

Regional Importance of Tennessee and Cumberland Basin Reservoir Systems

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Purpose and Goal

- The purpose of this Nashville District Water Management Brief is to inform you about:
 - Competing demands for water
 - Ability to moderate flows
 - Response to extreme events
- Goal – provide you with an understanding of how flows within the Tennessee and Cumberland Basins can be moderated to support water management objectives within their respective basins and also along the lower Ohio and Mississippi Rivers.



Authorizing Legislation

- **Flood Control Act of 1938: PL 75-761**
 - Wolf Creek (1952)
 - Dale Hollow (1953)
 - Center Hill (1951)
 - **J. Percy Priest (1970)**
 - Three Islands (Harpeth)
 - Rossview (Red)
 - Devil's Jump (Big South Fork Cumberland)
- **River and Harbor Act of 1946: PL 79-525**
 - Celina (Cumberland above Cordell Hull)
 - **Cordell Hull (1974)**
 - **Old Hickory (1957)**
 - **Cheatham (1959)**
 - **Barkley (1966)**
- **Flood Control Act of 1960: PL 86-645**
 - Laurel (1977)
- **Flood Control Act of 1965: PL 89-298**
 - Martins Fork (1978)



Congressionally Authorized Project Purposes

Project	Flood Control	Commercial Navigation	Hydropower	Recreation	Water Quality
Martins Fork Dam	Green	Red	Red	Green	Green
Laurel Dam	Red	Red	Green	Green	Red
Wolf Creek Dam	Green	Red	Green	Red	Red
Dale Hollow Dam	Green	Red	Green	Red	Red
Center Hill Dam	Green	Red	Green	Red	Red
J. Percy Priest Dam	Green	Red	Green	Green	Red
Cordell Hull Lock & Dam	Red	Green	Green	Green	Red
Old Hickory Lock & Dam	Red	Green	Green	Red	Red
Cheatham Lock & Dam	Red	Green	Green	Red	Red
Barkley Lock & Dam	Green	Green	Green	Red	Red
Project not designed for this purpose	Red				
Project designed for this purpose	Green				





