Environmental Flows in the Lower Colorado River

Water Quality Advisory Committee Meeting

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Overview

- What are environmental flows?
- Relationship between stream flow and aquatic habitat
- Components of an environmental flow regime
- Science of instream flow development
- How LCRA manages environmental flow

What are Environmental Flows?

- “Environmental flows describe the quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems…” **– Wikipedia**
- “The term ‘environmental flows’ is used to describe the flow of water (both quantity and timing of flow) needed to maintain ecologically healthy streams and rivers, as well as the bays that they feed.” **– Texas Water Development Board**
- “An environmental flow is an amount of water that should remain in a stream or river for the benefit of the environment of the river, bay, and estuary while balancing human needs.” **– Texas Commission on Environmental Quality**

Environmental Flow

- **Texas Senate Bill 3 (80th, 2007) defined an environmental flow regime as:**

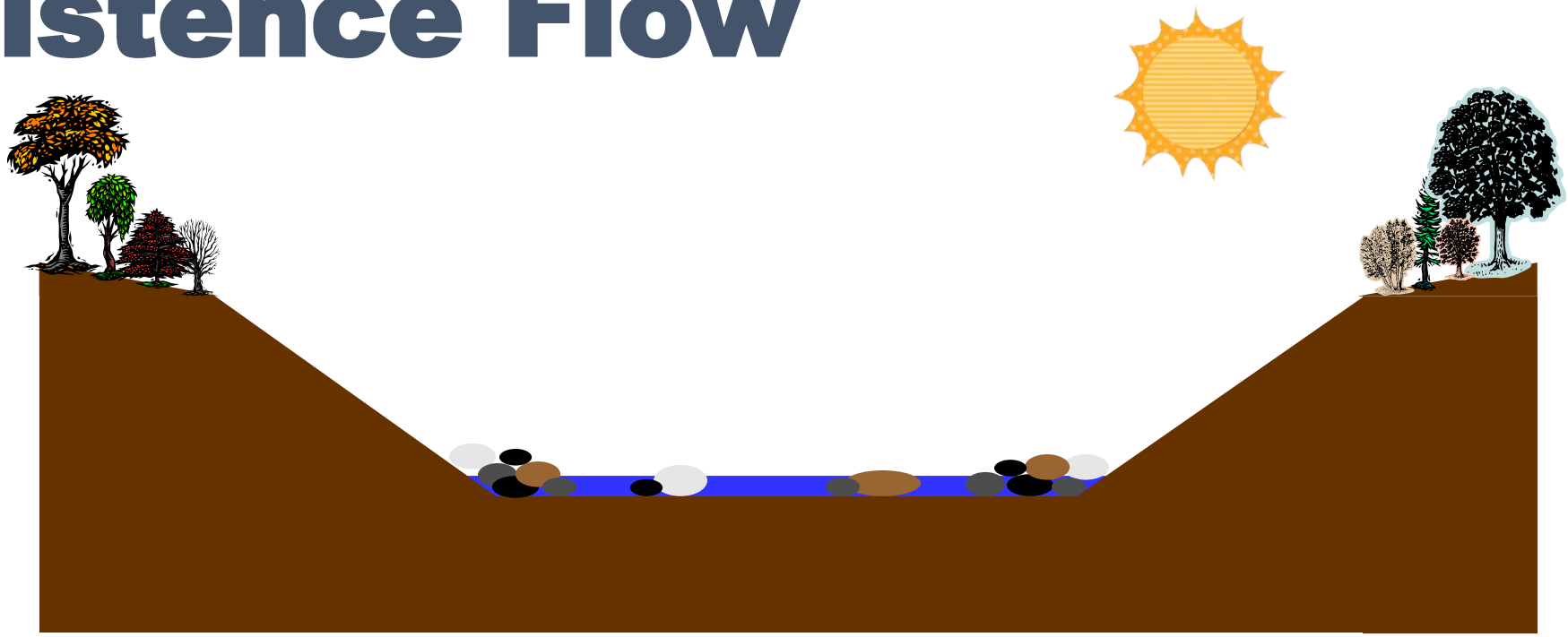
  "A schedule of flow quantiles that reflects seasonal and yearly fluctuations that would vary geographically, by specific location in a watershed, and that are shown to be adequate to support a sound ecological environment…"

Instream Flow Regime Components

- **No flow:** periods of no flow
- **Subsistence flow:** infrequent low flow
- **Base flow:** average flow conditions

