

# HTA: Responding to flooding events - best practices

## HTA-2024-001

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## Executive summary

This document provides guidance on best practices for responding to a flooding event or an escape of water incident within a healthcare facility. It assumes that the facility already has established emergency response plans and aims to complement them specifically for water emergencies. The document highlights the potential risks and hazards associated with flooding or water escape, including electrical hazards, spread of pathogens, water source contamination, and impacts on critical infrastructure. It emphasises the need for contingency plans to address these risks.

The document is intended for use when water has impacted the internal space of a healthcare facility, whether it's a large-scale flood or a plumbing-related water escape. It focuses on protecting people, minimising further damage to the facility, stabilising affected areas for remediation, and working in conjunction with relevant guidelines and procedures.

The document defines categories of water contamination to aid decision making in the response to an escape of liquid event. The unplanned presence of water in a medical facility can lead to the emergence of biological hazards such as pathogens (including bacteria, mould and yeast) and possible contamination from chemical hazards that may be present.

The document also addresses other hazards and damage, including the risk of electrocution due to the combination of water and electrical systems. It emphasises the need for electrical risk management, shutting off power supply in affected areas, and proper isolation procedures. Additionally, it mentions the isolation of hospital-specific service lines during water events to protect responders and infrastructure.

Effective communication and collaboration among stakeholders, such as hospital staff, administrators, patients, visitors, and contractors, are essential for a successful response to flooding or liquid escape events.

Overall, the document emphasises the importance of having an emergency response plan in place prior to water ingress events, conducting assessments of vulnerable areas, and taking mitigation measures to minimise potential damages and health risks.

# 1. Introduction

## 1.1. Introduction

The purpose of this document is to provide the reader with guidance on best practices for an internal response to a flooding event or large escape of liquid incident. From the outset, the authors presuppose that a healthcare facility has well established and practiced emergency response plans, and as such this document aims to complement those when responding particularly to water emergencies.

During instances of flooding or water escape (henceforth referred to as water ingress), it is important for healthcare facilities to have a clear understanding of the potential risks and hazards that may arise. For patients and staff, these risks may include electrical hazards, the spread of pathogens, contamination of water sources, and other potentially adverse health impacts. Meanwhile, there is a significant risk to critical infrastructure, such as power, water, and communication systems. It is therefore critical that facilities have contingency plans in place to address these risks and their impact.

Whilst there are a number of effective, pre-event, strategies that should be implemented to mitigate the risk, such as regular maintenance checks to plumbing and exterior guttering or the introduction of flood warning systems, this document focuses on the impact of the water ingress, itself, once it has occurred.

## 1.2. When to use this document

This document is to be used in occasion where water has impacted the internal space of a healthcare facility. This event may be as significant as large scale flood, or involve an escape of liquid from the internal plumbing network. It is the aim of this document to provide guidance on how best to effectively protect all human actors across the event, mitigate further damage to the facility, and stabilise and make safe any damaged areas in order that remediation can begin. This document has been designed to work in conjunction with *HTA-2024-002: Responding to flooding events - restoration for healthcare facilities* during cases of a water ingress event.

A flood can be defined as surface water rising from outside the building, which subsequently enters the internal spaces. Flooding events can either be unexpected, such as storm-related flash flooding, or can be expected, such as a slow-onset flooding. Flash floods often recede quickly following the storm. While slow-onset floods can last days or weeks, as water is unable to escape the immediate surrounding area. Flooding events can also create secondary effects that further complicate a facility's ability to respond. One of the most common of these complications is the backflow of sewerage outlets.

Alternatively, escape of liquid events can present in many forms. These can be categorised as internal water events, and typically include burst pipes, leaking plumbing fittings or top down water ingress. The severity of the escape of liquid event is characterised by the volume of water, as well as the type of water that has escaped, such as mains drinking water leaks versus sewage water backflows. In the interest of clarity, the term 'Water Ingress' will be used as an over-arching term for the remainder of this document, except in instances specific to an escape of liquid event impacting floor surfaces.

It is important that an emergency response plan is in place, prior to a water ingress event. Should these plans not currently be in place, then it is the authors' recommendation that such a document be developed as a matter of the utmost importance. This document should clearly outline the facility's plan for how best to deal with the discovery of an emergency event, and how best to protect the people in the facility as well as the facility itself. This document should also provide a clear communication plan to ensure that all staff, patients, and visitors are briefed on the incident and any necessary actions that must be taken.

For instances where prior knowledge of an imminent event is available, establishing a plan of action is vital. Determine the need and supply of preventative equipment, such as sandbags and sand. A ready and existing stockpile, as appropriate to each facility, may also be a prior consideration.

Complete assessments of areas where water is likely to or has historically entered or pooled following water ingress events to ensure maintenance staff are aware of the higher risk locations or areas. In

extreme cases impacted by time and resources limitations these assessments may assist in the triage of emergency response priorities

### 1.3. Relevant stakeholders

The response to hospital flooding involves a range of important stakeholders, each with unique responsibilities and roles to ensure the safety of patients and the preservation of medical equipment, supplies, and structures. Hospital staff bear the primary responsibility of safeguarding patients and assets, while hospital administrators are crucial in coordinating response efforts and liaising with emergency officials, local government agencies, and insurance providers. Patients and their families are also important stakeholders, due to potential evacuation and relocation requirements, as are contractors, such as builders, remediators, and hygienists, due to their involvement in the clean-up and restoration process of the facility. Effective communication and collaboration among all stakeholders is essential for a successful response to hospital flooding or escape of liquid event. Identification and involvement of these stakeholders is documented within **Appendix A: Internal response flowchart**.

