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COUNTY OF PRINCE WILLIAM

OFFICE OF EXECUTIVE MANAGEMENT
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Craig S. Gerhart
County Executive

February 3, 2009

TO: Board of County Supervisors

FROM: Chief Kevin J. McGee
Department of Fire and Rescue

THRU: Craig S. Gerhart
County Executive

RE: Brief the Board of County Supervisors on Issues Related to Dams and Water Impoundments in the County

I. **Background** in chronological order is as follows:

A. Dam History - The County has experienced weather events historically going back to Hurricane Agnes that have impacted the dams and water impoundments in the County. In recent history, the County has had hurricanes, tropical depressions and other severe rain events that have caused dam problems along with the river systems that run through PWC. None of the dams in Prince William County have ever failed during a major storm.

B. Classification - Dams are classified with a hazard potential depending upon the downstream losses anticipated in event of failure. The hazard potential is unrelated to the structural integrity of a dam. Rather, it is directly related to potential adverse downstream impacts should the dam fail. The dam classifications are as follows:

1. Class I - High - Dams that upon failure would cause probable loss of life or serious economic damage.
2. Class II - Significant - Dams that upon failure might cause loss of life or appreciable economic damage.
3. Class III - 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.

C. Regulations - Dam Safety Regulations are established and published by the Virginia Soil and Water Conservation Board (VSWCB). Each dam has specific requirements to certify the dam is safe.

D. Authority - The Virginia Dam Safety Act, Article 2, Chapter 6, Title 10.1 (10.1-604 et seq) of the Code of Virginia and Dam Safety Impounding Structure Regulations outline ownership and maintenance responsibilities.

E. Maintenance - The VSWCB 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.

F. 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 are required at the following frequency:

1. *High* - two years;
2. *Significant* - three years;
3. *Low* - six years. *Special criteria*: inspections by a professional engineer are not required for low hazard dams determined to cause damage to only the dam owner's property, but the dam owner must still annually inspect the dam and complete and submit an *Annual Inspection Report* to the regional dam safety engineer.

G. Certificates - The owner of each regulated high, significant, or low hazard dam is required to apply to the board for an Operation and Maintenance Certificate. The application must include:

1. An assessment of the dam by a licensed professional;
2. An Emergency Action Plan;
3. The appropriate fee(s), submitted under separate cover.

H. Definitions

1. Bladder - An inflatable rubber device which can be raised or lowered in a short period of time to increase a dam's ability to divert water.
2. 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 zone maps as required to show emergency management authorities the critical areas for action in case of emergency.
3. Flood Plain - Flat or nearly flat land adjacent to a stream or river that experiences occasional or periodic flooding
4. Inundation Zone - The area downstream of a dam that would be inundated or otherwise directly affected by the failure of a dam
5. Probable Maximum Flood (PMF) - Is the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area.
6. Spillway - A structure to provide for the controlled release of flows from the impounding structure into a downstream area.
7. Sunny Day Failure - The failure of an impounding structure with the initial water level at the normal reservoir level, usually at the lowest ungated principal spillway elevation or the typical operating water level. Sunny day failures occur when the dam fails unexpectedly for a reason unrelated to the weather. This could be due to conditions like poor dam maintenance, damage/obstruction of outlet systems, or vandalism.
8. Taintor Gate - A movable gate used to regulate water flow at the dam.

II. **Current Situation** is as follows:

A. PWC Classifications - The County has identified at least 30 dams and water impoundments that are located in or impact Prince William County. The following are classified as High Hazard Dams:

1. **Occoquan Dam (Lower)**

   a. Built in 1950 by Alexandria Water Company.
   b. Concrete gravity dam: 387 foot-long spillway that is 22 feet high and holds back approximately 55 MG of water.
   c. Powerhouse at the dam consists of one 350 kW hydroelectric generator.

2. **Occoquan Dam (Upper)**

   a. Built from 1955-1957 by Alexandria Water Company.
   b. Concrete gravity dam: 523 foot-long spillway that is 65 feet high and holds back approximately 11 BG of water.
   c. Powerhouse at the dam consists of two 500 kW hydroelectric generator.

3. **Lake Jackson Dam**

   a. The dam was built in 1928.
   b. The dam is 246' long and 28' high.
   c. Lake Jackson is approximately 26' at the base of the dam.
   d. The gate opening is 33' wide and 12' tall.

