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The U.S. Environmental Protection Agency and The Council of State Governments

Assessing Florida's large rivers: GIS-based data mining and the impacts of the Atlantic Multi-decadal Oscillation

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Florida MFL [Minimum Flows and Levels Program]

Section 373.042, Florida Statutes

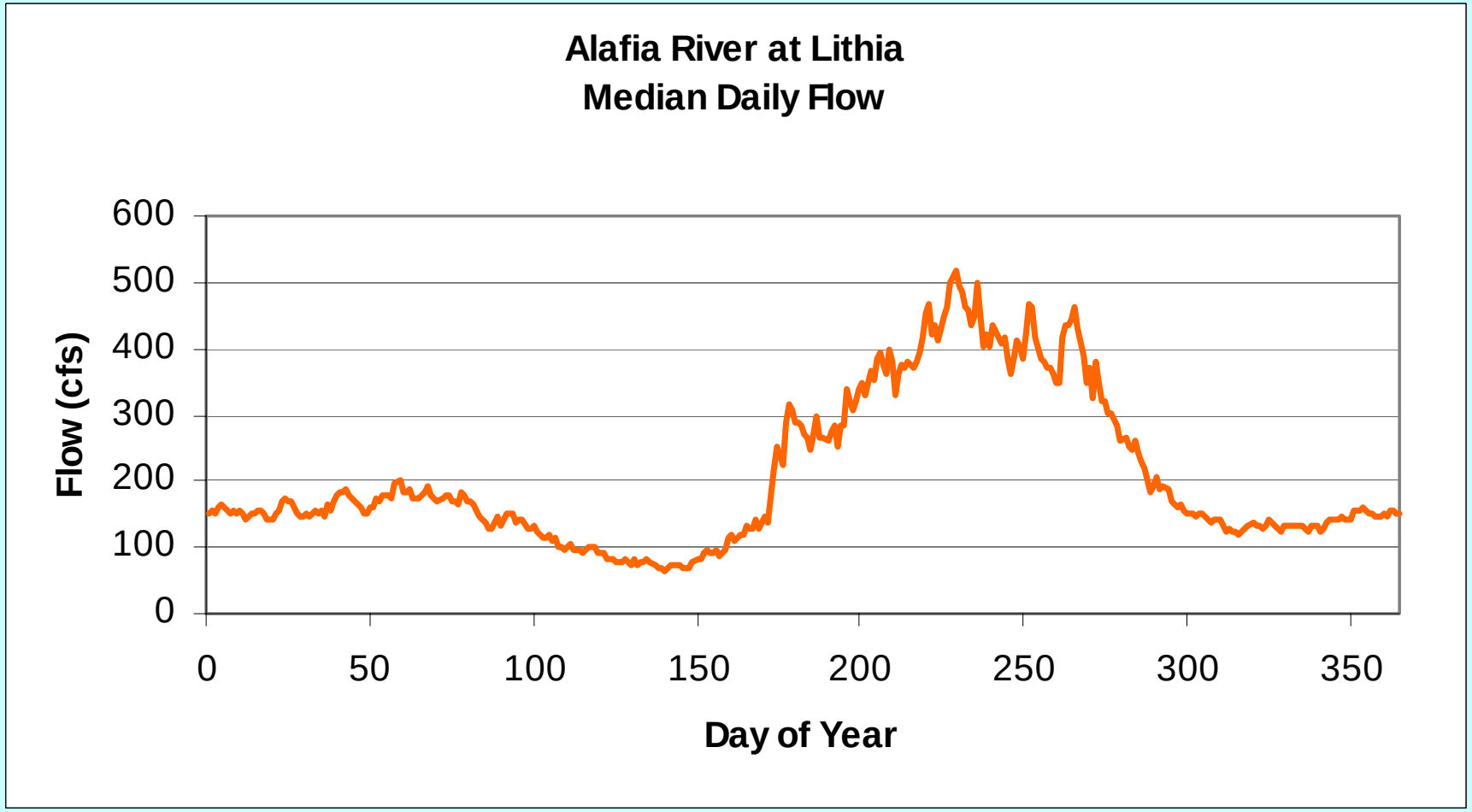
Directed to establish Minimum Flows and Levels (MFL's)

Balance between consumptive use and protection of the resource from "significant harm"

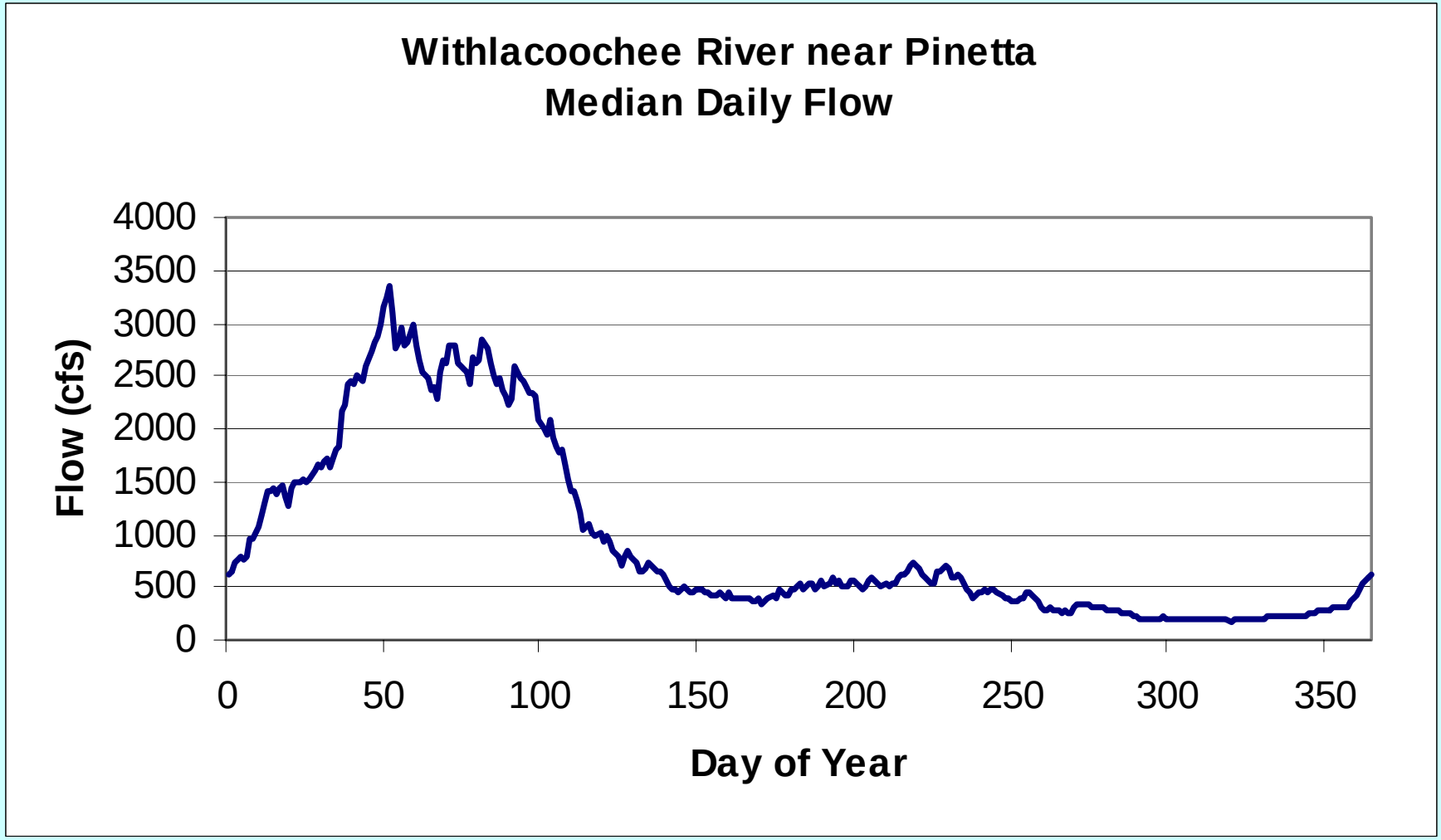
Southwest Florida Water Management District (SWFWMD)

1. IFIM / PHABSIM
2. Range of Variability (RVA)

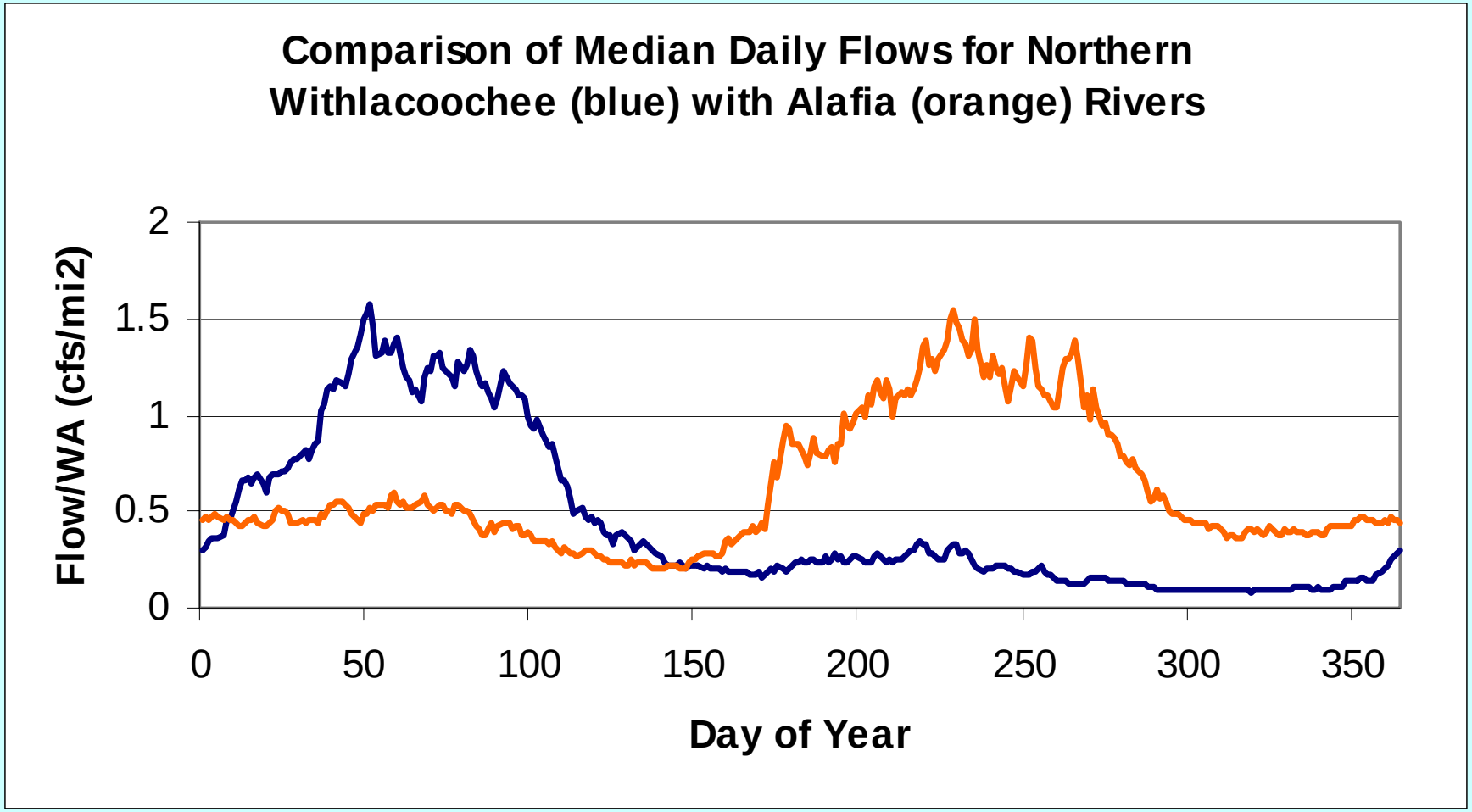
Southern River Pattern (SRP)

