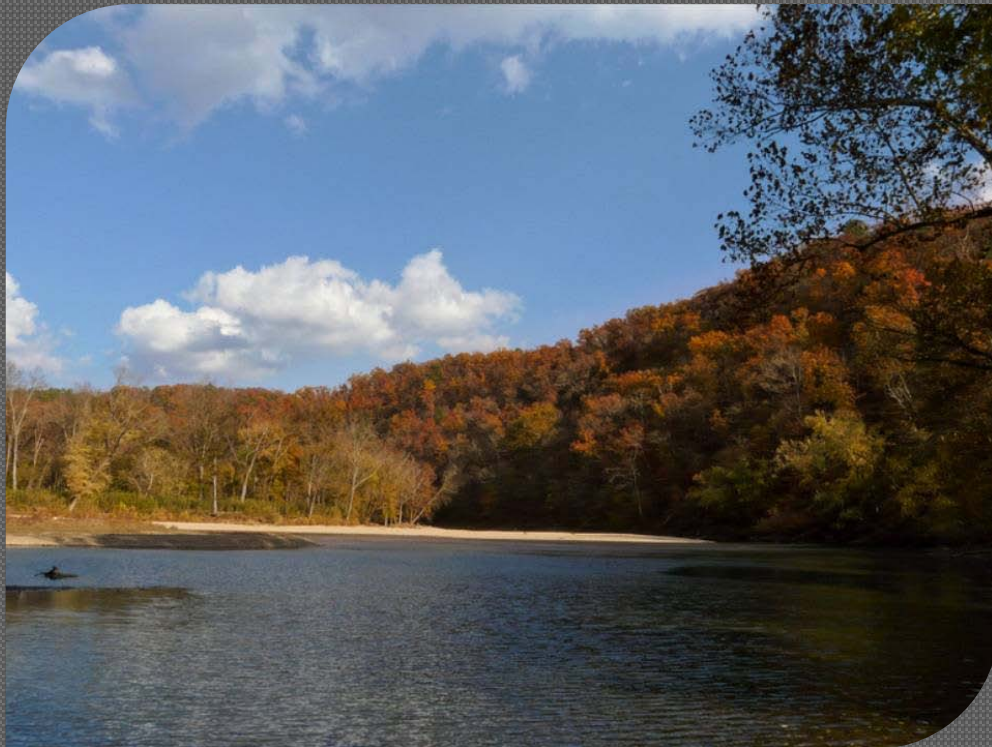


# Water Quality Monitoring and Constituent Load Estimation in the Upper Illinois River Watershed, 2009



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*Director,  
Arkansas Water Resources Center*

Funding provided by ANRC  
through the Illinois River  
Watershed Partnership

# 2009 Summary

## Loads and Flow-Weighted Concentrations

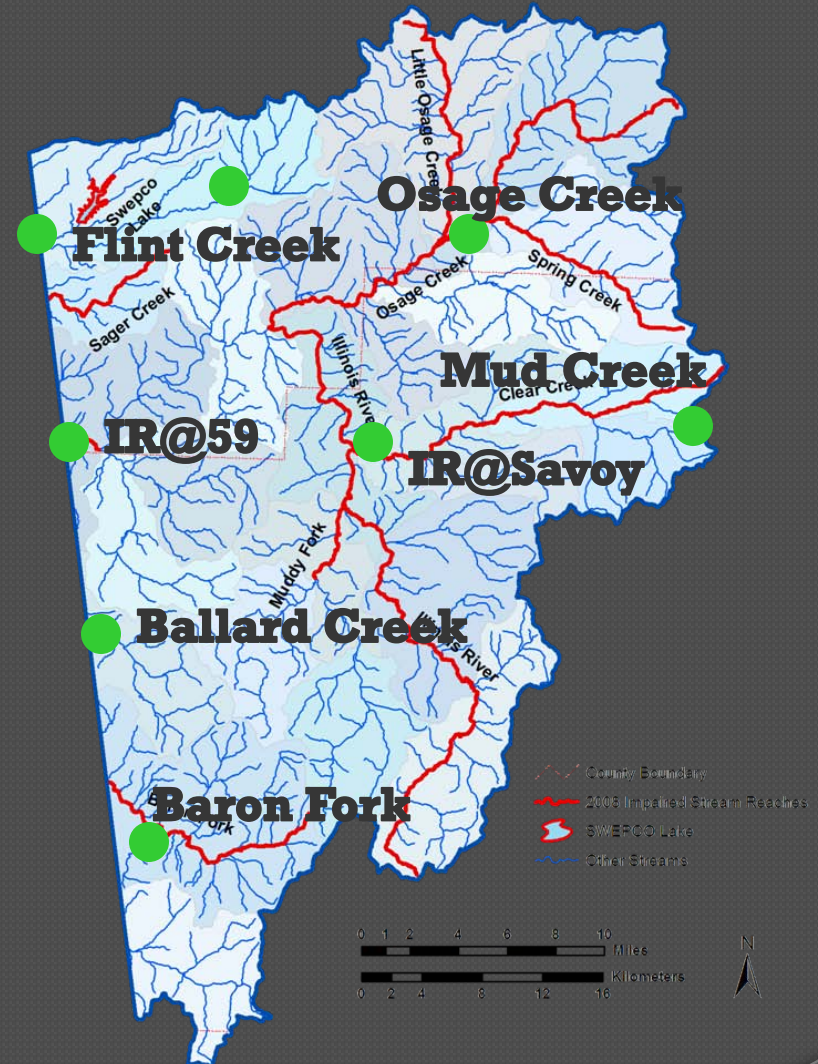
Site	Cl	SO <sub>4</sub>	NH <sub>3</sub> -N	NO <sub>3</sub> -N	SRP	TN	TP	TSS
Ballard Creek	461,000	767,000	5,300	119,000	21,000	139,000	29,000	6,492,000
Baron Fork	258,000	748,000	2,800	81,000	6,100	117,000	9,800	1,290,000
Flint Creek (W. Siloam)	521,000	1,201,000	1,300	116,000	2,400	130,000	5,300	1,852,000
Flint Creek (Springtown)	101,000	92,000	1,300	56,000	1,700	62,000	2,600	447,000
Illinois River (AR59)	8,011,000	9,546,000	31,000	1,740,000	82,000	1,970,000	236,000	111,961,000
Illinois River (Savoy, AR)	1,656,000	3,144,000	21,000	392,000	39,000	530,000	72,000	20,556,000
Mud Creek Tributary	14,000	18,000	100	900	60	1,600	300	1,342,000
Osage Creek	3,200,000	3,310,000	16,500	607,000	15,300	670,000	40,700	24,900,000

