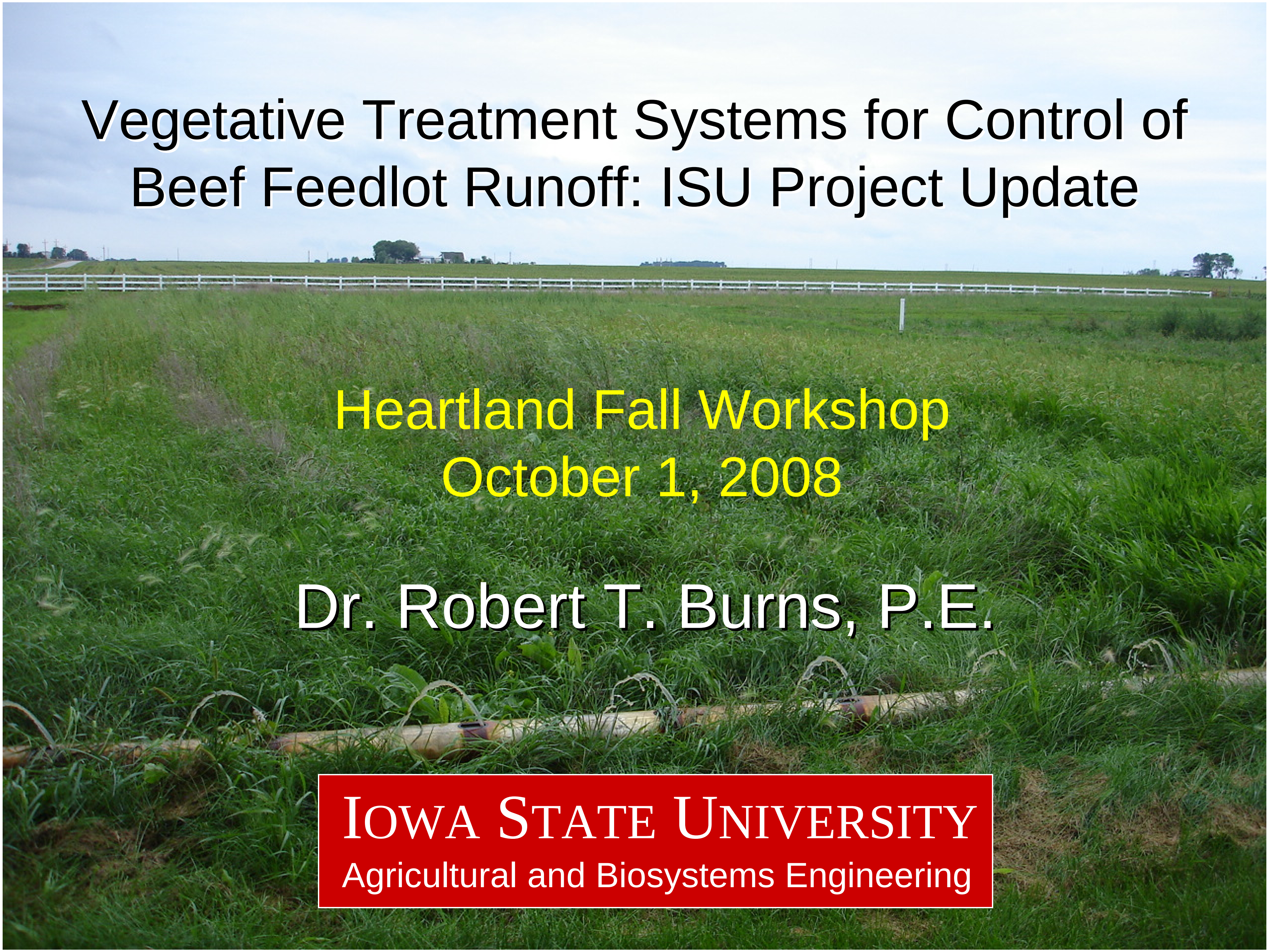


Vegetative Treatment Systems for Control of Beef Feedlot Runoff: ISU Project Update

Heartland Fall Workshop
October 1, 2008

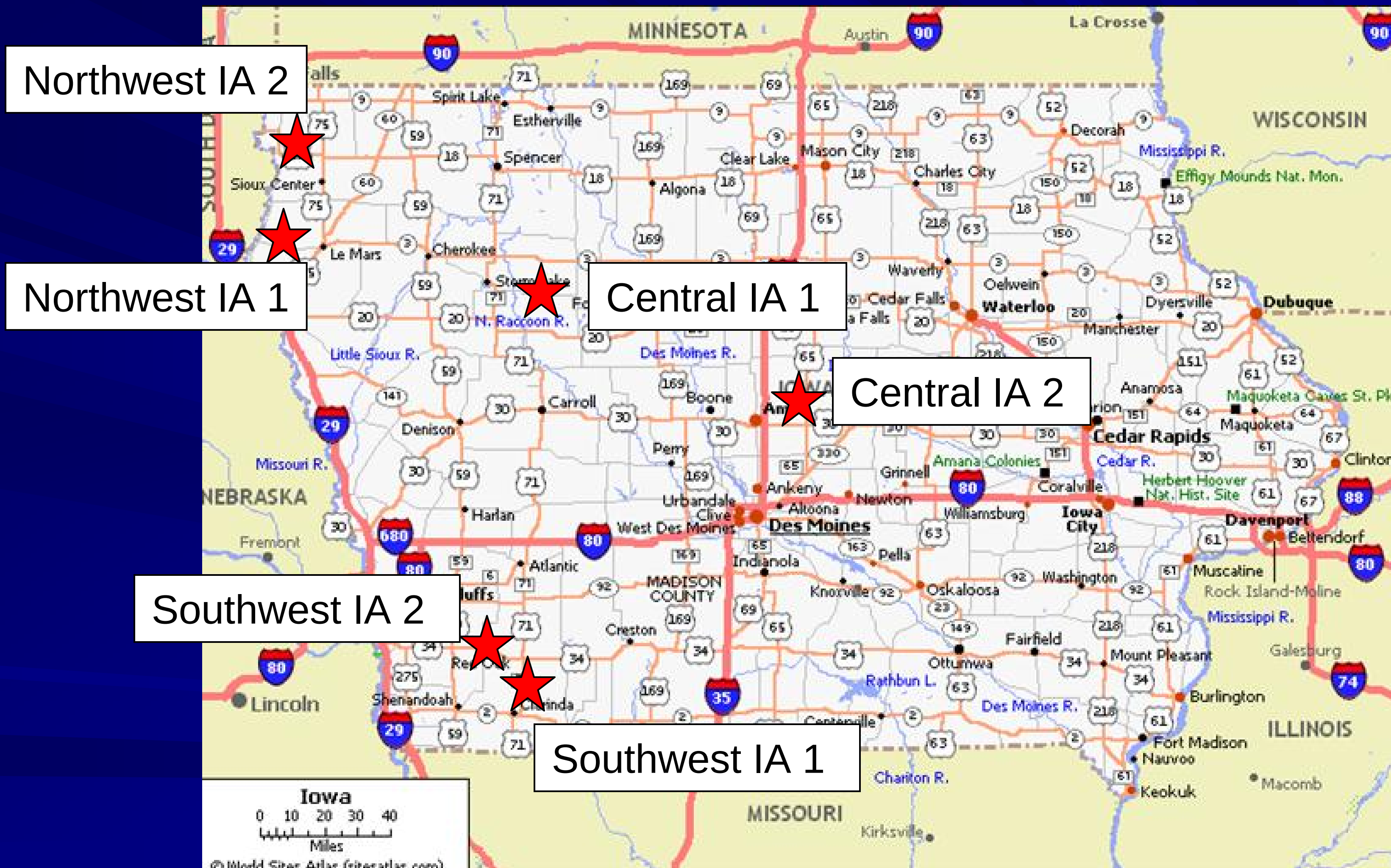
Dr. Robert T. Burns, P.E.

