Haul Road Workgroup Update

Regional/State/Local Modeler's Workshop

Portland, OR

May 2010

Disclaimer

- The following presentation represents the views and ideas of the haul road workgroup and does not represent an official viewpoint of EPA.

Outline

- Haul Road Issues
- Workgroup efforts
- Sensitivity Analysis Results
- Next Steps

Fugitive Roadway Dust

Tim Plander 2004 Presentation

http://whileoutriding.files.wordpress.com

Haul Road Concerns

- Emission Estimates
- Modeled Impacts Substantial
- Source Difficult to Characterize
- Lack of State-to-State consistency

Goal of Workgroup

- Examine and understand haul road characterization issues and recommend a modeling methodology.
  - (Group not dealing with emission factor issue)

- Benefit
  - Provide a technically supportable approach(es) for modeling haul road that could result in more consistent application across the states.

Workgroup Efforts

- Gathering relevant literature and field study data for use in evaluating potential approaches.
- Conducting sensitivity analyses to better understand critical variables

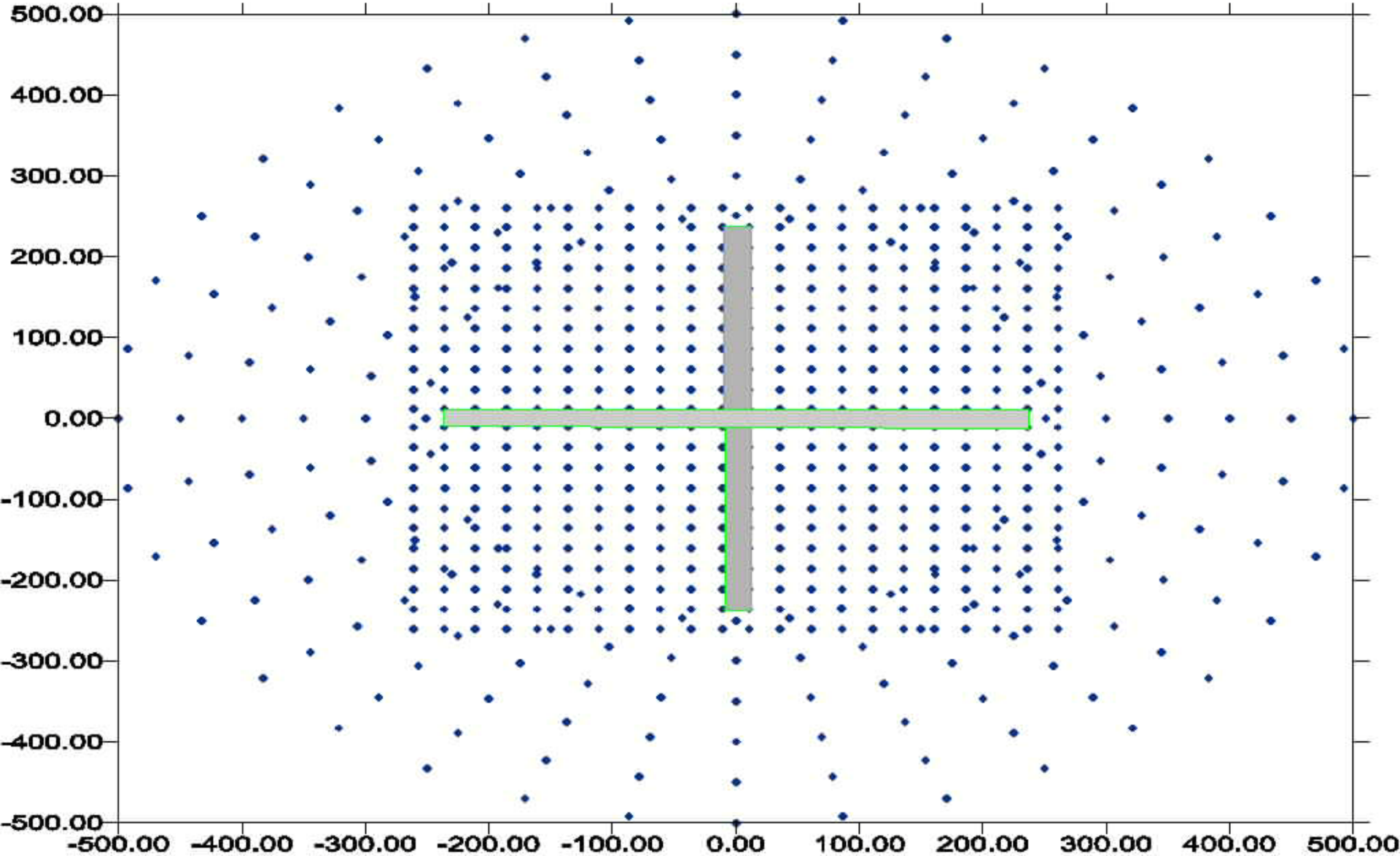
Sensitivity Analysis Work

- Used AERMOD Version 09292
- 1 year of meteorological data (variety of locations)
- N-S and E-W crisscrossing road segments. Each 500m long, 10m wide.
- Flat Terrain
- Receptor Grids – Cartesian and Polar; beginning as near as possible to the volume sources. 1 meter from edge of area source. No receptors within source.

Cont.

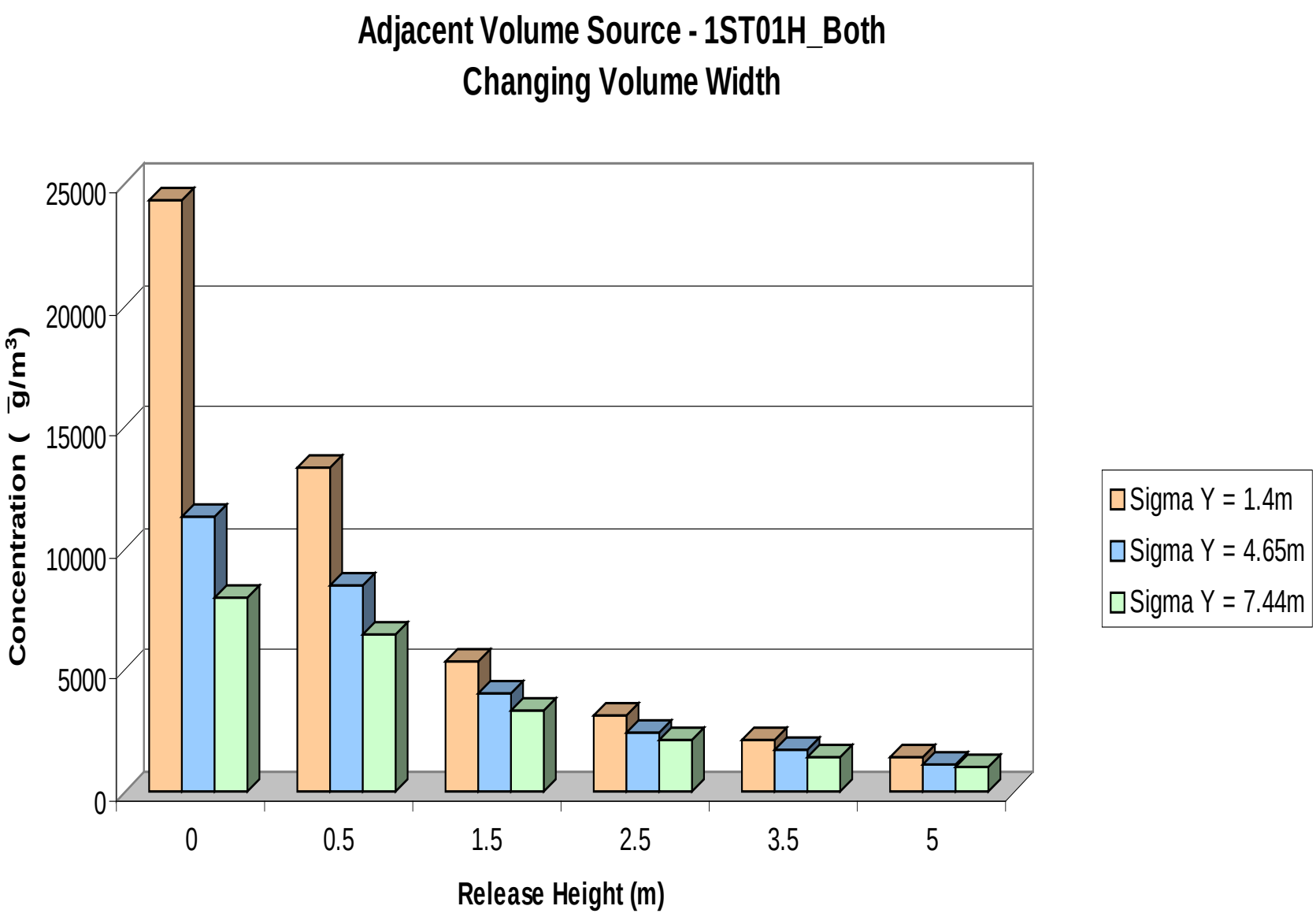
- Unit emission rate
- Evaluated range of values for top of plume height, Sigma Z, Sigma Y, and release height.
- Modeled using Adjacent Volume, Alternate Volume, and Area source representations.
- Calculated results for annual ave, peak 1hr, 8th H 1hr, peak 24hr, 8th H 24hr,