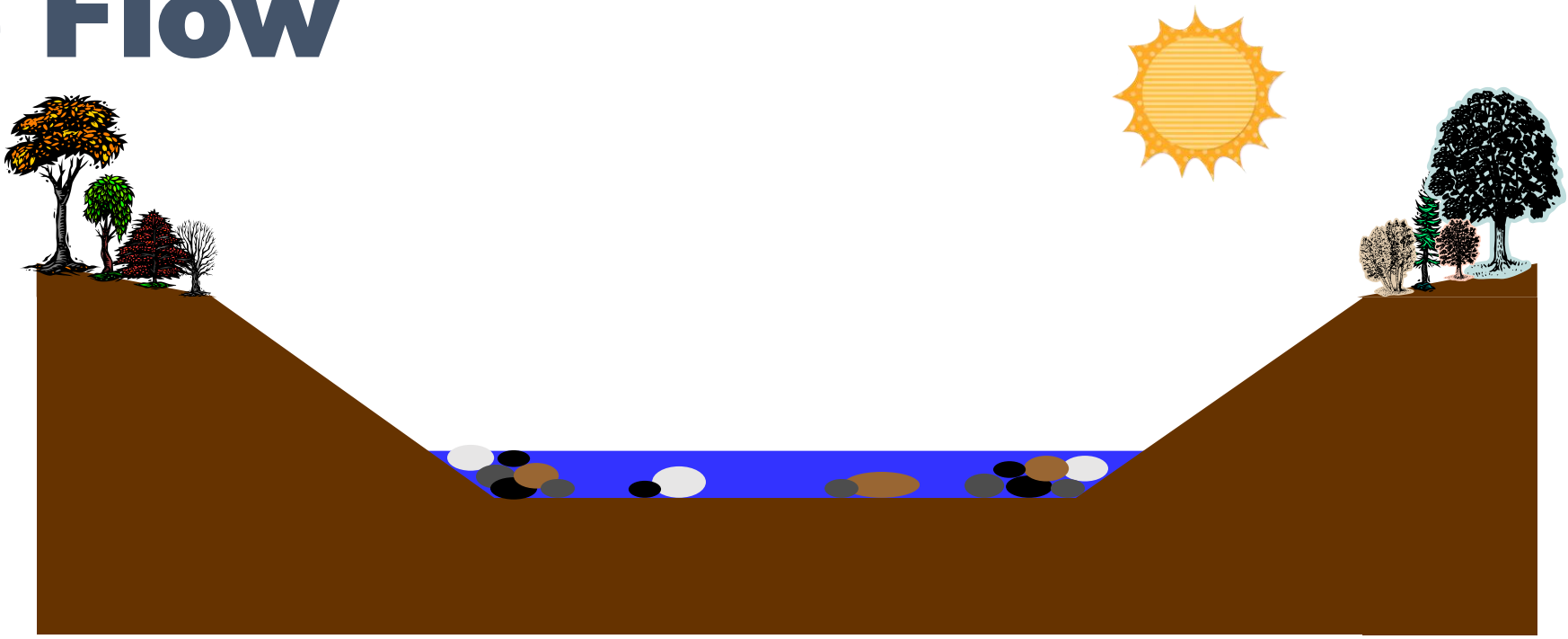
- **Channel maintenance:**
  - **High flow pulses**: in-channel, short duration, high flows
  - **Overbank:** infrequent, high flows that exceed the channel

