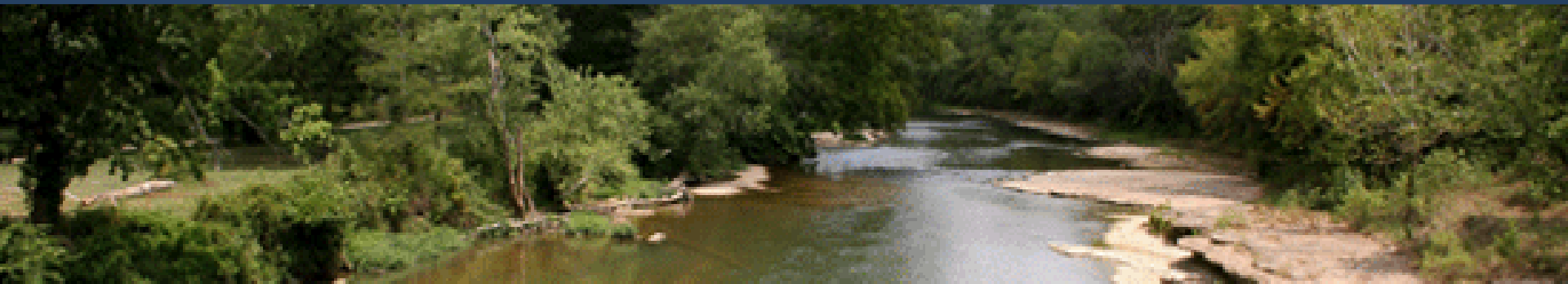


Water Quality Sampling, Analysis and Annual Load Determinations for Nutrients and Solids on the Ballard Creek, 2008

