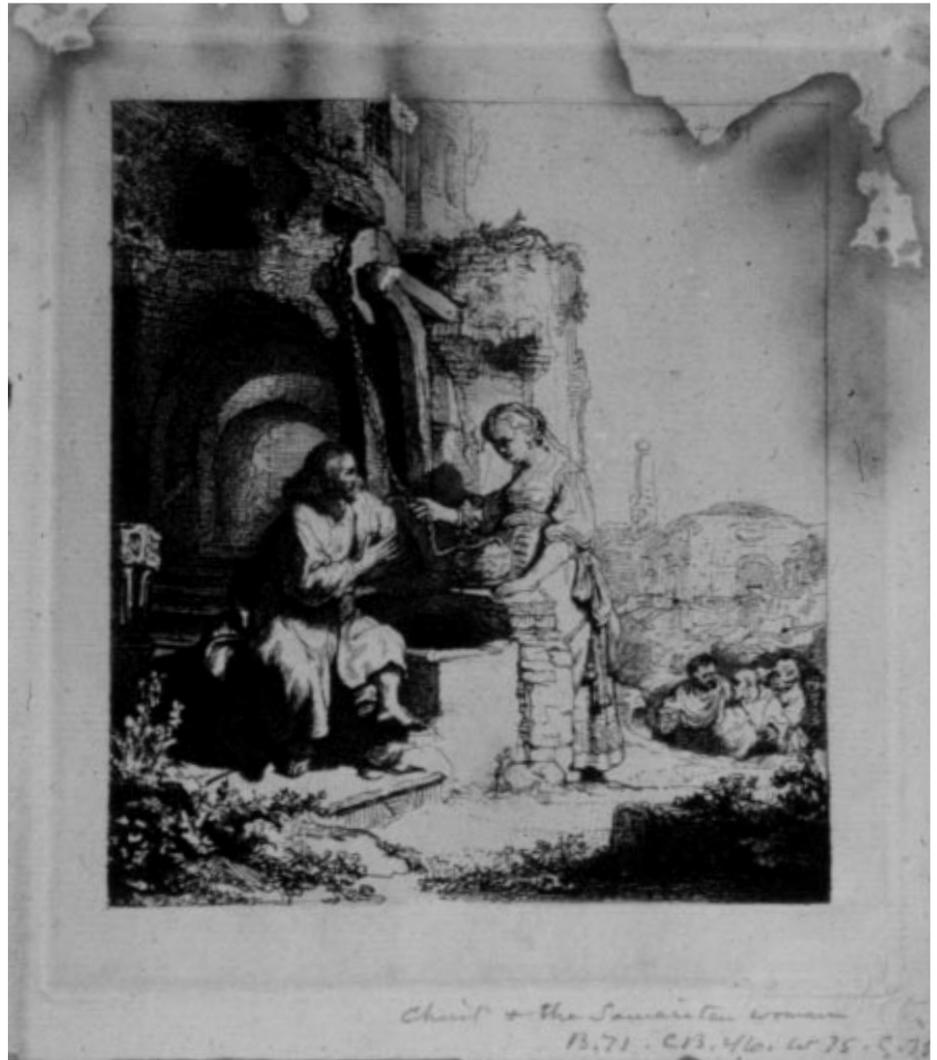


# Disaster Recovery

## Salvaging Art on Paper

All collections of works of art on paper are vulnerable to damage or destruction as a result of natural disasters like hurricanes, tornadoes, floods, or the ravages of fire, burst pipes, or furnace malfunction. Although disaster preparation and prevention can limit the damage that occurs, serious injury to a few or many artworks can nevertheless result from extreme weather, smoke, fire, or mechanical failure.

This technical bulletin describes how to plan an efficient recovery from disasters affecting works of art on paper. The discussion includes preparing for a disaster; assessing damage and setting salvage priorities; advantages and disadvantages of various recovery options; and additional resources for information and advice. The emphasis is on procedures for dealing with water damage, with a brief section on fire-related damage. In all emergencies affecting art on paper, it is essential that a paper conservator who is experienced in disaster recovery be included in the salvage process.



