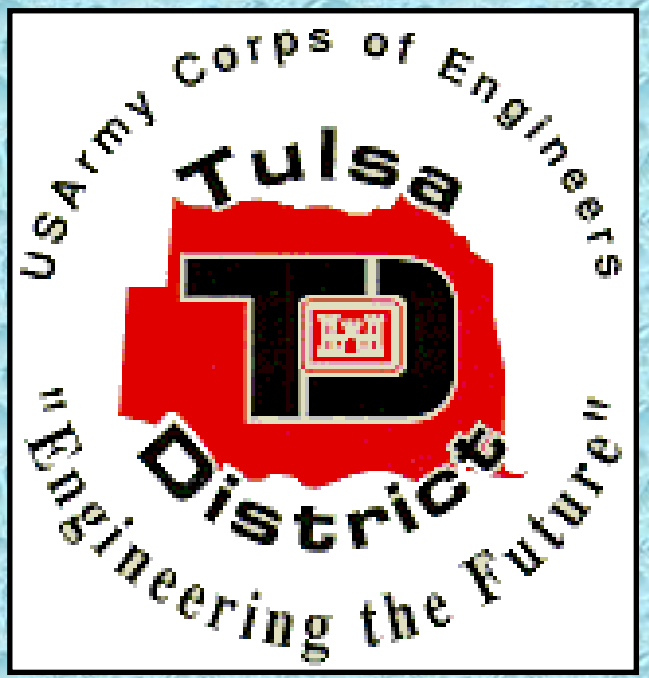
APPLICATION OF FLOOD CONTROL IN THE ARKANSAS RIVER BASIN

US Army Corps of Engineers
Tulsa District

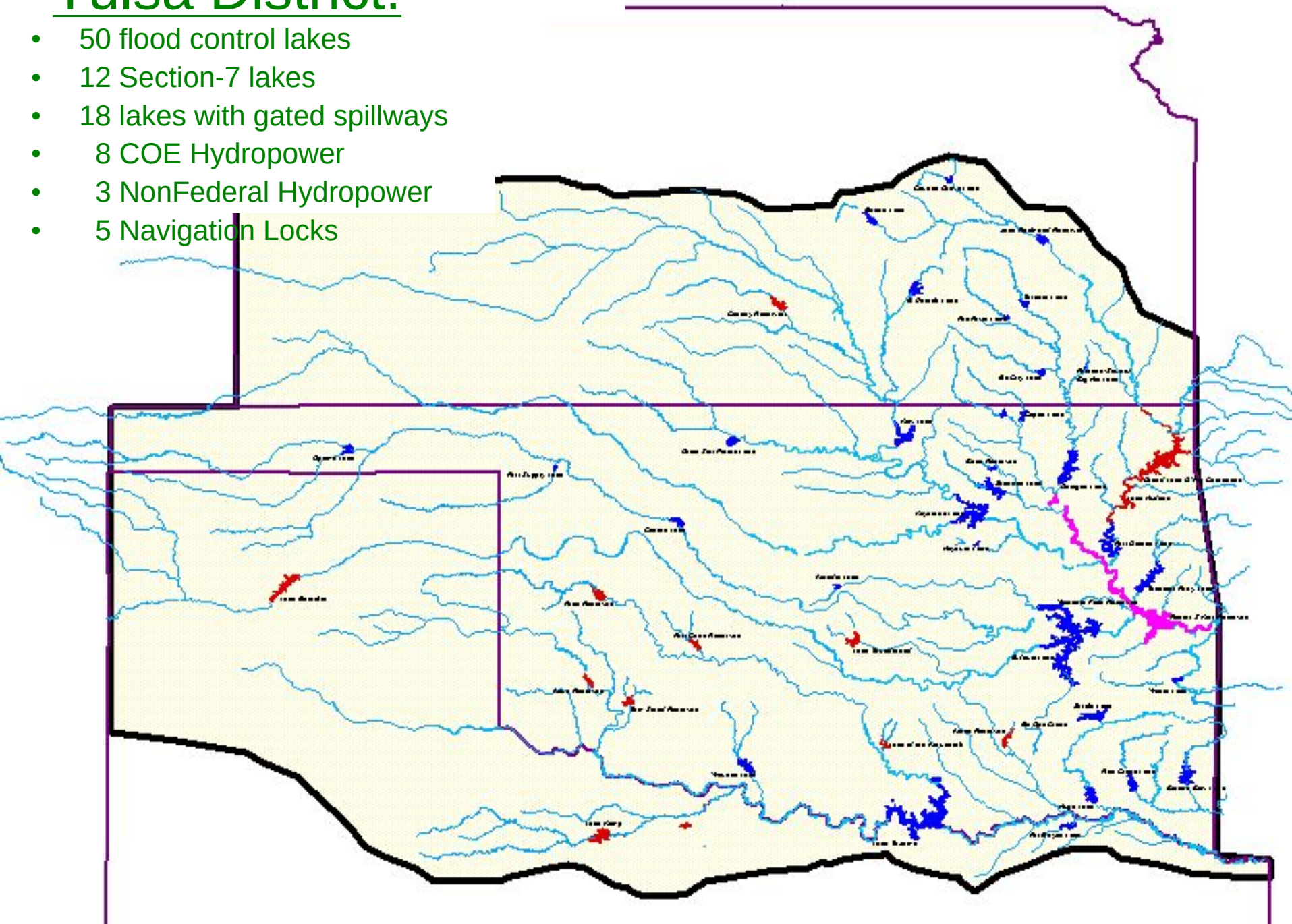


TODAY'S DISCUSION

- System/Project Features
- Flood Control Operation
- Need for Period Of Record (POR) Basin Simulation Model
- Transition to RiverWare