IOWA STATE UNIVERSITY
Agricultural and Biosystems Engineering

Presentation Outline

- Introduction
- Review of Iowa VTS performance data
  - 2006, 2007, 2008
- Lessons Learned
- Discussion

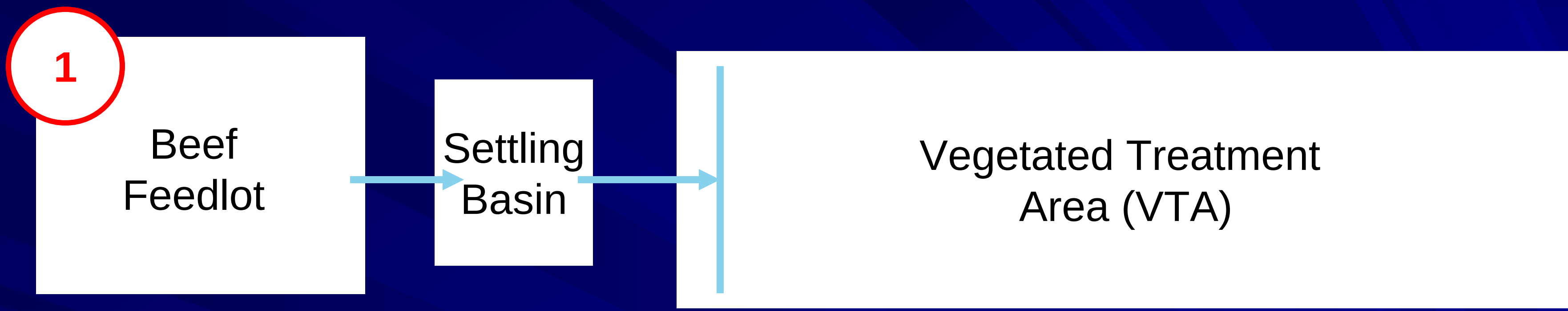
Research Site Locations



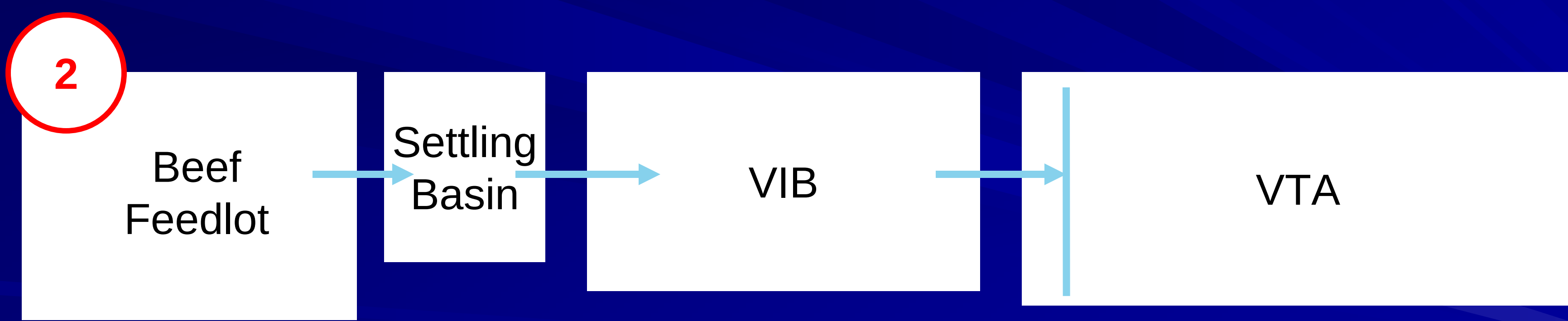
Initiation of VTS monitoring

- Central IA 1 – July 2006
- Central IA 2 – July 2006
- NW IA 1 – August 2006
- NW IA 2 – August 2006
- SW IA 1– September 2007
- SW IA 2 – April 2007

Vegetative Treatment Systems



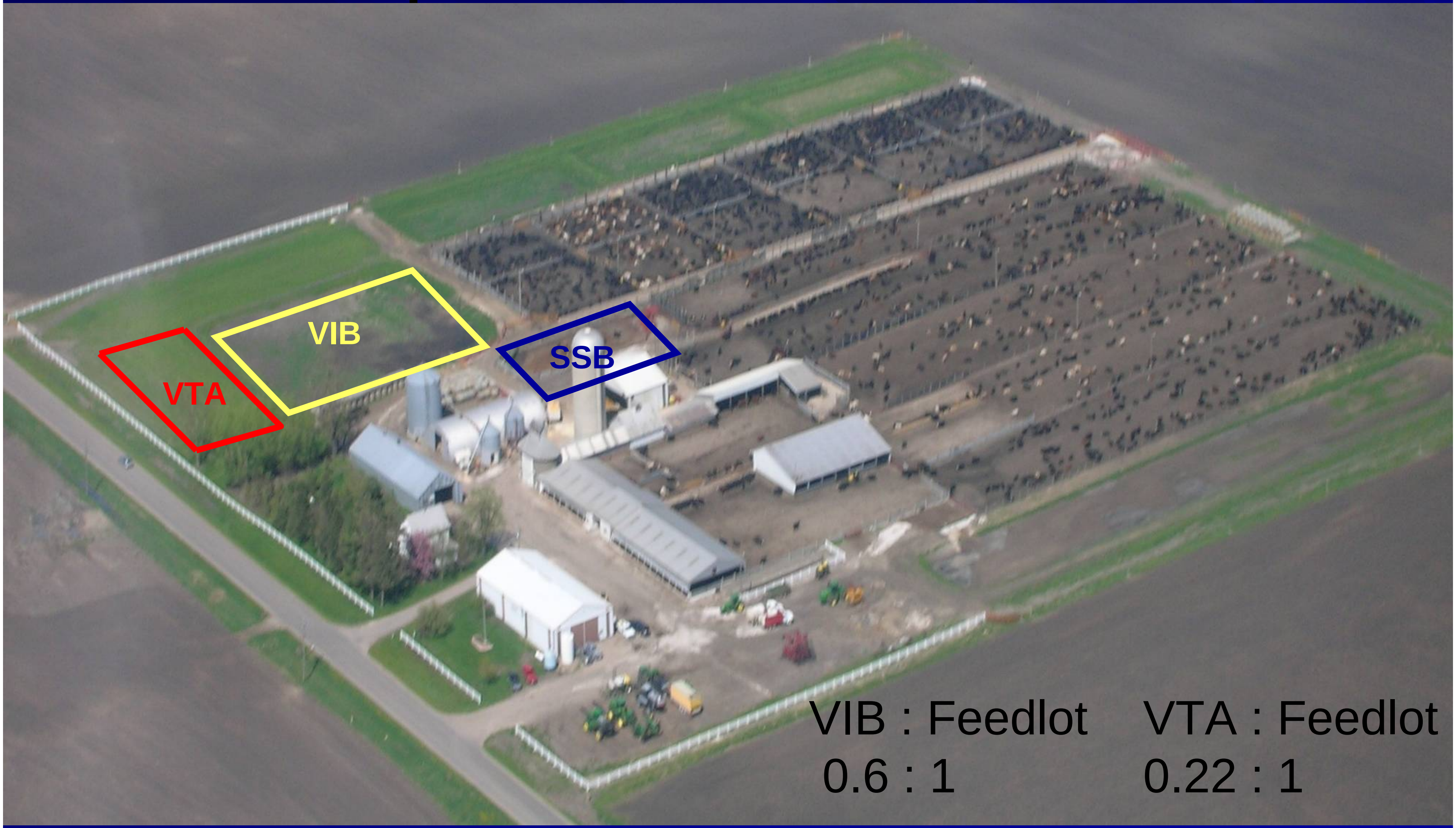
VTA - Level in one dimension with slope less then 5%
- Planted and managed in dense vegetation
- Material discharged thru spreader at top of VTA



VIB - Bermed area with tile lines below surface, designed for max. infiltration
- Planted and managed in dense vegetation (theoretically)
- VIB effluent discharged to VTA

Example SSB to VTA

Example SSB to VIB to VTA



VIB : Feedlot
0.6 : 1

VTA : Feedlot
0.22 : 1

VTS Performance Summary

	2006 (Start of monitoring – Oct.)			2007 (April – Oct.)			2008 (April – Sept.)		
	# of Rain Events *	Max. Storm (inch)	# of VTA Releases	# of Rain Events*	Max. Storm (inch)	# of VTA Releases	# of Rain Events*	Max. Storm (inch)	# of VTA Releases
NW IA 1	5	1.72	2	17	1.62	4	26	1.1	4
NW IA 2	6	2.53	5	22	2.13	1	28	1.85	17
Central IA 1	14	1.86	2	16	4.07	12	24	3.1	8
Central IA 2	22	3.02	5	17	3.19	12	22	3.81	21
SW IA 1	--	--	--	5	4.94	3	31	4.81	2
SW IA 2	--	--	--	20	5.05	4	28	3.2	11

*Rainfall events may consist of multiple rainfalls over the release period

VTS and ELG releases (2006 & 2007)

Site	Rainfall During Monitoring Period (inches)		# of Monitored VTS Releases		# of Modeled ELG Releases	
	2006	2007	2006	2007	2006	2007
Central IA 1	11	49	2	26	0	7
Central IA 2	14.5	37	5	15	0	2
NW IA 1	9	25	2	13	0	0
NW IA 2	9	26	5	1	0	0
SW IA 1 2007 (Sept – Oct.)	-	17	-	3	-	4
SW IA 2		32	-	4	-	9

The time period of the release may be greater than 24 hrs; the release time period is from release initiation to release termination.

