

Modeling and Measurement of Methyl Bromide at Food Processing Facilities

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Introduction

- Methyl Bromide undergoing re-registration under FQPA/FIFRA
- EPA Risk Assessment: Found potential health risks to workers and bystanders
- Proposed mitigation measures:
Management plans, respiratory protection, and buffer zones

Proposed Buffer Zones

- Used PERFUM model—originally designed to be applicable to simple emission scenarios (e.g., point source, soil fumigation)
- Current model does not take into account complexities in commodity/structural fumigations
- Published buffer zones not consistent with experience and field observations

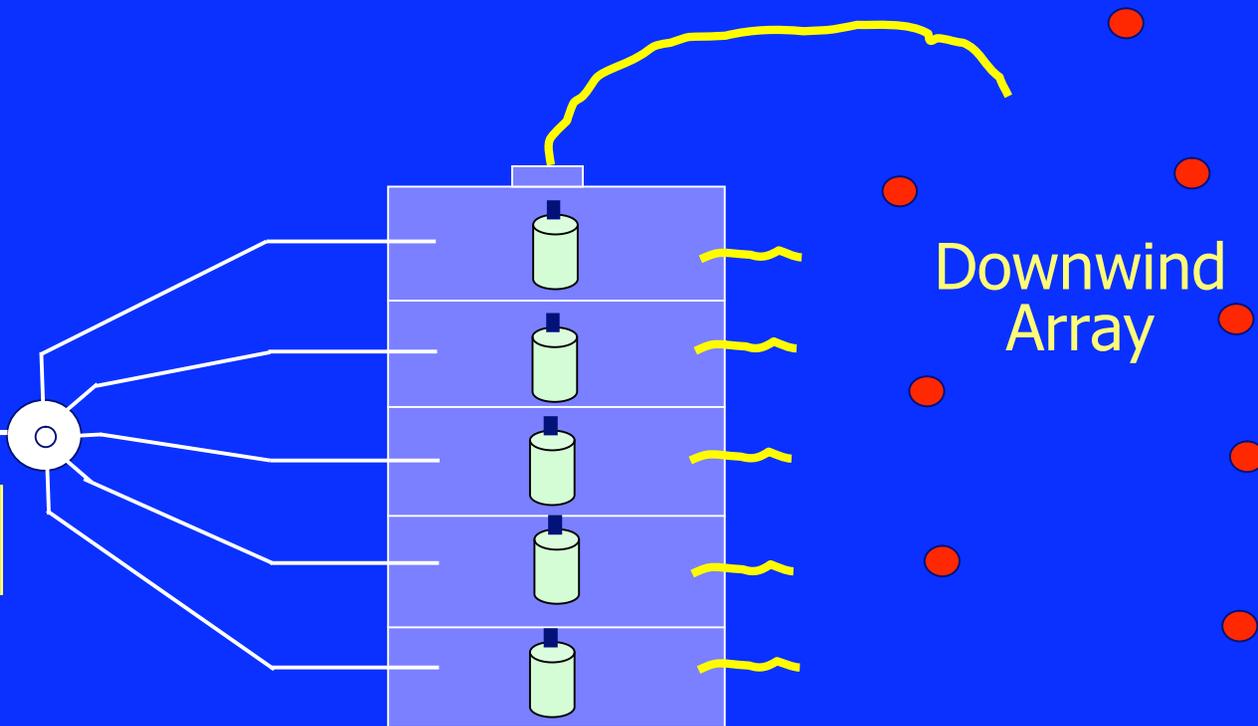
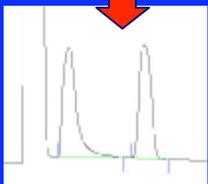
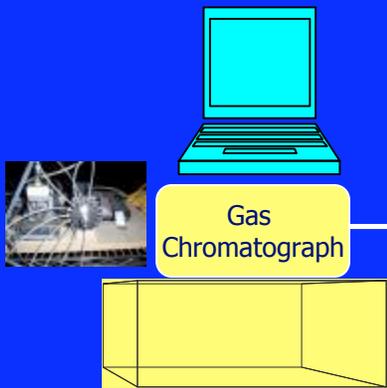
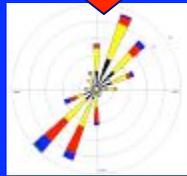
Study Objectives

- Select mill sites representative of a range of 'typical' industry practices in terms of size, type of operation, fumigation protocol, and treatment/aeration processes
- Characterize plant operations in detail
- Collect data to determine emission rates, mixing rates, ambient concentrations for use in subsequent site-specific modeling
- Perform modeling using PERFUM, AERMOD, or other models (e.g., Calpuff)
- Compare results with proposed buffer zones

Technical Approach

- Characterize source emissions and downwind concentrations during two periods—Treatment and Aeration
- Downwind array—short/long term: 2 hrs, 4 hrs, 8 hrs periods/24 hr: Analysis by GC/MS (MDL = 1 ppbv)
- Source measurements (Portable GC)—Inside mill (4-6 points) and at stack exhaust(s) at 5 to 60 minute frequency
- High sensitivity wind measurements

Test Approach



Time	Time (hr)	Test Period	Source	Downwind					Upwind		
				Integration	Number/Sites	Number	Type	Long Term	Sites	Type	
11:00	0	TREATMENT	5 min rotation 2 roof-top 3 internal	4 hr	6	6	BV	4 canister 24-hr	1	Canister	
12:00	1			4 hr	6	6	BV				
13:00	2			4 hr	6	6	BV				
14:00	3										
15:00	4										
16:00	5										
17:00	6										
18:00	7										
19:00	8										
20:00	9										
21:00	10										
22:00	11										
23:00	12										
0:00	13										
1:00	14										
2:00	15										
3:00	16										
4:00	17										
5:00	18										
6:00	19										
7:00	20										
8:00	21										
9:00	22										
10:00	23										
11:00	0	AERATION	5 min rotation 2 roof-top 3 internal	2 hr	(1-17)	17	BV	6 canister 24-hr	1 canister 24-hr	canister	
12:00	1			2 hr	(1-17)	17	BV				
13:00	2			2 hr	(1-17)	17	BV				
14:00	3			4 hr	(1-17)	17	BV				
15:00	4			4 hr	(1-17)	17	BV				
16:00	5										
17:00	6										
18:00	7										
19:00	8										
20:00	9										
21:00	10										
22:00	11										
23:00	12										
0:00	13										
1:00	14										
2:00	15										
3:00	16										
4:00	17										
5:00	18										
6:00	19										
				8 hr	(1-17)	8	Canister				

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Source Measurements

- Portable Two-channel Micro Gas Chromatograph (TCD). Calibrated with dilution system from certified standard: 50 to 5000 ppmv
- MDL ~1-10 ppmv
- Sampling manifold (1-6 locations through Teflon tubing)—continuously pumped/purged
- First channel—continuous at single location
- Second channel—switched locations through rotary valve

Ambient Sampling Stations

- Short-term sample (1-4 hr)—1 liter bottle vacs, with critical orifice flow controller
- Long-term sample (4 hr-24 hr)—1 to 6 liter Summa-type Silonite treated canister with adjustable orifice flow controller
- Analysis by EPA Compendium Method TO-15, MDL = 1 ppbv
- Precision ~10% (based on duplicate samples)

