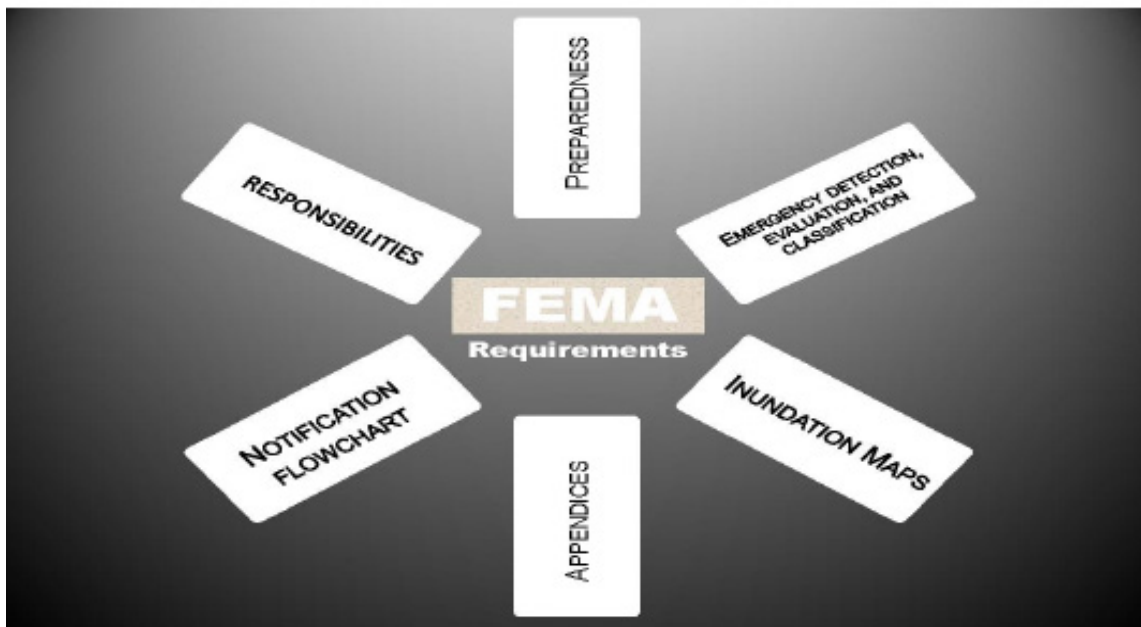


SPECIAL EDITION

KANSAS DAMS

2014

EMERGENCY ACTION PLANS



DAM BREAKS IN KANSAS: BEFORE, DURING, AFTER

DAMS OF POSSIBLE DANGER

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DAMS DO FAIL IN KANSAS

This publication was written and designed by C. A. Higgins in compliance with the public awareness objective of the federal Dam Safety Act from funding provided by the U.S. Department of Homeland Security, Federal Emergency Management Agency.



DAM BREAKS IN KANSAS: BEFORE, DURING, AND AFTER



The state of Kansas regulation K.A.R. 5-40-73 requires owners of significant and high hazard dams to complete an Emergency Action Plan (EAP). This formal document, which is required by most states, identifies potential emergency conditions at a dam and specifies preplanned actions to prevent loss of life and minimize property damage in case of a breach.

Developing an effective plan works best when all involved responders are part of the plan's creation and testing, which is why the Division of Water Resources Dam Safety Team hosted "Dam Breaks in Kansas: Before, During and After," an emergency action plan seminar designed for emergency management personnel in Kansas.

This free seminar at the Topeka & Shawnee County Public Library in Topeka consisted of short presentations by DWR engineers relating to dams and emergency planning; levee breach response efforts (Alan Ratcliffe, Franklin County Emergency Management); and dam break training exercises (Sandy Johnson, Homeland Security Specialist, Kansas Department of Agriculture).