Invariably insurance agencies such as the Victorian Managed Insurance Authority (VMIA) along with specialist loss assessors will form part of the stakeholder team. Often specialist teams will need to be engaged for various activities relating to the remediation of spaces impacted with water event. Insurance agencies can assist in providing contact details for remediation contractors who have experience with remediation works with the healthcare space.

## 2. Definitions

Term	Definition
<b>Actinomycetes</b>	A type of bacteria which can be found in soil or water.
<b>Bacteria</b>	Single cellular organisms that lack organelles and an organised nucleus.
<b>Built environment</b>	Human made structure
<b>Categories of water</b>	A four-level structure of water for the grading of contamination
<b>Containment</b>	An artificial barrier created to inhibit further contamination into otherwise unaffected areas.
<b>Contaminant</b>	The introduction of an unwanted and possible hazardous substance into or onto a previously clean source.
<b>Donning and doffing</b>	The correct procedure for putting on and removing personal protective equipment. If carried out correctly, the wearer should, at no point, come in contact with any contaminants.
<b>Escape of liquid</b>	Categorised as internal water events and characterised by the volume and type of water that has escaped.
<b>Flooding</b>	Surface water rising from outside the building, which subsequently enters the internal spaces.
<b>Fungal spores</b>	Fungal spores are microscopic biological particles that facilitate the reproduction of fungi, akin to the role of seeds in the plant realm.
<b>Hazard</b>	A hazard is a source or a situation with the potential for harm in terms of human injury or ill-health, damage to property, damage to the environment, or a combination of these.
<b>Heating, ventilation and air conditioning (HVAC)</b>	The system of plant, equipment and ducting used to control the temperature and air quality within the internal space.
<b>Make safe</b>	The process by which, following a major water ingress event, that the building, its structural materials and associated contents can be removed or stabilised in order that evaluation and remediation works can be arranged and undertaken safely.
<b>Mitigation</b>	The act of staking steps in order to reduce potential damages stemming from a water ingress event.
<b>Mould</b>	A type of fungus that grows with multicellular hyphae.
<b>Mycobacteria</b>	A genus of bacteria which includes pathogens known to cause tuberculosis and leprosy.
<b>Pathogens</b>	An organism that can cause disease
<b>Personal protective equipment (PPE)</b>	A range of clothing and equipment specially designed to protect the wearer from a range of different hazards.

Term	Definition
<b>Respirator</b>	A type of PPE that covers the nose and mouth to provide protection from breathing in harmful agents
<b>Specialist</b>	A person or company highly skilled in a specific field.
<b>Streptomyces</b>	A type of bacterium which can be found in soil.
<b>Water event</b>	An occurrence in which a quantity of water has impacted a location in a manner that is detrimental Examples include: a flood, a burst pipe, water ingress via storm damage, sewerage back flow and so on.
<b>Water ingress</b>	The potentially damaging introduction of water to the built environment. This can come in the form of large-scale external flooding or a smaller scale pipe burst.
<b>Yeast</b>	A type of microscopic unicellular fungus that reproduces by budding or fission.



## 3. Hazards and damage

### 3.1. Introduction

The presence of water in the internal space of a medical facility can cause significant damage and present a range of hazards. For the safety of all people involved and for the good of the building, each of these will need to be ascertained, considered and remedied.

### 3.2. Categories of water

The three categories of water, as defined by the ANSI/IICRC S5005, refer to the range of contamination in the water, considering both the water's original source and its quality after it comes into contact with materials in the built environment. Temperature and time can speed up or slow down the amplification of contaminants, thereby changing the category. In the context of this document, contamination is defined as the presence of undesirable substances, that have the potential to harm human health, harm a building's structure and contents, or have a negative impact on how well a building's systems operate.

In the context of a hospital, water categories can deteriorate quickly, as water ingress may come in contact with contaminants, discussed in **Biological hazards**, that are already present in the hospital.

While the source of the water is the primary criteria for the Category of water, other indications may be used. Odorous and turbid water is typical of Category 2 and 3 water, whereas Category 1 water should be clear and odour-free. The presence of faeces or deceased organisms will always indicate Category 3.

**Category 1 Water:** originates from a potable water source which does not pose a substantial risk if ingested, inhaled, or dermally exposed<sup>5</sup>. In the context of a hospital, the most typical example of a Category 1 water source would be the mains water supplied to the building, but it can also include rainwater, cisterns, plumbing, supply to appliances, such as fridges, and dish washers. However, this Category 1 water has the potential to deteriorate in quality and be re-classified as Category 2 or 3 water, dependent on contact surface type or condition and dwell time.

**Category 2 Water:** is water that contains contamination and has the potential to cause either illness or discomfort if exposed to or consumed<sup>5</sup>. The presence of microorganisms, chemicals or the nutrients for microorganisms, may cause such illness or discomfort. In a hospital, sources of Category 2 water might include discharge or overflow from a dishwasher or washing machine, aquariums, or overflow from toilet bowls on the room side of the trap with no faeces present.

