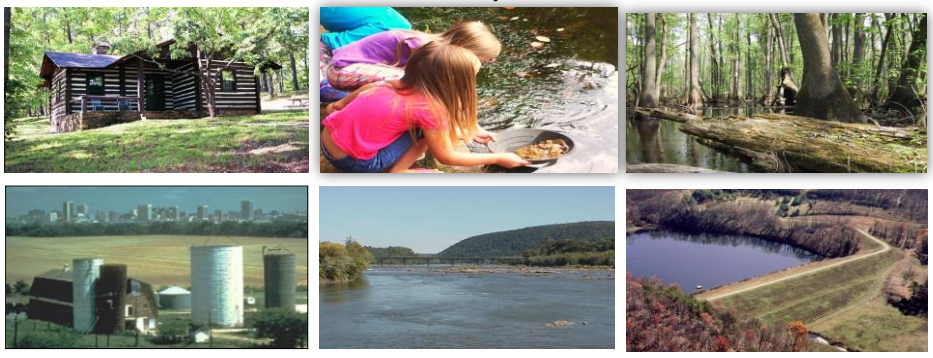
Virginia Department of Conservation and Recreation:

The Criticality of Virginia's Dams and Harnessing Technology to Provide Situational Awareness

Virginia Emergency Management Symposium

March 22, 2017



Dam Safety and Floodplain Management Program Purpose

- To provide for proper and safe design, construction, operation, and maintenance of dams to protect public safety.
- To coordinate the National Flood Insurance Program and to work with localities to establish and enforce floodplain zoning.

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Program Authority

Title 10.1; Chapter 6. Flood Protection and Dam Safety; Article 2
Dam Safety Act (§ 10.1-604 et seq. of the Code of Virginia)
http://law.lis.virginia.gov/vacode/title10.1/chapter6/

Impounding Structure Regulations (4 VAC 50-20-10 et seq.)
http://law.lis.virginia.gov/admincode/title4/agency50/chapter20/

Virginia Soil and Water Conservation Board Dam Safety Guidance
http://www.dcr.virginia.gov/dam-safety-and-floodplains/dcrdsdocs

3

Dam Safety Regions and Contacts

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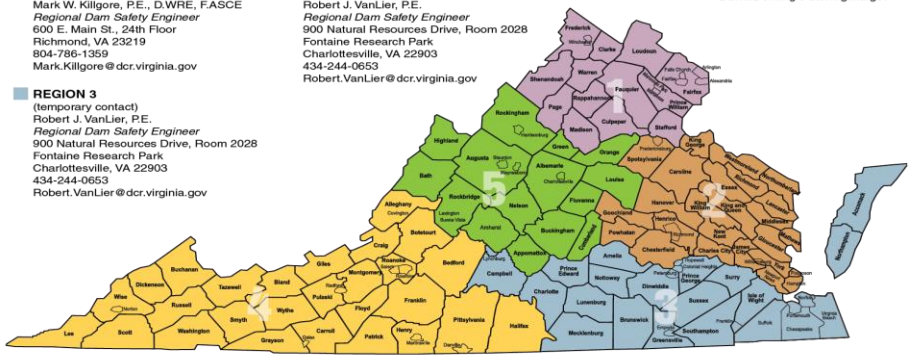

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3/7/17

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Dam Inventory

- 3550 in the Database
- 1579 Currently not regulated by DCR; largely exempt or unknown
- 1971 Regulated by DCR
  - 1775 Earthen (90%)

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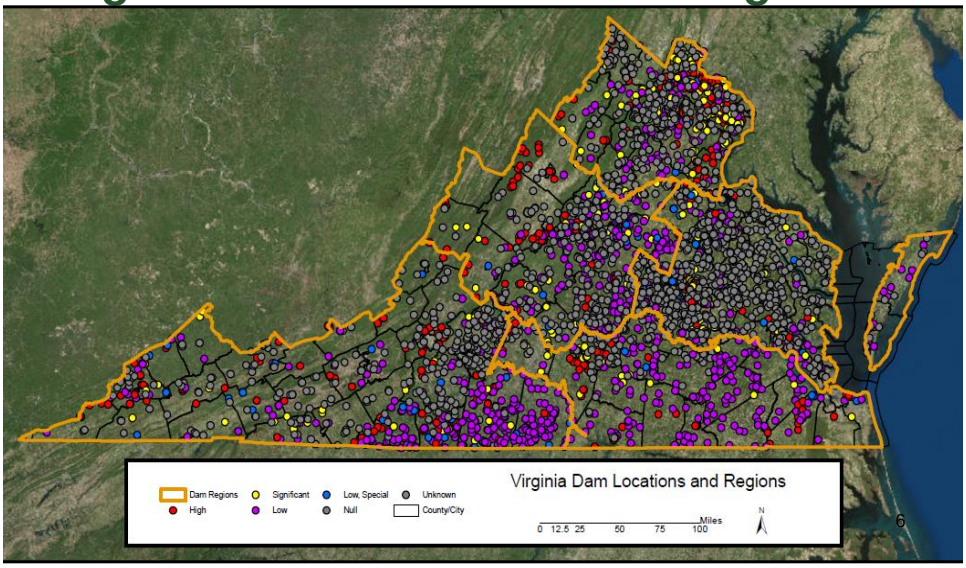
Virginia Dam Locations and Regions



