

Instream Flow Assessment of the Illinois River, OK Summary of Technical Studies

Presented to
Oklahoma Instream Flow Advisory Group and Technical Study Work Group

Presented by
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US Army Corps
of Engineers



ch2m.

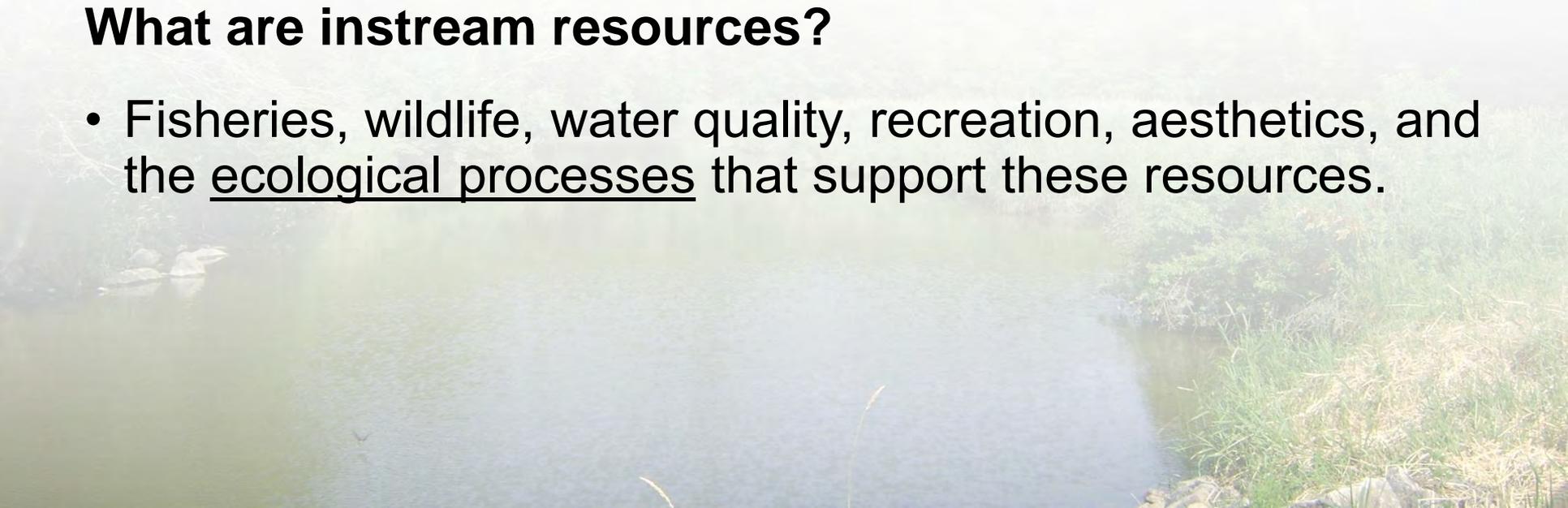
What is an instream flow?

OWRB working definition of instream flow:

“Flows necessary to provide for a healthy ecosystem and support water-related recreation (such as fishing, hunting, swimming and boating) as well as tourism.”

What are instream resources?

- Fisheries, wildlife, water quality, recreation, aesthetics, and the ecological processes that support these resources.



Technical Study Goal:

- Summarize technical resource information for use in supporting the decision making process in developing seasonal instream flow management prescriptions for the Illinois River including Barren Fork and Flint creeks.

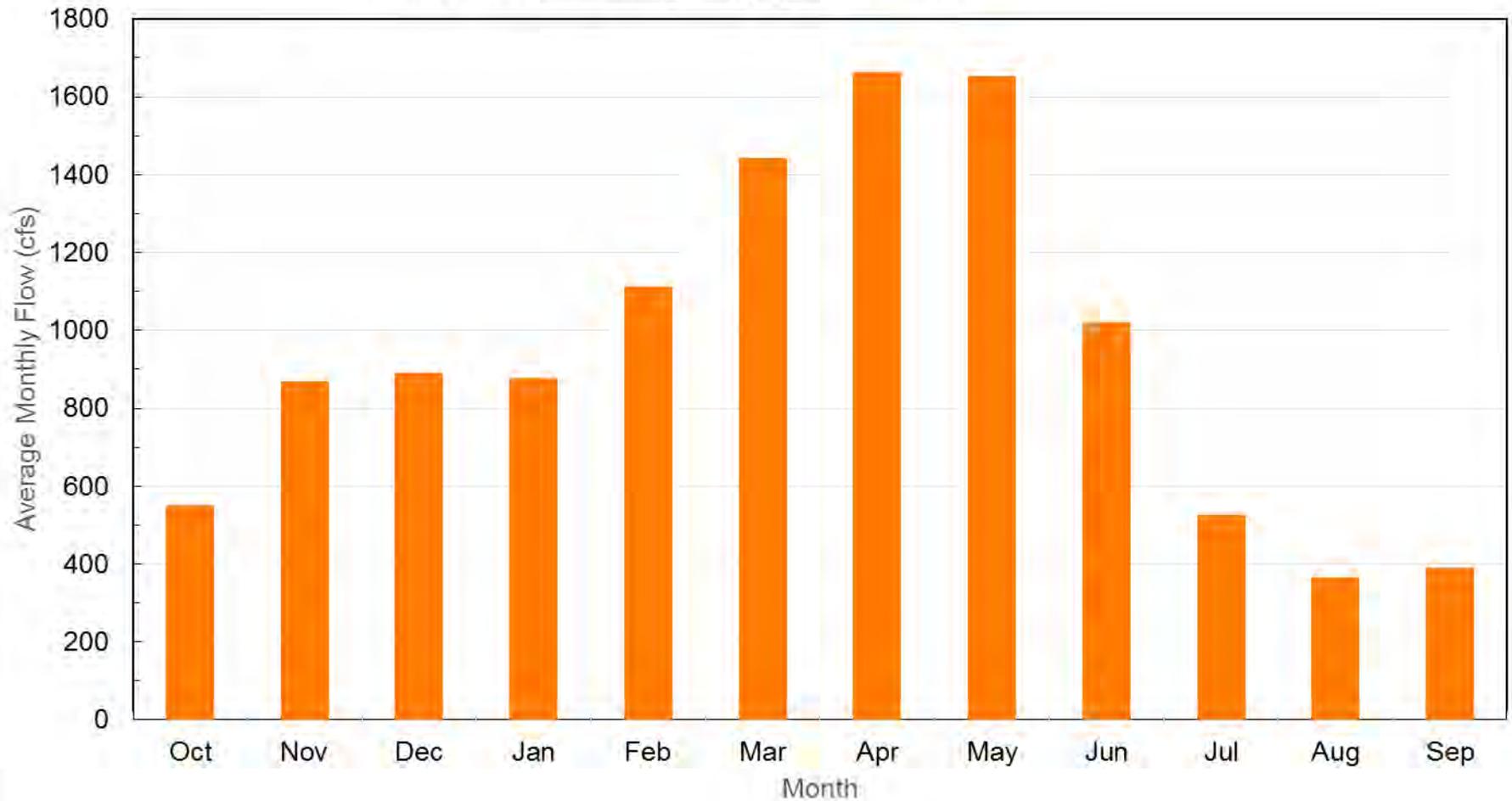
*Note: This study is **not** being done in response to a proposed water development project.*

