

*The Nature  
Conservancy*<sup>®</sup>

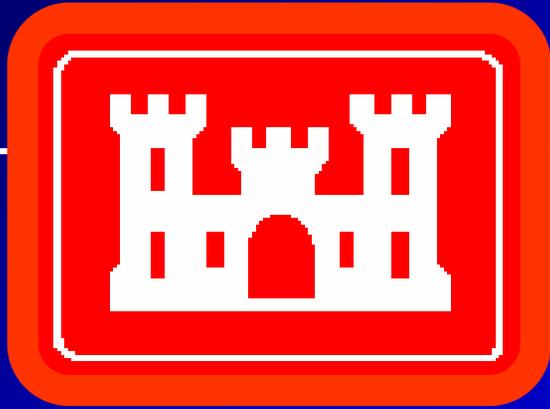


SAVING THE LAST GREAT PLACES ON EARTH



*Presentation for the  
First Annual Sustainable  
Rivers Project Meeting  
November 15-16, 2004*

***Presented by  
Leroy Crosby -USACE Savannah District  
and Amanda Wrona -TNC Georgia Chapter***



*Comprehensive  
Water Resources Study  
for the  
Savannah River*



SAVING THE LAST GREAT PLACES ON EARTH



# *Study Need*

- ◆ **More frequent severe droughts and floods**
- ◆ **More water demands by Georgia and South Carolina**
- ◆ **More need for water laws and interstate communication within the basin**



# Savannah River Basin Balancing Uses

*Wetlands / Habitat*



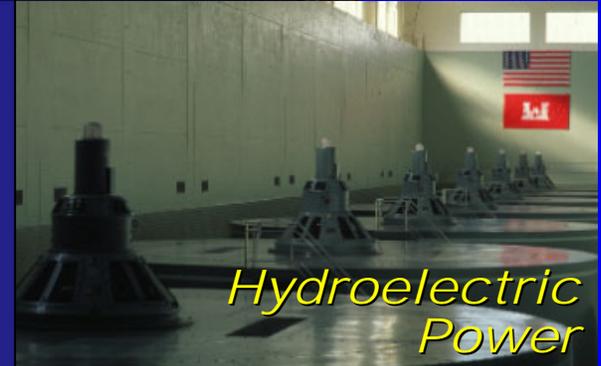
*Water Supply*



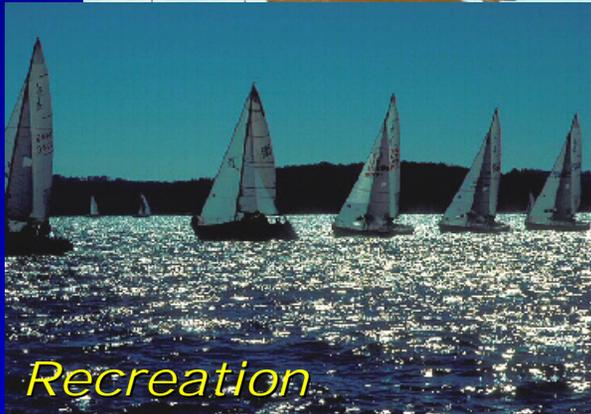
*Aquatic Plant Control*



*Hydroelectric Power*



*Recreation*



*Flood Control*



*Navigation*



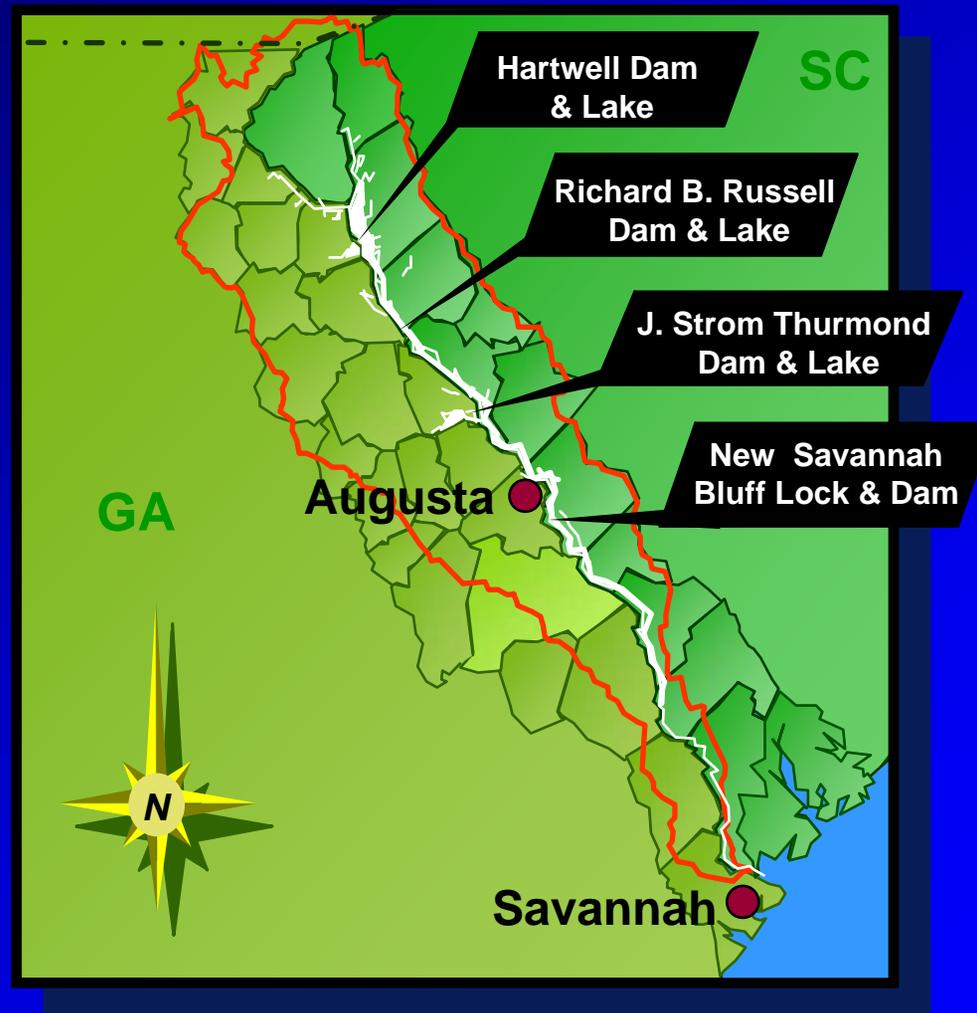


# *Guiding Principles*

- ◆ **Non-confrontational**
- ◆ **Science-based**
- ◆ **Cooperative, solution-oriented**
- ◆ **Emphasize places, people, and the future**
- ◆ **Partnerships and community-based conservation**
- ◆ **Share the wealth and the pain for both normal to high water years vs drought conditions.**



# Savannah River Basin Comprehensive





# *Savannah River Basin Comprehensive Water Resources Study*

## **Pertinent Basin Data**

**Over 500 Major Users**

**44 GA & SC Counties**

**312 River Miles**

**13 Hydropower Plants**

**1 Lock and Dam**

**3 COE Dams**

**11,000 Square Miles**



# *Savannah River Basin Comprehensive Water Resources Study*

---

**Utilize a “whole-basin” analysis  
to identify and provide recommendations  
for meeting the various water demands  
throughout the basin.**



# Cost Shared Requirements

---

- **50% Fed.                      25% SC                      25% GA**
- **FY04 Federal Funding = \$130,000**  
**to continue Phase I work.**
- **SC is providing Payment & In-kind Services**
- **GA is providing In-Kind-Services**

# *Savannah River Basin Comp. Study*



## *Project Delivery Team (PDT)*

---

- ◆ **Savannah District, US Army Corps of Engineers**
- ◆ **South Atlantic Division, US Army Corps of Engineers**
- ◆ **US Fish and Wildlife Service**
- ◆ **NOAA – National Marine Fisheries Service**
- ◆ **Southeastern Power Administration**
- ◆ **The Nature Conservancy**
- ◆ **South Carolina Department of Natural Resources**
- ◆ **Georgia Department of Natural Resources**
- ◆ **GA – USGS**

# *Savannah River Basin Comp. Study Stakeholders Group*



- ◆ **The Friends of Lake Keowee**
- ◆ **Duke Power**
- ◆ **Lake Hartwell Home Owners Associations**
- ◆ **Friends of Savannah River Basin**
- ◆ **Anderson, South Carolina Chamber of Commerce**
- ◆ **Savannah River Keeper**
- ◆ **Georgia Ports Authority**
- ◆ **City of Savannah**
- ◆ **City of N. Augusta and Aiken County, SC**
- ◆ **City of Augusta**
- ◆ **Goodale Landings**
- ◆ **Plant Vogel**
- ◆ **Savannah River Site**
- ◆ **Southeastern Natural Sciences Academy**
- ◆ **Buford-Jasper County Water & Sewer Authority**