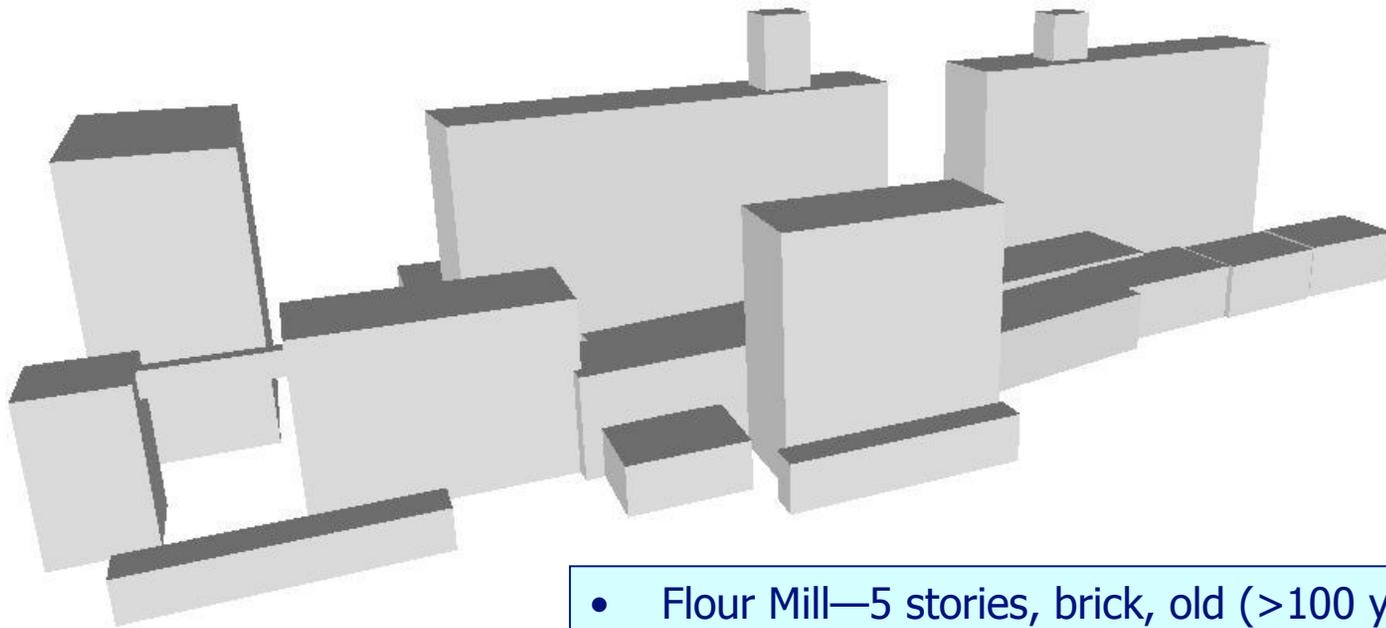


Meteorology

- 10 meter tower—sonic sensors at 10 and 2 meter heights
- 3 meter tower—vane sensor



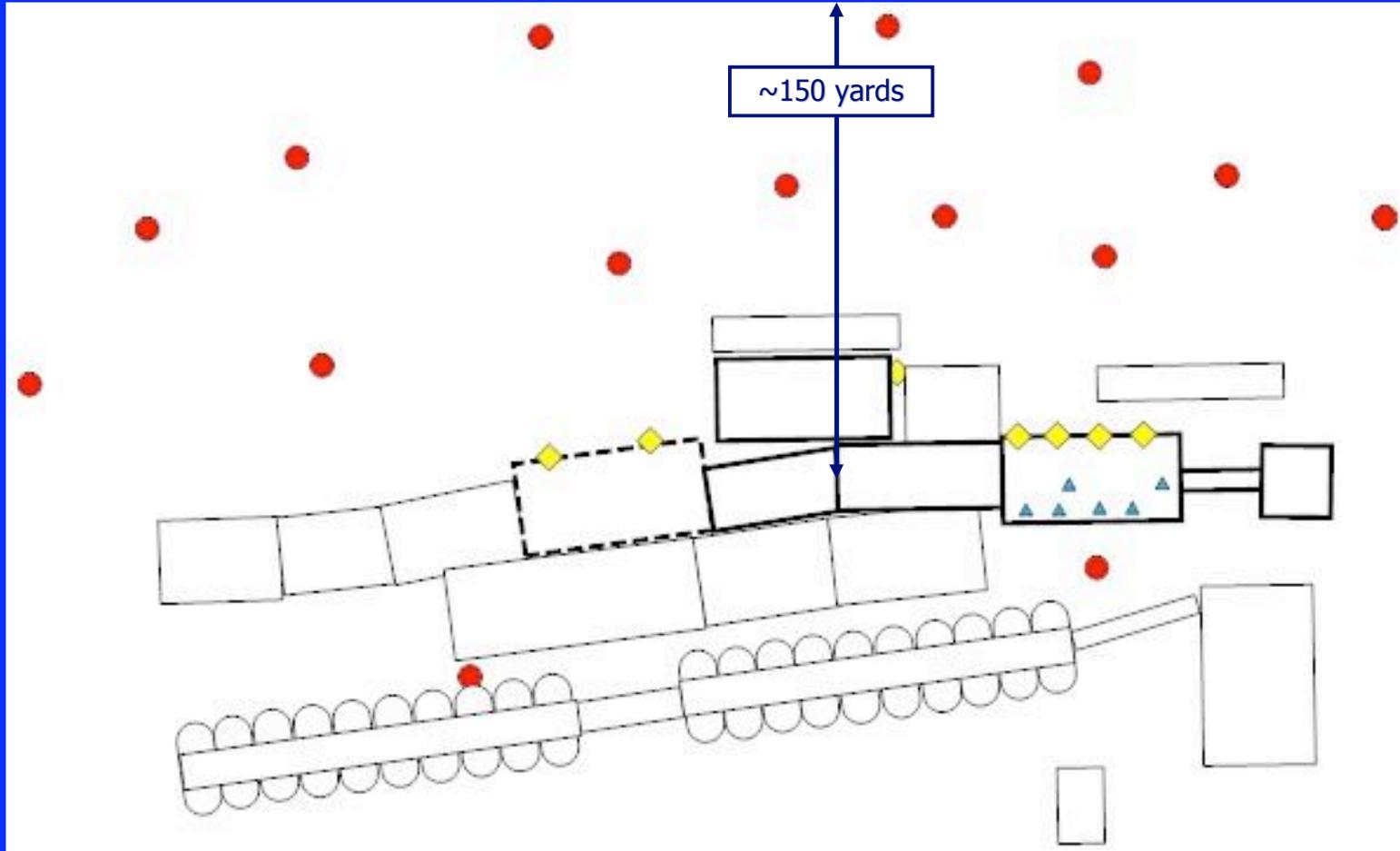
Site A



- Flour Mill—5 stories, brick, old (>100 yrs, considered 'not tight')
- 1.3 million ft³
- Treatment: 24 hrs @ 16 oz/1000 ft³
- 24 hrs under Passive Aeration—Vents, Windows, Doors