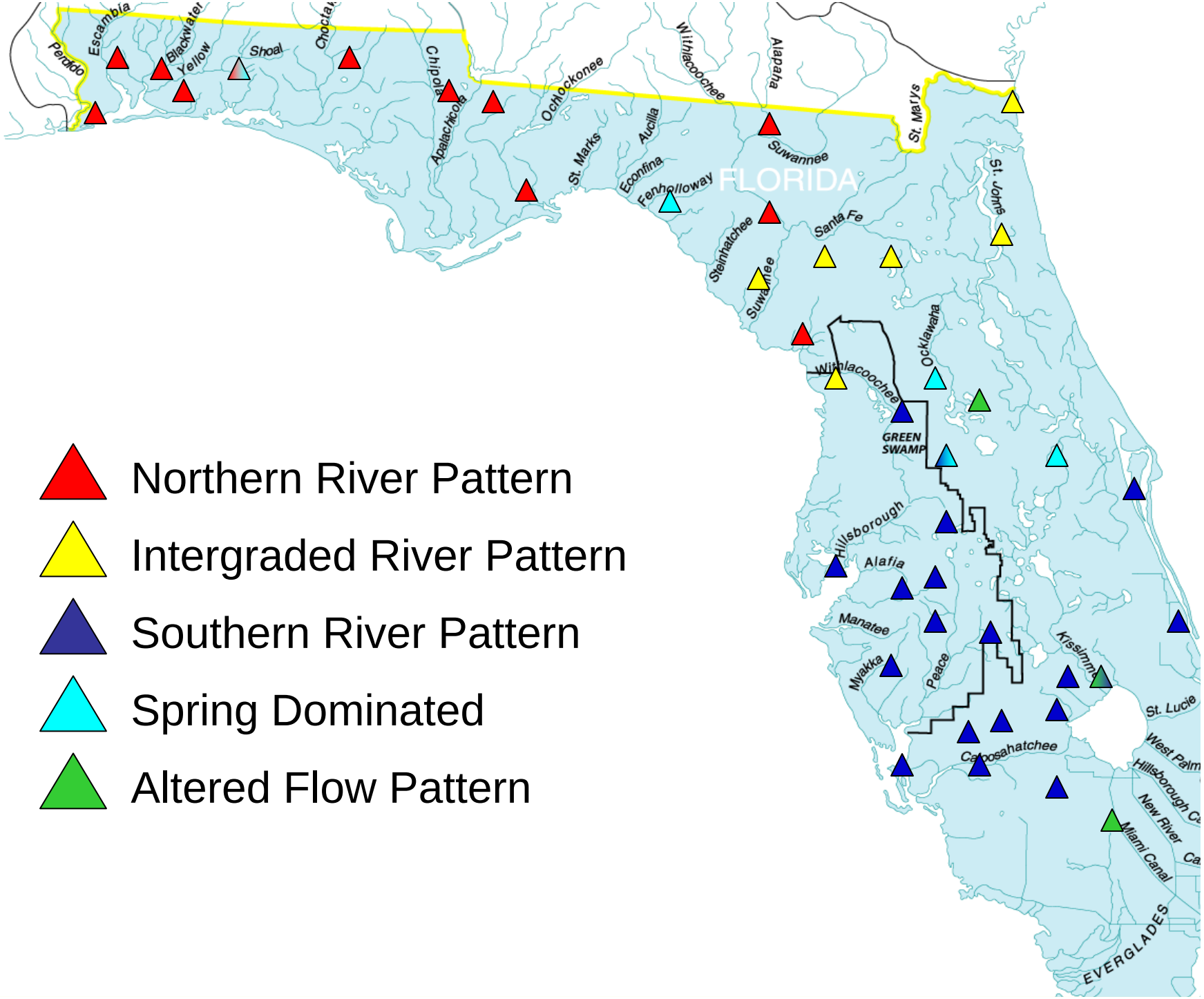


Northern River Pattern (NRP)

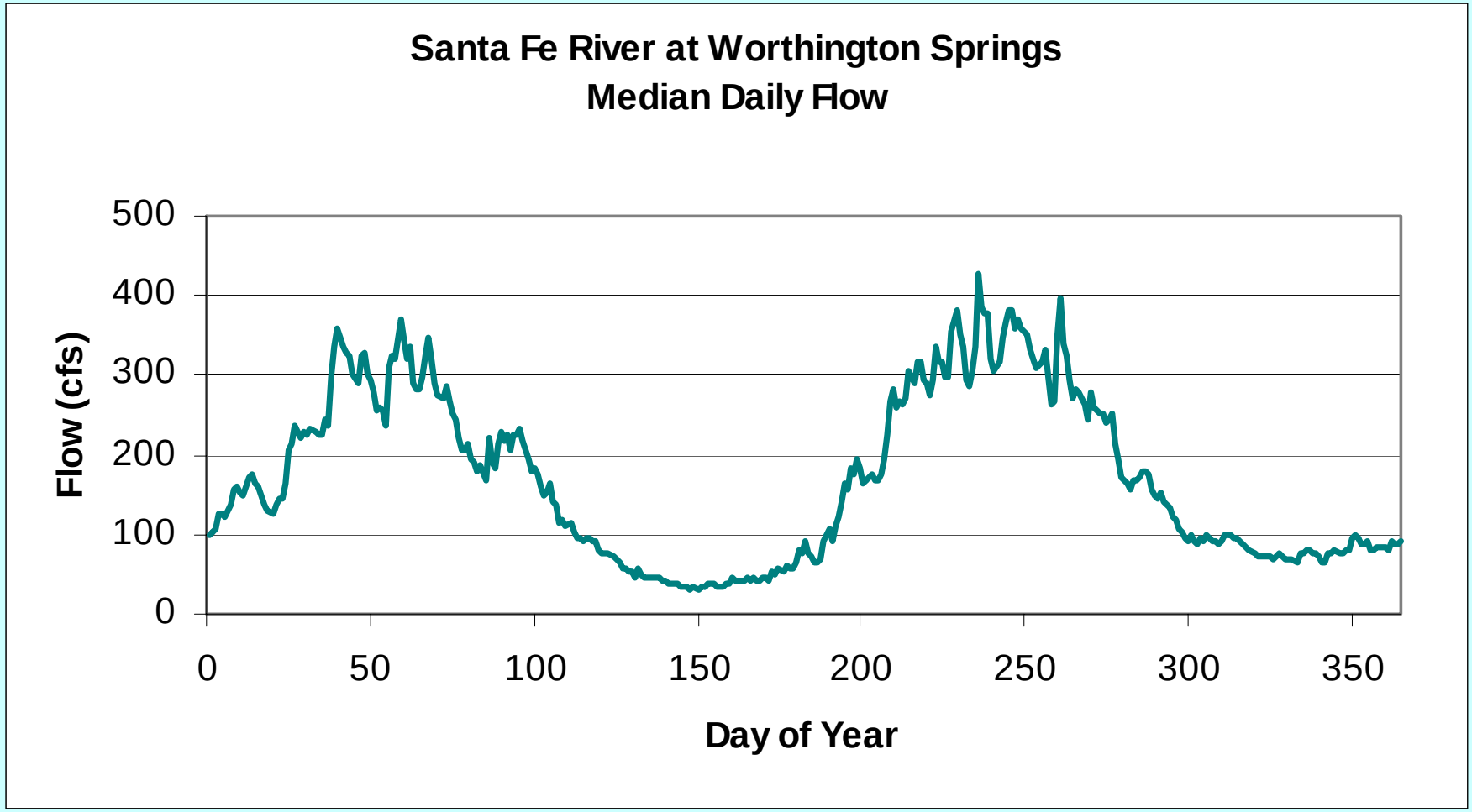


Comparison of SRP and NRP





Intergraded River Pattern (IRP)

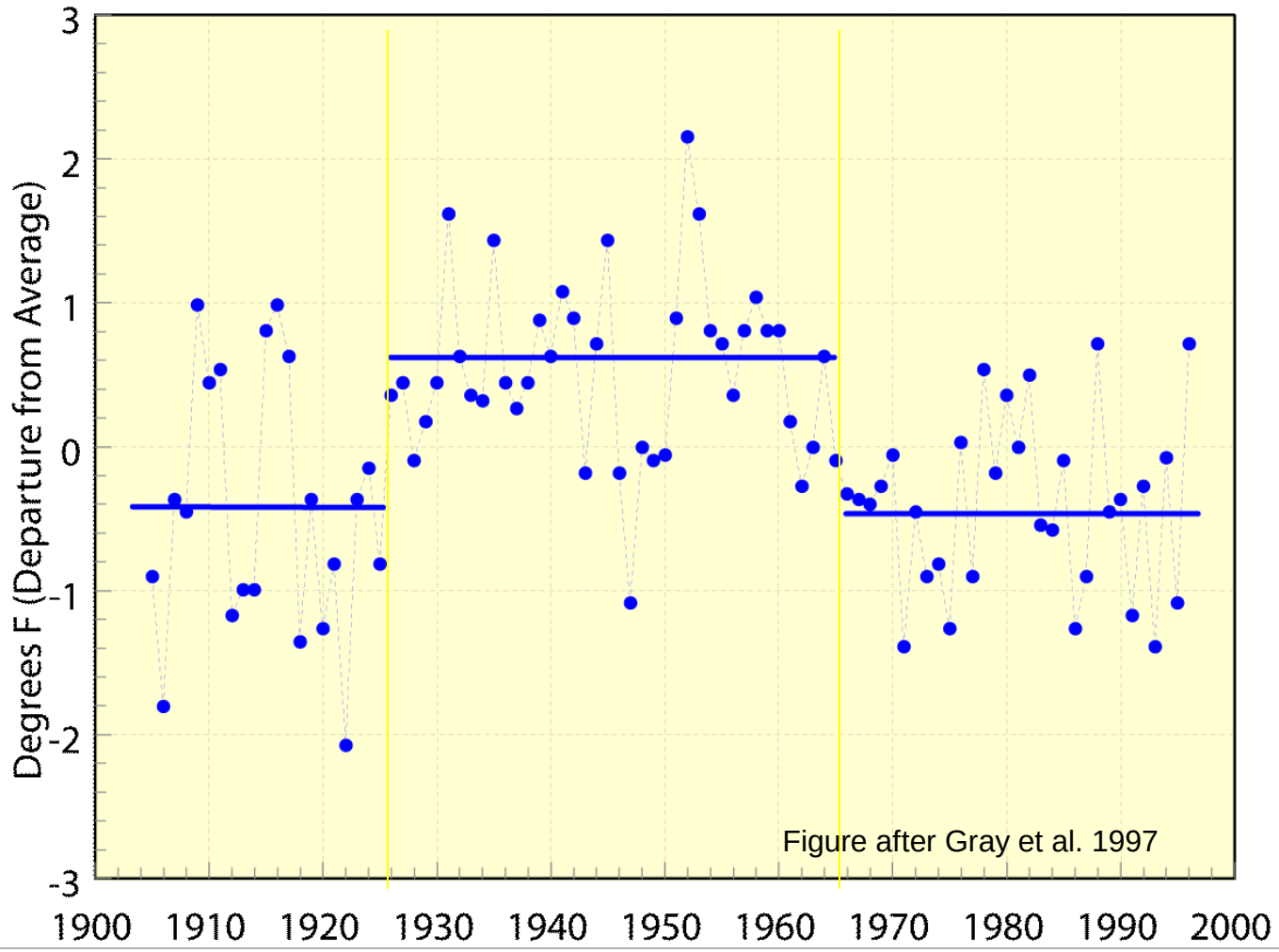


Time-Series Analysis

- Both IFIM and RVA require 20 years of daily flow records for the target river
- Historically, this has been the preceding 20-years of flow
- Enter the AMO !!!