**Arkansas Water Resources Center
UA Division of Agriculture**



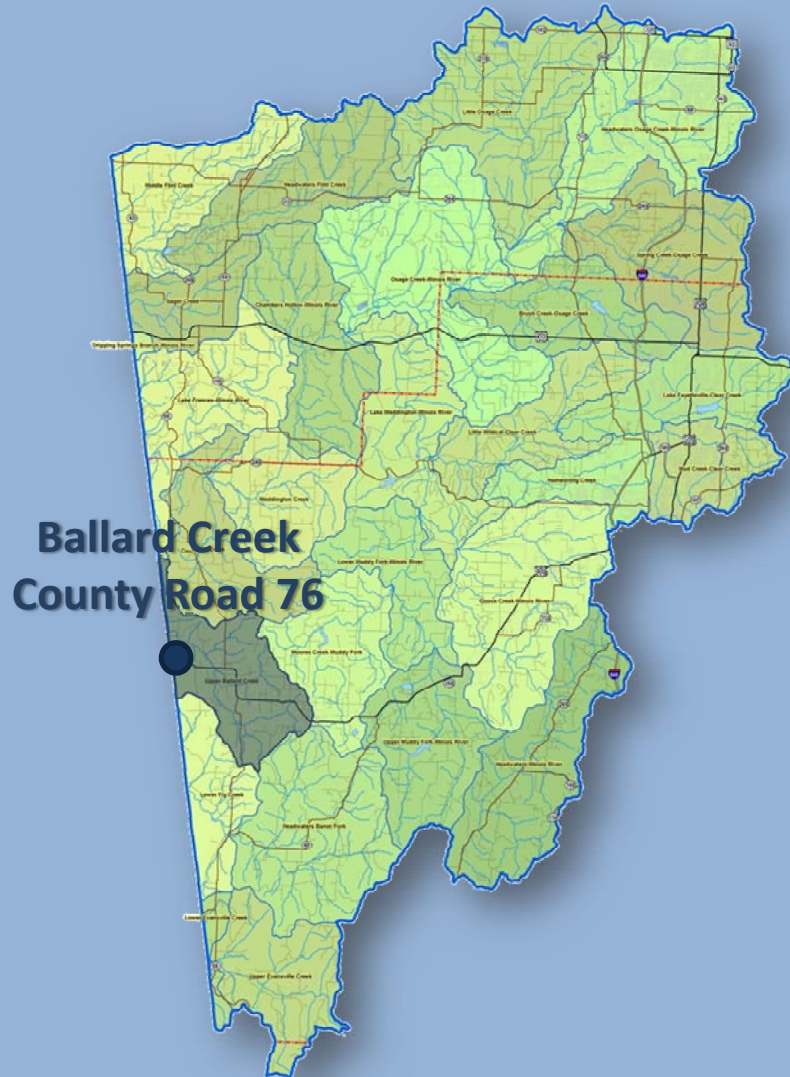
Summary 2008

Loads and Flow-Weighted Concentrations

Parameter	Base Load (kg)	Storm Load (kg)	Total Load (kg)
Chloride (Cl)	191,000	324,000	515,000
Sulfate (SO ₄)	238,000	455,000	693,000
Ammonia (NH ₃ -N)	288	5,700	5,990
Nitrate (NO ₃ -N)	63,000	88,600	151,000
Soluble Reactive Phosphorus (SRP)	1170	13,200	14,400
Total Nitrogen (TN)	66,200	118,000	184,000