**Category 3 Water:** is grossly contaminated, and has the potential to contain pathogens, toxins or other harmful agents which have the potential to cause significant reactions to humans if exposed to or consumed<sup>5</sup>. In a hospital, sources of Category 3 water may be sewage leaks or backflows and environmental floods from rivers, streams, dams or the ocean, and wind driven rain.

**Category 4 Water:** is water potentially contaminated with cytotoxic chemicals or radioactive materials. Exposure to such waters may cause a range of significant health implications. Radioactive materials may be present in backflow water from 'hot' toilets. It is important to consider the risk involved in exposure to either Category 3 or Category 4 water, and apply the relevant guidelines or standards to the contaminant that poses the greatest risk.

### 3.3. Biological hazards

The presence of contaminated water can bring with it any number of biological inclusions, many of these can be, or develop into, problems for people into which they come in contact.

#### 3.3.1. Pathogens

One of the key health concerns associated with a water ingress, particularly a flood or sewage leak, is the introduction and proliferation of potentially pathogenic organisms.

Water ingress poses a range of different risks and challenges in any built environment. However, healthcare facilities have a particularly unique setting. Due to the nature of these facilities, it is likely that immunocompromised individuals will be present. These circumstances dictate that the consequences of pathogen exposure are also uniquely more severe. As such, flooding and other large-scale liquid events in healthcare facilities demand immediate attention and appropriate measures to prevent the introduction and spread of harmful pathogens.

### **3.3.2. Bacteria**

3.3.2.1 During and after a water ingress event, bacteria may thrive and spread rapidly, posing a serious threat to both patients and healthcare workers. Flood waters can contain numerous bacterial pathogens, such as streptomycetes, actinomycetes, mycobacteria, gram-negative bacteria, and many others. The quantity, type, and persistence of pathogenic bacteria depend on several characteristics of the intruding water, including volume, chemical and biological content, surrounding environmental conditions, dwell time, temperature and humidity, building design, and response time<sup>1</sup>. Regardless of the specific circumstances, the introduction of bacteria into a water event is a cause for concern that needs to be considered and planned for.

### **3.3.3. Mould and Yeast**

Mould is a microscopic fungus that requires moisture and organic nutrients to grow. Mould reproduces by generating millions of microscopic spores, which predominately travel on wind and water currents and deposit on surfaces. Mould spores are known to be ubiquitous in both natural and most built environments. Following a flooding event, mould growth can begin to develop on building materials if they are not dried within 24 to 48 hours.

Yeast is a type of microscopic unicellular fungus that requires moisture and organic nutrients to grow and reproduces by budding or fission. Following a flooding event, yeast growth can begin to develop on building materials<sup>6</sup>.

Airborne fungal spores have the potential to cause irritation, allergies, asthma, infection, or toxicosis, and as such, in a healthcare setting, the control of fungal spores is imperative. Similar to bacteria, the type and quantity of mould, will depend on factors, such as the initial conditions of the environment, response time, materials and nutrients present, water content, temperature and humidity, and building design.

### **3.3.4. Biological hazards**

While mould, yeast and bacteria are the most obvious and immediate health related concerns, other chemical and biological hazards may also be present.

Protozoa, like Giardia and Cryptosporidium, may be present in flood waters, and can contaminate water sources, which can cause serious illness if ingested. Similarly, studies have shown that enteric viral infections increase following severe flooding. Therefore, when combined with factors such as bacteria, yeast and mould, these are all further complications that need to be understood, considered, and planned for.

### **3.3.5. Chemical hazards**

Toxins, such as pesticides and heavy metals, can accumulate in flood water which can then be deposited in silt, dirt or mud once flood waters recede.

## **3.4. Other hazards (services)**

### **3.4.1. Electrical risk management**

During serious water events, the combination of water and electrical distribution boards, systems, equipment and appliances creates a high risk of electrocution.

To prevent this, it may be necessary to shut off mains power or backup power to the affected areas of the hospital. Hospital staff and emergency workers should be trained to safely disconnect power supplies in these situations and should always assume that all electrical systems are live until proven otherwise. However, whilst staff can be trained to properly power down and disconnect equipment, only appropriately qualified people should isolate power supplies and lines. Power should be shut off when there is the risk of electrocution, consideration for appropriate arc flash rated PPE should be used if isolating switchboards. This decision will need to be made on a case-by-case basis with instruction from the facilities manager, hospital management, and in accordance with facility specific emergency response protocols. Where electrical isolation is required, but there are no circuits to differentiate different areas of the facility, the entire facility may require isolation.

In the event that portions of the hospital are still operational, backup power may be required to maintain essential services such as lighting, refrigeration, and life support systems. Backup power systems should be tested regularly and maintained in accordance with manufacturer guidelines to ensure that they are reliable and effective in emergency situations.

However, even with backup power in place, it is important to minimise the risk of electrocution when entering floodwaters within the hospital. Electrical isolation is a critical step in preventing electrocution and should be conducted before any staff or emergency workers enter flooded areas.

