The Environmental Protection Agency

EPA DRINKING WATER ADVICE NOTE
Advice Note No. 8:
Developing Drinking Water Safety Plans

epa
Office of
Environmental
Enforcement

EPA DRINKING WATER ADVICE NOTE
Advice Note No. 8:
Developing Drinking Water Safety Plans

Version 1

Issued: 2 August 2011

1 INTRODUCTION

THE EPA has adopted the World Health Organisation (WHO) water safety plan approach to ensuring drinking water is both "safe" and "secure". A supply is deemed 'safe' if it meets the relevant standards at the tap and 'secure' if a management system is in place that identifies all potential risks and procedures are in place to manage these risks. The methodology described in this Advice Note ensures that a drinking water supply is safe and secure through the use of a comprehensive risk assessment and risk management approach.

In 2009 the WHO published detailed guidance on the implementation of the Drinking Water Safety Plan approach, the document is entitled Water Safety Plan Manual: Step-by-step risk management for drinking water supplies and is available for download on the WHO website at *http://whqlibdoc.who.int/publications/2009/9789241562638_eng.pdf*.

This Advice Note is intended to give an overview of the steps involved in constructing a water safety plan and an outline of what it should contain in the Irish context. It contains guidance on hazard identification, risk assessment and the preparation of action plans for hazards identified. This document is aimed at all local authority staff involved in the production and distribution of drinking water and should be read in conjunction with the WHO guidance manual when implementing a Drinking Water Safety Plan.

The Agency introduced the DWSP concept in 2009 by issuing a letter to all county managers outlining the approach and advocating its use. The EPA Handbook published in 2010 also contains a section (Section 10) covering DWSP's. The approach applies equally to small and large drinking water supplies.

2 WHAT IS A DRINKING WATER SAFETY PLAN?

The WHO state that "The most effective means of consistently ensuring the safety of a drinking water supply is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer". This type of approach is called a Drinking Water Safety Plan (DWSP). The basis of the approach is risk assessment but the primary objective is to protect human health.

A DWSP is developed specifically for each water supply and should be considered as a risk management strategy to ensure the continuous supply of safe water. The water safety plan approach builds on existing good water supply management practices. An emphasis in the plan is placed on risk mitigation above sampling, although targeted operational monitoring is still a key component of the plan.

The Key components of a DWSP are:

- an assessment of the water supply from source to tap to determine whether the water supply can consistently deliver water of a quality that meets health-based targets. This assessment identifies the potential hazards in each component of the water supply, the level of risk presented by each identified hazard and the appropriate control measures for the identified risks to ensure that the water supply is safe, the standards and targets are met, and human health is protected;
- operational monitoring of an appropriate nature and frequency at an appropriate point in the water supply for each control measure identified and implemented from the supply assessment to ensure that any deviation from the required performance is rapidly detected; and
- documentation of management arrangements including details of the supply assessment, validation monitoring and operational monitoring. Documentation should also include a description of the actions to be taken under normal operating and under incident conditions. During incident conditions there is a risk of non-compliance with a standard (or target value) or failure to meet an operational control, or there may be a potential risk to human health. These actions should include appropriate investigations, remedial action in the form of improvement programmes, reporting and communication.

It is important to differentiate clearly between the purpose of a DWSP and a Drinking Water Incident Response Plan (DWIRP) though there is overlap between the two approaches. The DWIRP focuses on actions to be taken following an unplanned event leading to the interruption of supply or the contamination of a supply constituting a danger to public health. In comparison, the DWSP focuses on actions to be taken to prevent an incident leading to a failure of the Drinking Water Regulations and/or a potential danger to public health. A DWIRP is prepared at Water Services Authority level whereas a DWSP is prepared at scheme/supply level. In some cases, if a control measure for a hazard identified under the DWSP fails or if there is no control measure in place, then the hazard may have to be dealt with using the DWIRP (e.g. a Cryptosporidium outbreak or flooding of the treatment plant). When preparing a DWSP Water Service Authorities should integrate the DWIRP where relevant to avoid duplication or contradiction between the two approaches.

The River Basin District Plans and the Water Management Units with their associated Action Plans should be consulted and utilised for identification of hazards, assessment of risk and identification of control measures in the catchment.

