



Natural Disaster Lessons Learned for Water and Wastewater Utilities: WISE “Emergency Response Primer Project”

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Project Scope and Approach

- Project sponsored under the joint WISE initiative (ASCE, AWWA and WEF; funding provided by EPA)
- Purpose was to document experiences of water and wastewater utilities in preparing for and responding to natural disasters, particular novel approaches or effects.
- Primary information source was two-day workshop held at ASCE in August, 2006, with follow up to obtain documented information sources for report appendices.
- Report available at:
http://www.asce.org/uploadedFiles/ewri/Codes_and_Standards/FullPrimerReportwAppendices.pdf
- <http://www.wef.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=3612>

Lessons Learned

- 💧 Preparation for imminent events
(Lessons learned on what was successful or what we wished we'd done in preparation for onset.)
- 💧 Disaster incident effects and expedient response
(Remarkable characteristics of some disaster types, and expedient response measures)
- 💧 Suggested management considerations
(Some useful planning considerations)

Preparation for imminent events

- 💧 Have a facility and disaster specific checklist of last minute items that need to be accomplished before disaster strikes.
- 💧 Particularly applicable for disasters that occur with warning
 - Hurricanes and upriver flooding – generally forecasted
 - Wildfires and tornadoes – not forecasted well in advance, but potential conditions generally recognized

Contrast with

- Events typically not warned of:
 - Earthquake
 - Facility fire



Report contains appendicized checklists.

Preparation for imminent events - flooding

Securing the facility perimeter in advance of flooding



Greenville Utilities, NC - Hurricane Floyd, 1999 (S. Porter)



Cedar Rapids, IA - 2008 (B. Jacobs)

Be prepared for sandbag operations to protect the treatment works. (Corps of Engineers guide appendicized to report.)

Remember to plug floor drains inside the protected perimeter.

Preparation for imminent events - flooding

- 💧 Fill water and chemical storage tanks to better withstand wind damage and flotation.



Buras, LA, elevated water storage tank, destroyed by Hurricane Katrina, 2005 (C. Carlson, LA Dept of Health and Hospitals)



Cameron, LA, water storage tank, destroyed by Hurricane Rita, 2005 (R. Reeves, LRWA)

Preparation for imminent events - flooding

💧 Chemical tanks also need to be secured.

Hurricane Floyd, 1999

Rocky Mount, NC

“By 12:00 noon the water had risen to over four feet in the main lobby of the plant and to chest deep in other areas within the plant. **The cylinders, which were still in operation, were hanging upside down by their pigtails to the header.** Our Lead Mechanic entered the building and standing on the frame of the chlorine header turned off the ton cylinders at the tanks.”

Jay W. Van Hoose,
Superintendent



Rocky Mount, NC, water treatment plant; J. Van Hoose

💧 **Note: This is good advice for earthquakes, too.**

Preparation for imminent events - chlorine

- 💧 Wildfire protection - Maintain an adequate protective buffer surrounding critical facilities during high fire season.



One-ton containers burned in the 2007 “Rice Fire” at the Red Mountain Chlorination Facility (photos courtesy of Mike Page, Fallbrook Public Utility District.)



Expedient disaster operational responses

🔹 Expedient filter backwash operations under flood conditions.