Also presenting was John Roberts, an international incident command system instructor since the mid-1980s, from Oklahoma who served as the director of the federal government's National Interagency Coordination Center in Arizona and also organized Haitian churches to rescue orphans following the aftermath of the 2010 earthquake. Roberts stressed the need for readiness: "One dam gets blown up, what's one of the things you should be thinking about? Other dams might get blown up, right. There's a certain amount of anticipation we have to be prepared for."



Registrants included emergency management staff from Franklin County, Montgomery County, Bourbon County, Wyandotte County, Miami County, Douglas County, Mitchell County, Harvey County, Atchison County, Osage County, Pottawatomie County, Coffey County as well as regional and state emergency management personnel. In addition, representatives from the State Association of Watershed Districts, Kansas Department of Wildlife & Parks, Kansas Water Office, and area engineering firms attended.



DAMS OF POSSIBLE DANGER

A dam's hazard classification refers to its danger if it failed not its structural integrity

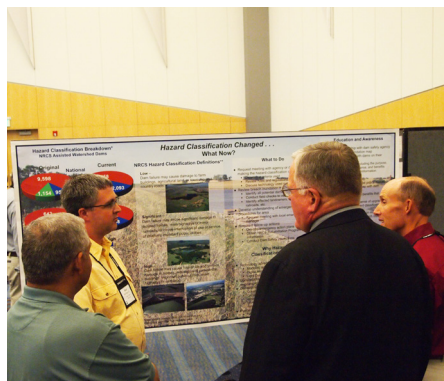
The state of Kansas assigns dams a hazard classification to categorize the risk a dam poses to human life and property if it should fail. By statute, high and significant hazard dams must be periodically inspected by a professional engineer. The higher the hazard classification of a dam, the more stringent the requirements, for example, soil testing and spillway capacity, are for its design and construction.

If a dam's hazard classification changes to a more stringent classification, the owner may be required to modify the dam to meet some or all of the standards that a new dam of the more stringent classification would have to meet. Upgrade requirements are limited to those changes deemed necessary to protect public safety.

If a dam is upgraded because of reclassification, owners may request reconsideration of the hazard class determination under K.A.R. 5-40-26. This request should be accompanied by a proposed hazard classification and an explanation along with support documentation and analysis. The request must be filed with the Chief Engineer at DWR within 15 days after the owner or applicant is served with written notice of the hazard reclassification or within any time extension authorized. In most cases, additional time will be allowed to complete the information required for the appeal process.

If the classification change is an upgrade from a lower hazard rating to a higher one, an owner has several options to consider, including modifying the dam, increasing spillway capacity, increasing dam height, or reducing permanent storage. The owner of the hazard also might be contacted to discuss possible removal or relocation from the breach inundation area.

Another option may be to breach the dam. Before taking any removal action, DWR staff should be consulted.



Herbert Graves reviews his hazard classification poster with Arvil Bass, NRCS, and Leonard Bristow, Division of Water Resources.

In his "Hazard Reclassification Change: Now What" presentation, Herbert Graves, State Association of Kansas Watershed, discussed owner options at the Association of State Dam Safety Officials Conference in Denver.

Graves said when a notice from Divisions of Water Resources or Natural Resources Conservation Service arrives regarding a change to higher classification options include: "Ignore it and hope the agency goes away is not a good option but it has been tried. It's better to contact the agency and ask why the new classification has occurred. Technology advancement? Regulation changes? Floodplain developments? Increased traffic on downstream road?"

If action is required, he advised rehabilitation; floodproofing, for example, buying the property that created the classification change; and decommission ("I hope that never happens on my watch.")

Advising "prevention is worth a pound of cure," Graves said complete all breach inundation maps, educate landowners in breach area, work on floodplain zoning, and consider floodplain easement. He concluded by saying the issue is not unique to Kansas and predicted the list of decommissioned dams is going to grow.

The Chief Engineer's regulations implementing the Obstructions in Streams Act define "hazard" as property or people possibly endangered by a dam failure and "hazard classification" as the categorization of the level of damage that could occur if a dam failed.