# *Savannah River Basin Comp. Study*

---

## ***Study Direction***

- ◆ **Conducting Feasibility Phase**
  - ❖ **Two Phased Effort**
    - **Preliminary Phase**
    - **Detailed Phase**



# *Savannah River Basin Comp. Study*

## ***Phase One – Focus On Changing Operations***

- ◆ Working With Stakeholder Groups
  - ❖ Clearly define their needs - current & future
- ◆ Model Preparation
- ◆ Develop Historical Data
- ◆ Develop & Evaluate Allocation Scenarios
- ◆ Have a plan? Or, on to Phase Two

# *Current Status*



- ◆ **GA USGS is finished the 50-year inflow data set**
- ◆ **HEC RES SIM (basin-wide computer model)**
- ◆ **Zapata finished the basin-wide water use and demand surveys**
  - ❖ **Hydropower**
  - ❖ **Public Involvement (Recreation and Residential)**
  - ❖ **Municipal & Industrial Users**
  - ❖ **Agricultural Users**
- ◆ **Nature Conservancy in concert w/ the scientific community developed ecological flow prescriptions for fish, wildlife, and plant habitat for river between Augusta Shoals and the Atlantic Ocean**



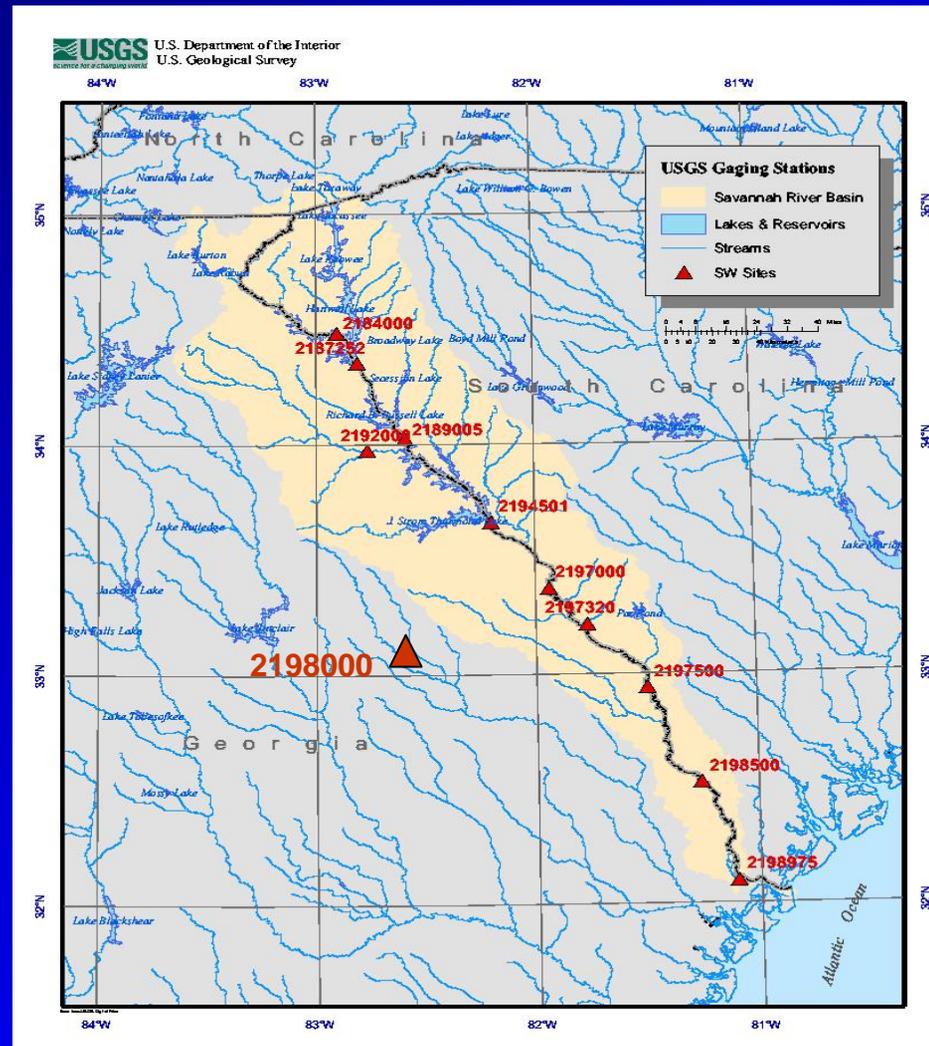
# USGS Data Sets

9 Sub Regions

Water Years 1940-2000

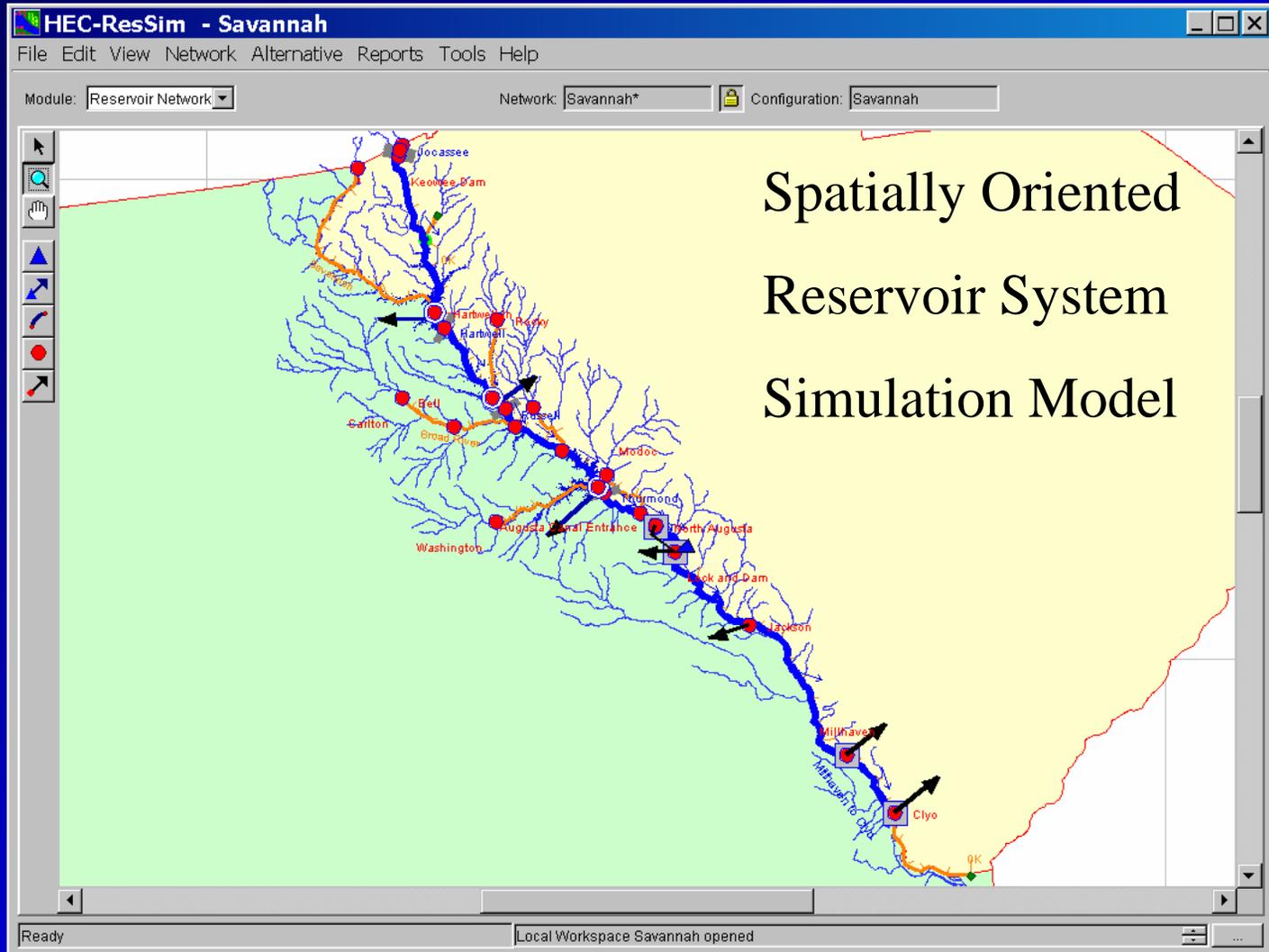
Routing Coefficients

Unimpaired Flows





# HEC-RES-SIM

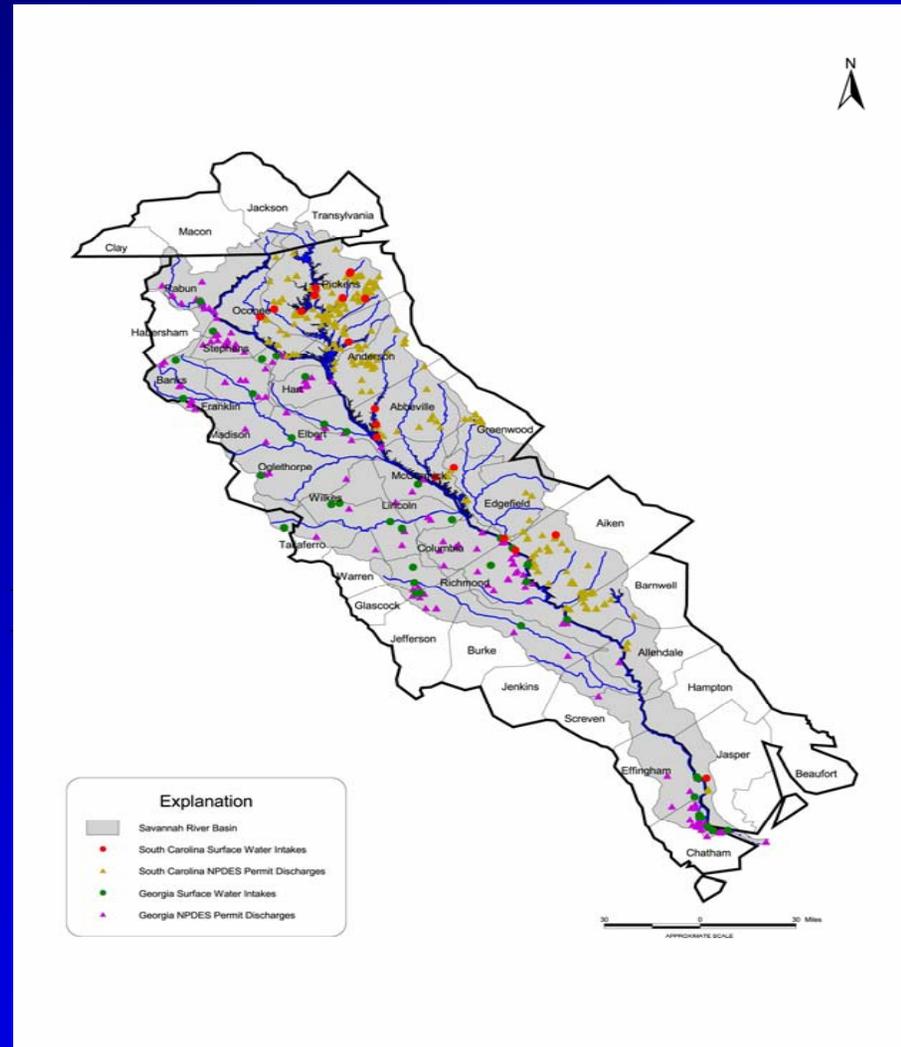




# Water Use Data Collection and Stakeholder Interaction

## Four Major Groups

- Industry/municipal
- Agriculture
- Homeowner and recreation
- Hydropower



**Ecologically sustainable water management  
on the Savannah River: Development,  
implementation, and monitoring of ecological  
flow prescriptions.**

*The Nature  
Conservancy*<sup>®</sup>



SAVING THE LAST GREAT PLACES ON EARTH

# *Savannah River Facts*

## *What are we Protecting?*



- ❖ Beginning in the Blue Ridge Mountains of north Georgia at the confluence of the Seneca and Tugaloo rivers