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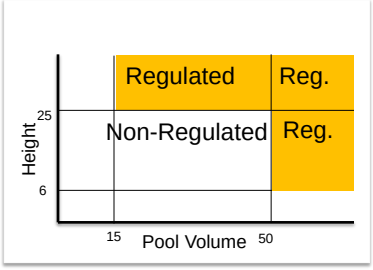
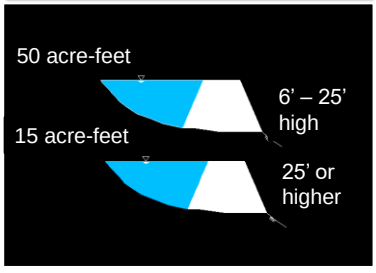
Regulatory Size and Volume Thresholds





All dams in Virginia "of size" are subject to the Dam Safety Act and Dam Safety Regulations unless specifically exempted. "Of size" includes:

- Structures 25 feet or higher, with maximum storage of 15 acre-feet or greater; and
- Structures 6 feet or higher, with maximum storage of 50 acre-feet or greater.

Exemptions

- Federally regulated; SCC regulated; agricultural use (<100 acre-feet or < 25 feet in height); mining dams.

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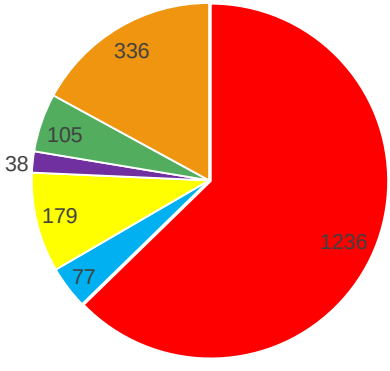
Ownership of DCR Regulated Dams

1971 dams



Private State Local Utility SWCD Unknown

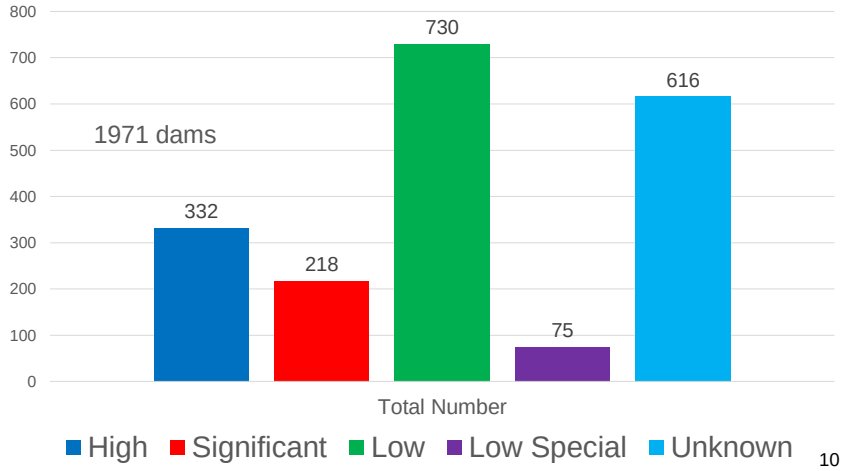
8

Hazard Potential Classification of Dams

- Dams are classified with a *hazard potential* depending upon the downstream losses anticipated in event of failure.
- Hazard potential is unrelated to the structural integrity of a dam. Rather, it is directly related to *potential* adverse downstream impacts *should* the given dam fail.
  - *High* - dams that upon failure would cause probable loss of life or serious economic damage
  - *Significant - dams that upon failure might cause loss of life or appreciable economic damage*
  - *Low - dams that upon failure would lead to no expected loss of life or significant economic damage. Special criteria: This classification includes dams that upon failure would cause damage only to property of the dam owner.*

9

Hazard Potential Classification (reg. dams)



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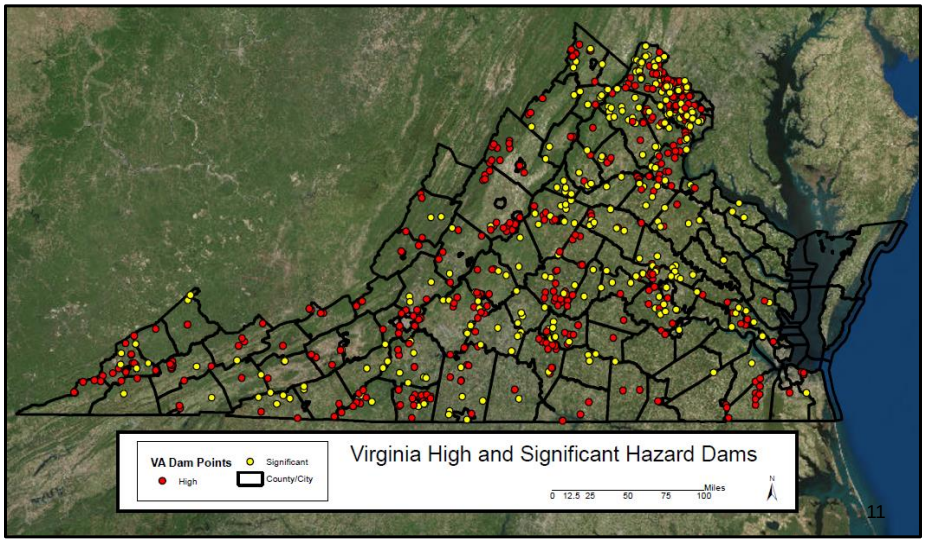
Virginia High and Significant Hazard Dams