Hazard classification does not indicate the condition of the dam – only the potential for death, major economic loss, or interruption of public utilities or services should a dam fail.

Kansas uses three hazard classifications to categorize potential loss and rates all dams in these categories:

- **Class A (low hazard):** Failure of a Class A dam may cause damage to uninhabited buildings, agricultural land, undeveloped land such as hiking trails, or traffic on low-volume roads (500 or fewer vehicles traveling by in an average 24-hour period).

- **Class B (significant hazard):** Failure of a Class B dam may endanger a few lives or cause damage to an isolated home; public utility serving a small volume of customers; traffic on a moderate-volume road (501 through 1,500 vehicle use in average 24-hour period); recreation facilities including campgrounds intermittently used for sleeping and serving a relatively small number of persons; or low-volume railroad tracks.

- **Class C (high hazard):** Failure of a Class C dam could potentially cause extensive loss of life or damage to more than one home; industrial or commercial facilities; a public utility serving a large number of customers; traffic on high-volume roads (more than 1,500 vehicle use in average 24-hour period); a frequently-used recreational facility serving a large number of persons; or a high-volume railroad line. Two or more individual Class B hazards below a dam also result in a Class C rating.

10 QUESTIONS ABOUT DAM HAZARD CLASSIFICATION

Ambrose Ketter, P.E., reviews hazard classification assessments on high priority dams in developing communities. His reviews analyze breach maps, field inspections of downstream hazards, topographic data, surveying, floodrouting, and database updates.



How are dams in Kansas classified?

The hazard classification of a dam in the State of Kansas is based solely on the downstream effects of the structure in the event it should catastrophically release the amount of water stored behind it due to the 1% chance storm. The hazard classification has no bearing on, or relation to, the structural integrity, physical condition, or functional capability of the dam.

Who determines the classifications?

When the downstream hazards have been identified relative to the inundation area, a hazard classification is assigned according to specific guidelines set forth by the rules and regulations of the Division of Water Resources. Three different classifications are possible for any dam under DWR’s jurisdiction: Class “a” low hazard, Class “b” significant hazard, and Class “C” high hazard. These classifications are directly related to the magnitude of possible damage and/or loss of life or property resulting from a catastrophic breach of the dam at the 1% chance storm level.

What is the most important thing to consider in classification?

A number of variables are involved in the process of hazard class evaluation. All relate to the downstream effects of a catastrophic breaching of the dam. First, and foremost, is an accurate approximation of the inundation area. This approximation begins with a flood routing of the dam to determine the water surface elevation in the reservoir at the time of the hypothetical breach. To complete a flood routing, numerous variables are used in the calculations. Primary spillway inlet diameter, auxiliary spillway width, drainage area, dam height, reservoir capacity, and rainfall data – they’re just some of the variables needed to calculate a “reasonable” approximation of the amount of water in the dam due to the 1 % chance storm. Much of the data needed for flood routing can usually be found in the original construction plans. If this is not available, a site visit may be required to take measurements and make visible observations.

How do you determine peak breach discharge?

Once the flood routing is completed, state regulations require peak breach discharge be determined with the NRCS “TR-60.”

The physical characteristics of the dam are needed to complete this analysis. Again, this data can usually be found in the original construction plans. If not, accurate survey data and/or measurements must be obtained through a site visit. The peak breach discharge is then used in combination with other site specific variables such as downstream drainage structures, topography, land use, vegetative cover, and stream characteristics to calculate an approximate breach inundation area. A list of downstream hazards including their elevations and locations relative to the breach inundation zone is then compiled. These are obtained using aerial photos, site visit photos, survey information, topographic maps, traffic maps, railroad data and other forms of information relative to the dam and the downstream area.

Are low hazard dams usually in rural areas?