Water damaged etching. *Christ and the Samaritan* by Rembrandt. Courtesy of Bucks County Historical Society.



*Christ and the Samaritan after conservation treatment.*

## PREPARING FOR A DISASTER

A thoughtful and well-organized disaster preparedness plan is essential for any institution containing valuable paper-based collections. Disaster planning requires considerable staff time and administrative support. Potential hazards must be analyzed, with consideration of factors specific to both the site and the building. Copies of the collection inventory and accession records should be maintained off-site. Priorities for salvage should be established based on the significance of the artworks to the collection and their vulnerability. It is important for a conservator to be part of this planning process. If the institution does not have a conservator on staff, or does not have a contractual arrangement with one, creating an alliance with a conservator should be part of the disaster preparedness plan.

Carefully chosen enclosure systems play a key role in making artworks less vulnerable to damage and in facilitating salvage efforts. Collections of art on paper should be housed properly in well-labeled individual enclosures and boxes or in flat files. Valuable artworks executed in media that are unlikely to survive extreme contact with water—such as pastels and watercolors—as well as a collection's treasures in any media should be stored in watertight housing whenever possible. Artworks that are kept in frames should be in sealed packages that are dust- and water-resistant. (In this type of housing, the various components—glazing, matted artwork, backing material—are sealed at the edges with tape or laminate material.) At all times, artworks should be stored at least a foot above the floor to help guard against water damage.

## FLOODS, HURRICANES, TORNADOES, STORMS, AND LEAKING PIPES

### WATER DAMAGE

Works of art on paper can present unique problems when wet. For each artwork, three separate elements may need to be considered: the paper support, the applied media, and in some cases, a surface coating or varnish. Each of these elements responds differently to moisture. In addition, exposure of any of the elements to moisture may encourage mold growth, resulting in serious damage to the artwork.

Paper, the first of these elements, expands from direct contact with moisture or even from elevated relative humidity within the environment. This can be particularly problematic if the paper is adhered within a mat or attached to any type of mount or secondary support. For example, hinges along the top edge of the paper will restrict that area, while the rest of the paper may expand significantly. This can cause distortion and possible tearing of the artwork. When the paper support becomes distorted, thickly applied media such as gouache or India ink lose their firm attachment and may cleave away from the paper. Factors other than expansion must also be considered when paper gets wet. For instance, some colored papers, such as construction papers, are manufactured with a dye component that may bleed when wet. Artworks may also be executed on thick paperboard, which, when wet, may take a long time to dry; and unless the paperboard is dried in a stable environment with a moderate relative humidity, mold growth may occur.

Applied media, the second element to be considered, can present varied and complex problems, particularly if a number of materials are used on a single art object. *Paints* or *drawing inks* (especially watercolor or felt-tipped markers) may bleed or transfer onto adjacent materials. Thickly applied paints, such as gouache, acrylics, or oil paint, will expand at a different rate than the paper support. This can result in cracking and loss of the paint. *Particulate media*, which include pastels, charcoal, chalks, crayon, and pencil, are often susceptible to water damage; particles of media may simply float off the substrate

and redeposit elsewhere on the paper support. *Oil-based inks*, such as those used on engravings, may react with any salts present in the water and weaken the inks. *Silk-screened prints*, *mezzotints*, and *aquatints* have a unique matte surface that is vulnerable to alteration by contact with water, causing darkening or a change in the surface finish.

The third element to be considered is surface coatings, such as *varnishes*, which may blanch following contact with water, partially obscuring the design beneath. *Gum glazes* on top of watercolors are typically extremely water-soluble and usually cannot be saved in the event of a water-based disaster.

For each of these elements, mold is the most serious potential source of damage to an artwork. It can weaken and destroy the paper support of an artwork, as well as cause intractable staining of paper, media, and surface coatings. Mold can grow and spread rapidly within 48 hours of the initial exposure to water. Even if the artworks do not appear to be wet, a damp environment can cause mold growth. Mold may grow on works if the relative humidity is higher than 65% and the temperature higher than 70°F.

