

Implementation of Alberta's drinking water safety plans

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ABSTRACT

Traditionally, the regulatory approach to maintaining the quality and safety of drinking water has largely been a prescriptive one based on the ability of any given supply to meet standards set for a number of different chemical and biological parameters. There are a number of issues around the assumptions and the limitations of a sampling and analysis regime. The basis for such regimes is essentially reactive rather than proactive and, consequently, the cause of the concern may already have impacted consumers before any effective action can be taken. Environment and Sustainable Resource Development has developed a template for recording drinking water safety plans together with guidance notes to help complete them. The template has been developed in MS-Excel and has been designed in a straightforward step-wise manner with guidance on the completion of each sheet. It includes four main risk tables covering each main element of water supply which are pre-populated with commonly found 'generic' risks and these are carefully assessed before considering what action is required to deal with significant risks. Following completion of the risk tables, key risks are identified and the interventions required to bring them into control.

Key words | implementation, legislation, water safety plans

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INTRODUCTION

Safe, secure supplies of drinking water are essential to all Albertans. Approximately three million Albertans, representing more than 80% of the province's population, receive their drinking water from systems regulated by Environment and Sustainable Resource Development (ESRD). Alberta uses a multi-barrier approach to ensure that safe drinking water is provided to all Albertans. This method is referred to as a 'source to tap, multi-barrier approach'. The term, 'source to tap' refers to the continuum of environments that water passes through – from a water body to the consumer's drinking water tap and is a five-pronged multi-barrier approach consisting of legislation, protection, drinking water systems, performance assurance and knowledge. Detailed risk assessment or risk mitigation may or may not be part of these five prongs but is not a fundamental requirement for any of them.

Traditionally, the regulatory approach to maintaining the quality and safety of drinking water has principally

been a prescriptive one based on the ability of any given drinking water system to meet standards set for a number of different biological, chemical and physical parameters. In Canada, guidelines for drinking water quality are developed and published by Health Canada through a Federal/Provincial/Territorial Committee on Drinking Water. These Guidelines for Canadian Drinking Water Quality are adopted in Alberta and form the basis of the drinking water quality standards used by the province.

The level of disease associated with contaminated drinking water has fallen dramatically over the last 160 years or so, virtually eliminating waterborne illness, but outbreaks still can and do occur with the potential to have severe or devastating consequences for those involved (Rizak & Hrudehy 2007).

These incidents highlight some of the limitations inherent in the 'traditional' regulatory approach. For example, there are a number of issues around the

assumptions and the limitations of a sampling and analysis regime. Further, the basis for such sampling and analysis programmes is essentially reactive rather than being proactive and, consequently, the cause of the concern may already have impacted consumers before any effective action can be taken. From this it is clear that the current governance models being applied to assure the quality of drinking water received by consumers still has some limitations. One approach designed to overcome these limitations is the adoption and use of an approach termed a 'water safety plan' or 'drinking water safety plan (DWSP)'.

WHAT IS A DWSP?

The World Health Organization comments in the fourth edition of their Guidelines for Drinking-water Quality (WHO 2011), 'The most effective means of securing 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 the water supply from catchment to consumer.' Binnie & Kimber (2010) define a water safety plan as 'a location-specific assessment of a water supply system, from the source, or sources, of the raw water through to the points of delivery, considering risks and hazards, means to address and monitor the hazards, and procedures for managing and operating the system under both normal and exceptional circumstances'. This comprehensive risk assessment and risk management approach is termed a 'water safety plan' by the WHO and a 'DWSP' in Alberta.

DWSP – THE ALBERTA APPROACH

A DWSP framework was developed that built on pre-existing regulatory requirements already being complied with by operators.

The compilation of an effective DWSP is dependent on four principal processes:

- Collecting and collating the best information about the water supply system.
- Analysing and understanding the risks that are present and that in certain circumstances will threaten the safety of the supply's customers.

- Assessing correctly what is required to be done in order to reduce risks to an acceptable level.
- Determining how to obtain the necessary resources to achieve this, how to prioritise and audit the tasks that have been identified, and how to deliver the actions within the required timescale.