Total Phosphorus (TP)	1,410	25,600	27,000
Total Suspended Solids (TSS)	50,600	5,180,000	5,230,000

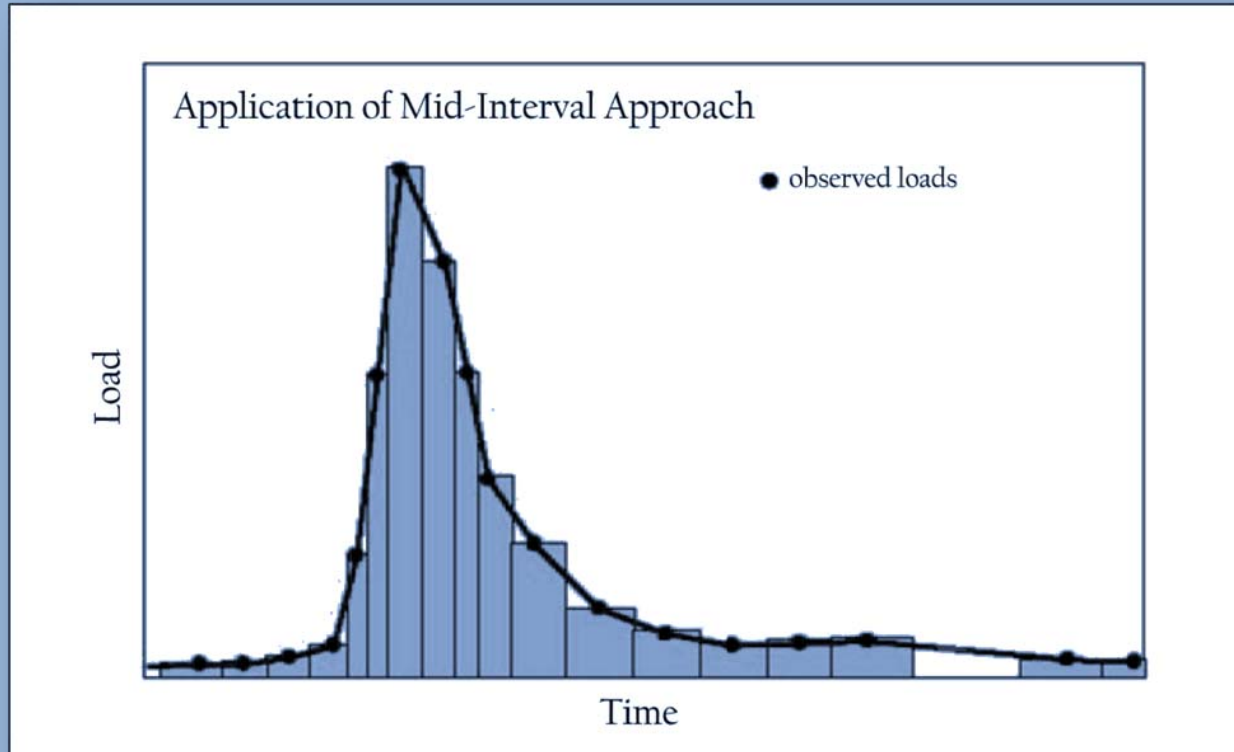
Parameter	Base FWC (mg L ⁻¹)	Storm FWC (mg L ⁻¹)	Overall FWC (mg L ⁻¹)
Chloride (Cl)	12.83	7.93	11.49
Sulfate (SO ₄)	15.96	11.14	12.42
Ammonia (NH ₃ -N)	0.02	0.14	0.11
Nitrate (NO ₃ -N)	4.22	2.17	2.70
Soluble Reactive Phosphorus (SRP)	0.08	0.32	0.26
Total Nitrogen (TN)	4.43	2.88	3.30
Total Phosphorus (TP)	0.09	0.63	0.48
Total Suspended Solids (TSS)	3.4	127	94