Rural or urban has nothing to do with the hazard classification. It’s just that rural areas tend to have less hazards and, thus, they usually contain low hazard dams. Vice versa: there are high hazard dams in rural locations and low hazard dams in urban settings.

What are specific traffic counts on a road for significant and for high hazard classification?

Significant is between 500 and 1500.

KETTER SAID

“Many of the dams currently being evaluated have previously undergone a breach analysis and inundation mapping. This greatly reduces the time and resource expenditure for a hazard classification review.”



WHAT IS AN EMERGENCY ACTION PLAN?

Similar to other states, Kansas law requires significant and high hazard dams to have a plan for dam failure.

Significant and high hazard dams also are required to have a safety inspection conducted by a licensed Professional Engineer. Class C dams are to be inspected every three years and Class B dams, every five years.



The Kansas Obstruction in Streams regulations K.A.R. 5-40-73 sets forth the following: (a) *The owner of each hazard class B dam shall create an emergency action plan (EAP) on a form prescribed by the chief engineer. The owner shall keep the original EAP and submit a copy of the EAP to the chief engineer. When the chief engineer of DWR sends a written notification to the dam owner then EAP must be sent to DWR within 180 days.*

Background

Since 1983, the Kansas Rules and Regulations associated with the Obstructions in Streams Act have required an Emergency Action Plan to be included with all permit applications submitted for Class C high hazard dams. As of May 18, 2007, a new requirement mandated owners of each Class B significant hazard dam also to submit an EAP on the form Kansas Department of Agriculture, Division of Water Resources, has available on the KDA website at www.ksda.gov/structures/.

EAP Requirements

- Name, address, and telephone number of each owner of the dam and also those persons responsible for operation and maintenance of the dam.
- Name, address, and telephone numbers of the person responsible for notifying local authorities in an emergency. This may be the owner, tenant, or other persons.
- Description of the dam, including the location of roads that provide access to the dam during flood events or dam breaches.
- Map or written description of area that could be inundated by breach of the dam. (State rules and regulations establish guidelines for breach analysis although a breach analysis may not be required for a significant hazard dam.)
- List of persons who should be notified in case of emergency, including their telephone numbers and responsibilities.

Owners of dams for which an EAP is required must annually review the EAP to determine whether it is accurate and applicable to the dam's current condition, including current downstream conditions. The following needs to be addressed in this review:

DWR has a toll-free emergency number, 800-915-6163, maintained 24 hours a day for dam failure reporting.

1. Determine whether contact names and related information are still current and up to date.
2. Determine whether the breach inundation map or description of the inundation area is current.
3. Check emergency procedures to verify that changes aren't necessary. Make any changes to the EAP needed and send a copy of the revised EAP to the chief engineer at DWR.
4. If any changes are made to the EAP, then a revised copy must be sent to the chief engineer.



EAPs vary in their details and length. DWR suggests formats to follow but these are not mandated. In several instances, dam owners hire an engineering or other form to create the EAP for a high hazard dam and to obtain an inundation map similar to the one pictured here.

When an unusual event occurs at a dam, it may not be necessary to implement the EAP. However, the owner should increase monitoring of the dam and implementation of the EAP may be required at a later time should the dam continue to deteriorate, or further problems develop.

If a dam is in danger of failing or failure is imminent or in progress, the dam owner or his or her representative should immediately contact the local emergency services and also the sheriff. Emergency management and other responders then will implement the EAP. Because they direct response and evacuations after notification, emergency personnel need to be involved in developing and approving the EAP. For example, they may take responsibility in the planning to notify property owners and other persons downstream who may be in the path of a possible dam breach. They also can contact others included in the EAP, including DWR that has a toll-free emergency number, 800-915-6163, maintained 24 hours a day.

10 QUESTIONS ABOUT EMERGENCY ACTION PLANS

Each EAP sent to Division of Water Resources is reviewed for requirement compliance, which benefits all, says Trevor Huhn, P.E.

What do you check for in emergency action plans?