Subsistence Flow



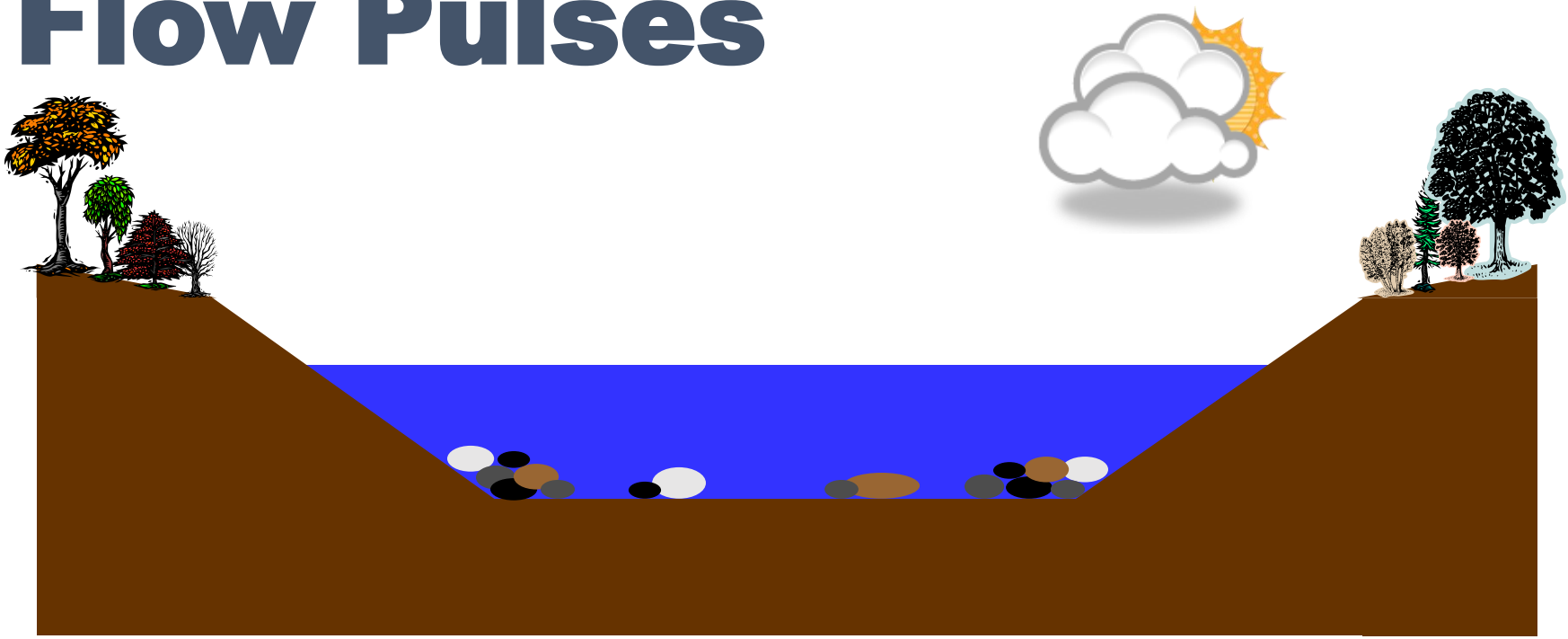
- Represents minimum conditions:
  - Water quality is maintained at acceptable levels
  - Aquatic habitats resemble those found during extreme conditions in a natural setting

Base Flow



- Provides a range of suitable conditions:
  - Maintains year-to-year variability
  - Maintains ecological functions associated with variability