Study Area



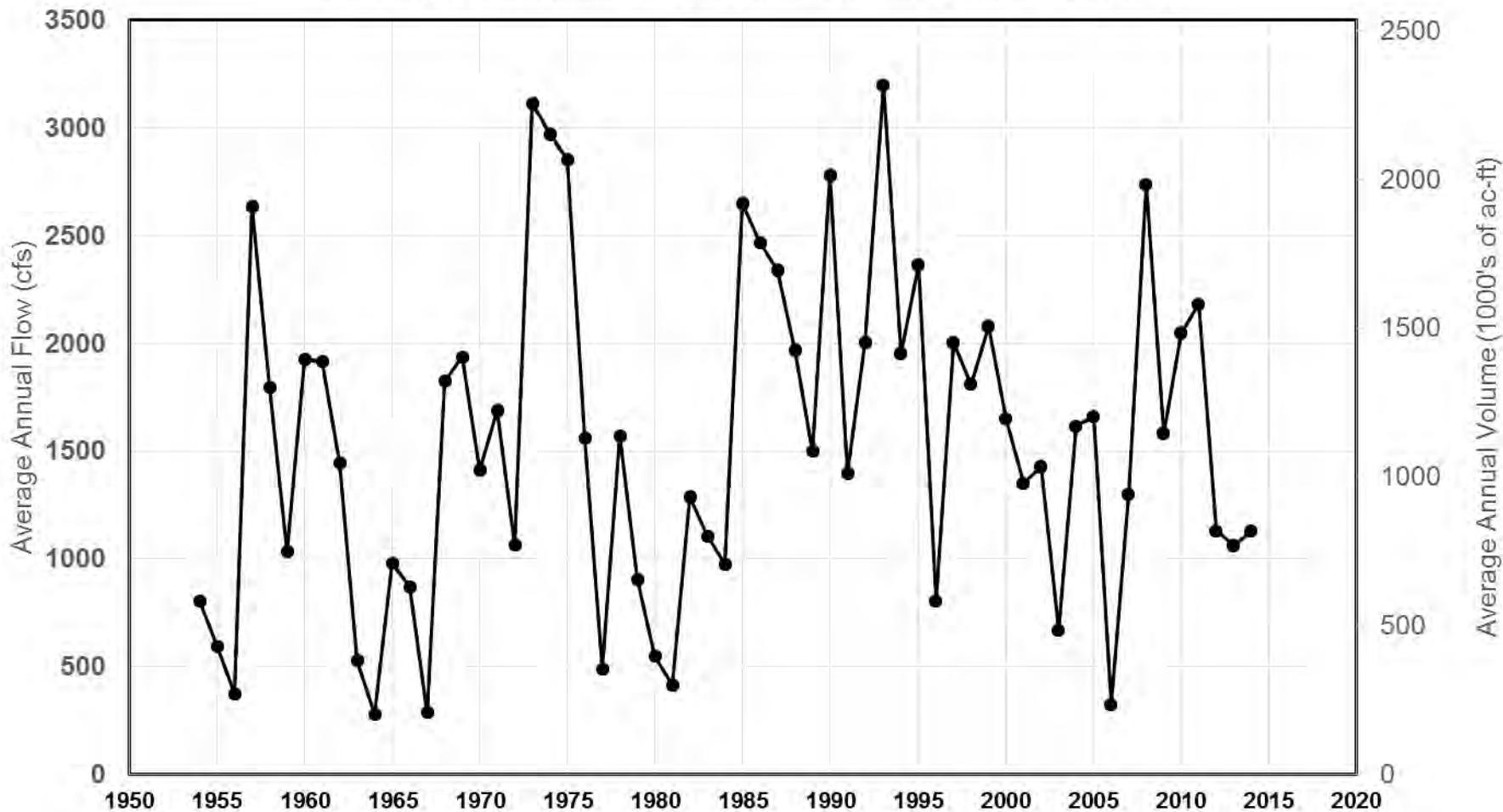
Illinois River Average Monthly Flows

Illinois River near Tahlequah (gage 07196500)



Average Annual Flows for the Illinois River near Gore

Average Annual Flow (cfs) and Volume (1000's of ac-ft)



Illinois River December 27, 2015



Peak Flow Recurrence Intervals

Peak Flow Return Period (Year)	Probability (%)	Flow (cfs)		
		Illinois River near Tahlequah	Illinois River near Watts	Barren Fork at Eldon
2	50	19,535	18,868	16,250
5	20	38,289	33,947	29,836
10	10	53,919	45,185	37,328
25	4	77,173	60,390	44,675
50	2	96,925	72,233	48,789
100	1	118,643	84,362	51,962

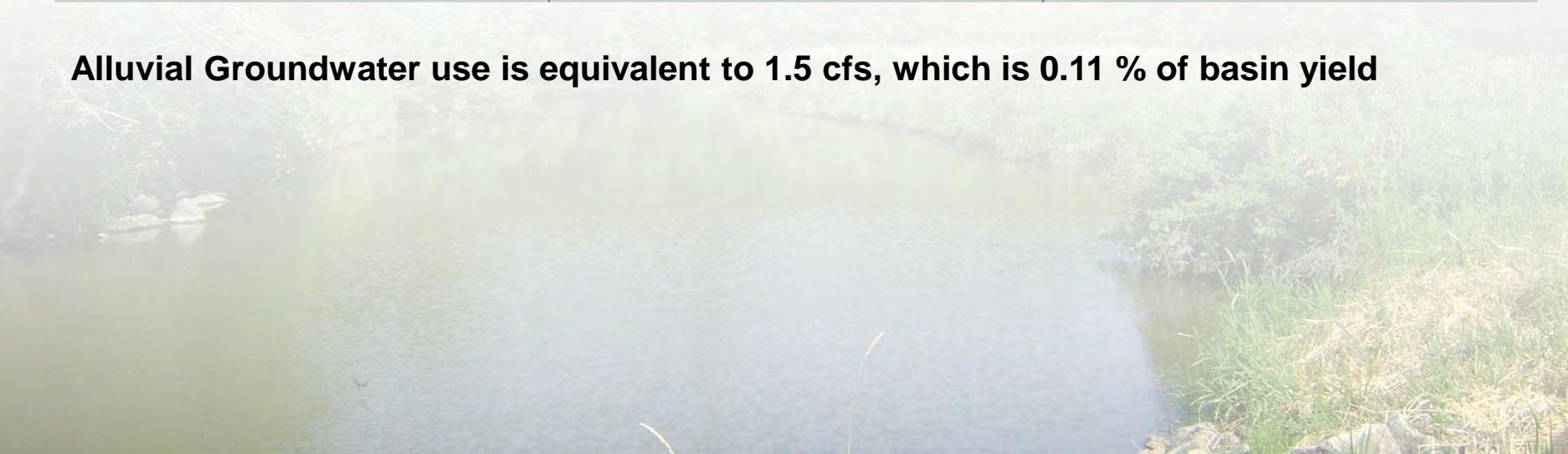
Average Annual Surface Water Usage (acre-feet) in the Upper Illinois River Basin (OK) above and including Barren Fork

Water Use	Total	Percent of Total
Irrigation	1,301.4	10.8
Agriculture	0	0.0
Public Supply	10,751.4	88.9
Rec, Fish, & Wildlife	0	0
Commercial	0	0
Industrial	0	0
Mining	0	0
Other	35.1	0.3
Total	12,087.9	100.0

Groundwater Usage

Deep Bedrock Aquifer	3,900 acre-feet (water right)	Little effect on streamflows
Shallow Alluvial Aquifer	1,050 acre feet (est. usage)	Direct but delayed effect on stream

Alluvial Groundwater use is equivalent to 1.5 cfs, which is 0.11 % of basin yield

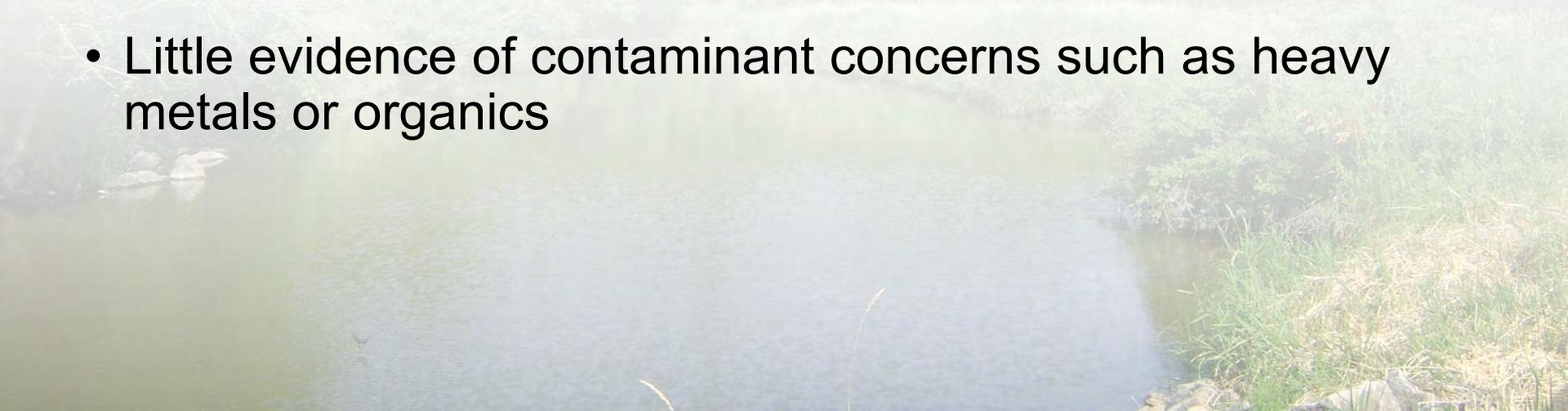


Water Use Summary:

1. Surface water use in Oklahoma portion of Illinois River above Barren Fork is only 1.3 % of the average annual basin yield
2. Most water use is for public supply – mostly Tahlequah
3. Basin water use in Arkansas is similar to Oklahoma in quantity and use category
4. White River water for Fayetteville area municipal use augments flows in Illinois River
5. Flow augmentation from White River may totally offset other surface water withdrawals in both states on annual average basis
6. Ground water use has minimal effect on streamflows

Water Quality

- Basin's major water quality concern is nutrient loading, primarily phosphorus
- Phosphorus affects the Illinois River and Lake Tenkiller
- Phosphorus loading is trending downward in Illinois River and Barren Fork Creek, not in Flint Creek
- Phosphorus concentrations are related to streamflow, but indirect common effect of runoff
- Little evidence of contaminant concerns such as heavy metals or organics



Fisheries

1. Highly diverse fish community of >72 species
2. Nearly all fish species (except carp) are native to the basin
3. Smallmouth bass are the most sought-after game fish
4. The smallmouth bass are of the Neosho subspecies thus of high conservation value
5. No fish species are listed as federal or state threatened or endangered