US Army Corps
of Engineers
Nashville District

Nashville District Cumberland River System

LEGEND



NAVIGATION

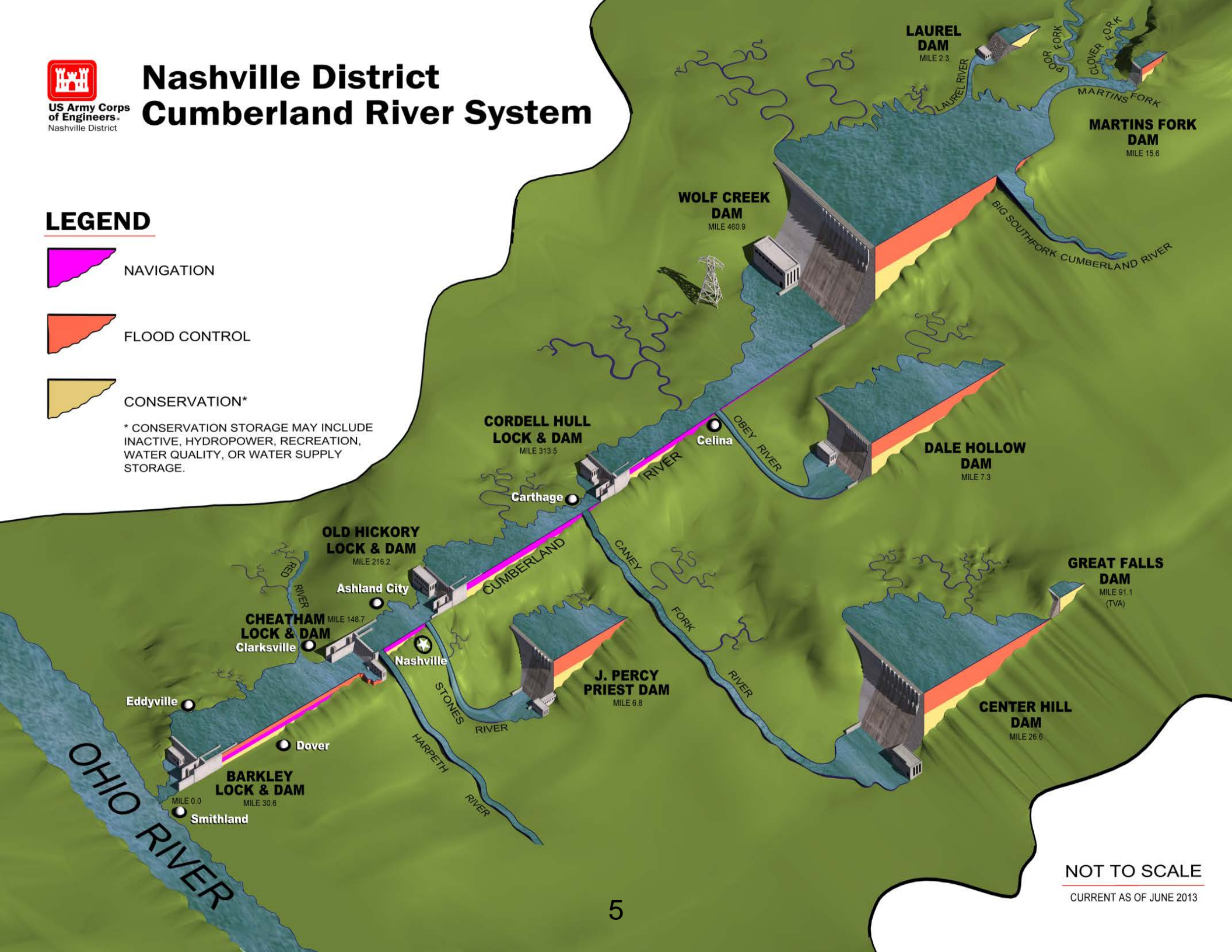


FLOOD CONTROL



CONSERVATION*

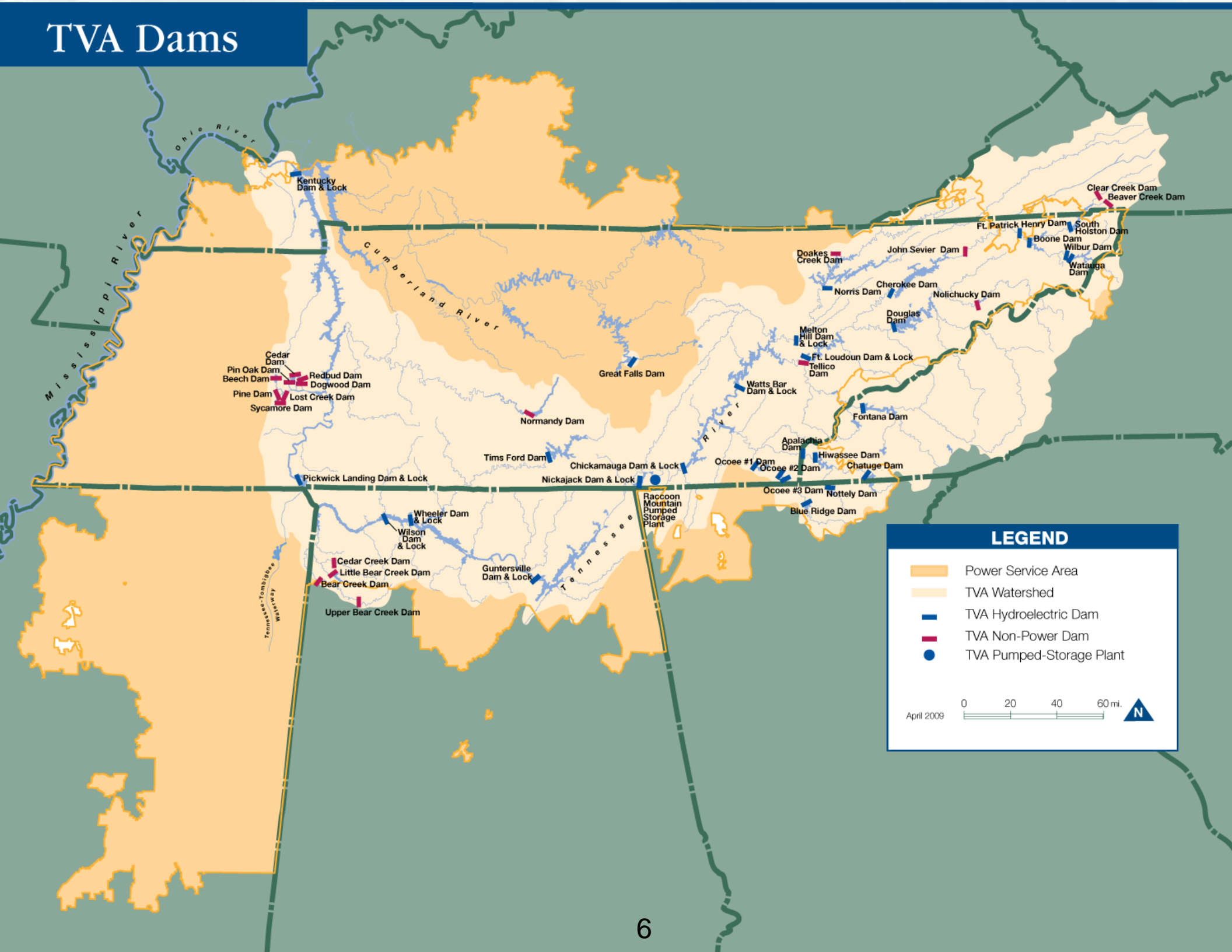
