Water distribution WSP	**Treated water storage** *Management/technical guidance*	

Information derived from:	**Related tools:**
○ Feedback from water suppliers	○ Asset management ○ Hygiene work practices ○ Network design & modelling ○ Microbial regrowth and disinfection

Important Notes to users:

This document provides information to support improved management of piped drinking water quality by water utilities and other stakeholders. It cannot however be definitive and users must ensure that they assess local factors and particularly take account of any national or regional legislative requirements before use. Where necessary this may also need close collaboration with others. The priority to be given to implementing controls to manage identified water quality risks will depend on a proper prioritisation process by each water supplier.

Summary

Most distribution networks have some form of treated water storage to balance day to day variation in demand. In some cases this also provides strategic storage to cope with bursts or other temporary disruption to the supply system. This storage can vary in size from small local steel tanks up to major concrete engineering structures with multiple compartments. Treated water storage structures are particularly at risk of contamination by ingress since the water is not under pressure. Once contamination has occurred there may be little opportunity to rectify the problem before it reaches consumers. This document summarises the type of risks that might occur and how they can mitigated.

Detailed information

Water quality risks

There are a number of risks associated with treated water storage reservoirs. These include:

- Microbiological contamination through ingress of contaminated surface water via the roof or walls.
- Malicious damage, potentially including deliberate or accidental introduction of a range of contaminants
- Deterioration of water quality due to stagnation and poor turnover
- Interaction with construction materials
- Deposition of debris which can subsequently become disturbed and enter the distribution network.

Risk mitigation measures

The risks identified above can be substantially mitigated by a comprehensive reservoir management plan which should form part of any overall asset management strategy. The type, location, condition and performance of each storage facility should be noted in an asset register and plans developed for both short and long term maintenance. Aspects impacting water quality which need to be considered by suppliers are set out below.

Design and Security Aspects

The detailed design of the structure will depend on a number of local factors. However as far as possible the following aspects should be taken into account:

- Treated water storage reservoirs should always be closed structures designed to prevent contamination through ingress of surface or groundwater
- The design should encourage turnover and circulation of the stored water within the structure
- Secure facilities for access, cleaning and drain down. This could include consideration of how the structure can be taken out of service without impacting on consumers. For example in larger reservoirs by having separate multiple compartments.

- Materials of construction, including any membrane or sealant should be approved for use with potable water.
- Hatch and vent covers should be secure and designed to prevent surface water ingress and access by birds, small animals, and insects.
- Water quality sampling facilities should be designed so that a representative sample can be obtained without inadvertently leading to contamination. Ideally this should be via dedicated sampling arrangements but if access covers have to be opened for dip sampling then the design should minimise risks of contamination.
- In long distribution networks, storage reservoirs may be suitable locations for additional booster disinfection, provided this can be provided with due regard to security and safety.
- Depending on the location it will be necessary to include appropriate security arrangements. As a minimum this would normally include secure locks for access hatches. In more sensitive or vulnerable locations this could also include fencing/gates to keep out intruders or animals and alarm and other security systems.

Inspection and maintenance

Treated water storage facilities should be included in routine inspection, sampling and maintenance programmes. The frequency and scale of each can only be determined locally and will need to take into account any regulatory requirements or national/regional codes of practice. It may also vary depending on local risk assessments with some larger, critical or higher risk sites having higher frequencies than others. Factors to take into account in designing such programmes include:

- *Inspection*

  Storage facilities should be inspected externally on a fairly frequent basis to note any sign of damage, deterioration or other factor which might prejudice water quality or other aspect of operational performance. Records should be maintained of each inspection and any necessary follow up action. Those carrying out the formal inspections should be appropriately trained. However any operational staff visiting the site for other reasons should be encouraged to note and report immediately any concerns.

  Less frequent internal inspections should be also be programmed using a risk prioritisation approach or when evidence from external inspection or water quality monitoring indicates a potential problem. However when doing so particular care must be taken to ensure strict hygienic work practices using specially trained staff. After internal inspection additional disinfection will normally be necessary and if possible water quality checks carried out before returning the reservoir to service.
- *Routine Maintenance*

  Routine maintenance programmes should be developed appropriate to the design, condition and operational criticality of the structure. Additional maintenance might be necessary as a result of external or internal inspections or when water quality monitoring indicates a potential problem. The type of maintenance programme necessary can only be determined locally but could include:
  - Replacing or repairing covers, vents and security equipment
  - Resealing joints or roof with appropriate materials
  - Cleaning accumulated debris from the internal floor of the structure
  - Cleaning and disinfection of walls and other surfaces

Typical control points

The most suitable control points for water quality risks associated with treated water storage facilities can only be determined locally taking account of a range of factors including level of risk and available resources. There are two basic approaches:

- Sampling and analysis

  Regular operational sampling of water leaving or within storage facilities provides useful trend information to monitor the onset of potential water quality problems. Frequent sampling with analysis for a small number of key parameters is probably more useful than less frequent sampling for a larger number of parameters. Key determinands could include simple

microbiological tests (E. coli, coliforms, heterotrophic plate count) and chemical tests (chorine, turbidity). As set out above, sampling arrangements must be designed appropriately in order to be representative of stored water whilst at the same time not itself leading to inadvertent contamination, for example when dip sampling from open hatches.

- Asset integrity

  Routine frequent external checks on the physical integrity of the structure, for example hatch covers and security fencing, can provide important control points for water quality and are simple to implement. Routine but less frequent internal inspections of the condition and structural integrity of the structure also provides a very useful control.

Reference for further detailed information:

- Relevant WHO publications
  - 2003 “Heterotrophic plate counts and drinking-water safety: The significance of HPCs for water quality and the human health” (Click here)
  - 2004“Managing microbial water quality in piped distribution systems” (Click here)
- Relevant case studies

Typical resources needed:

This will vary depending on the size of the water supplier and the asset base. Long term maintenance of the treated water storage facilities may be a complex and resource demanding activity which needs to be developed over a long timescale with priority given to the highest risk areas. However routine inspection, sampling and maintenance can be integrated with other operational tasks subject to appropriate training.

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