Annual Release Volume

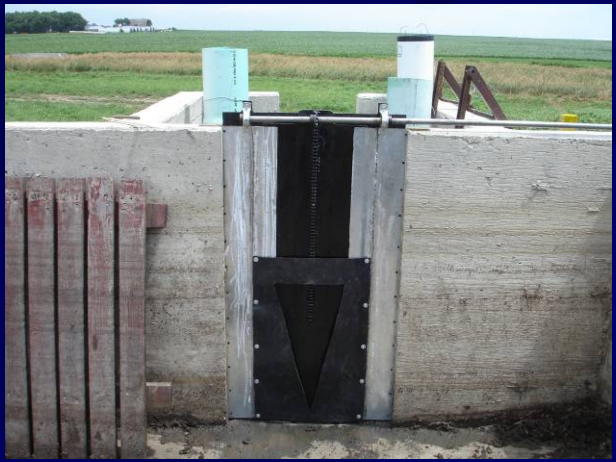
	2006 (ft^3)	2007 (ft^3)
Central IA 1	65	415,159
Central IA 2	1,119	56,939
NW IA 1	334	104,629
NW IA 2	160	777
SW IA 1	--	--
SW IA 2	--	149,637

Nutrient Mass released (2007)

Mass Released (kg)	C IA 2	C IA 1	NW IA 1	NW IA 2	SW IA 2
VTS TKN	21	1,397	506	9	279
ELG TKN	11	508	0	0	378
VTS NH4	7	687	212	2	83
ELG NH4	8	385	0	0	245
VTS Total P	9	429	135	1	130
ELG Total P	3	151	0	0	98
VTS Total Solids	934	27,830	14,007	196	10,638
ELG Total Solids	329	15,149	0	0	9,795
VTS COD	364	22,498	8,602	179	4,925
ELG COD	436	20,073	0	0	12,978

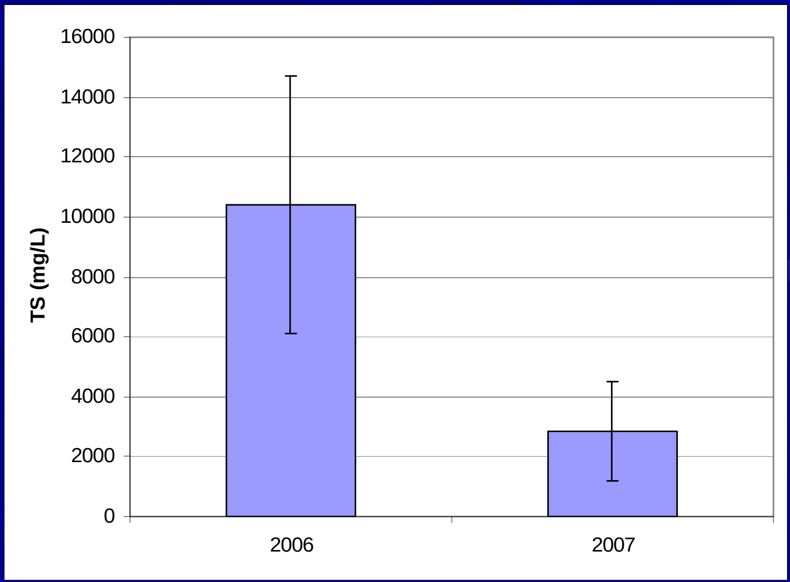
- 2006 VTA releases
  - Settling basins were managed passively
  - All VTA releases associated with settling basin release
- 2007 VTA releases
  - 2 sites actively managed settling basins
  - ~50% of the releases were associated with basin releases
- 2008 VTA releases
  - All 6 sites actively managing settling basins

Central Iowa 1



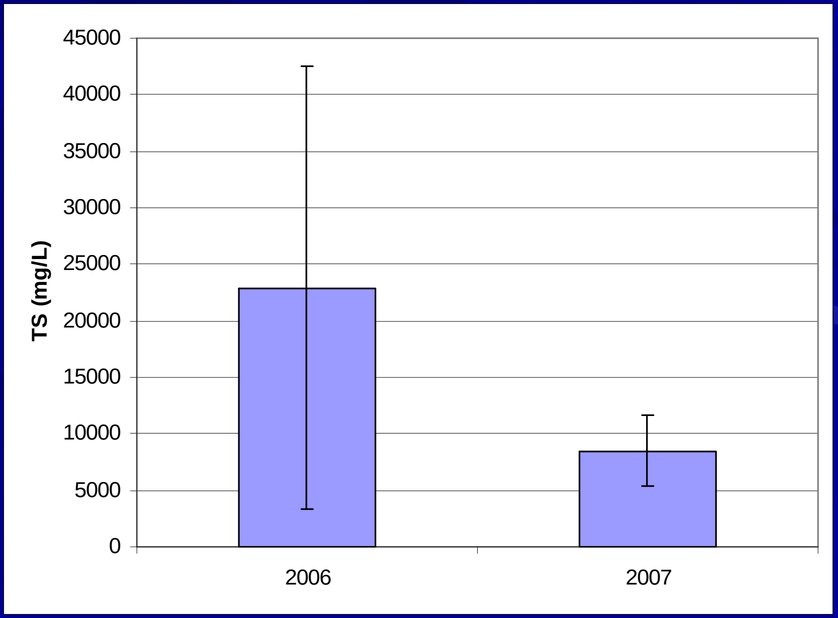
- Added valve to better control basin discharge

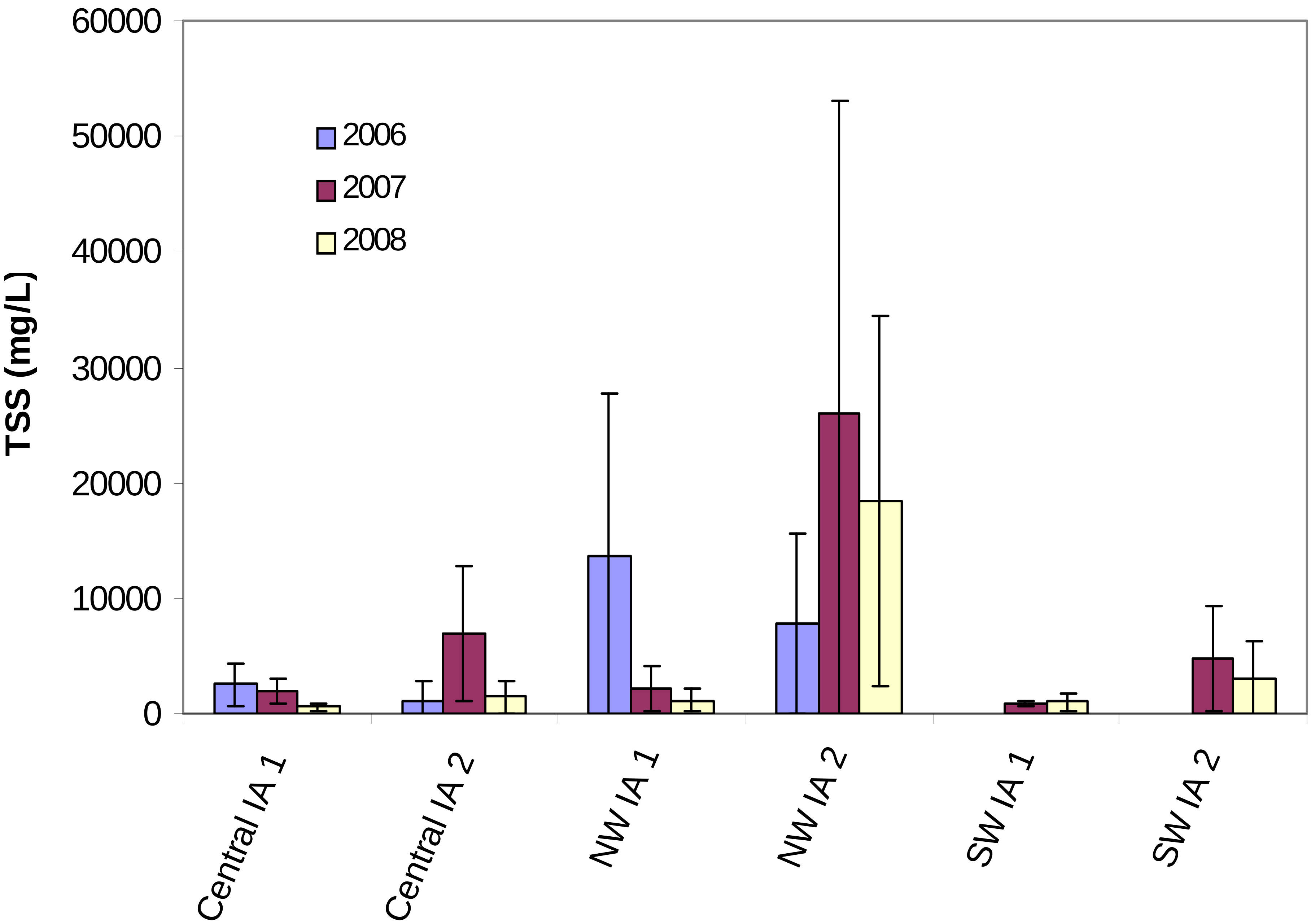
- Hold runoff until VTA achieves non-saturated conditions (when possible)