* CONSERVATION STORAGE MAY INCLUDE
INACTIVE, HYDROPOWER, RECREATION,
WATER QUALITY, OR WATER SUPPLY
STORAGE.



NOT TO SCALE

CURRENT AS OF JUNE 2013

TVA Dams



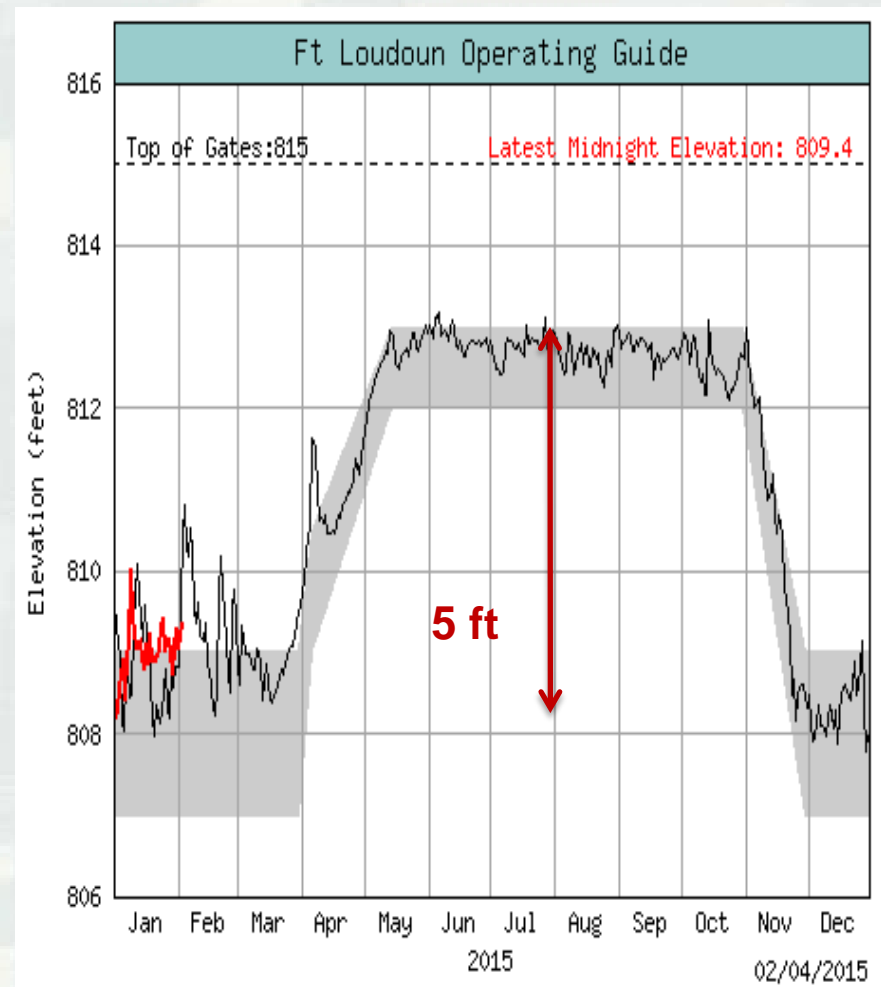
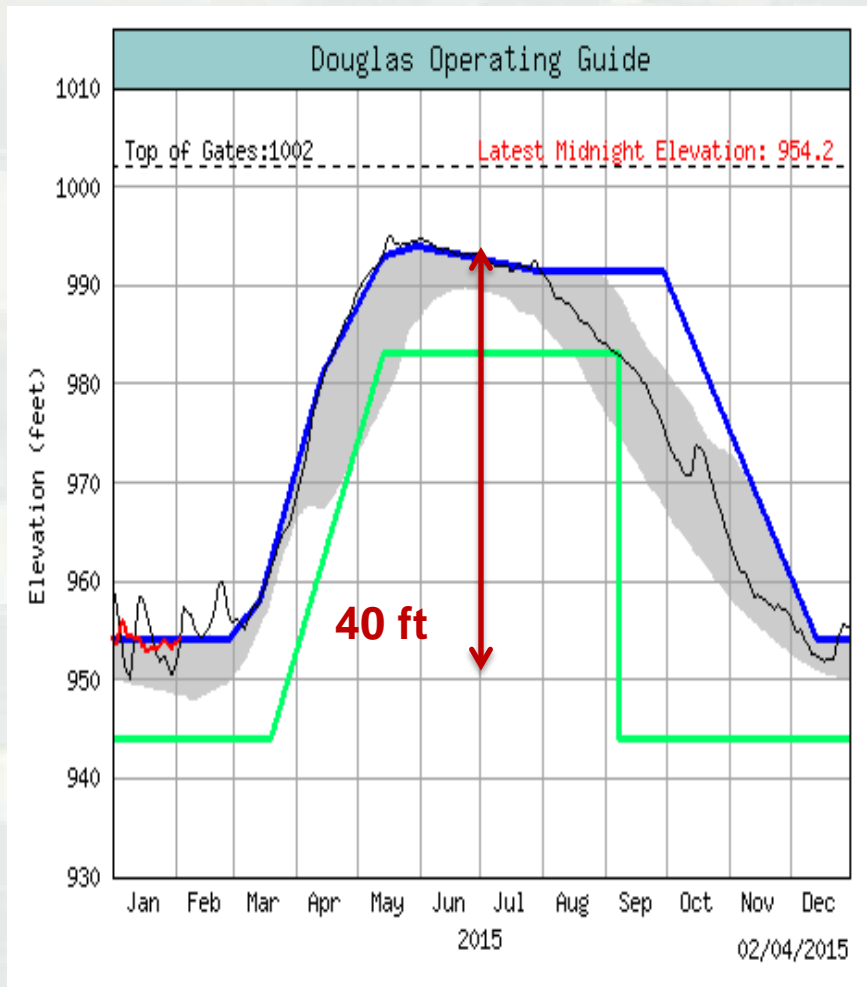
LEGEND

