Attachment C - Ruawai Water Safety Plan risk table

Stage	Event	No.	Cause	Likelihood	Consequence	Max Risk	Indicators	Preventive measures in place	Correction Actions	What to Check	Risk Managed	Likelihood	Consequence	Residual Risk	Acceptable	Certainty	Additional Measures	Resp
1. Bore recharge zone	Microbiological contamination	1.01	Surface contamination from farming/ag activities in the adjacent area	Possible	Catastrophic	High	High raw water E. coli results, Turbidity in raw water, Prolonged heavy rain, extreme weather events, Illness in community	Implementation of RMA Planning Rules ie Regional Policy Statement, NES for Sources of Human Drinking-water. Land use consents. Subsequent treatment barriers effective against microbiological contamination. Over 100m setback from bores. Abstraction depths over 60M with confining layers Testing has indicated that water in the aquifer to >1 year	Abstraction can be turned off and revert to treated water storage. Boil water notice can be issued. Incident response plan. Provision of tankered water	Effectiveness of disinfection barriers, source water monitoring results Land use changes. Weekly applications received from NRC for consents Regional Council HAIL list	Yes	Unlikely	Minor	Low	Y	Reliable	Schedule raw water sampling.	WWM PDE
	Microbiological contamination	1.02	Discharges from septic tank systems.	Possible	Catastrophic	High	High raw water E. coli results, Turbidity in raw water, Illness in community, Regional Council SoE reporting	Implementation of RMA Planning Rules i.e. Regional Policy Statement, NES for Sources of Human Drinking-water. Treatment barriers effective against microbiological contamination. Building Act obligations for septic tanks. Abstraction depths over 60M with confining layers	Abstraction can be turned off and revert to treated water storage. Boil water notice can be issued. District plan or Building Act abatement notices can be served. Provision of tankered water The plant will shut down if the raw water turbidity exceeds 3.5 NTU	Compliance with consent conditions. Weekly applications received from NRC for consents	Yes	Unlikely	Minor	Low	Y	Reliable		WWM PDE
	Chemical Contamination	1.03	Surface runoff containing chemical contaminants from agricultural/commercial activities.	Possible	Moderate	Medium	Taste and or odour. Information provided by Regional pollution hotline or public. Source water chemical screen indicates chemicals. Regional Council SoE reporting	Implementation of Resource Management Planning Rules ie Regional Policy Statement, NES for Sources of Human Drinking-water. Subsequent treatment barriers oxidise some chemicals HSNO control on using and handling chemicals. Regional Water Plan	Abstraction can be turned off and revert to treated water storage. Incident response plan. Consumers advise water cannot be consumed.	Chemical suite, trends in raw water composition Regional Council HAIL list	Yes	Unlikely	Minor	Low	Y	Unsure		WWM PDE
	Chemical Contamination	1.04	Naturally occurring chemical contaminants e.g iron manganese	Almost Certain	Minor	High	Chemical analysis results identify chemical contaminants in excess of 50% of the DWSNZ MAVs	Subsequent treatment barriers oxidise some chemicals	If there are any indications of chemical contamination of the source water in excess of DWSNZ MAVs or at levels that could be harmful, consumers must be advised not to consume the water	Chemical suite results provide a biennial check, otherwise taste and odour complaints indicate contaminants are in surface water	Partially	Unlikely	Insignificant	Low	Y	Confident		WWM PDE
	Chemical Contamination	1.05	Chemical spill in recharge zone e.g traffic or boating accident in Wairoa river	Possible	Moderate	Medium	Notification or report to pollution hotline or emergency services call out pH of raw water. Taste and odour	Abstraction depths over 60M Bores set back from road, low traffic area.	Abstraction can be turned off and revert to treated water storage. Incident response plan. Consumers advised water cannot be consumed. Provision of tankered water	Timeliness of Reporting	Yes	Unlikely	Minor	Low	Y	Reliable	Develop notification procedures with NRC and Police to inform of chemical spills	WWM PDE