3 GUIDANCE ON THE PREPARATION OF WATER SAFETY PLAN

3.1 Assemble a team of experts

The first thing to do in preparing a DWSP is to assemble a team of people with a thorough knowledge of each stage of the water supply. A team leader should be appointed, who as well as being a good leader and communicator, should be of an appropriate level to communicate to senior management and progress the work of the team. The team must have experience of the catchment and raw water sources, water treatment processes, distribution networks, operations management, drinking water quality, public health and domestic distribution systems. Most of the team will be drawn from within the Water Services Authority but others such as catchment and public health specialists may be required from other organisations.

In Ireland some or all of the catchment for supplies extend beyond the functional area of the Water Services Authority. In this case, it will be necessary to have a representative from the other Water Services Authority/Authorities either on the team or to serve as a contact during DWSP preparation and implementation.

At all stages it is imperative that the DWSP team is supported by the Water Services Authority and is given the necessary resources for the task.

3.2 Document and describe the supply

The next step is to document and describe the water supply and ensure that each element of the system is captured. A description of the water supply is required to support the subsequent risk assessment process. This step involves desk studies supported by site visits to confirm the knowledge, skills and schematics available to the water supplier such as: the infrastructure at source, number and type of sources, interconnectivity of sources, land use in the catchment, raw water storage, water treatment including processes and chemicals used, treated water storage, secondary treatment (i.e. secondary chlorination) and the distribution network. It is recommended that a simple flow diagram is prepared to describe the supply. Examples of flow diagrams are given in Module 2 of the WHO guidance manual.

3.3 Identify the hazards and hazardous events

This stage involves an assessment of what could go wrong at each step of the drinking water supply process as described in the flow diagram. Site visits as well as desk studies are required at this stage. Hazard identification also requires assessment of historic information and events as well as predictive information based on knowledge of the treatment and supply systems. Risks that are not readily obvious should also be considered such as the siting of the treatment works in a flood plain (where there is no record of flooding), the age of pipes or the presence of lead pipe work in the distribution system.

Appendix 1 of this document provides assistance to water suppliers in completing this step by providing a list of typical hazardous events associated with each element of the supply. It must be noted that the list is not exhaustive and additional hazards can be added by the water supplier where they are specific to a supply. Similarly, not every hazard on the list will apply to each water supply.

It is important to note that stakeholder involvement is important at this stage as the DWSP is not just about the water supplier, many other bodies can be involved and should be involved to ensure the success of the approach, such as: agriculture, forestry, industry, residents groups, consumers, regulators and other Water Services Authorities.

3.4 Perform a Risk Assessment

When each hazardous event is identified, an assessment is carried out to assess the level of risk posed by each hazard. The initial risk assessment assesses the risk posed by the hazard in isolation of any existing control measures that are in place. This is the worst case scenario, and can often be difficult to visualise due to our knowledge of the control measures downstream of the hazard.

Risk assessment is a consideration of both the likelihood of a hazard occurring, and the impact or severity should it occur. A semi-quantitative approach is recommended comprising informed estimations of likelihood and severity.

A risk matrix is provided in Appendix 2. Likelihood and severity are scored on a scale of 1 to 5, a set of descriptors is provided to help with scoring (Tables 1 and 2). The values for likelihood and severity are multiplied together to give a value for the risk posed, resulting in a maximum risk score of 25.
The risk scores are classified as follows:

- 1 to 5 – Low risk,
- 6 to 10 – Medium risk,
- 12 to 15 – High risk,
- 16 to 25 – Very High risk.

3.5 Define and Validate Control measures

Anything that reduces the risk posed is termed a control measure (also known as a mitigation measure or barrier), such as treatment stages, monitors and alarms, operator knowledge, training etc. Most hazards can be mitigated by control measures to reduce the risk, however this is not always the case particularly in the catchment. In this situation, the next stage (i.e. treatment) will act as mitigation and so on.

