

Attachment B - Maungaturoto 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. Catchment	Raw water quality too poor to treat	1.01	Bush catchment destroyed by fire/weather/harvesting allows for erosion and elevated turbidity (Piroa/Cattlemount/Baldrock)	Unlikely	Catastrophic	High	High NTU levels which enter treatment plant.	Alarm levels set on the raw water turbidity Treated storage available Implementation of Resource Management Planning Rules Rural Land Use Policy addresses adverse effects of intensive farming/forestry on rural land. Treatment barriers effective against dirty water. Regional Water and Soil Plan	Revert to secondary intake Invoke emergency water use restrictions for the town under the Water By-law. Refer to Contingency Plans	Turbidity is continuously monitored entering the water treatment plant. Weekly applications received from NRC for consents	Partially	Rare	Minor	Low	Y	Reliable		WWM PDE
	Microbiological contamination	1.02	Cattlemount - contamination from animals/wildlife Piroa - contamination from animals/wildlife	Likely	Catastrophic	Extreme	Animals reported in catchment. High raw water E. coli results, Turbidity in raw water, Prolonged heavy rain, extreme weather events, Illness in community	Attenuation from bush catchment Alarm levels set on the raw water turbidity Treated storage available Implementation of Resource Management Planning Rules Treatment barriers effective against microbiological contamination	Revert to secondary intake Invoke emergency water use restrictions Refer to Contingency Plans	Turbidity is continuously monitored entering the water treatment plant	Yes	Unlikely	Minor	Low	Y	Unsure		WWM PDE
	Microbiological contamination	1.03	Brynderwyn: Surface contamination from farmland/agri lifestyles in the adjacent area Baldrock: Surface contamination from farmland/agri lifestyles in the adjacent area	Likely	Catastrophic	Extreme	High raw water E. coli results, Turbidity in raw water, Prolonged heavy rain, extreme weather events, Illness in community	Only used for emergency/supplementary source Implementation of Resource Management Planning Rules ie Regional Policy Statement, NES for Sources of Human Drinking-water. Land use consents. Treatment barriers effective against microbiological contamination	Abstraction can be turned off and revert to treated water storage. Boil water notice can be issued. Incident response plan	Conditions prior to activating	Yes	Unlikely	Minor	Low	Y	Unsure	Complete five yearly catchment risk survey for all catchments.	WWM PDE
	Microbiological contamination	1.04	Brynderwyn: Discharges from onsite wastewater systems, dairy effluent irrigation, farmed animals or septic tank systems, unconsented overflow	Possible	Catastrophic	High	Commercial/residential development or construction. High raw water E. coli results, Turbidity in raw water, Prolonged heavy rain, extreme weather events, Illness in community	Only used for emergency/supplementary source Implementation of Resource Management Planning Rules ie Regional Policy Statement, NES for Sources of Human Drinking-water. Rural Land Use Policy to address the adverse effects of intensive farming and forestry on rural land. Treatment barriers effective against microbiological contamination	Abstraction can be turned off and revert to treated water storage and other sources. Boil water notice can be issued. Incident response plan	Activities in catchment	Yes	Unlikely	Minor	Low	Y	Reliable		WWM PDE
	Chemical Contamination	1.05	Brynderwyn: Surface runoff containing chemical contaminants from agricultural activities.	Possible	Moderate	Medium	Taste and or odour, information provided by Regional pollution hotline or public. Source water chemical screen indicates chemicals. Active weed control programme. Regional Council SoE reporting	Implementation of Resource Management Planning Rules ie Regional Policy Statement, NES for Sources of Human Drinking-water. Rural Land Use Policy to address the adverse effects of intensive farming and forestry on rural land. Treatment barriers employ coagulation, flocculation and sedimentation. Appropriate controls on pest management programmes. Treatment barriers effective against chemical contamination	Abstraction can be turned off and revert to treated water storage. District plan or Building Act abatement notices can be served. Incident response plan. Consumers advise water cannot be consumed.	Chemical suite, trends in raw water composition	Yes	Unlikely	Minor	Low	Y	Unsure	Consider assessment of raw water chemistry for allocation of Priority 2 chemicals	WWM PDE