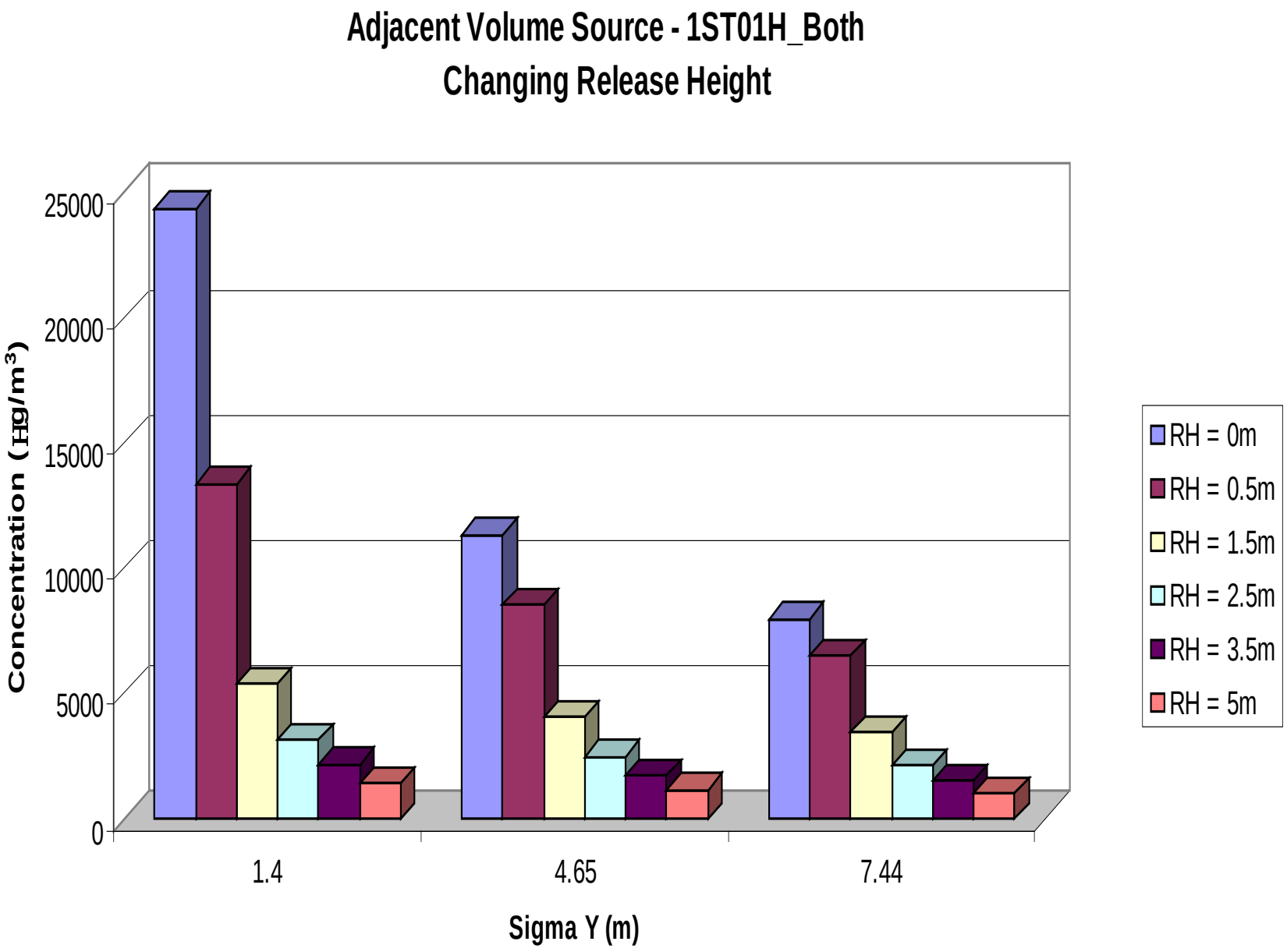
Receptors and Roadway

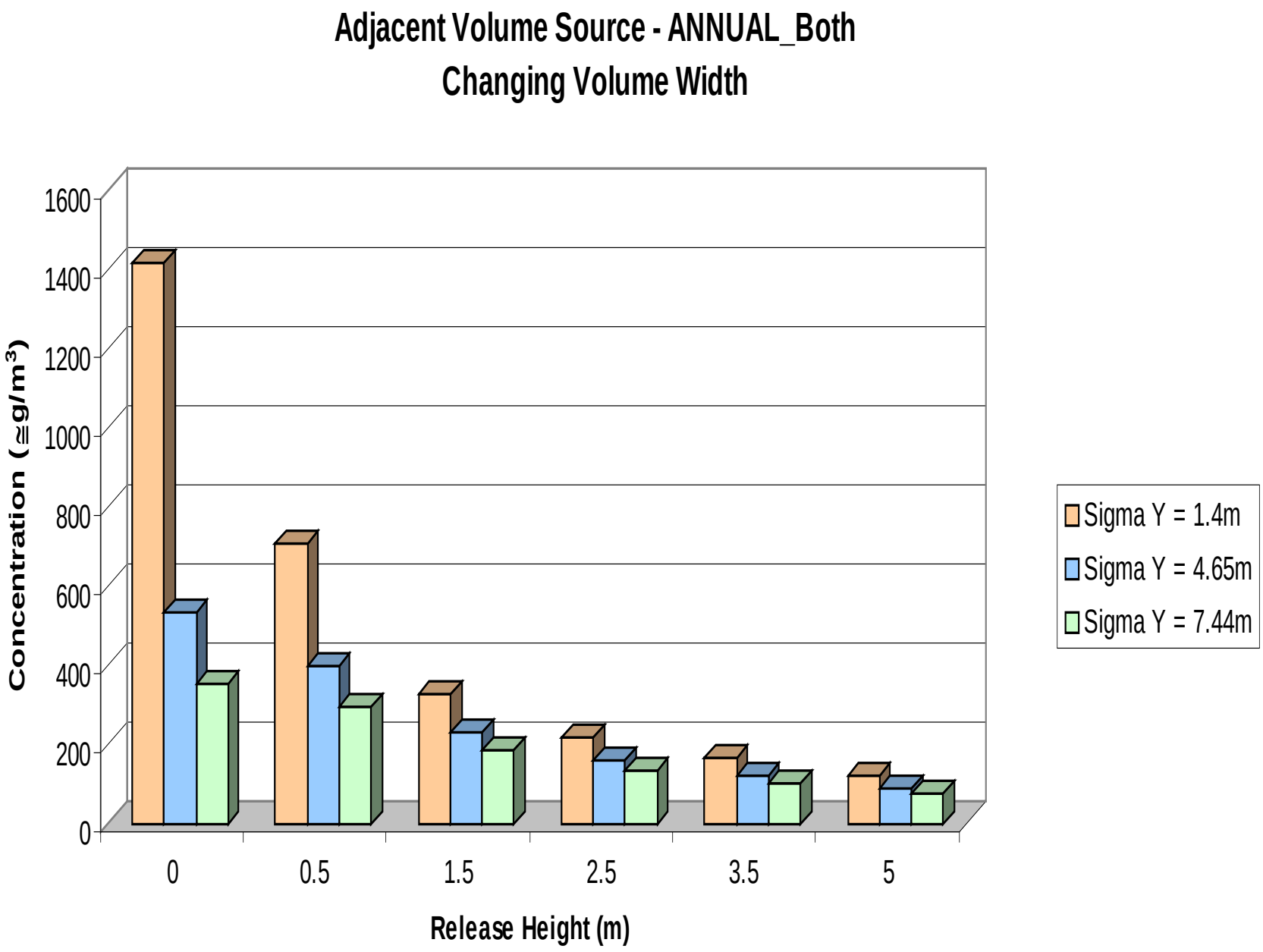


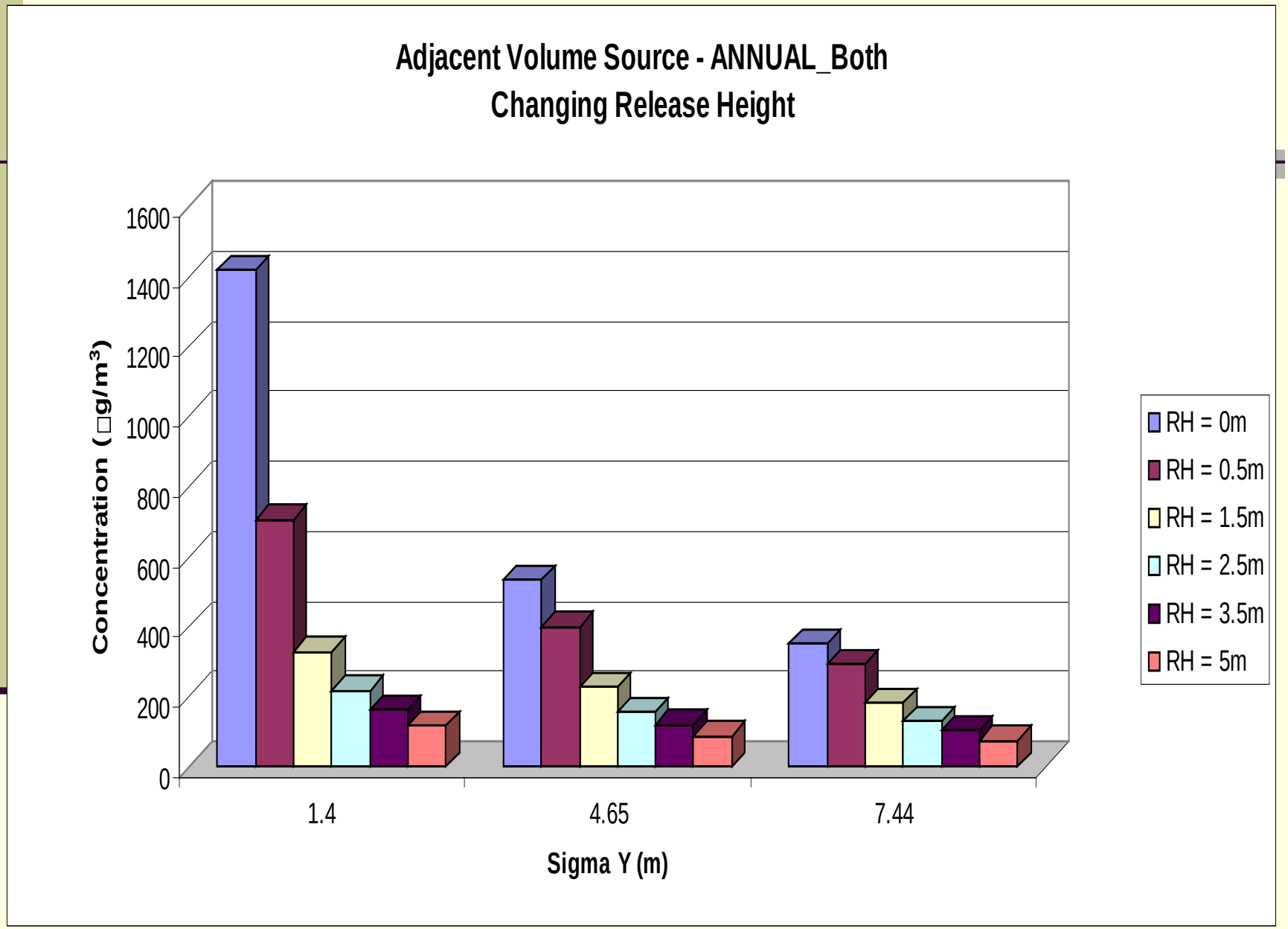
Matrix of Values for Analysis

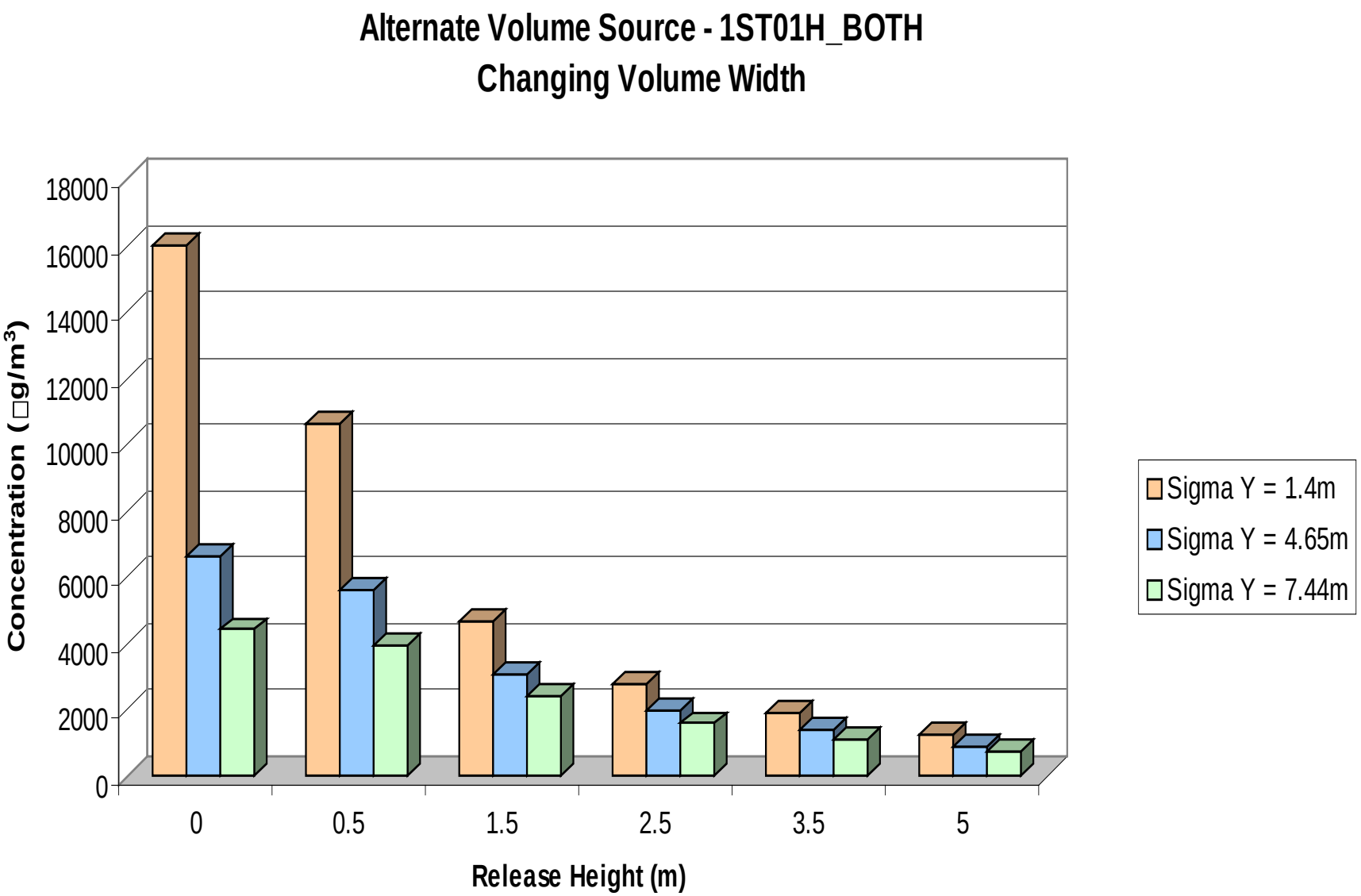
	Range of Values					
Top of Plume Ht	0m	1m	3m	5m	7m	10m
Sigma Z	Top of Plume Height / 2.15					
