

# Disaster Preparedness During Construction in Danger Areas

An emergency plan is essential in areas where floods, earthquakes, or fires are known but unpredictable threats to a historic resource. Typically, management teams associated with these historic resources have developed in-house programs to protect the public, the staff, and the resource in the event of disaster. However, little has been discussed in the literature concerning how to deal with these potential threats while the resource is undergoing major rehabilitation. Generally, during such projects, the areas receiving work are off limits to park personnel or the public. The control of the facility—and hence its protection—is in the hands of the general contractor, governed by the contract documents for the rehabilitation. While the normal, day-to-day protection of the resource is usually discussed—often in great detail—within the specifications for the project, the preparations and protections to be taken in the event of a major disaster are often completely overlooked.

## **Case Study**

During the mid-1990s, Harpers Ferry National Historical Park undertook a significant restoration and rehabilitation project involving seven buildings within the McGraw Block of the Lower Town.<sup>1</sup> Division One of the specifications, “General Requirements,” covered all normal circumstances associated with the protection of a construction project. Fencing was located and defined to secure the area of work and to protect the general public from exposure to construction hazards. Protection of archeological resources was addressed. Field offices and ancillary facilities were described and located. Cutting and/or patching of the historic fabric was discussed both in general terms under Division One and in specific terms within the other 15 divisions of the specifications, at the appropriate place for each of the materials involved, including brick, stone, stucco, wood, and metals.<sup>2</sup> Yet despite all the instructions, none of these “normal” sections of

Division One of the specifications addressed what the park personnel knew could occur.

## **Park Flood History**

Being a mill town that developed at the confluence of the Potomac and Shenandoah Rivers, Harpers Ferry has seen its share of floods. Since 1877, when flood recording for the area began in earnest; and 1993, when design for the rehabilitation began, there had been 37 storms exceeding “flood stage.”<sup>3</sup> Since 1944, when the area was established as a national historical park, the park administration has been entrusted with restoring, maintaining, and interpreting cultural resources that sit in a flood plain. The specific site of the seven buildings within the Lower Town is within the 20-year flood plain.<sup>4</sup> Any storm with a water-level crest of more than 24.3 feet would begin to flood the first floor of the corner buildings.<sup>5</sup> Twelve such storms have occurred since 1877.

The park administration initially developed a series of site-specific protective measures to enact in the event of a flood. These measures have been updated over time<sup>6</sup> and structured into a two-phased sequence, based upon flood “watch” and flood “warning” as established by the U.S. National Weather Service. Certain very specific operations will be “triggered” with each level of danger. The chain of command for both internal and media communications is clearly established. The documents set procedures for closing the park to the public. The park promulgates the requirements with their Flood Emergency Response Plan and provides this to all park staff. The plan relies heavily on all park maintenance and safety personnel.

## **Project Design Phase**

In order to provide a similar level of protection for the historic resource in the event of a flood during construction, the park and design team jointly developed a new specification section included in Division One, titled “Flood Contingencies.” The requirements of this section included:

- development of a Contractor’s Emergency Response Plan
- a process to allow the park to review, modify, and approve the plan
- a system to test the plan, in the field, on a regular basis

The design team and park felt that it was important that the contractor develop his own plan, rather than rely solely on the park’s existing document. The purpose of this was two-fold: the park’s plan was not geared to construction circumstances, and perhaps more importantly, the team felt that the contractor was in a better position, both experientially and legally, to generate the plan. Typically, the contractor is responsible for the site during construction, for the “means and methods” of construction, and by extension, its protection, safety, and security. The park’s plan was, however, made available to the contractor, and its incorporation into that overall plan was mandated. This assured a level of coordination between plans that would facilitate everyone’s work effort in the event of a disaster.

At Harpers Ferry, part of the anticipated process of rehabilitation included the removal and temporary storage of historic fabric into trailers. Material included wood trim, doors, windows, shutters, and hardware. To protect this material, the specification section required the contractor to address the stabilization, relocation, and/or removal of these mobile facilities in the event of flood.

The method of establishing a state of flood emergency was required of the contractor’s plan.

At Harpers Ferry, the contractor chose to parallel the park’s own system, so that the two plans would be in force simultaneously. Furthermore, the contractor’s plan called for “checks,” including mock drills, to be established that would assure that all construction personnel would be aware of the plan, and versed in its requirements.