When I review EAPs, I look to see whether they meet FEMA 64 requirements such as the notification flow-chart and KDA requirements: K.A.R. 5-40-73.

Do the plans usually include the required information?

There is no right or wrong EAP. That's why I don't review them for correctness. I review for content. I am not critiquing how they are going to handle emergencies. I am more verifying that they have included everything. I make sure everything we say you need to think about it is in there, like, how are you going to fix your dam if it is going to fail? Sandbags? Dirt? Rock on the top?

Is there something people tend to leave out of their EAPs?

Sometimes, people doing significant hazard dam EAPs don't describe how to get to the dam and the inundation area. High hazard EAP dam forms – I usually recommend that they include contractors, lighting equipment, and dam supplies in general.

Of all the EAPs that come in, how many do you turn back?

Oh, maybe one out of 7. The only ones I truly turn back are the ones that didn't update anything.

How does Kansas compare to other states?

Of all the dam owners who are to have them, we've got a little more than 80%. That number changes because of hazard classification changes and when we get more in. But does it really matter how many we have done? There's a state that has all its done, and they are all uniform but are they useful? Have the dam owners even looked at their EAP? The way we've been doing them has been having the dam owner do the forms so they know what is in their EAP. If dam is failing: They will know how to handle emergency.

One dam owner told me 'This is a stupid form. I know what it is going to happen.' What if you're on vacation? What is the other guy going to do? Does he know where to get the gravel? Does he know who to call?'"

Who's included in an emergency action plan?

The dam owner, DWR, the dam owner's technical representative (an engineer). You include police and fire, but to be honest, but emergency management agency is going to coordinate and do evacuations. They deal with everything downstream of the dam.

How do people get breach inundation maps that high hazard dam EAPs require?

They have to hire an engineer to get those. Some we have they can use that we have bought, and we are still buying some.

What do you do when you check a breach map?

I look at all the engineering. I make sure the map is to scale and all the calculations correct. I don't redo them but I check them. I use ArcView and HEC-RAS to verify there no upstream or downstream dams accounted for.



"There is no right or wrong EAP. Every dam is different."

HEC-RAS is program that models rivers. It can model the height of water in a river for a given flow. Basically, if you are given a storm and so much water is dropped, you can model the river system and get the theoretical level of river and where to put sandbags.

What's one thing you'd like people to know about EAPs?

Something people don't understand about EAP forms: They're for the dam owners and not the emergency professionals. I will walk you through it. I've sat down here at DWR with a dam owner who thinks he or she can't do it. They're embarrassed and it usually doesn't take long to do the form. I will also go to their site for table top or full blown exercise or whatever they want.



Trevor Huhn talks to a homeowners' association about information needed on their EAP and how to update their current plan.

EAP ADVICE FROM OTHER STATES

Missouri

Share EAP planning and results with stakeholders.

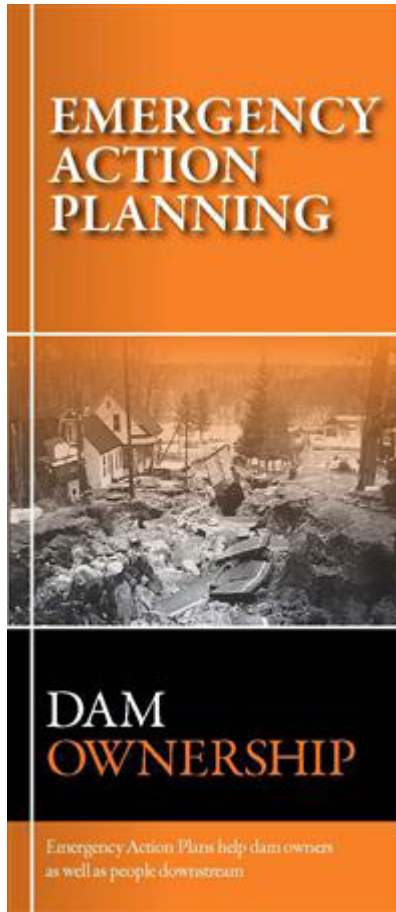
Stakeholders are citizens, business owners, and recreationists in harm's way at times, often without realizing it. Do you like to swim or fish in a Missouri lake? Like to hunt in areas below or near a dam? Like to RV or camp out along the shores of a lake? Enjoy canoeing a stream below a dam? Do you farm land or have livestock in a floodplain? Do you manage a nursing home, hospital or school in an area below a dam? Are you an emergency responder? Do you volunteer for the Red Cross or Salvation Army? Do you regularly need to travel across or have access to an area below a dam?

