



Government of **Western Australia**
Department of **Health**

Guidelines for Managing Mould and Dampness Related Public Health Risks in Buildings

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Purpose

This document provides guidance for the identification, evaluation, remediation and prevention of mould growth and/or dampness problems in indoor environments. The purpose of these guidelines is to reduce exposure to mould and dampness in indoor environments so as to manage potential health risks. The strategies and approaches are based on a review of both the existing literature and international and national guidelines/recommendations.

Scope

This document has been prepared for owners, landlords, residents and building managers of residential dwellings and public, government and commercial buildings. Public, government and commercial buildings include, but are not limited to, schools, office buildings, day care centres and nursing homes. The guidelines are not intended for infection control in healthcare facilities which is covered by the *Australian Guideline for the Prevention and Control of Infection in Healthcare*. They are also not intended for Microorganism control in the Food industry which is covered by the *Australia New Zealand Food Standards Code*. However, these guidelines can still be used in both the Healthcare and Food premises to assist in the recognition, evaluation, remediation and prevention of mould contamination or dampness.

This document covers both mould and dampness. Dampness is the most important condition conducive to mould growth in indoor environments but is also a risk factor for disease in the absence of any visible evidence of mould. Dampness can be defined as any visible, measurable or perceived, unwanted and excess moisture in an indoor environment.

These guidelines are designed for the identification and remediation of mould problems if they occur and the prevention of further contamination (if required). Ideally the prevention of dampness and potential mould problems should be considered at the building design and construction stages: the National Construction Codes have requirements for moisture control in both commercial (Vol 1, Part F1) and residential (Vol 2, Part 2.2) buildings. Building design and construction are beyond the scope of this document.

Context

The Western Australia Department of Health (WA Health) receives many enquiries about mould contamination in public, government, commercial and residential buildings. Currently WA Health provides generalised advice but has no specific guidelines about mould exposure, prevention and remediation.

The *Health Act 1911* specifies the role in protecting public health from indoor or outdoor environmental hazards. Local Government Environmental Health Officers (EHOs) are able to inspect, provide advice and/or issue a notice to address mould or dampness related health risks. When the mould or dampness problem occurs at a workplace and presents a hazard to workers, advice regarding occupational health issues should be sought from WorkSafe, Department of Commerce under the *Occupational Safety and Health Act 1984* and the *Occupational Safety and Health Regulations 1996*.

Building owners/managers are responsible for providing a healthy workplace, under Section 19(1), Section 22 and Section 23K of the *Occupational Safety and Health Act 1984* and Regulation 3.1 of the *Occupational Safety and Health Regulations 1996*. Under the section 42 (2) and 38 (1) of the *Western Australia Residential Tenancies Act 1987* the owner/agent of a premise must ensure that it is habitable and in a reasonable state of cleanliness and repair and tenants are responsible to ensure premise is in a reasonable state of cleanliness and notify the owner as soon as practicable after any damage to the premise. In terms of mould issues, owners are to ensure proper building construction and maintenance and occupants are required to manage the use of water, heating, ventilation and appliances in a manner that does not lead to dampness and mould growth (*Renting a home in Western Australia- a tenant's guide*).

Definitions

Mould: includes all species of microscopic fungi that grow in the form of multicellular filaments, called hyphae. Although the terms 'mould' and 'fungi' are often used interchangeably mould is only one of the many organisms that make up the kingdom, Fungi. The number of mould species is large and diverse.

Moisture: can be either (1) water vapour and/or (2) condensed liquid on the surface of objects. It refers to small amounts of liquid, sufficient to moisten or dampen the air or a surface.

Dampness: is the consequence of excess moisture in buildings.

Condensation: the process used to describe moisture formation on a surface as a result of moist air coming into contact with a surface which is at a lower temperature. As cool air is unable to retain the same amount of water vapour as warm air, excess moisture is released as condensation. Factors that contribute to condensation include high humidity of indoor air, low temperature of the walls/surfaces, and inadequate ventilation.

Ventilation: process of supplying or removing air by natural or mechanical means to or from any space; the air may or may not have been conditioned.

Background

Mould has been recognised as a key indoor biological pollutant that may cause adverse health effects to the building's occupants. Mould can also result in unpleasant odours and damage to building materials, contents and structures that may lead to expensive maintenance or management costs.

Mould is a common term for all species of microscopic fungi that grow in the form of multicellular filaments (hyphae). It can grow on most building materials including ceilings, carpets, glass and wood or in heating, ventilation and air conditioning (HVAC) systems. While nutrients, oxygen, moisture and appropriate temperature are all essential for mould growth, moisture is the key component. Moisture control is therefore the primary way to limit mould growth.