Atlantic Ocean Sea Surface Temperature

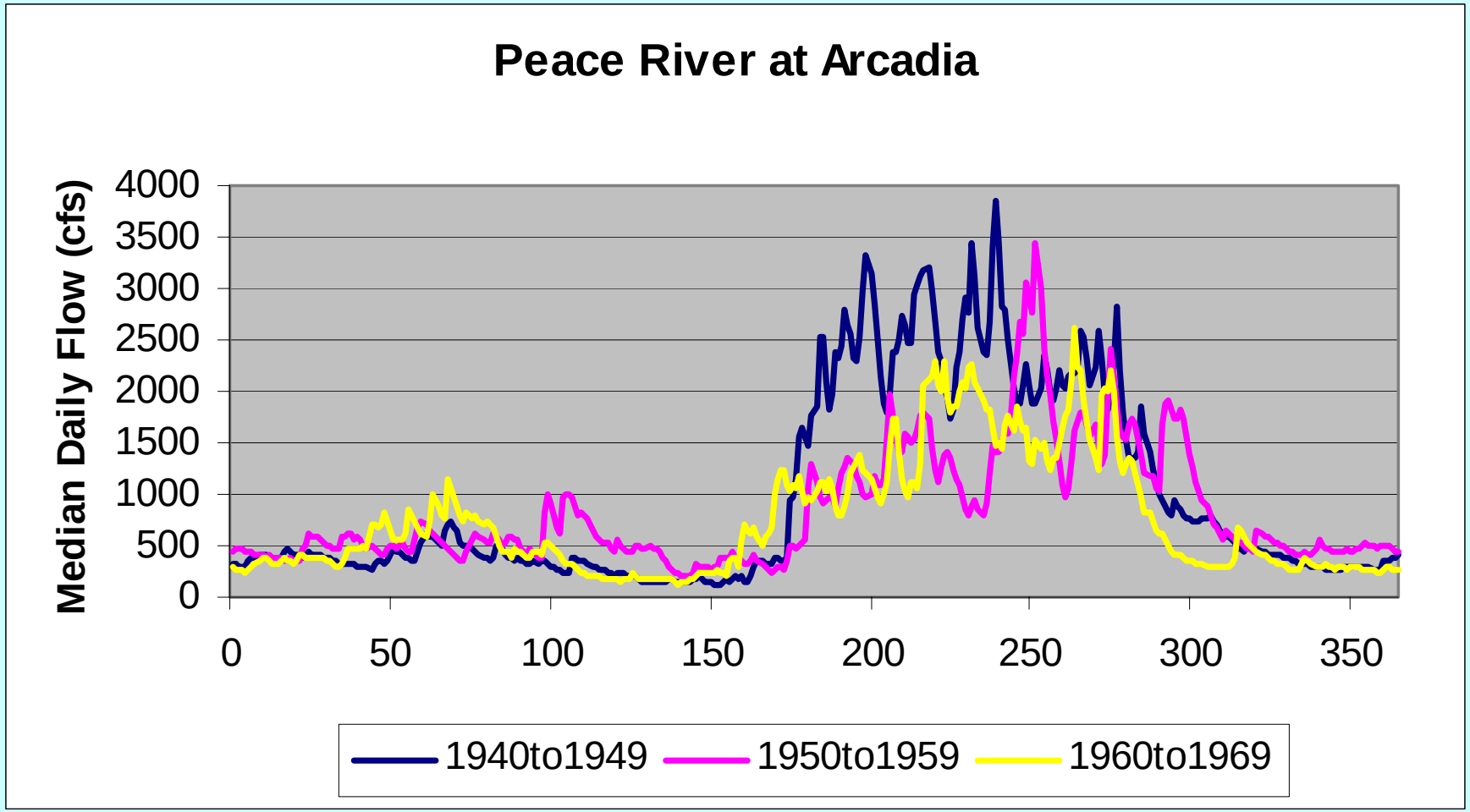
50N-60N Lat/10W-50W Long



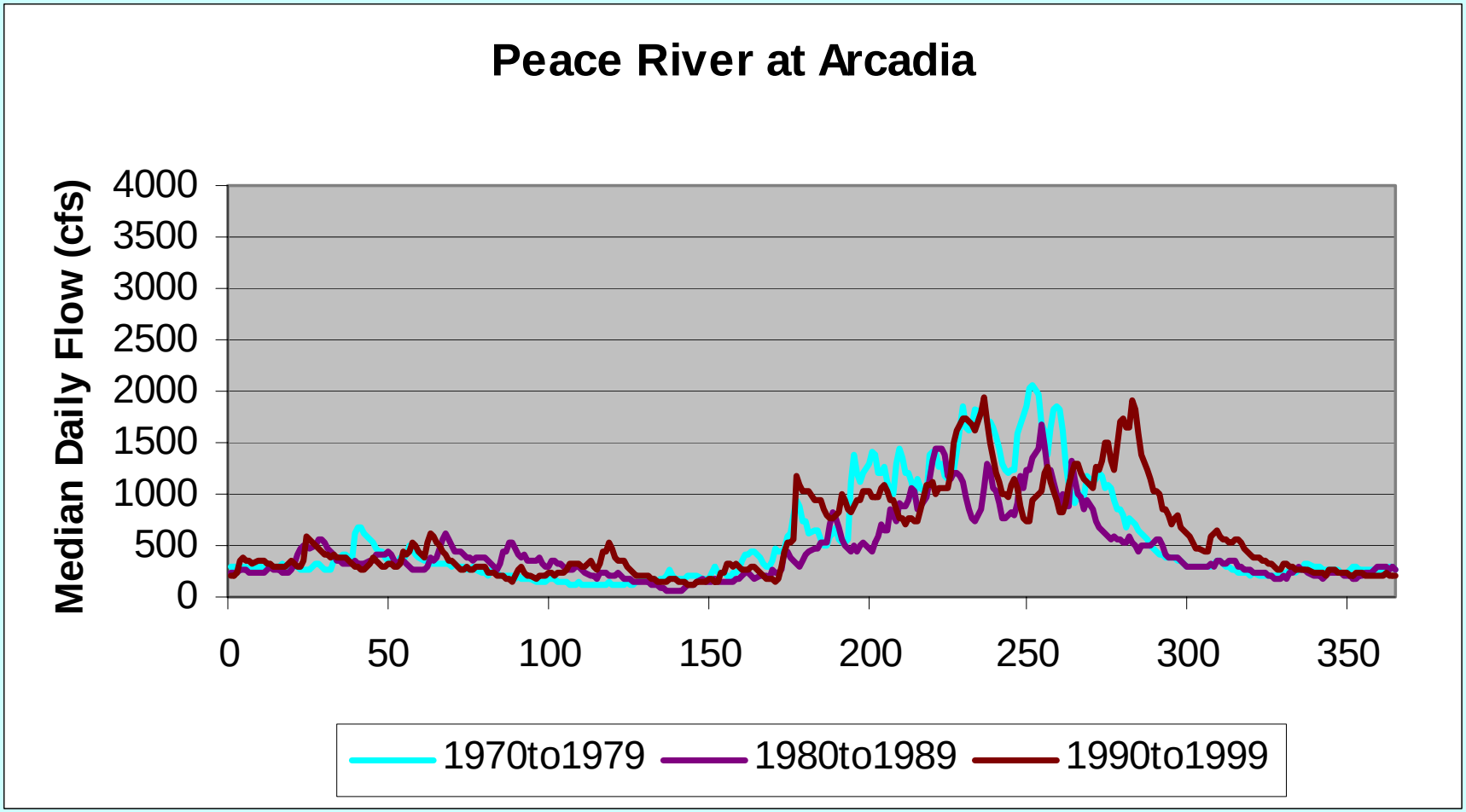
"North Atlantic sea surface temperatures for 1856-1999 contain a 65-80 year cycle with a 0.4 C range, referred as the Atlantic Multidecadal Oscillation (AMO) by Kerr [2000]."