	Chemical Contamination	1.06	Brynderwyn and Baldrock - use of agri herbicides or pesticides for weed control in catchment.	Possible	Moderate	Medium	Source water chemical screen indicates chemicals. Regional Council SoE reporting	Weed control programmes conducted to minimise run off or away from intakes. HSNO controls on use and certified operators used.	Abstraction can be turned off and revert to treated water storage. Incident response plan. Consumers advise water cannot be consumed. Defer or cease operation	Consents and approvals. Weekly applications received from NRC for consents	Yes	Unlikely	Minor	Low	Y	Reliable	Update sources details in DWO	WWM PDE
	Chemical Contamination	1.07	Brynderwyn chemical contamination/spill in catchment e.g traffic accident Piroa chemical contamination/spill in catchment e.g quarry activities	Unlikely	Moderate	Medium	Notification or report to pollution hotline or emergency services call out	Secondary catchment Some setback from road Attenuation from surrounding land Treatment barriers effective against chemical contamination Quarry operations awareness	Abstraction can be turned off and revert to treated water storage. Incident response plan. Consumers advise water cannot be consumed.	Timeliness of Reporting. Land use changes or new activities in the catchment	Yes	Rare	Moderate	Low	Y	Reliable		WWM PDE
	Algae	1.08	Growth of cyanobacterial blooms in Baldrock Dam	Possible	Catastrophic	High	Growth of planktonic blooms are observed Taste/odour reported Illness in community	Secondary catchment Treatment barriers employ coagulation, flocculation and sedimentation.	Abstraction can be turned off and revert to treated water storage. Incident response plan. Consumers advise water cannot be consumed.	Lake temperatures and nutrient conditions	Yes	Unlikely	Minor	Low	Y	Unsure		WWM PDE
	Loss of supply	1.09	Piroa, Cattlemount, Baldrock - Low flows in source water through drought	Unlikely	Major	Medium	Water levels and flow rates, weather conditions	Consent conditions. Visual checks. Regional Council monitoring programme provides for early detection.	Initiate water demand and conservation management. Follow Drought Management Plan and implement supplementary supplies	Catchment rainfall, steam and river levels	Partially	Unlikely	Moderate	Medium	Y	Reliable		WWM PDE
	Loss of supply	1.10	Brynderwyn- Low flows in source water through drought	Unlikely	Moderate	Medium	Water levels and flow rates, weather conditions	Secondary Intake Consent conditions. Visual checks. Regional Council monitoring programme provides for early detection.	Initiate water demand and conservation management. Follow Drought Management Plan and implement supplementary supplies	Catchment rainfall, steam and river levels	Partially	Rare	Minor	Low	Y	Reliable		WWM PDE
	Loss of supply	2.01	Raw water pipeline failure	Unlikely	Catastrophic	High	Loss of flow and pressure to plant Raw main consumers report loss of water Bridge collapse Civil Defence Events	Most breaks can be repaired quickly by maintenance Treated water storage Brynderwyn Emergency intake closer to plant so some capacity if failure occurs to the East. Bridge crossings under roading management	Carry out emergency work to reinstate/repair the intake. Invoke emergency water use restrictions for the town under the Water Bylaw. Use reservoir storage in the short term if sufficient.	Monitor plant intake flow rates continuously by Magflow meter.	Yes	Unlikely	Moderate	Medium	Y	Reliable	Perform in-depth condition assessment of the raw water transfer line	WWM PDE

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2. Abstraction	Loss of supply	2.02	Intake Vandalism/Sabotage	Unlikely	Major	Medium	Volume and flow to plants. Visible damage, threats, reported suspicious activity	Intakes are mostly located in isolated areas an private land . Treated water storage. Legal Deterrents. Intake structures designed to withstand some damage	Repairs, consumer advisory to conserve water	Review intakes security if interference or vandalism becomes more common	Yes	Rare	Moderate	Low	Y	Confident	Review intake sites security generally and improve it if vandalism becomes an issue	WWM PDE
	Loss of water	2.03	Pump failure @ Piroa, Baldrock, Brynderwyn	Possible	Major	High	Loss of water or pressure in reticulation Frequent low reservoir level	Main supply source at Cattlemount is gravity fed Asset management Certified maintenance staff.	Incident management plan. Demand restrictions imposed	Reservoir level	Yes	Unlikely	Minor	Low	Y	Confident	Install alarm for pump failure at Piroa and Brynderwyn	WWM PDE
	Micro & chem contamination	2.04	Provision of raw water to consumers on raw pipeline from Baldrock	Almost Certain	Major	Extreme	Consumer complaints, illness	Consumers advised water is untreated. Connections included backflow devices	Reminders provided	Number of connections Backflow devices	Partially	Likely	Minor	Medium	Y	Reliable		WWM PDE