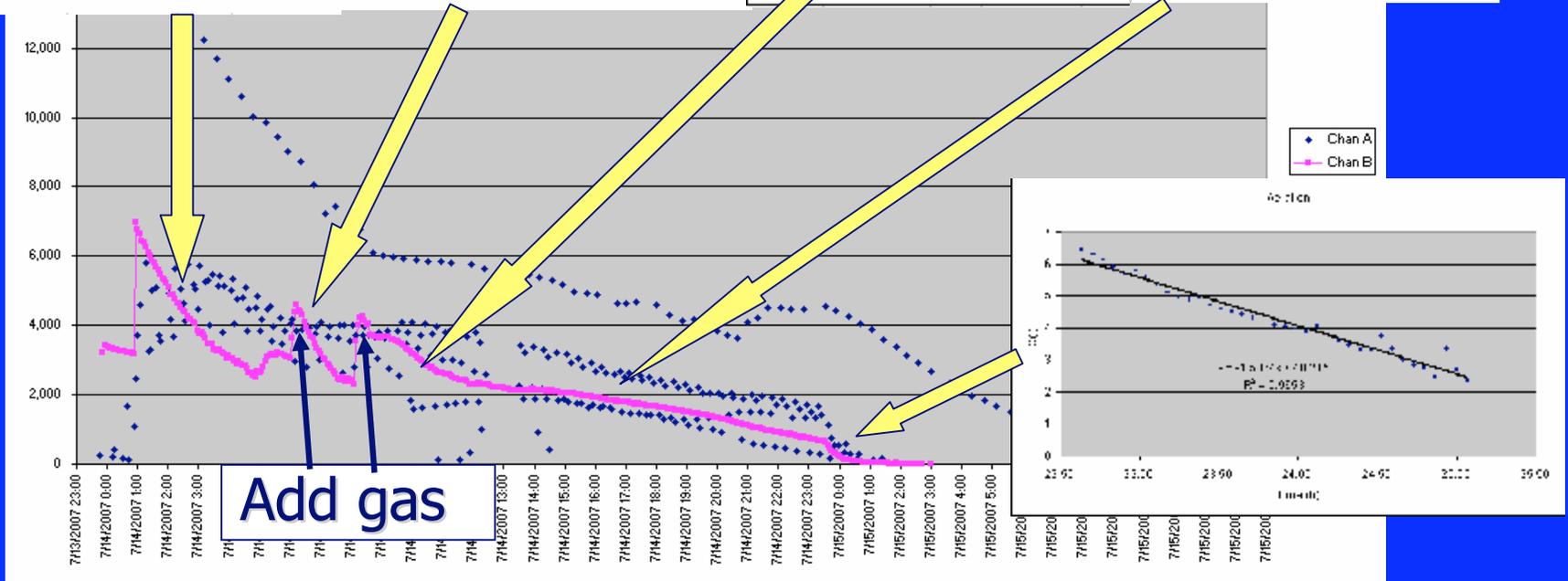
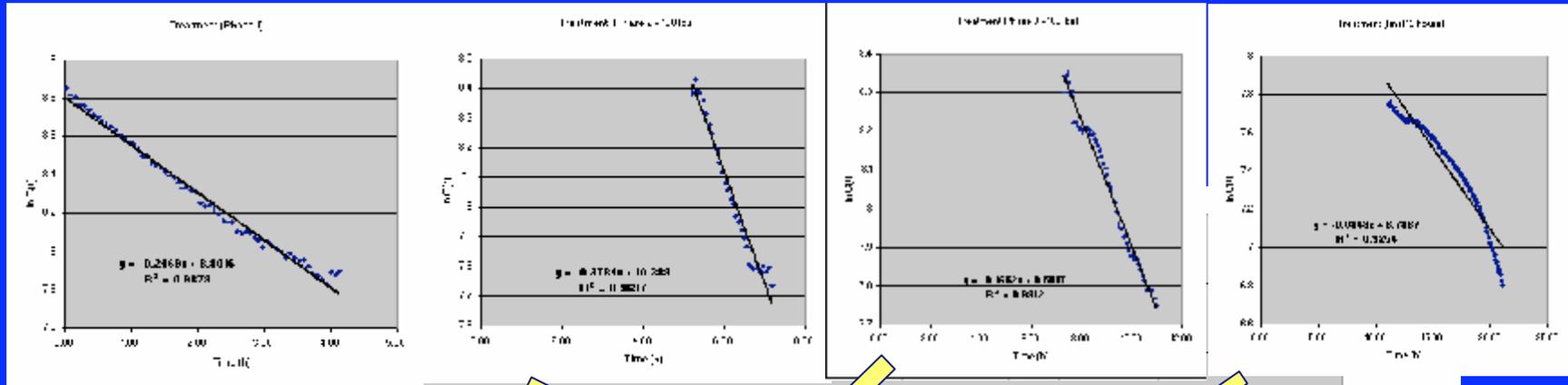


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Emission Profile—Losses/Emissions

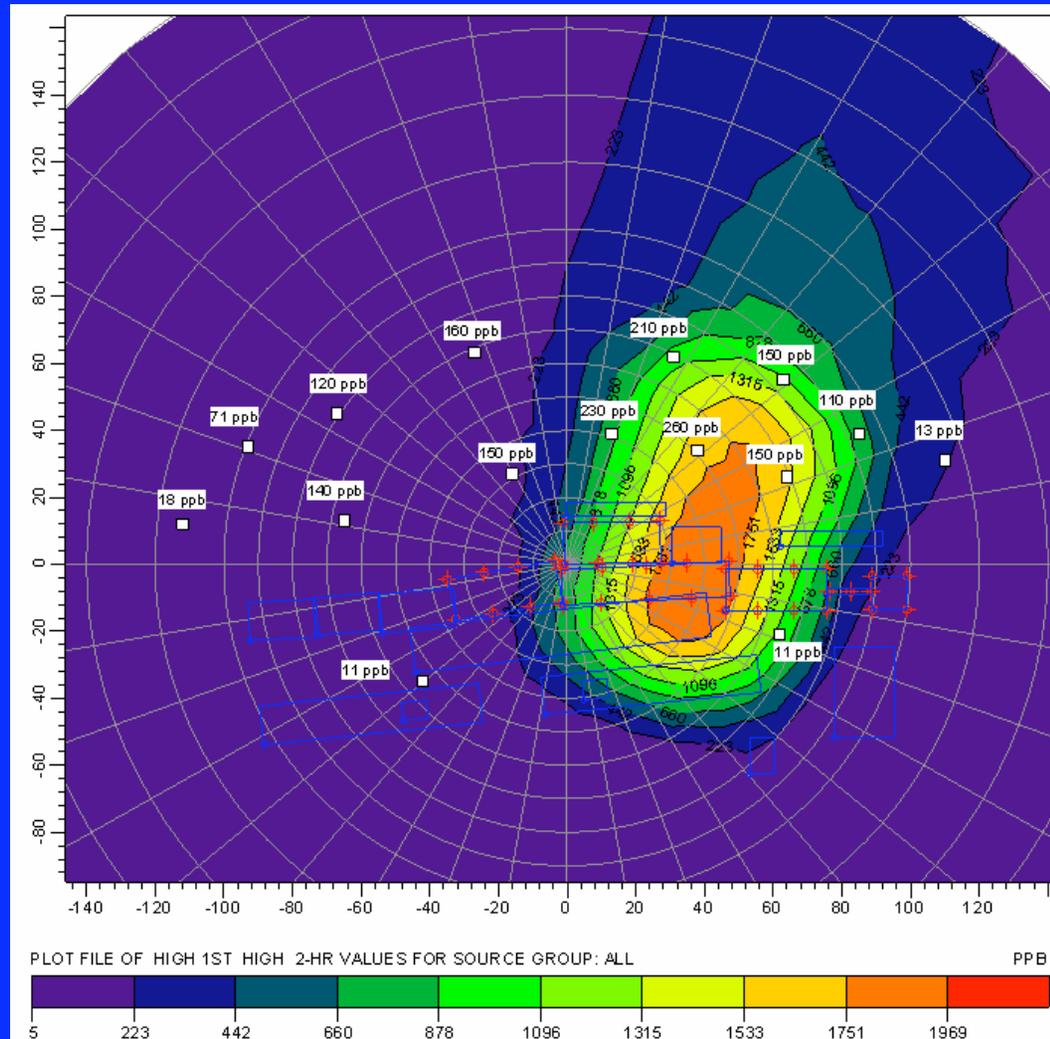


	7/13-14/2007	7/14/2007	7/14/2007	7/14/2007	7/14/2007	7/14/2007	7/14/2007	7/13-14/2007
Start	23:45	1:45	3:45	8:00	12:00	16:00		23:45
End	1:45	3:45	7:45	12:00	16:00	23:30		23:30
Duration	2 hr	2 hr	4 hr	4 hr	4 hr	8 hr		24 hr
1	14	57				12		
2	67	25			30	38		
3	100	57	220	35	38	69		100
4	24	28	140	15	28	50		64
5	120	68	290	30	30	78		100
6	130	49				55		
7	80	85	200	29	26	99		170
8	77	72	170	12	18	52		81
9	71	86	280	12	28	100		110
10	75	80						82
11	73	68						
12	110	150	270	24	34			120
13	45	75						
14	140	130	94	14	54	130		
15	88	96	20	15	4.2	43		