### ASSESSING DAMAGE AND SETTING SALVAGE PRIORITIES

In both small and large-scale disasters, a conservator's help is critical in assessing the damage. He or she can recommend the types of recovery procedures (described in the sections following) best suited for the materials affected. Procedures for handling wet artworks will also need to be discussed, as well as a plan for transporting the items for recovery.

The conservator will also be able to help set salvage priorities. Priority rankings are typically based on the type and degree of damage, the type of material affected, and the importance of the materials to the overall collection. In general, highly vulnerable artworks should be quickly stabilized first. These works can include any that contain water-soluble media and colored papers, as well as complex artworks (such as collages whose adhesive may fail quickly when wet or works with mixed media) and those with thickly applied media. Broader categories of artworks that may be especially at risk include oversized works (whose vulnerability to damage is increased as a result of handling when wet),

contemporary works, and naive and outsider art.

Priority is also usually given to very wet materials, partly because of the increased risk of mold growth. If mold has started to grow on any collection materials, isolate these artworks and contact a paper conservator. (For mold recovery procedures, refer to CCAHA's bulletin on *Managing a Mold Invasion: Guidelines for Disaster Response*).

## OPTIONS FOR RECOVERING WORKS OF ART ON PAPER

Several recovery procedures may be considered for water-damaged artworks, including:

- Immediate conservation treatment.
- Air-drying.
- Freezing.

In large-scale disasters, a combination of these techniques may be needed for a successful recovery.

**Water damaged lithograph exhibiting foxing stains from high humidity levels. Portrait of Suzanne Amiéé Cassirer 1909 by Max Lieberman. Courtesy of private client.**



## IMMEDIATE CONSERVATION TREATMENT

Contacting a conservator to immediately treat affected artworks is always the preferred option for safe and effective disaster recovery. This recovery option is strongly recommended for any artwork that exhibits mold growth.

### AIR-DRYING

Air-drying is a procedure best used for drying small numbers of materials. Although larger quantities may be dried in this manner, staff will be needed to carefully monitor the process for any problems that may occur.

Whether or not to air-dry may depend on the extent of damage, the types of paper supports, and the media involved in the affected works. Solubility of media or dyes in the paper support is the greatest potential hazard of air-drying. Many types of media may not show signs of solubility until the drying phase—media that remain liquid can, through capillary action, bleed into adjacent dry areas of the paper support, causing feathering or sinking of the media. If paint is mixed from two or more colors, an additional danger is that one of the colors may sink during air-drying, yielding an apparent color shift in the image. (For further information on making the decision to air-dry, see the box on “Air Drying” on page 4.) Generally, intaglio prints and lithographs respond well to air-drying.



## IMMEDIATE CONSERVATION TREATMENT

### Advantages

Produces the most desirable outcome of all recovery methods.

Good for significant or especially vulnerable artworks, including works with water-soluble media such as watercolors, drawing inks (especially felt-tipped markers), and gouache.

If mold growth has started, immediate treatment will prevent spreading of mold and possible destruction of collection materials. Immediate treatment to reduce mold staining will also achieve the best results.

### Disadvantages

Limitations include availability of conservation professionals; extent of immediate financial resources; and the number of damaged works.

Immediate treatment by a conservator has the greatest "up-front" cost per artwork of all recovery options. However, this cost may be offset by the need to later treat the damaged works.

### Air-Drying Procedures

*Important Note: Remember that severe damage can occur to an artwork by mishandling it while it is wet. If you are unsure about handling an object, consult a conservator first. Artworks damaged by mud or other contaminants may need to be rinsed by a conservator prior to air-drying.*

1. Keep the works wet until they have been separated from storage enclosures and from each other. The separation should be done by a conservator after the works have been transported to a stable drying environment. To maintain wetness, cover the materials with plastic sheeting or pack them in plastic garbage bags. Each package must be supported by a rigid board for transport. To prevent mold growth, be sure to initiate the drying procedure within 48 hours.