3. Maungaturoto Treatment - Coagulation, Clarification, Sedimentation, Filtration	Particles/ Protozoa not captured / removed	3.01	Floc not formed due to poor coagulant mixing	Likely	Major	High	No or poor floc formation. High turbidity in water leaving the clarifier or filter.	Baffling/retention in mixing tank Plant flow maintained at optimal rate Turbidity meters used to trigger alarm and shut down plant Coagulant dose controlled by SCM Subsequent filtration stage removes particles	Adjust plant flow. Run water to waste and rely on storage when turbidity is particularly high Refer contingency plan Zeroing of the streaming current meter	Online turbidity	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not captured / removed	3.02	Floc not formed due to polyaluminium chloride or poly dose pump failure.	Likely	Major	High	No or poor floc formation. High turbidity in water leaving the clarifier or filter.	Operator at plant 2x week Turbidity is monitored online in water leaving the filters Dosing pumps are well maintained and calibrated Subsequent filtration stage removes particles	Adjust plant flow. Adjust coagulant dose	Online turbidity	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not captured / removed	3.03	Floc not formed due to inappropriate dose rate of coagulant chemicals.	Likely	Major	High	No or poor floc High turbidity in water leaving the clarifier or filters. Chemicals exceeding MAVs in final water	Operator at plant 2x week Poly pump stroke is manually adjusted but flow paced Pumps are routinely calibrated Turbidity is monitored online and alarmed in water leaving the filters Subsequent filtration stage removes particles	Adjust plant flow. Increase capacity in other plants	Online turbidity	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not captured / removed	3.04	Clarifier fails to remove particles due to sudden change of raw water turbidity	Possible	Major	High	Poor floc formation or no floc blanket Filters clog up quickly High turbidity in water leaving filters	Filter headloss monitored and alarmed Turbidity is monitored online in water leaving clarifier and the filters Subsequent filtration stage removes particles	Adjust plant flow. Adjust coagulant dose	Sediment blanket Online Turbidity	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not captured / removed	3.05	Floc not formed due to coagulant chemical supply exhausted.	Possible	Major	High	No floc formed Filters clog up quickly High turbidity in water leaving filters. Co-ag day tank empty	Operator at plant 2x week to monitor use Chemicals are held in bulk at treatment plant Sufficient polyelectrolyte onsite for a minimum 20 days at maximum demand	Arrange urgent delivery Utilise storage	Delivery schedules. Bulk tank levels	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/ Protozoa not captured / removed	3.06	Poor floc formation due to raw water pH incorrect for optimal coagulation	Possible	Moderate	Medium	Poor floc formation Excessive floc carryover to the filters High turbidity in water leaving the clarifier Record pH on the plant log sheets. Calibration of pH meter is undertaken	Raw water pH rarely changes however pH is alarmed Turbidity is monitored online in water leaving the filters Operator vigilance and training. Subsequent filtration stage removes particles	Shut off the supply if a serious pH problem is suspected during plant visits Rely on stored water if this is clearly not affected by the event. Calibrate the pH meter as per manufacturers' instructions.	Online pH	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/Protozoa removed	3.07	Inability to backwash effectively due to power outage	Possible	Major	High	High turbidity in water leaving the filter. Other power dependent equipment goes offline	Turbidimeters on each filter indicate filter performance Back up power supply, mobile generators	Initiate emergency power, initiate water conservation measures	Backwash procedure	Yes	Unlikely	Minor	Low	Y	Confident	Install a generator interface at WTP so a backup generator can be installed.	OEWS WO&M
	Particles/Protozoa removed	3.08	Balance Tank Pump failure Backwash pump failure	Possible	Major	High	Flow rates Backwash cycle doesn't happen Increased post filter turbidity	Regular maintenance of backwash pumps Treated water Storage	Repair/Replace	Pumps monitored for noise and vibration	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M

