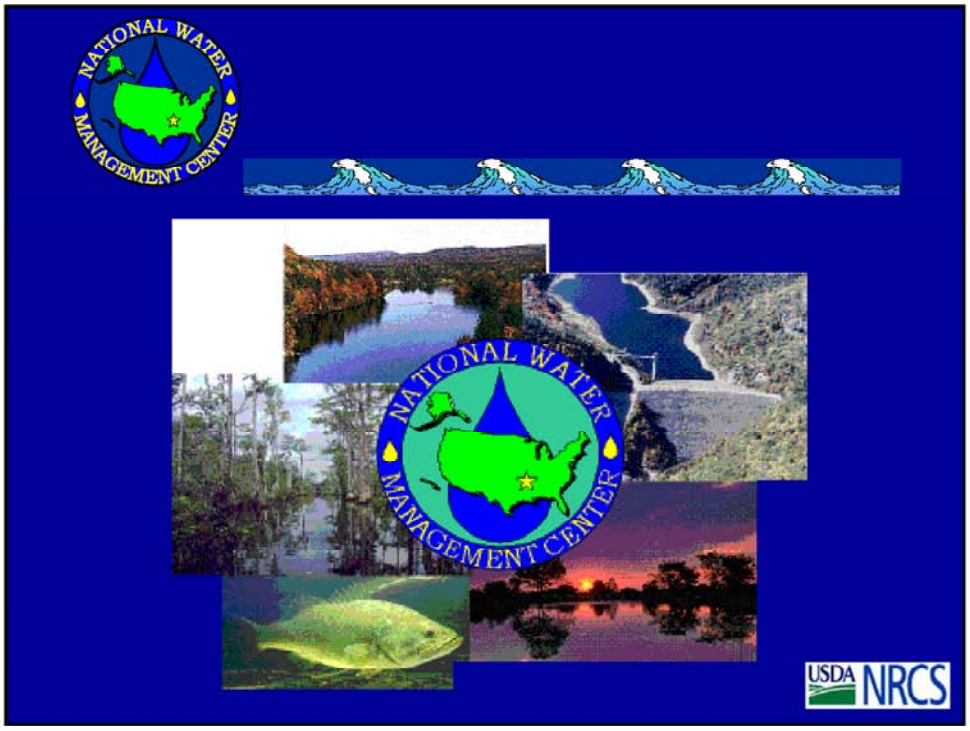
Presentation 9:
General Discussion — NRCS Designs and Research Needs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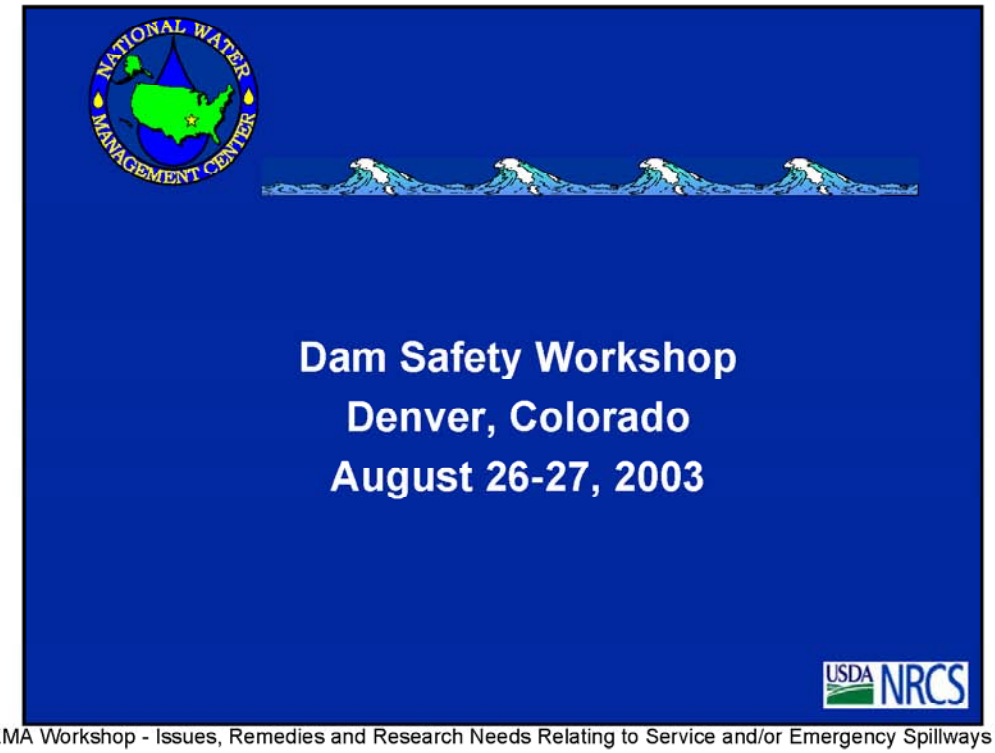