- ❖ encompasses more than 10,577 square miles on its path to the Atlantic Ocean.
- ❖ The Savannah River divides the states of South Carolina and Georgia and crosses three geographically distinct ecoregions – the **Blue Ridge**, the **Piedmont** and the **Coastal Plain**.
- ❖ The Basin covers approximately 710,000 acres and includes longleaf pine forests, Carolina bays, bottomland hardwood forests, tidal wetlands, outcrops, shoals and mesic bluffs.

# Why are we protecting this resource?



❖ Freshwater mussels are also abundant in the river system, with 9 rare species documented in the basin.



❖ 100 species of fish one of the broadest arrays of fish species in the Southeast. (largemouths, striped bass, chain pickerel and redbreast and the endangered short nose sturgeon).



❖ The Savannah River Basin is home to more than 75 species of rare plants and animals, including, the robust redhorse and the globally rare shoals spiderlilly.

# Globally Rare Species

- ◆ 2 Amphibians
- ◆ 5 Birds
- ◆ 4 Fish
- ◆ 1 Invertebrate
- ◆ 4 Mussels
- ◆ 21 Plants
- ◆ 2 Reptiles
- ◆ 89 Species listed by the GA & SC Heritage Programs



# Critical Threats



**Incompatible  
Forestry and  
Agricultural  
Practices**

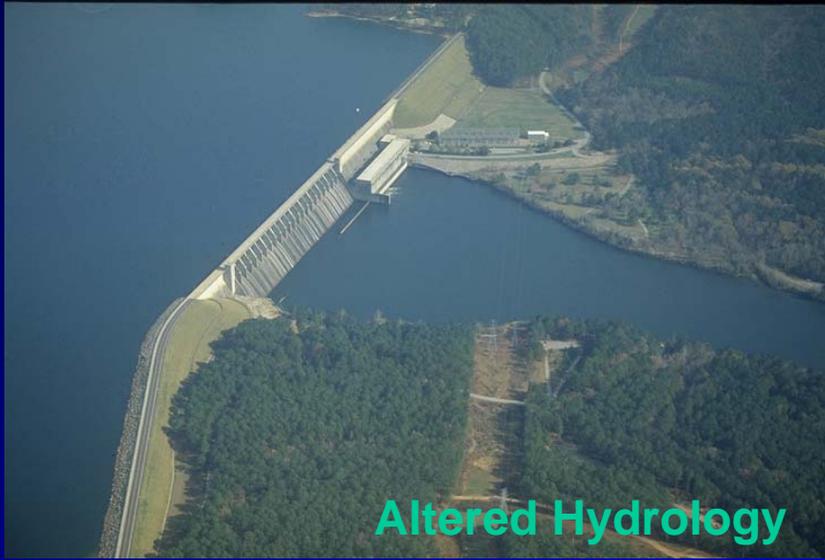


**Harbor Modification**



**Municipal water use**

# Critical Threats



# *Designing Ecological Flow Prescription*

## ◆ Orientation Meeting

- ❖ More than 50 individuals attended an orientation meeting in May 2002
- ❖ Reviewed background information (there's lots already out there)
- ❖ Developed team to write report

## ◆ Literature Review and Summary Report

- ❖ Four lead researchers, representing various disciplines, and a team of graduate assistants developed an annotated literature review  
[www.rivercenter.uga.edu/pdfs/ecosystem2.pdf](http://www.rivercenter.uga.edu/pdfs/ecosystem2.pdf)
- ❖ More than 375 sources were identified and reviewed

