants, provided appropriate planting selections are made. 2. Landscape design processes will ensure appropriate vegetation is selected in public open space irrigation areas.	B	Unlikely	2	Minor	Low
	Effluent SAR	Long term sodicity impacts on soil	Soil dispersion, reduction in permeability	1. Soil testing indicates loam top soils are generally non-sodic to slightly-sodic with Exchangeable Sodium Percentage (ESP) ranging from 2% to 5%. Deeper clay soils are sodic to highly-sodic with ESP ranging from 7% to 23%. 2. Gypsum/Lime application during construction to increase soil calcium and reduce ESP. 3. soil testing and Gypsum/Lime application to increase soil pH and soil calcium concentrations and reduce ESP if required	B	Unlikely	2	Minor	Low

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Metals and trace contaminants	Trace contaminants is irrigation supply resulting in long term accumulation in irrigation area	Contamination of soil and groundwater	1. Source catchment is >90% domestic wastewater hence the likelihood of trace contaminants is low. 2. Customer awareness campaigns, supply contracts, trade waste agreements and recycled water use agreements will further reduce the likelihood of contaminants. 3. Acceptable irrigation rates adjusted based on climatic and soil conditions. 4. Detailed monitoring of effluent quality for trace contaminant will be undertaken as required for trace contaminants 5. Soil monitoring in open space irrigation areas will be undertaken as required if build-up or increase in contaminants is deemed possible in a particular area. 6. If contaminants are detected then an investigation into the likely source will be undertaken and trade waste/source controls implemented.	B	Unlikely	2	Minor	Low
Recycled water	Pipe breakage	Potential contamination of surface or groundwater	1. Visual inspection to identify boggy areas or erosion etc. 2. Fault and main break reporting system through customer service processes. 3. Contact numbers on VWS and LL website 4. If Sydney water contacted first they will manage the problem immediately and refer on to LL/VWS for repairs.	B	Unlikely	2	Minor	Low
Odour	Odour released during irrigation	Odour impacts on nearby residents	1. Irrigation of high quality "Class A+" recycled water with low BOD reduces the likelihood of any odour issues.	A	Rare	2	Minor	Low

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					Likelihood		Consequence		Risk
Golf Course Irrigation network	Use of recycled water for irrigation	Use of recycled water for irrigation	Potential health or environmental impacts resulting from the use of recycled water	1. The Golf Course Irrigation Network is under the control of and owned by the Bingara Gorge Golf Club. A Golf Course management plan will be developed by the Golf Course as a DA requirement for the golf course. An irrigation management plan will be included as part of the overall management plan and will address issues specific to irrigation with recycled water. 2. A recycled water use agreement will be implemented with the golf course. 3. VWS staff will work with golf course staff during operation to assist with achieving sustainable outcomes for the scheme in terms of irrigation scheduling and the ongoing review of environmental monitoring results.	B	Unlikely	3	Moderate	Moderate
	Cross connection with potable networks	Cross connection between golf course irrigation network and potable networks	Contamination of other water supplies	The following cross connection controls will be included in the Golf Course Irrigation Management plan to be developed: 1. The golf course irrigation network is a completely independent network and has no direct connection to the potable networks. 2. Unique pipe materials. Golf Course Irrigation Network to use Lilac PVC or PE pipe. 3. Golf course Irrigation Network pipes to be laid in their own separate trench with identification tape and above ground signage. 4. Only approved, trained and supervised plumbing contractors are permitted to work on reticulation systems. 5. Golf course irrigation network is in separate footprint and isolated from the other water networks (with the exception of some road crossings).	B	Unlikely	3	Moderate	Moderate
	Unintended uses or human contact with recycled water	Unintended uses or human contact with recycled water	Potential health impacts	1. High quality "Class A+" area therefore no requirement for restricted irrigation only 2. Irrigation management plan to be developed including soil moisture probes and weather station override on irrigation controllers to prevent irrigation during rainfall, high wind or elevated soil moisture.	A	Rare	3	Moderate	Low