NATIONAL WATER MANAGEMENT CENTER
Dam Safety Workshop
Denver, Colorado
August 26-27, 2003
USDA NRCS

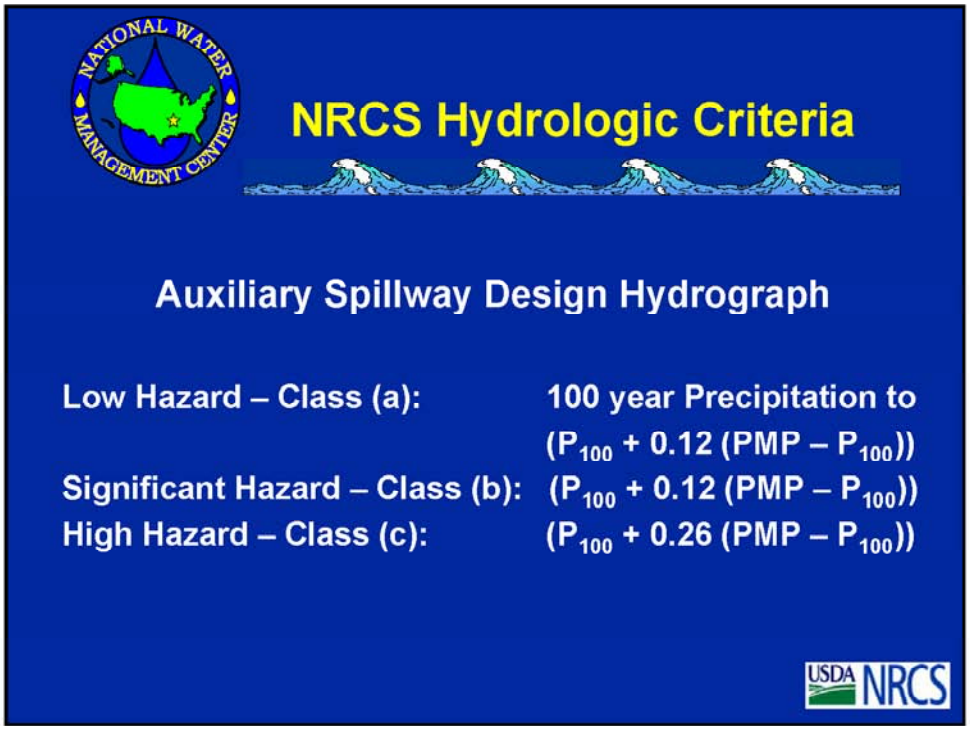
NWMC Functions

- Direct Technical Assistance
- Consultation and Training
- Watershed Plan Development and Review
- Linkage to Other Specialists

NRCS Hydrologic Criteria

Maximum Frequency of Use for Vegetated Auxiliary Spillway
(Storage above the Principal Spillway)

Low Hazard – Class (a):	25 year Precipitation to 50 year Precipitation
Significant Hazard – Class (b):	50 year Precipitation
High Hazard – Class (c):	100 year Precipitation