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Required Spillway Design Capacity

TABLE 1
Impounding Structure Regulations

Hazard Potential Class of Dam	Spillway Design Flood (SDF)[B] for New Construction[F]	Spillway Design Flood (SDF)[B] for Existing Impounding Structures[F, G]	Minimum Threshold for Incremental Damage Analysis
High	PMF[C]	0.9 PMP[H]	100-YR[D]
Significant	.50 PMF	.50 PMF	100-YR[D]
Low	100-YR[D]	100-YR[D]	50-YR[E]

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PMP, PMF, SDF Relationship

- The Probable Maximum Flood (PMF) is calculated from the Probable Maximum Precipitation (PMP) and is the flood that might be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. (Considers present and planned land-use conditions.)
- Accordingly, from the PMP and subsequently the PMF, the Spillway Design Flood (SDF) is calculated and represents the largest flood that needs to be safely passed by the impounding structure.
- A sufficient spillway design is critical as a high percentage of dam failures are due to overtopping.
- It is advisable to consider a higher SDF standard than is required due to potential for future development.

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Old Methodology: HMR 51 PMP-24hr 1000 sq. mi. (23 points – hand drawn smooth lines)

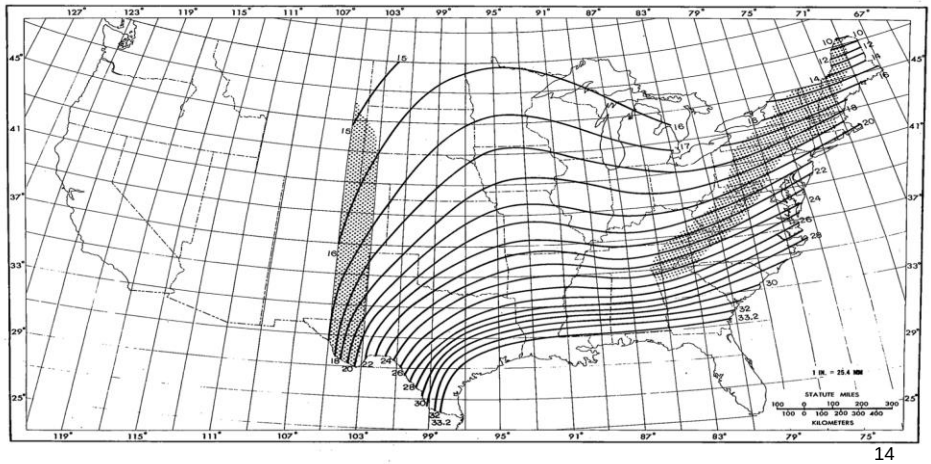

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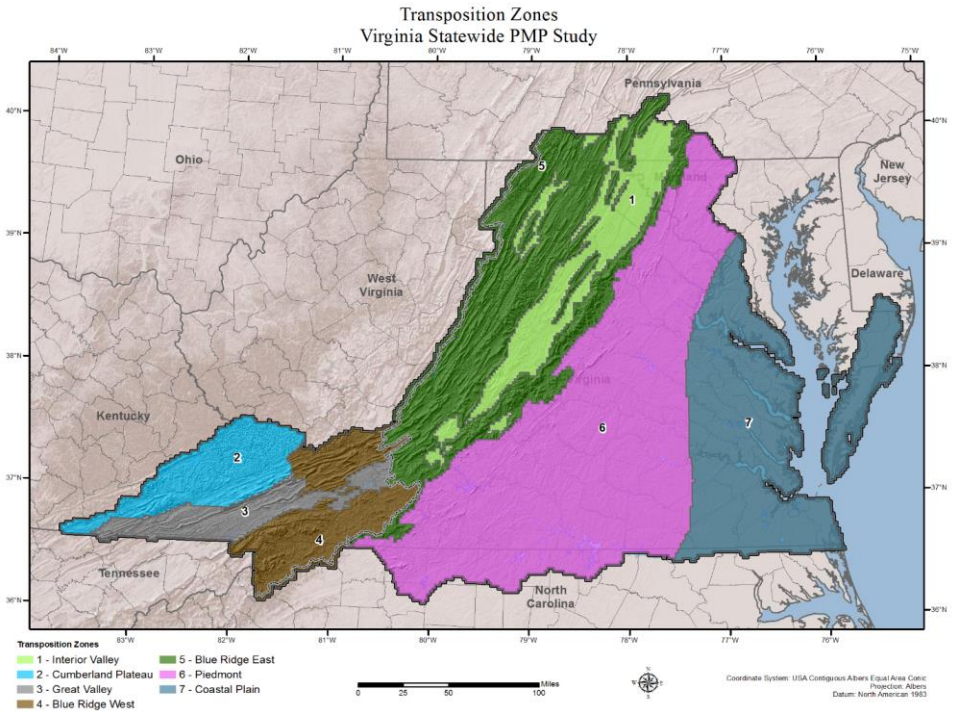
Figure 30.--All-season PMP (in.) for 24 hr 1,000 mi^2 (2,590 km^2).