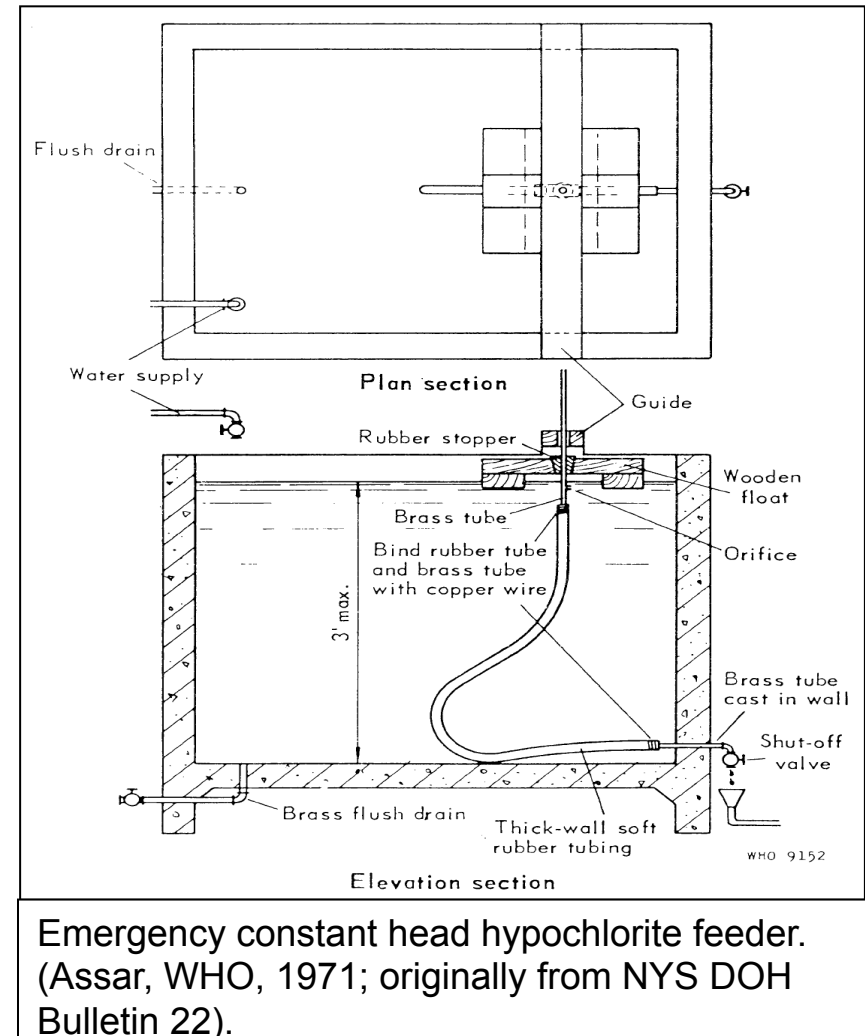
Use of sandbags to enable backwashing above floor grade and away from other filters when usual discharge lagoon was inundated following Hurricane Floyd flooding in 1999. (Porter, Greenville Utilities).

Expedient disaster operational responses

Alternative chlorination feed system suggestions.

Primary alternative feed system suggested was basic chemical metering pump, as typically used in swimming pool systems.

Secondary expedient would be for simple non-powered “constant head” feed system for discharging batch-mixed hypochlorite solution into open tank or open conduit.



Expedient disaster operational responses

Florida Rural Water Association suggestions for distributed lift station operations.

- Develop a circuit rider plan for pumpout of lift station wet wells to septic haul tankers or trailer mounted portable power.

- Use of small (5-15 kw) single phase generators and field-built VFDs to enable emergency powering of three-phase motor pump stations.



City of Sunrise, FL (Photo: R McVay, FRWA)

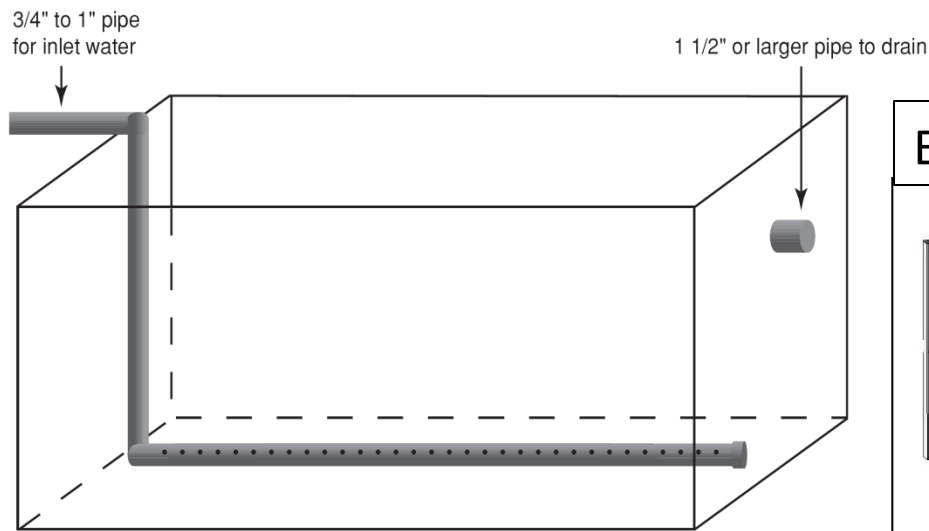


Field constructed VFD (McVay)