Excess moisture sources can be generated from factors such as inappropriate building design and construction, poor building maintenance and insufficient or inadequate ventilation. Indoor moisture can be affected by occupants' behaviour and moisture generating activities. Occasional events such as floods and storms can also lead to water damage indoors with the subsequent development of mould contamination if not adequately managed. Excess moisture not only increases the risk of mould growth but can also promote the proliferation of other indoor biological pollutants, including bacteria and allergens such as house dust mite, as well as increase chemical emissions from building materials. **All of these can adversely affect human health and therefore moisture, irrespective of the presence of mould, needs to be minimised in indoor spaces.**

Mould Levels and Health Risk Management

Mould spores constantly exist in outdoor air and usually present no health risks to normally healthy people. However dampness and prolific mould growth in buildings has been associated with health problems such as respiratory infections, allergic rhinitis, asthma exacerbation (and possibly initiation) and hypersensitivity pneumonitis. Other health effects that have been reported include neuropsychiatric symptoms and sick building syndrome (SBS), although the data are not conclusive. The main cause of concern for health impacts in buildings is through the inhalation of mould and mould fragments and byproducts (for examples, microbial volatile organic compounds - mVOCs), although dermal symptoms may be caused by skin contact to mould¹. Other biological and chemical contaminants arising from excess dampness inside buildings may also contribute to poor health. Apart from mould these include, bacteria, bacterial endotoxins and other cell wall components, protozoa (amoeba), allergens, and increased deterioration of building materials with consequent toxic gases. An excess level of any of these agents in the indoor environment can be a potential health hazard. However, the specific contribution of each agent to adverse health impacts is difficult to determine. This is because

¹ Any persons who think that they are experiencing adverse health effects from exposure to a mouldy environment should seek medical advice.

people are often exposed to multiple agents simultaneously and also to the complexities in accurate estimation of exposure to individual agents.

BOX 1

“Toxic mould” is a term often used for moulds, such as *Stachybotrys Chartarum* (often called black mould), that produce mycotoxins. The term “toxic mould” is not specifically defined in public health and current scientific evidence does not support a clear distinction between a category of “toxic mould” and other moulds found indoors. Health effects are consistently associated with the presence of mould and/or damp indoors but not necessarily the number or type of mould spores. Therefore, these guidelines are relevant for any indoor mould and/or dampness problems.

Individual responses to mould exposure vary depending on genetic makeup, allergic sensitisation, and underlying health and nutritional status. People with existing respiratory diseases, allergies, are immuno-compromised or who have a genetic predisposition are typically more vulnerable to dampness and mould related health risks. Infants, children and/or elderly people are often more susceptible to dampness and mould related health risks due to their respective developmental, immunological and health status.

Many studies have shown associations between subjective measures of indoor dampness or mould, such as visible dampness or water damage, visible mould, or mould odour, and adverse health outcomes. However, conventional quantitative measurements of fungi or other microbiologic exposures, such as counts of cultural airborne fungi, have shown less consistent associations with health effects. **Currently there is no consensus on quantitative health-based guideline values or thresholds that can be recommended for acceptable levels of contamination with micro-organisms.**

Any persistent indoor mould growth or excess dampness in buildings may cause problems and is a potential public health problem. Therefore, where possible, dampness and mould-related problems should be prevented and when they do occur they should be remediated. Public health is best protected by reducing exposure to mould growth or other related biological contaminants in damp buildings.

GUIDELINES

These guidelines are organised into the following sections:

- Assessment (Identification and evaluation)
- Remediation
- Prevention

Mould and Dampness Assessment

Overview:

- The early identification of mould problems, as well as the extent of the problem is important for determining the required remediation.
- The source of the mould and/or dampness problem needs to be identified so that it can be rectified.
- Visual inspection using indicators such as visible mould, visible water damage, excess condensation, standing water and mouldy odour is recommended. This should be part of regular building inspections or conducted in response to suspected contamination.
- Investigation and monitoring of the moisture level of the building structure, materials or the indoor air may be required to help determine the underlying source of the problem.
- Surface or air sampling of mould spores is not recommended for establishing the level of health risk. However sampling may assist in determining the extent of mould contamination ahead of defining the Scope of Works required for effective remediation, especially where hidden mould is suspected.
- Always consider the potential exposure to mould and the protection of people who conduct mould inspection.

Assessment procedures

The aims of mould assessment are to

- Determine the existence of the mould growth and/or dampness
- Assess the extent and nature of the problem
- Identify underlying causes

A preliminary mould/dampness assessment is conducted mainly by visual inspection and basic building product moisture survey. A comprehensive assessment is required if extensive mould/damp problems are evident or suspected. Professional help (see BOX 2) may be required for a comprehensive assessment

Mould/dampness assessments should be included in any regular building maintenance program. A Building Inspection Checklist for mould and dampness should be developed. A checklist, developed by the United States National Institute for Occupational Health and Safety (NIOSH), suitable for this purpose is appended as an example (Appendix A)².

People undertaking a mould inspection should always consider the potential exposure to mould, particularly if the inspection may disturb a contaminated area. They should have access to

² This is an example checklist and can be amended to be relevant to specific situations

appropriate personal protection equipment (PPE) including face masks and gloves (see section on PPE under heading of Mould and Dampness Remediation).

Visual inspection is the recommended method for identification of mould and/or dampness problems. However, surface and air sampling may form part of an extensive assessment or if mould/dampness is suspected but cannot be identified (see BOX 3). As there are currently no quantitative health-based microbial exposure guidelines or thresholds, sampling is not recommended for primary health risk management.