Site	Cl	SO <sub>4</sub>	NH <sub>3</sub> -N	NO <sub>3</sub> -N	SRP	TN	TP	TSS
Ballard Creek	7.61	12.67	0.09	1.97	0.34	2.29	0.49	107
Baron Fork	4.63	13.45	0.05	1.46	0.11	2.10	0.18	23
Flint Creek (W. Siloam)	9.56	21.93	0.02	2.12	0.04	2.37	0.10	34
Flint Creek (Springtown)	5.76	5.21	0.07	3.18	0.10	3.52	0.15	322
Illinois River (AR59)	10.93	13.02	0.04	2.37	0.11	2.69	0.32	153
Illinois River (Savoy, AR)	6.97	13.24	0.09	1.65	0.16	2.23	0.30	87
Mud Creek Tributary	8.53	11.14	0.07	0.56	0.04	0.95	0.16	824
Osage Creek	16.25	16.81	0.08	3.08	0.08	3.40	0.21	126

# Water samples were collected at seven sites in the UIRW.

- Stage recorded in 30 minute intervals by USGS to estimate discharge.
- Water samples were collected once a week and storm events were targeted
- Water samples were analyzed at the AWRC WQL for:
  - Chloride
  - Sulfate
  - Nitrate-N
  - Ammonia-N
  - Soluble reactive P
  - Total N
  - Total P
  - Total Suspended Solids



# Load Determination

◎ Linear regression was used to determine the relationship between daily load and daily flow:

- $\ln(L_d) = \beta_0 + \beta_1 \ln(Q_d)$  —or—
- $\ln(L_d) = \beta_0 + \beta_1 \ln(Q_d) + \beta_2 \sin(2\pi T) + \beta_3 \cos(2\pi T)$

◎ BCF was used to remove bias from log transformations:

$$\text{BCF} = \frac{\sum e^r}{n}$$

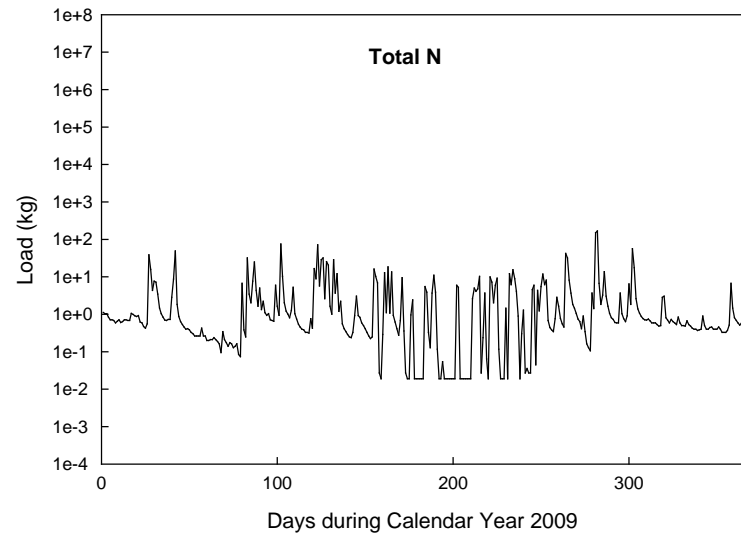
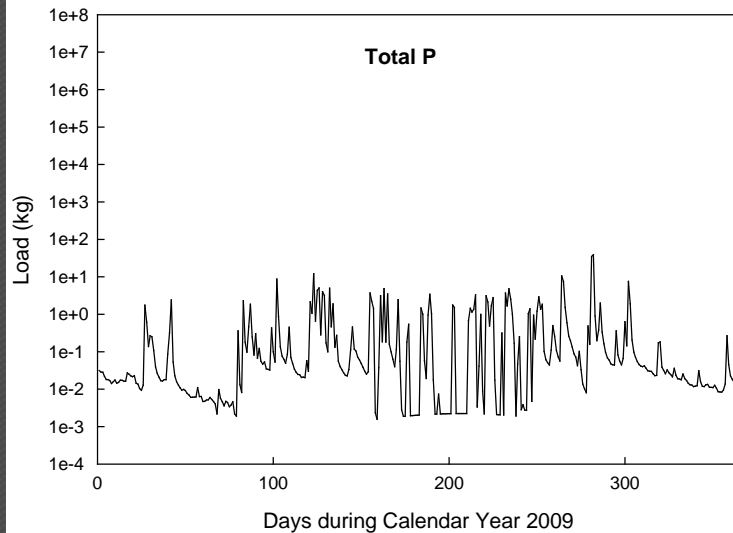
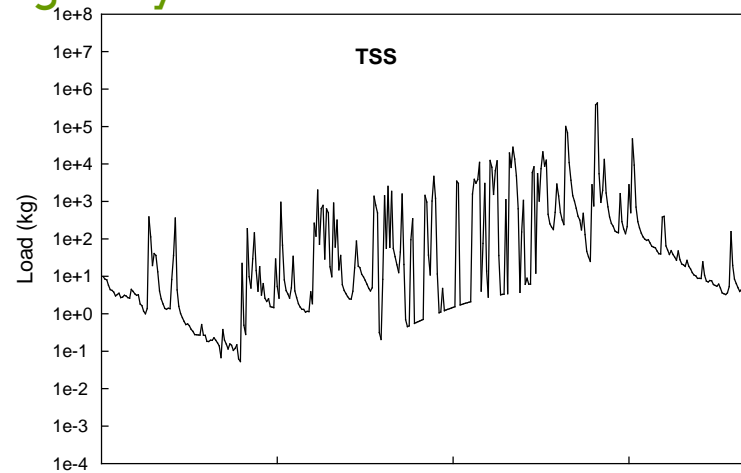
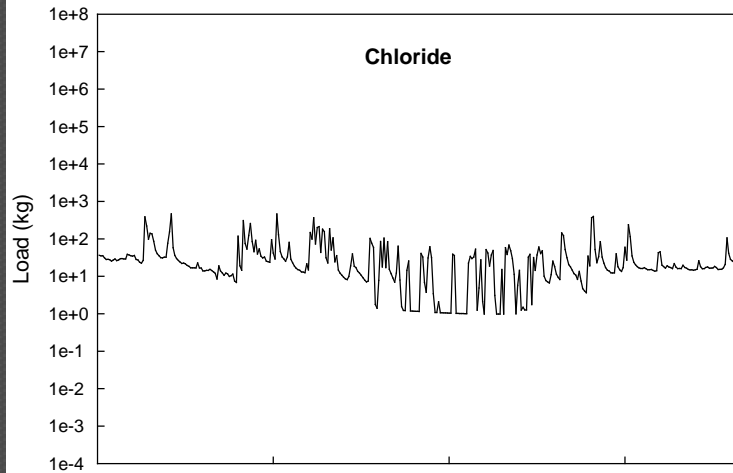


# Load Determination

	<b>BCF</b>	<b>R<sup>2</sup></b>
NH <sub>3</sub>	1.26-2.81	0.66-0.87
Cl	1.01-1.10	0.78-0.98
NO <sub>3</sub>	1.00-1.21	0.71-0.98
SRP	1.01-1.65	0.84-0.98
SO <sub>4</sub>	1.01-1.09	0.80-0.98
TN	1.01-1.11	0.87-0.99
TP	1.04-1.45	0.53-0.96
TSS	1.06-6.48	0.75-0.93

