Kentucky Dam Safety and Floodplain Compliance

Celebrating 10 years
KAMM Conference
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WHY SHOULD YOU BE CONCERNED WITH DAMS IN YOUR COMMUNITY?

Benefits:

Provides a Water Supply, Electrical Power, Irrigation, Livestock Water Supply, Containment of Mine Tailings, Transportation of goods, and Reduction of Flooding to Agriculture land as well as Homes and Businesses for your community.

Example SODR project: Willisburg Lake Dam – State owned – Only Water Supply for City of Springfield and County of Washington with no interconnection

Economics:

Brings in MONEY into your community: Hunting and Fishing, Recreational, Golf Courses, Factories, Businesses, Sub-divisions around lakes increase tax base, etc. Potentially lower flood insurance rates for community.

Example current state owned dam project: Bullock Pen Lake Dam – State owned – Provides fishing, recreation, Bullock Pen water supply, and tax base for approximately 55 properties around the lake

Example SODR project: Beech Creek Lake Dam – State owned – City of Manchester / Clay County Water Supply – Provides fishing, recreation, and a community park for community.

Risk:

Flood damage with or without a dam.
Kentucky Division of Water

• **Mission**
  • To manage, protect and enhance the quality of the Commonwealth’s water resources.

• **Primary Responsibilities**
  • Dam Safety and Floodplain Compliance
  • Floodplain Management / Risk MAP / NFIP
Kentucky’s Dam Safety Program

- Kentucky Revised Statutes 151 and Kentucky Administrative Regulations KAR 401 (4:030, 4:060) define Kentucky’s Dam Safety Program
  - Defines authority (enacted 1966 / amended 1990)
    - Administer and Enforce
    - Inspect / Assess
    - Permit
    - Set Standards
      - Safety / O&M

- Dam Inventory
  - 1073 dams
    - 18% high hazard
    - 82% low or moderate hazard

Ownership:
- 648 private
- 425 public

Regulated dams in 116 of 120 counties
Past vs. Present and Future

More conservative answers to solutions because of limited resources

- Land Surveying vs LIDAR
- HEC-RAS vs Geo-HEC-RAS
- NWS Simplified Dam Break and Dam-BRK vs HEC-RAS, FLO-2D, Geo-Dam-BREACH, and DSS-WISE

More refined financially feasible answers to solutions because of better data and engineering tools
What is a Dam?

• Definition based on 401 KAR 4:040 Section 2

• Minimum of 25 feet in height measured from the downstream toe to the top of the dam, or

• Impounds 50 acre-feet of water, measured at the top of dam, or

• Poses a hazard to life or property.
## Permits for dams

### New dam

**Required when:**

- Height of dam > 25 feet from downstream toe to top of dam
- Top of dam storage > 50 acre-feet
- Dam will pose a potential for loss of human life
- Dam is built across a stream as defined by KRS 151

### Existing dam

**Required when:**

- Modification or alteration is beyond the scope of routine maintenance.
- Change in operating procedures.
- Change in spillway height or dimensions.
- Conditions of permit may require meeting all current criteria for existing dams.
KRS 151.295 & KRS 151.293

Dam Safety Inspects:

- High and Moderate Hazard dams every 2 years.
- Low Hazard Dams every 5 years.
- Generally takes an hour.
- Inspectors look for:
  - Embankment items: **stability, vegetation, rodent burrows, erosion, seepage.**
  - Principle spillway: **debris, seepage, corrosion, cracking.**
  - Emergency spillway: **vegetation, erosion, debris.**
  - Ability to operate drains.
  - Downstream development.
  - Report is sent to the owner and filed.
When a tree grows on a dam
Hazard Classification

- Based on the potential consequences of failure.

- Classifications are Low, Moderate, and High.

- Hazard Classification can change as the consequences of failure change. (Downstream land use changes)

- Independent of condition and quality of existing or proposed dam.
Low Hazard Dam

Potential damage limited to:
- Loss of dam
- Loss of livestock
- Farm out-buildings
- Ag land
- Little used roads
- Loss of life unlikely
Moderate Hazard Dam

Potential damage limited to:

• Industry or commercial buildings
• Moderately traveled roads or railroads
• Interruption to utilities
• Public water supply
• No risk of loss of life
High Hazard Dam

- Failure may cause a threat to or loss of human life.
- Failure may result in serious damage to:
  - Residential, industrial or commercial areas
  - Important public utilities
  - Public buildings
  - Major transportation facilities
Hazard Classification Change

• When downstream conditions change, hazard classification can change.
• DOW normally assess the hazard classification of dams when performing routine inspections.
• DOW cannot control downstream development that complies with floodplain regulations.
• Dam breach flood often exceeds the 100-year flood event.
• Local ordinances can prevent some development.
• Dam owner can obtain downstream easements.