Many control measures will already be in place, although some will not have been tested. The next stage is to validate the control measures in place. Validation should not be confused with operational monitoring which verifies that the control measure is working and shows when there is an abnormal situation. For many controls, validation involves concentrated monitoring to test the control measure. For systems including filtration, validation could be carried out using daily turbidity monitoring, e.g. if the turbidity goes no higher than a pre-determined level, say 0.2 NTU, in at least 95% of the daily samples taken in a month. Validation of controls may also involve imitating a hazard e.g. an alternative power source may be validated by simulating a power outage and assessing if the backup power source is sufficient to run the required processes.

3.6 Reassess risk to determine current risk

The second stage of risk assessment takes into account the effectiveness of the control measures currently in place, and assesses the level of risk remaining. The same procedure is used as described above for the initial risk assessment (Appendix 2) in order to determine the current or residual risk.

At the initial and current risk assessment stages the team should record the reasoning behind the decisions made by the team for future reference.

The outcome of the current risk classification determines the action to be taken for the hazard (Table 4). If there is no control in place, the action should be applied after the initial risk assessment.

3.7 Establish improvement/action plan for risks

Following the initial and current risk assessment a risk classification for each hazard is required before and after mitigation. This may highlight deficiencies in the current control measure or the fact that a control measure is absent (e.g. absence of a Cryptosporidium barrier or inadequate fencing at the intake) and thus requiring action. An action plan is prepared for every hazard classified as medium risk or higher. A template action plan is provided in Appendix 3. The template details the initial risk assessment, control measures (both those validated and already in place and controls planned in the short-term) and the current risk classification for each hazard. The level of detail on each sheet will vary depending on the hazards but for those hazards that remain high or very high despite mitigation, a detailed action plan is required with target dates for completion of the planned actions. In this case the action plan should also be signed off at Director of Services level or by another suitably qualified person in the Water Services Authority.

In cases where there are plans in place by the Water Services Authority to provide additional mitigation in the future (may be dependent on funding in the longer term), the expected benefit of the proposed measures can be included in the Action Plan as a 'Target' risk assessment, indicating the eventual risk rating.

It is suggested that each risk in the hazard spreadsheet is linked (by hyperlink) to its corresponding Action Plan worksheet.

3.8 Define Monitoring of the Control Measures and Verify effectiveness of the DWSP

Operational monitoring should be defined for the supply (frequency of monitoring, who carries out monitoring, where monitoring takes place, who receives and assesses the results etc.). The level of monitoring will vary depending on the control measure in place. Operational monitoring can be measurable (chlorine residuals, turbidity) or observable (integrity of fencing, locks on reservoir covers). Critical control measures will normally be measured online. For some control measures it may be necessary to define 'critical limits' outside of which the safety of the water supply is diminished. Plant operators need to be aware when a system is operating under normal conditions and when there is an incident.

The DWSP needs to be verified to ensure that it is working properly, verification involves three activities:

- Compliance monitoring, to ensure the results are consistent with water quality targets;
- Internal and external audits to ensure water quality risks are controlled, and;
- Verification of consumer satisfaction.

3.9 Management procedures and Documenting

All aspects of the DWSP should be clearly documented (description of supply, hazard list, risk assessment, level of monitoring etc.) and the documentation should be available for review by the supervisory authority. Management procedures are the actions to be taken during normal operational conditions (as verified by operational monitoring) and the corrective actions to be taken during an incident. Near misses should also be recorded for future reference. It should be noted that there may be some overlap with DWIRP procedures in relation to some incident situations and recording of same.

3.10 Supporting programmes – develop skills & knowledge

Supporting programmes enable commitment to the DWSP approach and provide the capacity to deliver safe water. They include staff training, provision of equipment (for monitoring or calibration), preventative maintenance, hygiene and sanitation. Existing support programmes may need to be reviewed and updated.

3.11 Regular review of hazards, risks, controls (e.g. new equipment)

The DWSP is a working document and forms an integral part of operational practices. A schedule for periodic full reviews of the DWSP should be defined but it should also be reviewed after any significant event e.g. an exceedance notified to the EPA, an incident, installation of new key piece of equipment, staff changes etc.