Electrical isolation involves identifying and isolating all electrical sources in the affected area to prevent electrical current from flowing through the water. This may involve shutting off power at the main breaker or disconnecting electrical cords and appliances. The act of isolating electrical systems removes this hazard for staff and emergency workers. However, considerations will need to be made for required electrical equipment, such as temporary lighting.

The isolation of smoke detectors may also need to be considered to the affected areas. This should be done in consultation with the facilities manager and the local fire department.

### **3.4.2. Service lines**

During a water event, it may be necessary to isolate hospital-specific service lines, such as oxygen, nitrogen, and carbon dioxide, to protect both first responders and the infrastructure of the services. While these services are normally used for patient care and treatment, they can become a serious obstacle and liability if they become compromised. Isolating these lines can also prevent contamination of the service network and minimise damage.

Isolation of service lines should be covered in the hospital specific emergency response plans.

### **3.4.3. Excess or waste water**

During water events slip hazards can be introduced which will need to be mopped, squeegeed or extracted. During the removal of this bulk water, consideration as to where this waste water can be put needs to be factored. Such considerations that need to be made:

- Is the contaminated water suitable to dispose of via the sewer? Does the water contain hazardous liquid waste?
- Is the sewer in suitable condition to receive further wastewater? For example, sewerage blockage or back flow water damages.

Until a professional liquid waste removal company can be engaged to remove and dispose of the water appropriately, where can waste water be stored if the sewer is not appropriate? Or until the sewer line is back in operation?

#### **3.4.4. Hazardous materials**

In a hospital setting, there are a variety of hazardous materials that could potentially contaminate water during a water ingress event. These materials may include sharps, drugs, radioactive materials, biological waste, and other substances used in patient care and treatment.

If flood waters become contaminated with these hazardous materials, it can pose a serious threat to the health and safety of first responders and other individuals who encounter it. For example, sharps and other medical waste can cause injuries or infections, while drugs and other chemicals can cause adverse health effects if ingested or via dermal contact.

Therefore, during a water event, first responders should wear appropriate personal protective equipment (PPE) and take steps to prevent contact with contaminated water or other materials.

## 4. Personal protective equipment (PPE) for first responders

### 4.1. Personal protective equipment (PPE)

Responding to a water related emergency, such as a flooded hospital, can present a wide range of health and safety related risks for first responders. PPE plays an important role in protecting the health and safety of first responders by reducing the risk of injury, illness, or death whilst allowing them to continue with their vital work. Typically, emergency first responders will have predefined PPE requirements for emergency responses, however in the context of a hospital, extra care may need to be taken.

As part of the Hospital's emergency plan, external emergency service responders such as the Fire Rescue Victoria and will have been briefed by Hospital management of any specific hazard that requires any additional training and PPE above and beyond standard issue.

First responders shall wear risk based protective clothing, eyewear and respiratory protection that not only is commensurate with the potential hazards present within the water affected area that is being entered but also complies with any relevant Australian regulatory requirements and Australian Standards.

As a minimum, protective clothing (water resistant boots, gloves, and suit) that covers the entire body to prevent dermal exposure to the water, and any chemical or biological contamination that may potentially be present, shall be worn.

Eyewear will include appropriate safety glasses, goggles, or face shields to protect their eyes from the flood water, contaminants within the water and any particulate that may be present within the area.

It is important that internal first responders are properly briefed and trained to effectively execute their specific role in an emergency event. This will include appropriate training and competency to ensure that:

- All necessary PPE is worn correctly during the emergency, specifically responders have been fit tested for any respiratory protection required to be worn,
- All PPE is donned and doffed both safely and effectively in appropriate designated locations,
- All PPE is appropriately decontaminated or disposed of after use, affected and non-affected areas are clearly delineated and policed to prevent the spread of any possible contamination.

### 4.2. Thermal comfort

Depending on the temperature of the area being entered and the work load undertaken by first responders, thermal stress may be a significant health risk that needs to be effectively managed.

## 5. Mitigation

### 5.1. Assessment

The first step in responding to a water ingress event is to assess the situation and determine its severity. This will involve identifying the source of the water, the extent of the flooding, and any potential hazards that may be present.

Determining the extent of the water damage will involve mapping out a three-dimensional perimeter of where the water entered the building, the areas through which it travelled and ultimately the lowest point in which it accumulated. This stage is essential to develop a clear delineation between what are considered as affected areas and which can be considered as unaffected.

Upon completion of this initial assessment, the next step is to implement the appropriate response plan. It is important to ensure that all staff members are aware of their roles and responsibilities in the event of a water emergency, and that they are able to execute their duties efficiently and effectively.

### 5.2. Evacuation or restriction plan for staff and patients

Depending on the scale of the event, and the potential risk to both patients and staff, the decision may need to be made to evacuate the affected area, or to simply restrict access to the affected area. Stakeholders should refer to their already established emergency response plans to make this decision. However, should the event involve grossly contaminated flood waters, or a sewage leak, it is recommended that both patients and staff are evacuated from the affected areas to prevent exposure to potentially harmful pathogens and the cross contamination of unaffected areas.

Areas that are deemed as requiring evacuation should be appropriately signed and barricaded to ensure that staff, visitors or patients are not put in danger and also do not cause cross contamination from affected areas to unaffected ones.

Water categories (covered in [Categories of water](#)) may also provide guidance with decisions surrounding evacuation.