Sigma Y	3m / 2.15		10m / 2.15		16m / 2.15	
Release Height	Top of Plume Height / 2					

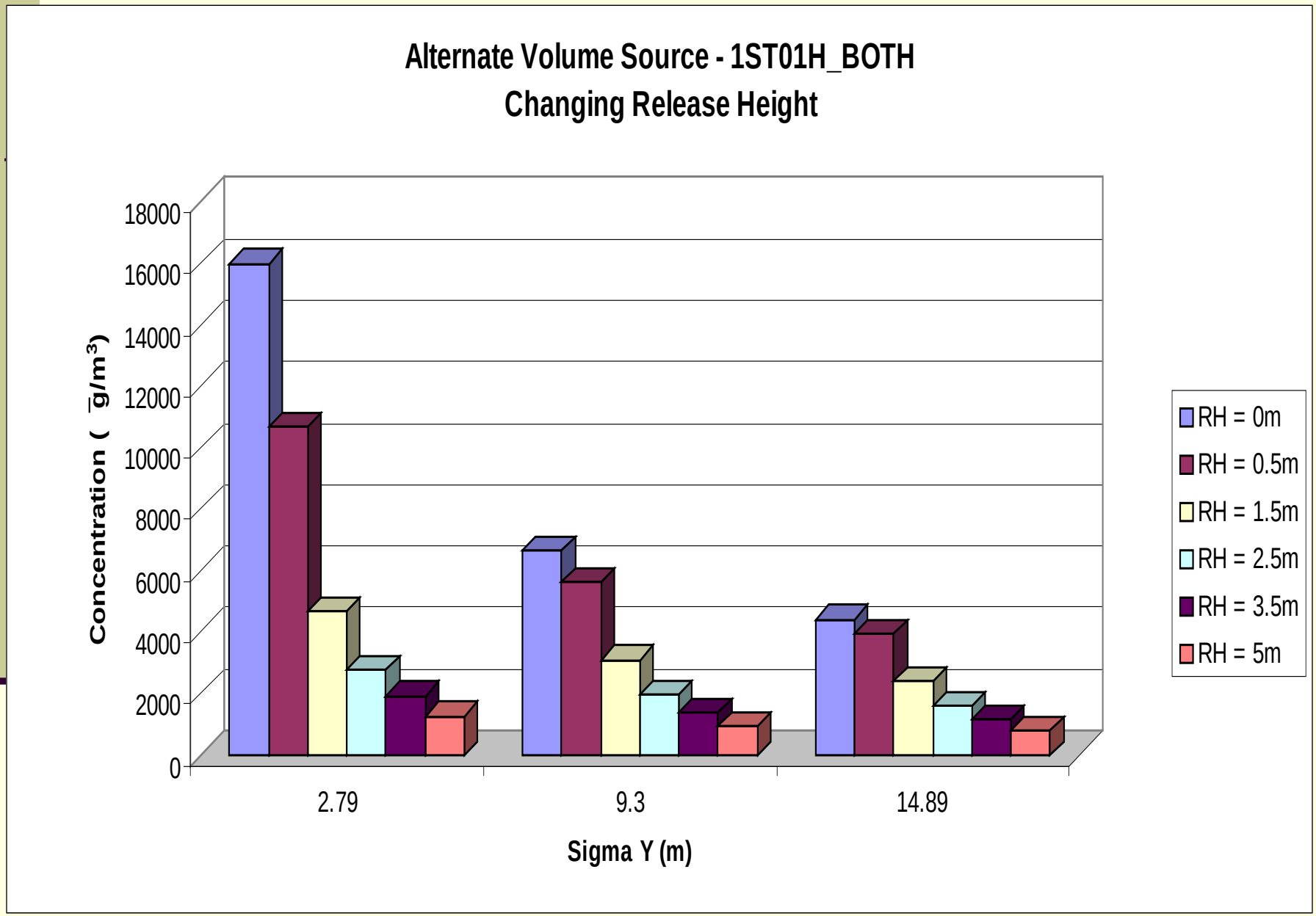

Adjacent Volume Source - 1ST01H_Both
Changing Volume Width
Concentration (g/m³)
25000
20000
15000
10000
5000
0
0
0.5
1.5
2.5
3.5
5
Release Height (m)
Sigma Y = 1.4m
Sigma Y = 4.65m
Sigma Y = 7.44m