	Chemical Contamination	1.06	Use of herbicides or pesticides in recharge zone	Possible	Moderate	Medium	Source water chemical screen indicates chemicals. Regional Council SoE reporting. Weed control or pesticide controls programme operating	Weed control programmes conducted to minimise run off. HSNO controls on use and certified operators used. Abstraction depths over 60M with confining layers	Abstraction can be turned off and revert to treated water storage. Incident response plan. Consumers advised water cannot be consumed. Defer or cease operation	Consents and approvals. Weekly applications received from NRC for consents	Yes	Unlikely	Minor	Low	Y	Reliable		WWM PDE
	Chemical Contamination	1.07	Saline intrusion	Possible	Minor	Medium	Source water chemical screen indicates salinity. Regional Council SoE reporting. Consumer complaints	Abstraction depths over 60M with confining layers. Consent controls on adjoin land use activities e.g wharf area	Abstraction can be turned off and revert to treated water storage. Incident response plan. Consumers advised water cannot be consumed. Provision of tankered water	Consents and approvals	Yes	Unlikely	Insignificant	Low	Y	Reliable		WWM PDE
	Loss of supply	1.08	Drought reduces quantity of water that can be abstracted	Possible	Catastrophic	High	Water levels and flow rates, weather conditions	Consent conditions for aquifer users. Visual checks. Regional Council monitoring programme provides for early detection.	Initiate water demand and conservation management Tanker supplies of treated water can be brought in during drought periods to overcome limitations of water source.	Catchment rainfall Monitor leakage and high flow rates, send contractor to investigate.	Partially	Unlikely	Moderate	Medium	Y	Reliable		WWM PDE
2. Bore and Well	Microbiological contamination	2.01	Bore casing, bore head or well structure failure allowing for contaminated water getting into the bore from shallow depths	Possible	Major	High	Positive E. Coli results from the bores or distribution system. Turbidity	Asset management and maintenance Bore head protection. Alarms at NTU >3.5	Treated water storage. Incident response plan. Consumers advised water cannot be consumed. Provision of tankered water	Raw water turbidity Visual inspection of bore head and well structure E. coli results	Yes	Unlikely	Minor	Low	Y	Reliable	Inspect bore casing 2 yearly Schedule a CCTV inspection of the bore	WWM PDE
	Microbiological contamination	2.03	Flooding of the bore chamber	Possible	Major	High	Positive E. Coli results from the bores or distribution system. Weather/flooding Turbidity	Secure bore head protection installed including bore head above flood level Alarms at NTU >3.5	Abstraction can be turned off and revert to treated water storage. Incident response plan. Consumers advised water cannot be consumed. Provision of tankered water	Turbidity trends, particularly after heavy rain	Yes	Unlikely	Minor	Low	Y	Reliable		WWM PDE
	Loss of supply	2.04	Mechanical or electrical failure of bore pumps	Possible	Major	High	Positive E. Coli results from the bores or distribution system Flow logs from bores	Asset management and maintenance Multiple Bores	Abstraction can be turned off and revert to treated water storage. Incident response plan. Consumers advised water cannot be consumed. Provision of tankered water	Maintenance logs	Yes	Unlikely	Minor	Low	Y	Reliable		WWM PDE
	Loss of supply	2.05	Cannot abstract water due consent conditions	Unlikely	Major	Medium	Volume and flow to plants. Expiry date of existing resource consents.	Implementation of Resource Management Planning Rules SCADA shuts the plant down if volume exceeds the consent limit.	Renew before expiry.	Any changing Regional Council policy	Yes	Unlikely	Minor	Low	Y	Confident		WWM PDE
	Loss of supply	2.06	Intentional vandalism or accidental damage to the bore head or well	Unlikely	Major	Medium	Volume and flow to plants. Visible damage, threats, reported suspicious activity	Exclusion zones around intakes and restricted access. Treated water storage. Legal deterrents. Intake structures designed to withstand some damage. Subsequent treatment barriers	Repairs, consumer advisory to conserve water	Raw water turbidity Access to intakes, recreational water use	Yes	Unlikely	Minor	Low	Y	Confident		WWM PDE