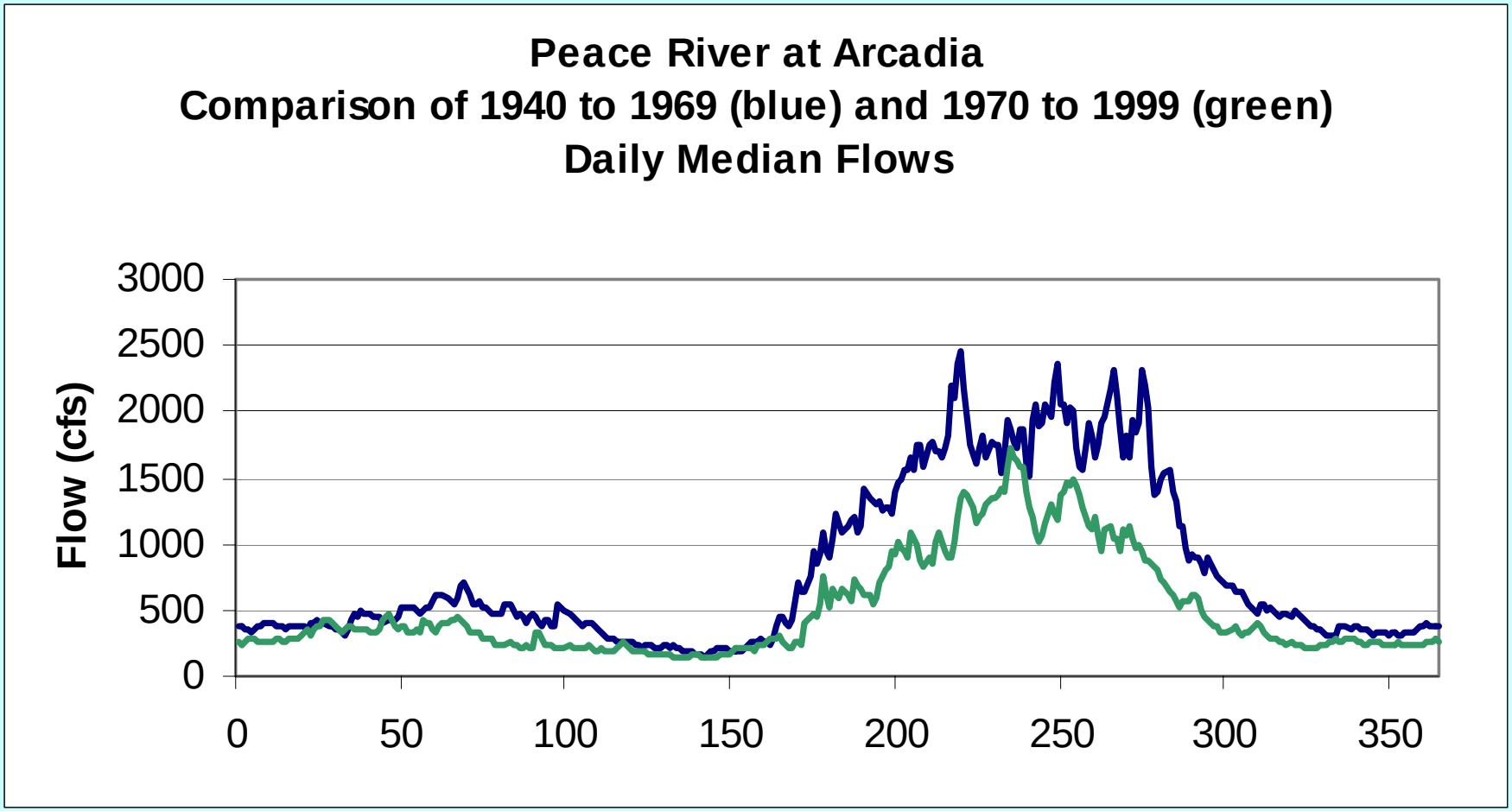
from Enfield et al. 2001

Mutidecadal flow pattern between 1940 and 1969

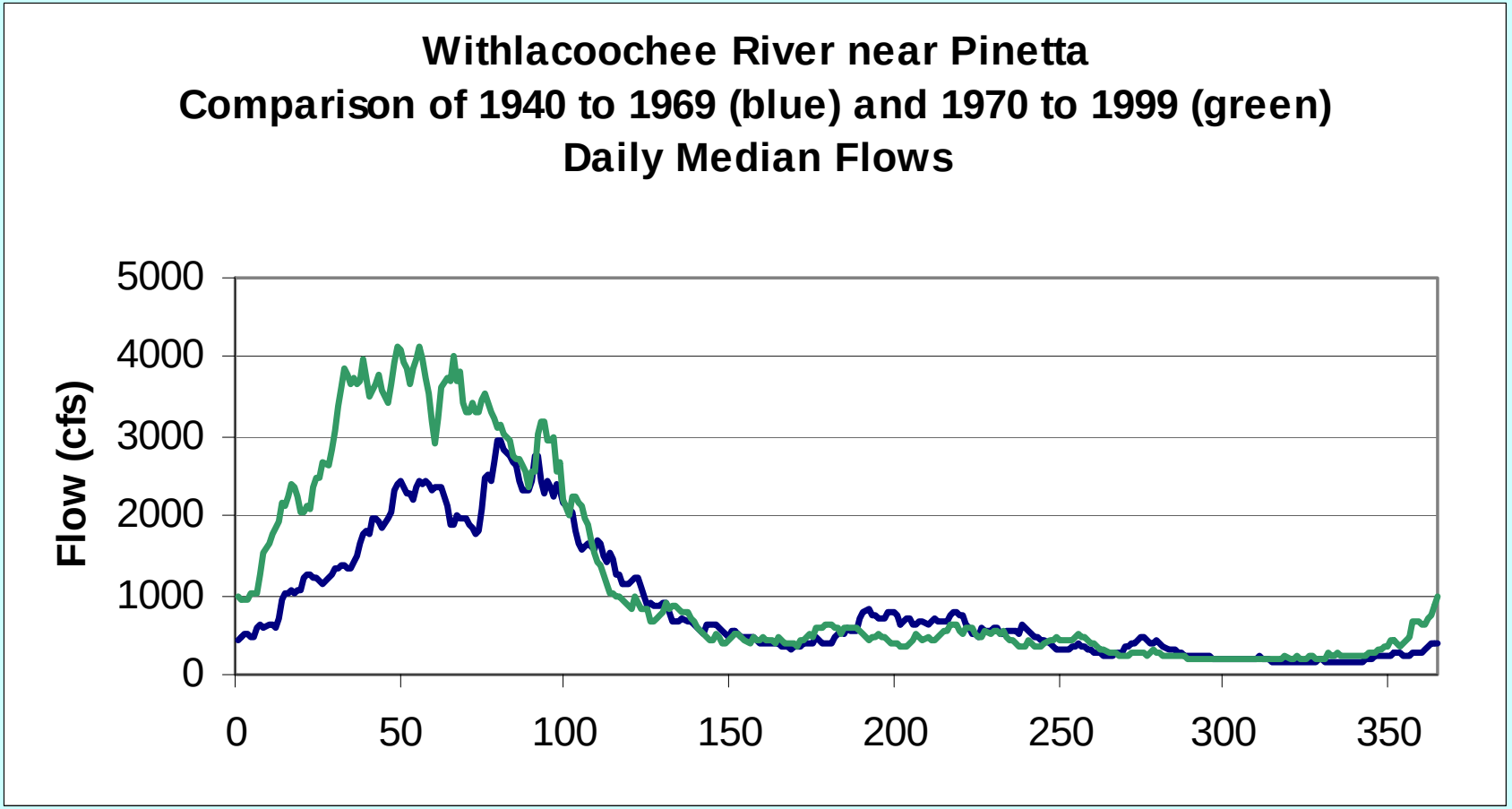


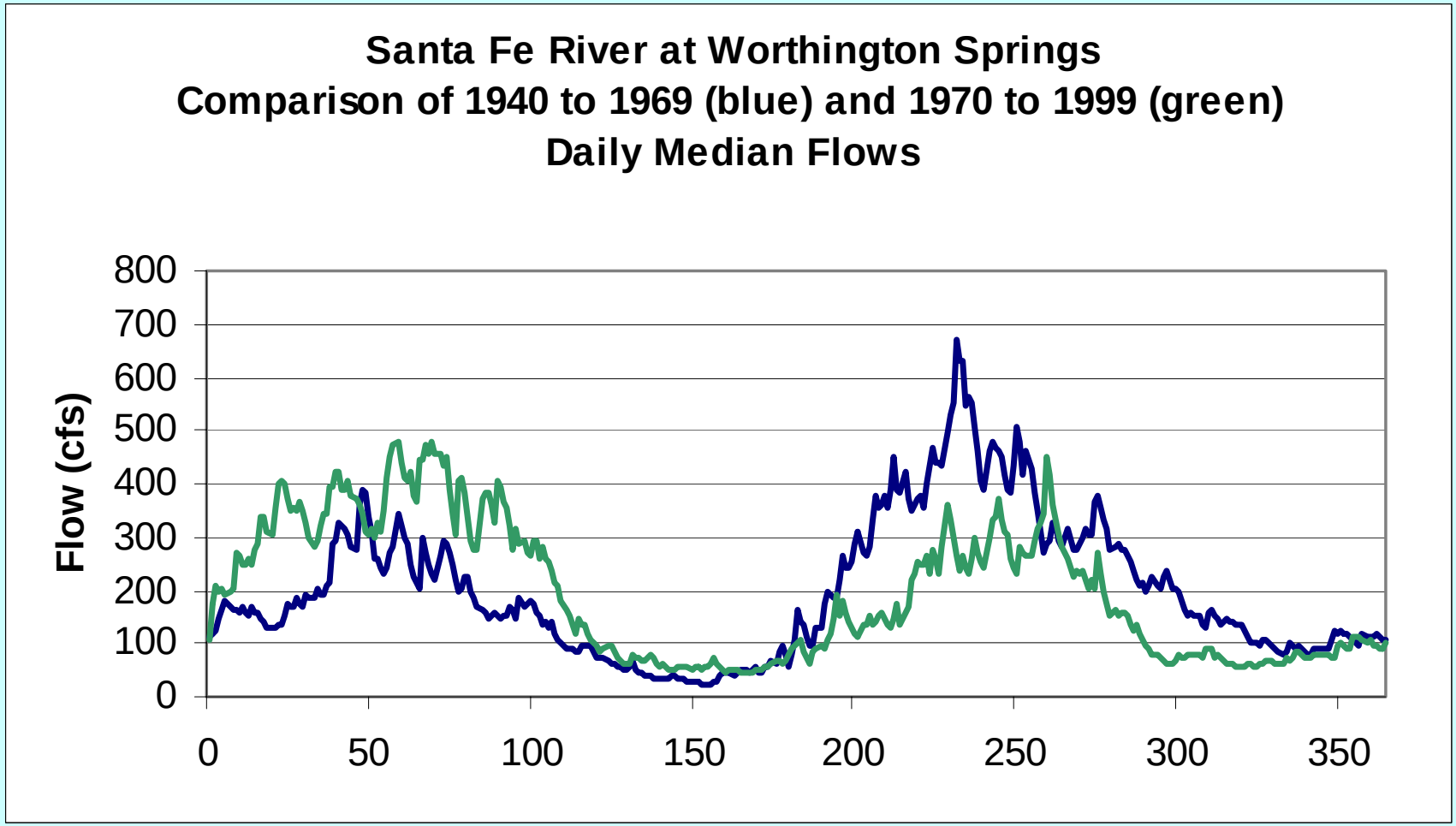
Between 1970 and 1999





For Rivers with NRP, flows for the period 1970 to 1999 were greater than for the period 1940 to 1969





Are there two flow management strategies ?

- **Dry Tri-Decade**
- **Wet Tri-Decade**

Month	Dry TriDecade Most Sensitive Life-Stage	Wet TriDecade Most Sensitive Life-Stage
January	Adult Largemouth Bass	Adult Spotted Sunfish
February	Adult Largemouth Bass	Adult Spotted Sunfish
March	Adult Largemouth Bass	Adult Spotted Sunfish
April	Adult Largemouth Bass	Juvenile Largemouth Bass
May	Spawning Largemouth Bass	Juvenile Largemouth Bass
June	Juvenile Largemouth Bass	Adult Spotted Sunfish
July	Adult Spotted Sunfish	
August		Benthic Macroinvertebrates
September	Adult Spotted Sunfish	Adult Spotted Sunfish
October	Adult Largemouth Bass	Adult Spotted Sunfish
November	Adult Largemouth Bass	Adult Spotted Sunfish
December	Adult Largemouth Bass	Adult Largemouth Bass

Month	Dry TriDecade Most Sensitive Life-Stage	Wet TriDecade Most Sensitive Life-Stage
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Are there two flow management strategies ?

- **Dry Tri-Decade**
- **Wet Tri-Decade**

Are there two reference conditions?

- Dry Tri-Decade
- Wet Tri-Decade

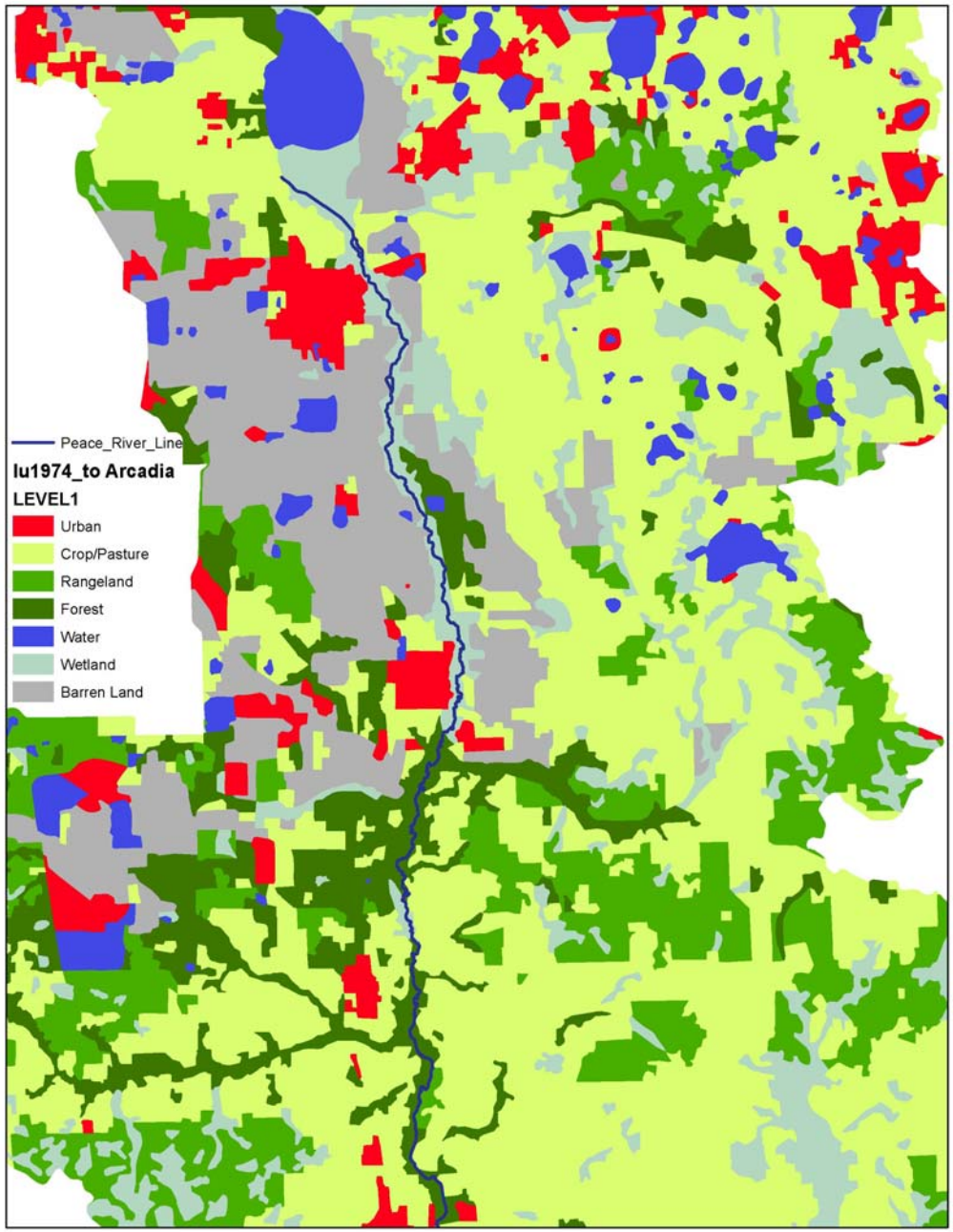
Are there two reference conditions?

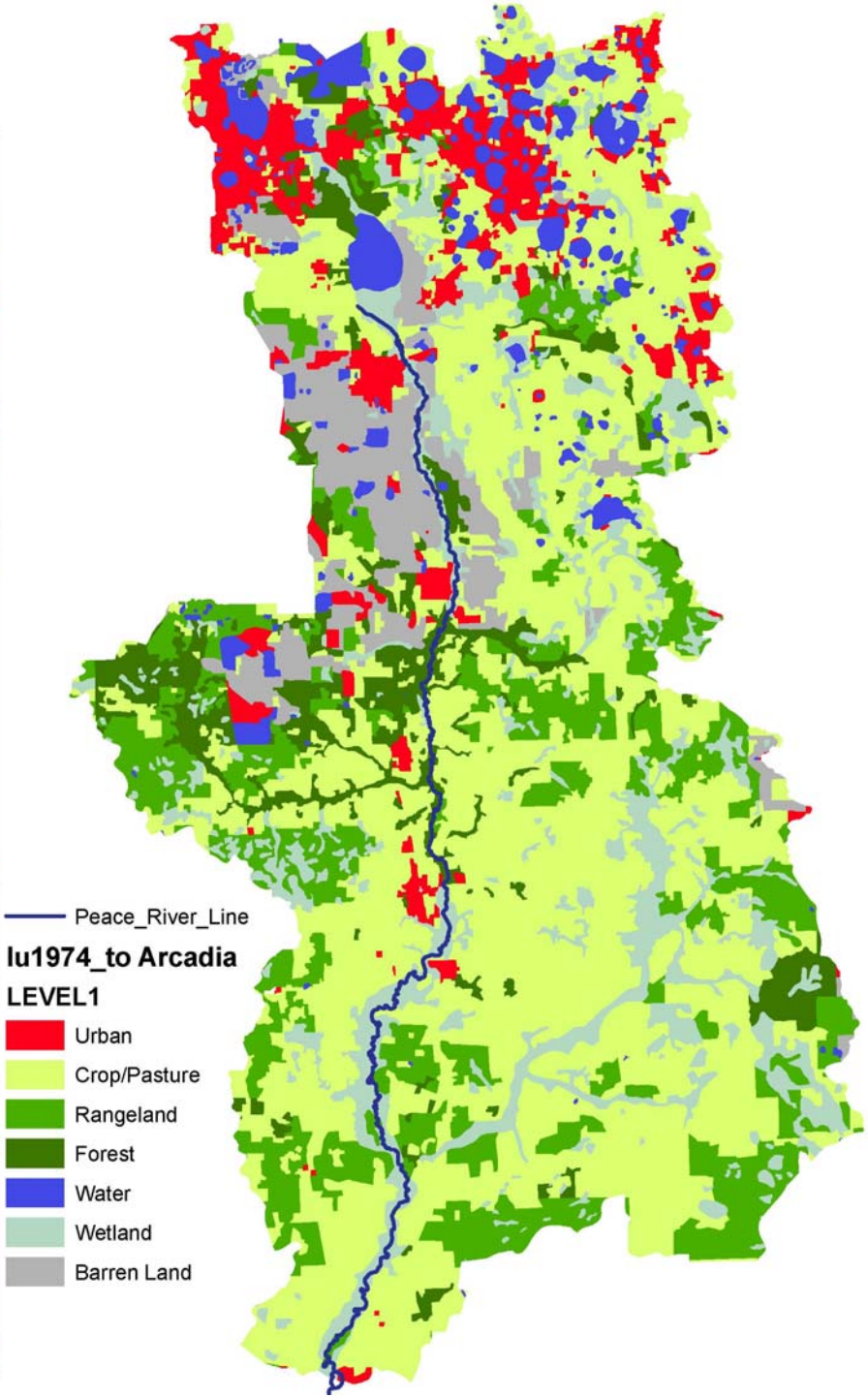
- How have (or will) changes in landuse affect management and monitoring?

Are there two reference conditions?

