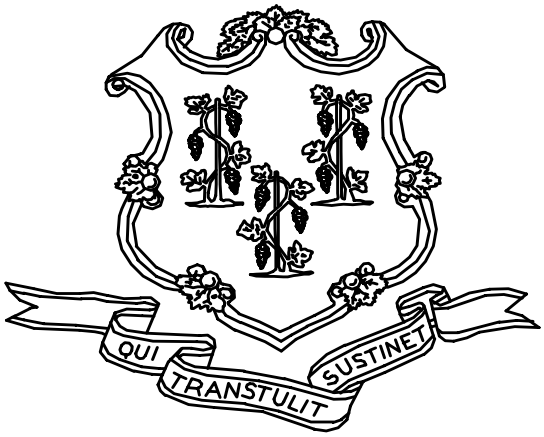
Water Intrusion Management Plan

STATE OF CONNECTICUT
DEPARTMENT OF PUBLIC WORKS

James T. Fleming
Commissioner



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Contents

Section I: Microbial Awareness and Risk Management

Chapter

1

Introduction

Risk for litigation arising from water damage and mold in buildings has dramatically affected the construction industry in recent years. For this reason, any firms involved in construction – but particularly general contractors and developers – must proactively work to prevent water intrusions, either during or subsequent to construction, that could lead to microbial growth in a structure. Opportunities to prevent water intrusion occur at all phases of construction: design, pre-installation, installation, and maintenance or warranty. In addition to prevention, construction firms must also respond immediately and appropriately, when a significant water intrusion event occurs in a building during critical phases of construction or during renovation.

The Connecticut Department of Public Works (DPW) can ultimately minimize their risk of water intrusion and possible resulting mold damage claims by establishing a Water Intrusion Management Program. This Water Intrusion Management Plan is integral to the program and is intended to help DPW personnel, particularly DPW Project Managers:

- Understand and employ the best prevention practices during the design, pre-installation, and installation phases of construction.
- Understand their responsibility to inform the building manager (Agency) of all maintenance requirements for systems equipment, weatherproofing, and other building components essential to ensuring a moisture-free environment for inhabitants of the structure. (Fulfilling this responsibility is part of an effective risk transfer program following construction.)
- Establish response protocols for key personnel to follow when water intrusion or microbial contamination does occur during construction.
- Establish roles and responsibilities for key personnel who will implement the program.
- Properly document their prevention efforts and response procedures, which will be critical should claims ever arise. Checklists and forms provided in Appendix One will help key personnel easily document these activities.

- Determine when to retain a third-party microbial consultant to assist with prevention efforts or response to incidents.

For DPW projects that encompass renovations or additions to existing buildings or healthcare facilities, the last two chapters of this plan address some special liability concerns associated with these activities.

This plan is intended for use in conjunction with a Water Intrusion Prevention and Microbial Awareness Training course designed to relate specifically to DPW projects.

Chapter

2

Mold 101 – The Basics

What is Mold? More than 100,000 identified species of fungi exist naturally in our environment today. Species have existed for millions of years, are generally present throughout the world at ambient airborne levels, and have limited negative impact on mankind. In fact, very few types of mold have been shown to be harmful to human health. Upon germination, some fungi will produce a mold colony. Germination or reproduction of fungi occurs when fungal spores, which are naturally present in or on building materials (such as ceiling tile, drywall, wood, carpet, insulation, etc.), are exposed to moisture. As long as the moisture is present the fungi will reproduce (grow).

Is Mold a Concern? We are constantly exposed to thousands of different types of fungi in our everyday lives, which are generally not harmful to our health. Inhalation of elevated levels of airborne fungi may result in health problems, the majority of which are usually allergic reactions consisting of sniffling, runny noses, coughing, itchy skin, and congestion. In very rare circumstances, more serious health problems can arise from mold exposure. Individuals who are already immune-compromised and infants appear to be particularly vulnerable. There are no established safe exposure limits for fungi. Individual health and sensitivities will influence both the impact and duration of any potential health effects of exposure.

Public concern regarding indoor air quality and the potential of fungal growth in the indoor environment has increased due to a variety of factors including media attention, increased litigation action, and general “air tight” building design.

Microbial particulates (fungi, mold, bacteria, mycelial fragments, etc.) are ubiquitous to the environment in which we live. Fungal spores are one component of settled dust, which, as we know, is present in the indoor environment as well as the outdoor environment. It is impossible to eliminate all microbial particulates from the indoor environment. Current guidance dictates acceptable levels of mold and fungi at levels and types quantitatively and qualitatively similar to that of outdoor air and removal of visible colonies of fungal growth by an acceptable method.

When Will Mold Develop? Generally, building materials must remain wet for more than 24-48 hours for mold to develop. If mold is visible prior to that time it is likely from a preexisting water problem and not from the immediate occurrence. It is, therefore, extremely important to respond quickly to issues of water intrusion by repairing the source of the leak, thoroughly drying all wet materials, and removing moisture from the air, as soon as a leak is discovered.

Importance of Visual Inspections. Once mold becomes visible it should be removed. A visual inspection is an important first step in any microbial investigation. Unfortunately, mold thrives in environments where there is a lack of ventilation such as in wall cavities, sub-floors, beneath wall/floor coverings, behind vapor barriers, and behind ceiling tiles. Therefore, when microbial growth is suspected it is critical to investigate all areas thoroughly for potential water impact.

Airborne Mold. Until the source of water intrusion is eliminated and all impacted materials dried, mold will continue to grow. Eventually, mold may become aerosolized (airborne). This occurs when fungus germinates and distributes millions of spores. Generally, the longer the mold has been germinating the higher the spore counts and the more likely mold will become aerosolized. Therefore, any drying in an area with existing mold should be performed only under controlled conditions.

Causes of Mold. Moisture problems have many causes including uncontrolled humidity. Many causes of fungal growth in the indoor environment include instantaneous or slow plumbing leaks, inadequate drainage, roof penetrations, uncontrolled humidity due to HVAC considerations, drain pan leaks, flooding events, uncontrolled exposure to the structure from inclement weather during construction, and other water accidents. It is important to avoid “simple” causes of water intrusion and leaks. Cautious practices and quality control during construction as well as prudent preventive maintenance are the first steps to preventing microbial contamination.

Mold and the HVAC System. The HVAC system in a building is the primary conduit and vehicle for the distribution of any airborne microbial contamination which may be present. It is therefore critical to immediately respond if visible fungal growth is present in any component of the HVAC system. The presence of microbial contamination in the HVAC system will expedite the process of aerosolizing (making airborne) the mold spores. Once mold spores become airborne the risk of exposure through inhalation increases as does the risk of mold induced illnesses. HVAC systems are especially conducive to mold growth because they draw supply air (usually laden with fungi and moisture) into a building containing ample food sources for fungal nourishment.

Mold and the Plumbing System. The plumbing system is the primary conduit for the introduction, circulation, and evacuation of clean water, gray water (dishwasher discharge, lavatory bowl overflows, sump pump failures, ruptured water beds), and black water (sewage, toilet backflows, flooding from natural/manmade bodies of water, contaminated water) from a structure. With respect to the development and proliferation of microbial contamination (mold), all of the above three types of water can be potentially problematic. Black water and/or gray water, however, will often precipitate mold growth due to the contaminants already present. Unlike clean water, gray and black water may also present bacterial issues as well as fungal (mold) issues.

Microbial Contamination. The term "microbial contamination" is used in this plan. "Microbial contamination" refers to the presence of mold or fungus at levels quantitatively higher and/or qualitatively different from the ambient outdoor conditions. The term is also used to describe visible fungal growth on surfaces and inside wall, ceiling cavities or HVAC ductwork and systems.

References

New York City Department of Health, "Guidelines on Assessment and Remediation of Fungi in Indoor Environments," updated January 2002, http://www.nyc.gov/html/doh/html/epi/moldrpt1.shtml.

Macher, J. M., ed., *Bioaerosols: Assessment and Control*, American Conference of Governmental Industrial Hygienists, 1999.

Chapter

3

Builder Risk of Water Intrusion

In recent years, the risk for litigation to owner/operators, architectural/engineering firms, and general contractors (GCs) from water intrusion and mold claims has skyrocketed. Reasons for this increase in risk include the following:

- Buildings provide the potential exposure for health-related issues;
- Many construction firms are self insured; and
- Construction industry firms are often regarded as “deep pockets.”

The inverted pyramid shown in Figure 1 demonstrates the diffusion of risk in a construction project. Those firms located at the bottom of this pyramid carry potential liability from all those who are higher up on the pyramid. In addition, small, specialty subcontractors often cannot get insurance or they have no assets, thereby creating even greater liability for those at the bottom.

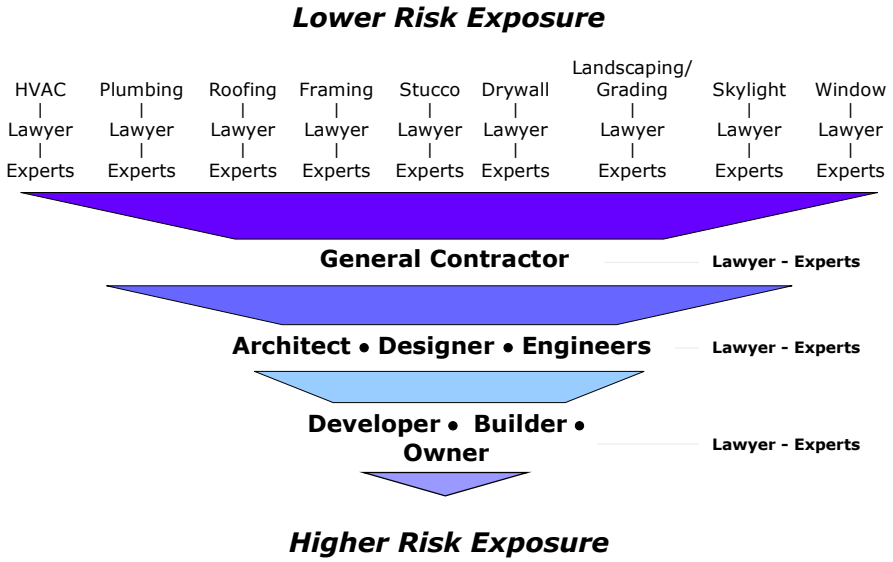


Figure 1. The Typical Construction Defect Mold Liability Pyramid

Most importantly, once it becomes known mold is present, the potential negative publicity (stigmatization) for a commercial or residential development along with possible significant diminution in income or value can be devastating. Therefore, it is critical for those in the construction industry to create water intrusion programs which address the risks unique to them and each of the entities working above them on the construction pyramid.

Water Intrusion Management Program Essentials

A good water intrusion program should always include provisions for prevention, response, training and organization, risk transfer, and documentation. All water intrusion programs should have:

1. Appropriate Water Intrusion Prevention Protocols in place at all stages of a project.
2. Appropriate Response Protocols in place when problems occur.
3. Appropriate Organization of DPW, GC, and Agency personnel in place to respond.
4. Appropriately Trained Personnel to perform the activities in components 1 and 2 above.
5. Appropriate Risk Transfer contractual language in place to shift liability to responsible parties.
6. Appropriate Documentation requirements that are consistently fulfilled.

Further Reducing Liability Exposure

The implementation of this Water Intrusion Management Plan, with the prevention protocols and documentation tools contained within, as well as the accompanying employee awareness training are two major steps to reducing liability. Contract review, proactive risk transfer methods, and independent, third-party construction oversight can help reduce liability even more.

Review Contracts. Examine your organization's potential exposure to liability from microbial issues as a result of contracts in place with any parties including architects, engineers, construction administrators and GCs:

- Review all contracts to verify the DPW is protected from ensuing mold caused by negligence;
- Verify/require all parties have training for mold/water intrusion issues; Consider requirement that they carry mold insurance;
- Ask for documentation from that all materials will be installed per manufacturer's instructions.

Review risk transfer provisions. Risk transfer contractual language places the burden of responsibility on the Agency to maintain the building after construction. Examples of items that typically could be included as the Agency's responsibilities (i.e., changing air filters, maintaining indoor air quality) are included in Appendix Two; however, it is important that maintenance issues deemed to be the Agency's responsibility are clearly spelled out in the commissioning process.. (These Agency responsibilities may be posted somewhere within the structure itself, such as in a maintenance area.)

Independent, third-party oversight. Construction activities, at certain critical stages of construction, should be documented to establish proof of proper construction practices. GC foremen and superintendents must take photographs, material moisture content measurements, comprehensive field notes and complete checklists, and DPW project managers must keep this documentation on file for each project. This documentation will be invaluable if a claim develops. Documentation of events and response to events is also critical.

Hiring of third-party water intrusion/microbial experts to conduct oversight on a project is another way to reduce liability and more easily generate documentation on a project. Third-party consultants can make inspections at the critical stages of construction, take photographs, and generate thorough documentation for the GC or DPW while relieving DPW construction managers or project managers of any added responsibilities associated with implementing a water intrusion management plan. The Agency should consider budgeting for third-party water intrusion/microbial experts for any construction projects that are considered high risks for mold.

If these third-party experts are involved in the project from the beginning design phase through construction and into the maintenance/warranty phase, they can build comprehensive documentation to show the contractor has made a cohesive effort to address water intrusion issues even before they arise. Third-party experts can also assist by reviewing and assessing the adequacy of any documentation the GC or DPW has generated in response to any issues or water intrusion events.

Section II: Best Design and Construction Practices

Chapter

4

Prevention Issues – Design Phase

To properly manage or prevent microbial contamination within a building envelope, it is essential to understand individual building components and their potential impact on water intrusion and bioorganic growth. A thorough knowledge of building components related to sources of water intrusion will best serve in the design of construction systems and the management/control of microbial incidents.

As previously discussed, the source of fungi and mold growth is moisture. In addition, any source introducing continuous moisture to building components and materials can be problematic to building envelope, wall, floor, and roof/ceiling assemblies must allow building components and materials to dry out if they get wet. Such assemblies that do not allow drying are very problematic to the building envelope.

A “tight building” is the ultimate goal for any project, yet good design and construction will include contingencies to ensure the removal of any moisture that may occur within the building envelope. Examples of these design considerations include the control of climate, temperature, relative humidity and dew points as they relate to the type of building components to be constructed. These factors affect the outside air requirements, airflow and the potential for condensation within building components. Hot and humid climates create their own set of moisture-inducing phenomena, which must be planned for in the building design.

It is the responsibility of the owner/operator and design team to weigh the numerous trade-offs between the expense of suitable materials and products, compatibility of materials with each other, and installation practices against the risk of long-term water intrusion.

Among other factors impacting the introduction of moisture to construction systems are *temperature* and *air flow*. Water intrusion in the form of *condensation* must also be considered in the design of building systems. Under any conditions of moisture-laden air proximate to cold surfaces below the dew point of the ambient air temperature, condensation can occur.

In addition to the seasonal and arbitrary nature of exterior climate and weather conditions, the building designers must also address the interior environment of the building envelope and limit condensation in components not intended to control this phenomenon.

Two key considerations in controlling moisture are:

- Design for the climate where you are working. Practices that work in Miami do not necessarily work in Minnesota.
- Prevent infiltration of moisture BUT ALSO provide a means for the building materials to dry. Building materials will get wet; they must be allowed to dry.

Common Water Intrusion Sources. As related to building design and construction, the origin of potential water sources responsible for bioorganic growth can be separated into two groups: exterior and interior. Listed below are examples of considerations contractors must take into account during the design of a project to manage possible intrusion issues.

Some Examples Of Exterior Building Water Intrusion Sources

- Rain
- Ground water
- Irrigation systems
- Hardscape and softscape drainage
- Septic systems
- Pools and spas
- Exterior plumbing (city water supply, etc.)
- Adjacent properties – the path of exterior water sources
- Roofs and roof drains
- Decks and deck drains
- Windows and doors
- Cladding (wood siding/trim, stucco, brick, one-coat systems and panelized systems)
- Concrete foundations
- Basement walls (waterproofing)
- Penetrations and junctions of above

Some Examples Of Interior Building Water Intrusion Sources

Plumbing:
- Piping and drains
- Plumbing fixtures (faucets, toilets, sinks, shower valves)
- Equipment (water heaters, dishwashers, disposals, ice makers)
- Sump pumps and other miscellaneous equipment
- Ejectors

Mechanical Systems:
- Heaters
- Air handlers
- Evaporators
- Condensate drains
- Chillers
- Pumps
- Tanks
- Boilers
- Piping
- Refrigerant lines
- Reservoirs

Fire Sprinklers:
- Piping
- Sprinkler heads
- Control boxes
- Stand Pipes

"Wet" areas:
- Showers
- Baths
- Steam rooms
- Laundry
- Lavatory
- Water closet
- Natatoriums
- Areas with higher-maintained relative humidity (such as for manufacturing processes, static control areas)

Construction Systems Design Checklist:
- Ensure the design team, including the architect, engineer(s), GC personnel and all others involved in the design, are knowledgeable of the moisture-sensitive systems required for the project.
- Verify all details related to the weatherproofing and waterproofing of the structure are properly designed and demonstrated on the construction drawings.
- Verify all specified materials provide for the adequate moisture control of the building envelope and are compatible with the design applications and other related materials to be used on the project.
- Ensure the availability and/or application of all specified materials will not negatively impact the anticipated construction schedule and installation of other moisture-control components.
- Confer with waterproofing consultants, manufacturer's representatives and approved applicators to ensure proper applications and installations of specialized systems.
- Verify the compliance of the construction plans, landscaping, and drainage plans, and/or site plans with the most current soils reports and/or civil drawings/reports with the responsible architects, engineers, and designers.

- Verify all design drainage systems adequately remove water away from the perimeter of the building to approved drainage receptacles.

Review Construction Documents and Contracts
Define accountabilities relative to the following:

- Moisture control
- Identification of mold cultivating conditions and mold growth
- Notification
- Documentation
- Remedial procedures
- Preventive maintenance
- Proper commissioning training to place the burden of maintenance responsibility on the Agency to maintain the building following construction.

  Examples of items that typically could be included as the Agency's responsibilities (i.e., changing air filters, maintaining indoor air quality) are included in Appendix Two on Prevention Issues—Maintenance; however, it is important that those issues deemed the Agency's responsibility are clearly spelled out in the commissioning process.. (These Agency responsibilities could be posted somewhere within the structure itself, such as in a maintenance area.)

Examine Exposure to Liability. As discussed in the earlier chapter entitled "Builder Risk of Water Intrusion," DPW project managers should regularly conduct a general examination of their business practices to reduce liability. However, liability exposure should also be considered on a project basis as well.

- Examine potential exposure to microbial or water intrusion liability from contracts with all third parties such as material suppliers, GCs, architects, and engineers.
- Review all contracts to verify the DPW is protected from ensuing mold caused by the negligence of the GC. Ask GCs to document that all materials are installed per manufacturer's instructions.
- Verify/require all GCs have training for mold/water intrusion issues. Consider requiring them to carry mold insurance.
- Review the commissioning process for the Agency for whom the building is constructed.

Chapter

5

Prevention Issues – Pre-Construction Phase

Reducing the risk of water intrusion and possible mold contamination should begin immediately during the pre-construction phase of a project. This practice applies not only to new construction, but also to remodels, renovations and repairs, where new building components are integrated with existing assemblies.

Leak Prevention Program. The DPW should establish a leak prevention program to assist GCs in identifying building components that are not designed for water impact and which may have been compromised by a moisture source. The program should also include the proper procedures for reporting and remediation of the moisture source.

Required Preventive Activities:

1. Implement a Water Intrusion Management Program (WIMP) plan with consideration of the unique characteristics of each project.
2. Conduct comprehensive training of the project management team, site supervisors, GCs, and other onsite personnel stressing the importance of maintaining a moisture-free environment to prevent mold growth.
3. Inspect all building components to ensure they are free of bioorganic growth prior to installation.
4. Check all items for proper working condition and damage prior to installation.
5. Consider the ramifications of climate and weather on the construction process.
6. Keep porous building materials dry at all times.
7. Never install wet building materials. If building materials do come into contact with a moisture source, dry out the affected areas or remove the affected materials immediately.
8. Perform a pre-installation inspection to confirm that the installation area is mold free. Bioorganic growth may not be visible, but should be suspected if stained ceiling tiles, odors, or evidence of leaks are found.

9. If mold is suspected, document the condition and report it immediately to the individual responsible for contacting the DPW Water Intrusion Manager. Keep a copy of this report in the field file. These measures will help in dealing with potential future claims.
10. Document everything: any changes to the plans, agreements of installation procedures, pre-installation conditions, etc. Place documentation into DPW field file.
11. Sequencing of a project is important to try to ensure that materials arriving on site be properly stored in a safe, dry condition.
12. Begin documentation process: photograph/examine all materials for proper packaging, damage, and mold (including lumber) prior to installation.
13. Verify site drainage/topography is consistent with the design; if not, document and notify appropriate parties.

Pre-Construction Check List for the General Contractor:

- Hire only competent, qualified subcontractors who have adequate experience to provide and install a reliable, moisture-sensitive work product and who possess appropriate insurance coverage. GC should check with their company attorney for specific requirements.
- Hold pre-construction peer review meetings and assign an overseer (independent third party) entity to monitor participants' adherence to the review findings.
- GC should hold subcontractor meetings with all trades responsible for providing all facets of the moisture control systems in the project.
- Develop a leak prevention program for all construction personnel and follow the guidelines of the *Required Preventive Activities* list so it can be applied to the various projects on a reasonably agreed upon schedule.

Chapter

6

Prevention Issues – Construction Phase

During construction, the GC implements their construction strategy through scheduling and coordination between design and the work product of the various trade subcontractors. As the entity most responsible for constructing a moisture-free building, the GC must have a broad knowledge of all trades and understand the consequences of how he chooses to schedule events. Material availability, the points of installation of these materials, and potential subsequent delays in material or labor can affect the entire project outcome and, whenever possible, must be identified before a realistic schedule can be established.

Failure to properly sequence the components of moisture-sensitive assemblies will undoubtedly create latent water intrusion incidences, some of which may not appear for months or years. For instance, in regions of little rainfall, such as in the southwestern United States, water intrusion at improperly installed windows may only appear (wet carpeting or drywall) during periods of abundant rainfall, which may only occur a few times each decade. Wall cavities adjacent to windows may become wet every time it rains, facilitating bioorganic growth, but without any manifestation in the living space of the building.

In addition to the GC, subcontractors are also responsible for understanding the effects of the installation of their specific building components on the entire related moisture control systems. This will require a general knowledge of adjacent materials of other trades and the proper integration of the entire assembly.

Finally, regardless of the quality and accuracy of the building plans, unique and/or peculiar situations and conditions arise in the field not adequately addressed in any of the construction documents. Solutions to these problems should be approved by the DPW project manager and agreed upon byl the GC and all their affected subcontractors. For conditions anticipated to reoccur throughout the project, the GC may require additional detailing from the design team. All directives and field modifications should be documented and included in the field file.

Personnel Supervision is CRITICAL. *The vast majority of water intrusion incidents are caused by improper installation of the moisture-control assemblies. Proper and adequate supervision of field personnel, therefore, is a critical element in the success or failure of these assemblies and, thus, the eventual performance of the building.*

The project supervisors, especially the GC (and subcontractor) foremen, must develop and conduct a system of checks and inspections to ensure that all installations of building components in moisture-sensitive assemblies adhere to the building plans, manufacturers' specifications, industry standards, and all relevant building codes.

The DPW project manager and/or Agency may want to consider engaging third-party water intrusion experts to assist with developing project-specific water intrusion management plans and prevention checklists and to conduct onsite inspections of work by various trade personnel, particularly at critical phases of construction, to reduce risk even further.

