Sewerage management guidelines

EPA VICTORIA | Environment Protection Authority Victoria

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Guideline

Management of sewerage systems in Victorian environmental legislation

Under the *Environment Protection Act 1970* (the Act), discharges to the environment must be managed so that they do not adversely affect the receiving environment. The Act includes requirements for works approval and licensing, administered by Environment Protection Authority Victoria (EPA), to ensure the appropriate control of such discharges.

The Environment Protection (Scheduled Premises) Regulations 2017 outline the premises and activities that are scheduled and subject to the works approval and licensing provisions of the Act. These regulations also provide for exemptions from these provisions for certain, otherwise scheduled, activities and premises.

While sewage treatment plants are subject to these requirements, the regulations identify that works approval and licences are not required for discharges to land or water from an emergency relief structure or other installations in the sewerage system. Sewage treatment plants have ongoing discharges during operation whereas emergency relief structures or other installations allow controlled spilling when the capacity of the sewerage system is exceeded.

When such spills do occur, they can pose serious environmental and human health risks. Untreated sewage discharges to waterways can exert physical, chemical and biological impacts on the receiving environment, resulting in human health, environmental and aesthetic risks which can be both acute and cumulative. Such events can be liable for pollution offences under the *Environment Protection Act 1970*.

The State Environment Protection Policy (Waters) (SEPP (Waters)) places statutory obligations on water corporations to minimise the risk of sewer overflows, leakages and collapses on the environment. These obligations are defined in Clause 27 of SEPP (Waters).

Clause 27 requires water corporations to implement measures to reduce losses of wastewater through sewer overflows, leakages and collapses. This clause also provides for a containment standard as a benchmark for industry to manage systems. While this containment standard can be achieved for new infrastructure, there is recognition that water corporations need to progressively upgrade existing infrastructure over time, with priority given to areas that pose the greatest risk to beneficial uses. In particular, SEPP (Waters) identifies that water corporations must upgrade existing sewerage infrastructure to meet this containment standard, *'so far as reasonably practicable'.*

The concept of 'so far as reasonably practicable' is intended to be used to support decision making by a water corporation on taking the appropriate measures to mitigate risk. The risk assessment requirements are defined in Clause 12, which states:

> *(1) Where this Policy requires actions or management practices to minimise risks to beneficial uses, so far as reasonably practicable, this means actions or management practices must have regard to:*
>
> *(a) the likelihood of those risks eventuating; and*
>
> *(b) the degree of harm that would result if those risks eventuated; and*
>
> *(c) what the person concerned knows, or ought to reasonably know, about the harm or risks of harm and any ways of eliminating or reducing those risks; and*
>
> *(d) the availability and suitability of ways to eliminate or reduce those risks; and*
>
> *(e) the costs of eliminating or reducing those risks.*

Purpose

These guidelines provide information to water corporations to support the effective risk management of sewer overflows and leakages to the beneficial uses of receiving waters, consistent with the obligations established by SEPP (Waters). In particular, the guidelines advise how water corporations can demonstrate that they are managing risks from their sewerage systems 'so far as reasonably practicable' in instances where their infrastructure is not meeting the containment standard in Clause 27.

The focus of the guidelines is to describe suitable approaches to managing the risk of sewage spills or leakage from a sewerage system, rather than prescribing what must be done and how.

After the *Environment Protection Act 2017* commences in 2021, these guidelines will need to be revised to align with the new regulatory framework. However, the content presented in this version is expected to support water corporations as they transition to the new regulatory framework and the introduction of a general environmental duty.

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1. Objectives

The objectives of these guidelines are to:

- assist in reducing risks of sewage discharges, including the potential adverse impacts on beneficial uses in receiving waters.[1]
- clarify expectations as to how water corporations should manage sewage containment.
- provide clear guidance on how water corporations can meet their obligations in SEPP (Waters) for sewerage system management. In particular, the guidelines provide guidance regarding how reasonably practicable measures can be identified and implemented to minimise the risks to and impacts on beneficial uses from sewage containment failure.

In support of these objectives, the guidelines set out measures that the water corporation could take to reduce, and to demonstrate that it has reduced, so far as reasonably practicable, the risk of failure to contain sewage within a sewerage system.

The guidance provided by the guidelines is not prescriptive. A water corporation is always expected to use its best judgement in its management of sewage containment risk. However, in designing and delivering its risk management, the water corporation should have regard for the approach set out in these guidelines. The degree to which a water corporation can demonstrate that it has followed the guidelines may be taken into consideration by EPA when assessing culpability consistent with its Compliance and Enforcement Policy.[2]

[1] 'Beneficial Uses' are prescribed in Schedule 2 of SEPP (Waters)

[2] EPA Victoria (2011) *Compliance and Enforcement Policy* (EPA Publication 1388)

2. Scope

The scope of the guidelines is limited to the containment of dry and wet weather flow in gravity, and pressure sewerage systems, including assets associated with sewer renewal and network expansion as well as existing assets. The inclusion of existing and future network performance within scope requires sewerage system risk management to consider various future influences, such as population growth and altered rainfall scenarios associated with climate change.

These guidelines recognise that there will be circumstances in which implementing measures ‘so far as reasonably practicable’ may not yield a satisfactory outcome. Other than high level commentary, discussion on the actions which should be taken by a water corporation in these situations is outside the scope of these guidelines. These guidelines define the steps a water corporation would need to demonstrate it had followed, prior to any alternative measures being considered.

3. Sewerage management risk framework

These guidelines assume that all water corporations operate:

- an asset management system that complies with the mandatory requirements of the Victorian Government's Asset Management Accountability Framework (AMAF), which is aligned with ISO55000; and
- a risk management system that is consistent with ISO31000:2018.

As such, it is expected that the recommended process and measures within these guidelines will be incorporated in existing water corporation quality management systems.

A high-level representation of a generic risk management framework, adapted from clause 5 of ISO31000, is shown in Figure 1.

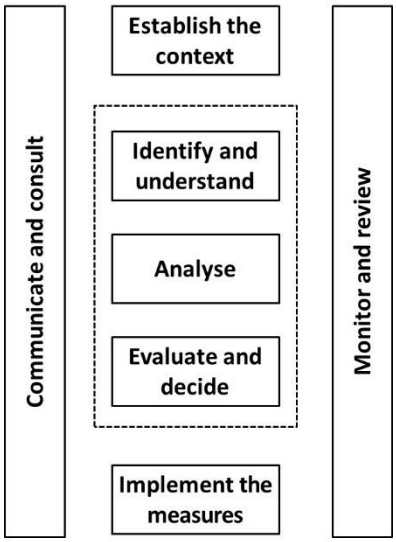

Figure 1 The framework for managing risk

The framework for managing risk includes a process comprising five step-wise stages (which are: 'establish the context', 'identify and understand', 'analyse', 'evaluate and decide', and 'implement the measures'). The process also includes two concurrent stages (which are: 'communicate and consult' and 'monitor and review'). These are discussed later in this section.

The water corporation is expected to use this risk framework, as it applies to sewerage system management, to manage the full range of potential impacts on beneficial uses. The framework should be applied to all aspects of managing sewage flow containment (including gravity and pressure systems).

Application of the risk management framework

This section provides guidance on how the framework in Figure 1 should be applied. In applying this framework, water corporations should consider the following objectives:

Dry weather:

- Maintain performance of the system in such a way as to avoid chronic (i.e. persistent) leakage. This means providing assurance that asset management practices (including monitoring performance) proactively and adequately manage this aspect of performance as a specifically defined Level of Service.

- Establish and maintain asset management practices (including those relating to operations and maintenance) which, so far as reasonably practicable, are effective in avoiding acute containment failures (collapses, blockages, operational failures, etc.).

Wet weather:

- Maintain the capacity of the sewerage system to meet the 'containment standard'[3]; and/or
- Where achievement of the containment standard is assessed as not being appropriate then develop, implement and maintain, so far as reasonably practicable, a risk-based process that achieves reduced impacts on beneficial uses consistent with alternative measures (i.e. other than the containment standard) established with input from relevant stakeholders and EPA.

All conditions:

- Establish and maintain operational management practices that are (so far as reasonably practicable, for all containment failure events, considering dry and wet weather flows) effective in:
    - minimising impacts where an event occurs.
    - communicating appropriate notifications, instructions and advice to help minimise impacts on beneficial uses in a timely manner; and
    - timely clean-up and restoration.