4. **T. Nelson Elliott Dam** (also called the Broad Run or Manassas Dam)

   a. Located in western Prince William County and encompasses approximately 72 square miles of watershed.
   b. Composite dam that has both concrete and earthen sections.
   c. The dam is 1,250 feet long and 60 feet high (including the 5-foot-high rubber bladder that was installed in 1999) from the ogee crest of the principal spillway to the toe of the dam.
   d. The concrete gravity portion is 636 feet long and the earthen embankment is 614 feet long.
   e. The left abutment is fixed into existing rock and the right abutment is tied into the earthen embankment.

f. The spillway is approximately 220 feet long and is designed to be both the principal and emergency spillways, able to pass approximately ½ of the probable maximum flood without overtopping the dam crest.

5. **Lake Montclair Dam**

a. Located in the community of Montclair, Virginia about 1.5 miles west of I-95 between Rt. 234 and PWC Rt. 610 and is used primarily for recreation.
b. Constructed on Powell's Creek in 1964 and the lake was first filled in July 1965.
c. Earth embankment 650 feet long and 74 feet high.
d. The primary spillway is siphon activated spillway crest elevation is 188 feet above mean sea level (msl) with a knife gate valve controlling the low-level 24-inch outlet pipe.
e. The crest of the dam proper is at elevation 206.5 feet msl with the emergency spillway crest elevation at 193 feet msl.
f. The emergency spillway is located beyond the right abutment of the dam and has a channel width of about 150 feet.
g. The dam is in a residential development with homes downstream which requires that the downstream area be classified as "high hazard."
h. The dam and emergency spillway are designed to pass the Probable Maximum Flood so failure by flooding over the top of the dam is not a probable mode of failure.

B. Federal Energy Regulatory Commission (FERC) Guidelines - These guidelines only apply to dams that produce energy (this applies to dams that create energy).

C. Additional Federal Requirements - These requirements address planning, exercises, and training and require that each dam operator develop and maintain an emergency action plan which ensures that the dam owner/operator is able to make appropriate decisions regarding safety concerns related to dam operations promptly. Dam operators are also required to review, exercise, and update the plan periodically to ensure first responders and/or operators are prepared to address issues associated with worst case scenarios.

D. Emergency Action Plan (EAP) or Emergency Preparedness Plan - An executed copy of either one of these plans must be filed with the appropriate local emergency official and the Virginia Department of Emergency Management. The EAP for each dam is reviewed by Public Works and Emergency Management.

III. Board Action Requested

A. No Board Action is requested at this time. This staff report is for information purposes only.

IV. Issues:

A. Occoquan Dam

1. If the dam fails the Town of Occoquan is impacted.
2. In the worst case dam failure scenario the water arrival would reach the town of Occoquan in five minutes with the maximum water elevation of 54 feet in 20 minutes.
3. If the Occoquan Dam were to fail several bridges would be impacted:

    a. Rt. 123
    b. Rt. I-95
    c. Rt. 1
    d. Railroad

4. Inundation zone for the dam includes the Town of Occoquan.

B. Lake Jackson Dam

1. **This is the only dam the County has operational responsibilities for.**
2. This dam is part of the river system so it is impacted by T. Nelson Elliott Dam. When the bladder on the T. Nelson Elliott Dam drops to let water out of the lake that water eventually comes into Lake Jackson and impacts residents that have lakefront property on Lake Jackson.
3. Size of the taintor gate limits volume of water released so it takes time to lower the lake level.
4. Inundation zone includes minimal development downstream.

C. **T. Nelson Elliot Dam**

1. When the bladder was initially installed, the County was not notified and the raising of the lake level changed the inundation zone in the county.
2. Numerous properties downstream of this dam are in the inundation zone or their property touches the inundation zone.
3. The bladder is designed to lower automatically to maintain the lake level; however, when it lowers a considerable amount of water comes down the watershed eventually into Lake Jackson.
4. In May 2008 a major rain storm caused the bladder to drop completely for 6 hours.
5. Inundation zone includes more than 3,000 properties.
6. Some of these properties are in the flood plain.
7. Probable Maximum Flood (PMF) for this dam is:

    a. 7.29" in 12 hours
    b. 30" in 24 hours

8. The City of Manassas receives 41.8 inches of rain in a year.

D. **Lake Montclair Dam**

1. The Montclair Dam is an earthen dam.
2. The spillway discharge pipe is 24 inches in diameter so there is limited spillway drainage to lower the lake level during an event.
3. The inundation zone includes lakefront and downstream property.
4. The cost to change from an earthen dam to concrete is cost prohibitive.
5. In recent history severe rainstorms have caused numerous boat docks and boat houses to be severely damaged.