Water samples were collected at Ballard Creek during base and storm flow events.



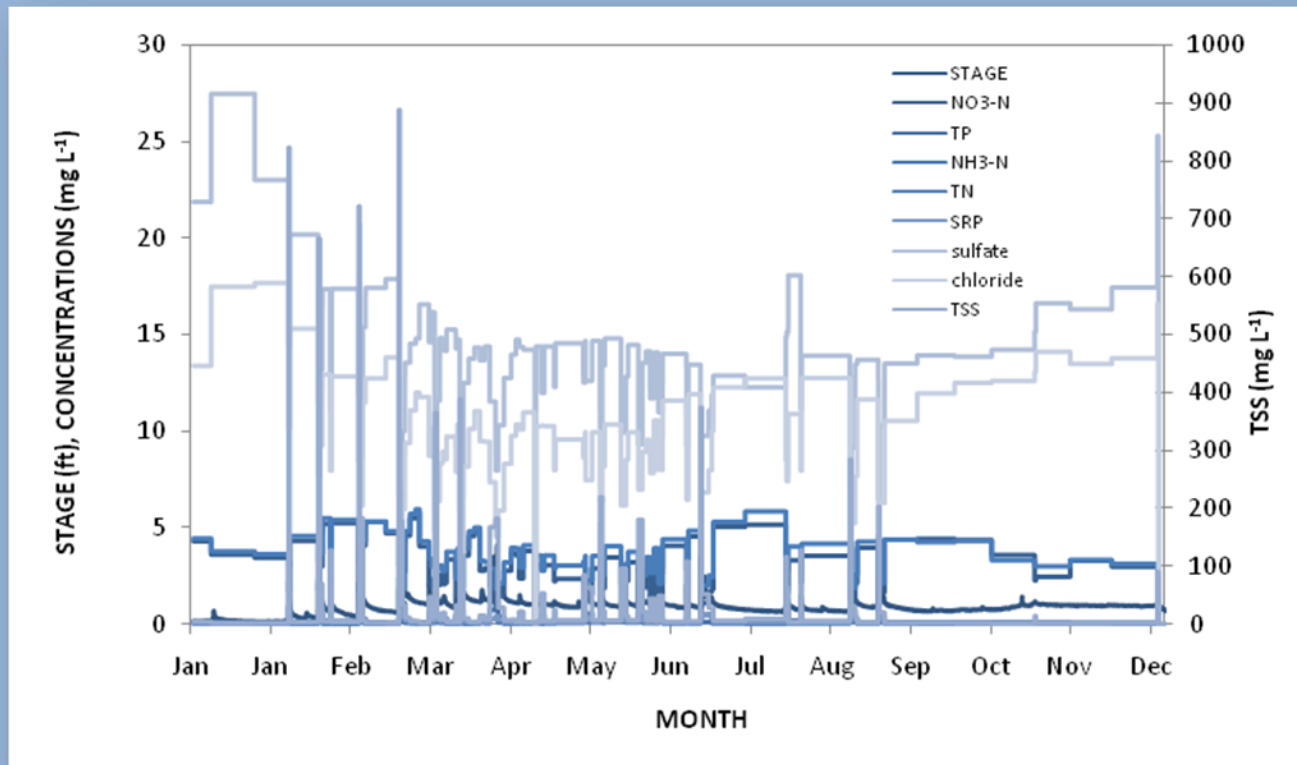
- Stage and discharge recorded in 30 min intervals by AWRC.
- Approximately every other week base flow samples were collected, and storm samples were above specified trigger level (i.e., 20 cfs).
- Water samples were analyzed at the AWRC WQL for:
 - $\text{NO}_3\text{-N}$
 - $\text{NH}_3\text{-N}$
 - TN
 - TP
 - SRP
 - TSS
 - SO_4
 - Cl
- Loads and flow-weighted concentrations of constituents were calculated for 2008.