Tulsa District:

- 50 flood control lakes
- 12 Section-7 lakes
- 18 lakes with gated spillways
- 8 COE Hydropower
- 3 NonFederal Hydropower
- 5 Navigation Locks



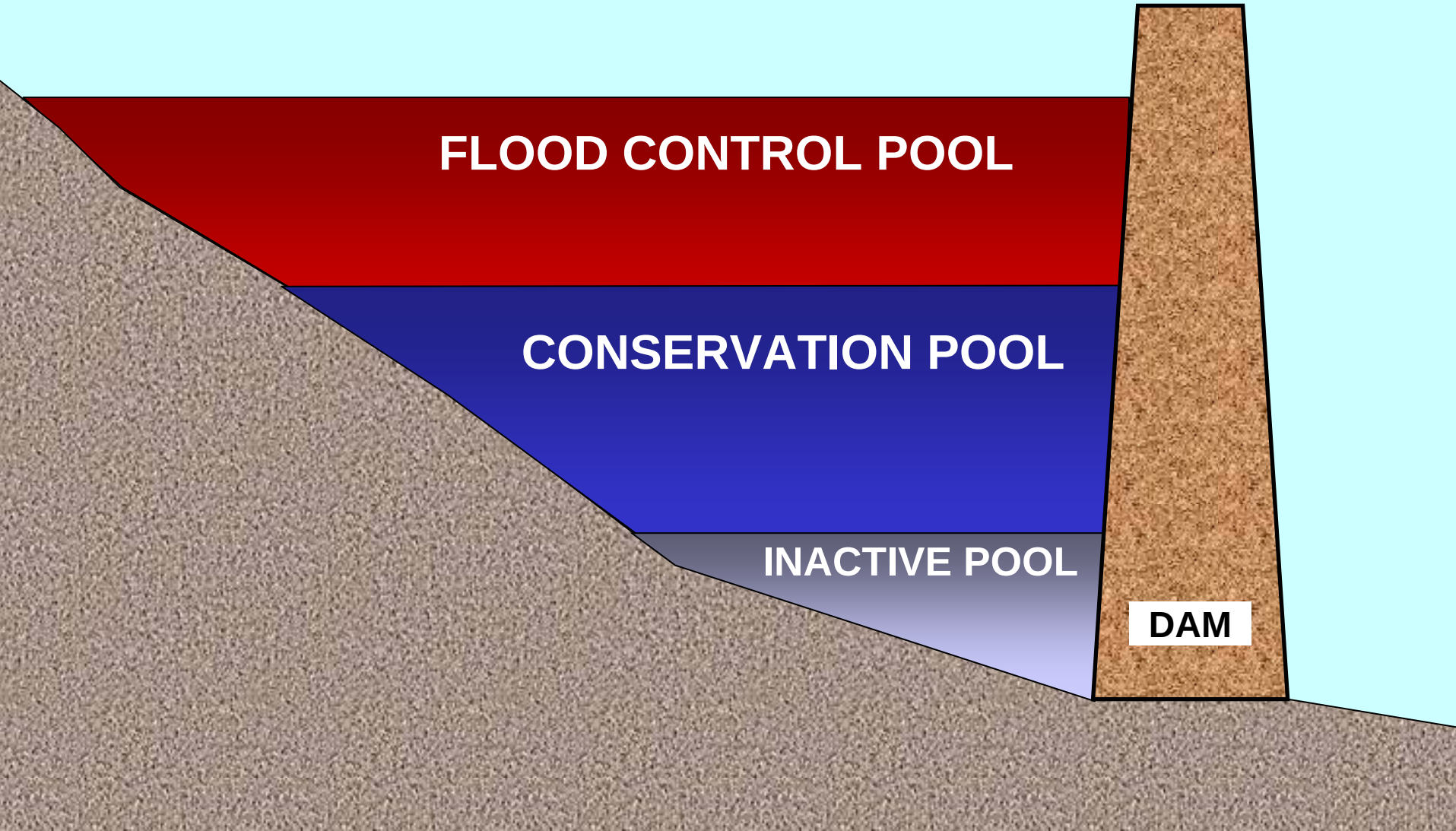
Tulsa District Corps System Project Purposes

- 35 Projects in Arkansas Basin & 15 Projects on Red River Basin
- Flood Control
- Hydropower
- Low Flow/WQ
- M&I
- Navigation
- Recreation
- Levees

PROJECT COMPONENTS

- Low Flow Conduit
- Hydropower
- Radial Arm (Tainter) Gates
- Gated Sluice Gates
- Gated Conduit Through Embankment
- Uncontrolled Conduit
- High Level Uncontrolled Spillway
- Combinations of Control