3. Raw Water Main	Microbiological contamination	3.01	Ingress of surface/ground water into raw water line	Possible	Major	High	Positive E. Coli results from the bores or distribution system Pumping and leakage Turbidity	Land use around raw water main provides some protection (mostly reserve land) Maintenance & repairs Treated water storage Plant shut down >3.5 NTU	Treated water storage. Incident response plan. Consumers advised water cannot be consumed. Provision of tankered water	Online turbidity Raw water sampling	Yes	Unlikely	Minor	Low	Y	Confident		WWM PDE
	Loss of supply	3.02	Raw water main failure	Possible	Catastrophic	High	Reduced/no flow to treatment plant Low storage tank levels Condition and type of materials of main Condition assessment of raw main shows materials in poor condition	Maintenance & repairs Treated water storage	Incident response plan. Provision of tankered water	Raw water turbidity Records of rising main failures and repairs	Yes	Unlikely	Moderate	Medium	Y	Confident		WWM PDE
tment	Particles not removed	4.01	Insufficient oxidation (pre and post balance tank)	Likely	Moderate	High	Sodium hypochlorite use Turbidity post filters	Oxidant dosing PLC controlled Treated water storage Subsequent treatment includes filtration barrier	Plant shut down if raw water >3.5NTU or pH outside 7-8 range	Raw water turbidity Balance tank level records	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M

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4. Pre-trea	Particles not removed	4.02	Insufficient (Filox) filtration of suspended solids, iron and manganese	Likely	Moderate	High	Pressure differential Turbidity post filters	3 x Filox allow redundancy backwash sequence to maintain production Back wash when filter pressure differential reaches set point or filter backwash at set cycle time or filter backwash at NTU setpoint Balance tank allows constant feed to filters Further filtration	Low balance tank level shuts of filtration	Turbidity Balance tank level records	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
5. Cartridge Filtration	Particles/protozoa not removed	5.01	Filter/cartridge malfunction including incorrect install/replacement	Likely	Major	High	Turbidity Filter pressure differential Leaks around housing Monitor High flow alarms	Trained operators Monitor Differential pressure and flow rates Filter housing chlorinated when changing the cartridge Water goes to waste for 3 minutes after start-up Treated water storage Maintenance & repairs	Replace the cartridge filter Identify short comings in staff training and rectify Shut down production Investigate VSD or any other cause of high flows	Filtered water turbidity Follow manufacturers instructions/speciation's Treatment plant manuals	Yes	Rare	Moderate	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not removed	5.02	Filter media failure including breakthrough	Likely	Major	High	Filter pressure differential High turbidity in water leaving the filter	2x Harmsco Filters allow some redundancy Pre-treatment oxidation and Filox filters Turbidimeters on each filter Treated water storage	Replace filter cartridge - held onsite Shut down production >0.4NTU	Filtered water turbidity Flow rates	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not removed	5.03	Filter media failure including clogging	Likely	Major	High	Filter pressure differential Flow meters	Pre-treatment oxidation and Filox filters Turbidimeters on each filter Treated water storage	Clean or Replace filter cartridge - held onsite initiate water conservation measures	Filtered water turbidity Cleaning procedure	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not removed	5.04	Backwash pump failure	Likely	Major	High	Backwash cycle doesn't happen. Increased post filter turbidity	Regular maintenance of backwash pumps Treated water storage	Shut down production	Filtered water turbidity Pumps monitored for noise and vibration	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
6. Chlorination	Inadequate disinfection	6.01	Inadequate contact time	Possible	Major	High	Calculation of retention time determines contact time is inadequate FAC levels E. Coli or elevated coliforms trends in verification testing	Contact time provided by reservoir and mains Groundwater source lower microbiological risk Pre-treatment controls chlorine demand	Chlorine dose point is set to 1.3mg/L (SCADA alarmed)	Contact time, Microbiological quality, Flow rates, Post treatment FAC and pH	Yes	Possible	Minor	Medium	Y	Reliable		OEWS WO&M