NRCS Hydrologic Criteria
Auxiliary Spillway Design Hydrograph
Low Hazard – Class (a): 100 year Precipitation to (P_{100} + 0.12 (PMP – P_{100}))
Significant Hazard – Class (b): (P_{100} + 0.12 (PMP – P_{100}))
High Hazard – Class (c): (P_{100} + 0.26 (PMP – P_{100}))
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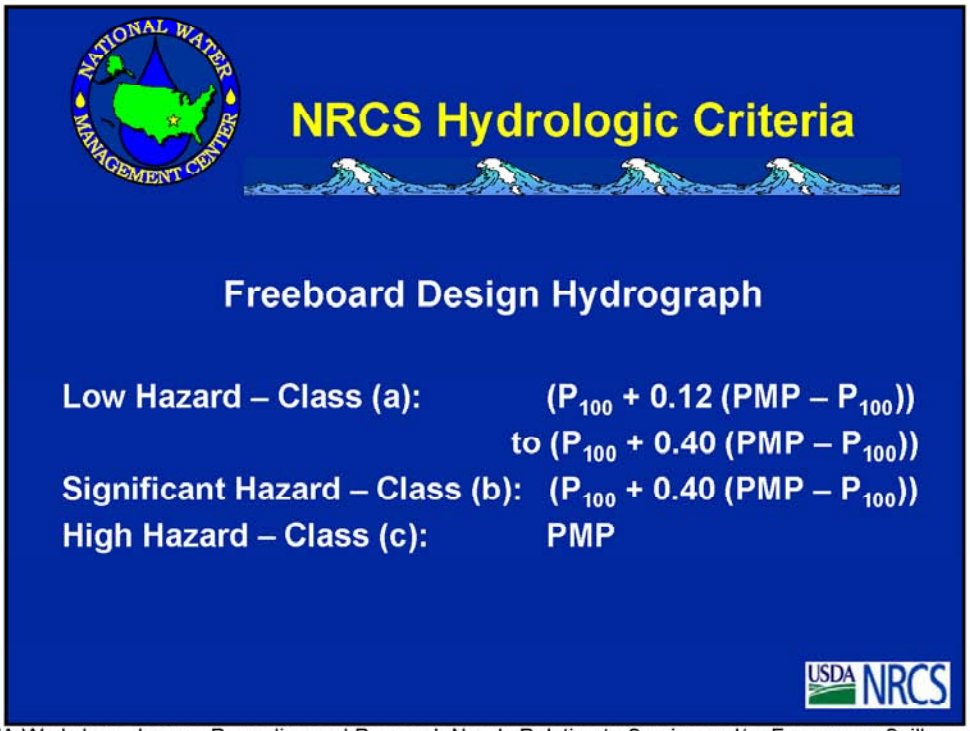
NRCS Hydrologic Criteria
Freeboard Design Hydrograph
Low Hazard – Class (a): (P_{100} + 0.12 (PMP – P_{100})) to (P_{100} + 0.40 (PMP – P_{100}))
Significant Hazard – Class (b): (P_{100} + 0.40 (PMP – P_{100}))
High Hazard – Class (c): PMP
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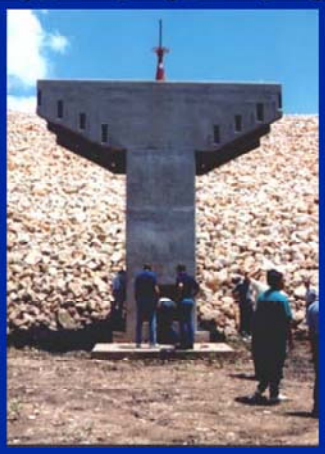
NRCS Principal Spillway

NRCS Principal Spillway



NRCS Principal Spillway

NRCS Vegetative Auxiliary Spillway

NRCS Vegetative Auxiliary Spillway

USDA NRCS

NRCS Vegetative Auxiliary Spillway

USDA NRCS

NRCS Straight Drop Auxiliary Spillway

USDA NRCS

NRCS Straight Drop Auxiliary Spillway

USDA NRCS

NRCS Roller Compacted Concrete Auxiliary Spillway

Research Needs

- Erosion Model for Breach Determinations from Dam Overtopping
- Peak Discharges from Erosion Breaches
- Stilling Basin Design for RCC Stepped Spillways
- Revised Rainfall/Frequency Maps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http://wmc.ar.nrcs.usda.gov
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Presentation 10:
Spillways — An Owner's Perspective

Spillways

Owners Perspective

Spillways

- PMP/PMF
  - Old Story…
  - But it is time to take another look!

Spillways – Recent History

- It appears that the upward ratcheting of spillway capacity has slowed…at least a little
- Phase I (1978) identified over 60,000 + dams, most were non federal, earth dams with "inadequate" spillways

The Problem

- Because most of the 60,000 dams are privately owned dams, many can not afford to meet the spillway criteria currently required
- A few owners that can comply (BUREC, FERC Regulated Dams, and Large Utilities) have the funds…most others do not

Spillways

- Most of the problems with private dams have been addressed except in the area of spillways
- Billions have been spent, storage has been lost … and still there are many dams that do not have “adequate” spillways
- The primary driver is the precipitation derived from HMR’s– the PMP

PMP/PMF – WHY?