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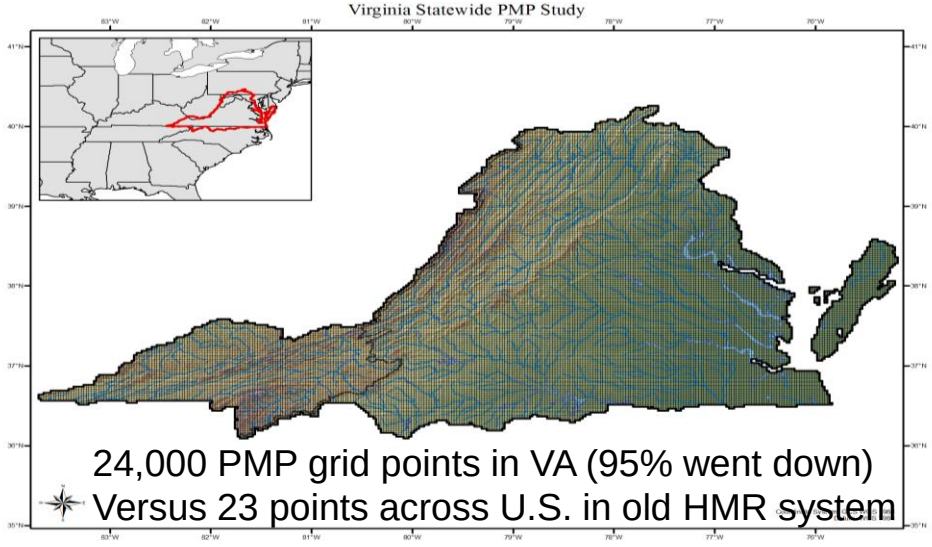
New Methodology Using the Virginia PMP Study



24,000 PMP grid points in VA (95% went down)
Versus 23 points across U.S. in old HMR system

Certificates and Permits

- The owner of each regulated dam is required to apply to the board for an *Operation and Maintenance Certificate*. The application must include an assessment of the dam by a licensed professional (Inspection Report), an *Emergency Action Plan* or and *Emergency Preparedness Plan*, a current dam break inundation zone map and modeling, a current hazard potential classification determination, a current SDF design, and the appropriate fee(s).
- An executed copy of the *Emergency Action Plan* (EAP) or *Emergency Preparedness Plan* (EPP) must be filed with the appropriate local emergency official and the Virginia Department of Emergency Management.
- The Board issues *Regular Operation and Maintenance Certificates* to the dam owner for a period of six years. If a dam has a deficiency but does not pose imminent danger, the Board may issue a *Conditional Operation and Maintenance Certificate*, during which time the dam owner is to correct the deficiency.
- No person or entity shall construct, begin to construct, alter or begin to alter an impounding structure until the Board issues a *construction permit* or an *alteration permit*.

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Continuing Inspections

- After a dam is certified by the Board, annual inspections are required either by a professional engineer or the dam owner, and the *Annual Inspection Report* is submitted to the regional dam safety engineer. Inspections by a professional engineer (P.E.) are required at the following frequency:
- *High* - two years;
- *Significant* - three years;
- *Low* - six years.
  - *Special criteria*: Inspections by a P.E. are not required for low hazard dams (special) determined to cause damage to only the dam owner's property, *but* the dam owner must still annually inspect the dam and submit a report.

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Current Enforcement Options for Regulated Dams

For unsafe but non-imminent situations

- Dam found “out of compliance”; letter sent outlining improvements needed and compliance date
- Owner fails to comply; Director issues administrative order
- Owner may petition Board for informal fact finding; Board shall afford opportunity for formal hearing and issues final order
- If owner fails to comply, DCR on behalf of the Board may refer the case to the Attorney General’s Office for enforcement by Court order.

For unsafe imminent situations

- Notify Virginia Department of Emergency Management and confer with the owner
- Governor may take action without a hearing
- Attorney General may seek Commonwealth’s expenses

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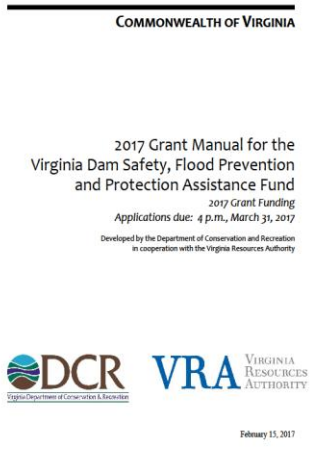
Dams-Grants Available

- Announced February 15, 2017
- $1.2 million available in grants from the Dam Safety, Flood Prevention and Protection Assistance Fund
- Application deadline of March 31, 2017



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Eligible Dam Safety Projects Include:

- Dam Break Inundation Zone Analysis, Mapping, and Digitization
- Probable Maximum Precipitation Impact Analysis and Certification
- Hazard Classification Analysis and/or ACER TM-11
- Emergency Action Plan Development
- Spillway Capacity Analysis
- Incremental Damage Analysis for Reduction of Required Spillway Design Flood
- Alternatives Analysis for Spillway Capacity and Stability
- Flood Warning and Response Systems such as IFLOWS
- Engineering and Design for one of the following:
  - Wave Berm Reconstruction
  - Graded Filter Drain and/or Toe Drains/Underdrains
  - Principle and/or Emergency Spillway and/or Trash Rack Repair/Replacement
  - Geotechnical Analysis for Dam/Spillway Stability
  - Outlet Basin Repair
  - Gate Valve Evaluation and Repair; Includes Other Water Elevation Control Mechanisms
  - Repair of Erosion or Deterioration of Dam and/or Appurtenant Structures

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Known Dam Failures 1995 - 2015

– At least 97 dams have failed.

– Four lives have been lost.

– 22 public roads have been washed out.

– 11 roads were still closed as of 2015.

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23

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Definition of an Emergency Action Plan

A formal document that recognizes potential impounding structure emergency conditions and specifies **preplanned actions to be followed to minimize loss of life and property damage**. The EAP specifies actions the owner must take to minimize or alleviate emergency conditions at the impounding structure. It contains procedures and information to assist the owner in issuing early warning and notification messages to responsible emergency management authorities. It shall also contain dam break inundation maps as required to show authorities the critical areas for action.

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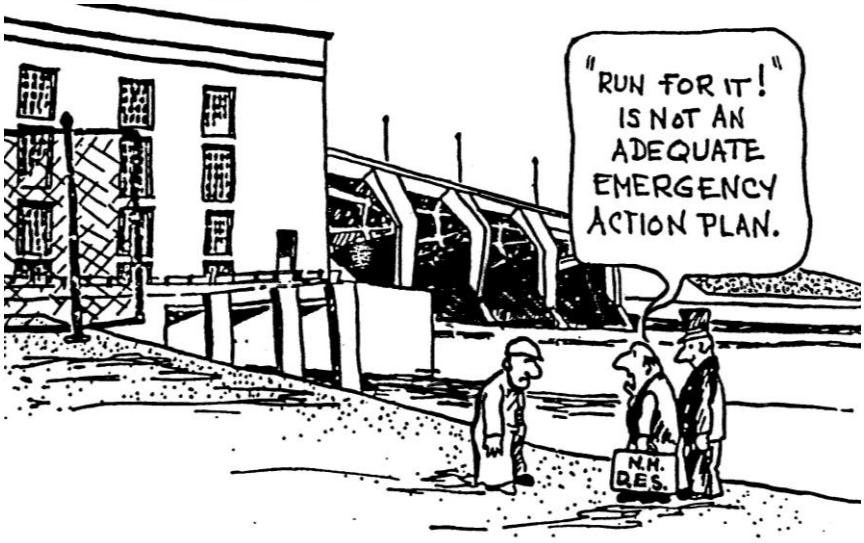

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Exercising the EAP

- A drill shall be conducted annually for each high and significant hazard dam.
- This Drill shall include a face to face meeting with local emergency management personnel.
- A Tabletop exercise shall be conducted once every 6 years. The Drills and Exercises shall be documented in writing to DCR once it is completed.
- All monitoring, sensing, and warning equipment in remote or unattended impounding structures shall tested a least 2 times per year. Testing documentation should be added to the appendences each test cycle.

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EAP Required Sections

9 PARTS: Regulation 4VAC50-20-175

- I. Certification
- II. Notification Flowchart
- III. Statement of Purpose
- IV. Project Description
- V. Emergency Detection, Evaluation and Classification
- VI. General Responsibilities
  - A. Owner
  - B. Notification Responsibility
  - C. Evacuation Responsibility
  - D. Termination/Follow Up Responsibility
  - E. EAP Coordinator
- VII. Preparedness
- VIII. Inundation Maps
- IX. Appendices

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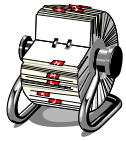
Implementing the EAP/EPP

Step 1 – Event Detection

Step 2 - Emergency Level Determination

- Stage 1: Non-emergency, unusual event, slowly developing
- Stage 2: Potential dam failure situation, rapidly developing
- Stage 3: Urgent - Dam failure is imminent or in process

Step 3 – Notification & Communication



Step 4 – Expected Actions

Step 5 - Termination

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Areas of Special Interest

- Schools
- Hospitals
- Roads
- Railroads
- Residential Dwellings
- Businesses
- Towns & Cities
- Parks
- Downstream dams & reservoirs
- Utilities