Managing Bioorganic Growth

This section details proactive activities to prevent and address instances of mold growth. Programs of instruction should be developed for all construction personnel working on DPW jobsites. Also, jobsite personnel should conduct routine inspections that consider the following:

Identifying potential mold issues. As a matter of habit, all construction personnel should be aware of possible mold contamination in and around the jobsite.

1. The most basic method is to rely on the senses:
   - Visual (growth, water damage)
   - Smell (odor)
   - Feel (dampness, humidity)
   - Listen (to complaints by occupants)

2. If contamination is suspected, inspect water-related systems for possible problems. Find building components with visible signs of moisture and check adjacent assemblies.
   - HVAC System
   - Plumbing fittings and connectors
   - Shower/tub assemblies
   - Waterproofing assemblies
   - Retaining walls and foundations
   - Fire sprinkler heads, valves, and connections
   - Drain lines

- Roof and deck assemblies
- Exterior building envelope penetration
- Window and door assemblies
- Site drainage

3. Required Activities
   - Immediately identify and document all mold-related issues.
   - Report to the DPW Water Intrusion Surveillance Team (WIST) and Water Intrusion Manager (WIM) (see Section III, Personnel Roles and Responsibilities).
   - Determine significance of event.
   - Determine remedial activities (collaborate with project designers, supervisors, WIST and WIM representatives, as required).
   - Use checklists/inspection forms for formal documentation

General Building Activities

- Discuss mold awareness and water intrusion in weekly site meetings.
- Cover open construction/repair areas to prevent water infiltration. Specify means to protect building components from moisture during adverse weather conditions.
- Schedule the work of all trades to eliminate the exposure of building materials that will absorb moisture.
- Document the construction process in sufficient detail, including photos, to allow reconstruction of events during key project phases.
- Schedule and document periodic inspections by the design professionals (i.e., architect, waterproofing experts, mechanical engineer, manufacturers' representatives) to inspect building components for potential sources of water intrusion. Consider hiring an independent, third-party water intrusion/microbial expert to conduct oversight and assist with conducting and documenting periodic inspections (see discussion in earlier chapter on Builder Risk of Water Intrusion).

IMPORTANCE OF DOCUMENTATION

It is essential for contractors to document conditions at certain critical stages of construction and keep this documentation on file for each project. The importance of documenting conditions (using photographs, moisture meters, good field notes, and checklists) to establish proper construction practices cannot be overstated. This documentation will be invaluable if claims/litigation develops. Documentation of events and response to events is also critical.

Specific Systems Criteria

The primary barrier for the prevention of water intrusion to a building is the continuous building envelope. This barrier may consist of a variety of similar and dissimilar materials installed by different subcontractors, under supervision of the GC, at various times during the construction schedule. The greatest risks of intrusion through the continuous building envelope occur at the transition and integration points of these materials. It is essential that all participants in the design and construction pay the utmost attention to these areas.

The following lists are basic principles for typical construction assemblies; the GC should be aware of and responsible for seeing that subcontractor personnel are adhering to these principles. Taking into account the wide variety of designs, engineering, and construction within the building industry, this list should be used as a guideline and not considered exhaustive:

Foundations/Crawl Spaces

- Make certain all affected subcontractors adhere to the recommendations of the geotechnical engineers and subsequent soils reports.
- If expansive soils are discovered, consult with the geotechnical and structural engineers and implement their recommendation(s) for the construction of the foundation and other soil-supported structural components of the building such as retaining walls.
- Document the special considerations to be taken by the mass and finish grader. Consider thickened edges of all flatwork, patio slabs, sidewalks and driveways to control soil drainage concerns.
- If corrosive soil conditions are identified, consult with the design professionals for special construction methods.
- Pay close attention to the sub-slab grade. Where specified, verify sand (thickness) and vapor barrier placement are plan compliant.
- Inspect concrete reinforcements (rebar, welded wire, etc.) for proper placement and depth within the slab as required.
- Water content of the concrete mix is determined by the amount of water needed for proper hydration of the cement plus an additional amount of “convenience water” to increase workability. Permeability of concrete increases rapidly in concrete mixes with a water/cement ratio in excess of 0.55 by weight[1]. Water/cement ratio, if not provided in the project specifications, should be selected on a basis of final concrete strength and workability requirements, but where permeability

[1] “Mix Design Hints for Watertight Concrete,” Publication #C710005, *Concrete Construction*, 1971.

conditions are an issue, a lower water/cement ratio is preferable to a higher ratio.

Verify the concrete mix meets the plan criteria and its placement conforms to industry standards. Monitor and document any water added to the mix at the time of placement and ensure it does not exceed industry standards or in any way affect the concrete mix and the expected performance of the slab or foundation.

- It has been standard practice and it is generally building code mandated to provide a certain amount of ventilation area in crawl space walls. Current research indicates that crawl space ventilation can be damaging in cooling climates because it facilitates moisture laden air entering the crawl space during the summer/ monsoon season. New building codes are providing alternatives to crawl space ventilation requirements, such as treating the crawl space as a mini-basement. Contractors should be aware of this evolving change in philosophy.
- Keep standing water away from the perimeter of the building foundation. Ensure that adequate drainage at sub-grade perimeter footings is provided and maintained.

Key Points for Foundations/Crawl Spaces:

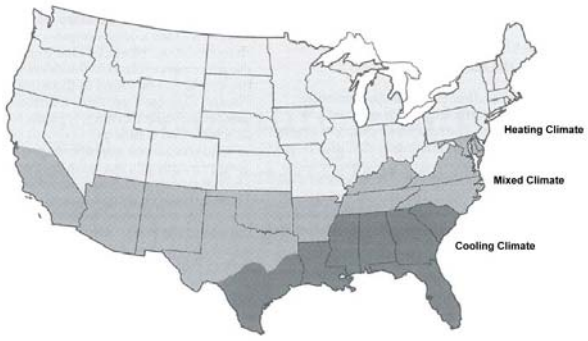
- Using water vapor emission testing, document moisture content of slab, if possible, upon foundation completion and building enclosure.
- Be aware that the flooring industry generally recommends that moisture emission rates not exceed 3.0 pounds per 1,000 square feet per 24 hours. This standard is extremely difficult to achieve even in the desert. Therefore be careful to avoid installing any internal vapor barriers on foundations such as vinyl flooring that will trap moisture.
- Crawl Spaces – Ventilation of crawl spaces (unless mandated by local codes) may not always be a good idea. It is important to understand the relationship between HVAC systems and the impact on crawl spaces. If the HVAC system is located in the crawl space – crawl spaces should be un-vented and conditioned. If the HVAC system is located elsewhere crawl spaces should either be vented and un-conditioned or un-vented and conditioned.
- Drainage – Ensure property slopes away from the perimeter of the building. Keep all vegetation 2 – 3 feet from perimeter of the building. Do not create built up areas of soil, sod, plantings, etc. that trap moisture and prevent the property from draining. Prevent sprinklers from impacting perimeter of building.

Exterior Walls

Water will invariably enter the most exterior skin of a building envelope, usually at transition points such as at windows/siding transitions, plumbing (i.e. hose bibs) and other penetrations. It is essential to design and install moisture and air infiltration barriers or retarders, which will allow water to exit the exterior wall systems.

- Review exterior wall designs and the wall section details for material selections and installation instructions. Suggest substitutions of technologically improved materials where applicable.
- Verify the location and application of specified moisture, vapor, and air barriers and retarders (if required) conforms to manufacturer's requirements for the wall components and are appropriate for the geographic region of the project.
- Verify external walls (especially on brick-faced buildings – which act like a sponge with respect to moisture) have appropriate drainage planes behind them with appropriate vapor barriers (if required).
- Review the terminations of the specified moisture, vapor, and air barriers and retarders (if required). The performance of these components will depend upon the adequacy of their sealed terminations. Verify avenues of exit for moisture outside the drainage plains are provided as designed and remain clear.
- Ensure subsequent building components do not block weep locations (such as by caulking, concrete, mortar, etc.).
- Verify exterior wall components are properly installed and integrated with adjacent building components. Make certain all flashing is installed as required and exterior wall penetrations are properly weatherproofed.
- Pay particular attention that the flashing, waterproofing components, and the moisture, vapor, and air barriers and retarders are installed properly at complex penetrations and integrations such as potshelves, corbels, fascia, decks, masonry and brick facades, etc.
- Make certain all flashing, waterproofing components, and moisture, vapor, and air barriers and retarders are free from unsealed holes, tears and gaps except those made by attachment devices.
- For masonry construction, verify all rebar, flashing, and weeping systems are provided and installed as required by the plans and industry standards. Verify the air space and weep holes in masonry and window frames are not filled or blocked with excess mortar or caulk.
- Verify the placement of moisture, vapor, and air barriers and retarders are located properly in the exterior wall assemblies allowing building material in the wall to dry if wetted. Use the following general guidelines for the proper placement of vapor barriers in different climates:

- **Heating Climates** (low winter temperatures, low relative humidity) – Generally, these climates are in areas above the 37th parallel. Locate vapor barriers in exterior walls to the warm side of the wall cavity, toward the interior of the building. *Note that the use and location of vapor barriers in exterior walls should be used only after careful examination of the prevailing regional climate conditions and the conditioning and pressurizing of the interior air environment, as it is important for walls to breathe, permitting drying of wall construction materials from moisture that will enter the wall cavity.*
- **Cooling Climates** (mild winter temperatures, high relative humidity) – Generally these climates are in areas on the gulf coast and lower east coast areas. Locate vapor barriers in exterior walls to the warm side of the wall cavity, toward the exterior of the building or eliminate the vapor barrier completely. *Note that the use and location of vapor barriers in exterior walls should be used only after careful examination of the prevailing regional climate conditions and the conditioning and pressurizing of the interior air environment, as it is important for walls to breathe, permitting drying of wall construction materials from moisture that will enter the wall cavity.*
- **Heating / Cooling Climates** (varied temperatures, moderate humidity) – Generally, these climates are below the 37th parallel, and are not a cooling climate. Roof design becomes more important. The use and location of vapor barriers in these climates is a complicated issue that should be determined in consultation with a moisture intrusion professional.



United States climatic zones used for moisture recommendations

- Damp proof all surface and subsurface building components as required by the climate and site conditions, such as basement walls, planters adjacent and/or above to building systems, adjacent retaining walls, etc.
- Insulation – The use of cellulose insulation versus fiberglass is debatable. Cellulose products provide excellent food for fungal growth, but cellulose products dry quickly because they tend to disperse (not concentrate) moisture. Fiberglass, on the other hand, is not a good food source for fungal growth but can entrap dirt and other debris upon which mold can grow. Fiberglass does not disperse moisture so it may stay wet longer, thereby creating a problem. However, by

concentrating moisture, the use of fiberglass may aid in rendering a water intrusion issue to be visible in a relative short period of time.
- Carpet – Contractors should carefully consider whether to place carpet in moist areas such as bathrooms and basements. Due to the likelihood of water impact, use of carpet in these areas is generally not recommended.

Window/Door Selection and Installation

Window and door systems and installation are one of the major, and most common, sources of water intrusion locations inside of buildings. Water intrusion at windows is often not noticed until it is too late. The proper selection and installation of windows should be a primary concern of the GC.

The quality of windows and doors selected for a project is very important. Poor quality will save a few dollars initially but, subsequently, could result in water intrusion and expensive repair costs. Use better quality double-glazed windows.

On a typical wood-framed structure, the framer usually installs the windows. The cost of installing windows is minimal compared to actual framing, however, the framer's greatest exposure to water intrusion and defect litigation is the window installation.

- Review window installation methods and sequencing with all affected subcontractors and agree on proper duties for each.
- Verify the installation adheres to the latest code requirements and industry standards.
- Properly lap all flashing, which should be free of tears, holes and folds.
- As a practice, do not nail aluminum window fins within 3" of the corners.
- Make certain there are no open gaps between window fins, stucco molds or flashings. This is especially critical at the stacking bars in field stacked-windows. **Flash a lot!**
- Caulk junctions of window fins and flashing on appropriate sides. The sill side should not be caulked.
- Emphasize the detrimental effects of reverse lapping, cuts, tears and inadequate attachments of window flashing and building paper when applicable.
- Pay close attention to installation and integration of flashing, waterproofing components, and the moisture, vapor and air barriers and retarders at potshelves and inset windows. Verify potshelves and ledges slope away from the structure.
- Wood-framed windows are not generally recommended as they are a good food source for mold.

- Window stacking is generally not recommended due to the potential problems of water intrusion.
- Ensure windows are properly sloped and drain properly.
- Do not drop windows. If they are dropped during construction, replace them.

Roofs and Balconies

Roofs and balconies are also a major source of water intrusion locations; however, unlike windows, water intrusion through roofing and balcony flooring is often noticed very quickly so the opportunity for fungal growth from leaks at these areas is reduced. Due to the wide variety of roofing systems and balcony flooring finishes and waterproofing materials, only a general discussion follows. Consult manufacturer and industry standards as required. Information is available from APA: The Engineered Wood Association, *Build a Better Home Series*, www.apawood.org.

The majority of roof leaks occur in locations where the plane of the roof is interrupted by a ridge, or another roof intersecting at an angle, a wall or a penetration. Proper flashing at all these locations, including chimneys, is critical to proper performance. Roof design is a major cause of roof issues especially in cold climates where ice dams may develop.

Verify balconies have appropriate drainage systems. Balconies should be sloped away from the structure. Promptly correct ponding issues observed on balconies and ensure thresholds are appropriately drained and above balcony grade.

- Review the installation methods and sequencing of all affected subcontractors and agree on proper duties for each. Typically this should include roofing, sheet metal, framing and siding, stucco and may include mechanical, electrical, plumbing and/or masonry.
- Make certain all manufacturers' installation guidelines are followed.
- Verify all roof penetrations are properly bibbed and sheet metal is properly installed.
- Pay close attention to roof junctions such as rake and headwalls, chimneys, plumbing penetrations, vents, skylights, parapet walls, ladders, HVAC and electrical penetrations, etc.
- Verify all drainage systems are in place where applicable (i.e., roof drains, crickets, scuppers, gutters, etc.)
- Direct roof drainage and gutter systems away from foundations and make certain the grade at foundation edge drains away from the building.
- Chimneys should be side fastened only – not top fastened. They should also be appropriately insulated.

Sealants

Sealants play an important role in maintaining a moisture-free building and are a critical finish element for most systems. Care must be taken to ensure sealants are placed only where required, do not block other designed weeping or evaporation systems installed on the building envelope, and are appropriate for the materials being sealed.

Sealant manufacturers generally provide detailed installation instructions, including descriptions of sealant mixing, bond breaker materials, primers, and size, shape, and thickness of the sealant bead.

- Make certain the proper type of sealant is used for each placement.
- Seal all appropriate penetrations in the building envelope.
- Seal all perimeters of the building envelope assemblies such as siding/wood trim, wood trim/windows, and doors, etc.

Interior Wall Systems

- Make sure drywall taping compound is allowed to dry, preventing the trapping of moisture behind wall coverings.
- Install a gap of ½-inch between the bottom drywall sheet and the floor to minimize possible water contact in the event floors become wet (i.e. from plumbing leaks).
- Document the moisture content of drywall at various stages of a project, but especially upon enclosure. Use moisture meters and document the conditions.
- Water resistant wall coverings (vinyl wall coverings) on interior surface of exterior walls should be avoided. These types of wall coverings will act as a vapor barrier preventing the exterior wall from “breathing”. Moisture trapped between the drywall system and wall coverings can induce mold growth. Include this information in an occupant’s manual (if provided) or notify occupants in writing.
- Avoid the use of fabric surface materials in areas where damp conditions occur, such as an atrium with plants or a fountain, restrooms, or locker rooms. Damp fabric surfaces are likely to sustain mold growth.

Plumbing and Fire Sprinklers

- Thoroughly inspect and test all rough plumbing before it is covered by other materials.
- Develop a standard checklist of plumbing connections, valves, fixtures, and sprinkler heads for leaks.
- Inspect and test all exterior plumbing assemblies such as irrigation systems, pools, spas, and exposed pipes.

- Verify all exterior plumbing penetrations and devices are properly supported and operating such as plumbing vents and roof drains.
- Insulate all required piping.
- Never put plumbing in exterior walls especially in climates where freezes are possible. Broken pipes in these walls may not even be noticed because insulation will hide the damage.
- Carefully consider potential problems before placing washing machines and/or hot water heaters in multi-story dwellings.

HVAC Systems

- Review the HVAC system plans with the subcontractor and consult with the mechanical (engineering) designer as necessary.
- Verify requirements and specifications for airflow, venting, duct work, humidity control, and condensate drainage and ensure compliance with all standards.
- Protect HVAC system from construction dust and dirt and make certain it is clean after construction. Test and balance the system per industry standards.
- Consider other ventilation requirements in the other building components such as basements, cellars, attics, crawl spaces, and other unoccupied areas.
- Do not permit installation of oversized A/C units.
- Verify all moisture-generating equipment is vented outdoors.
- Ensure complex computer-controlled systems are properly designed for the climatic conditions of the area and the usage requirements.
- Do not use ductboard in humid climates.
- Ensure all HVAC ductwork is accessible so that when leaks occur they can be promptly identified and repaired.
- It is not recommended to put ductwork in vented attic spaces, especially in warm humid climates, because the ducts will eventually leak, drawing moist, humid air into the living space.
- Design buildings and residential units with exhaust fans in high moisture areas and <u>make sure they are used</u>. Windows in water closets (as are required in some states like California) <u>DO NOT</u> necessarily adequately remove moisture from the bathroom area.

Floor Coverings

Due to a number of flooring industry changes in recent years, floor coverings of many types are more susceptible than ever to moisture infiltration. Of primary concern for flooring installers is the potential for moisture vapor emission through concrete slabs, which can provide a “continuous moisture source” to foster microbial growth as well as result in general flooring failure.

Floor covering manufacturers have standards on acceptable moisture vapor emission rates through slabs (for adhesive installations, this rate is generally 3 to 5 pounds/1000 sq. ft./24 hours). Under some field conditions, the recommended rates are realistic; in other situations these rates may be overly conservative and difficult to achieve. Failure to meet the standards, however, may result in eventual failure of the floor covering and may indicate increased risk of unacceptable moisture intrusion that may facilitate mold growth.

The American Society for Testing and Materials (ASTM) has developed the Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride (ASTM Standard F1869-04). This ASTM standard is the most widely accepted method of vapor emission testing because it is quantitative and provides a measure of exact emission rates.

Failure to run the test correctly, however, can produce erroneous results and lead to costly construction errors. Ideally, the test site should be at the same temperature and relative humidity as expected during normal use of the building. Thus, testing should preferably occur after the HVAC system is operating and the building has been in service conditions for at least 48 hours. If this isn't possible, the test site should be at 75°F (±10°F) and 50% (±10%) relative humidity for at least 48 hours prior to and during testing. These parameters should be measured and documented at the time of testing.[2]

Other commonly used but less precise testing methods include the polyfilm test and the phenolphthalein test. The polyfilm test involves sealing polyfilm to the floor for 24 hours to determine the presence of moisture emissions. In the phenolphthalein test, small holes are drilled in various areas in the slab (particularly near walls) and a 3% phenolphthalein solution is placed in the holes. Any color change indicates the need for further testing. In a shift away from surface tests, the relative humidity probe (ASTM Standard F- 2170) in which a sensor is placed in the body of the concrete, is also gaining usage.

Flooring contractors should make sure to rely on flooring manufacturers' recommendations for "acceptable moisture content" and the type of moisture testing preferred by the manufacturer. Testing of the surface alkalinity of the concrete slab is also typically required by manufacturers to determine the concrete's suitability as a substrate for the planned flooring material.

[2] B. A. Suprenant and W. R. Malisch, "Are Moisture Tests on Target?" *Concrete Construction,* Publication #C00A061, 2000.

Historically, the building industry has made the floor covering installer, dealer or contractor accountable for testing concrete slab moisture emissions. Since 2001, however, a number of professional floor covering associations have endorsed a position of requiring this testing to be performed by a qualified independent testing agency, not by the floor covering contractor. *In addition, these organizations support that the owner or GC should be responsible for obtaining this independent testing on the moisture and surface alkalinity of the concrete slab and providing a written test report to the flooring contractor.* Regardless of which party obtains the testing, it is recommended that all flooring contractors ensure that vapor emission testing has been performed to ensure that problems with moisture intrusion through the slab are recognized and addressed prior to installation of flooring materials.

Tile

Ceramic tile, with an emphasis on tile installed at bathtubs and showers, is an area where water intrusion frequently results due to poor installation of grout, the waterproofing membrane, shower/tub assemblies, or design.

- Review all installation procedures with the tile subcontractor, plumber, waterproofer, and installer of the tile substrate.
- Ensure all substrates, waterproofing membranes, shower pans, tubs, and fixtures are properly integrated before the installation of ceramic tile.
- Adhere to the latest industry installation techniques, manufacturer's recommendations, Ceramic Tile Institute procedures and applicable building code requirements.
- Verify all penetrations (i.e., shower door enclosures) of the ceramic tile are properly sealed.

The wet processes, associated with cutting tile and terrazzo, are a potential source of water intrusion that could impact moisture-susceptible building materials. These processes should be conducted outside the building whenever possible. If wet-cutting processes must be conducted inside the building, the flooring contractor should take special precautions to avoid allowing any process water to intrude on any other building materials that need to be kept dry, such as drywall or ceiling tiles. Installation of temporary barriers of waterproof materials should be constructed as necessary to isolate any susceptible materials from any wet-process areas. Control of humidity generated by wet processing or drying of wet materials should be considered as well. Good choices for supplemental drying equipment include dehumidifiers, ventilation fans, and electrical or properly vented heating equipment. Direct-fired heaters that burn fuel, such as propane and kerosene, should <u>not</u> be used due to the moisture they create during combustion.

Exterior Insulation Finish System (EIFS) (where allowed to be used)

There are two types of EIFS installation: a barrier system and a drainage system. In a barrier system, EIFS and sealants are designed as a barrier to moisture intrusion. The overall success of the system is dependent on the weakest links, the details that are typically found at the edges of the EIFS and at penetrations. Any water entering the building shell because of faulty detailing and/or construction may get trapped in the building shell when it cannot exit through the EIFS. Decay of moisture-sensitive materials may continue for an extended period of time before there are any cosmetic signs of damage. There have been many lawsuits involving barrier EIFS systems in the 1980s and 1990s. Some manufacturers do not permit the installation of their barrier EIFS for residential construction, because of the potential for water-sensitive materials to be damaged if the barrier is damaged.

Drainage (water-managed) EIFS installation adds a drainage plane inside the EIFS so that any moisture getting inside the system has a way to get back out. An air space or capillary break is also added between the EIFS board and the drainage plane material covering the wall. As with barrier EIFS, there must also be a system of foolproof flashings throughout the building shell.

Surveys indicate that the greatest problems occur with EIFS at windows, penetrations, wall-roof intersections and movement joints. Approximately 50% of the moisture intrusion problems have occurred at windows. Measures taken to ensure the correct installation at these locations will reduce the risk of failure with the EIFS systems. The coordination of these inter-related details with the EIFS is critical to the success of the EIFS. A pre-construction meeting to coordinate the trades involved is strongly advised.

With EIFS it is critical to follow and document manufacturer's installation instructions exactly; especially at transitions and penetrations and document compliance. Contact between the soil and EIFS must be avoided and use of EIFS in high-moisture climates should be given careful consideration.