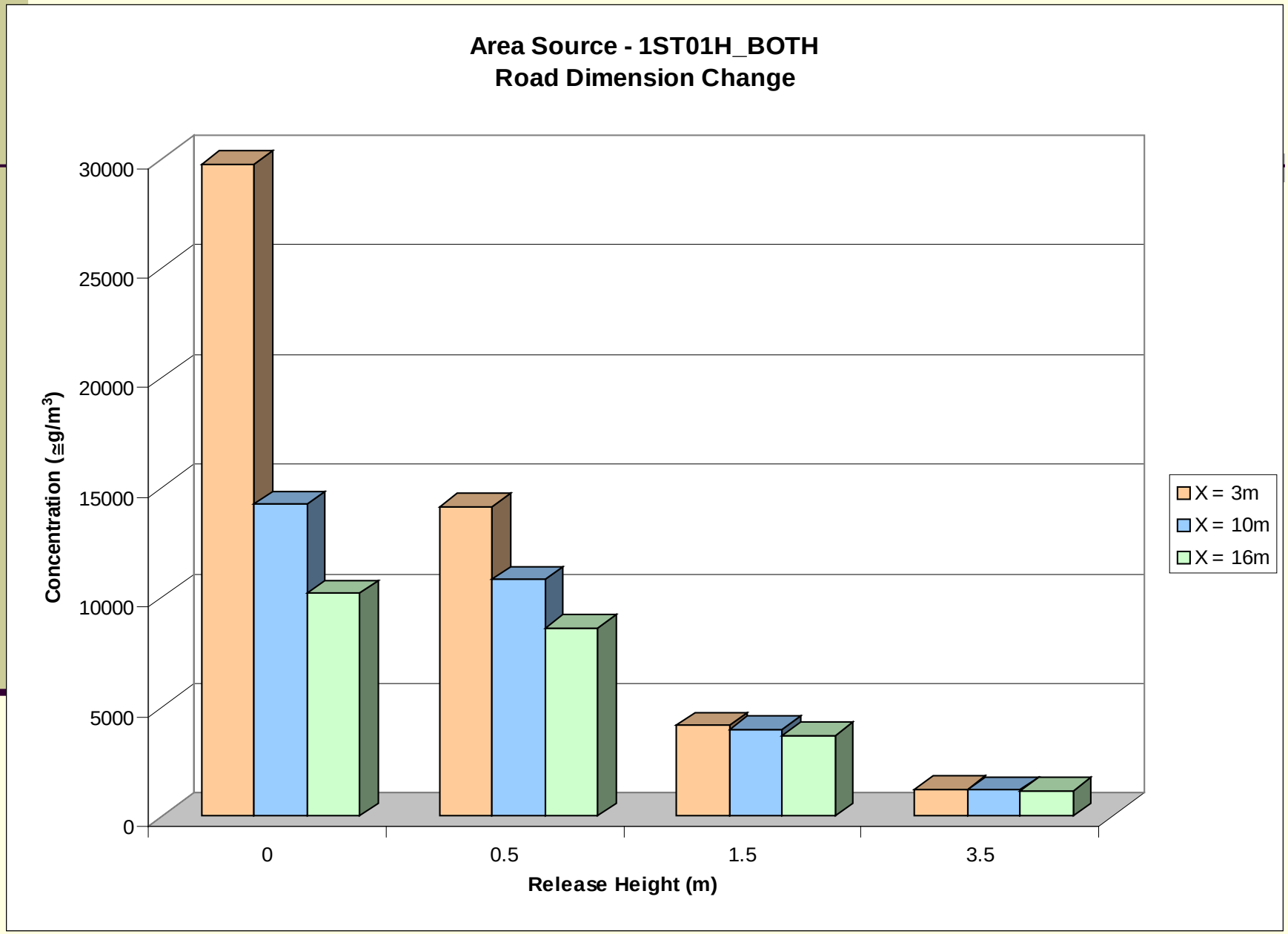

Adjacent Volume Source - 1ST01H_Both
Changing Release Height
Concentration (µg/m³)
25000
20000
15000
10000
5000
0
1.4
4.65
7.44
Sigma Y (m)
RH = 0m
RH = 0.5m
RH = 1.5m
RH = 2.5m
RH = 3.5m
RH = 5m

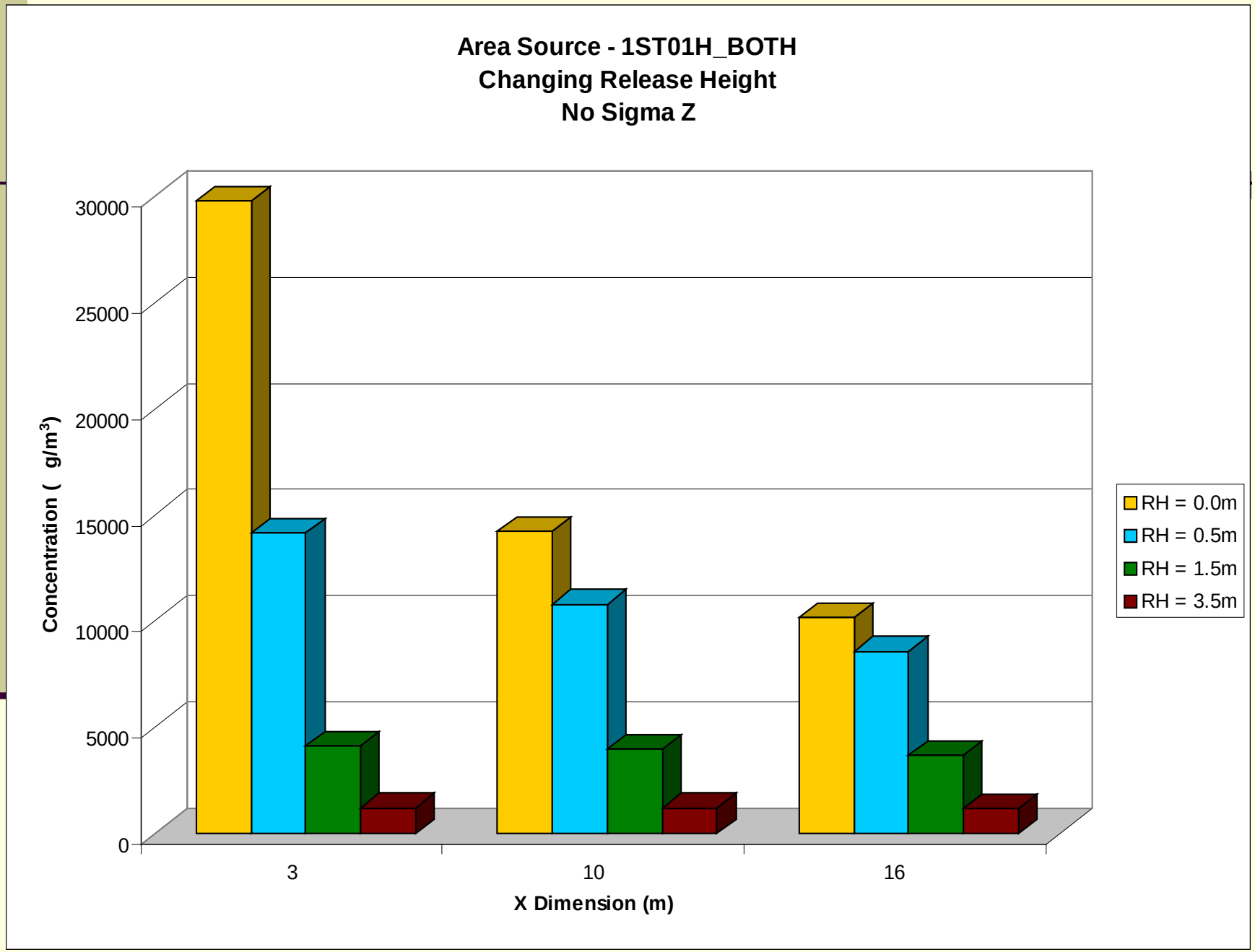

Adjacent Volume Source - ANNUAL_Both
Changing Volume Width
Concentration (≅g/m³)
1600
1400
1200
1000
800
600
400
200
0
0
0.5
1.5
2.5
3.5
5
Release Height (m)
Sigma Y = 1.4m
Sigma Y = 4.65m
Sigma Y = 7.44m

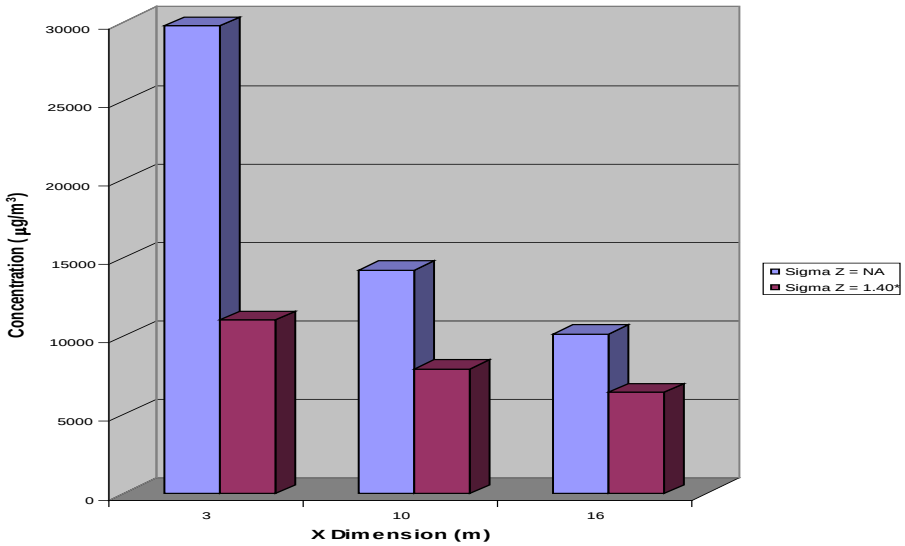

Adjacent Volume Source - ANNUAL_Both
Changing Release Height
Concentration (□g/m³)
1600
1400
1200
1000
800
600
400
200
0
1.4
4.65
7.44
Sigma Y (m)
RH = 0m
RH = 0.5m
RH = 1.5m
RH = 2.5m
RH = 3.5m
RH = 5m