- Power Service Area
- TVA Watershed
- TVA Hydroelectric Dam
- TVA Non-Power Dam
- TVA Pumped-Storage Plant

0 20 40 60 mi.

April 2009

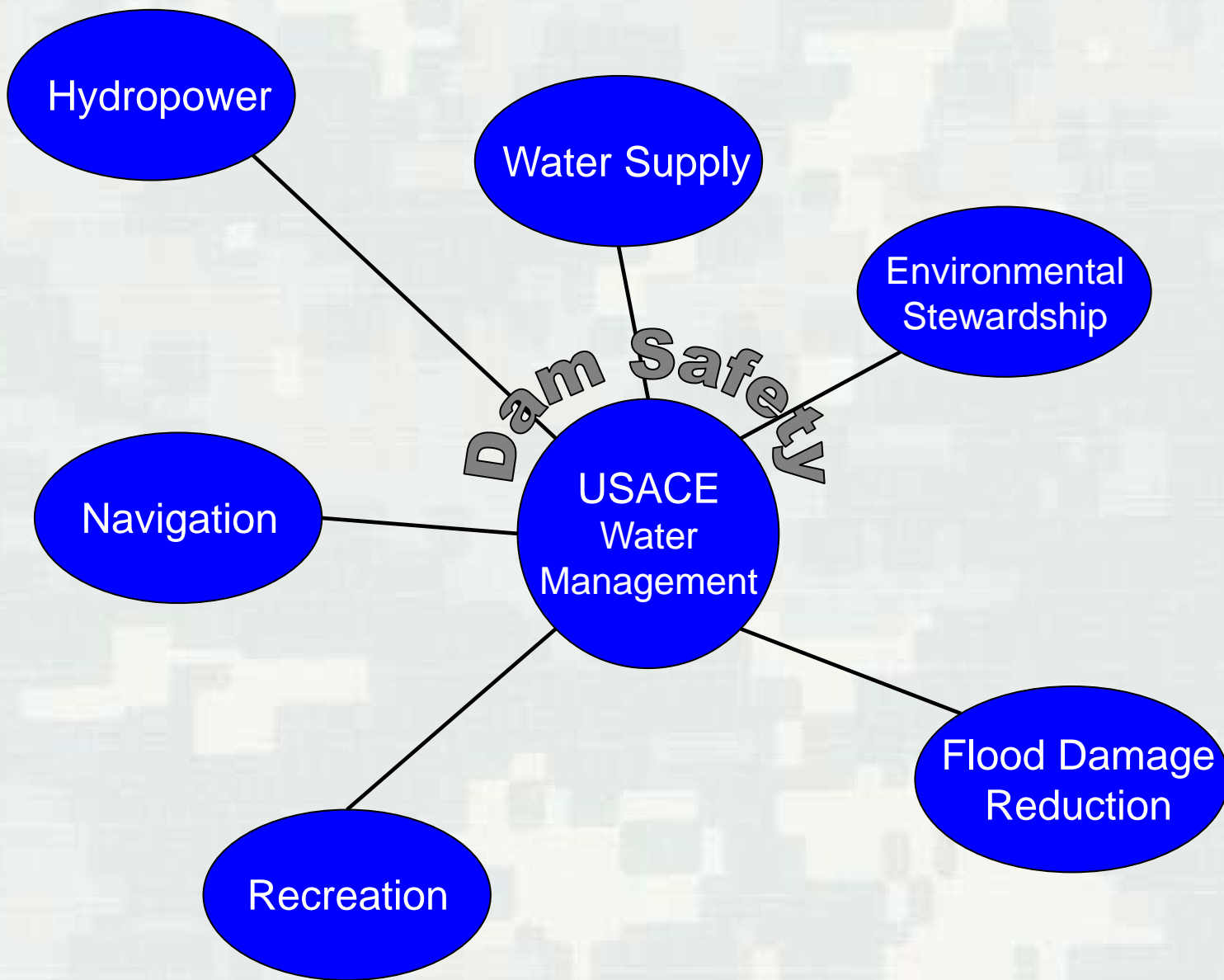
TVA Reservoir Operating Guides

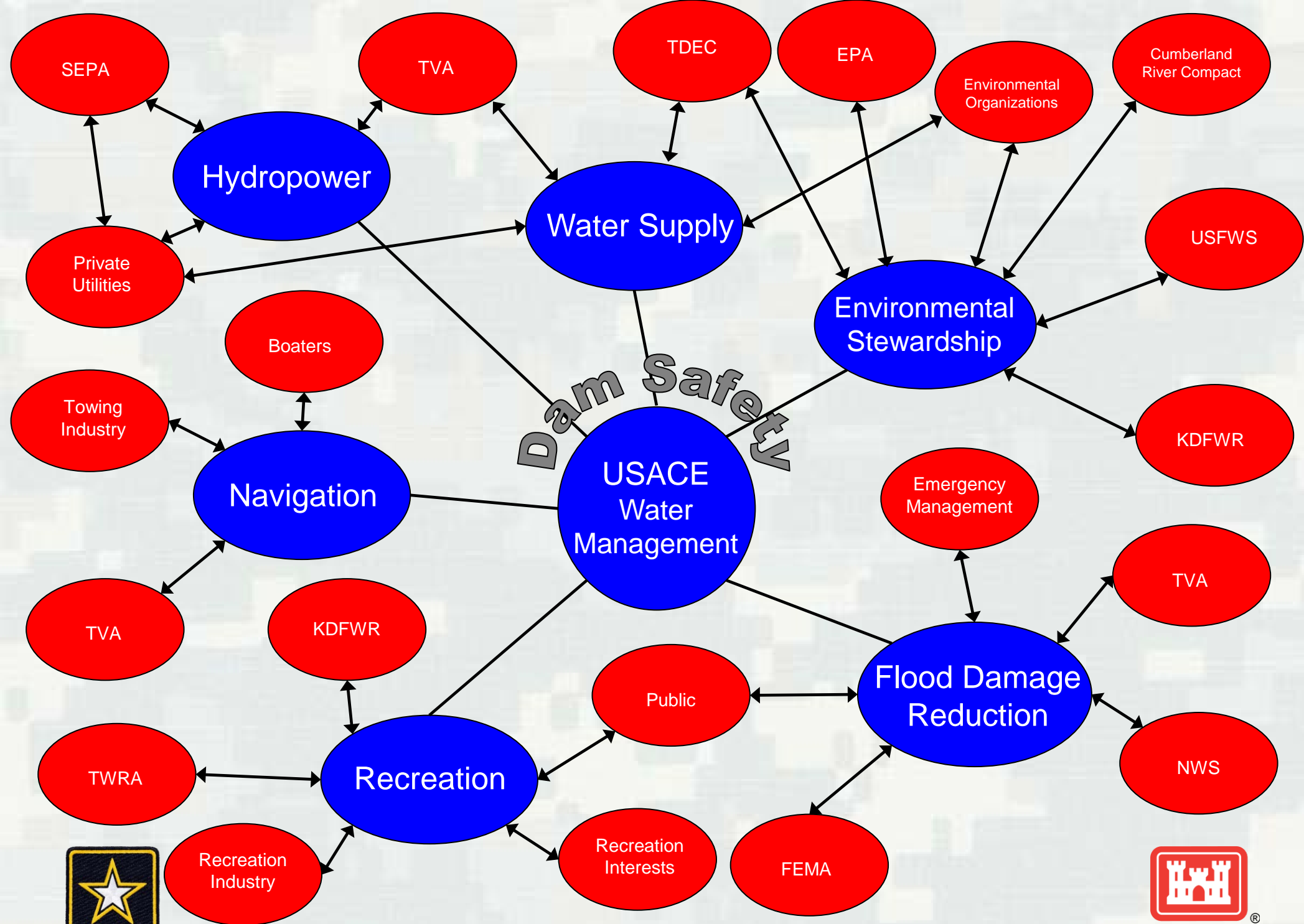


Main River

Tributary







Water Management Team

- Nashville District Water Management
 - Multidisciplinary staff – engineers & scientists
 - Perform complete system analysis every day
- Nashville District Hydropower Operators
 - 24/7 operational support
- Great Lakes & Ohio River Water Management
 - Ohio/Mississippi flood control operations
 - Program oversight
- Federal Partners
 - Tennessee Valley Authority (TVA)
 - National Weather Service
 - U. S. Geological Survey



Tennessee and Cumberland Reservoir Systems

- **Ability to Moderate Flows on the Ohio and Mississippi**
 - **Store water during high flow events**
 - **Kentucky and Barkley flood control storage**
 - **Winter Pool (354) – 5,480,000 acre-ft (top of gates - 375)**
 - **Summer Pool (359) – 4,502,000 acre-ft (top of gates - 375)**
 - **Summer Pool (359) – 1,431,000 acre-ft (flood easement – 365)**
 - **Upstream storage projects in both reservoir systems are operated to conserve flood control storage in Barkley and Kentucky**
 - **Augment Flows during low flow events**
 - **Upstream storage projects are operated to supplement main river flows during the dry time of the year**
 - **Fill tributary projects by end of May**
 - **Release stored during the summer and fall to meet downstream objectives – navigation, hydropower, water supply, water quality, recreation, etc.**
 - **Kentucky and Barkley winter drawdown (starts 1 July) coincides with low flow season**



Historic Flood 1937



*Cumberland River, mile 27.7, Eddyville gage 44.2, 2-20-37.
This cow was caught in the forks of a tree on the left bank
and left hanging 20' above water.*

1 and 2 May 2010
Radar and Observed
Precipitation Totals

Cheatham L&D
9.59 inches

Old Hickory L&D
14.12 inches

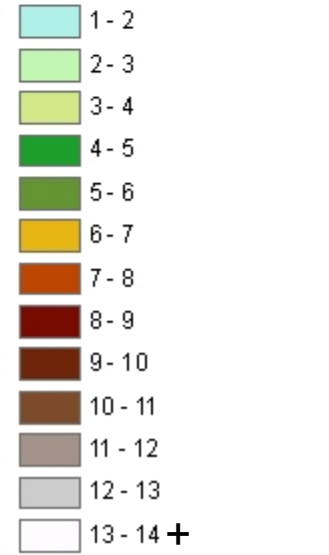
Nashville, TN
13.56 inches

J Percy Priest Dam
12.95 inches

Antioch, TN
16.21 inches

Franklin, TN
17.87 inches

**2Day Total Observed
Precipitation (in)**



Nashville, TN

- Up to 17 inches in around Nashville
- 140 years of rainfall data
 - 1 May - #3 wettest day on record
 - 2 May - #1 wettest day on record
- 2-day total > double the previous record
- 2-day total > 1,000 year rainfall event

Cumberland River Flood 1 and 2 May 2010 Radar Rainfall & Project Operations

Barkley Lock & Dam



Cheatham Lock & Dam



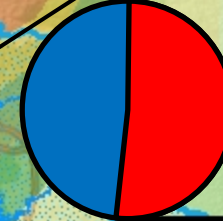
**Old Hickory Lock &
Dam**



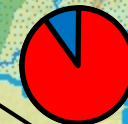
Cordell Hull Lock & Dam



Wolf Creek Dam



Dale Hollow Dam



**Center Hill
Dam**

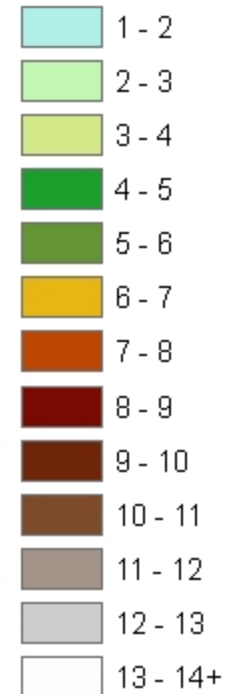


J. Percy Priest Dam

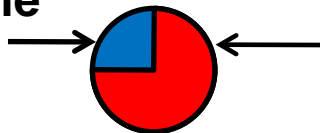


2Day Total (Sat & Sun) Radar Rainfall (in)

Radar Rainfall (in)



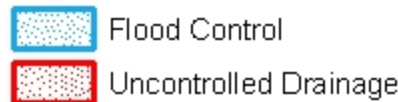
**Storage at Peak Elevation
Available** → **Peak**



Pie area scaled to Storage capacity.