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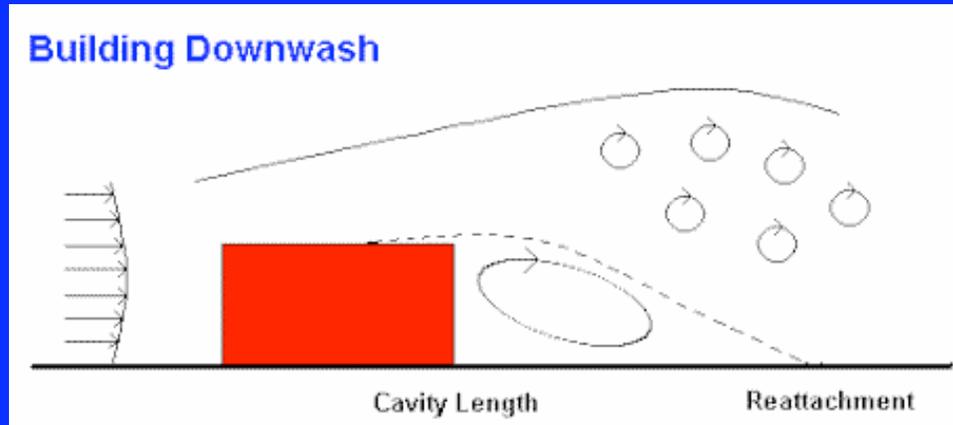
Site A Results

(Preliminary)



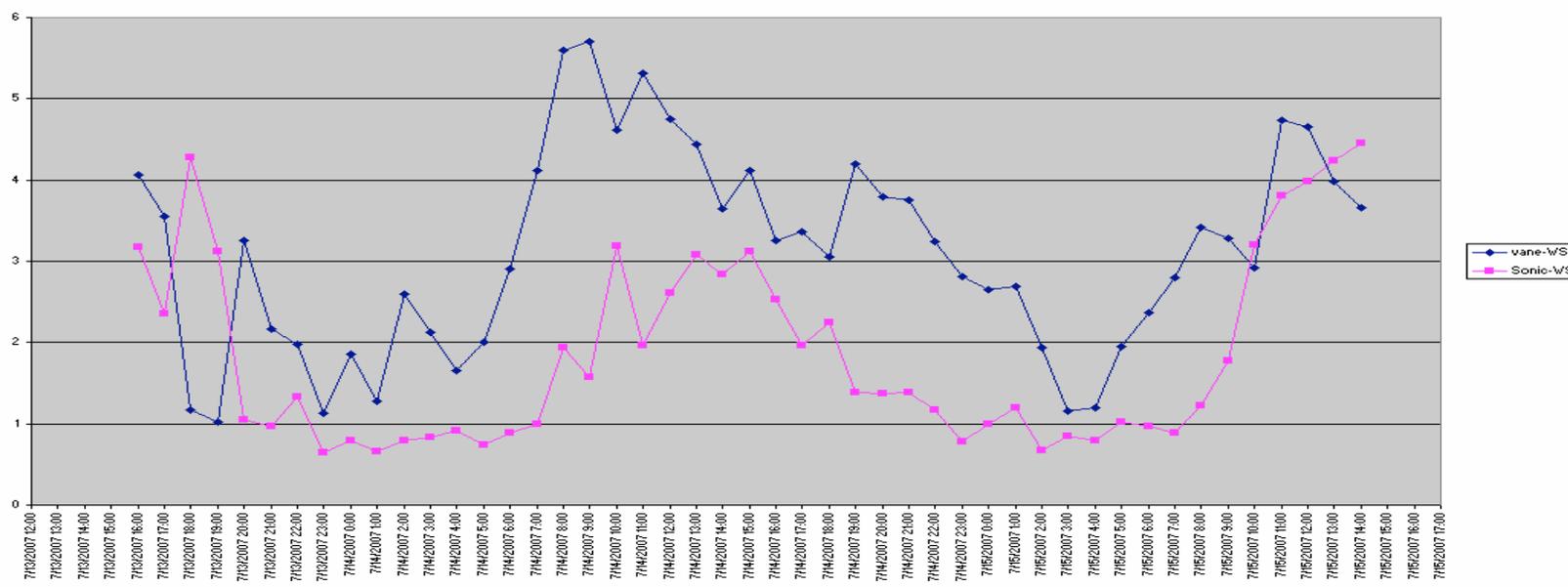
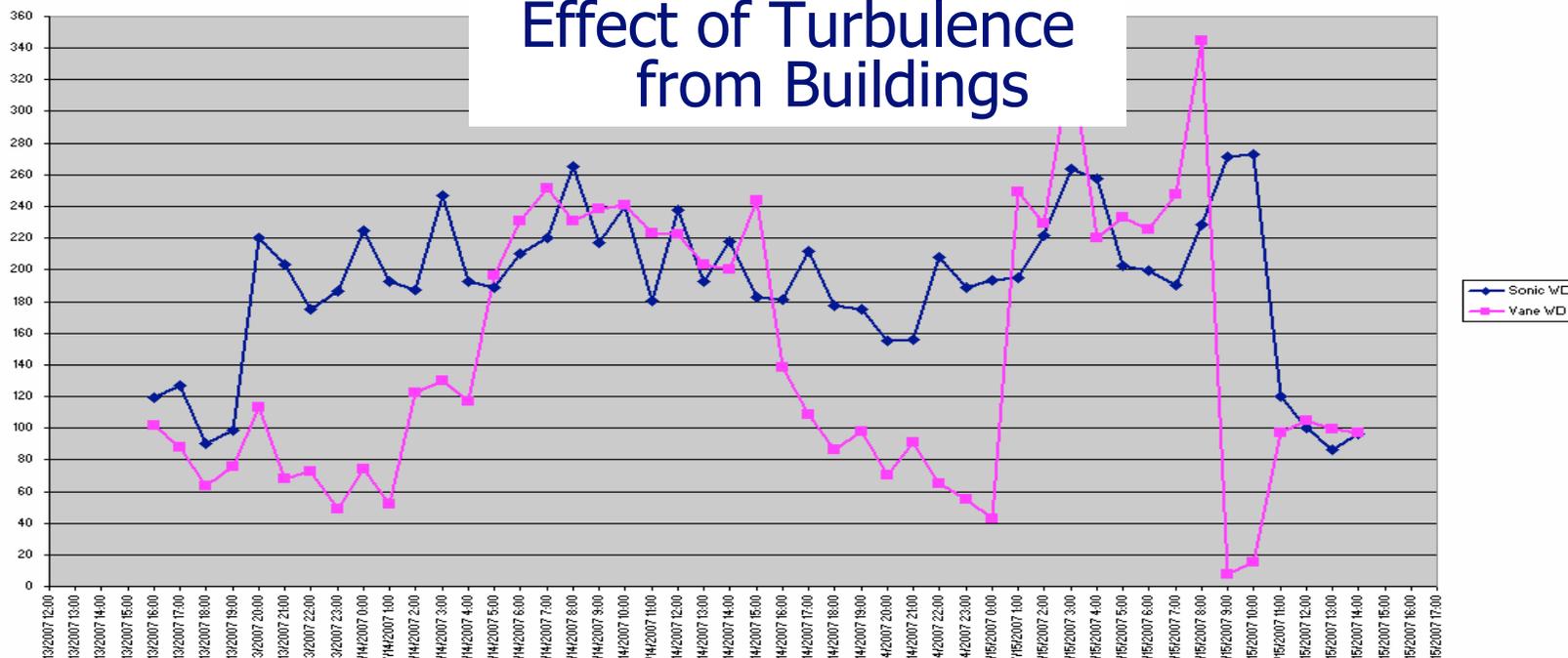
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Building Downwash