### 5.3. Water event response plan

Once any evacuation plan has been executed, the next step is to stop and contain the water. This response will vary depending on the source and quantity of water, but regardless the primary goal is to, where possible, prevent further water impact. If the source of water cannot be identified or controlled a specialist should be engaged. The speed at which the response plan is executed is critical in mitigating the opportunity for secondary damages, such as mould growth.

In the event of the large-scale flood, rapid removal of water may not be possible, as waters may not recede for weeks. It may be possible to undertake efforts to speed up access, such as sandbag around entry points and pump water out of these sandbagged areas, however the authors acknowledge that this would require significant resources and manpower. The individual facility's response to this should be listed in the emergency response plan.

In the event of water ingress due to building damage, it is vital to stop water entering the building as soon as it is safe to do so. This may include the creation of temporary barriers to damaged areas, such as the use of tarpaulins, or collecting intruding water in receptacles, such as buckets or other containers. Whatever is safe to use to stop the water as quickly as possible.

In the event of a burst pipe or plumbing fitting, it is important that water is turned off and isolated from the affected area immediately, and a suitably qualified plumber is engaged to rectify the issue as soon as possible.

## 5.4. Make safe

Upon first entry, it is important to assess all affected areas to ensure they are safe to enter. Top-down wetting events may result in damage to sheet material ceilings or ceiling tiles. These materials may become damaged and pose a risk of falling or collapsing. It is important that these risks are promptly identified and stabilised prior to entry into water affected areas. It is recommended that these materials are made safe, but not removed from the affected areas at this stage, as suitably qualified remediation technicians should remove these materials in accordance with recommendations detailed in *HTA-2024-002: Responding to flooding events - restoration for healthcare facilities*. An exception to this being, instances of required access by emergency workers, who have likewise been trained to understand the associated risks. If the area cannot be made safe a specialist should be engaged.

## 5.5. Patient vs. non patient area responses

Different responses may need to be applied for patient versus non patient areas of a facility.

Any impacts to services will need careful consideration against the business continuity plan, and any bed or area closures must include Riskman or equivalent notification and assessments.

### 5.5.1. Non-patient area response

Non-patient areas have been considered as, but are not limited to, cafeterias, laundries, kitchens, plant rooms, receptions, hallways, loading bays, administration offices, laboratories, server rooms, medical records, or conference rooms. Each area may have a slightly different response; however, some general recommendations are as followed:

- If the event has occurred in a public facing area, such as the reception or cafeteria, restrict public access where possible.
- Ensure that patient facing staff are not accessing the area and potentially cross contaminating into non-affected areas.
- Ensure water or contaminants do not enter heating, ventilation, and air conditioning systems.

### 5.5.2. Patient area response

Patient areas and other sensitive areas, such as sterile storage, will require a higher degree of caution following an event. As previously stated, evacuation is recommended, and containment will be necessary (covered in *HTA-2024-002: Responding to flooding events - restoration for healthcare facilities*) to prevent patient infection from cross contamination between affected and unaffected areas.

## 5.6. Ventilation systems

Heating, ventilation, and air conditioning (henceforth referred to as HVAC) systems are a critical item of hospital infrastructure that are not only responsible for maintaining comfort but more importantly provide uncontaminated air to potentially immunocompromised patients. However, in the case of a water ingress, HVAC systems can become contaminated with dust, debris and pathogenic organisms. This turns an important piece of equipment into a potential liability.

To prevent the spread of such contaminants to the entire network, HVAC systems should be shut off to affected areas or redirected. Positive pressurisation, such as a constant stream of conditioned air into a space, should be avoided in a contaminated area. This is because positive pressurisation can cause airborne contaminants to spread to adjacent areas. HVAC systems should be shut off at minimum within the first 48 hours, but preferably within the first 24 hours of a water event being discovered.

In addition to shutting off or redirecting HVAC supplies, it is important to decommission any return air vents located within the affected area. Return air vents are responsible for circulating air from the building space back to the HVAC system network, where it is filtered and treated before being recirculated. If a return air vent is located within a contaminated area, it can recirculate contaminated air to non-affected

areas of the building. To prevent this, the return air vent should be temporarily decommissioned until the area is properly cleaned and decontaminated.

Once the HVAC system has been properly reconfigured to prevent the spread of contaminants, it is possible for it to be used to assist with the drying process in the affected area. The utilisation of existing HVAC systems in the drying process is described in detail in *HTA-2024-002: Responding to flooding events - restoration for healthcare facilities*.

Consultation with the facilities manager or the appointed HVAC engineer is critical in understanding the movement of air between affected and unaffected areas to determine what components of the HVAC system need to be turned off or redirected.



## 6. Response

### 6.1. Initial response

Preventing the spread of water, where possible, at the time of ingress may save significant time, cost or even lives.

Depending on where or how water is escaping or entering, it may be possible to stop the spread into other areas. Due to the water-resistant floor coverings that are common in hospitals, water tends to travel quite far laterally before it can travel downwards. Often, when it does travel downwards, it is in a lift or services shaft, or any perforations in the flooring. Therefore, physically preventing the water reaching these locations is critical.

### 6.2. Containment of water

Where possible, physically containing water that is entering or escaping can significantly reduce the scale of any damage and the scope of remediation.