3.1 Stage 1 - Establish the context

As a first step, the water corporation should establish the appropriate context for managing sewage containment risks within its own sewerage system. At the organisation-wide level, a corporate risk management system aligned with ISO31000 will identify the internal and external contexts, including stakeholders, as well as the risk management context. Most, or all, water corporations will already have a well-developed and well-communicated understanding of this high-level organisational context.

The primary components of the sewerage system management context, which adds specific detail to the organisational context, are:

- a sound understanding of the physical environment
- clarity of generic risk objectives, including appetite and tolerance
- understanding of emerging regional or broader issues (e.g. water based recreation in Port Phillip Bay).

3.1.1 Understanding the receiving environment

The water corporation will require a sound 'base-level' understanding of the physical environment. This should derive from but not be limited to:

- comprehensive mapping of sewerage system assets
- an understanding of the extent to which failure to contain sewage may have an impact on beneficial use(s) of receiving waters
- asset management data (condition monitoring, inspections and/or analysis) which identifies parts of

[3] The 'containment standard' is defined in clause 27 of SEPP (Waters) as requiring the containment of flows associated with at least an '18.1% Annual Exceedance Probability (AEP). In previous statutory policies, this was defined as a '1-in-5-year rainfall event', however, this was updated in SEPP (Waters) to adopt more contemporary terminology for assessing the probability of rainfall events while retaining the equivalent standard.

the sewerage network which are, or may be, structurally compromised or otherwise have an increased susceptibility to failure

- hydraulic modelling calculations/systems which identify parts of the sewerage network where capacity is, or over a prudent planning horizon may become, inadequate or marginal due to future growth of the sewerage system or catchment, and/or other changes that might influence hydraulic load and system capacity
- condition modelling which identifies parts of the sewerage network where structural integrity may, over a prudent planning horizon, become, inadequate or marginal
- stakeholder consultation processes which identify beneficial uses that are valued by stakeholders (including customers, community groups and relevant regulators)
- failure rate of mains electricity supply (in locations where this is important)
- other sources, including those related to technological advances and emerging issues.

This understanding of the physical environment should include input from established and capable processes that:

- identify containment failure events
- capture relevant details about the cause and extent of the failure event
- measure and report the impact both initially and over time (including in response to any risk mitigation measures)
- seek input from the customers and other relevant stakeholders.

The base-level understanding described above is fundamental for the next stage of the risk process, which seeks to identify and understand localised hazards related to sewage containment.

How much 'base-level' understanding is enough

The level of detail in the base-level understanding that the water corporation has of the physical environment, and the richness and comprehensiveness of data underpinning it, is a matter for the individual water corporation to decide.

Choices will depend on the likelihood and environmental impact of any potential containment failures across the region, the extent of the system, the historical performance of the sewerage system, the performance of similar systems/assets in other areas (where similarities are sufficient to allow comparison, including across Victoria and Australia where relevant), the characteristics of the sewage being managed, and the expected future growth of the network and catchment. The target extent and quality of base-level understanding that a water corporation identifies as appropriate may require some years to establish; a plan should be prepared and used to manage the transition.

The water corporation should ensure it has sufficient base-level information to adequately direct more detailed risk assessment of any particular asset or sewerage system (as discussed in the following sections of these guidelines). Where the base-level understanding is deemed insufficient to inform strategic decision making, additional understanding should be sought (and appropriate operational measures implemented) before more detailed risk assessments are completed. Where this is not possible, risk assessments should draw on the available data and incorporate scientific and engineering expertise, but otherwise should consider a range (including 'worst case') of likelihoods and impacts.

The better the base-level understanding of the physical environment, the better the water corporation can tailor its risk management measures for specific locations and risks, leading to better outcomes.

Some sources useful for establishing the context

Establishing the context involves gathering and interpreting data that is relevant to the impact of sewage containment failures. Sources may include:

- customer sensitivity to spills in receiving waters
- community impacts of spills in receiving waters
- the configuration and condition of the system (including asset maintenance and inspection procedures)
- the locational details of the sewerage network assets
- historical overflow events (including location, volume, duration and frequency)
- operational and maintenance practices (including incident response and reporting procedures)
- operational controls and real time monitoring
- system analysis and modelling
- lessons learned from previous spills and continual improvements made
- emerging government or regulatory policy developments
- literature reviews
- the experience of other Victorian and Australian water corporations
- catchment management plans and strategies
- extent of inflow and infiltration
- adverse impacts on beneficial uses in receiving waters
- receiving water condition assessments
- management goals for waterways that may be documented in regional waterway strategies and regional catchment management strategies.

3.1.2 Corporate objectives, appetite and tolerance for risk

EPA expects that the water corporation will have clear documentation of its risk objectives for sewerage system management at a corporate level. This documentation will also cover the water corporation's appetite and tolerance for risk.

- appetite for risk may be represented in terms of what is acceptable as an appropriate balance between cost and outcomes.
- tolerance for risk may be represented as the thresholds beyond which – for various categories of risk – a risk-event is wholly unacceptable and to be avoided to the maximum extent possible.

3.1.3 Emerging regional or broader issues

Through consultation with stakeholders, the water corporation should ensure emerging regional or broader issues relevant to sewerage management, including changes in government policy, are understood.

3.2 Stage 2 - Identify and understand

The second stage of the risk assessment process builds on the information used to establish the context (in the previous stage). It proactively and systematically identifies individual location-specific hazards in each of the containment failure categories shown below.

Categories of containment failure:

Dry weather – chronic

- Leakage
- Cross-connection ('stormwater to sewer' and 'sewer to stormwater' are both failures).

Dry weather – acute

- Operational error
- Structural collapse or other failure
- Blockage
- External party impact
    - Damage to sewer network
    - Unauthorised discharge (including unauthorised or 'out of specification' trade waste).

Wet weather spills

- Insufficient hydraulic capacity - either under existing conditions or under anticipated future conditions over the planning horizon and service life of the system associated with:
    - growth in sewage flows caused by population growth within the catchment, and changes to rates of Inflow and Infiltration; and
    - climate change impacts.
- Failure (of pump station or other sewer network asset) to adequately manage containment of sewage flows within the system under wet weather conditions.

Together with the requirement for identification of risk is the requirement to understand those risks.

The water corporation has an obligation to:

- take all reasonable steps to identify and understand the risks relating to the failure of sewage containment
- understand, within the available state of knowledge (see section 3.4.2.2), the nature and degree of harm that a risk may cause, how the harm can eventuate and the likelihood of that harm occurring.

The water corporation will often have to carry out investigations and analyses in the course of a risk assessment to gain this understanding. However, the water corporation is not expected to put in place comprehensive, system-wide monitoring programs on a 'just in case' basis, but rather to adopt a targeted, risk-based approach.

The water corporation should seek to engage with the relevant waterway manager (or other relevant stakeholders) to improve its understanding of the receiving environment, both from the perspective of contextual understanding and of elevated monitoring results that may indicate containment failure.

3.3 Stage 3 - Analyse (likelihood and impact)

The analysis stage of risk assessment must be supported by an appropriate level of understanding; this may require additional investigation beyond the base-level understanding discussed in relation to the 'establish the context' stage (see section 3.1).

Analysis should be based on evaluation of likelihood and impact to receiving waters and include the measurement of system performance under repeatable operational (or event) scenarios over the full system service life planning horizon designed to demonstrate the capability of the sewerage system to contain sewage.

For each category of containment failure (see section 3.2), one or more operational (or event) scenarios is designed to test the sewerage network against a particular objective. These are shown in Table 1.

Table 1 The objectives that the scenarios are designed to test

Category of risk event	Objective of the operational (or event) scenario. ***The scenario is designed to test for…***
Dry weather spills – Chronic	• The containment of peak dry weather flow, including groundwater infiltration. • The existence and level of cross-connection contamination. • Ongoing exfiltration (leakage) to groundwater. • Potential damage to assets from contaminants/illegal discharges.
Dry weather spills – Acute	• The containment of sewage during asset/operational failure events. • The containment of sewage during power failure events.
Wet weather spills	• The containment of sewage during "critical" storm events, including groundwater infiltration, stormwater inflow and other sources of infiltration.

Dry weather spills – Chronic

The water corporation should use the operational (or event) scenario to test the capacity of the sewer to contain peak dry weather flows, both currently and in projected future flow scenarios. This 'test' will change as a catchment develops and/or as commercial and industrial discharges change and will be specific to each sewer catchment and sub-catchment.

The validity of a chronic dry weather test should be confirmed through calibration of models and observed performance of the sewer (i.e. history of dry weather spills and measured contamination of stormwater systems/waterways). The water corporation should also use condition assessment and modelling to identify parts of the sewerage network where structural integrity is, or may become, compromised, leading to chronic dry weather spills.