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Scheme Component	Hazard	Hazardous Event	Impact	Control Strategy	Mitigated Risk				
					Likelihood		Consequence		Risk
Golf Course Irrigation network cont...	Irrigation during wet weather	Irrigation during wet weather resulting in surface runoff or deep percolation of effluent	Contamination of surface and/or groundwater	1. Soil moisture probes and weather station override on irrigation controllers to prevent irrigation during rainfall, high wind or elevated soil moisture.	A	Rare	2	Minor	Low
	Dry Weather	Irrigation demand during dry weather exceeds available water	Insufficient irrigation water for golf course	1. Approximately three quarters of the irrigation demands are supplied by recycled water (approximately 320 mm/year). The remaining irrigation demands are supplied from the onsite storm water lake. 2. In an extreme dry event when the golf course stormwater ponds are empty, the golf course would implement irrigation demand management measures to minimise demand. .	A	Rare	3	Moderate	Low
	Irrigation rates and scheduling	Inappropriate irrigation scheduling	Increased risk of surface and ground water contamination	1. Irrigation scheduling will use programmable irrigation controllers to control irrigation frequency, time and duration. 2. Irrigation rates will be seasonally adjusted in the irrigation controller to match seasonal irrigation demand. 3. Monitoring of irrigation flows to each major irrigation zone and monitoring of the volumes of recycled water and stormwater reused. 4. Environmental monitoring of soil, groundwater, onsite stormwater ponds and downstream waterways to detect any contamination. 5. Details of irrigation rates, scheduling and environmental monitoring will be included in the golf course irrigation management plan to be developed. 6. VWS staff will work with golf course staff during operation to assist with achieving sustainable outcomes for the scheme in terms of irrigation scheduling and the ongoing review of environmental monitoring results.	B	Unlikely	2	Minor	Low
	Recycled water	Surface runoff during irrigation	Potential contamination of surface water	1. All golf course irrigation areas to use irrigation scheduling controls to control the time, frequency and duration of irrigation events. 2. Soil moisture probes and weather station override on irrigation controllers to prevent irrigation during rainfall or elevated soil moisture. 3. Golf Course stormwater drains to the storm water lake. 4. Irrigation rates will be seasonally adjusted in the irrigation controller to match seasonal irrigation demand. 5. Monitoring of irrigation flows to each major irrigation zone and monitoring of the volumes of recycled water and stormwater reused. 6. Environmental monitoring of soil, groundwater, onsite stormwater ponds and downstream waterways to detect any contamination. 7. Details of irrigation rates, scheduling and environmental monitoring will be included in the golf course irrigation management plan to be developed.	B	Unlikely	2	Minor	Low
	Nitrogen	Excessive nitrogen load resulting in leaching of nitrate from irrigation areas	Contamination of groundwater	1. Irrigation of recycled water with total nitrogen concentration of 10 mg/L. 2. Environmental monitoring of groundwater to detect any contamination. 3. Details of irrigation rates, scheduling and environmental monitoring will be included in the golf course irrigation management plan to be developed. 4. MEDLI modelling indicates all nitrogen applied in irrigation is taken up by vegetation. 5. MEDLI modelling indicates negligible nitrate concentration in deep drainage. 6. Low average irrigation rates, adjusted seasonally.	B	Unlikely	2	Minor	Low

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					Likelihood		Consequence		Risk
Golf Course Irrigation network cont...	Phosphorus	Excessive phosphorous load resulting in leaching of phosphate from irrigation area	Contamination of groundwater	1. Irrigation of recycled water with total phosphorus concentration of 0.3 mg/L. 2. Low average irrigation rates of approximately 0.9 mm/day. 3. Environmental monitoring of groundwater to detect any contamination. 4. Details of irrigation rates, scheduling and environmental monitoring will be included in the golf course irrigation management plan to be developed. 5. MEDLI modelling indicates the majority of phosphorus applied in irrigation is taken up by vegetation. 6. MEDLI modelling indicates negligible phosphate concentration in deep drainage. 7. MEDLI modelling predicted Phosphorus adsorption into soil at a low rate of 0.3 kg/ha/year. 8. Critical P-sorption life of the soil is conservatively estimated to be >6000 years based on an assumed critical P-sorption capacity of 2000 kg/ha.	B	Unlikely	2	Minor	Low