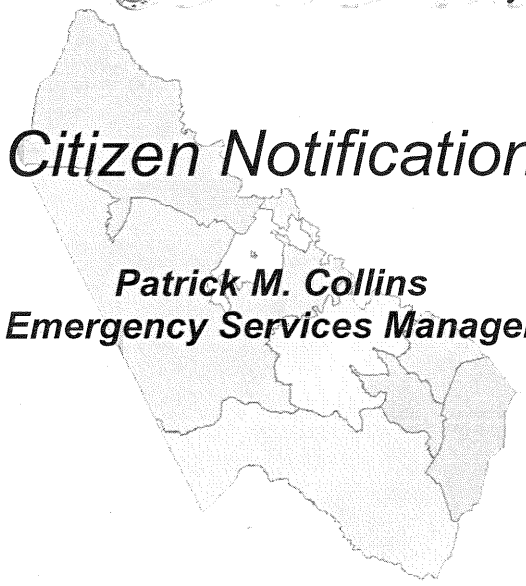
V. Next Steps

A. Continue to conduct training and exercises.
B. Continue to work with dam operators to ensure emergency action plans are up to date.
C. Continue to develop relationships with outside agencies.

Staff Contact: Patrick M. Collins – ext. 5828

Attachment: BOCS Powerpoint

Prince William County Government



Citizen Notification

Patrick M. Collins
Emergency Services Manager

Notification Considerations

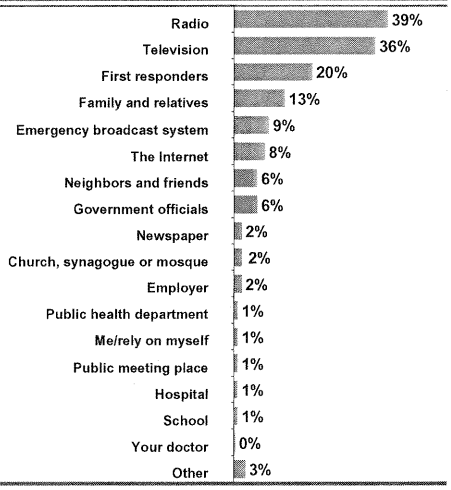
- Effectiveness
- Accuracy
- Speed
- Coverage
- Time of day
- Environmental impacts
- Legal impacts
- Cost

Current Methods

- PWCAN (Prince William Community Alert Network)
- Reverse Telephone Messaging
- NOAA Weather Radios
- News Media (TV, Radio)
- Manually (door-to-door)
- Sirens (proposed)

Where People Get Information

- When asked where or who they would turn to in an emergency, the largest number volunteered radio and then television.



UASI Study PIO Focus groups 2007

Prince William Community Alert Network (PWCAN)

- **Advantages:**
  - Can quickly reach a large number of people
  - Available 24/7
  - Text messages sent simultaneously to multiple devices
  - Accurate (we control the message)
- **Disadvantages**
  - People must register to receive messages
    → 3,847 people are registered on the system
  - Coverage
  - Time of day
- **Usage**
  - Rt 66 closure (2 times)
  - Automatic notifications (weather, Federal Government closings)

Reverse Phone Messaging

- We use a system called "A Child is Missing"
- **Advantages**
  - Telephone numbers used in the program are gleaned from the databases provided by an emergency communication network that updates its data bases quarterly.
  - Can target a specific area with a scripted message
  - Time of day
  - Coverage
  - Speed (1,000 calls in 60 seconds)
  - Cost – no cost to County
- **Disadvantages**
  - Cell phone numbers are not contained in that database. Residents with cell phones interested in receiving the alerts must sign up for the program.
- **Usage**
  - Alexis Glover case in January

Tone-Activated NOAA Weather Radios

- **Advantages**
  - NOAA Weather Radios is an "All Hazards" radio network
  - Single source for comprehensive weather and emergency information
  - Broadcasts warning and post-event information for all types of hazards – including natural, environmental (such as HazMat incidents) and public safety
  - Speed
  - **Time of day**
- **Disadvantages**
  - **Most homes do not have one**
  - Radio must be properly programmed for area
  - Radio must be near person for alert tone to be heard
  - Maintenance
  - Cost
  - Weather warnings are not always accurate
- **Usage**
  - Every time the NWS issues a weather or other alert for PW County