Due to their low volumes, cross-connection contamination and system exfiltration cannot typically be modelled in a scenario, and instead must be measured. The test of chronic sewage cross contamination and exfiltration is the presence of indicators (pathogens, chemicals, odour) in stormwater drains and waterways during dry weather conditions. The presence of a sewage indicator may illustrate the failure of the sewerage system.

Root cause analysis of system failure should inform the likelihood of sewers failing in the water

corporation's network which are managed under a similar asset inspection and maintenance program.

Analysing the impact of chronic dry weather spills does not require the water corporation to conduct comprehensive, pre-emptive monitoring of all waterways. In some instances, waterway managers or local councils may have their own reports or suspicions of chronic sewage containment failure and this can be used to support an understanding of risks.

To develop a monitoring approach that is achievable and appropriate to the level of risk being managed, the water corporation should work in co-operation with waterway managers. It is important to note that while a waterway manager might have expertise that can support the identification of chronic dry weather spills, the responsibility for understanding the integrity of the sewerage network always rests with the water corporation.

In assessing risks of dry weather spills, a water corporation should consider:

- infrastructure characteristics (e.g. condition, number of joints/sewer crossings/drains, soil type etc.)
- land use
- local impact on beneficial uses of the receiving waters (e.g. environment, recreation and amenity)
- downstream impacts
- age of assets
- previous history of failure
- proximity to waterways or drains.

Dry weather spills – Acute

The water corporation should use the operational (or event) scenario to test the ability of its sewerage system to contain sewage during operational and/or asset failure scenarios. EPA expects that a water corporation should have an adequate sewerage inspection and maintenance regime in place.

The adequacy of maintenance programs, alarming, and operational practice should be used to identify the likelihood and impact of an operational or asset failure occurring in its network, prioritised for those parts of the network at higher risk and/or known to have elevated rates of containment failure. Incident scenarios are a useful way of testing hypothetical combinations of hazards and can quickly identify the elements of the sewerage network at highest risk of acute containment failure.

The validity of a dry weather (acute) test is demonstrated in the effectiveness of the water corporation's ability to prevent and control dry weather spills in its network. If the water corporation has a history of low numbers of spills (and preventing impacts to beneficial uses when spills do occur) then this can indicate effective spill management.

The water corporation should also use condition assessment and condition modelling to identify parts of the sewerage network where structural integrity is or may become compromised, leading to acute dry weather spills. For both chronic and acute dry weather spills, the focus should be on appropriate asset management, together with appropriate preparedness for those blockages that will – in line with risk management expectations – sometimes occur.

Wet weather spills

In respect of testing wet weather spill containment, the water corporation should define one or more appropriate rainfall events as the operational (or event) scenarios [4] and apply these 'tests' consistently across similar elements of its sewerage network (e.g. reticulation, branch, or trunk sewers with similar topography and asset condition).

The rainfall event(s) should be based on the application of appropriate techniques consistent with the guidance provided by the most recent edition of the Australian Rainfall and Runoff (AR&R) national guidelines [5], using all relevant source data, including data issued by the Australian Bureau of Meteorology; the data used (including year of publication) should be contemporary.

Modelling of rainfall events by the water corporation should always refer to the directives of AR&R guidelines or any other relevant advice or guidance provided by the Victorian Government. Furthermore, the assumptions around catchment conditions (antecedent conditions), and coincident dry weather flow, should be explicit and applied consistently.

The intent of the definition of rainfall and antecedent conditions should be to establish the event which would lead to a spill with the highest consequence (i.e. the greatest impact on beneficial uses). The water corporation should consider the range of outcomes from available rainfall models and provide the rationale for its choice of models. In the event that guidance is issued by government regarding the most appropriate rainfall datasets to employ, these should be adopted by the water corporation.

The outcomes of an appropriately designed system test should provide assurance to the water corporation regarding the network's ability in all lesser scenarios and in other locations across the network that the model identifies as less susceptible to spills. Critically, the test(s) should be applied consistently from one year to another in order to enable comparison over time. Where there is a need to modify or change a test, the old and new tests should both be used for a crossover period sufficient to enable comparison over time.

The water corporation should verify, on an ongoing basis, the suitability of its chosen tests, including assessing changes to relevant parameters such as land-use, population growth and climate change. This should be done by comparing actual containment performance with that predicted by the relevant test. For example, if wet weather spills occur more frequently than predicted using a particular test, then this may indicate a different test would be more appropriate, or that model recalibration is necessary. For dry weather containment, review of the performance of the incident management system (including incident debriefs) should be used to examine whether actual responsiveness and control matched the expected levels.

Potential impacts to consider in the analysis stage

The water corporation should involve relevant stakeholders including EPA, risk managers, technical and scientific experts, resource managers, waterway managers and other relevant stakeholders during risk assessment to ensure a consistent understanding of the impacts that should be considered (including those at a regional or broader level).

Minimum impact considerations should include:

- all beneficial uses that are to be protected in the area
- aquatic ecosystems

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[4] The term '18.1% AEP' does not provide sufficient definition of the test scenario. The definition would need to articulate whether this was a short duration rainfall event or prolonged (over 36 hours, for example) and whether occurring in a dry catchment or one that is already wet).

[5] According to http://arr.ga.gov.au (accessed June 2018) "The digital delivery of ARR 2016 allows progressive updates to be made immediately for minor updates and the edition will not be updated. When major updates occur, the year will change in the title."

- biodiversity
- macroinvertebrate communities
- native fish populations
- threatened flora and fauna
- recreational uses of the waterbody (including aesthetics, and primary and secondary contact)
- human health
- amenity
- water extractions, including for human consumption.

3.3.1 Analysing likelihood

Likelihood should be assessed in the context of all existing measures and controls, including management, maintenance and operational practices. To the extent that adequate local historical data is insufficient or inadequate, it should utilise validated tests and incorporate the findings from tests (or observations) made on similar systems in Victoria and elsewhere in Australia.

3.3.2 Analysing impact

Impact (consequence) should be evaluated based on the assumption that all existing measures and controls – including management, maintenance and operational practices – are in place and operating correctly.

The water corporation should establish the environmental sensitivity of locations throughout its service area. This should consider, without limitation:

- how far the impact might extend spatially; whether it might cover a small area or a large area
- the sensitivity of the receiving environment, including human exposure
- how long the impact might endure; whether it might dissipate quickly or be felt for a much longer time.

In respect of the last point, many factors can be relevant at a particular site, including:

- compliance history
- seasonal variation in flows (or longer-term variation in flows due to drought)
- ecological cycles
- changes in catchment land use patterns which may affect inflow and infiltration, and hence system containment capability
- changes in waterway condition
- climatic variability.

The range of potential impacts to be considered should include all beneficial uses. Furthermore, to account for current and emerging beneficial uses, the water corporation should continually review containment effectiveness with stakeholders, and address risk as land use within a catchment develops and hydrology changes. As far as possible, the impact of a sewage spill should be measured objectively rather than subjectively. Impact should be gauged in terms of the change in a specific scientific/ecological process or an impact on beneficial use.

Many discussions on environmental impact are beyond the comprehension of the general public. Consequently, these impacts are often translated into descriptions of 'endpoints' (for instance the endpoint of 'safe to swim' is generally more understandable than a measurement of *E.coli* levels). The use of endpoints is appropriate if they can be effectively and understandably linked to beneficial uses, and the impact of the measures adopted by the water corporation to improve containment can be shown to have an effect on that endpoint.

Whatever approach is adopted, the water corporation should be capable of demonstrating the effectiveness of its impact assessment program, including effective monitoring programs and community engagement programs.

3.4 Stage 4 - Evaluate and decide

The evaluation stage interprets the analysis work described in section 3.3 through the use of a framework (such as a likelihood – impact matrix that will be discussed in section 3.4.1). It then considers available measures to mitigate risk, their costs and the overall value for money that each represents, before a decision is made. Some measures are more desirable than others, and decisions as to which risk reduction measures are most appropriate to adopt must consider relevant criteria. A prioritisation process should be used to help determine the sequence for implementing the relevant measures.

3.4.1 Risk evaluation

The likelihoods and impacts analysed earlier for each risk should be evaluated in a way that allows comparison. The usual approach is to use a likelihood – impact matrix consistent with ISO31000 (an example can be found in *Assessing and Controlling Risk: A Guide for Business* [6]). Such a likelihood – impact matrix is useful for grouping risks in the categories of 'Low', 'Medium', 'High' and 'Extreme'. Each category of risk will attract different breadth and depth of risk mitigation measures, as discussed in Section 4 of these guidelines.