It is possible that small flooding events may be contained using sandbags or other physical structures. This is preferably done outside the building envelope, however at times it may be required within the building itself.

Depending on their purpose and location within the building, hospital doors may have rubber seals, that when closed can prevent or limit the spread of water. Additionally, materials such as towels or items of similar absorbency may be used to help prevent water seeping through doors, however this strategy should only be utilised if the area has been evacuated and access or egress is not required.

Floor squeegees or brooms may also be used to temporarily redirect water. This may be useful in preventing water entering sensitive rooms or areas, such as operating theatres or MRI rooms.

Once professional remediation companies have been engaged, it is expected that they will confirm and determine the call of water intrusion, erect temporary containment barriers, utilising appropriate engineering controls. These measures further help to prevent the spread of contamination. Best practice for these containment and engineering controls will be described in *HTA-2024-002: Responding to flooding events - restoration for healthcare facilities*.

### 6.3. Initial cleanup, flooring protection and exit chambers

It is probable that during the periods of evacuation, inspection or mitigation, foot traffic will be transferring contamination from affected to unaffected areas. Ideally this should be prevented as quickly as possible. Once preventative measures are in place, it is strongly advised that an initial clean of non-porous floor surfaces should be performed to unaffected areas. This clean should utilise anti-microbials and slip safe chemicals to achieve most thorough results.

Consideration should be given to the Installation of an exit chamber, where shoes can be cleaned prior to entering affected areas. This Exit chamber can also assist with safe donning and doffing PPE and also with the controlled and clean removal of materials and equipment from an affected area.

The installation of flooring protection to both affected and unaffected areas should be considered based on the type of floor coverings and also the severity and location of the contamination.

### 6.4. Relocation of non-affected, dry equipment

The rapid removal of non-impacted equipment from the affected areas may save those items from requiring remediation or disposal, or at least potentially reduce the scale of remediation. Items that have not been directly wet from an event but are located within an impacted room should be moved to a non-affected area as soon as it is safe to do so, as potential increases in humidity may lead to degradation.

By way of an example, a low-level flood has occurred in a storage room. Equipment within the room has been stored on elevated shelves or cupboards that have not been affected. The items on these upper shelves can be removed from the room and stored in a different room to ensure they remain unaffected.

While another example may involve top-down wetting in one corner of the same room. Some items beneath the water entry will be affected but items stored in other areas around the room have not been wet. These items should likewise be removed to a different location.

If the event occurs in, or impacts, the sterile storage departments, all decisions to maintain or dispose of sterile items must comply with AS/NZS 5369:2023.

Relocated items should be identified as such and kept separate from items still in use. These items will still require an inspection from either a hygienist or remediation contractor to confirm that they have not been contaminated.

This proactive approach can help minimise damage and potential costs associated with remediation or disposal. By taking these steps, healthcare facilities can better protect their assets and minimise the impact of water events.

A full register of all relocated equipment is to be maintained to assist with future asset retrieval.

## **6.5. Management of wet equipment**

The unexpected nature of most water events means that inevitably some items and equipment will get wet. The management of these wet items will vary depending on their use, cost, and severity of impact. For example, if equipment or items dwell for a long time in water, particularly flood waters, restoration is typically not an option. Prior to an impending evacuation, if equipment can be stored off site, this should be considered. If a personnel or patient evacuation is occurring, it may prove prudent to remove or relocate equipment at this stage, where possible.

Reusable sterile items, such as scissors, containers, scalpels, tools and so on, can be reused after they have been appropriately sterilised in accordance with AS/NZS 5369:2023.

While non-reusable sterile items such as needles, IV tubing, PPE, drapes, dressings and so on will require removal and disposal, should they come in contact with water, or even condensation, from the water event. Disposal of such items should be done in compliance with the relevant guidelines for the individual items.

For items where sterility has not been compromised, the decision to dispose of an item should be decided by a cost-benefit analysis. Most non-porous, non-electrical items can be quickly and easily restored. Electronic components that have been damaged by water can occasionally be replaced, with the bulk of the item restored.

Some items may be damaged beyond repair or are not cost-effective to remediate. These should be disposed in accordance with the relevant environmental protection guidelines.

The cost of the individual item may mean disposal is not an option. This can be particularly true of high-cost equipment, such as MRI units, CT scanners, linear accelerators and so on. Fixing, cleaning and restoring the item, sometimes in situ, may be the only option. Remediation of such items should be undertaken in consultation with the equipment manufacturer or provider and may involve specialised remediation techniques.

Impacted items that are likely candidates for restoration should be separated from non-impacted items and those items still in use. Ideally, impacted items would be placed in a climate-controlled environment where they are able to dry thereby preventing fungal growth.

Insurance Assessors are likely to play a key role in this in this stage of the remediation process particularly in validating decisions and photographic evidence and or services reports will be required to be produced prior to disposal.