Identification of the mould and water damage

Mould or dampness is identified or confirmed by the presence of any of the following indicators, alone or in combination:

- Visible mould growth
- Visible signs of dampness
- Perceived mouldy/earthy odour
- Presence of condensation or high humidity
- Presence of standing water
- Previous documented building history of water damage or mould growth
- Moisture readings³ within the building materials or major furniture items elevated above 'environmentally normal' for the building at time of inspection.
- If occupants report symptoms consistent with mould or dampness this may also trigger a concern requiring further investigation. However, symptoms are often diverse and non-specific and can have multiple causes. Therefore, symptoms by themselves are not necessarily a good indicator.

Porous and non-porous materials: it is important to identify if the mould contaminated surfaces (for example, ceilings, floorings and furnishings) are made from porous or non-porous materials. Mould can often be removed from non-porous materials such as metals, glass and hard plastics. However, mould may be difficult to completely remove from absorbent or porous material, such as carpet, tiles, gyprock and raw wood, as the mould can grow into the empty spaces and crevices of the material. Often these items are not economically salvageable as part of typical remediation process' and must be thrown out. Items of high monetary value or sentimental significance should be referred to a remediation specialist.

Hidden mould: Mould/dampness may not be easily identified as it may occur behind walls and wall coverings (for examples, tiles or wallpaper), under floors and floor coverings (for example, carpets), within building structures and within the HVAC system. Hidden mould may be suspected if there is a persistent mouldy/earthy odour, there is- or has been a known water incursion, or if there are ongoing symptoms of occupants consistent with mould/damp exposure. Caution needs to be taken when investigating hidden mould as the mould spores may be

³ Moisture monitoring requires specialised equipment and is usually conducted and interpreted by experienced professionals

disturbed/released/aerosolised leading to the cross-contamination in the property. If mould or dampness is suspected but cannot be observed it may require professional help.

BOX 2

Professional help for mould and dampness assessment: Professional help may be required for the assessment of visible and/or hidden mould and/or dampness. Professional help may be obtained from trained building maintenance staff, mould assessors/remediators, building consultants, Indoor Environmental Quality (IEQ) assessors and Local Government Environmental Health Officers. Assessments should be conducted in a manner that provides useful information for the development of an action plan for remediation and rehabilitation of the affected area.

Finding Professional Help: there are currently no formal Australian qualifications for certifying mould assessors. However, there are a number of companies and individuals that have qualifications and experience in mould assessment. Some specialise in mould assessment, while others work more broadly in IEQ or building management/maintenance.

The Department of Health does not specifically endorse any company or individual nor does the Department keep a register of experts. To find a professional mould or indoor air assessor you should consult the Yellow Pages or search on the internet.

Before engaging a professional with expertise in mould assessment you should first establish their level of expertise and competence. This may include sighting qualifications, or any evidence of training, and previewing their previous project work/experience portfolio.

Evaluation of the extent of mould and dampness problems

If mould or dampness has been identified it is important to determine the extent of the problem in order to determine the required remediation and risk management procedures required. Evaluation includes:

- Identifying if the problem is recurrent or chronic: this means the regular and/or periodic appearance of moisture, water, or mould.
- Determining the extent of the contamination.
- Locating the source of the mould and/or dampness problem. This includes identifying if it is on the surface, in the building structure, behind walls and furniture or in the HVAC system.
- Identifying contaminated materials and furniture, including recognising whether contaminated material is either porous or non-porous.

When evaluating the extent of contamination it is important to consider the potential exposure of building occupants. This includes consideration of the likely frequency or duration of exposure, the activities of occupants that may lead to mould disturbance and the susceptibility of

occupants to potential health effects from mould and/or dampness. The building owner or manager should inform the occupants if mould or damp problems exist, the extent of the contamination, the remedial measures to be taken and a timetable for completion.

BOX 3

Surface or air sampling of mould: Based on the application of existing methods to analyse air and dust samples there are currently no quantitative health-based microbial or dampness guidelines or thresholds. Sampling is also limited by the lack of standard sampling and analytical procedures, a lack of comparability between sampling methods, high short term variability in measured levels, and difficulties interpreting the highly variable results. However, where the source of mould or the extent of a potential problem is unclear various analytical tests and moisture measurements may be considered as part of a detailed dampness and mould assessment.

Sampling should be conducted by competent professionals who have specific experience in designing mould sampling protocols, sampling methods, and interpreting laboratory analytical results (see 'Finding Professional Help' above). Laboratory testing should always be carried out in an appropriately accredited laboratory (National Association of Testing Authorities - NATA). It is important that the purpose of any sampling is made clear and that analytical test results are interpreted relative to that purpose. The laboratory analytical results should not be used for determining the level of health risk to the occupants.