Guidelines for the successful installation of EIFS are contained in numerous publications. These and related publications provide details and/or guidelines to help a GC avoid mistakes that have plagued the EIFS industry. They include:

- *Guide to EIFS Construction* – A set of installation details for typical EIFS configurations published by the EIFS Industry Members Association (EIMA)

- *Model Quality Plan for Use of Drainage – Type EIFS on One- and Two-Family Dwellings* published by the NAHB Research Center in 2001.
- *Sto EIFS Third-Party Inspection Manual,* published by Sto Corporation, revised January 2001.

The addition of drainage details may add approximately $1.25/sq/ft to the cost of EIFS installation, but these additional details make the EIFS far more forgiving of problems allowing moisture intrusion. The difference in price between a contractor expecting to perform the minimum EIFS installation vs. a contractor working to eliminate the potential for future moisture intrusion with careful detailing and execution of a drainage system may add more than $2/sq/ft. If the design intention is to have a low cost exterior wall covering that performs properly, EIFS is probably not a good alternative to more traditional wall coverings.

In summary, EIFS is an excellent moisture-protection system when the contractor is prepared to devote the extra effort required to install the system properly. Lacking the extra time and effort required to make EIFS work properly, the contractor is advised to recommend an alternative finish.

Stucco

Many of the issues raised in the discussion of EIFS are applicable to the installation of stucco. Unfortunately, should water intrusion problems arising from either of these systems can be very significant. The Northwest Wall & Ceiling Bureau's *Stucco Resource Guide* (3rd Ed., September 2002) contains a guide specification, stucco assemblies and details, a quality assurance checklist, and an outline for a pre-construction meeting.

With both stucco and EIFS, it is critical for contractors to document conditions at the time of project start up prior to application of the products, and upon system installation completion. This is especially true if subsequent work will penetrate these finishes. With stucco systems, it is important to verify exterior membrane installation is proper prior to stucco installation and obtain documentation to this effect from an independent third party.

- All stucco cracks less than 1/8th inch should be promptly repaired.
- All stucco cracks greater than 1/8th must be investigated as to cause.
- Follow manufacturer's instructions for stucco mix and installation exactly and document compliance.
- Verify screed terminations are properly located and unobstructed.

- Particular attention should be given to flashing and drainage of the stucco installation if elastomeric finish paints are applied to exterior stucco. In general, elastomeric paint on exterior stucco finish seals the stucco surface, entrapping infiltrated water behind and inside the stucco. As the entrapped moisture in the stucco tries to escape, it deteriorates the bond between the elastomeric paint and the stucco and causes the elastomeric paint to stretch and form blisters in the paint surface. The entrapped moisture either needs a direct path to escape along a drainage plane behind the stucco and on out the bottom edge of the stucco finish, or adequate joint sealants must be installed and maintained to prevent water intrusion behind the stucco completely.

  According to the Portland Cement Association, an advantage of using Portland cement plaster stucco as an exterior wall finish material is the plaster is a breathable material that allows moisture vapor to pass through, so it is capable of allowing drying of moisture that gets behind the stucco finish, preventing the moisture from being entrapped. Further, the Portland Cement Association recommends using a Portland cement-based paint to achieve the desired finish color of the stucco finish. This Portland cement-based paint allows the stucco finish to remain breathable.

Framing

Visible mold growth on wood framing can be problematic from a negative publicity standpoint. It is advisable to remove visible mold from wood framing when possible prior to building enclosure. This can generally be accomplished by wire brushing/sanding followed by a High-Efficiency Particulate Air (HEPA) vacuuming. While most fungi growing on wood may not be significant from a microbiological standpoint this can still be a significant issue from a liability standpoint for a builder. Photos taken of moldy framing during construction have been responsible for numerous lawsuits. Contractors need to be aware that even though it is common for wood framing to be received in this manner it can still create problems.

For this reason, we recommend considering the use of kiln-dried lumber along with the importance of keeping materials dry on the jobsite until ready for installation. In some areas, metal framing for structures is becoming common. Contractors should also be aware that many of the suppliers of products such as green wood have placed disclaimers on their products removing them from liability for mold since mold is inherent in the product.

Miscellaneous Assemblies

There are numerous, miscellaneous moisture-related systems found in the construction industry. Dead spaces such as equipment chases and elevator shafts can be exposed to the elements during construction and collect standing water or absorb moisture. All building personnel should use common sense and apply the applicable activities listed above to these other building components and assemblies.

Section III: Personnel Roles and Responsibilities

Chapter

7

Personnel Organization

Use of DPW, CA, and GC personnel organization to implement this plan is essential to the plan's success. This section will identify the DPW, CA, and GC personnel who will address water intrusion issues when they arise during installation projects. The responsibilities of these individuals are briefly listed in the Roles and Responsibilities Flowchart at the end of this chapter. These duties are outlined in greater detail in the next two chapters.

Water Intrusion Manager. ***The individual who serves as the Water Intrusion Manager (WIM) will be either the DPW Project Manager (for smaller projects) or the DPW Construction Administrator (if size/scope of project warrants assignment of a CA to the project).*** Regardless of their usual capacity, the person assigned as WIM should:

- Be knowledgeable of all aspects of building components, their installation and maintenance, and all potential areas of risk exposure for water intrusion and mold.
- Have excellent communication and people skills as interaction with CA,,GCs, property managers, occupants, and other DPW personnel will frequently occur.
- Be detail-oriented, organized, and familiar with documentation and record keeping as well as developing reporting forms pertinent to water intrusion.

Water Intrusion Surveillance Team (WIST). ***This team will consist of the GC's project foremen and project superintendents.*** They must act as the jobsite (project) inspectors and be alert to all potential water intrusion issues during all phases of work on the jobsite. All reports of water intrusion and all reports of mold must be treated as an EMERGENCY until the significance of the event can be determined. The WIST will immediately address or report to the WIM:

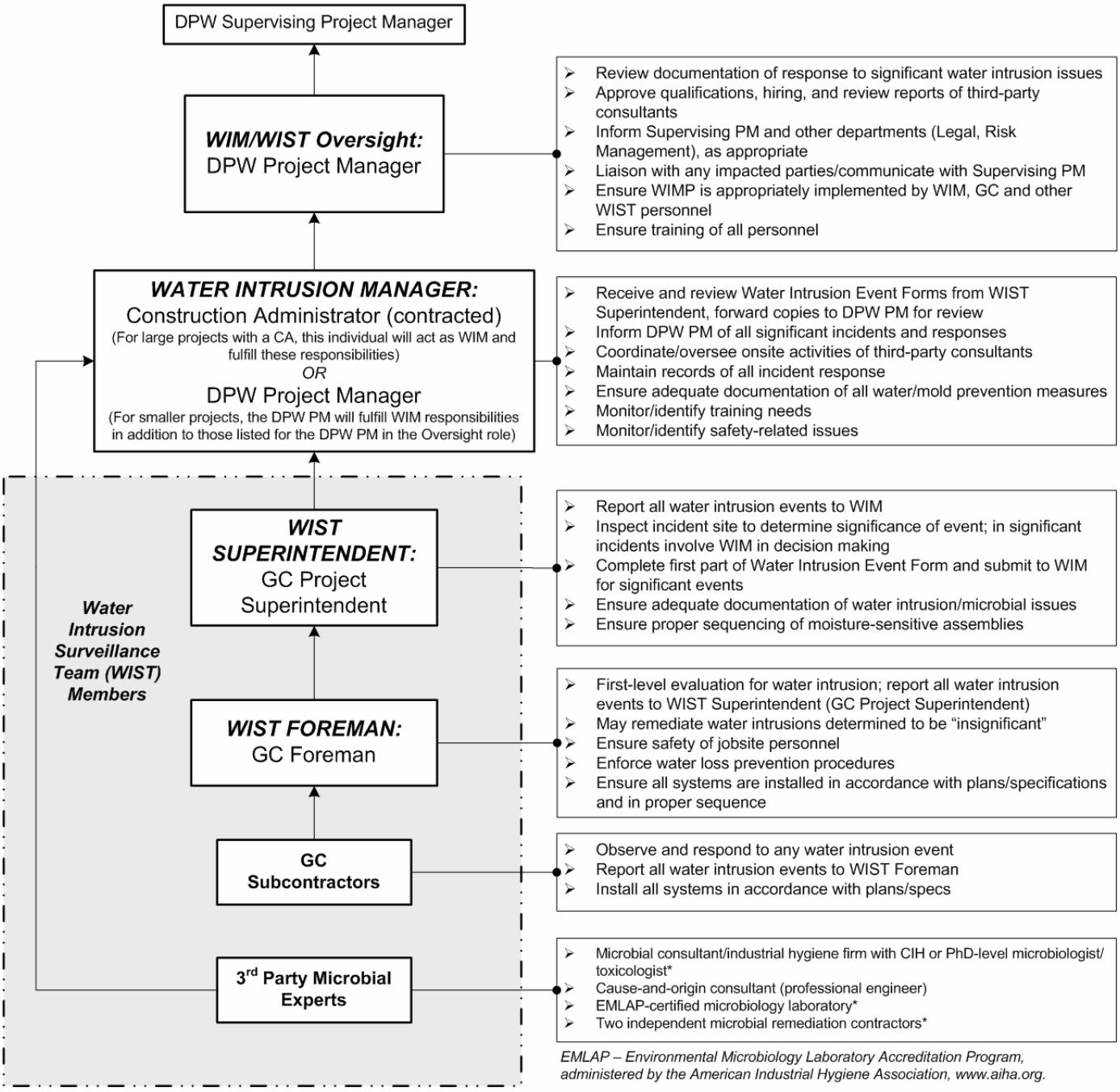
- All instances of water intrusion (no matter now small)
- All suspect areas of fungal growth (no matter how small)
- All complaints, reports, or other indications of a water intrusion or mold issue.

WIM/WIST Oversight. ***The DPW Project Manager will serve in an oversight role for the WIM Program on projects where the Construction Administrator is serving as the WIM.*** On these projects, the DPW Project Manager will be regularly informed of the handling of all water intrusion incidents and will review the documentation of all responses to significant incidents. In addition, the DPW Project Manager will approve the qualifications and hiring of and will review any reports generated by any third-party microbial experts which may be retained in any capacity with regard to the DPW WIMP.

The DPW Project Manager also will be responsible for overseeing the transfer of liability for water intrusion issues to the Agency of any buildings constructed by the DPW. This individual will also provide liaison between the GC and any interested parties or the DPW Supervising Project Manager.

Documentation and Communication Flow. All documentation and general communication regarding water intrusion and microbial incidents will flow upward from the WIST members to the DPW Construction Administrator and/or DPW Project Manager. The DPW Supervising Project Manager should be kept informed of events as necessary or as required by DPW policy, particularly for significant events. *If litigation/claim is threatened at any time during a water intrusion or mold event, the responding WIST member or WIM should immediately contact the person upstream of their position.*

Connecticut DPW
WATER INTRUSION PERSONNEL
Roles and Responsibilities



EMLAP – Environmental Microbiology Laboratory Accreditation Program, administered by the American Industrial Hygiene Association, www.aiha.org.

Personnel Contacts

DPW Project Manager_____
24-Hour Telephone/Pager_____
DPW Construction Administrator_____
24-Hour Telephone/Pager_____

Water Intrusion Surveillance Team Members (GC):
Name_____
24-Hour Telephone/Pager_____
Name_____
24-Hour Telephone/Pager_____
Name_____
24-Hour Telephone/Pager_____
Name_____
24-Hour Telephone/Pager_____

Third-Party Contacts

Microbial Consultant_____
Contact Name_____
Address_____
Telephone_____

Cause-and-Origin Consultant (Engineer)_____
Contact Name_____
Address_____
Telephone_____

Microbial Remediation Contractor_____
Contact Name_____
Address_____
Telephone_____

Chapter

8

GC Project Foreman:

WIST Foreman

WIST Foreman Role. The GC's subcontractors may likely be the first personnel to notice a water intrusion event. They should report any events to the foreman, who generally will be the first supervisor to observe and respond to any water intrusion event. The foreman will, in turn, report any incident of water intrusion and/or mold to the superintendent. The foreman may decide that some events which are very limited in size and impact can be remediated immediately and documented only with a verbal report to the superintendent. In instances involving water intrusion issues of greater impact and magnitude, it will be necessary for the superintendent to visit the jobsite, observe the event, and begin to create a documentation file.

WIST Foreman Responsibilities

Incident Response

- Evaluate severity of any and all water intrusion events on the jobsite and make determination if the event is significant and needs to be reviewed by the superintendent. This determination will be made according to specific guidelines presented in the chapter on Initial Response Actions. Significant risk factors which elevate potential liability exposure include:
  a. Event occurred in a building occupied by an infant and/or used as a day-care facility
  b. Event involved gray water or sewage
  c. Impacted party is hostile or threatens litigation
  d. Impacted party mentioned health-related complaints
  e. Visible mold is present in the HVAC system
- Report ALL water intrusion events at least verbally to the superintendent.
- Carefully document all water intrusion issues as directed by the superintendent.
- May remediate insignificant water intrusion issues according to a response plan developed in conjunction with the superintendent.

- Responsible for ensuring, above all else, the safety of jobsite personnel and immediately reporting any safety concerns to the superintendent, if available, or the WIM.

Prevention Responsibilities:

- Responsible for inspecting materials upon arrival at jobsite/prior to installation to ensure they are in good condition and free from visible fungal growth.
- Responsible for ensuring that all systems and their components have been delivered from third parties appropriately packed and free from visible contamination prior to arrival at jobsite (if possible).
- Attend weekly branch meeting as directed for his job
- Attend any required microbial training classes

General Note. *At any time during a water intrusion/mold event, if litigation is threatened, and no one upstream of the Foreman is available, the Foreman should promptly contact the WIM.*

Chapter

9

GC Project Superintendent:

WIST Superintendent

WIST Superintendent Role. Once the foreman has advised that a potentially significant water intrusion issue has occurred, the GC project superintendent should promptly respond, visit the jobsite, and observe the issue. The superintendent is also responsible to complete all documentation pertaining to mold and water intrusion and must discuss the issue and the response with the WIM. If necessary, the superintendent may contact the DPW Project Manager directly.

Superintendent Responsibilities

Incident Response

- Visit the jobsite where water intrusion issues has been identified by the foreman as a potentially significant event.
- Evaluate severity and significance of event and communicate issue circumstances to WIM. May develop a response plan in conjunction with the WIM. Determination of event significance will be made according to specific guidelines presented in the chapter on Initial Response Actions.
- Report ALL water intrusion events (significant or insignificant) at least verbally to the WIM.
- Carefully document all significant water intrusion issues and all incidents of suspected mold, as necessary, by completing a Water Intrusion Event Form and forwarding it to the WIM.
- May contact DPW Project Manager directly for assistance.
- Assist foreman in developing response plans to remediate insignificant water intrusion issues.
- Obtain and maintain any and all Material Safety Data Sheets (MSDS) for any products used by any GC employees during remediation.

Prevention Responsibilities:

- Responsible for inspecting the project environment prior to installation of any building systems to verify that the environment is appropriate for installation of materials and has not sustained prior water intrusion issues. Any pre-existing conditions found (such as stained ceiling tiles, roof leaks, floor tile buckling, etc.) should be addressed per applicable incident response procedures, documented through notes and photographs and the documentation forwarded to the WIM.
- Responsible for ensuring that all general and subcontractor personnel are informed of their responsibilities under the water intrusion management plan during job meetings.

Other General Responsibilities:

- Attend weekly meetings as directed for all jobs in progress.
- Attend any required microbial training classes.
- Responsible for ensuring above all else the safety of jobsite personnel and immediately reporting any safety concerns to the GC's safety director.
- Enforce all corporate water intrusion procedures.
- Identifies safety training issues at jobsites.
- Enforce all corporate water intrusion procedures.

General Note. *At any time during a water intrusion/mold event, if a claim is possible, the Superintendent should promptly contact the DPW Project Manager.*

Chapter

10

Construction Administrator or DPW Project Manager:

Water Intrusion Manager

On larger projects, where a Construction Administrator is contracted to facilitate the project, the Construction Administrator will serve as the WIM.

On smaller projects, where there is no Construction Administrator assigned to the project, the DPW Project Manager will assume the role of WIM and will fulfill all responsibilities assigned to the WIM in addition to fulfilling the responsibilities described in the WIM/WIST Oversight role in the next section.

WIM Role. The primary function of the WIM is to ensure that DPW policy with regard to water intrusion events and microbial issues is consistently applied and documented. The WIM should support the WIST Superintendent in determining the appropriate actions whenever a significant water intrusion or mold event occurs. The WIM will report to or involve the DPW Project Manager or Supervising Project Manager directly, if necessary, during the process. The WIM may function as the liaison between the DPW, GC, and Agency, if necessary. The WIM will maintain documentation that the Water Intrusion Management Plan has been implemented.

WIM Responsibilities

- Ensure that water intrusion prevention programs are implemented by the GC.
- Receive and review Water Intrusion Event Forms from WIST Superintendent, forward copies to DPW Project Manager for review.
- Inform DPW Project Manager of all significant events and responses.
- Evaluate risk factors and determine appropriate response to water intrusion/microbial issues.
- Coordinate/oversee onsite activities of third-party consultants or contractors.

- Maintain records of all incident responses.

General Note. *If at any time during a water intrusion/mold event a claim is possible,, the WIM will promptly contact the DPW Project Manager or Supervising Project Manager.*

Chapter

11

DPW Project Manager:

WIM/WIST Oversight

For large projects, the DPW will rely on its Construction Administrator (as WIM) and the GC firm (as WIST) to handle any water intrusion issues during construction, but the DPW Project Manager will retain oversight of this process at all times during construction and will be responsible for transferring liability for maintenance to the building manager (Agency) during the Commissioning process..

For smaller projects that do not require a Construction Administrator, the DPW Project Manager will fulfill the responsibilities of the WIM in addition to the duties outlined below.

Responsibilities of the DPW Project Manager in Oversight Role:

- Meets regularly with the WIM (Construction Administrator) to be informed of the handling of all water intrusion incidents.
- Reviews the Water Intrusion Event Forms and other documentation for all significant incidents.
- Evaluate risk factors and assist WIM in determining appropriate response to water intrusion/microbial issues, including hiring of third-party consultants/contractors.
- If third-party assistance is needed, contact the DPW Technical Services unit, which maintains a list of on-call third-party microbial consultants/contractors to be hired when needed.
- Verify all required documentation is completed and all appropriate DPW notices are sent and are filed in the field file.
- Must verbally advise the DPW Supervising Project Manager of all issues pertaining to water intrusion or mold events and may consult with the DPW Supervising Project Manager particularly if:
    1. The potential financial exposure is substantial and/or
    2. Additional risk factors are present which elevate the potential exposure such as:
        - Event occurred in a building occupied by an infant and/or used as a day-care facility
        - Event involved gray water or sewage

    - Impacted party suffers monetary damage and seeks a claim
    - Impacted party mentions health-related complaints
    - Visible mold present in the HVAC system
- Reviews any reports generated by any third-party microbial experts retained on a DPW project.
- Serves as liaison between the Construction Administrator and the DPW Supervising Project Manager, or any interested third parties (the Agency), with assistance from the WIM.
- Communicate directly with impacted party (parties), third-party consultants/contractors, DPW Supervising Project Manager, especially if the project is substantial or more information is needed to solve the problem.
- Ensures that all appropriate personnel on the project have received microbial awareness training.
- Oversees the transfer of liability for water intrusion issues to the Agency building managers.
- Ensures that building managers are properly informed and trained, during the Commissioning process, on the proper maintenance of all systems and components of the DPW built structures.
- Has received mold awareness training, at a minimum.

Section IV: Water Intrusion/Microbial Incident Response Procedures

Chapter

12

Initial Response Actions – All Incidents

This section will outline how WIST personnel should initially respond to all cases of water intrusion or mold.

Basic Protocol

- All reports of water intrusion must be treated as an *emergency*. A water problem handled in 24 – 48 hours usually carries little cost.
- All reports of water intrusion or mold must be investigated by the WIST and reported at least verbally to the WIM. The investigative and reporting process will NOT vary even though the responses to the problems may vary.
- All water intrusion events determined to be significant must be completely documented and the documentation retained. The WIST Superintendent will complete a Water Intrusion Event Form (WIEF) (see Appendix One), and forward it to the WIM.

Initial Response Procedures

Immediately upon notification or observation that a water intrusion issue may have occurred or is occurring, the responding personnel should immediately:

1. Shut off the HVAC System,
2. Shut off all water, and
3. Contact the WIM or the WIST Foreman or Superintendent.

The responding WIST member or WIM (possibly with assistance from a third-party consultant) must immediately inspect the incident, define the extent of damage, and cause of loss, if possible. **The main purpose of this inspection is to make a determination if the water intrusion event is significant. See the flowchart entitled "Initial Response Protocol: All Incidents" for a listing of criteria to use to determine event significance.**

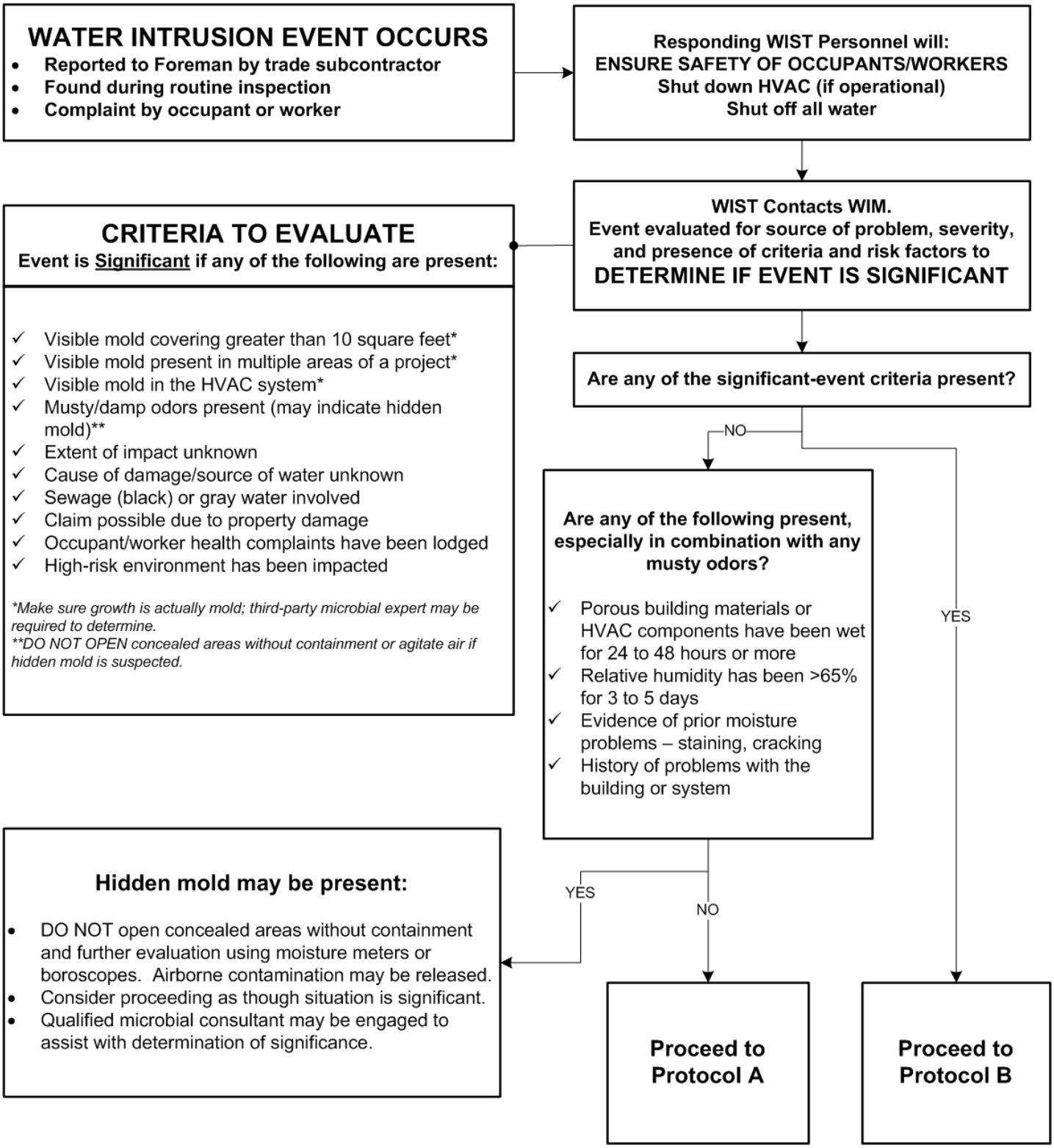
When should a contractor suspect mold even if none is visible? It is important to be aware that mold may be present and not visible. When determining event significance, WIST personnel and WIM should be aware of the following conditions, which may indicate the presence of hidden mold:

- Relative humidity in the building greater than 65% for 3 – 5 days
- Building materials/HVAC components wet for more than 24 – 48 hours
- Musty/Damp odors
- Building conditions conducive to mold growth are present – such as roof leaks, wet/stained carpet or other building materials
- Evidence of previous moisture problems — staining, cracking
- Wet HVAC filters
- Lack of maintenance
- Wet building materials that are porous or semi porous
- Occupant complaints
- Prior history of problems with the building or system
- Wet flex duct

If Mold Suspected But Not Visible. IMPORTANT: DO NOT OPEN any concealed areas without appropriate containment and do NOT agitate the air. It is possible for fungal growth to be present inside a wall cavity and not be visible on drywall that has been impacted by water.