STORAGE DIVISIONS

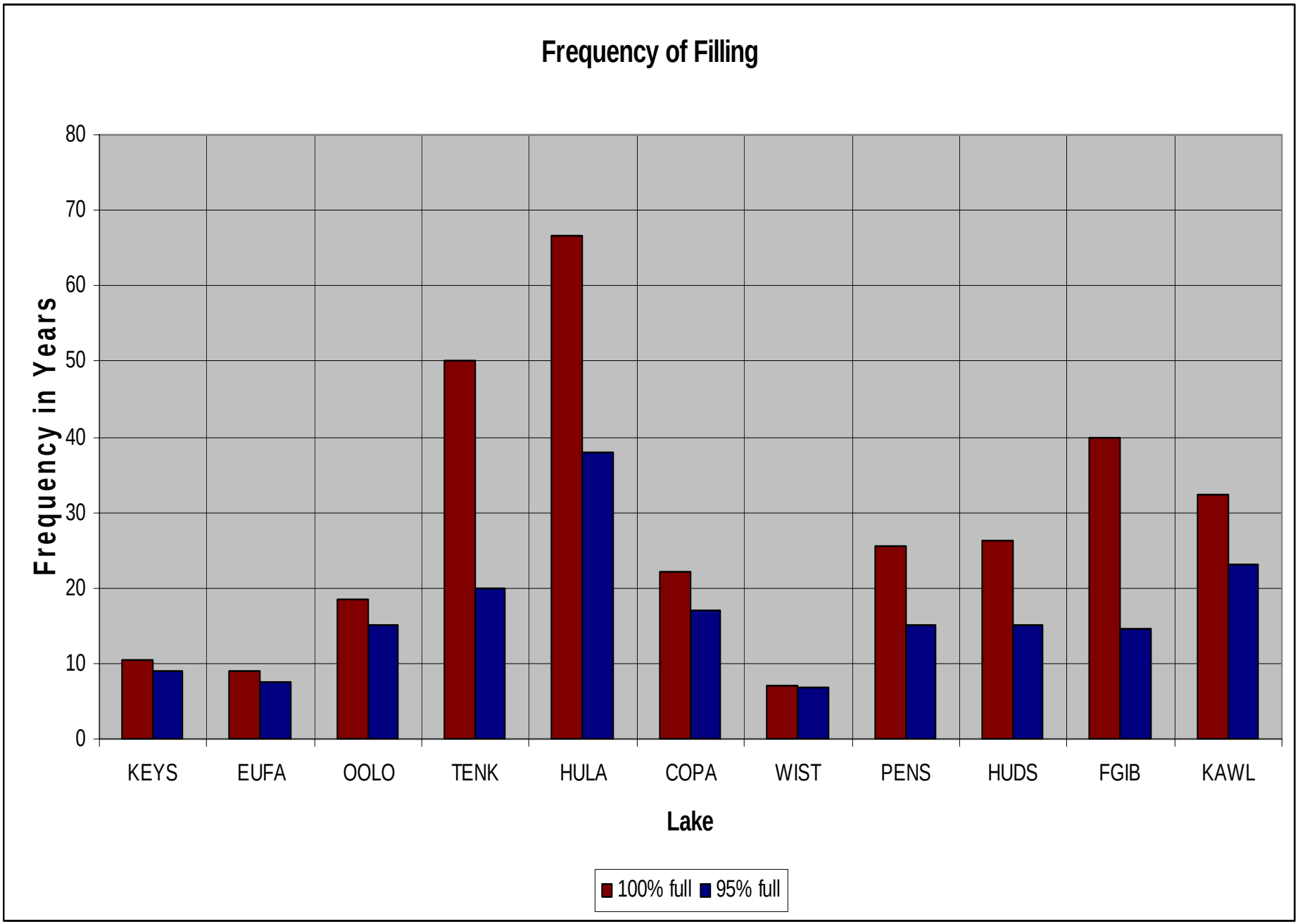


ORIGIN OF INFLOW

- Seasonal Rainfall - Spring/Fall
- Frontal Systems
- Remnants of Tropical Systems
- Snow Pack/Melt Insignificant