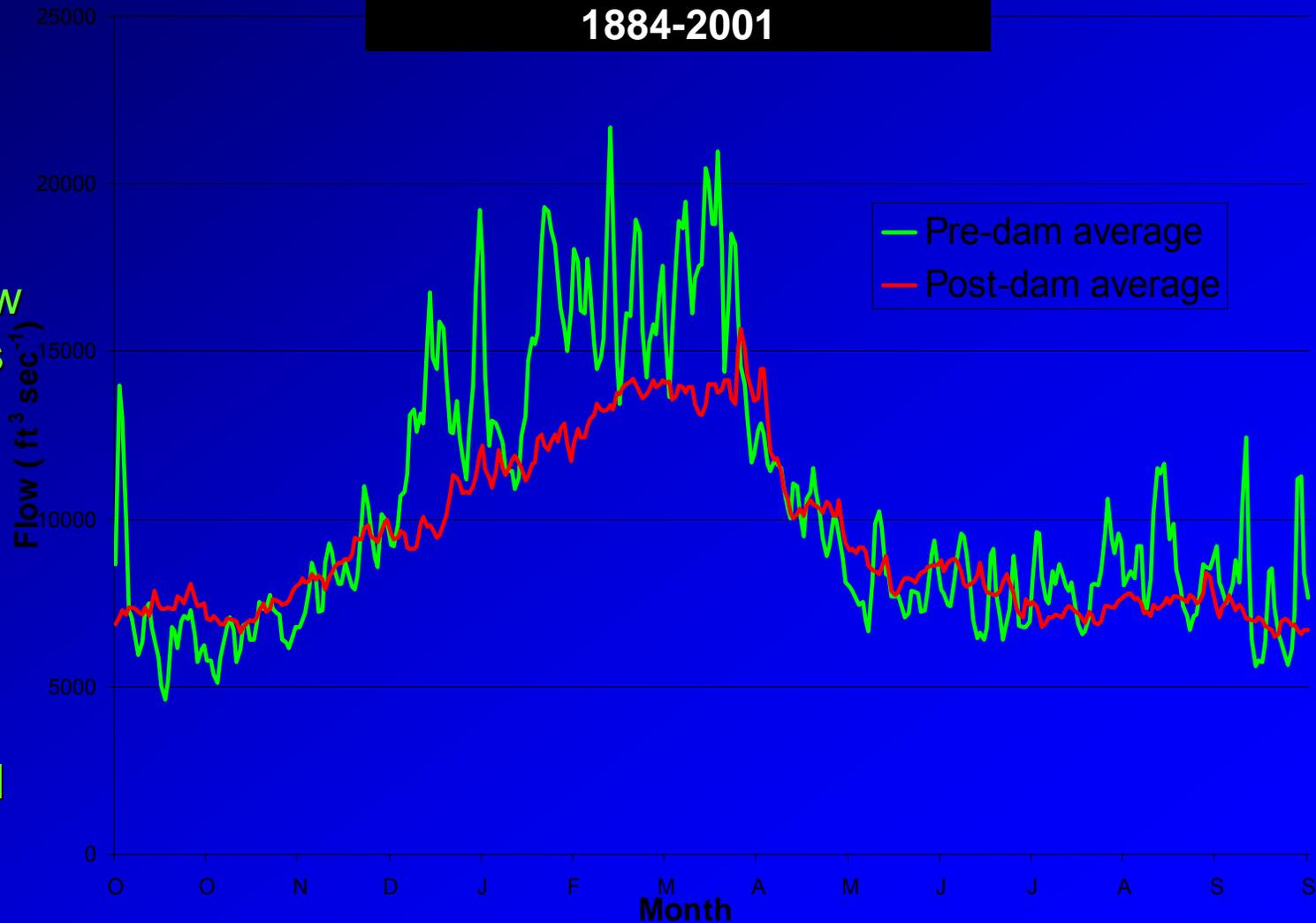
## ◆ Flow Recommendations Workshop

# *Savannah River Ecosystem Flow Workshop*

- ◆ ***Purpose:*** collaborative process to gain understanding of the influence of hydrologic processes on river ecology
- ◆ ***Contributors:*** The Nature Conservancy, USACE - Savannah District, USFWS - Charleston, University of Georgia River Science and Policy Center
- ◆ ***Outcome:*** designed a process to determine a set of essential flow characteristics to sustain the ecological integrity of the Savannah River ecosystem

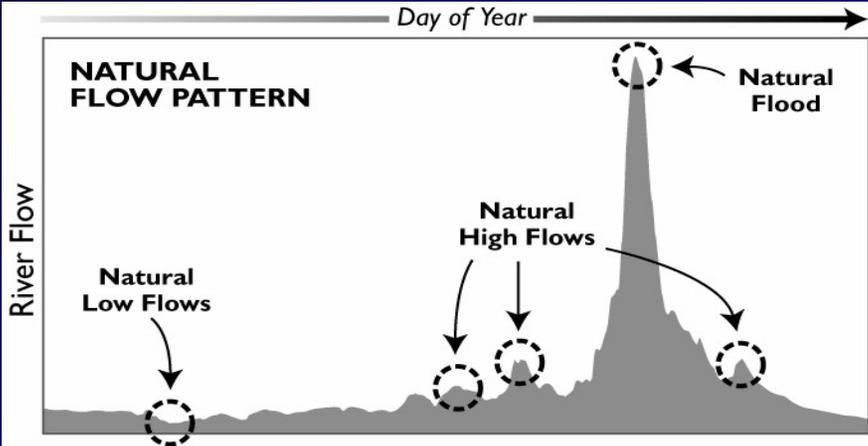
# Key Post-Dam Changes in the Savannah River Hydrograph

**Savannah River Flow at Augusta  
1884-2001**



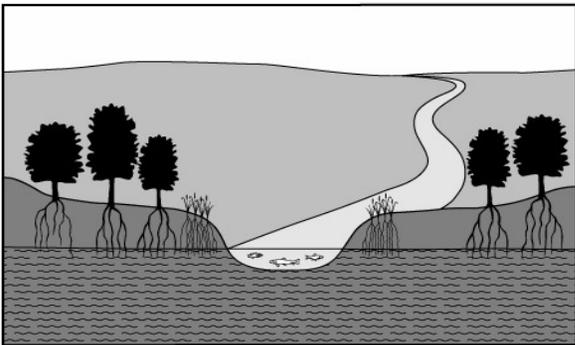
- ◆ Removal of natural variability in the hydrograph
- ◆ Increased low flow volumes
- ◆ Reduction in peak flow volumes and frequency
- ◆ Reduction in mean annual flow

Day of Year



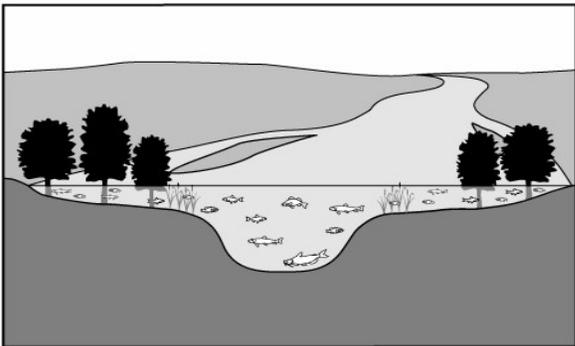
### Natural Low Flow

-  Fish have adequate oxygen and can move up- or downstream to feed
-  Riparian vegetation sustained by shallow ground water table
-  Insects feed on organic material carried downstream
-  Birds supported by healthy riparian vegetation and aquatic prey