News Media

- **Advantages**
  - Most homes have radio or TV
  - Coverage
  - Cost
- **Disadvantages**
  - Delay in getting information out
  - Accuracy of information
  - Time of day
  - Electrical power outage

Manually Door-to-Door

- **Advantages**
  - Personal contact can provide reassurance
  - Verify evacuated locations or problem areas
  - Time of day
  - Accuracy
  - Cost – does not require special equipment
- **Disadvantages**
  - Requires lots of resources (May divert county resources)
  - Time-consuming
  - Speed
  - Cost
- Usage
  - Hurricane Isabel
  - Tropical Depression Hanna

Sirens/Voice Communications Systems
Optimal Specifications

- Nighttime Effectiveness
- Durability
  - Backup power
  - Survive severe weather events
- Speed of Activation
- Indoor v Outdoor Alerting Capability
  - Simultaneous notifications over legacy systems
- Visual/Physical Alerting Method
  - Target special needs populations
- Localized Alert Mechanism
  - Single point alerting for dams and/or impoundments

Source:
Emergency Warning Systems Task Force
Seminole County Florida Emergency Management
March, 2007

Sirens/Voice Communications Systems
Effectiveness

- May not address special needs
- Must be accompanied by education piece
- Dependent on topography and weather conditions
- Increases when part of an over-arching "Warning System"
- Siren alerts maximum effective range 1.0-1.5 miles
- Voice messages maximum effective range .5 miles
  - Unintelligible messages can cause more harm than good
  - Dependent on structures, weather, topography, and indoor noise levels

Source:
George Washington University
Institute for Crisis, Disaster and Risk Management
"Public Safety Best Practices: Talking Siren Technology"
July, 2005

Sirens/Voice Communications Systems
Costs

- Tone Alert Radios
  - $3,301600 - $5,282,560
    - → $25-$40 per unit
    - → 132,064 households
    - → 1 per household
- Sirens
  - $12,000,000 - $24,000,000 for full County coverage
    - → 400 towers
  - $30,000-$60,000 per site
    - → Controllers
    - → Antennas
    - → Poles
    - → Battery back-ups
    - → Excludes any costs associated with leasing/purchasing land needed for siren sites

Sirens/Voice Communications Systems
Solutions

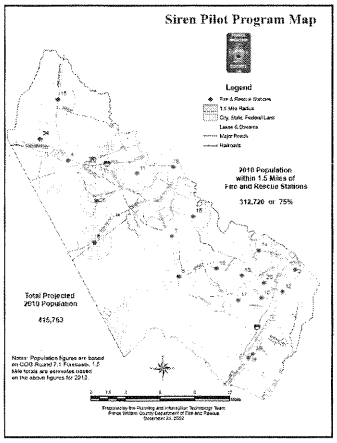
- Multi-model approach
  - Sirens/Voice Communications systems strategically located
  - Tone Alert Radios
  - Integration with existing technologies
  - Utilize creative solutions
    - →Reverse Phone Messaging Systems
- Currently no assistance programs available
  - Federal
  - State

Full County Coverage

- 400 sirens to cover the County ½ mile for a combination voice/siren system.

