STA1E PSTA
Demonstration Project

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STA1E PSTA
Demonstration Project Timelines

	12/17/03 Estimate	Actual
Start	12/15/03	12/15/03
Design Complete	5/15/04	
Construction Complete	3/3/04	
Tests Start	7/15/04	10/1/08
Tests Complete	7/22/05	12/31/10

STA1E PSTA Summary Results

		Cell A	Cell B	Cell C
Substrate		1" Limesludge	6" Limestone IL-6	6" Limestone IL-8
Area	acres	46.5	46.5	46.5
Oct - Dec 2008 (N=14)				
Flow	kacft/yr	3.4	3.7	3.6
HLR	cm/d	6.1	6.7	6.5
TP In	µg/L	11.6	12.1	12.1
TP Out	µg/L	11.9	9.9	10.4
Feb - July 2010 (N=24)				
Flow	kacft/yr	1.8	2.2	2.0
HLR	cm/d	3.3	4.0	3.5
TP In	µg/L	11.8	11.9	11.6
TP Out	µg/L	11.7	10.7	10.1

Red = no removal

Blue = removal not statistically significant

STA1E PSTA Analysis

Screening Level with N = 6 and C* = 4

		Cell A	Cell B	Cell C
Substrate		Limesludge	Limestone IL-6	Limestone IL-8
Oct - Dec 2008 (N=14)				
TP In	µg/L	11.6	12.1	12.1
TP Out	µg/L	11.9	9.9	10.4
PLI	gP/m2yr	0.27	0.31	0.30
TP k	m/yr		8.0	6.0
Feb - July 2010 (N=24)				
TP In	µg/L	11.8	11.9	11.6
TP Out	µg/L	11.7	10.7	10.1
PLI	gP/m2yr	0.14	0.17	0.15
TP k	m/yr	0.2	2.4	2.9

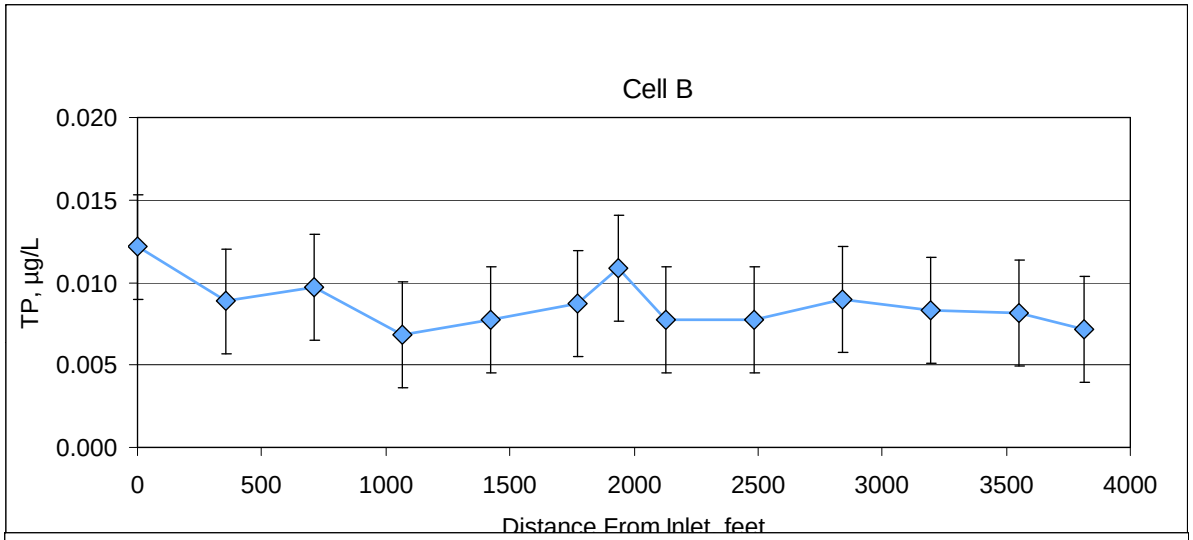
Most optimistic settling rate = 8.0 m/yr