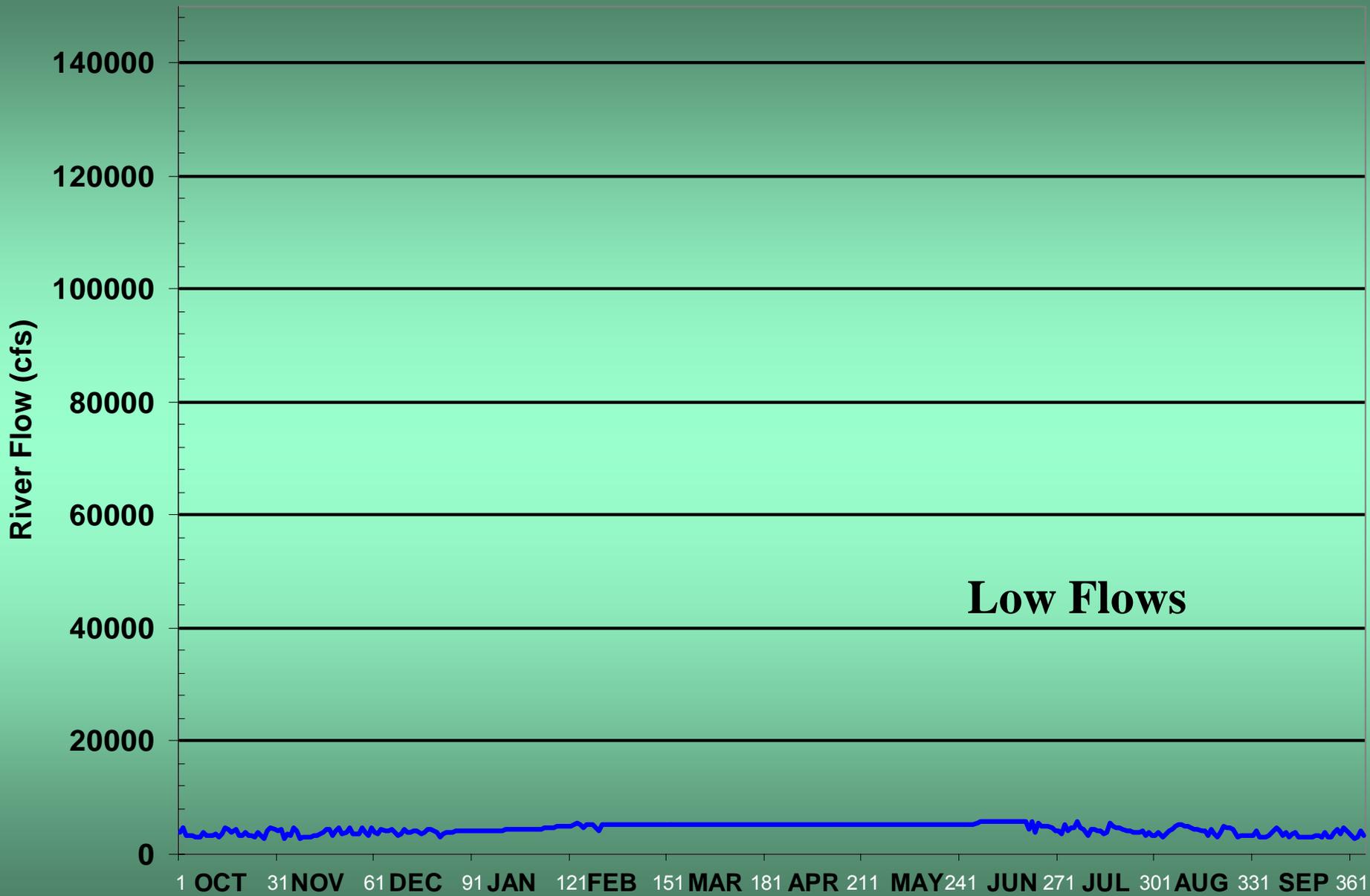
### Natural Flood

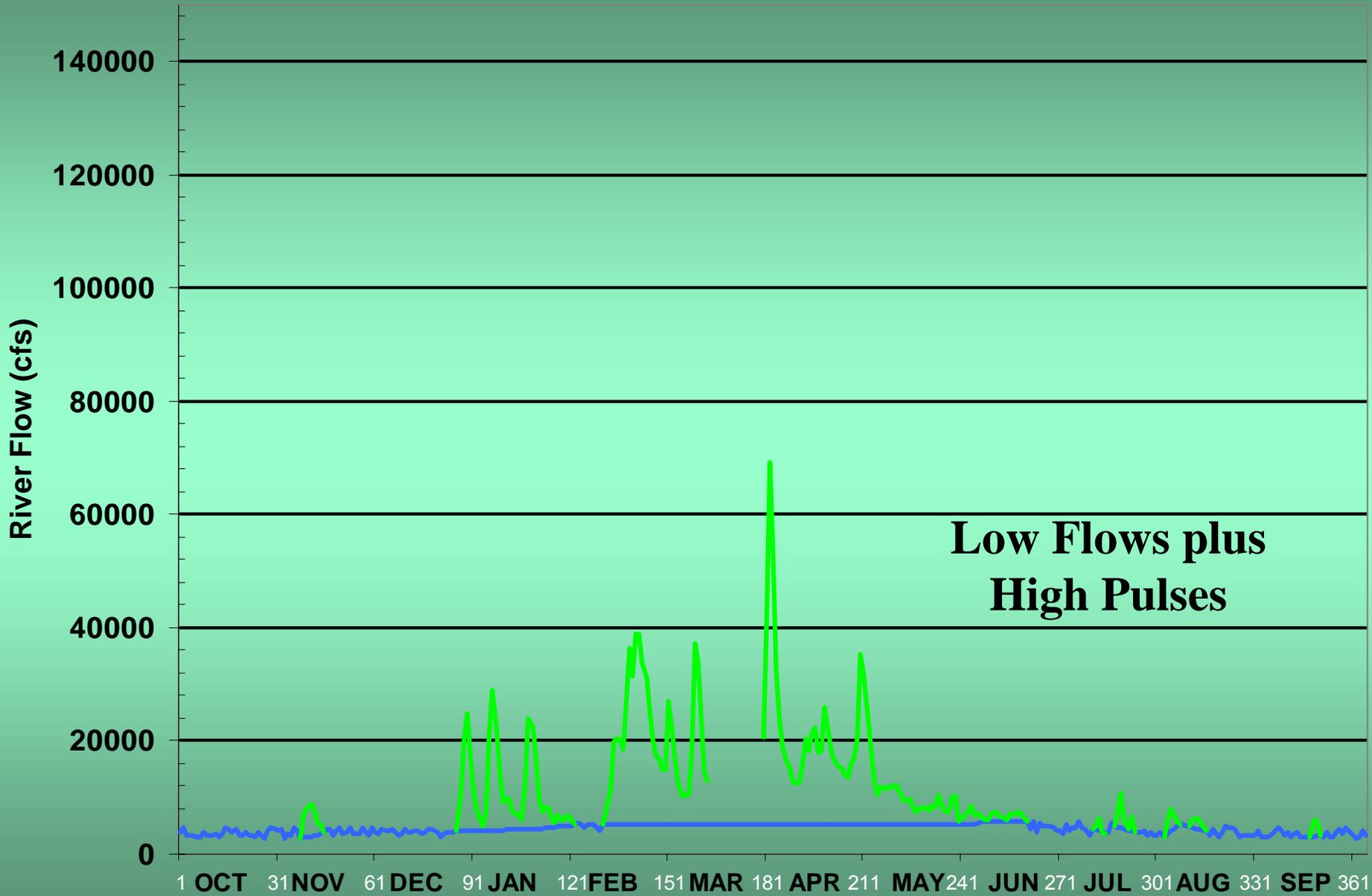
-  Fish are able to feed and spawn in floodplain areas
-  Riparian plant seeds germinate on flood-deposited sediments
-  Insects emerge from water to complete their lifecycle
-  Wading birds and waterfowl feed on fish and plants in shallow flooded areas