Northwest Iowa 1

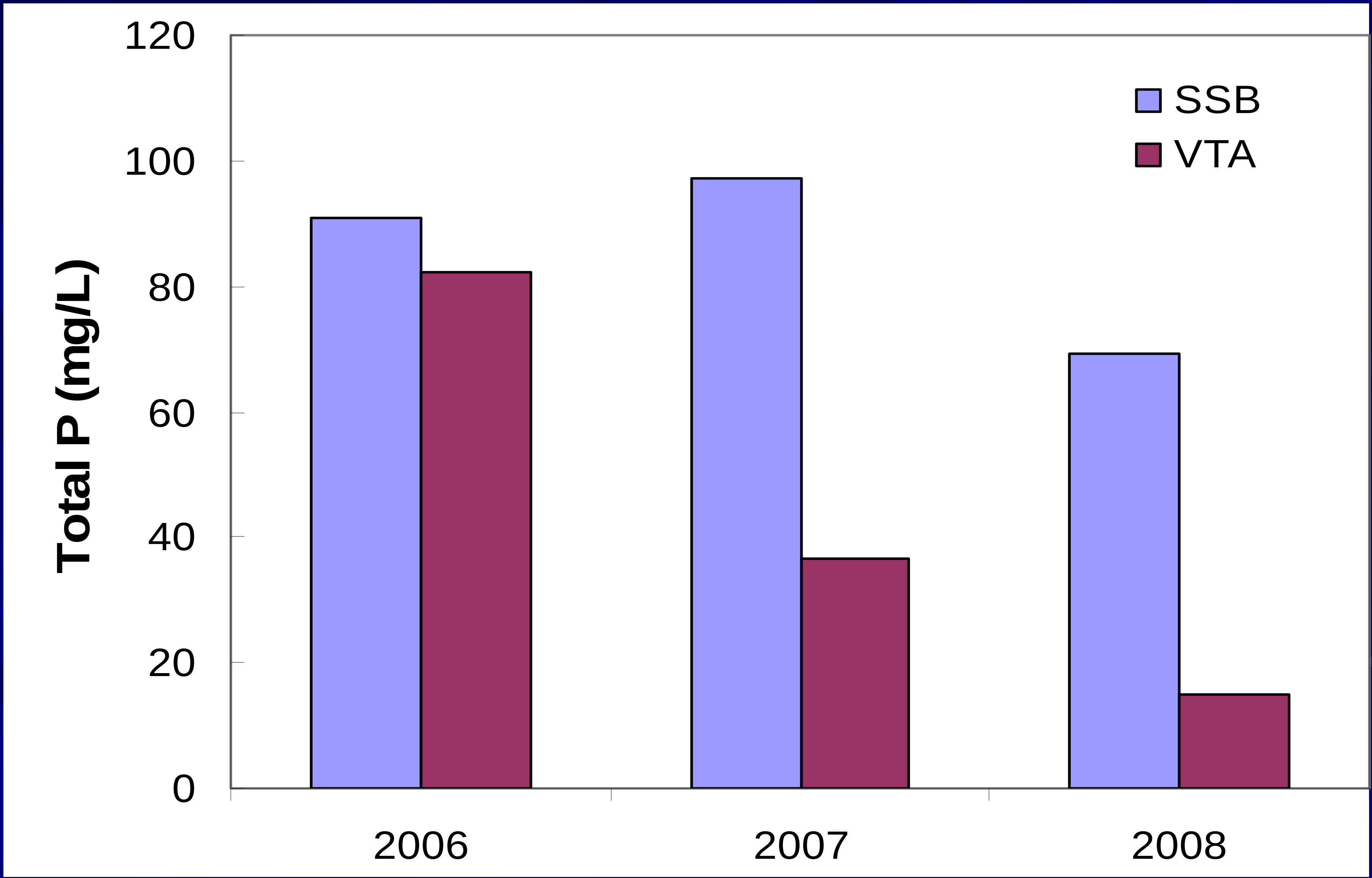
- Added valves to better control basin discharge
- Hold runoff until VTA achieves non-saturated conditions (when possible)



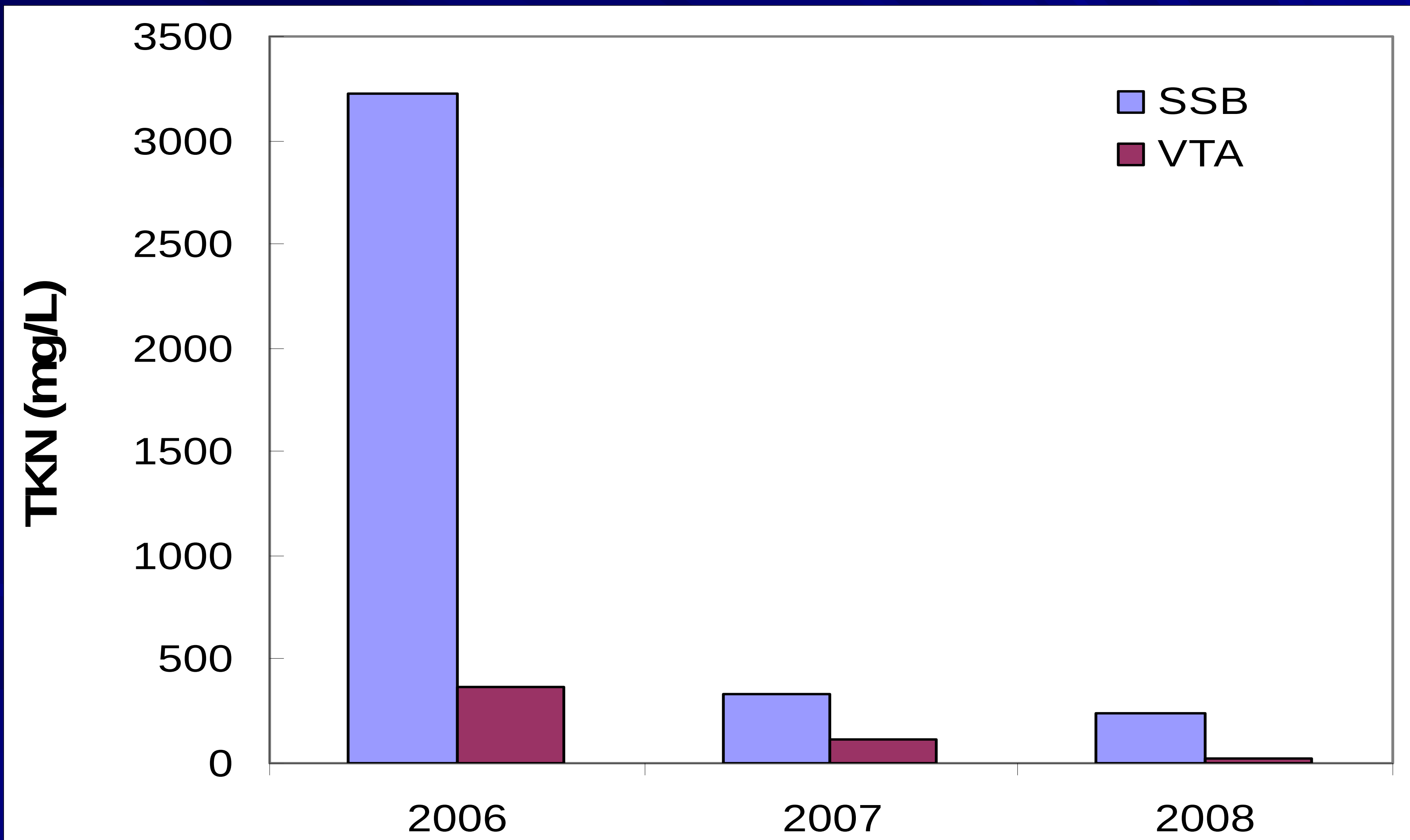


TSS (mg/L)
60000
50000
40000
30000
20000
10000
0
2006
2007
2008
Central IA 1
Central IA 2
NW IA 1
NW IA 2
SW IA 1
SW IA 2