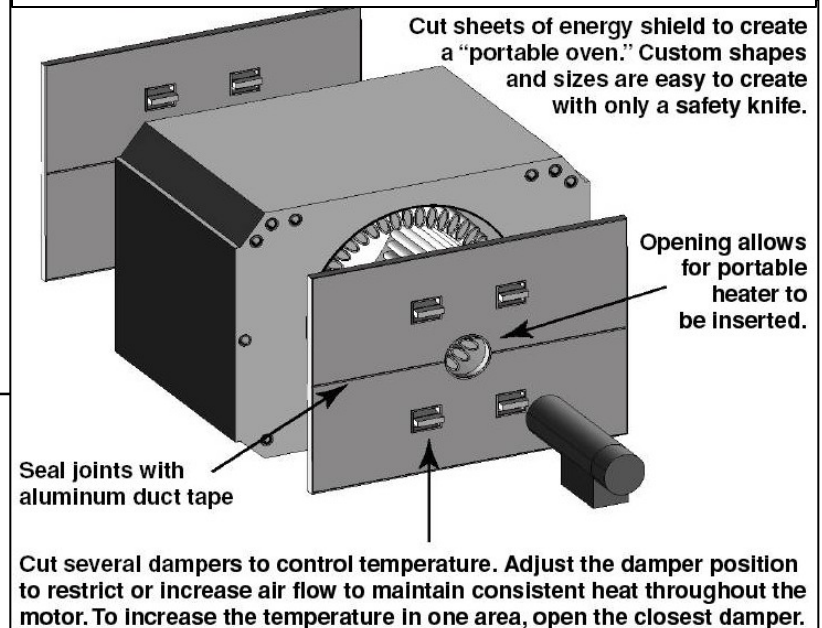
Expedient disaster operational responses

💧 Electrical Apparatus Service Association (EASA) recommendations for emergency salvage operations.

Tank for flushing saltwater from motor windings



Expedient field motor baking ovens



Expedient disaster operational responses

- 💧 Post event location and remediation of water service connections and sewer laterals.

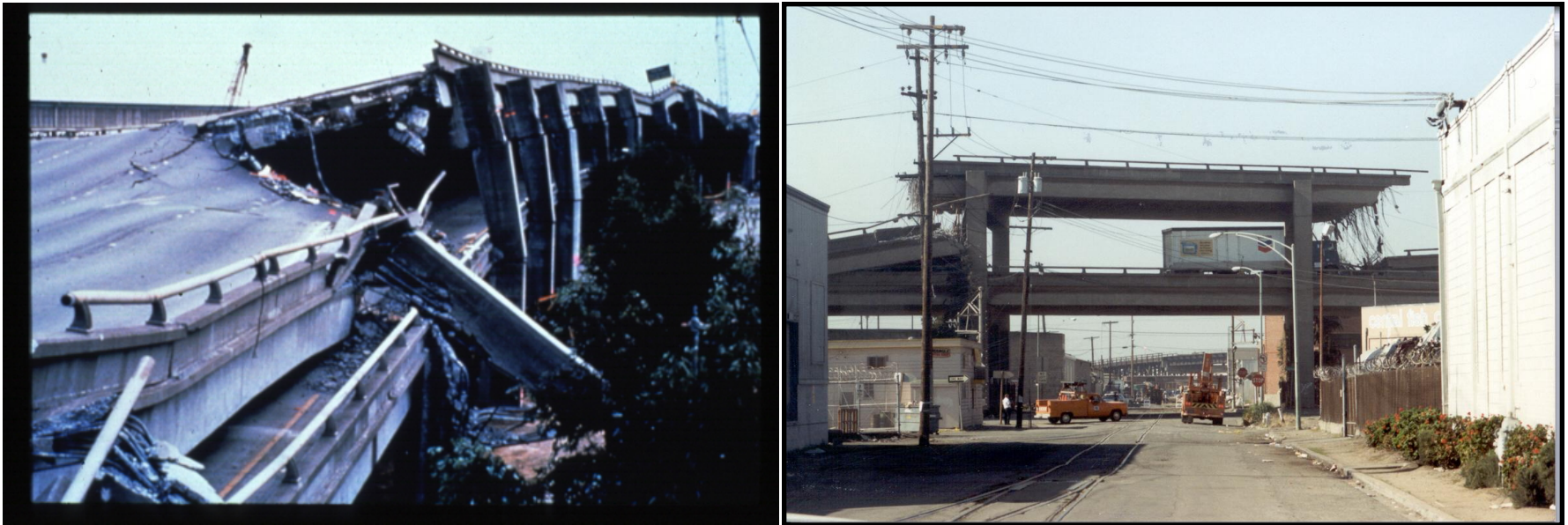
Location and capping of sewer laterals following wildfire devastation, so forestall inundation of wastewater treatment plant with silt and debris in following rains.