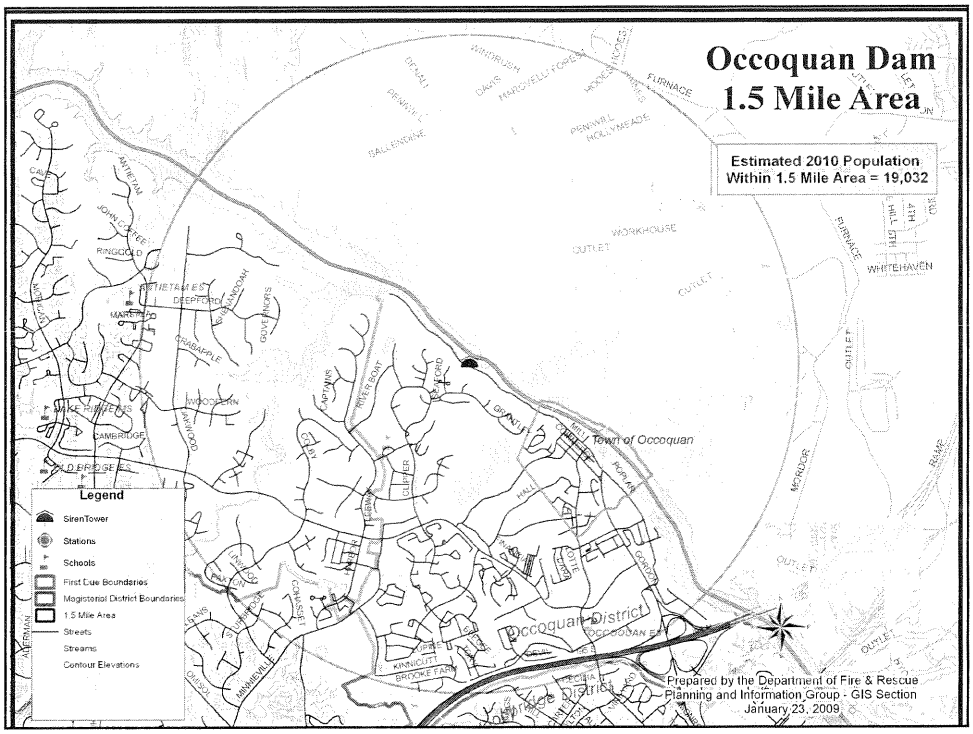
Strategic Coverage - County

- Cost
  - $600,000 - $1,200,000
  - 20 sites
  - $30,000 - $60,000 per site
    - Controllers
    - Antennas
    - Poles
    - Battery back-ups
- Issues
  - 75% of County's population covered 25% would not
  - Cost may not include maintenance and service fees/contract
  - Permission to place siren at location
  - Excludes any costs associated with leasing/purchasing land needed for siren sites



Targeted Coverage

- Occoquan River Dams
  - Cost
    - →$30,000 - $60,000
    - →Excludes any costs associated with leasing/purchasing land needed for siren sites
  - Specific to area in flood zone
  - Allows for targeted alerts at needed times
  - Vulcan Quarry



Comparison

	PWCAN	Reverse Phone	NOAA	Media	Manual	Siren
Cost	Currently being paid for by UASI	Free	$25-$40	Free	Variable	$75,000 each
Time of day	24/7 Device must be turned on	24/7	Yes	24/7 Must have media on	24/7	24/7 Limited effectiveness indoors
Speed	24/7	1,000 calls per minute	Immediate from NWS	Variable	Depends on notification area	Variable
Accuracy	We control the message	We control the message	Depends on NWS	We do not control the message	We control the message	We control the message
Coverage	Limited to registered users	Hard line phones and registered cell phones	Must have weather radio	Most households have radio and/or TV	Target area	Limited by distance and environment

Date: 2/2/2009

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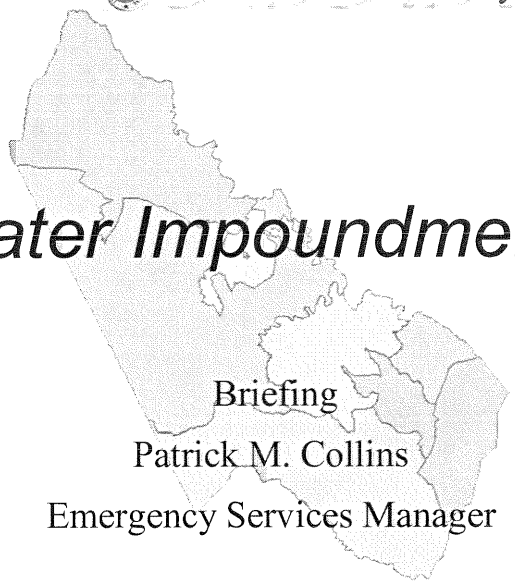
Notification in the middle of the night

- NOAA weather radio
- Reverse telephone messaging system
- Manual
- Sirens

Future Actions

- Continue to promote PWCAN
- Continue to promote NOAA weather radios
- Continue to work with the reverse telephone messaging systems
- Siren Pilot Program $75K for one Siren system