Opening of cavities may release airborne contamination. If substantial airborne fungal contamination is found, it will probably be necessary to remediate the HVAC system even if no visible fungi growth is seen in the system.

Initial Response Protocol: All Incidents



Chapter

13

Response Actions – Insignificant Water Intrusion Issues (Protocol A)

Following initial response, **for water intrusion events determined to be insignificant**, WIST personnel with help from a qualified third party, as necessary, will apply the following Protocol A (see Protocol A flow chart) to resolve and properly document the water intrusion event and response actions taken. This protocol may also apply in cases such as emergency flooding or weather disasters when event response is expedited. Qualified GC personnel can perform any necessary clean-up work under Protocol A provided that no gray/black water and mold are involved.

Summary of Clean-Up Actions

- Identify all sources of water intrusion or leaks prior to remediation.
- Contain impacted areas with 6-mil polyethylene sheeting and dehumidify, if necessary.
- Remove and replace any damaged building materials per Table 1 guidelines.

Post-Remediation Sampling. As a precaution (if directed by the WIM), an independent microbial consultant may perform post-remediation microbial sampling. (See chapter on Microbial Sampling for details.) This may be prudent if the project involves a high-risk environment, such as a day-care, or where there have been prior or current occupant health complaints or Indoor Air Quality issues related to the scope of work performed by the GC or if the issue is covered by warranty. Sampling should be performed **only by a qualified microbial consultant.**

NOTE. If any mold or suspected mold is encountered during the remediation process, immediately stop all work and proceed as per the next chapter on Response Protocol B.

PROTOCOL A:
Insignificant Event Response

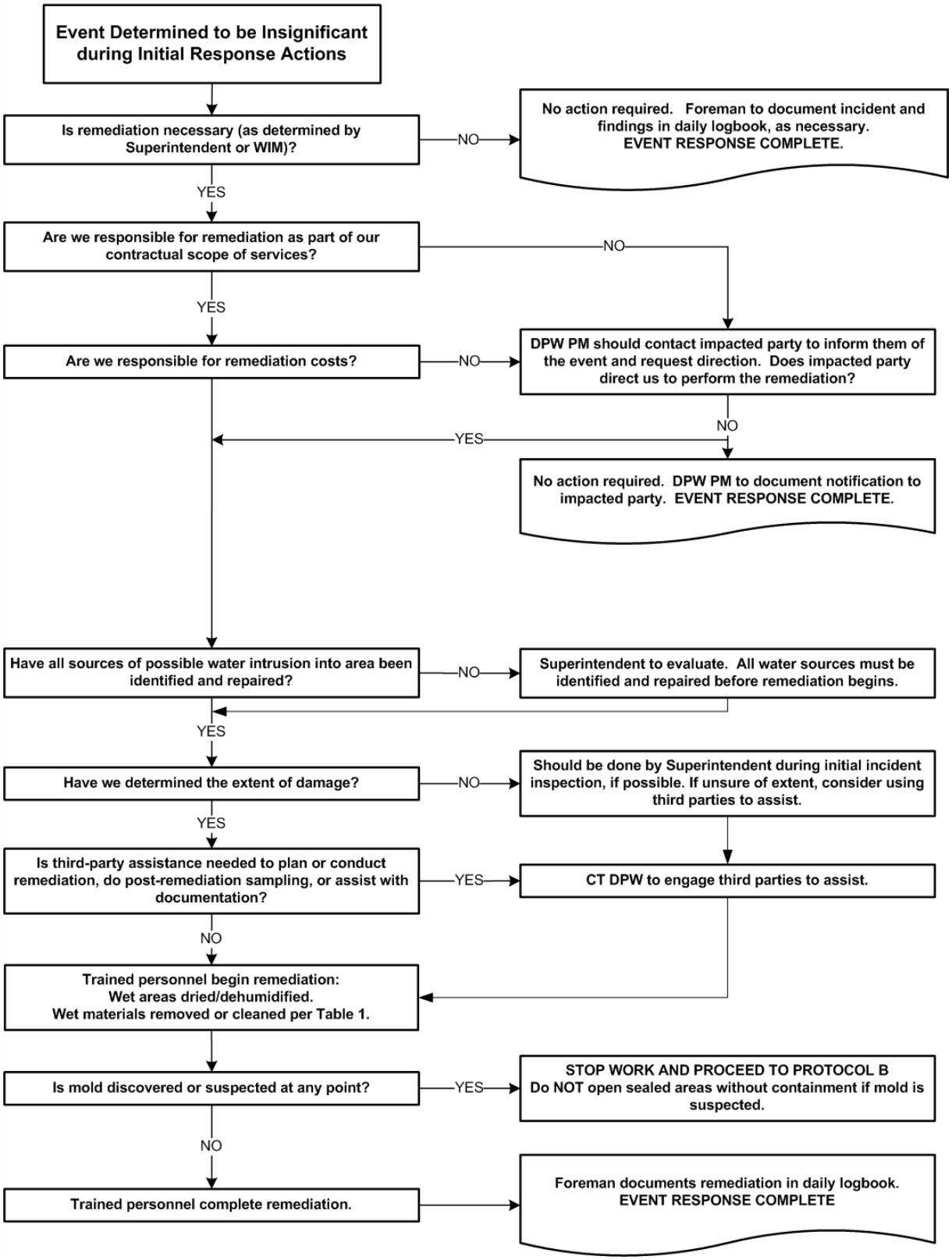


Table 1. Protocol A Clean-up Procedures (no mold present)

Baseboards	Remove from water impacted or suspected areas.
Books and Papers	Discard non-valuable items; freeze or freeze dry others.
Cabinetry	Remove from water impacted or suspected areas.
Carpet	Extract water and dry thoroughly. Consider pre/post treatment with anti-microbial/biocide.
Ceiling Tiles	Remove if water stained.
Ceramic Tile Flooring	Wet-wipe clean using two-towel system[3] for all impacted areas. Remove if visibly water damaged.
Concrete, Cinder Block, or Brick	Remove water with water extraction vacuum. Dehumidify or fan-dry if no visible mold present.
Cove base	Remove from water impacted or suspected areas.
Drapes	Launder/dry clean.
Drywall	If drywall is wet, remove wet portions. Drywall should be considered "wet" if its moisture content measures >1% on a gypsum scale or >30% on a wood scale.[4]
HVAC Duct System Components (hard components)	Wet-wipe clean using two-towel system.
Insulation	Remove from opened cavities (where drywall is removed).
Lined HVAC Components	Remove porous materials impacted by water; change filters.
Metal Doors and Window Framing	Wet-wipe clean using two-towel system.
Metal Studs, Braces/Rafters	Wet-wipe clean using two-towel system.
Padding	Remove impacted padding.
Plywood Floor	Wet-wipe clean using two-towel system or HEPA vacuum.
Tack Strips	Remove if visually impacted, otherwise treat with biocide and dry thoroughly.
Unlined Flexible Duct	No action necessary.
Upholstered Furniture	Remove water with extraction vacuum; accelerate drying process with dehumidification fans if no visible mold present.
Vinyl Sheet or Tile	If visibly damaged at edges, remove and wet wipe sub-flooring clean using two-towel system. If not visibly damaged, wet-wipe flooring clean via two-towel system and dry properly.
Wall Paper	Remove if visibly impacted or applied to impacted drywall, unless the drywall is also being taken out.
Wood Doors/Window Trim	Remove if water damaged otherwise wet-wipe clean using two-towel system. Pry trim away from wall to dry.
Wood Flooring	Sand if finish is impacted, then restore. Remove if water damaged.
Wood Paneling	Sand if finish is impacted, then restore. Remove if water damaged.
Wood Studs/Braces/Rafters	Wet-wipe clean using two-towel system or HEPA vacuum.

[3] Two-towel system: Wipe or scrub the impacted surface with a clean cloth, which is dampened with water only or water and detergent, followed immediately with a wipe down using a second clean, dry cloth to thoroughly dry the cleaned surface.

[4] Recommended to use the gypsum scale with a moisture meter such as the Delmhorst BD-2100.

Chapter

14

Response Actions – Significant Water Intrusion Issues (Protocol B)

Following initial response actions, for water intrusion events determined to be significant, or cases where microbial contamination is found, Protocol B should be followed (see Protocol B flow chart). Once it is determined an event is significant, the following additional initial response actions should be employed as necessary, either by qualified contractor personnel or a qualified third party:

- Identify and shut off or repair all sources of water leaks or intrusion (if not already done).
- Shut down the HVAC system (if not already done).
- Contain visually impacted areas with 6-mil polyethylene sheeting to reduce chance of mold spores spreading to other areas of the building. Negative air machines inside the contained area may also be employed to further reduce spread of contamination.
- Dehumidify impacted areas.

Once it is determined there is a significant water intrusion event, the WIM should consider the following:

Contact DPW Technical Services Unit for:

- Contracting the services of a microbial consultant to perform an investigation to determine cause and extent of loss
- Contracting the services of a microbial remediation contractor to perform removal

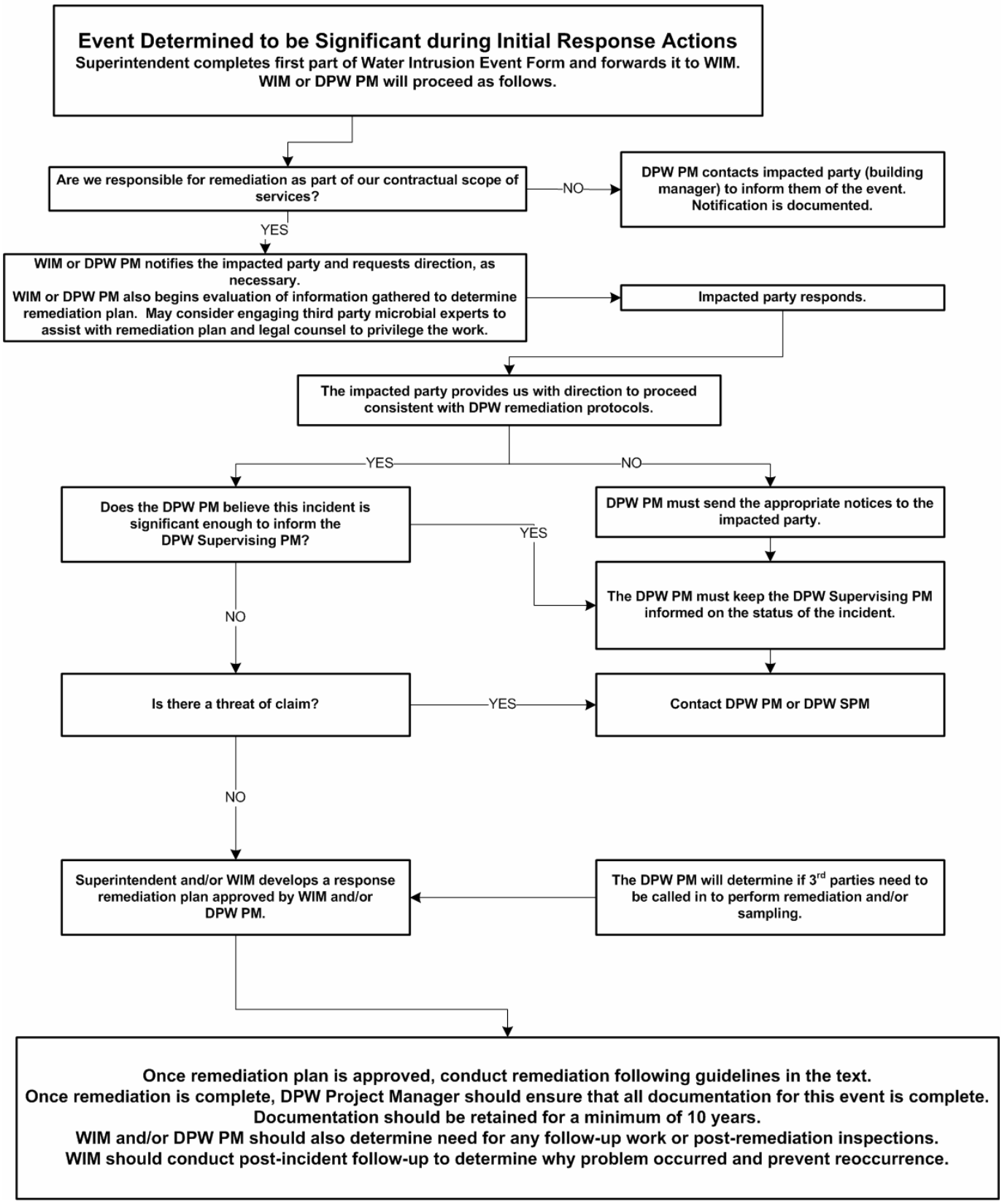
Pre-Remediation Microbial Investigations: When to Perform. If any significant risk factors are present, it is recommended that the WIM immediately contact the services of a microbial consultant to perform an investigation including sampling.

A microbial investigation may be necessary if the cause of loss is not known and the extent of loss is not known. If there are multiple causes of loss contributing to a problem, a microbial investigation may be able to identify these causes. This is especially important because if another contractor or entity contributed to the cause of loss or was wholly

responsible for the contamination found in the building, liability to the GC or DPW will be reduced or eliminated. If the extent of the contamination is not known, it may be important to perform sampling to delineate the parameters of the problem ensuring that the entire problem has been addressed. Microbial sampling also can help determine if any visible mold is also the source of any airborne mold.

PROTOCOL B

Significant Event Response



Remediation Planning. Just as there are no formally mandated guidelines or regulations for mold testing, neither are there any formal regulations for mold remediation. The following protocol, however, can be employed to mitigate mold without making an existing situation worse:

1. The WIM/WIST should work together or with a microbial environmental consultant to develop a scope of work or mold remediation plan.
2. Notify and discuss the plan with any impacted parties, particularly building occupants. Consider relocating occupants during remediation, especially if high-risk individuals or pets are present, or if the impacted area cannot be sufficiently isolated from the rest of the building.
3. Proper remediation and Personal Protective Equipment (PPE) must be utilized at all times. At a minimum, PPE will include gloves, eye protection, and an N-95 respirator. Based on the amount of contamination, respiratory protection may be increased.
4. In all cases involving the presence of visible mold, the WIST must develop a written plan for mold remediation. It is strongly suggested that this plan be developed in conjunction with an environmental consultant if other than clean water was involved or if more than 10 square feet of visible mold is present. Plans should include:
    a. Summary of the issue: including building age and location, identification of any occupants and all occupant comments (including health complaints), visual observations, cause of problem, immediate response actions, and photographs.
    b. Remediation plan, which will include remediation methods, what items are to be removed/cleaned, and all protocols, including detailed remediation/cleaning procedures.
    c. Types of PPE to be utilized.
    d. Whether occupants will be relocated.
    e. Plan for post-remediation sampling.
    f. Signoffs and releases by Agency or impacted party when work is complete.
    g. Plan to recoup any damages (if applicable).

The following guidelines for mold remediation may be used.

Visible mold growth <10 square feet (s/f) caused by clean water:

1. Trained WIST personnel can remediate these problems.
2. Contain area of visible contamination with 6-mil polyethylene.
3. PPE to include gloves, eye protection, and an N-95 respirator.
4. Engage a qualified microbial consultant to run post-remediation samples.
5. Remove and carefully wrap all impacted building materials.
6. Consider replacing HVAC filters.

Visible mold growth between 10 and 25 s/f caused by clean water:

1. Trained WIST personnel can remediate these conditions, but the services of a qualified microbial consultant and remediation contractor should be strongly considered due to additional remediation equipment and PPE that should be used.
2. Containment must be constructed and put under negative pressure. All HVAC system air vents, supplies, ducts, chases, and risers within the impacted area must be sealed to prevent migration of contaminants.
3. PPE may include half-face respirator and full-body protection, in addition to gloves and eye protection.
4. Surfaces of all objects removed from the containment area should be vacuum cleaned with a High-Efficiency Particulate Air vacuum prior to removal from contaminated area.
5. A qualified microbial consultant is needed to run post-remediation samples.
6. Replace HVAC filters.

Visible mold growth > 25 s/f and/or dirty water conditions:

These situations require initial involvement of environmental industrial hygiene consultant and environmental remediation contractor. They will always require post-remediation sampling.

Remediation Procedures. Once it is determined remediation can begin, qualified GC personnel or a qualified third party should remove and replace damaged building materials per the Table 2 remediation guidelines.

The following practices are also important with respect to solving water intrusion issues with suspected or visible mold present:

- Do not use biocides and/or anti-microbial chemicals as a substitute for microbial removal.
- Do not remove contaminated materials through the building without wrapping in plastic.
- Do not remove any materials that may contain lead or asbestos prior to testing.
- Do not run “post-remediation” sampling immediately following remediation. Utilize negative air machines equipped with HEPA filtration for 24 to 48 hours to “scrub” the air.
- Do not begin reconstruction prior to post-remediation sampling and receipt of successful sampling/visual inspection results.
- Do not delay instituting any mitigation procedures listed in this guide.
- Cut (do not tear) out wallboard.
- Ensure negative air machines and other equipment used on a site is decontaminated/cleaned prior to use in another site.
- Wet-wipe clean and/or HEPA vacuum surfaces in the remediation area to remove excessive settled spores. These areas should be free of dust and debris upon post-remediation monitoring.
- If removing visible contamination, remove and contain at least one-foot beyond visible water damage and/or visible contamination.
- Decontaminate all equipment prior to use in the work areas.
- All waste is currently non-regulated and may be disposed of in a regular landfill unless asbestos or lead-containing materials are also present. Microbial waste should be wrapped in plastic prior to disposal to protect from further exposure.

Table 2. Protocol B Remediation Procedures (mold present)

Books and Papers	HEPA vacuum after drying. Agitate over a negative air table.
Cabinetry	Remove if water damaged otherwise wet-wipe clean using two-towel system.
Carpet	Remove impacted carpet.
Ceiling Tiles	Remove if water stained or fungi – contaminated and place in plastic bag for removal.
Ceramic Tile Flooring	If grout is compromised remove and wet-wipe sub-flooring.
Concrete, Cinder Block, or Brick	Wire brush visible fungi. Wet wipe clean using two-towel system and HEPA vacuum. Apply biocide/sealant if unable to remove visible contamination.
Cove base	Remove from water impacted or suspected areas.
Drapes	HEPA vacuum after drying thoroughly. Dry clean if material is not water stained.
Drywall	Remove visibly impacted material 1 foot beyond impact, wrap in plastic, and remove from environment.
HVAC Duct System Components (hard components)	Wet-wipe clean using two towel system.
Insulation	Remove visibly impacted material 1 foot beyond impact, wrap in plastic, and remove from environment.
Lined HVAC Components	Remove porous materials impacted by water; change filters, wipe down nonporous components.
Mattresses	Remove and discard
Metal Doors and Window Framing	Wet-wipe clean using two-towel system.
Metal Studs, Braces/Rafters	Wet-wipe clean using two-towel system.
Padding	Remove impacted padding.
Plywood Floor	If structurally unsound remove, otherwise wire brush or hand sand visible fungi. Wet wipe clean using two-towel system and HEPA vacuum. Application of biocide/sealant may be necessary.
Tack Strips	Remove from areas of impact.
Unlined Flexible Duct	Remove and dispose of properly.
Upholstered Furniture	HEPA vacuum after drying thoroughly. May need to discard if visible mold present.
Vinyl Sheet or Tile	If visibly impacted, remove and wet wipe sub-flooring using two-towel system.
Wall Paper	Remove if visibly impacted or applied to impacted drywall, unless drywall is also being removed.
Wood Doors/Window Trim	Remove if water damaged, otherwise wire brush or hand sand clean visible fungi. Wet-wipe clean using two-towel system and HEPA vacuum.
Wood Flooring	If flooring cannot be restored, remove. Wet-wipe sub-flooring using two-towel system.
Wood Paneling	Remove visibly impacted material 1 foot beyond impact, wrap in plastic, and remove from environment.
Wood Studs/Braces/Rafters	If structurally unsound remove, otherwise wire brush or hand sand visible fungi. Wet wipe clean using two-towel system and HEPA vacuum. Application of biocide/sealant may be necessary.

Post Remediation Sampling. If a building has been impacted by fungal growth and remediation has been performed, post-remediation sampling should always be performed by only a qualified microbial consultant (see Chapter on Microbial Sampling). Post-remediation sampling:

- Generates a level of comfort for the Agency and occupants;
- Provides documentation of successful project completion should there be an issue of future liability;
- Provides scientific evidence that the remediation process has been successful; and
- Provides an independent, third-party evaluation of the project.

Post-Incident Follow-up. Once the cause of the problem has been identified, it is important to determine why the problem occurred and make any necessary changes (such as system improvements or increased inspections) to prevent reoccurrence of the problem. The WIM will be responsible for any post-incident follow-up.

Chapter

15

Selection of Experts

The Project Manager will determine when it is necessary to engage a qualified independent microbial consulting expert as well as a microbial remediation contractor. To engage an outside consultant or contractor, the Project Manager will contact the DPW Technical Services Unit, which is responsible for qualifying microbial consultants and microbial remediation contractors utilized by the DPW.

Not all instances of water intrusion will require the services of these outside vendors; however, their services should be considered when fungal growth (mold) is suspected or visible and when the event is deemed to be significant as defined in this text. Consideration should also be given to using a consultant to perform clearance (post remediation) sampling after all impacted materials have been removed, especially if any additional "risk factors" are present such as:

- Event occurred in area occupied by an infant or day-care facility
- Water intrusion involved gray water or sewage
- Possible claims due to monetary loss or health-related complaints
- Visible mold present in HVAC system

Chapter

16

Microbial Investigations & Testing

Once it has been deemed necessary to have a microbial consultant perform an investigation, the following should be included as part of that Scope of Work:

- Thorough visual examination and photographs
- Identification of cause of water intrusion
- Identification of extent of contamination
- Diagram with sampling locations
- Sampling date and weather conditions at time of sampling
- Sampling strategy
- Investigating microbial issues is contingent upon visual inspection of the building, assessing occupant symptoms (as applicable), evaluating building performance, testing potential environmental sources, and applying professional judgment.