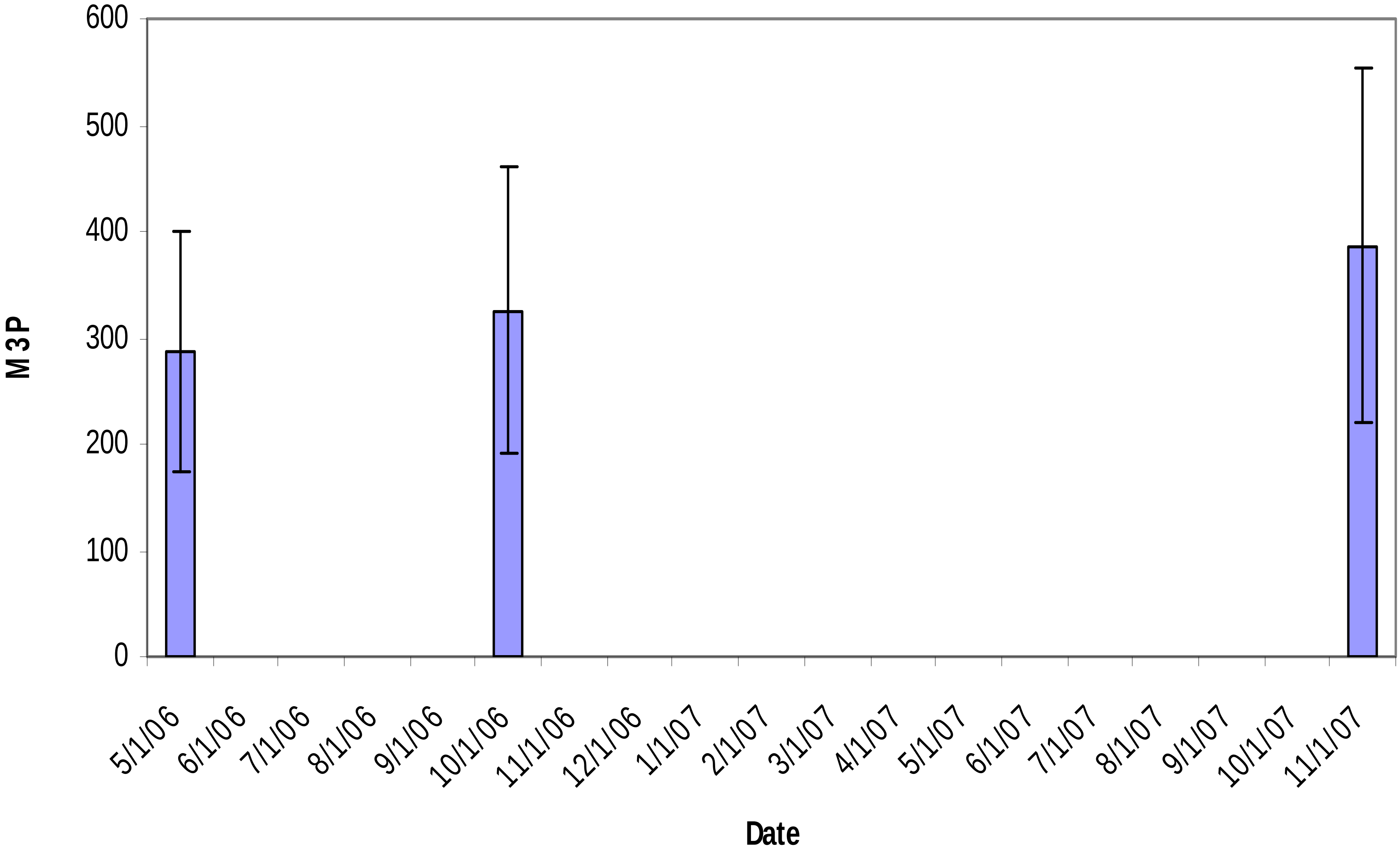
Flow weighted P concentration – Central IA 1



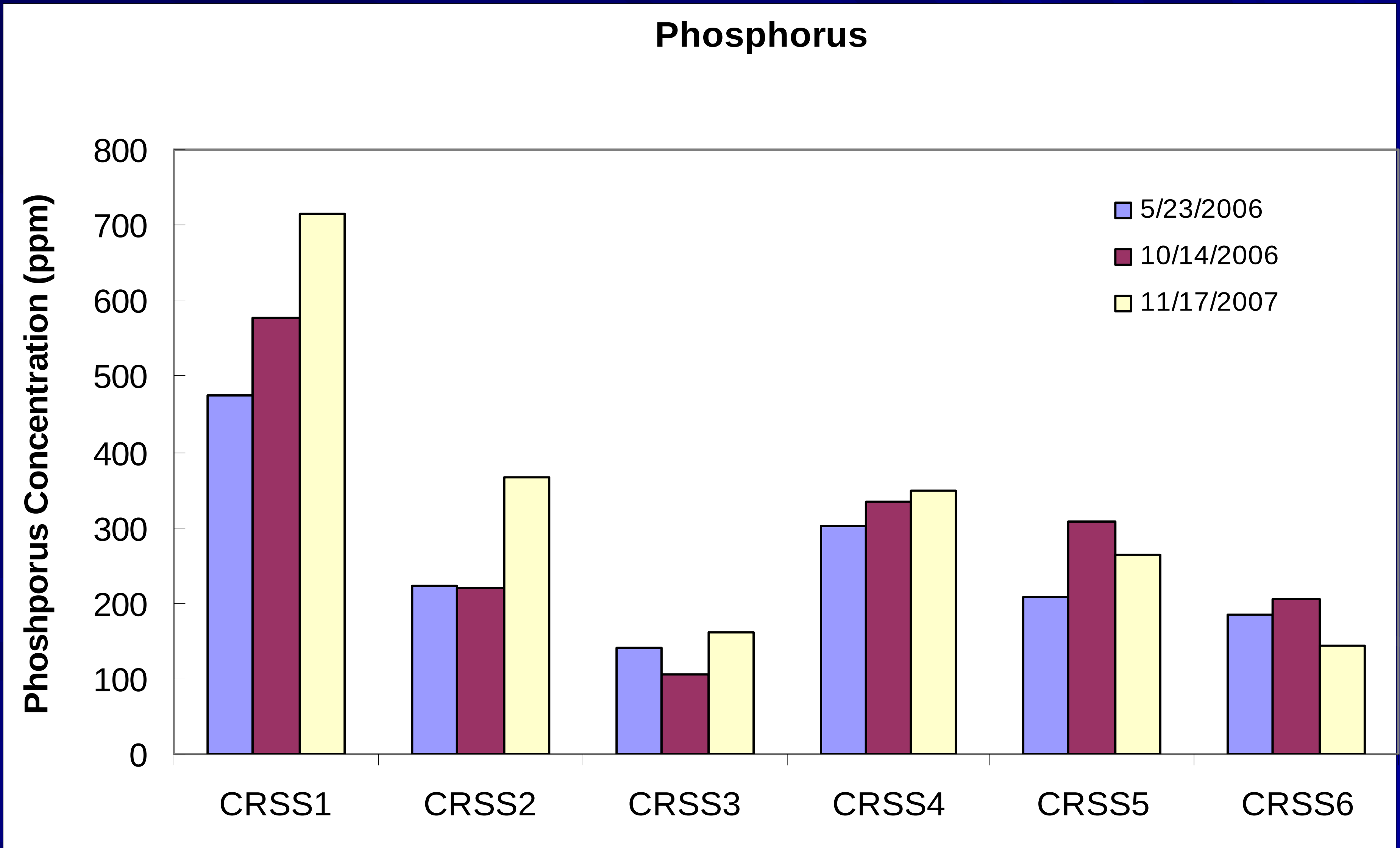
Flow weighted TKN concentration - Central IA 1