There are three other important considerations:

- A DWSP cannot work in isolation so the operator must communicate and discuss their findings with the main stakeholders and other relevant parties.
- For the DWSP to work the actions that the operator has identified as necessary to mitigate the risks must be implemented.
- Finally, the DWSP is a 'living document' and should not just sit on the shelf as if to say 'job done'; it should be reviewed regularly and updated when necessary.

THE ALBERTA DWSP

ESRD decided that developing a 'template' which would have pre-populated generic risks for four key risk areas or 'nodes' would be the most effective approach for introducing DWSPs to drinking water systems in the province. The template was built in MS-Excel and consists of a series of worksheets that together comprise the DWSP. Functionality within the template is provided by various macros which collate certain pieces of information into summary sheets (such as risks which have been scored as high) or replicate data entries (e.g., name of the waterworks system).

The DWSP is intended to act as a single source for all of the relevant information about the water supply system. As such, the basic information needs to be entered for each of the four elements of supply – source, treatment, network and consumer. There are five sheets of this type in all – core detail, source detail, treatment detail, network detail and customer detail.

Assessing the generic risks

Each of the four risk sheets – source, treatment, network and customer – have been populated with risks which are

commonly encountered across the water industry in Alberta. The information supplied provides a description of the risk, the hazard that would result from it and the means by which it would happen (also known as 'the causal chain'). In addition to this, the comments box provides additional explanation or background.

In three of the sheets – source, treatment and network – the risks have been grouped into sections to take account of the different types of source, treatment process or component part. If any of these groups do not apply to the system being considered, then a score of zero is entered, signifying that the risk is not applicable. As each risk that is applicable to the system is identified then the other fields on that risk line must be completed. These fields are as follows:

- Current monitoring – existing monitoring that is in place.
- How risk is currently controlled – measures in place now that are helping to control the risk. If not adequate then further intervention will be needed.
- Assess if control is adequate – does the control mitigate the risk?
- Do any standard procedures cover this – are there any standard operating procedures that help control this risk?
- Likelihood and consequence – the probability of the risk occurring and its effects.
- Likelihood and consequence scores – numerical values for quantifying the risk score.
- Risk score – calculated by multiplying the likelihood and consequence scores.
- Required intervention to prevent failure – what needs to be done to mitigate the risk if the score is 32 or greater.
- Responsible party – person who is responsible for delivering the intervention.

Adding other site-specific risks

Once all of the generic risks have been completed the next step is to assess whether the risks described cover all of the risks in the system. When an additional risk is identified it is added to the bottom of whichever supply element risk sheet it applies to. The process is the same as for the generic risks with the additional requirements to describe the risk, the hazard and the cause of potential failure. It is important to have clarity about the difference between the risk (the

probability of something happening) and the cause (what chain of events leads to the hazard materialising).

The key risk sheet

The key risk sheet is essentially a list of all the key risks identified. The key risks are those risks with a risk score of 32 or more and these risks will have become coloured red automatically when the likelihood and consequence descriptions (and scores) are added. The key risks are the most significant risks and they all need to be considered when determining what intervention is necessary to control each risk and reduce it to an acceptable level.

Completing the action plan

The action plan is essentially the summary plan for the mitigation of all of the key risks through the provision of new, or improved interventions (control measures). It is not anticipated that all of the interventions will require capital investment. It may be possible to deal with the risk by changing or adding work procedures, or by providing additional maintenance, or through increased or different monitoring regimes.

It was recognised that due to limited resources, and depending on the nature of the intervention, that not all interventions can be delivered within a short timescale. This means that in the short term there is no decrease in the vulnerability towards these risks.

It would be prudent, therefore, to consider what short-term measures can be taken immediately to provide extra protection. This might include things like increased visual monitoring, changes in alarm settings, additional or modified procedures that take account of the recognised risk. These measures are then entered in the short-term control box.

Next, the main interventions are considered. The description should be an accurate account of what is intended to be done and how this will be achieved and, crucially, who is responsible for delivering it. It may require funding, which should be indicated in the funding box and whether this has been approved, and then entered into the two date boxes when it is expected that the work will begin and when it is expected to be completed.