Load and Flow-Weighted Concentration Determination



- Loads (kg)
 - Calculated using the mid-interval approach where storm samples were composites
- Flow-weighted concentration (mg L^{-1})
 - Total load divided by discharge volume during specified time period (e.g., annual)

Discharge and constituent concentrations were variable throughout the year.



- Total discharge: 58,800,000 m³
 - Base flow: 27%
 - Storm flow: 73%
- 26 water samples were collected during base flow conditions
- 26 composite storm event samples were collected

Cl, SO₄, NO₃-N, and TN flow-weighted concentrations were greater during base flow.

Parameter	Base FWC (mg L⁻¹)	Storm FWC (mg L⁻¹)	Total FWC (mg L⁻¹)
Chloride (Cl)	12.83	7.93	11.49
Sulfate (SO₄)	15.96	11.14	12.42
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And, NH₃-N, SRP, TP and TSS flow-weighted concentrations were greater during storm flow.

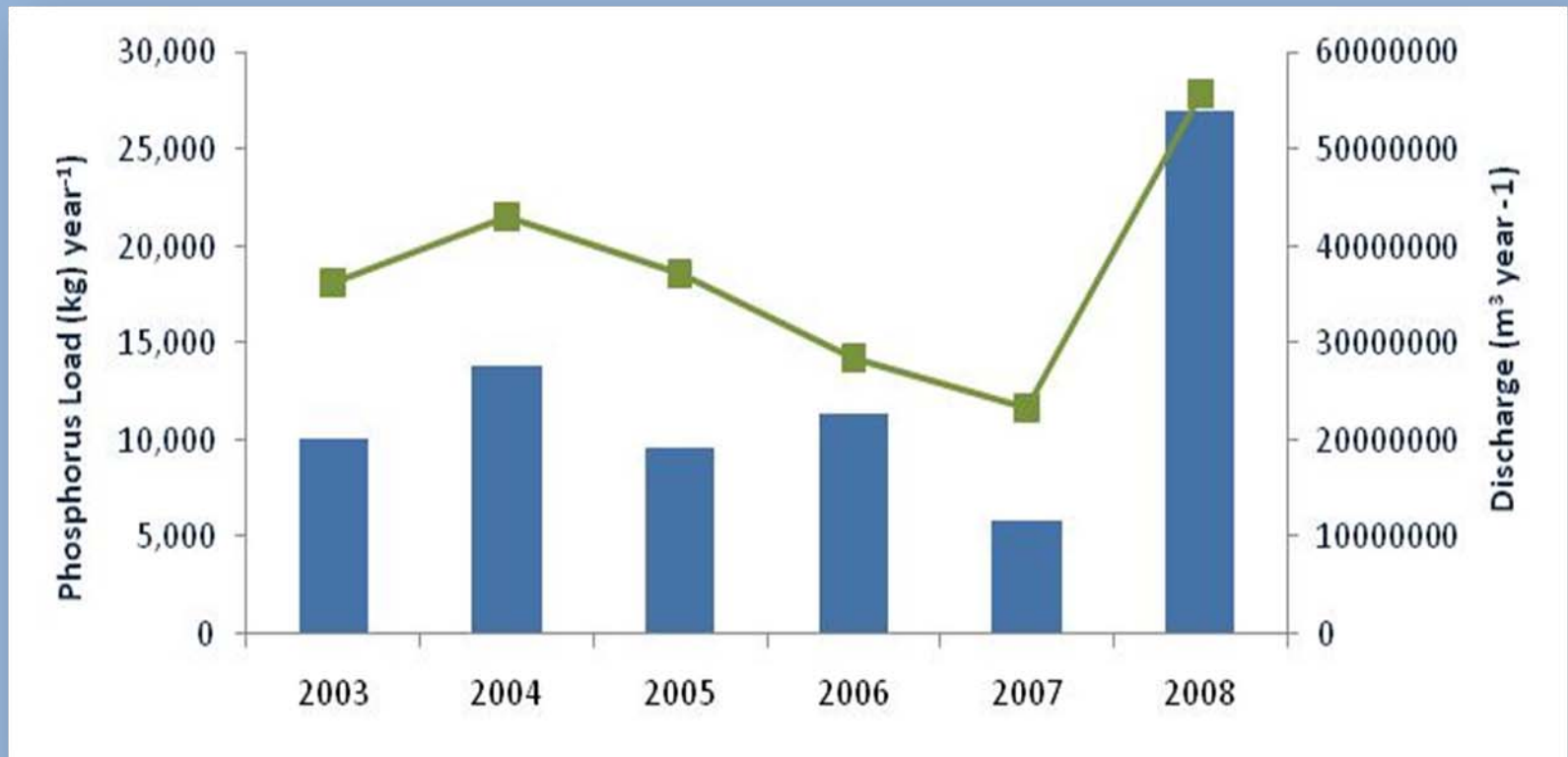
Parameter	Base FWC (mg L⁻¹)	Storm FWC (mg L⁻¹)	Total FWC (mg L⁻¹)
Ammonia (NH₃-N)	0.02	0.14	0.11
Soluble Reactive Phosphorus (SRP)	0.08	0.32	0.26
Total Phosphorus (TP)	0.09	0.63	0.48
Total Suspended Solids (TSS)	3.39	126.80	93.73