**Fire damaged etching. By William Hogarth.**  
Courtesy of private client.



**After Treatment.**

2. Gather supplies for transport and drying. Rigid supports such as cardstock, blotter, or corrugated cardboard are useful for transporting wet artworks, particularly if the works are oversized. Drying supports include blotter, paper towels, or unprinted newsprint. Blotter is the most useful drying support because it can absorb the greatest amount of moisture per square foot and also retains some strength when damp. Polyester webbing can be used to interleave works; however, do not stack artwork unless it is absolutely necessary—sensitive media can be damaged easily by placing anything against their surfaces.

3. Secure a protected location with a stable environment to dry the artworks. Ideally, tables should be set up, but a clean floor is acceptable. Place drying supports on the drying surfaces prior to transporting the works. Set up fans to increase air circulation. Fans should be directed away from the drying surfaces.

4. Pack the works to be air-dried, and transport them to the drying location. Ideally, very wet works should be handled by a conservator. Works should also be handled one at a time, faceup, with nothing touching the media, and as stated, should be transported on a dry, rigid support of cardstock, blotter, or corrugated cardboard. If large numbers of artworks with minimal damage are to be air-dried, they can be systematically packed in numbered and reinforced cardboard boxes or plastic crates with polyester webbing between each object.

## FREEZING

If the quantity of affected works is large, freezing may be a desirable recovery option. Freezing is especially recommended if the wet materials cannot be attended to within 48 hours, to avoid the risk of mold growth.

During the disaster-planning phase, institution staff should contact commercial freezing suppliers to inquire about potential services. Terminology on freezing can be confusing owing to the primary application of freezing within the food industry. Be sure to know exactly what services you need and are contracting for. Vendors should also be aware that artworks should not be dried to 0% moisture content. *The normal moisture content of a healthy paper support is 6–7% at 50% relative humidity.*

Freezing should never be used for artworks with thickly applied media or varnishlike surface coatings. Freezing may cause cracking and loss of these elements.

### Freezing Options

Freezing methods can be divided into three categories:

*Temporary freezing*—freezing as a temporary measure to stabilize artworks while deciding how ultimately to dry them.

*Freezer drying*—freezing to dry the works, in either a commercial freezer or a standard home freezer.

*Vacuum freeze-drying*—freezing to dry the works while they are in a vacuum chamber to reduce distortion.

## AIR-DRYING

### Advantages

Good for works with thickly applied media (gouache, acrylics, oil paint), but it is important to watch for water solubility. Conservation examination of thickly applied media is recommended after air-drying to verify that the media remain firmly attached to the paper support.

Appropriate for artworks with varnish or other surface coatings.

Very good for many stable prints (this can include etchings, engravings) on sturdy papers.

Often the least expensive of all recovery methods in terms of immediate cost. Hidden costs include treatment that may be needed later to rectify problems that occurred during air-drying, such as distortion, bleeding of media, and formation of *tidelines* (lines of residue created by movement of water-soluble media, acids, or other contaminants in the paper).

### Disadvantages

Limited by availability of trained professionals, staff, and volunteers.

Process is labor-intensive.

Limited by available air-drying space. A secure, clean, dry, and cool space is needed to safely dry the works. The size of the space needed will be determined by the number and size of damaged artworks.

Water-soluble media may be at risk during drying—careful attention should be paid to watercolors, gouache, and drawing inks (especially felt-tipped markers). Lateral bleeding may later necessitate conservation treatment.

Paper supports will distort. Fragile papers that have distorted will need to be housed individually in boxes to avoid creases. Paper distortion can also disturb thickly applied media, causing it to crack and cleave away from the paper surface.

Formation of tidelines can occur.

**Temporary freezing** of works on paper allows for time to safely plan and organize the many steps needed to dry the affected materials, as well as to prepare a rehabilitation site. This can be especially important if the collections cannot be treated or dried quickly enough to avoid mold growth. Materials to be frozen should be interleaved or wrapped in wax paper, and carefully packed in sturdy boxes. Large collections should be transported in refrigerated trucks to a freezer facility. Small quantities may be placed in standard self-defrosting kitchen freezers or commercial freezer units.

### TEMPORARY FREEZING

#### Advantages

Allows for time to make informed decisions regarding recovery.