Maintaining the plan

The most common reason for updating the plan is likely to be to update the action plan following progress with an intervention. When an intervention is delivered it will reduce the likelihood of that risk happening and the likelihood score should therefore be updated. This will in turn reduce the risk score and indicate that this risk is now under control.

Other reasons to update the plan would include any changes made to the water supply system. These might be changes within the watershed, changes to part of the process in the water treatment works or changes to the network.

Should an incident or 'near miss' occur this would also be an appropriate point to undertake a full review of the plan, in part to check whether the risk had been previously identified and was thought to be under full control, or if not identified, why not. Some incidents or events may be relatively easy to predict and may be seen as 'accidents waiting to happen'. Others, however, may be closer to an 'act of God' where a very unusual set of circumstances has resulted in a catastrophic outcome. These sorts of risks are much more difficult to predict and require a fair degree of lateral thinking to anticipate. It is not surprising that they are sometimes missed.

IMPLEMENTATION

Implementation of the DWSP approach required a multi-pronged approach. First, training workshops were developed and delivered to operators and ESRD staff. Through late 2011 and early 2012 a series of 15 workshops able to accommodate up to 35 participants were offered to all municipal waterworks systems operators, and over 251 communities (with over 355 individual attendees) participated in these workshops. This training component continued beyond the provision of workshops with drinking water operations specialists (who act as 'circuit riders' with geographically defined areas within the province) taking the lead role in providing small-group or individual training support to operators. The training elements were critical to the successful implementation of the DWSP.

Changes to various legislative instruments and supporting documents were also required to be made. Following

established departmental protocols the Code of Practice for Waterworks Systems Using High Quality Groundwater and the Code of Practice for a Waterworks System Consisting Solely of a Water Distribution System were revised and formally issued to affected facilities. Notices of change were issued to waterworks systems operating under an approval, and the standard approval template used to issue new or revised approvals was changed to reflect the DWSP requirement. The Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems were also revised to take account of the new DWSP requirements and these published in April 2012. In addition, ESRD established a webpage where the DWSP template, supporting documentation and training materials for self-directed training could be accessed (www.environment.alberta.ca/apps/regulatteddwq/dwsp.aspx) and a dedicated email account (aenv.dwsp@gov.ab.ca) to allow questions specifically related to DWSPs to be sent. All these elements were completed within eight months and were achieved through the coordination and cooperation of many areas within ESRD. All drinking water systems regulated by ESRD have a requirement to complete and maintain a DWSP by December 31, 2013.

ESRD will review the DWSP template after the initial completion date of December 31, 2013. Part of the ongoing commitment to the adoption of this policy direction is to develop and adopt a process of 'continual improvement' both to the content of the template but also to the mechanistic elements (such as the macros). Undoubtedly, there will be risks included in the present version of the template that do not warrant being retained as 'generic' risks and, conversely, there may be system-specific risks that appear often enough to be adopted as generic risks in future template revisions.

CONCLUSIONS

Alberta is the first province in Canada to introduce a regulatory requirement to have DWSPs for all regulated municipal drinking water systems. This requirement is thought to be the first such requirement in North America. As a leader in drinking water regulation and innovation for over 40 years, Environment and Sustainable Resource Development

has eagerly embarked on the adoption, implementation and ongoing development of DWSPs as part of the department's ongoing commitment to Albertans to ensure they have a safe and secure source of drinking water for their own health and the economic health of Alberta's communities. The approach developed in Alberta will be of interest to other jurisdictions looking to adopt the DWSP concept where issues of capacity constraints, geographic remoteness and lack of resources may have been considered as significant barriers to successful adoption. ESRD has demonstrated that it is possible to develop and implement DWSPs for all communities provided there is appropriate consideration given to the needs of the end-users and a commitment to ongoing partnerships with communities to support the implementation of the DWSP approach.

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REFERENCES

- Binnie, C. & Kimber, M. 2010 *Basic Water Treatment*, 4th edn. Thomas Telford, London.
- Rizak, S. & Hrudehy, S. 2007 Strategic Water Quality Monitoring for Drinking Water Safety. The Cooperative Research Centre for Water Quality and Treatment. Research Report 27.
- World Health Organization (WHO) 2011 *Guidelines for Drinking-water Quality*, 4th edn. World Health Organization, Geneva, Switzerland.

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