	Effluent Salinity	Impacts on plant growth due to salinity	Reduction in plant growth and water and nutrient uptake rates	1. MEDLI modelling indicated no impacts on plant growth due to salinity based on a conservative effluent TDS of 1000 mg/L. 2. If salinity is an issue, Golf Course to dilute recycled water with stormwater.	B	Unlikely	2	Minor	Low
	Effluent SAR	Long term sodicity impacts on soil	Soil dispersion, reduction in permeability	1. Soil testing indicates loam top soils are generally non-sodic to slightly-sodic with Exchangeable Sodium Percentage (ESP) ranging from 2% to 5%. Deeper clay soils are sodic to highly-sodic with ESP ranging from 7% to 23%. 2. Gypsum/Lime application during golf course construction to increase soil calcium and reduce ESP. 3. Annual soil testing and Gypsum/Lime application to increase soil pH and soil calcium concentrations and reduce ESP. 4. Soil moisture probes to control irrigation scheduling to minimise percolation into deeper soil layers. 5. If required the irrigation water SAR will be adjusted through addition of calcium/magnesium or reduction in sodium inputs to maintain effluent SAR<5.	B	Unlikely	2	Minor	Low
	Metals and trace contaminants	Trace contaminants in irrigation supply resulting in long term accumulation in irrigation area	Contamination of soil and groundwater	1. Source catchment is >90% domestic wastewater hence the likelihood of trace contaminants is low. 2. Customer awareness campaigns, supply contracts, trade waste agreements and recycled water use agreements will further reduce the likelihood of contaminants. 3. Monitoring of effluent quality for trace contaminant will be undertaken as required. 4. Soil monitoring in golf course irrigation areas as deemed to be at risk will identify any Build-up or increase in contaminants. 5. If contaminants are detected then an investigation into the likely source will be undertaken and trade waste/source controls implemented. 6. Details of irrigation rates, scheduling and environmental monitoring will be included in the golf course irrigation management plan to be developed.	B	Unlikely	2	Minor	Low
	Recycled water	Pipe breakage	Potential contamination of surface or groundwater	1. Visual inspection to identify boggy areas or erosion etc. 2. Golf course stormwater drains to natural stormwater ponds. 3. Environmental monitoring of soil, groundwater, onsite stormwater ponds and downstream waterways to detect any contamination. 4. Details of irrigation rates and environmental monitoring will be included in the golf course irrigation management plan to be developed.	B	Unlikely	2	Minor	Low
	Odour	Odour released during irrigation	Odour impacts on nearby residents	1. Irrigation of high quality "Class A+" recycled water with low BOD 2. Algae control in the wet weather storage 3. Irrigation at night time only. 4. Details of irrigation rates and environmental monitoring will be included in the golf course irrigation management plan to be developed.	A	Rare	2	Minor	Low

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					Likelihood		Consequence		Risk
Golf Course Irrigation network cont…	Stormwater runon	Stormwater running onto irrigation areas from up gradient	Water logging of irrigation area	1. Stormwater diversion drains to divert all up gradient stormwater runoff around golf course effluent irrigation areas and into stormwater ponds. 2. Appropriate buffers to waterways, ponds, stormwater drains and SEPP14 wetlands 3. Irrigation of effluent to areas used for stormwater management to be avoided (includes waterways, major drains, stormwater ponds, treatment basins and vegetated swales). 4. Details of irrigation rates and environmental monitoring will be included in the golf course irrigation management plan to be developed. 5. VWS staff will work with golf course staff during operation to assist with achieving sustainable outcomes for the scheme in terms of irrigation scheduling and the ongoing review of environmental monitoring results.	A	Rare	2	Minor	Low
	Percolation to groundwater	Excessive percolation of effluent to groundwater	Contamination of groundwater	1. Low average irrigation rates, adjusted seasonally. 2. Geotechnical investigation indicated that no groundwater was encountered within 20 m of the surface. 3. The primary rock type intersected during bore construction was recorded to be sandstone which minimises percolation of effluent to groundwater. 4. Irrigation only of high quality "Class A+" recycled water with low nutrients, suitable for relatively unrestricted irrigation. 5. Environmental monitoring of groundwater to detect any contamination. 6. Details of irrigation rates and environmental monitoring will be included in the golf course irrigation management plan to be developed.	B	Unlikely	2	Minor	Low