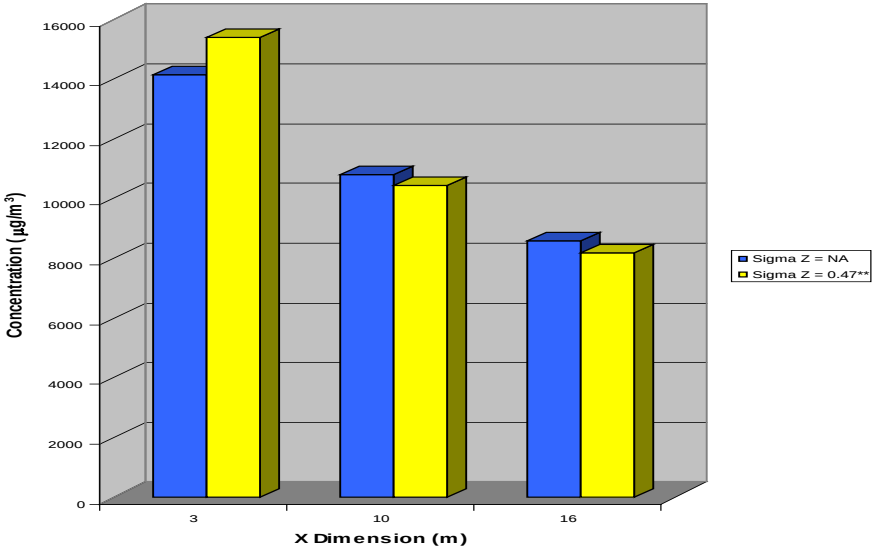

Alternate Volume Source - 1ST01H_BOTH
Changing Volume Width
Concentration (□g/m³)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
0.5
1.5
2.5
3.5
5
Release Height (m)
Sigma Y = 1.4m
Sigma Y = 4.65m
Sigma Y = 7.44m

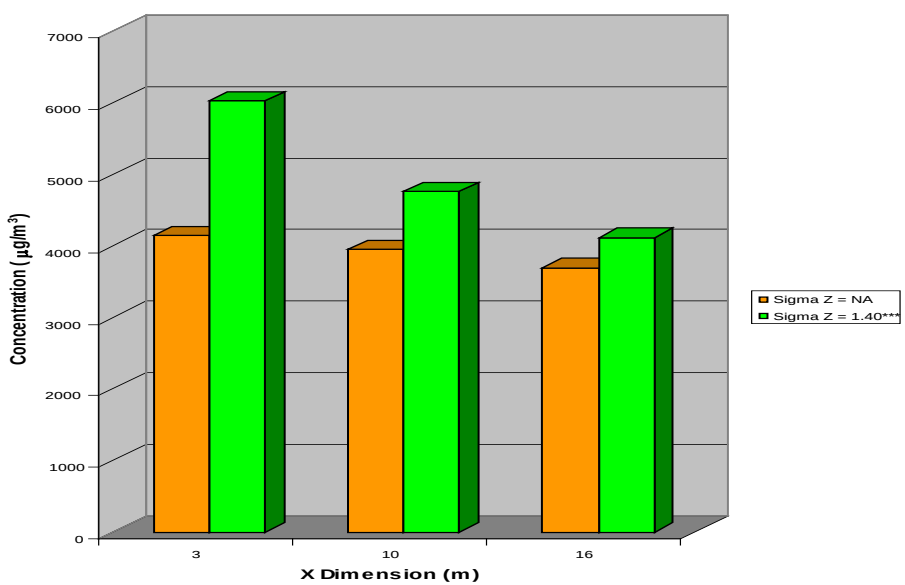

Alternate Volume Source - 1ST01H_BOTH
Changing Release Height
Concentration (g/m3)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
2.79
9.3
14.89
Sigma Y (m)
RH = 0m
RH = 0.5m
RH = 1.5m
RH = 2.5m
RH = 3.5m
RH = 5m

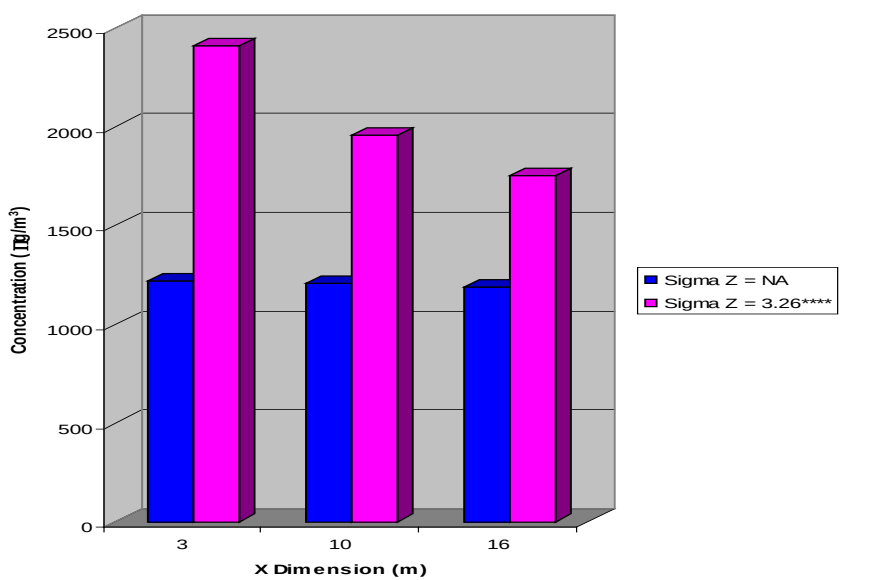

Area Source - 1ST01H_BOTH
Road Dimension Change
Concentration (≅g/m³)
30000
25000
20000
15000
10000
5000
0
0
0.5
1.5
3.5
Release Height (m)
X = 3m
X = 10m
X = 16m


Area Source - 1ST01H_BOTH
Changing Release Height
No Sigma Z
Concentration (g/m3)
30000
25000
20000
15000
10000
5000
0
3
10
16
X Dimension (m)
RH = 0.0m
RH = 0.5m
RH = 1.5m
RH = 3.5m

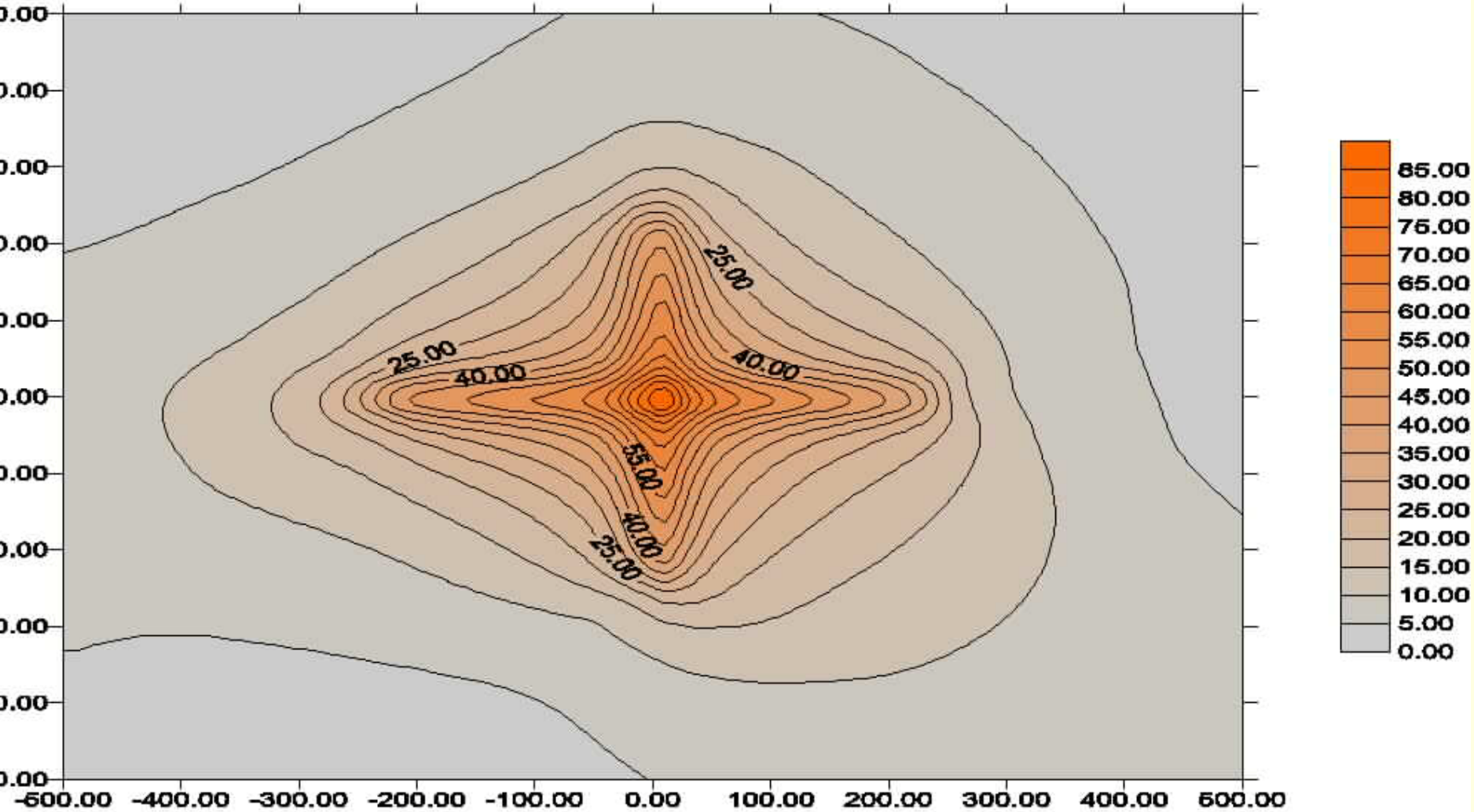

Area Source - 1ST01H_BOTH
Sigma Z Change (RH = 0.0)
Concentration (µg/m3)
30000
25000
20000
15000
10000
5000
0
3
10
16
X Dimension (m)
Sigma Z = NA
Sigma Z = 1.40*