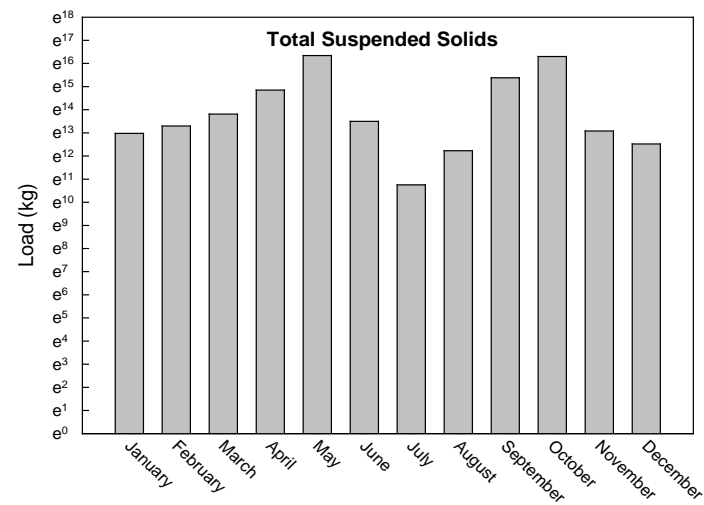
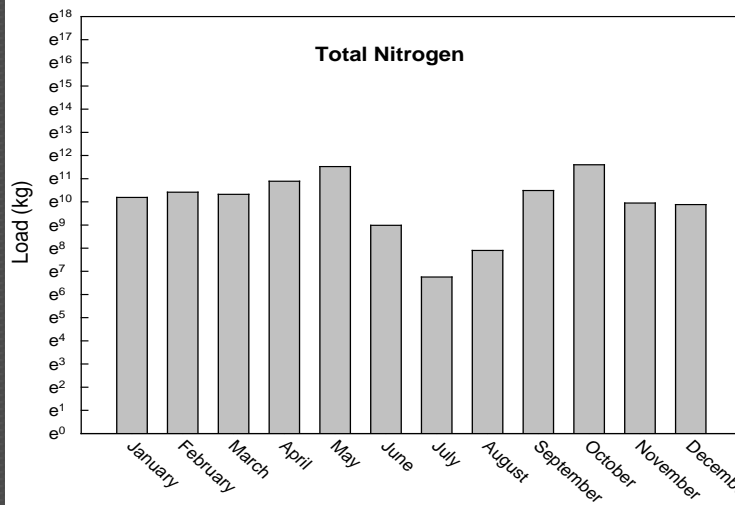
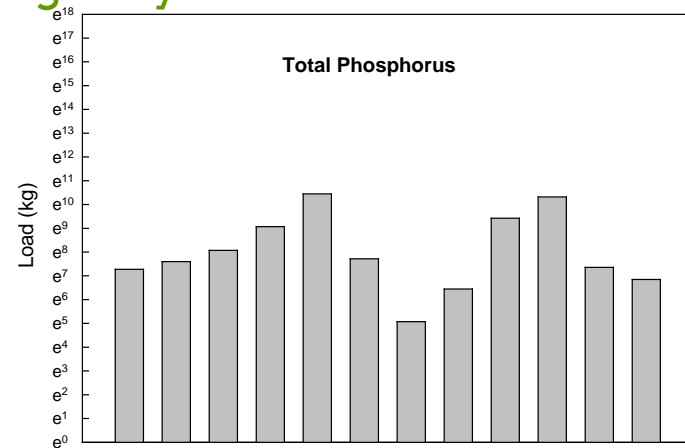
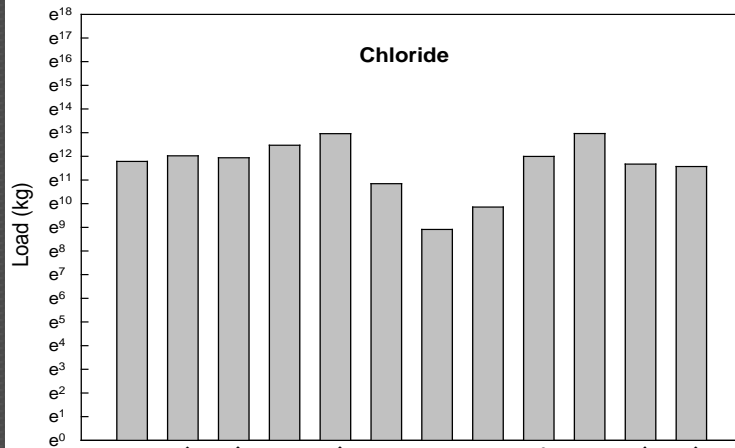