Prince William County Government



Water Impoundments

Briefing

Patrick M. Collins

Emergency Services Manager

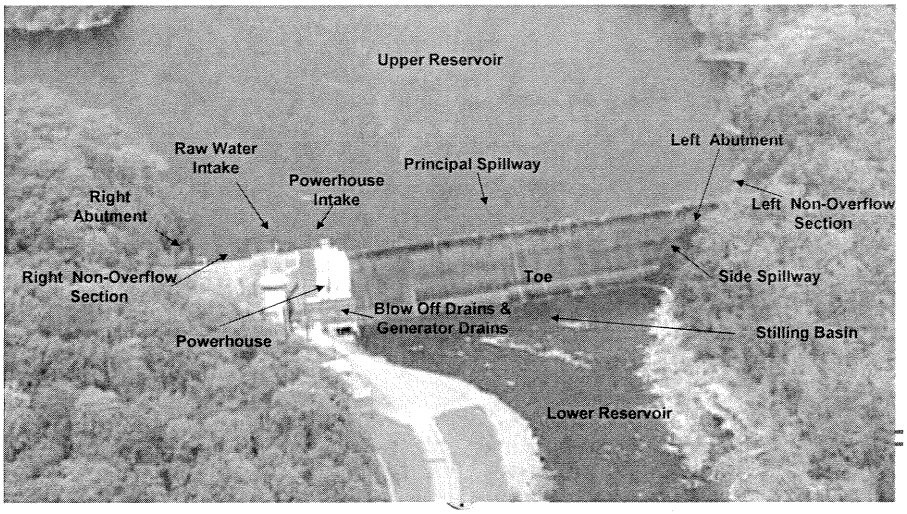
Water Impoundments in the County

- Occoquan Dam; Upper and Lower (Fairfax Water Authority)
- T. Nelson Elliott Dam (City of Manassas)
- Lake Montclair Dam (Montclair Property Owners Association, Inc.)
- Lake Jackson Dam (Prince William County)
- 26 Others (These are mostly water impoundments for drainage and storm water management)

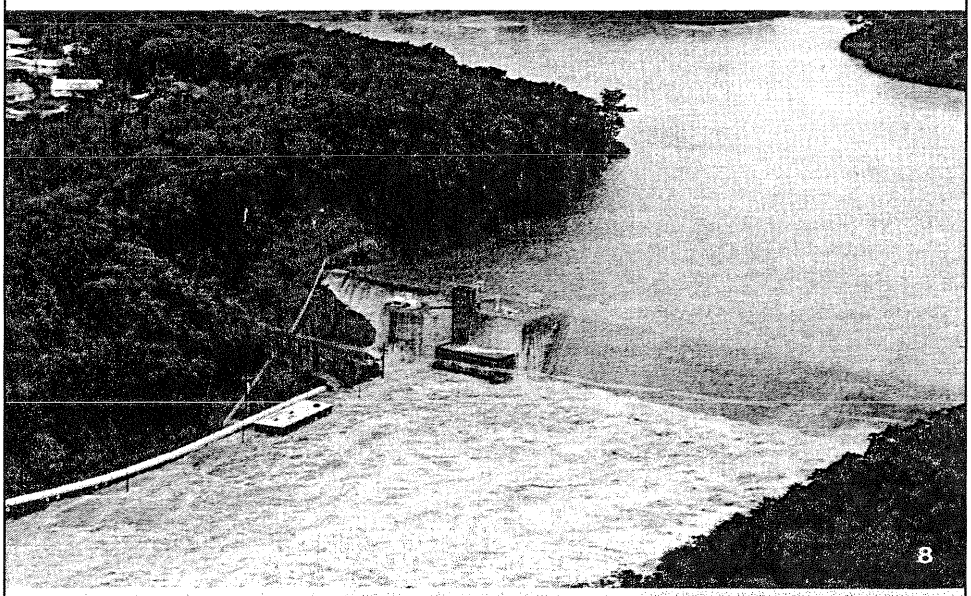
Occoquan Dam (Upper)

- Classification: 1
- Issues
  - If failure of the dam the Town of Occoquan is impacted
  - Speed of impact
  - Bridges impacted
    - →Rt 123
    - →Rt 95
    - →Rt. 1
    - →Railroad
- Inundation zone includes the Town of Occoquan