Area Source - 1ST01H_BOTH
Sigma Z Change (RH = 0.5)
Concentration (µg/m3)
16000
14000
12000
10000
8000
6000
4000
2000
0
3
10
16
X Dimension (m)
Sigma Z = NA
Sigma Z = 0.47**

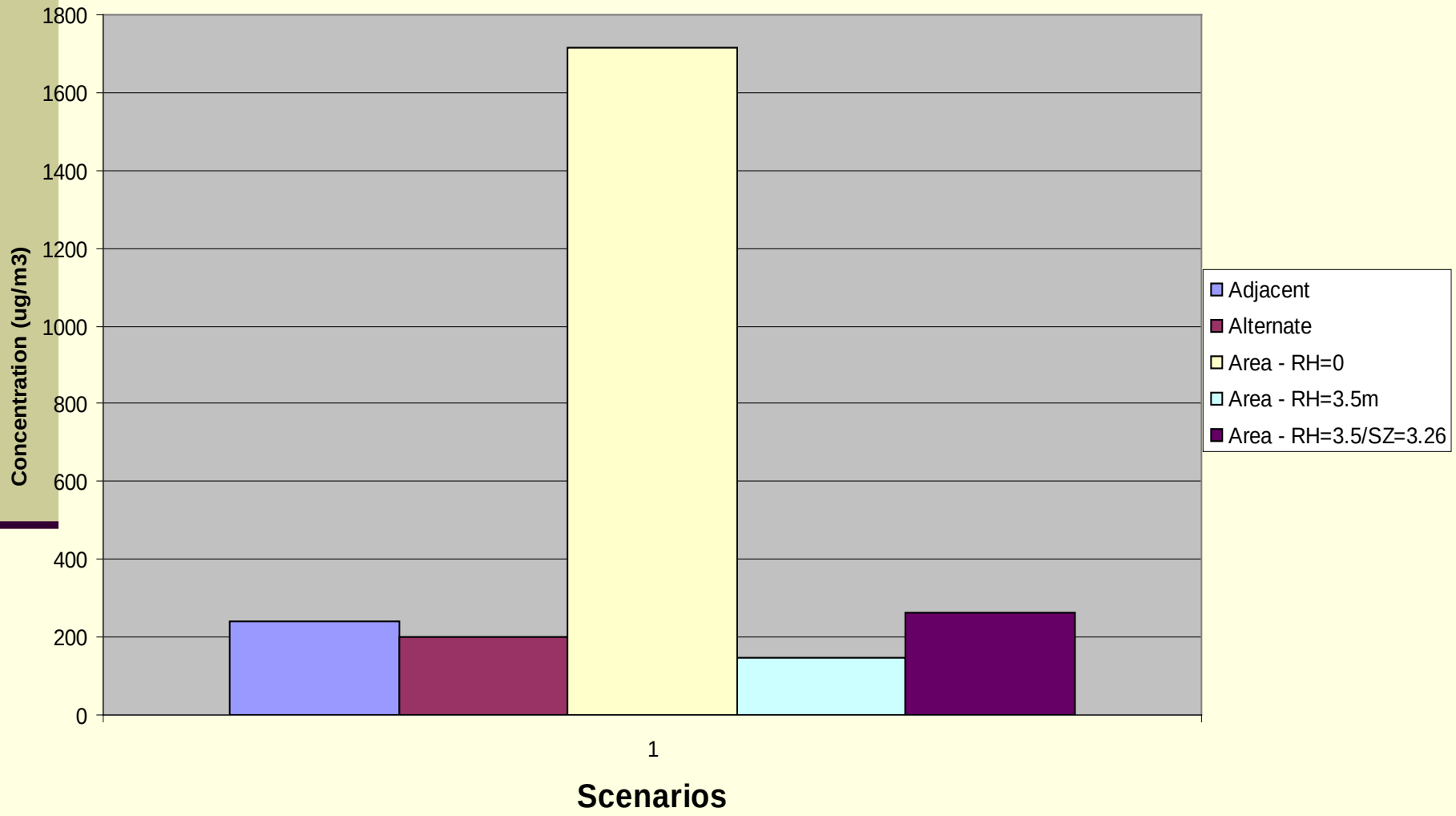

Area Source - 1ST01H_BOTH
Sigma Z Change (RH = 1.5)
Concentration (µg/m3)
7000
6000
5000
4000
3000
2000
1000
0
3
10
16
X Dimension (m)
Sigma Z = NA
Sigma Z = 1.40***

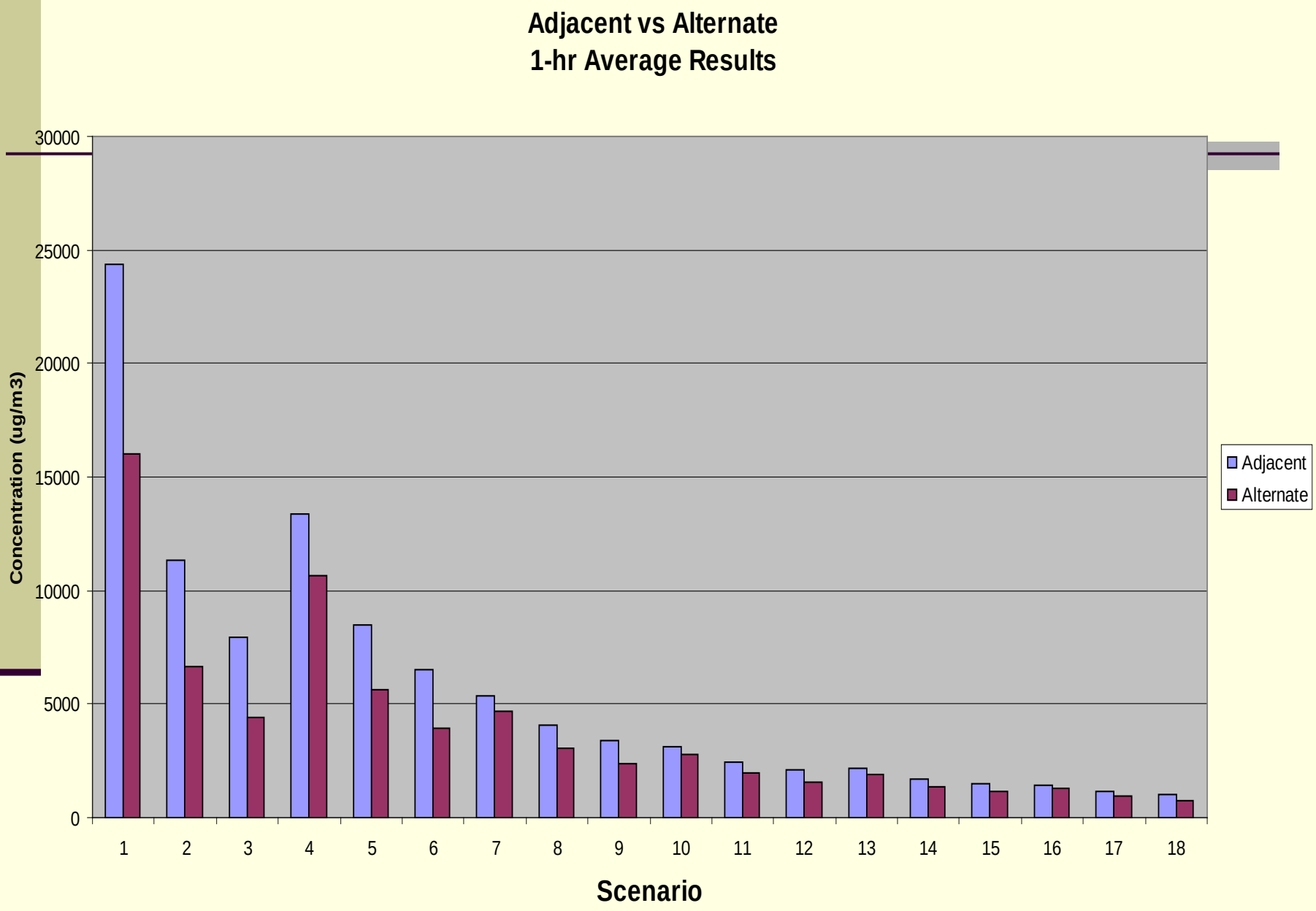

Area Source - 1ST01H_BOTH
Sigma Z Change (RH = 3.5)
Concentration (µg/m3)
2500
2000
1500
1000
500
0
3
10
16
X Dimension (m)
Sigma Z = NA
Sigma Z = 3.26****