# Daily loads were variable...

## Illinois River at Highway 59



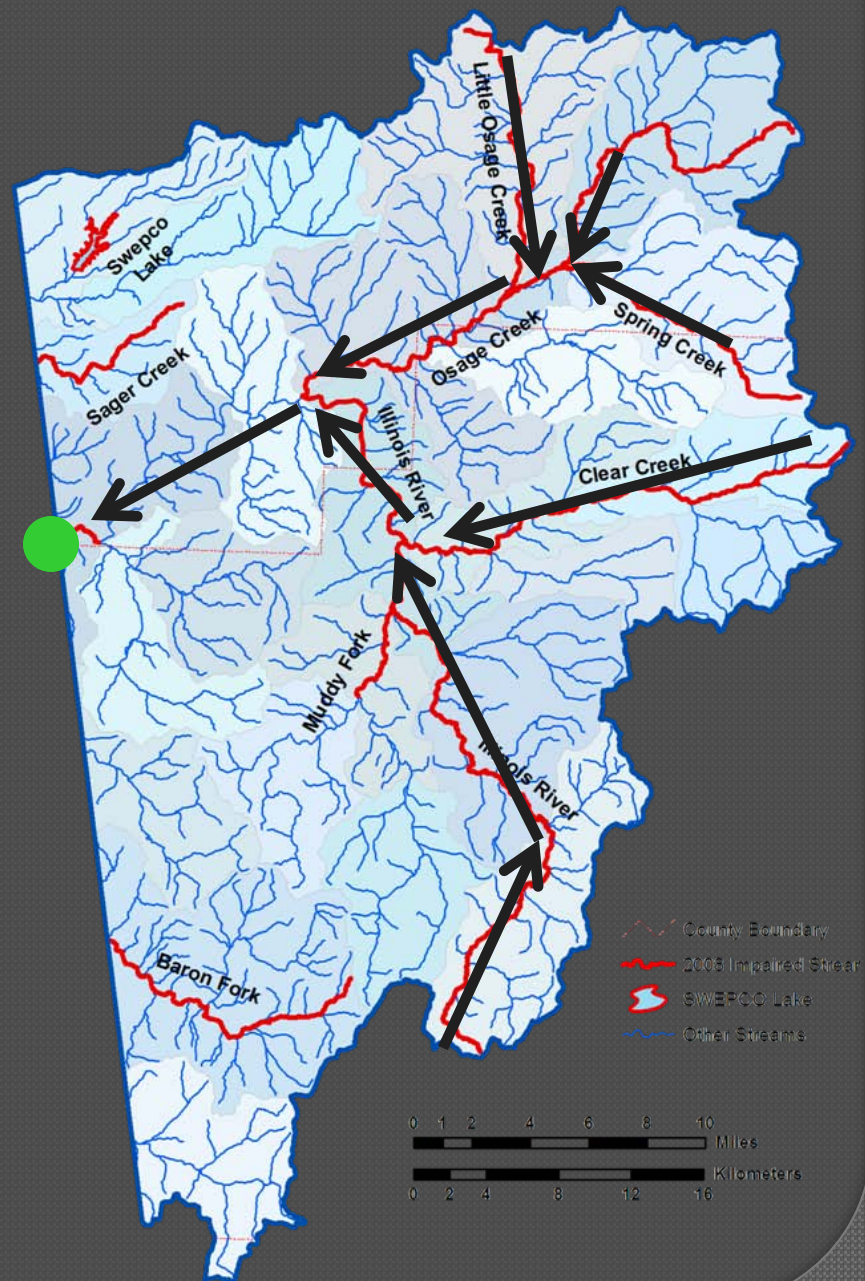
# Monthly loads were least during drier, summer months...