Red = no removal

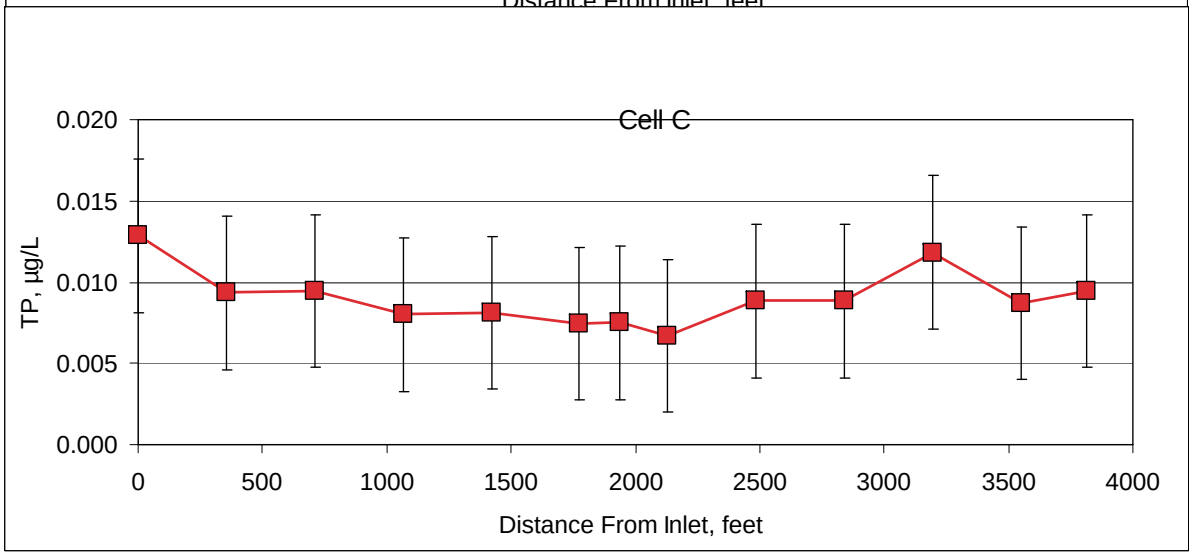
Blue = removal not statistically significant

STA1E PSTA Transect Results

7 transects, 2010; only slight distance trends; ±1 stdev error bars



k = 8 m/yr



k = 3 m/yr

Direct Scaleup STA1E

Assume:

1. Approximately 185 kacft/yr to be treated.
2. The demonstration loading is used, 3.7 kacft/yr on 46.5 acres.
3. Water is pretreated to 12 ppb by existing and expanded EAV/SAV STAs.
   A. Requires current STA (5100 ac)
   B. Requires additional EAV/SAV STAs (ca. 4000 ac)

Additional PSTA area required would be (185/3.7)x(46.5)= 2325 acres

Total new area = 6325 acres

The demonstration project was not necessarily operated at the optimal inlet concentration or optimal hydraulic loading - both very low. Direct scaleup not appropriate?