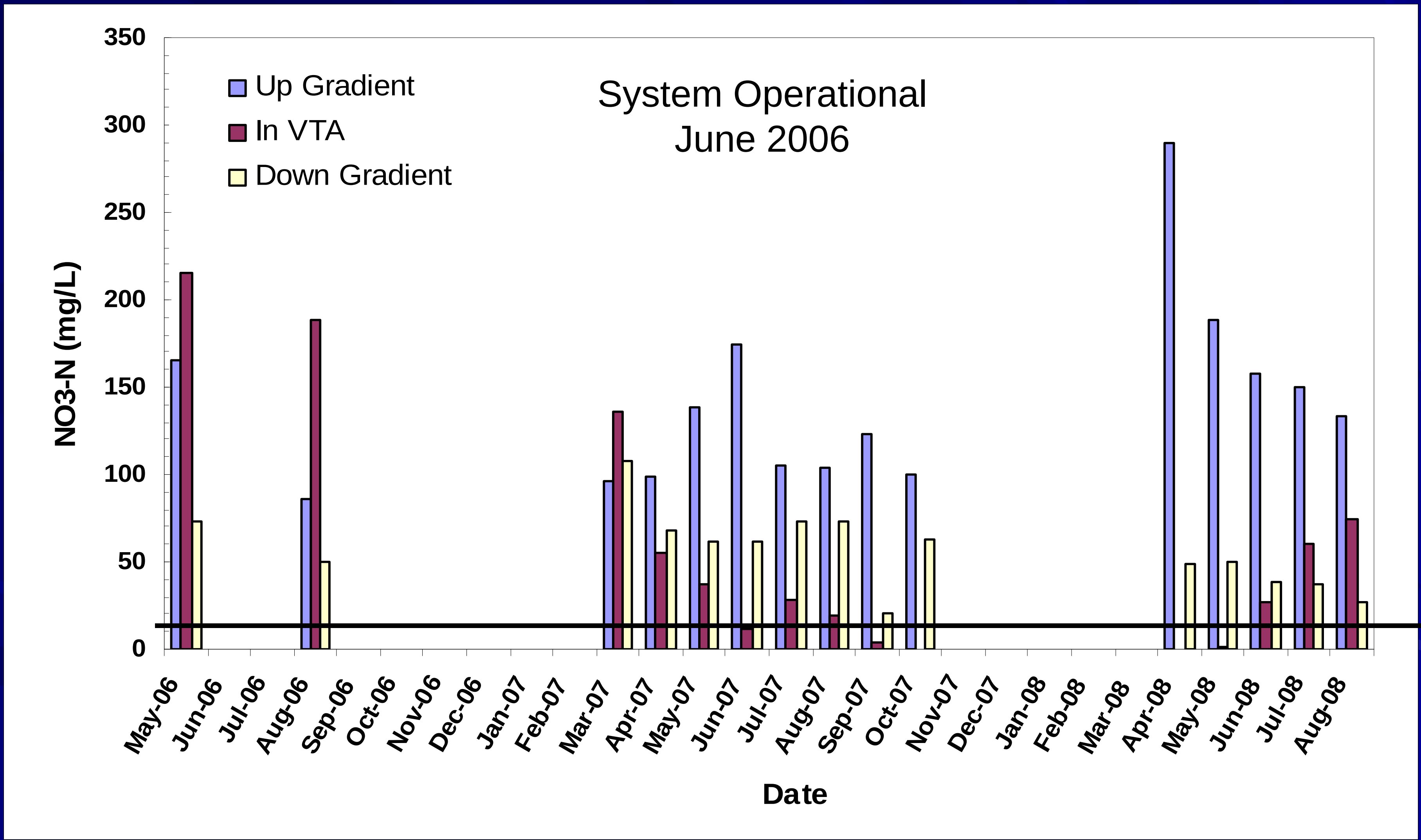
Soil P vs. Date – Central IA 1



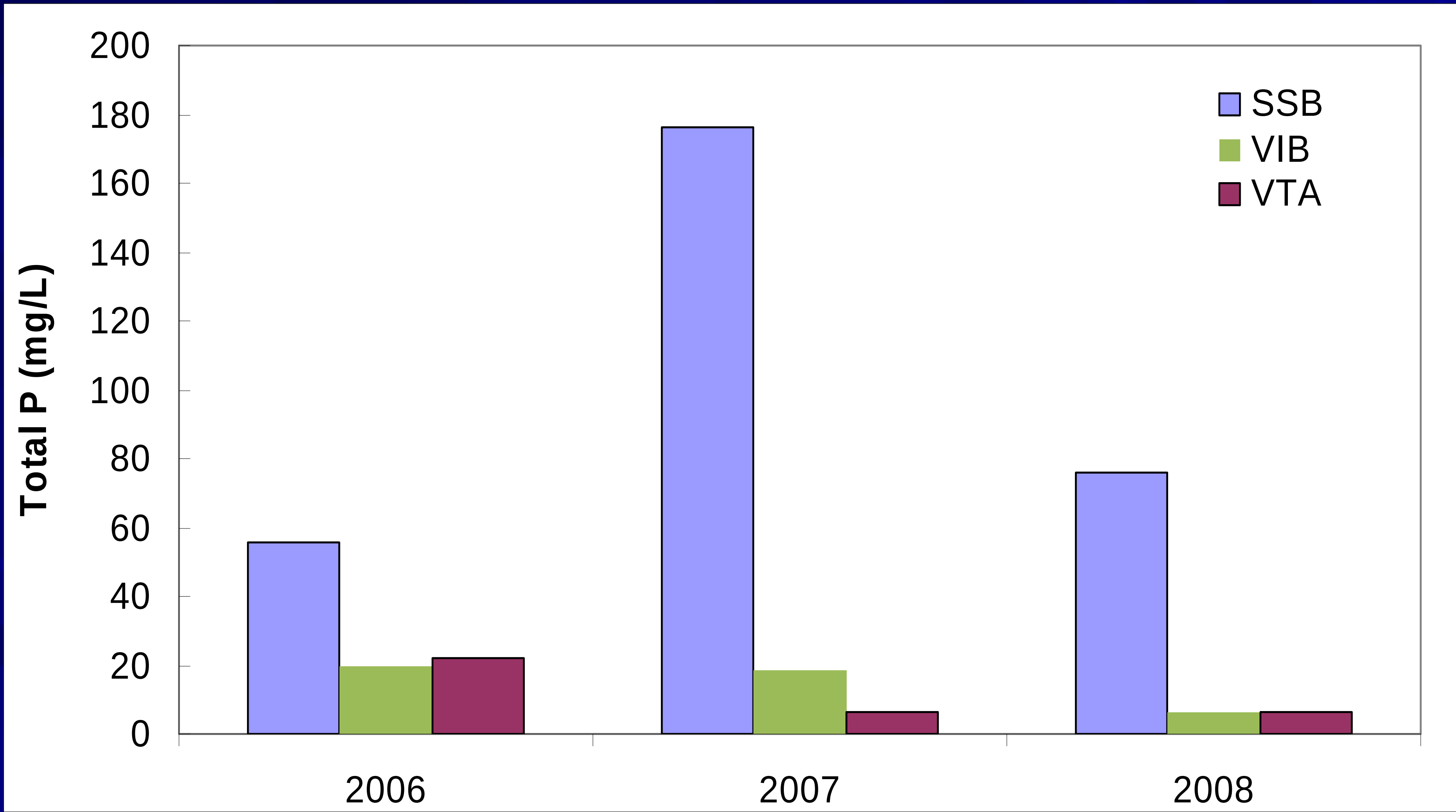
Soil P vs. Distance – Central IA 1