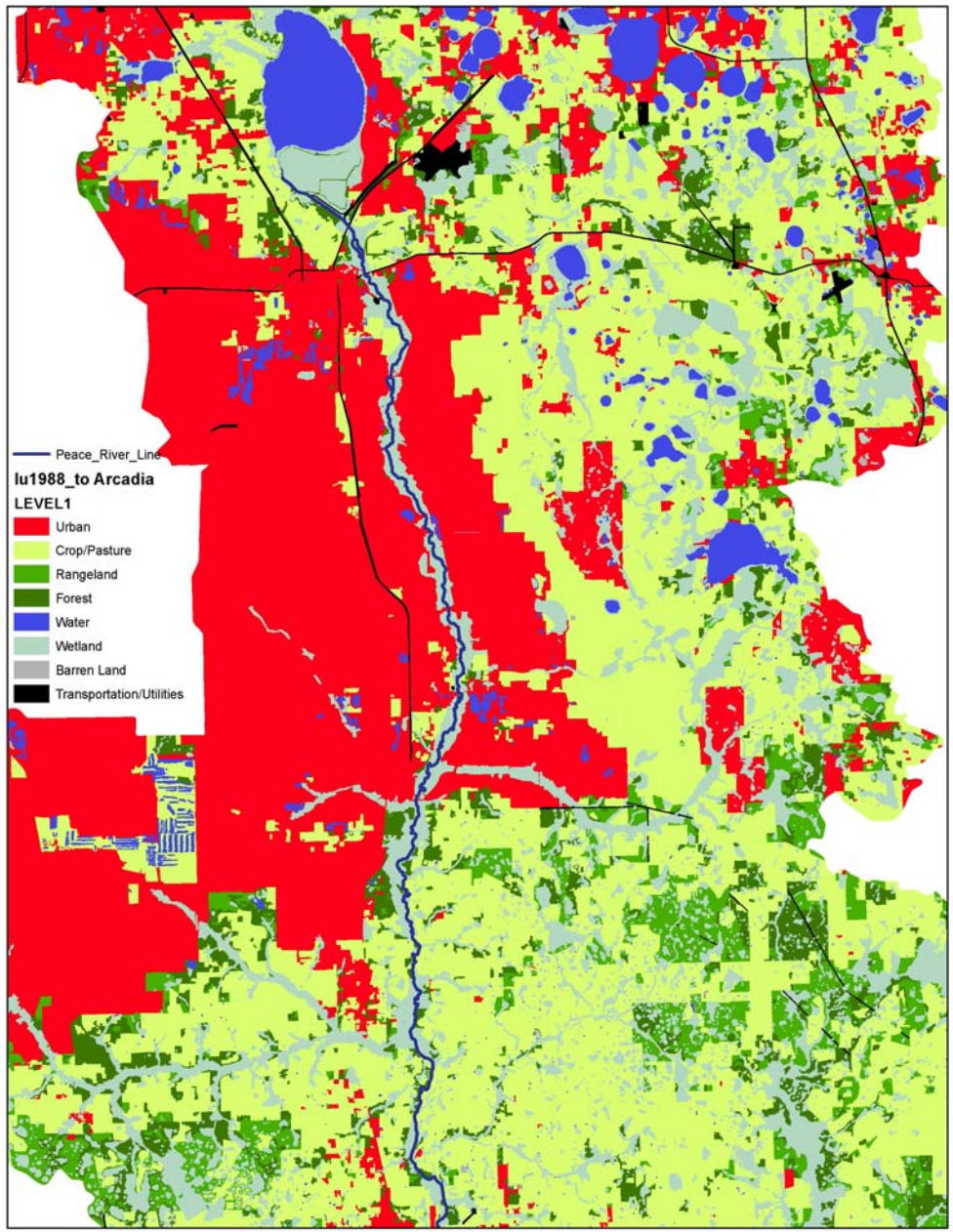
- **Influence of phospahte mining and citrus production?**