APPENDIX 1 HAZARD IDENTIFICATION SHEETS

Table 1. SOURCE – Catchment of Surface Water Supply

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
001	Flooding leading to rapid changes and variability in water quality/no balancing tank for raw water				
002	Absence of characterisation of the raw water source				
003	Presence of Cryptosporidium in the raw water				
004	Urban waste water – discharge with potential to cause microbial contamination				
005	Urban waste water – discharge of substances that are an imminent danger to public health				
006	Urban waste water – discharge from storm water overflow with potential to cause microbial contamination				
007	Drinking water – treatment plant discharging sludges upstream of intake				
008	Forestry – felling causing increased sedimentation of the raw water				
009	Aquaculture (freshwater) – causing contamination (feed, pesticides etc.)				
010	Run off from construction/development activities upstream of intake causing contamination | (oil spills, silt, cement, bentonites, soakaways, open tanks, surface water inceptors)				
011	Quarries – sedimentation or nitrate risk from explosives used				
012	Hydro power generation stations – changes in raw water quality due to hydro generation				
013	Wildlife – organic and microbial contamination				
014	Recreational use of source water causing microbial contamination or oil spills				
015	Algal blooms/eutrophication in lake source				
016	Stratification in lake source				
017	Risk of oil spill entering the supply (e.g. generators, household heating oil, farm fuel, ESB transformers, road traffic accident etc.)				
018	Dredging/arterial drainage works/flood protection works causing increased sedimentation upstream				
019	Any other urban run-off				

Table 2. SOURCE – Catchment of Ground Water Supply

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
020	Does the vulnerability category (including karst features and recharge) indicate that groundwater may become contaminated by surface or shallow discharges?				
021	Does the Aquifer Classification indicate a fast time of travel and hence pose a hazard to drinking water quality?				
022	Is the well head completion designed and constructed in a manner that will exclude surface water or spillages of contaminated material causing microbial or other contamination?				
023	Is the well head secured against livestock access causing microbial contamination?				
024	Does the borehole have a pump chamber casing, the annulus of which has been fully grouted (lined) by injection from the base of the casing to the ground surface to prevent intrusion of surface water or other contamination?				
025	Is the infiltration gallery influenced by surface water causing microbial contamination?				
026	Are there land drains causing preferential pathway for pollution of shallow well source?				

Table 3a. SOURCE – Catchment of Surface Water or Groundwater Supply

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
027	Effect of climate chance on source water				
028	On-site waste water treatment systems/septic tanks with potential to cause microbial contamination				
029	Good Agricultural Practice for the Protection of Waters Regulations (S.I. No. 101 of 2009) not complied with				
030	Agriculture – microbial contamination (from animal access, land spreading or storage of slurry or dung)				
031	Agriculture – contamination from dangerous substances (e.g. sheep dipping chemicals/ pesticides)				
032	Agriculture – contamination from nitrates/phosphates				
033	Abattoirs – organic and microbial contamination				
034	Forestry – chemical or organic fertilisation causing high nitrates				
035	Forestry – pesticides				
036	Forestry – PAH's (fires)				
037	Forestry – felling causing increased sedimentation of the raw water				
038	Industry, licensed or unlicensed (including IPPC/Section 4) – chemical contamination				
039	Industry, licensed or unlicensed (including IPPC/Section 4) – microbial contamination				

Table 3b. SOURCE – Catchment of Surface Water or Groundwater Supply

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
040	Industry, licensed or unlicensed (including IPPC/Section4) – loss of source water due to contamination				
041	Mining – chemical or metal contamination				
042	Transport – road run off (pesticides, chemicals)				
043	Transport – railway run off (pesticides)				
044	Transport – airport run off (organic chemicals)				
045	Geology – arsenic, lead, fluoride, uranium, radon or other potentially harmful natural substance in raw water				
046	Contaminated land upstream of intake causing contamination				
047	Landfill leachate entering water				
048	Reduced sufficiency of supply due to competing water users/over abstraction of source/drought conditions				
049	Vandalism – deliberate contamination of source and unauthorised access				
050	Nuclear disaster				
051	Any additional site-specific hazard(s) associated with the catchment				