Cumberland River Project Watersheds

Delineation



14

Map reflects radar rainfall –
actual amount may be
greater

Water Stored During May 2010 Flood

Project	Headwater (0600 - 1 May)	Headwater Crest	Water Stored (acre-feet)
Wolf Creek ¹	682.94	703.86	867,000
Dale Hollow	650.16	657.34	204,000
Center Hill ¹	630.44	646.76	279,000
J. Percy Priest	489.36	504.90	278,000
Total			1,628,000²

¹ Wolf Creek and Center Hill Dams had been classified as DSAC 1 dams and were under pool restrictions to assure the stability of the dams.

² This volume of water is roughly equivalent to 530 trillion gallons of water or if stacked on a football field it would be over 1.2 million feet (233 miles) high.



Cordell Hull

Top of Lock Gate: 508.50

Peak Lake Elevation: 508.33



Old Hickory Lock

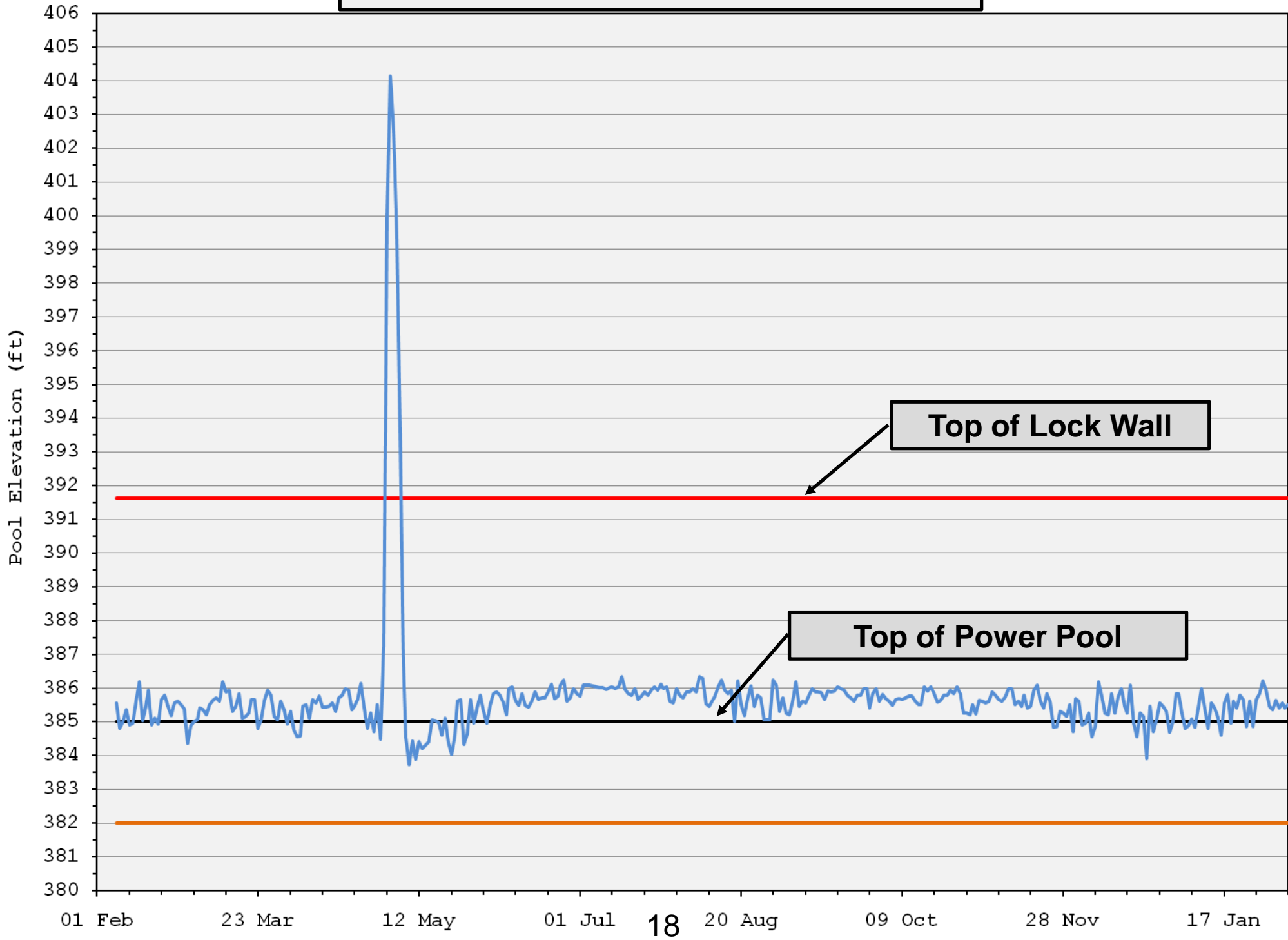
Top of Lock Wall: 452.00

Peak Lake Elevation: 451.45

6.60 inches



Cheatham Headwater Elevation





100
1 1

Record Setting Flood Event

Project	Lake Elevation (ft)		Project Discharge (cfs)	
	May 2010	Previous Record	May 2010	Previous Record
Cordell Hull Lock & Dam	508.33	508.00 (May 1984)	130,100	123,850 (March 1975)
Old Hickory Lock & Dam	451.45	450.17 (May 1984)	212,260	165,500 (March 1975)
Cheatham Lock & Dam	404.15	398.95 (March 1962)	240,000	203,670 (March 1962)
Barkley Lock & Dam	369.00	370.04 (May 1984)	303,200	241,980 (May 1983)



Post Flood Investigations

Supplemental Appropriations Act of 2010

6 Post Flood Investigations

- Post Flood Documentation Report
- Update of Flood Profiles
- Flood Warning & Emergency Evacuation Planning
- Emergency Action Plans
- Cumberland River Recon Study
- Harpeth River Recon Study