Recreational Use

- Annual visitation ~400,000 to Scenic section
- Approximately 15 Commercial Floatation Device Operators
- Annual floaters (canoe, raft, kayak) ~150,000
- Annual recreational economic value (above Tenkiller)
~ \$12 million
- Fishing is a popular activity, primarily for bass. No estimates of angler use or catch for Illinois River (some for Barren Fk)



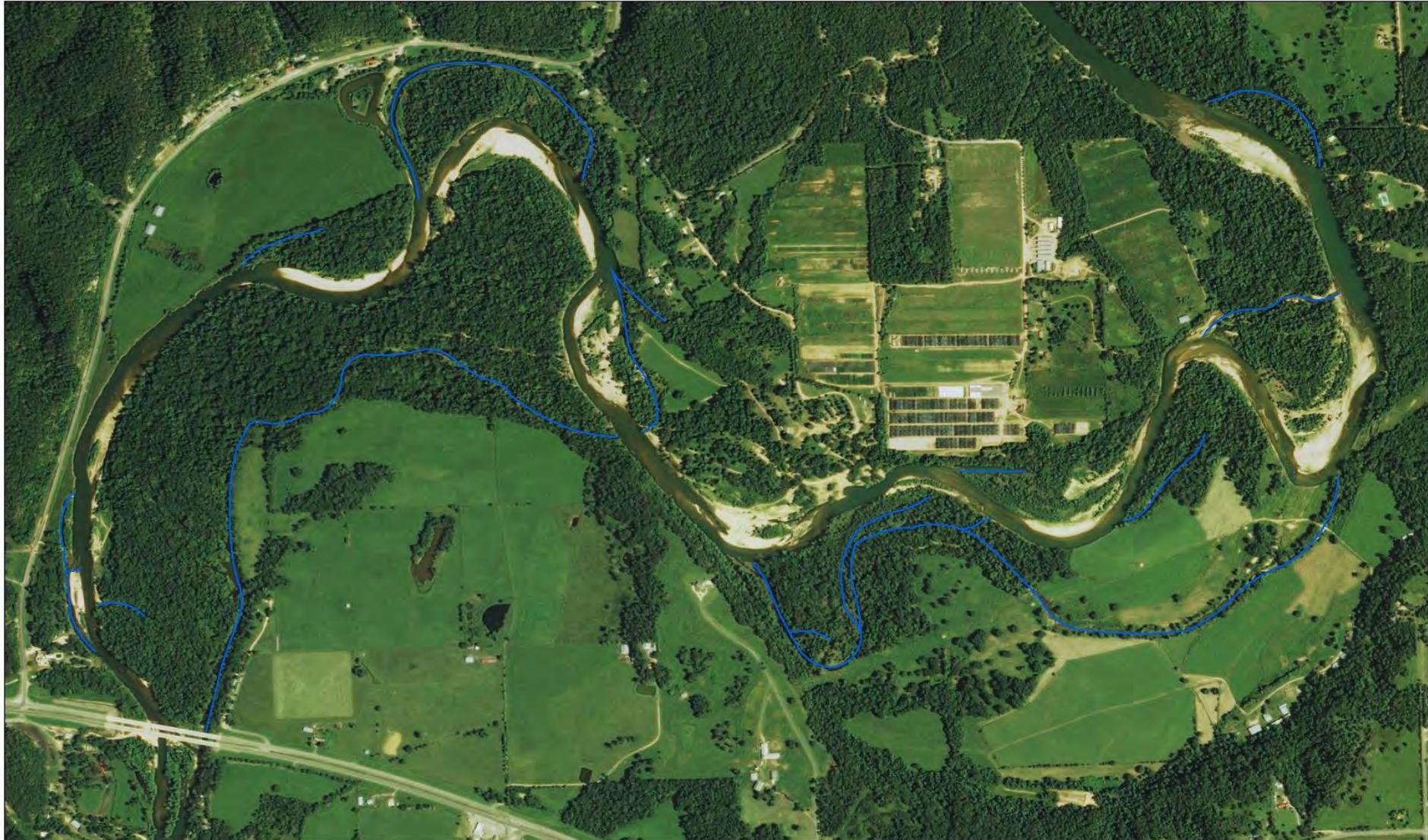
Illinois River Monthly Float Users, Average Annual for 2003-2008

Month	Commercial	Private	Total
January	1	35	36
February	2	34	36
March	110	19	129
April	348	81	429
May	9,938	411	10,349
June	22,734	681	23,415
July	37,441	1,094	38,535
August	24,540	804	25,344
September	8,657	400	9,057
October	878	93	971
November	76	24	100
December	6	48	54
Total	104,731	3,724	108,455

Flow Ranges for Recreational Floating (Tahlequah Gage) (source: OSRC)

Preferred range	400 – 1,200 cfs
Minimum for canoeing & kayaking	150 cfs
Minimum for rafting	250 cfs
Maximum for general safety	1,200 cfs
Maximum for experienced boaters	4,000 cfs

Riparian Corridor Secondary Channels

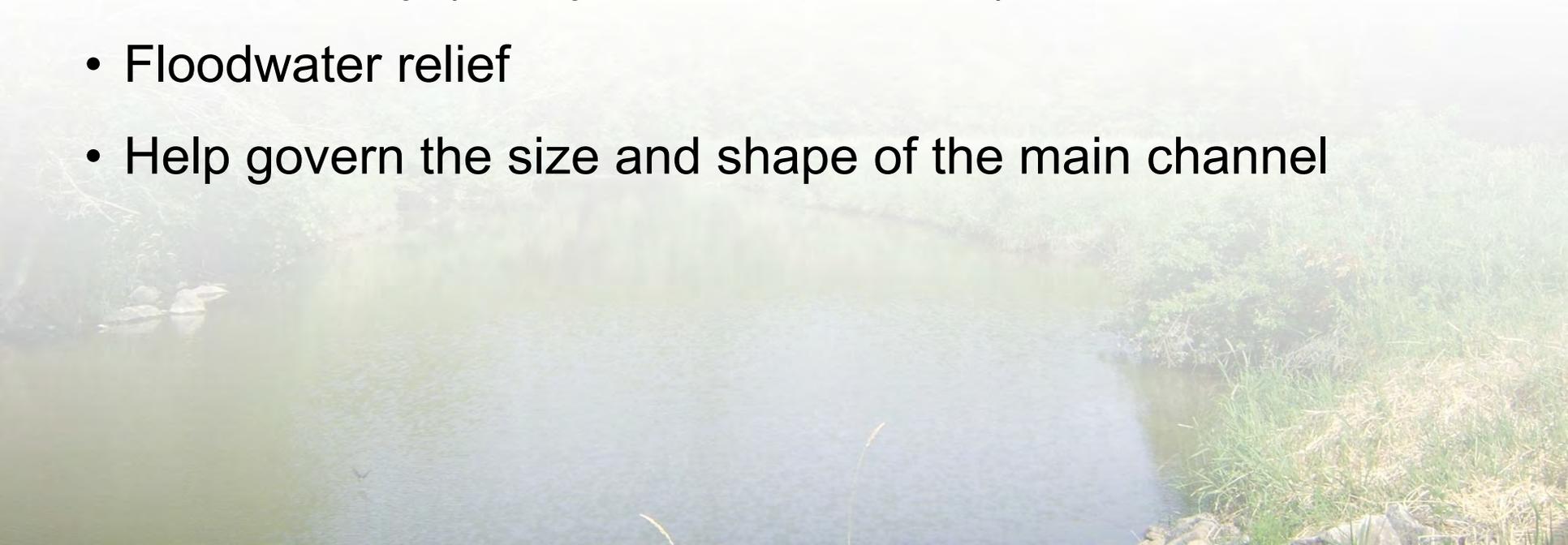


Ratio of secondary channel length to the main channel length in the Illinois River between Watts and Tahlequah, Oklahoma.