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4. Maungaturoto UV	Particles/Protozoa removed	3.09	Pressure sand filter malfunction including incorrect operation	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	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/ specifications Treatment plant manuals	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Particles/Protozoa removed	3.10	Backwash pump failure	Possible	Major	High	Backwash cycle doesn't happen Increased post filter turbidity	Regular maintenance of backwash pumps	Repair/Replace	Pumps monitored for noise and vibration	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Inadequate disinfection	4.01	UV intensity insufficient due to build-up of deposits on sleeve	Likely	Catastrophic	Extreme	E. coli detected in water leaving the plant or illness in the community. Visible build-up of deposits on sleeve and sensor lens UVI alarm	UV intensity is continuously monitored and alarmed. Dual reactors in place as contingency Routine cleaning and maintenance schedule for lamp sleeves and UV sensor. Regular replacement of UV lamp. UVI reference sensor checked regularly and calibrated annually	Clean UV sleeves, Undertake cleaning and maintenance Change lamps Incident Response plan – Microbiological contamination Increase chlorine dosing in reservoir Standby reactor switches to Duty	UV Intensity	Yes	Rare	Moderate	Low	Y	Confident		OEWS WO&M
	Inadequate disinfection	4.02	Flow rate through UV unit too rapid for effective treatment	Likely	Catastrophic	Extreme	Flow rate through plant greater than UV unit maximum Flow alarm	Routine maintenance and calibration checks on flow rate controller	Slow plant flow rate to that which is optimal for UV units Recalculate dose rates and change flow settings	Flow rates Maintenance records of flow rate controller Flow controller calibrations	Yes	Rare	Moderate	Low	Y	Confident		OEWS WO&M
5. Maungaturoto - Chlorination	Inadequate disinfection	4.03	Excessive turbidity/colour in water decreasing the effectiveness of the UV treatment (UVT too low)	Likely	Catastrophic	Extreme	High turbidity levels detected in raw water E. coli detected in water or illness in the community	Water receives clarification and filtration. Setpoints within validation conditions and are controlled by the supplier Regular replacement and maintenance of filters	Backwash filters Ensure coagulation dosing system operating correctly.	NTU, UVT Filter maintenance schedule	Yes	Rare	Moderate	Low	Y	Confident		OEWS WO&M
	Inadequate disinfection	4.04	Power failure resulting in UV unit being unable to work	Possible	Catastrophic	High	Alarms	Alarm to indicate power failure Regular maintenance of UV power supply Generator connections installed	Replace faulty equipment Initiate response contingency	Power supply maintenance schedule Maintenance log and schedule for equipment	Yes	Unlikely	Moderate	Medium	Y	Confident		OEWS WO&M
	Inadequate disinfection	5.01	Inadequate contact time	Unlikely	Major	Medium	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 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	Rare	Moderate	Low	Y	Reliable		OEWS WO&M
	Inadequate disinfection	5.02	Gas chlorine 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	5.03	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 the plant daily to check operation of chlorination system FAC is semi continuously monitored at the treatment plant and in the reticulation twice weekly Operator checks at least two times a week and more often to check the chlorine dosing equipment Annual check and servicing of the chlorine dosing equipment with overhaul every two years.	Repair and return to service Contractor staff competency audits Repair any equipment faults, with plant shutdown and reservoir storage used to cover repair period If corrective actions fail: Refer to FAC Concentration below Target Level Contingency Plan Re-train staff as necessary in correct procedures	Operation of chlorine dosing pump FAC alarms, on-line data FAC records stored on SCADA Record all events of chlorination problems Record chlorinator maintenance	Yes	Unlikely	Moderate	Medium	Y	Confident		OEWS WO&M
	Inadequate disinfection	5.04	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	FAC alarms, on-line data and in distribution zone	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Inadequate disinfection	5.05	Chlorine demand exceeds chlorine dose due to high raw water turbidity	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 on-line with alarms to operators and date telemetered	Increase chlorine dose level	Turbidity of water at treatment plant FAC alarms, on-line data and in distribution zone	Yes	Unlikely	Minor	Low	Y	Confident		OEWS WO&M
	Over Chlorination	5.06	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	5.07	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	Reliable	Test for Disinfection by-products after moderate to heavy rainfall at the end of the reticulation network.	OEWS WO&M