Avoids mold growth, which can occur within 48 hours of the disaster.

Allows the collection to be recovered in batches, reducing the overwhelming magnitude of artworks needing immediate attention.

#### Disadvantages

Is only appropriate for artworks with thinly applied media and no surface coatings.

**Freezer drying** the works completely can be a safe and controllable way to dry wet artworks. During this process, wet materials are quickly brought to low temperatures. This is sometimes referred to as "blast freezing" and is desirable because it prevents the formation of large ice crystals within the paper structure. As the works dry, the potentially damaging liquid state is bypassed, and the frozen water sublimates directly to vapor. The vapor is removed from the freezer unit during the defrosting cycle. This process is very slow and can take up to six months. However, the process can be interrupted at any time to assess the materials.

### FREEZER DRYING

#### Advantages

Very good reported drying results—possibly the safest way to dry an artwork, short of immediate treatment by a conservator.

Good for works with thin-layer, water-soluble media such as watercolors.

Suitable for collages (i.e., adhesives respond well).

#### Disadvantages

Use is limited to artworks with thinly applied media and no surface coatings.

Some distortion of the paper support will result, but it will not be as severe as that caused by air-drying.

Due to lengthy freezer time, considered to be the second-most-costly of all recovery options (in terms of up-front costs).

**Vacuum freeze-drying** is similar to freezer drying in many respects, but provides a faster drying time and less planar deformation to the paper support. In this process, a vacuum is created while a controlled heat source is added to the system to promote sublimation of the frozen water into gas. Despite the heat source, the materials are kept frozen during the entire process, until dry. The materials will dry in approximately 48 hours to two weeks.



Freezer drying of water damaged artifacts.

### VACUUM FREEZE-DRYING

#### Advantages

As in freezing, this process is only acceptable for works with thin-layer, water-soluble media such as watercolors.

Suitable for collages (i.e., adhesives respond well).

The vacuum reduces warping of materials.

Anecdotal information suggests that this method costs only slightly more than air-drying, due to the reduced costs of treatment needed later (e.g., flattening, treatment of tidelines, etc.).

Vacuum freeze-drying does not appear to affect the ability to treat artworks later—for example, reduction of tideline stains is typically still possible and, in some instances, is made easier after vacuum freeze-drying.

#### Disadvantages

Use is limited to artworks with thinly applied media and no surface coatings.

Due to the rapid drying system, materials may be overdried, so humidification after drying may be necessary.

The process cannot be interrupted to evaluate the materials.

## DAMAGE FROM SMOKE, SOOT, AND PARTICULATE MATTER

Damage caused by fires may be limited to smoke and soot. Heavy accumulations of particulate matter can also result from volcanic eruption, earthquake, or furnace malfunction. Artworks on paper are seriously, possibly irreversibly, affected by this kind of damage. Though salvaging sooty artworks should proceed as quickly as possible, this can wait until wet materials are stable. Staff should assess the extent of the problem, but should handle artworks no more than is necessary, so that surface dirt does not become embedded in the fibers of the paper support. All cleaning procedures must be developed and supervised by a paper conservator. Appropriate procedures can reduce dirt and discoloration, but because of the absorbent nature of paper, some disfiguration may remain.

Soot is a hazardous substance, and its precise composition should be assessed by an industrial hygienist with experience in art materials and environments to determine appropriate safety precautions. Depending on what materials were burned in the fire, lead or polychlorinated biphenyls (PCBs) may be present, requiring the services of professional abatement workers.

Smoky odors can sometimes be reduced by providing air circulation around the artworks, by storing artworks in enclosures with zeolites (molecular traps incorporated in the paper or paperboard), or by including zeolite-containing materials in existing enclosures. It is important to note that although anecdotal evidence suggests that zeolites reduce odors, controlled research has not been done. This treatment may be most effective with small amounts of collection materials. Do not employ ozone treatments for odor mitigation; ozone is effective in reducing odors, but it also has a strong potential to degrade paper and media.

---

These general recommendations are intended to provide practical guidance in the recovery of water-damaged objects. The recommendations are intended as guidance only, and CCAHA does not assume responsibility or liability for any resulting treatment of water-damaged objects.