	Inadequate disinfection	6.02	Sodium hypochlorite supply exhausted	Possible	Catastrophic	High	Illness in community. FAC is less than 0.2 mg/L or E. coli detected in water in the distribution system.	Supply agreement with IXOM Maintain 3 months chemical supply on-site FAC is continuously monitored on-line with alarms to operators and date telemetered Groundwater source lower microbiological risk Pre-treatment controls chlorine demand	Low chlorine contingency	Post treatment FAC Drums onsite/turnover	Yes	Rare	Moderate	Low	Y	Confident		OEWS WO&M
	Inadequate disinfection	6.03	Dosing system failure	Likely	Catastrophic	Extreme	FAC is less than 0.2mg/L or E. coli detected in water in the distribution system.	Operator visits plant at least 2x week FAC is continuously monitored with alarms to operators and shut down on low chlorine dose Groundwater source lower microbiological risk Pre-treatment controls chlorine demand Supervised & trained operators	Repair and return to service Calibration of analyser	FAC alarms, on-line data and in distribution zone	Yes	Unlikely	Moderate	Medium	Y	Confident		OEWS WO&M
	Inadequate disinfection	6.04	Automated chlorine dose rate incorrect	Likely	Catastrophic	Extreme	FAC is less than 0.2 mg/L or higher or E. coli detected in water leaving the WTP	Chlorine dose rate is flow paced Operator visits the plant at least daily to check operation of chlorination system FAC is continuously monitored on-line with alarms to operators and date telemetered	If FAC sampling indicates incorrect FAC level, adjust dose rate as required	Post treatment FAC FAC alarms, on-line data and in distribution zone	Yes	Unlikely	Minor	Low	Y	Confident	Update Operations and Maintenance manuals to reflect actual FAC target values as per actual practice.	OEWS WO&M
	Inadequate disinfection	6.05	Chlorine demand exceeds chlorine dose due to dissolved Fe & Mg	Possible	Catastrophic	High	High turbidity in water. Chlorine dose rate needs to be high to maintain an adequate residual FAC is less than 0.2 mg/L or E. coli detected in water leaving the WTP	Source water has turbidity monitored and alarms Operator visits the plant at least weekly to check operation of chlorination system FAC is continuously monitored with alarms to operators	Increase chlorine dose level Investigation filtration performance	Post treatment FAC FAC alarms, on-line data and in distribution zone	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Inadequate disinfection	6.06	Lack of chlorine due to dosing line failure or leak.	Possible	Catastrophic	High	FAC is less than 0.2mg/L or E. coli detected in water leaving the WTP Strong chlorine smell at treatment plant	Operator visits the plant at least weekly to check operation of chlorination system FAC is continuously monitored with alarms to operators and date telemetered	Repair chlorine dosing line	Post treatment FAC FAC alarms, on-line data and in distribution zone	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Over Chlorination	6.07	Dosing system failure.	Possible	Moderate	Medium	FAC level exceeds 1.3 mg/L setpoint leaving WTP Odour and taste complaints	Operator visits plant at least 2x week FAC is continuously monitored on-line with alarms to operators and date telemetered Pre-treatment controls chlorine demand Supervised & trained operators	Advise consumers if high chlorine FAC is delivered to the distribution zone Flush network if needed	Post treatment FAC Operation of chlorine dosing pump FAC alarms, on-line data and in distribution zone	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Over Chlorination	6.08	Chlorine dose rate incorrect	Possible	Moderate	Medium	FAC level exceeds 1.3 mg/L setpoint leaving WTP Odour and taste complaints	Chlorine dose rate is flow paced Operator visits plant at least 2x week FAC is continuously monitored on-line with alarms to operators FAC>2.0mg/L Pre-treatment controls chlorine demand Supervised & trained operators	Advise consumers if high chlorine FAC is delivered to the distribution zone Flush network if needed	Post treatment FAC Operation of chlorine dosing pump FAC in reticulation system downstream of treatment plant	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