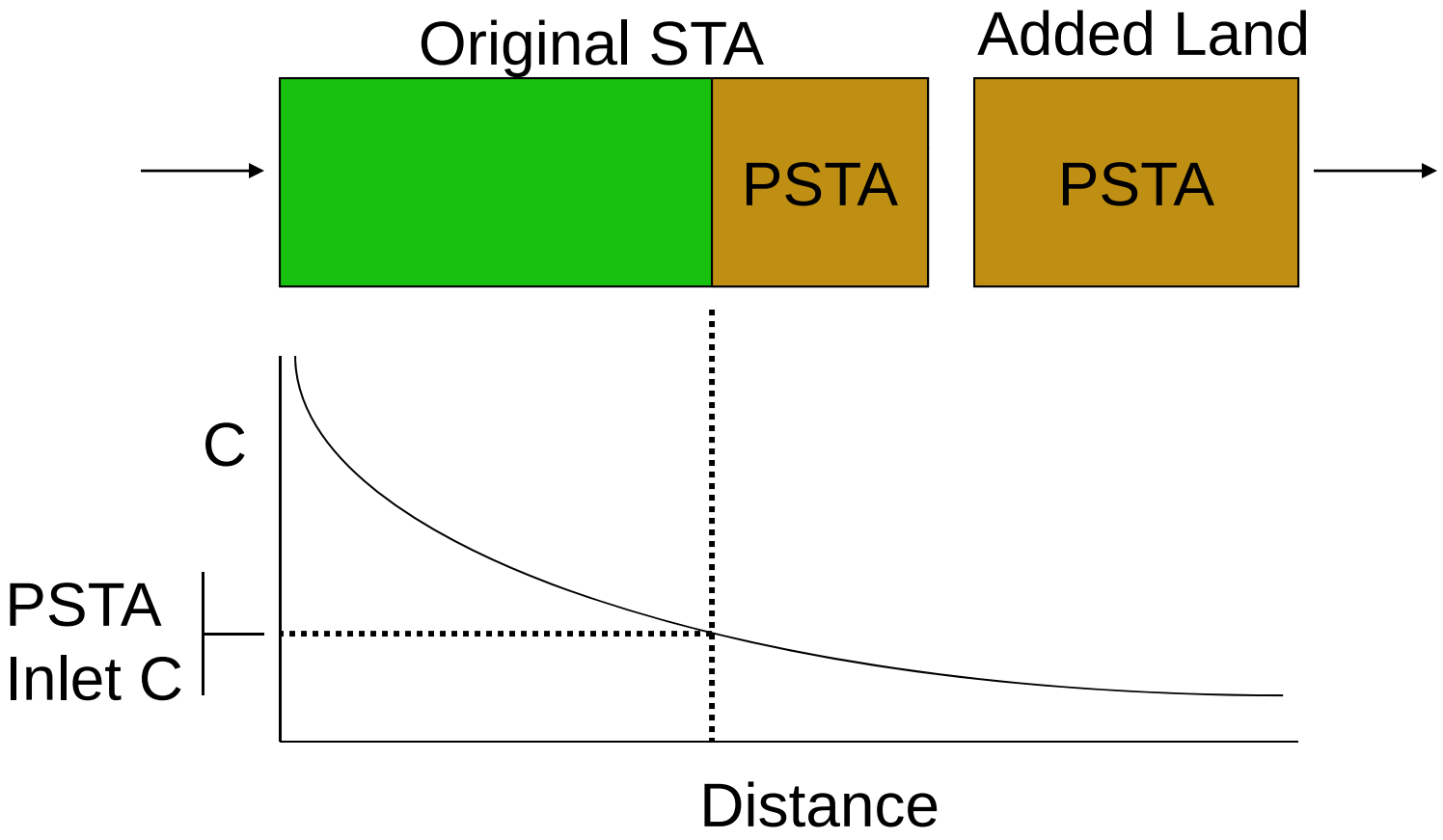
Adding PSTA to STA1E

Estimates based on screening model forecasts

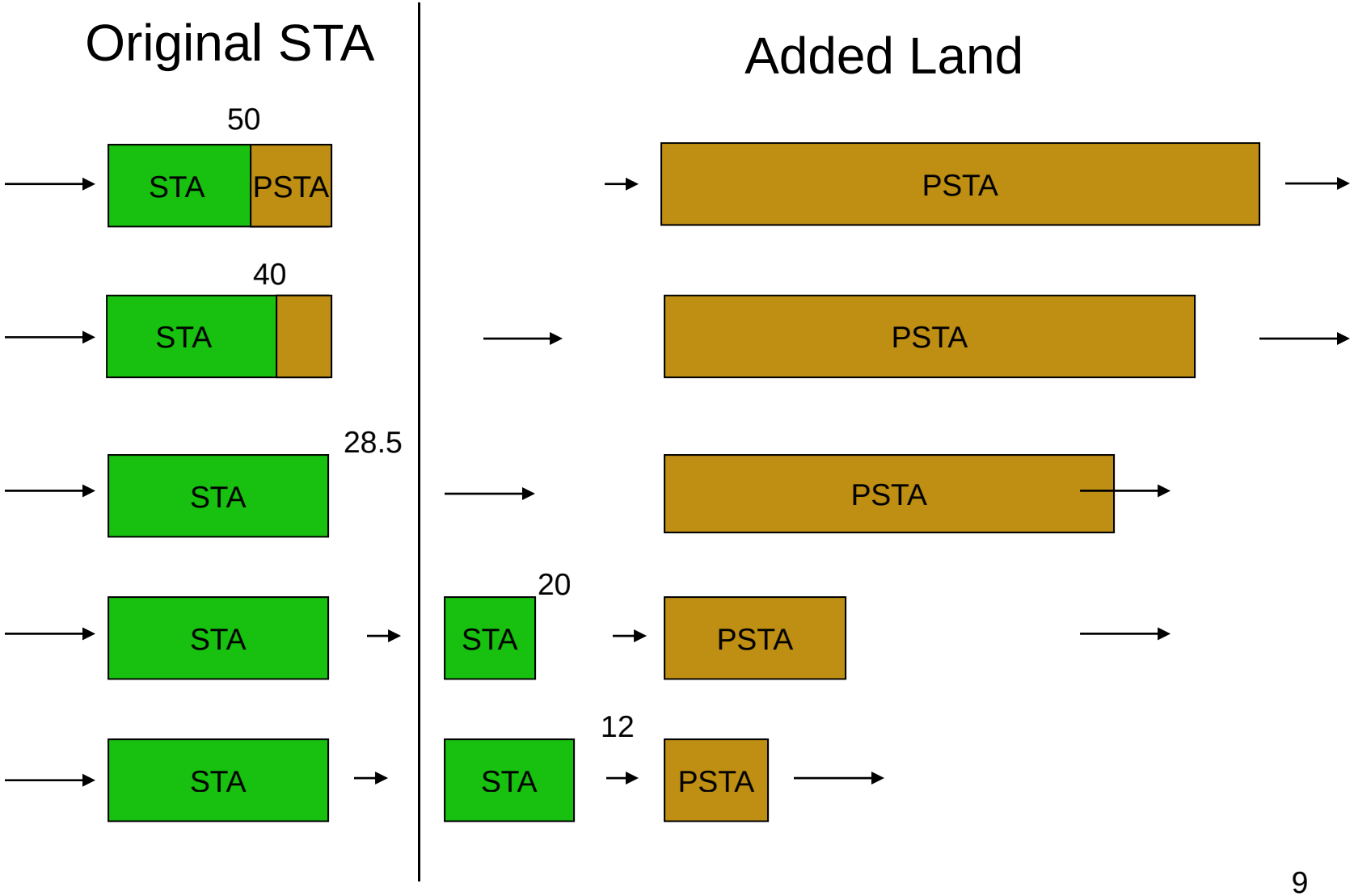
- Model forecasts that current 5100 acres achieves 28.5 ppb at 185 kacft/yr and 155 ppb
- Some can be converted to PSTA (retrofit) Additional PSTA acres needed
- If PSTA inlet <28.5, ppb, additional STA needed
- PSTA may not survive at > 50 ppb