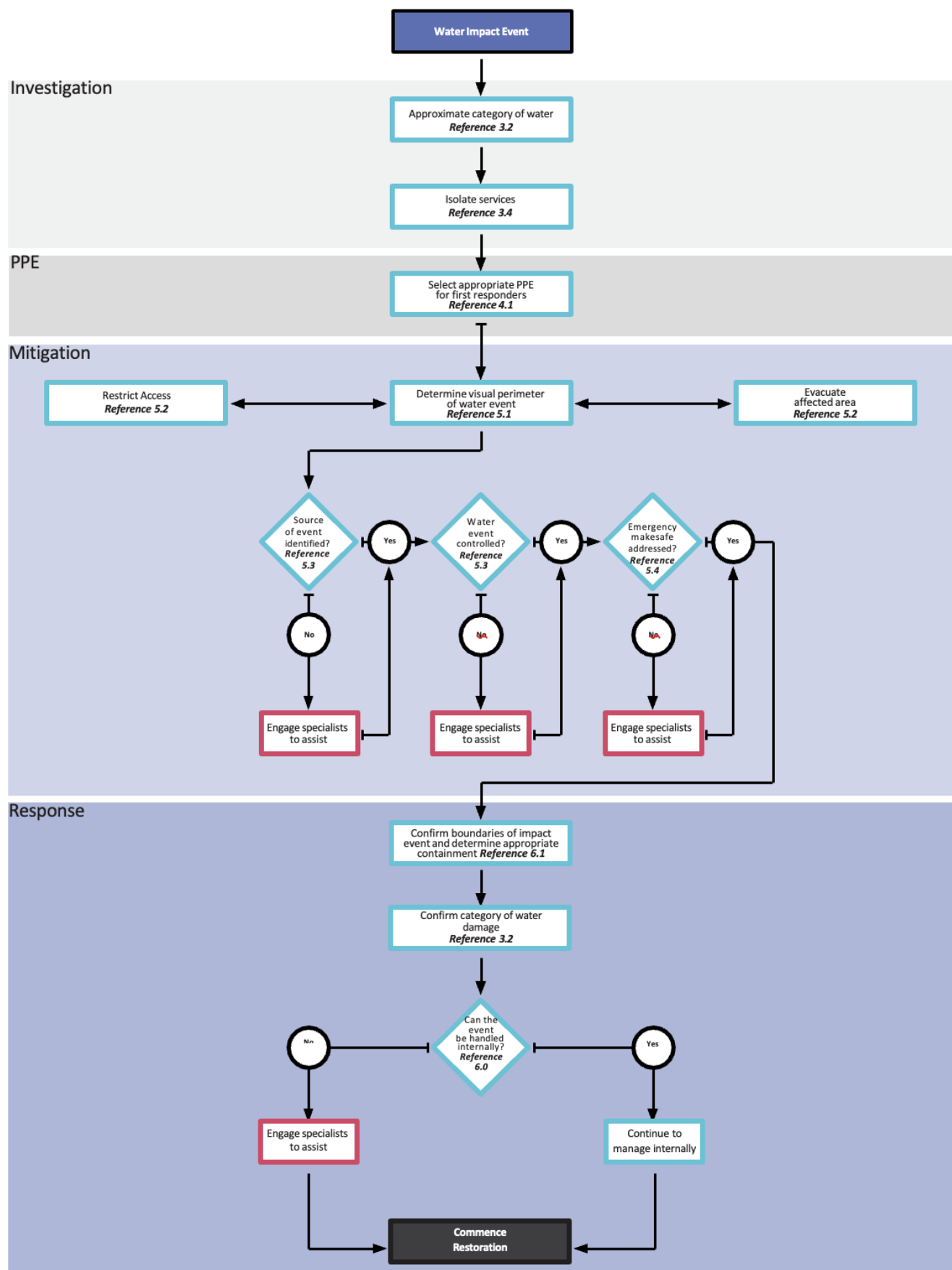
## 7. What is not covered by this document

- Pre-event checklist.
- Location of key infrastructure.
- How to determine which infrastructure is portable or immovable.
- Accounting for vulnerable stores (chemical, medicinal).
- Mapping vulnerable areas within the building (basements, lift shafts).
- Having an up to date, understood and clear evacuation plan.
- Having a clear mitigation strategy for dealing with lesser single room or lower level events.
- Understanding of the layout of the building, its vulnerabilities, and its strengths.
- Understanding methods and locations best suited to inhibit further damage.

## 8. References

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6. Andersen B, Frisvad JC, Søndergaard I, Rasmussen IS, Larsen LS. Associations between fungal species and water-damaged building materials. *Appl Environ Microbiol*. 2011 Jun;77(12):4180-8. doi: 10.1128/AEM.02513-10. Epub 2011 Apr 29. PMID: 21531835; PMCID: PMC3131638.

# Appendix A: Internal response flowchart



## Appendix B: Checklist

**Table 1: Approximate the category of water**

Item number	Item	Relevant document section	Example or comment	Yes or No?
1a	Has the water come directly from a potable source? – Category 1	3.2	Mains Water	
1b	Could the water contain bacteria, protozoa (that is, giardia, cryptosporidium) – Category 2	3.2	External Flood Event	
1c	Is the water likely to be grossly contaminated with bacteria, protozoa (that is, giardia, cryptosporidium) – Category 3	3.2	Burst Sewage Pipe	
1d	Has the water been contaminated (category 4) with any hazardous materials that may be present within the affected area?	3.2	Pesticides, medication, radioactive tracers, chemotoxic drugs	