Wastewater generation	Excessive wastewater generation	Peak population or excessive water usage	Build-up of raw wastewater in the inlet balance tank, SPS and PSUs. Potential overflow to the environment. Inadequate treatment capacity	1. Water demand management strategy including minimum 3-star rated water efficient fixtures and appliances as required by BASIX. 2. Education, encouragement and empowerment of customers to move towards best practice water efficiency with 5-star fixtures and appliances and smart water metering. 3. Pressure sewerage collection system on all new lots to minimise infiltration of groundwater and stormwater. 4. Ongoing monitoring and management of the gravity sewerage network to minimise groundwater & stormwater infiltration 5. Continuous online monitoring of pump starts and run hours on each Pressure Sewer Unit (PSU) and the gravity sewerage pump station (SPS) to allow abnormal flows to be detected by the central control system. 6. Trade waste agreements and waste minimisation plans will be required for non-residential customers (if relevant) 7. All non-residential customers will have their own dedicated PSU to enable direct monitoring of trade waste discharges through the central control system (if relevant) 8. Customer contracts and access agreements that outline the responsibilities of the customer with regard to appropriate water usage and waste disposal practices. 9. Ongoing awareness and communication with existing customers through additional information provided at each billing cycle & the Lend Lease Bingara Gorge website (https://www.bingaragorgeonline.com.au/Recycled-Water/default.aspx) and the existing VWS website (http://www.myrecycledwater.com.au/) 10. Treatment infrastructure sized assuming 625 L/EP/day, equivalent of ~200L/EP/day (including infiltration, etc.) This is above the 180L/EP/day expected based on experience elsewhere. 11. WWTP inlet balance tank ~330 kL 12. Inlet feed pumps and screens are sized for 205 m3/h which is equivalent of 6 x ADWF for the gravity sewer and 1.5 x ADWF for the pressure sewer at Stage 3. This allows capacity for screening of peak wet weather flows for transfer to the equalization tank storage. 13. Inlet screens are sized for Stage 3 PWWF (205 m3/h) at Stage 2 (where PWWF is only expected to be 122 m3/h). This will allow for assessment of the requirement to increase flow attenuation in the network prior to population growth, with significant additional capacity provided during Stage 2 for wet weather flows. 14. Equalisation Tank Storage of 2 ML at Stage 2 and 3 ML at Stage 3 for future growth. MBR units are sized for 2 x ADWF and therefore, the effective storage capacity of the Equalisation Tanks (in terms of difference between screen and MBR capacity) is 48 hours, allowing for even the most extreme storm event, including at Stage 3. 15. Road tanker pump out from individual PSUs and inlet balance tank if required (as is occurring currently under the VWS operations license to prevent overflow)	A	Rare	4	Major	High

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Trace contaminants in domestic wastewater	Poor household chemical use and disposal practices resulting in excessive contaminant levels in recycled water	Potential environmental impacts on effluent irrigation areas	1. Customer supply contracts and recycled water use agreement will be developed with each customer and will include obligations and education regarding appropriate substances to be disposed of to sewerage & substances that must be avoided (with fines applicable to discharge of banned substances.) 2. Ongoing customer awareness campaigns & information provided with each water bill & through the Lend Lease Bingara Gorge website (https://www.bingaragorgeonline.com.au/Recycled-Water/default.aspx) and the existing VWS website (http://www.myrecycledwater.com.au/) 3. Ability for LL to install online water quality monitoring probes (e.g. TDS, pH, TOC etc.) into pressure sewer pump wells to detect suspected inappropriate trade waste practices (if deemed necessary based on abnormal influent at the Bingara PWRP.	B	Unlikely	2	Minor	Low