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6. Maungaturoto Storage	Micro contamination	6.01	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		OEWS WO&M
	Micro/Chem contamination	6.02	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		OEWS WO&M
	Micro/Chem contamination	6.03	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		OEWS WO&M
	Loss of supply	6.04	Failure of reservoirs	Unlikely	Catastrophic	High	Complaints from consumers about loss of supply or pressure Obvious signs of leakage or failure at reservoir site	Reservoirs are constructed of concrete and steel and are regularly inspected for structural integrity 3x treated water reservoirs	Isolate damaged or failing reservoir and supply directly from treatment plant or use other reservoirs	Structural integrity of reservoir	Yes	Rare	Moderate	Low	Y	Confident		OEWS WO&M
	Loss of supply	6.05	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 230m3 plus 2x460m3 at Griffin Road Designed to achieve 20 hours reserve capacity @ average flow	Introduce conservation and efficiency measures	Reservoir level	Yes	Unlikely	Moderate	Medium	Y	Confident		OEWS WO&M
7. Reticulation	Loss of water	7.01	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	Yes	Rare	Moderate	Low	Y	Confident		OEWS WO&M
	Micro/Chem contamination	7.02	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		OEWS WO&M
	Micro/Chem contamination	7.03	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	Partially	Unlikely	Minor	Low	Y	Reliable	Audit commercial high risk premises /rural properties annually for back-flow testing Check reticulation pressures under very high demand situations	OEWS WO&M
	Loss of water	7.04	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	Suspicious of illegal connections	Yes	Unlikely	Insignificant	Low	Y	Reliable		OEWS WO&M
	Inadequate Supply	7.05	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		OEWS WO&M
	Sediment/ biofilm	7.06	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	Flushing undertaken in response to complaints. Regular dead end mains flushing Reticulation turbidity taken manually once per week	Undertake flushing as required	Dirty water complaints	Yes	Unlikely	Minor	Low	Y	Reliable		OEWS WO&M
	Operator error mismanagement	8.01	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	Partially	Unlikely	Moderate	Medium	Y	Confident	Carry out training needs annually Create O&M Manual for the Maungaturoto Water Supply	OEWS WO&M

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8. Other	Operator error mismanagement	8.02	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	Audit/review of monitoring activities and issue of non-compliances to the contractor where performance against the contract is inadequate. Clearly label and identify plant components and functions and update the O&M Manuals.	OEWS WO&M
	Sampling Failure	8.03	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	8.04	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, UVT, pH and turbidity continuous monitoring	Yes	Unlikely	Moderate	Medium	Y	Confident		OEWS WO&M
	Failure due to Inadequate Maintenance	8.05	Supply equipment fails due to inadequate asset information and inadequate maintenance planning	Likely	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	Moderate	Medium	Y	Confident		OEWS WO&M
	Failing to meet DWSNZ	8.06	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	8.07	Inadequate data collection, reporting and control systems	Almost Certain	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		OEWS WO&M
	Loss of supply	8.08	Resource consent limits reached or exceeded or no current consent	Unlikely	Major	Medium	Consent conditions Information from Regional Council	Priority consent Existing use rights Baldrock Water Supply Agreement until 2034	Daily abstraction rates are always within the water take limits	Regional Council Policy changes	Partially	Unlikely	Minor	Low	Y	Confident	Renew consent for Cattlemount	OEWS WO&M
	Micro/Chem contamination	8.09	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		OEWS WO&M
	Total Plant Failure	8.10	Catastrophic natural disaster or failure including earthquake and landslide	Rare	Catastrophic	Medium	Major natural disaster occurs. Intense sustained weather. River bank slip, flooding. Total plant failure is evident. Warnings from Govt agencies incl Met Office, Niwa, Civil Defence, Regional Council. Warnings from Govt agencies incl Met Office, Niwa, Civil Defence, Regional Council.	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	Confident	Complete the Emergency Response and Action Management Plan as a priority to align with the Regional Emergency Plan	OEWS WO&M