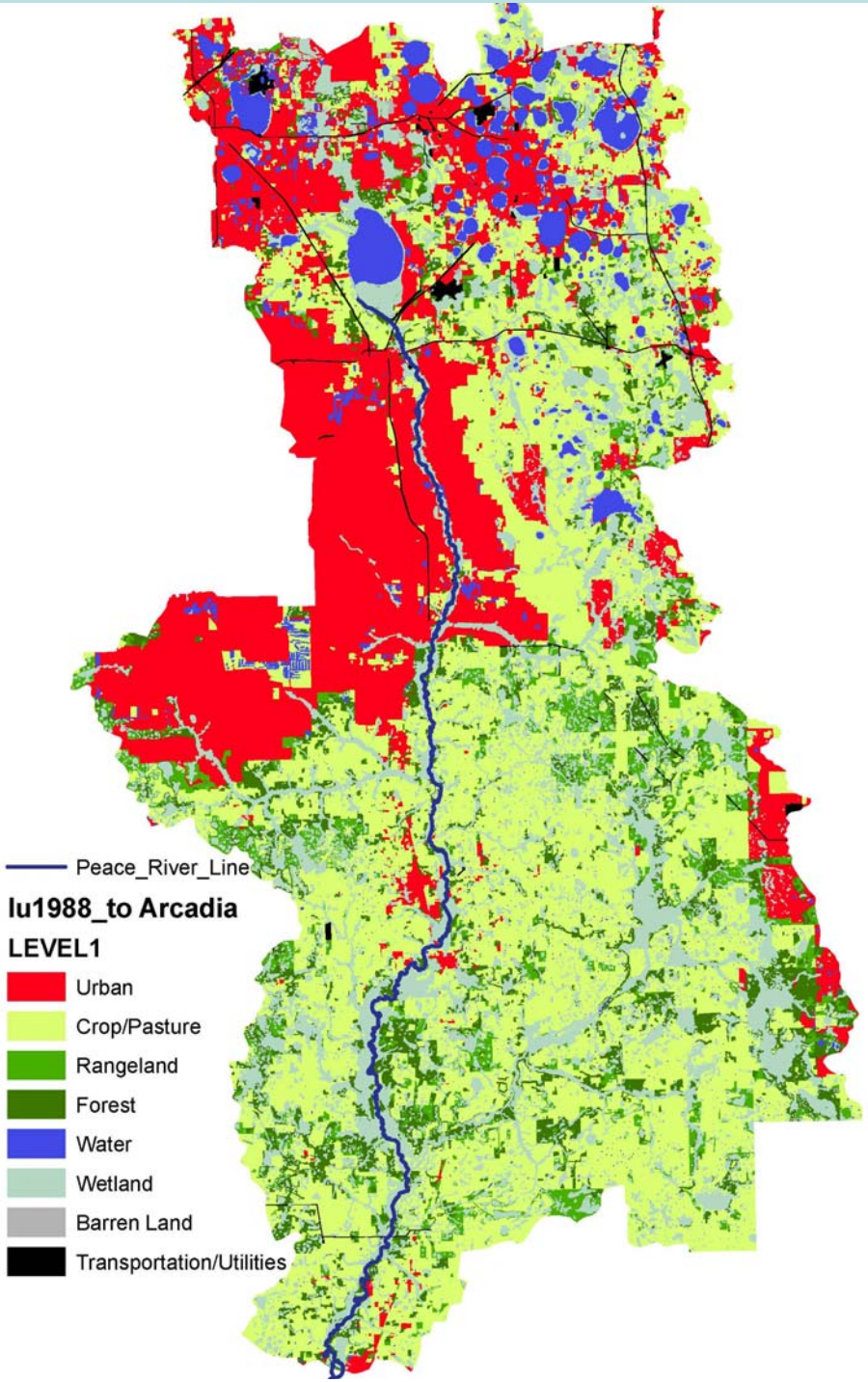
1974 Landuse



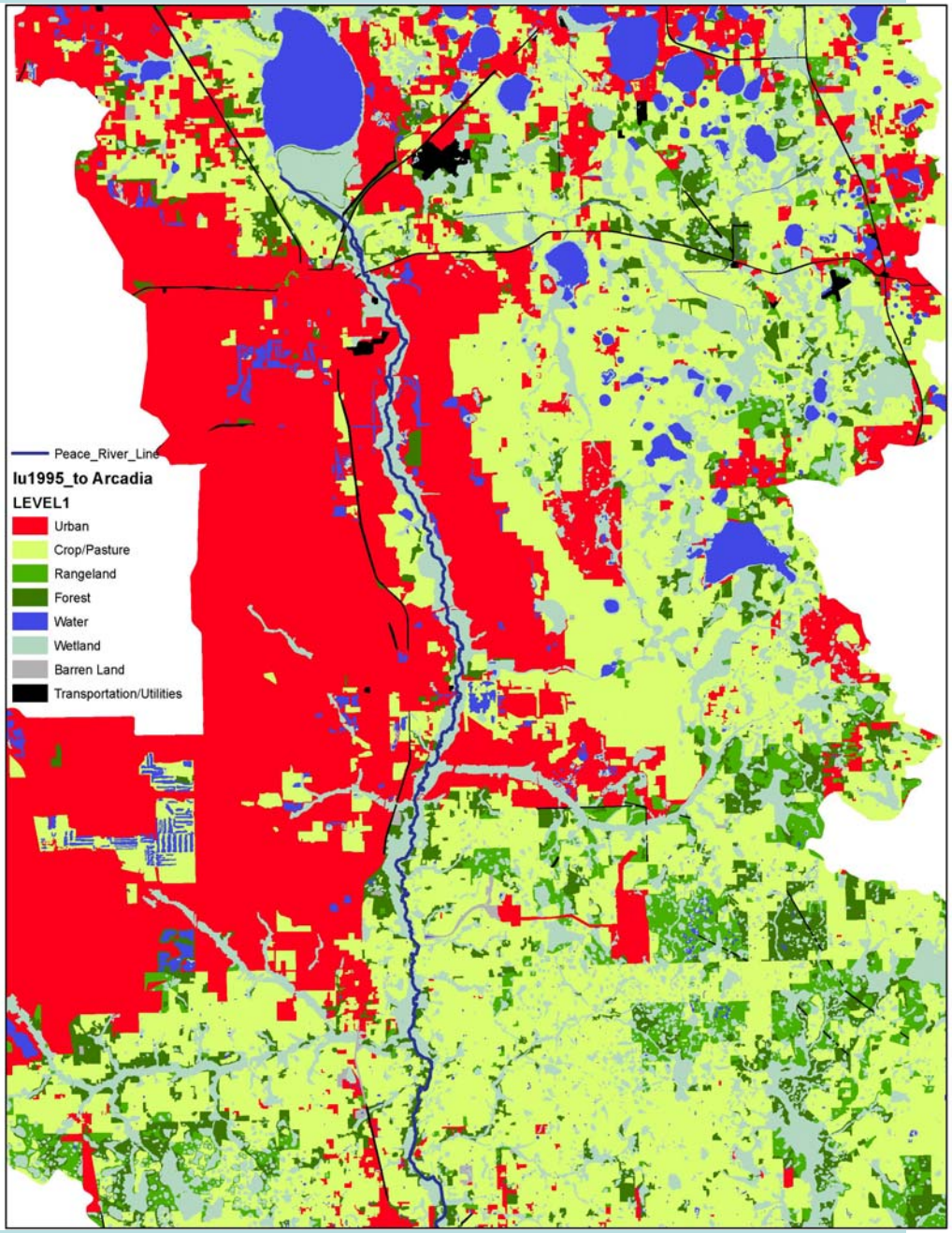


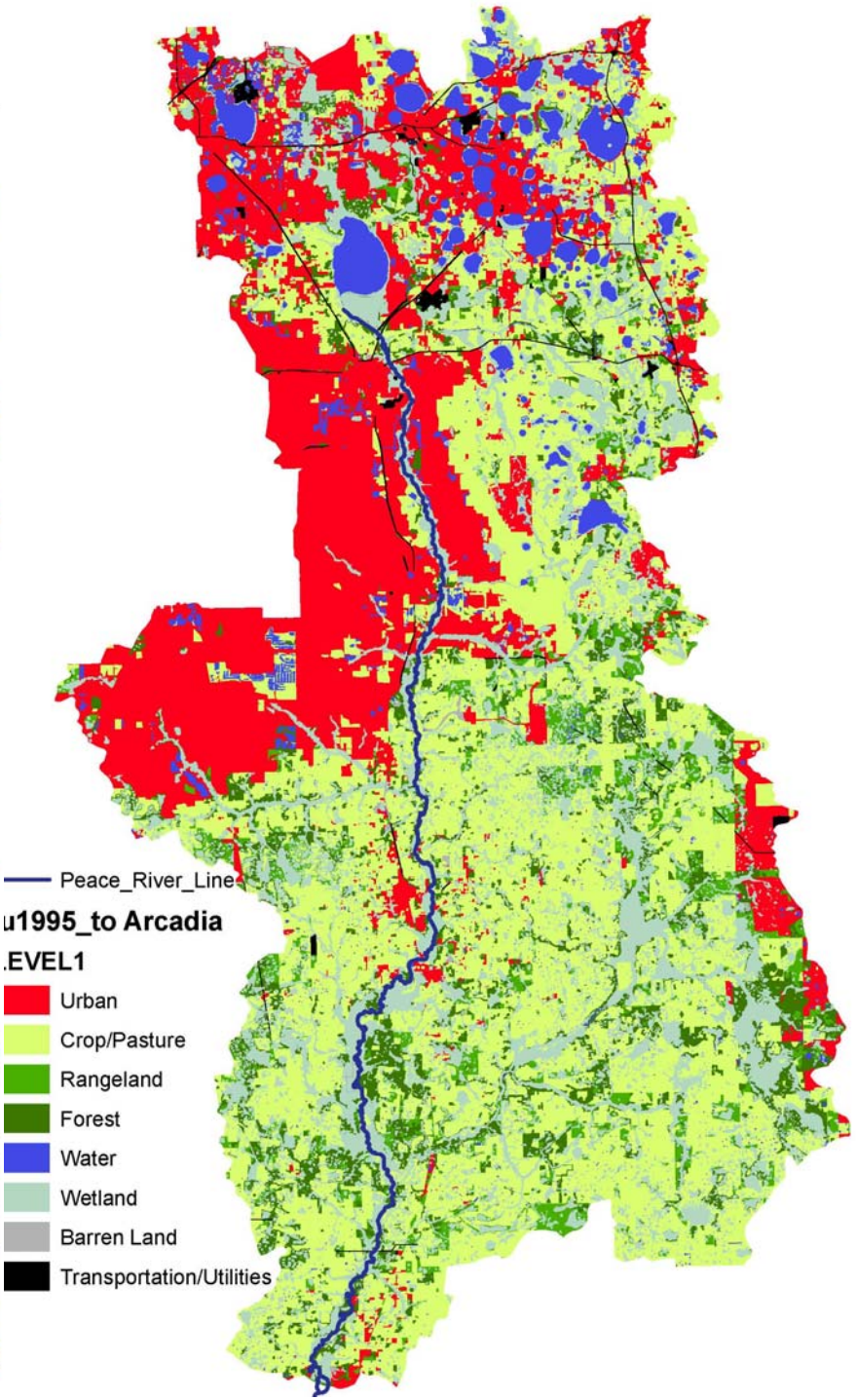
1988 Landuse



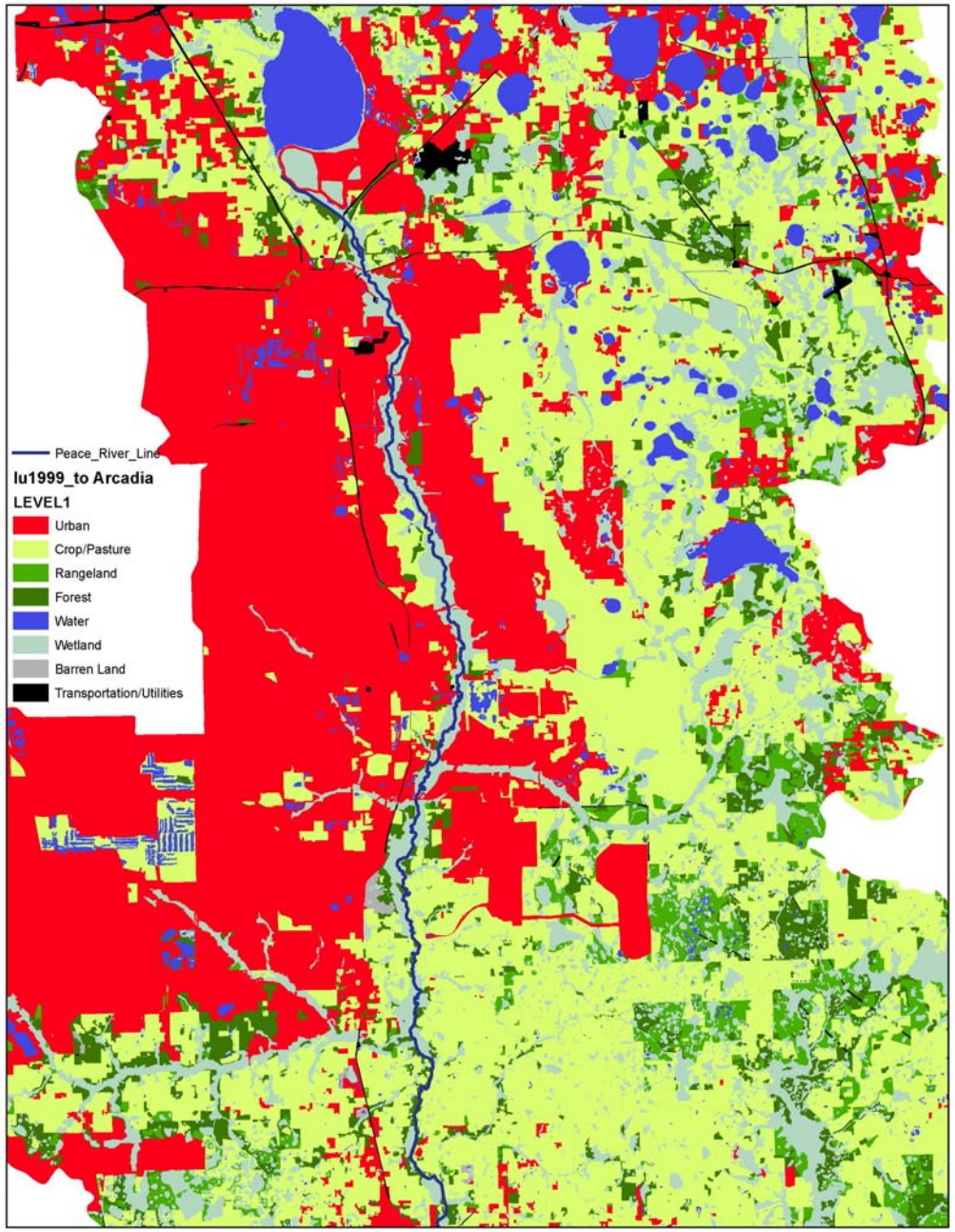


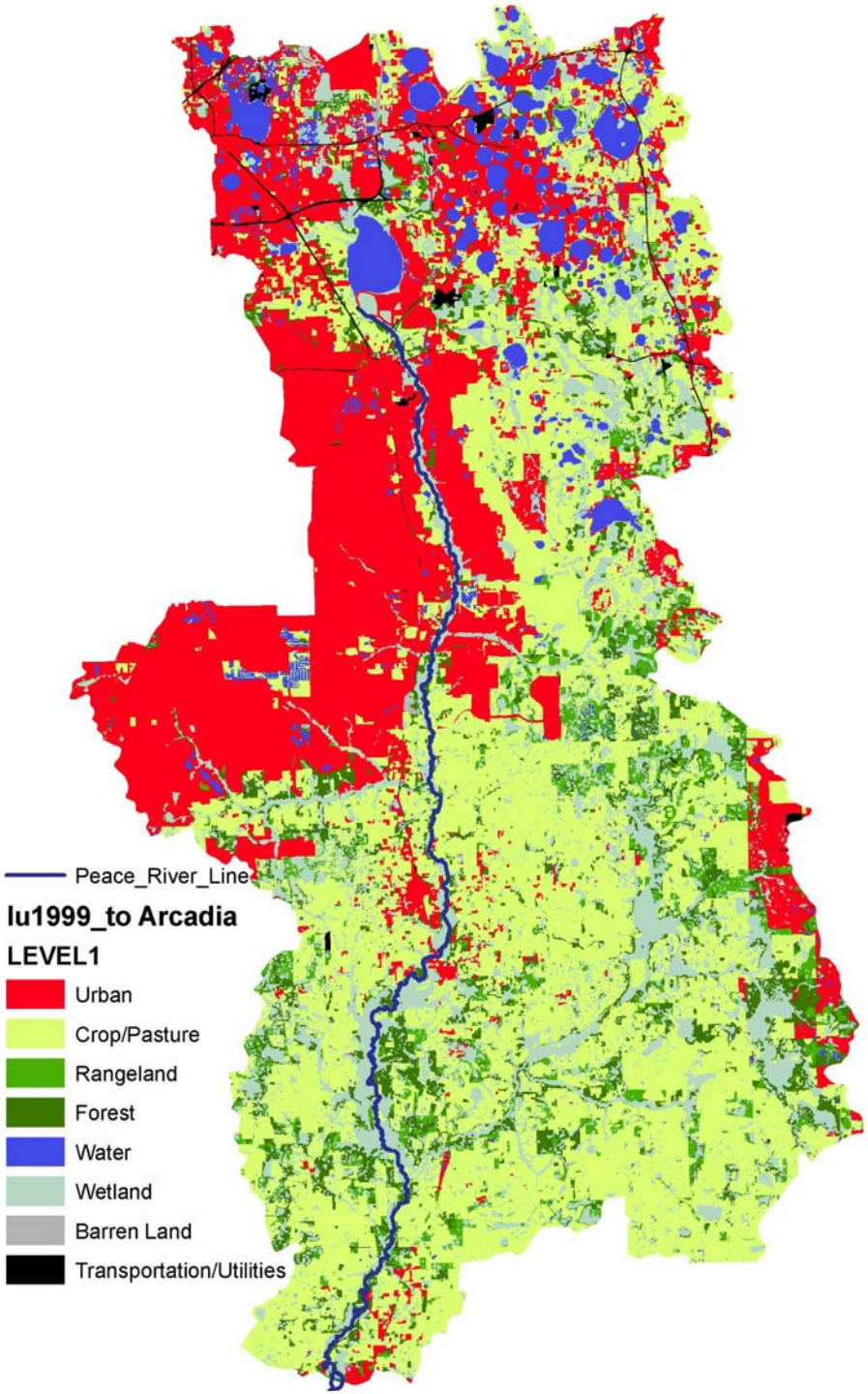
1995 Landuse





1999 Landuse

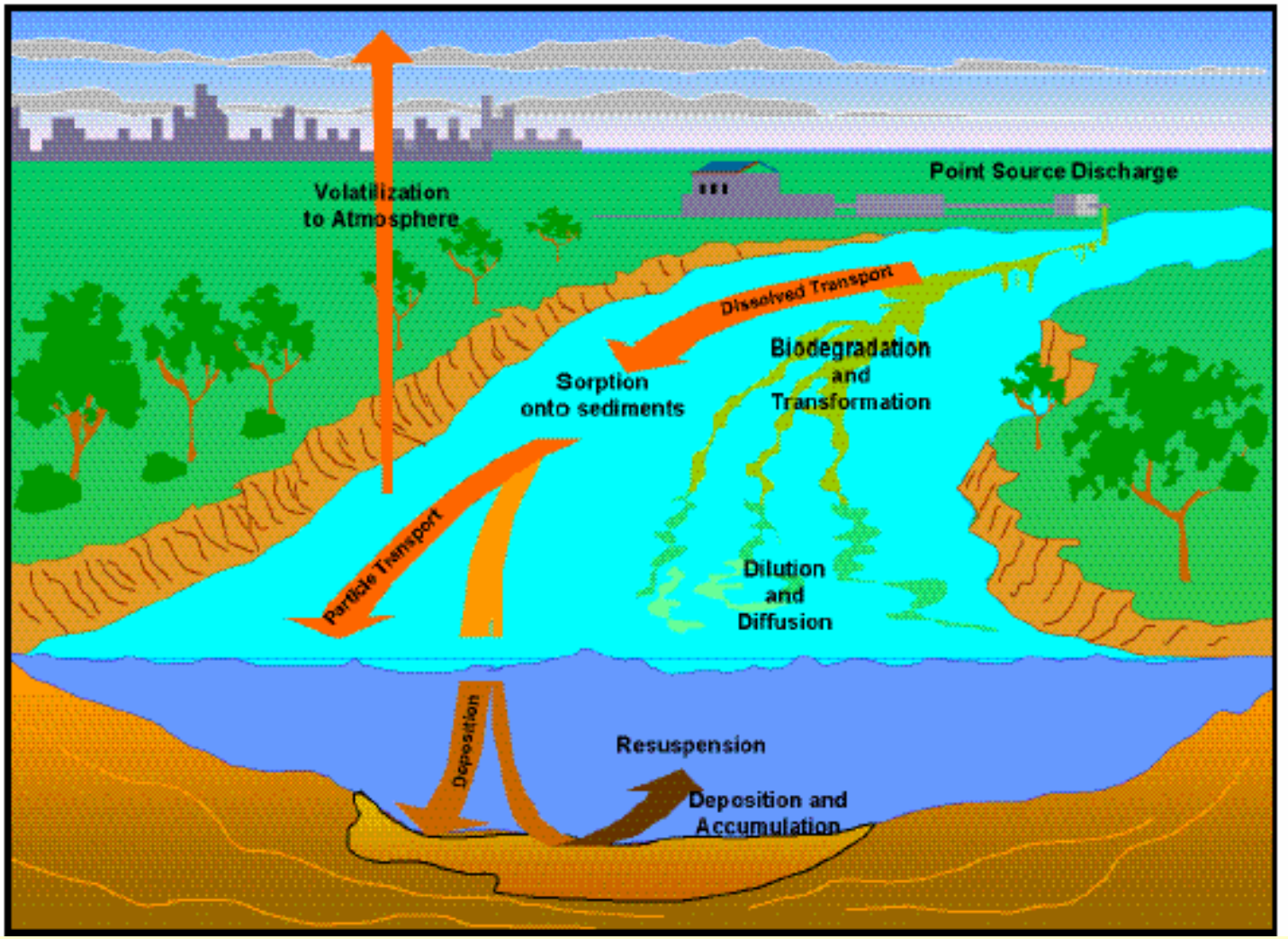




SWAT
(Soil Water Analysis Tool)

- GIS-based model supported by EPA for development of TMDL's
- Simulates a river's physical and chemical condition to various "management practices" / land-use changes