Lake Tahoe 2007 Angora Fire - Burned house with open sanitary sewer lateral (Photo: Paul A. Sciuto, STPUD)

General utility management considerations

- Consider the advantages of distributed deployment of water system assets in responding to disasters.



Alan Goodson, EBMUD, noted the challenge of deploying response crews in a post-earthquake environment. (Note the truck “trapped” between two collapsed spans in bridge at right.) This would also have applicability in other general disaster scenarios.

General utility management considerations

💧 Response personnel management.

💧 Track the number of hours worked. (You will likely find that dedicated employees work an excessive number of hours.)

💧 Plan for adequate food, water and other needs.

💧 Personal protective equipment (PPE):

“My people noticed the difference in their equipment and the firefighters they were working with on the fire line.”

💧 Access credentialing

See “Affiliation Access” provisions of **NIMS GUIDELINE FOR THE CREDENTIALING OF PERSONNEL**

Selected facilities impacted by Superstorm Sandy

◆ Passaic Valley Sewage Commission WWTP - New Jersey

- ▶ Total inundation of WWTP by storm surge, including flooding of critical below-grade equipment galleries
- ▶ Gradual recovery over several weeks - first primary treatment, secondary treatment and finally biosolids processing

◆ Middlesex County Utilities Authority - New Jersey

- ▶ Treatment facility itself is located on high ground, but three critical collection system pumping stations were flooded.
- ▶ Restoration of all flows took more than a month following the storm.

◆ Howard County's Little Patuxent Water Reclamation Facility - Maryland

- ▶ Downed trees disrupted power from both of its independently routed power supply feeds, resulting in estimated 25 million gallons release of untreated sewage over 12 hours.
- ▶ Biological process restoration took several days longer.

Supplemental material in "Recovery Practices Primer" report

1. "**Flood Preparation and Restoration**," American Water, 2003.
2. "**Sandbagging Techniques**" brochure from USACE, Northwest Div, 2004
3. "**Innovative Naples Generator Design Replaces Large Units in Temporary Power Restoration Following Hurricane Wilma**" (a paper by Bob McVay of FRWA describing use of VFD and small single phase generators for powering up lift stations in sequence)
4. "**Electrical Retrofit Aids in Hurricane Response**" (FEMA article on a "Best Practice" story)
5. "**Recovering From Disaster**" (Paper by C Yung, EASA, on electrical motor restoration from floods) - 2005 (after Katrina) - (first published in UptimeMagazine - January, 2006)

💧 Report available at: http://www.asce.org/uploadedFiles/ewri/Codes_and_Standards/FullPrimerReportwAppendices.pdf
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Additional resources on water / wastewater planning and response for natural disasters

- 💧 **“Natural Disaster Experiences: How to prepare environmental facilities for the worst”** American Academy of Environmental Engineers, 1995.
 - ▶ 1994 West Coast earthquakes and 1993 midwest river flooding
- 💧 **“Natural disaster mitigation in drinking water and sewerage systems: Guidelines for vulnerability analysis”** Pan American Health Organization, 2001.
 - ▶ Procedural approach
 - ▶ Case studies for earthquakes, hurricanes, floods, landslides, volcanic eruptions, and droughts
- 💧 **“Guide to Sanitation in natural disasters”** World Health Organization, 1971.
 - ▶ More basic discussion of sanitation issues in extremis conditions
- 💧 **“All-hazard consequence management planning for the water sector: Preparedness, emergency response, and recovery”** CIPAC Workgroup, 2009. <http://www.awwa.org/portals/0/files/legreg/security/allhazard.pdf>

THANK YOU

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