Types of Sampling. Testing for microbial contaminants is conducted utilizing two basic types of monitoring: surface sampling and air sampling.

- **Surface sampling** (including tape, bulk, or swab) provides information on the types of fungal growth on a building material (i.e., drywall, wooden studs, etc.). Results of these sample types can help identify fungal reservoirs, relate surface growth to airborne contamination, and confirm fungal growth on a surface. A specially designed particulate air sampling device may be used to confirm fungal growth in a wall cavity.
- **Air sampling** provides information regarding the level and types of fungal spores in the breathing zone of the building. *This is the only type of sampling that can be related to exposure via inhalation.* Indoor and outdoor samples are compared utilizing this method and quantity and types of fungal spores are directly compared to the outdoor air.

  Air samples are collected from indoor areas/rooms that are believed to be associated with the water loss and areas/rooms that are not associated with the water loss to discern whether there is evidence that fungal contaminants have aerosolized to other non-impacted

areas in the building. Outdoor samples are collected for comparison.

What is "Contamination"? Microbial contamination exists when the indoor concentrations are not quantitatively or qualitatively similar to the measured outdoor concentrations. Contamination also exists when there are visible reservoirs of fungi growing on building materials. Air sampling can be either viable which identifies only live spores or nonviable which identifies some live, but primarily dead mold spores. Both types of sampling involve spore trapping of some kind although the substances onto which the spores are impacted varies dependent upon whether the sampling is viable or nonviable.

Other Sampling Types. In instances wherein there are on-going leaks or health concerns, it is recommended to do both viable (culture) and particulate air sampling.

Particulate air sampling does not allow for differentiation of certain types of spores (i.e., *Aspergillus* vs. *Penicillium*). It also does not collect small fungal spores (less than 3 microns). It does capture *Stachybotrys* spores and provides a rapid turnaround.

Viable sampling is useful in separating out *Aspergillus* and *Penicillium* spores and smaller organisms. It does however take at least 7-10 days to culture.

Appropriate Sampling Strategy. Collecting at least two outdoor air samples at different times and different locations (if possible) is recommended, to account for different conditions at different times of the day as well as in different locations around the building. The determination of airborne fungal contamination should be made by comparing the outdoor overall total fungal spore levels to the indoor total fungal spore levels as well as comparing the individual fungal spore levels outside to those in the indoor environment.

If indications are that the debris rating is too high, it is likely the sampler collected samples for too long a period and fungal spore counts may be severely underestimated (i.e., collecting 150L or greater on a particulate air sampling device will likely result in too high of a debris rating).

Air samples should be collected in impact areas (location of loss) as well as non-impacted areas in order to determine the extent of airborne fungal contamination. This will help to determine if cleaning is warranted throughout the building or just limited to the area of the loss.

Report of Findings/Components. Once the microbial sample results are received a detailed report of findings should be produced which includes:

- Analysis of laboratory findings
- Diagram with laboratory results and locations for remediation
- Scope of work for microbial remediation
- Identification of extent and cause of loss.
- Laboratory results and chain-of-custody forms

Post-Remediation (Clearance) Sampling. Post-remediation or clearance sampling should always be performed by an independent qualified microbial consultant.

Post-remediation sampling generally consists of nonviable air sampling only, but on occasion it also may include a limited number of surface samples. The purpose of post-remediation sampling is to ensure the similarity of indoor microbial contaminants (levels and types) to outdoor microbial contaminants. Generally, it is recommended this sampling not be performed until after a 24 – 72 hour waiting period following completion of remediation.

Post-remediation sampling is necessary to verify that any remedial action taken has been successful. It is critical to retain any documentation relating to these clearance tests in the event a subsequent claim is made.

Note: If it is suspected that gray or black water may be involved, stop all work and contact third parties. This type of water infiltration damage will probably require bacterial as well as fungal sampling.

Section V: Special Liability Concerns – Renovations and Healthcare

Chapter

17

Special Concerns for Renovation

Although water intrusion can have serious consequences in any building, contractors should be aware that all buildings are not created equal in the sense that water intrusion and microbial issues may be of greater urgency in certain buildings depending on the following factors:

- Building Use/Occupant Type
- Building Age
- Building History
- Building Location
- Building Composition
- Building Maintenance

DPW Project Managers overseeing work on buildings of a high-risk type (as categorized below) should carefully evaluate risk factors inherent in those buildings and ensure that their water intrusion management plan addresses how those risks will be managed. This is particularly important when a building will remain occupied during the renovation or construction process. It is also wise to address with the Agency how water intrusion or microbial issues will be handled from a public relations standpoint when and if they arise. These issues and any development of contingency plans by the Agency responsible for the building should be discussed during pre-construction meetings.

Evaluating Risk Factors

1. Building Use

a. Hospitals/Health-Care Facilities/Nursing Homes

Risk Level: Extreme

Rationale: There is a documented elevated risk of significant fungal infections in certain immune-compromised patients housed at these facilities. The risk of infection is directly related to construction/renovation activities in or in proximity to these buildings. These buildings also typically have more ongoing construction/ renovation activities than other types of facilities. In addition the buildings are generally older with significant roof penetrations and

other opportunities for moisture intrusion. See the next chapter for basic concerns for extreme risk, healthcare facilities.

b. Residential

Risk Level: High

Rationale: Residential housing, especially multi-family housing, is at a greater risk of health complaints from mold. Historically, most mold claims have originated from this building type. Communication among occupants frequently results in the potential for claims, negative publicity, and potential stigmatizing of the development.

NOTE: *Be aware that while retirement homes fall into this category, these facilities must be evaluated as to whether they have a nursing home or assisted living facility component which may increase risk in those areas of the structure.*

c. Universities/Schools (especially dormitories)

Risk Level: High

Rationale: With schools, the public perceives that students are at higher risk for exposure, and also that schools should be "safe" places, generating tremendous financial exposure for these facilities. Schools also have a greater risk of health complaints if residential housing is present. The possibility of negative publicity is tremendous and potentially can make the school authorities appear negligent.

Be aware of the State of Connecticut Public Act No. 03-220 (see Appendix Three) which pertain to grades K-12. This is "An Act Concerning Air Quality in Schools" that pertain to "… every school building that is or has been constructed, extende, renovated or replaced …" Amongst its provisions is the following: that local or regional school boards are responsible for an inspection and evaluation program which shall include a review, inspection or evaluation of the following: "…(3) potential for exposure to microbiological airborne particles, including, but not limited to, fungi, mold and bacteria…"

d. Office Buildings

Risk Level: Medium

Rationale: Health risk exposure is limited due to limited occupancy times. As with hospitality, however, risk exists for negative publicity as well as worker compensation issues. In addition, in an office setting, the "domino effect" is present with respect to health complaints (once one employee complains of illness, many more are certain to feel sick as well).

g. Warehouse Facilities

Risk Level: Low

Rationale: Less risk in these buildings because of lower worker expectations for the building environment and better ventilation. In addition, these buildings are typically not constructed of many materials which can serve as good food sources upon which fungi can grow. The primary risk is from workers compensation claims and property damage.

2. Building Age

In general, older buildings have greater risk due to building material wear and tear. Pre-1970 buildings may have lead-based paint issues. Pre-1980 buildings may have asbestos issues as well. Buildings older than 40 years, however, may actually have fewer mold problems because they may not contain as many products that may serve as good food sources for mold, and they are typically built with materials and assemblies that allow moisture that enters the building time to dry out before water damage or mold growth occurs.

3. History of the Building

Past claims, prior issues, and inherited, non-remediated issues particularly with respect to roofs, windows, plumbing, HVAC, and exterior issues, all increase the risk.

4. Location of the Building

Geography and topography will affect the building's ability to resist moisture. Obviously, buildings located in warm, moist climates and in areas prone to flooding (Connecticut shoreline) are at highest risk. Buildings located in states where construction defect litigation is strongest, such as California and Nevada, will be at higher risk.

5. Building Composition

Different building materials provide different levels of acceptable food sources for mold. In general, cellulose-based products are usually at the top of the list. Building materials that are most susceptible to developing a mold problem if impacted by water:

Paper-faced drywall – High risk

Acoustic Ceiling Tiles – High risk

Lined HVAC system – High risk

Plumbed Exterior Walls – High risk

Carpet – High risk

Cellulose-based insulation – Medium risk

Wood framing – Low-Medium risk

Other at-risk assemblies or materials:

Exterior Insulation & Finish Systems (EIFS) – High risk

Interior vapor barriers – High risk

Metal framing – Low-Medium risk

These assemblies and components can be problematic because they allow exacerbated conditions when water intrusions occur (by not allowing water that enters the building to escape and the building to dry) or they may promote water intrusions if improperly installed.

6. Building Maintenance

Poorly maintained buildings are much more likely to have mold issues. Poor housekeeping including failure to maintain buildings in a clean, uncluttered condition will also contribute to mold growth.

Many of the risks identified in this section are non-controllable risks. However, good building construction and maintenance (including prevention and response) are controllable. If you are contracted to renovate an older facility or to construct a new building, be aware of the need to have appropriate response plans in place when problems do arise, particularly during renovations.

Addressing Risk Concerns

Earlier sections of this manual detailed the specific response plans that the contractor should employ during construction. For high-risk facilities being renovated that will remain occupied during construction, the owner/operator may need to develop their own response plans to handle any occupant complaints/concerns or publicity that may arise during or after construction. The DPW project manager should discuss the possible need for the following items with the building owner/operator during pre-construction meetings:

- **Establishing a mechanism to receive and address complaints from building occupants during construction.** The importance of responding quickly and sympathetically to occupant complaints or concerns about water intrusion or mold issues cannot be overstated. In most cases, grievances, OSHA and DPH complaints, can be avoided with prompt, sympathetic response and good communication with affected parties while an issue is being addressed.

- **Establishing policies/procedures for relocating occupants in areas affected by the construction or when water intrusion/microbial issues arise.**
- **Suggesting wording for letters to inform occupants or other affected parties (such as parents/faculty in the case of schools) about any mold findings and remediation.**
- **Designating a "community spokesperson" who will be authorized to speak to parents and media (especially in the case of schools).** This individual should be associated with the school administration or school board, but the DPW may be called upon to answer questions in a public forum. The DPW project personnel designated as the WIM or DPW Supervising Project Manager should be prepared to be called upon in this capacity.

Chapter

18

Special Concerns for Healthcare Facilities (Extreme Risk)

Over the past 20 years, numerous infectious outbreaks in hospitalized patients have resulted from construction or renovation activities in healthcare facilities.[5] Environmental disturbances in and around healthcare facilities (e.g., removing ceiling tiles, running cables through the ceiling, and structural repairs) may markedly increase the airborne *Aspergillus* spp. spore counts in the indoor air of such facilities, thereby increasing the risk of healthcare-associated Aspergillosis among high-risk patients. Any construction, renovation, repair, or demolition activities in healthcare facilities require substantial planning and coordination to minimize risk of airborne infection both during projects and after their completion.[6]

Although the major responsibility for the risk minimization process lies with the healthcare facility, contractors performing any type of construction or renovation work need to be aware of the special precautions that must be taken when working in healthcare facilities and their role in the risk minimization process.

Prevention Team

The healthcare facility should assemble a team to address prevention of fungal infections during the construction project. Ideally, this team will consist of the following members:

- Facility Engineering Department
- Facility Management
- Infectious Disease Professional
- Impacted Department Professional
- Toxicologist

[5] Population and Public Health Branch (PPHB), Health Canada, *Construction-Related Nosocomial Infections in Patients in Health Care Facilities* (July 2001) http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/01vol27/27s2/27s2g_e.html (as of January 11, 2005); CD – Healthcare Infection Control Practices Advisory Committee (HICPAC), *Draft Guideline for Environmental Infection Control in Health Care Facilities (2001).*

[6] CDC Healthcare Infection Control Practices

- Owner/Operator's Representative
- Industrial Hygiene Consultant
- Construction contractors
- DPW PM

Pre-Project Risk Assessment

Members of the team will develop a risk assessment which will evaluate the potential exposure posed to patients by the scheduled work. The risk assessment will evaluate the following:

- Types of construction activity planned, particularly the amount of dust expected to be created — increased dust = increased risk;
- Presence of microbial contamination or suspected contamination present – must be established through microbial sampling;
- Degree of risk posed based on usage of the facility area to be impacted (e.g., whether it is occupied by supplies, employees, or patients and, if patient-occupied, the risk level of the patients);
- Duration of the project; and
- Whether the space will remain occupied throughout the project.

The construction contractor may be asked to provide some input to the risk assessment, particularly with regard to the amount of dust that may be generated. The contractor may also assist with planning of certain construction logistics to minimize risk. The bulk of the risk assessment, however, will be conducted by an industrial hygiene consultant in conjunction with an infectious disease professional and toxicologist.

Risk Management and Preventive Measures During Construction Projects in Healthcare Facilities

The risk assessment should outline the level of preventive measures that will be effective in reducing the incidence of fungal infections caused by construction-related activities. Depending upon the degree of risk posed by the proposed construction activity and the impact to occupants, the following measures may be required:

- Contain all construction areas with minimum 6-mil polyethylene sheeting;
- Use negative air machines with HEPA filtration (exhausting to the building exterior) in all contained areas (open ends of exhaust should be capped to prevent reentry to building);
- Seal off (with minimum 6-mil poly) all critical areas--i.e., windows, doors, outlets, and any other areas which could allow migration of contaminants;

- Isolate HVAC systems and, if necessary, bring in new temporary units;
- Relocate immune-compromised patients during activities (facility responsibility);
- Develop a contingency plan in the event of a project emergency and hold weekly preventive maintenance meetings;
- Require 3-stage decontamination units to ensure workers do not transport contaminated materials into non-contaminated areas. Require protective clothing and respirators be disposed of properly so as not to impact patients;
- Designate that only certain areas of the hospital (i.e., hallways elevators, etc.) be used for construction activities and transit;
- Pre-clean areas to be impacted using HEPA vacuums and damp wipes. HEPA-vacuuming and wet-wiping of construction areas should be performed constantly to prevent dust accumulation and generation;
- Consider performing fungal air monitoring during the project in random areas adjacent to the construction area as a precaution against contamination and to protect the hospital from liability;
- Conduct periodic inspections of the work area to ensure there are no breaches in containments, that negative pressure is being maintained, and the specified air changes per hour are achieved.
- Educate workers on the importance of dust minimization/control and water intrusion impact to patients.
- Upon project completion, all surfaces should be thoroughly wiped down and HEPA-vacuumed. Then use negative air machines equipped with HEPA filtration for 24-48 hours to “scrub” the air of particles. Following this period, post-remediation fungal air sampling should be performed to verify that no residual contamination remains and to protect the healthcare facility from liability.

  Note: Clearance criteria for healthcare facilities are stricter than for non-health care environments. In most cases, the standard in a healthcare facility should be *no infectious fungal species present* (in microbial samples) in the impacted area prior to tear down of containment.

Response to Significant Water Intrusion Issues

In the event of significant water intrusion or microbial contamination, the contractor, independent third-party microbial consultant and the GC should work in conjunction with the hospital response team to accomplish the following:

- Shut off water
- Ensure safety of occupants – relocate and equip with personal protective equipment (respirators, gloves, etc.), if necessary
- Post appropriate signage
- Document all response actions
- Establish work zones and traffic patterns away from patient areas.
- Contain impacted areas with polyethylene sheeting and seal off return vents. Contained areas should be put under negative pressure with exhaust to the exterior. Use HEPA filtration.
- Document temperature, relative humidity, air changes, and pressure differentials.
- Continually monitor pressure and ventilation in the construction zone, adjacent areas, and high risk areas during the project to ensure no impact to patient areas.
- Continually monitor and document compliance with infection control plan. No worker should be permitted to leave the contained area prior to showering or at minimum removing all impacted protected clothing, equipment, etc.
- Require third party to monitor containment breeches with particle sampling.
- HEPA vacuum and wet-wipe all surfaces prior to starting work.
- Clean/replace HVAC filters in area of impact and verify no contamination will be dispersed upon re-activation. Do not tear down barriers until appropriate verifiable microbial post-remediation sample results have been received.
- Debris must be bagged prior to removal from construction/remediation zone. Removal should be performed via exit routes away from patient impact areas.
- Carefully wipe down all surfaces in impacted areas and ensure proper pressurization/filtration/ventilation is in place.
- Flush main water system to clear dust-contaminated lines.
- Do not remove any materials that may contain lead or asbestos prior to testing.
- Do not begin reconstruction prior to post-remediation sampling and receipt of successful sampling/visual inspection results.

- Wet-wipe clean and/or HEPA vacuum surfaces in the remediation area to remove excessive settled spores. These areas should be free of dust and debris upon post-remediation monitoring.
- Decontaminate all equipment prior to use in the work areas.
- Specify remediation methods that generate the least dust.

Appendix One: Forms and Checklists

Water Intrusion Event Form

This form MUST be completed each time there is a significant water intrusion event.

Date: _____ Time: _____

Site Location: _____

To be completed by the WIST Superintendent

1. Describe the incident: _____
2. _____
3. Was the cause of the event determined? Describe: _____

   _____

   _____
4. Was the extent of damage determined? Describe: _____

   _____

   _____
5. Occupied Building? □ Yes □ No

   a. Are there any occupant complaints? Describe: _____

      _____

      _____

   b. Were occupants relocated? □ Yes □ No
6. Were any of the following observed: □ Visible Mold □ Musty Odors
   □ Water Stained Building Materials □ Water Damaged Building Materials
   □ Impact to the HVAC System □ Sewage or Gray Water?

   Describe: _____

   _____
7. Was the WIM contacted? □ Yes □ No

WIST Superintendent: _____

Title: _____

Signature: _____ Date: _____

Remainder of form to be completed by WIM:

8. Was the customer contacted and direction requested?

   If yes: Customer: _____

   Contact: _____

   Date contacted: _____

9. What was the customer's direction? _____

10. What follow up precautions will be instituted? (If any) _____

    _____

11. Were the services of a microbial consultant retained?
    □ Yes □ No

    If so, what was the scope of services? _____

    _____

    _____

12. Was Clearance Sampling performed? □ Yes □ No

    Attach laboratory results.

13. Are there any outstanding issues? □ Yes □ No

    Please explain: _____

    _____

    _____

14. Has the cause of the problem been repaired? □ Yes □ No

    If not, why?

15. What remediation methods were instituted? _____

    _____

All reports filed must have accompanying photos.

Water Intrusion Manager _____

Signature: _____ Date: _____

Checklist for Water Intrusion Issues in Buildings/Condominiums – Warranty/Maintenance Phase

(For use during warranty phase and to assist with liability transfer to the Agency)

Agency: _____ **Inspector:** _____

Location: _____ **Superintendent:** _____

Address 2: _____

_____ **Telephone:** _____

Date of Inspection: _____

Interior Inspection (Check all that apply)

Area at Issue	Concern	Investigation Result/Location
Drywall – throughout	☐ Staining/Discoloration	_____
	☐ Visible Fungal Growth Suspected	_____
Bathroom		
☐ Tub/Shower Assembly	☐ Staining/ Maintenance/Grout	_____
☐ Toilet/Cabinet	☐ Staining/ Plumbing Issue	_____
☐ Water Closet	☐ Staining/Plumbing Issue	_____
☐ Fan/Exhaust	☐ Disconnected/Usage	_____
☐ Shower/Tub Shelving/Seat	☐ Design Issues	_____
☐ Walls/Floors	☐ Carpet/Wallpaper	_____
Closet		
☐ Carpet	☐ Tack Strip Staining/Plywood, OSB Stained	_____
☐ Smell-Musty	☐ Present/Absent	_____
☐ Clothing	☐ Mold Present	_____
☐ Hot Water Heater	☐ Staining/Maintenance	_____
☐ HVAC Closet	☐ Staining/Maintenance, Check Air Filters	_____
☐ HVAC Closet	☐ Check Maintenance of System	_____
Kitchen		
☐ Refrigerator	☐ Staining beneath or on wall behind maintenance/dirt Check Ice/Water Connection	_____
☐ Stove/Oven	☐ Check behind unit – examine maintenance	_____
☐ Sink	☐ Examine for staining below	_____
	☐ Examine plumbing/disposal issues	_____

French Doors/Sliding Doors	☐ Proper location of threshold	_____
	☐ Staining on carpet or tack strip	_____
	☐ Deck/balcony slope/drainage	_____
	☐ Track – Wood, Metal – clean, obstructed	_____
	☐ Condition below threshold – staining, cracked, etc	_____
Clothes/Dryer	☐ Vented to exterior & flashed appropriately	_____
Attic		
Venting	☐ Present, size, location, gable end vent, ductwork present	_____
Hot Water Heater	☐ Present?	_____
Washing Machine	☐ Present?	_____
Sheeting	☐ Staining?	_____
Skylight	☐ Staining, delamination, signs of water intrusion	_____
Ventilation		
Smells in building	☐ Musty?	_____
Humid in building	☐ Comfortable?	_____
Temperature in building	☐ Comfortable?	_____
Crawl Space	☐ HVAC located	_____
	☐ Ventilation	_____
	☐ Flooring	_____
	☐ Moisture Present/Staining	_____
	☐ Proximity to tub, shower, kitchen	_____
HVAC	☐ Size of unit – appropriate	_____
	☐ Maintenance	_____
	☐ Fans in high moisture areas	_____
Insulation	☐ Wet	_____
	☐ Stained/Dirty	_____
Ductwork	☐ Ductboard in humid climate	_____

Always note the potential impact of exterior issues on the interior such as berms, landscaping, sprinklers, planters, grading/paving, etc.