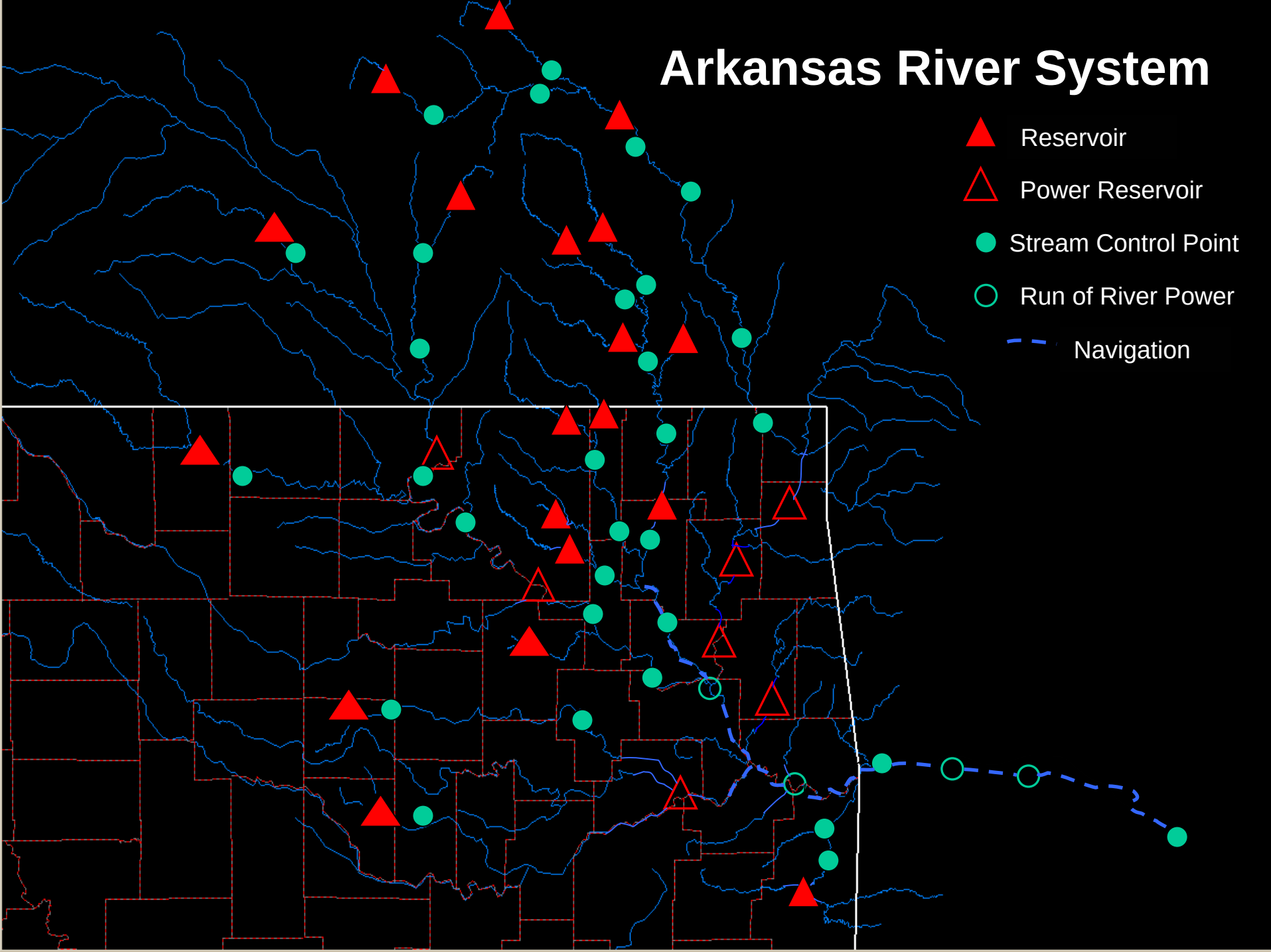
RUNOFF RESPONSE TIME

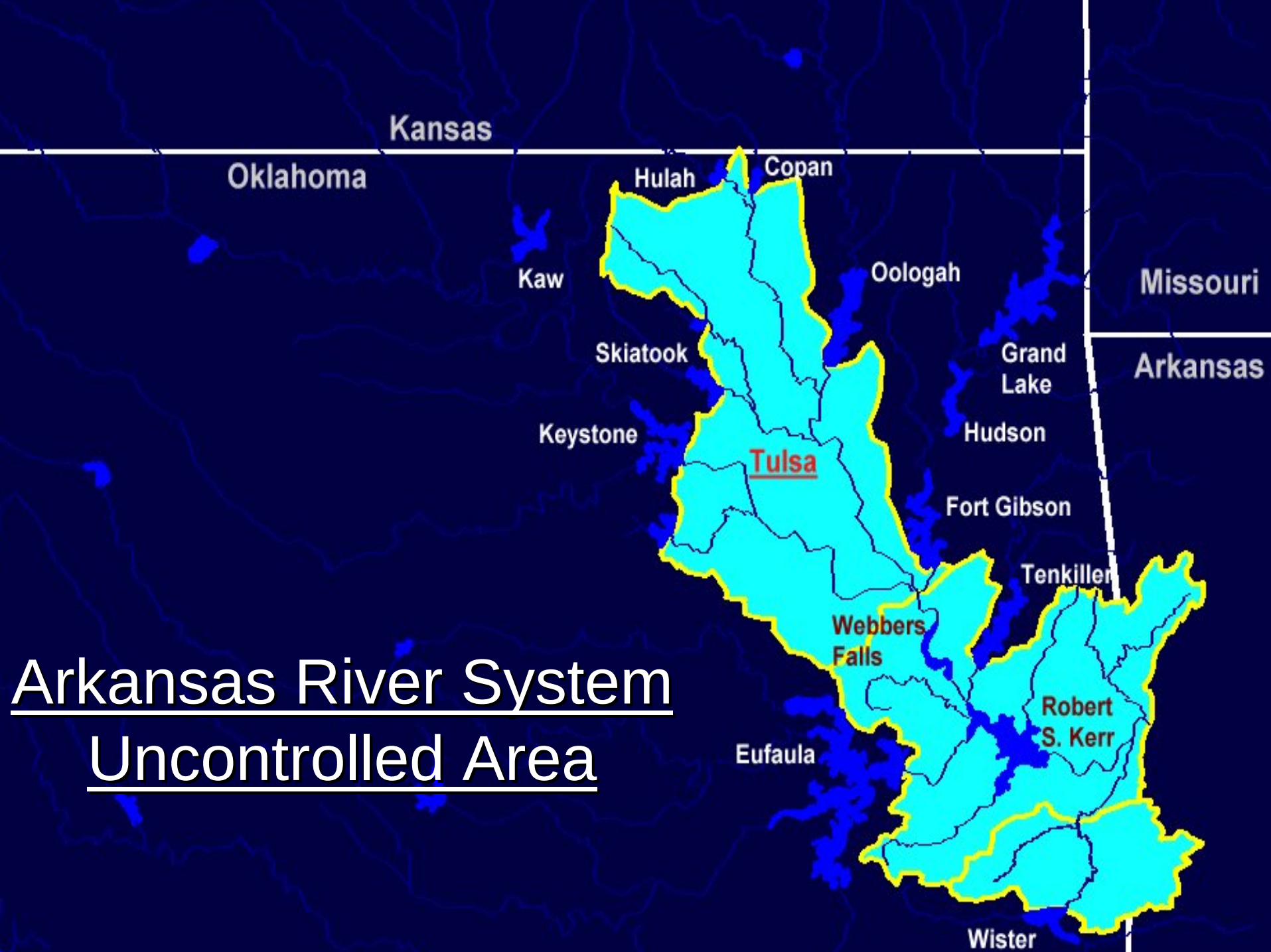
- Few Hours to Several Days
- Single to Multi-Day Event
- Evacuate Flood Control Storage Prior to Next Event, If Possible