Trace contaminants in commercial wastewater	Poor trade waste management practices resulting in excessive contaminant levels in recycled water	Potential environmental impacts on effluent irrigation areas	1. Predominately residential sewerage catchment with non-residential customers account for 10% of all wastewater generated. 2. Trade waste agreement will be developed with each non-residential customers to ensure wastewater is pre-treated to domestic standards before discharge into the sewerage system. 3. Each non-residential customer in the pressure sewer catchment will have its own low pressure sewage pump station to enable monitoring of customer specific compliance with trade waste agreements. 4. Ability to install online water quality monitoring probes (e.g. TDS, pH, TOC etc.) into pressure sewer pump wells to detect suspected inappropriate trade waste practices. 5. Effluent compliance monitoring at the WWTP discharge 6. Soil monitoring as required if determined a risk of poor quality/risk to plants	B	Unlikely	3	Moderate	Moderate
Shock load of chemical or other contaminants	Poor chemical or trade waste management practices resulting in shock load of contaminants on MBR	Potential biomass die off and reduction in MBR effluent quality Impact on membranes and other equipment Chemicals may also be an OHS hazard Impact on reuse potential	1. Concentrations of parameters unlikely to be above critical values for biomass activity 2. Continuous online monitoring of MLSS, DO, pH, EC and other process parameters at the BIngara PWRP to detect potential impacts on the treatment process (in bioreactors and on effluent) 3. If contaminants detected, an investigation will be undertaken into the source of contamination. This may involve review of Pressure Sewer Unit (PSU) operational data, water usage data, trade waste agreements etc. 4. Additional online water quality monitoring probes can be installed into suspect PSUs for tracing persistent sources of contamination if required. 5. Road tanker pump out of contaminated water from the WWTP inlet balance tank if required. 6. Trade waste agreement will be developed with each non-residential customers to ensure wastewater is pre-treated to domestic standards before discharge into the sewerage system	A	Rare	3	Minor	Low
Gross pollutants in raw wastewater	Poor solid waste management practices resulting in sewer blockage and overflow	Potential sewer blockage and overflow	1. Low pressure sewerage system with grinder pumps will macerate sewage prior to entering the pipe network. 2. Appropriately designed gravity network designed to achieve self-cleansing velocities. 3. Sewer/pump blockage Emergency Response Plan will be developed for the scheme and will include steps for identification of route cause and preventative actions. 4. Where multiple blockages have occurred at the same location, specific customer awareness/education will be implemented or compliance notices issued. 5. Maintenance regime will be developed for the pressure sewer network. 6. VWS will be on call with equipment for clearing blockages. 7. Gravity catchment flows are macerated prior to entering the WWTP inlet balance tank.	C	Possible	2	Minor	Moderate

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					Likelihood		Consequence		Risk
Low Pressure Sewerage Collection System	Inflow and infiltration to the sewerage network	Inflow and infiltration to the sewerage network	Potential overflow from inlet balance tank if combined inflows exceed capacity of the inlet screens/pumps	1. Low pressure sewerage system constructed with PE100, PN16 HDPE with welded joints and fittings. 2. D/S pumps in the majority of PSU 3. Contractor induction and education. 4. Inspection and quality assurance during construction. 5. Pump starts/runtime at each PSU to detect sources of inflow. 6. WWTP Inlet Balance tank provides buffer and emergency storage. 7. More than 24 hrs storage capacity in each PSU. 8. Inlet feed pumps and screens are sized for 205 m3/h which is equivalent of 6 x ADWF for the gravity sewer and 1.5 x ADWF for the pressure sewer at Stage 3. This allows capacity for screening of peak wet weather flows for transfer to the equalization tank storage. 9. Inlet screens are sized for Stage 3 PWWF (205 m3/h) at Stage 2 (where PWWF is only expected to be 122 m3/h). This will allow for assessment of the requirement to increase flow attenuation in the network prior to population growth, with significant additional capacity provided during Stage 2 for wet weather flows. 10. Equalisation tank storage 2 ML stage 2 11. Tanker in emergency situation	C	Unlikely	2	Minor	Low