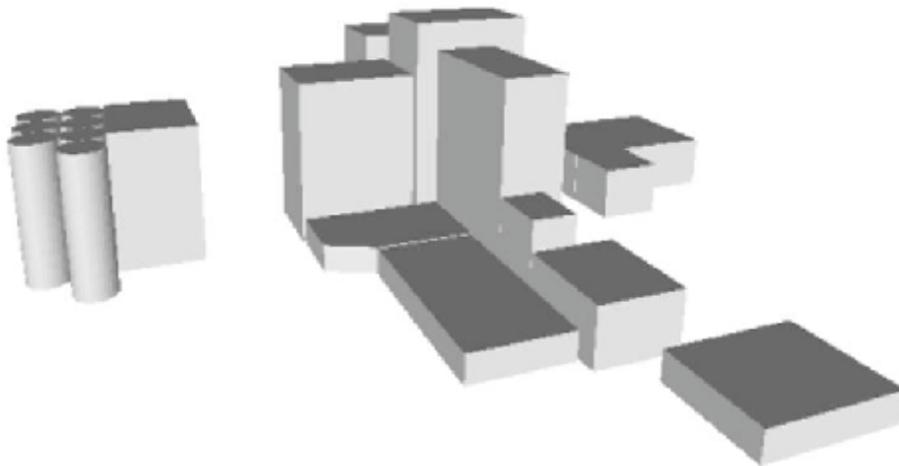
- Minimal loft (plume temp \sim ambient)
- Low velocity (passive venting)

Effect of Turbulence from Buildings



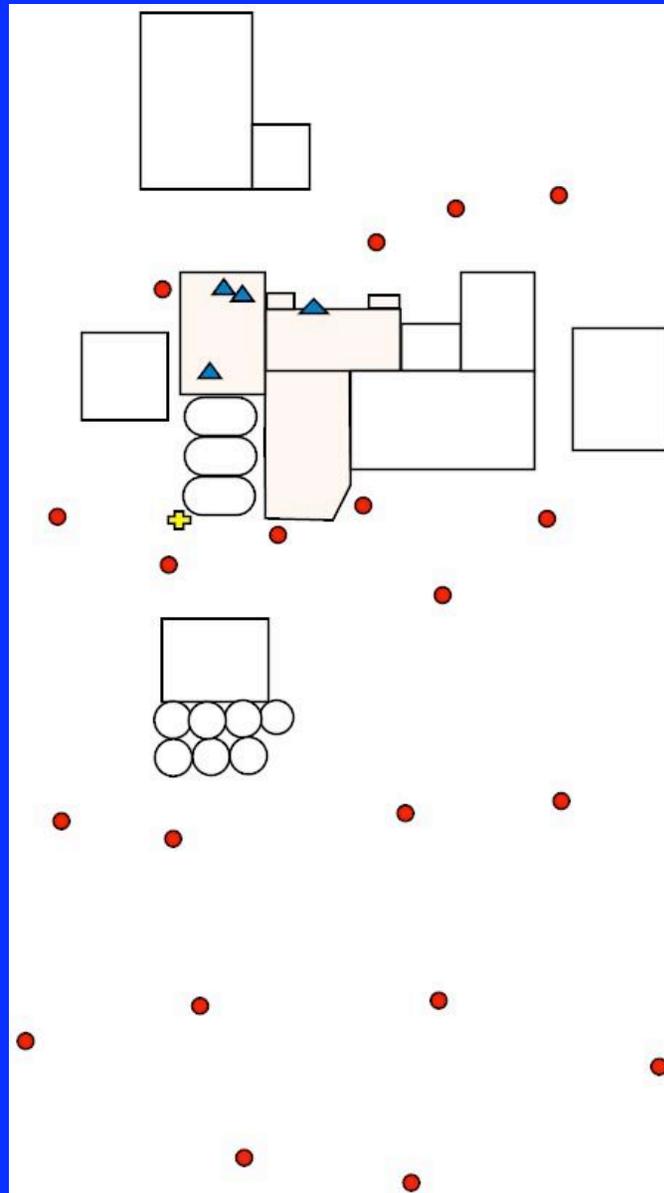
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Site B



- Flour Mill—8 stories, concrete, new (~10 yrs)
- 1.6 million ft³
- Treatment: 24 hrs @ 16 oz/1000 ft³
- 24 hrs under Passive/Active Aeration—Powered vents, short stacks

Wind out of North



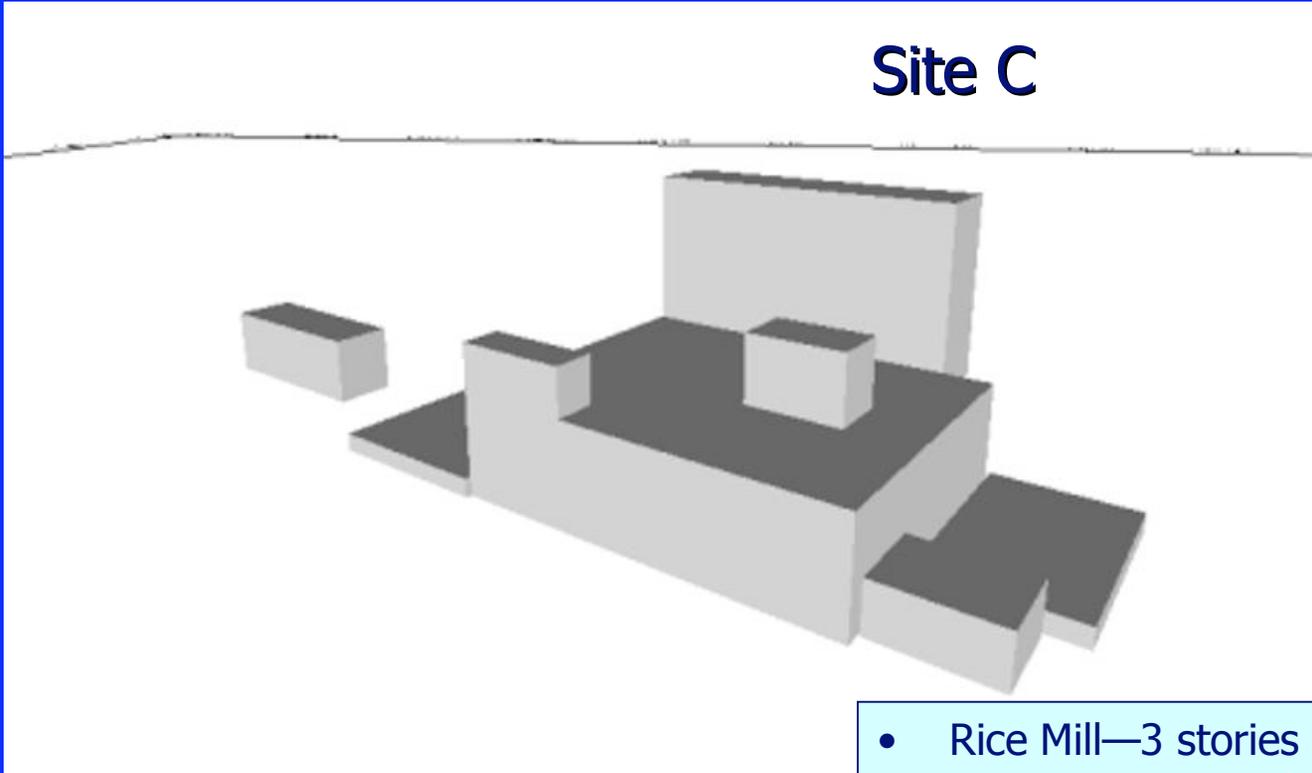
250 yd

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Site B Data

Notes	Start Time	End Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Passive aeration	7/29/07 8:30	7/29/07 10:30	11	2.0	1.5	4.3	3.6	1.0	1.9	19	36	43							
Active aeration	7/29/07 11:30	7/29/07 12:30	4.6	1.4	ND	1.5	ND	ND	ND	4.1	9.9	16	ND	7.2	25	10	ND	6.6	41
Active aeration	7/29/07 12:30	7/29/07 13:30	68	20	14	20	8.4	5.8	13	4.1	5.0	1.8	1.7	3.8	4.9	4.8	28	28	22
Active aeration	7/29/07 13:30	7/29/07 15:30	44	22	14	24	5.6	2.8	40	4.3	ND	1.2	ND	ND	ND	1.9	4.0	7.9	