Oklahoma

Test the EAP.

There are five types of exercises in a training program. It is not a requirement that every training program include all five exercises. However, it is advisable to build a program upon competencies developed from simpler exercises to achieve greater success with the more complex exercises. This means that emergency exercises should be developed and conducted in an ascending order of complexity. It is important that sufficient time be provided between each exercise to learn and improve from the experiences of the previous exercise before conducting a more complex exercise. The five exercise types, listed from simplest to most complex, include 1) an orientation seminar, 2) drill, 3) tabletop exercise, 4) functional exercise and 5) a full scale exercise

“Common deficiencies in EAP formats are that the formats fail to rapidly lead the user, misprioritize information, interweave extraneous material, or disregard site-specific needs.” *Improving Your Dam Safety Emergency Action Plan: Insights From the U.S. Fish and Wildlife Service, Duane McClelland & Brian Becker*



Brochure explains the emergency action plan, its key points, and tips for better EAPs with a list of resources.

Iowa

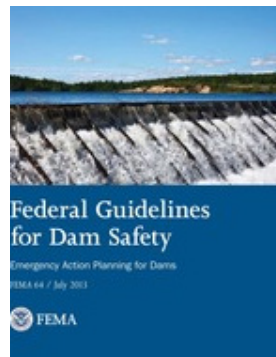
Include local emergency management in EAP process.

As the dam owner, you are responsible for developing and maintaining the EAP and for updating it on annual basis. The importance of meeting with your local emergency management agencies at least once a year cannot be overstated. This meeting ensures that everyone understands the EAP, including pre-planned emergency procedures and inundation maps.

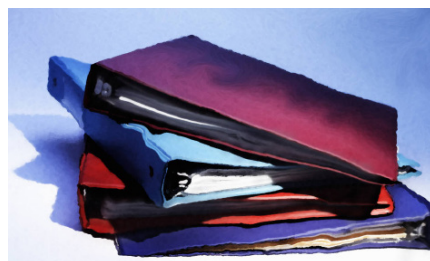
Colorado

Have dam repair supplies and equipment ready.

- Is outlet accessible and operable during emergency?
- Is heavy equipment readily available?
 - Light plants if at night?
 - Materials stockpiled?
 - ASTM C-33 Filter Sand?
 - 2 to 3 inch minus drain gravel?
 - 8 to 12 inch graded riprap?
 - Sand bags, plastic sheeting?



This document updated in 2013 provides guidance to help dam owners, in coordination with emergency management authorities, effectively develop and exercise EAPs for dams. The state of Kansas uses this publication for its EAP regulations, which is available at no cost from the Federal Emergency Management Institute.



- Place EPA in three-ring binder for field use.
- Use divider tabs and side labels to quickly access information.
- Use header and footer for sheet identification in case sheets get separated
- Keep list of each person receiving EAP for future updates.
- Date individual EAP pages.

5 WAYS TO TEST AN EAP

FEMA recommends five ways to test an EAP's effectiveness. EAP review also provides training for an actual event.

Testing an emergency action plan can be done several ways. From the simplest to the most complex, the Federal Emergency Management Agency recommends an orientation seminar, drill, tabletop exercise, and a full scale exercise.