## ADDITIONAL RESOURCES

### TRAINING AND PROFESSIONAL DEVELOPMENT

Knowledge and familiarity with disaster recovery techniques can be gained through training and educational seminars offered by groups such as the Conservation Center for Art and Historic Artifacts. Paper conservators and allied professionals are encouraged to enlarge awareness of recovery techniques by compiling and sharing anecdotal first-hand experience, organizing and participating in salvage workshops, and promoting scientific research into recovery methods.

### SUGGESTED REFERENCES

*Building an Emergency Plan: A Guide for Museums and Other Cultural Institutions.*

Compiled by Valerie Dorge and Sharon Jones. Los Angeles: Getty Conservation Institute, 1999.

Conservation Center for Art and Historic Artifacts. *Managing a Mold Invasion: Guidelines for Disaster Response.*

Conservation Center Technical Leaflet 1. Philadelphia: Conservation Center for Art and Historic Artifacts, 1996. Available in English and Spanish on CCAHA's website: [www.ccaha.org](http://www.ccaha.org).

*The Emergency Response and Salvage Wheel.* Heritage Preservation for the National Task Force on Emergency Response, 1997. A text version is available in Spanish. Available on Heritage Preservation's website: [www.heritagepreservation.org/programs/wheel1.htm](http://www.heritagepreservation.org/programs/wheel1.htm).

National Park Service. "Museum Collections: Emergency Planning." Chap. 10 and "Curatorial Care of Paper Objects." Appendix J. in *Museum Handbook*, Part I - Museum Collections. Washington, D.C.: U.S. Government Printing Office. Revised September 1990.

Rossol, Monona. "Compliance in Recovery: Regulatory Requirements in the Aftermath of Disaster." *AIC News* 23 (5) (1998): 1, 4-7.

*Steal This Handbook: A Template for Creating a Museum's Emergency Response Plan.* Columbia, S.C.: Southeastern Registrar's Association, 1994.

Walsh, Betty. "Salvage Options for Water Damaged Collections." *WAAC Newsletter* vol. 10, no. 2, May 1998. [palimpsest.stanford.edu/waac/wn/wn10/wn10-2/wn10-202.html](http://palimpsest.stanford.edu/waac/wn/wn10/wn10-2/wn10-202.html).

### OTHER RESOURCES

#### *Locating Conservators*

American Institute for Conservation of Historic and Artistic Works (AIC)  
1717 K Street, NW, Suite 200  
Washington, DC 20006  
(202) 452-9545; Fax: (202) 452-9328  
e-mail: [info@aic-faic.org](mailto:info@aic-faic.org); web site: [aic.stanford.edu](http://aic.stanford.edu) AIC provides free referral to conservators and various publications on collection care.

Regional Alliance for Preservation (RAP)  
[www.rap-arcc.org](http://www.rap-arcc.org)

#### *Health and Safety Information*

Arts, Crafts & Theater Safety, Inc. (ACTS)  
181 Thompson Street, #23, New York, NY  
10012-2586; (212) 777-0062  
e-mail: [ACTS@caseweb.com](mailto:ACTS@caseweb.com)  
[www.caseweb.com/acts/](http://www.caseweb.com/acts/)

CONSERVATION CENTER  
for Art and Historic Artifacts  
264 South 23rd Street  
Philadelphia, PA 19103  
215.545.0613  
Fax 215.735.9313  
E-mail [ccaaha@ccaaha.org](mailto:ccaaha@ccaaha.org)  
Website [www.ccaha.org](http://www.ccaha.org)

© 2000, Conservation Center for Art and Historic Artifacts (CCAHA), Philadelphia, Pa. All rights reserved. Not to be reproduced without permission from the Conservation Center for Art and Historic Artifacts.

Anne Downey and Mary Schobert, Senior Conservators at the Conservation Center for Art and Historic Artifacts, wrote this bulletin. The William Penn Foundation provided funding for the design and printing of this bulletin. Molly B.C. Ruzicka, copy editor, and Phillip Unetic, designer, provided additional assistance.