River Reach	Watts to Flint Creek	Flint Creek to Peavine	Peavine to Tahlequah	Total
River Reach Length (mi)	13.3	16.3	22.9	53
Secondary Channel Length (mi)	7.1	7.0	17.3	31.4
Ratio of 2 nd ary channel to main channel length	53.1 %	42.9%	75.6%	59.2%

Importance of Secondary Channels

- Rearing and refuge habitat for fish
- Support of many wildlife species that don't tend to use the main channel
- Water quality (clarity and temperature)
- Floodwater relief
- Help govern the size and shape of the main channel



How to Protect Secondary Channels:

- Preserve bank-full/channel maintenance flows (frequency and magnitude)
- Typically equates to the 1.5-year recurrence flow
- Approximately 14,000 cfs for Illinois River at Tahlequah



Fish Habitat Modeling

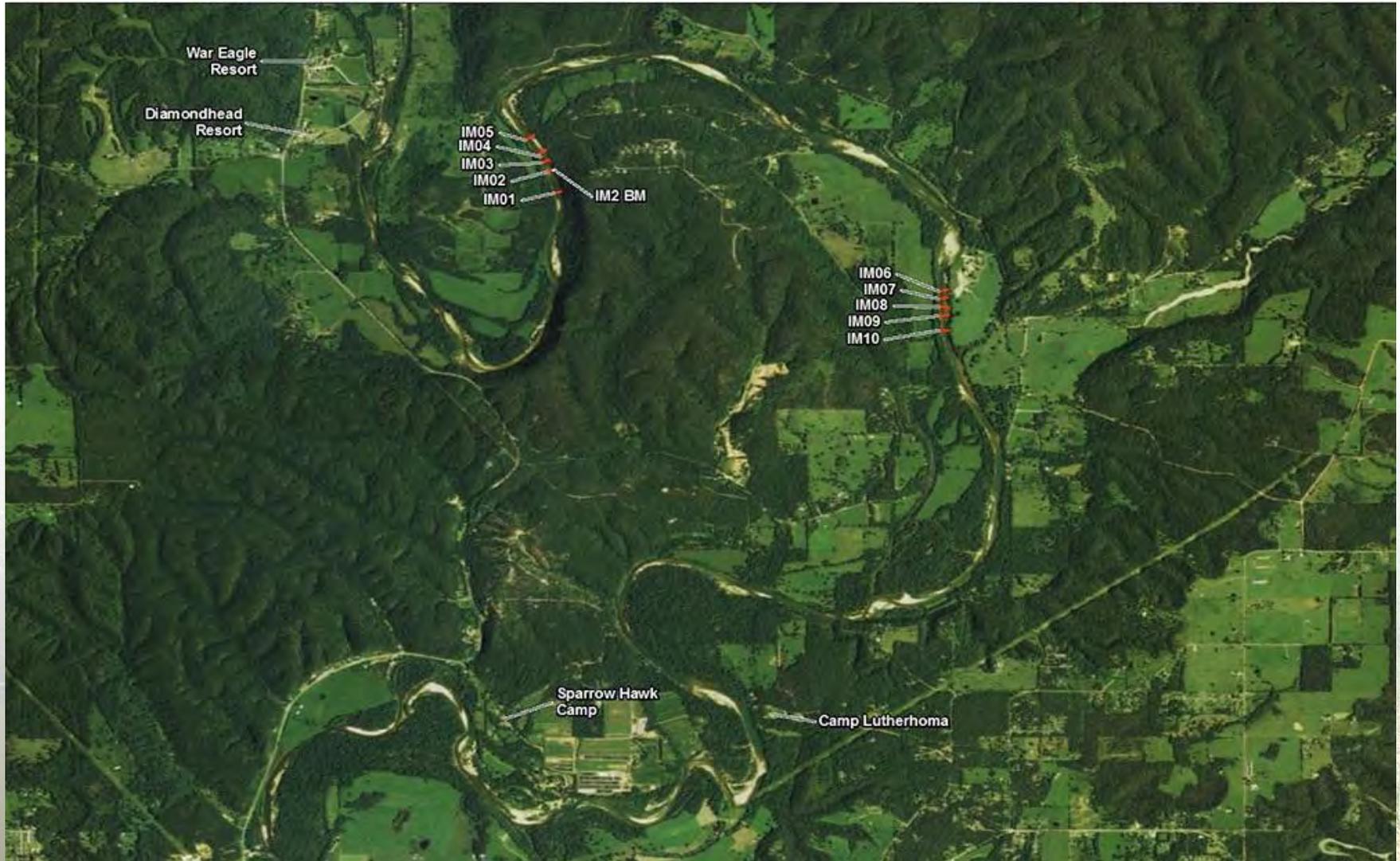
- Simple explanation of model
- Study sites (map with transects)
- Photos
- Results



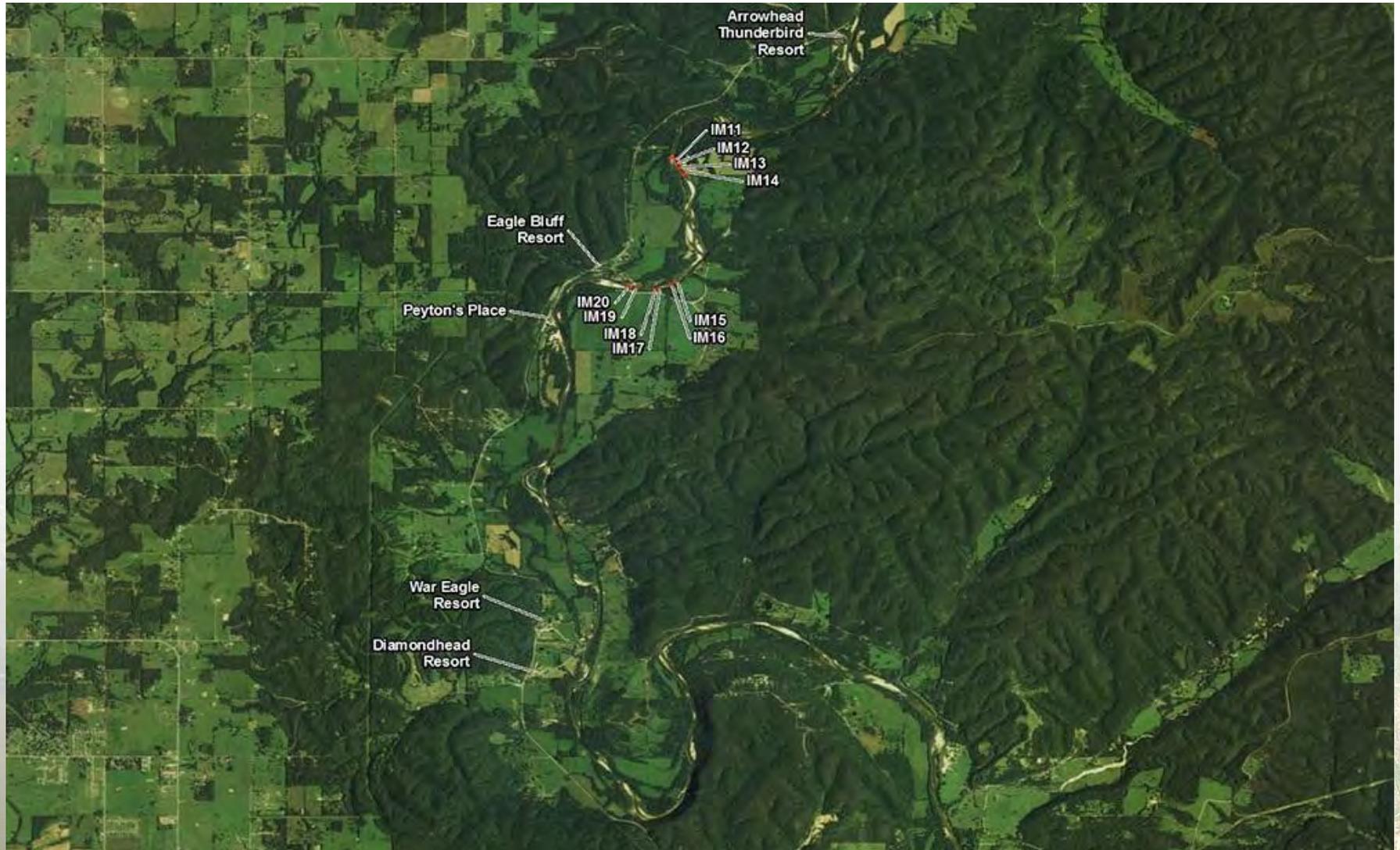
Habitat-Type Survey Results (% by type)

Habitat Type	Illinois River	Flint Creek	Barren Fork Cr
Pool	57	35	42
Glide	12	20	0
Run	22	20	36
Riffle	9	25	22
Gradient ft/mi	4.5	10	8

Illinois River Habitat Study Transects



Illinois River Habitat Study Transects



Flint Creek Habitat Study Transects



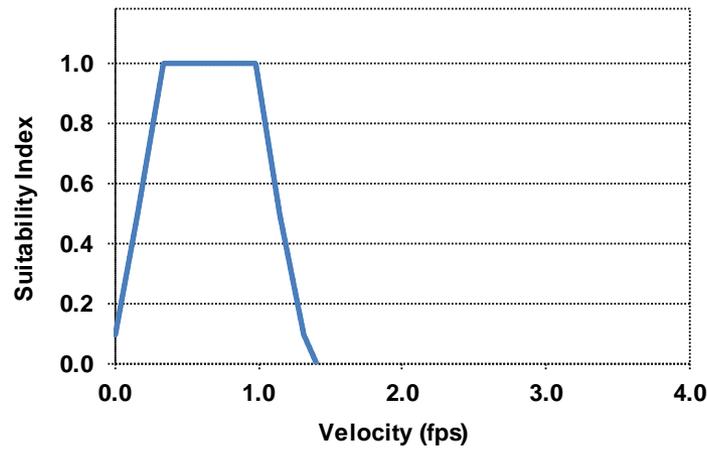
Fish Habitat Modeling

- Integrates a hydraulic model (that predicts water depths and velocities) with fish habitat criteria (expressed as preferred depth and velocity).
- Each measurement point (500-1,000) in the study site is evaluated separately as to its suitability for fish at a range of stream flows.
- The model then adds all the points (cells) together to get a total habitat vs flow relationship.