One additional contractor requirement established by the General Conditions proved significant. The “Supplementary

Provisions” of the General Conditions required that the contractor carry flood insurance for the duration of the construction.

The design, itself, of the rehabilitation also anticipated a flood-prone environment. Finish materials were chosen for their moisture durability. First floors of wood plank were designed with several removable boards covering concrete troughs that sloped to sump pumps. After a flood, the boards could be lifted up, and the mud residue hosed to the pump. Major equipment, including elevator machines and electrical panel boxes, were universally located above the first floor.

### **Project Construction Phase**

The Lower Town of Harpers Ferry was subjected to two significant floods in 1996 during the period of construction (see Noble, p. 16). The first flood was associated with an unusual 36-hour January thaw that melted much of the four feet of snow then on the ground. Water level crested at a height of 29.4 feet, rising approximately five feet up into the first floor of the Lower Town buildings. The second storm, a September hurricane, brought both significant water and wind within a two-day period. For this storm, water crested at 29.8 feet.

The General Contractor’s Flood Response Plan worked well. The park administration and the contractor communicated to establish both the Phase One and Phase Two states of emergency. At the flood-watch state, all vulnerable areas of the existing historic construction were checked. Unfinished areas of roofs were protected

*East elevation of buildings 32 and 33A following the January 1996 flood, looking west. Site debris was deposited as the water receded. The trees behind the buildings were lost.*



Close-up of buildings 33 and 34 during the January 1996 flood, looking southwest along Shenandoah Street.



with securely fastened tarps. Open wall or window areas were blocked off. Word was spread throughout the contractor's many sub-contractors of the flood state. At the flood-warning state, vehicles, trailers, and major pieces of equipment were moved to high ground. New materials stored inside the building were lifted onto scaffolds to keep them off the ground. Buildings were locked and evacuated.

After the floods, damage was assessed and clean-up efforts commenced. The contractor's plan was proven effective, as there was minimal damage, the majority of which could not have been prevented regardless of planning efforts. Site landscaping suffered and two 60-year-old trees to the west of Market Street were damaged beyond salvage. Mud and floating debris were strewn throughout the site. Site fencing, custom designed to allow visitors glimpses into the work area, was destroyed in about half of its locations and some small tools were damaged or destroyed. With regard to the buildings, some existing exterior stucco, originally designated for salvage and patching, had to be completely replaced. Inside, some first-floor gypsum wallboard below the five-foot line also had to be replaced and interior plaster walls required patching. Ultimately though, the damage was clearly and significantly reduced as a result of the team's efforts to develop and implement the Contractor's Flood Emergency Response Plan. To cover the costs of lost equip-

ment and to address the damages and repair to the building fabric and the landscaping, the contractor was able to receive insurance for the two occurrences.

### Conclusion

Many NPS cultural resources are located in areas prone to severe natural disasters—floods, earthquakes, or fire. Thoughtful planning for natural disasters can reduce damage to those resources undergoing major rehabilitation. Existing procedures for safety and protection promulgated by the park should be integrated into a contractor-generated Emergency Preparedness Plan. Review and mock drills of the plan should be required on a regular basis. The contractor should be required to carry special additional insurance to protect both the work and supplies and equipment against damage that could occur from the natural disaster.

### Notes

- <sup>1</sup> GWWO, Inc., Baltimore, Maryland, was the architect for the Project, HAFE Package 116. Peter Dessauer, park architect, served as the on-site park representative. Callas Contractors, Inc., Hagerstown Maryland, was the general contractor.
- <sup>2</sup> Package 116, Specification Section 01530 "Barriers," Section 01100 "Archeological Protection," Section 01590 "Field Offices and Sheds," Section 01045 "Cutting and Patching."
- <sup>3</sup> Defined as 18.5 feet above the Shenandoah River's mean high level.
- <sup>4</sup> Flood areas are defined in terms of storm severity. The most common term is based upon the "100-year" flood, that defines the storm severe enough that on-average it is only expected to occur once every 100-years. The level to which water rises during this magnitude of storm is defined as the 100-year flood plain. Typically, new construction cannot occur within the limits of the 100-year flood plain, to protect both people and the environment. A building in the 20-year flood plain is considerably more vulnerable to flooding than one in the 100-year flood plain.
- <sup>5</sup> Buildings 33, 33A, and 32.
- <sup>6</sup> The latest edition at the time of the project design was dated March 1993.

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