In some instances, the need for measures to mitigate risk, as well as the nature of the appropriate measure, may be 'obvious' (based on an existing thorough and generic understanding) without detailed analysis of the specific instance; the guidelines do not require extensive analysis in such situations.

It is acknowledged that within a water corporation, categorisation decisions must be completed consistently to enable prioritisation of risk (and therefore action), noting that the application of the framework should account for different asset types. Each water corporation is expected to employ a risk evaluation matrix relevant to its particular context and business practices. These guidelines do not prescribe a form of the matrix, allowing the water corporation to adopt a format that is in keeping with its corporate risk management framework.

3.4.2 Deciding on measures to mitigate risks

These guidelines are concerned with assisting water corporations to apply risk management measures which are 'reasonably practicable'. Clause 12 of SEPP (Waters) (excerpt of which is repeated in Box 1 below) provides guidance regarding what should be considered in any assessment of reasonably practicable. This section of the guidelines provides additional guidance on the requirements of Clause 12.

[6] EPA (2018) *Assessing and Controlling Risk: A Guide for Business* (EPA Publication 1695)

Box 1: Excerpt SEPP (Waters) Clause 12

SEPP (Waters) Clause 12 (Excerpt)

Where this Policy (SEPP) requires actions or management practices to minimise risks to beneficial uses, so far as reasonably practicable, this means actions or management practices must have regard to -

(a) the likelihood of those risks eventuating; and

(b) the degree of harm that would result if those risks eventuated; and

(c) what the person concerned knows, or ought to reasonably know, about the harm or risks of harm and any ways of eliminating or reducing those risks; and

(d) the availability and suitability of ways to eliminate or reduce the risk; and

(e) the costs of eliminating or reducing those risks.

3.4.2.1 Understanding the severity of a risk, and benefits of removal/mitigation

A water corporation should understand the risk (i.e. the likelihood and degree of harm if the risk eventuated) being managed through implementing the previous steps of the ISO31000 process, namely 'identifying and understanding', and 'analysing' the risk.

3.4.2.2 Understanding the risk and options for removing/mitigating the risk

For the water corporation to be in a position to implement 'Best Practice', it will need to maintain a current awareness and understanding of the **state of knowledge.**[7]

The extent to which a water corporation may be judged to have acted 'so far as reasonably practicable' will, in most cases, depend on it having been aware of, and acted consistently with, the relevant state of knowledge.

A water corporation that is aware of, and has acted consistently with, the relevant state of knowledge, will also be expected to have implemented appropriate systems and processes.

The state of knowledge includes environmental regulation, EPA guidelines, other legislation that relate to the identified risk, technical standards, materials from other reputable environmental regulators, industry guidelines, relevant published scientific and technical literature.

It is incumbent upon the water corporation to determine how and to what extent best practice is applicable to the management of its identified sewage containment risks.

Best practice standards and what is reasonably practicable in the adoption of environmental management practices may change over time; accordingly, practices taken in accordance with this policy must include the pursuit of continuous improvement.

3.4.2.3 Availability, efficiency and suitability of options to mitigate risk

A key principle in the approach to reducing the impact on beneficial uses is the application of a 'hierarchy of controls'. This concept is embedded in ISO31000 and is used widely in various forms; the version shown in Figure 2 is taken from *Assessing and Controlling Risk: A Guide for Business* (EPA publication 1695) and adapted to illustrate the type of risk mitigation measures which would be typical at each level of the hierarchy.

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[7] The term 'state of knowledge' means what the water corporation knows, or ought reasonably to know, about a hazard or risk and the ways of eliminating or reducing the hazard or risk.

Risk management measures within a higher level of the hierarchy of controls are preferred over those in a lower level. For example, elimination is preferred over substitution. It is also noted that risk management measures may have multiple benefits, making them more attractive to manage both wet and dry weather containment (e.g. relining sewer pipes).

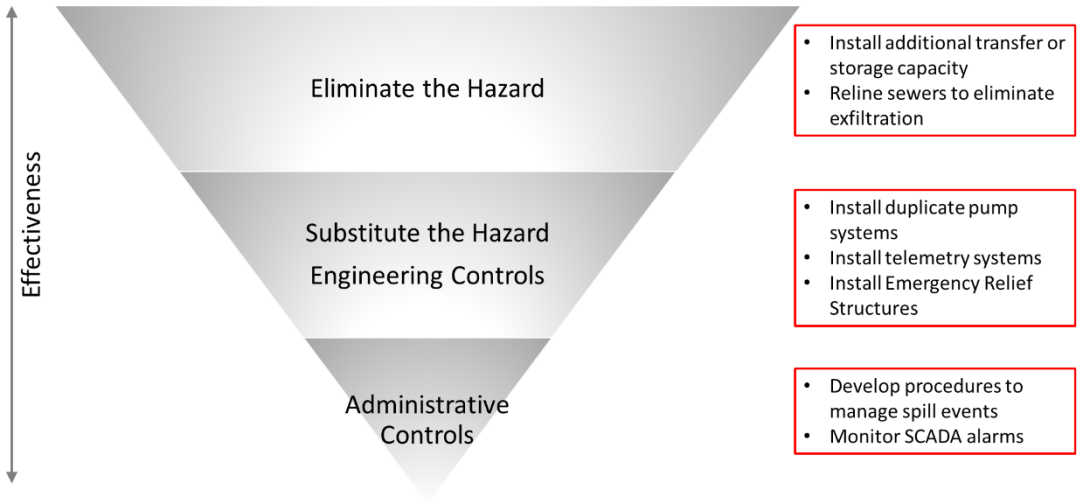


Figure 2 The hierarchy of controls applied to sewerage management

Practical sewerage management principles to consider

In parallel with the hierarchy, several practical factors should guide the choice of risk management measures by water corporations. These include the degree to which the risk management measures have the potential to:

- eliminate the hazard (e.g. an increase in sewer capacity can reduce the risk of a wet weather spill, or a pipe relining can eliminate a chronic dry weather leakage)
- lessen the risk (e.g. a new relieving sewer can make (less reliable) pump stations redundant, and additional network storage can be installed to reduce the risk of spills during power outage)
- result in a risk which is better (or worse than) the containment standard in Clause 27 of SEPP (Waters) (e.g. what is the 'base case' action that a measure to mitigate risk should be compared with)
- be long lasting and flexible (e.g. a new (larger) sewer is more capable of managing future changes in flow for a longer period of time)
- be implemented with minimal disruption to the community.

These principles are explored in Appendix A.

3.4.2.4 The financial and social costs and benefits of removing or mitigating risk

Ideally, a cost-benefit analysis[8] would be used to help inform decision making, with costs and benefits in current and future years discounted to the present day using an appropriate discount rate. However, this can be challenging in situations where different measures with different outcomes are being evaluated.

[8] Cost-benefit analysis is the preferred assessment framework for many public sector decision-making bodies, including the UK Treasury, the Canadian EPA and the US EPA. Useful material may be found in their publications.

Another approach is to engage the community impacted by the risk; their views can help guide an understanding of the appropriate trade-off between costs and benefits (within the constraints of non-negotiable regulatory requirements).

The question of whether a measure qualifies for implementation (under the 'so far as reasonably practicable' principle) is to be determined objectively with reference to multiple considerations including:

- the expectations of customers, the community and relevant stakeholders in relation to achieving tangible improvements in environmental outcomes
- achieving alignment with customer and community priorities and preferences
- ensuring that measures implemented are commensurate with the level of risk posed to the environment and human health
- achieving an appropriate and agreed balance between improvements in environmental outcomes and maintaining affordability in customer bills (see below), and
- not solely by reference to the capacity of the water corporation to pay or other particular circumstances.

EPA acknowledges that in exceptional circumstances meeting the containment standard will not be reasonably practicable. In such circumstances, the water corporation may want to consider adopting alternative measures to the containment standard on the grounds of maintaining affordability in customer bills while achieving an improved environmental outcome. An effective means of meeting this obligation should involve:

- consult with all relevant stakeholders including those specifically affected by the containment failure of the asset or network in question, as well as stakeholders more broadly
- ensure such stakeholders are able to offer informed input to the decision-making process, including by providing them with expert briefings where appropriate
- illustrate, with the support of its stakeholders, that the measures to achieve the containment objective, if implemented, would be unaffordable
- consult and seek feedback from EPA prior to adopting alternative measures (see section 5.2.1).