Adjacent Volume
Annual Average
elease Ht.- 5m / Sigma Z - 4.65 / Sigma Y - 4.65



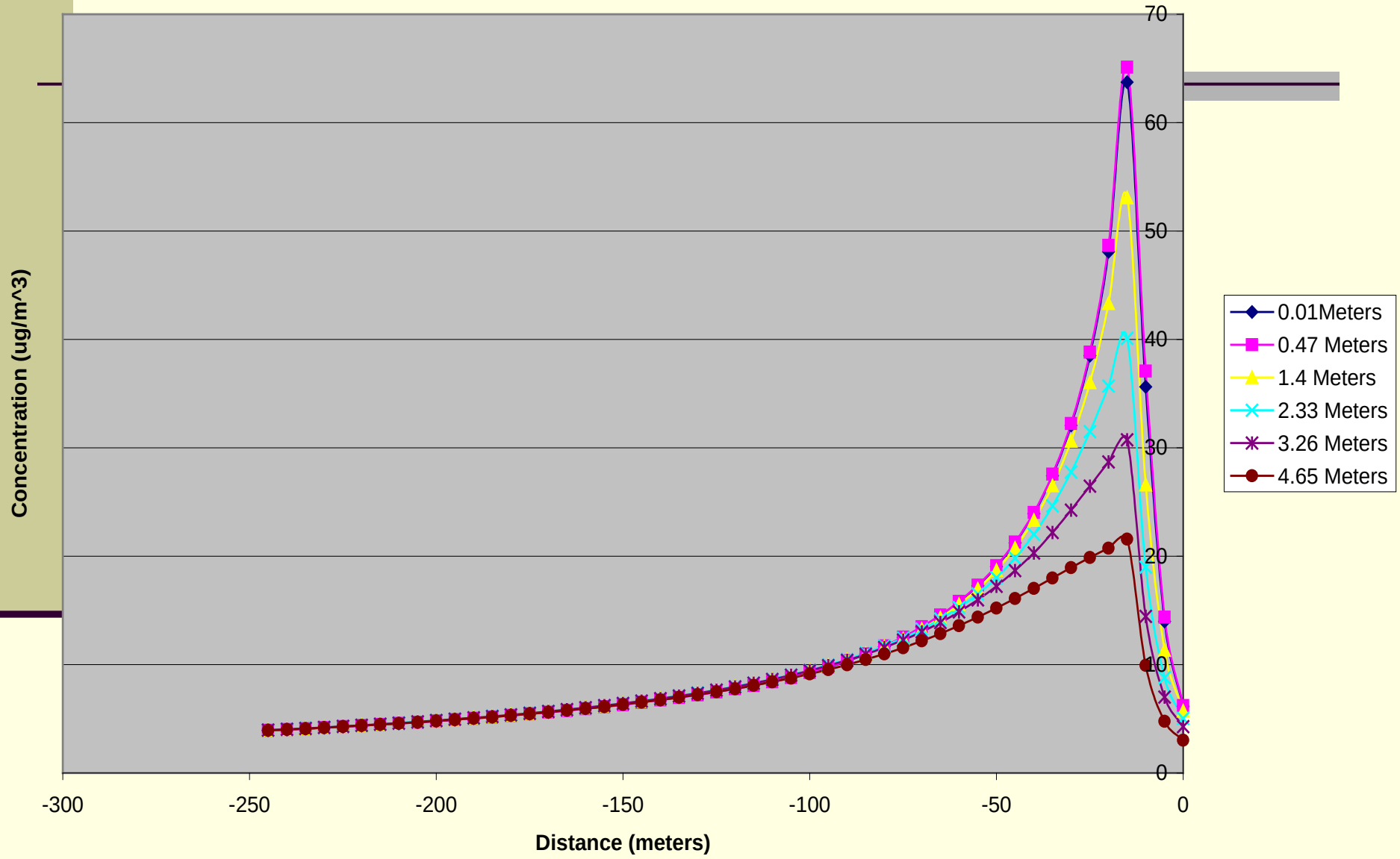
Case Study
7m Top of Plume / 10m Plume Width
8th High 24-hour Ave.



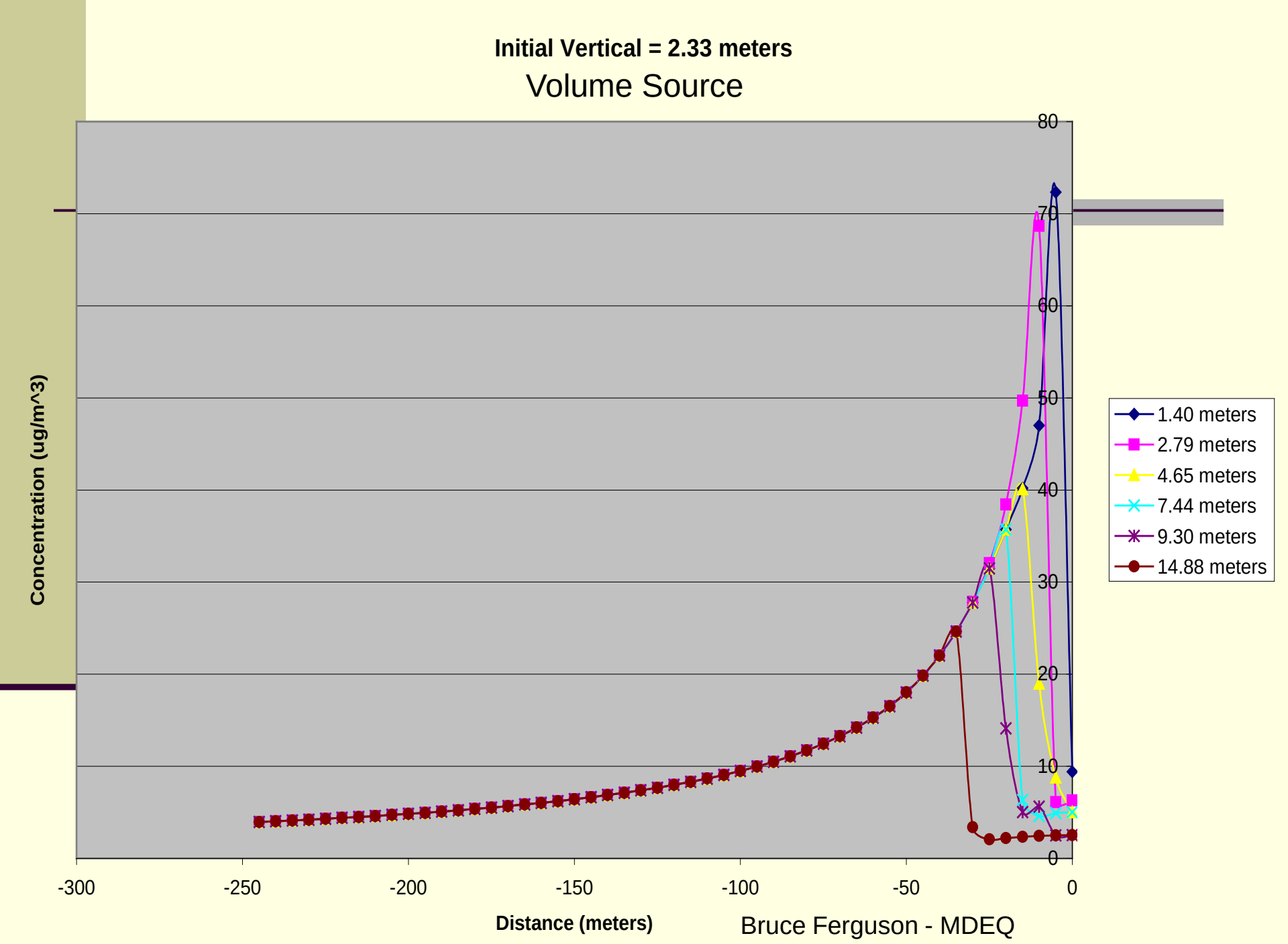

Adjacent vs Alternate
1-hr Average Results
Concentration (ug/m3)
30000
25000
20000
15000
10000
5000
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Scenario
Adjacent
Alternate

Initial Horizontal = 4.65

Volume Source



Bruce Ferguson - MDEQ


Initial Vertical = 2.33 meters
Volume Source
Concentration (ug/m^3)
80
70
60
50
40
30
20
10
0
-300
-250
-200
-150
-100
-50
0
Distance (meters)
1.40 meters
2.79 meters
4.65 meters
7.44 meters
9.30 meters
14.88 meters
Bruce Ferguson - MDEQ