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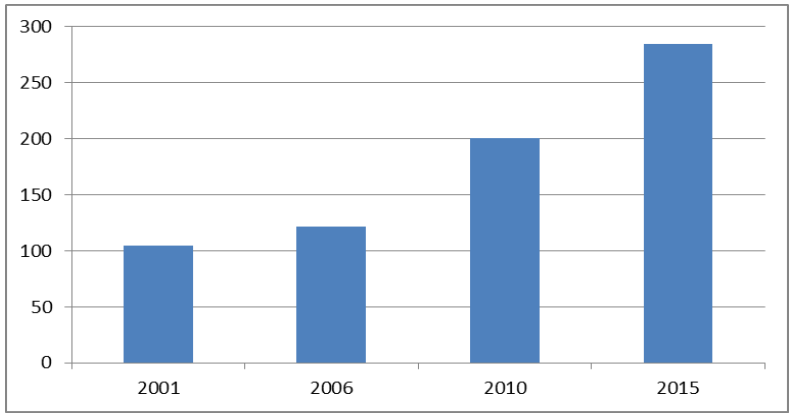
Number of High Hazard Potential Dams with an EAP



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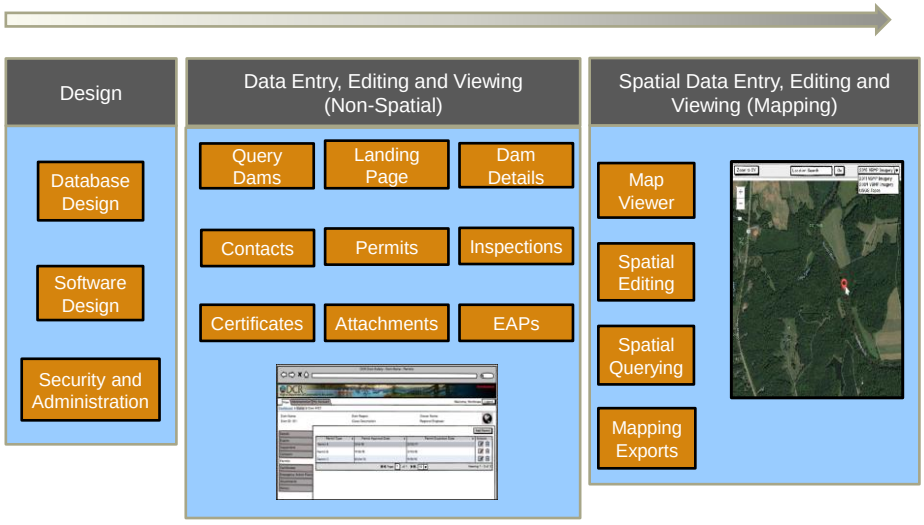
Phase 1 – Data Management Foundation



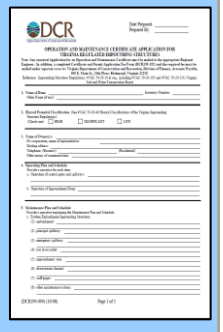
Phase 2 – Participant Interaction and Emergency Management

Conversation Tracking

- Enforcement Actions
- Event Log

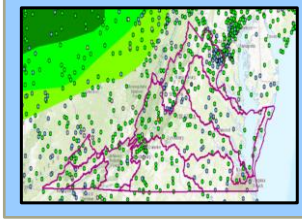
Participant Form Submissions

- Form Generation
- Form Fees
- Form Submissions

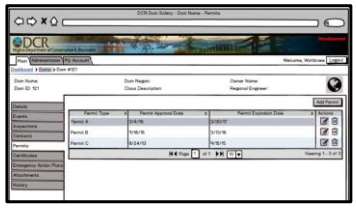


Emergency Management

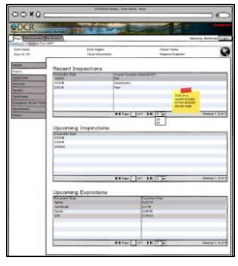
- EAP Dashboard
- Map Services (Real Time)



Dam Data Entry, Editing, and Viewing



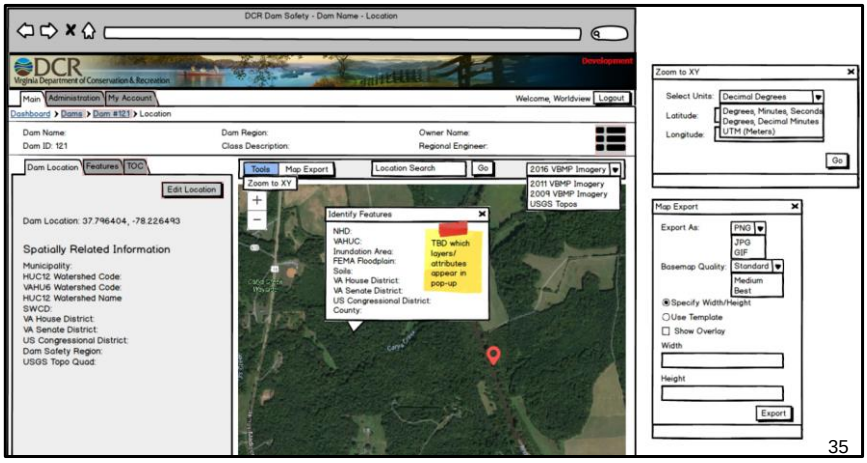
Data Entry and Viewing



Record Dashboard

Query Dam Records

Spatial Data Querying



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Core Spatial Data Example
Leatherwood Creek Dam #5 – Dam Point and Waterbody