Identifying the source of the problem

If mould and/or dampness are confirmed, the sources of the contamination must be located so that the problem can be remedied and further problems prevented. Common dampness sources are:

- Water accumulation. This may come from various sources such as:
 - Surface water: rainwater, groundwater or irrigation sprayers/drippers leaking into building roofs, ducting, walls, windows, or the building foundations.
 - Internal plumbing leaks: plumbing spills and leaks.
 - Capillary action: rising damp or water wicking through porous building materials from a moisture source such as groundwater, rainwater or plumbing water.
- Condensation: condensation is formed when moist air contacts a cool surface. It can be caused by:
 - High indoor relative humidity,

- Steam from indoor activities such as showering, cooking and using non-condenser clothes dryers without instalment or appropriate use of exhaust fans or,
- Inadequate ventilation, i.e. poor air exchange between indoor and outdoor air, and
- Inappropriate ventilation, for example, infiltration or exfiltration of warm and moist outdoor air
- Poor building design
- Events such as flooding, cyclones, storms or firefighting. This will be a problem if the building foundations or porous internal building components stay wet for over 48 hours.
- Occupant behaviours: occupants may contribute to indoor dampness by;
 - Generating excess moisture through activities such as showering, cooking and air drying clothes indoors without adequate ventilation and using appliances such as humidifiers, clothes dryers and unflued gas heater,
 - Failing to effectively vent or exhaust water vapour,
 - Failing to fix water leaks or dry excess water quickly,
 - Failing to maintain an irrigation system, or
 - Storing large amounts of water absorbent materials, such as books or cardboard boxes, in a damp space.

Appendix B provides more information for occupants to control moisture in indoor environments.

Water incursion: if the mould is caused by the incursion of water, either from an outdoor or indoor source, the type of water may also be important in both identifying the source as well as determining the level of remediation required. Water incursion can be categorised as follows:

- Category 1: Clean water. Water from a source that are not harmful to humans, including broken water supply lines, water from taps, clean groundwater and rainwater.
- Category 2: Grey water. This may contain a certain level of chemical, biological and/or physical contamination. It includes dishwasher or washing machine water, drain water, and water from fire hydrants. Category 2 Water may cause illness or discomfort if consumed.
- Category 3: Black water. This is considered extremely unsanitary water that contains pathogenic agents. It includes toilet overflow water containing faeces and urine, sewage water and floodwater from rivers or streams.

Determination of the mould contamination level

Evaluation requires determining if the mould contamination level is simple or complex. This is difficult to define but can be based on the size, location and nature of the problem. Criteria described below can be used as a general guide in deciding if remediation can be done 'in-house' or requires professional help.

Simple level contamination

Mould and damp contamination that are simple can be defined as follows:

- It is new⁴, isolated and visible.
- The size⁵ of mould contamination is no greater than 1m².
- When it is unlikely that the mould affects the HVAC system, split air-conditioning system or building structure.
- When the causes of dampness/condensation can be easily identified and removed or corrected.
- Water incursion, if any, is not highly contaminated, i.e. category 1 or 2 water.
- When there are no other hazards involved (such as asbestos or toxic chemicals).
- Simple mould problems can often be dealt with in-house by building occupants using appropriate personal protective equipment and taking the appropriate actions (see Remediation section).

Complex level contamination

More complex mould and dampness problems meet one or more of the following requirements:

- Mould contamination is larger than 1 m² or is found in multiple rooms or places (see footnote 4).
- There is evidence of recurring and persistent mould or dampness (see footnote iii).
- If any mould growth is confirmed or suspected in the HVAC system – not including low level mould growth within a single split-system.
- When the underlying causes of the dampness/condensation are due to the faults in building design or structure and/or are difficult to repair.
- Where there is highly contaminated water incursion (Category 3 water).
- When there are mouldy odours and/or unexplained illness associated with occupancy but no obvious visual signs of water or mould damage i.e. suspected hidden contamination.
- When other hazards are involved (such as asbestos or toxic chemicals).

⁴ Recurring problems may also be simple with regards to cleaning and removing of the mould. However, this will indicate that the source has not been addressed and help may be required in identifying the source.

⁵ This is an arbitrary size based on the United States Environmental Protection Authority (USEPA) and World Health organisation (WHO) recommendations. It is not precisely related to the frequency or severity of health effects. However, as the size of mould contamination increases so does the potential for exposure. This is only a recommendation and larger areas may be able to be remediated without professional help. The decision to employ professional help will be at the discretion of the building owner, manager or occupant.

Determination of Fitness for Habitation

Indoor mould and dampness can be injurious to health and can be deemed a nuisance under S182 (4) of the Health Act. If an Environmental Health Officer [EHO] of a local government is of the opinion that mould or dampness is visible in such quantities as to constitute a nuisance a notice could be issued requiring the owner to clean or repair the house. An order can also be issued under S139 without declaring the building unfit for habitation. In extreme situations the dwelling could be declared unfit for habitation under S 135. In this case a notice can be served directing the owner to repair or remove the dwelling (S137). Any of these options is based on the judgement of the EHO, though this judgement may be informed by the opinions or reports of various professionals.

Currently there are no quantitative or qualitative exposure limits, for either mould or dampness that can be recommended to declare that a premise is unfit for habitation. Current evidence suggests that the presence of any mould or dampness can pose a risk to health, although the level of that risk cannot be quantified.

The Department of Health recommends that any mould or dampness problems are remediated as soon as they are identified. The Department cannot recommend specific mould levels (quantitative) or degree of mould/damp contamination (qualitative) to invoke either S135 or S139. However, the extent of the contamination can be considered in the decision-making process. Other factors to be considered include persistence of the contamination (recurrence), the use of the building (for examples, child-care centre and health facility), the underlying health conditions of the occupants and reported health complaints of the occupants.