Post Flood Investigations

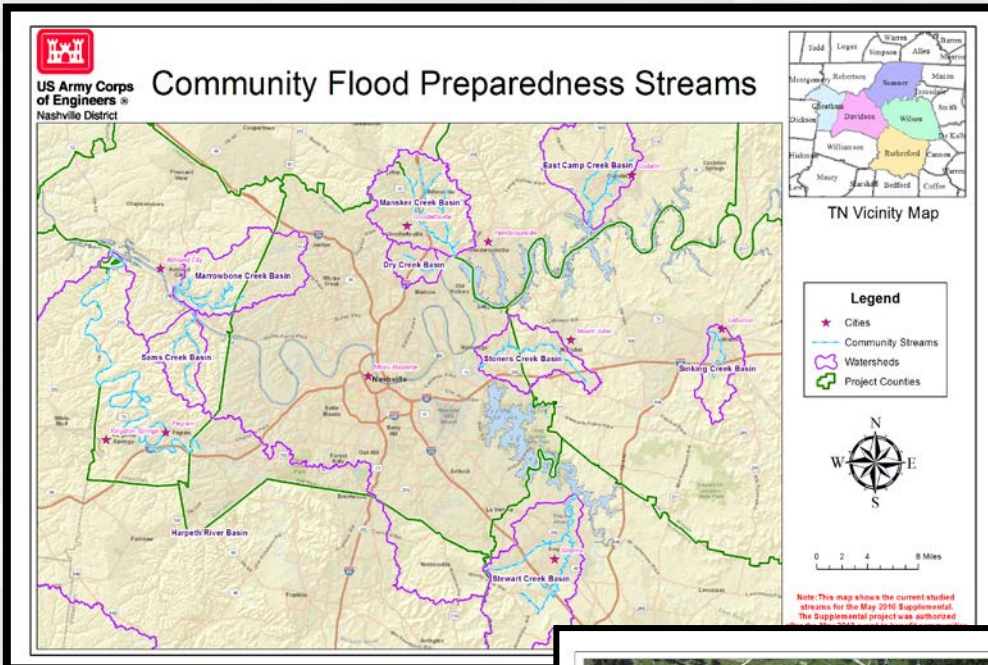
Supplemental Appropriations Act of 2010

Post Flood Documentation Report

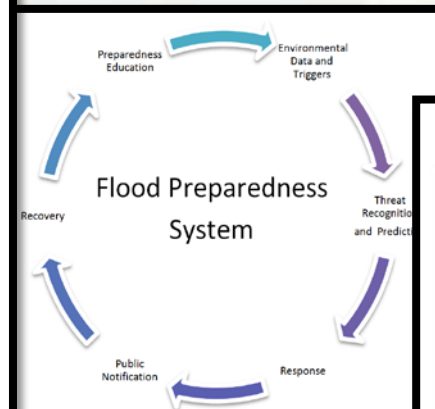
- Collect high water marks
- Gather and evaluate detailed damage data
- Develop rainfall summary/curves
- Construct flood profiles on the Cumberland & 25 tributaries
- Gage/stage discharge summary for Cumberland & tributaries
- GIS inundation layers
- Develop flood damage modeling, flood impact assessments, on the Cumberland & 25 tributaries



Community Mapping Efforts Post May 2010



- Local Streams
 - 12 Basins
 - 5 Counties



Flooded Bridge Crossings

The tables below outline bridge elevations from hydraulic modeling provided by the USACE. The data was used to determine which bridges overlapped at which Action Level. In some cases, water flows around the actual bridge. Roadway to the left or right in that case. A Roadway O/E Elevation was determined.

Stream	Name	Station	High Cord	Low Cord	Boundary of Elevation	C	D	E	F	G	H	I	J	K
Sinking Creek Basin	Manakeri Creek	2402.58	662.00	568.75	661.48	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00
	Manakeri Creek	2402.58	662.00	568.75	661.48	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00
	Manakeri Creek	2402.58	662.00	568.75	661.48	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00
	Manakeri Creek	2402.58	662.00	568.75	661.48	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00
	Manakeri Creek	2402.58	662.00	568.75	661.48	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00
	Manakeri Creek	2402.58	662.00	568.75	661.48	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00
	Manakeri Creek	2402.58	662.00	568.75	661.48	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00
	Manakeri Creek	2402.58	662.00	568.75	661.48	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00
	Manakeri Creek	2402.58	662.00	568.75	661.48	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00
	Manakeri Creek	2402.58	662.00	568.75	661.48	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00
Manakeri Creek	2402.58	662.00	568.75	661.48	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00	662.00	

- May 2010 Event
- Profiles for 9 incremental rainfall events.

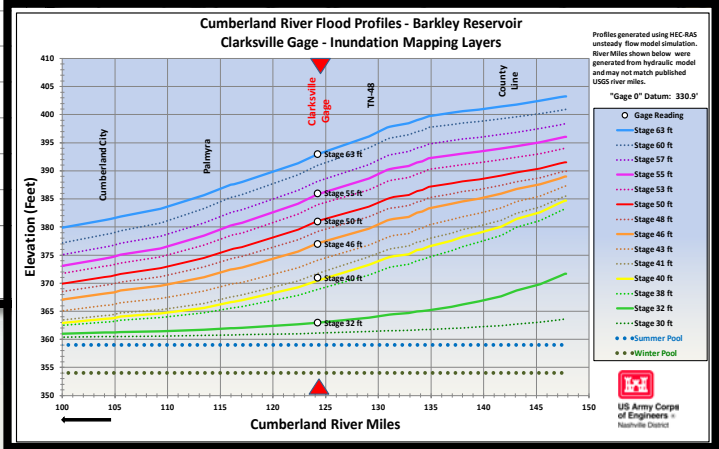
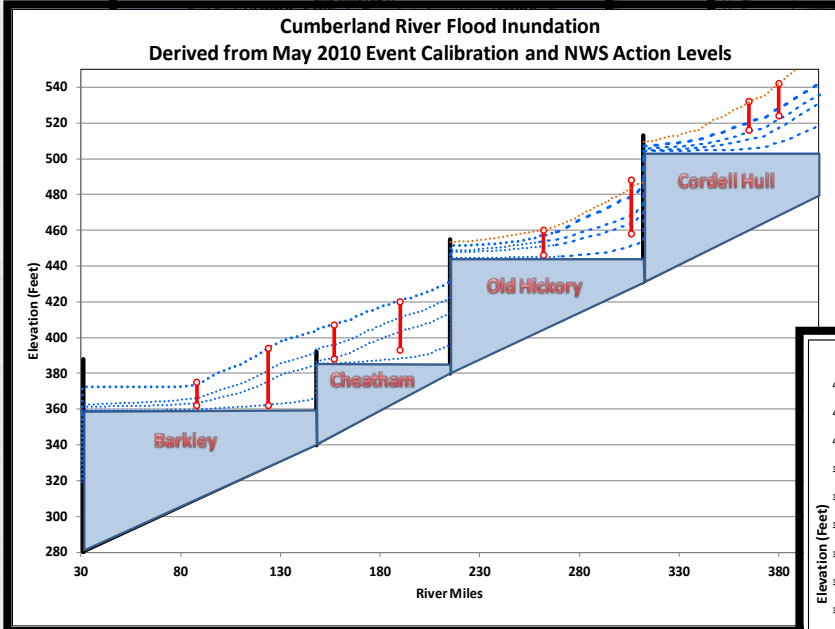
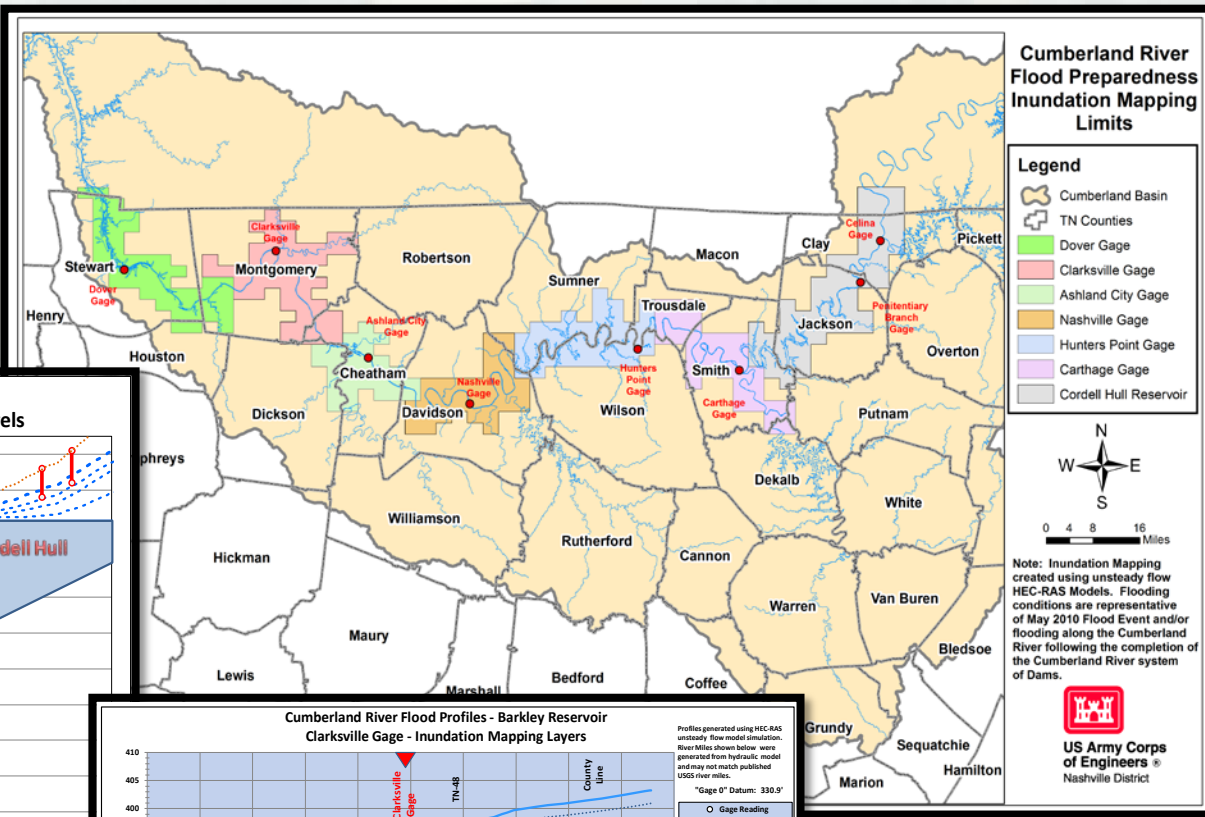
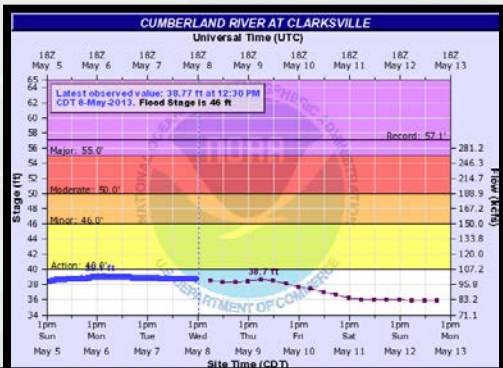