In-stream process modeled by SWAT



Needed to Create Links to SWAT

1. Surveys of channel geometry through time (Library of Congress, photographs, USGS profiles, remote sensing)

2. Development of habitat criteria for regional biota (largely unknown)

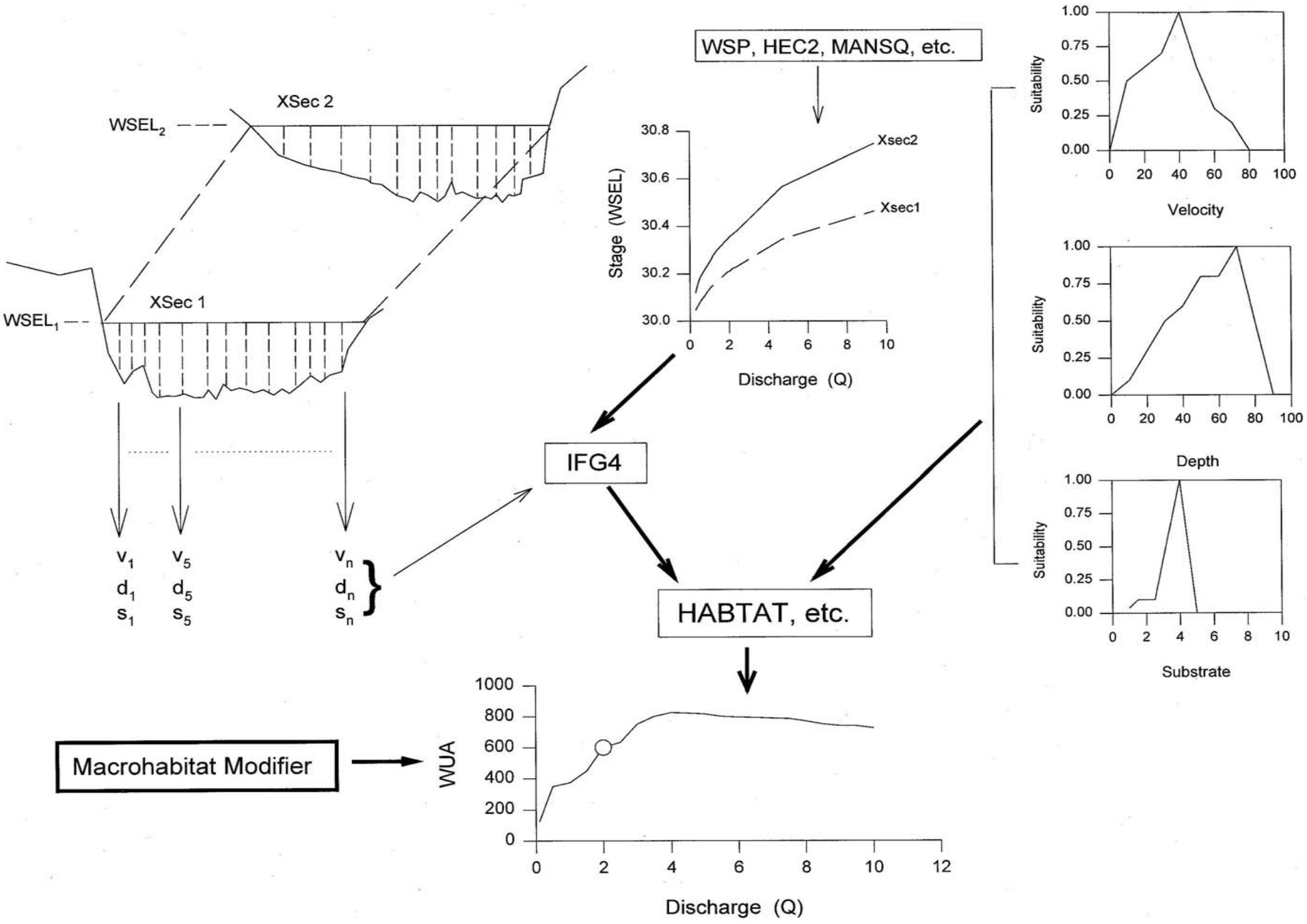
3. Assessment of biological response to increases/decreases in water quality and sediment loading

Instream Flow Incremental Methodology (IFIM)

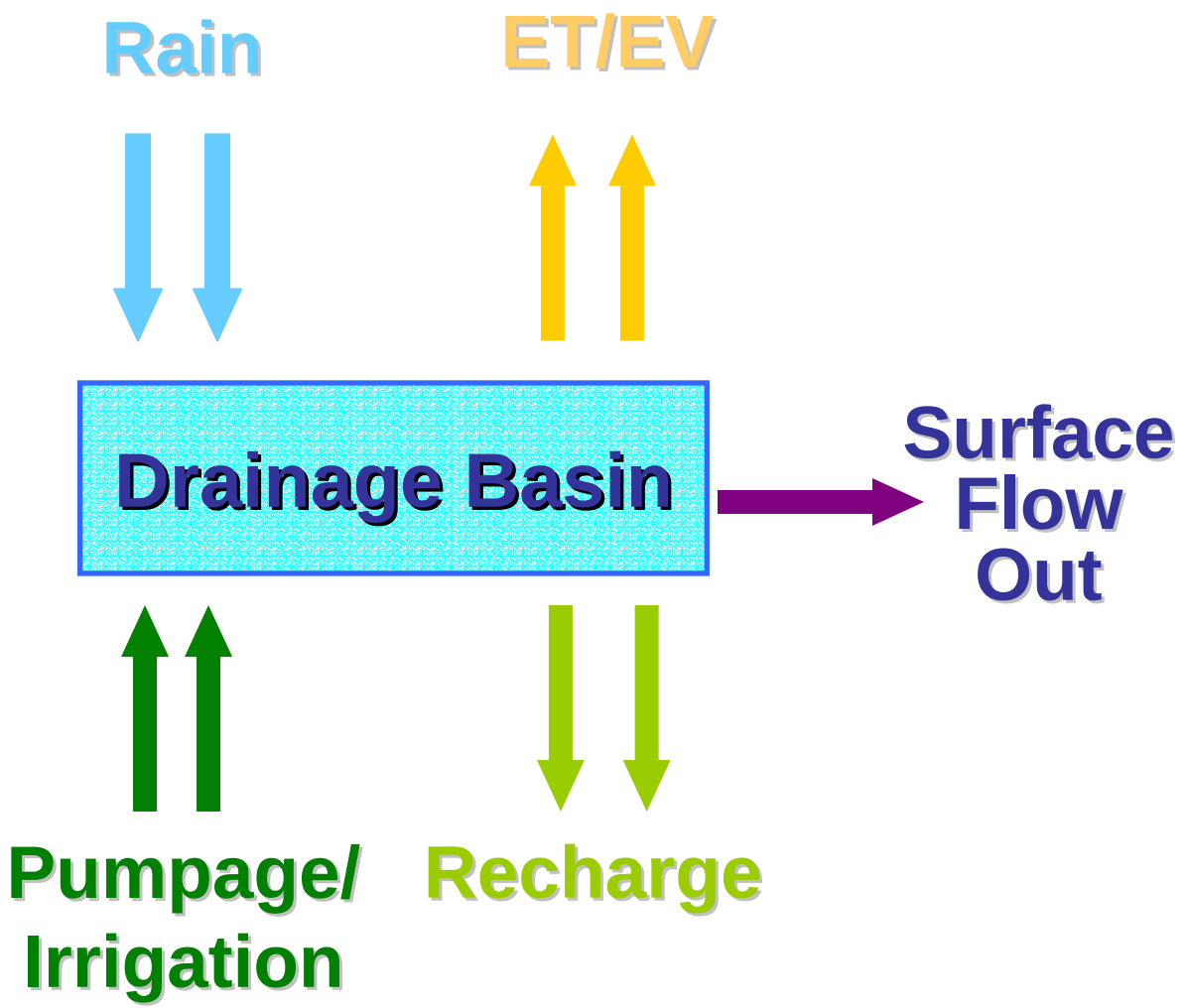
- Simulates Hydrologic Conditions
- Linked to Habitat Preferences (velocity, depth, substrate or complex hydraulics)
- Predicts Change in Habitat over a range of Discharges

Instream Flow Incremental Methodology (IFIM)

- Software: PHABSIM - The Physical HABitat SIMulation

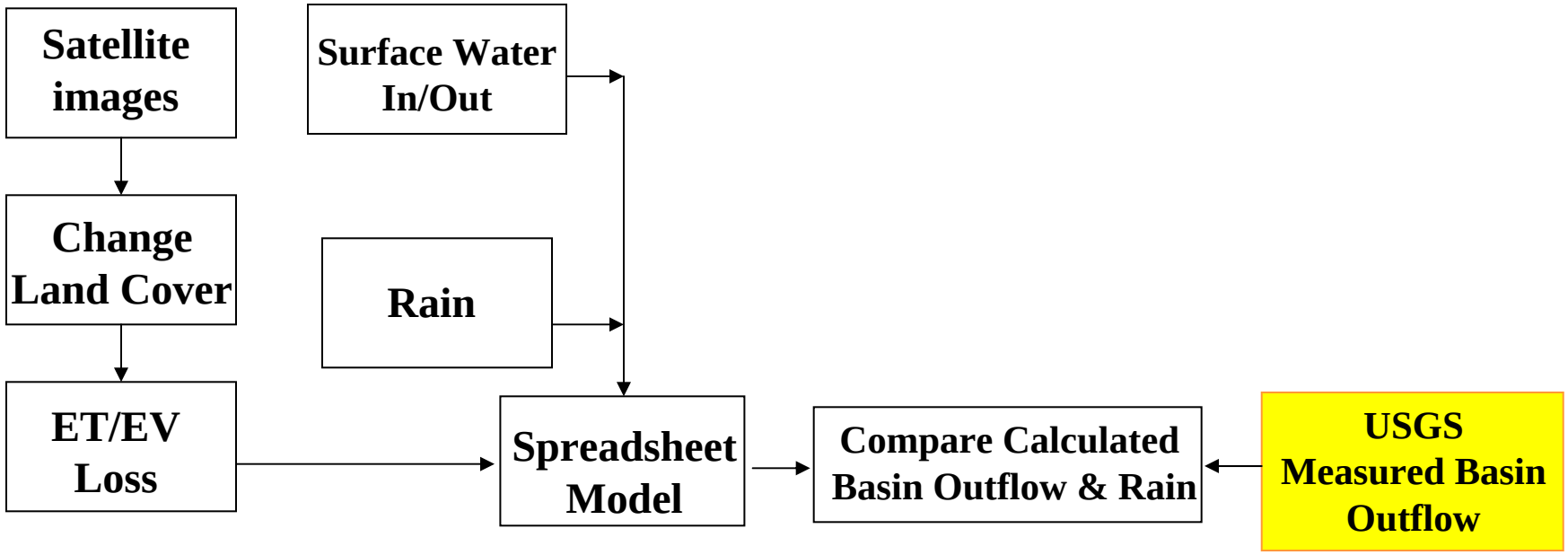

WSP, HEC2, MANSQ, etc.
XSec 2
WSEL2
XSec 1
WSEL1
Stage (WSEL)
Discharge (Q)
Xsec2
Xsec1
IFG4
HABTAT, etc.
Macrohabitat Modifier
WUA
Discharge (Q)
Suitability
Velocity
Depth
Substrate
v1 d1 s1
v5 d5 s5
vn dn sn

Water Balance



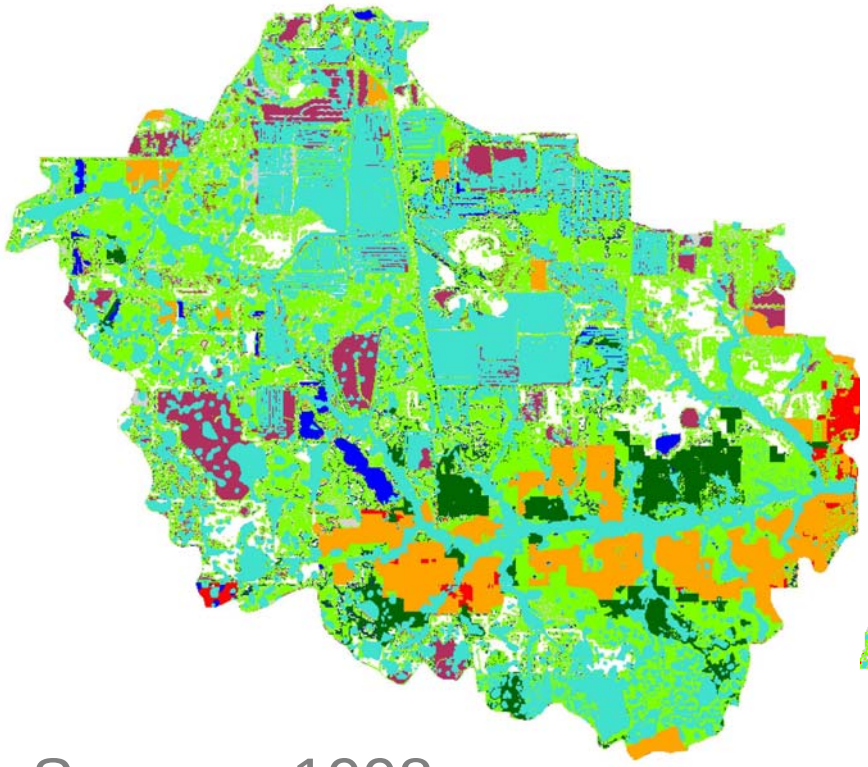
SWAT Analysis

- Document Land Usage/Land Cover changes and associated loss factors and correlation to streams