Table 4. SOURCE – Raw Water Intake

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
052	Intake not secured against livestock access causing microbial contamination				
053	Lake source intake point vulnerable to variation due to streams/ stratification/algal blooms/ increased turbidity				
054	Screens – no screening in place for raw water				
055	Screens – blocking or breakdown of mechanical screens				
056	Sediment build up at intake chamber causing contamination				
057	Risk of invasive species clogging up the intake (e.g. pond weed or zebra mussel)				
058	Any additional site-specific hazard(s) associated with the raw water intake				

Table 5. SOURCE – Raw Water Storage

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
059	Susceptible to algal blooms causing taste/odour issues				
060	Susceptible to build up of toxins				
061	Susceptible to stratification				
062	Subject to surface water influence, flooding or other microbial contamination (e.g. wildlife access)				
063	Vandalism – deliberate contamination of source and unauthorised access				
064	Sludge build up in raw water tank causing contamination				
065	Leaking impounding reservoir causing ingress of contamination				
066	Any additional site-specific hazard(s) associated with raw water storage				

Table 6. SOURCE – Raw Water Line

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
067	Pipe corroded or not watertight causing ingress of surface water				
068	Raw water serving consumers without disinfection or other treatment				
069	Pipe composition causing contamination (e.g. presence of lead pipe work)				
070	Any additional site-specific hazard(s) associated with the raw water line				

Table 7. TREATMENT PLANT – Plant Design

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
101	Surface water supply with no Cryptosporidium barrier in place				
102	Groundwater or spring supply, influenced by surface water with no Cryptosporidium barrier in place				
103	Treatment plant operating above design capacity				
104	By-passing of any stage of treatment				
105	Frequent and significant flow variations through the works				
106	Any additional site-specific hazard(s) associated with plant design				

Table 8. TREATMENT PLANT – Coagulation/Flocculation/Clarification Stage

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
107	Floc carry over due to inappropriate/inadequate dosing regime				
108	Floc carry over due to overloading of the plant/surge flows				
109	Floc carry over due to poor adjustment/maintenance/design of lamella plates				
110	Floc carry over due to poor maintenance or flooding of settlement channels				
111	Floc carry over due to variations in raw water characteristics				
112	Floc carry over due to effects of weather conditions				
113	Floc carry over due to inadequate cleaning regime for clarifiers				
114	Floc carryover due to poor settlement/unstable sludge blanket				
115	Floc carryover due to sludge float/scraper not operating properly				
116	Floc carryover due to sludge concentrators not operating properly				
117	Floc carryover due to sludge bleeds not operating properly				
118	Floc carryover due to insufficient sludge draw off				
119	Inadequate cleaning regime in chemical mixing/contact tank				
120	Algal or plant growth in clarifiers causing poor water quality and clogged filters				
121	Poor structural integrity of clarifiers causing contamination due to ingress				
122	Sludge recycled to head of works				
123	Any additional site-specific hazard(s) associated with Coagulation/Flocculation/Clarification				

Table 9. TREATMENT PLANT – Filtration

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
124	Inadequate pre-treatment (i.e. no clarification stage)				
125	Inadequate process control in place for filtration (e.g. lack of turbidity monitors)				
126	Inadequate particle removal due to overloading of the filters				
127	Inadequate particle removal due to blocked filters				
128	Inadequate particle removal due to inadequate filter media depth				
129	Inadequate particle removal due to inadequate filter media composition				
130	Inadequate particle removal due to inadequate backwashing regime (e.g. inadequate cycle length, uneven scour, pump failure, loss of filter media)				
131	Inadequate particle removal due to poor filter maintenance (cracks, boils etc)				
132	Filtered water from rapid gravity filters put back into supply without slow start/running to waste				
133	Filtered water from slow sand filters put back into supply without adequate ripening period				
134	Filtered Water – risk of Cryptosporidium breakthrough				
135	Filtered Water – turbidity breakthrough greater than 0.2 NTU in sites where there is a risk of the presence of Cryptosporidium in the raw water (as per Guidance in EPA Handbook)				
136	Backwash water recycled to head of works causing increased turbidity				
137	Algal growth in filters causing poor particle removal				
138	Any additional site-specific hazard(s) associated with filtration				

Table 10. TREATMENT PLANT – Membrane Filtration

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
139	Membrane filtration – fouling causing blockage and bypass of filters				
140	Membrane filtration – breach causing bypass of filters				
141	Any additional site-specific hazard(s) associated with membrane filtration				