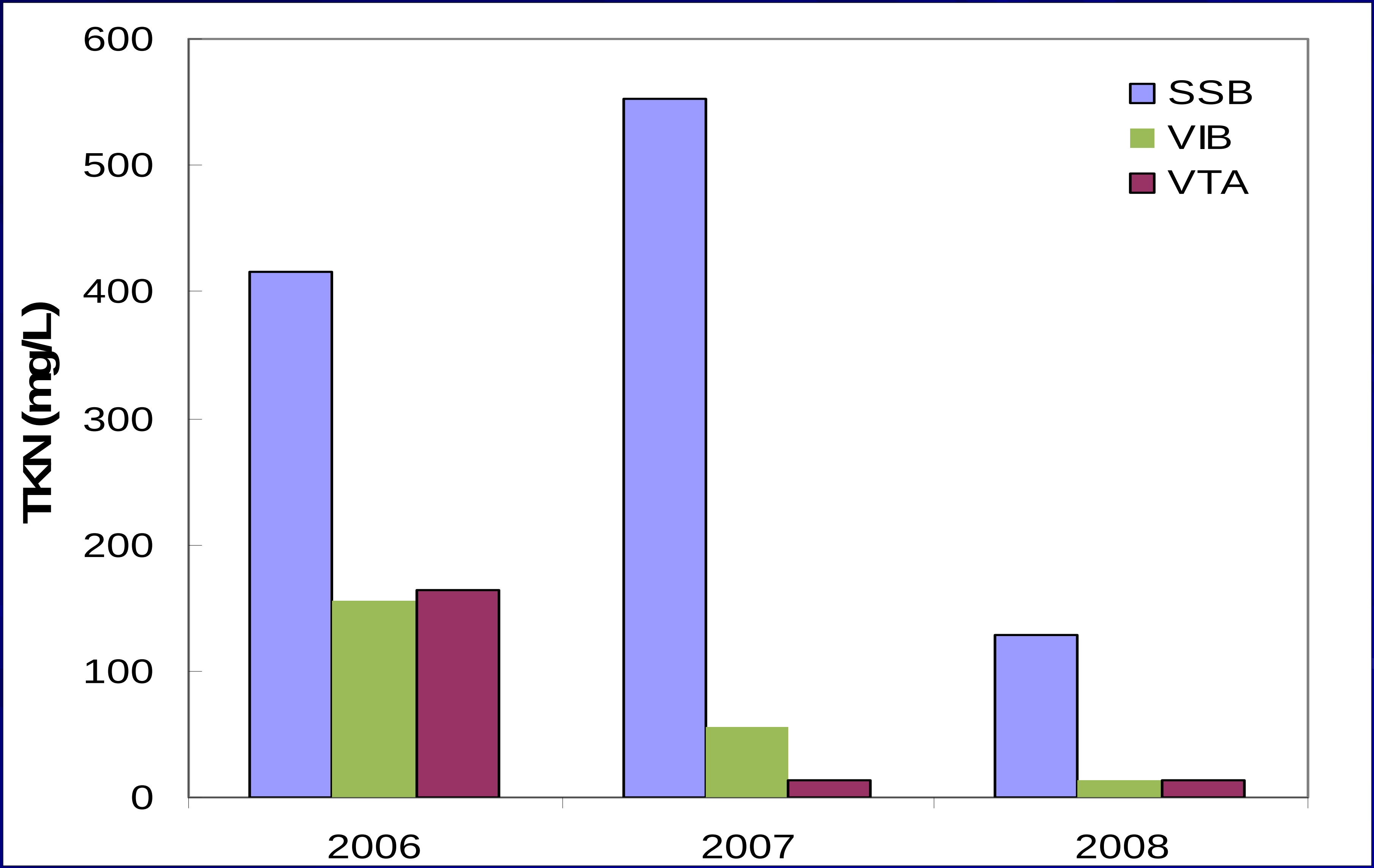
NO_3-N Concentration in Groundwater at Central IA 1



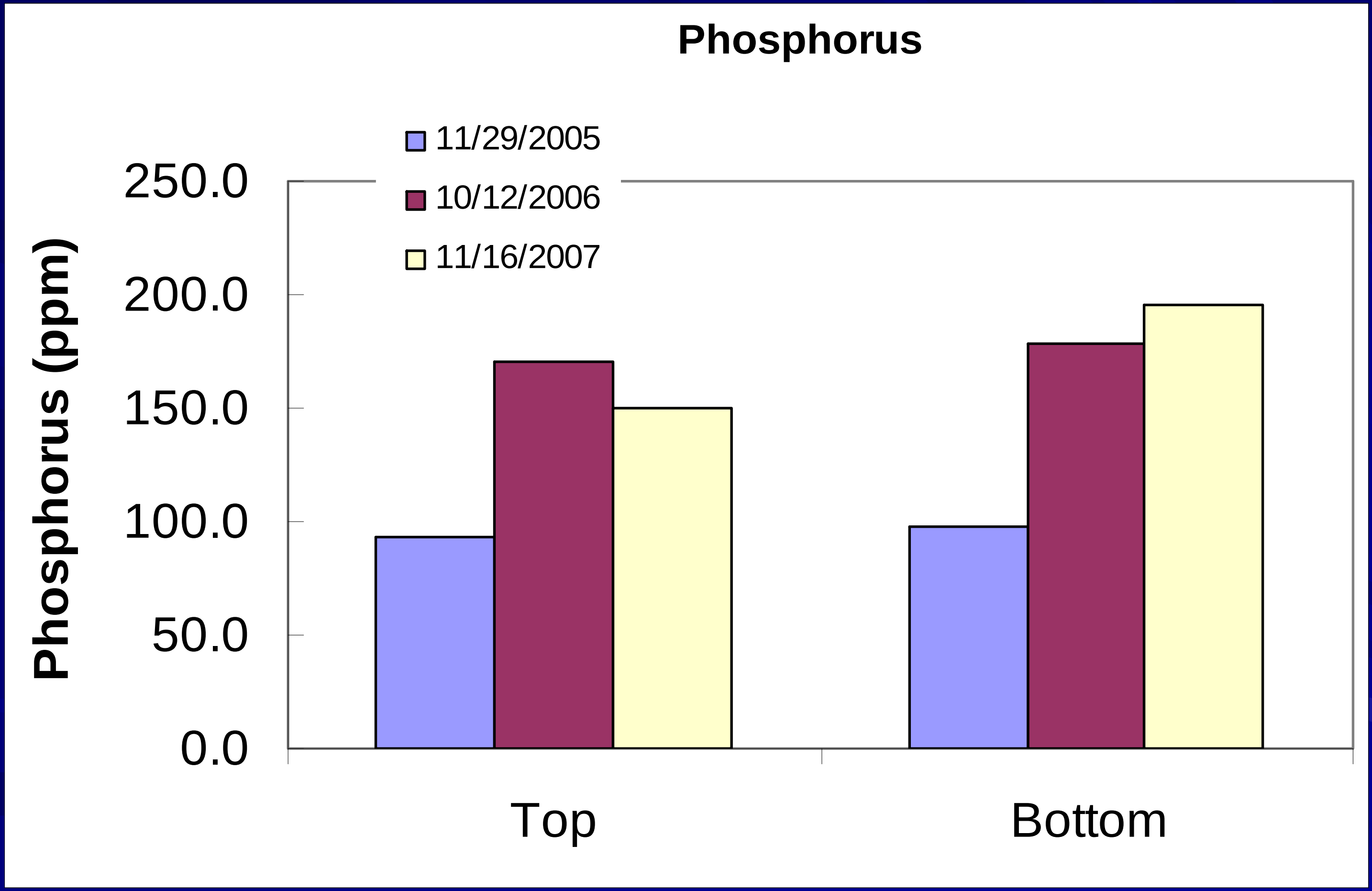
Flow weighted P concentration – Central IA 2