e	Micro contamination	7.01	Leakage through reservoir roof or other parts of structure or access by birds or vermin.	Likely	Moderate	High	Visual evidence of leakage E. coli in water leaving reservoirs	Reservoir is covered and all entry hatches are locked against unauthorised access Regular inspection of reservoirs is carried out. Asset condition assessment Chlorine residual leaving reservoir monitored	Repair any reservoir leaks or bird and vermin access points without delay. Take out of service. Install replacement liners where feasible	Post reservoir FAC Leakage from reservoir Access points for birds and vermin Evidence of birds or vermin inside reservoir	Yes	Unlikely	Minor	Low	Y	Confident	Review measures for protecting reservoirs from foreign matter	OEWS WO&M
	Micro /chem contamination	7.02	Vandalism or unauthorised entry to the storage reservoir	Possible	Moderate	Medium	E. coli in water leaving reservoir Reports from the public Evidence of damage or tampering with reservoir	Entry hatches locked against unauthorised access Reservoir is located on land with restricted access. Chlorine residual Operator site visits	Inspect reservoir in response to reports of suspicious activity	Post reservoir FAC Access hatches	Yes	Unlikely	Minor	Low	Y	Confident	Improve documentation and audit process for contractors working on reservoirs or other treated water services	OEWS WO&M

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7. Storage	Micro contamination	7.03	Sediment accumulation within reservoir	Likely	Moderate	High	Visible suspended matter in water in distribution system Visible sludge in bottom of reservoir Complaints from consumers	Source has low sediment load and turbidity below 1 NTU Regular inspection of reservoir is carried out and cleaning undertaken if required	Isolate and clean reservoir as required	Post reservoir FAC Check accumulation of sediment in reservoir every 5 years Turbidity	Yes	Unlikely	Minor	Low	Y	Confident	Implement regular reservoir cleaning/scouring at a five year interval	OEWS WO&M
	Loss of supply	7.04	Failure of reservoirs	Unlikely	Catastrophic	High	Complaints from consumers about loss of supply or pressure Obvious signs of leakage or failure at reservoir site	Assest condition assessments. Reservoirs are constructed of concrete and steel.	Isolate damaged or failing reservoir and supply directly from treatment plant or use other reservoirs	Visual assessment. Structural integrity of reservoir	Yes	Rare	Moderate	Low	Y	Confident		OEWS WO&M
	Loss of supply	7.05	Insufficient storage for peak demand	Possible	Catastrophic	High	Loss of water or pressure in reticulation Frequent low reservoir level	Planning controls on new development/connections Treated water storage provides 228m3 Designed to achieve 2 days peak flow storage	Introduce conservation and efficiency measures	Reservoir level	Partially	Unlikely	Moderate	Medium	Y	Confident	Develop policy on supply of water incl restriction thresholds. Develop policy on climate change and associated modelling	OEWS WO&M
8. Reticulation	Loss of water	8.01	Pump failure	Possible	Major	High	Loss of water or pressure in reticulation Frequent low reservoir level	Asset management, certified maintenance staff. Alarms	Incident management plan. Demand restrictions imposed	Reservoir level	Partially	Unlikely	Moderate	Medium	Y	Confident	Pumping- upgrade to duty and standby arrangement for pumping. Hold spares allowing for repair/replace <24hrs	OEWS WO&M
	Micro/Chem contamination	8.02	Inadequate controls on maintenance and construction work	Likely	Major	High	Complaints from consumers about taste or odour. E. coli present in reticulation system	Maintenance and replacement work is undertaken by trained qualified and experienced contractors. Specialist contractors used when required. Council audit of contractors	Implement a boil water notice as outlined in the contingency plan if the quality of the water supplied cannot be assured	Sanitation procedures and sanitation practices of contractors.	Yes	Unlikely	Minor	Low	Y	Confident	Review repairs for hygiene practice	OEWS WO&M
	Micro/Chem contamination	8.03	Backflow from consumer connections.	Likely	Moderate	High	Contaminants identified in the reticulation system. Taste or odour complaints from consumers.	Council policy (Bylaw Part 16 - Water Supply). Maintain pressure in the supply (400kPa)	Implement a boil water notice as outlined in the contingency plan if there is evidence of a backflow event	Land-use and building use changes	Yes	Unlikely	Minor	Low	Y	Confident	Improve backflow protection programme. Check pressures during high demand	OEWS WO&M