The monthly constituent loads at Ballard Creek varied by orders of magnitude.

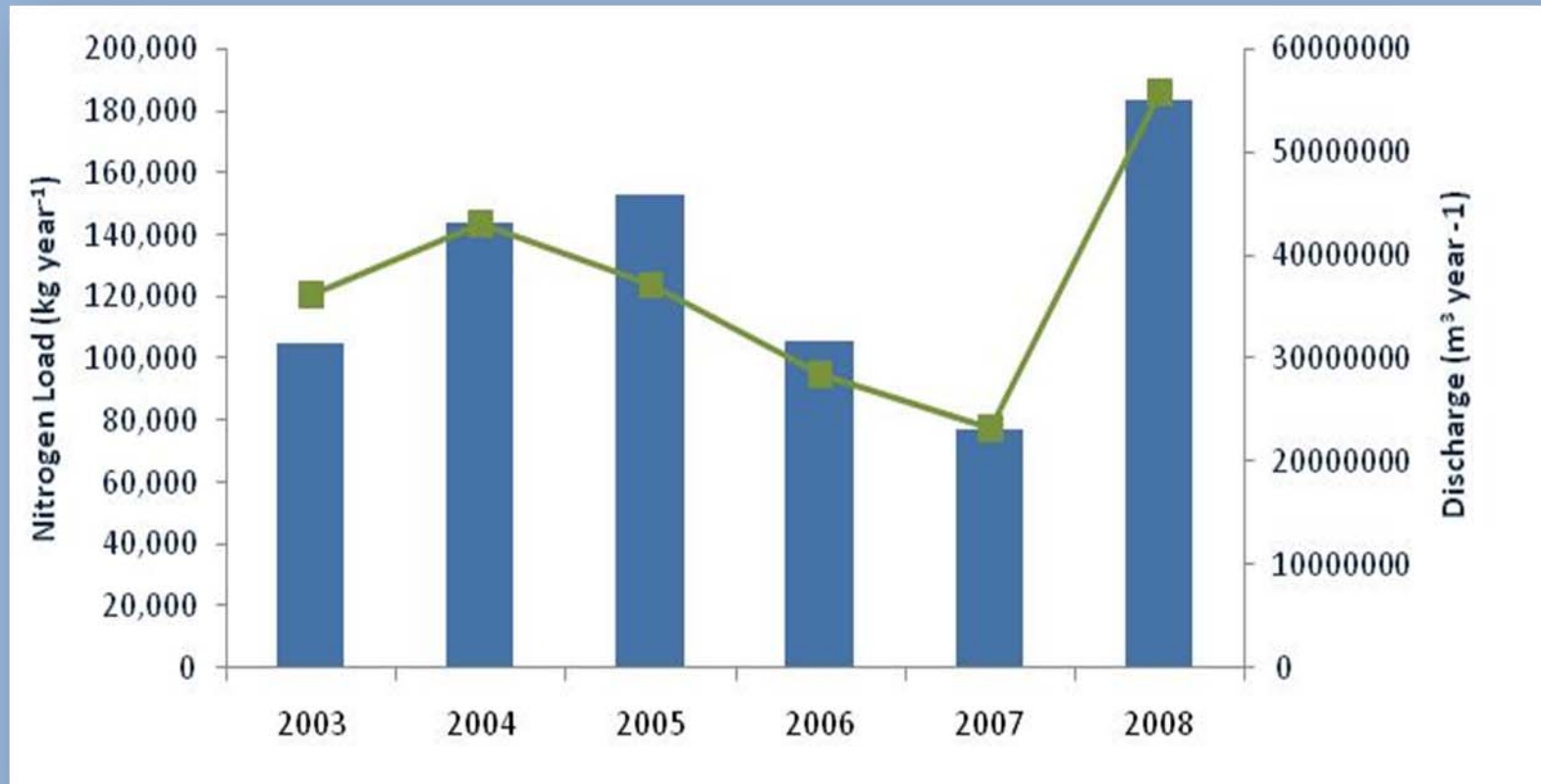
Month	Base Flow Load			Storm Event Loads			Total Load		
	Total Nitrogen (TN, kg)	Total Phosphorus (TP, kg)	Total Suspended Solids (TSS, kg)	Total Nitrogen (TN, kg)	Total Phosphorus (TP, kg)	Total Suspended Solids (TSS, kg)	Total Nitrogen (TN, kg)	Total Phosphorus (TP, kg)	Total Suspended Solids (TSS, kg)
January	4,960	90	2,470	0	0	0	4,960	90	2,470
February	8,940	226	4,940	4,910	2,320	596,000	13,800	2,550	601,000
March	6,150	109	7,730	27,400	12,000	2,620,000	33,500	12,100	2,630,000
April	550	16	272	21,500	4,770	936,000	21,900	4,780	936,000
May	1,520	71	2,790	11,100	722	67,800	12,500	784	65,500
June	788	25	426	14,100	1,750	239,000	14,400	1,760	239,000
July	10,200	163	11,100	8,450	1,060	342,000	18,300	1,210	353,000
August	12,300	294	14,200	1,660	216	14,200	13,900	508	35,500
September	7,300	155	3,180	7,300	155	3,180	17,000	2,510	353,000
October	12,240	235	2,720	0	0	0	12,240	235	2,720
November	1,180	24	0	9,840	210	3,273	10,800	229	3,270
December	740	26	162	9,720	186	11,300	10,500	211	11,450

- Monthly loads were variable depending on the frequency of storm event during the month.
 - Greatest loads transports during spring (March & April)
 - Lowest loads occurred late fall and winter
 - No storms in January or October