Site C

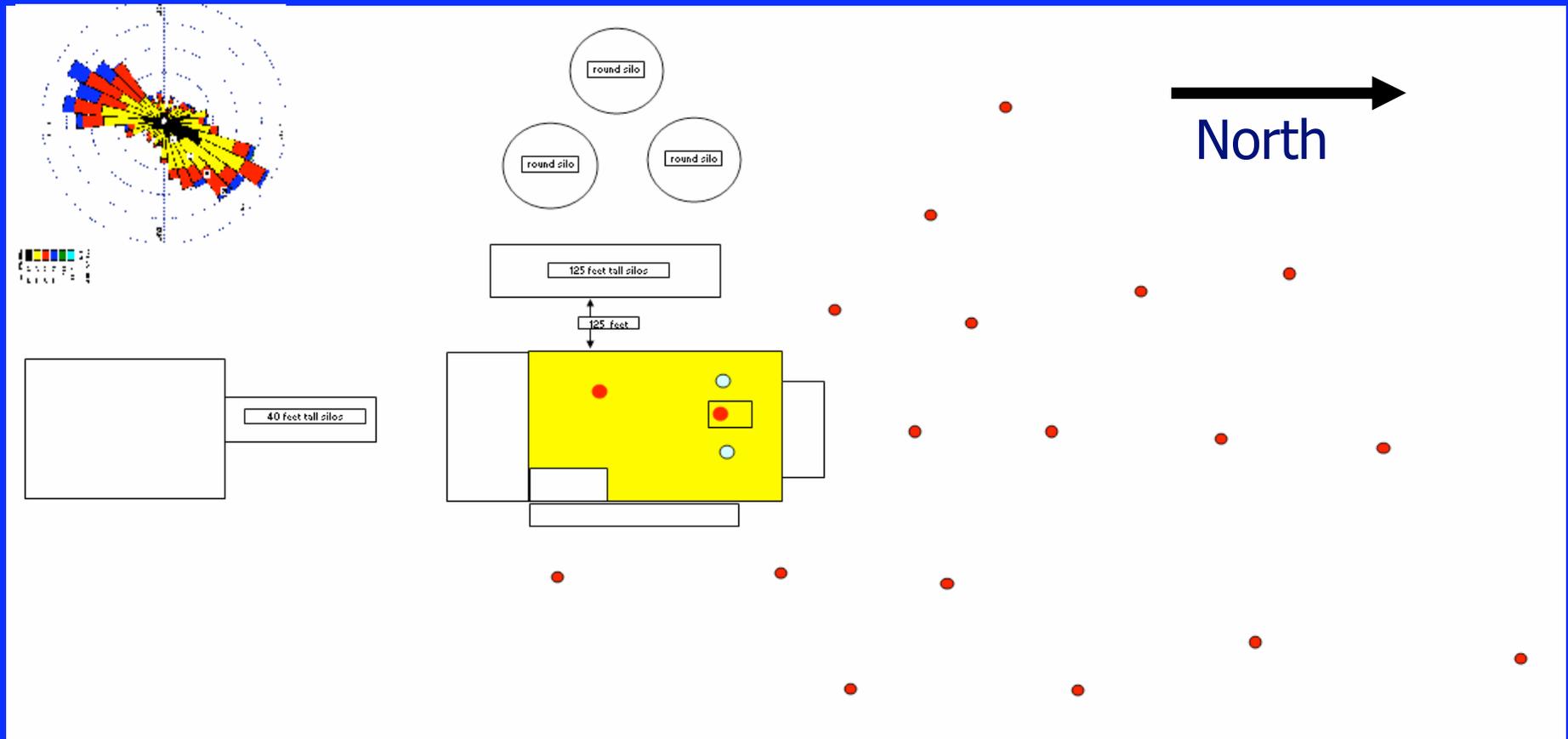


- Rice Mill—3 stories (main bldg, 5 stories vent tower) concrete, new (~20 yrs), considered fairly 'tight'
- 1.3 million ft³
- Treatment: 24 hrs @ 16 oz/1000 ft³
- 12-24 hrs under Passive/Active Aeration—Powered vents, short and tall stacks