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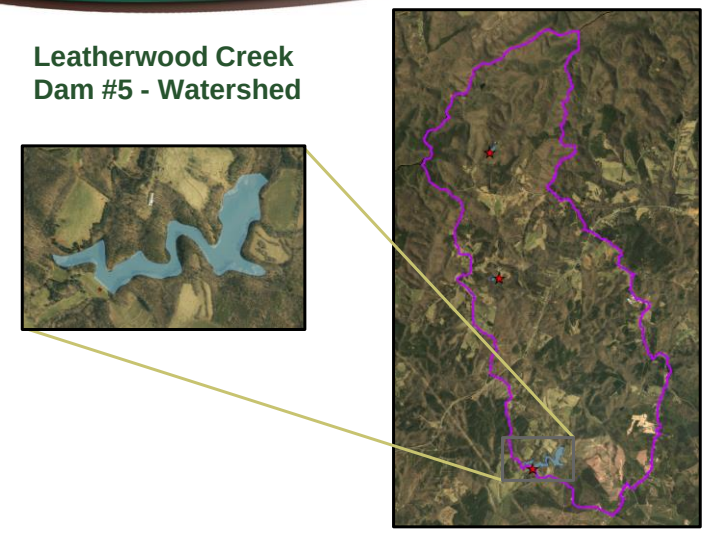
Leatherwood Creek Dam #5 - Watershed



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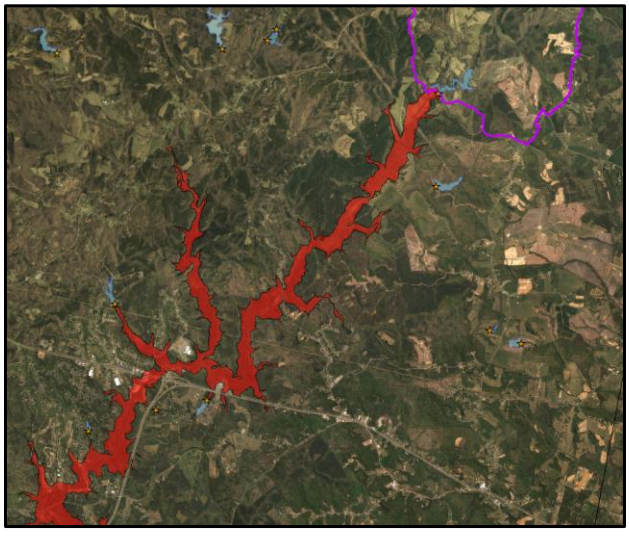
Leatherwood Creek Dam #5 - Inundation Zones