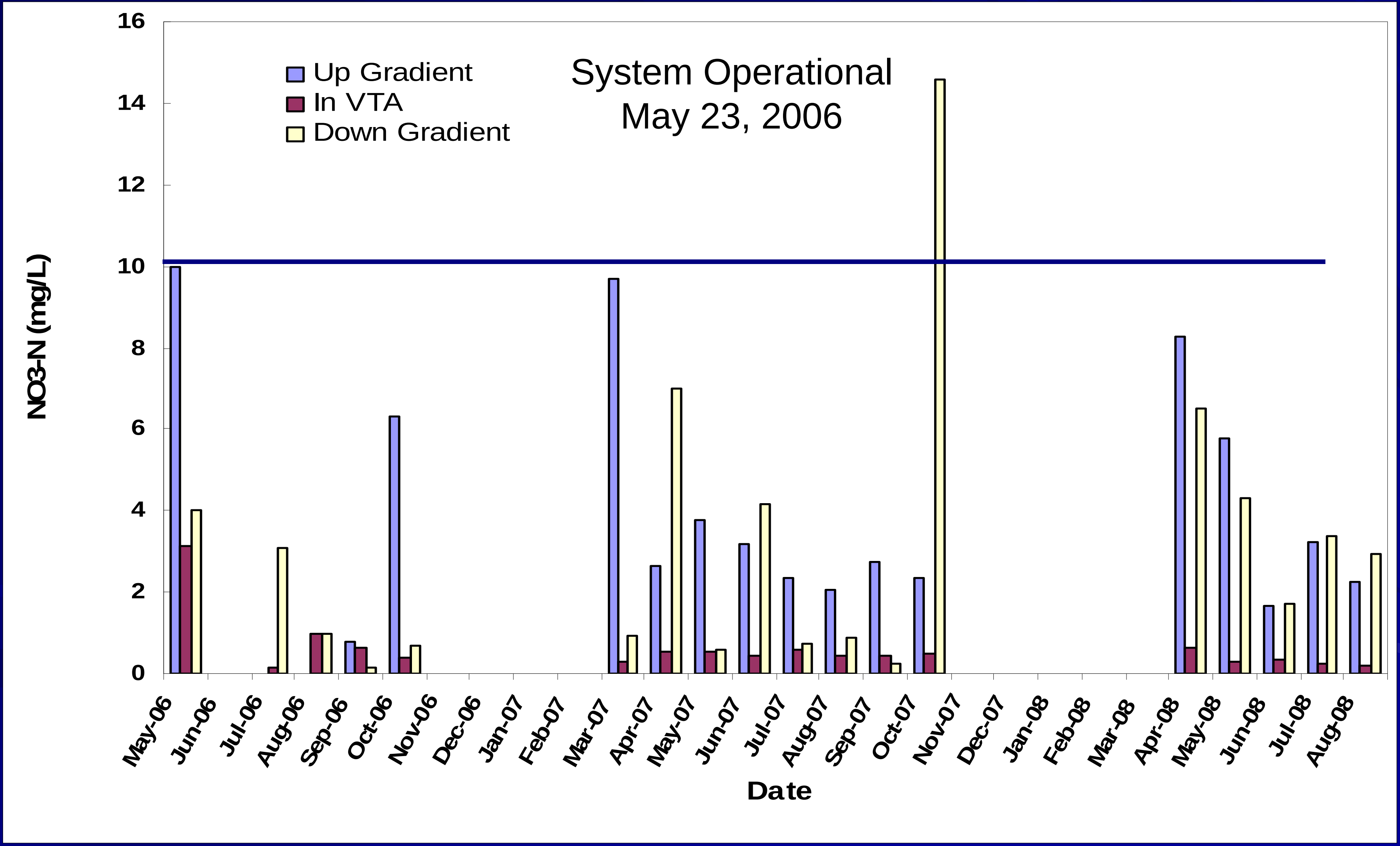
Flow weighted TKN concentration – Central IA 2



Soil P vs. Distance – Central IA 2



NO_3-N Concentration in Groundwater at Central IA 2



What have we learned so far ?

- Good solids removal before VTS is very important
  - Basin design must provide significant solids removal
  - Basins must be actively managed

- Larger basin sizing (more water storage) increases management flexibility and improves system performance

- Channeling is a continual problem – minimize cut and fill.

- The better the vegetation the better the system performance

Good solids removal is very important

- Basin design must provide significant solids removal

- Basins must be actively managed

Solids Build Up in VIB – Northwest IA 2

Ability to hold water before VTS provides needed management flexibility

Larger basin sizing (more water storage) increases management flexibility and improves system performance

Channeling is a continual problem – minimize cut and fill

Ridges in VTA to Hold Water – Southwest IA 2

Good vegetation is a must

Multi-State CIG
11/20/07 – 10/21/2009

- Nebraska – 2 sites
  - NE Cattleman and Univ. of Nebraska, Lincoln
  - Rockville, NE (1200 hd); constructed, vegetated, & data collection initiated
  - Spalding, NE (5000 hd); constructed, vegetation started, & preparing to collect data
- South Dakota – 2 sites
  - University of South Dakota
  - Brandon, SD; constructed, needs vegetation
  - 2nd site is having permitting issues
- Minnesota – 1 site
  - University of South Dakota
  - Morris, MN; constructed, vegetated, and data collection initiated
- Illinois – 1 site
  - University of Illinois, Urbana-Champagne
  - Yet to be determined

Rockville, NE

http://www.abe.iastate.edu/wastemgmt/beef-at-systems.html

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Non-Basin Technologies for Open Feedlot Runoff: Demonstration, Implementation, and Modeling

Project Leaders

Dr. Robert Burns, Lara Moody, Carl Pederson, Dan Andersen, Ishadeep Khanijo, Laura Pepple, Ross Muhlbauer, John Lester, Dr. Matt Helmers, and Dr. John Lawrence

Project Background

CAFO rules released by the EPA in 2003 include verbiage for use of modeled and tested Alternative Technologies proved to be as effective as traditional basin systems. The technologies in this study are settling basins releasing to Vegetated Infiltration Basins (VIBs) combined with Vegetated Treatment Areas (VTAs) or settling basins releasing to VTAs. The results are being compared to potential annual control attainable with traditional containment systems. This work is continued from a project started by Jeff Lorimor.

Settling Basin and a Vegetated Treatment Area

-

Project Objectives:

- Evaluate through field monitoring, performance of VIBs and VTAs on six sites in Iowa that were designed using the developed models.
- Assess feasiblility of VIBs and VTAs as alternative systems
- Assess feasibility of the models for design of future systems.
- Quantify contaminant concentrations and annual mass flow from treatment areas receiving settled feedlot runoff.

ISU VTS Publications

- L.M. Pepple, R.V. Muhlbauer, R.T. Burns, L.B. Moody, C. Pedersen, D.S. Andersen, T.A. Shepherd. Validation of a Low Cost Monitoring Vegetative Treatment System Performance. 2008 Proceedings: *2008 ASABE Annual International Meeting.* June 29-July 2, 2008.
- D. Andersen, R. Burns, L. Moody, C. Pedersen. The Use of Soil-Plant-Air-Water Model to Predict the Hydraulic Performance of Vegetative Treatment Areas for Controlling Open Feedlot Runoff. 2008. *Proceedings: 2008 ASABE Annual International Meeting.* June 29-July 2, 2008.
- D. Andersen, R. Burns, L. Moody, M. Helmers. Comparison of the Soil-Plant-Air-Water Model and the Iowa State University Effluent Limitation Guidelines Model to Replicate Holding Basin Performance. 2008. *Proceedings: 2008 ASABE Annual International Meeting.* June 29-July 2, 2008.
- R.V. Muhlbauer, I. Khanijo, R.T. Burns, L.B. Moody, L.M. Pepple, C.H. Pederson. Low Cost Method for Monitoring Flow from a Vegetative Treatment System. 2007. *Proceedings: International Symposium on Air Quality and Waste Management for Agriculture*. September 16-19, 2007.
- I. Khanijo, R. Burns, L. Moody, M. Helmers, J. Lawrence, C. Pederson, D. Anderson. Vegetated Treatment System Models: Modeled vs. Measured Performance. 2007. *Proceedings: International Symposium on Air Quality and Waste Management for Agriculture*. September 16-19, 2007.
- L. Moody, N. Heithoff, R. Burns, C. Pederson, I. Khanijo. Settling Basin Design and Performance for Runoff Control from Beef Feedlots. 2007. *Proceedings: International Symposium on Air Quality and Waste Management for Agriculture*. September 16-19, 2007.
- Khanijo, I., R. T. Burns, L. B. Moody, C. H. Pederson. 2006. Evaluation of Cost Effective Methods for Measuring Runoff Volume from Vegetated Treatment Areas. *ASABE Paper #064047*. St. Joseph, MI: ASABE.
- Moody, L. B., C. H. Pederson, R. T. Burns, I. Khanijo. 2006. Vegetative Treatment Systems for Open Feedlot Runoff: Project Design and Monitoring Methods for Five Commercial Beef Feedlots. *ASABE Paper #064145*. St. Joseph, MI: ASABE.


Questions & Discussion