## Illinois River at Highway 59



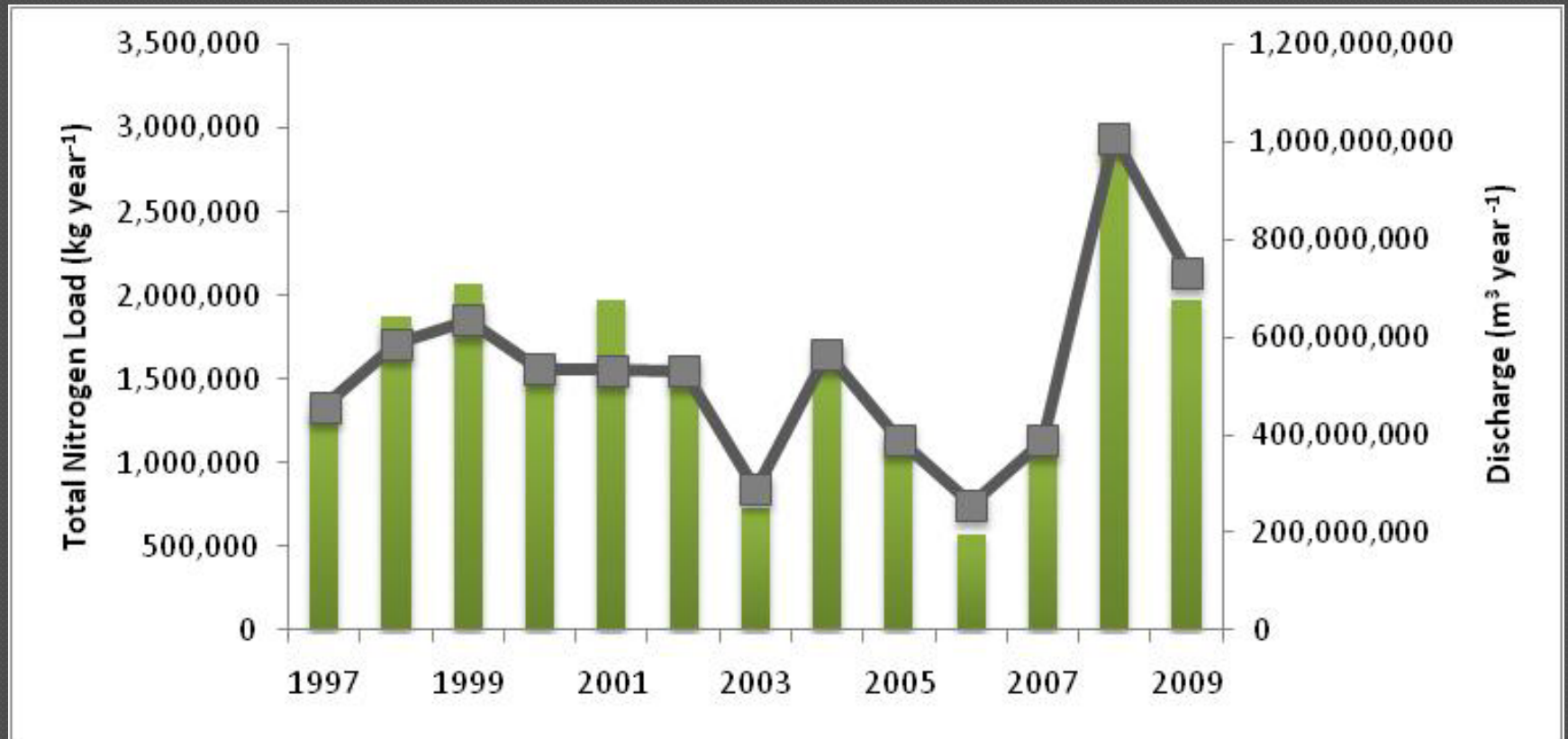


Illinois River at  
Arkansas HWY59  
is the watershed  
outlet...