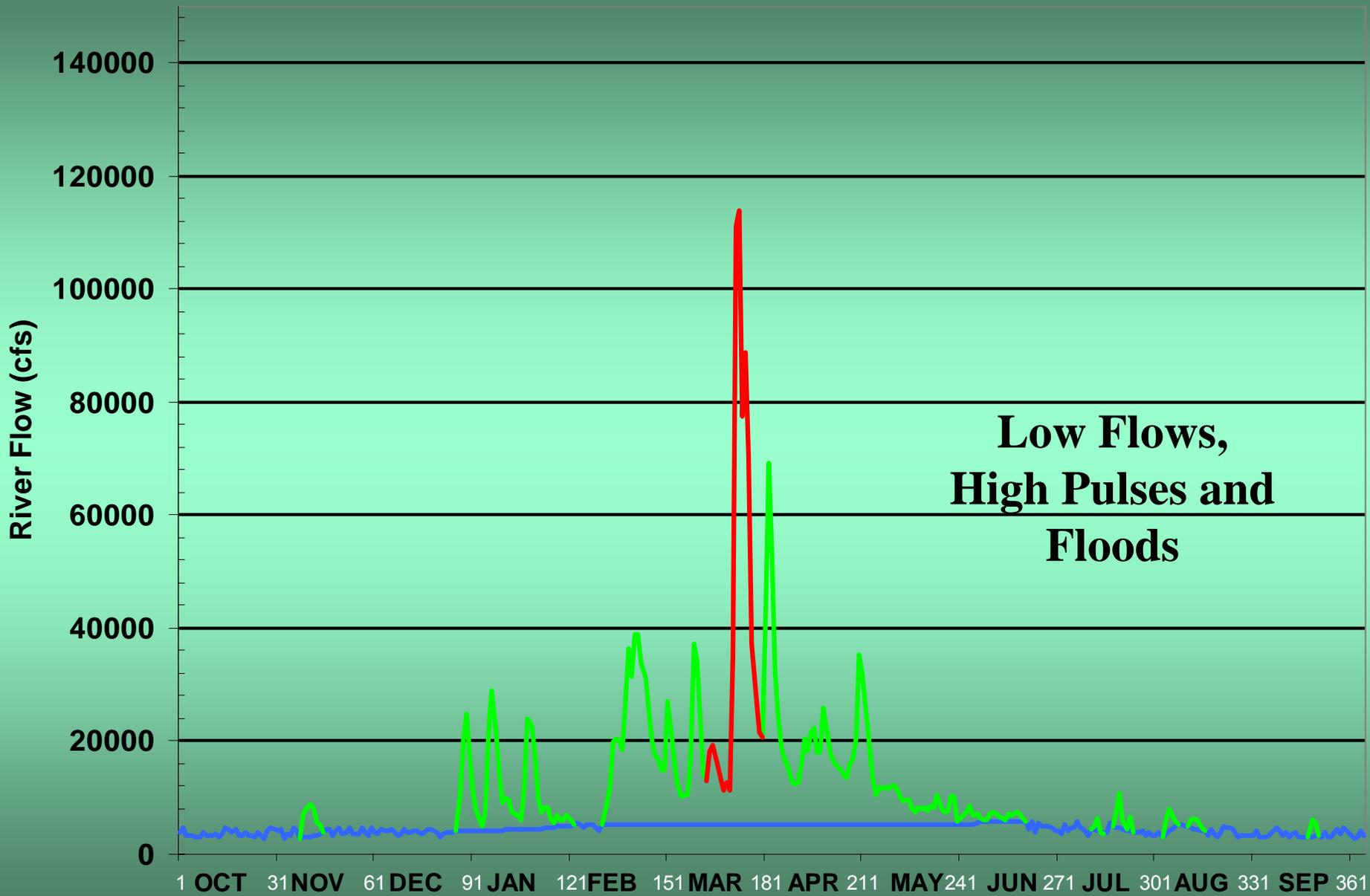


# *Savannah River Ecosystem Flow Workshop Participants*

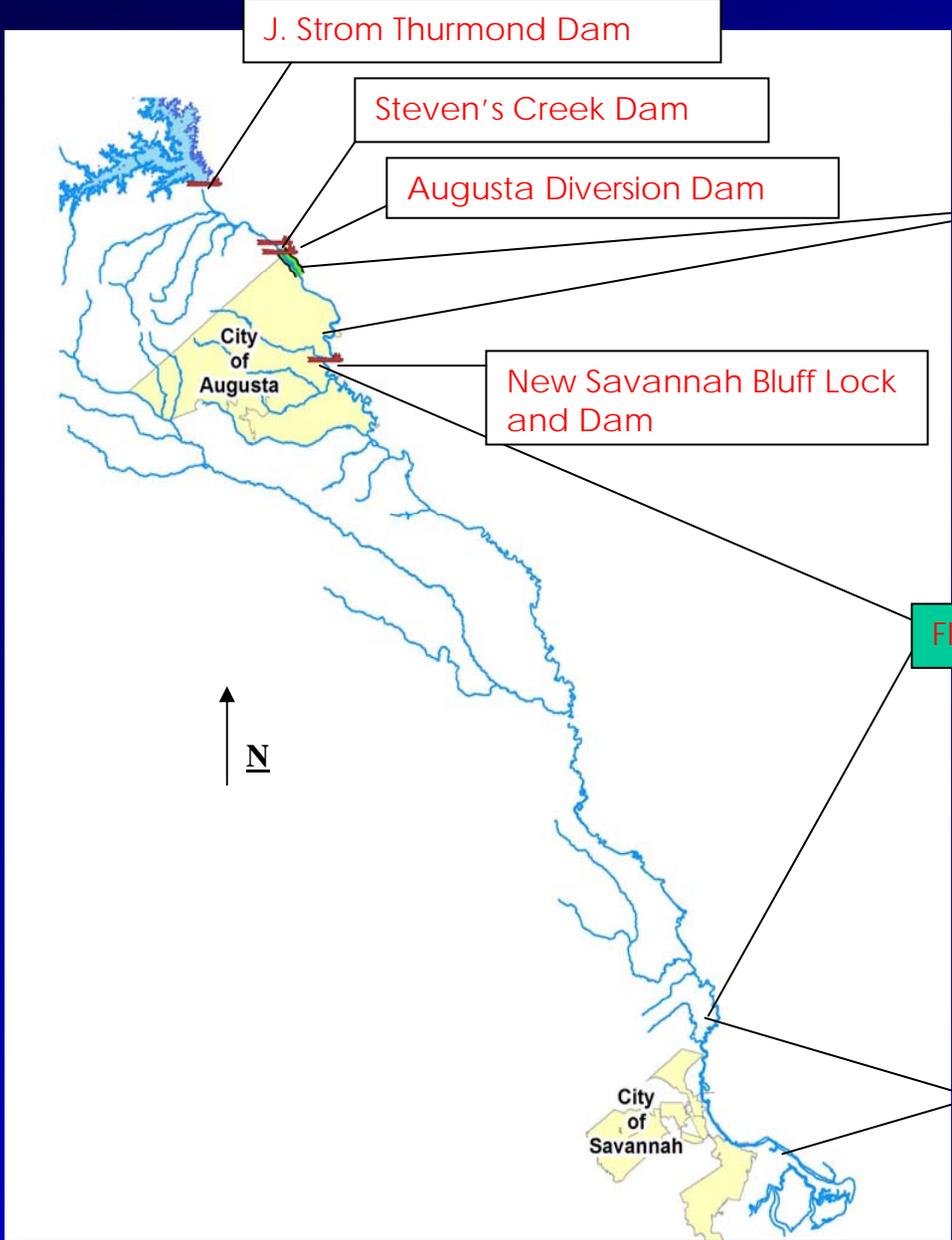








*The goal was not to create optimal conditions for all species all of the time; rather, we wanted to create adequate conditions for all native species enough of the time.*



Shoals



Flood plain



Estuary



# Ecosystem Flow Recommendations

## Savannah River, below Thurmond Dam (*Augusta Shoals*)

### Floods

*No flood flow recommendations provided for the Shoals*

### High Flow Pulses

**20,000-40,000 cfs;**  
2-3 days, 1/month | 14 days, 1/month  
Jan & Feb | Mar & Apr

**20,000-40,000 cfs; 2-3 days, 1/month**

>16,000 cfs; 1-2 days, 1-2 pulses

- Herring passage over NSBLD
- Morone egg suspension

**20,000 cfs;**  
**2-3 days, 1 pulse**  
• Sturgeon spawning

### Low Flows

>5,000 cfs;  
• Sturgeon spawning

**4,000-5,000 cfs;**  
• Sturgeon spawning

**6,000-10,000 cfs, with 6,000 cfs as baseflow**

**6,000-10,000 cfs, with 6,000 cfs as baseflow**

**4,000-6,000 cfs, 4,000 cfs as baseflow**

- Shad, striped bass, robust redhouse spawning and habitat

**4,000-5,000 cfs;**

**4,000-5,000 cfs;**

- Resident fish habitat
- Juvenile fish out-migration

**>2,700,000 cfs**

**>2,700 cfs** | **>2,000 cfs** | **>2,700 cfs**

**>2,700 cfs;**  
• Juvenile Outmigration

• protect spider lily from deer grazing

**Key**

- Wet Year
- Avg Year
- Dry Year

JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

# *Ecological Benefits of Implementation*



- ◆ **Decreased predation on Shoals Spider Lily**
- ◆ **Increased spawning habitat for anadromous species**

## Pulses for fish passage:

- ◆ At least 16,000 cfs for 5 days in March
- ◆ At least 16,000 cfs for 5 days in April



# Ecosystem Flow Recommendations

## Savannah River, below Thurmond Dam (*River-Floodplain*)

### Floods

**50,000-70,000 cfs; 2 weeks, avg every 2 yrs**

- Maintain channel habitats
- Create floodplain topographic relief
- Provide fish access to the floodplain
  - control invasive species
- Maintain wetlands and fill oxbows and sloughs
- Enhance nutrient cycling & improve water clarity
  - Disperse tree seeds

### High Flow Pulses

**>30,000 cfs; 5 pulses, >2 days with 2 events of 2 week duration (March and early April)**

**20,000-40,000 cfs; 2-3 days, 1/month**

- Provide predator-free habitat for birds
  - Disperse tree seeds
  - Transport fish larvae
- Flush woody debris from floodplain to channel
  - Floodplain access for fish
  - Fish passage past NSBLD

**<13,000 cfs; 3 successive years, every 10-20 years**

- Floodplain tree recruitment

**8,000-12,000 cfs;**

- Exchange water with oxbows

### Low Flows

**>8,000 cfs**

- Larval drift for pelagic spawners

**<5,000 cfs**

- Adequate floodplain drainage
- Create shallow water habitat for small-bodied fish

**3,000 cfs; 3 successive years every 10-20 years**

- Floodplain tree recruitment

### Key

- Wet Year
- Avg Year
- Dry Year

JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

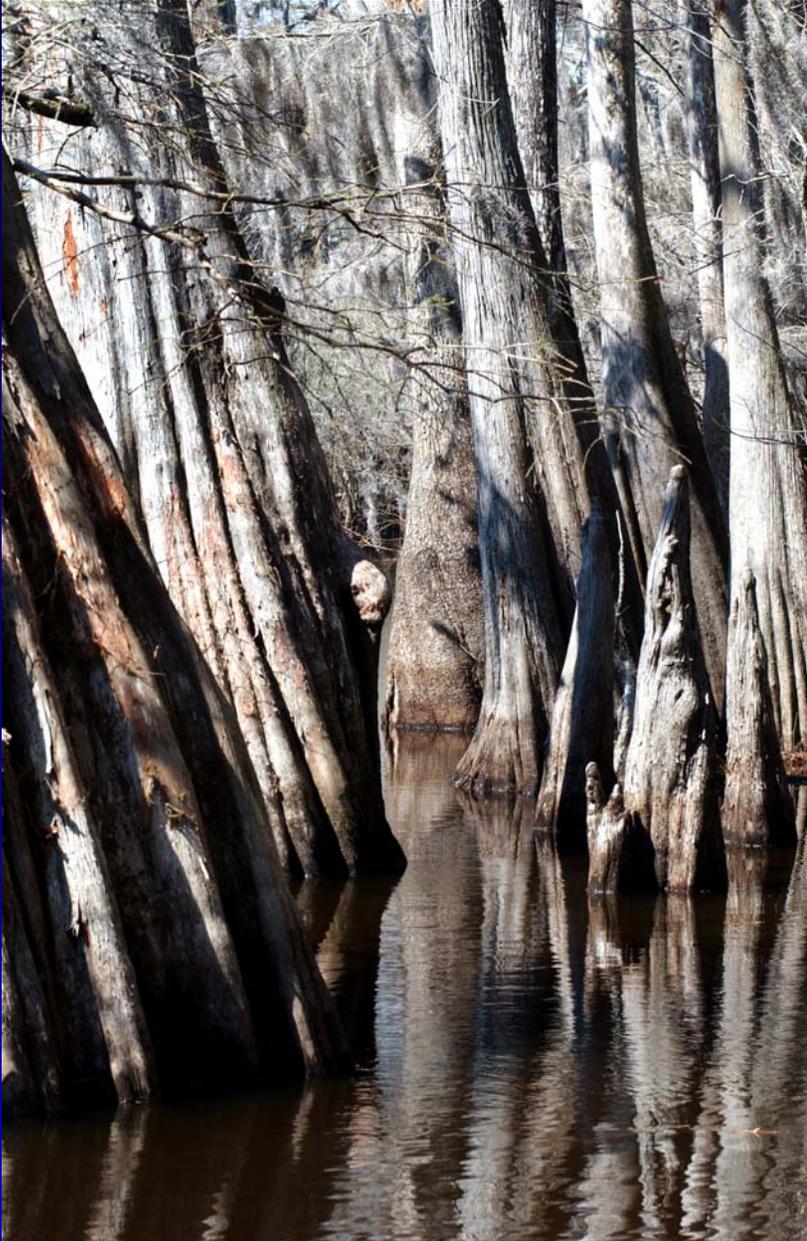
# *Ecological Benefits of Implementation*