Mould and Dampness Remediation

Overview:

- Mould remediation aims to remove the mould and mould damaged materials and to correct moisture problems in order to prevent excessive mould exposure and harmful health effects.
- Remediation activities need to be conducted in a manner that minimises the disturbance of the mould and mouldy materials and contain as much as possible the release of mould spores.
- Simple problems can generally be remediated by a building owner or occupants, although it is not recommended that these activities are undertaken by people who may be affected by the mould. Professional help may be required to fix the source of the problem.
- Complex problems typically require professional help to ensure that the mould and dampness is adequately removed and the underlying causes of the event do not reoccur.

The aim of mould remediation is to restore the building back to normal condition by correcting moisture problems, and removing any mould and mould damaged materials. The level of remediation depends on the level of contamination as determined in mould assessment. Remediation can be done by a building owner and/or occupier but professional assistance may be required for the remediation of complex problems. Professional help may also be required if occupants are concerned about undertaking the work themselves or if previous remediation attempts have been unsuccessful.

Professional help for remediation: professional help may be required for both mould removal and for fixing the underlying causes. Therefore, more than one professional may need to be engaged. For example, IEQ or mould specialists may be required to remediate mould problems, plumbers may be needed to identify and fix plumbing leaks, builders or roof specialists will be required to fix leaks in the building structure, and HVAC consultants/engineers may be needed for identifying problems with the HVAC system. As stated previously the Department does not endorse any company or individual, or keep a register of experts.

Simple Level Contamination

Small, isolated or simple mould contamination can be appropriately remediated by internal staff or building occupants.

Precautions

The following precautions need to be taken for remediation:

- Personal protection: anyone who is involved in the mould remediation process should protect themselves from exposure to airborne mould. The recommendations for personal protection are:
 - Face mask: A P2 or N95⁶ respirator face-mask should be worn to reduce exposure to airborne mould spores and other mould particles. These masks are available at any hardware store.
 - Gloves: Long gloves that extend to the middle of the forearm are recommended. When working with water and a mild detergent, ordinary household rubber gloves may be used. If you are using a disinfectant, a biocide such as chlorine bleach, or a strong cleaning solution, you should select gloves made from natural rubber, neoprene, nitrile, polyurethane, or PVC.
 - Safety goggles: Goggles or glasses are recommended to avoid getting spores or dust in your eyes.
- Environmental controls: efforts need to be made to prevent the spread of mould to other internal areas. These include:
 - Close doors between the affected room and other rooms.
 - Ensure adequate ventilation to outdoors. Consideration, however, should be given to outdoor conditions. For example if outdoor wind speed is high then opening external windows and doors of the affected room may just cause the dispersion of spores within that room.
 - Do not operate air-conditioners or exhaust fans when removing mould.
 - Ensure there is clear signage and restrict access to the area while it is being cleaned.
 - Communicate with persons in the vicinity of the area being remediated. Susceptible individuals may need to vacate the area while remediation is undertaken.

⁶ The Difference between N95 and P2 classification for respirator face masks is the N95 classification means the mask complies with USA testing requirements and the P2 classification indicates compliance with European testing requirements.

Remediation

Remediation involves removing the mould and mouldy materials, drying all surfaces and fixing the source of the contamination. Remediation should be done in a manner that minimises the release of mould spores. Removing the mould and dampness should be a priority but fixing the source needs to be done at the same time to ensure there is no further contamination.

- Removing the mould
 - Scrub mould off hard surfaces using soapy water⁷. The physical action of scrubbing is the most important component of removing mould from surfaces as all mould must be physically removed to prevent regrowth. The use of cleaning solutions only form a small part of the remediation process. It is the physical action of the removal of the mould particulates that determines the efficacy of remediation.
 - Dry brushing should be avoided as it will break up the fungi in to small fragments and cause the release of fungal spores.
 - The area being cleaned should extend 30 to 50cm beyond the edge of the visible mould contamination to ensure that all mould, including any new growth that is often invisible to the naked eye, is removed.
 - Mould residue that may accumulate around the clean-up area as the result of scrubbing needs to be removed using a damp cloth and/or a vacuum cleaner equipped with High Efficiency Particulate Air (HEPA) filtered vacuum. Vacuuming or wiping also needs to extend beyond the area of visible residue to capture spores not visible to the naked eye.
 - Remove any standing water and dry damp areas using towels, heaters, dehumidifiers, and fresh air from open windows.
- Removing or cleaning mouldy materials

Some materials, particularly porous or absorbent materials (for examples, carpets, clothes and shoes, soft furnishings and tiles) may not be able to be adequately cleaned without professional assistance. If this is the case they should be removed or discarded. Mouldy material that is to be discarded should be placed in a plastic bag to prevent cross-contamination when they are carried through un-contaminated parts of the building. Mould is not considered a 'hazardous waste' and as such can safely be disposed of through normal waste disposal channels. Appendix C provides a list of actions for different materials if they become damp or water damaged.

⁷ The Department recommends soapy water as this seems to be effective and has no potential environmental or health side-effects. Other options, such as commercially available mould removing products and natural anti-fungal agents, are discussed below.

- Fixing the source

Common sources of moisture have been described above. The source of contamination needs to be identified and fixed so problems will not recur. Professional help may be required for things like plumbing leaks or building repairs.