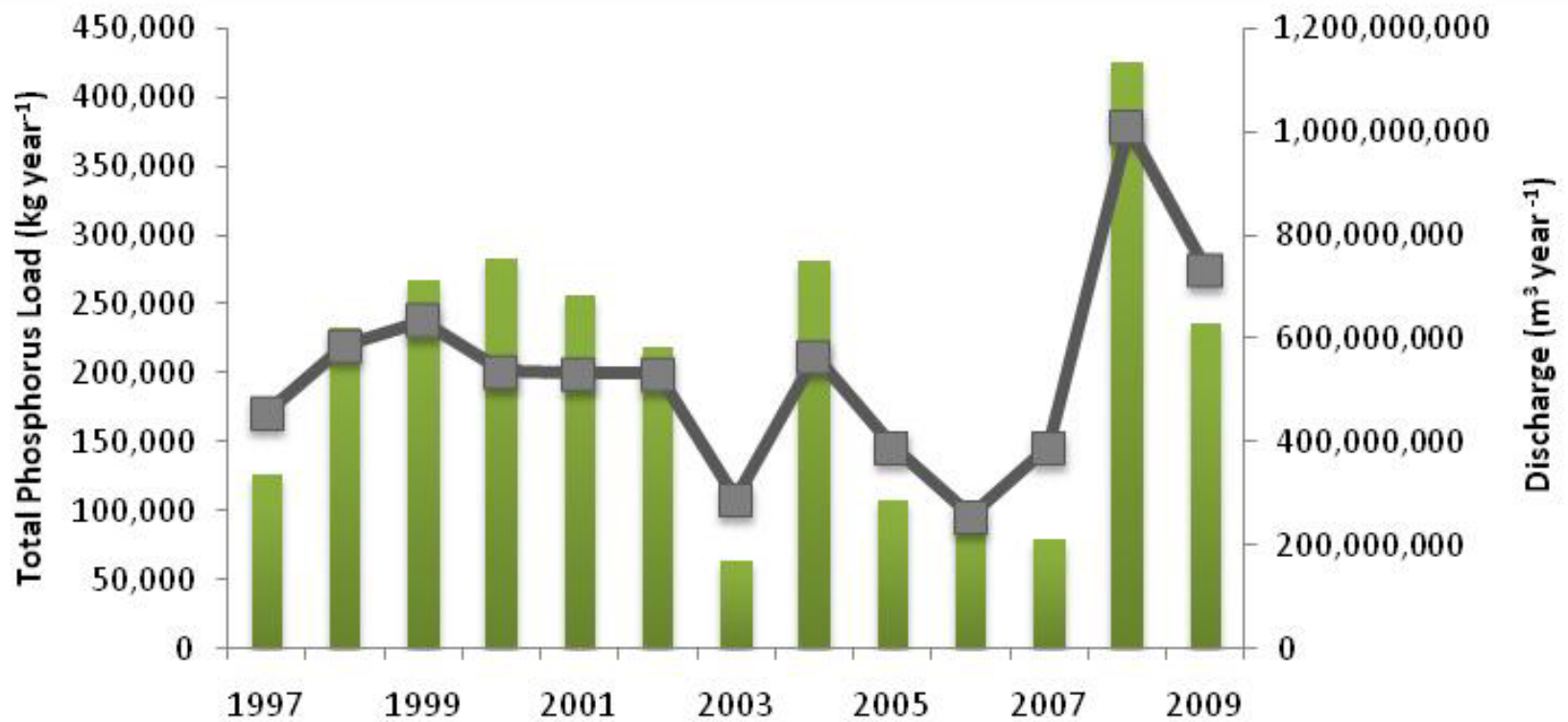




# Annual Total Nitrogen Loads at watershed outlet



# Annual Total Phosphorus Loads at watershed outlet



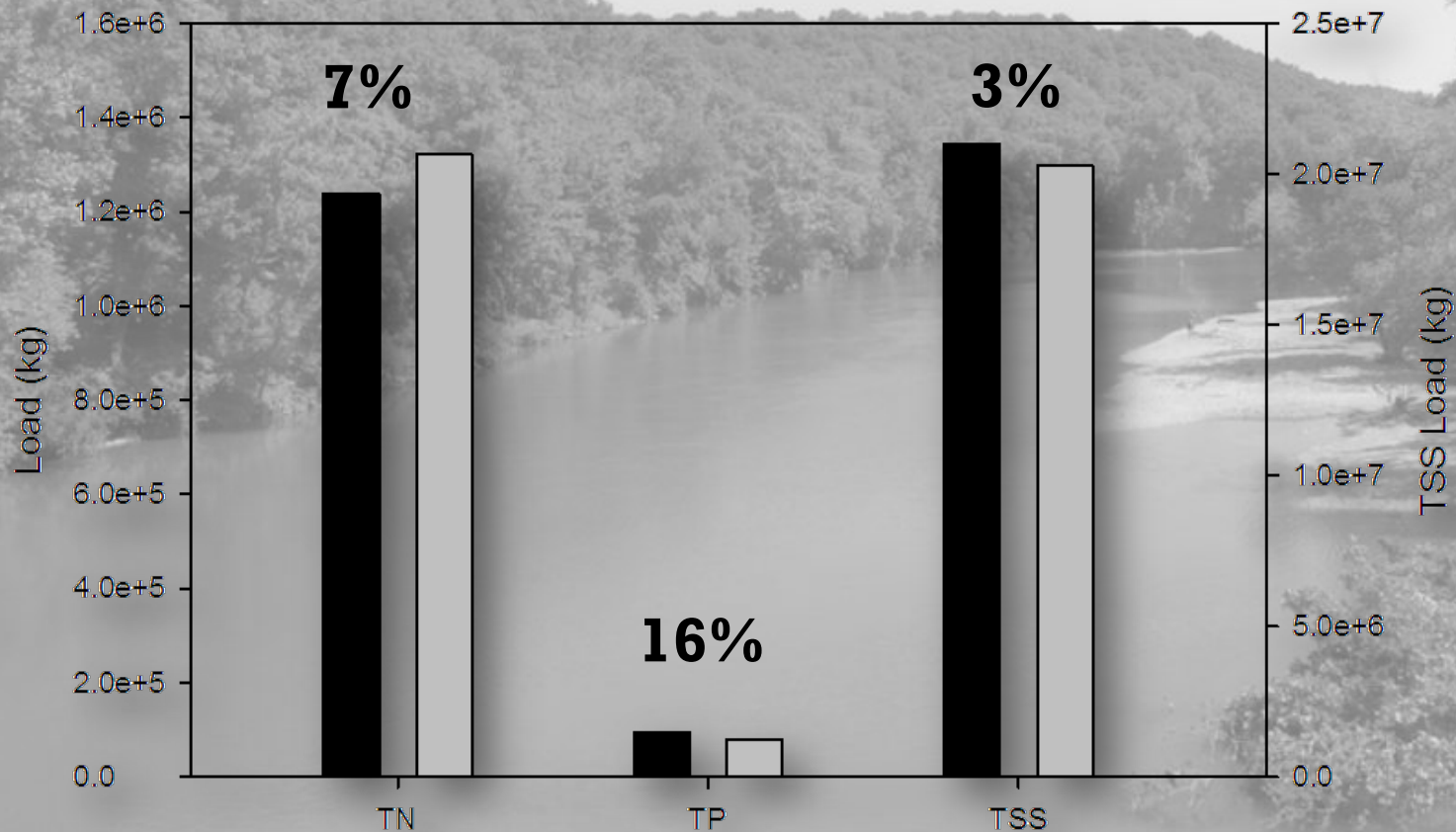
# We changed sampling methods in July 2009.

- Historically, loads have been estimated using autosamplers.
- In July 2009, we switched to collecting grab samples to estimate loads.
- We used the regression equations to predict loads from January 2009 to July 2009.
- But we also had autosampler data from IR59 and Ballard Creek from this time period.