Frequency of Filling
Frequency in Years
80
70
60
50
40
30
20
10
0
KEYS
EUFA
OOLO
TENK
HULA
COPA
WIST
PENS
HUDS
FGIB
KAWL
Lake
100% full
95% full

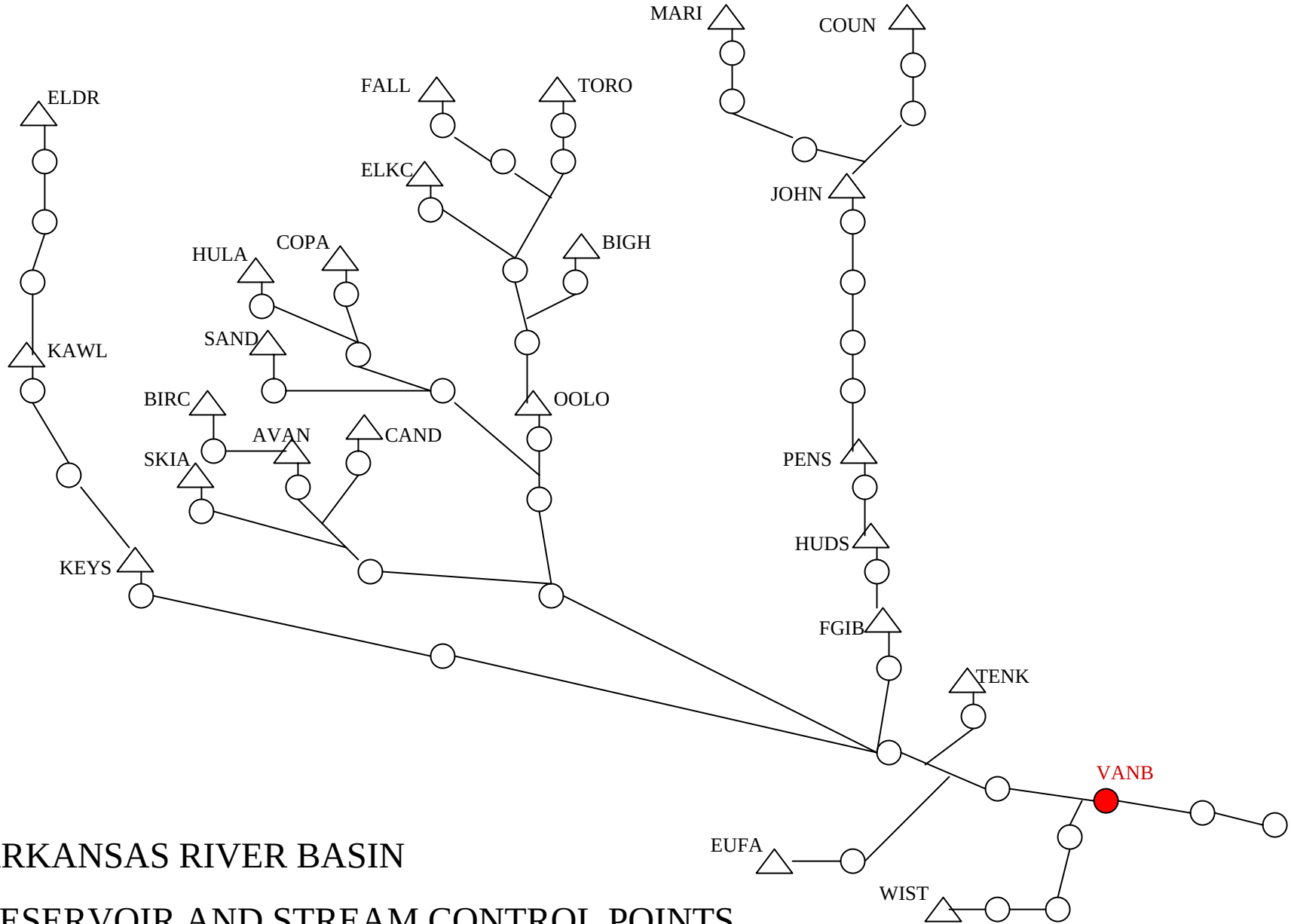
GOAL OF FLOOD CONTROL OPERATION

- Prevent overtopping: loss of control.
- Releases from the lake, when combined with downstream runoff will not cause flooding conditions, if possible.
- System balancing of flood control storage & evacuation.
- Flood waters will be stored to prevent downstream flooding and evacuated prior to next flood event, if possible.