- Drying surfaces

After removing the mould and fixing the moisture source any damp areas on walls, floors and ceilings need to be dried as much as possible. If it is not possible to dry the damp surfaces these may need to be removed and replaced (see Appendix C for actions required for different materials/surfaces). If the dampness or water damage is in the building structure professional assistance may be required.

- Dehumidifiers, fans and outdoor air (if outdoor humidity is low) can be used to help dry surfaces
- If using a fan, air should be directed across the face of the surface, not directly on to it, to carry the moisture away
- Air temperature should be ambient, not hot. Hot air can dry the outer surface and trap moisture inside
- Complete drying may take some time (days)
- Do not paint over, seal or cover surfaces until they are dry.

Commercially available biocides, antimicrobials and disinfectants: Various mould cleaning products are commercially available. The decision to use these products as part of remediation will be case-specific and a personal decision of the remediator. WA Health recommends scrubbing the mould with soapy water. Scrubbing with soap and water will clean most surfaces, can be used safely by the building occupant and is least damaging to the cleaned surface. The use of bleach, chlorine dioxide, quaternary ammonium salts and certain alcohols could be used in certain situations but these chemicals do not always totally remove mould, or mycotoxins, from infested building materials. Although bleach products can reduce mould growth on treated surfaces, they do not appear to be very effective at preventing longer-term re-growth. A potential side-effect of the use of these products is that they could leave residual chemicals that could pose health problems for remediation workers and occupants upon re-habitation. Therefore, the decision to use of these products as part of remediation will be case-specific and should take into account potential adverse effects of disinfectant exposure to applicators and building occupants. It is important to understand the limitations of each agent and its hazards and that manufacturer's guidelines are followed when using these products. Furthermore, prior to using any products it is important to understand if chemical treatments have been used previously. If there is residual contamination from a previous treatment this may react with any new (natural or synthetic) treatments.

- If using chemical cleaners the following precautions should be taken:
 - Read the label carefully before using and follow the instructions.

- Store chemical products in their original bottles or containers.
- Don't mix household products together as this may create harmful by-products. For example combining bleach and ammonia can result in toxic gases.
- Wear gloves to help protect the skin, safety glasses to protect the eyes.
- Ensure the working area is ventilated. Turn on any available exhaust fans and open all windows.
- Biocides, apart from natural biocides (see below), not specifically sold as mould cleaning products should not be used.
- Fungicides that are developed for outdoor use should not be used inside.

'Natural' biocides: Products such as vinegar, alcohol and essential oils (for examples, tea-tree oil) may be used to aid the mould remediation process. These are biocides, i.e. they can kill micro-organisms, and have been proposed as effective for mould remediation. Various levels of dilution, in water, have been suggested but these vary. As with commercially available products it is not known if these products are more effective than soapy water at removing mould. Even if biocides or other 'natural' cleaners are used, vigorous scrubbing, removal of mould residue and resolution of the moisture source is still required.

Complex Level Mould Contamination

When mould and dampness problems are complex, professional advice and help may be required. It is recommended that a site specific remediation plan is developed in consultation with competent professionals to ensure public health is protected and remediation is implemented effectively. The remediation plan should consider the following components:

- Remediation protocols including containment, structural drying, building surface and contents remediation, HVAC containment and remediation and waste disposal
- A schedule –when each stage of the remediation is expected to be carried out
- Use of Personal Protection Equipment
- Environmental Controls
- Post-remediation evaluation

Remediation Procedures

The basic principles of remediation

The basic principles of remediation are the same for small or large problems and include:

- Containment – isolation of the contaminated areas, including travel pathways, from unaffected areas of the building and building occupants.
- Removing dampness or standing water
- Removing mould and mouldy materials
- Complete drying of construction and building materials, furnishings, and carpet
- Repairing the source of the problem

Cleaning approaches, or disposal options, for contaminated areas and materials may vary depending on the extent and source of contamination. Procedures should be outlined in a remediation plan and discussed with the professionals undertaking the clean-up.

Personal Protective Equipment

The respiratory tract, eyes, and skin must be protected from mould exposure during remediation. More substantial protection may be required for extensive mould contamination and where substantial dust may be generated.

- For the remediation of large mould contamination full face powered air purifying respirators as well as non-breathable disposable overalls and gloves should be used. Professionals who conduct this type of remediation should follow WorkSafe relevant guidelines Australian/New Zealand Standard™ Respiratory protective device (AS/NZS1716).
- People who don't conduct remediation but are in the vicinity of the remediation and therefore may be exposed to contaminated dust should protect themselves with adequate PPE as per the hazard assessment for the site.

- People who are unable to use PPE or who have respiratory conditions, allergies, weakened immune systems or special health concerns that mean they are at high health risks from exposure to mould should be made fully aware of the potential hazards and strongly discouraged from entering any mould contaminated area during remediation.

Environmental Controls (Containment and Air flow)

- For complex level contamination problems the contaminated area and waste travel pathways must be completely isolated or sealed by heavy grade plastic covers and kept under negative pressure with the use of an exhaust fan with a HEPA filtered vacuum. An adjacent decontamination or changing room may be identified so mould is not transferred from clothing or PPE to other parts of the building that may not be contaminated. It is recommended that occupants are evacuated during remediation. If they cannot be evacuated all precautions should be taken to reduce their exposure.