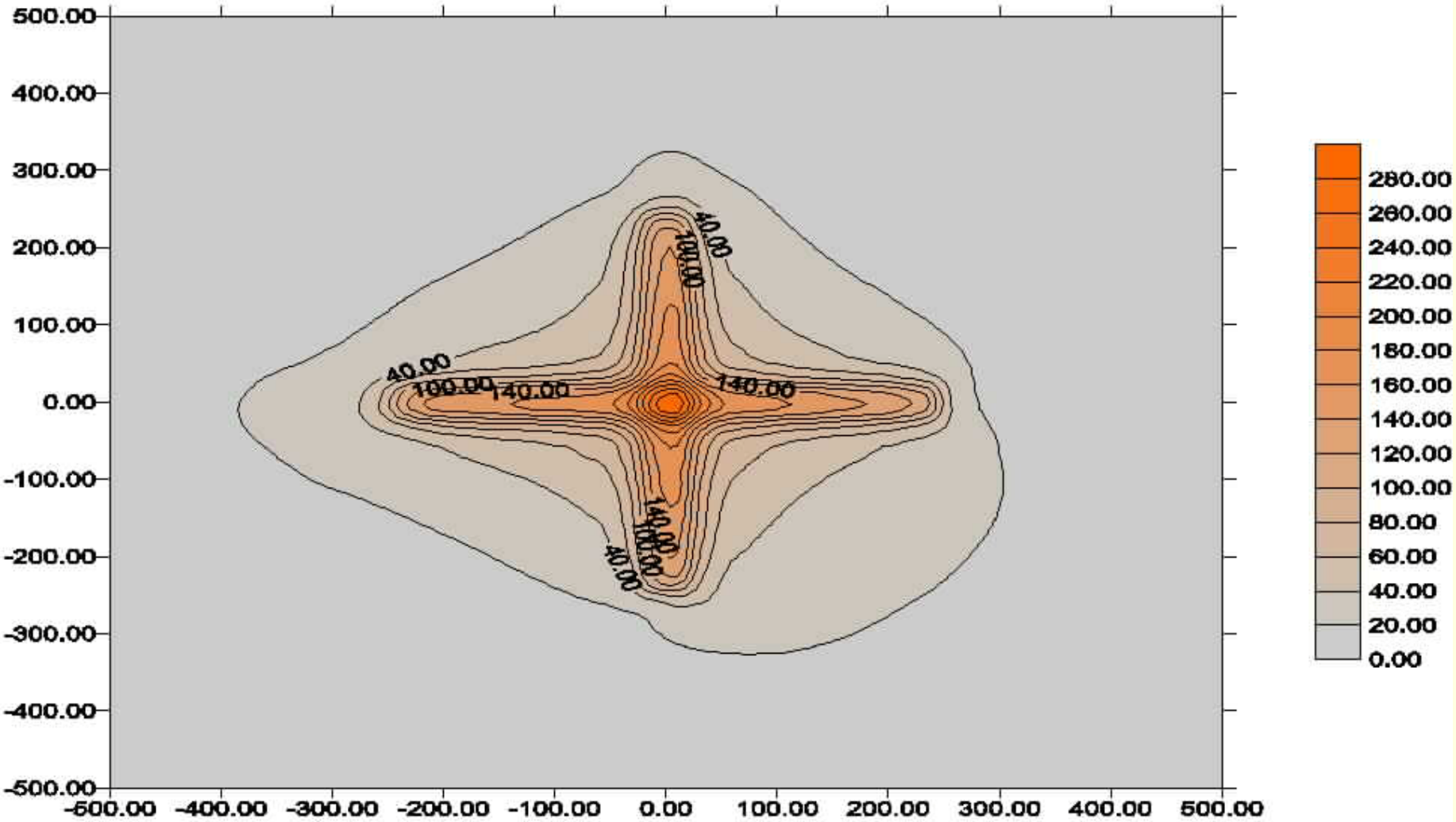
Haul Road as Downwash Point Sources

- Ran AERMOD using point sources to represent haul road
- Flat terrain
- Assume building with dimensions of 3m x 3m x 10m –oriented along roadway.
- Locate point at each corner of building - 384 total stacks.
- 1 g/s emissions distributed among stacks

Continued…

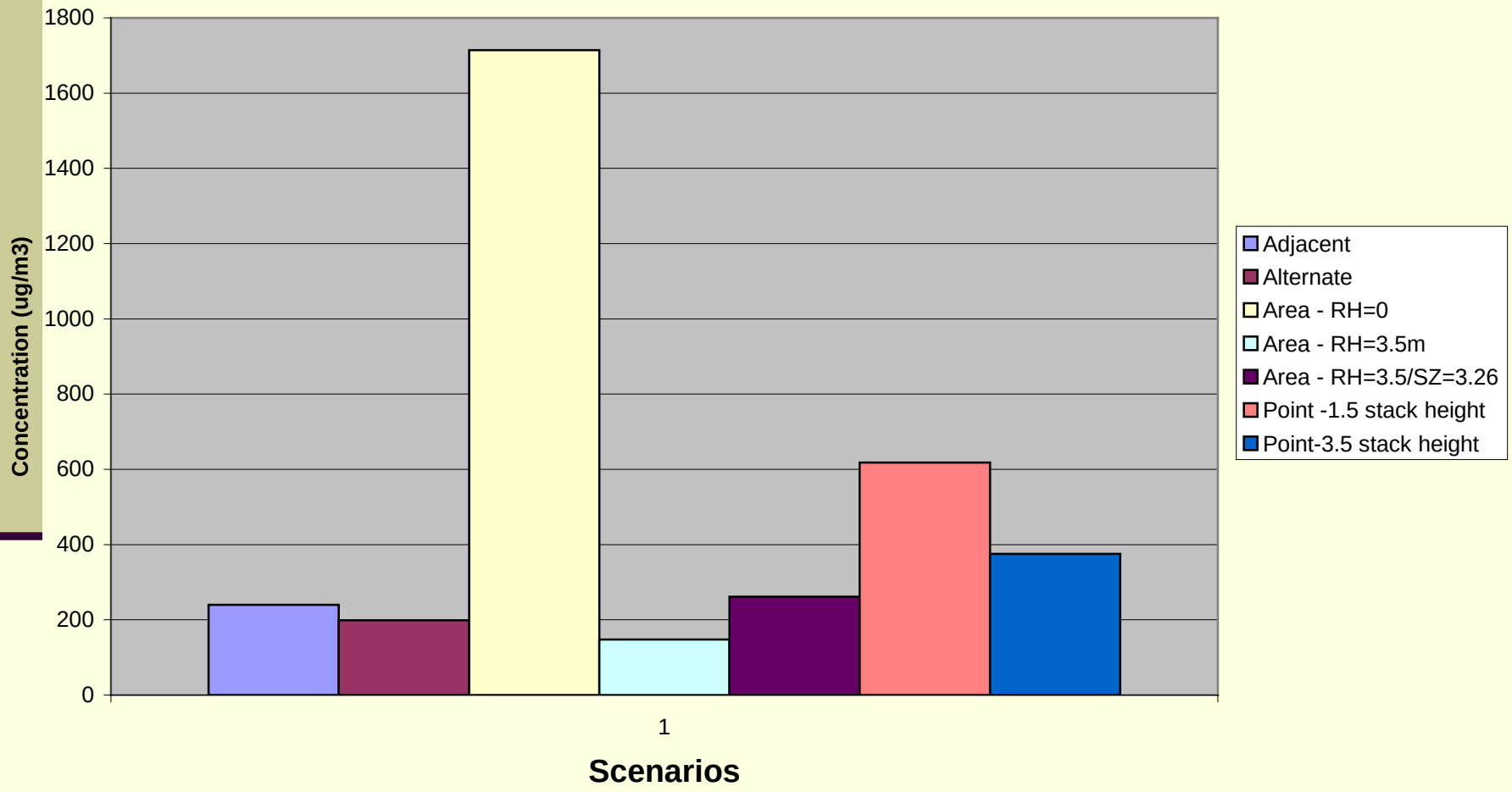
- Stack height = 1.5m and 3.5m
- Temperature = ambient
- Velocity = .001 m/s
- Diameter = 0.5m
- Receptors - cart. – start 11m from center of road at 25 m resolution plus 10 degree polar at 250m at 50 m resolution

Point Source with Downwash
Annual Average
tack Ht.- 1.5m / Diam. - 0.5m / Ambient T / Vel. - 0.001



Max. Conc. - 288 ug/m3

Case Study
7m Top of Plume / 10m Plume Width
8th High 24-hour Ave.



General Conclusions for Sensitivity Analysis Runs

- Increasing RH (release height) always led to lower concentrations.
- Increasing Sigma Y for alt. and adj. volume sources lowered concentrations.
- For area source – increasing X dimension lowered concentrations at 0 and 0.5 RH, at 1.5 and 3m RH, had little impact on concentrations.
- For area source – adding a sigma z lowered concentrations for 0 RHs, but usually increased concentrations at 1.5 and 3.5 RHs, mixed results for 0.5m RH.

Cont.

- For volume runs, adjacent gives higher concentrations than alternate.
- Point Source – limited modeling shows sensitivity to stack height; little sensitivity to stack diameter.
- On-site met data runs showed same trends as NWS, although concentrations higher with on-site.

Receptor issue

- Sensitivity work highlighted nearby receptor issue.
  - Within (sigma y x 2.15) + 1m from center of volume – receptors excluded.
  - Receptors must be placed beyond edge of roadway for multiple volume source characterization.
  - Options for revising AERMOD to allow receptors for multiple volume source to be placed near edge of roadway?

Summary

- Volume source
  - + Contains meander algorithm
  - + Conceptually, reflects the initial well-mixed plume
  - - Limited to receptors beyond edge of source
  - - Sensitive to release height, sigma values

Summary….

- Area Source
  - + No limit on receptor placement
  - + No need to determine sigma values (sigma z optional)
  - - Does not contain meander algorithm
  - - Sensitive to release height

Summary….

- Point Source
  - + Downwash algorithm can handle plume dimensions
  - + Can place receptors anywhere
  - + Downwash from trucks and nearby buildings
  - - Sensitivity to input parameters
  - - Limited experience

Next Steps

- More examination of point source approach
  - Additional sensitivity runs looking at building size and locations, stack parameters, nearby buildings.
- Incorporation of field data
  - Limited data available. Examine AERMOD estimates against measurements where appropriate
- Schedule – draft recommendation – Fall 2010, finalize early 2011

Thank You Workgroup

- Dawn Froning- MO
- Kelly Robson - MO
- Lisa Alam - NE
- Ralph DeSiena- SDiego
- Steve Moore - SDiego
- Jim Haywood - MI
- Sufi Mustafa - NM
- Eric Peters - NM
- Bruce Ferguson - MS
- Rosendo Majano- GA
- Dennis Becker- MN
- Peter Courtney- GA
- James Thurman – RTP
- Roger Brode - RTP
- Mary Portanova- R5
- Mick Daye – R7
- Randy Robinson – R5