Incremental Rainfall	Action Level
3in	C
4in	D
5in	E
6in	F
7in	G
8in	H
9in	I
10in	J
11in	K



Cumberland River Mapping Efforts

Post May 2010



Metro Nashville Flood Preparedness

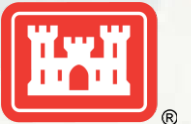
- Began in August 2010 with many agencies working together to develop products & applications to provide Metro officials with timely information.

Corps of Engineers' Participation

- Update hydrology & hydraulic modeling
- Transfer Models to FEMA for county-wide FIS Update
- Inundation Mapping for 11 scenarios used as inputs for the Nashville Situational Awareness of Flood Events (SAFE) program
- Real Time Simulation Modeling



2011 MR&T Flood Event



Water Stored After February 24, 2011

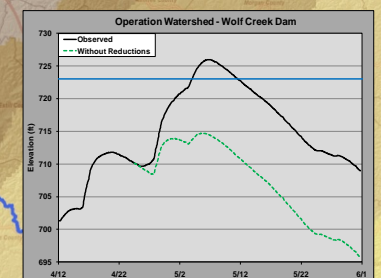
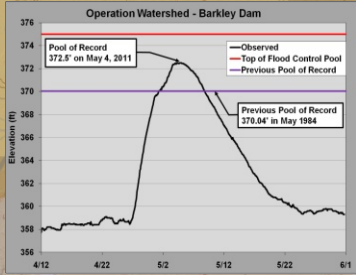
Project	Headwater (02/24/2011)	Headwater Crest	Water Stored (acre-feet)
Wolf Creek ¹	681.12	725.96	1,992,000
Dale Hollow	643.75	660.16	459,000
Center Hill ¹	625.70	658.15	576,000
J. Percy Priest	483.75	501.65	280,000
Total			3,307,000²

¹ Wolf Creek and Center Hill Dams had been classified as DSAC 1 dams and were under pool restrictions to assure the stability of the dams.

² This volume of water is roughly equivalent to 1.08 quadrillion gallons of water or if stacked on a football field it would be 2.5 million feet (474 miles) high.



Operation Watershed 4/26/2011 – 5/4/2011 Rainfall & Project Operations Cumberland River Basin



Barkley Lock & Dam

Cheatham Lock & Dam

Cordell Hull Lock & Dam

Wolf Creek Dam

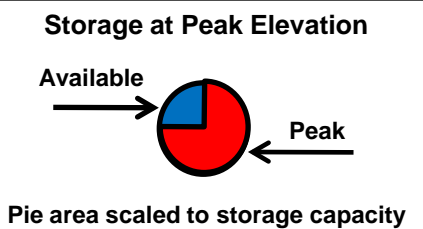
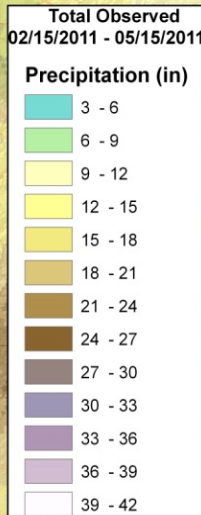
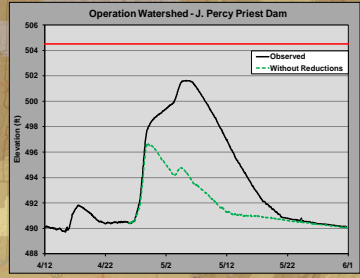
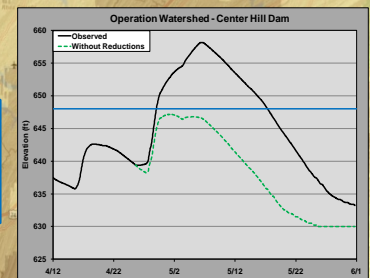
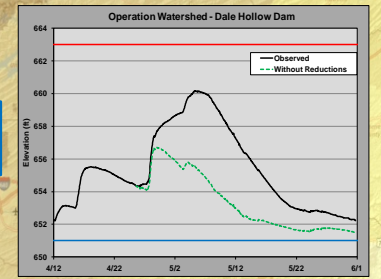
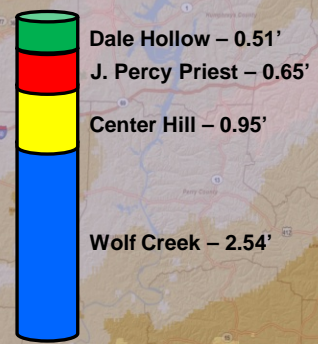
Old Hickory Lock & Dam