Post-remediation Evaluation

Remediation effectiveness is determined by following indicators:

- Remediation work has been conducted according to the remediation plan.
- Causes of moisture have been eliminated and water problems have been repaired.
- Visible mould or mouldy material has been removed and area is left dry, clean and free of mould, debris and dusts.
- There has been no recurrence of mould growth within two to four weeks after remediation.
- Occupants no longer report any mould related health complaints. (Due to the complexity of reported health problems, and their causes, reported health complaints should not be considered in isolation. However, if health problems continue after remediation it may indicate that a problem persists.)

A post remediation evaluation is encouraged, particularly if you use a professional cleaner. The post remediation evaluation will assess the above indicators. It is recommended that the post remediation evaluation is not carried out by the same entity that did the remediation work, otherwise there is likely to be a conflict of interest. There are no legal requirements for either a post remediation assessment or who should carry that out.

Mould Prevention

Overview:

Once a mould or dampness issue has been identified and resolved, mechanisms should be put in place to rectify the source of the problem to prevent future contamination.

Mould growth and dampness problems are preventable through moisture control, appropriate operation of the building (including HVAC), adequate building maintenance and education of occupants to reduce behaviours that facilitate moisture and mould growth.

Building owners/managers: Building owners and managers should develop maintenance plans that include mould & dampness prevention. These plans could include:

- Regular inspection for signs of mould and damp.
- Maintain indoor relative humidity below 65% (45-60% if possible).
- Identify and repair any water leaks or spills from roofs, walls and plumbing as soon as possible. Wet spots or materials must be dried and cleaned quickly.
- Ensure adequate drainage around building foundations.
- Keep the HVAC system clean, serviced regularly and in good condition, especially the air-handling components such as return air filters, coils, duct and registers⁸.
- Conduct a proper assessment, clean up and remediation of buildings and contents after a storm, flood or other event involving water ingress.

Occupants: Occupants can take steps to prevent the moisture problems. These are outlined in Appendix B and include:

- Take action to reduce the moisture production in household/building by using ventilation as appropriate when performing activities that increase indoor moisture.
- Identify and repair any water leaks or spills from roofs, walls and plumbing as soon as possible. Wet spots or materials must be dried and cleaned quickly.
- Ensure adequate drainage around building foundations. Ensure irrigation systems don't continually soak exterior walls or foundations
- Ensure that ventilation, heating and air-conditioning is adequate for the climate.
- Take action as soon as water damage or mould growth is noticed.

⁸ For specific information about HVAC maintenance refer to Australian Institute of Refrigeration, Air-conditioning and Heating (AIRAH) HVAC Hygiene Best Practice Guidelines.

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Appendix A- Building Inspection Checklist

Building Inspection Checklist	Yes	No	N/A
Ground Level			
Proper drainage is away from the building (including roof down pipes)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sprinklers spray away from the building and outdoor air intakes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walk-off mats are used at exterior entrances and are regularly cleaned	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Roof			
The roof is in water proof.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The roof is free of pooling water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
HVAC units operate properly (air flows in)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exhaust fans operate properly (air flows out)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
HVAC outdoor air intakes (dampers) are clear of obstruction and remain open, even at minimum setting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Outdoor air intakes are clear of nests, droppings, or collected leaves or debris	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
HVAC outdoor air intakes are free from entrainment of air from plumbing stacks and exhaust outlets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

All Rooms, Attic, and Plenums

Rooms are dusted and vacuumed regularly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rooms, attics, or plenums are free from odours (especially mouldy or musty)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Attic, plenums; walls, ceilings, floors, air supply and return vents; and areas under plumbing are free from visible mould and mildew growth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Attic, plenums, walls, ceilings, and floors are free from visible signs of water damage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inside exterior walls, windows, windowsills, and window frames are free from signs of condensation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cold water pipes are free from condensation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Attic and rooms are free from evidence of plumbing leaks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Ventilation

Air Supply and Air Exhaust

Air flows from supply vents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Air supply pathway is free from obstructions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Supply and exhaust vents are free from obstructions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bathrooms, restrooms, and kitchens have operating exhaust fans	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Filters

Filters are clean

Filters fit properly

Filters are properly installed (correctly for direction of airflow)

Filters have been changed according to the change-out schedule

Drain Pans and Coils

Drain pans slant toward the drain (to prevent water from accumulating)

Drain pans are free from accumulated water and/or are not clogged

Drain pans are clean and free of mould and mildew

Heating and cooling coils are clean

General

Temperature and humidity are maintained within acceptable ranges

Source: NIOSH

Appendix B- Moisture reduction strategies

This information sheet outlines activities that can lead to the accumulation of moisture indoors and the actions that can be undertaken to reduce this. Moisture problems will occur due to high indoor relative humidity and/or water damage from internal leaks/spills or external sources. To reduce the possibility of moisture and mould contamination, indoor humidity should not exceed 65% for extended periods and water damage, and the causes of the damage, should be dealt with as soon as they are identified.