COMMENTS: _____

_____

_____

_____

_____

Exterior Inspection (Check all that apply)

Area at Issue	Concern	Investigation Result/Location
Landscape		
Drainage	☐ Proximity to residence	
	☐ Blockage/Alteration created by occupant	
Standing Water	☐ Presence/location	
Irrigation	☐ Proximity to residence, overspray, impact to building, duration of use	
Planters	☐ Waterproofing, location	
Berms	☐ Presence/location	
Vegetation	☐ Proximity to building perimeter	
Planter Box	☐ Sheet Metal Flashing – 2" gap	
Roof		
Skylights, Penetrations, Vents	☐ Proper flashing	
Chimney	☐ Cap – Proper slope, deterioration, side/top fastened, insulated	
Fascia, Eaves	☐ Separation, splitting, nail pops, water staining, Damage	
Underlayment	☐ Density	
Tile	☐ Broken, Loose, Exposure	
Configuration	☐ Design issue/Ice Dams	
Valley	☐ Appropriately flashed	
Gutters	☐ Appropriately placed & free from debris	
Balcony/Decks		
Slope	☐ Appropriate	
Drainage	☐ Appropriate/Ponding, staining	
Coating	☐ Appropriate/Staining, deterioration, penetrations	

Windows

☐ Identify type – stacked, casement, etc. _____

☐ Identify composition & condition _____

☐ Stucco cracks at corners _____

☐ Pot Shelves – Slope, condition, separation _____

☐ Flashing _____

☐ Drainage/Slope/Weep hole obstruction _____

☐ Installation – Proper _____

Exterior Systems EIFS

- ☐ Drainage/Barrier _____
- ☐ Penetrations/Transitions _____
- ☐ Humid Climate _____
- ☐ Appropriate Installation/Product location (i.e., soil contact) _____

Stucco

- ☐ Cracks greater than 1/8 inch _____
- ☐ Potential Membrane Issues _____
- ☐ Flashing _____
- ☐ Screed Terminations – location/obstruction _____
- ☐ Appropriate air infiltration barrier (gap) and drainage plane _____

Operation/Maintenance (Check all that apply)

Area at Issue	Concern	Investigation Result/Location
Vapor Barriers		
Weep Holes	☐ Obstructed/Altered?	_____
Carpet	☐ High Moisture Areas?	_____
Wall Coverings	☐ High Moisture Areas?	_____
HVAC		
Air Filters	☐ Changed Regularly?	_____
Air Conditioner	☐ Oversized?	_____
	☐ Maintaining building at other than optimal temp/RH?	_____

Maintenance

- ☐ Improper storage of boxes? _____
- ☐ Lack of good housekeeping? _____
- ☐ Maintain flashing, grout/caulking? _____
- ☐ Accumulation of debris in gutters, door window tracks? _____
- ☐ Proper maintenance of interior plants, ponds, terrariums?
- ☐ Alteration of washer/dryer/refrigerator ice connections? _____

Exterior Systems

- ☐ Penetrations to walls/roofs? _____
- ☐ Alteration to irrigation? _____
- ☐ Alteration to paving/grading? _____

Plumbing

☐ Water Heaters – Fitting corrosion? _____

☐ Sealants – Condition? _____

☐ Pipes – Insulation intact? _____

Basement

☐ Sump Issues? _____

☐ Vapor Barriers – i.e. vinyl flooring wood paneling, carpeting? _____

Crawl Spaces

☐ Moisture accumulation? _____

☐ Vented/non-vented? _____

☐ HVAC present? _____

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager _____

Signature: _____

Date: _____

General Contractor/Construction Manager

Construction Risk Checklist

To assist WIM in assessing Water Intrusion Readiness

1.	Has the DPW designated a responsible party to function as the WIM (Water Intrusion Manager)?	☐ Yes ☐ No
2.	Does DPW have a designated team to respond to and evaluate water intrusion issues?	☐ Yes ☐ No
3.	Does DPW have 3rd party consultants/remediation contractors on call?	☐ Yes ☐ No
4.	Are mold issues addressed in weekly site safety meetings?	☐ Yes ☐ No
5.	Are GCs and their subcontractors required to have mold training?	☐ Yes ☐ No
	Are GCs and their subcontractors required to have mold insurance?	☐ Yes ☐ No
6.	Are you protected sufficiently in your contractual language from ensuing water damage caused by your GCs?	☐ Yes ☐ No
7.	Does DPW have a written water intrusion prevention and response plan?	☐ Yes ☐ No
8.	Are materials examined upon arrival at jobsite to verify they have not been impacted by water or mold damage? If yes, what documentation are you providing?	☐ Yes ☐ No
9.	Are materials kept at the jobsite stored in safe, dry condition? If yes, what documentation are you providing?	☐ Yes ☐ No
10.	Has a review of the project sequencing been performed to verify materials can be kept dry at all phases of the project?	☐ Yes ☐ No
11.	Are you documenting building and material conditions at critical stages of a project? If yes, list stages: If yes, how are you documenting conditions?	☐ Yes ☐ No
12.	Are you photographing condition of framing prior to enclosure?	☐ Yes ☐ No
13.	Are you taking sample moisture meter readings of susceptible building materials prior to and after installation?	☐ Yes ☐ No
14.	Are you taking vapor emission readings of the foundation prior to installing finishes?	☐ Yes ☐ No

15.	Are product mixes for concrete, stucco, etc. performed in compliance with manufacturer's recommendations and documented?	☐ Yes ☐ No
16.	Are inspections performed to verify all weep screeds are properly placed and unobstructed?	☐ Yes ☐ No
17.	Are interior/exterior vapor barriers appropriate for climate?	☐ Yes ☐ No
18.	Has appropriate flashing at windows been applied and documented	☐ Yes ☐ No
19.	Have roofs and balconies been inspected and documented for appropriate drainage and slope?	☐ Yes ☐ No
20.	Have you evaluated and documented the sufficiency of drainage plains and vapor barriers on exterior walls?	☐ Yes ☐ No
21.	Has a 3rd party verified the condition and sufficiency of the external membrane prior to stucco application?	☐ Yes ☐ No
22.	If penetrations of any exterior building materials will occur have you documented conditions prior to penetration?	☐ Yes ☐ No

Remember: There should never be any conditions occurring on any construction site that you would not want photographed as part of your standard building practices.

This includes:

- Photographs of mold impacted materials;
- Porous or semi porous materials exposed to weather;
- Improper design based on topography and or climate; and
- Construction practices/design which prevent houses from draining/drying out appropriately.

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager_____

Signature: _____

Date: _____

Water Intrusion Prevention Checklist: General Contractor – Pre-Construction Phase

Date: _____

Name & Title of Person/ Responsible Party: _____

Project Name: _____

Location: _____

1. Has the WIM, foreman and superintendent, or workforce been properly trained in the importance and methods of preventing mold growth?

   ☐ Yes
   ☐ No – If No, provide reason:

   _____
   _____
   _____

2. Has a peer review of the design phase and plans/specifications been carefully reviewed for adequate details with specific attention to ensure a watertight envelope?

   ☐ Yes
   ☐ No

3. Has an expert on waterproofing been involved in the peer review of a geometrically complex building?

   ☐ Yes
   ☐ No

   If yes, list issues requiring special attention:

   _____
   _____
   _____
   _____

4. Has due-diligence on prospective subcontractors been performed to ensure that they have adequate experience in their specific field of application that is being bid?

   ☐ Yes
   ☐ No

4a. Has due diligence on prospective subcontractors been performed to ensure they have received adequate training with respect to mold and water intrusion issues?

- ☐ Yes
- ☐ No

5a. Has due-diligence on prospective products been performed to confirm application methods and standards for recommended installation?

- ☐ Yes
- ☐ No

5b. Has a list of qualified installers been acquired?

- ☐ Yes
- ☐ No

6a. Have changes or deviations to specification or installation methodology been submitted to the architect of record for review and approval?

- ☐ Yes
- ☐ No

6b. Has the Agency been carbon copied on all requested changes or deviations in writing whether rejected or approved?

- ☐ Yes
- ☐ No

7. Have you surveyed the existing structure where a remodel or new addition has been proposed in order to identify any areas of pre-existing evidence of mold, or moisture intrusion to the structure in writing to the architect and Agency?

- ☐ Yes
- ☐ No

NOTE: If moisture intrusion and/or mold are found, it is recommended that an expert be enlisted to verify the extent and carefully document and photograph the pre-existing conditions. (if a pre-existing mold or water intrusion is found and not specifically identified in advance, it can become the contractor's problem once construction begins)

8a. Have you analyzed your anticipated construction schedule, taking into consideration adverse weather conditions?

- ☐ Yes
- ☐ No

8b. Have you considered how weather conditions will affect construction sequencing?

☐ Yes
☐ No

What considerations have gone into the analysis for protection of the affected building components?

_____
_____
_____
_____

8c. Has a detailed weather protection plan been integrated with the project schedule in order to guard and protect finishes such as insulation, gypsum board, etc.?

☐ Yes
☐ No

9. Has a plan been developed to protect building materials from the elements, which are susceptible to damage during their on-site or off-site storage pending installation?

☐ Yes
☐ No

10a. Has a plan been put into place, during winter construction, for the use of temporary heaters so to maintain a safe environment?

☐ Yes
☐ No

10b. Has a plan been developed to maintain a 30-55% relative humidity level within the building?

☐ Yes
☐ No

11. Has a peer review been performed as it relates to drainage at and around the building footprint and foundation?

☐ Yes
☐ No

NOTE: A review of civil, mass grading plans, finish grading plans, fine grading plans and irrigation and drainage plans should be performed to assure coordination.

12. Does your subcontract agreement incorporate your construction company's mold prevention policies?

☐ Yes
☐ No

13a. Have you reviewed the preliminary and final soils reports for recommendations?

- ☐ Yes
- ☐ No

13b. Have you compared your civil, foundation, and landscape/hardscape drawings for compliance to soils reports?

- ☐ Yes
- ☐ No

13c. Have you incorporated and made reference to all soils reports, plans, and specifications in your subcontract agreement?

- ☐ Yes
- ☐ No

14. Are there any other overall observations, considerations, or problem areas, which have arisen during pre-construction which are not on the plans, specifications, or material specification data sheets, etc.?

- ☐ Yes – List and explain; _____
  _____
- ☐ No

15. Will periodic interim inspections be performed at critical stages of construction with the observations detailed and documented?

- ☐ Yes
- ☐ No – Why not?

I have answered all questions to the best of my knowledge and accept responsibility for the responses submitted.

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager_____

Signature: _____

Date: _____

Construction Team Design Checklist: Recommended Design Elements

Problem design elements may require addition detail or notation. Verify that the following elements are clearly indicated. Do not "over design" needlessly. Details should be in accordance with trade practices common in the region. Review elements with the *General Contractor* before construction begins.

The owner/operator requests the Design Professional review the listed design elements and incorporate details or notations regarding the desired trade installations. The owner/operator will consult the design team regarding unusual conditions related to these elements.

Signed: _____ *Position:* _____ *Date:* _____
Project: _____ Review date: _____
Location: _____ Correction Revision Number: _____
Reviewed by: _____ Company: _____

DE #	Design Element Review; Items to include, but are not limited to:	Included Date	Revised Date	Detail, Plan sheet, or Standard
	Roof cover			
	Roof felt type and ply number indicated			
	Crickets indicated at chase / skylight ≥ 36"			
	Crickets indicated at captive down-roof walls			
	Valley flow direct to eave, no vertical blockage			
	Anti-ponding metal or filler at eave			
	Solid / membrane backing at wall connections			
	Frame / slope / trim at chimney, detail			
	Drain / overflow indicated at roof and deck			
	Drain location away from "strong" structures			
	Slope / cross-slope frame, detail or plan			
	Slope / material at parapet wall / cap, detail			
	Windows and Doors			
	Window / door flashing and seal, detail			AAMA 2400-02
	Window sill / trim 6" from roof, 4" from horiz			
	Potshelf / recess and window interface, detail			
	Wood trim / window / membrane, detail			
	Plaster trim / window / membrane, detail			
	Door threshold / pan / concrete, detail			
	Transom / window / trim / flashing, detail			
	Exterior Wall, Details, and Shelf areas			
	Elastomeric / membrane lap at horiz, detail			
	Water table at horiz wood trim, detail			
	Blocking / membrane at embedded trim			
	Through-wall wood penetration, detail			
	Concrete at plaster screed clearance ≥ 2"			
	Decks, Ledgers, and Pony walls			
	Deck coating / door flashing, detail			
	Deck coating / scupper / membrane, detail			
	Deck subfloor special fasteners / sheathing			
	Frame / ledger / membrane, detail			
	Rail attachment / frame/ membrane, detail			
	Pony wall / cap / wall / membrane, detail			

_____ *(Design Professional) has included details, plan graphics, or notes clearly indicating the listed elements.*

Signed: _____ ***Position:*** _____ ***Date:*** _____

Water Intrusion Prevention Checklist: General Contractor – Construction Phase

Date: _____

Name & Title of Person/ Responsible Party: _____

Project Name: _____

Location: _____

Construction Start Date: _____

Estimated Completion Date: _____

1. Has the schedule of work and sequencing plan been integrated with a weather protection plan to protect as-built building components and various stored building materials?

   ☐ Yes
   ☐ No

2. Has a memorialization and documentation program been implemented by your construction company breaking down crucial points of construction (example: a pre-pour foundation photograph and documentation, pre-lath and pre-dry-in of roof elements, lath and roof installation, landscape, hardscape and drainage at completion, etc.)?

   ☐ Yes
   ☐ No

3. Have pre-construction and construction jobsite meetings and inspections been implemented?

   ☐ Yes
   ☐ No

   If yes, documentation should be made of all attendees, specific issues addressed, questions or problems as they relate to specific water intrusion issues (example: below grade waterproofing subcontractor, manufacturer's representative, installation subcontractor, back-fill subcontractor, French-drain subcontractor, architect, general contractor, and/or owner/operator or their representative, etc.)

<u>Foundation Systems:</u>

4. Has a peer review been performed as it relates to drainage at and around the footprint and foundation?

   ☐ Yes
   ☐ No

5. Have you taken into consideration, proper curing and dry-time as recommended by various associations in order to eliminate moisture transmission through capillary voids created through hydration through the concrete slab?

☐ Yes
☐ No

Exterior Wall Systems:

6. Has your designer/architect incorporated the appropriate vapor barrier and assembly in order to prevent thermal bridging relative to colder climates?

☐ Yes
☐ No

7. Has your designer/architect incorporated the appropriate vapor retarder relative to the building assemblies in order to allow proper drying, due to potential humid air to the exterior?

☐ Yes
☐ No

8. Have the on-sight terminations of various vapor barrier locations been terminated and/or sealed properly to eliminate water intrusion?

☐ Yes
☐ No

Sealants:

9. Do the sealants, which are being used in the construction process, have compatibility with the materials in which they are being integrated?

☐ Yes
☐ No

10. Do you have specific data relative to installation recommendations:

☐ Yes
☐ No

11. Do the sealants meet the requirements of the manufacturer's relative to exterior cladding (example: EIFS, etc.)?

☐ Yes
☐ No

12. Have the appropriate contractor(s) and suppliers attended the pre-construction and construction meetings relative to the installation of the specified sealants?

☐ Yes
☐ No

Window Installation:

13. Do the windows and doors as specified, qualify for the area based on rate of failure?

    ☐ Yes
    ☐ No

14. Is it clear how the windows and doors are to be integrated into exterior lathing for proper waterproofing?

    ☐ Yes
    ☐ No

15. Has a pre-construction, construction meeting taken place where manufacturer's installation instructions have been incorporated into the meeting which would include all parties related to the installation (example: architect, window and door installation subcontractor, exterior lathing subcontractor, general contractor, etc.)?

    ☐ Yes
    ☐ No

Interior Wall Systems:

16. If a wood structure is being constructed, is the moisture content in the wood between 15-18%?

    ☐ Yes
    ☐ No

17. The installation of gypsum board and various taping and topping compounds, including textures, should also be in a range of 15-18% before installation of any wall finishes or wall coverings. Have moisture meters been utilized in documenting conditions pre-wall finish?

    ☐ Yes
    ☐ No

Plumbing and Fire Sprinklers:

18. Have all water supply lines been thoroughly checked for proper installation, protection, and insulation to ensure a leak-proof system?

    ☐ Yes
    ☐ No

Installation and Balancing of HVAC System:

19. Have you confirmed that the HVAC system is providing fresh air and proper distribution into the building cavity?

    ☐ Yes
    ☐ No

20. Have unoccupied spaces, such as chase areas, crawlspaces, etc. been properly ventilated and detailed by the architect?

☐ Yes
☐ No

If not done through pre-construction peer review, it is recommended this is done during construction. Identify areas of concern in writing and distribute RFI's to architect, mechanical subcontractor, owner/operator, other pertinent subcontractors and/or any parties involved for documentation purposes.

21. Have you had the HVAC system cleaned and certified by a third party with certification capability?

☐ Yes
☐ No

If so, carbon copies of the test and balance reports should be given to the architect, mechanical subcontractor, and any other subcontractors involved in the system for their records.

22. Has a plan been developed to maintain a 30-55% relative humidity level within the building (de-humidifier, descant/gas, etc.)?

☐ Yes
☐ No

23. Has all equipment, such as compressors, generators, heaters (which may generate carbon dioxide and/or moisture) been properly vented to the exterior of the building?

☐ Yes
☐ No

Cleanup for Construction:

24. Is your construction site maintained on a continuous clean-up basis throughout the project?

☐ Yes
☐ No

If so, you are practicing good maintenance habits. It is important to understand that all construction debris and dust must be cleaned up in all areas prior to the finished wall system being installed, which could entrap various trash, debris, and dust.

System Failure and/or Damage due to Water or Moisture Intrusion:

25. Have you analyzed the damaged areas thoroughly (such as below floor insulation) evaluated the exterior of damage from loss and documented these findings?

☐ Yes
☐ No

After making the appropriate repairs, you must get the proper clearance certificates from the appropriate trades relative to the loss. Copies of these reports relative to specific repairs should be forwarded to the architect, appropriate subcontractor(s), and the owner/operator and/or the their representative.

I have answered all questions to the best of my knowledge and accept responsibility for the responses submitted.

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager_____

Signature: _____

Date: _____

Mechanical Contractor

Water Intrusion Prevention Checklist: Mechanical Design Phase

Date: _____

Project Name_____

Project Location_____

Project Roles and Accountabilities

- ❑ Construction only
- ❑ Design-Build
- ❑ Design-Assist

Accountable Person_____

Checklist Items

1. Have design documents (drawings and specifications) been reviewed?
   - ❑ Yes
   - ❑ No

2. Moisture Intrusion
   a. Outside air inlets:
      (1) Is there adequate distance from moisture sources?
      - ❑ Yes
      - ❑ No

      (2) Will louver inlet velocity prevent rainwater carryover (consider effect of wind)?
      - ❑ Yes
      - ❑ No

      (3) Is there a requirement for drainage (interior)?
      - ❑ Yes
      - ❑ No

      (4) Is there a potential for exterior water accumulation?
      - ❑ Yes
      - ❑ No

   b. Will there be a negative building pressure?
      - ❑ Yes
      - ❑ No

   c. Are there details of penetrations in building envelope?
      - ❑ Yes
      - ❑ No

   d. Is proper weatherproofing of exterior equipment and installations provided?
      - ❑ Yes
      - ❑ No

3. Moisture Accumulation
   a. Insulation
      (1) Are cold surfaces insulated to prevent condensation?
         ❑ Yes
         ❑ No

      (2) Is there a protective jacket on insulation which could be subject to damage or moisture?
         ❑ Yes
         ❑ No

      (3) Is there a potential for moisture accumulation in insulation, because of its proximity to wet areas (i.e. cooling coils, humidifiers)?
         ❑ Yes
         ❑ No

      (4) Is the insulation thickness and type appropriate for the specific application?
         ❑ Yes
         ❑ No

   b. Condensate Collection Drain Pans
      (1) Are they constructed of non-corrosive materials?
         ❑ Yes
         ❑ No

      (2) Do they have positive slope to drain pipe connection(s)?
         ❑ Yes
         ❑ No

      (3) Is more than one drain pipe connection required?
         ❑ Yes
         ❑ No

      (4) Is there a requirement to provide more than one drain pan (i.e. for multiple coil assemblies) and drain pipe connections?
         ❑ Yes
         ❑ No

      (5) Does drain pan(s) extend a sufficient distance downstream of cooling coil(s) to capture potential moisture carryover?
         ❑ Yes
         ❑ No

      (6) Is drain pan insulated?
         ❑ Yes
         ❑ No

      (7) Is there a requirement for a secondary drain pan (i.e. for concealed fan-coil units)?
         ❑ Yes
         ❑ No

   c. Condensate Drainage
      (1) Is there an air gap at the point of discharge into the sanitary sewer system?
         ❑ Yes
         ❑ No

(2) Is the point of discharge into the sanitary sewer in an air handling unit equipment room that is used as a return air plenum (which is not acceptable)?
- ❑ Yes
- ❑ No

(3) Is there sufficient clearance to maintain continuous slope on drain piping?
- ❑ Yes
- ❑ No

(4) Is a condensate pump required?
- ❑ Yes
- ❑ No

(5) Should the condensate drain pipe be insulated (i.e. to prevent condensation)?
- ❑ Yes
- ❑ No

(6) Are P-traps of sufficient depth, considering the pressure within the air handling unit, and whether the unit is a draw-through or blow-through configuration?
- ❑ Yes
- ❑ No

d. Is there a requirement for moisture collection pans at potentially "wet" areas (i.e. humidification system dispersion tube locations; air washer sections in air handling units, etc.)?
- ❑ Yes
- ❑ No

e. Humidification Systems

(1) Has absorption distance been confirmed, and that there are no moisture absorbing materials within that area?
- ❑ Yes
- ❑ No

(2) Is there a relative humidity high limit sensor, that will shut off system?
- ❑ Yes
- ❑ No

(3) Is there a vapor barrier to enclose the humidified area?
- ❑ Yes
- ❑ No

f. If the system has an air-side "economizer cycle", does it have enthalpy control, to prevent introducing excessive moisture into the building?
- ❑ Yes
- ❑ No

g. Are any conditioned supply air outlets discharging low temperature air onto building surfaces where there is a potential for condensation accumulation?
- ❑ Yes
- ❑ No

h. In colder climates is heating required/provided at interior surfaces of exterior building elements to prevent condensation accumulation (i.e. glazing)?
   - ❑ Yes
   - ❑ No

i. Is there a means to capture process water vapors (i.e. exhaust hoods, negative area pressure, airflow patterns)?
   - ❑ Yes
   - ❑ No

j. Is insulation provided on roof drain and/or domestic cold water piping, because of the potential for low surface temperatures, and resultant condensate accumulation?
   - ❑ Yes
   - ❑ No

k. Are drainage fittings and proper sloping surfaces provided where there is the potential to accumulate moisture?
   - ❑ Yes
   - ❑ No

l. Are filters in air handling units located so as not to have the potential for moisture absorption?
   - ❑ Yes
   - ❑ No

4. Airborne spore circulation – introduction of a "food" source
   a. Is outside air inlet located so that there is no potential to draw contaminants into the building?
      - ❑ Yes
      - ❑ No

   b. Are filter efficiencies proper for the environmental contaminants?
      - ❑ Yes
      - ❑ No

   c. Should filters be provided in the outside air inlet?
      - ❑ Yes
      - ❑ No

   d. Is the design appropriate to contain potential airborne contaminants, considering the necessity for exhaust hoods, airflow patterns, pressure relationship, etc.?
      - ❑ Yes
      - ❑ No

   e. Is adequate space provided to allow proper cleaning and maintenance?
      - ❑ Yes
      - ❑ No

   f. Is there adequate air circulation to all building areas?
      - ❑ Yes
      - ❑ No

g. Will the building air balance result in maintaining a positive building pressure?
   - ❑ Yes
   - ❑ No

h. Is there adequate outside air ventilation to maintain "indoor air quality"?
   - ❑ Yes
   - ❑ No

5. Do the construction documents state that Commissioning is required to ensure proper system performance?
   - ❑ Yes
   - ❑ No

6. Do the construction documents require adequate Owner/Operator training?
   - ❑ Yes
   - ❑ No

7. Are there any elements that should be redesigned?
   - ❑ Yes
   - ❑ No

   Explain.

8. Have all Design Phase issues been resolved?
   - ❑ Yes
   - ❑ No

   Explain.

I have answered all questions to the best of my knowledge and accept responsibility for the responses submitted.

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager_____

Signature: _____

Date: _____

Mechanical Contractor

Water Intrusion Prevention Checklist: Mechanical Pre-Installation Phase

Date: _____

Project Name: _____

Project Location: _____

1. Has a review of the HVAC plans been conducted to identify any design/installation specification, site limitations, etc., which could have an impact or be responsible for water intrusion issues?
   - ❑ Yes
   - ❑ No

   Were any problems found? ❑ Yes ❑ No

   If yes, were the issues corrected? ❑ Yes ❑ No

2. Have contacts with third parties been examined to evaluate exposure to liability from microbial issues?
   - ❑ Yes
   - ❑ No

3. Is contractual language/protocol in place to ensure third parties are informed of their responsibilities regarding leak notification, preventive maintenance?
   - ❑ Yes
   - ❑ No

4. Has the construction team created a project specific plan of construction means and methods to prevent mold growth?
   - ❑ Yes
   - ❑ No

   Explain.