If there are multiple options available for eliminating or reducing a risk, and each can be expected to achieve the same level of reduction in likelihood or degree of harm, the water corporation may choose the least costly option. However, where a low-cost option provides less protection and is chosen simply because it is cheaper, the decision is unlikely to be considered to have followed the 'so far as reasonably practicable' principle.

The costs of implementing a particular control may include costs of purchase, installation, maintenance, operation of the control measure and any impact on productivity as a result of the introduction of the control measure. A calculation of the costs of implementing a control measure must also take into account savings from fewer containment failure incidents.

In all cost-benefit appraisals, the future costs and benefits associated with the proposed controls are compared against the future costs and benefits associated with existing controls; it is the difference that matters.

3.5 Stage 5 - Implement the measures

This stage relates to the implementation of the measures selected. Implementation may relate to the application of suitable resources to plan, construct, commission and/or operate risk management measures. As such activities are a core capability of water corporations, they are not discussed in this guideline.

Concurrent stages of the framework

Section 3.6 and 3.7 relate to the two concurrent stages of the framework presented in Figure 1, being to 'monitor and review', and 'communicate and consult'. These stages are presented as being concurrent as they should occur throughout and during the other stages of the framework.

3.6 Stage 6 - Monitor and review

The ISO31000 framework embeds the expectation that the performance of the risk management process will be overseen through a process of continual monitoring and review of process and performance outcomes. Implicit in this process is the requirement for an effective monitoring program, a structured approach to the review of performance, and a structured approach to feedback/converting experience into knowledge, leading to improvements in the systematic approach to risk management and its outcomes.

3.6.1 Monitoring

The extent of monitoring (and data collection) undertaken should be appropriate to the level of risk being managed. For example, monitoring should be more intensive for sewers located near sensitive waterways. This may include more frequent and more reliable monitoring, with the use of additional or more accurate sensors. The extent of monitoring should also take into account the likely effectiveness of the controls implemented against a particular risk.

Controls that are put in place to prevent or mitigate risks must be monitored to ensure they work as planned and are effective in reducing risks. Where administrative controls are implemented, increased monitoring is needed to reflect the likelihood that such controls will have a lower effectiveness over time (in contrast with measure higher in the hierarchy of controls).

Checking controls

Common methods that should be used to check the effectiveness of controls are:

- regular site inspections and audits
- consulting with employees, contractors, occupants and landlords to understand if controls have worked
- inspecting, testing and maintenance of risk control systems
- using available information, such as manufacturer/supplier instructions
- analysing records and data, such as incident reports, near miss reports and continuous flow data.

Checking these controls on a regular basis enables failures in controls and opportunities for improvement to be identified.

Maintaining effective controls

The following should be put in place to maintain controls and ensure they stay effective:

- review hazards and risk assessments regularly as these can change over time
- regularly review, test and maintain all engineering controls
- regularly check the correct operation of, and re-emphasise the purpose of, all administrative controls
- allocate responsibility and accountability for risks and their controls
- regular consultation with employees and other stakeholders such as insurance providers and

emergency services

- clear and effective communication about hazards and risk controls to all who may be affected by them
- regular training, including refresher training for administrative controls.

3.6.2 Review

The approach to the review process will be different for each water corporation, but should, as a minimum, include:

- a system (with suitable governance arrangements) which records and highlights more intensive risks and prompts the continual review of measures to lessen the risks. Such a review should occur whenever circumstances or state of knowledge change which influence risk, or on a periodic basis.
- a process which records and investigates any risk events which resulted in sewage spills which impacted (or had the potential to impact) beneficial uses. Learnings from this process should affect planning, operating procedures and/or decisions on measures to mitigate risk.
- a process which monitors the delivery of measures emerging from the analysis of risks and learnings from risk events. Measures could include the filling of knowledge gaps, updating assumptions made in the risk analysis, acknowledgement of data limitations, and strengths and limitations of the risk analysis methods (including models used).
- a transparent reporting process which allows stakeholders to consider and query the progress of measures to mitigate risk (see section 6). This includes the requirement to report sewage containment failures to EPA.
- a process to compare risk events before and after implementation of the controls.

3.7 Stage 7 - Communicate and consult

Communication and consultation should be undertaken throughout the risk management process to:

- drive stakeholder engagement and clearly articulate accountability of the water corporation and its stakeholders
- attract those with the appropriate expertise to reduce uncertainty and improve decision-making processes
- provide relevant information and reports to stakeholders
- increase awareness of risk management; how it works, and how it can add value.

It is expected that a water corporation will have explicitly and repeatedly communicated with relevant stakeholders through the risk management process to gain insight into risks and opinion on measures to mitigate risk. Ultimately, the decision on how to mitigate risk rests with the water corporation. However, understanding the views of stakeholders can reduce the risk of containment failure, improve the acceptability and practicability of measures, and can speed the reduction in risk to beneficial end uses. After a measure is implemented, stakeholder views can help the water corporation demonstrate the value that has been delivered.

4. Application of the guidelines

This section outlines expectations regarding how the risk framework outlined in section 3 should be applied. Emphasis is placed on the selection of appropriate measure to mitigate risk, which will depend on risk level ('extreme', 'high', 'moderate', and 'low'). The measures to mitigate risk presented in this section illustrate (minimum) suggested measures which are indicative of those expected for both investigation/monitoring of the risk as well as active mitigation of the risk. A water corporation should use its judgement to determine the most appropriate measures for any given sewerage asset or network.

Appendix B provides a (non-exhaustive) list of measures that may be available to water corporations to manage sewage containment risk.

4.1 Managing containment risk within a water corporation

The management of sewage containment risk requires co-ordination across numerous groups within a water corporation, and involves multiple steps. Flowcharts are provided in Appendix C to illustrate the steps that a water corporation should take to mitigate containment risk.

4.2 Dry weather flow containment

4.2.1 Managing chronic leakage and acute containment failures

The following guidance relates to the management of a sewerage system for containment of dry weather flow, in the context of the ISO31000 risk framework stages. In considering dry weather containment failure, it is assumed that there is no tolerance for (raw) sewage to impact beneficial uses.

Risk assessment stage	Recommended minimum measures – dry weather flow containment
Context	• Map sewerage network assets. • Map sensitive beneficial uses and identify impact pathways. • Establish asset management practices and status of assets (regarding their risk of collapse and/or leakage). • Consider regional and broader initiatives and policies (e.g. safety of swimmers in high value waterways).
Identify	• Identify assets which are at risk of failing or which threaten regional/broader goals. Highlight those assets/systems with the greatest potential impact to beneficial end uses. • Confirm 'at risk' systems with stakeholders.
Assess	• Conduct analysis to establish likelihood and impact of sewage containment failure on receiving waters. • Consider historical spill events and complete monitoring to confirm analysis.

Risk assessment stage	Recommended minimum measures – dry weather flow containment
Evaluate	• Identify and prioritise systems by risk rating. • Review best practice to establish measures to mitigate risk. • Consider measures for extreme, high, moderate, and low risk (as per section 4.2.2 below). • Evaluate measures which 'so far as reasonably practicably' deliver acceptable risk reduction. This includes establishing affordability, effectiveness and acceptability with stakeholders.
Treat	• Deliver preferred measures within a timeframe acceptable to stakeholders.
Monitor and review	• Monitor network performance / risk as assumptions and data is updated (particularly information relating to asset condition and likelihood of failure). • Analyse spill events to confirm compliance. • Monitor advances in industry best practice.
Communicate and consult	• Communicate performance of network with stakeholders.

4.2.2 Appropriate measures to mitigate risk by risk level

Table 2 illustrates the application of measures, and where appropriate the degree/frequency/timing of measures, which change as the risk level changes. It should be noted that the implementation of communications protocols to advise stakeholders of a spill event occurring (to the extent agreed with stakeholders) and the requirement to immediately clean up spills and rectify any physical damage caused to beneficial users is a consistent expectation across all levels of risk.

The measures in Table 2 are indicative and are not prescribed to water corporations. Nor are the technologies or techniques to monitor, sample or measure impact or effectiveness of measures prescribed.