Orientation seminar. This exercise brings together those with a role or interest in an EAP, i.e., dam owner and state and local emergency management agencies, to discuss the EAP and initial plans for an annual drill or more in-depth comprehensive exercise.

Drill. A drill is the lowest level exercise that involves a single emergency response procedure. One example would be a run-through of telephone numbers to verify the validity of telephone numbers.

Tabletop exercise. An informal tabletop exercise involves the dam owner and state and local emergency management officials. The exercise begins with the description of a simulated event and proceeds with discussions by the participants to evaluate the EAP and response procedures and to resolve concerns regarding coordination and responsibilities.

Functional exercise. The functional exercise involves the various levels of individuals in an actual emergency and takes place with time constraints. The participants act out their actual roles.

Full scale exercise. The full scale exercise evaluates the operational capability of all facets of the emergency management system in a stressful environment with the actual mobilization of personnel and resources. It includes field movement and deployment to demonstrate coordination and response capability. The participants actively "play out" their roles in an environment that provides the highest degree of realism possible for the simulated event.

Tabletop File Notes

Division of Water Resources staff attended a tabletop exercise in El Dorado to fulfill the requirements for Little Walnut Hickory, Rock Creek, Upper Walnut, and Whitewater River watershed dams in Butler and Harvey counties. After introductions and exercise explanation, the facilitator presented an emergency scenario involving heavy rains and floodwater making roads impassable. Next, she reported flooding one foot below top of dam and an emergency spillway flowing at full capacity at another dam along with a small sinkhole in the reservoir area. The last part of the scenario concerned the notice of severe erosion and headcutting on one dam and at the other site, a sinkhole doubling in size. During the discussion, EAP steps were reviewed and event log procedures detailed. At the EAP tabletop conclusion, the 17 attendees signed the dam EAPs that later were mailed to DWR and distributed to involved agencies and individuals.



Tabletop File Notes

The city of Horton held a Mission Lake Dam emergency action plan tabletop exercise attended by Division of Water Resource staff as well as area emergency responders; city representatives and police; school superintendent; utility company and road representatives; and National Weather Service employee. Evacuation route planning if the 36.3' tall dam failed proved to be a key discussion topic with questions regarding accessible routes. Participants also expressed concern regarding manpower, water flow timing following dam breach onset, patching materials, and realistic notification. In addition, participants updated telephone numbers and



SAMPLE EAP EXERCISE FORMS

TABLETOP EXERCISE SCENARIO EXAMPLE

The City of _____ has been excavating downstream of the dam and wants to breach the dam to draw down the lake. That's because they want to do a fish kill and fix some spots in the riprap. Instead of informing the Division of Water Resources about breaching requirements, the city manager told city workers to cut into the crest on Friday night "just a little bit" so water could slowly drain.

However, a spillway design routing error, continual rains, and an inexperienced backhoe operator have just resulted in a call from a jogger who said a stream of water is coming from the area by the dam top.

Not only is it Memorial Day weekend, which means the lake's campsites are in use, it's also the day the Kansas Adventure Scouts are hosting a geocaching event and the high school alumni association is hosting a noon picnic in the park. A lot of residents, too, are on vacation, including several from the city departments.

What are you going to do?

INVITATION EXAMPLE

This exercise is part of the safety planning for the city of _____ and the state of Kansas in the event the dam would fail. As with any plans, training is essential to evaluate each agency's role and work out any possible complications.

Representatives from [list specific organizations, such as Kansas Department of Agriculture Water Structures Program, Kansas Department of Transportation, county commission members, county emergency management, county sheriff's office, city commission, public works department, city police department, city fire department, local school district, news agencies, American Red Cross, and downstream property owners] will be present.

Attendance by a representative from each listed agencies is imperative to the success of this exercise. Only by working together in the planning and exercise stages can we better safeguard the public.

Please contact [name, phone number, and email address] to confirm your attendance or with any questions.