Anatomy of the Upper Occoquan Dam



Hurricane Agnes, June 1972



Upper Dam and inundation of powerhouse and carbon feed building

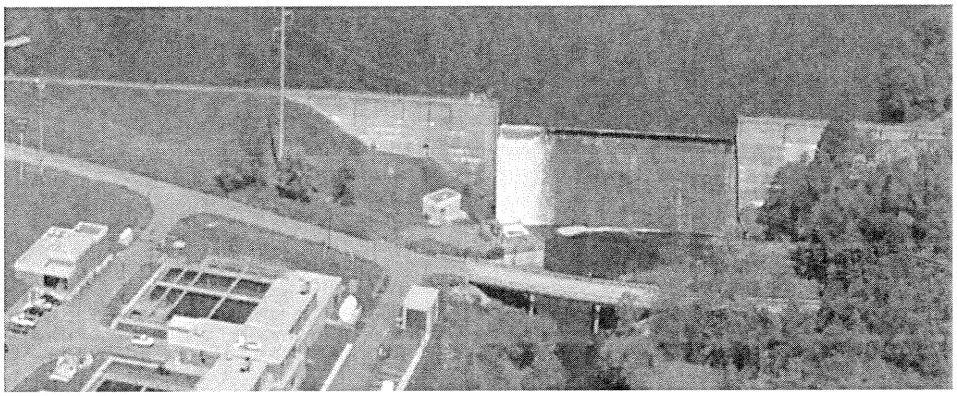
Sunny Day vs. PMF in Town of Occoquan

Type of Failure	Sunny Day (Failure of a 50ft. Monolith)	Probable Maximum Flood (PMF) 26 inches of rain in 72 hours
Water Arrival Time	10 minutes	5 minutes
Time to Peak Elevation	47 minutes	20 minutes
Peak Elevation	24 feet	54 feet

T. Nelson Elliott Dam (Broad Run Dam)

- Classification: 1
- Issues
  - Bladder
  - In May 2008 a major rain storm caused the bladder to drop completely for 6 hours
- Inundation Zone
  - Includes more than 3,000 properties
  - Some of these properties are in the Flood Plain
- PMF for Dam
  - 7.29" in 12 hours
  - 30" in 24 hours
- City receives 41.8 inches of rain in a year

Aerial of Broad Run Dam



Lake Montclair Dam

- Classification: 1
- Issues
  - Earthen dam
  - Limited spillway drainage
- Inundation Zone
  - Includes lakefront and downstream property

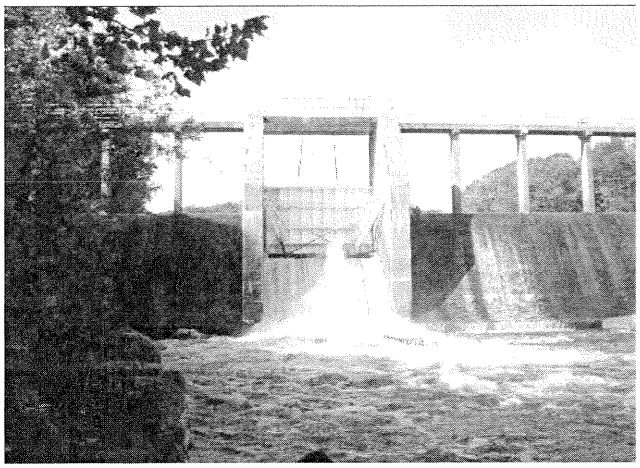
Weather (From NWS)

- The average amount of rain per year has not changed.
- The climate change scientists in recent years say that the total precip isn't expected to fall off or rise they do expect more extreme events
- With an increase in population in the area, the effects of these events will become more significant.

Lake Jackson Dam

- Classification: 1
- Issues
  - This is the only dam the County has operational responsibilities for
  - Is part of the river system so it is impacted by T. Nelson Elliott dam
  - Size of the tainter gate limits volume of water released
- Inundation zone
  - Minimal development downstream

Lake Jackson Dam Spillway



Dam Relationships

- Manassas Dam impacts Lake Jackson Dam
- The County and City of Manassas coordinate efforts during the release of water at Lake Manassas. During a typical planned water release, it takes approximately 6 hours for the water to reach Lake Jackson.
- The County coordinates with the Town of Occoquan and Fairfax County Water Authority when we release water from Lake Jackson.
- Communication between dams is critical
- Lake Jackson has limited management capacity

Exercises

- Real World Events
- Periodic Seminars and workshops
  - Lake Jackson
  - Lake Manassas
  - Lake Montclair
- Discussion Based Exercise
  - Fairfax Water Occoquan Dam Tabletop Exercise (TTX) November 2007
  - T Nelson Elliot Dam Tabletop Exercise (TTX) April 2008
- Operations Based Exercise
  - Fairfax Water Occoquan Dam Functional Exercise August 2008

Summary

- Each dam has an emergency plan
- Each dam is inspected
- We train, exercise, and communicate regularly with all of the responsible parties