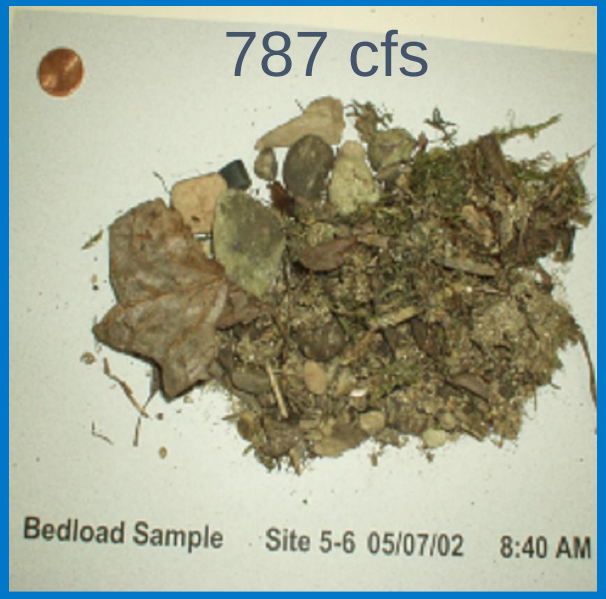
High Flow Pulses



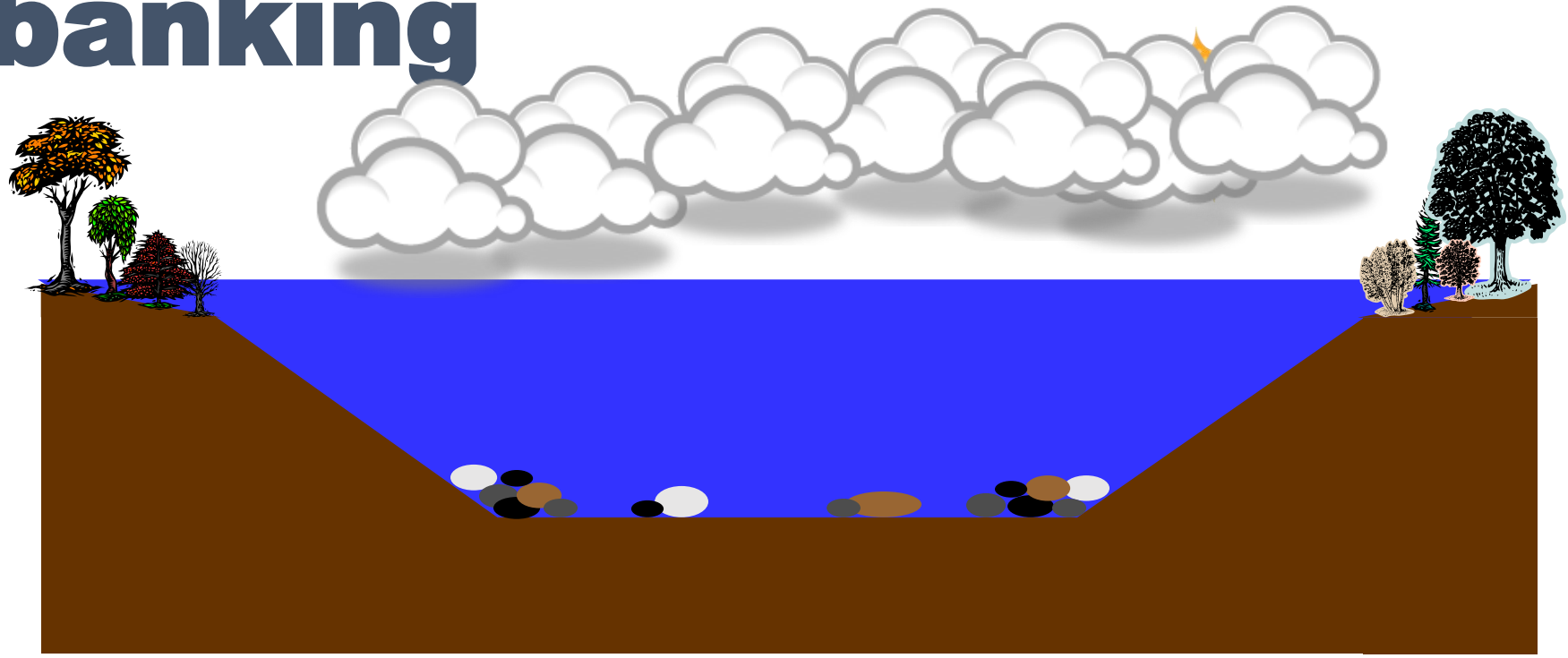
- Provides a myriad of ecological functions, including:
  - Nutrient and organic matter exchange
  - Limited channel maintenance
  - Flushing
  - Vegetation scouring
  - Seed dispersal

Geomorphology Activities Example

Bedload samples at different flows



Overbanking



- Inundates low floodplain areas adjacent to the river for:
  - Lateral floodplain and riparian connectivity
  - Floodplain maintenance and nutrient deposition
  - Recruitment of organic material and woody debris

Developing an Instream Flow Recommendation

Biological Data Collection

- Instream flow study in the lower Colorado River
- Over 13,000 individual fish collected
- Represents 50 species: catfish, bass, sunfish, shiner, carp, gar, etc.

Habitat Guild Development

Riffles

- *Percina sciera*
- *Percina carbonaria*
- *Ictalurus punctatus* (<180 mm)
- *Phenacobius mirabilis*
- *Etheostoma spectabile*
- *Campostoma anomalum*
- *Macrhybopsis spp*

Shallow runs

- Cyprinella lutrensis
- Cyprinella venusta
- Pimephales vigilax
- Notropis volucellus
- Micropterus treculi (< 170 mm)

Deep pools

- Ictiobus bubalus
- Cyprinus carpio

Shallow pools/Edge/Backwaters

- Micropterus salmoides
- Lepomis megalotis
- Lepomis macrochirus
- Lepomis cyanellus
- Cichlasoma cyanoguttatum
- Gambusia affinis
- Poecilia latipinna
- Fundulus notatus