	Loss of water	8.04	Unidentified leakage or illegal connections	Likely	Minor	Medium	Consumption exceeds calculated expectation	Known breaks and leaks repaired as a priority. Illegal connections identified	Repair leaks as priority. Disconnect or legitimise illegal connections	Suspicions of illegal connections	Yes	Unlikely	Insignificant	Low	Y	Reliable		OEWS WO&M
	Inadequate Supply	8.05	Poor quality workmanship or inappropriate materials used for reticulation pipes and fittings	Likely	Moderate	High	Contaminants identified in the reticulation system. Taste and odour complaints from consumers	Water supply bylaw. Materials used in reticulation to meet standard specifications. SoPs, and best practice reticulation approach taken to reticulation installation/repairs. Asset management and pipe replacement programme. GIS management of network and materials	Redo work that has been poorly undertaken. Replace any materials that do not meet minimum specifications. Initiate incident management plan	Quality of work undertaken. Types of material used	Yes	Unlikely	Minor	Low	Y	Reliable	Reticulation - Improve audit and tracking process of SoPs. Ensure auditing of development manual requirements and contract requirements are undertaken	OEWS WO&M
	Sediment biofilm	8.06	Silt build up or biofilm within reticulation pipes	Likely	Minor	Medium	Reduced flows in reticulation. Complaints from consumer about quality of water. Low FAC readings in network. Reticulation NTU	Flushing undertaken in response to complaints. Regular dead end mains flushing	Undertake flushing as required	Dirty water complaints	yes	Unlikely	Minor	Low	Y	Reliable	Model network analysis to identify potential problem pressure areas Install a flushing point at the dead end of reticulation.	OEWS WO&M
9. Other	Operator error mismanagement	9.01	Inadequate training, professional development and up-skilling of operators	Likely	Major	High	Staff not provided with adequate ongoing training. Poor operation of plant. Plant compliance failure. Loss of supply. Vacancies. Staff feedback. WSP not properly understood and followed by staff. Failure of staff to follow KDC QA procedures	Experienced staff employed. Staff attend appropriate professional conferences and other professional development opportunities. Operators have or are completing the National Cert or Dip in Drinking Water Treatment. Appropriately experienced and qualified engineering personnel. Regular staff training for new staff in particular. Regular refresher and induction training for new staff. Contractor performance measures include completeness of required documentation and recording. Up to date QA and O&M manuals. Include key staff in the WSP process and provide training before and during implementation. Comprehensive O&M Manual for the supply	Review documentation. Provide in-house training where abilities are in deficit. Amend the contract if service levels are inappropriate and/ or Council audit reveals weaknesses Amend the WSP to include any new supply elements Refer to Contingency Plan	Documentation. Operator abilities, knowledge and training qualifications Training attendances	Yes	Unlikely	Moderate	Medium	Y	Reliable		OEWS WO&M
	Operator error mismanagement	9.02	Inadequate supply planning and management	Likely	Major	High	Lowering levels of service. Consents not renewed. Capital costs uncontrolled. Failing infrastructure strategy. 3rd party audits e.g OAG. Reduction in funding	Relevant statutory obligations ie LGA, RMA, Council policies. Sub regional three waters strategy. Infrastructure planning team	Apply contingencies for changes in legislation or other key planning considerations	New Legislation, regulations or Standards. Residential and industrial growth/connections	Yes	Possible	Moderate	Medium	Y	Confident		OEWS WO&M