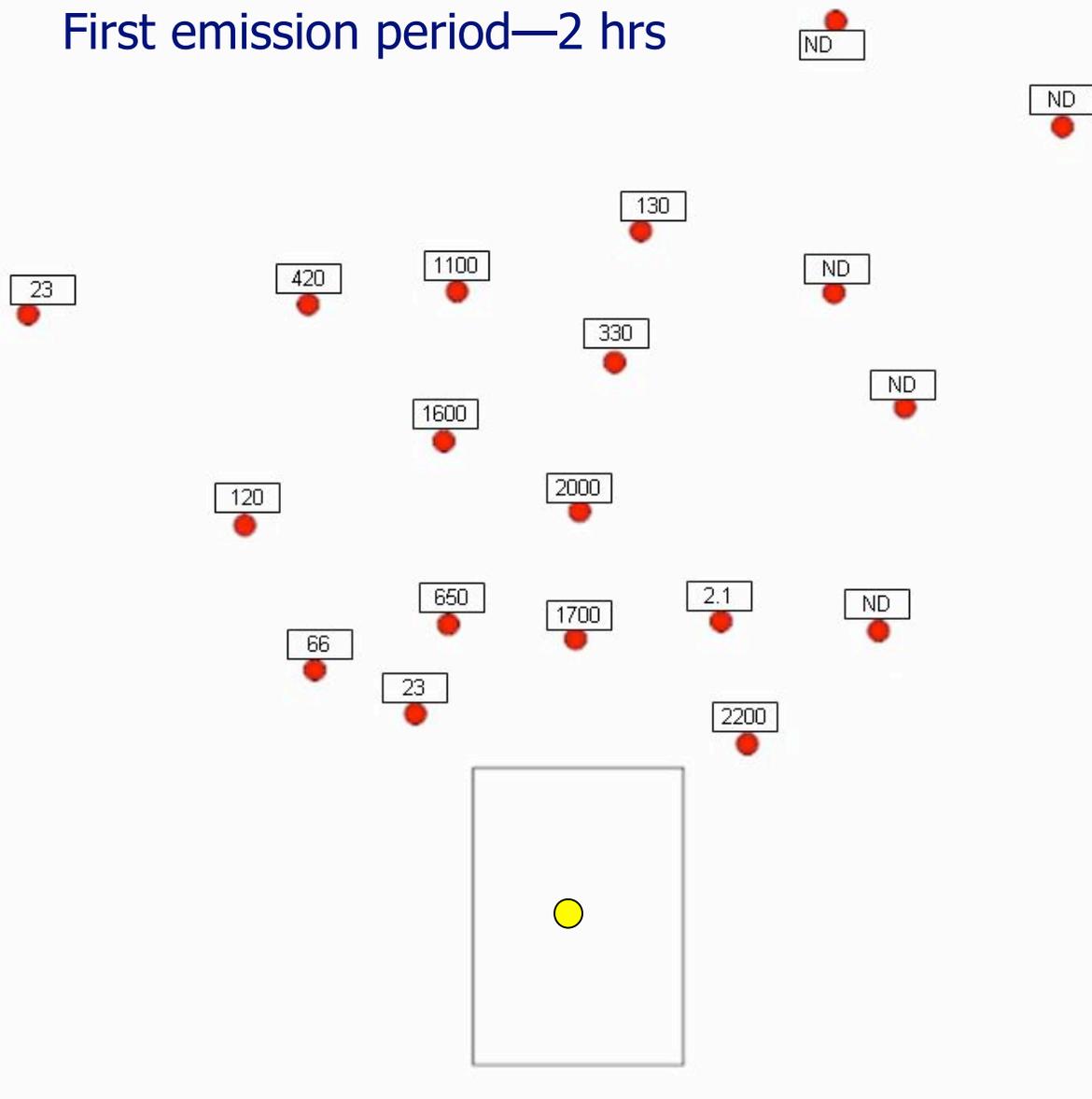


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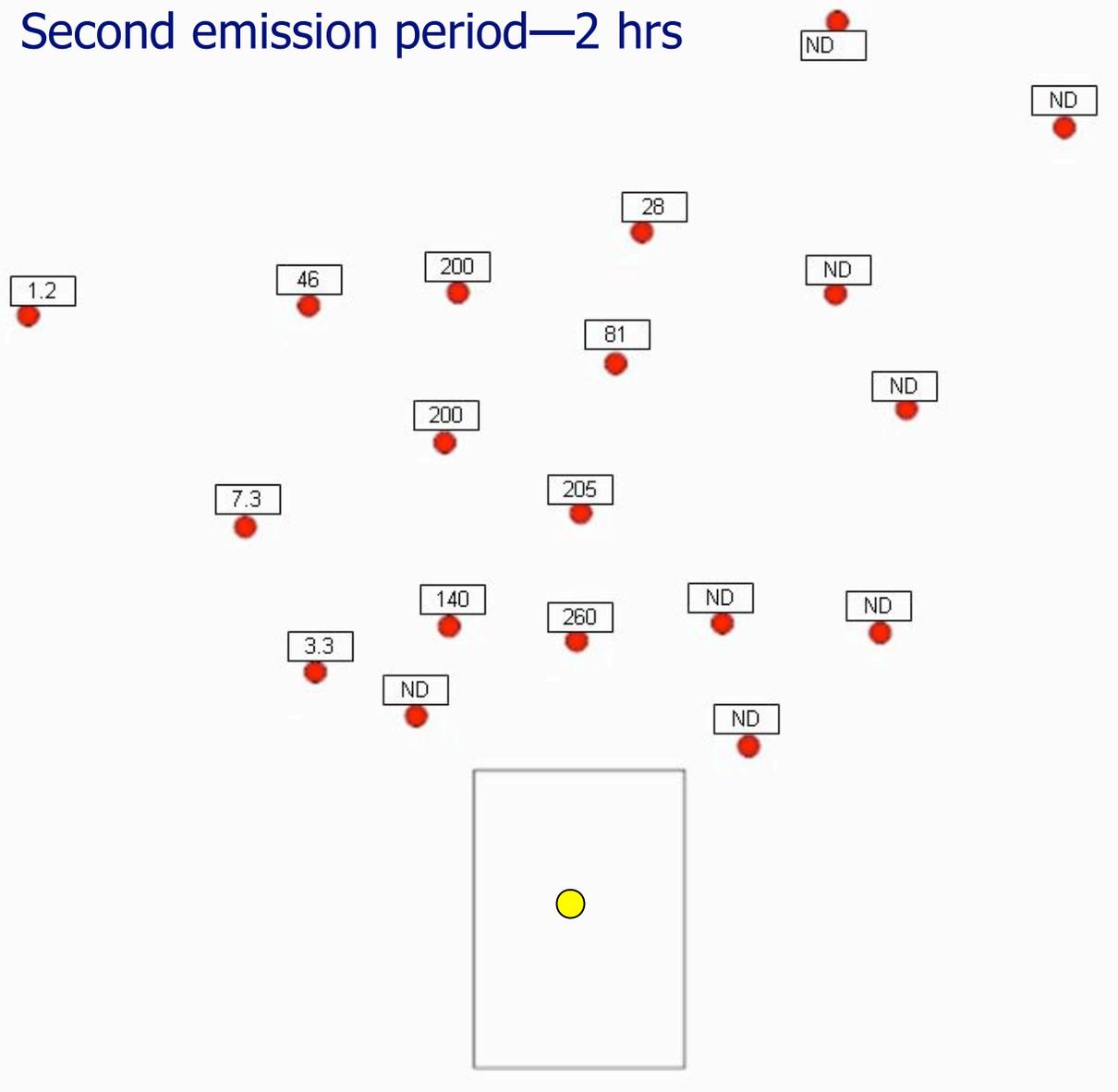
Downwind Array