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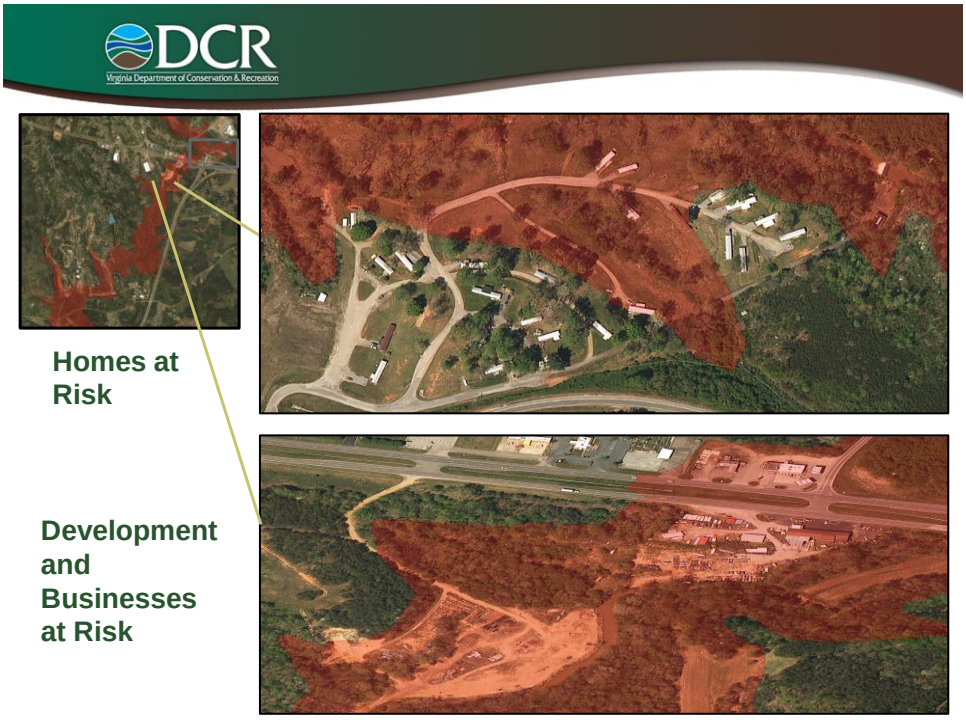
DCR
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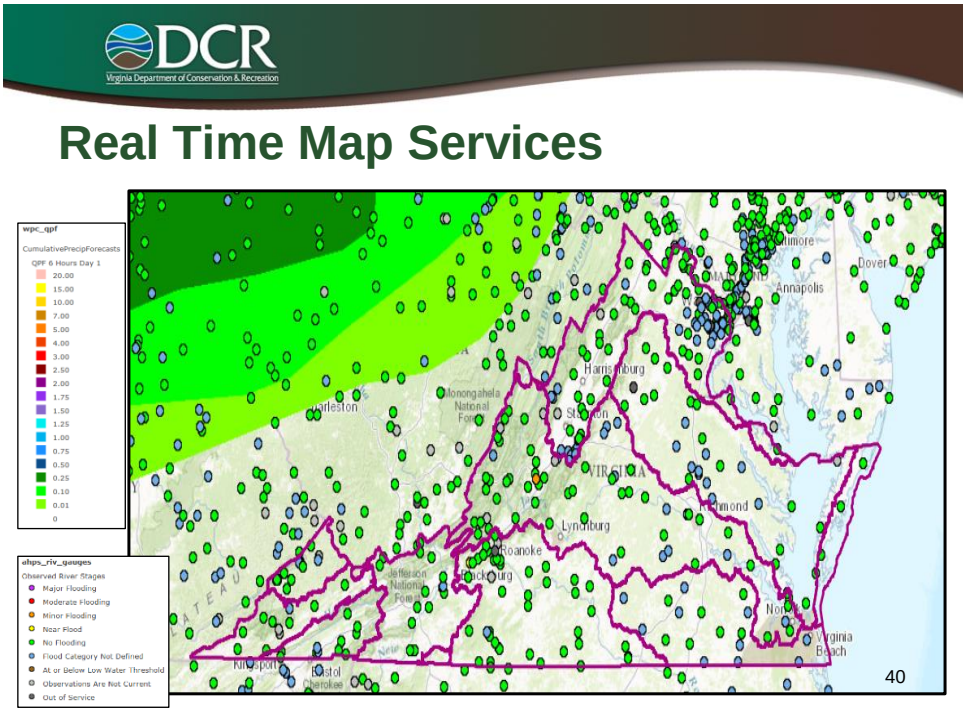
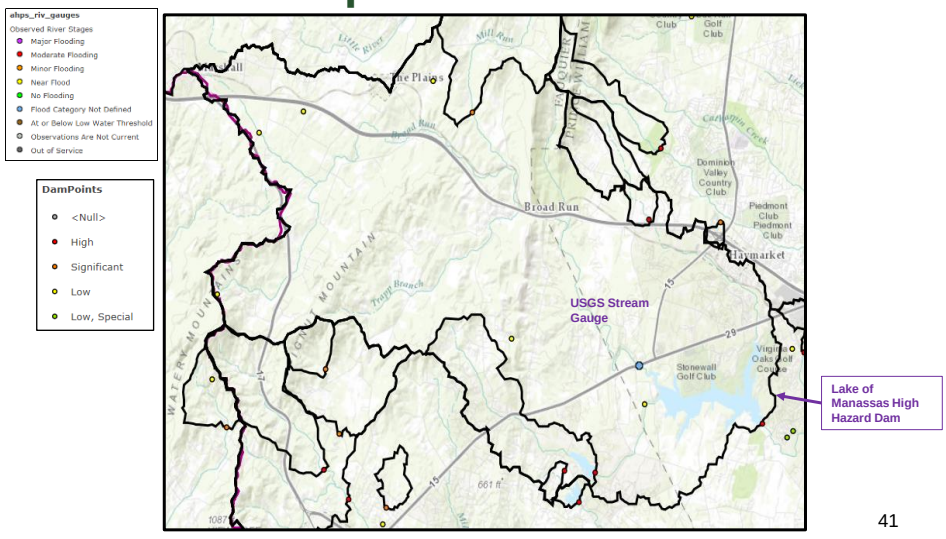
Homes at Risk
Development and Businesses at Risk


DCR
Virginia Department of Conservation & Recreation
Real Time Map Services
wpc_qpf
CumulativePrecipForecasts
QPF 6 Hours Day 1
20.00
15.00
10.00
7.00
5.00
4.00
3.00
2.50
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.10
0.01
0
ahps_riv_gauges
Observed River Stages
Major Flooding
Moderate Flooding
Minor Flooding
Near Flood
No Flooding
Flood Category Not Defined
At or Below Low Water Threshold
Observations Are Not Current
Out of Service
Annapolis
Dover
Harrisburg
Charleston
Monongahela National Forest
VIRGINIA
Lynchburg
Roanoke
Jefferson National Forest
Virginia Beach
Bristol
Cherokee
40

Real Time Map Services



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Virginia Flood Risk Information System

Users can turn on a flood depths layer for areas that FEMA has mapped the 1% annual chance flood depths.

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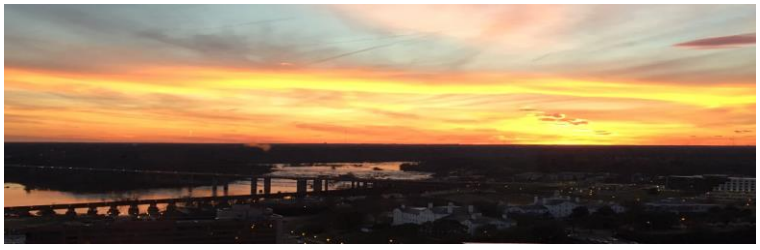

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