	Sampling Failure	9.03	Inadequate sampling programme or sample collection error.	Likely	Moderate	High	DWSNZ compliance failure due to days of week, days between samples, insufficient samples, information gaps, positive results or sampling error	Sampling programme prepared and checked against standards. IANZ accredited laboratory	Review sampling programme	Sampling programme against DWSNZ	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Unidentified Operational Failure	9.04	Insufficient monitoring and alarming of key operational data	Almost Certain	Major	Extreme	Contamination identified in supply. Operational near miss identified. Inadequate information collected to provide confidence in supply operation	Continuous on-line alarmed monitoring for pH and turbidity at the treatment plant. Operators validate treatment plant equipment weekly and calibrate equipment as required	Undertake manual grab sampling if required. Initiate incident management plan.	Trends and alarms of Cl2, pH and turbidity continuous monitoring	Yes	Unlikely	Minor	Low	Y	Confident	Data - review SCADA management	OEWS WO&M
	Inadequate Maintenance	9.05	Supply equipment fails due to inadequate asset information and inadequate maintenance planning	Almost Certain	Moderate	High	Unexpected plant equipment failure.	Annual check and servicing of the chlorine dosing equipment with overhaul every two years Subcontractor agreements Active preventive maintenance programme in place	Attend to failure as a priority Plan to renew or improve assets as required	Condition and forward planning for asset renewal asset register and maintenance programme	Yes	Unlikely	Minor	Low	Y	Reliable		OEWS WO&M

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	Failing to meet DWSNZ	9.06	Treatment processes of the water supply are not sufficient to comply with the requirements of the DWSNZ	Almost Certain	Major	Extreme	Insufficient treatment processes at the treatment plant to comply with the DWSNZ	Continuous on-line alarmed monitoring for pH and turbidity at the treatment plant. Chlorination. E.coli and FAC monitoring	Implement boil water notice if safety of supply cannot be guaranteed	DWSNZ compliance data	Yes	Unlikely	Moderate	Medium	Y	Confident		OEWS WO&M
	Failure to Provide Safe Water	9.07	Inadequate data collection, reporting and control systems	Likely	Moderate	High	Information about how the supply is operating is not available. Manual collection and recording of data. IT failure	Continuous on-line alarmed monitoring for pH, NTU, FAC at the treatment plant	Undertake manual grab sampling if required	Trends and alarms of continuous monitoring	Yes	Possible	Moderate	Medium	Y	Confident	Conduct a review of data storage capacity at treatment plants and remote RTU sites. Conduct a review of data collection, Storage and validation	OEWS WO&M
	Micro/chem contamination	9.08	Vandalism to plant equipment	Possible	Major	High	Obvious signs of damage to treatment or storage equipment Reduced/no flow to treatment plant or distribution system	Controls and treatment plant are in robust concrete block buildings. Supply equipment is visited and checked regularly. Legal deterrents, ie prosecution	Implement boil water notice if safety of supply cannot be guaranteed. Activate incident management plan. Provision of tankered water	Condition of treatment buildings and equipment	Yes	Rare	Moderate	Low	Y	Confident	Establish security policy	OEWS WO&M
	Loss of Supply	9.09	Power fault or outage	Possible	Catastrophic	High	Power Company notifies planned outages Plant production	Maintenance inspection of internal wiring	Introduce conservation and efficiency measures Provision of tankered water	Bring in emergency generator	Partially	Unlikely	Moderate	Medium	Y	Confident	Install on-site electricity generator interface	OEWS WO&M
	Total Plant Failure	9.10	Catastrophic natural disaster or failure including earthquake and flooding	Rare	Catastrophic	Medium	Major natural disaster occurs. Intense sustained weather. Flooding. Total plant failure is evident. Warnings from Govt agencies incl Met Office, Niwa, Civil Defence, Regional Council or Police.	Prior warning from Govt agencies incl Met Office, Niwa, Civil Defence, Regional Council or Police. Robust secure plant structures and buildings. Business continuity plan in place and exercised. Emergency response plan	Implement all measures necessary to ensure plant continues to operate in a natural disaster	Prior warnings issued by Govt agencies incl Met Office, Niwa, Civil Defence, Regional Council or Police	Partially	Rare	Major	Medium	Y	Reliable	Complete ERP	OEWS WO&M