	Inflow and infiltration upstream of Pressure Sewer Unit (PSU)	Inflow and infiltration upstream of Pressure Sewer Unit (PSU)	Potential overflow from PSU	1. Plumbing inspection of all household plumbing installation prior to connection. 2. Customer contract required that do not connect rainwater to the PSU 3. Reports on PSU levels, runtimes, including during rainfall, to assist in detecting infiltration. 4. Customer education and rectification noticeswill be provided if required. 5. Solvent welded joints in gravity sub sewers.	C	Possible	2	Minor	Moderate
	Blockages upstream of Pressure Sewer Unit (PSU)	Blockages upstream of Pressure Sewer Unit (PSU)	Overflow from household and customer complaints	1. Induction and awareness training for pressure sewer contractors working in the scheme. 2. Upstream pipes designed and constructed to AS3500 plumbing code with 1:60 grade for self cleansing. 3. level monitoring and pump start/runtime at each PSU to identify sources of blockages. Customer education and rectification notices will be provided if required. 4. VWS on call with cleaning equipment for removing blockages. 5. Contractors called in for removing blockages if necessary.	C	Possible	2	Minor	Moderate
	peak flow above 1.5 x ADWF	Excessive peak inflows	Potential overflow from inlet balance tank if combined inflows exceed capacity of Inlet Screens	1. PSU pump operation centrally controlled at the treatment plant to individual pump stations. 2. Capacity to switch off PSU (to be automated if necessary) *See additional controls for excessive inflows above.*	A	Rare	2	Minor	Low
	Pressure main break	Pressure main failure or breakage due to unapproved excavation activity	Discharge of raw sewage to the environment	1. All mains constructed with PE100, PN16 HDPE pipe with welded joints and fittings. 2. All mains are pressure tested and certified during construction. 3. Pressure sewer mains are generally located at the bottom of a common services trench, hence other pipes will be damaged from poor excavation practices before the pressure sewer. 4. Signage and identification tape to be installed above all pressure mains. 5. All sewer pipe locations registered with dial before you dig service. 6. Customer Service Centre and fault reporting with maximum response times for operations staff. 7. Sewer spill Emergency Response Plan and clean-up procedures will be developed.	B	Unlikely	2	Minor	Low
	Leakage from PSU wet well	Failure of PSU wet well resulting in subsurface leakage	Discharge of raw sewage to groundwater	1. Clean water static pressure test of each wet well during construction. 2. Wet well designed to include allowances for all structural loads including hydrostatic and soil pressures. 3. PSUs out of trafficked areas.	B	Unlikely	2	Minor	Low
	Pump Failure	Pump failure by power surge, blockage, loss of suction etc.	Potential discharge of raw sewage to the environment	1. All pumps in the scheme are monitored and an alarm raised if any abnormality is detected. Monitoring includes: wet well water level, pump fault detection, power system fault detection, number of starts and run hours for both the duty and standby pumps (where D/S), current draw in operation and during start up and energy consumption. 2. Duty and standby pumps in each PSU in the Bingara Gorge pressure sewerage catchment. 3. Fail safe in electrical system so pump can operate during control system failure. 4. High quality robust pumps with long design life. 5. Standard pumps with spare pumps maintained onsite for quick changeover if required.	B	Unlikely	3	Minor	Low

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					Likelihood		Consequence		Risk
Low Pressure Sewerage Collection System cont…	Power failure	Extended power failure across pressure sewer network	Potential discharge of raw sewage to the environment	1. 24 hours storage is provided in all PSUs. 2. Road tanker pump out from individual PSUs if required. 3. Water usage low during power failure – therefore actual storage in this circumstance is greater.	B	Unlikely	2	Minor	Low
Gravity Sewerage Collection System	Inflow and infiltration to the gravity sewerage network	Inflow and infiltration to the gravity sewerage network	Potential overflow from SPS or inlet balance tank if combined inflows exceed capacity of Inlet Pumps/Screens	1. Inlet balance tank at WWTP provides buffer and emergency storage. 2. Audit of the gravity sewer network will be undertaken to repair existing damage. 3. Operational monitoring of the SPS flows and wet well water level with high level alarms. 4. 150 kL emergency storage in SPS wet well, 110 kL emergency storage tank and upstream reticulation network. 5. Emergency truck pump out from inlet balance tank if required. 6. Total of >24 hours storage in PSU scheme (can switch off the PSUs if required via control panel at WWTP) 7. Inlet feed pumps and screens are sized for 205 m3/h which is equivalent of 6 x ADWF for the gravity sewer and 1.5 x ADWF for the pressure sewer at Stage 3. This allows capacity for screening of peak wet weather flows for transfer to the equalization tank storage. 8. Inlet screens are sized for Stage 3 PWWF (205 m3/h) at Stage 2 (where PWWF is only expected to be 122 m3/h). This will allow for assessment of the requirement to increase flow attenuation in the network prior to population growth, with significant additional capacity provided during Stage 2 for wet weather flows.	C	Unlikely	2	Moderate	Moderate