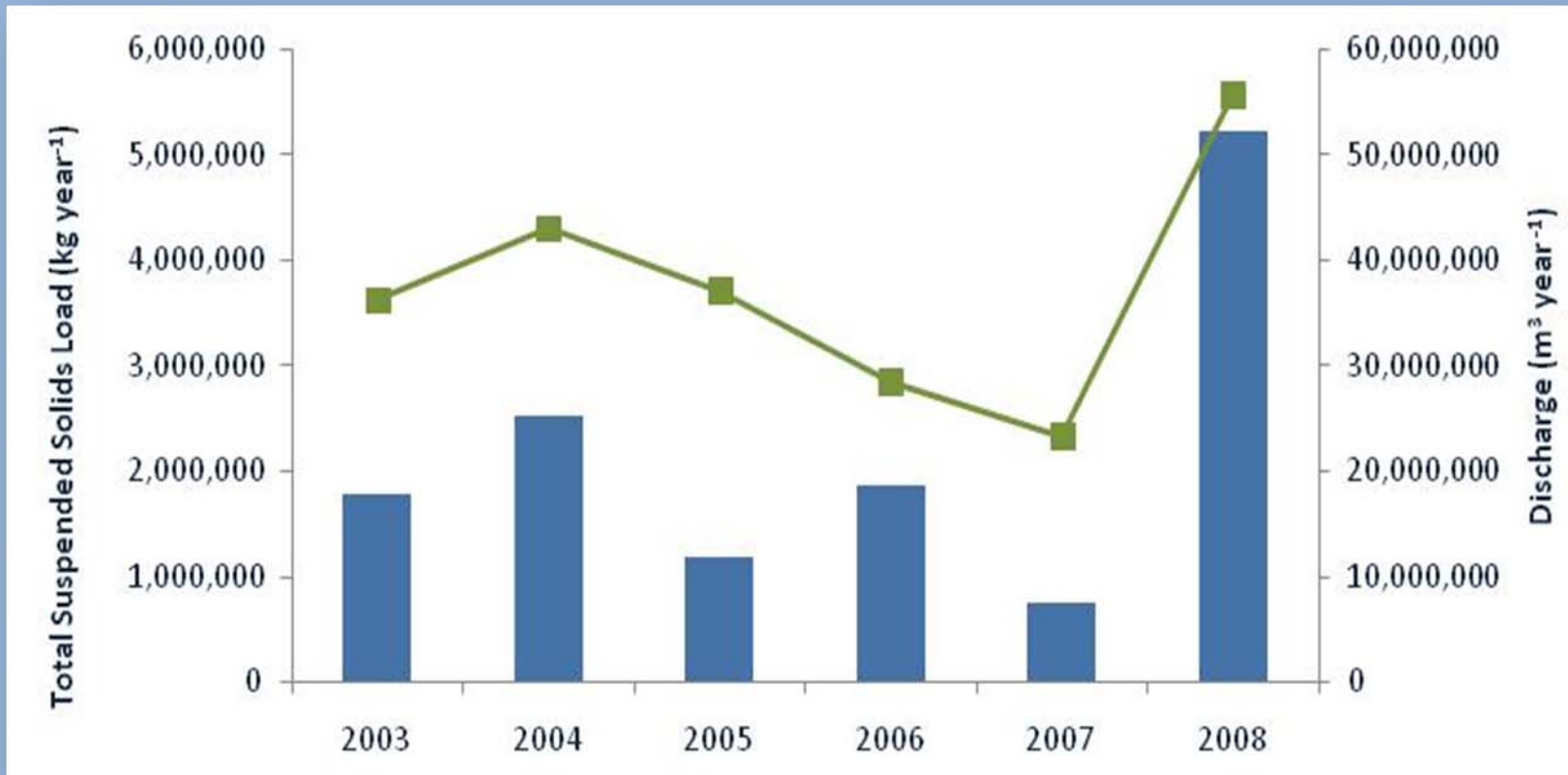
Phosphorus loads were highest in 2008, but so was annual discharge.



Variability in nitrogen concentrations from 2003-2008 follows the pattern of annual discharge.



Total suspended solids loads in 2008 were also the highest since monitoring began in 2002.



Summary 2008

Loads and Flow-Weighted Concentrations

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Total Suspended Solids (TSS)	3.4	127	94