Table 11. TREATMENT PLANT – Disinfection

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
142	Lack of duty/standby arrangements for disinfection equipment (e.g. chlorine, UV) in the event of failure or during maintenance. For small supplies treated with UV, the ability to shut off the supply in the event of a failure or during maintenance is acceptable if no undisinfected water can enter the mains				
143	Lack of automatic switchover arrangements for disinfection equipment (chlorine dosing, UV) in the event of failure or during maintenance				
144	Lack of online monitor for key disinfection equipment				
145	Lack of dial out alarm in the event of a failure of key disinfection equipment				
146	Inadequate contact time in place in accordance with WHO requirements				
147	Chlorine dosing is not flow proportional				
148	Lack of appropriate validation certificate for UV treatment system				
149	Lack of UVI or UVT monitor (to verify UV is operating within its validated range at all times)				
150	UV system operating outside its validated range				
151	Any additional site-specific hazard(s) associated with disinfection				

Table 12a. TREATMENT PLANT – Other

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
152	Any other hazard not controlled in the catchment				
153	Contamination with unapproved treatment chemicals/materials				
154	Chemicals used after expiration date – ineffective chemicals				
155	Chemicals delivered to incorrect storage vessel				
156	Chemical injection point(s) vulnerable to potential damage				
157	Loss of power supply/no backup or alternative power supply				
158	Electrical surge causing loss of communication and records				
159	Electrical equipment and pumps that could contain PCBs (large transformers, power correction units and oil filled circuit breakers)				
160	Vandalism – causing loss of supply or deliberate contamination at treatment plant				
161	Instrumentation failure – loss of control e.g. set points for turbidity monitors				
162	Telemetry – communication failure				
163	Flooding – loss or restriction of treatment works				
164	Loss or restriction of access to the plant due to weather extremes or other event				
165	Adverse weather conditions affecting treatment chemicals and/or processes				

Table 12b. TREATMENT PLANT – Other

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
166	Fire/explosion – loss or restriction of treatment works				
167	Spill from unbunded chemical or oil storage tank causing contamination				
168	Fuel spill due to ancillary works at the plant from equipment such as generators, con-saws etc.				
169	Use of flow meters containing mercury				
170	Chemical overdose due to poor process control				
171	Availability and continuity of supply of treatment chemicals – inadequate storage of chemical stocks, risk of running out of key treatment chemicals				
172	Availability and continuity of supply of spare parts for key water treatment equipment e.g. UV bulbs				
173	Critical pump failure leading to loss of supply				
174	Risk of fluorine overdose in treated water				
175	Poor quality batch of chemicals (e.g. low concentration) delivered or made up on-site leading to inadequate treatment				
176	Any additional site-specific hazard(s) associated with treatment				

Table 13a. DISTRIBUTION – Distribution Network

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
201	Any hazard not controlled/mitigated by the treatment plant				
202	Presence of disinfection by-products in the network (e.g. THM's)				
203	Insufficient disinfection in distribution network causing microbial recontamination				
204	Procedure for disinfection of water mains following repair and maintenance not in place causing microbial contamination				
205	Mains burst causing ingress of contamination				
206	Ingress of contaminated water caused by low pressure or pressure waves				
207	Unmaintained pipe network causing ingress of contamination				
208	Leakage/blocked pipes/malfunctioning pumps and valves causing ingress of contamination				
209	Intermittent supply causing ingress of contamination				
210	Opening/closing valves causing reversed flow and disturbing deposits				
211	Opening/closing valves causing introduction of stale water				
212	Scouring operations causing disturbed deposits				
213	Use of unapproved materials causing contamination of water supply				

Table 13b. DISTRIBUTION – Distribution Network

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
214	Third party access to hydrants causing contamination due to backflow				
215	Third party access to hydrants causing increased flow disturbing deposits				
216	Backflow from industrial premises, domestic premises, unauthorised connections or unregulated supplies without adequate backflow prevention devices causing contamination of the public water supply				
217	Presence of lead mains in the ownership of the Council				
218	Presence of lead communication pipes in the ownership of the Council				
219	Leaching and pipe work corrosion leading to entry of corrosion by-products into water supply (e.g. lead, copper. etc)				
220	Contaminated land or oil or solvent spillage causing contamination through permeable plastic (uPVC or polyethylene) pipe work				
221	Any additional site-specific hazard(s) associated with the distribution network				