Table 2 Measures to mitigate risk (dry weather containment)

Action	Low risk	Moderate risk	High risk	Extreme risk
Monitor network performance.	• High priority sites monitored as appropriate. (e.g. short 'time to spill' pump stations).	• High and medium priority sites monitored as appropriate. • Intermittent monitoring of impact to beneficial use (in consultation with the waterway manager or other expert group).	• High and medium priority sites monitored as appropriate. • Surcharge monitors installed in high risk sub-catchments. • Frequent monitoring of impact to beneficial use (in consultation with the waterway manager or other expert group).	• High and medium priority sites monitored as appropriate. • Surcharge monitors installed in high risk sub-catchments. • Continuous monitoring of impact to beneficial use (in consultation with the waterway manager or other expert group).
Implement asset management practice to prevent chronic and acute blockages and leakage.	• Assets replaced upon failure, repeated blockages, or observed (deteriorated) operational performance.	• Preventive asset replacement program in place to progressively improve network condition.	• Preventive asset replacement and upgrade program in place to rapidly improve network condition.	• Comprehensive asset replace-ment and upgrade program in place to urgently improve all systems in extreme risk.
Ensure operational capability is in place to minimise the risk of chronic and acute blockages and leakage.	• Standard operational controls.	• Prioritised operational controls to mitigate risk.	• Additional operational controls on standby (e.g. additional pumping capability and standby maintenance crews).	• Additional operational controls installed and operating.

4.3 Wet weather flow containment

4.3.1 Management to the containment standard

The following guidance relates to the management of a sewerage system to the containment standard in the context of the ISO31000 risk framework stages.

Risk framework stage	Recommended minimum measures – containment standard (wet weather)
Context	• Map sewerage network assets.
Identify	• Set the risk appetite at containment standard level. • Assets at risk of failure. • Consider regional broader initiatives and policies.
Assess	• Identify impact of failure on beneficial uses of receiving waters. • Engage with stakeholders to explain how meeting the containment standard affects beneficial uses generally. • Identify any systems where an alternative measure is appropriate. • Identify sites where a significant spill has occurred as a starting point before completing modelling and establishing the likelihood of spills across the network.
Evaluate	• Confirm key sites/systems at risk of spills with stakeholders. • Assess solutions to achieve the containment standard.
Treat	• Consider measures for extreme, high, moderate, and low risk (as per 0).
Monitor and review	• Monitor performance. Identify any systems which do not achieve compliance with the containment standard.
Communicate and consult	• Report on performance and delivery of program to key stakeholders.

4.3.2 Management using alternative measures (wet weather)

In some instances, hydraulic upgrades to meet the containment standard in SEPP (Waters) may be assessed as not being practicable. The following guidance identifies measures that a water corporation could consider to minimise the environmental risks from its sewerage infrastructure. For further information see section 5.2.1.

Risk framework stage	Recommended minimum measures (wet weather). ***Applicable where hydraulic upgrades to meet the containment standard are not reasonably practicable.***
Context	• Map sewerage network assets. • Establish the highly valued beneficial uses for different regions/communities through engagement with key stakeholders. • Confirm the risk appetite for all beneficial uses through engagement with stakeholders. • Consider regional as well as broader initiatives and policies.
Identify	• Identify assets which are at risk of impacting the identified beneficial uses or which threaten regional/broader goals. Highlight those assets/systems with the greatest potential impact to beneficial end uses. • Confirm ‘at risk’ systems with stakeholders.
Assess	• Conduct analysis of critical duration event to establish likelihood and impact of sewage containment failure. • Consider historical spill events and calibration events to confirm analysis.
Evaluate	• Identify and prioritise systems by risk rating. • Review best practice to establish potential measures to mitigate risk. • Consider measures for extreme, high, moderate, and low risk (as per section 4.3.3). • Evaluate measures to mitigate risk which ‘so far as reasonably practicably’ deliver acceptable risk reduction. This includes establishing affordability, effectiveness and acceptability with stakeholders.
Treat	• Deliver preferred measures within a timeframe acceptable to stakeholders.
Monitor and Review	• Monitor network performance / risk as assumptions and data is updated (including updated climate and rainfall and runoff data). • Analyse spill events to confirm compliance to agreed containment objective. • Monitor advances in industry best practice.
Communicate and consult	• Communicate containment performance to stakeholders.

4.3.3 Appropriate measures to mitigate risk by risk level

Table 3 illustrates the application of measures, and where appropriate the degree/frequency/timing of measures, which change as the risk level changes. A degree of uncertainty will accompany most or all risk assessments. The water corporation should use its discretion in dealing with this. In some situations, this may require making a 'worst case' assumption until the uncertainty can be reduced.

Importantly, a water corporation may identify a sewerage system as holding any level of risk (low through to extreme) regardless of whether or not a containment standard, or alternative measure is adopted.

It should be noted that the implementation of communications protocols to advise stakeholders of a spill event occurring (to the extent agreed with stakeholders) and the requirement to immediately clean up spills and rectify any physical damage caused to beneficial users is a consistent expectation across all levels of risk.

The measures in Table 3 are indicative and are not prescribed to water corporations. Nor are the technologies or techniques to monitor, sample or measure impact or effectiveness of measures prescribed.

Table 3 Measures to mitigate risk (wet weather containment)

Action	Low risk	Moderate risk	High risk	Extreme risk
Monitor network performance during wet weather events via telemetry of the sewerage network and monitoring of beneficial uses.	• Limited system monitoring sites. • Intermittent monitoring of spill sites.	• Limited system monitoring sites. • Frequent monitoring exercises of spill sites.	• Extensive system monitoring sites. • Frequent monitoring exercises of spill sites and network.	• Extensive system monitoring sites. • Continuous monitoring of spill sites and network.
Model network performance.	• Regular updates to hydraulic models or analysis with in keeping with rate of change of catchment.	• Regular updates to hydraulic models or analysis with calibration in keeping with rate of change of catchment.	• Regular updates to hydraulic models with calibration to support capital planning processes (two to five years).	• Regular updates to hydraulic models with frequent calibration (one to two years).
Implement permanent solution (using hierarchy of controls).	• Reassess in five years for potential augmentation in 10-15 years.	• Reassess regularly for potential augmentation within 10 years.	• Within five years.	• As soon as possible.
Ensure operational capability is in place to minimise the risk of sewage overflows before permanent solution is operational.	• Standard operational controls (e.g. preventive maintenance schedule and responsive maintenance resources/ systems).	• Prioritised operational controls to mitigate risk.	• Additional operational controls on standby (additional pumping capability).	• Additional operational controls installed and operating.

Action	Low risk	Moderate risk	High risk	Extreme risk
Implement processes to minimise wet weather flows.	• Review processes for new connections.	• Review processes for new connections. • Conduct investigations in select areas.	• Review processes for new connections. • Conduct investigations across contributing sewerage catchment. • Act to reduce stormwater flows into the system where practicable (public assets).	• Review processes for new connections. • Conduct investigations across contributing sewerage catchment. • Act to reduce stormwater flows into the system where practicable (public and private assets).

4.4 Capacity to manage impacts of containment failure

The risk management framework in this guideline is directed at eliminating, so far as reasonably practicable, the risk of failure to contain sewage within the sewerage network in dry and wet weather conditions. The approach is expected to reduce the impact of any spills from sewerage systems, but will never completely eliminate the occurrence of spills. Therefore, a water corporation must be prepared to mitigate the impact of containment failure.

Such management should include operational controls to minimise impact, communicate information, and remediate any impacts created by the spill. The operational actions which are listed in section 4.4.1 below are indicative and are not prescribed to water corporations. Nor are the technologies or techniques to manage spills prescribed.

4.4.1 Operational controls

For any level of risk (low to extreme), the water corporation should have procedures and contingency plans in place. These pre-prepared approaches to managing spill events should include measures to prevent spills from occurring in the first instance, as well as established and practiced reactive measures to limit the severity of spills.

Preventive measures could include:

- regular maintenance and testing of mechanical and electrical assets (to reduce the risk of breakdown)
- management of assets to maximise storage available to contain sewage flows (including cleaning of detention basins, and operating sewer pump station wet wells at an appropriate (low) level
- cleaning of sewerage network to clear tree roots, fat build-up, sedimentation, and foreign materials (rubbish, dumped concrete etc.)
- maintaining access to the sewerage system
- installation of redundant assets (pumps, valves, instrumentation for control input, back-up Programmable Logic Controls (PLC), battery for DC power, communications, etc.)

- adequate inspections to maintain integrity and manage asset condition.

Reactive measures could include:

- automatic alarms at high risk sites, monitored continuously
- trained and capable maintenance crews
- installation, and confirmed operation of, electrical backup at high risk sites
- current standard operating procedures for each site
- access to emergency maintenance parts, materials, equipment, and labour
- clear contingency plans which are practiced by operations staff to ensure their effectiveness during incidents
- a well-defined and practised incident escalation and governance procedure.