• Dam Safety may require upgrades or removal if the dam does not meet requirements for the current hazard classification.
• Upgrades may include enlarging the spillway, raising the dam or lowering the normal pool elevation.
• Dam removal may be the least expensive alternative and must be done in a controlled manner.
Red Lick Creek MPS 1 - Owsley Fork – Berea Water Supply – Owned by Berea College
Designed by NRCS as Moderate Hazard and due to development has been reclassified as a High Hazard
Kentucky’s Dam Safety Program

• Open to New Technology and Approaches
  – Construction and structural rehabilitation of dams

This RCC Dam at Winchester was one of the first of its kind designed and built in 1985 – 2\textsuperscript{nd} in Country
Kentucky’s Dam Safety Program

Guist Creek Lake Dam
• Labyrinth weir (One of the first constructed in U.S. - 1999).
Kentucky’s Dam Safety Program

Fox Creek MPS 4 (PLU 566 dam)

- Upgraded to meet high hazard requirements
- Stepped Roller Compacted Concrete spillway (1st in Kentucky) - 2012.
  - Pilot working for NRCS.
  - Approval by the Dam Safety program was a programmatic paradigm shift.
Kentucky’s Dam Safety Program

• Vision
  • Improved Service
  • Enhanced Productivity
  • Better Accuracy

• Challenges
  • Knowledge transfers to next generation employees / dam owners
  • Transitioning from paper files to electronic
    • Dam Safety paper file security
  • Improving the database
  • Updating National Inventory of Dams (NID)
  • Testing new tools (Geo-Dam-BREACH, DSS-WISE, HEC-RAS 2-D, and FLO-2D)
  • Kentucky Dam Safety Advisory Council
  • Considering a modern PMP Study
  • Updating Dam Safety regulations and Engineering Memorandum No. 5
  • Emergency Action Plans (EAP’s)
Kentucky’s Dam Safety Program Strategy

• Strategic Partnerships

  • Association of State Dam Safety Officials (ASDSO)
  • Dam Safety Advisory Council
  • Federal Emergency Management Agency (FEMA) National Dam Safety
  • Federal Emergency Management Agency (FEMA) Risk MAP
  • Kentucky Association of Mitigation Managers (KAMM)
  • Kentucky Department of Fish and Wildlife (KYF&W)
  • Kentucky Department of Parks (Tourism)
  • Kentucky Emergency Management (KYEM)
  • Kentucky Transportation Cabinet (KYTC)
  • National Weather Service (NWS)
  • Natural Resource Conservation Service (NRCS)
  • University of Kentucky Hazard Mitigation Grants Program
  • University of Louisville Center of Hazards Research
  • United States Army Corps of Engineers (USACE)
  • United States Geological Survey (USGS)
Kentucky’s Dam Safety Program

- Kentucky’s Strategic Projects
  - Lake Beshear Dam
    - Better engineering model → Reclassified dam
  - Spurlingtonton Lake Dam
    - Better engineering model → Purchased downstream residences and property → Reclassified dam
  - McNeeley Lake Dam
    - Better engineering model → Maintained classification*
      *Downstream zoning change ensured permanent classification
  - Willisburg Lake Dam
    - Better engineering model → Identify residences to purchase? → May be able to reclassify dam?
Kentucky’s Dam Safety Program

- Strategic Projects – Kentucky Dam Safety Mitigation Project
  - Original Scope
    - Validate hazard classification
      - 100% (~200) of state-owned and locally owned dams
    - Dam failure inundation modeling and mapping
    - Risk mitigation planning
    - Emergency Action Plans (EAP)
    - Catastrophic Long-Term Response Plans (CLTRP)
    - Expanded outreach and education
Kentucky’s Risk Map integration into Dam Safety

- Useful for:
  - Community Dam Safety Awareness
  - Dam Owner Risk Awareness
  - Dam Owner Risk Mitigation

Leverage Risk Map’s Non-Regulatory (Prototype)
- Per each dam studied
- FEMA’s Risk MAP Products

Strategic Projects
- “Proof of Concept” - Avoid large dam capital improvement projects through:
  - Better engineering
  - Better data
  - Downstream risk mitigation
  - Outreach and education
Kentucky Dam Safety Modernization Tools – Inundation Zone Mapping

- **FEMA National Dam Safety Semi-automated Inundation Mapping**
  - Extracts data from portal, models various dam failure modes
  - Computes and maps dam failure inundation boundaries
Kentucky Dam Safety Modernization Tools – Risk Screening

- **Semi-automated** NRCS/USBR tool with *FEMA HAZUS-MH*
  - Incorporates damages and Population At Risk (PAR) from dam breach
  - Provides metric to consistently / objectively rank dams
Illustrates the difference between 1% annual chance (formerly named 100 year flood) floodplain and various breach scenarios