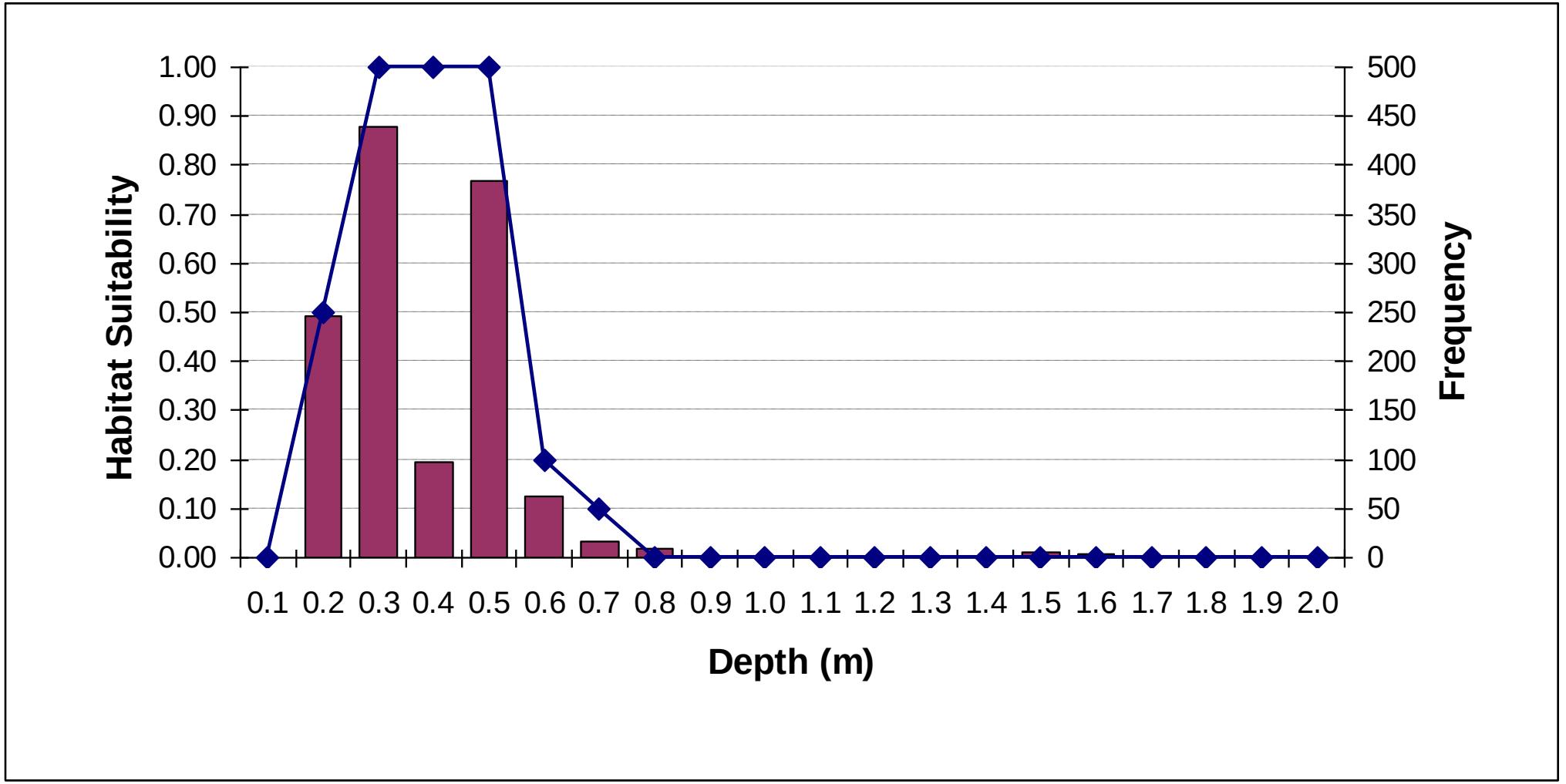
Riverine Habitat

- Riffles
- Runs
- Deep pools
- Edge, Backwater
- Rapids

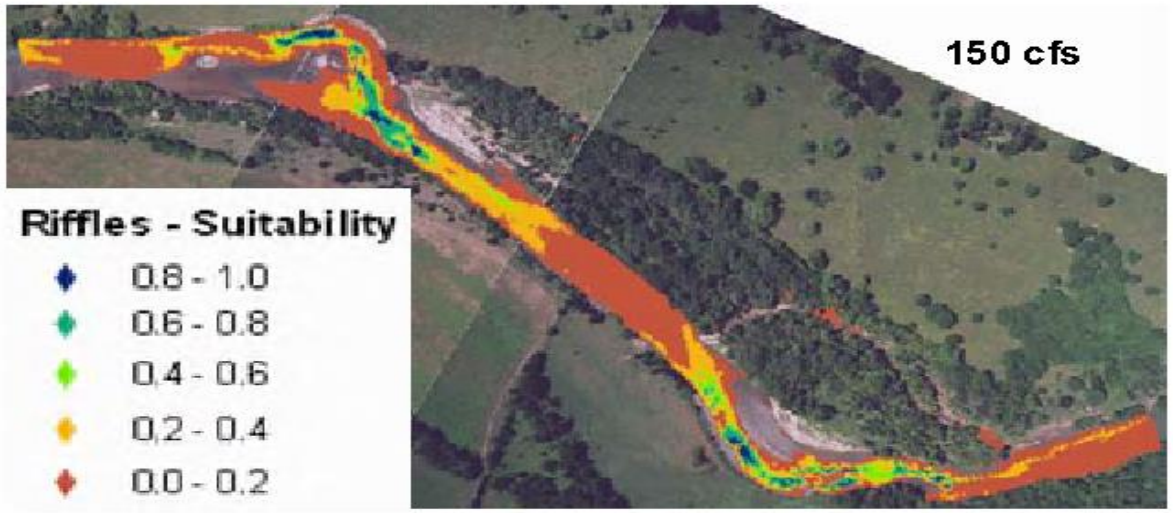
Habitat Suitability

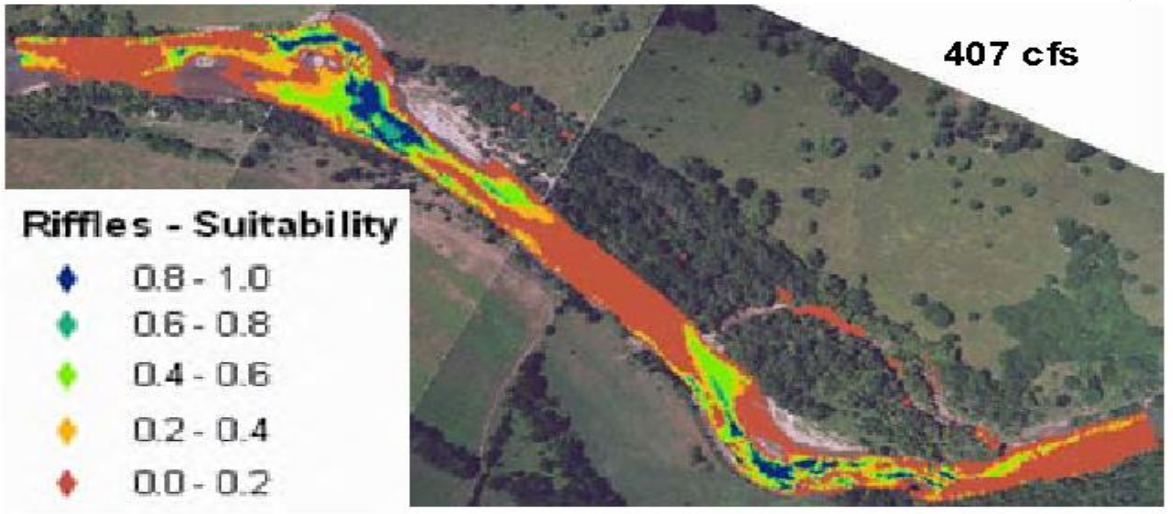
- **Three key variables**
  - Depth
  - Velocity
  - Substrate
- **Links aquatic habitat to predictive river model**
  - Parallel process developing a physical/flow model
  - Evaluates habitat at various flow rates