Sincerely,

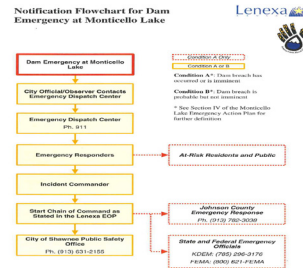
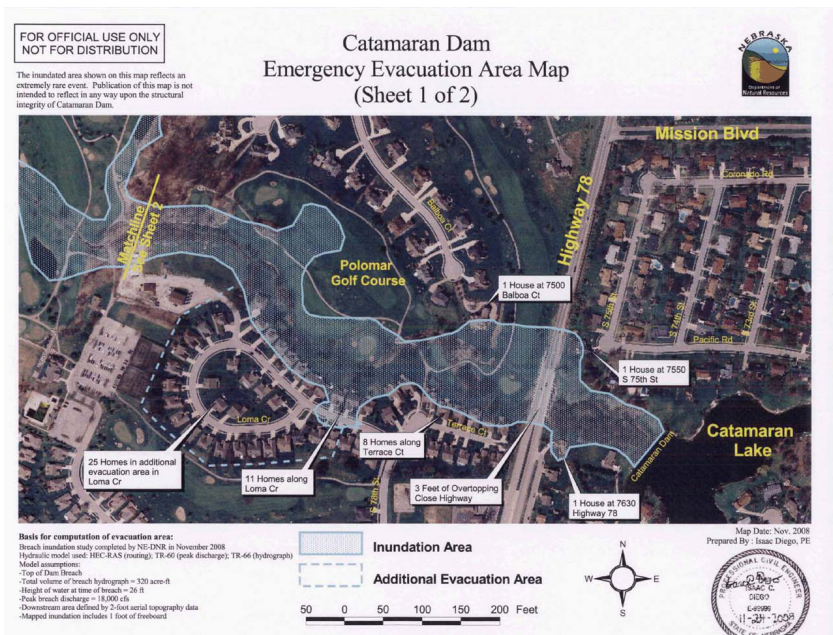


Figure A-1

PARTICIPATION ACKNOWLEDGEMENT LETTER EXAMPLE

Cooperative partnership is what makes resolution of critical incidents smooth and decisive. I wanted to take the time to thank each of you who attended the recent [name of dam and reservoir] emergency action plan exercise. Your attendance, attention, and participation showed a pledge toward that cooperative partnership.

More exercises such as this one will be offered in the future to keep this possibility fresh in the minds of those who will be responding as well as prompting any new ideas and issues with the current emergency action plan. Again, I thank you for your time and commitment to proactive response and for coming together to work critical incidents through as a team. This continued cooperation will enable us to handle future incidents with success.



DAMS DO FAIL IN KANSAS

While Kansas hasn't had catastrophic dam failures as many states have, it does have dam failures, especially during flood events.

Known examples in a recent 10-year span

Dam overtopped upstream of feedlot and lagoons during flooding.



Clark County

Dam breached, rebuilt, and breached three years later.



Republic County

Dam overtopped twice in one year.



Dickenson County



Wilson County

Dam break resulted in silt and rubble deposit that ruined another's downstream crops and field.

Osage County

The prevailing mechanisms for earth-dam failure can be traced to several causes.

These causes can be classified into: (1) hydrologic and (2) geotechnical failures.

Eventual development of a breach compromising a certain length of embankment is the result of failure.

Dam-breach studies have shown the shape and time evolution of the breach determine to a large extent the characteristics of the out-flow hydrograph.

SDSU Civil Engineering Series, No. 82149



Dam failed 2005 during installation of pipe and subsequent storm.

**EMERGENCY ACTIONS
OVERTOPPING**

Open outlet

Sand bags on crest

Cover weakened areas of crest and downstream slope with riprap, plastic sheeting, etc. to provide erosion resistance

Dam breached during flooding.



Doniphan County