- The National Weather Service (NWS) introduced the PMP/PMF primarily for COE and other federal dams
- This technology was transferred to private dams (first large then small dams) with little thought about the increased costs to the private sector

Problems with Using HMRs

- Infrastructure costs are simply too high and so states and local governments have invented creative ways to work around the numbers:
  - Incremental Damage Studies
  - "Site Specific" Hydrologic Studies
  - "Grandfathering"
  - Changing Precip. requirements for classes of dams
  - Changing definitions of dam classifications
  - Risk based analysis

More Problems with HMRs

- Data that supports the HMR findings is often lost or can not be supported by the record
- The CORE or the BUREC have not found the "need" or the money to further the science of extreme precipitation events
- The procedures used in the HMR are not well understood and are considered by most to be too conservative

Questions

- Was and is the NWS the right agency to plant the PMP seed that resulted in so many spillways to be inadequate?
- After 25 years, do we need to take another look at why we need “zero” risk when it comes to spillways?

More Questions

- With new techniques and computer models that have been developed in the past 25 years, should new methods and criteria be developed and instituted (site specific)
- With the variety of “state by state” criteria, why should people in one state be more or less protected than other people in another state?... Isn’t there a need to apply the criteria uniformly?
- Is a 5,000 or 10,000 year storm large enough?

Proposal

Have National Academy of Science (Engineering) or similar group:

- Re-review the idea that the PMP level of storm event vs need to protect the public at all costs and risks

Proposal (cont.)

- Develop a new techniques for the PMP/PMF to be used nationally… by all states
- Develop new computer models that are simple to use and understand, easy to update with new precipitation data
- Keep it simple and keep it cost effective for owners

Presentation 11:
General Discussion — Consultant's Spillway Design and Research Needs

Hydraulic Structures Technical Committee

To promote and/or advance research, analysis, design, construction, operation and maintenance of state-of-the-art methodology associated with hydraulic structures.

To accomplish this purpose, the committee proposes and organizes task committees and/or subcommittees to complete projects which advance the science. In addition, the committee promotes the technical exchange of ideas through sponsored sessions at conferences, publications of reports, papers, and monographs, and interaction with other professional and technical societies.

http://www.wadepmoore.com/HSTC/

Hydraulic Structures Technical Committee

Current Membership

• John Hite	Waterways Experiment Station
• Bruce Muller	USBR Technical Center
• John Finnie	University of West Virginia
• Bruce Brand	FERC
• Kevin Nielsen	Carroll College
• Kerry Robinson	USDA - Agricultural Research Service
• Rick Voigt	Polaris Group
• Walt Heyder	USBR Technical Center
• Mike Buechter	Parsons Brinckerhoff Quade and Douglas
• John Laboon	USBR Technical Center
• Wade Moore	Montgomery Watson Harza
• Yifan Zheng	Bechtel
• Richard Stockstill	Waterways Experiment Station