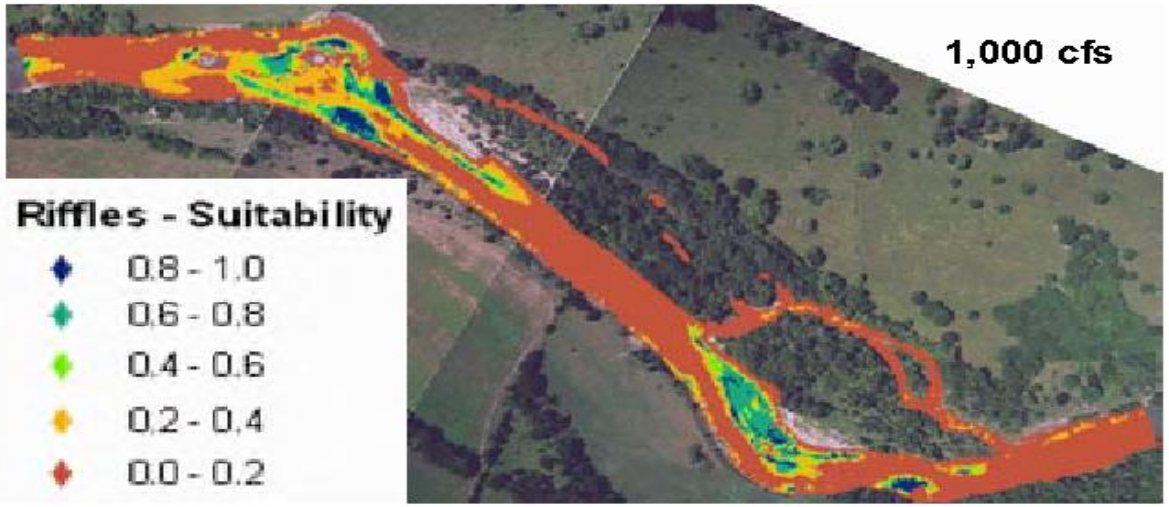
Depth Habitat Suitability: Riffle

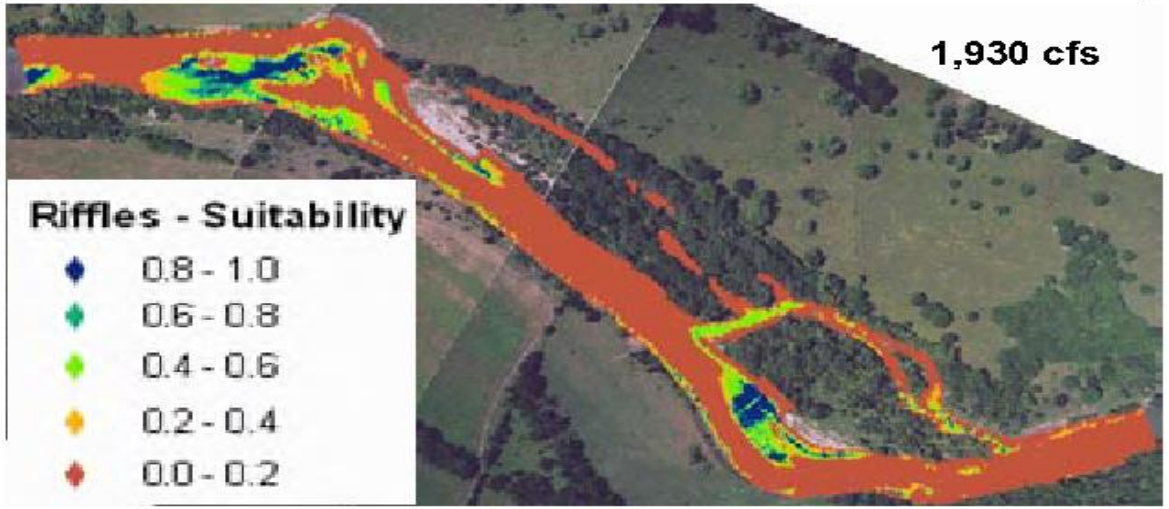


River 2-D Modeling



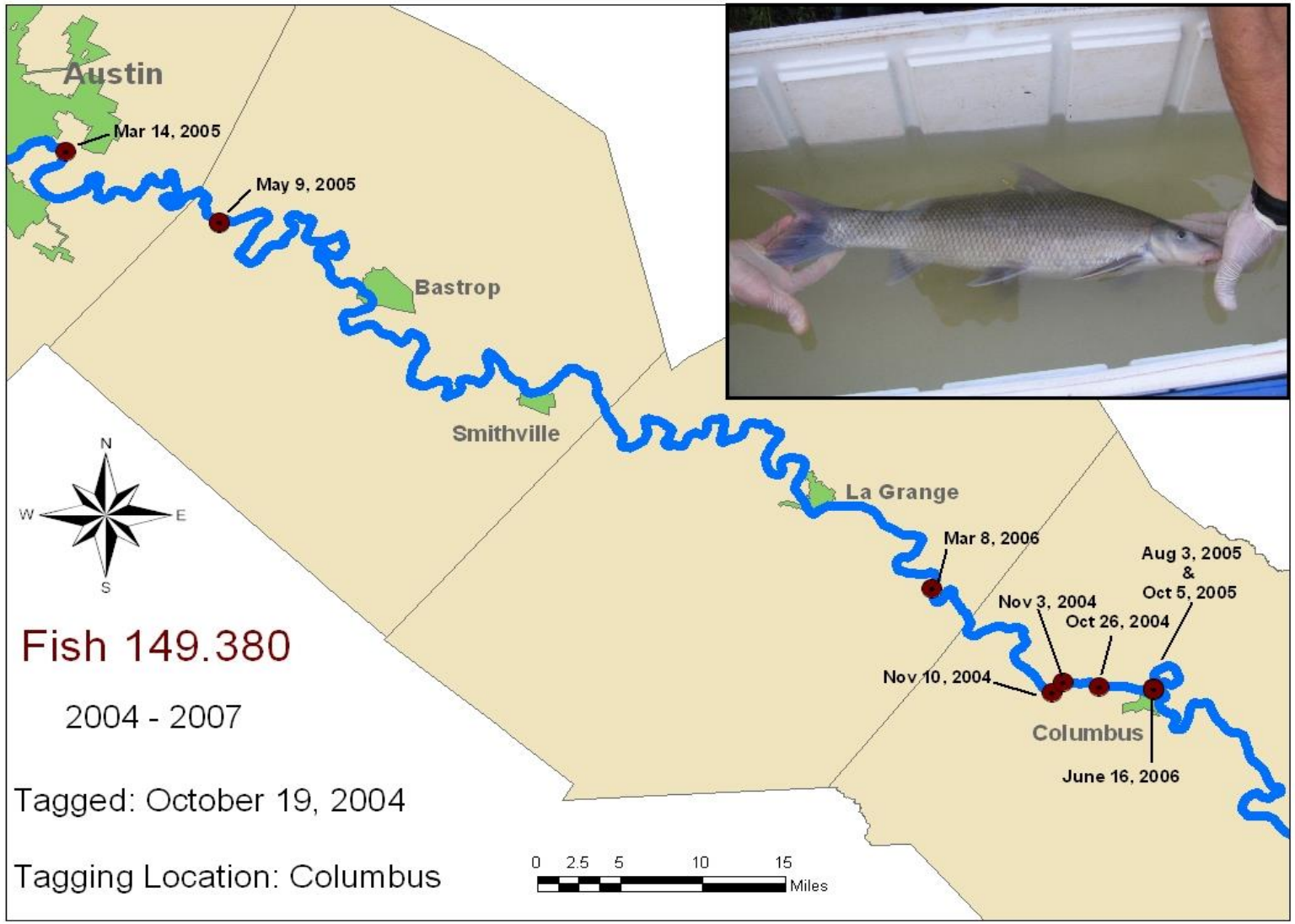






Species of Special Interest

Tagging Information



Environmental Flow

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Flow Recommendations for Lower Colorado River

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
AUSTIN REACH												
Subsistence	50	50	50	50	50	50	50	50	50	50	50	50
BASTROP REACH												
Subsistence	208	274	274	184	275	202	137	123	123	127	180	186
Base-DRY	313	317	274	287	579	418	347	194	236	245	283	311
Base-AVERAGE	433	497	497	635	824	733	610	381	423	433	424	450
COLUMBUS REACH												
Subsistence	340	375	375	299	425	534	342	190	279	190	202	301
Base-DRY	487	590	525	554	966	967	570	310	405	356	480	464
Base-AVERAGE	828	895	1,020	977	1,316	1,440	895	516	610	741	755	737
WHARTON REACH												
Subsistence	315	303	204	270	304	371	212	107	188	147	173	202
Base-DRY	492	597	531	561	985	984	577	314	410	360	486	470
Base-AVERAGE	838	906	1,036	1,011	1,397	1,512	906	522	617	749	764	746

COLORADO RIVER DOWNSTREAM OF AUSTIN	
PULSE FLOWS	
Base	MAGNITUDE (2,000 to 3,000 cfs); FREQUENCY (8–10 times annually); DURATION (3–5 days)
High	MAGNITUDE (@ 8,000 cfs); FREQUENCY (2 Events in 3 year period); DURATION (2–3 days)
CHANNEL MAINTENANCE	MAGNITUDE (27,000 - 30,000 cfs); FREQUENCY (1 Event in 3 years); DURATION (3 days)
OVERBANK	MAGNITUDE (> 30,000 cfs); FREQUENCY and DURATION (Naturally Driven)

LCRA Water Management Plan

- **Flow recommendation translated into operational guidelines**
  - Daily management
- **Instream flow needs balanced with other demands**
- **Hydrologic condition sets flow tier (e.g. subsistence, base-dry, base average)**
  - inflows into the Highland Lakes are passed if needed in the river downstream
- **Subsistence flows are supported with stored water as needed**


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