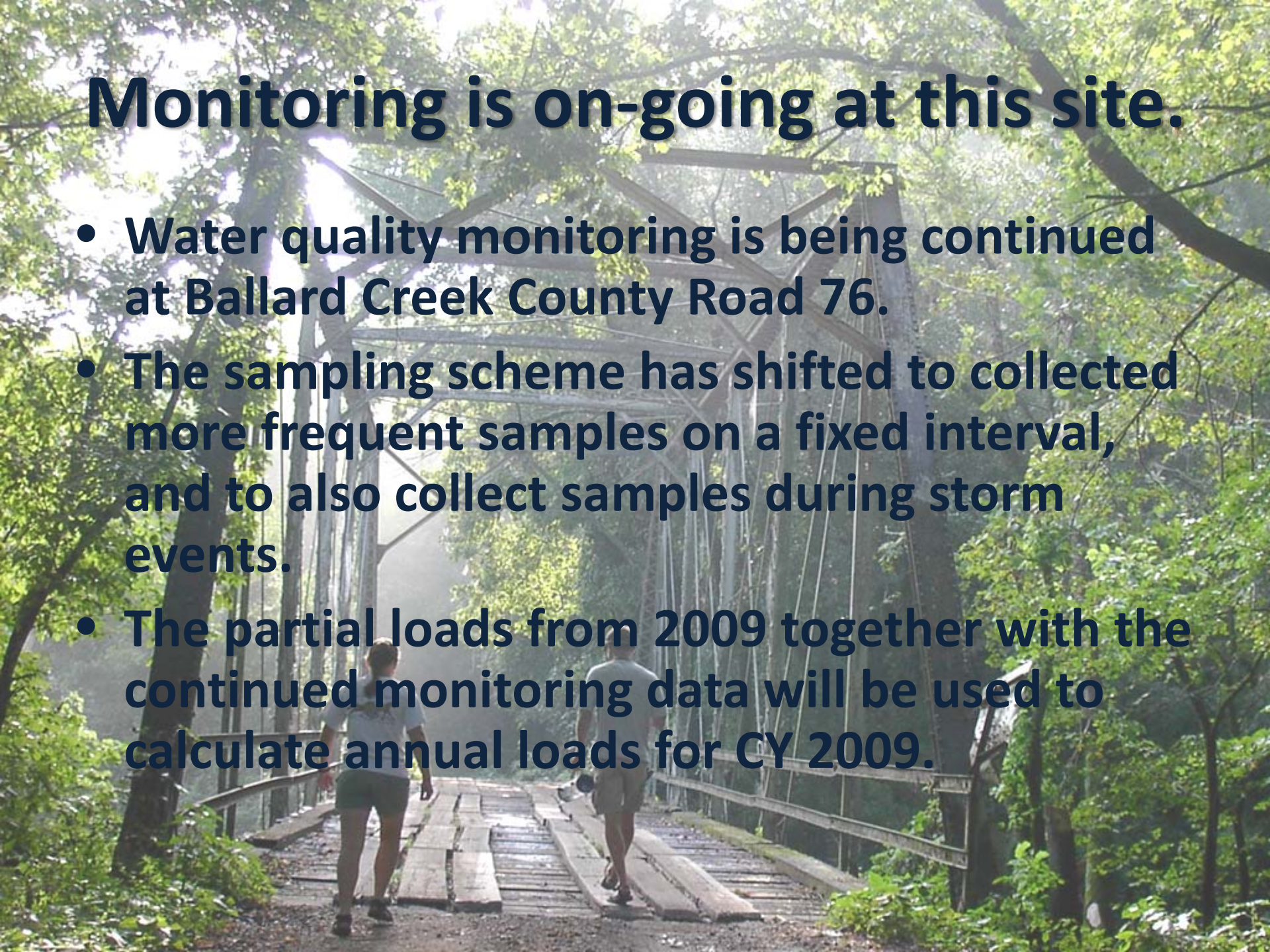
What about the data collected from January to June 2009?

Parameter	Base Flow (kg)	Storm Flow (kg)	Total (kg)
Chloride (Cl)	131,000	111,000	242,000
Sulfite (SO ₄)	199,000	189,000	388,000
Ammonia (NH ₃ -N)	411	2,720	3,130
Nitrate (NO ₃ -N)	30,100	21,300	51,400
Soluble Reactive Phosphorus (SRP; PO ₄ -P)	573	5,100	5,670
Total Nitrogen (TN)	32,300	32,000	64,300
Total Phosphorus (TP)	852	8,540	9,390
Total Suspended Solids (TSS)	33,900	1,070,000	1,100,000

- Total discharge was 25,200,000
 - Base flow: 42%
 - 13 Base flow samples collected
 - Storm flow: 58%
 - 19 Composite storm events sampled

Monitoring is on-going at this site.

- **Water quality monitoring is being continued at Ballard Creek County Road 76.**
- **The sampling scheme has shifted to collected more frequent samples on a fixed interval, and to also collect samples during storm events.**
- **The partial loads from 2009 together with the continued monitoring data will be used to calculate annual loads for CY 2009.**



Take Home Message: Total constituent loading is dependent on annual discharge volume which is closely tied to the frequency and duration of storm events.

QUESTIONS?