Dale Hollow Dam

J. Percy Priest Dam

Center Hill Dam

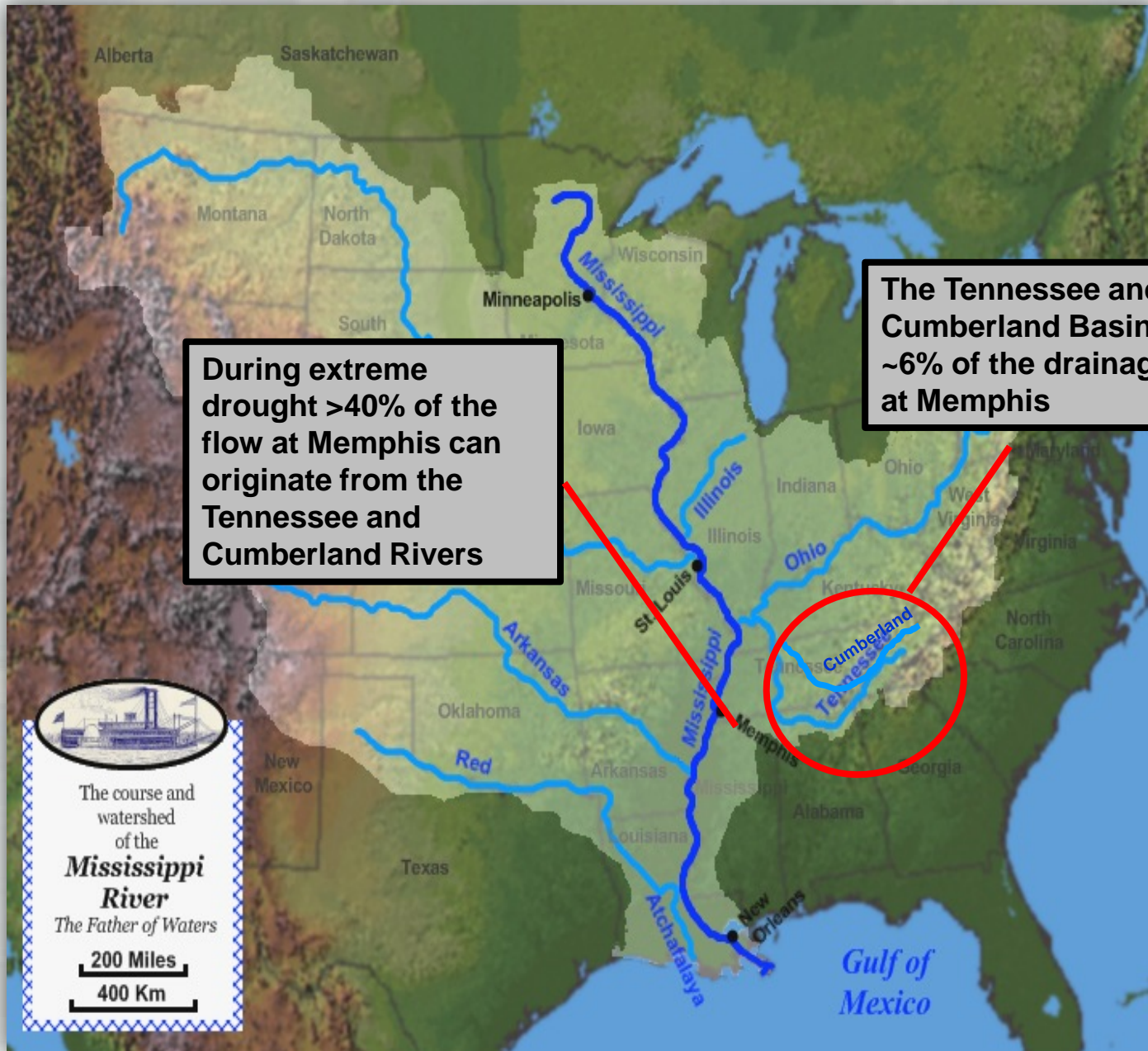
Storage conserved in Barkley and Kentucky
4.65 feet



2012 Regional Drought



Mississippi River Navigation



Mississippi River at Memphis

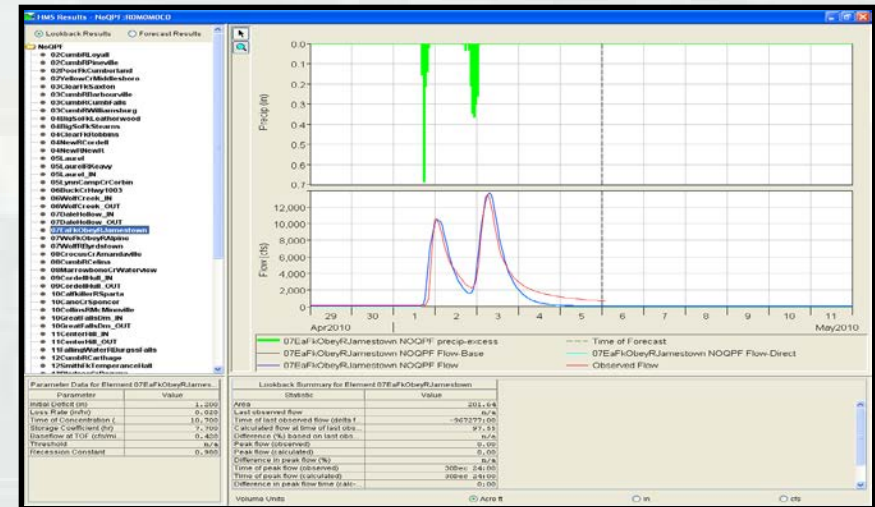


- Historic Low Levels
 - 1) -10.70 (7/10/1988)
 - 2) **-9.86 (9/19/2012)**
 - 3) -9.20 (9/20/2000)
- 19 September 2012
 - ▶ Flow of 146,000 cfs
 - ▶ Tennessee and Cumberland provided 53,000 cfs (36%)
 - ▶ Stage at 93,000 cfs ~-15.4



Recent Water Management Initiatives

- Water Management Center
- Update Modeling Tools
- Spillway Gate Monitoring Systems
- RiverStatus Mobile Web-site
- Educational Videos



Questions?



Nashville District Homepage

www.lrn.usace.army.mil