	Blockages upstream of SPS	Blockages upstream of SPS	Potential overflow from sewer	1. Upstream pipes designed and constructed to WSAA code to achieve self-cleansing. 2. VWS on call with cleaning equipment for removing blockages. 3. Maintenance access designed into the sewerage network. 4. Customer Service Centre and fault reporting with maximum response times for operations staff. 5. Sewer spill Emergency Response Plan and clean-up procedures.	C	Possible	2	Minor	Moderate
	Overflow event	Overflow from SPS	Public health or environmental risk following an overflow event	1. The occurrence of all overflow events will be detected by the control system based on water level monitoring in the SPS wet well. 2. SPS and rising main to be upgraded as required to meet current and future flows (major limitation is currently rising main which is under construction) 3. D/S pumps in SPS 4. Generator installed to power SPS pumps 5. Capacity to Tanker – no overflow intended to occur under any circumstance from the SPS.	C	Rare	2	Moderate	Low
Gravity Sewerage Collection System	High peak diurnal flows	Excessive peak inflows	Potential overflow from SPS or inlet balance tank if combined inflows exceed capacity of Inlet Pumps/Screens	1. Inlet screens sized to manage PWWF which is well above peak diurnal expectations. 2. Equalisation Tank Storage of 2 ML at Stage 2 and 3 ML at Stage 3 for future growth allows the equivalent of > 16 hours storage at PWWF at Stage 3. 3. MBR units are sized for 2 x ADWF and therefore, the effective storage capacity of the Equalisation Tanks (in terms of difference between screen and MBR capacity) is 48 hours, allowing for even the most extreme storm event, including at Stage 3. This is more than adequate capacity for diurnal variation in flows. 4. Equalisation tanks with 2 ML able to flatten diurnal variation to membranes to be negligible. 5. Membranes sized for 2xADWF (with D/S), adequate for peak flow with Equalisation Tank volume, and more than adequate for diurnal variation.	A	Rare	2	Minor	Low

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					Likelihood		Consequence		Risk
Gravity Sewerage Collection System	Gravity main break	Gravity main failure or breakage due to unapproved excavation activity	Discharge of raw sewage to the environment	1. Signage and identification tape to be installed above all gravity mains. 2. All sewer pipe locations registered with dial before you dig service. 3. Customer Service Centre and fault reporting with maximum response times for operations staff. 1. Sewer spill Emergency Response Plan and clean-up procedures	B	Unlikely	2	Minor	Low
	Leakage from SPS wet well	Failure of SPS wet well resulting in subsurface leakage	Discharge of raw sewage to groundwater	1. SPS wet well designed to include allowances for all structural loads including hydrostatic and soil pressures.	B	Rare	2	Minor	Low

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					Likelihood		Consequence		Risk
Gravity Sewerage Collection System	Pump Failure	Pump failure by power surge, blockage, loss of suction etc.	Potential discharge of raw sewage to the environment	1. All pumps in the scheme (including SPS) are monitored and an alarm raised if any abnormality is detected. Monitoring includes: wet well water level, pump fault detection, power system fault detection, number of starts and run hours for both the duty and standby pumps, current draw in operation and during start up and energy consumption. 2. Duty and standby pumps in SPS.	B	Unlikely	3	Moderate	Moderate
	Power failure	Extended power failure at SPS	Potential discharge of raw sewage to the environment	1. Standby power generator provided at SPS. 2. 150 kL emergency storage in SPS wet well, 110 kL emergency storage tank and upstream reticulation network. 3. WWTP Inlet balance tank provides storage for peak inflows that could occur if a control system failure and power failure occur simultaneously. 4. Emergency bunded road tanker pump out from inlet balance tank if required.	B	Rare	2	Minor	Low