Arkansas River System
Reservoir
Power Reservoir
Stream Control Point
Run of River Power
Navigation



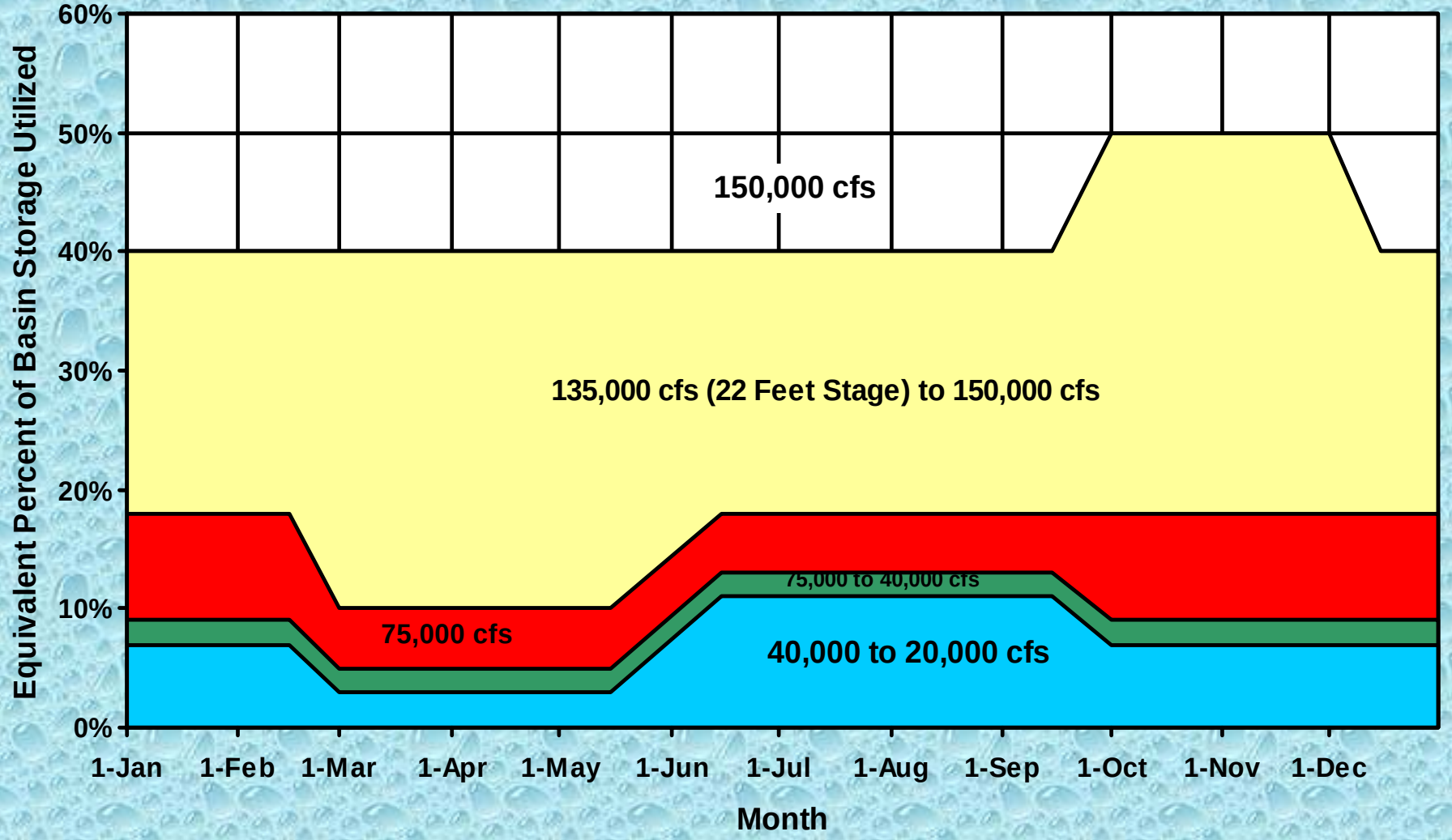
Arkansas River System Uncontrolled Area



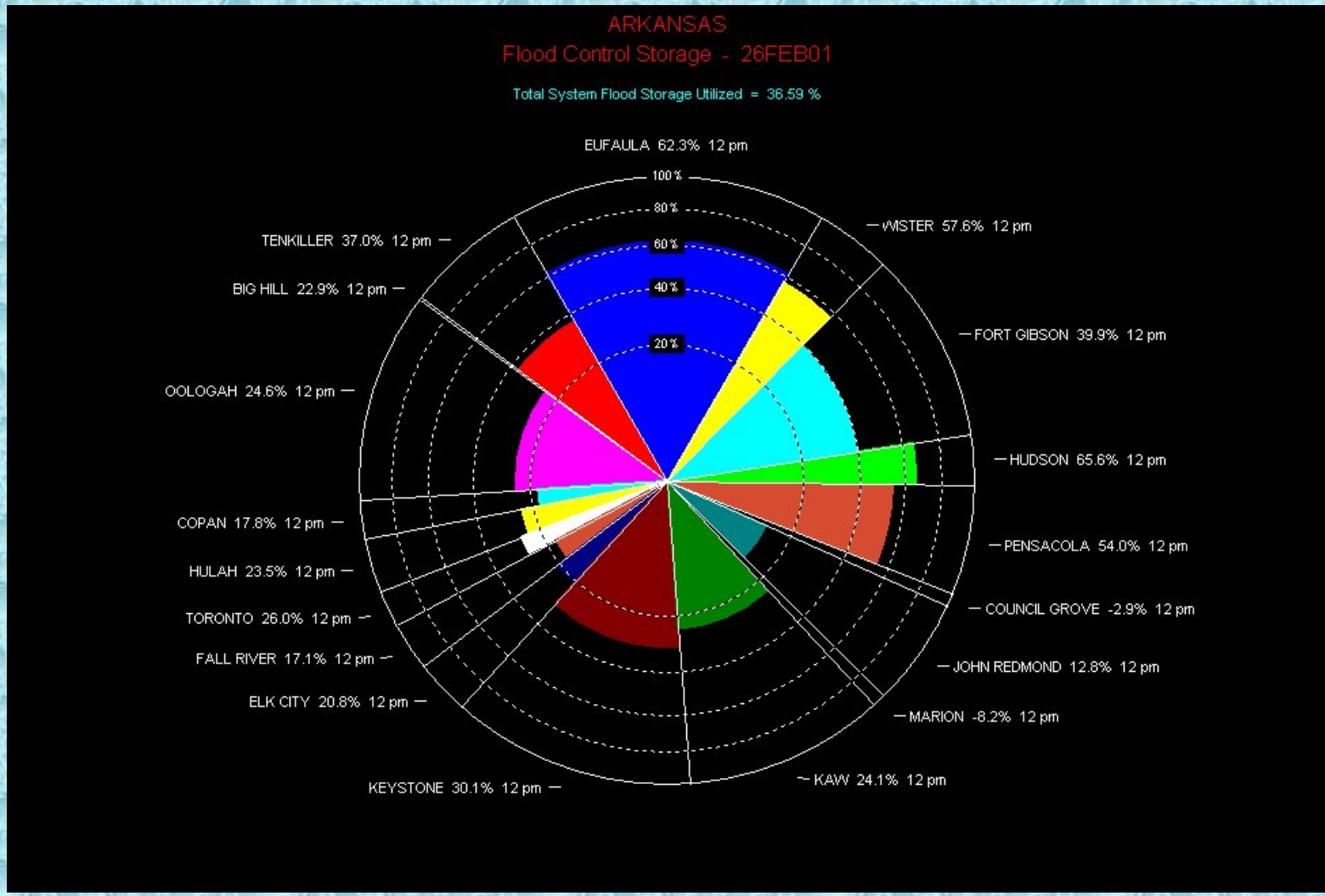
ARKANSAS RIVER BASIN

RESERVOIR AND STREAM CONTROL POINTS

Van Buren Guide Curve
Existing Operation



ARKANSAS RIVER BASIN: PROJECT FLOOD CONTOL %



TULSA DISTRICT
WATER CONTROL PROGRAMS

- **Real-Time Water Control:**
  Data Collection/Processing
  Current "State of the System" - Numerous Utility Programs
  Web Site
  Inflow Forecast

- **Stage Reduction & Benefit Analysis**

- **Annual Water Control Reports**

- **Planning Investigations/Alternative Operations – POR Basin Simulation & Planning Model**
  (Not Real-Time)

NEED FOR POR SIMULATION & PLANNING MODEL

- Period of Record Statistical Analysis
- Alternative operational approaches
- Reallocation of authorized storages
- Recreation Investment
- M&I Dependability
- Hydropower
- Navigation
- Environmental Issues

EXISTING POR SIMULATION & PLANNING MODEL

- Southwest Division and subordinate Districts have been using a system planning model for 30 years - “Super”. Development/Expert (Ronald L. Hula) SWD Corps, Retired.

- “Super Program” application has been accepted by SWPA/DOE, State Water Distr’s, navigation, others.

- Districts have limited ability to use/revise program.