Table 14. DISTRIBUTION – Service Reservoirs & Water Towers

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
222	Open reservoir causing recontamination by wildlife etc.				
223	Leaking Reservoir causing ingress of contamination				
224	Unprotected access covers and/or vents causing contamination				
225	Vandalism – deliberate contamination of treated water and unauthorised access				
226	Lack of maintenance and cleaning of reservoirs causing contamination (sludge build-up in reservoirs, presence of dead vermin, etc)				
227	Level sensor failure in reservoir causing reservoir to run low resulting in poor water quality or outage				
228	Any additional site-specific hazard(s) associated with reservoirs and water towers				

Table 15. CONSUMER PREMESIS

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
301	Any hazard not controlled/mitigated within the distribution network				
302	Lack of contingency plans in place to aid vulnerable customers				
303	Lead pipe work in the ownership of the consumer causing lead contamination				
304	High colour/turbidity/iron levels at consumers tap				
305	Unapproved taps and plumbing equipment in the ownership of the consumer causing contamination				
306	Any additional site-specific hazard(s) associated with consumer premises				

Table 16. MANAGEMENT & CONTROL – Monitoring

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
401	Supply is high risk or very high risk in Cryptosporidium Risk Assessment				
402	Appropriate Cryptosporidium monitoring programme not in place				
403	Lack of online monitors and alarms critical to plant management (e.g. turbidity, chlorine, ammonia, pH)				
404	Compliance monitoring not carried out in accordance with DW Regulations				
405	Operational monitoring not carried out as necessary				
406	Any additional site specific hazard(s) associated with monitoring				

Table 17a. MANAGEMENT & CONTROL – Management

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
407	Lack of a documented Management System in place				
408	Standard operating procedures not in place or not documented				
409	Procedure for dealing with non-compliances with Table A, B and C parameters and notification to EPA/HSE not in place				
410	Hygiene procedures not in place or plant operator manages waste water and drinking water treatment plants causing risk of cross contamination				
411	Lack of record keeping for critical controls				
412	Lack of daily checks on key equipment				
413	Inadequate caretaking cover (including shift) at the plant				

Table 17b. MANAGEMENT & CONTROL – Management

Risk No.	Hazard Description	Initial Risk Ranking (see worksheet)	Validation of Control Measures (include date validation took place)	Revised Risk Ranking (see worksheet)	Date of Revised Risk Assessment (To provide a time line on upgrades and improvements)
414	Inadequate call-out facilities in place for caretakers, relief caretakers, technicians, electricians, plumbers etc				
415	Caretaker or relief caretaker not adequately trained in respect of his/her duties				
416	Caretaker has not completed the WSTG 5 day drinking water (FETAC Level 5) course				
417	System for reporting incidents or exceedances to management not in place				
418	System for follow up of EPA Audits, Directions or other recommendations not in place				
419	Drinking Water Incident Response Plan not in place				
420	System of internal audit not in place				
421	Procedure for responding to alarms not in place or not operational due to HR issues				
422	Complete Information System showing the distribution network etc. not up to date				
423	Calibration schedules not in place for key dosing and monitoring equipment including monitors and alarms				
424	Maintenance schedule/contract not in place for key treatment and monitoring equipment including monitors and alarms				
425	Customer complaint protocol not in place				
426	System for an annual review of DWSP not in place				
427	Improvement programme for supply on the RAL not in place				
428	System for feedback of monitoring results (source and treated water) to plant operators not in place				
429	Poor housekeeping causing contamination (birds, flies in the treatment plant)				
430	Any additional site specific hazard(s) associated with management				