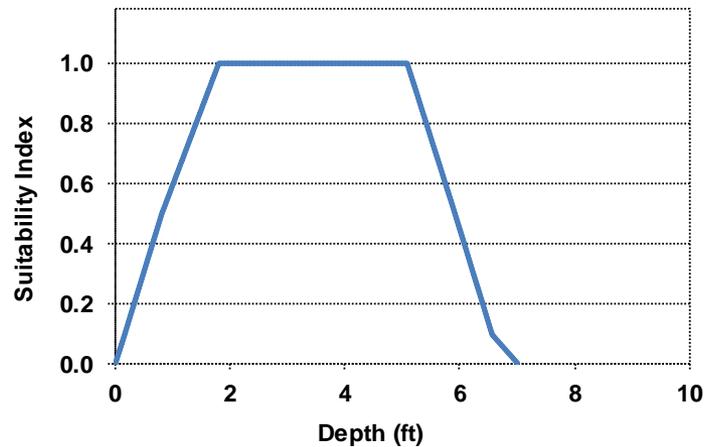


Smallmouth Bass Adult Habitat Criteria

Smallmouth Bass Adult



Velocity (ft/s)	SI
0.00	0.10
0.16	0.50
0.33	1.00
0.98	1.00
1.15	0.50
1.31	0.10
1.40	0.00

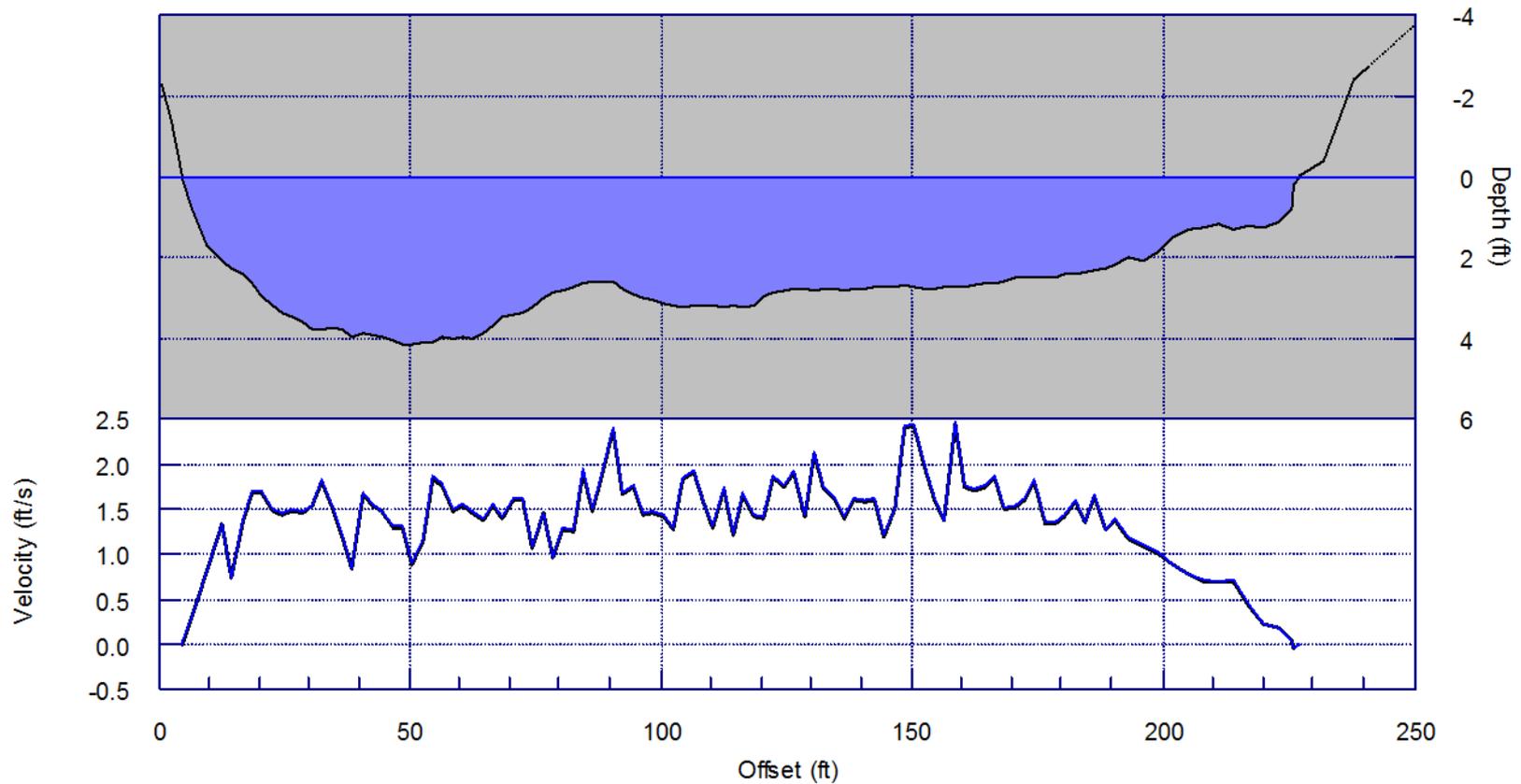


Depth (ft)	SI
0.00	0.00
0.16	0.10
0.82	0.50
1.80	1.00
5.09	1.00
5.91	0.50
6.56	0.10
7.00	0.00