**Low flows will facilitate:**

- ◆ **Germination and establishment of bottomland hardwood species**
- ◆ **Growth of adult trees**
- ◆ **Juvenile fish survival**
- ◆ **Spawning in gravel shoals**

# *Ecological Benefits of Implementation*



**Pulses will facilitate:**

- ◆ **Seed dispersal**
- ◆ **Floodplain access for fish spawning and foraging**
- ◆ **Nutrient replenishment to floodplain soils**
- ◆ **Nesting habitat for birds**

# Ecosystem Flow Recommendations

## Savannah River, below Thurmond Dam (*Estuary*)

### Floods

**50,000 cfs; 4 weeks,**  
**1 pulse every 5 years**

- Fisheries productivity boost
  - Species mixing
  - Sediment & nutrient replenishment
- Improved bird habitat & forage

### High Flow Pulses

<b><u>4,000-5,000 cfs; 2 weeks,</u></b> <b><u>1 pulse</u></b>
<b><u>4,000-5,000 cfs; 2 weeks,</u></b> <b><u>1 pulse</u></b>
<b><u>4,000-5,000 cfs; 2 weeks,</u></b> <b><u>1 pulse</u></b>
<ul style="list-style-type: none"> <li>• increase nutrient inputs</li> <li>• increase seed dispersal</li> <li>• control oyster and blue crab parasites</li> </ul>

### Low Flows

<b><u>10,000 cfs (monthly); 6,000 cfs (instantaneous)</u></b>	
<ul style="list-style-type: none"> <li>• More extensive seed dispersal across freshwater tidal marsh</li> <li>• enhanced nutrient cycling and invertebrate productivity</li> <li>• inter-annual spatial variability of salinity gradient and associated fish distributions</li> </ul>	
<b><u>8,000 cfs (monthly); 6,000 cfs (instantaneous)</u></b>	
<b><u>8,000 cfs (monthly); 5,000 cfs (instantaneous)</u></b>	<b><u>6,000 cfs (monthly); 5,000 cfs (instantaneous)</u></b>
<ul style="list-style-type: none"> <li>• Maintain tidal freshwater marsh</li> <li>• Maintain salinity gradient (0.5 PSU for fish access to tidal marsh habitat)</li> </ul>	

**Key**

- Wet Year
- Avg Year
- Dry Year

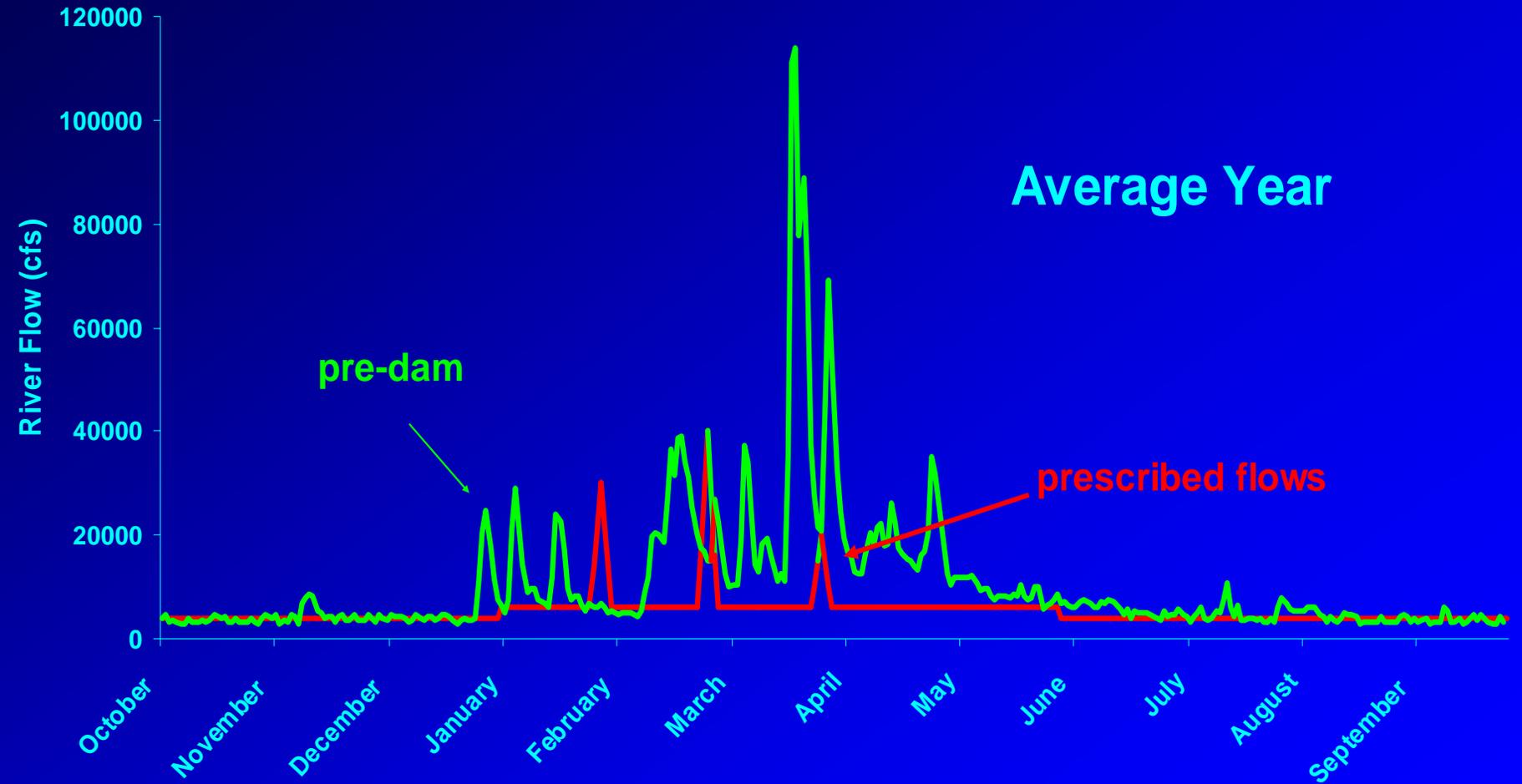
JAN   FEB   MAR   APR   MAY   JUN   JUL   AUG   SEP   OCT   NOV   DEC

# *Ecological Benefits of Implementation*

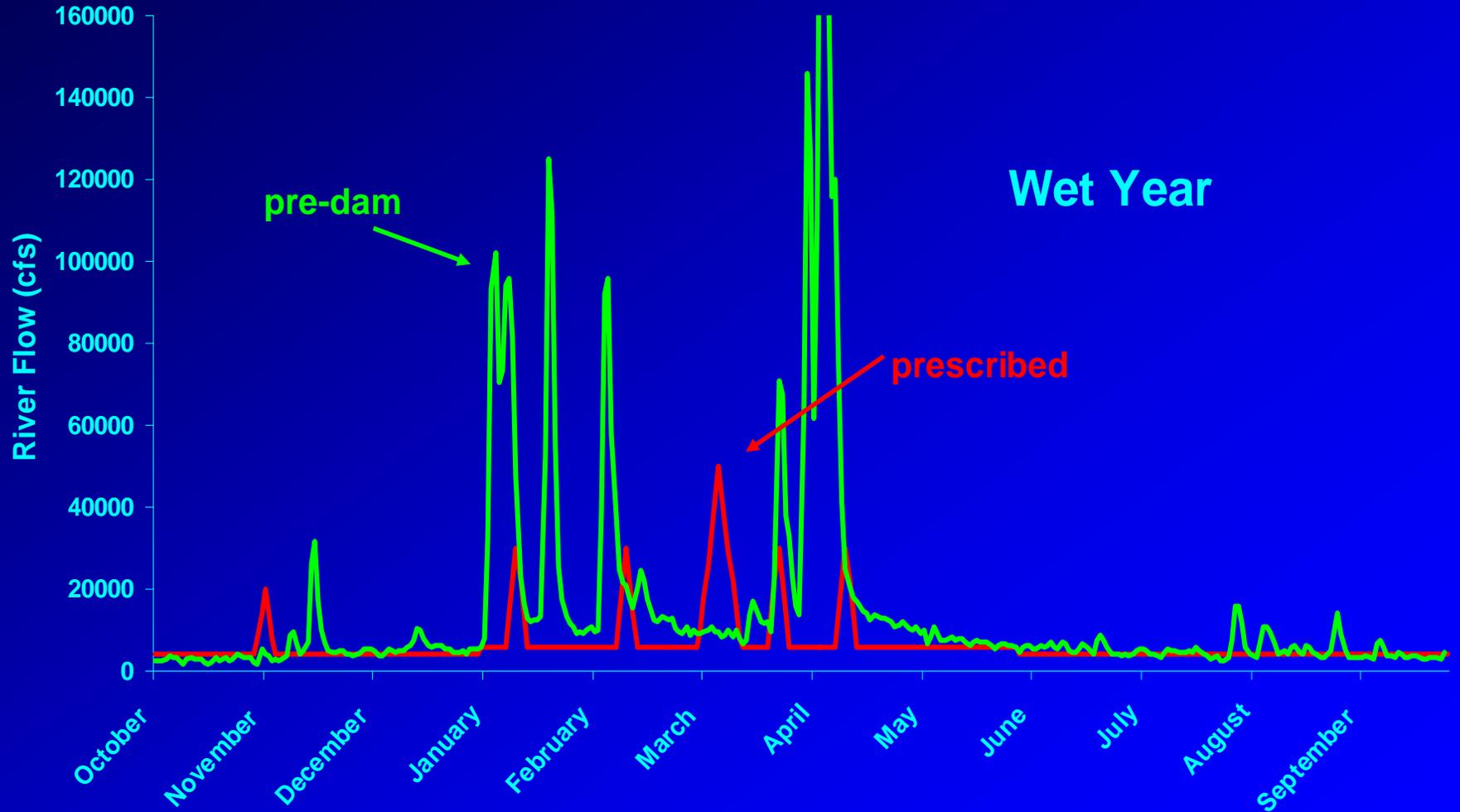
Pulses will facilitate:

- ◆ Reduced parasitism of oysters and blue crabs
- ◆ Nutrient cycling
- ◆ Invertebrate productivity
- ◆ Seed dispersal
- ◆ Fish habitat utilization

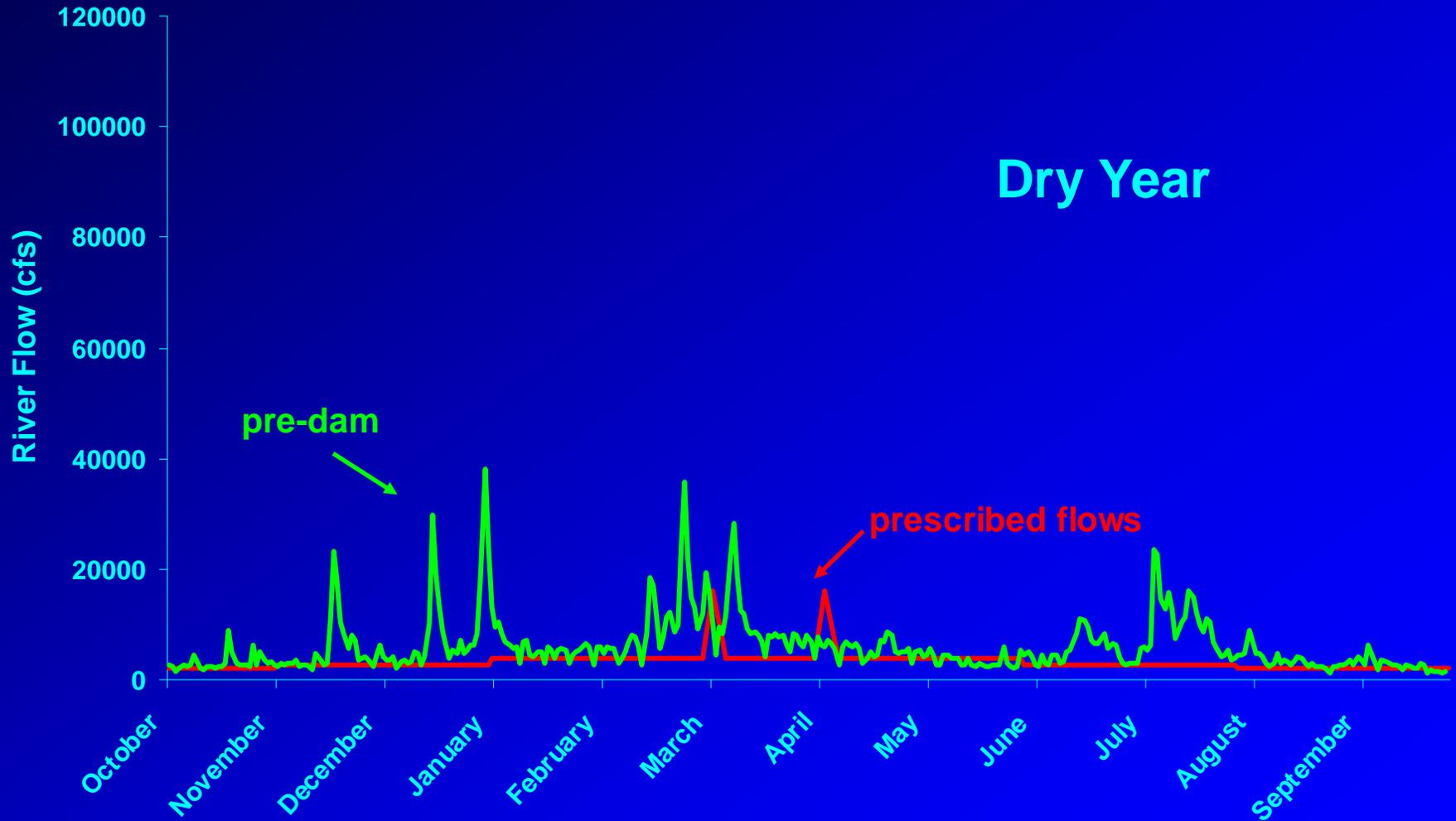
# Savannah Flow Prescription



# Savannah Flow Prescription



# Savannah Flow Prescription



# *Fish Passage*





# Pulse Release 'Controlled Flood'



# *Electrofishing*











# *Why Measures?*

- ❖ **\$1 Billion spent annually on conservation**
  - ❖ **TNC - \$350 Million**
- ❖ **Current metrics are rudimentary but easily quantifiable**
  - ❖ **dollars raised**
  - ❖ **acres protected**
  - ❖ **# projects**
  
- ❖ **Number of fish that spawn in the Shoals?**
- ❖ **Number of young Cypress trees?**



## Current "Work"



- ◆ **Monitoring plan for the Ecological Flow Prescriptions**
- ◆ **Looking for study sites**
- ◆ **Implementation of flow restoration**
- ◆ **Education and Outreach**





- ◆ **Run computer model through 50 years with different operational criteria**
- ◆ **Select a group of favorable operation rules**
  - ❖ **The least number of violations for all demands**
  - ❖ **All users share the pain during water shortages**



# *Savannah River Basin Comp. Study – Operational Scenarios*

- ◆ ***Drought Plan Changes***
- ◆ ***Storage Changes***
- ◆ ***Flow Changes***
  - ❖ ***TNC Downstream Springtime Flow Pulses***
  - ❖ ***TNC High Flow Downstream Pulses***
    - Up to 50,000 cfs
  - ❖ ***Compare 15,000 cfs and 30,000 cfs JST releases.***
- ◆ ***Operational Rules Changes***

# *Goal of Phase I*



- ◆ **Can we meet present and future demands?**
  - ❖ **YES? Good**
  - ❖ **NO? What steps can be taken?**
- ◆ **Make final recommendations, including conflicts of interest**
- ◆ **Decision to enter Phase II ?**



# Milestones FY 05

<u>Task</u>	<u>Completion Date</u>
◆ Evaluate Water Allocation & Operational Scenarios	Oct 04 - Apr. 05
◆ Complete Draft Drought Management Plan Changes	Oct 04 - Dec 04
◆ Initiate NEPA on Drought Recommendations	Jan 05
◆ Complete Phase 1 Draft Recommendations on Allocations, Storage, Flow Changes, and Operational Measures	Jun 05

# Milestones FY 05 (Cont.)



## Task

## Completion Date

- ◆ **Complete NEPA on Drought Management** Jun / Jul 05
- ◆ **Complete Phase I Decision Document  
and Amend Cost Share Agreements** Sep 05
- ◆ **Complete Interim Drought Management Plan** Sept 05
- ◆ **Execute Phase 2** FY 06



# *Comprehensive Water Resources Study for the Savannah River Basin*

## **Phase Two Tasks – Focus Reallocation**

- ◆ **Work With Stakeholder Groups**
  - ❖ **Clearly quantify** their needs - current & future
- ◆ **Additional Studies to support demands**
- ◆ **Additional Model Evaluations**
- ◆ **Evaluate Allocation Scenarios**
- ◆ **Recommendations** to Congress



# *Coordination / Communication*



[www.sas.usace.army.mil/srbstudy.htm](http://www.sas.usace.army.mil/srbstudy.htm)

[www.rivercenter.uga.edu/pdfs/summaryreport.pdf](http://www.rivercenter.uga.edu/pdfs/summaryreport.pdf)