# Variation between sampling methods at the watershed outlet...

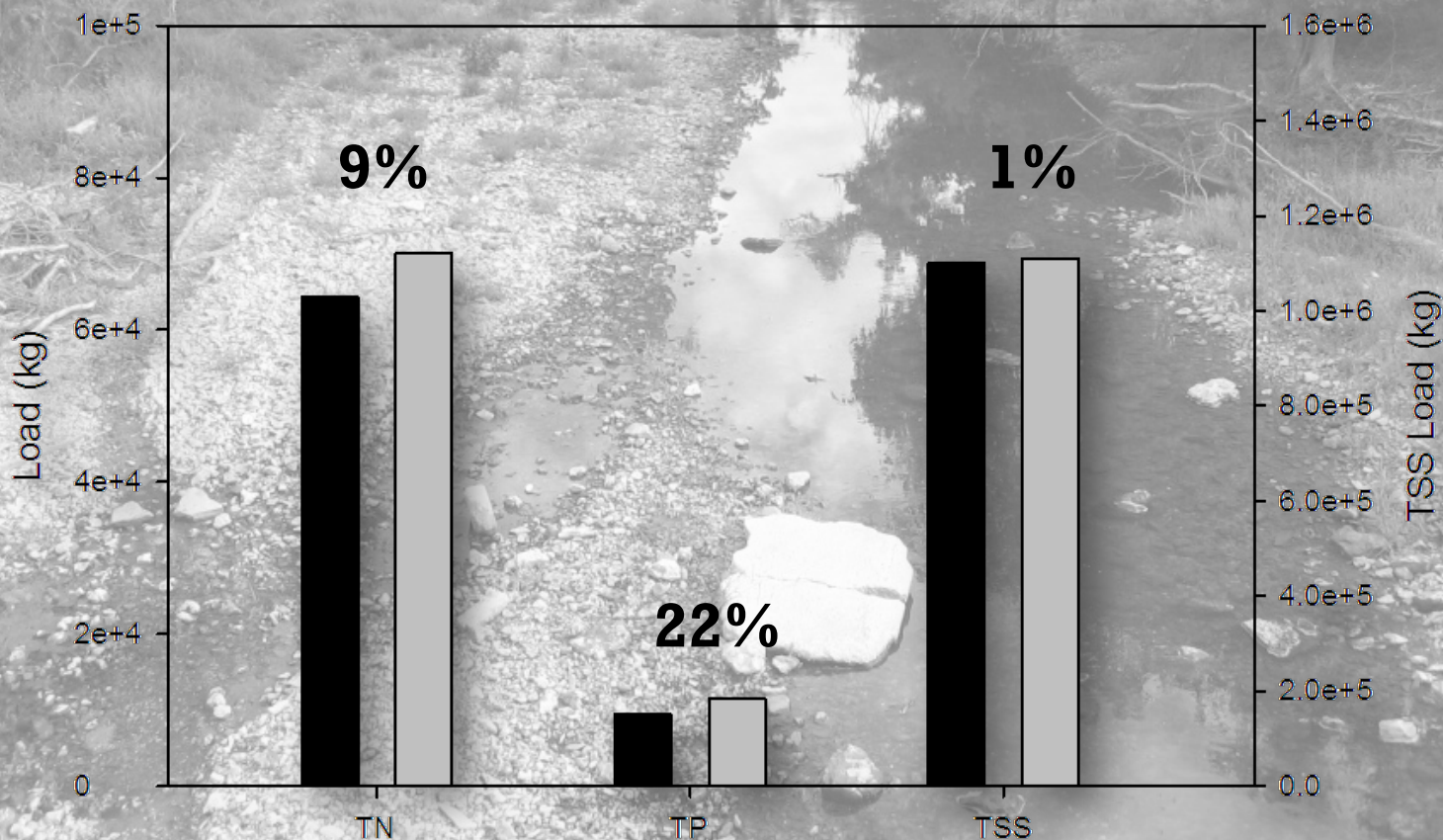
## Illinois River at AR59

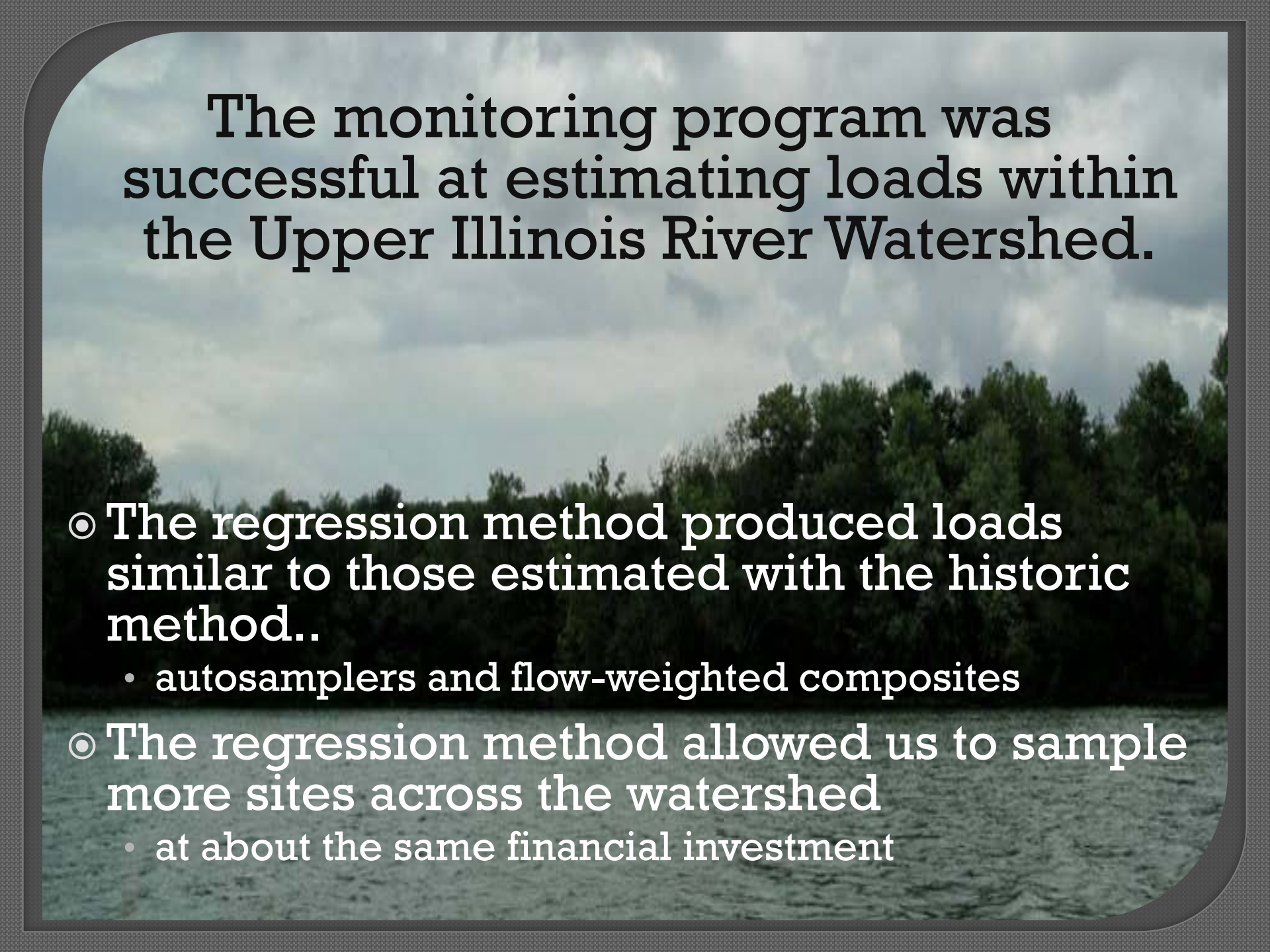




# Variation between sampling methods at a smaller watershed...

## Ballard Creek





**The monitoring program was successful at estimating loads within the Upper Illinois River Watershed.**

- ◎ **The regression method produced loads similar to those estimated with the historic method..**
  - autosamplers and flow-weighted composites
- ◎ **The regression method allowed us to sample more sites across the watershed**
  - at about the same financial investment