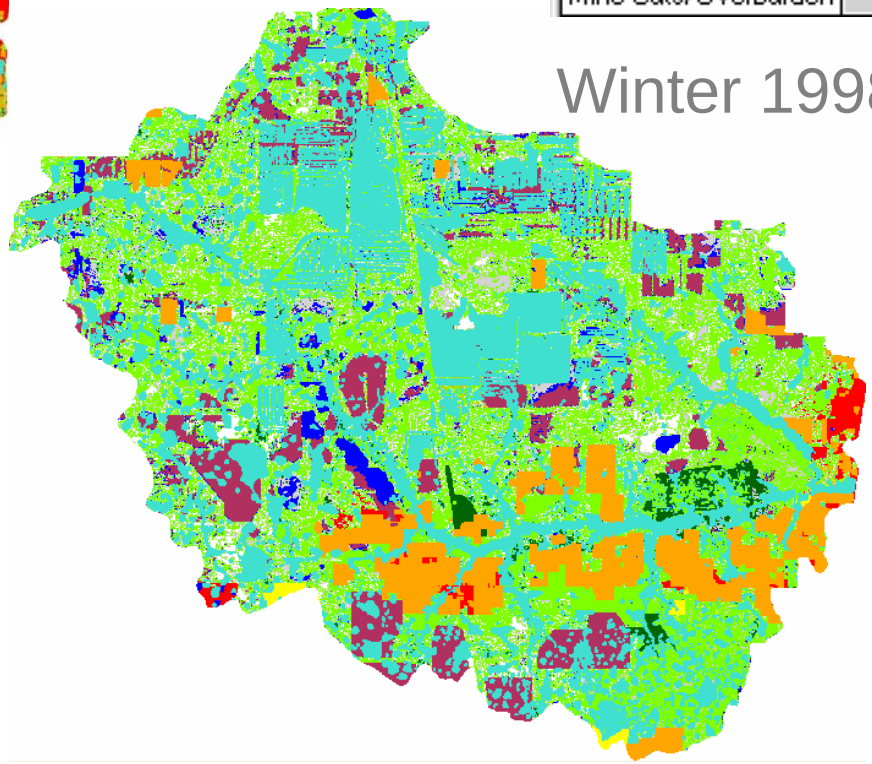
Assumption: $\Delta s = \sim 0$

Payne Summer & Winter - 1998

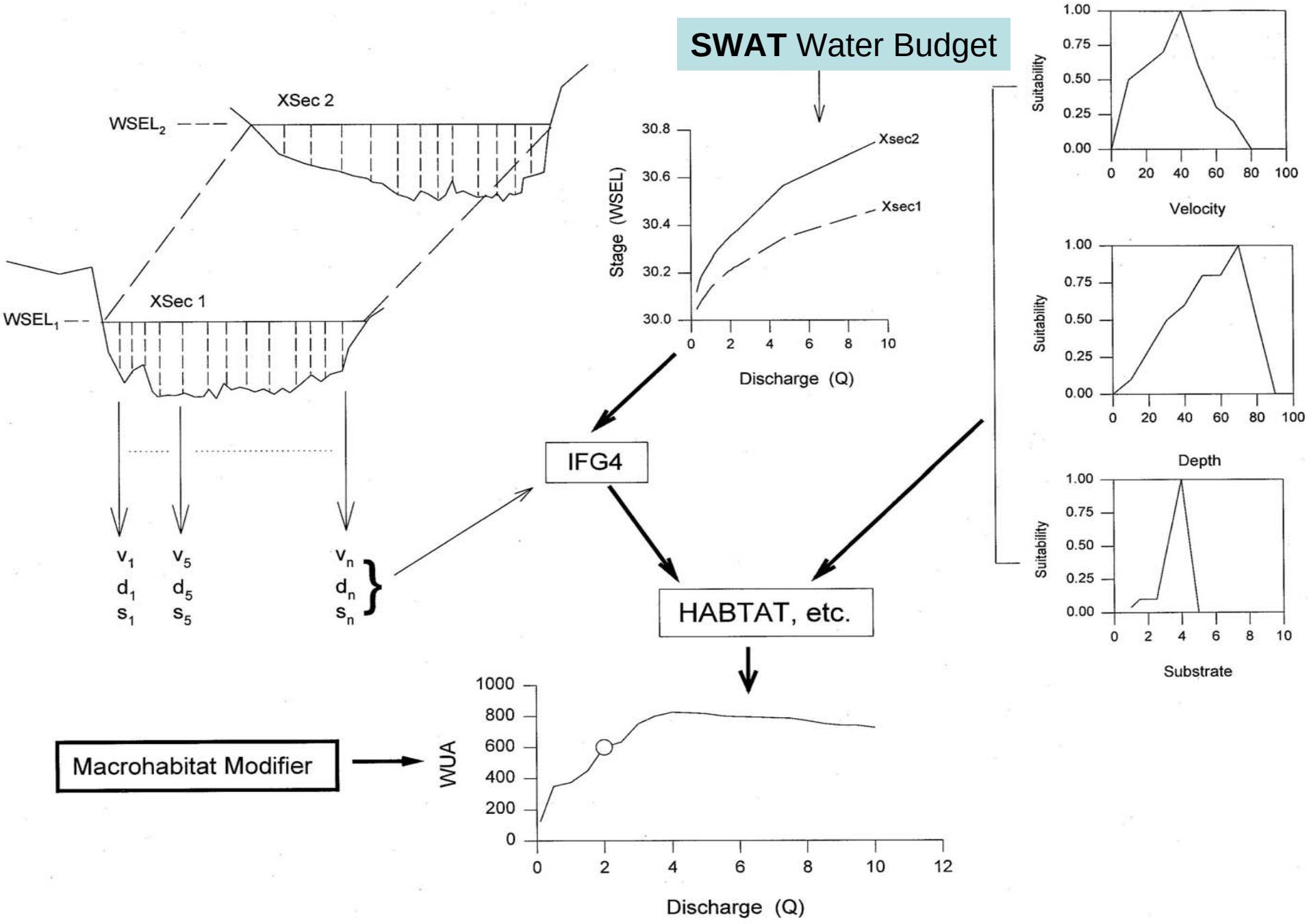


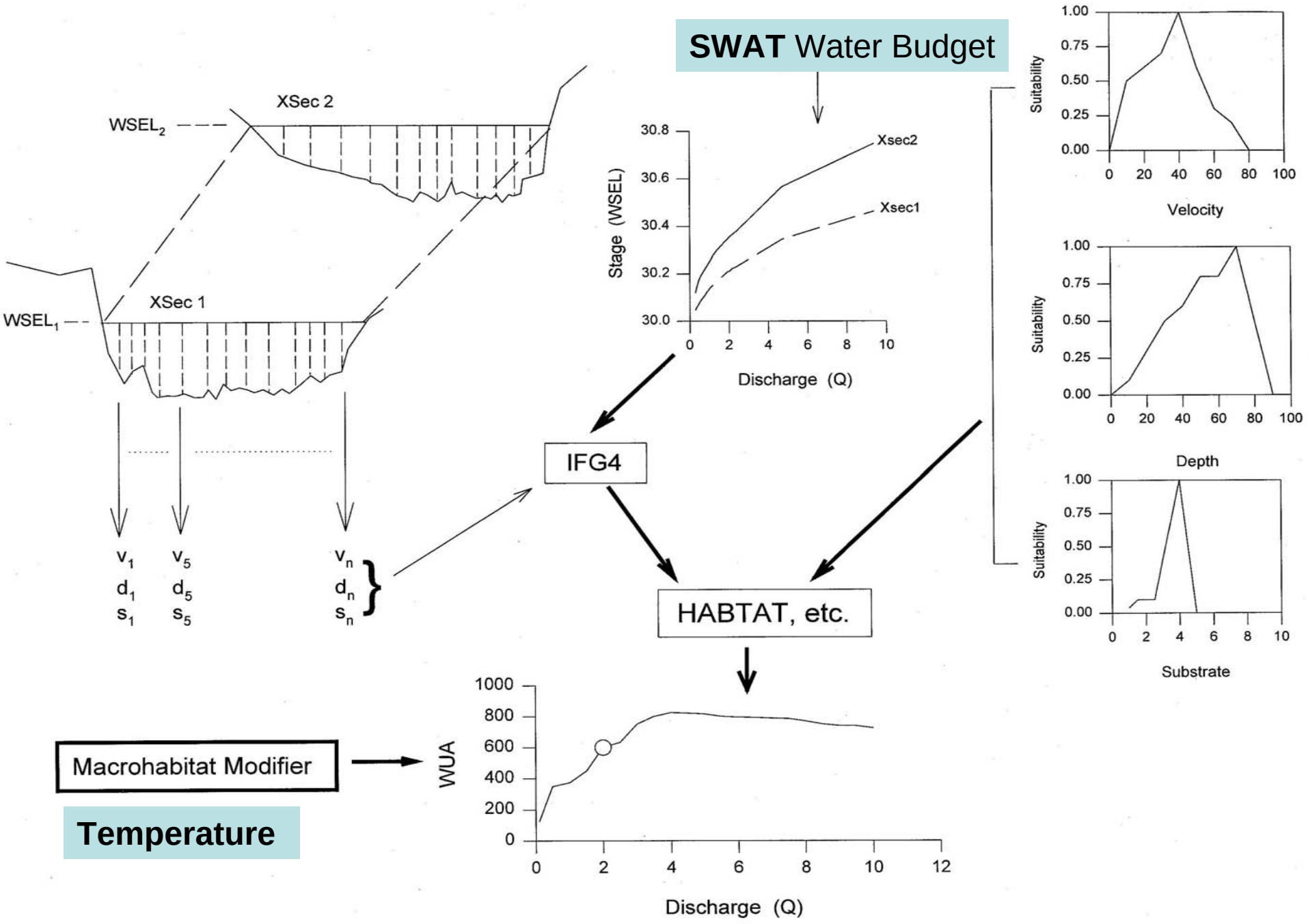
Summer 1998

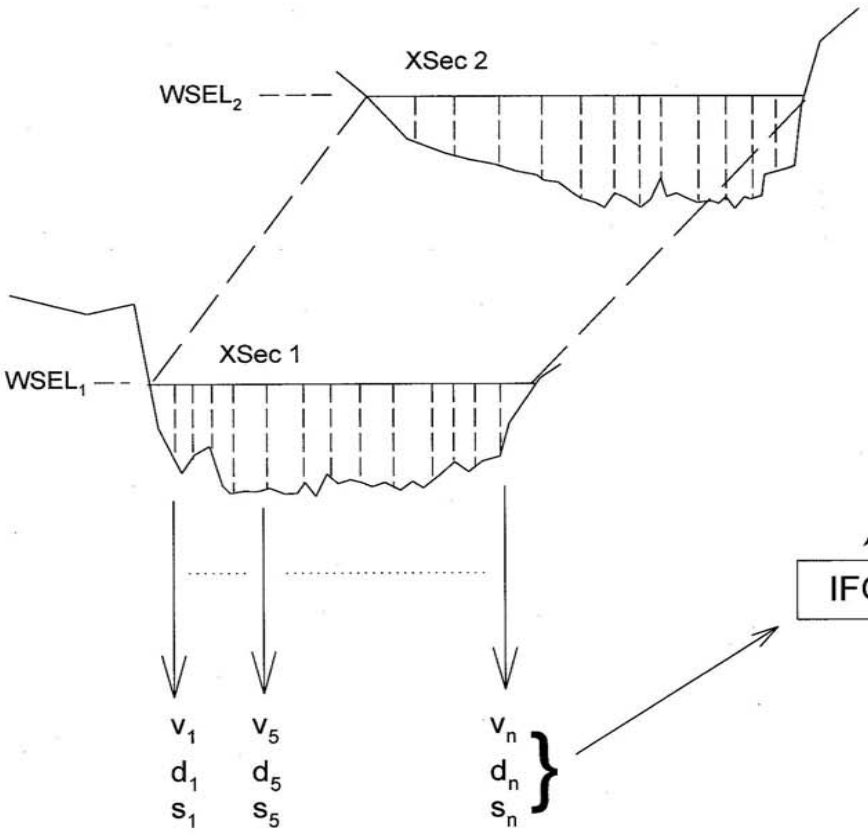
Class Names	Color
Pasture	
Citrus	
Wetland	
Urban	
Timber	
Water	
CSA/Water	
Sand Tailings	
Mine Cuts/Overburden	



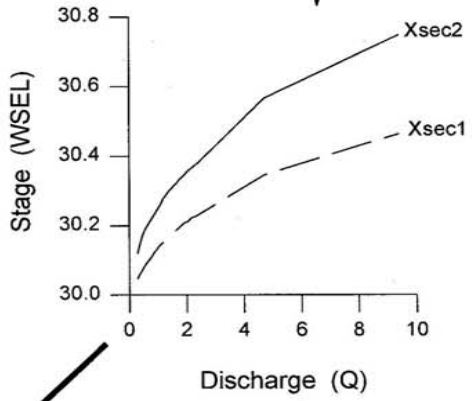
Winter 1998

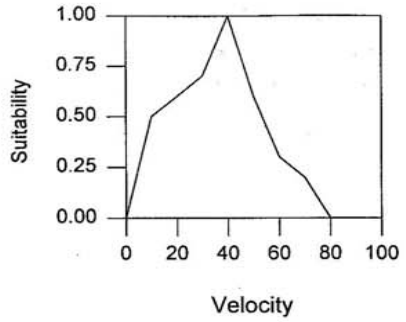


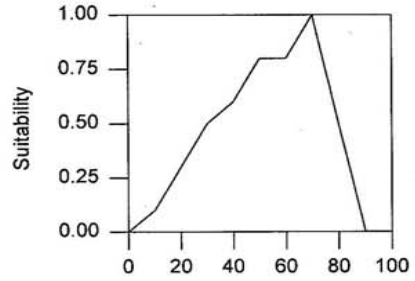


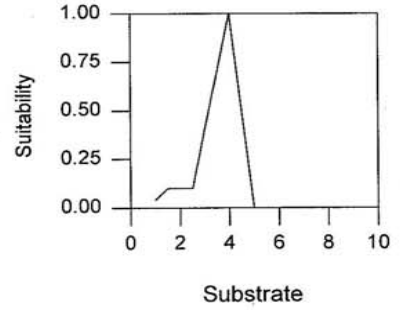


SWAT Water Budget





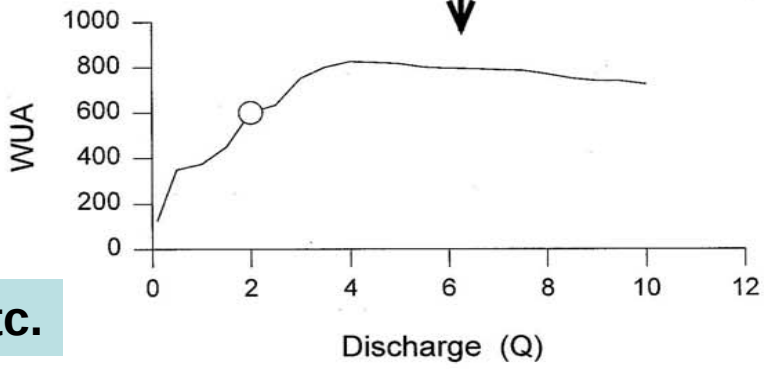




IFG4

HABTAT, etc.

Macrohabitat Modifier



Temperature

Sediment, Nutrients, etc.