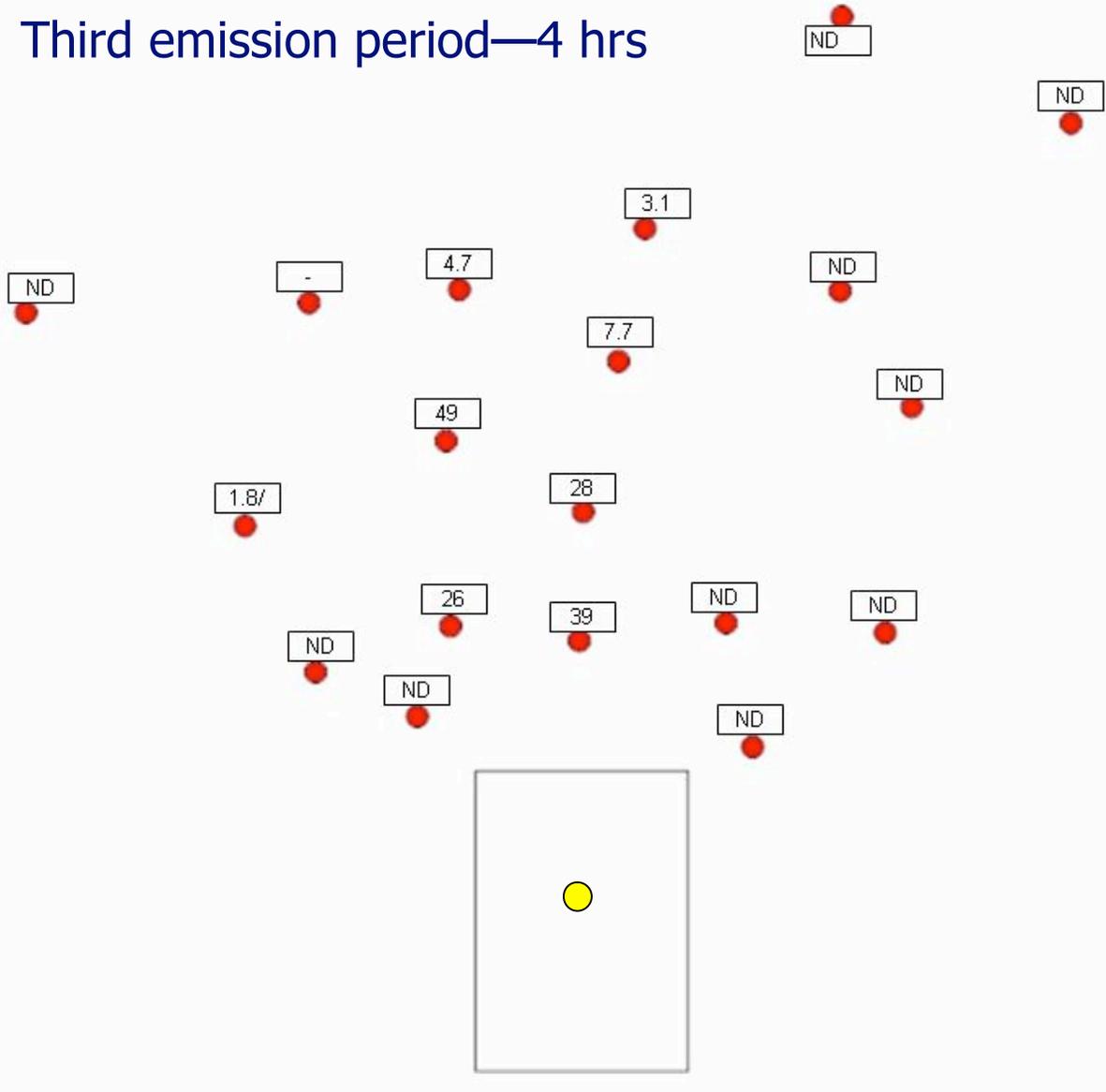
First emission period—2 hrs



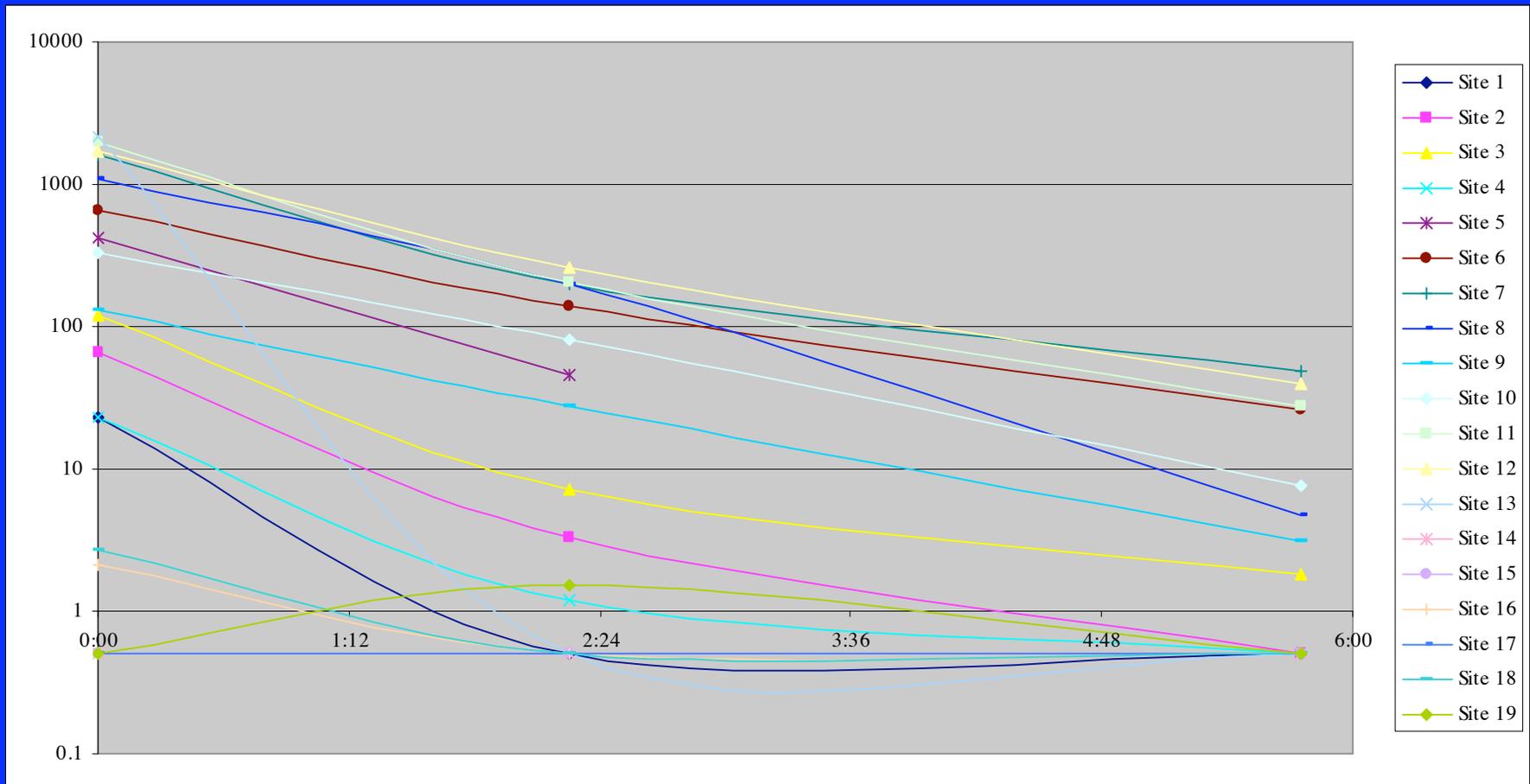
Second emission period—2 hrs



Third emission period—4 hrs



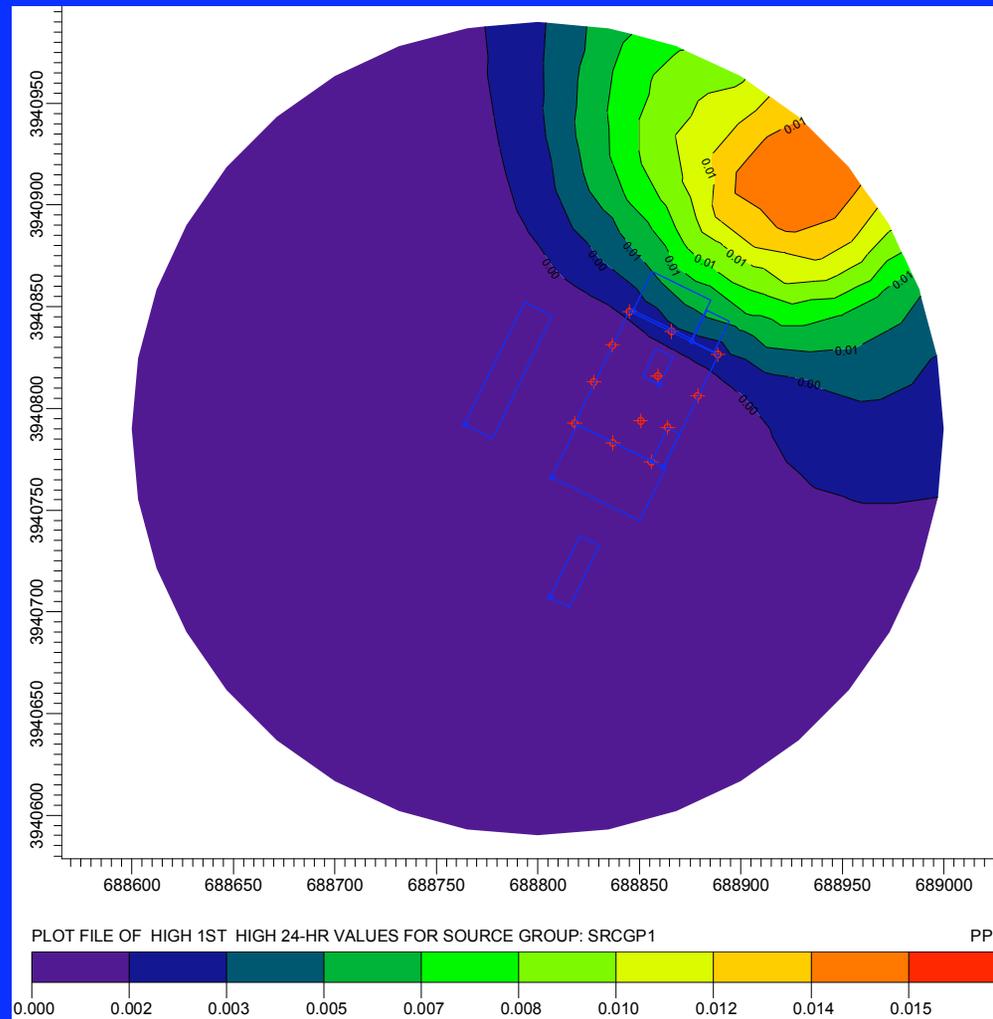
Downwind Concentrations



Start	8/19/07 12:15	8/19/07 14:30	8/19/07 16:30
End	8/19/07 14:15	8/19/07 16:30	8/19/07 20:00
1	23	ND	ND
2	66	3.3	ND
3	120	7.3	1.8
4	23	1.2	ND
5	420	46	
6	650	140	26
7	1600	200	49
8	1100	200	4.7
9	130	28	3.1
10	330	81	7.7
11	2000	205	27.5
12	1700	260	39
13	2200	ND	ND
14	ND	ND	ND
15	ND	ND	ND
16	2.1	ND	ND
17	ND	ND	ND
18	2.7	ND	ND
19	ND	1.5	ND

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Preliminary Model—Default Met Conditions



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Conclusions

- Downwind concentrations from 3 mills were less than predicted from EPA model assumptions.
- Emissions during Treatment period results in lower mass emissions during aeration.
- Typical complex plant configuration challenges routine modeling.
- Proposed buffer zones were significantly larger than data suggest.