5. Have inspections been made on the equipment to be installed to verify that no contamination is present?
   - ❑ Yes
   - ❑ No

   If yes, supply supporting documentation.

6. Have inspections been performed to verify all materials/supplies have been appropriately shipped, packed, and stored prior to installation and/or delivery to the jobsite?
   - ❑ Yes
   - ❑ No

   If yes, supply supporting documentation.

7. Has a thorough visual inspection for visible or suspected mold growth and/or prior water intrusion issues been performed on the facility where work is to be performed?
   - ❑ Yes
   - ❑ No

   If yes, supply supporting documentation.

I have answered all questions to the best of my knowledge and accept responsibility for the responses submitted.

Accountable Project Person: _____

Title: _____

Signature: _____ Date_____

Water Intrusion Manager: _____

Signature_____ Date_____

Mechanical Contractor

Water Intrusion Prevention Checklist: Mechanical Installation Phase

Date: _____

Project Name: _____

Project Location: _____

1. Is there a project specific plan of construction means and methods to prevent mold growth?
   - ❑ Yes
   - ❑ No

2. Are mold awareness/water intrusion issues included in weekly site safety meetings?
   - ❑ Yes
   - ❑ No

3. Have provisions been made to protect the construction site and work areas from water infiltration?
   - ❑ Yes
   - ❑ No

4. Has HVAC equipment been installed only when the project is ready and able to maintain dry and controlled conditions?
   - ❑ Yes
   - ❑ No

   If no, document the situation and reasons.

5. Is supply/return duct work sealed prior to installation to prevent possible contamination from mold, moisture, dirt, etc.?
   - ❑ Yes
   - ❑ No

6. Is ductwork inspected section-by-section during installation to ensure no contamination, and are the sections capped at the end of each shift?
   - ❑ Yes
   - ❑ No

   Supply documentation showing evidence of compliance.

7. Have penetrations through exterior building envelope been checked for proper flashing and sealing?
   a. Yes
   b. No

8. Is it confirmed that all surfaces to be insulated were clean and dry when insulation was installed?
   a. Yes
   b. No

9. Is it confirmed that insulation was not wet, both before and during the installation process?
   a. Yes
   b. No

10. Has any installed insulation been compressed?
    a. Yes
    b. No

11. Is all insulation vapor barrier continuous and with no penetrations?
    a. Yes
    b. No

12. Is pipe and duct insulation appropriate?
    a. Yes
    b. No

13. Has the location of insulation been verified to ensure there is no impact from cooling coil, humidifiers, or condensate drain pans?
    a. Yes
    b. No
14. Are drain lines inspected to verify proper connection to condensate pan, and that there is proper slope?
    a. Yes
    b. No

15. Are secondary condensate overflow termination points accessible and visible?
    a. Yes
    b. No

16. Have the interior surfaces of equipment been inspected and cleaned prior to system startup?
    a. Yes
    b. No

17. Have filters been installed in air handling equipment, prior to startup?
    a. Yes
    b. No

18. Have there been any incidents of piping leaks?
    a. Yes
    b. No
    Explain results and remedial work.

19. Have required area pressure relationships been achieved and maintained?
    a. Yes
    b. No

20. Is there a commissioning process to verify that the systems will perform in accordance with the design intent?
    a. Yes
    b. No

21. Has it been confirmed and documented that the systems do, in fact, perform as intended?
    a. Yes
    b. No

22. Have as-installed conditions been documented onto record drawings?
    a. Yes
    b. No

23. Have System Operation and Maintenance Manuals been prepared?
    a. Yes
    b. No

I have answered all questions to the best of my knowledge and accept responsibility for the responses submitted.

Accountable Project Person: _____

Title: _____

Signature: _____ Date_____

Water Intrusion Manager: _____

Signature_____ Date_____

Mechanical Contractor

Water Intrusion Prevention Form: Mechanical Maintenance Phase

To be completed on a regular basis for HVAC Maintenance.

Date: _____

Project Name: _____

Location: _____

Must Be Completed Upon Each Site Visit

1. Has hydronic piping been inspected for evidence of leaks?
   - ☐ Yes
   - ☐ No

   Document any issues.

2. Have HVAC parts been inspected for proper seals, secondary overflow drains, appropriate slope, fungal growth?
   - ☐ Yes
   - ☐ No

   Document any issues.

3. Have collars been inspected for proper flashing and seals at exterior wall penetrations especially for refrigerant lines?
   - ☐ Yes
   - ☐ No

   Document any issues.

4. Have secondary condensate lines been inspected to see if they are dry?
   - ☐ Yes
   - ☐ No

   Document any incidents of wet lines.

5. Are appropriate controls in place in the building and/or residence to reduce condensation in the air such as leak repair procedures, dehumidification, ventilation?
   - ☐ Yes
   - ☐ No

6. Are HVAC units appropriately sized for the areas to be heated/cooled? If not, explain problems?
   - ☐ Yes
   - ☐ No

   If not explain, problems? _____

7. Is indoor humidity maintained below 60%?
   - ☐ Yes
   - ☐ No

   If not, why not? _____

   _____

8. Has ductwork/supply line insulation been inspected to verify condition and appropriateness of insulation?
   - ☐ Yes
   - ☐ No

   If not, explain why? _____

   _____

9. Are mold awareness issues included as part of weekly site meetings?
   - ☐ Yes
   - ☐ No

10. Have plenum areas been inspected for cleanliness, general housekeeping, etc.?
    - ☐ Yes
    - ☐ No

    Describe condition: _____

11. Are humidifiers (if any) cleaned on a weekly basis?
    - ☐ Yes
    - ☐ No

12. Have air coils been inspected for cleanliness?
    - ☐ Yes
    - ☐ No

13. Have biocides been used in the building?
    - ☐ Yes
    - ☐ No

    If yes, where, how often, date of use, attach MSDS: _____

    _____

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager _____

Signature: _____ Date: _____

Plumbing Contractor

Water Intrusion Prevention Form: Plumbing Design

To be completed during the Plumbing System Design phase.

Date: _____

Project Name: _____

Location: _____

1. Has a review of plans, specifications, etc. been performed to review any areas which could create potential water intrusion problems such as design, installation issues, improper specifications, or site limitations?
   - ☐ Yes
   - ☐ No

   If yes, supply supporting documentation.

2. Has a review been performed of existing soils condition to determine the chemical make-up as related to "hot" soil?
   - ☐ Yes
   - ☐ No

   If yes, supply supporting documentation.

3. Are underground copper pipes DWV?
   - ☐ Yes
   - ☐ No

   If yes, supply supporting documentation.

4. Are all underground solder connections done with silver solder?
   - ☐ Yes
   - ☐ No

5. Are P-Traps properly trapped based on the static pressure of the blow thru or draw thru system?
   - ☐ Yes
   - ☐ No

6. Are die-electric unions specified at water heaters?
   - ☐ Yes
   - ☐ No

7. Does the design allow for "hot" soils?
   - ☐ Yes
   - ☐ No

8. Are underground pipes below the vapor barrier?
   - ☐ Yes
   - ☐ No

9. Are through slab penetration sleeves specified?
   - ☐ Yes
   - ☐ No

10. Are penetrations through the exterior specified to be flashed?
   - ☐ Yes
   - ☐ No

11. Are shut-off valves specified in accessible locations?
   - ☐ Yes
   - ☐ No

12. Do the designs call for approved insulation and pipe wrap?
   - ☐ Yes
   - ☐ No

13. Has the design compensated for condensation?
   - ☐ Yes
   - ☐ No

14. Are floor drains located to allow proper drainage?
   - ☐ Yes
   - ☐ No

15. It the trade responsible for ice maker installation and hook up clearly defined?
   - ☐ Yes
   - ☐ No

16. Is the dishwasher air gap assembly properly installed?
   - ☐ Yes
   - ☐ No

17. Are all sinks properly sealed at the counter to fixture juncture?
   - ☐ Yes
   - ☐ No

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager _____

Signature: _____

Date: _____

Plumbing Contractor

Water Intrusion Prevention Form: Plumbing Pre-Installation Phase

To be completed prior to installation of the Plumbing System.

Date: _____

Project Name: _____

Location: _____

1. Has the company performed inspections on the equipment to be installed to verify that no contamination is present?
   - ☐ Yes
   - ☐ No

   If yes, supply supporting documentation.

2. Have inspections been performed to verify all materials/supplies have been appropriately shipped, packed, and stored prior to installation and/or delivery to the jobsite?
   - ☐ Yes
   - ☐ No

   If yes, supply supporting documentation.

3. Has a thorough visual inspection for visible or suspected mold growth and/or prior water intrusion issues been performed on the building where work is to be performed?
   - ☐ Yes
   - ☐ No

   If yes, supply supporting documentation.

4. Has a review of the plumbing plans been conducted to identify any design/installation specification, site limitations, etc. which could have an impact or be responsible for water intrusion issues.
   - ☐ Yes
   - ☐ No

   Were any problems found? □ Yes □ No
   If yes, were the issues corrected? □ Yes □ No

5. Have contracts with third parties been examined to evaluate exposure to liability from microbial issues?
   - ☐ Yes
   - ☐ No

6. Is contractual language/protocol in place to ensure third parties are informed of their responsibilities regarding leak notification, preventative maintenance?
   - ☐ Yes
   - ☐ No

7. Has a maintenance schedule for proper upkeep of the plumbing system been developed?
   - ☐ Yes
   - ☐ No

8. Have as-built drawings been obtained and retained?
   - ☐ Yes
   - ☐ No

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager_____

Signature: _____

Date: _____

Plumbing Contractor

Water Intrusion Prevention Form: Plumbing Installation Phase

To be completed during the Plumbing System Installation phase.

Date: _____

Project Name: _____

Location: _____

1. Has all water piping been puncture tested prior to being concealed?
   - ☐ Yes
   - ☐ No

   If no, document the situation and reasons.

2. Are below slab copper pipes silver soldered?
   - ☐ Yes
   - ☐ No

3. Have provisions been made to protect the construction/repair sites from water infiltration?
   - ☐ Yes
   - ☐ No

   If no, supply documentation.

4. Are all hot water pipes insulated?
   - ☐ Yes
   - ☐ No

5. Are valves accessible?
   - ☐ Yes
   - ☐ No

   If no, document means to assess.

6. Is pipe/duct insulation appropriate?
   - ☐ Yes
   - ☐ No

7. Are mold awareness/water intrusion issues included in weekly site safety meetings?
   - ☐ Yes
   - ☐ No

8. Have penetrations through exterior building envelope been checked for proper flashing and sealing?
   ☐ Yes
   ☐ No

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager_____

Signature: _____

Date: _____

Plumbing Contractor

Water Intrusion Prevention Form: Plumbing Maintenance Phase

To be completed on a regular basis for Plumbing Maintenance.

Date: _____

Project Name: _____

Location: _____

Must Be Completed Upon Each Site Visit

1. Has piping been inspected for evidence of leaks?
   - ☐ Yes
   - ☐ No

   Document any issues.

2. Has pipe insulation been inspected for signs of deterioration?
   - ☐ Yes
   - ☐ No

   Document any issues.

3. Have collars been inspected for proper flashing and seals at exterior wall penetrations?
   - ☐ Yes
   - ☐ No

   Document any issues.

4. Have all shut-off valves been inspected for leaky seals?
   - ☐ Yes
   - ☐ No

   Document any incidents of wet lines.

5. Are the plumbing maintenance inspections for this building performed on a regularly scheduled basis?
   - ☐ Yes
   - ☐ No

   If yes, define the schedule and services provided: _____

   _____

   _____

6. Have water heater connections been inspected for corrosion?
   - ☐ Yes
   - ☐ No

7. Have all caulk joints been inspected for cracking or separation?
   - ☐ Yes
   - ☐ No

   If not, explain problems. _____

   _____

8. Has the floor covering, in wet areas, been inspected for moisture stains?
   - ☐ Yes
   - ☐ No

9. Have the escutcheons at plumbing fixtures been inspected to ensure proper seal?
   - ☐ Yes
   - ☐ No

   If not, explain why. _____

   _____

   _____

10. Are mold awareness issues included as part of weekly site meetings?
    - ☐ Yes
    - ☐ No

11. Have tub & shower pans been inspected for cracks?
    - ☐ Yes
    - ☐ No

    Describe condition. _____

    _____

    _____

12. Have shower door seals been inspected?
    - ☐ Yes
    - ☐ No

13. Are shower/tub assemblies properly designed?
    - ☐ Yes
    - ☐ No

14. Has the water closet(s) been inspected for looseness?
    - ☐ Yes
    - ☐ No

    If yes, describe condition. _____

    _____

    _____

15. Inspect all under sink tubing and hose for kinks or sharp bends?
    - ☐ Yes
    - ☐ No

    If no, describe condition. _____

    _____

    _____

16. Have biocides been used in the building?

☐ Yes

☐ No

If yes, where, how often, date of use, attach MSDS: _____

_____

_____

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager_____

Signature: _____

Date: _____

Exterior Contractor

Water Intrusion Prevention Form: Exterior Design Phase

To be completed during the Exterior Building Envelope system design phase.

Date: _____

Project Name: _____

Location: _____

1. Has a review of plans, specifications, etc. been performed to review any areas which could create potential water intrusion problems such as design, installation issues, improper specifications, site limitations or design?
   - ☐ Yes
   - ☐ No

   If yes, supply supporting documentation.

2. Has a review been performed of geotechnical reports to ensure proper design of the foundation system?
   - ☐ Yes
   - ☐ No

   If yes, supply supporting documentation.

3. Is the design of the roofing system adequate to direct water run off away from the exterior cladding?
   - ☐ Yes
   - ☐ No

   If yes, supply supporting documentation.

4. Are all proposed products specified and well documented?
   - ☐ Yes
   - ☐ No

5. Are locations of weep screeds properly identified?
   - ☐ Yes
   - ☐ No

6. Are exterior cladding penetrations designed with appropriate flashing system?
   - ☐ Yes
   - ☐ No

7. Are window and door penetrations properly detailed for flashing system to be used?
   - ☐ Yes
   - ☐ No

8. Are horizontal exterior surfaces properly detailed to slope away from the structure?
   - ☐ Yes
   - ☐ No

9. Are horizontal exterior surfaces properly detailed for water resistant construction?
   - ☐ Yes
   - ☐ No

10. If ornamental iron components are used, are the exterior cladding to iron connections designed to prevent water intrusion?
    - ☐ Yes
    - ☐ No

11. Does the design specify proper elevations for flatwork and landscape elements?
    - ☐ Yes
    - ☐ No

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager _____

Signature: _____

Date: _____

Exterior Contractor

Water Intrusion Prevention Form: Exterior Installation Phase

To be completed during the Exterior Building Envelope Installation phase.

Date: _____

Project Name: _____

Location: _____

1. Have the preceding trades completed their work in an acceptable manner?
   - ☐ Yes
   - ☐ No

   If no, document the situation and reasons.

2. Are windows and door penetrations properly flashed in a weather resistant manner?
   - ☐ Yes
   - ☐ No

   If no, document the situation and reasons.

3. Have provisions been made to protect the construction/repair sites from water infiltration?
   - ☐ Yes
   - ☐ No

   If no, supply documentation.

4. Is the wall framing true and straight with proper blocking?
   - ☐ Yes
   - ☐ No

   If no, supply documentation.

5. Is there adequate clearance between the exterior grade and the exterior cladding?
   - ☐ Yes
   - ☐ No

   If no, document condition.

6. Is the building wrap properly lapped in a weather board manner?
   - ☐ Yes
   - ☐ No

7. Have horizontal surfaces been sloped to drain away from the structure?
   - ☐ Yes
   - ☐ No

8. Have penetrations through the exterior building envelope been checked for proper flashing and sealing?
   - ☐ Yes
   - ☐ No

9. Have appropriate gaps been maintained to prevent bridging of mortar to OSB?
   - ☐ Yes
   - ☐ No

10. Have all walls been constructed with appropriate drainage planes and vapor barriers?
    - ☐ Yes
    - ☐ No

11. If EIFS will be used, is there appropriate drainage?
    - ☐ Yes
    - ☐ No

12. Has contact between EIFS and the soil been prevented?
    - ☐ Yes
    - ☐ No

13. Has compliance of EIFS manufacturer's instructions for handling details at transitions and penetrations been documented?
    - ☐ Yes
    - ☐ No

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager_____

Signature: _____

Date: _____

Exterior Contractor

Water Intrusion Prevention Form: Exterior Maintenance Phase

To be completed on a regular basis for Exterior Building Envelope Maintenance.

Date: _____

Project Name: _____

Location: _____

Must Be Completed Upon Each Site Visit

1. Have window sill/jambs been inspected for evidence of water intrusion?
   - ☐ Yes
   - ☐ No

   Document any issues.

2. Have base boards at sliding glass doors been inspected for signs of water intrusion?
   - ☐ Yes
   - ☐ No

   Document any issues.

3. Has the caulking/seal around exterior penetrations been inspected to be sure it is serviceable?
   - ☐ Yes
   - ☐ No

   Document any issues.

4. Have exterior painted surfaces been inspected for cracking, peeling or flaking?
   - ☐ Yes
   - ☐ No

   Document any issues.

5. Has the perimeter of the foundation been inspected for proper clearance between the exterior cladding and the soil/flatwork?
   - ☐ Yes
   - ☐ No

   Document any issues.

6. Have the sliding windows and sliding glass door tracks been inspected for smooth and free operation?
   - ☐ Yes
   - ☐ No

7. Have all caulk joints been inspected for cracking or separation?
   - ☐ Yes
   - ☐ No

   Explain problems. _____

   _____

   _____

8. Has the floor covering, in wet areas, been inspected for moisture stains?
   - ☐ Yes
   - ☐ No

9. Have horizontal surfaces been inspected for deterioration and/or ponding of water?
   - ☐ Yes
   - ☐ No

   Explain problems. _____

   _____

   _____

10. Are mold awareness issues addressed properly?
    - ☐ Yes
    - ☐ No

11. Has the irrigation system been inspected for proper operation and alignment?
    - ☐ Yes
    - ☐ No

12. Has the exterior cladding or trim been inspected for rusting nails and fasteners?
    - ☐ Yes
    - ☐ No

13. Has the site drainage system been inspected for proper elimination of water accumulating around the foundation?
    - ☐ Yes
    - ☐ No

    If yes, describe condition. _____

    _____

    _____

14. Have the roofing eaves and drain system been inspected to eliminate direct water runoff from damaging the exterior cladding?
    - ☐ Yes
    - ☐ No

    If yes, describe condition. _____

    _____

    _____

15. Have doors been inspected for warps or damage to weather seals?

☐ Yes
☐ No

Describe deficiencies: _____

_____

Accountable Project Person: _____

Title: _____

Signature: _____

Date: _____

Water Intrusion Manager_____

Signature: _____

Date: _____

CONSTRUCTION TEAM INSPECTION CHECKLIST and ACCEPTANCE

Building Envelope Inspection and Acceptance Form

Visual inspection to be conducted, existing conditions accepted by the *General Contractor,* in a timely manner; from scaffolding, after exterior lath placement and field repairs, before plaster installation.

The Lath Contractor requests the General Contractor Inspect and Accept the exterior membrane.
Signed: _____ *Position:* _____ *Date:* _____
Project: _____ Inspection date: _____
Lot / Address _____ Phase: _____
Inspected by: _____ Company: _____

BE #	Proper Condition; Items to include, but are not limited to:	Accepted Date	Corrected Date	Location / Note
	Membrane			
1	Field sealant repairs at fasteners and tears			Sealant used:
a	Check window / door frames; roof terminations; horizontal shelf; pony wall connections; rim joist area; above sole plate; gable ends; inside corners			
b				
c				
2	Field sealant at penetrations			
3	Field sealant at scaffold ties			
4	Field bib repairs at long tears (over 12")			
5	Proper lap at window sill flashings			
6	Proper weather board laps, no reversed laps			
7	Membrane type proper			
8	Two membrane layers at wood panels			
9	Proper vertical connection to other materials			
10				
	Plaster screeds and terminations			
11	Proper screed lap behind door flashings			
12	Proper screed clearance to grade or flatwork			
13	Proper 2" screed clearance to exterior deck			
14				
	Metal flashings and penetrations			
15	Metal collar / bib at wood penetrations			
16	Metal collar / bib at scupper			
17	Water table flashings over horizontal trim			
18	Proper bib backing / lap at plant-on trim			
19	Proper service panel seal			
20	Proper flexible flashing at TV / phone panels			
21	Proper flexible flashing at gable / wall vents			
22	Proper flexible flashing / lap at deck ledger			
23				
	Chimney chase cover			
24	Membrane laps 6" to horizontal at chase top			
25	Plaster stop installed, proper			
26	Proper frame slope to exterior edge			
27	Chase cover lap of 2", side nails (if installed)			
28				
	Non-vertical surfaces			
29	Elastomeric cover of surfaces < 60° vertical			
30	Elastomeric sheet vertical 4" at connections			
31				

_____ *(General Contractor) accepts the condition of the completed exterior membrane. Existing conditions will not significantly effect the proper and complete installation of the exterior cladding. The building is ready for plaster.*

Signed: _____ *Position:* _____ *Date:* _____

CONSTRUCTION TEAM INSPECTION CHECKLIST and ACCEPTANCE

Roof Membrane Inspection and Acceptance Form

Visual inspection to be conducted, existing conditions accepted by the *General Contractor,* in a timely manner; after roof layout and loading, after roof metal placement, before roof cover installation.

The Roof Contractor requests the General Contractor Inspect and Accept the roof membrane.
Proceed: _____ signed; Date: _____

Project: _____ Inspection date: _____
Lot / Address _____ Phase: _____
Inspected by: _____ Company: _____

RM #	Proper Condition; Items to include, but are not limited to:	Accepted Date	Corrected Date	Location / Note
	Membrane			
1	Field mastic repairs (under 12" tears)			
2	Field bib repairs complete (over 12")			
3	Roof felt type and ply number proper			
4	Proper weather board installation			
5	Sweat sheet under valley membranes			
6	Felt vertical 4" at walls, proper seal			
7	Felt laps over rakes 1½" minimum			
8	Membrane clear of debris			
9	Batten boards are 4'-0" maximum, proper			
10				
	Bib, cricket, and valley flashing			
11	Roof penetrations complete			
12	Holes (mistakes) covered with metal			
13	Vents penetrations 12" apart minimum			
14	B-vents 1" from combustibles			
15	B-vents extend 12" above roof deck			
16	Proper bib to all membrane flashings			
17	Proper bib to valley / valley connections			
18	No penetrations 12" from valley center			
19	Riser / birdstop flashing clear of valley flow			
20	Valley attachment proper @ 24" o.c.			
21				
	Roof edge, Z-Bar, and pan metal			
22	Anti-ponding metal or filler at eave			
23	Z-Bar flashings complete, proper lap			
24	Z-Bar termination proper with kicker			
25	Pan metal complete, 12" tails minimum			
26	Pan flashing lip undamaged			
27				
	Chimney chase cover			
28	Chase cover lap of 2", side nails			
29	Proper slope to exterior edge			
30				
	Low-sloped roofing			
31	Proper lap to / from sloped roof			
32	Proper parapet cap lap and seal			
33	Mechanical supports parallel to flow			
34				

_____ *(General Contractor) accepts the condition of the completed roof membrane. Existing conditions will not significantly effect the proper and complete installation of the finished roof. The roof is ready for finished cover.*
Signed: _____ *Position:* _____ *Date:* _____

CONSTRUCTION TEAM INSPECTION CHECKLIST and ACCEPTANCE

Roof Sheathing Inspection and Acceptance Form

Visual inspection to be conducted, existing conditions accepted by the *Roof Contractor,* in a timely manner; after Building Official inspection, after roof edge metal placement, before roof membrane installation.