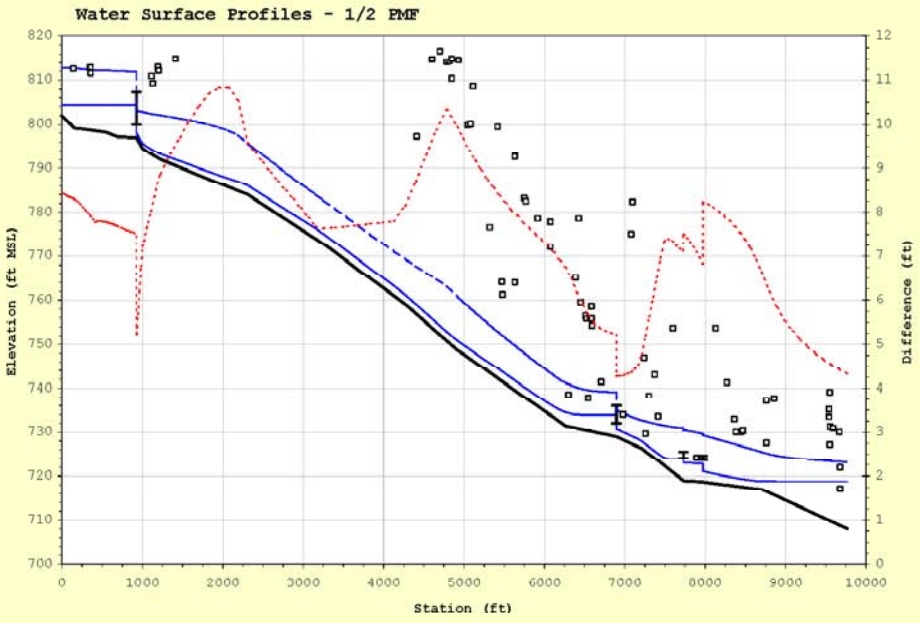
Spillway Expansions by Harza

Cushman I	1990	Conventional Spillway
Brule	1991	Fuse Plug
Ponca	1992	Overtopping - RCC
He Dog	1993	Overtopping - RCC
Blue Ridge Dam	1994	Conventional Spillway
Boney Falls	1994	RCC Fuse Plug
Bald Hill	1997	Overtopping - Conventional Concrete
Devil's Gate	1999	Conventional Spillway
Big Dalton	2000	Modify Outlet Works
Granite and Crystal Dams	2000	Fuse Plug
Middle Branch	U/C	Overtopping - RCC

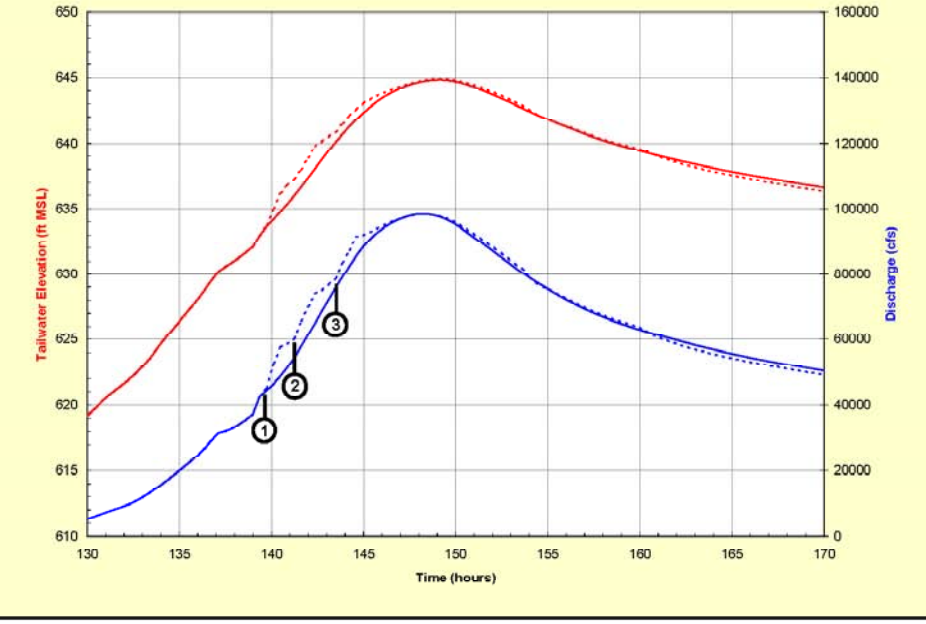
Dam Failure Analysis

- Develop 1-D Unsteady Flow Model of System
- Use FERC criteria to "control" outflow from reservoir
  - 1:1 Side Slopes
  - 2h-4h Breach Width
  - 0.1-1.0 hour Failure Time
  - Failure at Peak Water Elevation
- Perform Sensitivity Analysis
- Perform IDF Analysis
  - Largest Inflow that does not raise water levels d/s more than 2 feet

Dam Failure Analysis



Dam Failure Analysis



Research Needs

- Overtopping Protection - economics of slab vs RCC
- Rip-rap stability – dumped vs hand placed
- Fuse Plugs – speed of erosion, trigger mechanisms, smaller sizes
- Fuse Gates – ice, debris, seals
- "Single" Use Spillways - allowable damage and repair
- Small Spillways - rock chutes, etc.
- Exceeding Design Head - damage prediction
- Conventional Chutes - converging walls, supercritical transitions
- Stepped Spillways - step size and shape vs head loss

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