4.4.2 Communications

Like operational controls, a water corporation should implement communications whose primary objective is to prevent the risk of sewage spills and, as a secondary objective, to manage a spill after it has occurred.

Prevention communications, which can be coordinated across a region or more broadly, should act to change behavior of the community and companies regarding the appropriate products to discharge through the sewerage system.

A water corporation should have several established channels of communicating that a sewage spill has occurred. The approach used by each corporation should match the expectations and preferences of stakeholders, but could include:

- notifications via websites and social media
- notification via official signs/barriers at the affected site(s)
- notification via radio/TV/newspaper as deemed appropriate
- creation of a dedicated telephone, social media, website portal
- allocation of a dedicated spokesperson to manage queries and complaints.

The water corporation is encouraged to report back to the community the number and type of communications that it has received from the community regarding any sewage containment failure.

4.4.3 Spill remediation

A water corporation should establish standard approaches to remediate beneficial uses affected by sewage spills. Engagement with stakeholders is an essential aspect of the establishment and performance of remediation procedures to ensure that sensitive uses are managed appropriately.

5. Governance

5.1 Authority of the guidelines

As sewer spills can constitute a pollution offence under the *Environment Protection Act 1970*, water corporations have an obligation to address the risks posed by the infrastructure they are responsible for managing. Compliance with the guidelines does not rule out EPA taking compliance and enforcement action in the event of a containment failure. However, in such circumstances EPA will take into account the extent to which the water corporation has implemented these guidelines (as well as the risk of harm to public health and the environment) when assessing the culpability and determining its response, consistent with the EPA Compliance and Enforcement Policy.

5.2 EPA role and expectations

EPA expects water corporations to be accountable for the impacts they have on the environment and to report to the community and EPA (consistent with the *EPA Notification Protocol for Reporting High Priority Sewer Spills* [9]) when impacts occur. Noting that these guidelines are not prescriptive, EPA expects water corporations to apply them in their entirety with due diligence and in a manner that is verifiable, including each stage and each element of the risk management process. As necessary, a water corporation should engage third party auditors to verify performance (both compliance and effectiveness).

Where non-compliance with the guidelines occurs, EPA may require remedy, and, where appropriate, may apply sanctions.

Consistent with the relevant sections of the guidelines, the water corporation should:

- undertake appropriate risk assessments relating to sewage containment (covering dry and wet weather) across their network.
- undertake a proactive process of engagement with customers and the community, as well as with EPA and other relevant agencies, to assist in developing and refining appropriate management programs and programs of initiatives.
- ensure such engagement results in management programs and programs of initiatives that:
    - demonstrably deliver tangible improvements in environmental outcomes and value to customers and the community;
    - align with customer and community priorities and preferences; and
    - achieve an agreed balance between meeting broader environmental and policy objectives and maintaining affordability in customer bills.
- proactively engage with EPA, and lead meaningful dialogue, in the event that the water corporation forms the view that all available measures to manage a particular risk are not viable; such a view should only be formed in the light of the state of knowledge, having taken into account all relevant factors and having fully pursued all elements of these guidelines.
- prepare and publish consistent, accurate, and timely reports (as described in section 5.3) that will enable verification of its compliance and progress.

[9] EPA (2015) *EPA notification protocol for reporting high priority sewer spills* (EPA Publication 1603)

5.2.1 Adoption of alternative measures

On occasions, the water corporation may be unable to devise measures that reduce a particular risk to an acceptable level; even the most suitable of the available measures may be determined to not be practicable for one reason or another. Some of the reasons why this may occur are:

- the cost of the delivering the measure is vastly disproportionate to the potential benefits
- the cost of implementing the measure would result in unacceptable decreases in the affordability or quality of services to customers provided by the water corporation (as agreed with customers and relevant stakeholders)
- the measure would be unacceptable to the community
- the measure would be too hazardous
- implementation of the measure would take an unacceptably long time
- the measure would be only a temporary solution
- the measure is beyond the capability of the available resources.

In such situations, it may be more appropriate for the water corporation to consider alternative measures to achieve an improved environmental outcome. This situation is represented in the flowcharts (Appendix C) by the workflow step '*Consult with EPA on alternative measures'*. EPA expects that such alternative measures should only be considered in exceptional circumstances, and EPA must be consulted with prior to a water corporation exploring alternative risk management paths. Any failure to consult effectively with EPA before implementing alternative measures may risk non-compliance with Clause 27, if EPA takes the view that the alternative measures are of a lesser standard than required by the clause.

Any consultation with EPA should address, as a minimum, the following matters:

- measures considered
- evaluation of those measures
- customer and stakeholder consultation, where relevant
- demonstration that these guidelines have been followed to their full extent prior to proposing alternatives
- justification of the level of protection of human health and the environment provided by the alternative measures.

The water corporation may also explore potential alternative funding avenues directly with relevant agencies and government. EPA does not have responsibility for endorsing or approving requests for additional funding.

5.3 Reporting - plans and progress

5.3.1 Risk management plan

It is expected that a water corporation will prepare some form of risk management plan to guide and communicate its overall sewage containment risk program. Such a plan may be part of the water corporation's asset management system. A risk management plan should set out the planned outcomes from the applications of these guidelines, and establish a plan to fund, deliver, and manage the required program of measures to appropriately mitigate risk.

The risk management plan should be reviewed and submitted to EPA periodically (in line with the timing of economic regulatory price review processes) – for noting, not approval, by EPA. The purpose of this is to ensure that each corporation is actively managing its spills risk to achieve environmental improvement, and demonstrate to the community, customers, and regulators that this is being done appropriately.

A progress report on the outcomes of the application of each risk management plan (including results of independent environmental auditing to check that the plans are appropriate, effective and being implemented accordingly) should be incorporated into any periodic review of the plan provided to EPA for noting. EPA expects that this progress reporting should demonstrate the extent to which there has been an improvement in containment performance with reference to prior years and in line with implementation of the measures proposed by the water corporation in its plan.

5.3.2 Ongoing operational reporting

Water corporations must adhere to the reporting requirements of the *EPA Notification Protocol for Reporting High Priority Sewer Spills* (EPA Publication 1603). However, in keeping with the intent of the guidelines to involve stakeholders in sewage containment risk management, a water corporation may also consider publishing on its website near-real time information of sewer containment failures including, in each case:

- location (displayed spatially)
- date and time reported
- estimated impact (updated as information becomes available).

Furthermore, subject to the expectation of stakeholders, the water corporation may consider regularly publishing summary performance reports (dry and wet weather, including assessment of impacts, operational responses to minimise impacts and outcomes) and updates of progress against its risk management plan.

5.3.3 Audit

EPA believes transparency of reporting and independent auditing contribute to effective compliance assurance. In support of this, each water corporation should independently verify that its risk management plan has been developed in accordance with these guidelines. The verification of the risk management plans will be supported by regular auditing as part of the water corporation's quality management systems (performed in each case by an appropriately accredited auditor).

If deemed necessary, EPA may request that a water corporation submit to independent audit of its risk management plan in relation to adherence to these guidelines and/or its performance in sewage containment.

Appendix A: Principles applicable to the hierarchy of controls

Principle	Comment
For poorly understood risks, the focus should be on investigation. For well understood risks, the focus should be on mitigation	The water corporation faced with an assumed heightened spill risk must act prudently to fully understand that risk before identifying measures. Once a risk is understood, appropriate measures can be identified and a decision taken on the most appropriate to employ. Notwithstanding efforts to investigate the risk, every effort must be taken to prevent and respond to any containment failure event during the investigation.
More intensive risks demand greater familiarity with the state of knowledge, and greater attention	The greater the likelihood of a hazard or risk eventuating, or the greater the degree of harm that would be likely to result, the greater should be the water corporation's familiarity with the relevant best practice; this helps improve understanding. A water corporation is expected to proactively make itself aware of, and/or develop, best practice relating to these heightened risks.
Lower risk measures and management are preferred	Civil works should be considered as a lower risk measure before pump-based measures with telemetry. However, pump-based measures are still likely to be preferable to measures that rely on human intervention.
Longer lasting and flexible measures are preferred	A measure that provides adequate sewage containment for five years is clearly less preferred than one that lasts relatively indefinitely. Also given that future demand may be uncertain, it is preferable to factor in flexibility.
Measures that can be implemented soon are preferred	A measure in the form of an action to improve a water corporation's understanding of a risk, in support of a longer-term objective of eliminating that risk, may nonetheless be regarded as a preventive measure; it just has a longer timeframe.
Non-disruptive measures are preferred	Where a measure is capable of implementation without disrupting customers or the community (either during implementation or in use), it will be preferred over one that is not.
Set-and-forget measures are preferred	Ideally, a measure will not require ongoing maintenance, monitoring, or active management by the water corporation. Such a measure will be preferred over one that does.
Measures that allow existing (temporary) measures to be discontinued, and which result in the elimination of higher risk measures and management are preferred	A measure which enables the discontinuation of (potentially multiple) temporary measures is preferred. For example, the installation of a new diversion sewer which makes a series of pump stations and rising mains redundant is a preferable course of action.