**Table 2: Identify appropriate PPE for first responders**

Item number	Item	Relevant document section	Example or comment	Yes or No?
2a	Will first responders be required to walk through Category 1 water?	4.1	Eyewear, gloves, slip resistant shoes, Water resistant suit, boots, eyewear, gloves	
2b	Will first responders be required to walk through Category 2 water?	4.1	Eyewear, gloves, slip resistant shoes, Water resistant suit, boots, eyewear, gloves and P2 Respirator	
2c	Will first responders be required to walk through Category 3 or Category 4 water?	4.1	Category 2 requirements plus any hazard specific PPE identified in 1d.	
2d	Is the category of water unknown?	4.1	Treat as Category 3 requirements	
2e	Has the thermal load of PPE required to be worn been considered?	4.1	Excessive PPE may generate a risk of heat stress or strain.	
2f	If there is a thermal risk has the appropriate controls been implemented to effectively manage the risk?	4.1	May require administrative controls to manage time spent working	

**Table 3: Isolation of services**

Item number	Item	Relevant document section	Example or comment	Yes or No?
<b>3a</b>	Are there services lines present within the affected area that may pose a significant risk to First Responders?	3.4	-	
<b>3b</b>	Have Services to affected area been isolated for electricity?	3.4	Risk of electrocution	
<b>3c</b>	Have Services to affected area been isolated for Water?	3.4	-	
<b>3d</b>	Have Services to affected area been isolated for Gas lines?	3.4	Oxygen - Explosion	

**Table 4: Setup**

Item number	Item	Relevant document section	Example or comment	Yes or No?
<b>4a</b>	Have First Responders visually confirmed the boundary of the water?	5.1	-	
<b>4b</b>	Have physical or administrative boundaries been implemented to prevent access to affected area by non-authorised persons?	5.1	-	
<b>4c</b>	Have all non-essential persons been cleared or evacuated from the area?	5.2	-	
<b>4d</b>	If the source of the water ingress is not confirmed by first responders has a specialist been engaged to identify source?	5.3	-	

**Table 5: Event response**

Item number	Item	Relevant document section	Example or comment	Yes or No?
<b>5a</b>	Has the event been controlled?	5.3	-	
<b>5b</b>	If unable to control water event, has a specialist been engaged to control?	5.3	-	
<b>5c</b>	In the event that the source cannot be immediately controlled, has appropriate mitigation strategies been implemented to stop the spread of water into unaffected areas?	5.3	-	

**Table 6: Make safe**

Item number	Item	Relevant document section	Example or comment	Yes or No?
<b>6a</b>	Has final make safe has been established to allow persons to safely remove residual water?	5.4	-	
<b>6b</b>	Has the structural integrity of the affected area been assessed?	5.4	-	
<b>6c</b>	If structural integrity cannot be determined utilising internal resources, engage a specialist	5.4	-	
<b>6d</b>	Have all hazardous chemicals, drugs or radioactive materials been safely managed or removed?	5.4	-	



**Table 7: Confirmation**

Item number	Item	Relevant document section	Example or comment	Yes or No?
7a	Has it been confirmed all areas where water may have infiltrated?	6.1	-	
7b	Has final containment been established to consider any areas not originally identified as water affected?	6.1	-	
7c	Has the PPE requirements been reviewed in light of final water category assessment?	4.1	-	
7d	Has the category of water damage been confirmed?	3.2	-	
7e	Has equipment been assessed and relocated if appropriate?		-	
7f	Has an item triage system been implemented to safely identify salvageable moisture affected items?		-	

**Table 8: Remediation**

Item number	Item	Relevant document section	Example or comment	Yes or No?
8a	Can internal resources safely and effectively remediate the affected area?		-	
8b	Can excess water be safely removed utilising internal resources?		-	
8c	If unable to safely remove excess water internally has a specialist been engaged?		-	
8d	Can water affected structure, materials and equipment be effectively remediated using internal resources?		-	
8e	If affected structure, materials and equipment are not able to be remediated internally has a specialist been engaged?		-	

# Appendix C: Image descriptions

## Flowchart

### Start

Water impact event.

### Investigation

**Step 1:** Approximate category of water (Reference 3.2).

**Step 2:** Isolate services (Reference 3.4).

### PPE

**Step 3:** Select appropriate PPE for first responders (Reference 4.1).

### Mitigation

**Step 4:** Determine visual perimeter of water event (Reference 5.1).

- Go to Question 1.

**Question 1:** Source of event identified (Reference 5.3)?

- If Yes: Go to Question 2.
- If No: Engage specialists to assist. Go to Question 2 when source identified.

**Question 2:** Water event controlled (Reference 5.3)?

- If Yes: Go to Question 3.
- If No: Engage specialists to assist. Go to Question 3 when water event controlled.

**Question 3:** Emergency make safe addressed?

- If Yes: Go to Step 5.
- If No: Engage specialists to assist. Go to Step 5 when addressed.

### Response

**Step 5:** Confirm boundaries of impact event and determine appropriate containment (Reference 6.1).

**Step 6:** Confirm category of water damage (Reference 3.2)

- Go to Question 4.

**Question 4:** Can the event be handled internally (Reference 6.0)?

- If Yes: Continue to manage internally.
- In No: Engage specialists to assist.

### End

Commence restoration.

Return to **Appendix A: Internal** response flowchart.