APPENDIX 2 DESCRIPTORS, RISK ASSESSMENT MATRIX AND ACTION MATRIX

Table 1. Likelihood Descriptors

Level	Descriptor	Description
1	Most unlikely	Has not happened in the past and is highly improbable that it will happen in the future
2	Unlikely	Has happened in the past, is possible and cannot be ruled out completely
3	Foreseeable	Has happened in the past, is possible and under certain circumstances could happen again
4	Likely	Has occurred in the past more than once, is likely to happen again
5	Almost certain	Has occurred in the past, is an ongoing problem, and is very likely to happen again

Table 2. Severity/Impact of Consequence Descriptors

Level	Descriptor	Description(s)
1	Insignificant	Wholesome water, no public health impact
2	Minor	Short term or localised, aesthetic or not health related. Treatment compromised. No regulatory failure
3	Moderate	Long term non-compliance, widespread aesthetic issues or not health related. Treatment compromised. Regulatory failure but no health risk
4	Major	Potential long term health effects (e.g. lead, THM's, nitrate). Treatment compromised. Regulatory failure. Disruption to consumers in the supply
5	Catastrophic	Presence of micro-organisms, parasites or substances that are an imminent danger to public health (e.g. E.coli, Cryptosporidium). Treatment compromised. Regulatory failure. Disruption to consumers in the supply

Table 3. Risk Assessment Matrix

			Severity/Impact of Consequence				
			Insignificant	Minor	Moderate	Major	Catastrophic
			1	2	3	4	5
Likelihood	Almost certain	5	5 (L)	10 (M)	15 (H)	20 (VH)	25 (VH)
	Likely	4	4 (L)	8 (M)	12 (H)	16 (VH)	20 (VH)
	Foreseeable	3	3 (L)	6 (M)	9 (M)	12 (H)	15 (H)
	Unlikely	2	2 (L)	4 (L)	6 (M)	8 (M)	10 (M)
	Most unlikely	1	1 (L)	2 (L)	3 (L)	4 (L)	5 (L)

Low 1 – 5, Medium 6 – 10, High 12 – 15, Very High 16 – 25

Table 4. Action to be taken following risk assessment

Risk Classification	Action
Low	Manage using routine procedures, keep under review
Medium	Action required, plan and prepare
High	Priority action required to mitigate hazard in short term
Very High	Urgent action required to prevent hazard (e.g. shut down supply/ boil notice or water restriction), action required to mitigate hazard in short term

APPENDIX 3 ACTION PLAN TEMPLATE

Table 1. Risk Assessment Action Plan

RISK ASSESSMENT – Action Plan			**Revision: A**	**Date:**	
Hazard	As per hazard sheet				
Hazard Ref Number	As per hazard sheet				
Scope of hazard	A brief explanation of the hazard				
Responsibility for putting controls in place	Overall: e.g. Director of Service/ Senior Engineer				
	Local: e.g. Senior Executive Engineer/Executive/Plant Manager				
Estimated Liklihood & Severity	Likelihood: Rating: with brief explanation of reason for the decision		Severity: Rating: with brief explanation of reason for the decision		
Initial Risk Assessment (Refer to Risk Assessment Matrix) e.g Very High				**Calculation of Risk Rating**	
				Likelihood Category	**4**
				Severity category	**4**
				Risk Rating	**16**
Control/ Mitigation Measures Briefly describe the control measures in place. If no control measures are in place, outline the planned control measures with dates. If risk is High or Very High despite mitigation provide an action plan with target dates including long term mitigation measures	1. 2. 3. 4. 5. 6.	Target Completion Date	Actual Completion Date	Action by:	Validated Yes/No
Validation of Control Measures Include brief comment on the validation method for each control measures	1. 2. 3. 4. 5. 6.				
Current Risk Assessment (Refer to Risk Assessment Matrix)	Risk assessment with existing controls in place e.g Very High			**Calculation of Risk Rating**	
				Likelihood Category	4
				Severity category	3
				Risk Rating	12
Sign off	Name:	For High and V High risks, the Director of Service or a suitably qualified person must sign-off			
	Position:				
Target Risk Assessment (Refer to Risk Assessment Matrix)	Risk assessment when future planned controls are in place e.g Low			**Calculation of Risk Rating**	
				Likelihood Category	4
				Severity category	1
				Risk Rating	4
RA Completed by:	Name:	DWSP team member as defined in DWSP			
	Position:				