Appendix B: Measures to mitigate risk of wet weather spills

Examples of **shorter term measures**, which are generally non-structural and of moderate cost, are:

- operation and maintenance practices
- recording procedures; those responsible for management of the sewerage network should record events and causes of overflows, particularly dry weather overflows, for statistical predictive, and management purposes
- encouraging continual improvement through the reporting procedures on overflows
- implementation of minor structural works
- reducing overflows to a specified level (e.g. a limit on the average annual frequency of choke-related overflows)
- reducing overflows (surcharges) into properties
- informing the public of overflows with potential human health impacts
- coordinating and optimising major industrial trade waste discharges.

Examples of **longer term measures**, which are generally structural and relatively costly, are:

- rehabilitating degraded elements of the sewerage network
- installing additional elements of the sewerage network
- installing additional network storage to reduce vulnerability to power outage
- installing surge detention tanks or emergency relief structures
- installing telemetry and alarm systems
- upgrading pumping stations.

Further investigation, design, and environmental impact assessment may be needed before decisions are made. This is especially likely where actual flows in the network may be vastly different from the original design flows. Available tools include:

- flow monitoring
- hydraulic modelling
- statistical predictive techniques.

Examples of **emergency response measures** are:

- temporary weirs or bunding
- the use of sewage pumping or vacuum trucks (to remove pools of sewage or to pump out overflowing pump wells)
- temporary generators for pumping stations if the power supply has failed, and temporary pumps if the pumps have failed
- bypass pumping
- staggered pump station operation
- ’within sewage network’ storage (if feasible)
- ‘within stormwater system’ storage and recovery

- ground disinfectant (limited to localised areas and small pools produced by the spill)
- waterways disinfectant only as directed by EPA.

Actions to prepare **emergency response teams** include ensuring the availability of:

- emergency notification phone numbers/contact details
- access to physical plans of the system so that, for example, the volume of sewage stored in a rising main and the estimated time taken for that main to empty by gravity via a breach in the main can be determined
- appropriate screening equipment to remove floatable and coarse solids
- backup sewage pumps
- excavation equipment to construct temporary dams
- tanker trucks that can pump or vacuum sewage and sludge
- public warning signs and emergency tape to mark affected areas
- communication plans for notifying those of the public who may be affected
- sampling equipment
- occupational health and safety equipment to protect employees.

Other available options

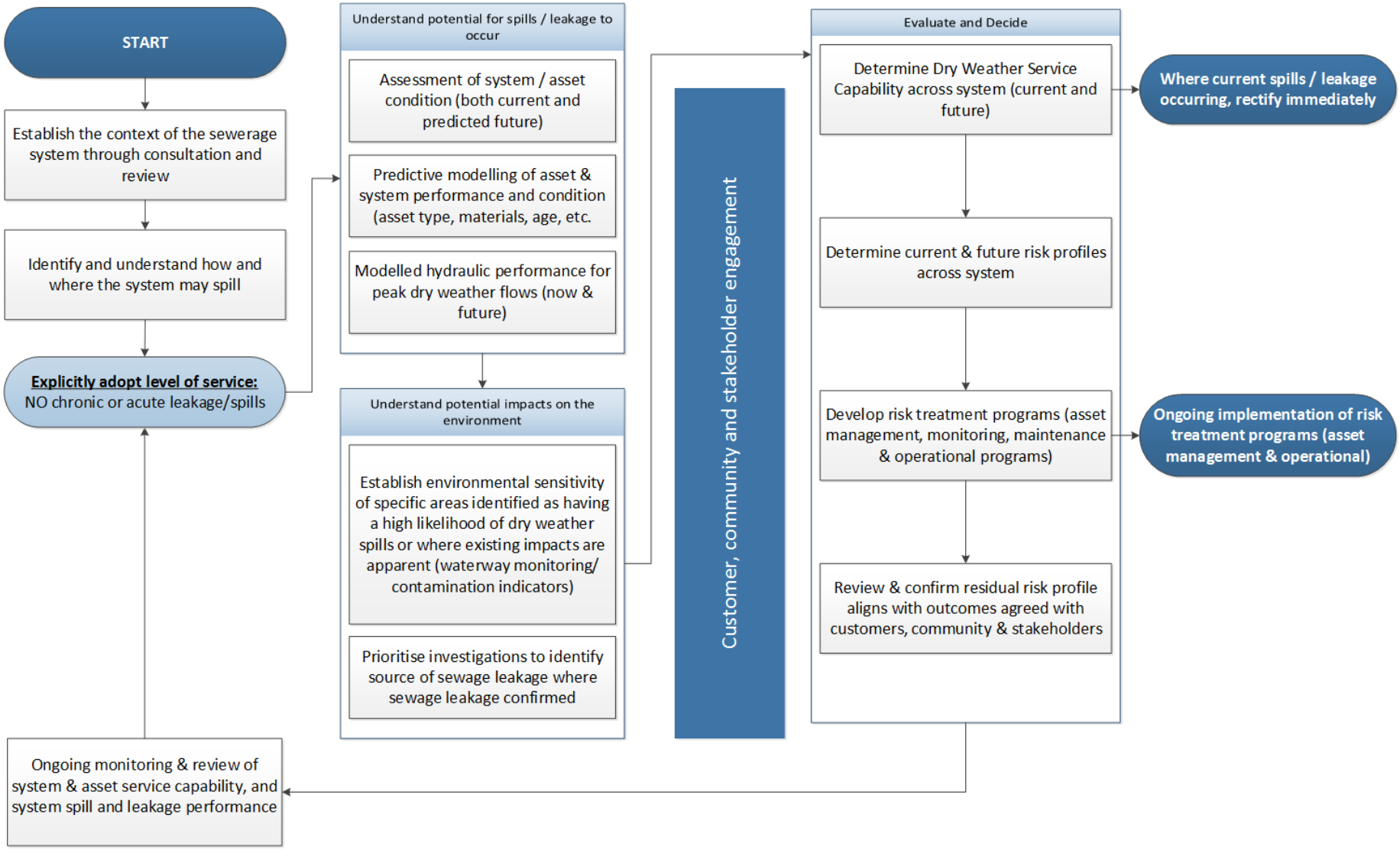
- systematic risk identification and evaluation processes, including processes for:
    - identifying and documenting what mitigation approaches (management activities, systems and initiatives) are already in place for each of the risks
    - evaluating, for each risk, the effectiveness of the risk mitigation approaches already in place and hence producing residual risk ratings for each
    - evaluating, for each risk, whether the residual risk is currently being managed to minimise ‘so far as reasonably practicable’ risks and impacts on beneficial uses as required under SEPP (Waters), and hence identifying which risks require further measures and management (in the context of understanding what types of further measures would be required and whether or not these would be practicable)
    - developing and implementing ongoing programs of active risk management that are routinely monitored and assessed against progress in reducing risks to the target levels that are determined to be reasonably practicable in each case
    - incorporating these assessments and management actions into an appropriate sewerage system management risk register and risk management program, embedding these into corporate business management and reporting systems (including reporting to EPA) to ensure high level focus, commitment and support at an organisational level.
- planning processes that estimate and allow for changes in future (network capacity) demand
- management systems (including management/prevention of strategic risks)
- programs to monitor environmental conditions
- comprehensive reporting of spill events (operationally and as annual summaries)
- asset management systems (with objectives that are specific to and appropriate to the relevant

sewerage network) and associated implementation programs (including asset performance monitoring)

- response planning and establishing of necessary response capabilities
- periodic assessment and review linked to appropriate monitoring to confirm:
    - systems are appropriate, effective and implemented as intended;
    - actual environmental impacts (spills to the environment) are well-monitored and align with the water corporation's understanding/articulation of performance against the containment objective and/or other documented risk evaluations.

Appendix C: Flowcharts illustrating measures by a water corporation to mitigate containment risk

Dry weather spill containment



Wet weather spill containment