1. Moisture generating activities	
Problems	Actions
Many day-to-day activities can generate excess moisture indoors. These include showering, cooking, drying clothes indoors, and using appliances such as clothes dryers, humidifiers and unflued gas heaters.	<ul style="list-style-type: none"> • Use exhaust fans in the bathroom when showering. Keep exhaust fans working and the doors of the bathroom shut until the water vapour has cleared. • Use exhaust fans when cooking. Put a lid on saucepans to keep the steam inside. Do not leave kettles boiling. • Ensure that there is adequate ventilation when using unflued gas heaters. • Dry washing outside whenever possible. • If you have a vented clothes dryer make sure it is correctly installed and the damp air is exhausted outdoors. If you have condensing clothes dryers make sure the room is well ventilated when using it. • Avoid growing an unusually large number of live plants indoors without exhausting or otherwise removing the humidity they produce. • Wipe up and dry condensation or moisture that collects on indoor surfaces. • Move items of furniture away from the wall slightly so that air can pass behind them. Leave the doors of cupboards open from time to time to air them. • Avoid storing large amounts of documents, furniture, or cardboard boxes in damp basements or crawlspaces or in contact with cold exterior walls or foundations.

2. Internal leaks and spills	
Problems	Actions
Liquid spills, plumbing leaks and leaks from appliances such as refrigerators, washing machines and dishwashers can dampen indoor surfaces and building structures.	<ul style="list-style-type: none"> • Keep shower or bathtub splash within the bathroom enclosure, limiting the amount of water that can soak the walls of the bathroom. • Mop and dry up any spilt liquids promptly. If liquid is spilt on a rug this can be dried by airing. If there is a spill on a fixed carpet complete drying of the damp area may require a fan or heater. • Ensure soft furnishings are completely dried if they get damp. • Intermittently check under and around white goods to ensure there are no leaks, standing water or damp patches. • Repair plumbing or other water leaks as soon as you can.
3. Outdoor water incursion	
Problems	Actions
Rainwater, groundwater and/or water from irrigation systems can leak into building through roofs, ducting, walls, windows and foundations, dampening indoor surfaces and building structures.	<ul style="list-style-type: none"> • Keep irrigation spray heads aimed carefully so that they do not continually soak the exterior walls or foundations. • Maintain the slope of exterior landscaping to ensure water runs away from the building. • Keep rainwater runoff from the roof at least 1 metre away from the foundation. • Clean and maintain roof gutters. • Keep air conditioning drip pans clean and the drain lines unobstructed and flowing properly. • Check and fix building damage, and clean and dry up any water incursion within 48 hours (if possible) after flooding, cyclone or storms.
4. Heating, ventilation, and air-conditioning (HVAC)	
Problems	Actions
Poor ventilation and inadequate HVAC can increase humidity and/or surface condensation inside buildings.	<ul style="list-style-type: none"> • Ventilation, heating and air-conditioning need to be adequate to ensure indoor relative humidity is maintained below 65% as much as possible. • Buildings need to be adequately insulated. • HVAC systems should be fit for purpose and relevant for the outdoor climate.

Appendix C- Damp and Water Damaged Materials

Guidelines for Response to Clean Water Damage	
Water-Damaged Material	Actions
Books and papers	<ul style="list-style-type: none"> * For non-valuable items, discard books and papers. * Photocopy valuable/important items, discard originals.
Carpet and backing – dry within 24 – 48 hours [§]	<ul style="list-style-type: none"> * Remove water with water extraction vacuum. * Reduce ambient humidity levels with dehumidifier. * Accelerate drying process with fans.
Ceiling tiles	<ul style="list-style-type: none"> * Discard and replace.
Cellulose insulation	<ul style="list-style-type: none"> * Discard and replace.
Concrete or cinder block surfaces	<ul style="list-style-type: none"> * Remove water with water extraction vacuum. * Accelerate drying process with dehumidifiers, fans, and/or heaters.
Fibreglass insulation	<ul style="list-style-type: none"> * Discard and replace.
Hard surface, porous flooring [§] (Linoleum, ceramic tile, vinyl)	<ul style="list-style-type: none"> * Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary. * Check to make sure underflooring is dry; dry underflooring if necessary.
Non-porous, hard surfaces (Plastics, metals)	<ul style="list-style-type: none"> * Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary.
Upholstered furniture	<ul style="list-style-type: none"> * Remove water with water extraction vacuum. * Accelerate drying process with dehumidifiers, fans, and/or heaters. * May be difficult to completely dry within 48 hours. If the piece is valuable, you may wish to consult a restoration/water damage professional who specializes in furniture.
Wallboard (Drywall and gypsum board)	<ul style="list-style-type: none"> * May be dried in place if there is no obvious swelling and the seams are intact. If not, remove, discard, and replace. * Ventilate the wall cavity, if possible.
Window drapes	<ul style="list-style-type: none"> * Follow laundering or cleaning instructions recommended by the manufacturer.
Wood surfaces	<ul style="list-style-type: none"> * Remove moisture immediately and use dehumidifiers, gentle heat, and fans for drying. (Use caution when applying heat to hardwood floors.) * Treated or finished wood surfaces may be cleaned with mild detergent and clean water and allowed to dry. * Wet panelling should be prised away from wall for drying.
<p>[§]The subfloor under the carpet or other flooring material must also be cleaned and dried. See the appropriate section of this table for recommended actions depending on the composition of the subfloor.</p>	

Source: USEPA



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