Useful to:

- Pursue Easements
- Pursue Mitigation
- Support Emergency Action Planning
- Support Long-Term Recovery Planning
Inundation Depth Grids

Communicates depth of water in inundation areas

Useful to:
- Assess Risk
- Evacuation Routes
- Pursue Mitigation
- Support Emergency Action Planning
Kentucky Dam Safety
Datasets - Velocity Grids

- Communicates the velocity of water in inundation area
- **Useful to:**
  - Communicate flood risk
  - Evacuation Routes
  - Pursue Mitigation
  - Support Emergency Action Planning
Kentucky Dam Safety Datasets – Depth / Velocity Severity Grid

- Illustrates Combined Effects of Depth and Velocity
  - Indicates areas of high potential risk
    - Loss of Life
    - Property Damages

- Useful for: To target / prioritize mitigation
Kentucky Dam Safety
Datasets - Flood Wave Arrival Time

- Useful for:
  - Emergency Action Plan
  - Emergency Response
- **Hazard Classification Validation**
  - User Defined Facilities (UDF)
    - PVA Data

- **Risk Assessments**
  - Parcel or building footprints (PVA)
  - NOT Census block-based!

- **Includes attributes:**
  - Scenario ID
  - Actual losses
    - Building ($) / Content ($)
    - Inventory ($)
  - Percent damages
    - Building / Content
    - Inventory

- **Useful for:**
  - Prioritizing mitigation
Kentucky Dam Safety - Datasets

Inundation Zone

Critical Facilities

- Risk Assessments
  - Not limited to typical definition

- Includes attributes:
  - Scenario ID
  - Facility Name
  - Flood Stage
  - Description
    - Primary Hospital for 3 county area
    - The only fire station for the community.
    - Factory that employs 30% of county’s workforce

- Useful for:
  - Targeting mitigation
  - Long-Term Recovery Plans
Risk of Kentucky’s Dams - Datasets
Emergency and Recovery Plans

- **Emergency Action Plans (EAP)**
  - IDs Primary / Secondary Dam Failure Response Stakeholders
  - Address At-Risk Populations
  - Flood Wave Time Dependent

- **Catastrophic Long-Term Recovery Plans (CLTRP)**
  - Dam Function Specific
    - Water Supply
    - Flood Control
    - Recreation
    - Power
Useful to your Mom:
- Communicating risk
- Promoting preparedness and mitigation
- Provides Snap-Shot of dam safety risk preparedness

Report Card: Short-cut to understanding Risk
Kentucky Dam Safety Modernization Tools - Field Reconnaissance

• Supports Dam Inspection / Field Data Collection
  – **Arc-GIS Mobile Application**
    • *GPS linked*
    • Tablet/Handheld device (Beta Testing several devices)
  – **Database Driven**
    • Promotes Consistency
    • Allows Rapid Data Input
      – Observations / Remarks / Photographs
      – Deficiencies / Recommendations
• Supports Dam Inundation Zone Encroachment Inspections
  – Avoids Hazard Classification Creep
  – Avoids Future Risk
Kentucky Dam Safety Modernization Tools – Portal

• Working on Data Portal to Support Dam Safety Program Functions
  – Data Management
  – Inspections
  – Reporting
  – Communications
Kentucky Dam Safety Modernization
Future Direction

• Moving forward – So, where are we headed?

• Integrate new processes and auto-tools
  • Integration of Field Data Collector into SOP
  • New database
  • Integration of CHAMPS / IFLOOD
  • Expand dam safety education and outreach
  • Integration with KY All Hazard Mitigation Plans

• Implement projects and Expand analysis to ALL dams
  • Solicit partnerships
  • Reduce risk
  • Communicate risk
  • Expand compliance

Partners:

FEMA, KACo, Ky F&W, Ky Tourism, Ky EM HMGP, KLC, NRCS, KYTC, NWS, USACE, USGS, Private Parties
What has YOUR Dam Safety staff been doing for you lately!
Kentucky Dam Safety’s 1sts

- Hazard Mitigation Grant – Risk Assessments
- Top User of Homeland Security’s DSS-WISE
- FEMA Pilot Project – Model Comparisons
- Dramatically increasing number of EAP’s
- FEMA grant to develop inspection tool and database
- Revolution of Dam Safety while still keeping up with current workload
So, Why should you be concerned with dams?

Benefits:

Every community must have water!

Economics:

Brings in money into your community!

Risk:

Flood damage with or without a dam.

So, How can you help us to work with you to sustain your community?

Partnerships, Maintaining Structures, Zoning downstream, and PVA data.
Kentucky Dam Safety and Floodplain Compliance

Mitigation comes in many different forms and really does matter

Questions / Comments

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