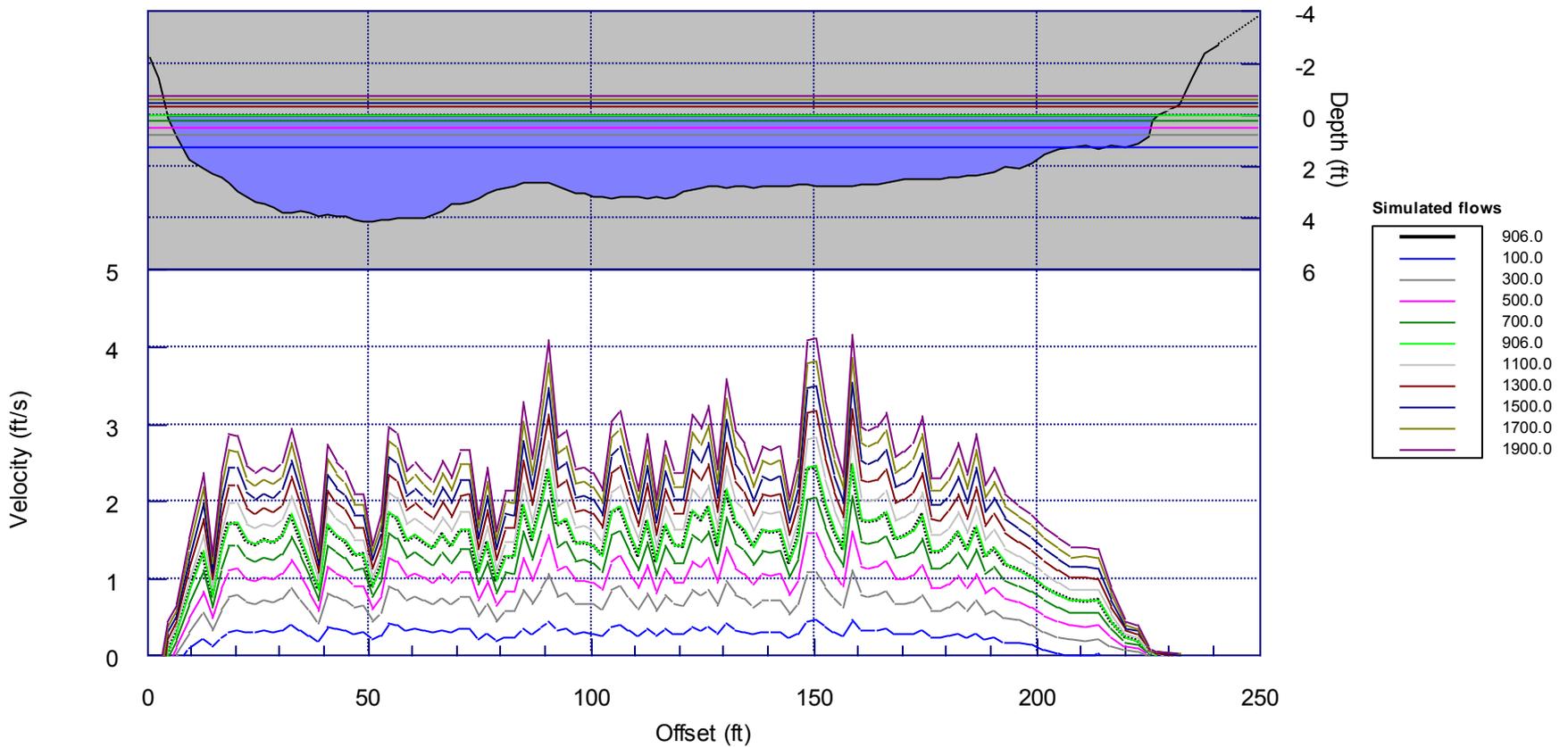
Substrate

Code SI

Cross-section: T7 Pool: Manning Ns applied IFG4 method



Cross-section: T7 Pool: Manning Ns applied IFG4 method



Lower Flint Creek



Flint Creek Study Transect



Lower Illinois River



Upper Illinois River Bedrock Pool Transect

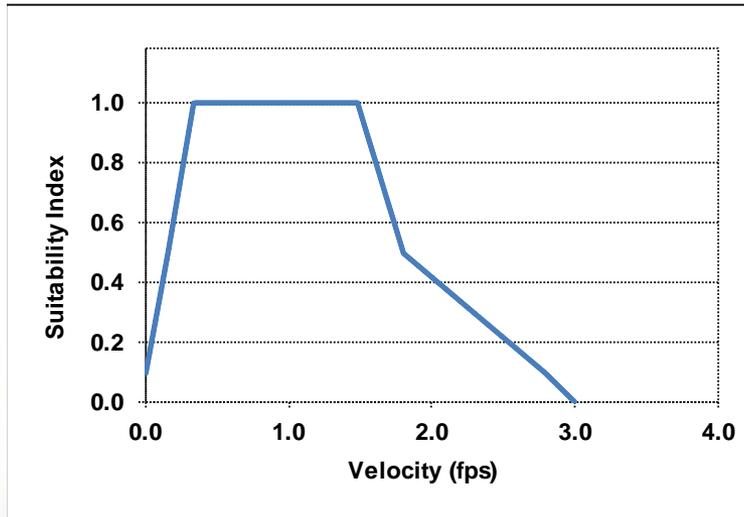


Fish Assemblages

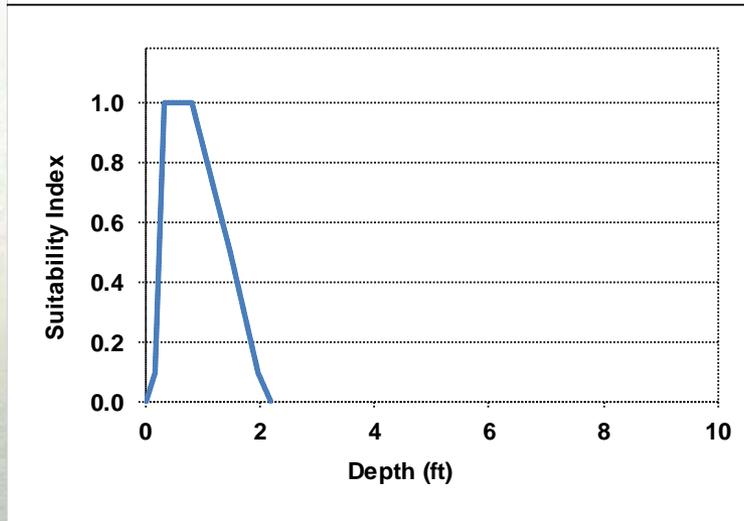
Shallow Fast	Intermediate	Deep Slow
Darters (4)	Stoneroller (1)	Suckers (5)
Topminnow (2)	Chubs (3)	Sunfish (9)
Madtom (1)	Shiners (2)	Bullhead (3)

Shallow-Fast Habitat Criteria

Shallow-Fast



Velocity (ft/s)	SI
0.00	0.10
0.16	0.50
0.33	1.00
1.48	1.00
1.80	0.50
2.79	0.10
3.00	0.00



Depth (ft)	SI
0.00	0.00
0.16	0.10
0.33	1.00
0.82	1.00
1.48	0.50
1.97	0.10
2.20	0.00

Substrate

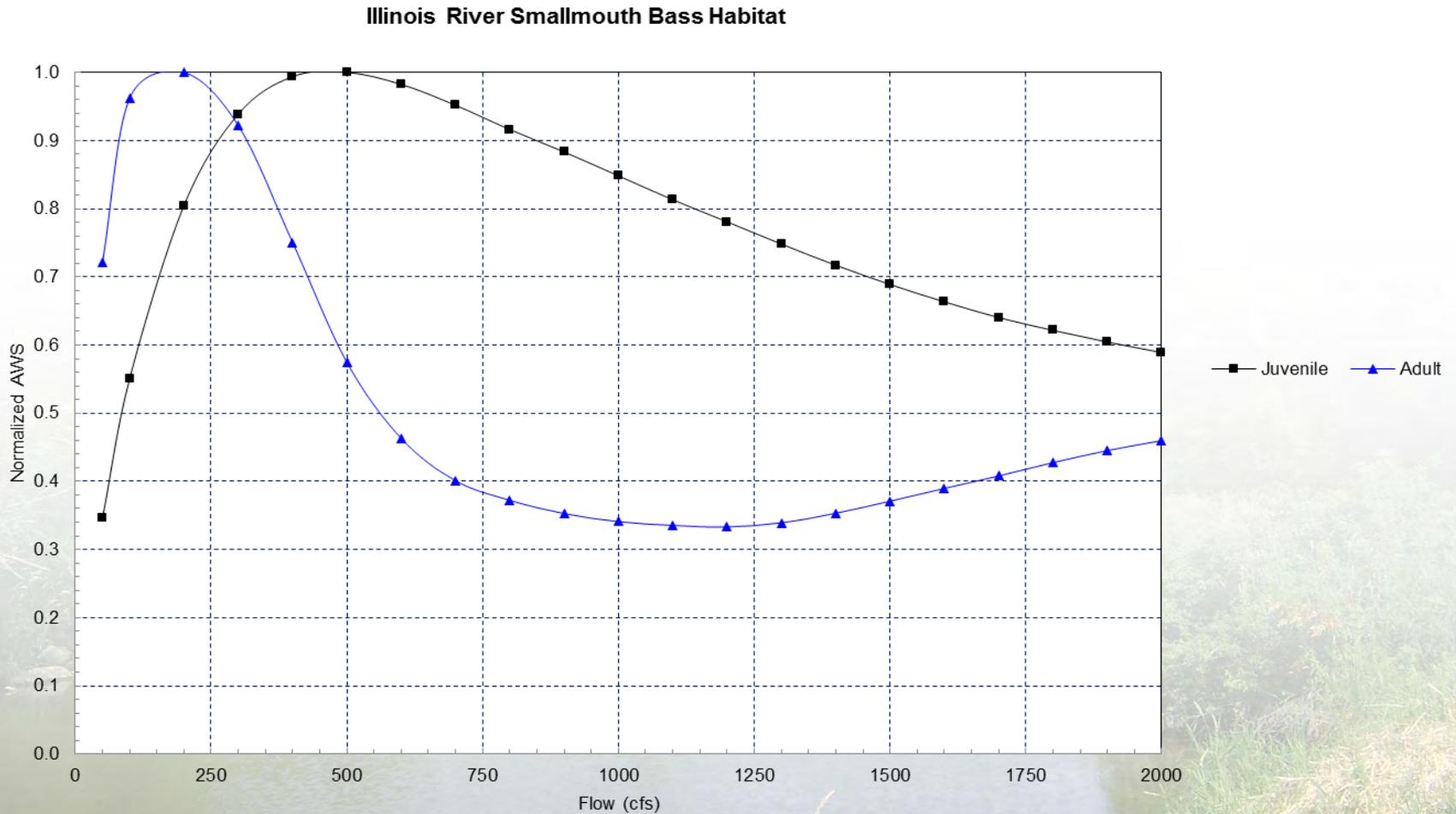
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Median Stream Flows

Stream	Month					Average Median Flow
	July	August	September	October	November	
Illinois River	297	217	200	225	308	249
Flint Creek	40	31	29	31	49	36
Barren Fork Cr.	69	45	40	50	83	57