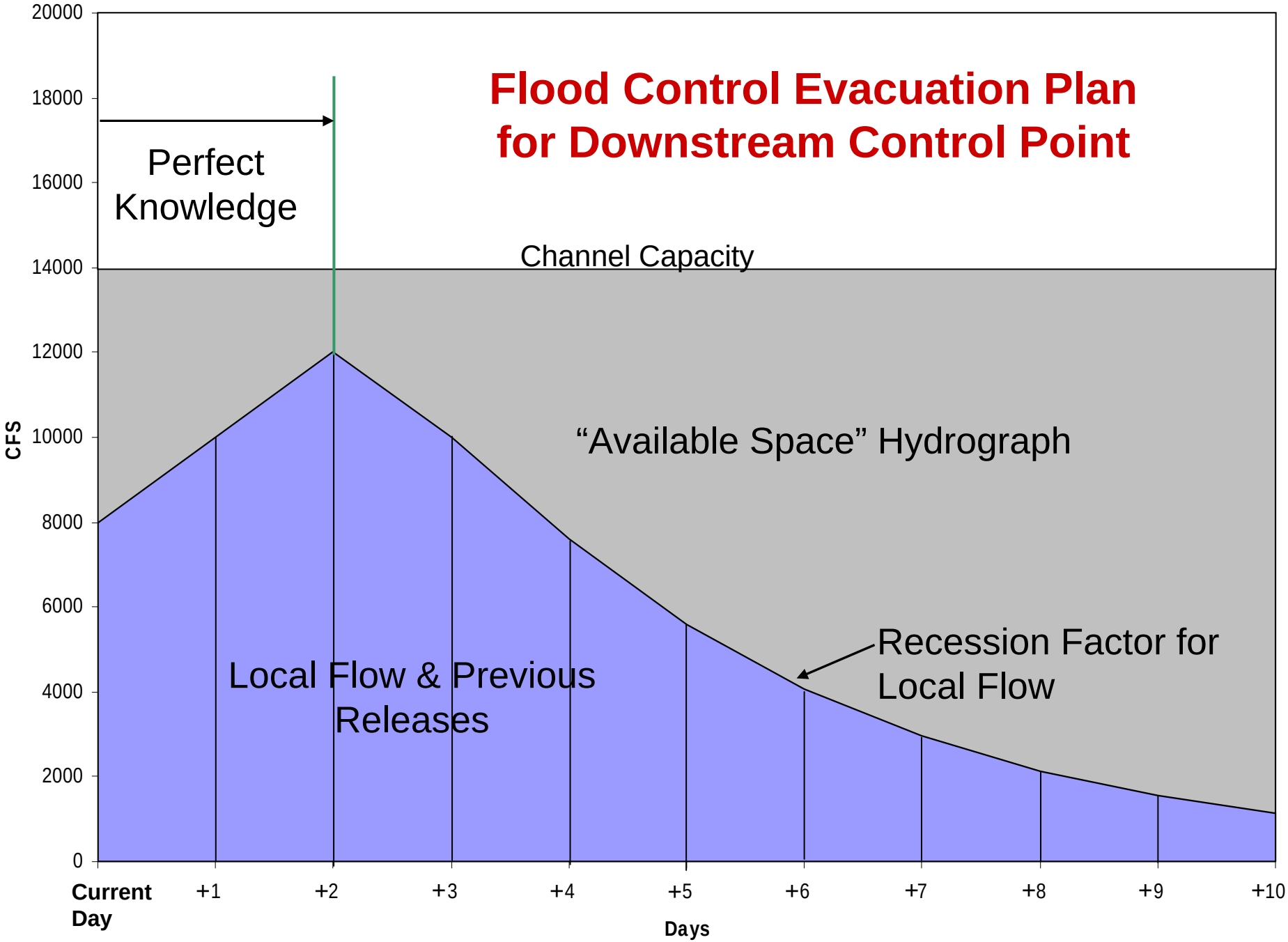
- Retiree is temporarily on contract.

BASIN SIMULATION & PLANNING MODEL with RIVERWARE

- 1999 - Southwest Division Lead Effort to Investigate Existing Simulation Models.
- 1999 - 2000: Determination That Riverware Has Potential to Meet SWD Corps Needs. Simulation and Rules Training.
- CADSWES Incorporating Super Flood Control Logic into RiverWare – Nearly complete with ongoing testing & verification.
- Currently Using Super Program with Assistance of Retiree. Migration to RiverWare….

GENERAL METHODOLOGY TO SIMULATION

- Period of Record Simulation (61 Years, Daily time steps) of Local Flow and Project Operation Based on Predefined Constraints.
- Local Flow Developed From Historic Gage Data and Project Releases.
- On Any Given Day of Simulation, Know Current State of the System with 1-3 Days “Perfect Knowledge” of Inflow and Downstream Local Flow.
- Releases Are Made to Evacuate Flood Control Storage to Achieve a “Balance” in the System. Balance Level, Not Necessarily %
- System Balancing Extended to Conservation Storage.
- Ten Day Decision Plan.


Flood Control Evacuation Plan
for Downstream Control Point
Perfect
Knowledge
Channel Capacity
"Available Space" Hydrograph
Local Flow & Previous
Releases
Recession Factor for
Local Flow
CFS
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Current
Day
+1
+2
+3
+4
+5
+6
+7
+8
+9
+10
Days

SIMULATION WITH RIVERWARE:

- Pre-Defined Rules of Operation/Simulation.
- Reservoir Object: Balance Level Definition
- Control Point Object: Local Flow With Forecast, Channel Control, List of Regulating Reservoirs.
- Key Control Point Definition.
- Stream Routing.
- Evacuate Flood Control Storage In A Way To Achieve System Balance.

CORPS USE WITH RIVERWARE

- Replace Period of Record “Super” Program Used By Tulsa, Ft Worth, & Little Rock Corps Distr’s.
- HEC’s CWMS Programs.
- Real Time Evacuation of Flood Storage - TAPER program used in Tulsa.
- Other Corps Districts?

FUTURE WORK WITH CADSWES

- Critical Dependable M&I Yield Routine.
- Conditional Probability Routine.
- Constant Leakage.
- Multi-Year Periodic Slot: Regulation Guide.
- RiverWare Interaction with HEC's CWMS.
- Corps Hydropower Assessment.
- Statistical Analysis.
- User's Guide: Corps Super Algorithm.

Photo by Jim Zingo
Interior Least Tern
Survival of Fittest: Bird Eats Minnow