The General Contractor directs the Roof Contractor to Inspect and Accept the roof sheathing.
Proceed: _____ *signed; Date:* _____
Project: _____ Inspection date: _____
Lot / Address _____ Phase: _____
Inspected by: _____ Company: _____

RS #	Proper Condition; Items to include, but are not limited to:	Accepted Date	Corrected Date	Location / Note
	Frame and nailing			
1	Sheathing complete			
2	1/8" panel gaps			
3	Fasteners flush to surface			
4	Proper nail spacing			
5	Supported panel edges			
6	No excess panel offsets			
7	Skylight frame installed			
8	Clear of construction debris			
9	Drag nailing marked and nailed			
10	Missed nails removed (view from below)			
11	Missed nails replaced			
12	Is sheathing temporarily protected from weather until next phase of installation?			
13				
	Eaves			
14	Rakes properly supported			
15	Starter board edges supported			
16	No exposed nails under eaves			
17	Tight mitered fascia corners			
18	Proper shadow board or raised fascia			
19				
	Backing			
20	Z-Bar boards in place			
21	Solid backing at terminations			
22	Membrane backing at terminations			
23	Wood crickets as required			
24				
	Sheet metal			
25	Roof edge metal complete			
26	Anti-ponding at raised fascia			
27				
	Low-sloped roofing			
28	¼" per foot slope (minimum)			
29	Recessed drain pan			
30	No apparent frame sags			
31	Mechanical platforms complete			
32	Roof penetrations complete			
33				

_____ *(Roof Contractor) accepts the condition of the of the completed roof sheathing. Existing conditions will not significantly effect the proper and complete installation of the roof membrane. The roof is ready for Dry-in.*
Signed: _____ *Position:* _____ *Date:* _____

CONSTRUCTION TEAM INSPECTION CHECKLIST and ACCEPTANCE

Steep-Sloped Roof Finish and Acceptance Form

The Roof Contractor requests the General Contractor to inspect and accept the finished roof cover.
Proceed: _____ *signed Date:* _____
Project: _____ Inspection date: _____
Lot / Address _____ Phase: _____
Inspected by: _____ Company: _____

SSF #	Proper Condition; Items to include, but are not limited to:	Accepted Date	Corrected Date	Location / Note
	Field and Trim Tiles (or shingles)			
1 a	Field tiles not cracked or broken			
b	Rake/ridge/hip tiles not cracked or broken			
2 a	Field tiles not overexposed (3" min. lap)			
b	Rake/ridge/hip not overexposed			
3	Mastic bond at hip / ridge tiles			
4	Closure at ridge / hip trim to field tiles			
5	Proper attachment of field tile, no slipped tile			
6	Proper attachment at roof / wall tiles			
7	Proper eave riser flashing or shadow board			
8	Proper nesting of trim / field tiles at rakes			
9	Wind clips are installed as required			
10				
	Valley installation			
11	Valley and pan flashings are clear of debris			
12	Cut tiles 1" from valley centerline			
13	Cut valley tiles are fastened, lugs removed			
14	Valley flashing extends 1" beyond fascia			
15	Eave riser flashing is cut back at valley flow			
16	No penetrations 12" from valley centerline			
17				
	Roof penetrations and flashings			
18	Vents are sealed at tile flashings			
19	Vent flashings are lapped to finished roof			
20	Tile pans lapped to tiles, edges not flat			
21	B-vents are 12" from the roof deck			
22	B-vents have storm collar and termination			
23				
	Chimney chase cover and crickets			
24	Chase cover lap of 2" with side fasteners			
25	Proper slope / support toward exterior edge			
26	Up-roof tiles are cut back 2" from wall			
27	Felt bib laps over cricket flashing			
28				
	Low-sloped roofing			
29	No roof membrane damage observed			
30	Drain and overflow are at low point			
31	Proper parapet cap lap and seal			
32	Mechanical supports parallel to water flow			
33				

_____ *(General Contractor) accepts the condition of the finished roof. Observed conditions will not significantly effect the proper function of the roof system. The roof is complete, according to manufacturer requirements.*

Signed: _____ *Position:* _____ *Date:* _____

CONSTRUCTION TEAM INSPECTION CHECKLIST and ACCEPTANCE

Window/Door/Vent Inspection and Acceptance Form

The General Contractor directs the Plaster Contractor to inspect and accept the window / door installation. Signed: _____ Position: _____ Date: _____

Project: _____ Inspection date: _____
Lot / Address _____ Phase: _____
Inspected by: _____ Company: _____

WD #	Proper Condition Items to include, but are not limited to:	Accepted Date	Corrected Date	Location / Note
	Window installation			
1	Flashings are 9" wide, durable (no sisalkraft)			
2	Flashings not damaged			
3	Flashings installed; sill, jambs, head			
4	Sealant used at frame fin to flexible flashing			
5	No gaps/voids at Arched window flashing			
6	Window fasteners >3" and <10" from corner			
7	Window fin not damaged, no bent nails			
8	Top flashing extends past underlying flashing			
9	Stacked window frames sealed; no gaps			
10	Vinyl fin sealant top-coated, covers all holes			
11	Vinyl window sill fully supported (interior)			
12	Separate flashings at window/window or window/door combinations			
13				
	Window / door trim and features			
14	Trim bibbed; 6" bib tail beyond trim			
15	Solid blocking at membrane fastening areas			
16	4" clearance from windowsill to potshelf			
17	Membrane lapped under 6" bib at shelf			
18	Caulk at wood trim to window frame			
19	Plaster key at wood trim / plaster connection			
20				
	Door installation			
21	Transom sill flashing over door head flashing			
22	Head / jamb frame corners are not "open"			
23	Aluminum threshold / concrete separation			
24	Threshold / jamb area sealant filled to frame			
25	Plaster screed laps under jamb flashings			
26				
	Decks, pony walls, and ledgers			
27	Proper deck edge / door pan metal flashing			
28	Proper elastomeric flashing under ledger			
29	Solid backing / membrane at rails, posts, etc			
30				
	Wall vents and penetrations			
31	Proper solid backing / flashing at wall vents			
32	Gable end vents are flashed like windows			
33				

_____ *(Plaster Contractor) accepts the condition of the window / door / vent installation. Existing conditions will not significantly affect the proper and complete installation of the exterior membrane. The building is ready for lath.*
Signed: _____ *Position:* _____ *Date:* _____

Appendix Two: Building Maintenance

Appendix

2

Prevention Issues – Maintenance Phase

The DPW, architect and general contractor have a responsibility to the Agency, using the building, to identify all maintenance requirements for equipment, weatherproofing and other building components to ensure a moisture-free environment for the inhabitants of the structure as built. This is also an important aspect of risk management and transfer discussed earlier in this plan.

Typical Maintenance Problems. The first step in developing an adequate maintenance program is to recognize the various areas of a building the Agency should maintain.

Areas where failure to properly maintain a building can lead to water intrusions are:

- Servicing of mechanical equipment
- General maintenance
- Caulking at roofing and wall penetrations
- Sealant caulking at various expansion locations throughout the building
- Roof gutter systems clear of soils and debris, which may cause backups creating unanticipated moisture intrusion
- Irrigation systems around the perimeter of the building

Maintenance Manual: Activities for Mold Related Issues. It is a good general practice for the architect and/or the GC to create an Owner/operator's Maintenance Manual. This manual should demonstrate a general knowledge and understanding of maintenance concerns and should specifically identify:

- Building assemblies to be inspected and maintained
- Required procedures and material types
- Maintenance intervals

The Agency should be provided the following:

- Formal Owner/operator/System Operator training for specialized equipment
- Comprehensive operation and maintenance manuals
- Checklist and clean-up plan to help prevent mold growth
- Record drawings
- Schedules for: Inspections, Cleanup, and Maintenance

Annual Procedures. The Agency should conduct an annual inspection of all accessible building components one year after placement and every other year thereafter. Many manufacturers and trade associations recommend more frequent inspections, and these recommendations should be followed. The intent of the inspection is to identify:

- Leaky pipes, fittings, valves, water closet assemblies, and tub and shower enclosures
- HVAC condensate drains, pipe and duct insulation
- Leaky roofs
- Leaking exterior wall penetrations
- Moisture accumulation on or around doors and windows
- Any other building components for signs of leaking, corrosion, moisture or water intrusion.

Minimum Maintenance Requirements. Advise the Agency to abide by the following list of requirements, as a minimum, to attempt to maintain a mold-free building:

General

- Fix leaky plumbing and leaks in the building envelope as soon as possible.
- Watch for condensation and wet spots. Fix source(s) of moisture problem(s) as soon as possible.
- Clean and dry wet or damp spots within 48 hours.
- Do not allow foundations to stay wet. Provide drainage and slope landscape beds away from foundations.
- Ensure landscape irrigation system does not spray building in any way.
- Keep vegetation away from building perimeter.
- Do not permit built-up areas (berms) at building perimeter.
- Periodically verify flow in roof drain leaders to prevent backup and potential infiltration of moisture into building.

HVAC Systems

- Perform regular building/HVAC inspections and maintenance as scheduled.
- Prevent moisture from condensation by increasing surface temperature. To increase surface temperature, insulate or increase air circulation.
- Prevent moisture by reducing the moisture level in the air (humidity). To reduce the moisture level in air, repair leaks, increase ventilation (if outside air is cold and dry), or dehumidify (if outdoor air is warm and humid)
- Keep heating, ventilation, and air conditioning (HVAC) drip pans clean, flowing properly, and unobstructed
- Vent moisture-generating appliances, such as dryers, to the outside
- Maintain low indoor humidity, at/or below 60% relative humidity (RH), ideally 30-50%, if possible
- Install and maintain proper filters on all air-moving equipment
- Respond to occupant complaints about air quality

Plumbing Systems

Inspect all plumbing connections and fittings for signs of leaks:

- All valves, accessible sink angle stop valves and water closet shut-off valves
- Corrosion of water heater fittings
- Plumbing fixture trim and escutcheons
- All locations where flexible sealant has been used, such as sinks, tub/ shower enclosures, tub/pan to ceramic tile junctures, valves, and other locations.
- Pipe insulation exposed to the elements
- Pipe and pipe insulation exposed to UV light
- Fire sprinkler systems – Follow state and local code required maintenance schedules and inspect all pipe joints, connections, valves, and sprinkler heads for weeping and/or corrosion.

Painting

Follow manufacturer's maintenance recommendations. Paint should be inspected and touched up every year.

Windows and Doors

Periodic maintenance of the windows and doors includes:

- Periodic caulking and painting of wood trim, window frame connections, exterior fixtures, etc.
- Inspecting window and sliding glass door frame corners and the application of an approved sealant
- Cleaning blocked weep holes in window frames, inspect and replace worn or damaged weather stripping as needed.

- Checking window and door operations

Trim and Siding
- Periodic caulking and painting of wood trim, window frame connections, and exterior fixtures.

Stucco
- Cracks less than 1/8" should be patched using a compatible caulking
- Cracks greater than 1/8" should be investigated to determine the cause and an appropriate repair should be made which may include using fiberglass-reinforcing tape and new color

Walking Decks and Balconies
- Provide/verify the deck-coating manufacturer's specifications and maintenance requirements. Many deck coatings require refinishing at 2-3 year intervals
- Avoid wall-to-wall carpets, area rugs, and heavy potted plants, which can cause an accumulation of moisture on the flooring surface. In addition, avoid chairs with small-diameter legs or similar items that will apply an excessive point load, damage the deck or balcony floor surface finish, and lead to water intrusion at the damage location
- Watch for ponding
- Ensure proper slope for drainage
- Ensure thresholds are above the flooring surface grade

Roofing Systems
Care should be used on tile and wood roof covers to avoid damaging the existing materials. Generally, foot traffic on finished roof covers should not be permitted.
- At a minimum, the roof cover should be inspected by the Agency, or by a qualified third-party, one year after placement and every other year thereafter. Many trade associations recommend more frequent inspections.
- Inspections should take note of:
  1. Maintenance seals at penetrations
  2. Debris accumulations at valley and cricket areas
  3. Organic debris or vegetation contact
  4. Broken or damaged roof products and/or other detrimental conditions.

Damaged Components
As a general note, all damaged building components should be repaired immediately to ensure an intact, moisture-free building envelope and life-safety concerns, including breeches in the exterior envelope, broken electrical fixtures and cover plates, terrain erosion, and any other

threatening conditions which would permit moisture intrusion on the building or property.

Appendix Three: IAQ Act No. 03-220

Substitute House Bill No. 6426

Public Act No. 03-220

AN ACT CONCERNING INDOOR AIR QUALITY IN SCHOOLS.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. Subsection (a) of section 10-220 of the general statutes is repealed and the following is substituted in lieu thereof (*Effective July 1, 2003*):

(a) Each local or regional board of education shall maintain good public elementary and secondary schools, implement the educational interests of the state as defined in section 10-4a and provide such other educational activities as in its judgment will best serve the interests of the school district; provided any board of education may secure such opportunities in another school district in accordance with provisions of the general statutes and shall give all the children of the school district as nearly equal advantages as may be practicable; shall provide an appropriate learning environment for its students which includes (1) adequate instructional books, supplies, materials, equipment, staffing, facilities and technology, (2) equitable allocation of resources among its schools, **[**and**]** (3) proper maintenance of facilities, and (4) a safe school setting; shall have charge of the schools of its respective school district; shall make a continuing study of the need for school facilities and of a long-term school building program and from time to time make recommendations based on such study to the town; shall adopt and implement an indoor air quality program that provides for ongoing maintenance and facility reviews necessary for the maintenance and improvement of the indoor air quality of its facilities; shall report annually to the Commissioner of Education on the condition of its facilities and the action taken to implement its long-term school building program and indoor air quality program, which report the **[**commissioner**]** Commissioner of Education shall use to prepare an annual report that said commissioner shall submit in accordance with section 11-4a to the joint standing committee of the General Assembly having cognizance of matters relating to education; shall advise the Commissioner of Education of the relationship between any individual school building project pursuant to chapter 173 and such long-term school building program; shall have the care, maintenance and operation of buildings, lands, apparatus and other property used for school purposes and at all times shall insure all such buildings and all capital equipment contained therein against loss in an amount not less than eighty per cent of replacement cost; shall determine the number, age and qualifications of the pupils to be admitted into each school; shall develop and implement a written plan for minority staff recruitment for purposes of subdivision (3) of section 10-4a; shall employ and dismiss the teachers of the schools of

such district subject to the provisions of sections 10-151 and 10-158a; shall designate the schools which shall be attended by the various children within the school district; shall make such provisions as will enable each child of school age, residing in the district to attend some public day school for the period required by law and provide for the transportation of children wherever transportation is reasonable and desirable, and for such purpose may make contracts covering periods of not more than five years; may place in an alternative school program or other suitable educational program a pupil enrolling in school who is nineteen years of age or older and cannot acquire a sufficient number of credits for graduation by age twenty-one; may arrange with the board of education of an adjacent town for the instruction therein of such children as can attend school in such adjacent town more conveniently; shall cause each child five years of age and over and under eighteen years of age who is not a high school graduate and is living in the school district to attend school in accordance with the provisions of section 10-184, and shall perform all acts required of it by the town or necessary to carry into effect the powers and duties imposed by law.

Sec. 2. Section 10-220 of the general statutes is amended by adding subsection (d) as follows (*Effective July 1, 2003*):

(NEW) (d) Prior to January 1, 2008, and every five years thereafter, for every school building that is or has been constructed, extended, renovated or replaced on or after January 1, 2003, a local or regional board of education shall provide for a uniform inspection and evaluation program of the indoor air quality within such buildings, such as the Environmental Protection Agency's Indoor Air Quality Tools for Schools Program. The inspection and evaluation program shall include, but not be limited to, a review, inspection or evaluation of the following: (1) The heating, ventilation and air conditioning systems; (2) radon levels in the water and the air; (3) potential for exposure to microbiological airborne particles, including, but not limited to, fungi, mold and bacteria; (4) chemical compounds of concern to indoor air quality including, but not limited to, volatile organic compounds; (5) the degree of pest infestation, including, but not limited to, insect and rodents; (6) the degree of pesticide usage; (7) the presence of and the plans for removal of any hazardous substances that are contained on the list prepared pursuant to Section 302 of the federal Emergency Planning and Community Right-to-Know Act, 42 USC 9601 et seq. ; (8) ventilation systems; (9) plumbing, including water distribution systems, drainage systems and fixtures; (10) moisture incursion; (11) the overall cleanliness of the facilities; (12) building structural elements, including, but not limited to, roofing, basements or slabs; (13) the use of space, particularly areas that were designed to be unoccupied; and (14) the provision of indoor air quality maintenance training for building staff. Local and regional boards of education conducting evaluations pursuant to this subsection shall make available for public inspection the results of the inspection and evaluation at a regularly scheduled board of education meeting.

Sec. 3. Section 10-282 of the general statutes is amended by adding subdivision (19) as follows (*Effective July 1, 2003*):

(NEW) (19) "Certified school indoor air quality emergency" means the existence of a building condition determined by the Department of Public Health to present a substantial and imminent adverse health risk that requires remediation in an amount greater than one hundred thousand dollars.

Sec. 4. Subsection (b) of section 10-283 of the general statutes is repealed and the following is substituted in lieu thereof (*Effective July 1, 2003*):

(b) Notwithstanding the application date requirements of this section, the Commissioner of Education may approve applications for grants to assist school building projects to remedy damage from fire and catastrophe, to correct safety, health and other code violations, to replace roofs, to remedy a certified school indoor air quality emergency, or to purchase and install portable classroom buildings at any time within the limit of available grant authorization and make payments thereon within the limit of appropriated funds, provided portable classroom building projects shall not create a new facility or cause an existing facility to be modified so that the portable buildings comprise a substantial percentage of the total facility area, as determined by the commissioner.

Sec. 5. Subsection (a) of section 10-286 of the general statutes is amended by adding subdivision (9) as follows (*Effective July 1, 2003*):

(NEW) (9) In the case of projects approved to remedy certified school indoor air quality emergencies, the eligible percentage, as determined in section 10-285a, of the eligible cost as determined by the Commissioner of Education.

Sec. 6. Section 10-291 of the general statutes is repealed and the following is substituted in lieu thereof (*Effective July 1, 2003*):

(a) No school building project for which state assistance is sought shall be undertaken except according to a plan and on a site approved by the **[**state**]** Department of Education, the town or regional board of education and by the building committee of such town or district. No such school building project shall be undertaken at an expense exceeding the sum which the town or regional district may appropriate for the project. In the case of a school building project financed in whole or in part by an energy conservation lease purchase agreement, the expense of the project shall not exceed the sum which the town or regional school district approved for the project. A copy of final plans and specifications for each phase of site development and construction of all school building projects and for each phase thereof including site development shall be filed with the Commissioner of Education subject to the provisions of section 10-292

before the start of such phase of development or construction shall be begun. In the case of a school building project which is a new construction, extension or replacement of a building to be used for public school purposes, the town or regional board of education and the building committee of such town or district, prior to the approval of the architectural plans pursuant to the provisions of section 10-292, shall provide for a Phase I environmental site assessment in accordance with the American Society for Testing and Materials Standard #1527, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process, or similar subsequent standards. The costs of performing such Phase I environmental site assessment shall be considered eligible costs of such school construction project. A town or regional school district may commence a phase of development or construction before completion of final plans and specifications for the whole project provided a copy of the latest preliminary plan and cost estimate for such project which has been approved by the town or regional board of education and by the building committee shall be submitted with the final plans and specifications for such phase. Any board of education which, prior to the approval of a grant commitment by the General Assembly, commences any portion of a school construction project or causes any such project to be let out for bid, shall not be eligible for a school construction grant until a grant commitment is so approved.

(b) The Department of Education shall not approve a school building project plan or site, as applicable, if:

(1) The site is in an area of moderate or high radon potential, as indicated in the Department of Environmental Protection's Radon Potential Map, or similar subsequent publications, except where the school building project plan incorporates construction techniques to mitigate radon levels in the air of the facility;

(2) The plans incorporate new roof construction or total replacement of an existing roof and do not provide for the following: (A) A minimum roof pitch of one-half inch per foot, (B) a minimum twenty-year unlimited manufacturer's guarantee for water tightness covering material and workmanship on the entire roofing system, (C) the inclusion of vapor retarders, insulation, bitumen, felts, membranes, flashings, metals, decks and any other feature required by the roof design, and (D) that all manufacturer's materials to be used in the roofing system are specified to meet the latest standards for individual components of the roofing systems of the American Society for Testing and Materials;

(3) In the case of a major alteration, renovation or extension of a building to be used for public school purposes, the plans do not incorporate the guidelines set forth in the Sheet Metal and Air Conditioning Contractors National Association's publication entitled "Indoor Air Quality Guidelines for Occupied Buildings Under Construction" or similar subsequent publications; or

(4) In the case of a new construction, extension, renovation or replacement, the plans do not include a plan that the building maintenance staff responsible for such facility are trained or are receiving training or that the applicant plans to provide training in the appropriate areas of plant operations including, but not limited to, heating, ventilation and air conditioning systems pursuant to section 7 of this act, with specific training relative to indoor air quality.

Sec. 7. (NEW) (*Effective July 1, 2003*) (a) For purposes of this section "Standard 62" means the American Society of Heating, Ventilating and Air Conditioning Engineers Standard 62 entitled "Ventilation for Acceptable Indoor Air Quality", as referenced by the State Building Code adopted under section 29-252 of the general statutes.

(b) Each local or regional board of education shall ensure that its heating, ventilation and air conditioning system is (1) maintained and operated in accordance with the prevailing maintenance standards, such as Standard 62, at the time of installation or renovation of such system, and (2) operated continuously during the hours in which students or school personnel occupy school facilities, except (A) during scheduled maintenance and emergency repairs, and (B) during periods for which school officials can demonstrate to the local or regional board of education's satisfaction that the quantity of outdoor air supplied by an air supply system that is not mechanically driven meets the Standard 62 requirements for air changes per hour.

(c) Each local or regional board of education shall maintain records of the maintenance of its heating, ventilation and air conditioning systems for a period of not less than five years.

Sec. 8. Section 10-286 of the general statutes is amended by adding subsection (d) as follows (*Effective July 1, 2003*):

(NEW) (d) In the computation of grants pursuant to this section for any school building project authorized by the General Assembly pursuant to section 10-283 after January 1, 2004, any maximum square footage per pupil limit established pursuant to this chapter or any regulation adopted by the State Board of Education pursuant to this chapter shall be increased by up to one per cent to accommodate a heating, ventilation or air conditioning system, if needed.

Sec. 9. (NEW) (*Effective July 1, 2003*) Each local and regional board of education may establish an indoor air quality committee for each school district or facility to increase staff and student awareness of facets of the environment that affect the health of the occupants of school facilities including, but not limited to, air quality, water quality and the presence of radon. Such committee shall include, but not be limited to, at least one administrator, one maintenance staff member, one teacher, one school health staff member, one parent of a student and two members-at-large from the school district. No

local or regional board of education, superintendent or school administrator may prohibit a school safety committee established pursuant to section 10-220f of the general statutes from addressing indoor air quality issues that affect the health of occupants of school facilities.

Approved July 9, 2003