PSTA Implementation

Partially retrofit in existing STA, and
partially new construction on additional land



PSTA Implementation



Model Based Scaleup STA1E

STA Screening Level Model
Assume various PSTA inlet concentrations
Assume k = 8.0 m/yr for PSTA, 23.5 m/yr for SAV

PSTA Start	Total PSTA	Internal PSTA	New STA	New PSTA+STA
ppb	acres	acres	acres	acres
12	2,076	0	3,999	6,075
20	7,507	0	1,435	8,942
29	11,171	0	0	11,171
40	14,711	1,216	0	13,496
50	17,087	1,947	0	15,140
SAV Start	Total SAV	Internal SAV	New STA	New SAV
ppb	acres	acres	acres	acres
29	2,979	0	0	2,979

Screening Model Scaleup Economics

PSTA Start ppb	Retrofitting $ millions	New Area $ millions	Total $ millions
12	0	167	167
20	0	344	344
29	0	469	469
40	27	567	594
50	43	636	679

SAV Start ppb	Retrofitting $ millions	New Area $ millions	Total $ millions
29	0	60	60

Land = $10k/ac

Retrofit PSTA = $22k/ac

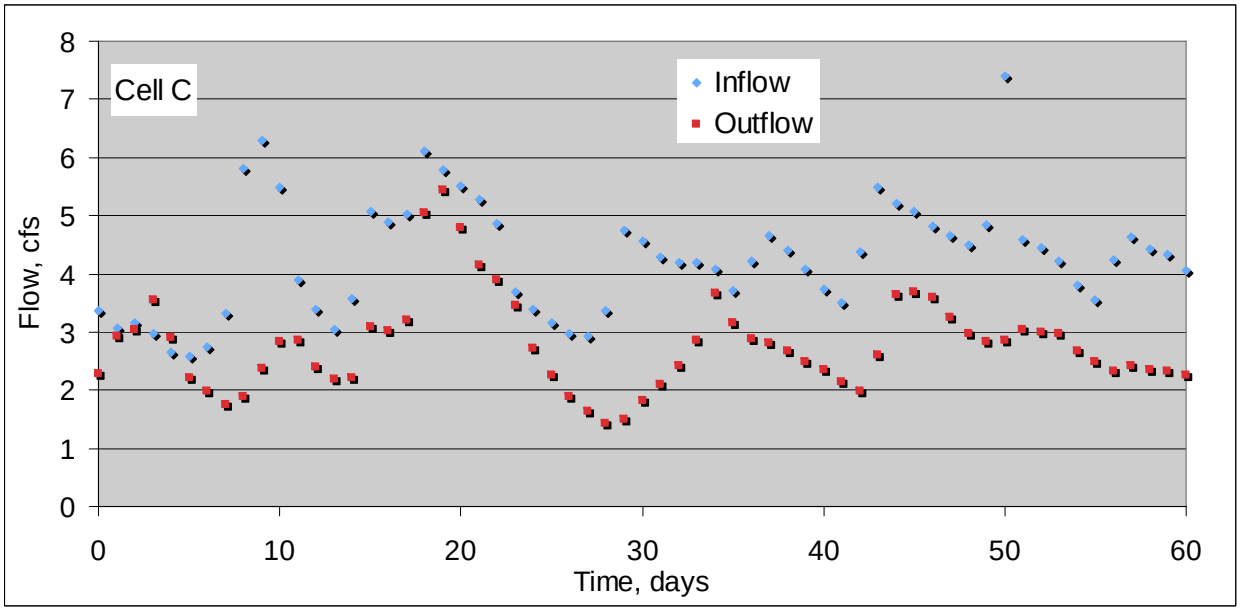
Build STA = $10k/ac

Land + Build PSTA = $42k/ac

Additional Issue: Pulsed Inflows

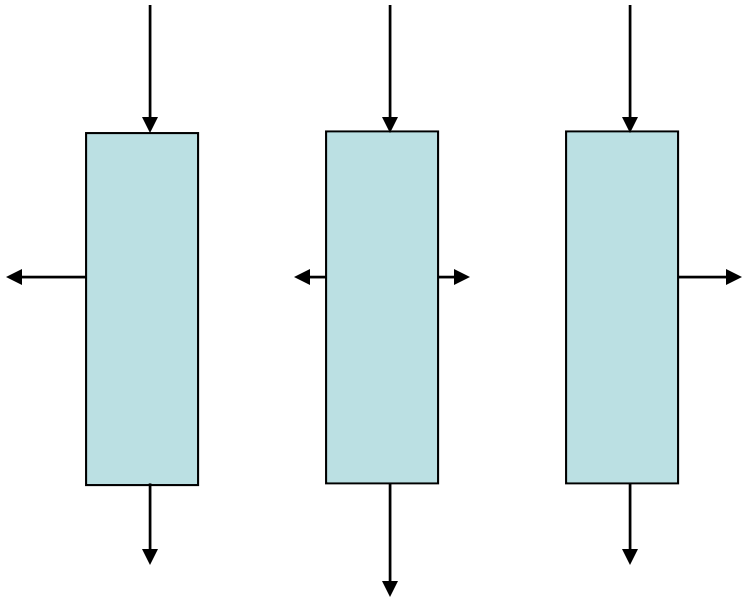
The demo project has been run under controlled flow conditions. The effect of pulsing is to lower the efficiency of a wetland system. Performance is expected to be worse under pulsing.

Alternatively, flow equalization could be employed. That would add the expense of building a FEB, which are typically more costly per unit flow than STAs.



Additional Issue: Seepage

		Cell A	Cell B	Cell C
Mean Stage	ft	17.31	17.27	17.33
In	cfs	4.19	4.27	4.27
Out	cfs	2.36	3.70	2.78
Loss	cfs	1.84	0.56	1.49
		42%	13%	35%



Effect on settling rates:
Lower by 6 - 20%

Effect on areas:
More acres

Summary

- ✓ The demo project has lasted seven years, and produced one year of data.
- ✓ Outlet concentrations were often less than 10 ppb; inlet concentrations were about 12 ppb.
- ✓ Removals were negative in one of six datasets.
- ✓ Removals were statistically insignificant in four of six datasets.
- ✓ The most optimistic settling rate (Cell B, 2008) was far less than for other wetland types:
  - 8.0 m/yr STA1E Demo PSTA best case
  - > 22 m/yr STA34 PSTA (also produces <10 ppb)
  - > 20 EAV/SAV STA
- ✓ Forecasted added areas required are double to quadruple the existing STAs
- ✓ Forecasted area for PSTA about triple that for SAV for same job
- ✓ Forecasted cost for PSTA about eight times that for SAV for same job