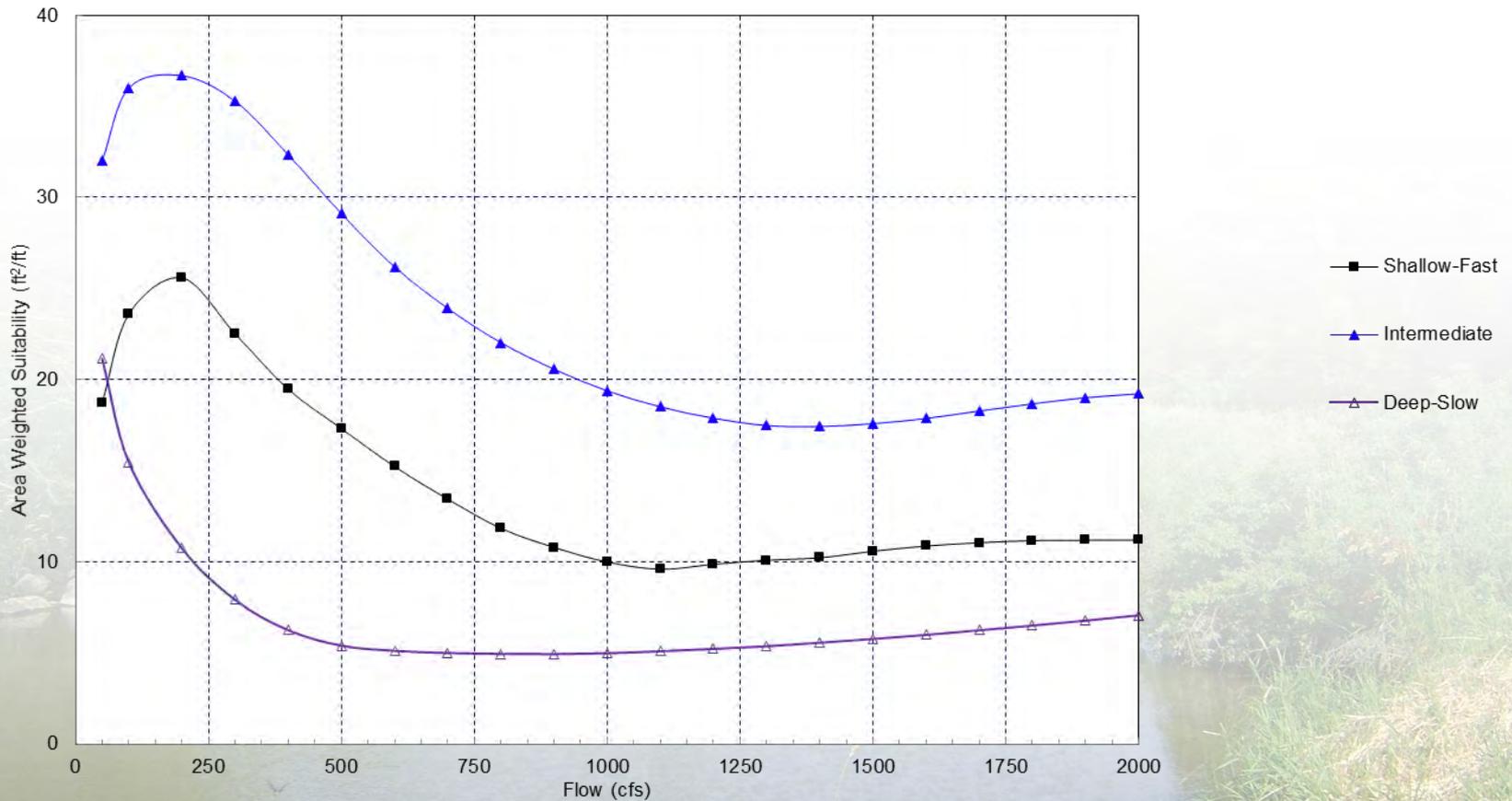


Illinois River Smallmouth Bass Habitat

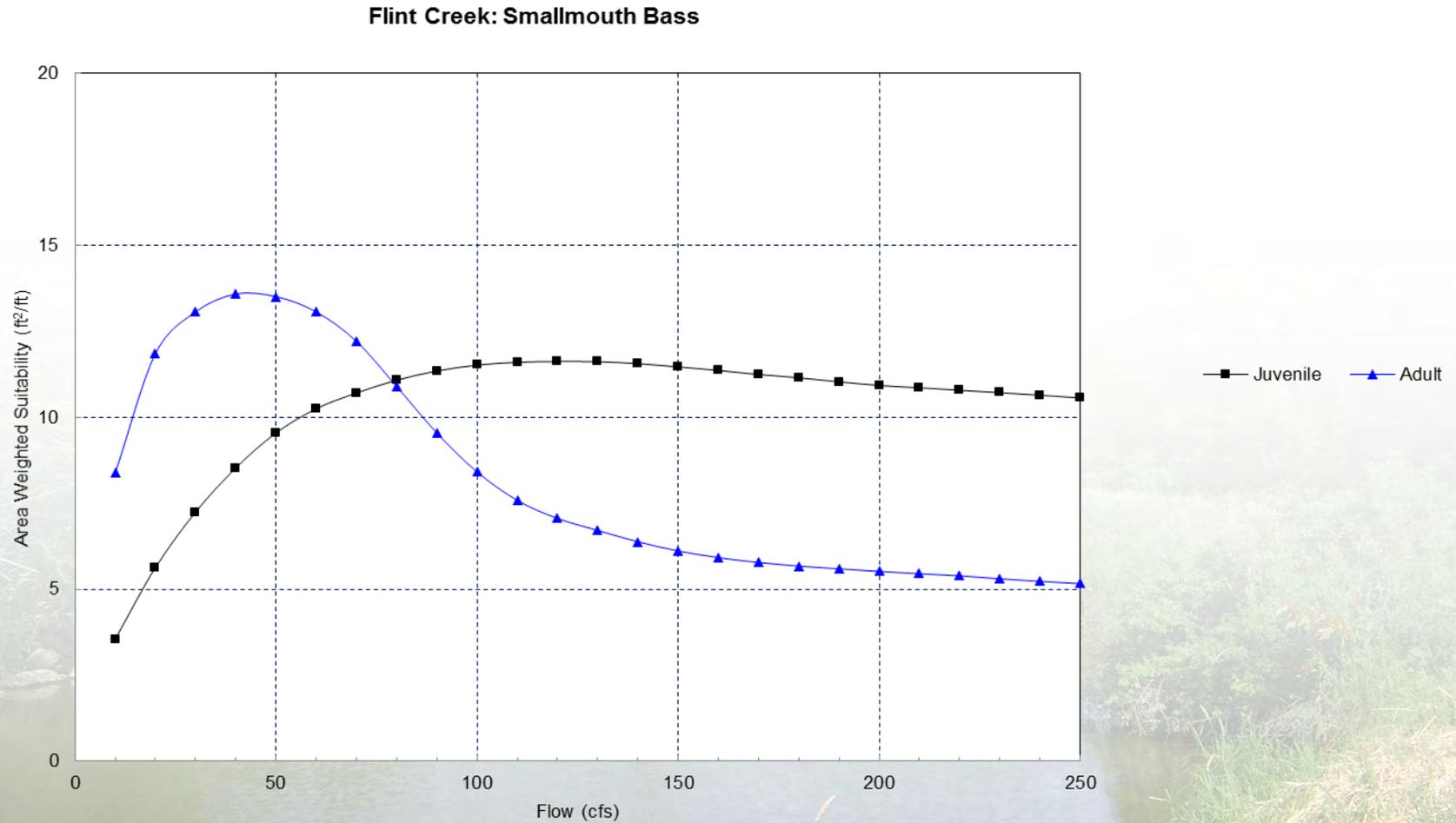


Illinois River Fish Assemblage Habitat

Lower Illinois River: Fish Assemblages

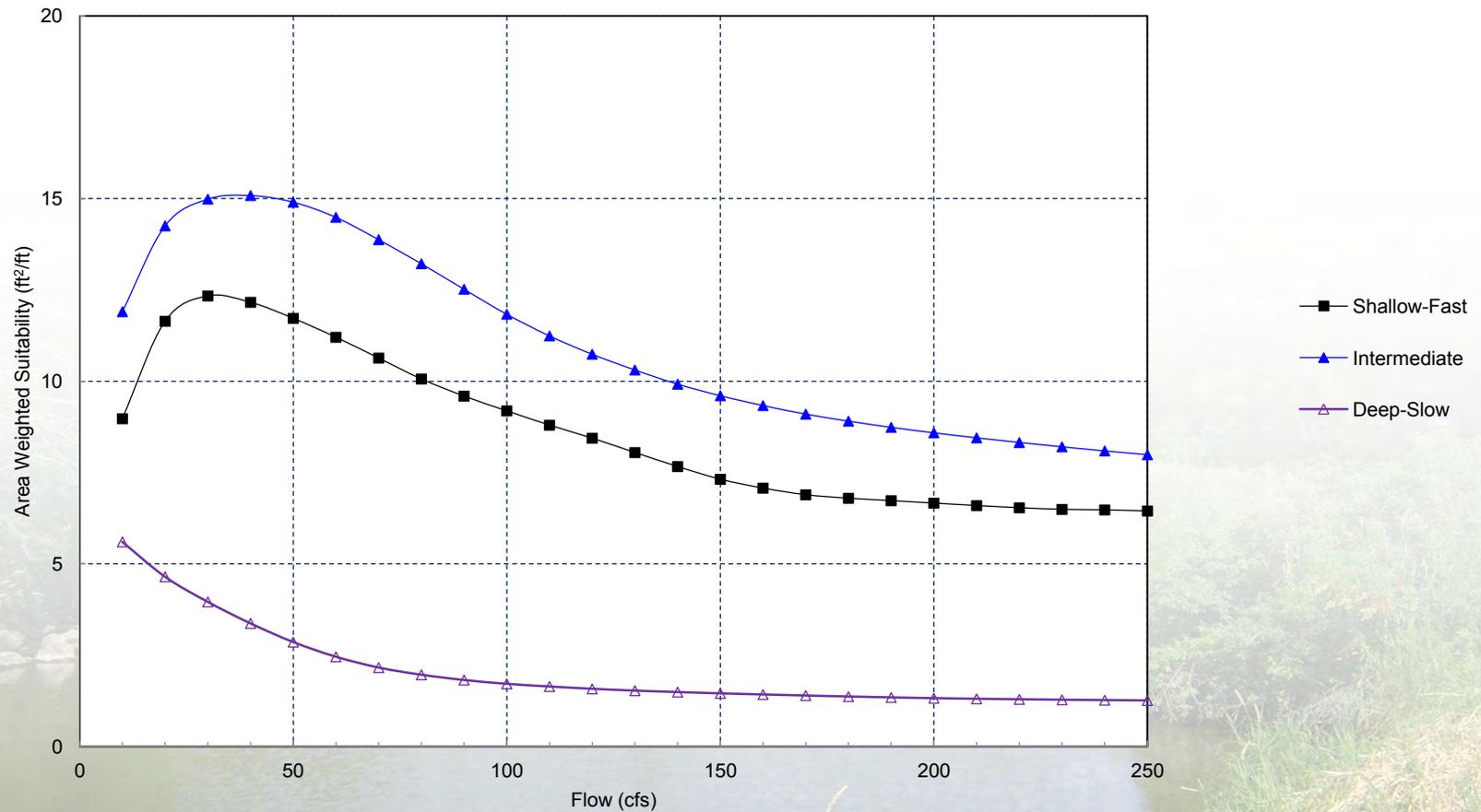


Flint Creek Smallmouth Bass Habitat

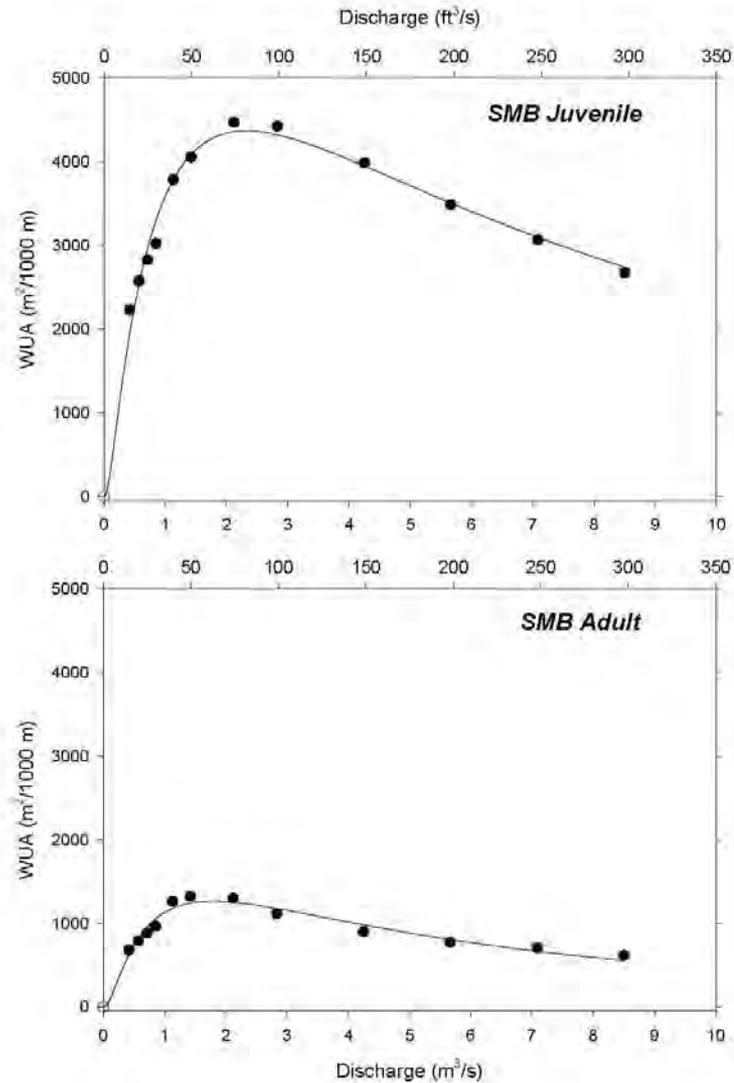


Flint Creek Fish Assemblage Habitat

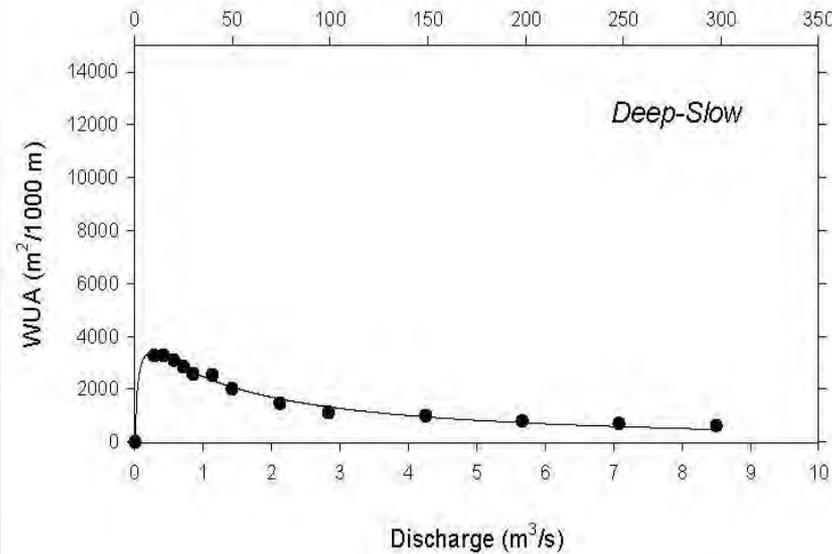
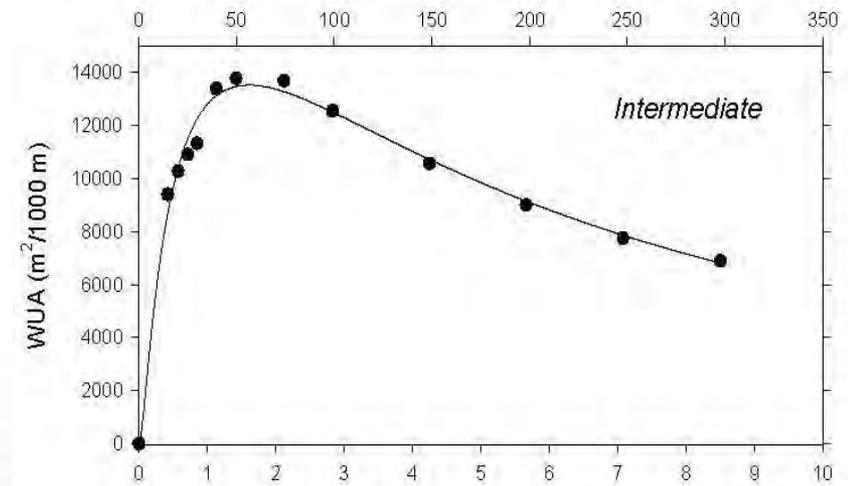
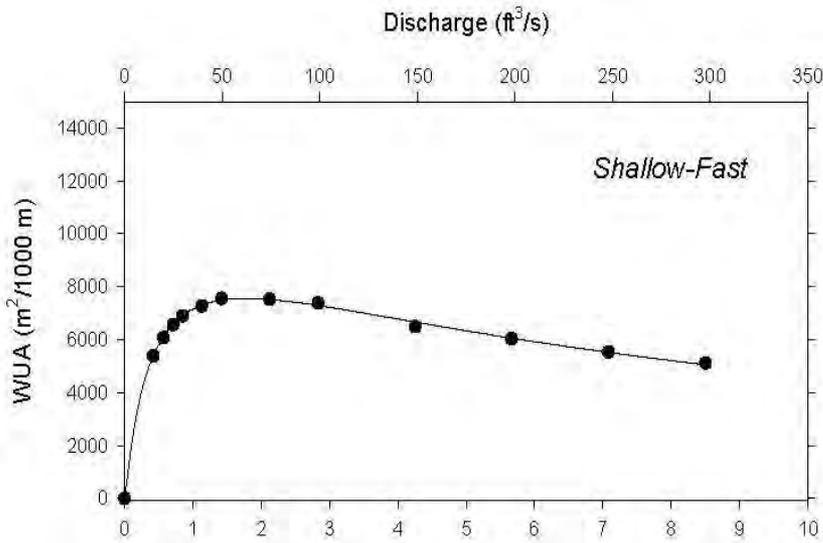
Flint Creek: Fish Assemblages



Barren Fork Creek Smallmouth Bass Habitat



Barren Fork Creek Fish Assemblage Habitat



Summary

- Flows in the Illinois River basin are largely unregulated
- Water diversions from the river are minimal (1-2%)
- Water quality is not a major issue related to instream flows
- The extensive riparian corridors support many important ecological processes and resources
- The basin supports >70 species of native fish
- Illinois River supports recreational use of about 400,000 user days annually
- Summer/fall base flows average ~250 cfs (Illinois R), 36 cfs (Flint Cr), and 57 cfs (Barren Fork Cr)

Conclusions

- Preferred flows for Illinois River floating are 400-1,200 cfs
- Minimum flows for rafting (most popular means) is 250 cfs
- Flows providing good rearing habitat conditions for most fish species:
 - Illinois River : 100 – 300 cfs
 - Flint Cr : 20-60 cfs
 - Barren Fork Cr: 40-100 cfs
- Prescriptions for channel maintenance flows are important to preserve the ecological process associated with the study streams
- Desired flows for fish and recreation are not in conflict

Conclusions (continued)

- Decision Making Considerations:
 - River basin goals
 - All stream-related resources and priorities
 - Water availability
 - Ecological flow needs



Questions

